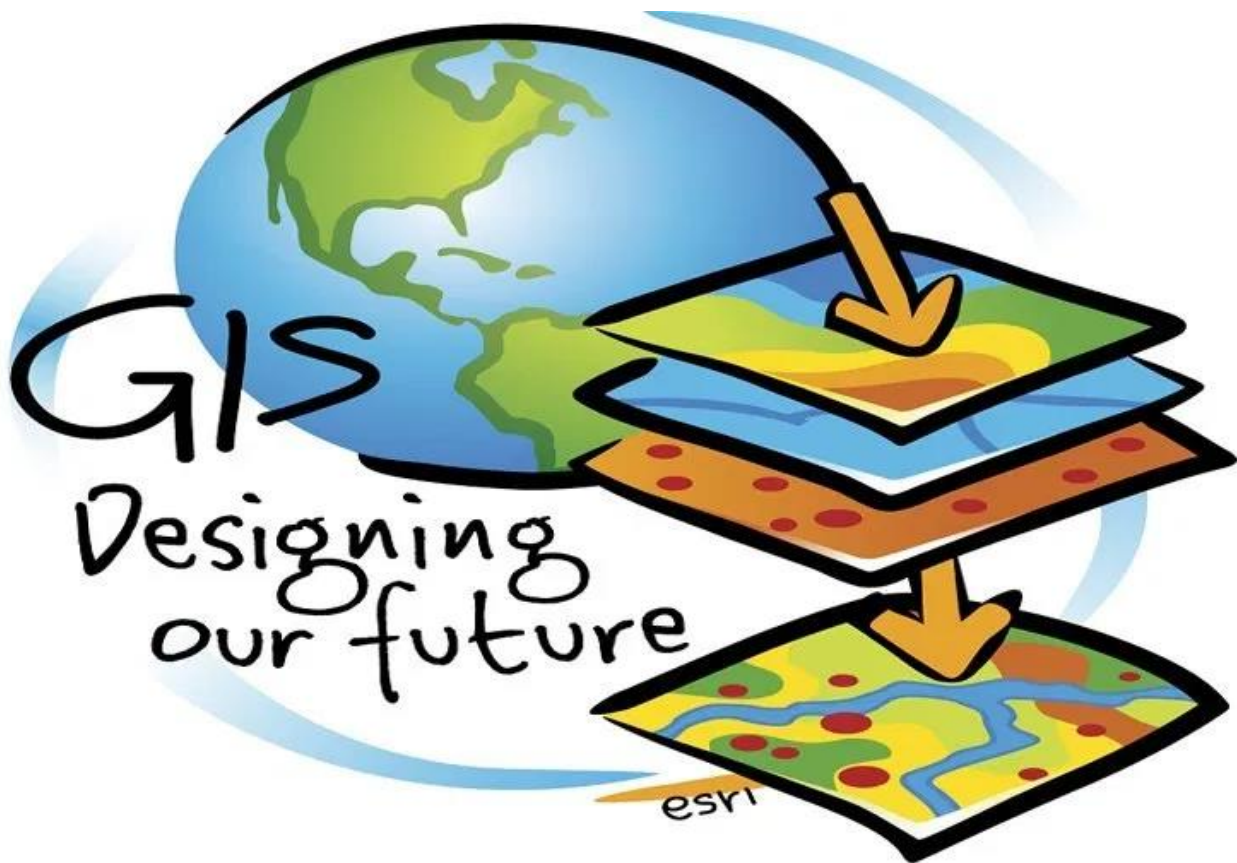




Revision Lecture Notes

(Compiled by Jocelyn Altona de Klerk and Marilda van Niekerk)
(Presented by Jocelyn Altona de Klerk)



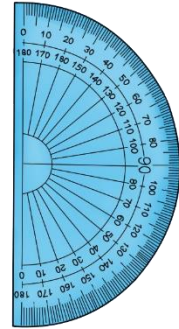
Mapwork & GIS

MAPWORK NOTES

1. Equipment

Make sure that you always have the correct equipment for mapwork.

- a good ruler
- a 360° protractor
- a sharp pencil
- a piece of string
- a few coloured pencils/ highlighters.



wonkeedonkeetools.co.uk

2. Political Map of South Africa

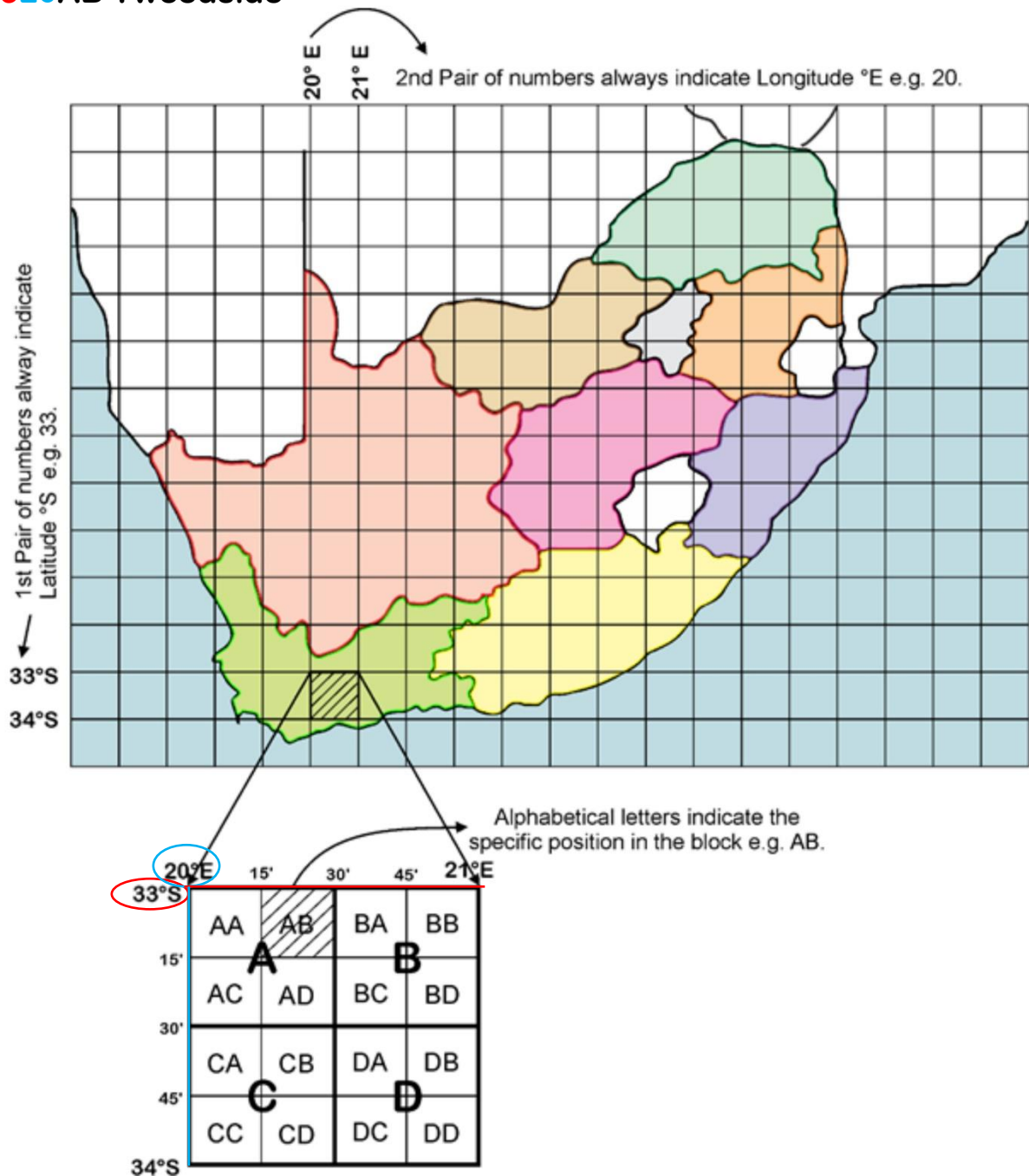
- This map shows the major political features of a region.
- Know your map of RSA with provinces, capitals, neighbouring countries, oceans & currents.
- The first few multiple - choice questions in the exam are asked on this.



3. Map reference number / Map code

- Each map sheet has a number at the top which indicates exactly where the sheet fits into the Index chart of all the **1 : 50 000 sheets** of South Africa.
- This is known as the reference number of the map e.g. **3320AB Tweedside**.
- The first number **33** refers to the latitude line.
- The second number **20** refers to the longitude line.

3320AB Tweedside



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4. Co-ordinates

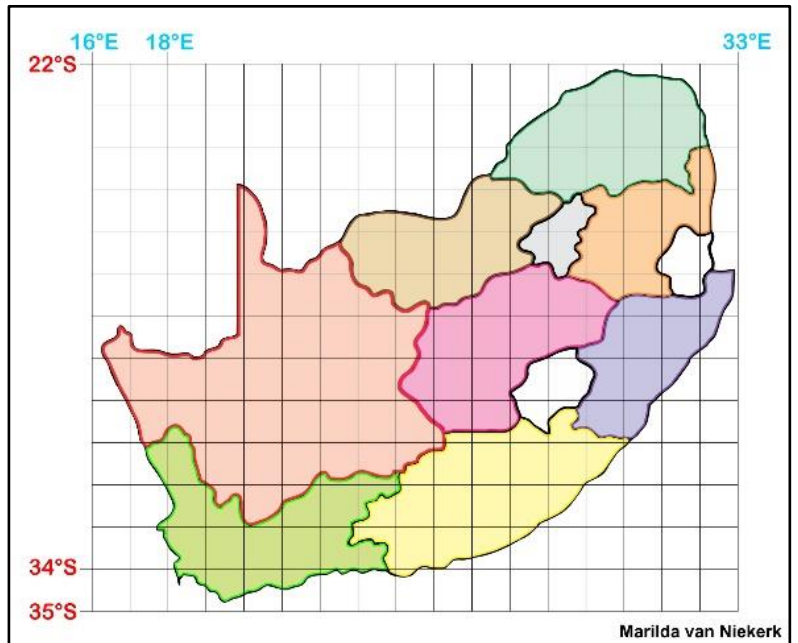
- The 'A' of **L**atitude comes before the 'O' of **L**ongitude so Latitude is always FIRST.
- Write co-ordinates in ONE line.

4.1. Latitude

- 'Flat'itude (the lines going across the page) in a flat line.
- South Africa is always **South** of the equator between 22° S and 35° S.

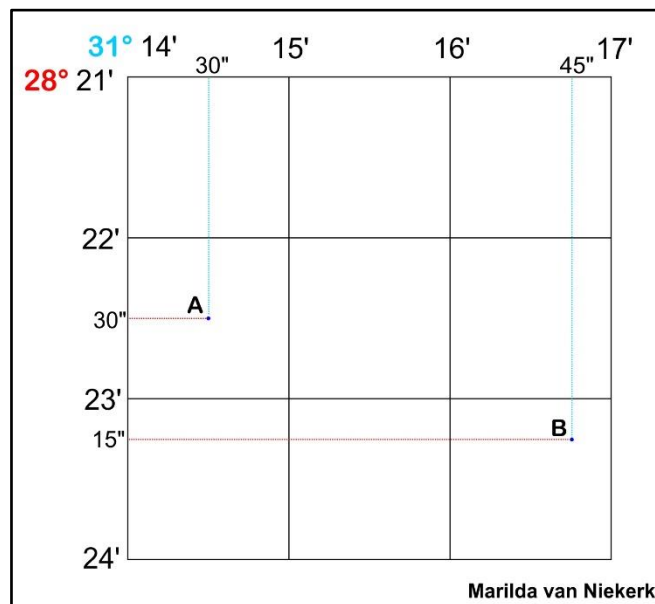
4.2. Longitude

- South Africa is always **East** of the Greenwich meridian between 16° E and 33° E.
- The lines go long ways down the page from top to bottom.



4.3. Calculation of co-ordinates

- Calculate the co-ordinates of A and B below, using the diagram below.
- In each case, the exact degrees and minutes are calculated but the seconds need to be estimated (there is 5" leeway for the seconds).
- South and East must also be added for this to be correct.
- The answers for A and B will be given in the Mapwork webinar.



5. Direction and Bearing

5.1. Direction

- Direction is indicated by a compass.
- There are 16 CARDINAL compass directions.
- Read the question carefully – look out for the word '**from**'.

What is the direction **from** A to B?
East-north-east (ENE)

A compass rose with 16 directions. North (N) is at the top. East (E) is to the right. South (S) is at the bottom. West (W) is to the left. The direction from A to B is ENE.

What is the direction of A **from** B?
West-south-west (WSW)

A compass rose with 16 directions. North (N) is at the top. East (E) is to the right. South (S) is at the bottom. West (W) is to the left. The direction of A from B is WSW.

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5.2. Bearing

- This is the angle measured **clockwise** from north.
- It is more accurate than direction.
- Read the question carefully.

What is the bearing **from** A to B?
 68°

A diagram showing a compass rose with a line from point A to point B. The bearing from A to B is 68 degrees.

What is the bearing of A **from** B?
 $180^\circ + 69^\circ = 249^\circ$

A diagram showing a compass rose with a line from point B to point A. The bearing of A from B is 249 degrees, calculated as 180 degrees plus 69 degrees.

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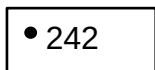
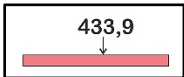
5.3. The direction a river flows in

- Rivers flow downhill from high lying areas to lower lying areas (the sea).
- Tributaries enter the main river and point downstream.
- A dam wall always faces downstream (water can only get through the wall through sluice gates).

6. Scale & distance

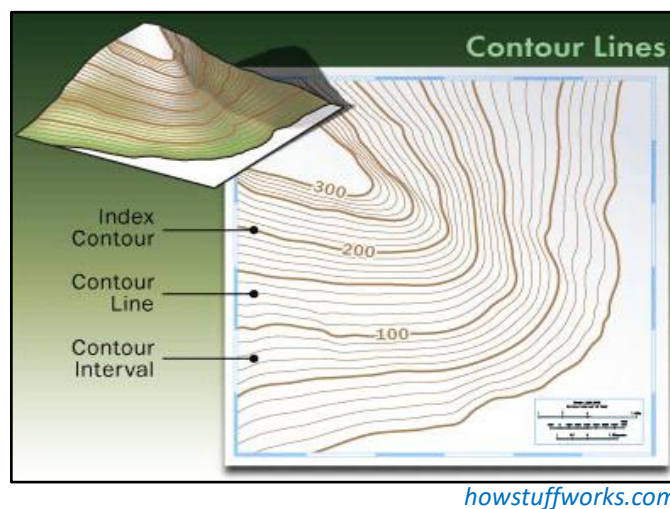
- 1: 50 000 means 1cm on a map = 50 000 cm in reality.
- Let's convert this to more realistic units:
As there are 100 cm in 1m, we divide 50 000 by 100 to convert to meters.
 $1\text{cm} = 500\text{m} = 0.5\text{km}$
- GOLDEN RULE: on a 1:50 000 map, measure the distance in cm & divide by 2 (to get km). e.g. 20cm = 10km.
- Distance can be asked in two ways:
 - The straight-line distance between two places (as the crow flies).
 - The actual distance = the real distance e.g. along a curvy road or river. It is easiest to calculate distance on the map with a piece of string, then use your ruler to measure it in cm and then convert it to the units asked for (usually km).

7. Height on maps

- This is given as height in **meters** above sea level.
- There are 4 ways of showing it:
 - A trig beacon 
 - Spot height 
 - Benchmark (height of roads/ railways) 
 - Contour lines (usually in 20m intervals, every 5th one is darker)

8. Contour lines

- A contour is a line drawn on a map that connects places with the same height above sea level.
- Certain contour lines are printed DARKER.
- They are known as **INDEX CONTOURS**.
- The difference in height between successive contours is known as the **CONTOUR INTERVAL**.



8.1. Slopes

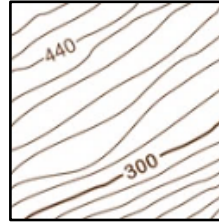
a) Gradual slope:

- Contour lines are far apart.



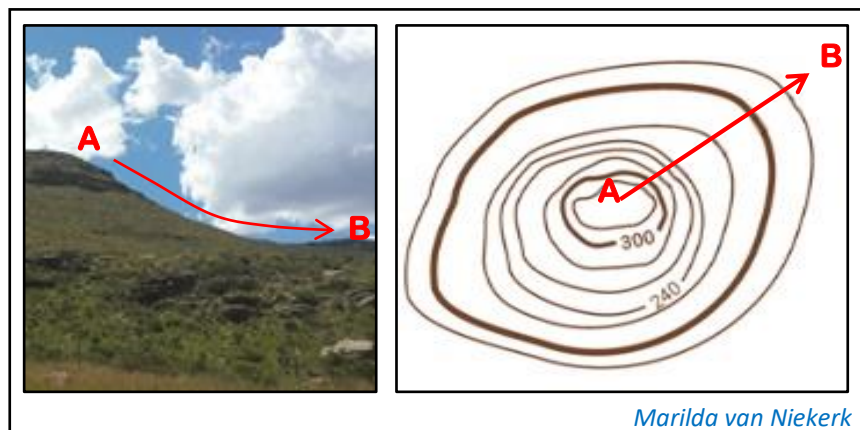
b) Steep slope:

- Contour lines are close together.



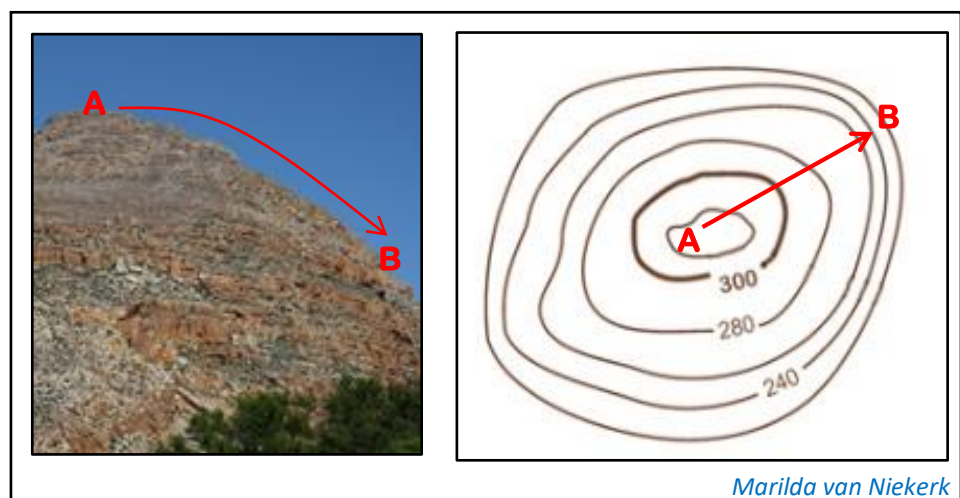
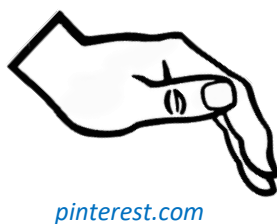
c) Concave slopes:

- Hollow /cave shaped.
- Hold your hand as shown in the photo below: Your fingers represent the land which is steep on top (contours close together) and gentle at the bottom (contours far apart).



d) Convex slopes:

- Bulb shaped.
- Hold your hand as shown in the diagram: Your hand represents gentle land on top (contour lines far apart) and steep land below (contour lines close together).



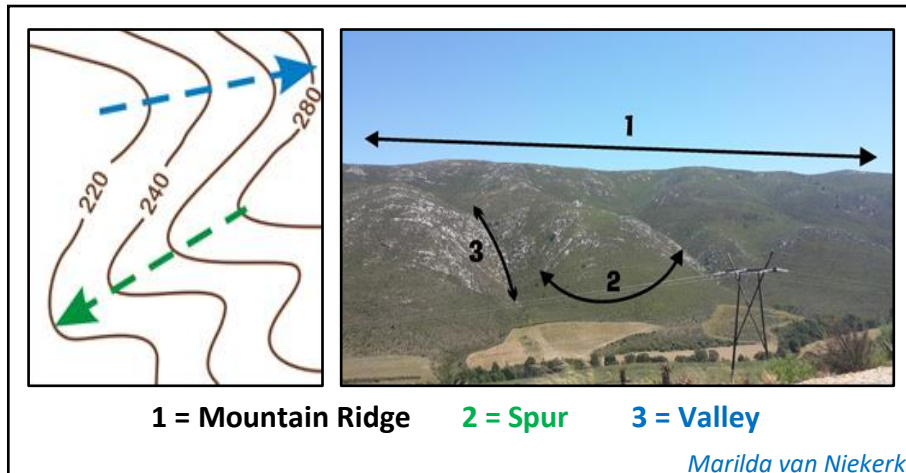
8.2. Landforms

a) **Spur: a tongue of land descending from a mountain**

- Contour lines curve towards the lowest contour (see 2 on the diagram below).

b) **Valley: a low area between hills/ mountains**

- Contour lines curve towards the highest contour (see 3 on the diagram below).
- Usually a valley has a river flowing in it.



9. Area

- Area = L (length in m or km) x B (breadth in m or km)
- Always do the calculations the long way round by measuring in cm first and then converting to km using the golden rule (divide by 2 on a 1: 50 000 map).
- On an orthophoto, the scale is usually 1: 10 000 so 1cm = 100 m

Calculation:

NB! Always do conversion before applying the formula for km or m.

a) **Answer in kilometres**

Scale: 1: 50 000

$$L = 8 \text{ cm} \div 2 = 4 \text{ km}$$

$$B = 3 \text{ cm} \div 2 = 1,5 \text{ km}$$

$$\text{Area} = l \times b$$

$$= 4 \text{ km} \times 1,5 \text{ km}$$

$$= \underline{6 \text{ km}^2}$$

b) **Answer in meters**

Scale: 1: 50 000

$$L = 8 \text{ cm} \div 2 = 4 \text{ km} (\times 1\,000 \text{ to convert from km to m}) = 4\,000 \text{ m}$$

$$B = 3 \text{ cm} \div 2 = 1,5 \text{ km} = 1\,500 \text{ m}$$

$$\text{Area} = l \times b$$

$$= 4\,000 \text{ m} \times 1\,500 \text{ m}$$

$$= \underline{6\,000\,000 \text{ m}^2}$$

c) **Answer in hectares**

- Do your calculation in meters (as above) and convert your answer to hectares.
- **1 ha = 10 000 m²**
Area = 6 000 000 m² (÷ 10 000 to convert to ha)
= 600 ha

Scale: 1: 10 000 (1cm = 100 m so the golden rule is to x cm by 100 to get meters)

L = 8 cm (x 100) = 800 m = 0,8 km (÷ by 1000 to convert from m to km)

B = 3 cm (x 100) = 300 m = 0,3 km

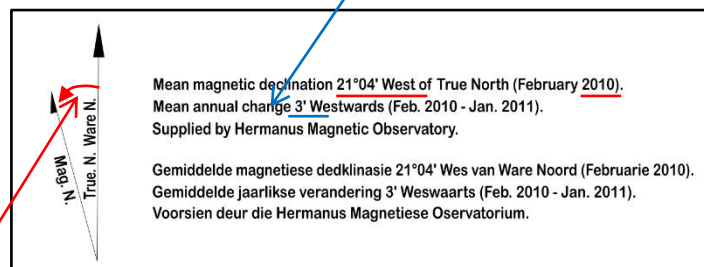
Area = l x b

= 0,8 km x 0,3 km

= 0,24 km²

10. Magnetic declination and magnetic (compass) bearing

- Magnetic north, as indicated by a compass, is west of True north.
- The angle between magnetic north and true north is called the magnetic declination.
- The magnetic bearing is used by aircraft when they fly.
- Magnetic north is not stationary and changes every year (annually).
- Always write down the information given on the map.



- Magnetic Declination in **2010** = 21°01' W
- Annual change = **3' W**
- Use the following steps:

a) **Calculate the number of years**

- Current year minus **given year**.
- 2020 – **2010** = 10 years

b) **Calculate the change in magnetic declination**

- Number of years multiplied by the **annual change**.
- **10 years** x **3' W** = 30' W

c) **Calculate the magnetic declination for the current year (2020)**

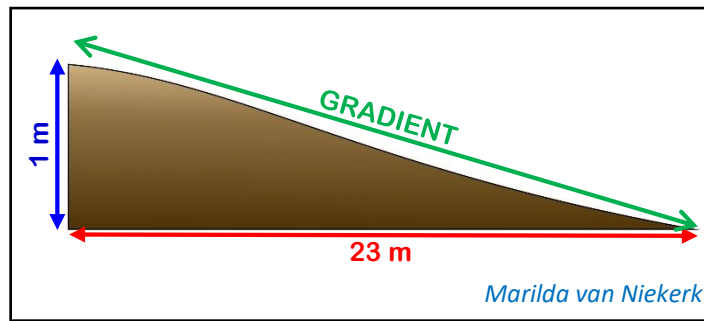
- If the change is **West**, **ADD**
- If the change is **East**, **SUBTRACT**
- Magnetic declination in 2010 + **change**
- 21° 01'W + 30' W = 21° 31' W

d) **Calculate the magnetic bearing**

- Angle measured (whatever is asked) + **current magnetic declination**
- 210° + 30' W = 210° 30' (no direction needed)

11. Gradient

- Gradient is a ratio written as 1: 23



- In this example, for every 1 m to go up, you move 23 m forward.
- The gradient (steepness of the slope) is labelled on the diagram.
- A ratio of 1:10 and less is classified as a steep slope. Anything progressively more than this is a gentle slope.

- The formula is:

$$\text{Gradient} = \frac{\text{Vertical Rise (VR)}}{\text{Horizontal Distance (HD)}}$$

- Calculate the VR, distance in height between the 2 points (in meters)
- Measure the HR, distance between the 2 points (convert to km and then METERS)
- Simplify your fraction to get 1 for the numerator.
- Given as a ratio of 1: ...

- Calculate the Vertical Rise (VR)

$$\begin{aligned}\text{VR} &= \text{Highest point} - \text{Lowest point} \\ &= 1254.1 \text{ m} - 1084 \text{ m} \\ &= 161.1 \text{ m}\end{aligned}$$

- Calculate the Horizontal Distance (HD)

$$\begin{aligned}\text{HD} &= \text{Map distance in meter} \\ &= 5.7 \text{ cm } (\div 2 \text{ to convert to km}) \\ &= 2.85 \text{ km } (\times 1000 \text{ to convert to m}) \\ &= 2850 \text{ m}\end{aligned}$$

**The Vertical Rise
and Horizontal
Distance must
both be in
METERS!**

- Calculate the Gradient

$$\text{Gradient} = \frac{\text{VR}}{\text{HD}}$$

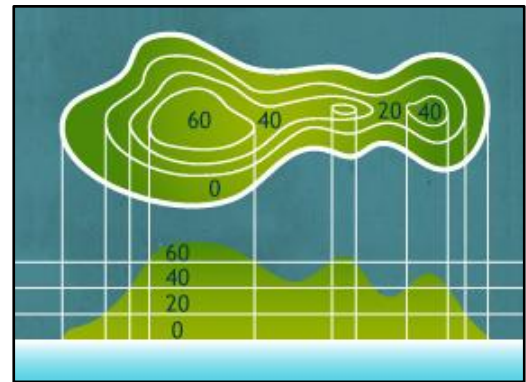
$$= \frac{161.1 \text{ m} \div 161.1 \text{ (divide numerator by itself to get 1)}}{2850 \text{ m} \div 161.1 \text{ (what you do on top, you must do below)}}$$

$$= \frac{1}{17.69}$$

$$= 1: 17.69 \text{ or } 1: 17.7$$

12. Cross sections

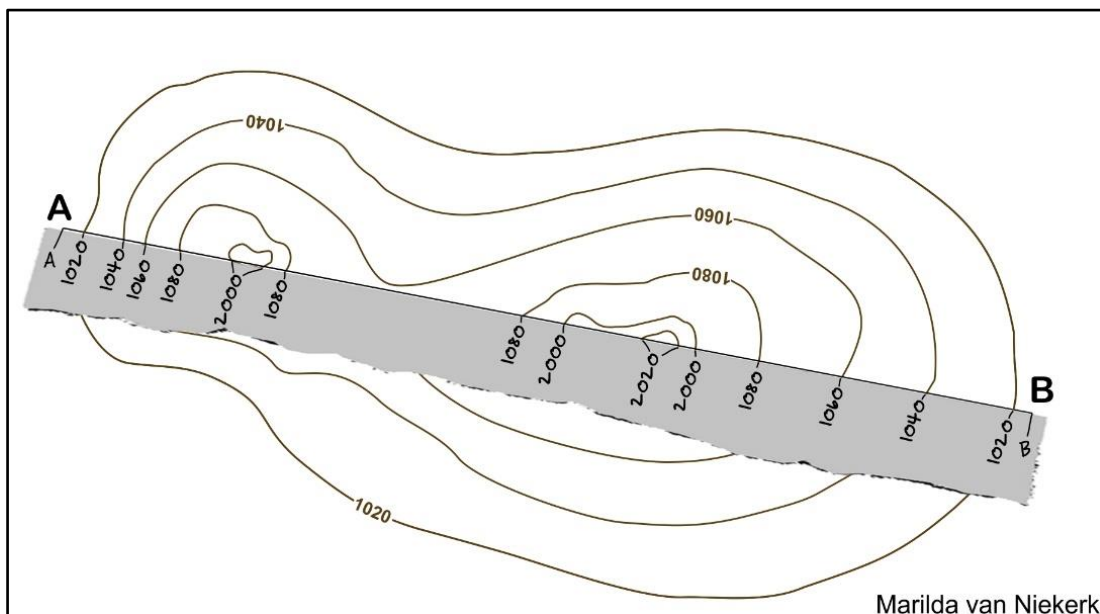
- What do the actual landforms on the ground look like based on the contour patterns?
- A cross section is a side profile of the topography indicated with contour lines.



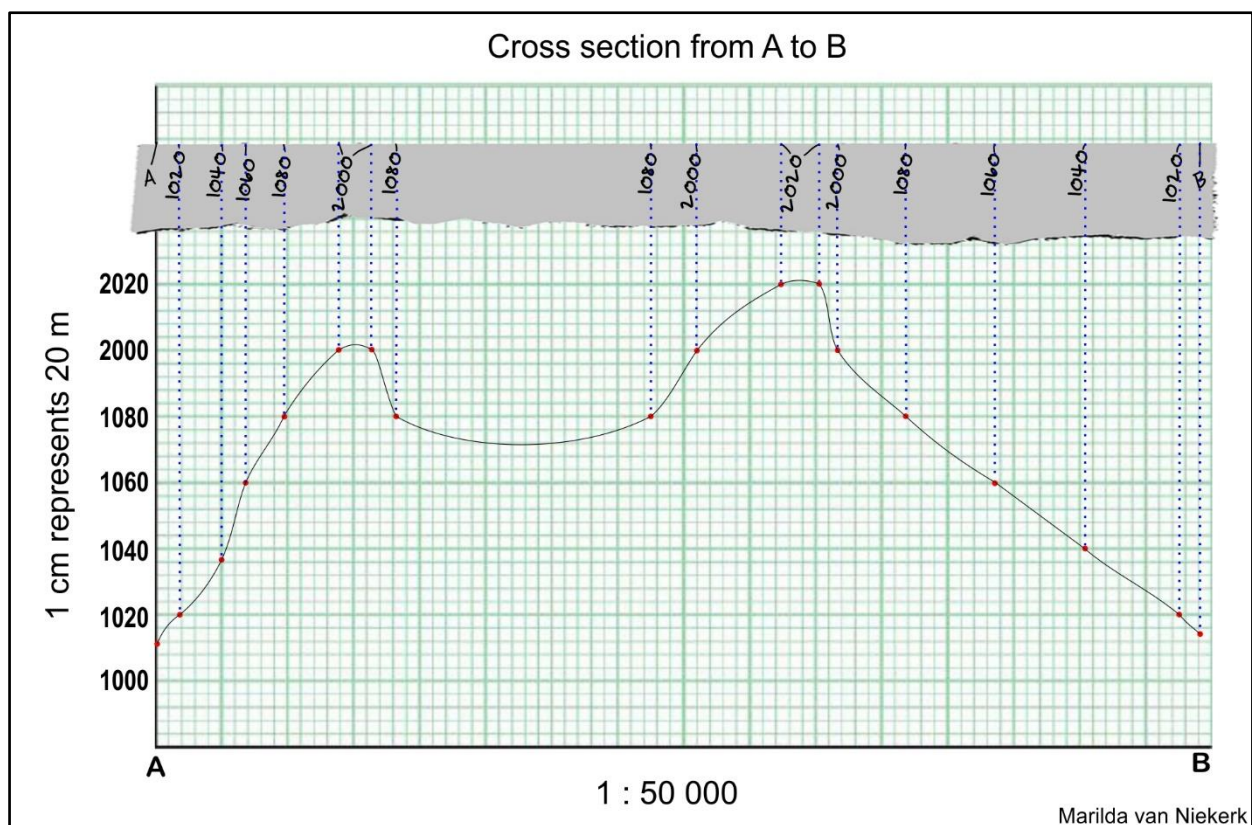
[pinterest.com](https://www.pinterest.com)

12.1. Drawing a cross section:

- 1) Draw a connecting line between the 2 points. **NB!** The point from which you are working is always on your LEFT.
- 2) Place a white strip of paper just under the connecting line.
- 3) Indicate the start and end points (A and B) on the paper and make a mark for all the other contour lines in between and write in the heights.

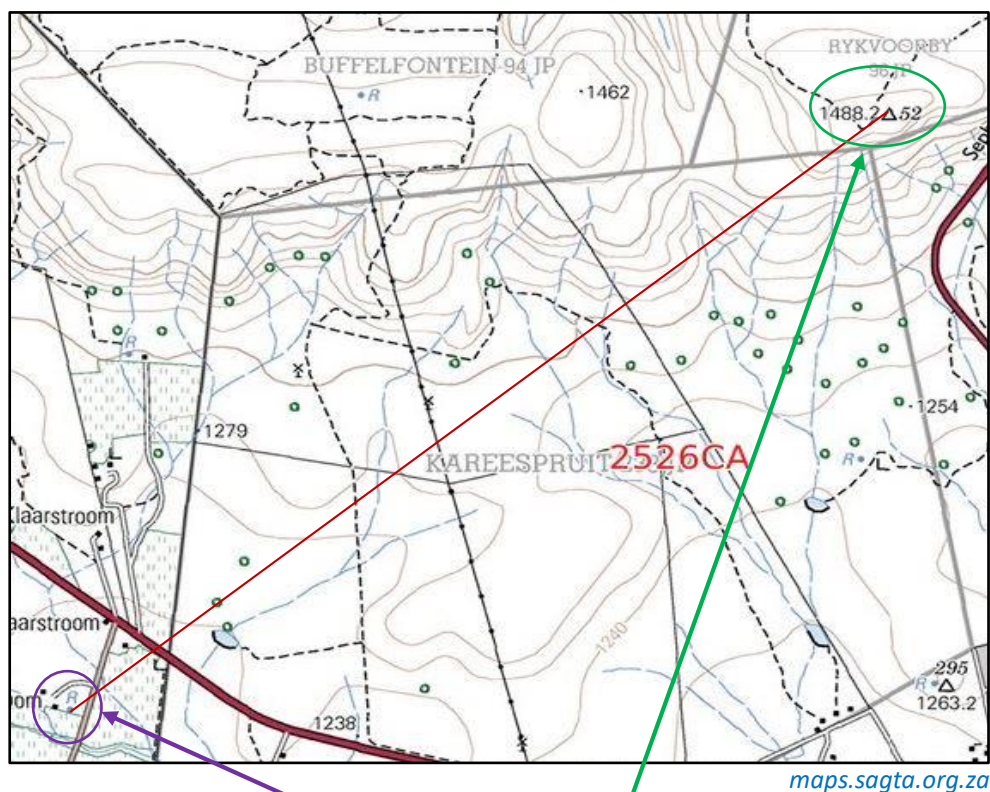


- 4) Write in these heights on the vertical scale of your graph paper (start with 20m lower than the lowest contour on your paper strip at the bottom of the graph paper).
- 5) Use the vertical scale given to you in the question e.g. 1cm = 20m.
- 6) Transfer the points on the paper strip to the graph paper.
- 7) Join the dots with a free – hand line.
- 8) Add the title to the top, the vertical scale on the y-axis (this will be given to you) and the horizontal scale on the x-axis (this is the same as the map scale).



12.2. Add features from a map to a cross section:

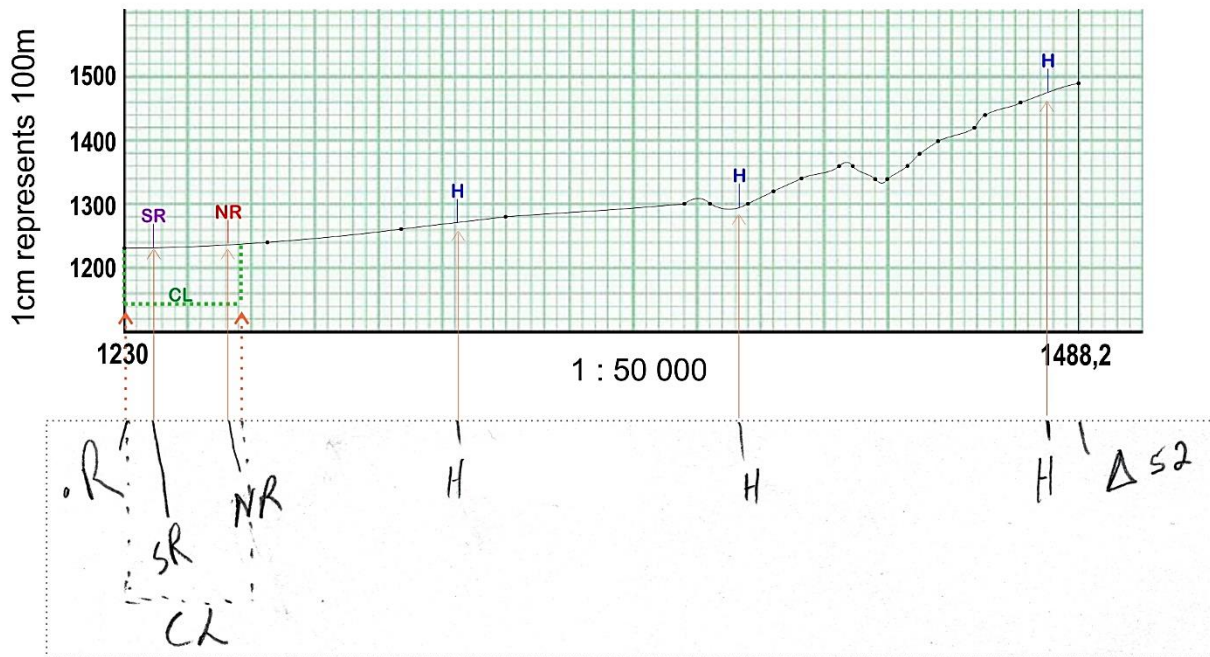
Extract from 2526CA Zeerust topographical map



- A cross section from the reservoir to trig beacon 52 is given.

- Indicate the following features on the cross section:
 - Area of cultivated land (CL)
 - National Route (NR)
 - Secondary Road (SR)
 - Hiking trail (H)

Cross section from reservoir to trig beacon 52



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12.3. Calculate the vertical exaggeration of the given cross section.

$$\text{Vertical exaggeration} = \frac{\text{Vertical Scale (VS)}}{\text{Horizontal Scale (HS)}}$$

a) Vertical scale (VS) is always given to you in the question:

- E.g. 1 cm represents 100 m
- Convert to cm so that it's in the same units as the map scale
- Always x by 100 (as there are 100 cm in 1 meter)
- Write in same format as the map scale **1: 10 000**

b) Horizontal scale (HS) is always the same as the map = **1: 50 000**.

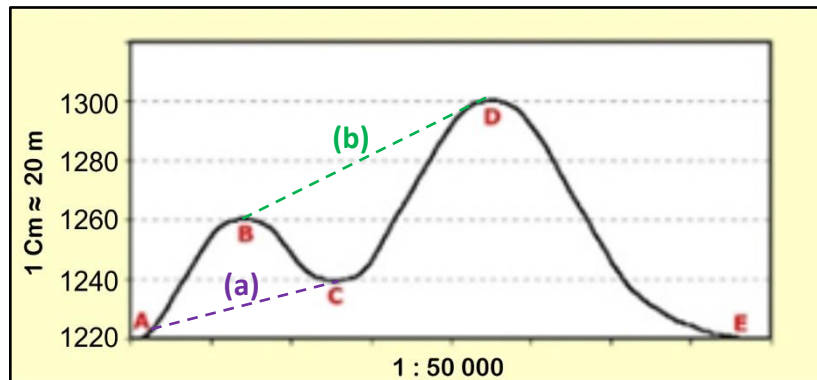
$$\text{VE} = \text{VS} \div \text{HS}$$

$$= \frac{1}{10\,000} \div \frac{1}{50\,000}$$

$$= \frac{1}{10\,000} \times \frac{50\,000}{1} \quad (\text{golden rule: invert and multiply})$$

$$= \underline{5 \text{ times}} \quad (\text{the cross-section has been enlarged 5 times})$$

12.4. Intervisibility



slideshare.net adapted by Marilda van Niekerk

- a) Can point A be seen from point C? **No**, the two points are not intervisible. Mountain B is blocking the line of sight (line a).
- b) Can point B be seen from Point D? **Yes**, the two points are intervisible. There is nothing blocking the line of sight (line b).

13. Map symbols

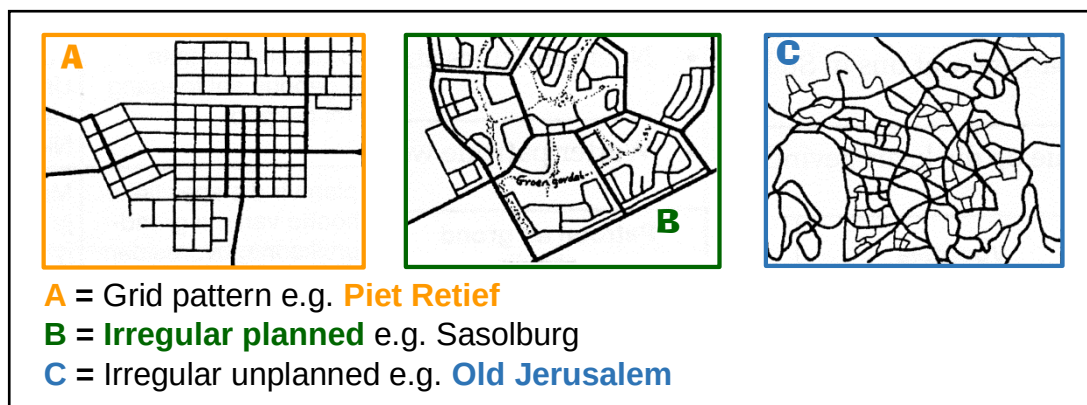
Most map symbols are printed on the map, shown in the key.

13.1. Types of map symbols:

- Points: Buildings, Trigonometrical beacons, Reservoirs etc.
- Lines: Rivers, Railway lines, Roads, Borders etc.
- Areas (polygons): Golf course, Dam, Cultivated land etc.

13.2. Colour of the map symbols:

- a) **Red:**
- **Construction features** e.g. national, arterial and main roads, lighthouses and marine lights.
- b) **Grey:**
- **Construction features** e.g. built up areas and walls of farm boundaries. The different street patterns are shown in built-up areas.



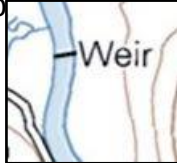
Window on the World, Standard 10

c) **Black:**

- **Construction features** e.g. roads, railways, bridges cemeteries, dam walls, power lines, trig beacons, cutlines, a weir, etc.
 - **Cutlines** are areas where vegetation is cut in order to bury pipes or put up a fence.



- A **weir** is a small wall built over a river to hold back water for use by farmer or prevent flooding.



d) **Blue:**

- Mostly **water landmarks** e.g. canals, rivers, lakes, dams, furrows, swamps etc.
 - **Furrow** – man made canal to divert water from river to cultivated lands
- A national freeway is also indicated in blue.

e) **Brown:**

- **Height landmarks** and relief e.g. contours, dunes, eroded areas etc.

f) **Green:**

- **Vegetation landmarks (natural)** e.g. cultivated fields, golf courses, trees, firebreaks, protected areas etc.
 - A **firebreak** is an area where vegetation is removed in order to prevent a fire.



14. Aerial photographs

- Aerial photographs are photos of the landscape taken from an aircraft.

14.1. Oblique aerial photographs

- If the camera in an aircraft has its axis pointed at an angle to the ground
- There are two kinds of oblique photos:
- A **low oblique** shows no horizon (low shows no).
- A **high oblique** has the horizon (high has horizon).



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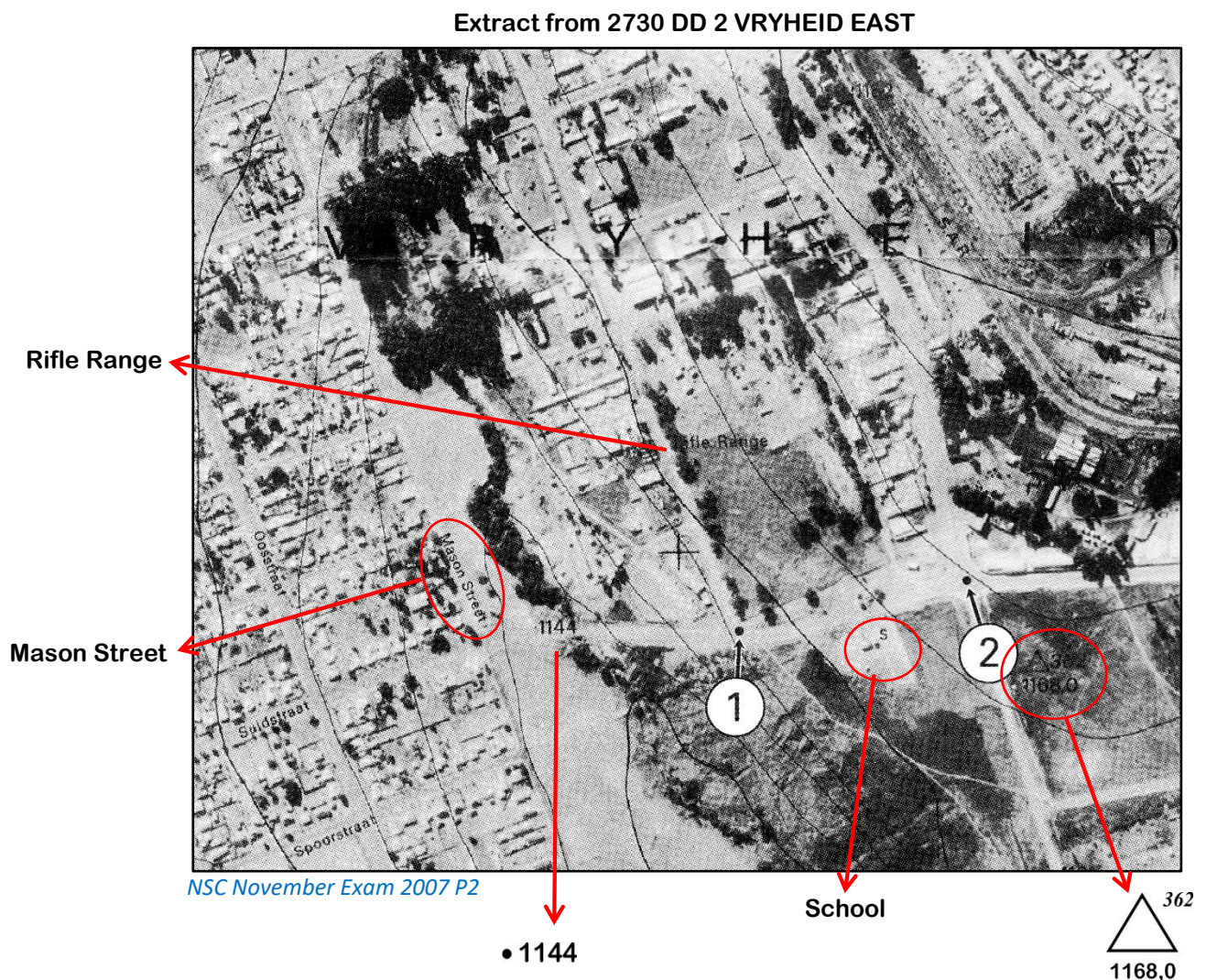


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- An oblique photograph is used to show large areas and particularly features such as communications, topography, vegetation and settlement patterns.
- The main advantage of oblique photos is that they show objects from the side.
- One disadvantage of oblique photographs is that they cannot show scale because the closest objects appear biggest and the larger objects further from the camera appear smaller.
- Another disadvantage is that large objects near to the camera, such as mountains, hide objects behind them.

14.2. Orthophotos

- These are special aerial photos with map symbols, contour lines and other information on.
- The scale is **1: 10 000** so 1cm = 100m.
- It is usually a zoomed in section of your map.
- Use obvious parts of the photo e.g. roads/ rivers to orientate where this is on the map.
- If asked to label features on the photo, find them on the map. Do not guess!

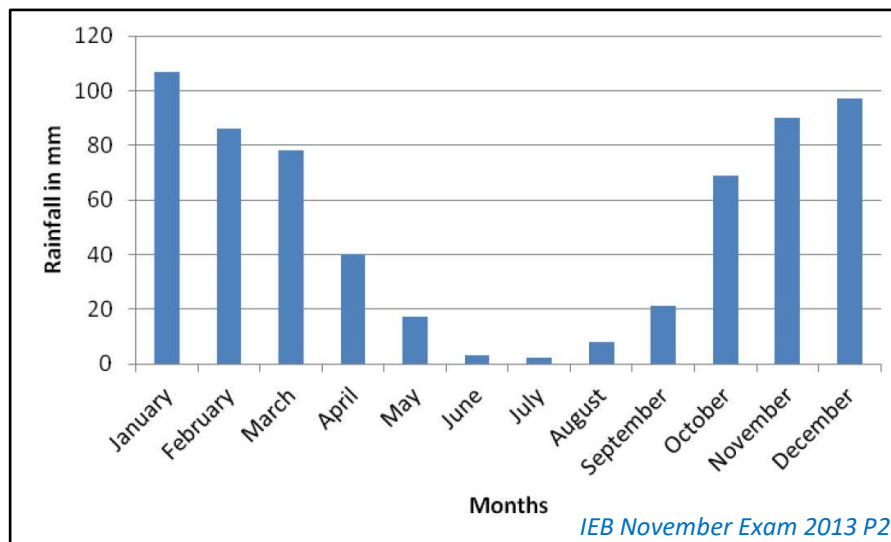


15. Interpretation of topographic maps

- All work done in theory can be applied to topographic maps.

15.1. Climate

- Climate graphs are often asked.
- Line graph shows temperature. Bar graph shows rainfall.
- Remember to read the information off the correct **AXIS** and to use the correct units.
- Make sure you can calculate temperature **range** (difference between highest and lowest) and **annual** rainfall (ADD ALL UP)!



15.2. Geomorphology

- Identify drainage patterns (dendritic, radial, trellis etc.)
- Know the difference between perennial vs non perennial rivers.
- High rainfall areas typically on the eastern half of RSA, trees & cultivated land is widespread (not only along the river where it is irrigated).
- Look out for CIRCULAR cultivated lands – which are this shape due to the central irrigation pivot.

15.3. Settlements

- Identify the settlement pattern (dispersed/ nucleated).
- Identify street patterns.
- Evidence of Apartheid cities – 'Townships' are often seen outside 'White towns' on maps. The plot sizes are much bigger in towns, with more services. Buffer zones were put to separate the 'white' and 'black' areas such as roads and railway lines.

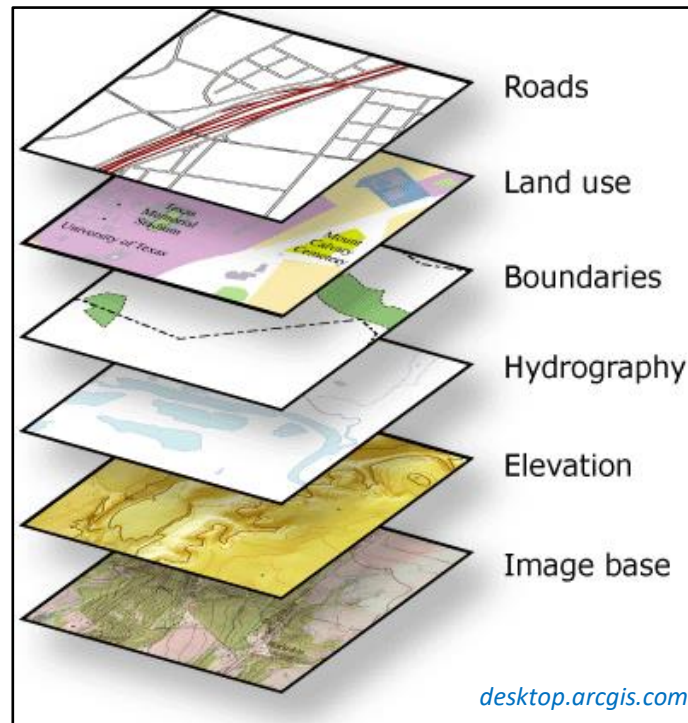
15.4. Economic Geography

- Know the different types of agriculture.
- Commercial farmers sell to market. Water management will be evident e.g. Irrigation schemes, reservoirs, weirs and dams.
- Subsistence farming occurs when farming is done for one's own needs.
- Extensive – on vast areas e.g. cattle farming.
- Intensive – smaller areas with a patchwork pattern of green fields, all land used e.g. growing vegetables in tunnels/ vineyards.

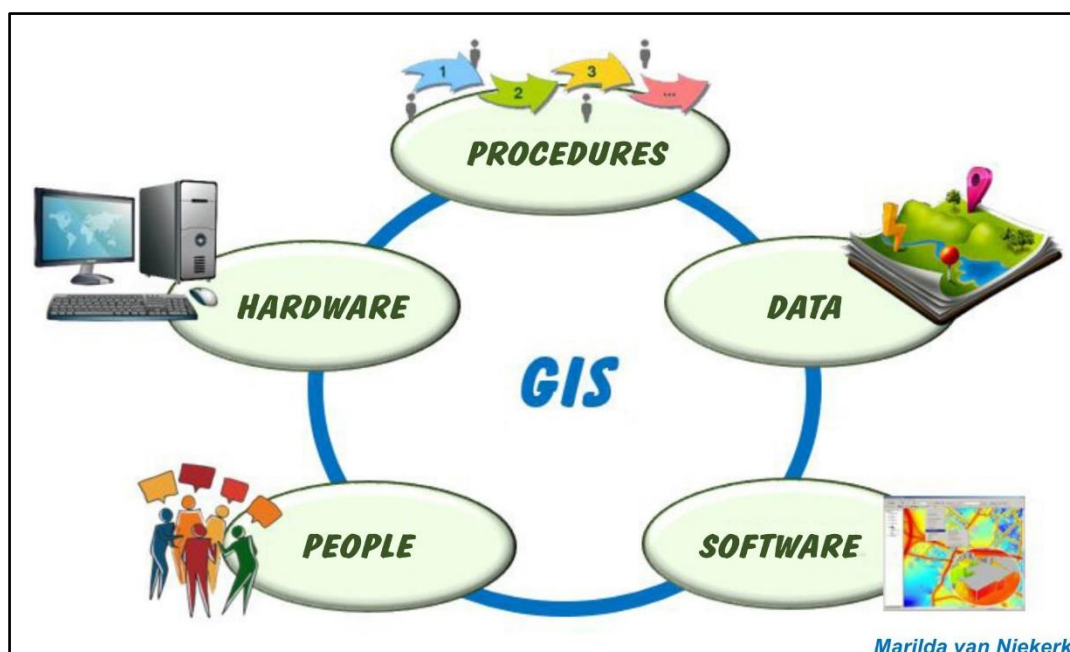
GIS NOTES

1. Information layers

- GIS is a computerized system that deals with the digital collection of layers of spatial data about a place, imbedded one of top of another (overlying).
- The data is collected and used to answer various problems and offer models to suggest possible solutions.
- Examples:
 - **Natural:** Vegetation, drainage (hydrography), elevation (relief), etc.
 - **Man-made:** Roads, land use, boundaries, built-up areas etc.



2. Components of GIS



3. GIS concepts:

3.1. Remote Sensing

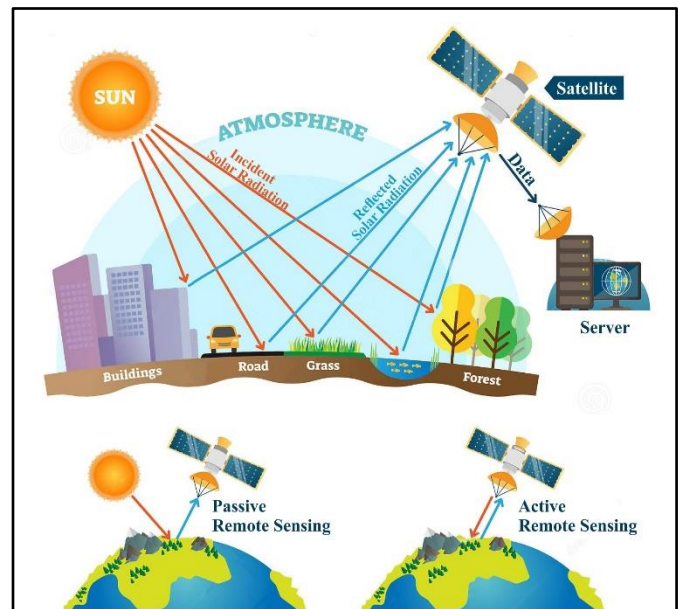
- The method of obtaining data about the environment and surface of the Earth from a distance through an aircraft or satellite.

3.1.1. Passive remote sensing

- A system with sensors that measure energy signals radiating from Earth.

3.1.2. Active remote sensing

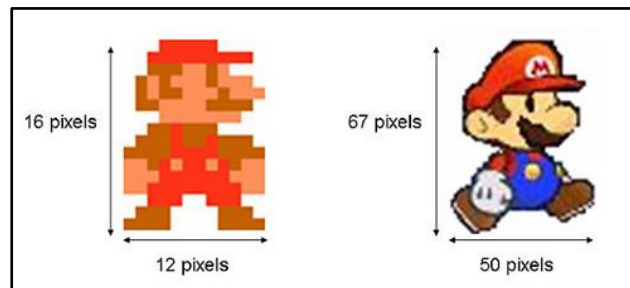
- A system that sends out its own radiations towards a landscape target on Earth.
- The sensors on the satellite then measure the radiation which the landscape target sends back to the satellite.



dreamstime.com

3.2. Resolution

- Resolution refers to the sharpness of an image.
- It is a measure of the accuracy or detail of a graphic display expressed as dots per inch or pixels per line.



sciencebuddies.org

3.3. Data management

- Computers (hardware) are used with special programs (software) that handle the data.
- GIS software is able to handle spatial and attribute data:
- An **ENTITY** is a concrete feature that forms a unit e.g. a house, road, river or field.
- An **ATTRIBUTE** is information or data about a spatial feature, e.g. information about a school could include the name and the number of learners.
- The **OBJECT** is the point or set of points that a GIS uses to represent a concrete entity e.g. Points, Lines and Polygons
- Every GIS depends on having a **database management system**.
- This is a set of computer software that can **store, retrieve and reorganise** attribute information.

3.3.1. Spatial data:

- This is data about the **visual representation** of a geographic space such as the location and shape of geographic features, for example Bloemfontein is located at 29° 06'S 26° 09'E and has an altitude of 1 395 m.

3.3.2. Attribute data

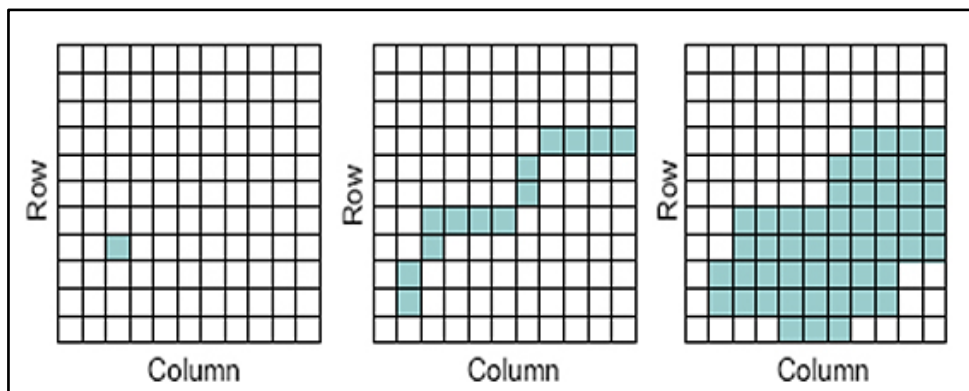
- This data is descriptions, measurements, and/or classifications of geographic features in a map.
- Here are some attributes (characteristics) of Bloemfontein taken from various school atlases:
 - Population of 645 441.
 - Vegetation is grassland.
 - Mean annual rainfall is 559 mm.
 - Mean temperature of 22,5°C in January, and of 8,5°C in July.

3.4. Storage of data

- Data that is fed into a GIS can be stored in two possible ways:

3.4.1. Raster method:

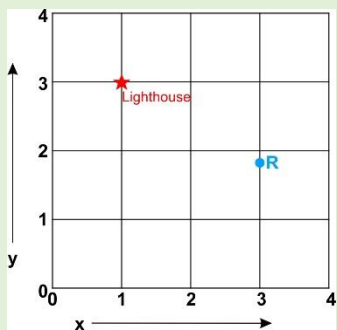
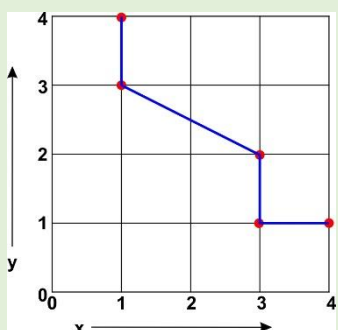
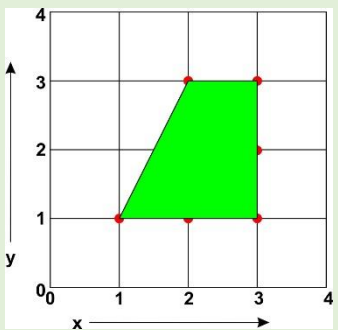
- Each given area is divided into rectangular grid cells (pixels or dots).
- A graphic is made up of a large number of pixels, each pixel having a location & colour value in a grid-like format.
- Aerial photographs and satellite images are generally in a **raster format**.



Focus Geography Grade 12

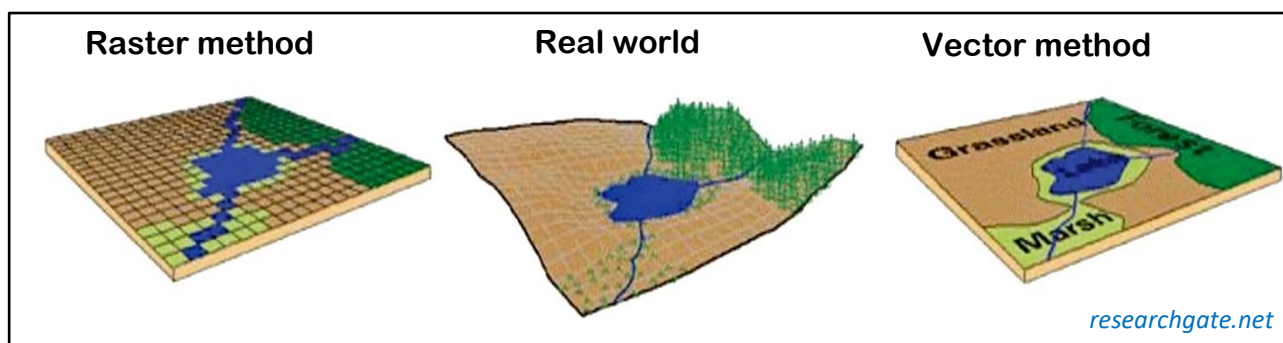
3.4.2. Vector method:

- This method uses points, lines & areas inside polygons to define data.
- These features are recorded in a digital format with a value attached to every location co-ordinate.
- **Vector graphics** are used to represent features like roads, rivers, housing.

POINTS	LINES	POLYGONS
- These points are indicated by their coordinates. - For example, a lighthouse or a reservoir or post office.	- A line consists of a series of co-ordinates that indicates a small, one dimensional geographical object. - The start and end point of a line are called NODES. - For example, a street, river or railway line.	- A polygon consists of a series of co-ordinates that form a boundary together. - The two dimensional centre that is boarded by a polygon is called an area. - For example, a dam, recreational area or a park.
		

Marilda van Niekerk

- Raster and Vector graphics are frequently used together.



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4. Important concepts

4.1. Data standardisation

- GIS have been developed over the past 50 years with many different formats.
- There is a great increase in the number of organisations collecting data.
- It is now essential that all organisations producing and using GIS standardise the methods they are using to collect and store data.

4.2. Data sharing

- Gathering high quality imagery and capturing data is very expensive, so it is important for GIS practitioners to share information.

- Standardising makes data sharing easier.
 - Advantages: Makes a wide range of data available to people all over the world.
 - Avoids expensive repetition of data acquisition like placing sensors in orbit.
 - It reduces workload and costs.

4.3. Data security

- Some government data is freely available to the public.
- Other information like tax records, bank accounts, medical information etc. is confidential and must be protected.

5. Data manipulation

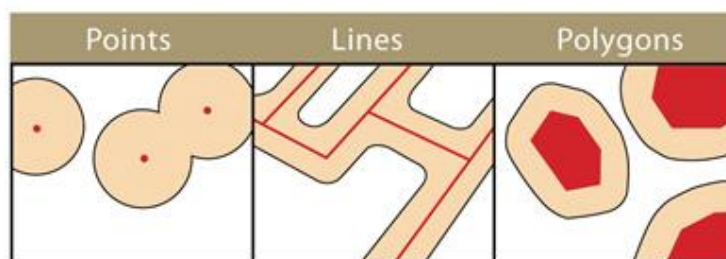
- This is the skilful treatment of information to make it more meaningful.
- A GIS allows us to analyse large amounts of information quickly.

5.1. Data integration

- **Primary geographic data** – data is downloaded directly into the GIS package from remotely-sensed satellite images and GPS.
- **Secondary data** like paper maps & photos have to be converted into a computer-readable form by a process called digitising.
- GIS is not just a way of making maps. It is a powerful way of making use of vast sets of data and looking for patterns, trends and relationships between things.
- Different types of information can be combined in layers to make an analysis.
- The following factors or themes are often used: **(Google Earth)**
 - Social factors (population statistics, activities of people)
 - Land use (residential, industrial, commercial, greenbelts etc.)
 - Natural features of the landscape (forests, different biomes, relief)
 - Drainage (where the rivers and wetlands are)
 - Infrastructure (road, rail and pipelines networks)
 - Geology (the underlying rock)

5.2. Buffering

- Buffering occurs when lines are drawn a specific distance around a feature
- These areas are also called demarcated areas
- It is used to:
 - Determine the floodplain next to a river.
 - Determine the number of students within a school's catchment area.
 - Work out the bus routes to and from school.
 - Plan the possibility of new schools.
 - Determine the pollution in an area by looking at wind directions (mountain and valley winds) from the nearest industrial area.



saylordotorg.github.io

5.3. Querying

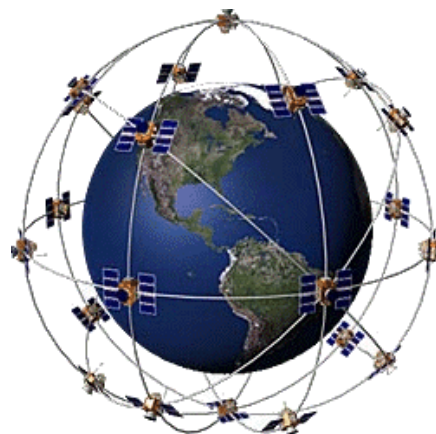
- Querying is a way of asking questions, normally using a keyword, statement or logical expression.

5.4. Statistical Analysis

- Statistical analysis helps you to extract additional information from your GIS data that might not be obvious by simply looking at a map.
- For example, to find the risk of landslides in an area the following layers might be needed:
 - Altitude;
 - Slope angles;
 - Types of rock;
 - Rainfall data;
 - Vegetation cover;
 - Distance from roads etc.

6. Uses of GIS

- GIS is very useful in any industry.
- Many economic activities can benefit from the analysis of information and many problems could be solved by using GIS.
- GIS can be used to define boundaries and do government planning e.g. election results.
- Most cities use a GIS to manage water and power networks.
- Census use GIS to create maps and models of the location and distribution of people.
- GIS is used to map and manage protected areas.
- GIS can be used to decide where to put water points in a mountain bike race.
- GIS is used to manage disasters – we use it to gather and analyse all the information so that we can reduce the impact and manage the consequences for example, it can be used to decide where an exclusion zone should go around an active volcano.



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