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Chief Directorate National Geo-spatial Information
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South Africa

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Study Skills

Here are some handy hints and tips to get you through the stressful examination time and to help you to Ace your exams!

BEFORE THE EXAMINATION

Manage your time carefully
Draw up a revision schedule so that you have enough time to revise. Sit down with your exam timetable, and make sure that you allocate enough time for revision to each subject, paying particular attention to those subjects you might be struggling with. Give yourself two hours each day to cover a certain subject or area of the curriculum.

Break the work down into manageable sections or topics that you can cover in the time allocated. Reward yourself if you complete a section successfully and have done well in the revision questions.

Don’t be distracted by the radio, television or your cell phone or computer. Switch these devices off, and make sure that you are able to focus without interruption.

When managing your time, remember to also make sure that you have some leisure time to spend with friends and family. Spending time relaxing with your friends can help reduce stress, but you must make sure that you keep on top of your studies!

Ask for help
If you are struggling with a particular subject or topic, don’t be afraid to ask for help. Remember that your teacher is there to help you understand your subject. Alternatively, you may want to have a look at the Internet which can help you with video tutorials. Also ask your friends or fellow learners. They may have a way of explaining the problem that will help you understand it better.

Practice makes perfect
Your Ace-it Study Guide will be a great help in preparing for your examinations by giving you practical examples, revision questions and hints and tips for exam success.

Try to access copies of past examination papers so that you can exercise your skills. Your school library may have copies of past papers, but alternatively you could have a look at the Department of Basic Education website: www.thutong.doe.gov.za, which has copies of past papers, together with marking memoranda.

Get enough exercise
Getting plenty of regular exercise not only helps you to keep healthy, it also has been proven to lower stress levels and leads to better sleep. Even if you are not a sportsman or sportswoman, a quick walk around the block during a study break will help you to de-stress, and clear your head.

Eat a healthy diet and drink plenty of water
It is extremely tempting to keep snacking on chips, sweets and chocolates while studying, but these snacks won’t help your body in the long term. Try to eat foods that will keep you fuller for longer. Aim for a balanced diet, with lots of fruit and vegetables, and wholewheat or wholegrain bread.

Drink plenty of water. Your brain and your body need water to function properly. Make sure that you drink plenty of water while you are studying. Research suggests that drinking water can help improve exam results and lower stress levels.
Above all, DON'T PANIC!

Try to keep a clear head. Getting into a panic is a sure recipe for disaster when you are preparing for an exam. Try meditating for 10 minutes every morning and evening to help you relax and think clearly. If you are struggling with a particular topic, put it aside for a while, revise another subject before going back to the problem area. You may very well find that if you approach it after a break, it doesn’t seem quite so frightening after all.

Remember

If you are feeling deeply depressed and anxious at this stressful time, make an effort to seek help from a parent, teacher or counsellor. There are plenty of people out there who are willing and able to help!

ON THE DAY

☐ Pack your bag with all your stationery, calculator, ruler and any other items you may need the day before. Make sure that you have extra pens and pencils, and double-check them before you leave for the examination venue.

☐ Have a good night’s sleep. Cramming the night before will just make you tired and unable to think clearly during the exams.

☐ Get up in good time. Ask your family to wake you earlier than usual, or ask a friend to give you a wake-up call.

☐ Leave plenty of extra time when travelling to the venue, in case there are traffic or other hold-ups.

WRITING THE EXAMINATION

☐ Keep calm and relaxed and have confidence in what you have learned and revised.

☐ When you receive the paper, you are given time to read through the paper. Make use of this time by identifying all the questions you know you can easily finish.

☐ Read all questions carefully, making sure you know what is being asked. Underline the key words that will tell you what type of answer is required.

☐ Don’t write a long paragraph when only a brief list is required. Conversely, don’t write a bulleted list when a detailed description or explanation is required.

☐ Start with the questions you know best, but keep the numbers in the correct order. If you can’t answer a question, don’t waste time. Move on and come back to it later. Sometimes a later question will remind you about something to help answer an earlier one.

☐ Keep an eye on the time. Each question has a mark allocation. Work out how much time you need for each question or section, and stick to it, or else you won’t get to the other questions.

☐ Always leave your weakest topic for last so that you don’t waste valuable time struggling with the answers.

☐ Do not leave the exam room before the time is up until you have completed the entire paper and make sure that you have attempted all questions.

Ace it!
How do you learn Geography?

Each of us is an individual, and we all have different ways of learning. Some people like to write everything down when revising, others draw huge colourful mind maps, still others recite lists and facts. Some learners need to walk up and down or be physically active when learning.

It can be very useful for you to find out what kind of a learning style you have. You can then learn techniques to help you when revising the large amount of content in Geography Grade 12..

Take the quiz below to see what type of learning style you have.

Question 1
When you read a book for relaxation, which do you prefer?

a) A travel book which has a lot of photographs.

b) A crime mystery which has a lot of dialogue.

c) A book where you need to solve problems or answer questions.

Question 2
When you listen to music, do you:

a) Daydream or create pictures in your mind that go with the music?

b) Sing or hum along with the music?

c) Dance, move to the music, or tap your feet?

Question 3
As an out-of-school activity, which of these would you prefer?

a) An art class.

b) A music class.

c) An exercise class.

Question 4
When you see the word 'c – a – t' what is the first thing you do?

a) Get a mental image or picture of a specific cat.

b) Say the word 'cat' to yourself.

c) Get the feeling of being with a cat, for example feeling its fluffy fur or playing with it.

Question 5
You are struggling to spell a word. What are you most likely to do?

a) Write it out to see if it looks right.

b) Sound it out phonetically.

c) Write it out to see if it feels right.

Question 6
You are waiting in a long queue at the movies. What are you most likely to do?

a) Look at the posters up on the walls advertising other films.

b) Talk to the person next to you.

c) Move around, fidget or tap your foot.

Question 7
You have a new smartphone. To figure out how it works, which would you rather do?

a) Watch a YouTube video on the features of the phone.

b) Listen to someone explain it to you.

c) Fiddle with the phone yourself to figure out how it works.
Question 8
If you are really angry, what are you most likely to do?
   a) Frown or have a thunderous expression on your face.
   b) Shout and lose your temper.
   c) Slam doors, punch a pillow and stomp around.

Question 9
You are visiting a museum for the first time. What do you do first?
   a) Look around for a map or guide book showing the location of the various exhibits.
   b) Talk to a museum guide and ask them about the different exhibits.
   c) Go into the first exhibit that looks interesting and worry about directions later.

Question 10
You are trying to concentrate on doing your homework. What is most distracting for you?
   a) Visual distractions.
   b) Noise.
   c) Sensations like feeling hungry, having an itch, or feeling your shoes are too tight.

Question 11
You have been to a party. What are you most likely to remember the next day?
   a) The faces of the people you met, but not their names.
   b) The names of the people you met, but not their faces.
   c) The things you did and said while you were there.

Question 12
When learning for a Geography test, what would you rather do?
   a) Read notes, read headings in a book, look at photos and illustrations.
   b) Ask a friend to ask you questions, or repeat facts silently to yourself.
   c) Write things out on index cards, or make diagrams or models.

| Number of a’s: _____ | Number of b’s: _____ | Number of c’s: _____ |

Results:
A If you answered mostly a’s you may be a visual learner. You tend to learn by seeing and looking.

B If you answered mostly b’s you may be an auditory learner. You tend to learn by hearing and listening.

C If you answered mostly c’s you are probably a kinaesthetic learner. You tend to learn best by touching and doing.

Remember that nobody is all visual, all auditory or all kinaesthetic. You may find that you are a combination of the three, or you might find that you will use different learning styles for different tasks.

Throughout this study guide you will see tips to help you learn the content, based on your learning style. Look out for the icons above to help you as you work through Grade 12 Geography.
SECTION 1
Geographical skills and techniques

Unit 1  Mapwork techniques

CHECKLIST:
- Applying map skills and techniques: scale, contours and cross-sections
- Direction: magnetic north, true north and magnetic declination
- Grid referencing and map code
- Comparing a topographic map with an orthophoto map
- Other techniques required for map interpretation: tance and area land use maps and field sketching.

Mapwork requires you to apply your knowledge and skills to THREE types of maps (visual material), namely
- Topographic maps
- Orthophoto maps
- Aerial photographs

Table 1.1 summarises the features of these maps and photographs.

<table>
<thead>
<tr>
<th></th>
<th>Topographic maps</th>
<th>Orthophoto maps</th>
<th>Aerial photographs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scale</strong></td>
<td>1:50 000</td>
<td>1:10 000</td>
<td>Various scales depending on the flying height of the plane.</td>
</tr>
<tr>
<td><strong>Colour</strong></td>
<td>There are six colours used, namely, blue, green, black brown, red and grey.</td>
<td>Black and white. Sometimes it may be in colour.</td>
<td>Black and white. Sometimes it may be in colour.</td>
</tr>
<tr>
<td><strong>Symbols</strong></td>
<td>Conventional signs are used. A reference or key is used.</td>
<td>Conventional signs are used. No reference or key is given. Information is superimposed onto the orthophoto, for example shops, church, contour lines, road names.</td>
<td>No reference, key or conventional signs are used. There may be flight information along the margin of the photograph.</td>
</tr>
<tr>
<td><strong>Characteristics</strong></td>
<td>Detailed with symbols or conventional signs. No 'real' objects are shown. For example: a main road is represented by a red line – not the actual road itself.</td>
<td>All details are seen as they are in reality. No symbols are used to represent roads, houses, trees, recreational areas and farmlands.</td>
<td>All details are seen as they are in reality.</td>
</tr>
<tr>
<td><strong>Contours</strong></td>
<td>Contour lines are solid brown lines and are 20m apart. Every 100m metres the brown contour line is slightly thicker than the rest.</td>
<td>Contours are superimposed as solid black lines and are 5m apart. Every 20m the black contour line is slightly thicker than the rest.</td>
<td>No contours are visible or superimposed.</td>
</tr>
<tr>
<td><strong>Orientation</strong></td>
<td>Always orientated northwards. North is always at the top of the topographic map.</td>
<td>Always orientated northwards. North is always at the top of the orthophoto.</td>
<td>Orientation may not be obvious. Use the shadows of tall objects, buildings or trees on the photograph to assist with orientation.</td>
</tr>
</tbody>
</table>

Table 1.1 Summary of the three types of maps used in mapwork.
Scale

Scale is the relationship between the actual geographical area (reality) and the size of the map.

<table>
<thead>
<tr>
<th>Topographic map</th>
<th>Orthophoto map</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Statement scale</strong> (written or word)</td>
<td>One centimetre (cm) represents half a kilometre (km).</td>
</tr>
<tr>
<td>1cm on the map = 50 000cm in reality (50 000cm = 500m or 0.5km or ½km)</td>
<td>1cm on the map = 10 000cm in reality (10 000cm = 100m or 0.1km or 1/10km)</td>
</tr>
</tbody>
</table>

2. Representative fraction (ratio scale)

| 1 : 50 000 or \(\frac{1}{50 000}\) | 1 : 10 000 or \(\frac{1}{10 000}\) |

3. Linear scale (a straight line marked off in centimetres representing the ground distance in kilometres).

Table 1.2 Types of scale

**NOTE:**

- A small scale map (large number in the ratio scale) shows a larger area with less detail, for example 1:50 000
- A large scale map (small number in the ratio scale) shows a smaller area with greater detail, for example 1:10 000

Direction

Direction is the description of the position of one place in relation to another. There are 16 compass points with the four cardinal points being North, South, East and West.

MY OWN NOTES

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
**True north, true bearing, magnetic north, magnetic declination and magnetic bearing**

On a 1:50 000 topographic map there are TWO north points, namely magnetic north and true north. The magnetic north and true north are not in the same place.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Information</th>
<th>Calculation and/or diagram</th>
</tr>
</thead>
</table>
| True North (TN) | - This is the geographical North Pole as we understand it.  
- All the lines of longitude converge at this point. | ![Figure 1.3 Lines of longitude converging at true north](image) |
| Magnetic North (MN) | - The Earth has a magnetic field, which exerts a pull on the magnetic needle of a compass.  
- This causes the needle to align itself with the Earth's magnetic field.  
- Magnetic north drifts over time, giving different values for bearing that is time dependent. | ![Figure 1.4 True north and magnetic north as they appear on all 1:50 000 topographic maps.](image) |
| True Bearing (TB) | - This is the angle from one place to another measured from the True North line.  
- It is read **clockwise** from 0° on the North-South line.  
- A protractor is used to calculate the angle. | Calculate the true bearing of place A from place B:  
1. Measure the true bearing from B to A. Draw a line connecting both these places.  
2. Then draw a N-S line through place B (The place you are measuring from).  
3. Place the protractor on the N/S line with centre of the protractor on place B.  
4. Measure the angle ‘x’ in a clockwise direction from the N-S line to the line that joins the two places together. ![Figure 1.5 The calculation of true bearing from place B to A.](image) |
### Magnetic Declination (MD)

- This is the angular difference between magnetic north and true north.
- MD can be calculated as long as the angle between true north and magnetic north is known.
- The angle of difference is recorded at the bottom of the map, usually alongside the true north and magnetic north arrows.
- The angle is recorded for the year of publication of the map and the rate of change is given.
- Figure 1.5 shows an example of the magnetic declination found on a 1:50 000 topographic map.

![Magnetic Declination Diagram](image)

**Figure 1.6 Magnetic declination on a 1:50 000 topographic map (3125BD Steynsburg)**

To calculate the present day magnetic declination of a map you need to do the following:

1. Write down the present year
2. Write down the year of the magnetic declination being published
3. Calculate the difference in years obtained in steps 1 and 2 above
4. Write down the annual change (this is always in minutes)
5. Multiply the annual change by the difference in years (step 3).
6. If the rate of annual change is WESTWARDS then ADD and if EASTWARDS then SUBTRACT the change from the magnetic declination given.

For example: Using information from Figure 1.6

1. 2017
2. 2002
3. 15
4. 9' west
5. 12 x 9 = 135' (which is 2° and 15')
6. 23° 21' + 2° 15' = 25° 36'

### Magnetic Bearing (MB)

- This is the sum of true bearing and magnetic declination.
- MB = TB + MD
- Having calculated the true bearing and magnetic declination, the magnetic bearing can then be determined.
- This will ensure that the correct direction is obtained.
- Pilots and ship navigators use this in their route course plotting.

**Table 1.3** The concepts of true north, magnetic north, true bearing, magnetic declination and magnetic bearing

For example: The true bearing (TB) of place A from place B is 237°. The magnetic declination (MD) is 25° 36' present day. Then: MB = 237° + 25° 36' = 262° 36'

**For auditory learners:** Working with a partner, take turns to explain all the concepts in the table above to each other, until you understand the concepts and how to do the calculations.
Grid referencing

Alphanumeric grid

• This is a grid which may be placed on a topographic map to assist with the location of points and places.
• To read an alphanumeric grid you have to read the letter before the number ie. D4

Grid reference (co-ordinates)

• This is the method used for finding an exact position on a map.
• It is a point where a line of latitude intersects a line of longitude.
• In South Africa all places are SOUTH of the equator and EAST of the Greenwich meridian.
• Grid reference is always written in ° (degrees) ’ (minutes) and “ (seconds).
• NOTE: 1° (degree) = 60’ (minutes) and 1’ (minute) = 60” (seconds)
The answer will always be written ___ ° ___ ’ ___ “ S ___ ° ___ ’ ___ “ E

Example: Determine the grid reference of trigonometrical station 273 in the extract of the topographic map in Figure 1.8.

Determining latitude and longitude:

• Locate the point in question on the topographic map (trigonometric station 273).
• Draw in the latitude and longitude lines to intersect at this point (make sure your lines are parallel with the margins of the map).
• The ‘degrees’ and ‘minutes’ for the latitude and longitude can now be noted.
  
  Latitude = 27° 45’ 
  Longitude = 29° 59’
• To determine the ‘seconds’ of the grid reference, two methods can be used:
Method 1 (the short method)
Divide the minute block up into quarters and then estimate the seconds.

Example:
Latitude
-59° ±17' or 18° 30'00" -15°
-30° ±46' or -45° 48'
-60° 46'

Longitude

<table>
<thead>
<tr>
<th>Method 2 (the accurate method)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Divide the minute block up into quarters and then estimate the seconds.</td>
</tr>
</tbody>
</table>

1. Measure the full length of the minute block.
2. Measure the length of the portion of the minute block where the line of latitude or longitude cuts it.
3. Calculate the ‘seconds’ value of the block as follows:

\[
\frac{\text{Length of the portion of the minute block} \times 60}{\text{Full length of the minute block}}
\]

Example:
Latitude seconds: 1.9cm \(\times 60 = 114\) seconds
Longitude seconds: 3.7cm \(\times 60 = 222\) seconds

\[
= 47\text{°} \text{ (seconds)} \quad = 18\text{°} \text{ (seconds)}
\]

Table 1.4 How to calculate ‘seconds’ for grid reference

Answer: 27° 45' 47" S 29° 59' 18" E

Map Code (topographic map)
- For easy reference, the mapping system used in South Africa allows for the division of a map into a number of 1° by 1° blocks. Each of these blocks is referenced from the coordinates in the NW corner. Latitude is referenced first then longitude. Cape Town’s 1° x 1° reference is 3318 (33° latitude and 18° longitude).

- Each of these 1° x 1° blocks is in turn divided up into four blocks labelled A, B, C and D. These are called the ‘big blocks’. Each ‘big block’ is further divided into four smaller blocks, also labelled A, B, C and D. These are called “small blocks”. Each small block represents a 1:50 000 topographical map.

Example: Cape Town’s map code is listed as:

![Map Code Illustration](image)

Figure 1.9 Illustration of how to obtain Cape Town’s map code on a topographic map

SECTION 1 GEOGRAPHICAL SKILLS AND TECHNIQUES
NOTE: Map Code for an Orthophoto map

There are 25 orthophoto maps to each 1:50 000 topographic map.
3321BC 25 Mbotji (Orthophoto)

The orthophoto is referenced from the topographic map reference. The exact orthophoto map sheet is numbered from 1-25.
3321BC Mbotji (Topographic)

Table 3.3 Comparing an orthophoto map with a topographic map

Other techniques required for map interpretation

Distance
• Map distance is measured in centimetres using a ruler, a piece of paper or string.
• Ground distance (reality) is expressed in metres or kilometres.
• To convert map distance to ground distance the scale of the map is required.

<table>
<thead>
<tr>
<th>Topographic maps</th>
<th>Orthophoto maps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:50 00 means that for every 1 centimetre on the map it represents 50 000 centimetres in reality.</td>
<td></td>
</tr>
<tr>
<td>50 000cm = 500m = 0.5km or ½km</td>
<td></td>
</tr>
<tr>
<td>To calculate the distance:</td>
<td></td>
</tr>
<tr>
<td>• measure from one point to another on the map (either with a ruler, a piece of paper or string) to get an answer in centimetres.</td>
<td></td>
</tr>
<tr>
<td>• multiply the map distance in centimetres by 0.5 to get an answer in kilometres.</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Measured distance on topographic map = 6.4cm</td>
<td></td>
</tr>
<tr>
<td>Actual distance on the ground = 6.4 x 0.5</td>
<td></td>
</tr>
<tr>
<td>= 3.2km</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.5 Calculating distance on a topographic map and orthophoto map

Short cut to check your answer:
Divide the cm distance on the map by 2 to get the answer in km.
Answer: 6.4 ÷ 2 = 3.2km

Area of a regular shape
• Area is the surface space occupied by a feature.
• Area is expressed in square units (m² or km²) or in hectares (ha)
• 1 ha = 100m x 100m = 10 000 m²
  (an answer in m² can be divided by 10 000 to get answer in ha)

The formula for area is:
Area = length x breadth

If you are asked to calculate hectares (ha).
100m x 100m = 10 000m² = 1ha

100m

1 ha

The hectare (ha) is a land unit used in farming or urban land utilisation
Then divide your answer in m² by 10 000 to get ha.
Example 1: Topographic map (1:50 000)
The length of a feature on a topographic map is 4cm and its breadth is 1.3cm. Determine the actual area of the feature in km².

Length = 4cm
Length in km = 4cm × 0.5 = 2km
Breadth = 1.3cm
Breadth in km = 1.3cm × 0.5 = 0.65km
Area = l × b
   = 2km × 0.65km
   = 1.3km²

Example 2: Orthophoto map (1:10 000)
The length of a feature on an orthophoto is 3.2cm and its breadth is 2.7cm. Determine the actual area of the feature in m².

Length = 3.2cm
Length in m = 3.2cm × 100 = 320m
Breadth = 2.7cm
Breadth in m = 2.7cm × 100 = 270m
Area = l × b
   = 320m × 270m
   = 86 400m²
Area in hectares = \frac{86 400m²}{10 000}
State the area in ha = 8.64ha

Area of an irregular feature (on a topographic map)
Method for determining the area of an irregular feature:
• Trace the feature onto paper
• Draw a 1cm x 1cm grid onto the paper to cover the feature.
• The scale of the topographic map is 1:50 000 therefore 1cm = 0.5km.
• Each square on the grid will have an area of: 0.5km x 0.5km = 0.25km².
• Count the total number of complete squares that cover the irregular area.
• Then count all the remaining ‘part’ squares and divide by 2 or estimate how many full squares they would fill.
• ADD the two totals together to work out the total number of squares that cover the irregular area.
• MULTIPLY the total number of squares by the area of each square (0.25km²) to establish what the area of the irregular feature is.

Formula: Area = Total number of squares x 0.25km² (where the scale of the map is 1:50 000)

Example:

No. of completely filled squares = 3
No. of partially filled squares = \frac{11}{2} = 5.5
Area = Total number of squares x 0.25km²
   = 3 + 5.5 \times 0.25km²
   = 8.5 \times 0.25km²
   = 2.125km²

Figure 1.10 An irregular feature (dam) with the 1cm x 1cm grid drawn over it
Land-use maps
- Show simple patterns (natural and constructed) on the landscape.
- The relationship between the physical environment and the human activities is usually highlighted on a land-use map.
- The idea is to generalise the patterns and to show relationships between:
  o lowlands and highlands
  o relief and drainage, transport or settlement
  o relief and agricultural land use.

Note:
Land-use maps are simplified maps of what appears on the topographical map. Colour and shading is used to distinguish different land-use types.

<table>
<thead>
<tr>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>|\ Highlands</td>
</tr>
<tr>
<td>- Roads</td>
</tr>
<tr>
<td>- - Tracks (4 x 4)</td>
</tr>
</tbody>
</table>

Sketches (from the field or a photograph)
- A sketch is a simplified summary of a landform or landscape observed in the field or from a photograph.
- The sketch highlights the form and shape of the important geographical features.
- All the features should be labelled.
- Horizontal photographs are taken from the ground and are useful for field sketching.
- An example of a field sketch of Photograph 3.2 is shown in Figure 3.3.

Photograph 3.2

Figure 3.3 Sketch of Photograph 3.2

MY OWN NOTES
Unit 2  Topographic maps

CHECKLIST
- 1:50 000 maps: Conventional signs and symbols
- Contours and landforms
- Cross sections on 1:50 000 maps
- Vertical exaggeration
- Intervisibility
- Gradient

Conventional signs and symbols
Colours are used on topographic maps to make the symbols clearer. There are six basic colours.

<table>
<thead>
<tr>
<th>Colour</th>
<th>Category</th>
<th>Type of feature</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Water</td>
<td>Physical features</td>
<td>Dams, rivers, pipelines, canals, swamps and marshes, non-perennial water features, reservoirs etc.</td>
</tr>
<tr>
<td>Green</td>
<td>Vegetation</td>
<td></td>
<td>Cultivated lands, orchards and vineyards, recreation areas, natural vegetation, nature reserves and woodlands etc.</td>
</tr>
<tr>
<td>Brown</td>
<td>Mainly Relief</td>
<td>Contour lines, dry pans or dry river beds, rock outcrops and secondary roads.</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>Man-made (constructed) features</td>
<td>Railways, buildings, industrial areas, power lines, other roads, excavations, cemetery's, trig beacons, spot heights etc.</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td></td>
<td>Arterial routes, main roads, international boundaries and lighthouses.</td>
<td></td>
</tr>
<tr>
<td>Grey</td>
<td></td>
<td>Build-up areas (residential areas) and cadastral information.</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.1 Colours used on a topographic map

Altitude
- Altitude is the height above sea level (sea level is at 0m).
- There are four ways to indicate altitude on a topographic map:

  Contour line – lines that join places of equal height above sea level. The contour interval on a topographic map is 20m and they are brown lines. On orthophoto maps the contour interval is 5m and they are black lines.

  Spot height – a black dot with an exact height next to it. (> 960 the height is 960m).

  Trigonometrical station – found at high points on the map. These beacons consist of a triangle with two sets of numbers. The NUMBER of the trig beacon is always to the right side of the triangle and the HEIGHT of the trig beacon is always below the triangle.

    \[
    \triangle 84 \quad (\text{trigonometrical station 84 with a height of 1022.6m}).
    \]

  Bench mark – these are heights along roads. They are indicated with an arrow with a height next to it. 948.4→|| (the height at the bench mark is 948.4m).
<table>
<thead>
<tr>
<th>Point symbols (cont.)</th>
<th>Line symbols (cont.)</th>
<th>Area symbols (cont.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bench mark</td>
<td>National route</td>
<td>Mine dump</td>
</tr>
<tr>
<td>Bridge</td>
<td>Arterial route</td>
<td>Excavation</td>
</tr>
<tr>
<td>Ruin</td>
<td>Main road</td>
<td>Cemetery</td>
</tr>
<tr>
<td>Building</td>
<td>Secondary road</td>
<td>Embankment/road cutting</td>
</tr>
<tr>
<td>Post office</td>
<td>Other road (gravel)</td>
<td>Built-up area</td>
</tr>
<tr>
<td>Police station</td>
<td>Track or trail</td>
<td>Perennial water</td>
</tr>
<tr>
<td>Shop</td>
<td>Railway station</td>
<td>Constructed dam</td>
</tr>
<tr>
<td>Place of worship</td>
<td>Railway siding</td>
<td>Non-perennial water</td>
</tr>
<tr>
<td>Hotel</td>
<td>Telephone line</td>
<td>Dry pan</td>
</tr>
<tr>
<td>School</td>
<td>Powerline</td>
<td>Marsh or vlei</td>
</tr>
<tr>
<td>Wind pump</td>
<td>Coastal rocks</td>
<td>Prominent rock outcrop</td>
</tr>
<tr>
<td>Monument</td>
<td>International boundary</td>
<td>Erosion</td>
</tr>
<tr>
<td>Communication tower</td>
<td>Provincial boundary</td>
<td>Sand</td>
</tr>
<tr>
<td>Trigonometrical station (beacon)</td>
<td>Wall</td>
<td>Woodlot</td>
</tr>
<tr>
<td>Marine beacon</td>
<td>Perennial river</td>
<td>Cultivated land</td>
</tr>
<tr>
<td>Dipping tank</td>
<td>Non-perennial river</td>
<td>Orchards/vineyards</td>
</tr>
<tr>
<td>Light house or Marine light</td>
<td>Dry watercourse</td>
<td>Recreation ground</td>
</tr>
<tr>
<td>Water tower</td>
<td>Pipe line</td>
<td>Protected area (nature reserve, national park of conservancy)</td>
</tr>
<tr>
<td>Reservoir</td>
<td>Row of trees</td>
<td></td>
</tr>
<tr>
<td>Water point (spring or fountain)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2.2 Conventional symbols
New, changing or back in fashion
Pay careful attention to the key of conventional signs on a topographic map. There are many new or updated symbols. Some symbols which have been used for a long time are suddenly reappearing with more regularity on the new, updated maps.

<table>
<thead>
<tr>
<th>Example</th>
<th>The symbol used on a topographic map</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutline</td>
<td>Cutline</td>
<td>A clearing of vegetation for putting in pipelines such as a servitude or for powerlines. Marking previous or existing mining operations where ground is unstable.</td>
</tr>
<tr>
<td>Built-up Area (High, Low Density)</td>
<td><img src="image" alt="Symbol" /></td>
<td>The shading in the blocks is darkest on the left-hand side and lightest on the right-hand side of the symbol shown. The darkest shading shows a high density of buildings in a built-up area. The size of the land-parcels and the street pattern will indicate density as well.</td>
</tr>
<tr>
<td>Ground sign</td>
<td><img src="image" alt="Symbol" /></td>
<td>A physical marking on the surface; either the name of a place or a symbol.</td>
</tr>
</tbody>
</table>

Contours and landforms
An understanding of contour lines is necessary in order to interpret relief features on a topographic map. The following examples are basic representations of the most common geomorphological features.

<table>
<thead>
<tr>
<th>Type of slope</th>
<th>Characteristics of contour pattern</th>
<th>Contour diagram</th>
<th>Cross section diagram of the contour pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Even slope</td>
<td>Contours are evenly spaced.</td>
<td><img src="image" alt="Contour Diagram" /></td>
<td><img src="image" alt="Cross Section" /></td>
</tr>
<tr>
<td>Gentle slope</td>
<td>Contours are far apart.</td>
<td><img src="image" alt="Contour Diagram" /></td>
<td><img src="image" alt="Cross Section" /></td>
</tr>
<tr>
<td>Steep slope</td>
<td>Contours are close together.</td>
<td><img src="image" alt="Contour Diagram" /></td>
<td><img src="image" alt="Cross Section" /></td>
</tr>
<tr>
<td>Type of slope</td>
<td>Characteristics of contour pattern</td>
<td>Contour diagram</td>
<td>Cross section diagram of the contour pattern</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Stepped slope</td>
<td>Contours close together in sets. Each group or set is further apart.</td>
<td><img src="Contour_Diagram_Stepped_Slope.png" alt="Contour Diagram" /></td>
<td><img src="CrossSection_Diagram_Stepped_Slope.png" alt="CrossSection_Diagram_Stepped_Slope" /></td>
</tr>
<tr>
<td>Vertical slope (Cliff)</td>
<td>Contours merge or run very close together at this point.</td>
<td><img src="Contour_Diagram_Vertical_Slope_Cliff.png" alt="Contour Diagram" /></td>
<td><img src="CrossSection_Diagram_Vertical_Slope_Cliff.png" alt="CrossSection_Diagram_Vertical_Slope_Cliff" /></td>
</tr>
<tr>
<td>Convex slope</td>
<td>Contours are close together at the bottom of the slope and further apart at the top of the slope.</td>
<td><img src="Contour_Diagram_Convex_Slope.png" alt="Contour Diagram" /></td>
<td><img src="CrossSection_Diagram_Convex_Slope.png" alt="CrossSection_Diagram_Convex_Slope" /></td>
</tr>
<tr>
<td>Concave slope</td>
<td>Contours are far apart at the bottom of the slope and closer together at the top of the slope.</td>
<td><img src="Contour_Diagram_Concave_Slope.png" alt="Contour Diagram" /></td>
<td><img src="CrossSection_Diagram_Concave_Slope.png" alt="CrossSection_Diagram_Concave_Slope" /></td>
</tr>
<tr>
<td>Valley</td>
<td>Contours always point upstream or towards the highest point. Rivers may flow through valleys.</td>
<td><img src="Contour_Diagram_Valley.png" alt="Contour Diagram" /></td>
<td><img src="CrossSection_Diagram_Valley.png" alt="CrossSection_Diagram_Valley" /></td>
</tr>
<tr>
<td>Spur</td>
<td>Contours always point ‘downstream’ or away from the highest point. They do not have rivers flowing over them as they form the ‘highland’ between valleys.</td>
<td><img src="Contour_Diagram_Spur.png" alt="Contour Diagram" /></td>
<td><img src="CrossSection_Diagram_Spur.png" alt="CrossSection_Diagram_Spur" /></td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waterfall</td>
<td>Two or more contours meet at a point with a river flowing at right angles to the contour lines.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ridge and saddle</td>
<td>A ridge is an area of highland that may also form a watershed. A saddle is a small dip in the ridge but may still be impassable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pass</td>
<td>A dip between two pieces of highland that is accessible by road and sometimes by rail. Many railway lines actually pass through tunnels in passes. It is costly to build railways in such areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poort or water gap</td>
<td>A total break between two pieces of highland that is passable by road and railway. It may have a river flowing through it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watershed</td>
<td>An imaginary line that separates one drainage basin from another. It is found in an area of highland.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mesa</td>
<td>A flat topped hill that is wider than it is high. [\text{height} &lt; \text{width}]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butte</td>
<td>A flat topped hill that is higher than it is wide. [\text{height} &gt; \text{width}]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Scarp and dip slopes (homoclinal ridge) These occur on ridges with inclined (tilted) rock layers. The dip slope is usually gentle (contours further apart) and the scarp slope is steep (contours closer together).

Table 2.3 Identifying Contour patterns and landforms

Cross sections (on 1:50 000 topographic maps)
- A cross section is a profile or side view of a relief feature.
- The horizontal scale (HS) is on the x-axis. On topographic maps this is always 1:50 000.
- The vertical interval (VI) is on the y axis.

Example: Drawing a cross section from A to B. (Assume a topographic map scale of 1:50 000)

Step 1:
- Draw a line joining points A and B (if none exists).

Step 2:
- Place a piece of paper along the line A-B and mark off each contour interval on the paper.
- Write down the contour values on the lines marked.
- Mark off any major features such as rivers, roads and power lines if you are required to.
Step 3:
- Draw a system of axes on which the profile is to be drawn.
- The y-axis must start one interval lower than the lowest value of the cross section and end one value higher than the highest value.
- HS = 1:50 000 for a topographic map and 1:10 000 for an orthophoto map.
- VI is 1 cm = 20 m or a VS of 1:2 000.

Step 4:
- Place the piece of paper onto the system of axes ensuring that it is accurately aligned.
- Mark off the contour intervals from the paper onto the corresponding horizontal lines.
- To ensure accuracy the piece of paper with the contour marks must always be aligned with the x-axis.

Step 5:
- Join the dots (freehand) to reveal the cross section.
- If asked to label the cross section then an arrow pointing down to the feature is drawn. It is then labeled.
- Give the cross section an appropriate title.
**Vertical exaggeration**

- Refers to the proportion by which the vertical scale of a cross section is increased so as to aid reading and analysis of the drawn features.

- To calculate vertical exaggeration (VE) divide the vertical scale (VS) of the cross section by the horizontal scale (HS).

\[ \text{VE} = \frac{\text{VS}}{\text{HS}} \]

NOTE: To convert a vertical interval (VI) of 1 cm = 20 m to a vertical scale (VS) then you need to convert the metres to centimetres by multiplying by 100.

\[
\begin{align*}
\text{Conversion:} & & \\
1 \text{ cm} & = 20 \text{ m} \\
& = 20 \times 100 \\
1 \text{ cm} & = 2000 \text{ cm (now they are both cm)} \\
\text{Therefore VS} & = 1:2000
\end{align*}
\]

<table>
<thead>
<tr>
<th>Topographic maps</th>
<th>Orthophoto maps</th>
</tr>
</thead>
<tbody>
<tr>
<td>On topographic maps the HS is always 1:50 000. The VI is usually 1 cm = 20 m (VS 1:2000) or 1 cm = 100 m (VS 1:10 000)</td>
<td>On orthophoto maps the HS is always 1:10 000. The VI is usually 1 cm = 5 m (VS 1:500) or 1 cm = 20 m (VS 1:2000).</td>
</tr>
</tbody>
</table>

**Example:**

\[
\begin{align*}
\text{Topographic maps:} \\
\text{VE} & = \frac{\text{VS}}{\text{HS}} \\
& = \frac{2000}{10000} \\
& = 0.25 \text{ (exaggerated 25 times)} \\
\text{Orthophoto maps:} \\
\text{VE} & = \frac{\text{VS}}{\text{HS}} \\
& = \frac{2000}{10000} \\
& = 0.2 \text{ (exaggerated 5 times)}
\end{align*}
\]

Table 2.4 Vertical exaggeration calculations

**Intervisibility**

- The ability to see one point from another point.

- One can determine intervisibility by joining the two points with a straight line on a cross section. If the line crosses through any feature then the points are not intervisible.

**Example:**

- Points 1 and 2 are intervisible – you can see point 1 from point 2 (and vice versa).

- Points 3 and 4 are not intervisible – you cannot see point 3 from point 4 (and vice versa).
Note: It is possible to determine intervisibility between two points on a gentle slope, preferably a concave one, without drawing a cross section:

- Place a ruler along the line of vision between the two points.
- Note the height of the highest point (A or B) then move along the ruler looking for a contour value greater than the highest point.
- Look for trigonometrical beacons along this line as well.
- If any higher value is found, then the points are not intervisible.
- In the diagram below, A and B are intervisible.

Note: This method cannot be applied with certainty to a stepped slope or a convex slope.

**Gradient**

- Gradient is the average steepness of a slope.
- Gradient is expressed as a ratio, for example 1:30. This means that for every 30 m travelled along the ground, the height increases by 1 m.

![Gradient Types](image)

**To calculate gradient two things must be known:**

1. *Height (H)*: Point with the higher altitude – point with the lower altitude (i.e. calculating the height difference). Height or VD (Vertical Difference) is always expressed in metres (m)

2. *Distance (D)*: The distance between the two points. Distance is also referred to as Horizontal Equivalent (HE). The distance between the two points (straight line) is measured on the map with a ruler, and the answer expressed in metres. (You may use the short cut shown earlier.)

The formula for gradient is: \[ G = \frac{H}{D} \] or \[ G = \frac{VD}{HE} \]

**Note:** A simpler way of calculating gradient and expressing it as a ratio is:

\[ G = 1 : \frac{D}{H} \] or \[ G = 1 : \frac{Big number}{Small number} \]

**QUICK QUIZ**

Test yourself

Calculate the gradient between A and B in Figure 2.2.b. Assume that the scale is 1:10000.

This means 1 cm = 100 m

Answer: 1:40 (very gentle)
Unit 3  Aerial photographs and orthophoto maps

CHECKLIST
- Interpreting vertical aerial photographs
- Orthophoto maps: identifying features
- Comparing an orthophoto map with a topographic map

Aerial Photographs
There are THREE types of aerial photographs that are named according to the angle from which they are taken.

<table>
<thead>
<tr>
<th>Type of aerial photograph</th>
<th>Information</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical</td>
<td>• Bird’s eye view (90°) which is ideal for making and updating maps as one is able to calculate distance and scale.</td>
<td><img src="image" alt="Figure 3.1" /></td>
</tr>
<tr>
<td>Low angle oblique</td>
<td>• The camera is angled at 30° to the vertical which results in features in the foreground being distorted. A small, definite area is photographed.</td>
<td><img src="image" alt="Figure 3.2" /></td>
</tr>
<tr>
<td>High angle oblique</td>
<td>• The camera is angled at 60° to the vertical and the horizon is visible. A large area can be photographed.</td>
<td><img src="image" alt="Figure 3.3" /></td>
</tr>
</tbody>
</table>

Table 3.1 The three types of aerial photographs

Analysis of aerial photographs

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape</td>
<td>Natural features are irregular (rivers, mountains) and constructed features are more geometric (roads, railway lines, golf courses).</td>
</tr>
<tr>
<td>Shade</td>
<td>Depends on the amount of light that is reflected. Light (exposed sand, muddy water) or dark (vegetation, clear water).</td>
</tr>
<tr>
<td>Patterns</td>
<td>Large-scale contour ploughing indicates extensive, commercial farming, while small patches may indicate intensive, irrigation farming or subsistence farming.</td>
</tr>
<tr>
<td>Texture</td>
<td>Rough (trees, natural bush) or smooth (grasslands).</td>
</tr>
<tr>
<td>Shadow and orientation</td>
<td>In the southern hemisphere (SH) shadows always fall to the south. In the morning shadows fall SW and in the afternoon shadows fall SE in the SH. At midday the shadow is shortest and falls due south as the sun is directly overhead.</td>
</tr>
<tr>
<td>Relief and drainage</td>
<td>Rivers may be indicated by lines of trees or natural bush, while relief can be observed by looking for rocky out crops or different shaded slopes. (Aspect is determined by whether there is shadow or not.)</td>
</tr>
</tbody>
</table>

Table 3.2 Analysing aerial photographs
Interpreting vertical aerial photographs

- Vertical aerial photographs are taken by a camera that is attached to the undercarriage of the aeroplane.
- The photographs are taken directly from above in flight strips.
- Each photograph overlaps the one in front and behind it by 60% (along the flight strip) and the photographs between two consecutive flight strips overlap by 30%.
- This overlapping helps to reduce distortions.
- Figure 3.1 shows how this process occurs.

The technical information that is shown on an aerial photograph is shown in Photograph 3.1.

![Figure 3.1 Overlapping of vertical aerial photographs](image-url)
<table>
<thead>
<tr>
<th>Feature</th>
<th>What to look for</th>
<th>Interpretation and/or analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rainfall</strong> (All rainfall in South Africa is seasonal. The Western Cape experiences winter rainfall and the rest of the country experiences summer rainfall)</td>
<td>• Perennial rivers or non-perennial rivers.</td>
<td>• Perennial rivers indicate a high seasonal rainfall. • Non-perennial rivers indicate low seasonal rainfall.</td>
</tr>
<tr>
<td></td>
<td>• Extensive cultivation or high river density.</td>
<td>• These features indicate a high rainfall area.</td>
</tr>
<tr>
<td></td>
<td>• Swamps and marshes</td>
<td>• These are water logged areas showing the level of the water table.</td>
</tr>
<tr>
<td></td>
<td>• Dry pans, sparse vegetation, windmills, furrows and dams.</td>
<td>• These features indicate a low rainfall area.</td>
</tr>
<tr>
<td><strong>Drainage</strong></td>
<td>• Drainage patterns.</td>
<td>• Is the pattern dendritic, trellis, rectangular, radial, parallel, deranged or centripetal.</td>
</tr>
<tr>
<td></td>
<td>• Which direction is the river flowing?</td>
<td>• Use contour lines and spot heights. Dam walls are located on the side where the river is flowing out of the dam.</td>
</tr>
<tr>
<td></td>
<td>• Over what surface does the water flow over?</td>
<td>• This will influence infiltration or run-off. This may be interpreted using hydrographs.</td>
</tr>
<tr>
<td></td>
<td>• Are there dams on the rivers?</td>
<td>• Dams can impact on the ecology of the area, economic activities and flow patterns of the river.</td>
</tr>
<tr>
<td><strong>Relief</strong></td>
<td>• Look for mountains, valleys, rivers, mesas, buttes, conical hills, saddles, passes, gaps.</td>
<td>• Relief can influence land use in an area such as transport, agriculture, industry and the site of settlements. • Steep slopes vs gentle slopes • South facing slopes vs north facing slopes.</td>
</tr>
<tr>
<td><strong>Natural Vegetation</strong></td>
<td>• Look for grasslands, forests, wetlands, trees and bush, nature reserves and conservation areas.</td>
<td>• What impact have these areas had on human activities in the area? • Why are these areas important? • What economical or recreational value do these areas have?</td>
</tr>
<tr>
<td><strong>Land use</strong></td>
<td><strong>Agriculture</strong> • Subsistence or commercial farming. • If commercial is it intensive or extensive farming. • If commercial is it crop (arable) or livestock (pastoral) farming.</td>
<td>• How well developed is the infrastructure? • Look at the size of the farms, proximity to transport routes and the market. • Crop farming shows cultivated lands or orchards and vineyards. • There are irrigation systems, storage silos, reservoirs and dams. • Look for contour ploughing or crop rotation systems.</td>
</tr>
<tr>
<td></td>
<td><strong>Mining</strong> • Look for shafts and mine dumps (excavations)</td>
<td>• Note the railway and roads, settlements for labour and the ecological impact.</td>
</tr>
<tr>
<td></td>
<td><strong>Industry</strong> • Is it light or heavy industry? • Factors to consider when locating an industry.</td>
<td>• Light industry is close to settlements. Heavy industry is close to natural resources and away from settlements. • Flat land, transport links, labour, water, market, power, raw materials.</td>
</tr>
<tr>
<td></td>
<td><strong>Infrastructure</strong> • Where are the roads, railway lines, telephone lines and power lines?</td>
<td>• The relief of an area determines the location of roads and railway lines. • Note how dense the network of roads is and what type of roads have been built. This will indicate the importance of the area.</td>
</tr>
<tr>
<td>Relief</td>
<td>• Look for mountains, valleys, rivers, mesas, buttes, conical hills, saddles, passes, gaps.</td>
<td></td>
</tr>
<tr>
<td>Natural Vegetation</td>
<td>• Look for grasslands, forests, wetlands, trees and bush, nature reserves and conservation areas.</td>
<td></td>
</tr>
<tr>
<td>Land use</td>
<td>• Relief can influence land use in an area such as transport, agriculture, industry and the site of settlements. • Steep slopes vs gentle slopes • South facing slopes vs north facing slopes.</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>• What impact have these areas had on human activities in the area? • Why are these areas important? • What economical or recreational value do these areas have?</td>
<td></td>
</tr>
<tr>
<td>Mining</td>
<td>• How well developed is the infrastructure? • Look at the size of the farms, proximity to transport routes and the market. • Crop farming shows cultivated lands or orchards and vineyards. • There are irrigation systems, storage silos, reservoirs and dams. • Look for contour ploughing or crop rotation systems.</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>• Note the railway and roads, settlements for labour and the ecological impact.</td>
<td></td>
</tr>
<tr>
<td>Settlement</td>
<td>• Light industry is close to settlements. Heavy industry is close to natural resources and away from settlements. • Flat land, transport links, labour, water, market, power, raw materials.</td>
<td></td>
</tr>
<tr>
<td>Microclimate</td>
<td>• Settlement type</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Is it rural or urban? • Note the size and situation of the settlement. • Note services and facilities that are available. • Is it unifunctional or multifunctional?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Settlement pattern (rural) • Is it nucleated or dispersed?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Street pattern (urban) • Grid, planned irregular, unplanned irregular or organic.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Look for the zones of an urban centre. • CBD, transition zone, industrial zone, residential zones, buffer zones, rural-urban fringe, greenbelts.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Settlements located in valleys. • Aspect, anabatic and katabatic winds, frost pockets and temperature inversion, smog.</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.3 Summary of reading and analysis of the physical environment

For visual learners: Use colour and pictures to create a mind map summarising all the features outlined in the table above. Use the mind map to help you revise for tests and exams.
Unit 4  Geographical Information Systems (GIS)

**CHECKLIST**

- Summary of the concept of GIS
- Remote sensing: satellite images and resolution
- Spatial and attribute data: vector and raster data
- Data standardisation, data sharing and data security
- Data manipulation: data intergration, buffering querying and statistical analysis
- Application of GIS techniques

**Summary of the concept of GIS**

Important GIS concepts are:

- **Area data** – has a closed two-dimensional shape defined by a boundary like dams and nature reserves.
- **Attribute data** – also known as ‘count data’ (numerical) and is displayed as columns in table form. The attributes that make up a record in a GIS, describe a feature.
- **Buffering** – an area of distance or time created around a feature.
- **Data** – any collection of related facts arranged in a particular format.
- **Line data** – represent narrow linear features like roads, rivers, railways and boundaries. They have length but no area.
- **Nodes** – central points in a system (nodal point) like a town where roads converge.
- **Pixel** – a single point (dot) on a raster image. A pixel is the smallest unit of a picture and stores its datum as a number.
- **Point data** – mark specific locations of geographic features like windmills and lighthouses. They have no length or area.
- **Polygons** – a vector graphic figure that is representative of an area.
- **Product map** – the single new map that is generated from all the thematic layers that have been superimposed and merged.
- **Querying** – A question or request used for selecting features.
- **Raster data** – the representation of an area as a regular grid of cells called pixels.
- **Spatial data** – describes the location of things using co-ordinates (latitude and longitude).
- **Thematic layer** – themes of information or data such as river drainage patterns, relief and communication networks that is collected.
- **Vector data** – points, lines, areas, polygons using grid coordinates

GIS stands for Geographical Information Systems:

G – Geographical (the real world with its spatial patterns).
I – Information (data that has been collected).
S – Systems (computers technology and support infrastructure).

A GIS is a map-based system that uses computer software to combine the all data collected. A GIS has several functions, namely: capture, storage, analysis, display and mapping of spatial data.

**GIS works in the following way:**

1. A GIS usually consists of a series of layers of information that can be overlaid (superimposed). These layers are called thematic layers and may include information such as schools, relief, vegetation, drainage, infrastructure (road networks) and housing developments.
2. A computer is used as it can combine a number of different geographical themes, from different sources and in different formats.
3. The final map produced is called the product map.
The Figure 4.1 shows the inputs of the geographic information into the system and then the output being ‘New Geographic Information’ in the form of a product map.

**Figure 4.1 How a GIS works**

**GIS data collection**

Geospatial information is data that is collected about a specific place or area. Using a Geographical Information System (GIS), geospatial information can now be layered and analysed to understand complex situations like economic trends, natural disasters, ocean levels, military action, or even population shifts.

There are also many other ways in which GIS data can be collected and these include:

- **Aerial photographs** (type of remote sensing) – only a limited amount of information can be gathered.
- **Satellite images** (satellites use scanners to pick up electromagnetic radiation).
- **Thermal scanners and radar** (type of remote sensing – non-photographic imagery).
- **False colour** – certain radiation (like infrared) is not visible to the human eye so the satellite imagery programme gives certain wavelengths “false colour” to help us understand what we are looking at. For example, vegetation appears red, soil and concrete appears blue and deep water appears black.
- **Photographs** – visible electromagnetic radiation captured on film.
- **GPS** (Global Positioning System) – a GPS receives information from satellites to locate latitude and longitude.
- **Paper maps** – topographic maps or street maps.
- **Field notes** – this is the manual collection of data on paper or maps.
Remote sensing: satellite images and resolution

<table>
<thead>
<tr>
<th>Type of satellite</th>
<th>Information</th>
<th>Image</th>
</tr>
</thead>
</table>
| **LANDSAT TM** Land Satellite Thematic mapper | • Low-orbiting satellite operated by the USA.  
• Only a small area is covered.  
• Produces large scale images and is mostly used for environmental management.  
• Landsat 8, launched 11 February 2013, is the next satellite in the Landsat series. | Photograph 4.1 |
| **EUMETSAT** European Meteorological Satellite | • European operational satellite agency for monitoring weather, climate and the environment. | Photograph 4.2 EUMETSAT image of superstorm Sandy (October 2012) |
| **METEOSAT** Meteorological Satellite | • The Meteosat series of satellites are geostationary (non-orbiting) meteorological satellites operated by EUMETSAT.  
• These satellites cover large areas (Africa or Europe).  
• It produces small scale images that are used to study the weather patterns.  
• It is able to provide vital information about "now weather" and helps with prediction and disaster management. | Photograph 4.3 METEOSAT image of Africa |
| **SPOT** "Satellite Pour l'Observation de la Terre" meaning "Satellite for observation of Earth". | • Low-orbiting satellite operated by France.  
• High-resolution, optical imaging earth observation satellite system operating from space. | Photograph 4.4 |

There are many different satellites that are used to collect spatial data for use in GIS.
Remote sensing and resolution
- Remote sensing is the collection and interpretation of information about the earth from a distance.
- Data is collected by special instruments (satellites and aerial photographs) that are not actually in physical contact with the earth.
- Remote sensing is an essential tool when it comes to modelling our environment and mapping the earth.
- Resolution has to do with the clarity of an image and is associated with pixel density (the number of pixels per unit area).
- A low resolution image has fewer pixels for a defined unit area, while a high resolution image has more pixels for the same defined unit area.

Spatial and attribute data: vector and raster data

### Raster data
- Organised as a matrix or grid that has rows and columns; each row/column intersection is a cell or pixel.
- Each cell has a value. Images and digital elevation models are composed of raster data.
- They are a specific number of pixels high and wide, with each pixel representing a certain size on the ground.
- Generally produced by satellites and airborne sensors.
- Advantage is that data is consistent and reliable.

### Vector data
- Represented as coordinates that define points, or points that are strung together to make lines and polygons.
- This data often has an associated table of information, one for every feature (point, line, or polygon) in the dataset.
- Disadvantage is that resolution may be low and cloud cover may restrict sensors.

<table>
<thead>
<tr>
<th>Type of satellite</th>
<th>Information</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODIS</td>
<td>MODIS is a key instrument aboard the Terra (EOS AM) and Aqua (EOS PM) satellites.</td>
<td>[Image]</td>
</tr>
<tr>
<td></td>
<td>Terra’s orbit around the Earth is timed so that it passes from north to south across the equator in the morning.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aqua passes south to north over the equator in the afternoon.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Terra MODIS and Aqua MODIS are viewing the entire Earth’s surface every 1 to 2 days.</td>
<td>[Image] Photograph 4.5 October 6, 2013 – Dust storm off Tunisia (afternoon overpass). Aqua Satellite</td>
</tr>
</tbody>
</table>

Table 4.1 Different types of satellites

The world can be represented in two ways:

![Raster data](image1)

![Vector data](image2)

Figure 4.2 Raster data compared to vector data – source: vimeo.com
Data standardisation, data sharing and data security

- **Data standardisation** is the first step to ensure that your data is able to be shared between countries, industries and businesses. Data standardisation establishes trustworthy data sources for use by all role players. Ideally, such standardisation should be performed during data entry.

- **Data sharing** is important between GIS practitioners, as gathering high quality imagery and capturing data is very expensive.

- **Data security** means that some private companies may want to protect or copy right their material. They will then put certain security measures in place. Government data is freely available to the public and there are also a number of private enterprises that are prepared to share their data.

- **Data management** involves secure and dependable access to centrally managed information so that comparisons can be made, relationships identified, accurate conclusions can be drawn up and new data products can be created. Data may also be analysed and queried, resulting in improvements.

Data manipulation: data integration, buffering, querying and statistical analysis

Data manipulation deals with the way in which we change data to make it more meaningful.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data integration</td>
<td>• combining data from various sources (thematic layers) to produce a single product.</td>
</tr>
</tbody>
</table>
| Buffering data            | • in mapwork buffering means to put a protective boundary around or between something. An example of a buffer zone is an area that separates or protects one activity/area from another.  
                                • a buffer zone creates a new boundary that is a specified distance away from the existing boundary of the feature. |
| Querying data             | • when data that has been collected or acquired is retrieved and questions are then asked in order to solve a problem. |
| Statistical analysis of data | • this involves collecting, examining, summarising, manipulating, organising and interpreting quantitative data (numbers) to discover its underlying causes, patterns, relationships, and /or trends. |

Table 4.3 Concepts of data manipulation

Application of GIS techniques

GIS can be applied and used in many different aspects of society. Figure 4.3 is a spider diagram showing how and where GIS can be applied in everyday society.

Government
National Government: health, disaster management, education, fund distribution, census.  
Military Defence, Intelligence and National Security  
Regional and Local Government: area of governance, fund allocation, service and facility management.

Emergency Services
Fire, Police and Ambulance and Disaster management

Business
Site Location, Delivery Systems  
Banking, Insurance, Real Estate and Telecommunications

Industry
Transportation, Communication, Mining, Pipelines, Surveying, Healthcare and Engineering (construction of infrastructure)

Environmental
Monitoring & Modelling, Settlement planning and Environmental Impact Assessment (EIA), Conservation, River management and Weather monitoring

Education
Research, Teaching Tool, Administration, School location and development  
Provision of services and facilities

How and where GIS is used and applied

Figure 4.3 How and where GIS can be applied in daily activities
Data standardisation, data sharing and data security

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Table 4.3 Concepts of data manipulation

Application of GIS techniques

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![Figure 4.3 How and where GIS is used and applied](image_url)

**Government**
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Regional and Local Government: area of governance, fund allocation, service and facility management.

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Fire, Police and Ambulance and Disaster management

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Research, Teaching Tool, Administration, School location and development, Provision of services and facilities

**Business**
Site Location, Delivery Systems, Banking, Insurance, Real Estate and Telecommunications

**Industry**
Transportation, Communication, Mining, Pipelines, Surveying, Healthcare and Engineering (construction of infrastructure)

**Environmental**
Monitoring & Modelling, Settlement planning and Environmental Impact Assessment (EIA), Conservation, River management and Weather monitoring

Figure 4.3 How and where GIS can be applied in daily activities
Unit 5  Using Atlases

CHECKLIST

- Examining thematic maps and comparing information from these maps.
- Thematic maps
- Comparing information from different maps

Maps in an atlas are colourful and each colour has its own purpose. By using the key you can establish what each colour means. The colours may indicate physical features or height above sea level.

Figure 5.1 is a map of South Africa showing main cities, surrounding countries, main dams, main rivers, main mountain ranges and the two oceans. All this information is very important for your mapwork examination.

For visual learners: Use coloured pens to colour in all the important features on the map above.

For kinaesthetic learners: Use your finger to trace all the details shown on the map, while reciting the name of each feature.
Unit 5 Using Atlases

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Figure 5.1 Water transfer schemes of South Africa

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Examining thematic maps and comparing information from these maps
Thematic maps show different aspects of the geography of a country or region. Figure 5.2 is a thematic map showing the amount of rainfall and Figure 5.3 shows the core industrial regions of South Africa. Figure 5.4 shows the infrastructure of the country.

Amount of rainfall

<table>
<thead>
<tr>
<th>mm</th>
<th>Amount of Rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1000</td>
<td></td>
</tr>
<tr>
<td>800-1000</td>
<td></td>
</tr>
<tr>
<td>600-800</td>
<td></td>
</tr>
<tr>
<td>400-600</td>
<td></td>
</tr>
</tbody>
</table>
Examining thematic maps and comparing information from these maps

Thematic maps show different aspects of the geography of a country or region. Figure 5.2 is a thematic map showing the amount of rainfall and Figure 5.3 shows the core industrial regions of South Africa. Figure 5.4 shows the rail and port infrastructure of the country.

**Amount of rainfall**

![Map showing amount of rainfall](image)

**Core Industrial regions of South Africa**

![Map showing core industrial regions](image)

Source: Adapted from updated.up.ac.za
Railways and ports in South Africa

Figure 5.4

MY OWN NOTES
QUICK QUIZ
Test yourself
1. Refer to the map of South Africa

1.1 Name the following:
Provinces:
A__________________
B__________________
C__________________
Neighbouring countries:
F__________________
G__________________

Lines of:
D__________________
E__________________

1.2 Match the columns
Only write down the correct matching number, for example 1.2.1 - A.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2.1 Alphanumeric grid</td>
<td>A The described direction of one place or feature in relation to another.</td>
</tr>
<tr>
<td>1.2.2 Altitude</td>
<td>B The exact position of a place or feature on a map, determined by using the coordinate of a line of latitude and longitude.</td>
</tr>
<tr>
<td>1.2.3 Bearing</td>
<td>C The line of vision between two points. If this line is obscured, the two points are not intervisible.</td>
</tr>
<tr>
<td>1.2.4 Direction</td>
<td>D A letter and numeric grid superimposed over a map.</td>
</tr>
<tr>
<td>1.2.5 Gradient</td>
<td>E The angular difference between magnetic and true north.</td>
</tr>
<tr>
<td>1.2.6 Grid reference</td>
<td>F The angular measurement of one place from another, read in a clockwise direction from true north.</td>
</tr>
<tr>
<td>1.2.7 Intervisibility</td>
<td>G The mapping reference system used for 1:50 000 topographical map series.</td>
</tr>
<tr>
<td>1.2.8 Scale</td>
<td>H The relationship between the map distance and the actual distance in reality.</td>
</tr>
<tr>
<td>1.2.9 Map code</td>
<td>I The steepness of slope, usually expressed as a ratio.</td>
</tr>
<tr>
<td>1.2.10 Magnetic declination</td>
<td>J Height above sea level.</td>
</tr>
</tbody>
</table>

ANSWERS

SECTION 1 GEOGRAPHICAL SKILLS AND TECHNIQUES
SECTION 2
Climate and weather

CHECKLIST:
• Revision of: Pressure Cells
  Seasonal movement of pressure systems and wind belts
  Synoptic weather maps
• Mid-latitude cyclones
• Tropical cyclones
• Subtropical anti cyclones
• Valley climates

General climate concepts
• Weather – the condition of the atmosphere in a particular place over a short period of time (daily).
• Climate – the average weather conditions experienced in an area. Climate is established over a long period of time (±20 years).
• Cyclogenesis – the development of weather systems such as mid-latitude cyclones and tropical cyclones.

Revision of pressure cells

<table>
<thead>
<tr>
<th>Low pressure cell</th>
<th>High pressure cell</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image-1" alt="Pressure Cell Diagram" /></td>
<td><img src="image-2" alt="Pressure Cell Diagram" /></td>
</tr>
</tbody>
</table>

- Usually circular in shape.
- Air ascends (rises) at the centre.
- Air circulates in a clockwise direction.
- Air converges at the centre.
- Also known as a cyclone.
- Weather associated with low pressure cells is unstable with cloud cover and rainfall.
- Isobars decrease towards the centre of the low pressure cell.

- Usually on
- Air descends (sinks) at the centre.
- Air circulates in an anti-clockwise direction.
- Air diverges at the centre.
- Also known as an anticyclone.
- Weather associated with high pressure cell is stable with clear, cloudless and dry conditions.
- Isobars increase towards the centre of the high pressure cell.

Revision Table 1. Characteristics of pressure cells for the southern hemisphere

Note: Air circulates in the opposite direction in the northern hemisphere.
Seasonal movement of pressure belts and wind systems
The pressure belts and wind systems migrate as the heat equator (ITCZ) moves. This migration is from one tropic to the other, depending on the season being experienced in each hemisphere.

<table>
<thead>
<tr>
<th>Summer</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>* In December all the pressure belts appear to migrate southwards as summer is experienced in the southern hemisphere.</td>
<td>* In June all the pressure belts appear to migrate northwards as summer is experienced in the northern hemisphere.</td>
</tr>
<tr>
<td>* In summer the sun’s direct rays shine south of the equator.</td>
<td>* In winter the sun’s direct rays shine north of the equator.</td>
</tr>
</tbody>
</table>

(Key: SAH = South Atlantic High; SIH = South Indian High; TL = Thermal or Heat Low; KH = Kalahari High)

Revision Table 2. Seasonal movement of the pressure belts affecting South Africa

Synoptic Weather Maps
‘Synopsis’ means a summary. Synoptic weather maps give a summary of the recorded weather conditions at a specific time. All readings are taken at 12.00 GMT (Greenwich Meridian Time) which is 14.00 SAST (South African Standard Time).

Sources of information:
• Meteosat is a weather satellite which relays photographic information to a receiving station at Hartebeeshoek (near Pretoria), which is important in forecasting the weather.
• Weather balloons are also released into the atmosphere. These balloons carry instruments that record temperature and humidity at different altitudes. The information is relayed back to the receiving station at the South African Weather Service (SAWS).
• Official weather stations, floating buoys in the ocean, ships at sea and local weather stations all relay information to SAWS.

The meteorological office at SAWS co-ordinates all this information and issues daily synoptic weather maps. At each weather station the summary of the weather conditions at that place is shown by a series of symbols.

For auditory learners: Record yourself on your cellphone, while you read out all the features of pressure cells. Play the recording back to yourself until you remember all the information.
Symbols used on synoptic weather maps

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Cloud cover</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clear</td>
</tr>
<tr>
<td></td>
<td>1/8</td>
</tr>
<tr>
<td></td>
<td>1/4</td>
</tr>
<tr>
<td></td>
<td>3/8</td>
</tr>
<tr>
<td></td>
<td>1/2</td>
</tr>
<tr>
<td></td>
<td>5/8</td>
</tr>
<tr>
<td></td>
<td>3/4</td>
</tr>
<tr>
<td></td>
<td>7/8</td>
</tr>
<tr>
<td></td>
<td>Overcast</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Windspeed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 knots</td>
</tr>
<tr>
<td></td>
<td>5 knots</td>
</tr>
<tr>
<td></td>
<td>10 knots</td>
</tr>
<tr>
<td></td>
<td>15 knots</td>
</tr>
<tr>
<td></td>
<td>20 knots</td>
</tr>
<tr>
<td></td>
<td>25 knots</td>
</tr>
<tr>
<td></td>
<td>30 knots</td>
</tr>
<tr>
<td></td>
<td>50 knots</td>
</tr>
</tbody>
</table>

1 knot = 1.852 km/h (approx.)

An example of how weather is recorded at a weather station

<table>
<thead>
<tr>
<th>Temperature:</th>
<th>24°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dew point temperature:</td>
<td>18°C</td>
</tr>
<tr>
<td>Precipitation:</td>
<td>Drizzle</td>
</tr>
<tr>
<td>Cloud cover:</td>
<td>Overcast</td>
</tr>
<tr>
<td>Wind speed:</td>
<td>25 knots</td>
</tr>
<tr>
<td>Wind direction:</td>
<td>South easterly</td>
</tr>
</tbody>
</table>

Important information related to weather map interpretation

- Date is always given and the season represented can be established from this.
- Black lines on a synoptic weather map are called isobars and these join places of equal air pressure.
- Isobars are measured in hectopascals (hPa).
- The interval between two isobars is called the isobaric interval and is 4 hPa. Sometimes a 2hPa line, which is dashed, is used.
- If the pressure decreases towards the centre of a series of closed isobars, it is a low pressure cell.
- If the pressure increases towards the centre of a series of closed isobars, it is a high pressure cell.

<table>
<thead>
<tr>
<th>Winter</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date – will help determine the season.</td>
<td>Date – will help determine the season.</td>
</tr>
<tr>
<td>The mid-latitude cyclone has a cold front passing over the continent.</td>
<td>The mid-latitude cyclone is too far south to affect the continent.</td>
</tr>
<tr>
<td>There is a high pressure cell (Kalahari High) present over the interior. There is NO low pressure cell over the land.</td>
<td>A thermal low may be present over the interior. There is NO high pressure cell over the land.</td>
</tr>
<tr>
<td>There may be a coastal low present but it is ahead of a cold front.</td>
<td>There may be a coastal low present.</td>
</tr>
<tr>
<td>Low air temperatures with very low dew point temperatures over the interior with little or no chance of rain due to the large temperature range.</td>
<td>Weather stations show high air temperatures with dew point temperatures nearly as high (greater chance of rain due to a small temperature range).</td>
</tr>
<tr>
<td>The weather stations usually indicate clear weather conditions due to the presence of the Kalahari high over the interior.</td>
<td>The weather stations usually indicate cloudy weather due to the presence of the thermal low over the interior.</td>
</tr>
</tbody>
</table>

Revision Table 3. Summary of the characteristics of a summer and winter synoptic weather map
Interpretation of summer and winter synoptic weather maps

Revision figure 3A. A typical winter synoptic weather map

Revision figure 3B. A typical summer synoptic weather map

Analysing climate using climate graphs

A climate graph is a graphic or visual summary of the climate for a particular place. It plots the average rainfall and temperature data for the year. There are two vertical axes on a climate graph:

- the primary (left-hand) vertical axis which records rainfall in mm as a bar graph
- the secondary (right-hand) axis which records temperature (°C) as a line graph.

The months of the year are plotted on the horizontal axis.

**Analyses**

Cape Town receives most rainfall during the winter months with an approximate total annual rainfall of 515mm. The summers are hot and dry, while winters are cool and wet. A distinct seasonal difference in temperatures is noticed (range of 9°C). Cape Town experiences a Mediterranean type of climate.
QUICK QUIZ

Study the climate graph of Bela Bela.

1.1 (a) Estimate the total rainfall per annum for Bela Bela.

________________________ mm

(b) Comment on the distribution of the annual rainfall.

__________________________________________________________________________

1.2 Calculate the range in annual temperature for Bela Bela.

________________________ °C

1.3 Explain how you would use the type of river flow (permanent and non-perennial) to explain the rainfall pattern of an area.

__________________________________________________________________________

1.4 Identify four water features you would look for on a map to show that an area experiences seasonal rainfall.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

1.5 Describe the climate of Bela Bela as presented in Figure 2.5.

__________________________________________________________________________

__________________________________________________________________________
CHECKLIST:
- General characteristics
- Areas where mid-latitude cyclones form
- Conditions necessary for the formation of mid-latitude cyclones
- Stages of development
- Weather patterns associated with cold, warm and occluded fronts

General characteristics
- A mid-latitude cyclone is a travelling low pressure system.
- Also called depressions, extra-tropical cyclones or temperate cyclones.
- Occur between 40° to 60° N and S of the equator.
- They form all year round but only affect South Africa in winter when the pressure belts have shifted northwards.
- The cold front of the mid-latitude cyclone extends over the southern coastal regions bringing with it rain and colder weather.
- Mid-latitude cyclones form to the south west of South Africa and move in an easterly direction (from west to east).
- They may occur in groups or families with one following after another.
- Because these systems cover such vast distances (thousands of kilometres), extended periods of similar weather conditions may be experienced.

Areas where mid-latitude cyclones form
Figure 6.1 shows the global location of mid-latitude cyclones.

Figure 6.1 The paths taken by mid-latitude cyclones on a global scale
Source: http://www.physicalgeography.net
Conditions necessary for the formation of mid-latitude cyclones

<table>
<thead>
<tr>
<th>Condition</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two different air masses converging</td>
<td>The air masses have different temperature and moisture content.</td>
</tr>
<tr>
<td>Disturbance (friction)</td>
<td>Frictional drag occurs between two different air masses or air may be disturbed as it flows over uneven surfaces such as mountain ranges.</td>
</tr>
<tr>
<td>Front</td>
<td>Zone which forms a barrier between two different air masses. Prevents the mixing of air.</td>
</tr>
</tbody>
</table>

Table 6.1 Conditions necessary for the formation of mid-latitude cyclones

Stages of development

<table>
<thead>
<tr>
<th>Stage of development</th>
<th>Characteristics of stage</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial stage</td>
<td>• Cold air from the polar easterlies meets with warm air from the westerlies at the polar front (60°).</td>
<td></td>
</tr>
<tr>
<td>Developing stage</td>
<td>• Wave movements develop along the polar front.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The regular surface becomes disturbed and a vortex of low pressure develops at the apex of the wave.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The air in circulation converges in a clockwise direction in the southern hemisphere around the low pressure centre.</td>
<td></td>
</tr>
<tr>
<td>Mature stage</td>
<td>• A clear low pressure centre has formed with a distinct cold front and warm front.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Behind the warm front, the mass of warm air turns towards the poles and forms the warm sector.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Behind the cold front, the cold air mass turns towards the equator and forms the cold sector.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The entire mid-latitude cyclone moves eastwards.</td>
<td></td>
</tr>
</tbody>
</table>
Occluded stage

- While the mid-latitude cyclone is moving eastwards the cold front catches up with the warm front (cold air is more dense and therefore travels faster).
- The cold air then pushes the warm air from the warm sector up and out of the cyclone until the cold front merges with the warm front and they form an occluded front.

Dissipating stage

- Eventually the low pressure centre is surrounded entirely by cold air and the weather system dissipates.

<table>
<thead>
<tr>
<th>Table 6.2 Stages of development and related weather conditions</th>
</tr>
</thead>
</table>

Weather patterns associated with cold, warm and occluded fronts

**Cold front**
- Dense, cold air ridges underneath the warm sector and lifts it.
- Warm air rises, cools and condenses to form huge cumulonimbus clouds.
- Heavy rain and thundershowers are experienced.
- Sharp drop in temperature.
- Pressure starts to rise and the wind changes direction from northwest to southwest. This is called a backing wind.

**Warm front**
- Warm air glides over the cooler air and forms cirrus, stratus and nimbostratus (soft rain) clouds.
- Pressure falls and when the warm air passes there is a rise in temperature.

**Cold sector**
- Humidity decreases and temperatures are very low.
- Snow is possible in high lying areas.
- Pressure continues to rise and eventually the temperature will also rise.

**Warm sector**
- Rising warm, moist air mass forms stratus clouds resulting in widespread, light rain.
- Low pressure is experienced.

Figure 6.3 Cross section through a mid-latitude cyclone with its associated weather conditions

SECTION 2 CLIMATE AND WEATHER
If the cold air mass is colder than the front air mass, the front air mass is lifted and a narrow zone of precipitation is experienced.

If the air mass ahead of the warm front is cooler than the air behind the approaching cold front a wider zone of precipitation is experienced.

**Table 6.3 Cross section through occluded mid-latitude cyclones**

**General impact of weather associated with a mid-latitude cyclone**

- Brings rain to the Western Cape in winter.
- In winter the water table rises and periodic rivers flow.
- Deciduous fruit and grapes and winter wheat suited to this climate are grown.
- Snow on the Drakensberg and frost in the interior may damage crops, and result in stock losses.

Photograph 6.1 Snow in the Drakensberg  Source P Esterhuysen

**MY OWN NOTES**

---
Unit 7  Tropical cyclones

CHECKLIST:

- General characteristics
- Areas where tropical cyclones form
- Conditions necessary for their formation
- Stages of development
- Associated weather patterns
- Impact of tropical cyclones on human activities and the environment
- Strategies that help to prepare for and manage the effects of tropical cyclones

General characteristics

- Air pressure is very low (about 986hPa).
- Also called typhoons, hurricanes and cyclones, depending on the area in which they form
- Develop between 5° and 30° N and S of the equator (Not along the equator, where Coriolis Force is zero).
- Develop over tropical oceans where the water temperature is above 27°C.
- Form in regions where the airflow is generally westward (tropical easterly wind belt). They move from east to west.
- They occur in late summer, after a prolonged period of heating.
- They affect the east coast of continents.
- These storms die out rapidly over land, owing to the increased friction over land surfaces and the lack of moisture.
- Tropical cyclones are nowadays fairly predictable in speed and direction.
- Tropical cyclones are smaller in size than mid-latitude cyclones and reach diameters of between 400-600 km.

Areas where tropical cyclones form

![Map of Occurrence of tropical cyclones on a global scale](image)

Figure 7.1 Occurrence of tropical cyclones on a global scale
Conditions necessary of the formation of tropical cyclones

<table>
<thead>
<tr>
<th>Condition</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm tropical oceans, temperature over 27°C</td>
<td>Leads to high evaporation rates and high humidity.</td>
</tr>
<tr>
<td>Over the oceans</td>
<td>Less friction over a smooth surface; warm moist air also rises.</td>
</tr>
<tr>
<td>Beyond 5° N and 5° S of the equator</td>
<td>Between 5° N and 5° S the Coriolis Force is too weak to cause the air</td>
</tr>
<tr>
<td></td>
<td>to start spinning around a low pressure centre.</td>
</tr>
<tr>
<td>Surface air convergence</td>
<td>Air is forced to rise when it converges.</td>
</tr>
<tr>
<td>Upper air divergence</td>
<td>More moist air is drawn into the system at the surface as a result of</td>
</tr>
<tr>
<td></td>
<td>the cooler air that diverges at the top of the system.</td>
</tr>
<tr>
<td>Condensation</td>
<td>The large-scale condensation of rising moist air, leads to the release</td>
</tr>
<tr>
<td></td>
<td>of latent heat from this cooled air. This promotes further instability,</td>
</tr>
<tr>
<td></td>
<td>resulting in the formation of the system.</td>
</tr>
<tr>
<td>Winds must be light to variable</td>
<td>Strong prevailing winds will prevent the formation of a vortex, disturb</td>
</tr>
<tr>
<td></td>
<td>the low level distribution of water vapour, and lower the surface</td>
</tr>
<tr>
<td></td>
<td>temperature of the water.</td>
</tr>
</tbody>
</table>

Table 7.1 Factors necessary of the formation of tropical cyclones

Stages of development

<table>
<thead>
<tr>
<th>Stage of development</th>
<th>Characteristics of stage</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial stage (Also known as a tropical low)</td>
<td>• There is convergence of air towards a low pressure centre to create a vortex.</td>
<td><img src="initial-stage.png" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>• Air pressure is about 1002 hPa and winds reach speeds of up to 60 km/h.</td>
<td></td>
</tr>
<tr>
<td>Developing stage (Also known as a tropical storm)</td>
<td>• The intensity of the storm increases as air continues to converge and rise at the low pressure centre.</td>
<td><img src="developing-stage.png" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>• In the upper atmosphere divergence takes place.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pressure continues to drop to about 990 hPa and wind speed increases to about 120 km/h.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The low pressure centre forms an eye and huge cumulonimbus clouds swirl around the eye creating a vortex.</td>
<td></td>
</tr>
<tr>
<td>Mature stage (Also known as a tropical cyclone and is named)</td>
<td>• The storm has reached its maximum intensity.</td>
<td><img src="mature-stage.png" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>• Pressure drops to a low of about 950 hPa and wind speeds exceed 180 km/h.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The eye is fully developed and is a clear, cloudless centre of the cyclone due to cooler, subsiding air.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The vortex is well developed and the cyclone may reach up to 600 km in diameter.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• There is torrential rain, thunder and lightning associated with a tropical cyclone.</td>
<td></td>
</tr>
<tr>
<td>Decaying stage</td>
<td>• Dissipation occurs when the tropical cyclone cools down when entering the temperate latitudes.</td>
<td><img src="decaying-stage.png" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>• Cooler air flows into the cyclone increasing the pressure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• It may also dissipate when the storm moves inland because there is no longer a supply of moisture and surface friction slows it down.</td>
<td></td>
</tr>
</tbody>
</table>

Table 7.2 Stages of development of a tropical cyclone
**Associated weather patterns**

- Temperatures decrease as the wall approaches.
- Pressure also decreases and cumulonimbus clouds appear bigger.
- Wind speed starts to increase and rough seas and storm surges may occur.
- The wall of Vortex 1 is where the most intense features of the cyclone are experienced: torrential rain, hail, thunder, lightning and destructive wind speeds of over 180 km/hour from the south.

<table>
<thead>
<tr>
<th>Vortex 1</th>
<th>Eye</th>
<th>Vortex 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Temperatures increase slightly and the wind speed suddenly drops.</td>
<td>• Temperature increases slightly and the wind speed suddenly drops.</td>
<td>• As wall of Vortex 2 approaches</td>
</tr>
<tr>
<td>• Air is calm with clear skies and no rain.</td>
<td>• Air is calm with clear skies and no rain.</td>
<td>• the storm intensity is greatest.</td>
</tr>
<tr>
<td>• Pressure is at its lowest.</td>
<td>• Pressure is at its lowest.</td>
<td>• Temperatures initially drop then start to increase.</td>
</tr>
</tbody>
</table>

- Temperature increases slightly and the wind speed suddenly drops.
- Air is calm with clear skies and no rain.
- Pressure is at its lowest.

**Figure 7.2 Weather associated with a tropical cyclone**

**Impact of tropical cyclones on human activities and the environment**

**Weather associated with these storms**
- Torrential rain
- High wind speeds (up to 300 km/hour)
- Mini tornadoes
- Extremely low pressure

**Effect on the sea**
- Swell waves of up to 10m out at sea
- Storm waves
- Storm surges along the coastline which cause coastal flooding

**Environmental damage on land**
- Flooding due to torrential rain and rising river levels (can result in mudslides and landslides)
- Coastal flooding from storm surges
- Damage and destruction to buildings and infrastructure (transport and communications links), especially in less developed countries
- Agricultural lands and crops are damaged

**Impact of tropical cyclones on human activities and the environment**

**Effect on human activities**
- Drowning
- Loss of homes
- Disease outbreaks and eventually starvation
- Economies that rely on monoculture may experience great losses
- Loss of workplaces and jobs
- Major financial strain on people, families and businesses

**Figure 7.3 Mind map showing the impact of tropical cyclones on human activities and the environment**
Reading and interpreting satellite images and synoptic weather maps

Synoptic weather map with tropical cyclone for analysis. Refer to pages 40-42 as well.

Figure 7.4 Synoptic weather map dated 22/01/2012
Strategies that help to prepare for and manage the effects of tropical cyclones

Monitoring Tropical Cyclones
- Satellite tracking is very effective in monitoring the development and path of tropical cyclones. Advanced weather predictions and warnings can be issued to enable people to move to safety.
- Satellite borne sensors enable the collection of extra details such as rainfall rates.
- Microwave radiometers allow core temperatures and surface pressures to be taken to estimate wind speeds.

The Saffir Simpson scale
The Saffir Simpson scale is a commonly used measuring tool to give warnings. This rating scale indicates the potential damage of a predicted tropical cyclone.

<table>
<thead>
<tr>
<th>Name</th>
<th>Scale</th>
<th>Pressure (hPa)</th>
<th>Wind speed (km/h)</th>
<th>Description of potential damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical depression</td>
<td>-</td>
<td>Above 1010</td>
<td>Below 60</td>
<td>Nil</td>
</tr>
<tr>
<td>(low)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tropical Storm</td>
<td>-</td>
<td>995-1010</td>
<td>61-114</td>
<td>Minimal</td>
</tr>
<tr>
<td>Tropical Cyclone</td>
<td>1</td>
<td>&gt; 980</td>
<td>115-150</td>
<td>Minimal: some damage to houses, crops and trees</td>
</tr>
<tr>
<td>(usually named)</td>
<td>2</td>
<td>965-980</td>
<td>150-179</td>
<td>Moderate: minor damage to houses, trees. Heavy damage to crops</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>945-965</td>
<td>179-210</td>
<td>Extensive: power failure, structural damage</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>920-945</td>
<td>210-249</td>
<td>Extreme: airborne debris, flying caravans</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>&lt; 920</td>
<td>&gt; 250</td>
<td>Catastrophic: widespread devastation</td>
</tr>
</tbody>
</table>

Table 7.3 The Saffir Simpson scale
Precautionary strategies and disaster management

<table>
<thead>
<tr>
<th>Early warning systems and use of technology</th>
<th>More economically developed countries (MEDCs)</th>
<th>Less economically developed countries (LEDCs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Advanced technology and early warning systems which allows inhabitants time to evacuate.</td>
<td>Lack technology and the effective early warning systems.</td>
</tr>
<tr>
<td></td>
<td>Satellites and weather monitoring stations are established.</td>
<td>Often rely on MEDC’s to relay information.</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Infrastructure is good and can often withstand the destructive forces.</td>
<td>Infrastructure is in poor condition and usually totally destroyed.</td>
</tr>
<tr>
<td></td>
<td>If damage occurs it can be easily and quickly repaired.</td>
<td>Poor housing cannot withstand flood waters and wind.</td>
</tr>
<tr>
<td></td>
<td>Some personal effects may be lost and costly to replace.</td>
<td>Damage is often not repaired or takes a very long time.</td>
</tr>
<tr>
<td>Medical Care</td>
<td>Medical care is available and there is less chance of disease outbreak.</td>
<td>Medical care is poor or slow to arrive and the chances of disease outbreaks are high.</td>
</tr>
<tr>
<td>Economic activities</td>
<td>Most farmers are insured and are able to cope with crop losses.</td>
<td>Lack of food and water lead to starvation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subsistence farmers loose everything with no chance of recovery.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The environment takes a long time to recover as farmers do not have resources to rehabilitate the land.</td>
</tr>
<tr>
<td>Emergency Services</td>
<td>Emergency services are efficient and well-equipped.</td>
<td>Emergency services are poorly equipped and slow to respond.</td>
</tr>
<tr>
<td></td>
<td>Local civic services are well-prepared to assist.</td>
<td>LEDCs have to rely on international aid and volunteers to assist.</td>
</tr>
</tbody>
</table>

Table 7.4 Comparison between more economically developed countries (MEDCs) and less economically developed countries (LEDCs)

For visual learners: Use a piece of paper to cover the MEDC column of the table, and see how many strategies you are able to remember. Then do the same with the LEDC column. Repeat this until you are able to remember all the points.
Unit 8  Subtropical cyclones and associated weather conditions

CHECKLIST:
• Location of the high pressure cells that affect South Africa
• General characteristics of these high pressure cells
• Anticyclonic air circulation around South Africa and its influence on weather and climate
• Travelling disturbances: moisture front, line thunderstorms, coastal low pressure systems and South African berg winds

Location of the high-pressure cells that affect South Africa
The atmospheric circulation over Southern Africa is greatly influenced by the sub-tropical high pressure belt (30°S). The resultant high pressure systems are influenced by the seasonal positioning of the pressure belt and their positioning and intensity will vary from summer to winter.

<table>
<thead>
<tr>
<th>Winter</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colder, stable, subsiding air causes the pressure cells to strengthen and they are found closer to the land.</td>
<td>Warmer, unstable, ascending air causes the high pressure cell to weaken and it is found at a higher altitude.</td>
</tr>
<tr>
<td>The inversion layer is low and does not allow moist air to reach the plateau.</td>
<td>The inversion layer is higher and allows moist air to reach the plateau.</td>
</tr>
</tbody>
</table>

(Key: KH = Kalahari High; SIH = South Indian High; SAH = South Atlantic High; TL = Thermal Low)
Table 8.1 Location of the high-pressure cells
Unit 8  Subtropical cyclones and associated weather conditions

CHECKLIST:
- Location of the high pressure cells that affect South Africa
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<table>
<thead>
<tr>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Colder, stable, subsiding air causes the pressure cells to strengthen and they are found closer to the land.</td>
</tr>
<tr>
<td>• The inversion layer is low and does not allow moist air to reach the plateau.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Warmer, unstable, ascending air causes the high pressure cell to weaken and it is found at a higher altitude.</td>
</tr>
<tr>
<td>• The inversion layer is higher and allows moist air to reach the plateau.</td>
</tr>
</tbody>
</table>

(KEY: KH = Kalahari High; SIH = South Indian High; SAH = South Atlantic High; TL = Thermal Low)

Table 8.1 Location of the high-pressure cells
General characteristics of these high-pressure cells

a) South Atlantic High
A semi-permanent high pressure cell found off the west coast of Southern Africa over the Atlantic Ocean. It is associated with cooler, denser and subsiding air.

<table>
<thead>
<tr>
<th>Winter</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Airflow behind the mid-latitude cyclone is southwesterly.</td>
<td>• Moves southwards and may ridge around the southern tip of South Africa.</td>
</tr>
<tr>
<td>• May ridge in behind the MLC causing the weather to clear from the south-west.</td>
<td>• Brings general rainfall to the south east coast (George and Knysna).</td>
</tr>
</tbody>
</table>

Table 8.2 South Atlantic High

b) South Indian High
A weaker high pressure cell found off the east coast of Southern Africa over the Indian Ocean. It is associated with warm, moist sub-tropical air.

<table>
<thead>
<tr>
<th>Winter</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Has a blocking effect as it advances towards the coastline.</td>
<td>• Weaker and therefore allows warm, moist maritime air to be fed into the interior.</td>
</tr>
<tr>
<td>• More intensely developed.</td>
<td>• May also block the southward movement of tropical cyclones. Tropical cyclones may move westwards over the land and dissipate, or towards the SE and dissipate over cooler ocean waters.</td>
</tr>
</tbody>
</table>

Table 8.3 South Indian High
c) Kalahari High
A high pressure cell which intensifies over the interior of southern Africa in winter, but in summer, due to the surface heating, is displaced upwards towards the northwest.

<table>
<thead>
<tr>
<th>Winter</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The Kalahari High is well developed and due to cold, subsiding air sits close to the land.</td>
<td>- The Kalahari High weakens and is elevated about 2km above the land surface.</td>
</tr>
<tr>
<td>- The air is stable and clear skies and dry conditions prevail as no moist reaches the interior.</td>
<td>- A thermal low* is found at the surface.</td>
</tr>
<tr>
<td>- Warm moist air flows into the interior from the east Coast.</td>
<td>- Winter months the inversion layer lies at about 1000m above sea-level, therefore lower than the plateau level.</td>
</tr>
</tbody>
</table>

Table 8.4 Kalahari High

Note:
Thermal low – a thermal or heat low that develops over the central interior of southern Africa in summer.

d) Ridge
This is a bulge off a high pressure cell.

Anticyclonic circulation around South Africa and its influence on weather and climate
The effect of the inversion layer on rainfall over the interior of South Africa.
- The inversion layer is present all year round, but its altitude varies seasonally.
- In the winter months the inversion layer lies at about 1000m above sea-level, therefore lower than the plateau level.
- In summer this layer weakens and lies 2000m or more above sea-level.

Winter
- In winter when the colder, stable air descends (sinks), a high pressure cell forms at the surface over the interior of South Africa.
- This high pressure cell is called Kalahari High.
- The South Indian High to the east of the country also sinks to a lower altitude due to the cooler, stable, subsiding air.
- These high pressure cells "sit" on top of the inversion layer and do not allow air to flow in from the east coast, thus creating dry atmospheric conditions over the interior.
Summer

- In summer the warmer, moist, unstable air ascends (rises) creating a low pressure area at the surface of the interior (thermal low).
- The Kalahari High as well as the South Indian High weaken and are displaced into the upper atmosphere to a level of 2000m or more.
- With the inversion layer now elevated, warm, moist air from the Indian Ocean flows into the interior of South Africa.
- This air ascends, cools and condenses to form cumulonimbus clouds and rainfall occurs in the interior.
- This rainfall may be associated with both line thunderstorms and convectional thunderstorms.

**Travelling disturbances associated with anticyclonic circulation:** moisture front, line thunderstorms, coastal low pressure systems and South African Berg Winds

**Moisture front**

<table>
<thead>
<tr>
<th>Description</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>A moisture front is created when there is a thermal (heat) low pressure cell as well as a coastal low pressure cell is located over South Africa at the same time, forming a trough of low pressure.</td>
<td><img src="image" alt="Diagram of moisture front" /></td>
</tr>
<tr>
<td>The moisture front may also be referred to as a squall line or a trough axis.</td>
<td></td>
</tr>
<tr>
<td>To the south west of the moisture front is what is known as the dry line.</td>
<td></td>
</tr>
<tr>
<td>No rain falls to the south west of the moisture front, hence the name.</td>
<td></td>
</tr>
</tbody>
</table>

Table 8.5 Moisture front
Line thunderstorms

Formation

- Thunderstorms are summer storms that occur when a trough of low pressure develops over the interior between the thermal low and a coastal low. Warm, moist air moves into the interior from the northeast and it converges with cold, dry air from the southwest.
- These two air masses converge along a moisture front or squall line that extends from the northwest to the southeast.
- The denser, colder air forces the lighter, warmer air to rise.
- The rising air then cools, condenses and forms a line of thunderstorms.

Key

<table>
<thead>
<tr>
<th>SIH</th>
<th>SAH</th>
<th>CL</th>
<th>TL</th>
<th>T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Indian High</td>
<td>South Atlantic High</td>
<td>Coastal Low</td>
<td>Thermal Low</td>
<td>Thunderstorms</td>
</tr>
</tbody>
</table>

![Figure 8.2A Line thunderstorm formation](image)

Associated weather

Late afternoon thunderstorms are experienced in summer. These storms may be accompanied by a torrential downpour of rain, lasting an hour or two, hail, thunder and lightning.

Impact on human activities

Rainfall may cause slight damage, interruptions and wash-aways, but nothing too serious. Hail may cause damage to cars, houses, crops and livestock.
Coastal low
- A small, weakly developed low pressure system.
- They occur all year round and form on the west coast and then move southwards and eastwards along the east coast.
- They are always found ahead of an approaching cold front.

**Figure 8.3** A coastal low

Berg winds
These are hot, dry winds that occur in winter.

**Formation**
- In winter there is a continental high over the interior.
- If there is a coastal low at the coast, air will be drawn down the pressure gradient from the high pressure over the interior towards the low pressure area.
- Berg winds usually precede an approaching cold front.
- Stable, subsiding air descends down the escarpment and as it descends it is heated adiabatically and due to friction.

**Figure 8.4A** Conditions necessary for berg wind formation

**Figure 8.4B** Cross section showing berg wind conditions
An explanation of why berg winds are hot and gusty as illustrated in Figure 8.4B.
1. Stable, subsiding air is forced to descend the escarpment slopes (from an area of high pressure towards the coastal low).
2. Air is heated up adiabatically and becomes drier as the temperature rises.
3. Berg winds are strong and gusty, and hot, dry conditions are created.
4. The coastal low along the coast sets up a pressure gradient and ‘pulls’ air towards this low pressure area at the coast.

**Associated weather**

Gusty hot, dry winds and are often the cause of runaway veld fires.

**Impact on human activities**

- The natural environment, humans and animals are affected by veld fires.
- Farmers may lose houses, equipment and livestock.
- Thousands of hectares of natural bush and grazing may also be lost.
- Animals and their habitats may be destroyed and the forestry industry may also be adversely affected.
- The dry, warm conditions mean that very strict fire precautions and warnings are issued between April and September each year.

**Cut-off low pressure system**

A cut-off low is an isolated cell of low pressure which usually forms ahead of a mid-latitude cyclone. Table 8.6 shows the stages involved in the formation of a cut-off low over South Africa.

1. A disturbance causes a “low pressure tongue” or trough to move towards the continent.
2. Mid-latitude cyclone is moving south of South Africa.
3. The ridging of the South Atlantic High and the blocking of the South Indian High creates a pinching effect and the low pressure system becomes cut off and remains stationary over the land.
4. Heavy rain is experienced due to warm air being fed in from the north east. This creates a push-pull effect as warm moist air is pushed out of the South Indian High and pulled into the cut-off low resulting in heavy rain and possible floods. Such a low-pressure system is more common in summer.
The Cape South Easter (also known as the Cape Doctor)

A strong, persistent and dry south-easterly wind that blows on the South African coast from spring to late summer (September to March). It is known to clear the air of pollution and pestilence. It originates from the South Atlantic High (SAH) pressure system. The south easter varies in speed from 20-125 km/h at times during gale-force wind events.

The well known ‘table cloth’ (cloud cover) is usually present over the mountain during south-easter conditions.

The black south easter

Referred to as such, when the south-easter is blowing, rather strongly and it is raining at the same time. It is caused by the development of a cut-off low pressure system over the interior and a strongly ridging South Atlantic High south of the country. Usually occurs during spring and autumn. Examples of black south-easter events when heavy rains fell over the Western Cape are the Laingsburg floods (1981) and the Easter floods (1994).

MY OWN NOTES
Unit 9  Valley climates

CHECKLIST:
• The microclimate of valleys
• Development of anabatic and katabatic winds, inversions, frost pockets and radiation fog
• The influence of local climates on human activities such as settlement and farming

Microclimate refers to the climate of a small local area and is studied in the context of valley and urban climates.

The microclimate of valleys
In hilly or mountainous regions there may be considerable variation in the climate between the valley floor and upper slopes. There are four areas that are studied with respect to valley climates.

The effect of the slope aspect
• This is the angle at which the sun’s rays strike the earth.
• Aspect is important in temperate regions as slopes facing the equator will be warmer than those slopes facing away from the equator.
• In the southern hemisphere the north-facing slopes receive the sun’s direct rays and are warmer.

The effect of slope aspect

![Diagram showing the effect of slope aspect on slopes in the southern hemisphere](image)

Figure 9.1 The effect of aspect on slopes in the southern hemisphere

- North facing slopes are warmer due to direct sun’s rays. Smaller surface area is heated up. More inhabitants.
- South facing slopes are cooler due to indirect sun’s rays. Larger surface area also needs to be heated up. Fewer inhabitants.
Development of anabatic and katabatic winds

<table>
<thead>
<tr>
<th>Anabatic flow</th>
<th>Katabatic flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Occur during the <strong>day</strong> due to heating of the Earth’s surface.</td>
<td>• Occur at <strong>night</strong> due to the cooling of the Earth’s surface.</td>
</tr>
<tr>
<td>• Air rises up the valley sides to form an upslope wind.</td>
<td>• Air sinks down the valley sides due to gravity flow to form a downslope wind.</td>
</tr>
<tr>
<td>• Winds that blow up the valley floor are called valley winds or anabatic winds.</td>
<td>• Winds that blow down the valley floor are called mountain winds or katabatic winds.</td>
</tr>
</tbody>
</table>


Temperature inversion and frost pockets

Temperature inversion occurs:
- on calm, cold, clear winter nights
- when cold air drains down the valley slopes and collects at the bottom of the valley
- when warm air is displaced upwards to form an inversion layer located in the mid-valley just above the cold air at the bottom of the valley. This layer is called the thermal belt.

A frost pocket:
- may form at the bottom of the valley if the temperature drops below \(0^\circ\)C
- may affect farmers if frost sensitive crops are grown on the valley floor
- causes people to settle on the mid-slope in a valley as they will be situated in the thermal belt.
Radiation fog and visibility

Radiation fog occurs:
- in the lower valley while the upper slopes remain clear
- on cold, clear, cloudless nights when terrestrial radiation (out-going radiation) loss occurs rapidly
- when air temperatures cool below dew point temperature
- when low-level condensation occurs.

When the sun rises the fog lifts as heat from the sun causes air to rise and the fog dissipates.

In winter fog can be a problem for cities that are located in valleys as it slows down traffic and this could lead to accidents. Fog combined with pollution in the atmosphere forms smog which is a health hazard.

The influence of local climates on human activities such as settlement and farming

For kinaesthetic learners: When you are out and about, keep an eye open for ways in which the local climate influences human activity in your own local area. Make a note of these from your own experience and relate it to the theory you learn in class.
Reasons for difference between rural and urban climates

![Diagram showing urban modification of climate](image)

<table>
<thead>
<tr>
<th>Climate factor</th>
<th>Rural area</th>
<th>Urban area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Cooler due to fewer artificial surfaces and more vegetation cover.</td>
<td>• Warmer due to lack of vegetation cover and more artificial surfaces.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• More artificial heating, air conditioning units and vehicle emissions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• More dust also prevents heat from escaping.</td>
</tr>
<tr>
<td>Pollution</td>
<td>Less pollution and dust particles.</td>
<td>• More pollution and dust due to industrial activities, combustion processes and traffic.</td>
</tr>
<tr>
<td>Cloud cover</td>
<td>Fewer clouds</td>
<td>• More clouds form as there are more dust and pollution particles in the atmosphere.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• These particles are called hygroscopic nuclei or condensation nuclei.</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Less rain and hail is experienced in rural areas but there may be more snow.</td>
<td>• More rain and hail due to more hygroscopic nuclei in the atmosphere and strong up-draughts of air.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The warmer temperatures may cause snow to melt.</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>Higher relative humidity due to water retention in soil and vegetation.</td>
<td>• Lower relative humidity due to the lack of vegetation cover and natural surfaces.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Although warmer air is also able to hold more moisture, there is a lack of evaporation due to less vegetation and more artificial surfaces.</td>
</tr>
</tbody>
</table>

Figure 10.1 Urban modification of climate
Wind Speed

<table>
<thead>
<tr>
<th>Wind speed is higher but</th>
<th>turbulence is less</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind speed is less as buildings act as windbreaks.</td>
<td></td>
</tr>
<tr>
<td>Turbulence is greater because wind is channeled between the buildings.</td>
<td></td>
</tr>
</tbody>
</table>

Fog and visibility

<table>
<thead>
<tr>
<th>Less fog resulting in better visibility.</th>
</tr>
</thead>
<tbody>
<tr>
<td>More fog and poorer visibility due to more hygroscopic nuclei in the atmosphere.</td>
</tr>
<tr>
<td>Fog is a problem in winter when temperature inversion causes the pollutants to settle close to the surface of the earth.</td>
</tr>
<tr>
<td>Smog causes traffic accidents and health related problems.</td>
</tr>
</tbody>
</table>

Table 10.1 Difference between rural and urban climates

**Urban heat islands**

The heat island effect is due to the variation in temperature over the central business district (CBD) or urban area between day and night.

<table>
<thead>
<tr>
<th>Day</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Heating causes air to expand and rise so the heat island grows vertically.</td>
<td>• It is cooler so the air becomes denser and sinks.</td>
</tr>
<tr>
<td>• The inversion layer is elevated to over 800m above the surface.</td>
<td>• The heat island is more dome shaped and pollutants are more concentrated in this area.</td>
</tr>
<tr>
<td>• There may be other built up areas along arterial routes around the CBD that also show higher temperatures.</td>
<td>• The inversion layer sits closer to the surface at about 400m.</td>
</tr>
<tr>
<td></td>
<td>• The trapped heat is more concentrated over the CBD area.</td>
</tr>
</tbody>
</table>

Table 10.2 Urban heat island effect

**Urban heat islands – causes and effects**

Artificial heat in urban areas is produced by:

- combustion processes in factories
- specialised ovens and heating units such as those found in bakeries
- air-conditioning units in office blocks which cool the offices down but release warm air from the back of the unit out into the environment.
- vehicle emissions, especially along arterial transport routes.

Artificial surfaces in urban areas:

- absorb heat during the day and radiate heat from these surfaces at night
- absorb heat such as concrete, bricks, tarmac and stone
- such as glass radiates heat back into the environment.

**Concept of pollution domes – causes and effects**

Pollution domes are the same as the urban heat domes, but the emphasis is on the pollution levels and mixing depth levels. The pollution dome is shown in Table 10.3
Pollution plumes also assume different shapes due to prevailing wind conditions. The plume may resemble a windsock and flows in the direction of the wind. Durban frequently experiences onshore north easterly winds which displace the warm polluted air towards the Berea ridge.
Strategies to reduce the heat island effect

**Greening the city**
- Plant more trees and vegetation
  - help to reduce CO2 levels
  - helps to provide more shade, which has a cooling effect
- Green belts and parks
  - reduce temperatures and air pollution

**Changing the colour of artificial surfaces**
- Dark surfaces absorb more heat than light surfaces
- Black surfaces may be up to 21°C hotter than light surfaces
- Concrete roads, pavements and building materials that are lighter in cooler reflect more light and heat

**Vehicle emissions**
- Use catalytic converters in exhaust systems
  - reduces noxious gas emissions
- Park and ride schemes
- Better public transport systems

**Roof-top gardens**
- reduce temperatures and air pollution
  - can act as natural water filtering systems and reduce urban runoff
  - referred to as breathing roofs
  - light coloured roof surfaces are cooler than darker roofs

**Industrial monitoring**
- Filters and scrubbers in industrial chimneys
- Stricter legislation and more fines
- Use alternative, sustainable energy sources

**Figure 10.3 Strategies to reduce the heat island effect**

**Analysing a photograph: Urban microclimate**
A mind map is used to suggest how cities, as shown in Photograph 10.1, can solve problems associated with urban climate.

**Greening the city**
- Trees and vegetation
- Trees lining streets
- Absorb heat (also carbon dioxide)

**Roof-top gardens**
- Help with heat balance and CO2 levels

**Artificial surfaces**
- White surfaces – reflect light; cooling effect
- Mirrored buildings – with reflective glass – less absorption of heat – cooling effect
- Use of neutral and natural materials, less heat absorption properties

**Traffic congestion**
Alleviates congestion by implementing:
- multilevel transport layers
- public transport – trains
- pedestrian walkways across roads
- 1-way traffic flow

**Water surfaces – cooling effect of the canal**
- Cooling effect of water
- Hygroscopic nuclei – absorbs heat and more clouds form – more rainfall – cooling
- Cleaner air from more rainfall
QUICK QUIZ
Refer to Photograph 10.2, a street scene in Monaco. **Discuss** the effect that rooftop and vertical gardens would have on modifying urban temperatures.

MY ANSWER

Answer:

- Decreases heat at night as they do not radiate heat as much as artificial surfaces would.
- Absorbs heat (also carbon dioxide)
- Can promote more evapotranspiration and cloud formation = rainfall, also a cooling effect
- Roof-top and vertical gardens create an albedo effect – they absorb heat rather than reflect heat and regulation – shading effect
- Help with heat balance and CO2 levels

ANSWER:
SECTION 3
Fluvial Geomorphology

Unit 11 Drainage systems in South Africa

CHECKLIST:
- Important drainage basin concepts
- Types of rivers: permanent, periodic, episodic and exotic
- Drainage patterns
- Drainage density
- Use of topographic maps to identify stream order and density
- Discharge of a river; including hydrographs

Important drainage basin concepts: drainage basin, catchment area, river system, watershed, tributary, river mouth, source, confluence, water table, surface run-off and groundwater

The drainage basin – terminology

**Watershed:** forms an imaginary dividing line between two drainage basins. The high-lying source area of a river.

**Drainage basin boundary:** this forms the catchment area of the drainage basin.

**Confluence:** the point where two (or more) streams meet along the course of a river.

**Tributary:** a branch of a main river.

**Source:** the origin of a river, in the catchment area.

**Interfluve:** the area between two tributaries, which are about to form a confluence point.

**River mouth:** the point at which the river enters the sea.

**Indian Ocean**

Key:  

Drainage basin – the area drained by a river system and its tributaries.

Watershed

Figure 11.1 The Tugela River drainage basin

The hydrological cycle
- This cycle shows the movement of water over and through the earth’s surface (run-off and infiltration)
- The transfer of moisture from the large ocean masses (evaporation) through the atmospheric circulation, and
- Finally the release of moisture from the atmosphere (precipitation).
Sources of water supply (Figure 11.2)
- Rainwater may evaporate, be intercepted by vegetation or contribute to surface runoff.
- Rainwater may flow over the surface as overland flow or sheet wash, and this runoff eventually flows into stream channels.
- Rainwater may also infiltrate the soil and into permeable rocks underground, forming ground water.
- The upper level of this saturated ground water zone is called the water table.

Types of rivers: permanent, periodic, episodic and exotic
The groundwater can seep into the riverbed and flow in the river as base flow. This level may also be referred to as the water table.

<table>
<thead>
<tr>
<th>Type of river flow</th>
<th>Examples of rivers</th>
<th>Sketch to show the water table levels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Permanent rivers:</strong></td>
<td>Tugela, Vaal, and Crocodile Rivers</td>
<td>![Sketch of water table during wet and dry season]</td>
</tr>
</tbody>
</table>
| • receive water all year  
• the water table always lies above the bed of the river (base flow). | | ![Sketch of water table during wet and dry season] |
| **Periodic rivers:** | Most South African streams | ![Sketch of water table during wet and dry season] |
| • have base flow that only contributes to the river runoff during the rainy season. | | ![Sketch of water table during wet and dry season] |
| **Episodic rivers:** | Swakop and Buffels Rivers | ![Sketch of water table during wet and dry season] |
| • never supplied with groundwater  
• will only flow after a heavy downpour, causing a flash flood for a day or so. | | ![Sketch of water table during wet and dry season] |
| **Exotic rivers:** | Gariep (Orange) and Nile Rivers | ![Sketch of water table during wet and dry season] |
| • rise in high rainfall areas, but flow for most of their courses through arid regions.  
• groundwater does not contribute to the base flow in these arid areas. | | ![Sketch of water table during wet and dry season] |

Table 11.1 Types of river flow

Key:
- Water table during wet season
- Water table during dry season
Drainage patterns

The pattern of a stream and its tributaries is determined mainly by the underlying rock type (geology) and the relief of the area.

<table>
<thead>
<tr>
<th>Stream Pattern</th>
<th>Description of features</th>
<th>Requirements for pattern to develop</th>
</tr>
</thead>
</table>
| Dendritic      | • Pattern is tree shaped.  
• The tributaries join at an acute angle.  
• Distinct interfluves are formed. | • Underlying rock types are uniformly resistant to erosion.  
• There is little variation in slope or gradient. |
| Trellis        | • Prominent ridges which lie parallel to each other.  
• The main river has cut through the ridges forming poorts or gaps.  
• The tributaries join the main streams at right angles.  
• The main streams are parallel | • Form in areas where there are alternating layers of hard and soft rock.  
• Layers are often inclined or folded.  
• Strong main stream which cuts across the landscape. |
| Rectangular    | • An angular pattern develops along exposed joints.  
• Surface water flows along the exposed joints.  
• Sharp angles in the stream pattern. | • Well-jointed rock outcrops, such as granite.  
• Joints exposed at the surface, which erode easily. |
| Radial         | • Streams radiate outwards from the central point (hilltop).  
• Looks like the spokes of a wheel. | • A dome or cone shaped feature such as a volcano or isolated hill. |
| Centripetal    | • Streams flow towards a depression or lake.  
• Water does not usually flow out of the lake or water body. | • Drainage patterns like these occur where there are depressions or low-lying swampy areas.  
• The relief of the area determines the pattern. |
| Deranged       | • Haphazard pattern of drainage.  
• Numerous lakes, swamps or meander scars occur; oxbow lakes may form. | • Found in areas which are geologically young.  
• Surface rocks are unconsolidated and sediments have accumulated more recently. |
| Parallel       | • When rivers flow parallel to each other.  
• Usually a few stream all flowing in the same direction down the slope. | • Uniformly resistant slopes which may be steep. |

Table 11.2 Stream flow patterns
Drainage density

Drainage density is the average length of streams within the area of a drainage basin.

\[
\text{Drainage density} = \frac{\text{Total length of the streams in the drainage basin (kilometres)}}{\text{Total area of the drainage basin (square kilometres)}}
\]

The number of streams (tributaries) in an area differs from one basin to another. **Drainage texture** is used to describe the two different basins and is the number of streams in relation to the area of the drainage basin.

<table>
<thead>
<tr>
<th>Low density and coarse texture</th>
<th>Medium density and texture</th>
<th>High density and fine texture</th>
<th>Extremely high density and very fine texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Few streams flowing in the drainage area creates a coarse texture.</td>
<td>More streams in the drainage area create a medium texture.</td>
<td>Many 1st and 2nd order streams in the drainage area, creating a finer texture.</td>
<td>Many small streams create a very fine drainage texture.</td>
</tr>
</tbody>
</table>

Table 11.3 The drainage density and texture of various drainage basins

The drainage density of an area is also influenced by a number of factors which determine how much water sinks into the ground (infiltration) and how much runs off the surface. These factors (Table 11.4) will reduce infiltration and increase surface runoff.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description of the influence of the factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>The type of rock and soil over which the rivers flow (permeability)</td>
<td>• If the basin overlies rock of high permeability, such as limestone or sandstone, it is likely that a coarse texture, low density pattern will develop as most of the water will soak into the ground. • If the area is too clayey, then the drainage pattern is likely to be finely textured, with a high drainage density.</td>
</tr>
<tr>
<td>The slope of the ground (gradient)</td>
<td>• If the ground is too steep, then the tributaries will be more closely spaced (high density) than those on a gentle slope, where the tributaries are able to spread out.</td>
</tr>
<tr>
<td>The climate (amount and type of rainfall)</td>
<td>• In arid regions where there is little rainfall, many streams will be periodic, while in areas experiencing higher rainfall, there will be many tributaries which are permanent (low density).</td>
</tr>
<tr>
<td>The vegetation cover (how much of the area is covered)</td>
<td>• The amount of runoff is affected by the type of vegetation cover and the area covered. • In forested areas, interception of rainfall by vegetation slows down the rate and the amount of runoff (low density). • With insufficient vegetation cover, the surface runoff will be greater as less water is able to penetrate the ground (high density).</td>
</tr>
</tbody>
</table>

Table 11.4 Factors which influence the drainage density of an area
The impact of flood and drought conditions on the drainage network

<table>
<thead>
<tr>
<th>Normal flow</th>
<th>Flooding flow</th>
<th>Drought flow patterns</th>
</tr>
</thead>
</table>

- The drainage density and texture of a drainage basin may vary from season to season and annually.
- If we compare this as well as the stream ordering in basin, we can predict expected discharge patterns in a season of high rainfall compared with the dry season.
- The drainage network becomes more highly connected with many 1st and 2nd order streams flowing, for a short period of time.
- This impacts on the flow regime and runoff increases.
- Flood peaks are also likely to be higher.
- Drainage density is high.
- The 1st order streams are the first streams to dry up and cease to flow.
- Drainage density will be low.

Table 11.5 Impact of flood and drought conditions on the drainage network

Use of topographic maps to identify stream order and density

Stream ordering

Stream ordering is another useful technique for comparing river systems. When hydrologists or engineers conduct research on drainage basins, for example to decide where the best site for a dam would be or to implement an Integrated Water Management Plan for the catchment, they compare different streams in a river system.

- A system of stream ordering is a way in which one can determine the connectivity in a drainage basin.
- A first order stream is simply the very small stream at the source of the river and it has no tributaries.
- Where two first order streams join, they form a second order stream; where two second order streams join, they form a third order stream.

<table>
<thead>
<tr>
<th>Explanation</th>
<th>Note:</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Diagram" /></td>
<td>1 + 1 = 2nd order stream</td>
</tr>
<tr>
<td></td>
<td>1 + 2 = 2nd order stream</td>
</tr>
<tr>
<td></td>
<td>2 + 2 = 3rd order stream</td>
</tr>
<tr>
<td></td>
<td>2 + 3 = 3rd order stream</td>
</tr>
<tr>
<td></td>
<td>3 + 3 = 4th order stream</td>
</tr>
</tbody>
</table>

Where two streams of a different order join, the stream retains the higher order of the two ordered streams that have joined, for example: 2 + 3 = 3rd order stream.

If two streams of the same order join, then the stream order increases by 1, for example 3 + 3 = 4th order stream.

- The information may be tabulated and graphed (refer to Table 11.6 and Figure 11.4).
- The relationship between the number of stream segments in a stream order and the highest order reached in a drainage area may be analysed.
- In the Tugela drainage area, we see that the lower the stream order, the greater the number of tributaries present.
**Law of stream orders**: the lower the stream order, the greater the number of tributaries of that stream order.

**Drainage basin analysis checklist:**
1. Shape
2. Type of flow: perennial or non-perennial
3. Typical hydrograph to show flow
4. Drainage density and texture
5. Order streams

Medium to high density with fine texture during rainy seasons

Drainage basin boundary - shows area drained by this sub-catchment basin

Most streams are non-perennial. This suggests seasonal rainfall

Inverted pear shape basin

**Map 11.1 Extract of drainage basin for analysis**

<table>
<thead>
<tr>
<th>Order</th>
<th>Number of tributaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

**Table 11.6**

<table>
<thead>
<tr>
<th>Stream order</th>
<th>Number of streams within an order</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
Discharge of a river

Laminar and turbulent flow
Water can flow in two ways:
- laminar flow – when the river bed is very level and even, and the velocity of the river is low, the water may move in thin layers.
- turbulent flow – when the velocity of the river increases or if the river bed is uneven, a more irregular, whirling flow results.

<table>
<thead>
<tr>
<th>Laminar flow</th>
<th>Turbulent flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheet flow</td>
<td>Eddy</td>
</tr>
<tr>
<td>Smooth channel bed</td>
<td>Bubbles</td>
</tr>
<tr>
<td>Gradient</td>
<td>Gradient</td>
</tr>
<tr>
<td>Rough channel bed</td>
<td></td>
</tr>
</tbody>
</table>

- Water flows in sheets
- No turbulent eddies, not churned up
- Smooth river channel reduces friction and hence turbulence
- Usually a gentle gradient
- River is mostly transporting the stream load.

- Water forms eddies and bubbles
- Seethes down slope
- Surface friction in the channel causes more turbulence
- The gradient is often steeper and the erosion takes place.

Table 11.7 Laminar and turbulent flow

Factors affecting laminar and turbulent flow
The river load
This refers to the material transported by a river downstream. The river or stream load consists of solid materials or particles in suspension or solution (Figure 11.5).
Speed of flow

The river requires energy to cause erosion and to transport the river load. This energy is determined by:

- The gradient of the river course, and
- The volume of water.

The gradient of the slope determines the gravitational force. However, this force is opposed by the frictional force between the water, air and river channel.

<table>
<thead>
<tr>
<th>Narrow channel</th>
<th>Deep channel</th>
<th>Wide, shallow channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>less surface friction</td>
<td>surface friction - air</td>
<td>surface friction - air</td>
</tr>
<tr>
<td>( \frac{5}{2} ) = stream speed in cumec</td>
<td>channel friction</td>
<td>channel friction</td>
</tr>
<tr>
<td>• Less surface friction – air</td>
<td>• More surface friction – air</td>
<td>• Greatest surface and channel friction</td>
</tr>
<tr>
<td>• More channel friction – rough surface</td>
<td>• Deeper channel so decreased channel friction</td>
<td>• Broad, shallow channel creates greater friction</td>
</tr>
<tr>
<td>• Small volume of water</td>
<td>• Large volume of water</td>
<td>• Fairly slow moving water (medium pace)</td>
</tr>
<tr>
<td>• Slow moving water body</td>
<td>• Fast moving water</td>
<td></td>
</tr>
</tbody>
</table>

Table 11.8 Speed of flow in a river channel

Hydrographs

Hydrographs show the runoff in a river channel at a given point, over a certain period of time. The graph shows the relationship between the amount of precipitation and runoff (Figure 11.6).

Features of a storm hydrograph

This hydrograph is used to show the effect a storm event has on the runoff in a river channel or system.

Before a storm: discharge is made up of groundwater only, namely the base flow.

After the onset of a storm: there is no initial increase in discharge because:

- rainwater has to saturate the dry soil, before runoff will occur
- water has to reach the water table by infiltration before base flow will be increased
- water takes time to travel through tributaries and to reach the gauging station.

For kinaesthetic learners: See if you can safely access a river or stream in your local area. Dip your hands and feet in the water and see whether you can identify the type of flow, river load and speed of flow. Relate this to the theory learned in class.
Figure 11.6 Diagram of storm hydrograph

Explanation of the various features of the hydrograph
A storm or flood hydrograph shows the base flow of a river as well as the flood peak.
It is important to determine whether or not a flood surge or a flash flood (which is a sudden increase in flow) has occurred.
To establish when this may occur, the lag time is important as this reflects the time period between the maximum precipitation and the peak flow.

Note:
Runoff or discharge: the volume of water passing a given point at a given time, is usually measured in cubic metres per second (cumec).

Factors which affect the flow hydrograph
The physiographic features of a drainage basin, namely the climate, geology, relief and vegetation as well as the built environment, will all impact on runoff and the shape of the hydrograph.

Figure 11.7 Factors influencing the flow hydrograph
<table>
<thead>
<tr>
<th>Factor</th>
<th>Hydrograph features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size of the river basin</strong></td>
<td>If rainfall is the same, the discharge of the stream within:</td>
</tr>
<tr>
<td></td>
<td>• a large catchment is greater</td>
</tr>
<tr>
<td></td>
<td>• a small catchment is less.</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Small area" /> short lag time</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Large area" /> longer lag time greater volume</td>
</tr>
<tr>
<td><strong>Shape of the basin</strong></td>
<td>A long, narrow basin</td>
</tr>
<tr>
<td>A long, narrow basin:</td>
<td>• yields an even runoff.</td>
</tr>
<tr>
<td></td>
<td>• water of the furtherest tributaries will take much longer to reach the point of</td>
</tr>
<tr>
<td></td>
<td>outflow than the water of the closer tributaries</td>
</tr>
<tr>
<td></td>
<td>• peak flow is more evenly spaced.</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="A long, narrow basin" /></td>
</tr>
<tr>
<td><strong>Relief</strong></td>
<td>A circular basin</td>
</tr>
<tr>
<td></td>
<td>• runoff produces a sharp peak in the hydrograph</td>
</tr>
<tr>
<td></td>
<td>• runoff in all the tributaries covers about the same distance before it reaches</td>
</tr>
<tr>
<td></td>
<td>the point of outflow of the drainage basin</td>
</tr>
<tr>
<td></td>
<td>• Example: Laingsburg floods in January 1981.</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Relief" /></td>
</tr>
<tr>
<td><strong>Underlying rock type and soils</strong></td>
<td>Permeable rock types – less runoff and more infiltration.</td>
</tr>
<tr>
<td></td>
<td>• Impermeable rock types – more runoff and less infiltration.</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Underlying rock type and soils" /></td>
</tr>
<tr>
<td><strong>Climatic features</strong></td>
<td><img src="image" alt="Climatic features" /></td>
</tr>
<tr>
<td>Rainfall (amount and type)</td>
<td><strong>Heavy rainfall</strong> may cause a lot of runoff, creating a high peak flow.</td>
</tr>
<tr>
<td></td>
<td><strong>Soft soaking rainfall</strong> allows for more infiltration and a lower peak flow.</td>
</tr>
<tr>
<td><strong>Vegetation cover</strong></td>
<td><img src="image" alt="Vegetation cover" /></td>
</tr>
<tr>
<td></td>
<td><strong>Forested</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Grassland</strong></td>
</tr>
<tr>
<td><img src="image" alt="Vegetation cover" /></td>
<td><strong>Low level of urbanization</strong></td>
</tr>
<tr>
<td><img src="image" alt="Vegetation cover" /></td>
<td><strong>Highly urbanised</strong></td>
</tr>
<tr>
<td><strong>Human Impact</strong></td>
<td>Artificial surfaces and developments</td>
</tr>
<tr>
<td></td>
<td>• In a highly urbanised area, fully sewered and with many permeable surfaces,</td>
</tr>
<tr>
<td></td>
<td>runoff is rapid and high.</td>
</tr>
<tr>
<td><img src="image" alt="Human Impact" /></td>
<td><img src="image" alt="Human Impact" /></td>
</tr>
<tr>
<td><strong>Table 11.9</strong> Factors affecting</td>
<td>The runoff and infiltration rates will increase with increased rainfall.</td>
</tr>
<tr>
<td>the flow hydrograph</td>
<td>• However, the nature of rainfall will determine the hydrograph shape.</td>
</tr>
<tr>
<td><img src="image" alt="Table 11.9" /></td>
<td><img src="image" alt="Table 11.9" /></td>
</tr>
</tbody>
</table>

SECTION 3 FLUVIAL GEOMORPHOLOGY
Unit 12  Fluvial processes

CHECKLIST:
• River profiles: transverse profile, longitudinal profile and their relationship to different stages of a river
• Identification and description of fluvial landforms
• River grading
• Rejuvenation of rivers: reasons and resultant landforms
• Superimposed and antecedent drainage patterns
• River Capture

River profiles: transverse profile, longitudinal profile and their relationship to different stages of a river

River profiles

<table>
<thead>
<tr>
<th>Transverse profile (cross section)</th>
<th>Longitudinal profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shows the shape of the river channel.</td>
<td>Shows the side view of a river from the source to the river mouth.</td>
</tr>
<tr>
<td>Various factors may influence the shape of the cross section.</td>
<td>Usually concave in shape.</td>
</tr>
</tbody>
</table>

Table 12.1 Comparing river profiles

MY OWN NOTES
**Relationship of the transverse and longitudinal profiles to different stages of a river**

![Diagram of the Tugela River profile](image)

**Figure 12.1** Longitudinal profile of the Tugela River

<table>
<thead>
<tr>
<th>Features of the river channel</th>
<th>Upper Course</th>
<th>Middle course</th>
<th>Lower course</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transverse / cross section of channel</strong></td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>Deep, narrow</td>
<td>Wider</td>
<td>Broad, flat</td>
<td></td>
</tr>
<tr>
<td><strong>Type of work performed by running water</strong></td>
<td>Vertical erosion</td>
<td>Lateral erosion is dominant over vertical erosion</td>
<td>Deposition</td>
</tr>
<tr>
<td><strong>Gradient</strong></td>
<td>Very steep</td>
<td>Gentler, less steep</td>
<td>Gentle or flat</td>
</tr>
<tr>
<td><strong>Volume</strong></td>
<td>Low volume, with little load</td>
<td>Load and volume increased as channel widens</td>
<td>Increased volume and suspended load</td>
</tr>
<tr>
<td><strong>Flow</strong></td>
<td>Turbulent, swift flowing water</td>
<td>Less turbulent, more laminar in places</td>
<td>Laminar</td>
</tr>
</tbody>
</table>
| **Features that occur commonly along this part of the river course** | - Cascades  
- Waterfalls  
- Rapids  
- Gorges or ravines  
- Boulders along river bed  
- Potholes | - River begins to meander  
- Floodplain starts to develop  
- Alluvial fans  
- Interlocking spurs | - Marshes  
- Wide meanders  
- Leves  
- Oxbow lakes  
- Wide floodplains  
- Braiding |

| Table 12.2 Summary of the characteristics of the profiles of a river system |

---

**SECTION 3 FLUVIAL GEOMORPHOLOGY**
Identification and description of fluvial landforms

Features of the upper course

<table>
<thead>
<tr>
<th>Waterfalls</th>
<th>Rapids</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Waterfalls" /></td>
<td><img src="image2.png" alt="Rapids" /></td>
</tr>
</tbody>
</table>

- Waterfalls form when a river plunges over a resistant layer of rock, such as a sill.
- As the water falls to the plunge pool it undercuts the softer rock below, creating an overhang.
- This overhang may collapse due to gravity and its own weight.
- The process may be repeated.
- Over time a waterfall retreats backwards up the valley (headward erosion).
- A steep sided gorge may be left in front of the waterfall.

Table 12.3 Waterfalls and rapids

Fluvial features of the middle course

<table>
<thead>
<tr>
<th>Interlocking spurs</th>
<th>Alluvial fans</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Interlocking spurs" /></td>
<td><img src="image4.png" alt="Alluvial fans" /></td>
</tr>
</tbody>
</table>

- As the river meanders from side to side, the spurs form first on one side of the valley, then the other, alternating from bank to bank.
- If you look along the valley the spurs seem to join together or interlock.

- Water cascades over outcrops of resistant rocks.
- Turbulent flow over bands of rocks.
- Potholes often found around rapids.

- As a mountain stream leaves the hills it spreads out to become a braided stream.
- The speed of flow is reduced.
- Sediment is deposited.
- The narrowest point of the fan is the apex and the widest part is called the apron.
Features of the middle and lower course

<table>
<thead>
<tr>
<th>River meandering</th>
<th>Stream Braiding</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="River Meandering Image" /></td>
<td><img src="image2.png" alt="Stream Braiding Image" /></td>
</tr>
</tbody>
</table>

- As a river makes its way across the flood plain it bends and loops.
- Flow is slower and more laminar and the gradient is gentle.
- The winding pattern of s-shaped bends is the result of lateral erosion of the river.
- The inside bend of the meander (B) forms the slip-off slope, where the water moves slowly and deposits its load.
- The outside bend of the meander (A) forms the cut-off slope, where the water is flowing faster and is eroding the bank.

Generally found where the gradient is gentle (lower course).
- The river which is carrying a heavy load (suspended) loses its energy and deposits this silt.
- The river starts to divide into a number of segments and islands and the streams develop a rope-like pattern.

### Table 12.4 River meandering and stream braiding

Features of the lower course

<table>
<thead>
<tr>
<th>Floodplains and levees</th>
<th>Deltas</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Floodplain and Levee Image" /></td>
<td><img src="image4.png" alt="Delta Image" /></td>
</tr>
</tbody>
</table>

- A levee is a natural river bank formed along the sides of the river channel.
- Formed by the river depositing materials when it floods.
- Coarser material is deposited first and a small embankment forms on the edge of the river channel.
- Finer material is carried further and deposited onto the surrounding, flatter floodplain.

Deltas form under the following conditions:
- When the river flow slows down and loses its energy as it enters a lake or the sea
- When the sea into which it flows does not have strong currents to remove the material deposited
- When the river is heavily silted and thus carries a large load of sediment.

### Table 12.5 Floodplains, levees and deltas
Oxbow lakes

- Oxbow lakes form in the lower course as river meanders become more pronounced.
- Rapid lateral erosion will cut into the neck of the meander, narrowing it considerably.
- Eventually the force of the river will break through the neck, leaving an old meander without any water flowing through it.
- The river deposits material along the side of its new course, completely blocking off the old meander.

A river meander:
1. Erosion occurs on the outward curve and deposition on the inside curve.
2. The loop widens from the continued erosion on the outside curves. The neck of the loop becomes narrow due to erosion.
3. The neck is finally cut through by erosion and allows the water to flow in a more direct route. This cuts off the river loop, forming an oxbow lake.

Table 12.6 Formation of oxbow lakes

**River grading**

**A smooth (graded) profile**

This is a concave, graded profile. The concave profile is made up of:
- a short, steep upper section (upper course),
- a more gradual, middle section (middle course), and
- a long, almost flat lower section (lower course).

The lowest level to which a river can erode is called the base level of erosion. In a smooth, graded profile this level will be at sea level and is also called the **permanent base-level of erosion**.
An uneven (ungraded or multi-concave) profile

- Sometimes a smooth profile may be interrupted by a knickpoint, which changes the angle of the slope.
- A knickpoint may be caused by a rapid, waterfall or dam wall to give a multi-concave or ungraded profile.
- The knickpoint creates a temporary base-level of erosion and the river is unable to erode the landscape upstream so that it is lower than the knickpoint or waterfall.

![Figure 12.3 An uneven, ungraded profile, caused by a waterfall creating a knickpoint](image)

**Note:**

**Knickpoint** – indicates a change in gradient in the longitudinal profile of a river. Usually marked by rapids and waterfalls.

Rejuvenation of rivers: reasons and resultant landforms

**Rejuvenation** is the renewed ability of a river to erode into a landscape because of the change in the base level of a river system.

**Reasons for rejuvenation:**

- A change in the permanent base level of erosion of a river due to a change in sea level
- Uplift of continental material due to tilting or warping
- A change in the climate, for example, increased rainfall.
- An increase in discharge of a river system after river capture has taken place. This causes an increase in discharge after the river capture has taken place.

![Figure 12.3 Longitudinal profile of a rejuvenated river](image)

**Resultant features of rejuvenation**

- Paired terraces
- Incised meanders which are either entrenched (through vertical erosion) or ingrown (through lateral erosion).
- Knickpoint rapids and waterfalls may be found where the longitudinal profile of a river displays a sharp change in gradient. A dam wall or weir also creates a human-made knickpoint.
<table>
<thead>
<tr>
<th>Feature</th>
<th>Characteristics</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paired terraces</td>
<td>• Renewed vertical erosion cuts a new channel within the existing one.</td>
<td>![Diagram of Paired terraces]</td>
</tr>
<tr>
<td></td>
<td>• Original river floodplain or terraces are at a higher level than present floodplain.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Knickpoint waterfall may be present.</td>
<td></td>
</tr>
</tbody>
</table>
| Incised meanders which are entrenched | • Symmetrical in cross section.  
  • Fall in base level is rapid.  
  • Rock may be soft.  
  • Vertical erosion dominant.  
  • rejuvenation gorge may develop. | ![Diagram of Incised meanders which are entrenched] |
| Incised meanders which are ingrown | • Asymmetrical in cross section.  
  • Fall in base level is slow.  
  • Vertical and lateral erosion evident.  
  • Resistant rocks. | ![Diagram of Incised meanders which are ingrown] |

**Table 12.7 Summary of the various features of rejuvenation**

**Superimposed and antecedent drainage patterns**

**Superimposed drainage**  
Rivers have eroded a course or path through mountains.

**Antecedent drainage**  
Rivers do not flow around higher lying ground but cut "poorts" through the resistant rock layers or fold mountains.

- Older layers of horizontal strata are exposed at the earth’s surface because of erosion.
- The river now develops its course on this older landscape.
- The river pattern does not match the structure of the underlying surface.
- Rivers are superimposed on a landscape that is older than the river itself.
- Superimposed streams are younger than the landforms (structures) that they cut through.
- Rivers have inherited their courses from the former overlying layers.

Good examples are the Vaal River near Parys and the Sand River in the Limpopo Province.

- An area of the crust is raised because of folding or faulting (tectonic forces).
- The river develops its course on a former landscape.
- The river was able to erode fast enough to keep pace with the uplifting landscape.
- The stream is able to erode through the folded structures or resistant rocks.
- Rivers maintain their original course by cutting a poort or water gap, through the newly folded mountain.
- These rivers are older than the structures through which they flow.

A good example is the Orange River (Gariep) which flows through the escarpment to the Atlantic Ocean.

**Table 12.8 Summary of Superimposed and Antecedent drainage**

**Note:**  
Poort or water gap – where a river has cut through a ridge or mountain range.
River Capture

Concepts of abstraction and river capture

Abstraction refers to the shifting of the watershed by headward erosion. Figure 12.4 shows how the watershed moves from position 1 to position 2 as headward erosion occurs in the upper course of river.

![Diagram of abstraction](image)

- Drainage basin A has a steep gradient with less resistant rock.
- Headward erosion occurs in the area between 1 and 2.
- The water from the area between 1 and 2 will no longer flow into the catchment area of B but will flow into the catchment area of A.

Figure 12.5 The process of abstraction.

Footnote

Headward erosion – the lengthening of a river course as it cuts back into the source area.

Concept of and conditions necessary for river capture

River capture occurs when a river, which has gained more energy, captures or intercepts the head waters of another river.

- The two drainage basins must lie adjacent (next to) each other.
- The watershed always moves in the direction of the river with less energy.

<table>
<thead>
<tr>
<th>Influencing factor</th>
<th>How this factor contributes to river capture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradient</td>
<td>If one side of the watershed is steeper than the other side, the watershed will move in the direction of the source area of the river flowing over the gentler slope.</td>
</tr>
<tr>
<td>Rainfall</td>
<td>The river flowing on the side which receives a higher rainfall will have a greater velocity and more energy due to a greater volume of water. The watershed will move in the direction of the drainage basin that receives less rainfall.</td>
</tr>
<tr>
<td>Nature of the underlying rock</td>
<td>If one side of the watershed is made up of less resistant (softer) rock than the other side, the river will erode more easily into the softer rock causing active headward erosion. The watershed will move in the direction of the river flowing over the more resistant rock.</td>
</tr>
</tbody>
</table>

Table 12.9 Conditions necessary for river capture
River Capture

Concepts of abstraction and river capture

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</tr>
</tbody>
</table>

Table 12.9 Conditions necessary for river capture

Features associated with river capture

Before river capture

1. Captor stream – gains more water, has more energy and erosion takes place at a greater rate.
2. Headward erosion occurs and watershed moves in the direction of the slower flowing river.
3. Captor stream is also called a pirate stream.

After River Capture

1. Elbow of capture – This is the point where the river captures the headwaters of another river. The bend at the elbow. A change in direction of the river is here.
2. Misfit stream – This is the stream that is too small or in the area it drains as it headwaters have been captured. Also called the beheaded stream.
3. Dry gap or wind gap – part of the river valley that has been left dry after capture has taken place. Found immediately below the elbow of course.
Figure 13.1 shows the 500mm isohyet, the wetter and drier regions as well as the influence of the ocean currents on climate.

Rainfall decreases from east to west

- Low rate of evaporation from ocean surface.
- Air cool and dry
- Low rainfall along west coast.
- Non-perennial rivers.
- Winter rainfall area.
- Seasonal river flow.

**Note:**

**Isohyet** – a line joining all places with the same amount of rainfall.

Due to the erratic, low rainfall in South Africa, water management schemes have been built to meet the demand for fresh water. As population numbers increase, so too does the demand for fresh water. These projects involve rivers, dams and storage schemes to ensure that there is a sufficient water supply. Figure 13.2 shows the main dams in South Africa.
Inter-basin transfer schemes
Water is usually transferred by tunnels, pipes or open canals to a holding area, where a pump station will assist in the transfer of the water from one drainage basin into another drainage area.

Tugela-Vaal Transfer Scheme (TUVA)
The Tugela-Vaal (TUVA) project has been constructed in the Drakensberg near Bergville and was completed in 1974. This pumped-storage scheme serves the dual purpose of supplying water to Gauteng's urban and industrial complex and of generating electricity at times of peak demand.

- Water from Tugela River is transferred via dams and canals to the Kilburn Dam.
- Water is pumped from the Kilburn into the Driekloof holding dam during off peak periods.
- At times of peak electricity demand, water held in the Driekloof Dam is released to drive the huge turbines that generate hydro-electric power for ESKOM. The water collects in the Kilburn Dam.
- When the Driekloof Dam is full, water may be released into the Sterkfontein Dam where it is stored.
- From there water may be released via the Wilge River to the Vaal Dam before being distributed to both urban and industrial users in Gauteng.

The Tugela Vaal Pumped Storage Scheme

Orange (Gariep) River Project
The aim is to provide the Eastern Cape and dry Karoo areas with water for irrigation, urban and industrial use. Water is transferred from the Gariep Dam via tunnels into the Fish and Sundays rivers. The Darlington Dam is a storage dam on the Sundays River (Figure 13.4).

Lesotho Highlands Water Project
Water is diverted from the Malibamatsu River in Lesotho and stored in the Katse Dam. It is then piped through the mountains and released into the Ash River, which eventually flows into the Vaal Dam via the Wilge River.

The mountains of Lesotho receive a lot of water in the form of rain and snow, and therefore this area has a water surplus. An agreement between Lesotho and South Africa saw the Lesotho Highlands Water Project come into being, as South Africa needed more fresh water than it had available.
The advantages of the LHWP for the people of Lesotho include:

- construction of infrastructure such as roads, bridges and school classrooms
- training and development in the areas of forestry, agriculture and aquaculture
- a renewed awareness of conservation and the planting of trees
- the establishment of a National Botanic Gardens at Katse Dam
- the provision of jobs and subsequent economic growth

The disadvantages include:

- many people were relocated due to their lands being where the dams have been constructed.

**Western Cape water transfer schemes**

**Steenbras – Palmiet scheme**
Water from the Palmiet River is transferred into the Steenbras Dam in the Hottentots Holland Mountains. This water is used by the Cape Town metropolitan area.

**Berg River scheme**
Water is transferred from the Theewaterskloof Dam on the Sonderrand River to the Berg and Eerste Rivers. Water is stored in the Berg River Dam for the dry summer months for Cape Town’s urban and industrial use.

**Impact of water users on drainage basins and catchment areas**

Water users

- Urban; 23.23%
- Commercial forestry; 3.3%
- Industry and mining; 6%
- Rural; 4.4%
- Power generation; 2%
- Irrigation; 62%

Fig 13.4 Users of water

How are the water users creating a huge demand?

- Rapid population growth
- Greater urbanisation leading to greater consumption of water
- Industry, mining and power stations
- Agriculture uses 62% and forestry uses 3% of the total water supply. This is about 65% of water usage.
Local water management: Strategies reducing the impact of drought or a water scarcity

The following table shows various methods that can be used to increase water supply to areas where there is a water scarcity.

<table>
<thead>
<tr>
<th>What works?</th>
<th>How does it work?</th>
<th>Examples of where this is done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation schemes</td>
<td>Provides dry areas with water for irrigation.</td>
<td>Orange River scheme via the Fish and Sundays River tunnels.</td>
</tr>
<tr>
<td>Building of dams and reservoirs</td>
<td>Stores water for times of drought. Water released via sluice gates once the dam reaches 100% capacity</td>
<td>George Dam</td>
</tr>
<tr>
<td>Using groundwater</td>
<td>Wind pumps are used to draw groundwater for domestic use. Water often tastes salty, due to high concentration of minerals in the ground water.</td>
<td>Dry western parts of South Africa.</td>
</tr>
<tr>
<td>Desalination</td>
<td>Desalination plant in Knysna</td>
<td>Used in Sedgefield, Knysna and George, Western Cape which are water-stressed areas.</td>
</tr>
<tr>
<td>Water transfer schemes</td>
<td>Water is transferred from one area to another through dams and tunnels, for example the TuVa and LIHWP schemes.</td>
<td>Lesotho Highlands Water Project</td>
</tr>
</tbody>
</table>
Fog collection refers to the collection of water from fog using large pieces of vertical canvas to make the fog condense into droplets of water and flow down towards a trough below the canvas.

Grey water (or gray water) is neither fresh nor polluted water. Typically a grey water system recycles water from baths, basins showers and washing machines to irrigate lawns and gardens. In the traditional sense grey water is fed through a filter to a pump chamber where the water is automatically released via a drive pipe to a garden sprinkler system [http://www.savingwater.co.za/grey-water-systems](http://www.savingwater.co.za/grey-water-systems).

Rain-water harvesting: Using JoJo tanks or other tanks to catch the runoff from the roof of a house.

Chile in South America

Working for Water Programme (WFW)

Another water strategy that has been implemented by The Department of Water Affairs and Forestry (DWAF) is the Working for Water Programme (WFW). The aim of WFW is to eliminate invasive alien species (plants, animals and microbes) from our natural water systems. The biggest threats they pose are not only to the country’s biological biodiversity, but also to water security, the ecological functioning of natural systems and the productive use of land.

The WFW programme works in conjunction with local communities to not only educate them on the environment and biodiversity, but to provides jobs and to help them in their struggle against poverty.
SECTION 4
Rural settlement and urban settlement

Unit 14  Study of settlements

CHECKLIST:
- concept of settlement
- site and situation
- rural and urban settlements
- settlement classification according to size, complexity, pattern and function

Concept of a settlement
A settlement refers to where a community of people live, with buildings and communication links that function together as a single, connected system. A settlement could be anything from an isolated farmhouse to a megacity (which contains over 10 million people).

Settlements can either be temporary (short term) or permanent (long term). Temporary settlements include refugee camps, while permanent settlements are all those places which have permanent building structures such as towns and cities.

Site and situation
Site is the exact point upon the land where the settlement was established. The site is determined by physical factors such as relief, soil type and a water source. Defense has also played a role in determining the site of early settlements.

Factors that determine the site of a settlement

- **Dry-point site** - a site that avoids the risk of flooding. These sites are located a distance from the water source, as water is abundant.
- **Wet-point site** - a site close to a supply of water. Occurs in dry areas where water may be scarce.
- **Harbours** - sheltered sea inlets provide suitable sites for fishing and trading ports.
- **Resources** - many settlements developed close to where natural resources could be found, such as trees and fertile soil. These resources provide food, building materials and fuel.
- **Relief** - flat, low-lying land is much easier to build on than mountainous land.
- **Defensive site** - a site located on high ground allowing the inhabitants of the settlement to see the enemy approaching from a distance.
- **Aspect** - in the southern hemisphere many settlements are located on the north-facing sides of valleys which are sunny and warmer.

Figure 14.1 Factors that determine the site of a settlement

**Situation** describes where a settlement is located in relation to its surrounding human and physical features, such as neighbouring settlements, the closest market place and communication links.
Rural and urban settlements

Settlements are categorised as either rural or urban and these differences are outlined in Table 14.1.

<table>
<thead>
<tr>
<th>Rural settlements</th>
<th>Urban settlements</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Characterised by farms, traditional family units and small villages.</td>
<td>• Referred to as towns or cities.</td>
</tr>
<tr>
<td>• Found in the open countryside, often isolated and with a low population density.</td>
<td>• May be classified as urban because of function as a central place which provides a range of services such as shops, banks, and offices.</td>
</tr>
<tr>
<td>• Main economic activities are primary activities.</td>
<td>• Usually have a high population density.</td>
</tr>
<tr>
<td></td>
<td>• Main economic activities are secondary, tertiary and quaternary activities.</td>
</tr>
</tbody>
</table>

Table 14.1 Difference between rural and urban settlements
Settlement classification according to: size, complexity, pattern and function.

Settlements vary in size and are therefore classified accordingly.

---

**TABLE 14.2 The differences between rural and urban settlements in terms of size, complexity, pattern and function**

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>RURAL SETTLEMENTS</th>
<th>URBAN SETTLEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIZE</td>
<td>• Rural settlements are smaller in population size and density.</td>
<td>• Urban settlements are large, built-up areas with a large population and high population density.</td>
</tr>
<tr>
<td>COMPLEXITY</td>
<td>• These settlements are simple and the establishment of dwellings may be planned or at random.</td>
<td>• These settlements are highly complex with buildings often planned.</td>
</tr>
<tr>
<td></td>
<td>• These settlements are simple and the establishment of dwellings may be planned or at random.</td>
<td>• The process of urban expansion sees some growth being planned while in other parts of the urban environment, growth is uncontrolled.</td>
</tr>
<tr>
<td>PATTERN</td>
<td>• Dwellings may be nucleated or dispersed.</td>
<td>• The settlement is nucleated.</td>
</tr>
<tr>
<td></td>
<td>• The settlement pattern is often easy to identify as these settlements are smaller and less complex.</td>
<td>• Over time the settlement grows and the original pattern may not be clearly defined</td>
</tr>
<tr>
<td></td>
<td>• Some of the patterns include: round or ring patterns, linear or ribbon patterns, cross-road patterns and T-junction shaped patterns.</td>
<td>• Some modern cities have been built from scratch and their patterns are easily identifiable. For example: Canberra, Australia and Brasilia, Brazil.</td>
</tr>
<tr>
<td>FUNCTION</td>
<td>• Rural settlements are said to be un-functional as their focus is on one economic activity.</td>
<td>• Urban settlements are said to be multi-functional as their focus is on a variety of economic activities (secondary and tertiary).</td>
</tr>
<tr>
<td></td>
<td>• Primary activities are the main economic activity supporting these settlements.</td>
<td>• Note: Quaternary activities occur more in MEDCs and involve in use of high levels of expertise and technology.</td>
</tr>
<tr>
<td></td>
<td>• Primary activities include farming, fishing, forestry and mining.</td>
<td></td>
</tr>
</tbody>
</table>

---

**Unit 15 Rural settlements**

**CHECKLIST:**

- how site and situation affect the location of rural settlements
- classification of rural settlements according to pattern and function
- reasons for the different shapes of settlements
- land use in rural settlements

How site and situation affect the location of rural settlements

Refer to page 76 for how site and situation affect the location of rural settlements.
Settlement classification according to: size, complexity, pattern and function.

Settlements vary in size and are therefore classified accordingly.

![Diagram of rural and urban settlements]

**Table 14.2 The differences between rural and urban settlements in terms of size, complexity, pattern and function**

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<td>PATTERN</td>
<td>- Dwellings may be nucleated or dispersed. - The settlement pattern is often easy to identify as these settlements are smaller and less complex. - Some of the patterns include: round or ring patterns, linear or ribbon patterns, cross-road patterns and T-junction shaped patterns.</td>
<td>- The settlement is nucleated. - Over time the settlement grows and the original pattern may not be clearly defined. - Some modern cities have been built from scratch and their patterns are easily identifiable. For example: Canberra, Australia and Brasilia, Brazil.</td>
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</table>

**Unit 15 Rural settlements**

**CHECKLIST:**
- how site and situation affect the location of rural settlements
- classification of rural settlements according to pattern and function
- reasons for the different shapes of settlements
- land use in rural settlements

**How site and situation affect the location of rural settlements**

Refer to page 76 for how site and situation affect the location of rural settlements.

**SECTION 4 RURAL SETTLEMENT AND URBAN SETTLEMENT**

Classification of rural settlements according to pattern and function

Rural settlements may be dispersed (isolated) where houses are well separated from each other or nucleated (clustered) where houses are close together.

Whether a settlement is dispersed or nucleated depends on:
- physical factors – how steep or gentle the land is?
- economic factors – what activities are taking place?
- social factors – who owns the land and what traditions and customs prevail?

<table>
<thead>
<tr>
<th>Dispersed Settlements (Isolated)</th>
<th>Nucleated settlements (Clustered)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Forms made on buildings are linear and more dispersed.</td>
<td>2. Buildings are close together.</td>
</tr>
</tbody>
</table>
Classification of rural settlements according to pattern and function

Rural settlements may be dispersed (isolated) where houses are well separated from each other or nucleated (clustered) where houses are close together.

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- physical factors – how steep or gentle the land is?
- economic factors – what activities are taking place?
- social factors – who owns the land and what traditions and customs prevail?

<table>
<thead>
<tr>
<th>Dispersed Settlements (Isolated)</th>
<th>Nucleated settlements (Clustered)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Farmsteads or buildings are located some distance apart.</td>
<td>• Buildings are close together.</td>
</tr>
<tr>
<td>• This type of pattern is also seen in traditionally white-owned lands where a single farmhouse is surrounded by farmland and out-buildings.</td>
<td>• Buildings may cluster around a central point, along a road or an intersection (cross-shaped or T-shaped).</td>
</tr>
<tr>
<td>• This type of pattern is typical in rural areas, especially in KwaZulu-Natal.</td>
<td>• The settlement may be nucleated due to other physical factors.</td>
</tr>
<tr>
<td>• Flat land will result in dwellings being more dispersed.</td>
<td>- Dry-point settlements occur away from the water source.</td>
</tr>
<tr>
<td>• Dry-point settlements occur away from the water source and dwellings may be dispersed across the landscape.</td>
<td>- Wet-point settlements are built near the water source.</td>
</tr>
<tr>
<td><strong>Advantages are:</strong></td>
<td>- Settlements occur where there are gaps or poorts in a mountainous landscape.</td>
</tr>
<tr>
<td>• space for large housing estates or extensive farming</td>
<td>• May be referred to as a compact village.</td>
</tr>
<tr>
<td>• the freedom to make own decisions</td>
<td>• Land tenure systems may result in nucleated villages where communal land ownership occurs. For example: Tswana villages.</td>
</tr>
<tr>
<td>• modern telecommunication systems allow people living in rural areas to remain in contact</td>
<td><strong>Advantages are:</strong></td>
</tr>
<tr>
<td>• quieter with less air pollution.</td>
<td>• safety in numbers for defence and protection</td>
</tr>
<tr>
<td><strong>Disadvantages are:</strong></td>
<td>• social contact and community support</td>
</tr>
<tr>
<td>• far from services and schools</td>
<td>• sharing of information and equipment</td>
</tr>
<tr>
<td>• less social interaction</td>
<td>• services that are more efficient as more people have access to these</td>
</tr>
<tr>
<td>• expensive transport, electricity and telecommunication services</td>
<td>• resources may be divided and shared</td>
</tr>
<tr>
<td>• safety becomes a concern (in South Africa).</td>
<td>• transport and communication links are better</td>
</tr>
<tr>
<td></td>
<td>• employment opportunities are more abundant.</td>
</tr>
</tbody>
</table>

**Disadvantages are:**
- the lack of consideration for others (noisy)
- less space and privacy
- sharing of equipment may result in damage
- more air and solid waste pollution.

Photograph 14.3 Isolated farmstead. Source: D Preston

Photograph 14.4 Nucleated rural settlement. Source: D Preston

Table 15.1 Differences between dispersed and nucleated settlements.
Reasons for different shapes of settlements: round, linear, t-shaped and cross-road
In rural areas, nucleated settlements have different shapes. Table 15.2 outlines the different types of shapes and the reasons for their shape.

<table>
<thead>
<tr>
<th>Shape</th>
<th>Picture</th>
<th>Reason</th>
</tr>
</thead>
</table>
| Round (circular) or ring shaped | ![Round Shaped Settlement](image) | • These settlements are circular, often with a central feature such as a church or a green.  
• Roads radiate out from the centre.  
• In KwaZulu-Natal traditional settlements are often established around a central kraal. |
| Linear                 | ![Linear Shaped Settlement](image) | • These settlements may follow a road, railway line or a river and are long and narrow in pattern.  
• The Vaal-Harts irrigation scheme shows this type of pattern. A canal transports water to the scheme; farmsteads and storage dams are arranged along the straight roads. |
| Cross-road             | ![Cross-road Shaped Settlement](image) | • These settlements are found where two or more roads intersect.  
• Crossroad and star-shaped settlements occur at junctions of many roads.  
• They develop as a result of trade. |
| T-shaped               | ![T-shaped Shaped Settlement](image) | • These settlements are found where a farm or secondary road joins a main road. Usually a stopping point.  
• Sometimes a Y-junction is formed depending on how the roads intersect. |

Table 15.2 Shapes of rural settlements

Land use in rural settlements
Land use varies from place to place and is dependent on a number of factors.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governance</td>
<td></td>
</tr>
</tbody>
</table>
• The National Government, Provincial Government or Municipalities in the various rural areas may decide on how the land is used.  
• These governing bodies may put development plans in place that would dictate:  
  i) what type of crops or animals may be farmed.  
  ii) how much land may be used.  
  iii) how the crops or animals farmed may be distributed throughout the rural area.  
  iv) what type of development may take place in the area.  
• Some of the plans set in place by these governing bodies in rural areas include an Integrated Development Plan (IDP) and a Local Development Plan (LDP). |
| Economic  |  
• The potential of the land to sustain the local rural communities is a consideration, and whether the land can yield an income.  
• The distance that people and goods have to travel to the market in order to sell the goods.  
• If the land is used for commercial farming then large companies and farmers would want to produce large quantities of crops for a maximum financial return. |
| Environmental |  
• The climate, soil type and topography determine the types of crops or animals that can be farmed.  
• The presence or availability of natural resources, such as water or minerals may also determine where farming, mining or other commercial activities may take place.  
• If there is a need for water, then dams and reservoirs are often built to store water. |
Farming is the major land use in rural areas. The differences between subsistence farming and commercial farming are outlined in Figure 15.1.

**Farming land-use type**

<table>
<thead>
<tr>
<th>Subsistence farming</th>
<th>Commercial farming</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Takes place on a small-scale.</td>
<td>• Farming may be done on a small scale (intensive) or on a large scale (extensive).</td>
</tr>
<tr>
<td>• Farming done to provide food for their own family or the local community.</td>
<td>• To ensure a profit is made, farms are run as a business.</td>
</tr>
<tr>
<td>• Farmers usually cannot improve their output due to lack of capital, technology and land productivity or availability.</td>
<td>• The farmers use capital to maximise the yield per hectare.</td>
</tr>
<tr>
<td>• Farmers usually grow different crops to meet their needs.</td>
<td>• Modern machinery and technology is used.</td>
</tr>
<tr>
<td>• The land is used over and over again.</td>
<td>• The farmer may focus on a single crop (monoculture).</td>
</tr>
<tr>
<td>• Soil often ends up infertile and eventually unproductive.</td>
<td>• Farmers allow their fields to lie fallow every three to four years. They may plant legumes (beans) to allow the soil to replenish itself and remain productive.</td>
</tr>
</tbody>
</table>

![Photograph 14.5 Subsistence farming](source: D Preston)

![Photograph 14.6 Commercial farming](source: D Preston)

Figure 15.1 Differences between subsistence and commercial farming

Intensive commercial farming is done on a small-scale, while extensive commercial farming is done on a large scale (Table 15.4).

<table>
<thead>
<tr>
<th>Intensive commercial farming</th>
<th>Extensive commercial farming</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Small areas of land are farmed to their maximum potential.</td>
<td>• Large-scale farming done on large tracts of land.</td>
</tr>
<tr>
<td>• The yield per hectare is usually high.</td>
<td>• The amounts of capital and labour are small in relation to land area.</td>
</tr>
<tr>
<td>• The amount of capital or labour invested per hectare is high.</td>
<td>• The land is usually less fertile, so large areas are needed to sustain farming activities.</td>
</tr>
</tbody>
</table>

![Photograph 14.7 Intensive poultry farming](source: D Preston)

![Photograph 14.8 Extensive commercial farming](source: D Preston)

Table 15.4 Difference between intensive and extensive commercial farming
Unit 16  Rural settlement issues

CHECKLIST:
• rural-urban migration
• causes and consequences of rural depopulation
• strategies to address the effects of rural depopulation
• social justice issues in rural areas, such as access to resources and land reform

Rural-urban migration
When people move from rural areas (villages) in the country-side into urban areas such as towns and cities, we call this rural-urban migration. Rural-urban migration leads to rural depopulation (the number of people in rural areas is decreasing).

Causes and consequences of rural depopulation on people and the economy

Causes of rural depopulation
Push and pull factors are involved in the process of rural-urban migration as outlined in Figure 16.1.

<table>
<thead>
<tr>
<th>Push factors (force people away from rural areas)</th>
<th>Pull factors (attract people to the urban areas)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Mechanisation, specialisation, better farming methods leads to loss of jobs.</td>
<td>• Employment opportunities.</td>
</tr>
<tr>
<td>• Natural disasters like drought and floods.</td>
<td>• Better services such as health and medical services.</td>
</tr>
<tr>
<td>• Small pieces of farmland that are not economical to farm.</td>
<td>• Better facilities such as education and training.</td>
</tr>
<tr>
<td>• Overpopulation and over-utilisation of land (leads to soil erosion).</td>
<td>• Better social, cultural and recreational opportunities (bright lights syndrome).</td>
</tr>
<tr>
<td>• Poverty.</td>
<td>• Lower risk of being affected by natural disasters.</td>
</tr>
<tr>
<td>• Unreliable rainfall.</td>
<td>• Better quality of life.</td>
</tr>
<tr>
<td>• Degradation of the environment due to over-cropping and drought.</td>
<td>• Transport services available.</td>
</tr>
<tr>
<td>• Lack of services, for example: water, electricity and entertainment.</td>
<td></td>
</tr>
<tr>
<td>• Poor housing conditions in rural areas.</td>
<td></td>
</tr>
</tbody>
</table>

Figure 16.1 Push and pull factors

Effects of rural depopulation
Rural decline occurs as a result of people leaving rural areas and moving to peri-urban or urban areas (towns and cities). The rural areas become neglected and this creates a cycle of rural decline.

Less people employed in agriculture (people move to urban areas).

Less investment in rural towns (services are affected and may close down).

Less demand for services in rural towns as there are fewer people.

Older people left behind (less productive). Usually take care of the young.

Figure 16.2 The cycle of rural decline

Many people left in the rural areas are also faced with other serious problems, which include:
• unemployment
• poverty, and
• disease such as TB and HIV/AIDS.
Poverty

Poverty is more than just having insufficient income to meet basic needs. It can be defined as the inability of individuals, households or entire communities to have enough to achieve an acceptable standard of living. As a result people are locked into a cycle of poverty.

![The poverty cycle](image)

Figure 16.3 The poverty cycle

Strategies to deal with rural depopulation

Various approaches and philosophies are used to address the movement of people from rural areas to the towns and cities.

Non-Governmental Organisations (NGOs)

- These organisations are voluntary, non-political, non-commercial and self-governing. They involve themselves in community-based upliftment programmes, especially in rural areas.
- These organisations also address environmental issues to ensure sustainability.
- The status and importance of NGOs has grown over the years.

Basic needs approach

- This strategy focuses on improving the quality of life for rural dwellers and regards human development as a prerequisite to economic development. The basic needs include access to:
  - water
  - sanitation
  - shelter
  - employment
  - growing food successfully (good soils).
- The provision of basic services to communities has changed focus, the government is focusing more on the provision of sustainable development.

Agenda 21 – ‘Think globally, act locally’

- The United Nations (UN) approach to the concept of sustainable development is through Agenda 21.
- A comprehensive plan of action to be taken by organisations of the UN, governments and major groups in every area in which humans’ impact on the environment. Agenda 21 (an agenda for the 21st century) was decided upon at the United Nations Conference on Environment and Development (Earth Summit), held in Rio de Janeiro in June 1992. Here 178 governments voted to adopt Agenda 21.
- Sustainable development focuses on improving the quality of life for people while ensuring that no environmental damage and enough resources are left for future generations.
- The success of Agenda 21 has been highly variable. Despite being a comprehensive plan to deliver sustainable development, implementation has not always been systematic.
Comprehensive Rural Development Programme (CRDP)

In August 2009 the Government approved the Comprehensive Rural Development Programme (CRDP) to enable people to deal with rural poverty through efficient use of natural resources.

1. Promoting food security through food gardens and school nutrition programmes
2. Creating business opportunities
3. Providing basic essential services such as clean running water, sanitation and electricity
4. Opportunities for women, youth and the elderly
5. Ensuring secure communal land ownership

Figure 16.5 Main goals of the Comprehensive Rural Development Programme (CRDP)


Can I design a sustainable rural strategy?

- What is my focus?
- What actions would I take?
- How would I implement the strategy?
- What are the benefits of such a strategy?
Other approaches to creating more sustainable rural economies

Attract high-tech, **footloose industries** which would bring highly skilled people to live in the countryside. The Internet Café in Prince Albert offers a global service.

Government support for **agricultural activities** such as beekeeping or basket weaving.

Attract people who would like to invest in **weekend holiday homes** close to large cities, for example: Clarens.

Hosting **special events** such as music festivals or sporting activities, for example: Prince Albert Olive Festival and the Mahem Festival in Memel.

Table 16.1 How rural towns are reviving their economies

**MY OWN NOTES**
Social justice issues in rural areas; such as access to resources and land reform.

Social injustice is when people in the world or within a country are treated in inhumane/unfair ways and do not have the resources (food, clothing, shelter) and opportunities (political freedom, work opportunities) that they should.

Access to resources

Resources can be defined as sources of wealth, such as timber, fresh water or a mineral deposit that occurs in a natural state and that has economic value. Resources may be renewable or non-renewable resources. A renewable resource is a resource that grows in quantity or renews itself over a short period of time and the rate of extraction does not exceed the pace at which the resource is renewed. Examples of renewable resources are fisheries and forests.

Non-renewable resources are defined as all resources that do not grow or otherwise renew themselves over time. They are finite resources, so every unit consumed today reduces the amount available for future consumption.

Examples of non-renewable resources are fossil fuels and mineral deposits. Access to, control and management of natural resources, especially land, is key to rural livelihoods, income, power and status. Increasing the security of tenure (ownership) for the most vulnerable groups can decrease poverty, vulnerability, food insecurity and conflicts. Sustainable agriculture and rural development depends upon policies and legislation that ensure clear, secure and enforceable rights to land and natural resources for all rural producers.

Figure 16.16 A timeline of the land issue
Land reform
Land reform refers to transfer of land ownership. The injustices of South Africa’s apartheid past, where people were forcibly removed from their land, are addressed in the land reform program.

The African National Congress (ANC), South Africa’s current ruling party, has an approach that involves three aspects to land reform.

**Land redistribution**
- This involves the provision of land to the black majority who cannot afford to buy land.
- The government buys the land and makes it available for the ‘previously disadvantaged’ people.
- The philosophy of ‘willing seller/willing buyer’ applies.
- The ‘use it or lose it’ principle applies, in that the land must continue to be economically productive.

**Land restitution**
- This is the return of ancestral land to its original owners. Land restitution involves compensating those who lost land during the apartheid era.
- ‘People who were disposed of their rights to land may claim RESTITUTION against the state. Where claims are legitimate, the claimant is given either state owned land OR monetary compensation.’

**Land tenure reform**
- This is to secure the rights of those living on land that is owned by others. In this way labour tenants are protected from eviction and are given the rights to acquire ownership of the land they are living on.

**Figure 16.7** The different types of land reform in South Africa.

**Challenges for Land Reform in South Africa**

- **Huge costs:** claims and restitution are set to cost upwards of R50-billion by the time the process is completed.
- **Claim disputes**: it is a long process to mediate and resolve claim disputes (for example unresolved disputes between the Makgoba Traditional Council and the Trust in the Limpopo Province, South Africa).
- **Beneficiary** selection: it is a lengthy process and time consuming process to select the rightful beneficiaries for land redistribution.
- **Resettlement support:** it requires enough resources and time to effectively facilitate post-resettlement support to new land owners. The Government has not provided support packages for these ‘new’ farmers.

**Figure 16.8** Challenges for land reform

**KEY CONCEPTS**
- **agrarian** – to do with agriculture
- **beneficiary** – the person or group that gain from a process
- **disputes** – arguments over land claims
- **willing seller-willing buyer** – both the seller and the buyer of the land agree to the sale terms.
Unit 17 Urban Settlements

CHECKLIST:
- origin and development of urban settlements
- how site and situation affect the location of urban settlements
- classification of urban settlements according to function

The origin and development of urban settlements – urbanisation of the world’s population
Cities exist for many reasons, and the diversity of urban forms can be traced to the complex functions that cities perform. These reasons are:
- cities serve as centres of storage, trade, and manufacture.
- the agricultural surplus from the surrounding countryside is processed and distributed in cities.
- cities also grew up around marketplaces, where goods from other places could be exchanged for local products.
- cities were founded at the intersections of transportation routes, or at points where goods must shift from one mode of transportation to another, as at river and ocean ports (break-of bulk).

The following concepts are important to understand:

**Urbanisation** – An increase in the proportion or percentage of the population living in towns, due mainly to rural-urban migration. There are higher levels of urbanisation in first world countries than in third world countries due to greater wealth, higher education levels and more advanced mechanisation.

**Urban growth** – The rate at which the number of people in an urban population grows.

**Rate of urbanisation** – The rate at which people from rural areas are migrating into urban areas. The rate of urbanisation is much higher in LEDCs such as Lesotho and Mozambique than it is in MEDCs such as the UK and the USA.

**Urban sprawl/Urban expansion** – The unplanned and/or uncontrolled spread of the built up urban environment into rural areas or the countryside next to the city.

Figure 17.1 Development of urban settlements

How site and situation affect the location of urban settlements
Location is used to describe where a place is found. The location may be influenced by the site of the place – which is the exact point upon the land where the settlement was established or its situation which describes where a settlement is located in relation to its surrounding human and physical features. Refer to page 91.

Classification of urban settlements according to function, such as central places, trade and transport, break of bulk points, specialised cities, junction towns and gateway towns or gap towns
Urban settlements are classified according to their function. Function refers to the purpose for which the settlement was initially established.
Unit 18 Urban hierarchies

CHECKLIST:
- concepts of urban hierarchy, central place, threshold population sphere of influence and range of goods; lower and higher order centres
- lower and higher order functions and services

Concepts of urban hierarchy, central place, threshold population, sphere of influence and range of goods

Urban hierarchy
Urban settlements have a range of functions in terms of supplying goods and services. Goods are items that are bought and a service is something that assists people in their day to day activities, such as the post office, bank or petrol station. The larger the population of the settlement, the more functions and services are offered. The more functions a settlement has, the higher it is placed on the urban hierarchy.

Settlements are ranked according to a hierarchy with the smallest settlements located at the base of the triangle and the largest settlements locates at the apex.
Lower and higher order centres

Figure 18.2 Graph showing the hierarchy of urban settlements

Central place
A central place serves the people in the surrounding area. A central place may vary in size, with smaller central places being located at the base of the urban hierarchy triangle and larger central places being located higher up the urban hierarchy triangle (Figure 18.1).

Central place theory
- Developed by a German named Walter Christaller in 1933.
- According to Christaller the surrounding area would take on the shape of a hexagon as opposed to a circle, because a circular shape does not allow all the surrounding area to be served by the central place.
- Christaller came to the conclusion that hexagonal shaped central places were more effective in servicing the surrounding areas than circular shaped central places.

Figure 18.3 Series of diagrams showing the development of the hexagonal central place areas
The range, sphere of influence and threshold population

The important concepts associated with central place theory are explained in Figure 18.3.

### Sphere of influence
- The area served by a central place.
- The size of the area varies depending on the size of the settlement.
- A low-order centre will have a small sphere of influence, while a high-order centre will have a large sphere of influence.

### Range
- The maximum distance that people are prepared to travel in order to obtain goods or a service.
- People will not travel far in order to obtain low-order convenience goods such as bread and milk.
- People will travel further in order to obtain high-order comparison goods such as a car or furniture.

### Threshold population
- The minimum number of people required for a service to be sustained.
- Low-order convenience goods or services have a lower threshold population.
- High-order comparison goods or services have a higher threshold population.

Figure 18.4 Important concepts associated with central place theory

The range, sphere of influence and threshold population of a service or settlement is shown in Figure 18.4 below.

![Figure 18.4 The range, sphere of influence and threshold population of a service or settlement](image)

### Lower and higher order functions and services

Urban functions and services can be classified as low order and high order (Table 18.1)

<table>
<thead>
<tr>
<th>Low order functions and services</th>
<th>High order functions and services</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Less specialised functions or services that are found in settlements of all sizes. For example: corner café, clinic, bank agency and police station.</td>
<td>• More highly specialised functions or services that usually only occur in larger settlements. For example: University, hospital, magistrate's court and bank branch.</td>
</tr>
<tr>
<td>• There is a smaller threshold population.</td>
<td>• There is a large threshold population.</td>
</tr>
<tr>
<td>• There is a smaller range and sphere of influence.</td>
<td>• There is a large range and sphere of influence.</td>
</tr>
<tr>
<td>• People are not prepared to travel far in order to obtain low order functions or services.</td>
<td>• People are prepared to travel further in order to obtain high order functions or services.</td>
</tr>
<tr>
<td>• Goods and services are used frequently and the cost is fairly low. For example: bread, milk, petrol station, bottle store.</td>
<td>• Goods and services are expensive and bought less frequently. For example: lounge suites, cars, computer hardware.</td>
</tr>
</tbody>
</table>

Table 18.1 The differences between low order and high order functions, goods and services.
Unit 19 Urban structure and patterns

CHECKLIST:
• internal structure and patterns of urban settlements: land-use zones, urban profile and factors influencing the morphological structure of a city
• models of urban structure: multiple nuclei model, modern American-western city, the third worlds city and the South African city
• changing urban patterns and land use in South Africa

Internal structure and patterns of urban settlements: land use zones; concepts of urban profile; factors influencing the morphological structure of a city

Land-use zones (also known as precincts)
Urban settlements have different land-use zones, but not all cities have the same arrangement of zones. The factors that also need to be considered when determining the location of each land-use zone include:
• function of the land-use zones (industrial, residential, retail, commercial or green space)
• physical nature of the land (flat land or steep land)
• accessibility
• town planning to ensure that certain zones are not located next to each other, such as heavy industry or a landfill site next to high income residential areas.

![Diagram of urban structure]

Figure 19.1 Typical urban arrangements of land-use zones

<table>
<thead>
<tr>
<th>Zone</th>
<th>Where located</th>
<th>Characteristics</th>
<th>Photograph</th>
</tr>
</thead>
</table>
| Central Business District (CBD)| In the centre of the urban area. | • Most accessible part of the city and transport routes converge.  
• There is a concentration of shops and offices.  
• Tallest buildings and greatest concentration of buildings.  
• Highest land values.  
• High-order commercial functions (such as: banks, hospital and municipal administration). | ![Image](image_url) |
<table>
<thead>
<tr>
<th>Zone</th>
<th>Where located</th>
<th>Characteristics</th>
<th>Photograph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transition Zone or Zone of Decay</td>
<td>On the outskirts of the CBD.</td>
<td>• A mixture of poorer quality housing and old industrial buildings (in poor condition) with newer residential and light industrial developments.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If this zone is redeveloped (gentrification or renewal) then it may become desirable to work or live here.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Invasion and succession occurs in this zone.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td>High Income Residential</td>
<td>Furthest from the CBD.</td>
<td>• Most of the area of a city is taken up by residential housing.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Convenience stores as well as shopping centres may be established here.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Municipal services and facilities are available.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Size of houses and pieces of land will vary depending on income.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td>Middle Income Residential</td>
<td>In between high and low income areas.</td>
<td></td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td>Low Income Residential</td>
<td>Closest to the CBD.</td>
<td></td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td>Informal Housing</td>
<td>On the fringe of the CBD or in the rural urban fringe.</td>
<td>• Established due to rural depopulation.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Established on any undeveloped land within the urban boundary close to industrial areas, water or work.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Very poor quality housing with few or no services and facilities.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• There is severe overcrowding and extreme poverty.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td>Light Industry</td>
<td>Away from the CBD in the transition zone along transport routes.</td>
<td>• Found along main transport routes</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No heavy machinery used and little generation of pollution (air, water, noise).</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• May be found close to residential areas or in residential areas.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Includes industries such as clothing, food and furniture.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td>Heavy Industry</td>
<td>Away from residential areas or on the outskirts of urban areas.</td>
<td>• Near major transport routes.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Associated with lots of pollution (air, water, noise).</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Heavy machinery is used such as container trucks, tip trucks and front-end loaders.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Includes industries such as steel works and chemical factories.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td>Rural-urban Fringe</td>
<td>On the outskirts of the city.</td>
<td>• More open space and larger property sizes.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• In recent years shopping centres have developed in these areas.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Developed due to improved transport facilities and technological advances.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Land values may be quite high because of the demand for future development of land.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mixed land-use area.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td>Green belts</td>
<td>Within or surrounding the CBD or transition zone.</td>
<td>• Areas of parks and recreation.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Also known as the “lungs” of the city – the vegetation absorbs CO₂ and releases O₂.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• They are the “green” areas of the city.</td>
<td><img src="image" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Urban sprawl may threaten greenbelt areas.</td>
<td><img src="image" alt="Image" /></td>
</tr>
</tbody>
</table>

Table 19.1 Land use zones of a city

Traditionally most main retail (shopping) centres were concentrated in the CBD. However, in recent years there has been a trend for retail centres and malls to move outwards into the suburbs or into the rural-urban fringe (decentralisation).
The urban profile

An urban profile shows the shape of the urban area viewed from the side and shows the height of the buildings. The tallest buildings are usually found in the CBD and then decrease in height towards the outskirts of the city.

![Figure 19.2 Typical Urban profile](image)

An urban profile may also indicate population density, land value as well as the height of the buildings.

![Figure 19.3 Simplified urban profile showing population and land values](image)

Factors influencing the morphological structure of a city

Urban morphology means the shape or form of urban areas. The factors that influence the shape of urban settlements are:

- physical features, such as rivers, mountain ranges and coastlines
- transport routes along which urban sprawl occurs
- the location of resources, such as mineral resources and arable soil.

External morphology: shape of an urban area

![Figure 19.4 Shape and form of settlements](image)
Internal morphology: street patterns

The history of an urban place is reflected in its street patterns.

<table>
<thead>
<tr>
<th>Pattern name</th>
<th>Characteristics</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Grid or rectangular               | • A very old street pattern used by early settlers. The roads intersect at right angles.  
• Example: Cape Town             | • Easy to find places.                                                          | • Many intersections which halt the flow of traffic (gridlock).               |
|                                   |                                                                                 | • Easy to establish on flat land.                               | • Accidents and traffic congestion may occur.                                 |
| Radial concentric or cobweb       | • Occurs in planned urban areas.                                               | • Easy to find places.                                                          | • All roads converge at a central point – leads to traffic congestion.         |
|                                   | • Roads radiate outwards from a central point.                                  | • Easy to establish on flat land.                                  |                                                                                |
|                                   | • Pattern looks like a spider's web.                                            | • Ring roads allow for traffic to bypass the city centre.          |                                                                                |
| Irregular/Modern planned          | • May be planned or unplanned.                                                 | • If the pattern is planned this pattern can alleviate traffic congestion can be alleviated | • It is difficult to locate places.                                            |
|                                   | • There is no clear structure.                                                  |                                                                             |                                                                                |
|                                   | • It is often established on hilly terrain.                                     |                                                                             |                                                                                |
|                                   | • Street lengths and blocks vary in size.                                       |                                                                             |                                                                                |
|                                   | • Example: Sasolburg and Kimberley                                              |                                                                             |                                                                                |
|                                   | • Common in newly formed suburbs                                                |                                                                             |                                                                                |
|                                   | • Circular drives, cul-de-sacs feature                                           |                                                                             |                                                                                |

Table 19.4 Different street patterns

Models of urban structure: the multiple-nuclei model, the modern American-western city, the third world city and the South African city

Land use models are theories which attempt to explain the layout of urban areas. A model is used to simplify complex, real world situations and make them easier to explain and understand. Geographers have proposed many models of land use in urban centres over the decades.

For visual learners: Create a colourful poster summarising the different types of street patterns. Display it in a prominent place to help you revise.
1. Concentric Zone Model
(Based on Chicago in the 1920s)
- Proposed by Ernest Burgess in the 1920s.
- City zones are divided into concentric zones around the CBD.
- Transport routes radiate outwards from the CBD.
- Oldest areas located near the centre, newer areas on the outskirts.
- Poor live close to CBD - close to work.
- Wealthy people, who have greater mobility and access to transport, live further away from the CBD.

2. Sector Model
- Proposed by Homer Hoyt in 1939.
- Zones or 'sectors' are found around or moving outwards from the CBD (wedges).
- Poor live near industrial zones - close to work.
- Industrial areas usually found along railway lines.
- Wealthy live along main roads and are buffered by middle income zones.
- This model doesn't allow for the possibility of decentralising new shopping (retail) centres and residential estates.

3. Multiple Nuclei Model
(Based on typical American Cities)
- Proposed by Chauncy Harris and Edward Ullman in the 1940s.
- There may be more than one main area (nucleus) of activity.
- The CBD is no longer the central focal point.
- Outlying business districts and suburbs now exist.
- Expansion around nodes or growth points is possible.

4. Apartheid City Model
(Based on South African cities)
- Proposed by Prof. Davis (S.A.) in the 1950s due to Group Areas Act enforced during apartheid.
- Residential zones established on race.
- Black and white zones separated by a buffer zone (highway, railway line or river).
- Poorer people of colour lived close to the CBD, transition zone and industrial areas, as well as in segregated zones.
- The disadvantages:
  - Black areas lacked services and facilities.
  - White areas were less crowded and had better infrastructure, services and facilities.
  - Racial divisions are difficult to overcome.

Table 19.5 Models of urban structure

Note:
Buffer – separating zone.
Comparing land use models: modern American-Western city with a typical third world city

<table>
<thead>
<tr>
<th>Modern American-western city (MEDCs)</th>
<th>Third world city (LEDCs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Private land ownership.</td>
<td>• The CBD is found in the centre of the urban area.</td>
</tr>
<tr>
<td>• Clearly defined land-use zones.</td>
<td>• The high quality housing tends to be located near the CBD and will be either apartments or old Colonial houses.</td>
</tr>
<tr>
<td>• CBD well established and developed.</td>
<td>• The richer people want to live near the centre close to work.</td>
</tr>
<tr>
<td>• High levels of technology and development.</td>
<td>• Poor but permanent housing further from the CBD.</td>
</tr>
<tr>
<td>• Advanced transport infrastructure and social facilities.</td>
<td>• On the edge, informal settlements are built on marginal land. The informal housing has been built by migrants moving from rural areas to urban areas. These informal settlements are also referred to as squatter settlements or shanty towns.</td>
</tr>
<tr>
<td>• Employment opportunities are mostly in the formal sector.</td>
<td>• Industry tends to be focused on the main transport routes (roads and railways).</td>
</tr>
<tr>
<td>• The CBD has the highest population density and this density decreases steadily outwards.</td>
<td>• There will also be poorer housing and informal settlements along these main transport routes.</td>
</tr>
<tr>
<td>• Low income groups are found near the CBD.</td>
<td>• Examples: New Dehi, Lagos and Mexico City.</td>
</tr>
<tr>
<td>• Upper income groups are found outside the inner core on the periphery.</td>
<td>• Examples: New York, Boston, London and Paris.</td>
</tr>
<tr>
<td>• Examples: New York, Boston, London and Paris.</td>
<td>In general, the QUALITY OF HOUSING increases with distance from the CBD.</td>
</tr>
</tbody>
</table>

In general, the QUALITY OF HOUSING decreases with distance from the CBD.

Table 19.6 Comparison between a modern America/Western city and a typical Third World City.

There are also different problems associated with the CBD and inner city of MEDCs and LEDCs (Table 19.7)

<table>
<thead>
<tr>
<th>Problems in the CBD and inner city of MEDCs</th>
<th>Problems in the CBD and inner city of LEDCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Traffic congestion</td>
<td>• Informal housing (illegal and unplanned)</td>
</tr>
<tr>
<td>• Lack of space</td>
<td>• Health issues and diseases</td>
</tr>
<tr>
<td>• High land values</td>
<td>• Lack of schools and education</td>
</tr>
<tr>
<td>• Pollution (water, air, land and noise)</td>
<td>• Social issues – crime, vandalism, unemployment, and poverty.</td>
</tr>
<tr>
<td>• Urban decline</td>
<td>• Overcrowding</td>
</tr>
<tr>
<td>• Unemployment</td>
<td>• Informal trading on street pavements</td>
</tr>
<tr>
<td>• Ghetto</td>
<td></td>
</tr>
</tbody>
</table>

Table 19.7 The problems in western and third world cities

Changing urban patterns and land use in South African cities

South African cities have slowly changed since the end of apartheid in 1994 and racial segregation. In South African cities today separation occurs more based in income rather than race. The different types of changes in land use in South African cities are:

**Urban renewal**

This is the process whereby an urban area is improved and rehabilitated. The renewal process can involve demolishing old or run-down buildings and constructing new, up-to-date housing, or building a new stadium.

Photograph 19.1 Derelict building in Point Road area of Durban. Source: D Preston
Inner city renewal is an attempt to regenerate these areas which have large numbers of derelict buildings and pieces of unused land. The ways in which urban renewal takes place are:

- **Gentrification:** The upgrading and modernizing of houses or areas within the city zone. The area becomes trendy and popular to live in and land values increase dramatically. This is also known as Chelseafication, based on the revival of the Chelsea district in London, UK.

- **Façadism:** This involves keeping the façade (front) of an old building and demolishing the rest of the old building. A new building is then constructed behind the old façade and the old façade is incorporated into the new building.

- **Rezoning:** Changing the land use of an area from one thing to another. For example: changing an old inner city industrial zone to a residential zone.

- **Mixed land-use:** This involves the combination of various land uses within one zone or area, such as residential, commercial, light industrial, office, educational and so on.

- **New development projects:** These occur on unused land or where derelict buildings have been removed in the inner city vicinity. Developments are built from scratch.

**Invasion and succession**

This process occurs when a new and successful land-use activity takes over the original function of a land-use zone. This process may take place between an industrial area and the adjacent low-income area or between the CBD and transition zone. There is a greater need to expand the industrial area and so the new, dominant activity invades the less dominant zone and eventually takes over.

![Figure 19.4 Invasion and succession](image)

**Informal trading**

This is illegal trading outside of government control. The role these traders play in society is important so municipal bylaws on trading laws have been somewhat relaxed. Informal trading is practiced by most of the world’s population, and it includes the barter of goods and services, mutual self-help, odd jobs, street trading, and other such direct sale activities. Income generated by the informal economy is usually not recorded for taxation purposes, and is often unavailable for inclusion in gross domestic product (GDP) calculations.

![Photograph 19.2 Informal trading in Soweto](image)
Source: D Preston

![Photograph 19.3 Informal trading in Durban](image)
Source: D Preston
Unit 20  

Urban settlement issues

CHECKLIST:
- recent urbanisation patterns in South Africa [✓]
- urban issues related to rapid urbanisation
- growth of informal settlements and associated issues

Recent urbanisation patterns in South Africa
Urbanisation and the migration trends associated with it, are reshaping South Africa’s urban and rural environments, economy, lifestyles and livelihoods.

Counter urbanisation is a reverse trend to urbanisation where people move back to rural areas to escape the city rush, its lifestyle and the associated crime. The main reasons for counter urbanisation are:
- increased car ownership
- urban areas becoming unpleasant to live in (pollution, crime, congestion, dereliction, unemployment)
- property usually cheaper in rural areas
- new business parks outside the urban centre are easier to access and more pleasant to work in
- large shopping centres are locating on the outskirts of urban centres (more space, cheaper, easily accessible)
- the use of electronic media has increased the possibility of working from home in the countryside.

New ruralism is a conscious choice by people to live in a rural area, with space, privacy and nature on one’s doorstep. Technology provides a way of staying connected with the world, but at a safe distance. There is no longer a need or choice to stay in urban centres and have to deal with all the associated problems.

Sustainable settlements are developed with the needs of the present taken into account, without compromising the ability of future generations to meet their own needs.

<table>
<thead>
<tr>
<th>Urban trend</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postmodern cities</td>
<td>• These cities do not fit clearly into the traditional patterns and structure of urban settlements.</td>
</tr>
<tr>
<td></td>
<td>• No clearly defined city centre as there may be numerous centres.</td>
</tr>
<tr>
<td></td>
<td>• High income areas may be found alongside low income areas or informal housing (ghettos).</td>
</tr>
<tr>
<td></td>
<td>• Other land-use zones found in the city may include: waterfronts, office towers, gated communities or theme parks.</td>
</tr>
<tr>
<td>Densification: Concentrated</td>
<td>• Modern, more sustainable urban areas that have a high residential density with mixed land uses. The main characteristics of compact cities are a well-designed public transport system, the encouragement of walking and cycling, low energy consumption and lower pollution levels.</td>
</tr>
<tr>
<td>(compact) cities</td>
<td>• City space is used more efficiently and the idea that single story living is not practical.</td>
</tr>
<tr>
<td></td>
<td>• More sustainable than sprawling cities and are associated with the term ‘green urbanism’.</td>
</tr>
<tr>
<td></td>
<td>• South African example is Cape Town.</td>
</tr>
<tr>
<td></td>
<td>On the other hand, dispersed (sprawling) cities expand beyond the urban fringe. There is less efficient use of energy with services and infrastructure being spread over a far wider area, but there is more space and less pollution.</td>
</tr>
</tbody>
</table>

MY OWN NOTES
**New towns**
- The establishment of an entirely new self-sustaining community away from large cities on a completely new site.
- Consist of homes, schools, hospitals, industries, commercial activities, cultural activities, recreational facilities, and shopping centres for the community population.
- They are developed to:
  - alleviate growth problems such as urban sprawl
  - stimulate economic growth
  - decentralize urban populations
  - build attractive new urban places
  - re-house residents from informal settlements
- New towns have been used in LEDCs to try and control urban growth and the expansion of informal settlements. A South African example of a new town is Cosmo City outside Johannesburg (See Photograph 19.4). It marks the change the once open land has undergone, becoming a viable, liveable town for people from widely varying financial, cultural and social backgrounds.

**Edge cities**
- New urban areas built about 20-50 km outside the main CBD area of a major city.
- Have a high population density and a concentration of shopping, business, commercial, medical, educational and entertainment activities.
- Located in areas that were once suburbs or rural-urban fringe areas.
- Easy to access from major transport routes and the pleasant surroundings mean that edge cities avoid many inner-city problems.
- More wealthy inhabitants move out to the new ‘edge cities’.
- Gated communities / residential estates / leisure estates are common. These accommodate the middle to high income groups. Security is important and these places are walled and often have guards at an entrance gate.
- South African examples include Sandton outside Johannesburg and Umhlanga new town outside Durban.

**Eco-cities (also known as green or sustainable cities)**
- Designed with consideration of environmental impact in mind.
- People living in green cities are conscious of their energy output and concerned with lowering their carbon footprints and waste output.
- Ensure minimal human impact on air, soil and water – this is a conscious effort to reduce the human ecological footprint on the environment.
- Recycle, reduce and reuse are terms associated with green cities.
- Green cities have built-in green spaces and may sometimes be referred to as garden cities.
- Some of the strategies to make cities more sustainable include:
  - **Green roof**: This is the roof of a building that is partially or completely covered with vegetation (trees, plants or vegetables) planted over a waterproofing membrane. A green roof may also include additional layers such as a root barrier and drainage and irrigation systems. They may also be known as ‘living roofs’ and serve several purposes for a building, such as absorbing rainwater, providing insulation, creating a habitat for wildlife, and helping to lower urban air temperatures and combat the heat island effect.
  - **Rain water harvesting**: This is the process of collecting rainwater in JoJo tanks from roof gutters and street runoff in urban areas so as to reduce the amount of water usage in urban areas.
  - **Grey water**: This is water that has already been used for one thing and is then used for another thing. For example, bath water used to water the garden or wash a car. This help with reducing water use, as well as recycling and reusing water.

Table 20.1 Changes that have taken place in urban centres
Urban issues related to rapid urbanisation: lack of planning, housing shortage, overcrowding, traffic congestion and problems with service provision

Urban areas are faced with many problems which are outlined in Table 20.2.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Consequence</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprawl</td>
<td>• Urban areas grow rapidly and expand into the surrounding rural areas.</td>
<td>• Unplanned growth. &lt;br&gt;• Rural areas developed too quickly and are unable to cope with the new demands.</td>
<td>• Better planning and management.</td>
</tr>
<tr>
<td>Informal housing and poverty</td>
<td>• People move into urban areas from rural areas.</td>
<td>• Poor quality housing constructed from plastic, mud and cardboard. &lt;br&gt;• Overcrowding. &lt;br&gt;• Unhygienic living conditions.</td>
<td>• Government housing projects (low-cost housing).</td>
</tr>
<tr>
<td>Urban decay or blight</td>
<td>• Abandoned properties because rents too high (often transitional zone)</td>
<td>• People move out to more desirable areas. &lt;br&gt;• Buildings deteriorate. &lt;br&gt;• Attracts vagrants and detracts investors. &lt;br&gt;• Overcrowding and slum like conditions occur.</td>
<td>• Allow invasion and succession to take place. &lt;br&gt;• Renovate buildings (gentrification) or demolish and rebuild (renewal). &lt;br&gt;• Supply parking. &lt;br&gt;• Rezone.</td>
</tr>
</tbody>
</table>

**Traffic congestion and pollution**

<table>
<thead>
<tr>
<th>Traffic congestion and pollution</th>
<th>Cause</th>
<th>Consequence</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic congestion</td>
<td>• Peak hour traffic. &lt;br&gt;• Too many cars with one person in them. &lt;br&gt;• Not enough public transport. &lt;br&gt;• Roads cannot cope with increased volume of traffic.</td>
<td>• Routes into and out of CBD blocked. &lt;br&gt;• Traffic jams, accidents and road maintenance.</td>
<td>• Improve public transport. &lt;br&gt;• Park and ride schemes. &lt;br&gt;• Synchronise robots. &lt;br&gt;• Better parking facilities. &lt;br&gt;• One way streets, ring roads and alternative routes.</td>
</tr>
<tr>
<td>Pollution</td>
<td>• Air pollution is the main problems due to vehicles, trains, factories, fire and people. &lt;br&gt;• Litter in the streets.</td>
<td>• Leads to smog which leads to traffic accidents. &lt;br&gt;• Can cause health ailments (respiratory) and spread of disease. &lt;br&gt;• Contributes to the greenhouse effect. &lt;br&gt;• Unattractive and smelly.</td>
<td>• Use public transport and unleaded fuel. &lt;br&gt;• Filters on chimney stacks. &lt;br&gt;• Fines. &lt;br&gt;• Smokeless zones. &lt;br&gt;• Rubbish bins. &lt;br&gt;• Educational programmes.</td>
</tr>
</tbody>
</table>

**Service provision**

<table>
<thead>
<tr>
<th>Service provision</th>
<th>Cause</th>
<th>Consequence</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Waste</td>
<td>• General household, commercial and industrial waste.</td>
<td>• Municipal dumpsites fill up too quickly. &lt;br&gt;• Often smelly and unsightly.</td>
<td>• Better management and monitoring by municipal authorities.</td>
</tr>
<tr>
<td>Water supply</td>
<td>• Inadequate supply due to growing numbers in urban areas. &lt;br&gt;• Water wastage due to broken pipes. &lt;br&gt;• Low rainfall.</td>
<td>• Polluted water and communal taps servicing far too many people. &lt;br&gt;• Diseases spread easily. &lt;br&gt;• High demands mean treatment plants cannot cope.</td>
<td>• Build reservoirs and improve piping to low cost housing areas. &lt;br&gt;• Educate about conserving water. &lt;br&gt;• Stable government with clear long-term goals. &lt;br&gt;• Fix water infrastructure (pipes and drains).</td>
</tr>
</tbody>
</table>

**Overcrowding and unemployment**

<table>
<thead>
<tr>
<th>Overcrowding</th>
<th>Cause</th>
<th>Consequence</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many people migrate to the CBD in search of employment.</td>
<td>• Overcrowding in the CBD. &lt;br&gt;• Overcrowding in the informal settlements.</td>
<td>• Rural upliftment programs will mean fewer people will want to travel to the cities in search of a ‘better life’. &lt;br&gt;• Provide more housing.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unemployment</th>
<th>Cause</th>
<th>Consequence</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too many people migrate to the cities unskilled for urban jobs.</td>
<td>• Unable to find jobs so join the informal economy.</td>
<td>• Education and skills training programmes. &lt;br&gt;• Development of the craft industry to promote tourism.</td>
<td></td>
</tr>
</tbody>
</table>
The growth of informal settlements and associated issues

**What?**
- An informal settlement is a settlement (sometimes illegal or unauthorized) Where people who in make-shift dwellings made from scrap materials: often plywood, corrugated metal, and sheets of plastic.
- Informal settlements may also be known as squatter settlements, shanty towns or slums.

**Problems?**
- Informal settlements often do not have proper sanitation, electricity connections, refuse removal, or other basic services.
- The infrastructure is usually very poor with inadequate transport or communication links.
- These areas are often susceptible to fire due to the high concentration of homes.
- Population density within informal settlements is amongst the highest in the world.

**Where?**
- Informal settlements are usually built on the edge of cities or in open spaces within the inner city.
- As urbanisation has led to urban sprawl in LEDCs, some squatter settlements can be up to 30 km away from the CBD.

**Reasons?**
- As the number of migrants into the cities increases so too does the demand for housing.
- The housing sector, especially in LEDCs is unable to cater for this demand and hence the establishment of temporary sub-standard living conditions.
- Cities around the world are expanding rapidly and associated with this rapid growth is also the growth of informal settlements.

Over time, informal settlements tend to improve as many local authorities work in partnership with NGOs, local charities and residents. Three schemes for informal settlements improvement are outlined below.

**Site and service schemes**
People buy or rent a piece of land on which they build their own home. They are provided with connections to services such as water and electricity and have good transport links.

**Self-help schemes**
Residents are provided with building materials which they use to construct their own homes. People are given training and tools to do this. Low-interest loans may be provided to help people do this.

**Rural investment**
This involves improving the quality of life in rural areas by encouraging people to stay in the rural areas instead of migrating to urban areas. The provision of basic services, skills training programmes and small business opportunities are used to challenge the people to remain.

**For auditory learners:** Work with a partner and take turns reading out the information about informal settlements. Then explain each part of the mind map above to each other, using your own words.
Economic sectors

**Primary Activities:**
- Extraction and exploitation of raw materials
- Activities include farming, mining, forestry and fishing.

**Secondary Activities:**
- Processing and manufacturing of primary materials into products
- Examples are food processing, car manufacturing and oil refining.

**Tertiary Activities:**
- Providing goods and services to the consumer
- Also called the service industry
- Examples include transport, banking, health services and education
- Also includes trade and tourism.

**Quaternary Activities:**
- Use of high levels of expertise and technology
- Occur mostly in MEDCs
- Examples include research, education (universities), information and communication technologies, financial planning and some government activities.

Economic sectors' contribution to the South African economy: value and employment

**Value**

The value of the economic sector is expressed as the gross domestic product (GDP). The GDP refers to the total annual contribution made by all sectors to the economy of a country. Table 21.1 shows the percentage contribution of each economic sector to South Africa's GDP.

<table>
<thead>
<tr>
<th>Economic sector</th>
<th>Contribution to GDP (%)</th>
<th>Sub-sectors contribution to the GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>11.8</td>
<td>Agriculture 2.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mining 9.4</td>
</tr>
<tr>
<td>Secondary</td>
<td>21.0</td>
<td>Manufacturing 13.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Utilities (electricity, gas and water) 3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Construction 4.3</td>
</tr>
<tr>
<td>Tertiary</td>
<td>67.2</td>
<td>Trade, retail and wholesale 14.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transport and communications 8.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finance and real estate 21.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>General government services 16.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Personal services 6.9</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 21.1 Contribution of economic sectors to the economy
Note:
**GDP:** the value of goods and services produced in a country in one year. GDP is usually quoted as a percentage contribution of one sector of the economy.

**Quaternary:** these include services such as research and development (R & D), high-level decision-making and all aspects of information processing. Quaternary activities are common in more advanced economies of the world (MEDCs).

According to Table 21.1:
- the primary sector’s contribution is the least at 11.8%
- the secondary sector’s mining and minerals still play an important role in the South African economy (9.4%)
- the tertiary sector contributes over two thirds to the value of the GDP (67.1%).

Figure 21.2 shows:
- GDP growth rate for each quarter.
- South Africa went through a recession in 2009.
- How the country’s GDP has fluctuated from 2007 to 2013.

Figure 21.2 South Africa’s GDP growth rate

MY OWN NOTES
1. What is meant by the term GDP growth rate?

2. Verify the statement ‘South Africa went through a recession in 2009’ by using evidence from Figure 21.2.

3. State two factors that will influence GDP growth rate.

**Answers:**

- Increase in the employment rate
- A positive balance in the trade balance

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**Employment**

The percentage of employment in each economic sector is also important to look at. The pie chart in Figure 21.2 shows the percentages in each sector as well as sub sectors.

The primary sector employs the lowest percentage of the labour force with the tertiary sector employing the largest percentage of the labour force.

The unemployment rate in South Africa (2016) is 27%
CONTRIBUTION OF AGRICULTURE TO THE SOUTH AFRICAN ECONOMY

Agriculture only contributes 2.4% to the GDP.
Agriprocessing contributes about 15% to the GDP.
The farming sector employs 4.7% of the labour force.
South Africa is food sufficient and exported agricultural products earned over R90 billion in 2011.
South Africa is one of the top producers of GM (genetically modified) crops in Africa.

ROLE OF SMALL-SCALE AND LARGE-SCALE FARMERS

Small-scale farmers generate employment and income opportunities in rural areas. Small-scale farming plays an important part in the South African economy and has grown as a result of the government's policy of land reform and the development of the emerging farmer. There are more small-scale farmers than commercial farmers in South Africa.

<table>
<thead>
<tr>
<th>Description</th>
<th>Small-scale farmer</th>
<th>Large-scale farmer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inputs</strong></td>
<td>limited fertiliser</td>
<td>fertilisers</td>
</tr>
<tr>
<td></td>
<td>manual labour</td>
<td>machinery</td>
</tr>
<tr>
<td></td>
<td>limited used of mechanisation</td>
<td>large amounts of capital</td>
</tr>
<tr>
<td></td>
<td>some capital</td>
<td>paid labour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GM seeds</td>
</tr>
<tr>
<td><strong>Farm size</strong></td>
<td>larger than subsistence farmer</td>
<td>huge in size and operation</td>
</tr>
<tr>
<td></td>
<td>farm is more viable than for subsistence farmer</td>
<td>monoculture</td>
</tr>
<tr>
<td></td>
<td>variety of produce</td>
<td>extensive farming</td>
</tr>
<tr>
<td></td>
<td>intensively farmed</td>
<td>irrigation schemes</td>
</tr>
<tr>
<td></td>
<td>irrigation in the form of weirs, pumps, dams and pipes</td>
<td>highly mechanised</td>
</tr>
<tr>
<td><strong>Types of crops</strong></td>
<td>vegetables</td>
<td>maize</td>
</tr>
<tr>
<td></td>
<td>flowers</td>
<td>wheat</td>
</tr>
<tr>
<td></td>
<td>chickens</td>
<td>sugar cane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>beef</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sheep</td>
</tr>
<tr>
<td><strong>Markets</strong></td>
<td>local consumer market</td>
<td>local consumer market as well as for export</td>
</tr>
<tr>
<td><strong>Processing plants</strong></td>
<td>sugar mills</td>
<td>sugar mills</td>
</tr>
<tr>
<td></td>
<td>timber mills</td>
<td>wood chipping plants</td>
</tr>
<tr>
<td></td>
<td>charcoal factories</td>
<td>timber mills</td>
</tr>
<tr>
<td></td>
<td>wood chipping</td>
<td>canning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>juicing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>packaging such as yoghurt</td>
</tr>
</tbody>
</table>

Table 22.1 Comparison of small and large-scale farming

Note:
Agriprocessing – This involves the processing of raw agricultural products
Genetically modified (GM) seeds – hybridised seeds developed to withstand disease or climatic conditions.

SECTION 5 ECONOMIC GEOGRAPHY OF SOUTH AFRICA
Main products produced: home market and export market

Location of field and pastoral farming in South Africa is shown on the map in Figure 22.1.

Some facts about farming in South Africa include:
- Only 12% of South Africa is arable
- 69% is suitable for pastoral farming
- Rainfall in the eastern and south western parts is above 500mm and this is where most of the crop farming takes place
- Animal products include: meat, poultry, ostrich and wool
- Crops include sugar, fruit, maize, wheat and grapes (wine production)

MY OWN NOTES

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Note:
Arable – land that has fertile soils that are good to farm on.
Foreign exchange – money earned when goods are sold to other countries in the export market.

Some products can be exported to other countries which brings in foreign exchange. Other products may need to be imported, which means that South Africa has to pay in rands for them.

<table>
<thead>
<tr>
<th>Exports (out)</th>
<th>Imports (In)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary exported products:</strong></td>
<td><strong>Primary imported products:</strong></td>
</tr>
<tr>
<td>• citrus fruit</td>
<td>• wheat</td>
</tr>
<tr>
<td>• sugar</td>
<td>• rice</td>
</tr>
<tr>
<td>• grapes</td>
<td></td>
</tr>
<tr>
<td>• maize</td>
<td></td>
</tr>
<tr>
<td>• deciduous fruit</td>
<td></td>
</tr>
<tr>
<td>• flowers</td>
<td></td>
</tr>
<tr>
<td>• meat</td>
<td></td>
</tr>
<tr>
<td>• soya beans</td>
<td></td>
</tr>
<tr>
<td>• sunflowers</td>
<td></td>
</tr>
<tr>
<td>• timber.</td>
<td></td>
</tr>
<tr>
<td><em><em>Value-added products</em> exported (secondary):</em>*</td>
<td><strong>Value-added products imported (secondary):</strong></td>
</tr>
<tr>
<td>• wine</td>
<td>• cereals</td>
</tr>
<tr>
<td>• wool</td>
<td>• soya-bean oil</td>
</tr>
<tr>
<td>• fruit juices</td>
<td>• palm oil</td>
</tr>
<tr>
<td>• preserved fruit</td>
<td>• spices</td>
</tr>
<tr>
<td>• nuts</td>
<td>• processed food</td>
</tr>
<tr>
<td>• skins and hides</td>
<td>• tea, coffee and beverages</td>
</tr>
<tr>
<td>• dairy products</td>
<td></td>
</tr>
<tr>
<td>• ostrich products.</td>
<td></td>
</tr>
</tbody>
</table>

Table 22.2 Imports and exports of South Africa

Note:
**Value-added product** – The value of a product is increased by processing the raw product, for example turning wood into furniture.

Factors favouring and hindering agriculture in South Africa: such as soil, climate land ownership and trade

<table>
<thead>
<tr>
<th>Factors favouring agriculture in South Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Climate</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Rainfall and water</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Relief</strong></td>
</tr>
<tr>
<td><strong>Research</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Land ownership</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Trade</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Climate monitoring</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Table 22.3.a Factors favouring agriculture in South Africa
Factors hindering agriculture in South Africa

<table>
<thead>
<tr>
<th>Factors</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate</td>
<td>Drought is a common occurrence in some areas.</td>
</tr>
<tr>
<td></td>
<td>Rainfall is not reliable and unevenly distributed.</td>
</tr>
<tr>
<td></td>
<td>Only 13% of South Africa is suitable for crop farming.</td>
</tr>
<tr>
<td>Rainfall and water</td>
<td>Rainfall is erratic in some areas.</td>
</tr>
<tr>
<td></td>
<td>Irrigation schemes are costly especially for small-scale farmers.</td>
</tr>
<tr>
<td>Soils</td>
<td>Only 7% of the land is arable.</td>
</tr>
<tr>
<td></td>
<td>Soil is lost due to soil erosion.</td>
</tr>
<tr>
<td></td>
<td>Soils are thin and over used.</td>
</tr>
<tr>
<td>Hazards</td>
<td>Foot and mouth outbreaks cause financial loss.</td>
</tr>
<tr>
<td></td>
<td>Ostrich industry often crippled by avian flu.</td>
</tr>
<tr>
<td></td>
<td>Flooding causes loss of crops and livestock.</td>
</tr>
<tr>
<td></td>
<td>Droughts are frequent.</td>
</tr>
<tr>
<td>Land ownership</td>
<td>Historical land ownership has impoverished many limiting agricultural development.</td>
</tr>
<tr>
<td></td>
<td>Resulted in little improvement of animal breeds, crop strains and farming methods.</td>
</tr>
<tr>
<td>Trade</td>
<td>Exchange rate fluctuations have a negative effect on export value of produce.</td>
</tr>
<tr>
<td></td>
<td>Farm attacks.</td>
</tr>
<tr>
<td></td>
<td>Rising costs of staple products making them unaffordable for a majority of the citizens.</td>
</tr>
<tr>
<td>Climate change</td>
<td>Loss of crops due to the weather becoming hotter and drier.</td>
</tr>
</tbody>
</table>

Table 22.3.b Factors hindering agriculture in South Africa

The importance of food security in South Africa- influencing factors

Figure 22.2 explains the main concepts related to food security

Food security index measures the affordability, availability, quality and safety of food.

Food security concepts

Food insecurity refers to the lack of access to food and water. Food insecurity can lead to starvation and malnutrition.

Food security refers to the access that individuals, households, communities and a nation have to food at any given time.

The food security situation in South Africa:
- climate change will affect the availability of water.
- irrigation schemes will become necessary.
- the government launched the Integrated Food Security Strategy (IFSS) to eradicate hunger, malnutrition and food insecurity by 2015.
- The IFSS intends to increase food production and trading, generate jobs and income in agriculture, improve food security and draw up a food emergency management system.

MY OWN NOTES

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SECTION 5 ECONOMIC GEOGRAPHY OF SOUTH AFRICA
Figures 22.3.a and 22.3.b show the factors that hinder and favour food security in South Africa.

**Factors hindering food security in South Africa**

**Political factors:**
- small farm units
- government corruption.

**Social factors:**
- population growth faster than the ability to increase food production.

**Economic factors:**
- small-scale farmers lack capital to buy better machinery
- trade policies.

**Physical factors:**
- climatic hazards
- soils are poor
- soil degradation
- biomes are destroyed.

---

**Factors favouring food security in South Africa**

**Social factors:**
- empowering women
- support for small-scale farmers.

**Physical factors:**
- variety of crops planted allowing for a balanced diet
- climatic regions allow for diverse crops.

**Political factors:**
- land reform programmes
- land re-distribution
- government provided an incentive for farmers to improve.

**Economic factors:**
- strengthen trade ties with African countries
- value adding processing plants.

---

Figure 22.3.a Factors hindering food security in South Africa

Figure 22.3.b Factors favouring food security in South Africa
Case Study: Food security in South Africa

Suggested time frame: 45-60 minutes

Read the Fact File.

Fact File

Feedback Food Security and Community Development Programme

Description:
- 44% of South Africans do not have a stable food source.
- Feedback's Food Security and Community Development Programme (NGO) was initiated in 2000 as a result of one woman's efforts to redistribute excess food from Cape Town's film industry to those in need.
- Feedback aims to ensure that nobody goes hungry when there is an excess of food nearby, and to inspire community development by encouraging the development of independent food sources.
- Feedback delivers food donations to select community-based organisations, allowing them to focus on the service they deliver to the community and then provides support for these organizations to achieve sustainability and food security on their own.
- This project uses food that retailers will throw away as they have reached their sell by date but are still safe for people to eat.
- Food is not provided as a hand-out but is part of a long-term upliftment process.
- Feedback targets grassroots community organisations with little or no support and with no means of transport to collect food donations.
- Food is delivered to them, allowing them to focus on the services they offer to their community.

Effectiveness:
- More than 200 community organisations, assisting a total of approximately 24,000 individuals, receive food support and are responsible for preparing nutritious meals.
- 23 beneficiary organisations have achieved food security, are sustainable and are no longer reliant on Feedback for food donations.

Poverty Impact:
- This project addresses hunger, malnutrition, a lack of nutritional knowledge and a lack of food preparation and planning in poor communities.
- It is not suited for extreme rural areas as there is a lack of excess food in rural areas for redistribution.
- Durban and Pietermaritzburg have similar projects in operation and Johannesburg is soon to follow suite.

1. Provide definitions for the following:
   a. food security: ________________________________

   b. food insecurity: ________________________________ (2x2) (4)

2. With the aid of a mind map, discuss how food security is influenced by climate change, government intervention, economic factors and population growth.
2. Read the Fact File on the Feedback Food Security and Community Development Programme.
   a. **Outline** of how the Feedback Food Security and Community Development Programme works.

   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________

   b. **Discuss** how food security in rural areas differs from food security in urban areas.

   • ____________________________________________
   ____________________________________________
c. Give TWO reasons to explain why the Feedback Food Security and Community Development Programme does not apply to deep rural areas.

    •
    
    •
    
    •
    
    •

(2x2)(4)

d. In your opinion would you agree that the Feedback Food Security and Community Development Programme is successful? Justify your answer.

    •
    
    •
    
    •
    
    •

(2x2)(4)

e. Identify TWO drawbacks of the Feedback Food Security and Community Development Programme.

    •
    
    •
    
    •
    
    •

(2x2)(4)

3. Comment on how one could alleviate food insecurity in rural areas.

    •
    
    •
    
    •

(2x2)(4)

Total: 50
Unit 23  Mining

CHECKLIST:
• contribution of mining to the South African economy  
• significance of mining to the development of South Africa  
• factors that favour and hinder mining in South Africa  
• case study: coal - one of South Africa’s main minerals

Contribution of mining to the South African economy
Some important facts about mining in South Africa
• The contribution of mining to the GDP has declined relative to the growth of the secondary and tertiary industries.
• Mining still remains a cornerstone to the economy of South Africa.
• Mining creates 1 million jobs.
• Accounts for 19.4% of the GDP (9.4% directly from primary products and 10% indirectly from value added products).
• Mining is an earner of foreign exchange, due to the minerals that are exported.
• Accounts for 20% of foreign investment.

Significance of mining to the development of South Africa
• The discovery of diamonds on the banks of the Gariep River and rich Kimberlitic pipes and gold near Barberton started the mining industry.
• Mining has been the main driving force in the development of South Africa into one of the most advanced and richest economies in Africa.
• Mineral wealth extends past just gold and diamonds.
• South Africa is a leading world producer of chrome, manganese, platinum, vanadium and vermiculite.
• Mining helped with the establishment of the Johannesburg Stock Exchange.
• Mining has led to the development of secondary and tertiary industries as well as the development of the country’s infrastructure.
• Timber industry started as a result of the demands of the mines for wooden supports for the mine shafts.

MY OWN NOTES
Figure 23.1 shows South Africa’s world ranking in terms of world reserves.

Some facts from Figure 23.1:
- PGM stands for platinum group minerals.
- PGM minerals include ruthenium, rhodium, palladium, osmium, iridium, and platinum. They have similar physical and chemical properties, and tend to occur together in the same mineral deposits.
- South Africa has 87% of the world reserves of PGM’s and is ranked 1st in the world.
- South Africa is also ranked 1st in the world for gold, manganese, chromium and alumina-silicates.
- South Africa is ranked 2nd in the world for vermiculite, vanadium, zirconium minerals, titanium minerals, as well as fluor spar.
- South Africa is a mineral rich country.

**Factors that favour and hinder mining in South Africa**

<table>
<thead>
<tr>
<th>Factors that favour mining</th>
<th>Factors that hinder mining</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Large deposits of good quality and variety of minerals.</td>
<td>• Labour problems – strikes are frequent.</td>
</tr>
<tr>
<td>• Large coal fields- cheap electricity – greater profits.</td>
<td>• Idea of nationalising the mines causes uncertainty.</td>
</tr>
<tr>
<td>• Abundant cheap labour.</td>
<td>• Power struggle between labour unions.</td>
</tr>
<tr>
<td>• Minerals are located near the surface of the earth, making extraction cheaper.</td>
<td>• Foreign investors concerns over labour unrest.</td>
</tr>
<tr>
<td>• Rock layers have lower temperatures making it easier to work underground.</td>
<td>• Mines filling up with water.</td>
</tr>
<tr>
<td>• Government’s positive involvement.</td>
<td>• Ore grades are deteriorating.</td>
</tr>
<tr>
<td>• Source of revenue.</td>
<td>• Mines are far from ports which increase road transport costs.</td>
</tr>
<tr>
<td>• Off shore listing of companies.</td>
<td>• Exported minerals are dependent on the exchange rate.</td>
</tr>
<tr>
<td></td>
<td>• Environments have been destroyed by the mining activities.</td>
</tr>
<tr>
<td></td>
<td>• Impact of HIV/AIDS on the labour force and productivity.</td>
</tr>
</tbody>
</table>

Table 23.1 Factors that favour and hinder mining in South Africa
Figure 23.2 Location of minerals in South Africa

MY OWN NOTES
Case Study: Coal mining in South Africa

Read the information below from www.bullion.org.za (Figure 23.3), as well as Figure 23.2 showing the location of sources in South Africa.

1. **Name** the economic sector to which coal mining belongs.

2. Where are the major coal mines located in South Africa?

3. **List** TWO factors that hinder coal mining in South Africa?
   
   •

4. **Comment** on the fact that “coal mining is responsible for producing 94% of SA’s electricity”.
   
   •

5. Discuss ONE environmental impact of coal mining.

---

**Figure 23.3**

COAL MINING IS RESPONSIBLE FOR PRODUCING 94% OF SA’S ELECTRICITY.
The development of the economy progresses from primary sector activities to secondary, tertiary and the quaternary sector. The primary sector forms the base of the economy while the quaternary sectors forms the top of the economic activities.

**Contribution of the secondary and tertiary sectors to the South African economy**

At a glance Figure 24.1 shows:
- the economy was traditionally dominated by primary activities
- in 1919 the secondary activities contribution to the GDP was small
- the secondary and tertiary sectors contribution to the GDP has grown at the expense of the primary sector from 1946 onwards
- the tertiary sector has driven economic growth since 1990.

![Graph showing contributions of the sectors to the economy of South Africa from 1900 to 2012](image)

**MY OWN NOTES**
QUICK QUIZ

Refer to Figure 24.1

1.1 Estimate the contribution of the tertiary sector to the economy in 2012.

1.2 Provide two examples of tertiary sector activities.

1.3 Compare the trend of the primary and secondary sector contributions to the GDP since 2000.

<table>
<thead>
<tr>
<th>Primary sector</th>
<th>Secondary sector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Types of industries

There are many types of industries found in the secondary sector. These are outlined in Table 24.1

<table>
<thead>
<tr>
<th>Type of Industry</th>
<th>Characteristics of the type of industry</th>
</tr>
</thead>
</table>
| Heavy industries                       | - large amounts of material are handled
|                                       | - often generates pollution            |
|                                       | - use large amounts of energy and raw materials to produce products |
|                                       | - create environmental problems for waste materials. |
| Example: Iscor.                        |                                          |
| Light industry                         | - uses smaller amounts of material     |
|                                       | - produces less pollution              |
|                                       | - found close to markets               |
|                                       | - situated nearer to residential areas.|
| Example: Clothing manufacturers.       |                                          |
| Raw-material orientated industries     | - uses raw material to make goods and products. |
| Example: a fruit canning plant near to where the fruit is grown; a paper mill close to the plantations where the trees are sourced from; a sugar mill close to the cane lands. | |
| Market-orientated industry             | - these industries located close to where the market is for their product keeps transport cost down. |
| Example: fresh produce market close to residential areas | |
| High technology industries             | - concerned with advanced technology such as food research; or IT related industries. |
| Example: Microsoft                     |                                          |
| Bridge (break-of-bulk) industries      | - this type of industry processes raw materials before they are transported |
|                                       | - not dictated by the location of the raw material or market |
|                                       | - they are located where the transport type of the raw material changes |
|                                       | - Durban has many of these industries and call centres. |
| Example: Hulett's Sugar.               |                                          |
| Footloose industries                   | - industry’s location is not dictated by the access to materials or markets |
|                                       | - highly skilled                       |
|                                       | - small light components are manufactured |
|                                       | - does not generate any pollution      |
|                                       | - service orientated.                  |
| Example: research and design industries. |                                      |
### Table 24.1 Types of industries

| Ubiquitous industries | • if raw materials are evenly spread and have no influence on the location of that industry this type of industry develops  
• They are found anywhere.  
**Example:** cellphone industry. |
|-----------------------|---------------------------------------------------------------|
| Link industry         | • attracts other similar or complementary industries  
• called functional magnetism or agglomeration.  
**Example:** such as car assembly plants and the petrochemical industry. |

### Factors influencing industrial development

Figure 24.3 shows the factors that favour and hinder industrial development.

![Physical factors: raw materials, power, natural resources, availability, infrastructure](image1)

![Human factors: labour, capital, market, transport, government policies, imported goods](image2)

**Physical factors**
- raw materials: close by
- power: cheap reliable and abundant
- natural resources: good water supply
- available flat land: cheaper to build on
- infrastructure: road and rail network

**Human factors**
- labour: semi and skilled labour needed
- capital: money to invest
- market: close to local or access to international markets
- transport: how reliable and accessible the transport is
- government policies
- imported goods: expensive and reduces profits

### Factors favouring industrial development:
- **Water:** close water supply for cooling
- **Capital:** access to capital, rural areas lag behind with this
- **Competition:** local competition is good
- **Markets:** access to local markets as well in Africa as well as overseas markets
- **Raw materials:** large amount of raw materials available
- **Labour:** access to skilled and semi-skilled labour
- **Power:** large coal reserves available for cheap electricity
- **Political intervention:** government policies in place to support local industries and help growth rate.

### Factors hindering industrial development:
- **Pollution:** industrial pollution of the atmosphere, water and soil.
- **Over concentration:** over concentration in our 4 major urban areas results in little room for expansion.
- **Pressure on resources:** water and electricity in high demand.
- **Labour unrest:** strikes and unrest has a negative effect on foreign markets and investors.
- **Transport:** unreliable, repair of roads and railways is costly, long distances to markets, isolated from the rest of the world markets.
- **Fluctuating rand value:** weaker rand make exports valuable but imports expensive, makes it difficult for investors to plan.
- **Diseases:** HIV/AIDS epidemic results in companies financial loses as staff have to be replaced and trained, work productivity declines. Additional health costs are incurred.

Figure 24.3 The factors that favour and hinder industrial development

### South African industrial regions

South Africa has four main industrial regions, namely Gauteng or PWV (Pretoria, Witwatersrand, Vereeniging), Durban – Pinetown, Port Elizabeth-Uitenhage and the South Western Cape. Physical and human factors have affected their location and factories and are outlined in Figure 24.2.
Location and main industrial activities of the major industrial regions and their industrial output for each area

**PWV or Gauteng (48%)**

**Factors of location:**
- situated in Gauteng province
- discovery of gold originally led to the growth and development of this area
- most important industrial area in South Africa
- large labour force, water (Vaal Dam), flat land and space, power (coal), transport networks, raw materials and a market available.

**Main industries:**
- main industries include iron and steel, engineering, metal processing, machinery, explosives and chemicals, jewellery, textiles, food products, drinks and electronics.

**South Western Cape – Cape Town (14%)**

**Factors for location:**
- situated in the Western Cape
- Cape Town harbour is the 3rd most important in South Africa
- large labour, transport and nuclear power available
- rainfall and water shortages are a problem.

**Main industries:**
- large production of wool, wheat and fruit
- other industries include fishing, fruit canning, wine-making, food products and drinks, textiles, footwear, oil refining, car assembly, chemicals and fertilizers.

**Durban-Pinetown (15%)**

**Factors for location:**
- situated in KwaZulu Natal
- Durban harbour is the largest and busiest in South Africa
- large labour force, water, transport networks and accessible markets locally and overseas.

**Main industries:**
- sugar milling, pulp and paper, ship building, car assembly, oil refining, rubber goods, chemicals, food products, textiles and footwear.

**Port Elizabeth-Uitenhage (9%)**

**Factors for location:**
- situated in the Eastern Cape
- exports from P.E. and East London harbours
- labour available, transport networks and power

**Main industries:**
- area is characterised by fruit, sheep and cattle
- main industries are fruit canning, automotive parts, car assembly, tyres and textiles.

---

**Figure 24.4 Location and activities of the major industrial regions in South Africa**

**South Africa’s industrial areas: case study of each area**

1. **PWV or Gauteng:**

---

**Figure 24.5A Location of Gauteng**

**Figure 24.5B Map of the PWV region showing favourable factors of location**

---

**SECTION 5 ECONOMIC GEOGRAPHY OF SOUTH AFRICA**

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Example: Amalgamated Beverage Industries (ABI)
- Coco-Cola soft drinks is a part of ABI
- ABI is the soft drink division of South African Breweries
- ABI operates across South Africa
- It has the most technically advanced manufacturing facility in the whole of Africa
- ABI supports many industries such as food, agriculture, packaging, chemicals, iron and steel, motor vehicles, electricity, business services and general trade sectors.

2. Durban-Pinetown

Example: NCT Durban Wood Chips
- Located at Maydon Wharf in the Port of Durban.
- Eucalyptus hardwood chips are exported from Durban to paper manufacturers in Japan.
- It is the fourth wood chip export facility in South Africa but the first one for Durban – the other existing plants are located in Richards Bay.
- Tree growers from central and southern KZN send their trees to this plant.
3. Port Elizabeth-Uitenhage:

**Example: Volkswagen assembly plant in Uitenhage**
- Uitenhage is situated close to Port Elizabeth.
- The Volkswagen assembly plant is one of its main industries (automobiles).
- Many of the industrial activities in Uitenhage centre around Volkswagen such as Good Year (tyres), and Gearmax.

Adapted: [http://uitenhage-ec.co.za/uitenhage-industry.htm](http://uitenhage-ec.co.za/uitenhage-industry.htm)

4. Western Cape

**Example: Deciduous fruit canning industry**
- Directly employs many thousands of people, mainly in rural areas.
- Supports a number of other industries who supply the canners with raw materials. Other inputs and services such as the fruit and vegetable growers, the sugar industry, as well as the packaging industry are also supported.
- It is an export driven industry, exporting more than 85% of its production.
- The industry employs nearly 40 000 factory and farm workers.
- A large number of the employees are women.
- Capital investment in the industry is very high.
Overview of apartheid and post-apartheid industrial development strategies.

**Apartheid era in South Africa**
- Influenced spatial development.
- Influenced the landscape, infrastructure, and provision of services such as water, electricity, transport, education, health care and sanitation.
- Poverty in the rural areas (homelands) became widespread.
- Centralised economic development around core urban areas namely Gauteng (as a major area) and the other three core areas namely Durban-Pine Town, Cape Town and Port Elizabeth.
- In the 1980s there was a shift to develop smaller economic nodes. The Nationalist government had a counter-urbanisation policy designed to prevent workers moving to the core urban areas.
- This was achieved by identifying growth points in the homelands. The Good Hope Plan was designed.

**Post apartheid South Africa**
- More focus on equal distribution of industries.
- Would provide more growth, jobs and development to the areas outside the core ones.
- Strategies designed include RDP, GEAR, SDI and IDZ.
- Asgi-SA, SEZ and the National Development Plan are most recent economic strategies.

Table 25.1 Apartheid and post-apartheid development strategies
Unit 25 Strategies for industrial development

CHECKLIST:

• overview of apartheid and post-apartheid industrial development strategies
• Concept and distribution of industrial development zones – case studies
• issues associated with industrial centralisation and decentralisation

Overview of apartheid and post apartheid industrial development strategies.

Apartheid era in South Africa

- Influenced spatial development.
- Influenced the landscape, infrastructure, and provision of services such as water, electricity, transport, education, health care and sanitation.
- Poverty in the rural areas (homelands) became widespread.
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Post apartheid South Africa

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- Would provide more growth, jobs and development to the areas outside the core ones.
- Strategies designed include RDP, GEAR, SDI and IDZ.
- Aspi-SA, SEZ and the National Development Plan are most recent economic strategies.

Table 25.1 Apartheid and post-apartheid development strategies
Table 25.1 Time line of apartheid and post-apartheid economic development strategies.
### Summary of the economic development strategies

Table 25.2 outlines the numerous economic development strategies used by the South African Government over the years.

<table>
<thead>
<tr>
<th>Development strategy</th>
<th>Characteristics of the strategy</th>
</tr>
</thead>
</table>
| **Good Hope Plan 1981** | • to spread economic wealth in South Africa  
• led to the geographic regions that make up our 9 provinces  
• de-concentration points created (Atlantis in the Cape) and isolated industrial development points identified (De Aar)  
• tax incentives to encourage industries to move to these areas  
• border industries created on the borders of homelands. |
| **Reconstruction and development plan (RDP) 1994** | • improve the quality of life  
• it focussed on redistributing wealth, improve health care, create jobs and provide basic services such as water and electricity, land reform, education and training  
• aimed at local development. |
| **Spatial Development Initiatives (SDI) 1995** | • identified eleven underdeveloped corridors  
• attract foreign investors and allow for economic growth  
• disadvantaged communities in the corridors would benefit from the growth  
• attempt to decentralise industries.  
• develops the secondary economy with value added and high tech products. |

![Map showing the location of the 11 corridors](image)

**Figure 25.1** for the map showing the location of these eleven corridors

<table>
<thead>
<tr>
<th>Development strategy</th>
<th>Characteristics of the strategy</th>
</tr>
</thead>
</table>
| **Industrial Development Zones (IDZ) 2001** | • is a specialised industrial zone found in an SDI  
• they are export driven industries  
• located close to harbours and airports  
• purpose built industrial parks and up-to-date infrastructure  
• companies are offered reduced import costs and tax deductions  
• areas include Saldanha Bay, Coega (PE), West Bank (East London), Durban, Richards Bay, Johannesburg, Polokwane and Upington. |
| **Growth, Employment and Redistribution (GEAR) 1996** | • macro-economic policy  
• focussed on growth, employment and redistribution of wealth and eradicate poverty  
• designed to attract foreign investors  
• focused on the country as a whole. |
| **Accelerated and Shared Growth in South Africa (Asg-SA) 2006** | • macro development plan  
• halve poverty and unemployment by 2014  
• ease infrastructure bottlenecks, create more efficient delivery of services and attract investors  
• each province identified a special project to increase growth. |
| **The National Development Plan** | • eliminate poverty and inequality by 2030  
• unite South Africans and unleashing the energy of its citizens, building capabilities and working together. |

Table 25.2 Economic development strategies


Case Study: Concept and distribution of industrial development zones

Fact File 1 Dube tradeport
Dube Tradeport is located between the southern hemisphere’s largest container seaport in Durban and largest bulk seaport in Richard’s Bay) and home to King Shaka International Airport. It is Africa’s first purpose-built aerotropolis.

It allows for easy access to African as well as African and global markets. Services include:

- **Dube Cargo Terminal**: The most secure, fully-automated cargo terminal in the Southern Hemisphere, with on-site customs and a single handler – Worldwide Freight Services.
- **TradeZone**: A world first with integrated air-cargo services, where freight forwarders and shippers are located in a single facility with direct airside access. This results in efficient processing and assurance of delivery.
- **Dube AgriZone**: Source the freshest perishables, offer produce with the longest shelf life from the most sophisticated agricultural growing, packing and distribution facility in Africa.
- **Dube City**: The first green precinct in Africa, Dube City offers a secure, world-class, cosmopolitan, 24-hour business, trade and retail experience.
- **iConnect**: Access the most advanced IT with iConnect – Dube TradePort’s dedicated IT and telecoms provider, delivering global connectivity.

Adapted from http://www.commonwealthofnations.org/partner/dube_tradeport/

Fact File 2 East London Industrial Development Zone (ELIDZ)
- East London was South Africa’s first operational IDZ and it had already attracted investments.
- The area is located next to the port, the N2 and the airport.
- The income generated by the zone is expected to be in excess of R 1.8 billion by 2010
- The ELIDZ is expected to generate about 30 000 jobs in the next 10 years. The multiplier effect is eight indirect jobs created for each direct job.
- The area has been developed into a world class industrial zone. It is geared towards value-added industries such as automotive, agro-industry and information and technology.
- It is aimed at providing a platform for the zone’s manufacturers to become globally competitive as exporters.

Adapted from http://www.panoramio.com/photo/14815593
Study Fact Files 1 and 2

a. **Explain** the following terms:

   • value-added industry  
   
   • multiplier effect  

b. **Explain** what is meant by an areotropolis as mentioned in Fact File 1.

c. Complete the table to **compare** the two case studies.

<table>
<thead>
<tr>
<th>Advantages of the location (provide two)</th>
<th>Dube Tradeport</th>
<th>East London Industrial Development zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Industrial activities (examples)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closest city</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benefits for the area (provide two)</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>
Issues associated with industrial centralisation and decentralisation

The centralisation (concentration) of industries in urban areas can lead to numerous advantages as well as disadvantages. These are outlined in Table 25.3.

<table>
<thead>
<tr>
<th>Advantages of centralisation</th>
<th>Disadvantages of centralisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Four core areas highly developed.</td>
<td>• Uneven spread of wealth.</td>
</tr>
<tr>
<td>• Clustering of similar industries which gain from the multiplier effect.</td>
<td>• Peripheral areas remain underdeveloped.</td>
</tr>
<tr>
<td>• Infrastructure and service network established.</td>
<td>• Congestion, pollution and environmental degradation.</td>
</tr>
<tr>
<td>• Good market.</td>
<td>• Social problems.</td>
</tr>
<tr>
<td>• Large labour force available.</td>
<td>• Labour problems such as strikes, violence and poor living conditions.</td>
</tr>
<tr>
<td></td>
<td>• Demand for housing.</td>
</tr>
<tr>
<td></td>
<td>• Rural towns decline.</td>
</tr>
</tbody>
</table>

Table 25.3 Advantages and disadvantages of centralisation of industries

The impact on urban and rural areas when industries change their location

Industries moving from urban areas

**Why are they moving?**
- decentralisation is needed
- depletion of primary resources
- to be closer to the market
- functional magnetism
- political
- fall in demand

**Effects:**
- Job losses
- Buildings become derelict
- Inner city planning
- High density housing on former industrial site
- New office parks
- Light industry

Industries relocating to rural areas

**Why are they relocating?**
- land available
- land cheaper
- closer to market

**Effects:**
- improved infrastructure
- improved facilities
- improved services
- greater job opportunities for the local people
- less unemployment in these areas

Example of an industry changing its location

**Bison Board factory in Pietermaritzburg**

**Note:**
- large amounts of land needed for the factory
- proximity to residential areas in the city impacts on the health of residents
- additional polluting of the air in Pietermaritzburg
- limited space to expand.

**Re-location of Bison Board factory to Ugie in the Eastern Cape**

**Note:**
- the proximity to the raw resources namely timber plantations
- proximity to large labour force
- benefits to the town of Ugie such as employment, greater spending power, infrastructure is upgraded and improvement of services.
Unit 26  The informal sector

CHECKLIST:
• concept and characteristics of informal sector employment
• reasons for high informal sector employment in South Africa
• challenges facing South Africa’s informal sector

Employment in South Africa:
• 58% of economically active people are employed in the formal sector
• 33% of the economically active work force is unemployed
• 9% of the economically active work force is in the informal sector.

Concept and characteristics of informal sector employment

Concept of informal sector employment
There are two economies in South Africa namely:

Formal economy:
• big corporate companies
• attracts foreign investments
• legal and registered.

Informal economy:
• cash economy
• small business traders
• hidden part of the economy as it is not included in the GDP of the country
• business belongs to the owner
• offers a wide range of jobs, which unskilled labour can pursue.

Characteristics of informal sector employment
• Does not meet legal requirements, standards and procedures of formal sector employment.
• Services and goods are sold informally without a legal licence or business permit as in the formal sector.
• Types of activities include building, pottery, hairdressing, car guards, fast food stands, casual labour, sewing mending carpentry, transport services, arts and crafts.

MY OWN NOTES
Reasons for high informal sector employment in South Africa

There are a number of reasons that the informal sector has a large number of people employed in it. There are also advantages and disadvantages of the informal sector which are highlighted in Figure 26.1.

**Reasons for high informal sector employment:**
- high unemployment rates in the country
- rural migrants are mainly unskilled
- need to make a living.

**Advantages of the informal sector:**
- contributes to the economy
- reduces unemployment
- easy to start, no overheads or rent
- learn new skills
- able to support their needs
- locally produced crafts attracts

**Disadvantages of the informal sector:**
- government loses revenue as no tax is paid
- no control or regulation
- overcrowding of the formal business areas
- Littering occurs and is a potential health hazard.

Figure 26.1 Reasons for high informal sector employment, as well as the advantages and disadvantages of the informal sector

**Challenges facing South Africa’s informal sector**

**Job description:**
- lowly paid
- no job security
- workers can be exploited
- no access to social services
- no formal training limits work prospects
- illegal immigrants employed in this sector.

**The employer:**
- some purposely remain in informal sector to maximise profits
- some are unscrupulous and employee has no legal come back.

**Solutions:**
- permit and licence system
- set aside an area for informal traders to gather and do their business
- fine system for defaulters on permits, littering or trading in the wrong area
- encourage small businesses to get involved in training traders in business skills.

**Regulation:**
- unregulated
- no regard for official laws and regulations
- encouraged urban decay
- unhygienic conditions
- congested pavements
- increases crime in the area.

Figure 26.2 Challenges facing South Africa’s informal sector
Case Studies and Activities
SECTION 1

Paper GIS on Howick

Suggested time: 2 hours class time, 1 hour homework
Marks: 60

Refer to the topographic map extract 2930AC Howick on page 4.
1. Define the term geo-referencing.

2. Creating themed layers
   1.1 You will require tracing paper or overhead transparencies.
   1.2 You are going to create thematic layers of information which will be superimposed over a base map. This technique is called overlaying. This is a basic principle of how a GIS works.
   1.3 Carefully study the topographical map extract 2930AC Howick before answering the questions. The topographical map will be the base map for this task.
   1.4 Using the base map, sheets of tracing paper or overhead transparencies and coloured pens, create your geo-referenced themes of Howick.

Points to remember:
1. Always mark in the four corners of the map on each sheet of tracing paper. These markings are called fiducial markers. Work from the base map for this.
2. When compiling a key, use the area, line and point symbols.

Overlay 1  Land use (Area data)  (4x2) (8)
a. Draw an outline around the town of Howick and shade it in grey.
b. Shade in the industrial area of Howick in black.
c. Shade in the areas used for forestry in dark green.
d. Shade in the areas used for agriculture in light green.

Overlay 2  Drainage (Line and area data)  (3x2) (6)
a. Mark in perennial rivers, dams and other water features.

Overlay 3  Infrastructure (Line data)  (2x2) (4)
a. Draw in all the national roads and main roads.
b. Draw in the railway line

Overlay 4  Places of interest (Point data)  (4x1) (4)
a. Beacon Hill (Trigonometrical beacon 270)
b. Police Station in Howick
c. Tweedie Hall
d. Caravan Park
Key for the task

- Compile a key for all the layers of information that you have created.
- Make sure that the paper GIS has the following:
  - a title
  - orientation
  - each layer is matched to the base map (using the fiducial points in the corners of the overlay)
  - the thematic layers are in the correct sequence (area, line then point symbols)

3. Analysing the Information

3.1 Compare the routes taken by the national road (N3) and the main road (103).

3.2 Account for the location of the agricultural land in relation to the main rivers and dams.

3.3 Comment on the location of the following:
   a. Police Station -
   b. Caravan Park -

3.4 Discuss whether the mapped area is a high rainfall or low rainfall area. Use evidence from the thematic layers to support your answer.
Photographic Analysis Task

Suggested time: 1 - 1½ hours
Marks: 85

Photographs are essential in mapping and research. Aerial photographs are taken from aeroplanes and are used to compile and update maps. There are many different types of photographs, and these include:
- horizontal photographs
- high angle oblique photographs
- low angle oblique photographs
- vertical photographs
- satellite images

1. Horizontal photographs
   1.1 Study Photograph 1.

![Photograph 1](source: D Preston)

a. (i) **Classify** the settlement in Photograph 1.

   (2)

(ii) **Justify** your answer.

   (2)

b. **Identify** a possible service available to the inhabitants of this area. Use photographic evidence to support your answer.
c. **Discuss** TWO possible environmental hazards that people living in this area may have to face.

   • ____________________________

   • ____________________________

1.2 Study Photograph 2.

![Photograph 2](source: D Preston)

a. **Identify** the fluvial feature shown in Photograph 2.

   ____________________________

b. **Draw** a simple sketch of the feature in Photograph 2 and label the following:
   - undercut slope
   - slip-off slope
   - fast flowing water
   - where erosion is taking place
   - slow moving water
   - where deposition is taking place
2. High-angle oblique photographs

2.1 Study Photograph 3.

Photograph 3

Source: S Steijl
a. Using evidence from Photograph 3, **give** ONE reason why this is a high-angle oblique photograph.

b. **Describe** the type of farming taking place in Photograph 3.

c. **Comment** on the irrigation method/s used by farmers in Photograph 3.

2.2 Study Photograph 4.

a. **Identify** the land-use zone shown in Photograph 4
b. Using evidence from Photograph 4, **outline** THREE characteristics of this land use zone.

- 
- 
- 

2.3 Study Photograph 5.

![Photograph 5](Source: S Steijl)

a. **Discuss** the relationship between relief and settlement as seen in Photograph 5.

- 
- 
- 
- 
- 

(3x2) (6)

[21]
3 Low-angle oblique photographs

3.1 Study Photograph 6

Photograph 6

Source: S Steijl

Avocado trees

a. Photograph 6 shows commercial avocado farming. **Explain** commercial farming.

3.2 Study Photograph 7

Photograph 7

Source: D Preston
3.2.1 Photograph 7 shows a school and its sports fields.
   
a. **Compile** a key to show the symbols of the features listed, as they would appear on a topographic map. Fill this in onto the table below.

b. **State** whether the symbol is a point, line or polygon (area). Fill this in onto the table below.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Symbol</th>
<th>Point, line or polygon</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport fields</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trees and bush</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary road</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4 Vertical photographs

4.1 Study Photograph 8 showing an estate development.

Photograph 8

Source: S Steijl
a. **Describe** the shape of the settlement in Photograph 8.


(2)

b. **Outline** TWO advantages and TWO disadvantages of living in a settlement like this.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

(4x2) (8)

[10]

Total [56]
Map Skills Test – Somerset West

Suggested time: 1 Hour
Marks: 75

Instructions:
Refer to the 1:50 000 topographical map extract 3418BB Somerset West and the 1: 10 000 orthophoto map extract 3418BB 12 before answering the questions.

QUESTION 1
1.1 Multiple Choices
Tick the correct answer.

1.1.1 The latitude of trigonometrical beacon 148 (block C8) is ...

A 18° 03' 10" S
B 34° 04' 15" E
C 34° 02' 19" S
D 18° 02' 15" S

1.1.2 The longitude of trigonometrical beacon 148 (C8) is ...

A 18° 50’ 15” S
B 18° 51’ 05” E
C 34° 51’ 10” S
D 18° 52’ 10” E

1.1.3 Calculate the distance you would travel by road on the N2 from where the N2 intersects the R44 (block E5) to Cape Town. Give your answer in kilometres.

A 8 km
B 16 km
C 34 km
D 42 km

1.1.4 The street pattern at the Strand in block G5 is mainly...

A Unplanned irregular
B Planned irregular
C Planned grid
D Circular
1.1.5  The most likely crop to be grown in block D4 is ...

A  Grapes
B  Wheat
C  Citrus fruit
D  Forests

1.1.6  The most likely type of rainfall to occur in Somerset West is...

A  Convectional
B  Relief
C  Cyclonic
D  Convergence

1.1.7  The highest altitude on the topographic map is ........m:

A  967.3
B  1137.2
C  1240.6
D  1003.1

QUESTION 2
Map skills and calculations

2.1  Study the cross sections labelled A - C from trigonometrical beacon 148 (C8) to the school (E8). Place a tick next to the sketch section which is most correct.
2.2 Identify the type of slope from trigonometric beacon 148 (C8) to the school (E8).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Convex</td>
</tr>
<tr>
<td>B</td>
<td>Concave</td>
</tr>
<tr>
<td>C</td>
<td>Even</td>
</tr>
<tr>
<td>D</td>
<td>Steep</td>
</tr>
</tbody>
</table>

2.3 Calculate the vertical exaggeration for the cross section you have chosen.

a. If the vertical interval is 1cm represents 300m, state the vertical scale of the cross section.

   ____________________________

b. Determine the vertical exaggeration of the cross-section.

   ____________________________ times.

2.4 Refer to the topographical map. Calculate the average gradient from the Trig. Beacon 148 (C8) to the school at Land en Zeezicht (E8).

   a. Distance from the Trig beacon to the school __________ metres

   b. Difference in altitude between the Trig beacon and the school __________ meters

   c. Gradient 1: __________

2.5 Calculate the area of the block marked 1 on the orthophoto map in hectares.

   a. Length: ________________ m

   b. Breadth: ________________ m
c. Area: _______________ m²

(1)

d. Area: _______________ ha

(2)

Calculation

QUESTION 3
Interpretation and application of photographs, topographical maps and orthophoto maps

3.1 Photograph analysis
Study Photograph 1 that was taken in block A5 from Longridge Winery looking towards the Helderberg mountain range

3.1.1 In which direction was the camera pointing when the photograph was taken?
Tick the correct answer box.

<table>
<thead>
<tr>
<th>A</th>
<th>West</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>South-west</td>
</tr>
<tr>
<td>C</td>
<td>East</td>
</tr>
<tr>
<td>D</td>
<td>South-east</td>
</tr>
</tbody>
</table>

(2)
3.1.2 **Draw** a simple field sketch of the Helderberg mountain range from Photograph 1. Label the following:
- The orientation of Photograph 1
- The exposed folded mountains
- The vineyards

3.2 **Refer to the topographic map and orthophoto map.**

3.2.1 Name the functional zones of the areas numbered on the orthophoto map:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

3.2.2 **Identify** the features numbered 5 and 6 on the orthophoto map.

5: __________________________

6: __________________________

3.2.3 a. **Identify** the main primary economic activity in the mapped area of the topographic map.

______________________________

b. **Predict** the impact that urban sprawl will have on the economic activity that you identified in question 3.2.3.a.

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

(2x2) (4)
3.2.4 **Discuss** the impact relief has had on the location of the infrastructure of Somerset West.

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

(2x2) (4)

3.2.5 Somerset West and the Strand are potential tourist destinations. Use map evidence to **design** a billboard that will attract tourists to the region.

__________________________________________________________________________

(5)

**Billboard**

__________________________________________________________________________

[29]

**QUESTION 4**

Geographic Information Systems (GIS)

4.1 **Identify** THREE ways in which data is collected for a GIS.

- _____________________________________
- _____________________________________
- _____________________________________

(3x2) (6)
4.2 Study Photograph 2, a Google Earth image of Somerset West taken on 8 March 2013.

a. **Explain** what you understand by the term ‘thematic layer’.

   ______________________________________________________

   (4)

b. **Identify** TWO thematic layers that have been used in Photograph 2.

   * ____________________________________________________

   * ____________________________________________________

   (2x2) (4)

Photograph 2
SECTION 2

Class work exercise – synoptic weather maps

Suggested time: 45 - 60 mins
Marks: 45

1. Study Figure 1 and Figure 2 on the following pages.

1.1 Complete the table below by:
   a. **stating** the season represented by each synoptic Weather Map (Figures 1 and 2) (2)
   b. providing **TWO** pieces of evidence to **justify** the season chosen (apart from the date). (4x2)(8)

<table>
<thead>
<tr>
<th>Synoptic weather map A</th>
<th>Synoptic weather map B</th>
</tr>
</thead>
<tbody>
<tr>
<td>a Season:</td>
<td>Season:</td>
</tr>
<tr>
<td>b Justification:</td>
<td>Justification:</td>
</tr>
<tr>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.2 **Name** the pressure cells A and B found on both synoptic weather maps.

A ______________________

B ______________________ (2x2)(4)
**DISCUSSION:** With a surface trough over the western interior and a high east of the country, partly cloudy to cloudy conditions with scattered showers and thundershowers occurred over the Free State and Northern Cape and isolated showers and thundershowers over Mpumalanga, the Limpopo Province, North-West, Eastern Cape and KwaZulu-Natal. Haze to very hazy conditions prevailed over the western interior.

**BESPREKING:** Met 'n oppervlakte trop oor die westelike bineland en 'n hoë oos van die land, het gedeeltelike bewolkte tot bewolkte toestande met verspreide buie en donderbuie oor Mpumalanga, die Limpopo Provincie, Noord-Kaap, van die oos en buie en donderbuie oor KwaZulu-Natal. Haisie warm tot heersend warm toestande het oor die westelike bineland geheers.

Figure 1 Synoptic weather map A dated 2005-01-17

[Source: SA Weather Service]
DISCUSSION: With a surface trough over the western interior and a high east of the country, partly cloudy to cloudy conditions with scattered showers and thundery showers occurred over the Free State and Northern Cape and isolated showers and thundery showers over Mpumalanga, the Limpopo Province, North-West, Eastern Cape and KwaZulu-Natal. 

Haie to very hot conditions prevailed over the western interior.

BESPREKKING: Met 'n oppervlakstrooms oor die westelike binneland en 'n hoog oos van die land, het gedeeltelik bewolkte tot bewolkte toestande met verspreide buie en binnesteun bokkies, voornamelijk in Mpumalanga, die Limpopo, Noord-Transvaal, Die Harderwoud, die Bo-Kaap en KwaZulu-Natal. Haie warm tot bleek warm toestande het oor die westelike binneland geheers.

Figure 1 Synoptic weather map A dated 2005-01-17 [Source: SA Weather Service]
**FIGURE 2**

**DISCUSSION:** With a cold front moving in over the Western Cape, partly cloudy to cloudy and cold to mild conditions with widespread rain occurred over the Western Cape and in places over the Northern and Eastern Cape. The remainder of the country was mainly sunny and mild to warm, but hot in the offshore flow along the KwaZulu-Natal coast.

**BESPREKING:** Met 'n kouefront wat oor die Wes-Kaap inbeweeg, het gedeeltelik bewolke tot bewolke koue tot matige toestande met wydverspreide reën oor die Wes-Kaap voorgeskyn en plaaslik oor die Noord- en Oos-Kaap. Die rest van die land was hoofsaaklik somrig en matig tot warm, maar baie warm in die alleslange vloo langs die KwaZulu-Natal kus.
1.3 Refer ONLY to Figure 1, synoptic weather map A dated 2005-01-17 for the following questions.

1.3.1 **Identify** the low pressure cell C.

D  ................................................................................................................... (2)

1.3.2 **Account for** the presence of low pressure cell C over the interior of South Africa.

*  .................................................................................................................. (2x2)(4)

*  .................................................................................................................. (2x2)(4)

1.3.3 **Describe** the weather conditions associated with low pressure cell C over the interior of South Africa.

*  .................................................................................................................. (2x2)(4)

*  .................................................................................................................. (2x2)(4)

1.4 Refer ONLY to Figure 2, synoptic weather map B dated 2005-06-12 for the following questions.

1.4.1 **Identify** the low pressure system labeled D.

D  ................................................................................................................... (2)

1.4.2 **Explain** the location of the low pressure system D in relation to South Africa.

*  .................................................................................................................. (2x2)(4)

*  .................................................................................................................. (2x2)(4)
1.4.3 Complete and label the cross section through the low pressure system D from X-Y, showing the weather experienced. (5)

1.4.4 a. **Describe** the weather conditions being experienced at Upington.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________ (6)

b. **Account for** the weather conditions being experienced at Upington.

- ________________________________________________________________________

- ________________________________________________________________________  (2x2)(4)
SECTION 3

Fluvial geomorphology – The Gouritz drainage basin

Class exercise – looking at drainage basin characteristics
Time: 45 minutes
Marks: 50

1. Study Figure 1A, the drainage basin of the Gouritz River, incorporating the Goudveld Forest Reserve and Figure 1B, a graph showing monthly climate averages for Goudveld (South Africa).

![Figure 1A Drainage basin of the Gouritz River, incorporating the Goudveld Forest Reserve](image)

![Figure 1B Climate graph for Goudveld](image)
1.1 **Identify** the shape of the drainage basin as shown in Figure 1A. (2)

1.2 a. **Calculate** the total annual rainfall for Goudveld. (2)

b. **Describe** the rainfall characteristics of the area (refer to Figure 1B). (2)

c. **Suggest** ONE reason for the high incidence of non-perennial streams in the area. (2)

d. A sketch of the perennial streams in the Gouritz Drainage basin is provided in Figure 2 below.

![Figure 2: Stream ordering of the Gouritz River system](image)

(i) **Order** the streams in the marked drainage basin. Complete Table 1 below to show the stream order and the number of tributaries of each order. (4x2)(8)

<table>
<thead>
<tr>
<th>Stream order</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of streams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1
(ii) Draw a graph to show the relationship between stream order and number of streams. (4)

(iii) Describe the relationship that is represented in the graph above and Table 1. (2)

3 A rainstorm has occurred in the Goudveld Forest Reserve area. A gauging station is located at X (Figure 1A). THREE possible hydrographs are illustrated below.

![Hydrographs A, B, and C](image)

a. Select ONE hydrograph (A, B or C) that would represent the runoff at X after this rainstorm has occurred. Justify your answer. (2x2)(4)

Graph ___________

b. If large scale deforestation occurred in the area, draw an annotated hydrograph to explain how the runoff regime would change compared with your answer in 1.3.a. (4+4)(8)
c. Write a paragraph in which you evaluate catchment management in this area. **Provide** recommendations for improved management of the drainage basin. Write your answer on an A4 sheet of paper.

(7x2)(14)
Classwork task – Superimposed drainage, river capture and flooding

Suggested time: 45 minutes – 1 hour
Marks: 60

1. Superimposed drainage

Study Photograph 1 and Photograph 2, a Google image. Sections of the Orange River show aspects of both antecedent and superimposed drainage. Photograph 1 illustrates the exposed, older fold mountains in the Richtersveld on either side of the Orange River. This section shows superimposed drainage. Photograph 2 shows a GPS track overlay on Google Earth of the Orange River rafting route taken by commercial rafting companies.

Photograph 1

Source: B. Fleming

Photograph 2
Classwork task – Superimposed drainage, river capture and flooding

Suggested time: 45 minutes – 1 hour
Marks: 60

1. **Superimposed drainage**
   
   Study Photograph 1 and Photograph 2, a Google image. Sections of the Orange River show aspects of both antecedent and superimposed drainage. Photograph 1 illustrates the exposed, older fold mountains in the Richtersveld on either side of the Orange River. This section shows superimposed drainage. Photograph 2 shows a GPS track overlay on Google Earth of the Orange River rafting route taken by commercial rafting companies.

---

**Photograph 1**

Source: B. Fleming

**Photograph 2**

© 2014 AEROGIS (Pty) Ltd, Google
1.1 Complete the sentences below by underlining the correct term in brackets:
   a. The surface is eroded and the river may reach (older, younger) underlying rock.
   b. The stream network has a pattern, which bears (a relation, no relation) to the geology and relief of the landscape.
   c. The river (maintains, changes) its original course.

1.2 With the aid of annotated diagrams, explain the development of this superimposed section of the Orange River.
2. **Tugela River System**

Study Figure 1 and Photograph 3, showing the Tugela Falls, Drakensberg.

![Tugela River Catchment Area](image)

**Figure 1** Tugela River Catchment area  
[Source: P Esterhuysen]

![Photograph 3 Tugela Falls, Drakensberg](image)

**Photograph 3** Tugela Falls, Drakensberg  
[Source: www.jumbo-lodges.co.za (2011)]

2.1 a. **Explain** the following terms, with reference to Figure 1 and Photograph 3.

Watershed: ____________________________

______________________________
Knickpoint: ________________________________

Headward erosion: ________________________________

b. **Identify** the rock type found at Q in Photograph 2.

________________________________________________________________________

(3x2)(6) (2)

c. **Suggest** why there are deeply carved valleys in this area.

________________________________________________________________________

________________________________________________________________________

(2x2)(4)

2.2 Refer to Figure 2.

![Figure 2 The source of the Tugela River](Image)

[Source: Adapted from IEB 1999]

2.2.1 a. **Name** the river that has had its headwaters captured.

________________________________________________________________________

(1)
b. Which river has enlarged its drainage basin area? (1)

c. Give TWO environmental factors that have contributed to river capture in this area. Use evidence from Photograph 2 and Figure 2.

•

• (2x2)(4)

d. With the aid of an annotated diagram, explain the process of river capture that has taken place at R in Figure 2. (Remember to identify and label all the features of river capture.)

(4x2)(8)

e. Explain the significance of river capture to the Tugela River Basin.

•

• (2x2)(4)
3. **Flooding**

Refer to Photograph 4 which shows flooding of agricultural land along the Orange River, January 2010.

![Photograph 4 Flooding of agricultural land along the Orange River, January 2010](source: B. Fleming)

3.1 Draw a sketch map of the Orange River (as shown in Photograph 4) to show:

- the actual river course (and characteristics)
- extent of the flooding
- the extent of the floodplain
- evidence of irrigation farming along this section of the river.
3.2 **Evaluate** the impact flooding has on the surrounding agricultural land. Mention both positive and negative impacts. **Tabulate** your answer.

<table>
<thead>
<tr>
<th>Positive impacts of flooding</th>
<th>Negative impacts of flooding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

(4x2)(8)

[18]
SECTION 4

Case Study – South Africa’s Land Reform Program

Suggested time: 45 minutes – 1 hour
Marks: 50

Read Articles 1, 2 and 3 carefully before answering the questions.

Article 1

In 1994, the Government of South Africa inherited one of the most racially skewed land distributions in the world – whites owned 87 percent and blacks owned only 13 percent of the agricultural land.

To support fundamental change in patterns of land ownership, the World Bank developed an extremely productive partnership with the Ministry for Agriculture and Land Affairs in the early 1990s, one that ultimately has played – and continues to play – a constructive role in land reform, agricultural policy, and rural development. In particular, the World Bank and South African partners developed a new approach to land reform, based on a system of grants that eligible beneficiaries could use to purchase land on the open market. In addition, the partnership contributed to the formulation of the government’s Integrated Sustainable Rural Development Program (ISRDP), and the publication of several papers on agricultural land reform.
(Source: http://web.worldbank.org)

Article 2

Is Land Reform Failing in Africa’s Most Prosperous Nation?

South Africa’s thriving farming industry runs the risk of failing because of an ineffective land reform programme. With the reputation of being one of the most prosperous nations in sub-Saharan Africa, South Africa is struggling with many of the same developmental challenges as its neighbours. High poverty levels, high crime rates and inequitable land distribution threaten the country’s stability.

Much like its embattled neighbour, Zimbabwe, South Africa’s colonial history resulted in unequal land tenure with the white minority owning the majority of farmland. The product is insecure tenure rights for black farm workers and the targeting of white owners with violent criminal attacks. To improve the equity of the situation, the government embarked upon an ambitious land reform program. The primary objective of the program is the transfer of approximately 30 percent of land to black ownership by 2014. The transfer of the land would take place through land restitution to people’s disposed after 1913 and targeted land redistribution to vulnerable communities.

As honourable, and necessary, as the land reform program is, its failure threatens to lead South Africa to a Zimbabwe-style crisis.
(Source: Odilile Ayodele 1 March 2009)

Article 3

Apparent Land Reform Failure

In a series of articles published in March this year, Bongani Mthethwa of the Sunday Times warns that South Africa’s food security is endangered by its disorganised rural land reform. In the article, “Farms collapse as land reform fails”, Mthethwa’s investigation uncovers the failures of the land reform programme showing thousands of formerly productive farms lie abandoned. He claims that many commercial farmers, as a result of the uncertain future of the South African land reform process, are halting investment in their properties with some leaving the country for neighbouring Mozambique and Botswana.

Mthethwa contends that the reasons for the failure of the land reform program are a lack of post-settlement support for new farm owners and minimal monitoring and evaluation on the ground. In an interview with
Ann Bernstein, the executive director of the Centre for Development and Enterprise (CDE), she pointed out that CDE research had shown that "some beneficiaries had no interest in farming and just wanted a place to stay." Which means that land that would be used for food production has been turned into unproductive, and aid dependent, lodgings. Administrative challenges have also been blamed for the failure of the program.

In another article “Bungle has ruined new black farmers”, Mthethwa delves into the recent liquidation of the company that was set-up by the Land Claims Commission to assist newly restituted farms in Limpopo and Mpumalanga. South African Farm Management (SAFM) went into liquidation with more than R100 million rand (approximately USD 10 million) in debt. It has been claimed that SAFM failed in its mandate and did not provide the services that it was paid for since 2005. This has resulted in the collapse of projects by up-and-coming farmers in the lucrative fruit regions. Despite all these apparent problems, in “Farms collapse as land reform fails”, the acting chief land claims commissioner, Andrew Mphela, is quoted as saying that "it was too early to measure performance or to talk of failure."

(Source: http://south-africa.suitel01.com/article.cfm/south_africas_land_reform_programme)

1. Before answering the questions, complete the glossary of terms below. Give a concise definition of each concept.

   Food security
   
   Land reform
   
   Land redistribution
   
   Land restitution
   
   Land tenure

   (5x2) (10)

2. **Outline** what you think TWO of the main objectives of the ISRDP would be.

   •
   
   •

   (2x2) (4)

3. **Explain** why it is important to ‘change the patterns of land ownership’ in South Africa.
4. Draw a mind-map to **outline** the challenges faced by the Land Reform Programme in South Africa. Use the following sub-headings:
   - social challenges
   - financial challenges
   - environmental challenges

![Mind-map diagram]

**Social Challenges**

- _____________________________________________
- _____________________________________________

**Challenges faced by the Land Reform Program**

**Financial Challenges**

- _____________________________________________
- _____________________________________________
- _____________________________________________

**Environmental Challenges**

- _____________________________________________
- _____________________________________________
- _____________________________________________
SECTION 5
Primary Activities  Economic Geography of South Africa

Suggested time frame: 50 minutes
Marks: 40

1. Provide definitions for:
   a. primary sector ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________

   b. centralisation ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________

   c. food security ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________

   (3x2)(6)

1. Agriculture in South Africa
   Study Figure 1 below showing crop farming in south Africa.
   
   Figure 1  Crop farming in South Africa

   a. Fill in the 500mm isohyet on the map. (2)
   b. Explain why this isohyet is an important factor when looking at the location and distribution of field farming in South Africa.
   
   • ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________

   CASE STUDIES AND ACTIVITIES  183
c. Which food crop is the staple food for South Africa?

   ____________________________________________ (1)


d. i. **Name** the areas where winter wheat and wheat are grown.

   ____________________________________________ (2)

   ii. **Compare** the growing conditions for wheat and winter wheat.

   ____________________________________________  
   ____________________________________________

   ____________________________________________ (2x2)(4)


e. In developed countries, crops are being grown for the production of biofuels.

   i. **Name** TWO crops that South Africa produces, which could be used for the biofuels industry.

   ____________________________________________
   ____________________________________________

   ____________________________________________ (2)

   ii. **Discuss** ONE advantage and ONE disadvantage of producing biofuels from agricultural products in South Africa.

   • Advantage ____________________________________________

   ____________________________________________  
   ____________________________________________

   • Disadvantage ____________________________________________

   ____________________________________________ (2x2)(4)


f. **Identify** and **explain** THREE factors that have a negative impact on agriculture in South Africa.

   ____________________________________________

   ____________________________________________

   ____________________________________________

   ____________________________________________ (2x2)(4)
Answers: Section 1 Paper GIS on Howick

Fiducial point

CASE STUDIES AND ACTIVITIES
Key for the task

- **Correct use of colour. ✓**

<table>
<thead>
<tr>
<th>Overlay</th>
<th>Town of Howick</th>
<th>Industrial area</th>
<th>Forestry</th>
<th>Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grey</td>
<td>Black</td>
<td>Dark Green</td>
<td>Light Green</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overlay</th>
<th>Rivers, dams and other water features</th>
<th>Swamp and Marshes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Blue</td>
<td>Blue</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overlay</th>
<th>National Road</th>
<th>Main road</th>
<th>Railway line</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Purple</td>
<td>Red</td>
<td>Black</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overlay</th>
<th>Beacon Hill (Big Beacon 270)</th>
<th>Police Station</th>
<th>Tweedie Hall</th>
<th>Caravan Park</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
</tr>
</tbody>
</table>

- Make sure that the paper GIS has the following:
  - a title – *Thematic layers for the topographical map 2930AC Howick ✓*
  - orientation (North) ✓
  - each layer us matched to the base map (using the fiducial points ✓ in the corners of the overlay)
  - the thematic layers are in the correct sequence (area, line then point symbols) ✓✓

(20)

3.1 **The N3 takes the shortest most direct route. The N3 follows a NNW / SSE direction. The N3 bypasses the town of Howick**

The main road (103) is more winding and less straight and direct as the N3. The 103 follows an ESE / WNW direction. The 103 travels directly through the town of Howick.

(2x2) (4)

3.2 **The agricultural land (cultivated land) is mostly located near the major water sources of the Mgeni River, Midmar dam and the swamp and marsh (wetlands) near Lion’s River. The reason for the proximity of agricultural land to the water sources is for irrigation.**

The agricultural lands that are located away from the major water sources have small dams nearby to assist with irrigation.

(3x2) (6)

3.3 a. Police Station – *In the town of Howick – easily accessible.*

b. Caravan Park – *On the water’s edge of Midmar Dam – good holiday, relaxing, pretty location.*

(2x2) (4)

3.4 **The mapped area has a high rainfall as there are perennial rivers (Mgeni River) and other smaller perennial rivers (Shelter River and Lions River). There is also a major dam – big dams are built in high rainfall areas. There is also evidence of swamps and marshes (wetlands) which is common in high rainfall areas.**

(Any 2 points) (2x2) (4)
Map Skills – Somerset West

Suggested time: 1 Hour
Marks: 75

Instructions:
Refer to the 1:50 000 topographical map extract 3418BB Somerset West and the 1:10 000 orthophoto map extract 3418BB 12 before answering the questions.

QUESTION 1

1.1 Multiple Choices
Tick the correct answer.

1.1.1 The latitude of trigonometrical beacon 148 (block C8) is ...

<table>
<thead>
<tr>
<th>Option</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>18° 03’ 10” S</td>
</tr>
<tr>
<td>B</td>
<td>34° 04’ 15” E</td>
</tr>
<tr>
<td>C</td>
<td>34° 02’ 19” S</td>
</tr>
<tr>
<td>D</td>
<td>18° 02’ 15” S</td>
</tr>
</tbody>
</table>

(2 marks)

1.1.2 The longitude of trigonometrical beacon 148 (C8) is ...

<table>
<thead>
<tr>
<th>Option</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>18° 50’ 15” S</td>
</tr>
<tr>
<td>B</td>
<td>18° 51’ 05” E</td>
</tr>
<tr>
<td>C</td>
<td>34° 51’ 10” S</td>
</tr>
<tr>
<td>D</td>
<td>18° 52’ 10” E</td>
</tr>
</tbody>
</table>

(2 marks)

1.1.3 Calculate the distance you would travel by road on the N2 from where the N2 intersects the R44 (block E5) to Cape Town. Give your answer in kilometres.

<table>
<thead>
<tr>
<th>Option</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8 km</td>
</tr>
<tr>
<td>B</td>
<td>16 km</td>
</tr>
<tr>
<td>C</td>
<td>34 km</td>
</tr>
<tr>
<td>D</td>
<td>42 km</td>
</tr>
</tbody>
</table>

(2 marks)

Calculation:

\[15\text{cm} = 7.5\text{km} + 34\text{km} = 41.5\text{km} = 42\text{km}\]
1.1.4 The street pattern at the Strand in block G5 is mainly...

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Unplanned irregular</td>
</tr>
<tr>
<td>B</td>
<td>Planned irregular</td>
</tr>
<tr>
<td>C</td>
<td>Planned grid</td>
</tr>
<tr>
<td>D</td>
<td>Circular</td>
</tr>
</tbody>
</table>

(2)

1.1.5 The most likely crop to be grown in block D4 is ...

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Grapes</td>
</tr>
<tr>
<td>B</td>
<td>Wheat</td>
</tr>
<tr>
<td>C</td>
<td>Citrus fruit</td>
</tr>
<tr>
<td>D</td>
<td>Forests</td>
</tr>
</tbody>
</table>

(2)

1.1.6 The most likely type of rainfall to occur in Somerset West is...

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Convectional</td>
</tr>
<tr>
<td>B</td>
<td>Relief</td>
</tr>
<tr>
<td>C</td>
<td>Cyclonic</td>
</tr>
<tr>
<td>D</td>
<td>Convergence</td>
</tr>
</tbody>
</table>

(2)

1.1.7 The highest altitude is:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>967.3</td>
</tr>
<tr>
<td>B</td>
<td>1137.2</td>
</tr>
<tr>
<td>C</td>
<td>1240.6</td>
</tr>
<tr>
<td>D</td>
<td>1003.1</td>
</tr>
</tbody>
</table>

(2)
QUESTION 2  Map skills and calculations

2.1 Study the cross sections labelled A-C from trigonometrical beacon 148 (C8) to the school (E8). Place a tick next to the sketch section which is most correct.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><img src="image" alt="Cross Section A" /></td>
</tr>
<tr>
<td>B</td>
<td><img src="image" alt="Cross Section B" /></td>
</tr>
<tr>
<td>C</td>
<td><img src="image" alt="Cross Section C" /></td>
</tr>
</tbody>
</table>

2.2 Identify the type of slope from trigonometric beacon 148 (C8) to the school (E8).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Convex</td>
</tr>
<tr>
<td>B</td>
<td>Concave</td>
</tr>
<tr>
<td>C</td>
<td>Even</td>
</tr>
<tr>
<td>D</td>
<td>Steep</td>
</tr>
</tbody>
</table>

2.3 Calculate the vertical exaggeration for the cross section you have chosen.

a. Vertical scale: 1:30 000 ✓ ✓  

b. Vertical exaggeration: 1.67 times. ✓ ✓

Calculations:

a. \(300 \text{m} \times 100 = 30 000\)

b. \(\text{VE} = \frac{\text{VS}}{\text{HS}}\)
   \[= \frac{1}{30 000} \times \frac{1}{50 000} \text{ or } \frac{50 000}{30 000}\]
   \[= 1.67 \text{ times}\]
2.4  
\[ \begin{align*} 
\text{a. } & \quad 4 \text{ 100 metres } \\
\text{b. } & \quad 933.1 \text{ meters } \\
\text{c. } & \quad \text{Gradient } 1:4.4 
\end{align*} \]

Calculations:

\[
\text{Gradient} = \frac{\text{VI}}{\text{HE}} \quad \text{or} \quad G = 1: \frac{\text{D}}{\text{H}} \quad (G = 1: \frac{\text{HE}}{\text{VI}})
\]

\[
\begin{align*} 
\text{VI} & = 1 \ 003.1 - 70 \ m \\
& = 933.1 \ m \\
\text{HE} & = 8.2 \ \text{cm} = 4.1 \ \text{km} = 4 \ 100 \ m \\
\end{align*}
\]

\[
\begin{align*} 
\text{Gradient} & = \frac{933.1 \ m}{4100 \ m} \ \text{or} \ 1: 4100 \ m / 933.1 \ m \\
& = 1: 4.39 \\
\end{align*}
\]

2.5  
\[ \begin{align*} 
\text{a. } & \quad \text{Length: } 420 \ m \\
\text{b. } & \quad \text{Breadth: } 110 \ m \\
\text{c. } & \quad \text{Area: } 46 \ 200 \text{m}^2 \\
\text{d. } & \quad \text{Area: } 4.62 \ \text{ha} \\
\end{align*} \]

Calculations:

\[
\begin{align*} 
\text{a. } & \quad 4.2 \text{cm} \times 100 = 420 \text{m} \\
\text{b. } & \quad 1.1 \text{cm} \times 100 = 110 \text{m} \\
\text{c. } & \quad 420 \times 110 = 46 \ 200 \text{m}^2 \\
\text{d. } & \quad 46 \ 200 / 10000 = 4.62 \ \text{ha} \\
\end{align*}
\]

**QUESTION 3** Interpretation and application of photographs, topographical maps and orthophoto maps

3.1 Photograph analysis

Study Photograph 1 that was taken in block A5 from Longridge Winery looking towards the Helderberg mountain range.
3.1.1 In which direction was the camera pointing when the photograph was taken?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>West</td>
</tr>
<tr>
<td>B</td>
<td>South-west</td>
</tr>
<tr>
<td>C</td>
<td>East</td>
</tr>
<tr>
<td>D</td>
<td>South-east</td>
</tr>
</tbody>
</table>

(2)

3.1.2

3.2 Refer to the topographic map and orthophoto map.

3.2.1 Name the functional zones of the areas numbered on the orthophoto map:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Holiday flats / Caravan park – recreational/tourism ✓</td>
</tr>
<tr>
<td>2</td>
<td>Planned residential / Low-income residential ✓</td>
</tr>
<tr>
<td>3</td>
<td>School ✓</td>
</tr>
<tr>
<td>4</td>
<td>Commercial (shopping centre) as next to a station / storage warehouses / light industry. ✓</td>
</tr>
</tbody>
</table>

(4)

3.2.2 5: Bridge (secondary road going over the railway line) ✓ ✓

6: Dam ✓ ✓

(2x2) (4)

3.2.3 a. Farming / agriculture / viticulture (growing grapes) ✓ ✓

b. Urban areas will spread out into the farmlands taking up good soils and lands for growing grapes ✓ ✓. There will be less area to farm if more urban development takes place. ✓ ✓

(2x2) (4)

3.2.4 The town of Somerset West is located on flat land as it is easier and cheaper to build on flat land ✓ ✓. The roads follow the flattest course possible and that is mainly along the coastline ✓ ✓. The R44 travels inlands and again the flattest route is taken as there is the Helderberg Mountain range to consider in the area. The railway line also follows the flatter coastal route. ✓ ✓ (Any 2)

(2x2) (4)
3.2.5 Billboard

Excellent (5 marks)
Many attractions stated using map evidence
Good design for a billboard, clear and eye catching

Good (3-4 marks)
Few attractions stated
Some design planning and lay out

Poor (1-2 marks)
One or two attractions stated and not necessarily found on the map
Little thought gone into design, untidy and no planning shown.

0 marks
No attempt

QUESTION 4 Geographic Information Systems (GIS)

4.1 Horizontal photographs ✓✓
Aerial photographs ✓✓
Field notes ✓✓
GPS (Global Positioning System) ✓✓
Satellite imagery ✓✓
Topographical maps and other paper maps ✓✓
Thermal scanners and radar ✓✓

(Any 3) (3x2) (6)

4.2 a. A theme of information or data that is collected and can form a layer of information ✓✓ that can then be superimposed ✓✓ over other thematic layers of information or data to make the information more meaningful.

(4)

b. Place names / suburb names / area names ✓✓
Road names ✓✓

(2x2) (4)

TOTAL 75 marks
SECTION 2

Class work exercise memo – synoptic weather maps

Suggested time: 45-60 mins

Marks: 50

1.1 Complete the table below.

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Season: SUMMER ✔</td>
<td>Season: WINTER ✔</td>
</tr>
<tr>
<td>1.1.2 Justification:</td>
<td>1. Justification:</td>
</tr>
<tr>
<td>1. There is a thermal low present</td>
<td>1. Although no high pressure cell is</td>
</tr>
<tr>
<td>over the interior of South Africa</td>
<td>visibly present, the pressure over</td>
</tr>
<tr>
<td>– this is due to hot summer</td>
<td>the interior of South Africa is high</td>
</tr>
<tr>
<td>temperatures and the rising</td>
<td>– this is due to cooler winter</td>
</tr>
<tr>
<td>of air. ✔</td>
<td>temperatures and the sinking of air.</td>
</tr>
<tr>
<td>OR</td>
<td>✔</td>
</tr>
<tr>
<td>The cold front of the mid-latitude</td>
<td>OR</td>
</tr>
<tr>
<td>cyclone is passing south of South</td>
<td>The cold front of the mid-latitude</td>
</tr>
<tr>
<td>Africa due to all the pressure belts</td>
<td>cyclone is passing over South Africa</td>
</tr>
<tr>
<td>shifting southwards during the</td>
<td>due to all the pressure belts</td>
</tr>
<tr>
<td>southern hemisphere summer. ✔</td>
<td>shifting northwards during the</td>
</tr>
<tr>
<td>(2)</td>
<td>southern hemisphere winter. ✔</td>
</tr>
<tr>
<td>2. The weather stations at Pretoria</td>
<td>2. The weather stations at Upington</td>
</tr>
<tr>
<td>or Bloemfontein show overcast</td>
<td>and Bloemfontein indicate clear</td>
</tr>
<tr>
<td>conditions that are typical of</td>
<td>weather conditions that are</td>
</tr>
<tr>
<td>unstable conditions and rising</td>
<td>typical of stable conditions</td>
</tr>
<tr>
<td>warm air. ✔</td>
<td>associated with subsiding air. ✔</td>
</tr>
<tr>
<td>OR</td>
<td>(2)</td>
</tr>
<tr>
<td>The South Atlantic High is riding</td>
<td>Cannot use a Tropical Cyclone as an</td>
</tr>
<tr>
<td>around the southern tip of South</td>
<td>answer – there is none present. (2)</td>
</tr>
<tr>
<td>Africa which typically occurs in</td>
<td></td>
</tr>
<tr>
<td>summer due to the shifting of the</td>
<td></td>
</tr>
<tr>
<td>pressure belts southwards during the</td>
<td></td>
</tr>
<tr>
<td>southern hemisphere summer. The SAH</td>
<td></td>
</tr>
<tr>
<td>has a blocking effect on passage of</td>
<td></td>
</tr>
<tr>
<td>the mid-latitude cyclone. ✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.2 A South Atlantic High ✔ ✔

B South Indian High ✔ ✔

(2x2=4)

1.3.1 C Thermal low ✔ ✔

1.3.2 Summer – Temperatures are high, therefore warm, unstable air rises and creates a low pressure area at the surface. ✔ ✔

(2)

1.3.3 • Overcast due to warm, moist air rising, cooling condensing and forming clouds. ✔ ✔

• Rain is a possibility due to the warm, moist air rising. ✔ ✔

• Thunderstorms are also a possibility due to the unstable, rising, moist air. ✔ ✔ (Any 2)

(2x2=4)

1.4.1 D Mid-latitude cyclone ✔ ✔

1.4.2 • The mid-latitude cyclone has moved northwards as it is winter in the southern hemisphere and all the pressure belts shift northwards. ✔ ✔

• The low pressure centre of the mid-latitude cyclone is south of South Africa and the cold front is passing over the land. ✔ ✔

(2x2=4)
1.4.4 a. **Weather at Upington**
- Air temperature of 21°C
- Dew point temperature -1°C
- Precipitation is nil
- Cloud cover is 0/8 or clear
- Wind direction is ESE, and
- Wind speed is 10 knots

b. - Clear conditions as it is winter. Cold air is stable and subsides resulting in no cloud cover. ✓✓
- There is no possibility of rain as stable air sinks and therefore no evaporation can take place. ✓✓
- The air temperature and dew point temperature are also far apart, indicating a large range between the two temperatures, therefore little chance of rain. ✓✓
- Air is blowing anti-clockwise around the South Atlantic High hence the wind direction being ESE. ✓✓

(Any 2) (2x2=4)
SECTION 3

Fluvial geomorphology  The Gouritz drainage basin
Marking guidelines

Class exercise – looking at drainage basin characteristics
Time: 45 minutes
Marks: 50

1.1 The shape of the drainage basin is round or circular.

1.2 a. The total annual rainfall for Goudveld is 859 mm. Allow a range. (845-870 mm)

b. Rain occurs throughout the year; rainfall is quite high for the area.

c. Nature of the rocks

d. A sketch of the perennial streams in the Gouritz Drainage basin is provided in Figure 2 below.

Figure 2  Stream ordering of the Gouritz River system

(i) Stream order 1  2  3  4
Number of streams 3  7  3  1
Table 1

(ii) The relationship that is represented in the graph above: as the stream order increases, the number of tributaries in that order decreases (or vice versa). It is an inversely proportional relationship.
1.3 a. Graph B

The area is quite densely forested and therefore the amount of runoff is reduced and the rate of flow is also reduced. The base level also takes longer to recharge. ✔✔

b. 

Explanation
The rate of runoff and amount would increase ✔✔. There would be no interception ✔✔ of rainfall and more surface runoff. ✔✔

b. • Protected area – therefore good conservation practice ✔✔
• Forested area – this helps with ground water recharge ✔✔
• Covered with vegetation – reduces the level of erosion; prevents silting of streams ✔✔ and wash away of valuable topsoil ✔✔

Recommendations
• Building of storage dams in the upper catchment; reduces flooding runoff and provides water in the long term ✔✔
• Continue to protect the catchment area by maintaining hiking trails ✔✔
• Prevent any form of water pollution; maintain the self-regulating properties of rivers. ✔✔
Classwork task  Superimposed drainage, river capture and flooding

Marking guidelines
Suggested time: 45 minutes – 1 hour
Marks: 60

1. Superimposed drainage
1.1 Complete the sentences below by underlining the correct term in brackets:
   a. The surface is eroded and the river may reach (older ✓✓/ younger) underlying rock.
   b. The stream network has a pattern, which bears (a relation / no relation ✓✓) to the geology and relief of the landscape.
   c. The river (maintains ✓✓/ changes) its original course. (3x2)(6)

1.2 With the aid of annotated diagrams, explain the development of this superimposed section of the Orange River. (2x3)(6)

2. Tugela River System
2.1 a. Watershed
   The catchment area of two adjacent drainage basins – dividing river flow. Water will flow from the watershed downslope into the drainage area ✓✓
Knickpoint
Sometimes a smooth profile may be interrupted by a knickpoint. A knickpoint may be caused by rapids, waterfalls, dam walls or any interruption in the river course to give a multi-concave, or ungraded profile. The knickpoint creates a temporary base-level of erosion, and the river is unable to erode the landscape upstream so that it is lower than the knickpoint or waterfall.

Headward erosion
Refers to the retreat (backward movement) of the source of rivers without the loss of steepness, especially in arid regions. ✓✓

b. Basalt ✓✓
c. Highly jointed rock and high rainfall – active erosion takes place along the joints ✓✓
   Landscape carved ✓✓
   Rejuvenation takes place and rivers erode actively ✓✓
   Uplift of landscape also renew vigour of rivers ✓✓ (Any 2)

2.2 a. Qwa Qwa River ✓✓
b. Tugela River ✓✓
c. • Higher rainfall on eastern slopes ✓✓
   • Steeper slopes along the eastern side ✓✓
   • An increased volume of water, important for damming below the escarpment ✓✓
   • Renewed erosion along the upper course of the river ✓✓
3.2 Evaluate the impact flooding has on the surrounding agricultural land. Mention both positive and negative impacts. Tabulate your answer.

<table>
<thead>
<tr>
<th>Positive impacts of flooding</th>
<th>Negative impacts of flooding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Deposits silt on the floodplain ✓✓</td>
<td>1. Washes away valuable topsoil; river banks and crops ✓✓</td>
</tr>
<tr>
<td>2. Recharges water table /ground water sources ✓✓</td>
<td>2. Loss to farmers – crops, animals and valuable topsoil ✓✓</td>
</tr>
</tbody>
</table>

Any suitable evaluation
SECTION 4

Case Study – South Africa’s Land Reform Program

Suggested time: 45 minutes – 1 hour
Marks: 50

Read Articles 1, 2 and 3 carefully before answering the questions.

1. **Food security:** This refers to the availability of food and one’s access to it. A household is considered food-secure when its occupants do not live in hunger or fear of starvation. ✓✓

**Land reform:** This refers to transfer of land ownership. This transfer occurs from a relatively small number of wealthy owners to individual ownership by those who work the land. ✓✓

**Land redistribution:** This involves the provision of land to the black majority who are unable to afford to buy land. ✓✓

**Land restitution:** This is the return of ancestral land to its original owners. Land restitution involves compensating those who lost land during the apartheid era. ✓✓

**Land tenure:** This is to secure the rights of those living on land that is owned by others i.e. to protect labour tenants from eviction and give them rights to acquire ownership of the land they are living on. ✓✓ (5x2) (10)

2. • Sustainable means to make sure that there are resources for available for use by future generations, so this would mean using the land and resources available now wisely. ✓✓
   • Development and upliftment of rural areas. ✓✓ (2x2) (4)

3. • The majority of South Africa’s population live on mostly unproductive land. This was due to race segregation during apartheid. 87% of the land was owned by whites and 13% by blacks. ✓✓
   • It is important that more black people become land owners and are able to farm to sustain their needs as well as produce extra for sale in the commercial markets. ✓✓
   • Land distribution needs to be more evenly balanced between black and white farmers. ✓✓
   • People that were forcibly removed from their land have the right to get their land back. ✓✓ (Any 3 points) (3x2) (6)
Social Challenges
- Possible violent clashes between land owners and non-landowners. This change process needs to be carefully monitored.
- Some commercial farmers choose to leave South Africa to farm elsewhere in Africa – with them goes knowledge and expertise.
- Teaching, training and changing the mind-set of rural communities who are granted with new land ownership.
- Union driven strikes – can turn violent.
- Farm attacks. (Any 2)

Financial Challenges
- Breaking up commercially efficient enterprises for land reform poses a danger to food security and potential excess of agricultural products for exports (which brings in foreign exchange).
- The very high costs of buying land and redistributing it will have a major financial impact.
- Changing the wealth and income distribution of the South African people
- Productivity levels of farms may decrease with subsequent poor financial return for new farmers (which may then need financial aid and intervention)
- Training and teaching new land-owners how to farm commercially and in a financially viable manner carry’s huge costs. (Any 2)

Environmental Challenges
- Degradation of the lands leading them to be unproductive.
- Soil erosion, soil infertility, poor farming methods.
- Removal of indigenous vegetation to create more farming space. (Any 2)

5. The success of land reform is debatable. The reasons for this are:
   - The process of acquiring and distributing a particular piece of land is often lengthy, and this increases the cost of redistribution because the former owner stops investing in the land. ✔✔
   - Many of the redistributed farms are in a poor state of repair at the point of acquisition due to farmers moving off the land and them to go into a state of disrepair. ✔✔
   - Poor support packages from the Government for these "new" farmers which worsens the problems of low productivity and poor crop production. ✔✔
   - No incentives for previous commercial farmers to support and mentor the "new" farmers so experienced, knowledgeable farmers move on and leave their farms to inexperienced "new comers" who are ill equipped to maintain productivity levels. ✔✔

6. He warns that South Africa's food security is endangered by its disorganised rural land reform. In the article, "Farms collapse as land reform fails", Mthethwa's investigation uncovers the failures of the land reform programme showing thousands of formerly productive farms lie abandoned. ✔✔ He claims that many commercial farmers, as a result of the uncertain future of the South African land reform process, are halting investment in their properties with some leaving the country for neighbouring Mozambique and Botswana. ✔✔

7. Effective administration and management is vital to the success of the land reform program. Claims need to be processed and finalised as quickly as possible. Money needs to be managed and spent correctly and effectively. ✔✔

When farms are handed over there needs to be a clear plan in place for educating and equipping the new land owners with the skills and knowledge on how to continue high productivity levels and getting effective returns out of the land. ✔✔

Investment in agriculture and agro-processing is vital to food security in South Africa and the failure to successfully achieve land and agricultural reform has negatively impacted food security. National levels of malnutrition and under nutrition are now a major concern in a food exporting nation like South Africa. ✔✔

Land reform, food security, market reform and access to a balanced diet are each aspects that have not been adequately addressed and in order for South Africa to become food secure, more focus needs to be placed on ensuring that land reform is a more holistic, achievable and accessible approaches where very clear support structures are in place. ✔✔

TOTAL 50
Photograph Analysis

Time: 60 minutes
Marks: 65

<table>
<thead>
<tr>
<th>Photograph 1</th>
<th>Photograph 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rural ✓</td>
<td>1. Rural ✓</td>
</tr>
<tr>
<td>2. Subsistence ✓</td>
<td>2. Subsistence ✓</td>
</tr>
<tr>
<td>3. Nucleated ✓</td>
<td>3. Dispersed ✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photograph 3</th>
<th>Photograph 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rural ✓</td>
<td>1. Rural ✓</td>
</tr>
<tr>
<td>2. Commercial ✓</td>
<td>2. Commercial ✓</td>
</tr>
<tr>
<td>3. High ✓</td>
<td>3. Yes on flat land at foothills of the mountains ✓</td>
</tr>
<tr>
<td>4. High capital investment (lots of money invested) ✓</td>
<td>4. Yes, isolated ✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photograph 5</th>
<th>Photograph 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Urban ✓</td>
<td>1. Pollution ✓</td>
</tr>
<tr>
<td>2. Nucleated ✓</td>
<td>• Poor infrastructure ✓</td>
</tr>
<tr>
<td>3. Town ✓</td>
<td>2. Poor municipal services ✓</td>
</tr>
<tr>
<td>4. Low order ✓</td>
<td>3. Low order ✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photograph 7</th>
<th>Photograph 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Urban ✓</td>
<td>1. High income ✓</td>
</tr>
<tr>
<td>2. Yes ✓</td>
<td>2. Low income ✓</td>
</tr>
<tr>
<td>3. Low order ✓</td>
<td>3. B ✓</td>
</tr>
<tr>
<td>4. Retail (shops), cell phone communication ✓</td>
<td>4. Buffer zone ✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photograph 9</th>
<th>Photograph 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High density ✓</td>
<td>1. CBD ✓</td>
</tr>
<tr>
<td>2. High income ✓</td>
<td>2. High land values ✓</td>
</tr>
<tr>
<td>3. Tourism ✓</td>
<td>3. Urban decay ✓</td>
</tr>
<tr>
<td></td>
<td>4. Pollution, congestion, informal settlements, overcrowding and unemployment ✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photograph 11</th>
<th>Photograph 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Urban blight ✓</td>
<td>1. Informal ✓</td>
</tr>
<tr>
<td>2. Yes ✓</td>
<td>2. False ✓</td>
</tr>
<tr>
<td>3. Low order ✓</td>
<td>3. High unemployment levels ✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photograph 13</th>
<th>Photograph 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low cost ✓</td>
<td>1. Suburban office park</td>
</tr>
<tr>
<td>2. RDP ✓</td>
<td>2. Decentralised – outside the CBD</td>
</tr>
<tr>
<td>3. RDP – Reconstruction and Development Program ✓</td>
<td>3. Cheaper land, more space, easily accessible, cleaner environment, no traffic congestion.</td>
</tr>
<tr>
<td>IDZ – Industrial development Zone ✓</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photograph 15</th>
<th>Photograph 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High density residential ✓</td>
<td>1. Heavy</td>
</tr>
<tr>
<td>2. Urban renewal ✓</td>
<td>2. High</td>
</tr>
<tr>
<td>3. In CBD ✓</td>
<td>3. False</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photograph 17</th>
<th>Photograph 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Green belt ✓</td>
<td>1. Residential estate ✓</td>
</tr>
<tr>
<td>2. • Trees release oxygen and take in carbon dioxide</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Healthy, clean air</td>
</tr>
<tr>
<td></td>
<td>• Open space to walk or for recreation</td>
</tr>
<tr>
<td></td>
<td>• Visually appealing ✓ ✓</td>
</tr>
<tr>
<td>3. True ✓</td>
<td>3. High ✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Photograph 5</th>
<th>Photograph 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Urban ✓</td>
<td>1. High income ✓</td>
</tr>
<tr>
<td>2. Yes ✓</td>
<td>2. Low income ✓</td>
</tr>
<tr>
<td>3. Low order ✓</td>
<td>3. B ✓</td>
</tr>
<tr>
<td>4. Retail (shops), cell phone communication ✓</td>
<td>4. Buffer zone ✓</td>
</tr>
</tbody>
</table>

TOTAL 65
SECTION 5

Class Test Economic Geography of South Africa – marking guidelines

Suggested time frame: 1 hour
Marks: 65

1. Definitions for:
   a. primary sector – activities that involve the extraction and exploitation of raw materials from the environment which included fishing, mining, forestry and farming ✔ ✔
   b. centralisation ✔ ✔
   c. food security – the access to food at any given time. ✔ ✔ (3x2) (6)

2. Agriculture in South Africa

   a. See the black line on the map. ✔ ✔ (2)
   b. The isohyet line separates South Africa into those areas on the eastern ✔ ✔ half which receives 500mm and more rainfall per annum. Areas west of the line receive less than 500mm of rainfall in a year. The location of crops and the type of crop will be determined by its growing needs such as the amount of water needed as well as amount of sunlight available. ✔ ✔ (2x2) (4)
   c. Maize is the staple food in South Africa. ✔ ✔ (1)
   d. i. Winter wheat is located in the Western Cape and wheat is located in the Free State, North West and Gauteng. ✔ ✔ (2)
      ii. Winter wheat’s main growing season is in the winter and the crop needs winter rainfall. ✔ ✔ Summer growing wheat that relies on summer rainfall. ✔ ✔ (2)
   e. In developed countries, crops are being grown for the production of biofuels.
      i. Potatoes ✔ ✔, maize ✔ ✔, sugar cane ✔ ✔, sunflower seeds ✔ ✔ (Any 2) (2)
      ii. Advantages of using biofuels – biofuels are a cleaner burning source of energy, coal is running out, CO₂ emissions from coal are causing greenhouse gases to increase which increases temperature. ✔ ✔ Disadvantages – growing population in South Africa increases the demand for food, maize is our staple diet and is needed for food security, good agricultural land is being used not to produce food. ✔ ✔ (2x2) (4)
   f. • Climate – areas prone to drought, erratic rainfall, uneven spread of rainfall, irrigation water is expensive. ✔ ✔ • Climate change – loss of crops such as maize as weather becomes hotter and drier, flooding of areas where rainfall has intensified. ✔ ✔ • Historical land situation – poverty limits agricultural development, results in little improvement of animal and crop strains, poor soil management, training of farmers, use of insecticides. ✔ ✔ • Trade – price fluctuations caused by foreign competition, crime and farm attacks an issue of safety, rising prices of staple products like maize affects affordability of food. ✔ ✔
3. Mining in South Africa
   a. Mining belongs to the primary economic sector. ✓ ✓ (2)
   b. The major coal mines are mainly found in the northern areas of KZN ✓ as well as in the Mpumalanga ✓ (2)
   c. Factors that hinder coal mining in South Africa include: labour unrest ✓, aging infrastructure ✓, exporting coal which is far from the coast ✓, environmental issues ✓ and the restoration of the land, acid mine drainage ✓, workforce has been impacted by HIV/AIDS. ✓ (Any 2 factors) (2x2)(4)
   d. South African electricity is generated mainly by burning coal ✓ ✓. 94% of the electricity used is from coal fired power stations ✓ ✓. The rest is generated from alternative sources such as nuclear, gas, wind, hydro-power and solar power. ✓ ✓ (Any 2) (2x2)(4)

4. Secondary and tertiary economic sectors
   a. Value-added industry – industries that turn a basic resource or material into a product and by doing so add more value to it. An example would be juice factory making juices from fruit. ✓ ✓ (2)
   b. An areotropolis is the building and development of industries around an international airport ✓ ✓. These industries use the services of the airport allowing for the quick and efficient exporting of perishable goods. It also reduces transport costs. ✓ ✓ (2x2)(4)
   c. Complete the table comparing the two case studies.

<table>
<thead>
<tr>
<th>Advantages of the location</th>
<th>Dube Tradeport</th>
<th>East London Development zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural activities, IT, trade retail ✓ ✓</td>
<td>Automobile, agro-industry, IT ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Closest city</td>
<td>Durban ✓</td>
<td>East London ✓</td>
</tr>
<tr>
<td>Benefits for the area</td>
<td>Development of the periphery, job creation, less congestion ✓ ✓</td>
<td>Job creation, develops the area, infrastructure ✓</td>
</tr>
</tbody>
</table>

(4x2)(8)

5. Types of informal activities
   - Entertainment,
   - Arts and crafts like beadwork, basket weaving,
   - Medical treatments such as herbs and sangomas
   - Building industry
   - Fast food stalls, spaza shops
   - Transport taxis
   - Manufacturing – sewing, panel beaters, (Any 2) (2x2)
   - Advantages and disadvantages of the informal
   - Advantages – contributes to the economy, reduces unemployment, encourage entrepreneurs, no overheads or rent, provides a cheap service to others, can become a tourist attraction like a basket market. (Any 1)
   - Disadvantages
     - No money goes to the tax payer
     - No control or regulations as with a formal business
     - Litter and unhealthy conditions
     - Clutter the walk ways in streets (Any 1)