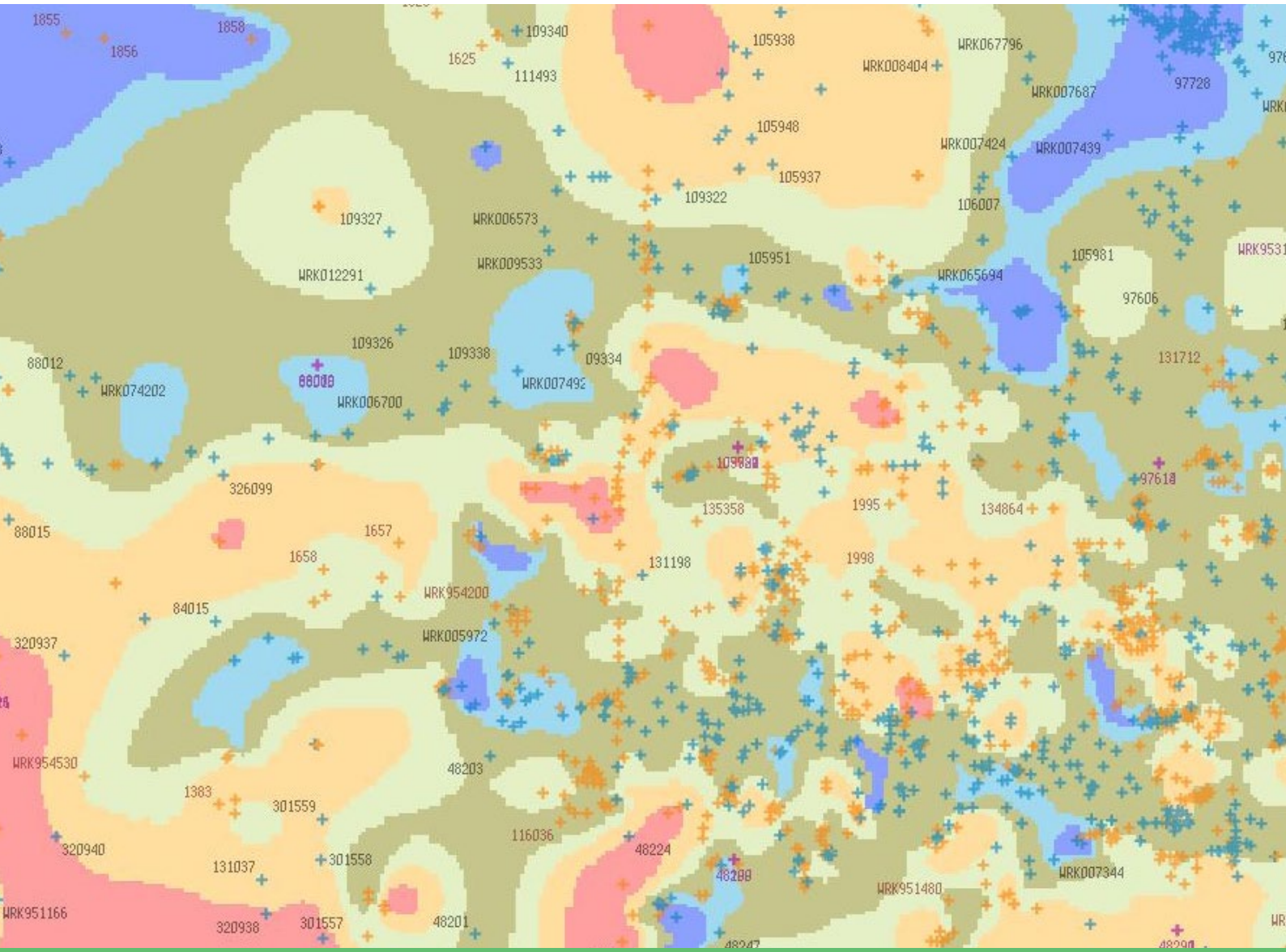
SPATIAL CONNECT

An activity based project



Visualising Victoria's Groundwater

LEVEL 9/10

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SPATIAL CONNECT

Visualising Victoria's Groundwater

Level

Victorian Curriculum: Level 9/10

Australian Curriculum: Year 10

Aim

- To promote understanding of the natural and human dimensions of groundwater through the use of spatial technology in a real world context.

Lessons required

3–4 lessons

http://www.vvg.org.au/resources/VVG%20Newsletter%20Dec%202012.pdf

Curriculum Links

Victorian Curriculum Geography Content Description [Australian Curriculum equivalent]	Victorian Curriculum Science Content Description [Australian Curriculum equivalent]
Geographical concepts and skills	**Science as Understanding**
Identify, analyse and explain significant spatial distributions and patterns and identify and evaluate their implications, over time and at different scales (VCGGC128) [ACHGK075]	Different types of chemical reactions are used to produce a range of products and can occur at different rates; chemical reactions may be represented by balanced chemical equations [VCSSU125]
Geographical data and information	**Science Inquiry Skills**
Select, organise and represent data and information in different forms, including by constructing special purpose maps that conform to cartographic conventions, using digital and spatial technologies as appropriate (VCGGC131) [ACHGS074]	
Analyse and evaluate data, maps and other geographical information using digital and spatial technologies and Geographical Information Systems as appropriate, to develop identifications, descriptions, explanations and conclusions that use geographical terminology (VCGGC132) [ACHGS076]	Analyse patterns and trends in data, including describing relationships between variables, identifying inconsistencies in data and sources of uncertainty, and drawing conclusions that are consistent with evidence [VCSIS138] [ACSIS203]
Geographical knowledge	
Different types and distribution of environmental changes and the forms it takes in different places (VCGGK144) [ACHGS070]	
Environmental, economic and technological factors that influence environmental change and human responses to its management (VCGGK145)	

Part 1: Groundwater, seasons and rainfall

Introduction

Visualising Victoria's Groundwater is a web portal developed to assist industry, farmers and researchers to understand the natural and human factors influencing the availability and quality of groundwater. Groundwater can be accessed through drilling what is known as 'bores'. These bores have many different uses including for irrigation purposes, drinking water, and as a way to scientifically understand the amount and quality of groundwater. Groundwater fluctuates through the seasons and the level of the water table (how far underground the groundwater is located) will vary over time. In this activity, students develop skills in spatial technology to explore the earth's precious but hidden resource.

Aims

Students will:

- understand the nature of groundwater and its role/importance in the water cycle
- observe that groundwater is variable and interconnected
- conclude that seasonality and climate (drought and high rainfall events) affect groundwater
- utilise mapped groundwater data (point and continuous) using a geographic information system (GIS)
- interpret data from map and graphed sources
- relate data from various sources to draw conclusions, replicating the process to validate those conclusions.

Preparatory knowledge (teacher resource)

Teachers can use the resources related to groundwater and bores as background information for their students prior to completing the GIS activity.

Groundwater	Bores
1. What is groundwater? 2. What is the water table? 3. How does groundwater form part of the water cycle? 4. What are the uses of groundwater? 5. Why is groundwater important?	1. What is a bore? 2. How is groundwater monitored in Victoria?
Resource 1 Resource 2 Resource 3	Resource 1

How does groundwater change over space?

- Visit the Visualising Victoria's Groundwater web portal.
- Turn on the spatial layers *Depth to water table (DEWLP)* and *Bores - DEWLP WMIS (groundwater)*.
- Click on the *Legend* tab to interpret the spatial layers.
- Zoom in and explore the distribution of bores.
- Go to the *Tools* tab and adjust the transparency of the spatial layers to make viewing easier.

1. What is the relationship between the location of bores and depth to water table?

- Next, turn on the spatial layers *Surface elevation (DEWLP)* and *Bores - DEWLP WMIS (groundwater)*.
- Click on the *Legend* tab to interpret the spatial layers.

2. What is the relationship between the location of bores and surface elevation?
3. What do questions 1 and 2 tell you about suitable locations for accessing and monitoring groundwater?

What can you learn from bore data?

- Visit the Visualising Victoria's Groundwater web portal.
- Turn off all layers except for *Bores - DELWP WMIS (groundwater)*.
- Click on the *Legend* tab.
- Zoom in if required.

1. What do the different coloured bores represent?
2. Who is accessing groundwater from unmonitored bores?
3. What type of bores would a scientist be interested in? Why?

- Click on *Search* tab and use the bore search function.
- Search for **Bore ID: 88009** and click on *locate on map*.
- Zoom out if required.
- Click on the bore and *view details*.
- Look at *Bore details* tab.

4.

a) Describe where this bore is located? What water features are near this bore? (Try turning on the satellite image).

b) Are these water features natural occurring or made by people? How can you tell?

5. Record data for the following:
   - Total bore depth
   - Completion date
   - Bore use
   - How often is the bore monitored?

- Click on the monitoring tab.
- Hover the cursor over chart.

6. What does this chart tell you? What is the x axis / y axis telling you?
7. As of the last monitoring date, how far underground in the water table?

- Click on the *chemistry* tab.

8. Drinking water has a pH of 7, what is the pH of the groundwater for this bore?

- Click on the *attachments* tab.
- Follow the link below *Further links*. This will take you to the Department of Water, Land and Planning (DEWLP) Water Management Information System.

9. Look at the attached pictures. What colour is the bore?

Summary

1. Who is likely to use this information? Why might they be interested?

How does a change in season affect groundwater?

- Visit the Visualising Victoria's Groundwater web portal.
- Click on *search* tab and use the bore search function.
- Search for **Bore ID: 26683** and click on *locate on map*.
- Click on the bore and *view details*.
- Click on the *monitoring* tab.
- Hover cursor over chart.

1. Where in Victoria is this bore located?
2. When did monitoring start in this location?
3. Is this bore still being monitored?
4. For the most recent reading, what is the depth of the water table below the ground surface?
5. Did the groundwater ever reach the surface? If so, when?
6. During which months are there peaks and troughs?
7. How do these peaks and troughs on the graph suggest there is a connection with the seasons?

What are some long-term trends that can be observed in groundwater data?

- Use the search function to visit the following bores:
  a) 110706
  b) 110190
  c) 110534.
- Turn on the *depth to water table* and make an estimate using the *legend*. Repeat for the *surface elevation* layer. Write down estimates in the table below.
- Click on the *monitoring* tab to complete the rest of table. When thinking about the trends over time, insert one of the following words in each box:
  - Decline
  - Variable
  - Steady
  - Rapid increase.

Bore ID	Location in Victoria	Depth to water table (m)	Surface elevation (m)	Depth (m) closest to surface (year)	Depth (m) deepest to surface (year)	Difference (m)	Trend up to end of 1999	Trend 2000-2009	Trend 2010-2011	Trend 2012 -present
110706										
110190										
110534										

- Interpret the data table.

1. In which years was the water table at its highest (closest to surface) and lowest (deepest to surface)?
2. Is there a consistent pattern between bores?
3. Comment on the overall difference in water depth from bore to bore?
4. Overall, do the bores appear to behaving in the same way in terms of their trends and changes?

- Refer to the following series of maps showing Australia's climate over many years.
- Locate the approximate position of the bores (near Winchelsea in Victoria).
- Using the time slider, scroll between the 1993 and 2013.
- Refer to the legend.

5. Does there appear to be any relationship between the level of rainfall in Victoria and the pattern observed in water table level monitoring of bores? What is this relationship?

- Visit the Bureau of Meteorology and view a weather station close to the three bores: Bannockburn (Hillside), VIC.
- Click on the annual chart icon to create a graph of annual rainfall since records in this area began.
- Interpret chart.

6. Looking at the rainfall data for the years 1993 to 2010, how many times was the total annual rainfall below the median annual rainfall?
7. What happens to rainfall levels in 2010? How might this relate to your observations of the water table change seen in the monitoring graphs?

- Follow the steps as above for the following bores:

  a) 80238

  b) 79930

- Visit the Bureau of Meteorology and view a weather station close Bore 80238 - Molka (Lowana) and Bore 79930 - Coldstream.

- Complete the table below for two different locations in Victoria. When thinking about the trends over time, insert one of the following words in each box:

  i) Decline;

  ii) Variable;

  iii) Steady;

  iv) Rapid increase.

Bore ID	Location in Victoria	Depth to water table (m)	Surface elevation (m)	Depth (m) closest to surface (year)	Depth (m) deepest to surface (year)	Difference (m)	Trend up to end of 1999	Trend 2000-2009	Trend 2010-2011	Trend 2012 -present
80238										
79930										

9. Does the trend of total annual rainfall in relation to the long term median (blue line) appear to match the trend seen in the depth to water table monitoring graphs?

Summary

Based on your analysis, what overall conclusion can you draw about the relationship between rainfall and change in the water table?

Part 2: How is groundwater used by people?

Introduction

In regions where access to water is limited, drilling bores deep below the ground surface allows people to access water for a variety of important uses, including for irrigation, livestock, drinking water, gardening or washing. However, the quality and availability of groundwater will vary across a landscape due to natural variation and human activities. Spatial technology can help determine whether groundwater can be accessed in a particular region and if it is of suitable quality for its desired use.

Aims

Students will:

- develop an understanding of the relationship between human activity and groundwater
- conclude that the quality of groundwater influences how it can be used
- identify the range of applications suitable for different levels groundwater salinity
- utilise mapped groundwater data (point and continuous) using a geographic information system (GIS)
- interpret data from map and graphed sources
- relate virtual data to fieldwork.

Preparatory knowledge (teacher resource)

Teachers can use the resources related to groundwater impacts and salinity as background information for their students prior to completing the GIS activity.

Groundwater impacts	Salinty
What are some of the major issues affecting groundwater in Australia?	What types of salt exist in groundwater? Where does it come from? Why worry about salts in groundwater? How is salinity in groundwater measured?
Resource 1	Resource 1 Resource 2

Exploring groundwater salinity in Victoria

- Visit the Visualising Victoria's Groundwater web portal.
- Turn on the spatial layer *Groundwater salinity (DEWLP).*
- Click on the Legend tab to interpret this spatial layer.

1. Describe distribution of salinity in groundwater in Victoria.
2. In general, in which region is there the highest salinity levels?
3. In general, in which region is there the lowest salinity levels?

- Using the search function, search for the following bore IDs:
  a) 40629
  b) 110140
  c) 144979
- Click on *locate on map*. Zoom out if necessary.
- Click on the bore and *View details*.
- Click on the *Chemistry* tab and scroll to find information.

Complete the table below.

a) Use conversion equation (see Introduction) to convert Electrical Conductivity into Total Dissolved Solids, and vice versa.

b) Refer to the table attached which shows the range of applications suitable for different levels of salinity in groundwater.

CONVERSION EQUATIONS

Electrical conductivity (EC) → Total dissolved solids (TDS)

TDS = 0.67 x **EC**

Total dissolved solids (TDS) → Electrical conductivity (EC)

EC = 0.67 ÷ **TDS**

Bore	Hydrochemical composition - element (per cent)	EC (mS/cm)	TDS (mg/L) (calculate?)	Salinity range (from map)	Suitable applications for this groundwater
40629					
110140					
144979					

4. Based on this table, what application are possible if you were to extract groundwater in this region?

How is groundwater used in the Mallee?

- Visit the Visualising Victoria's Groundwater web portal.
- Copy the following address in the search function:
  Benetook Ave / Millewa Rd, Koorlong VIC 3501
- Select the spatial layer *Groundwater salinity (DEWLP)*.
- Zoom out if necessary.
- Click the legend and go to *Tools* to turn up the transparency of the salinity layer so you can view it and the roads and buildings.

1. What do you observe about the salinity levels near within this area compared with that of the surrounding region?
2. By looking at the satellite image of this area, do you think the salinity levels in this region are natural or influenced by human activity?
3. Describe what do you think has caused groundwater in this small area to become less saline.
   (Hint: In this area, water for agricultural purposes is extracted from the Murray River)

Part 3. Drill your own bore!

As a class, follow the steps and answer the questions below:

- Turn on *Google Hybrid*.
- In query mode, select *Drill virtual borehole*.
- Click on the location of your school.

1. What is the salinity range around your school?
2. What is the depth to the water table?
3. Is the groundwater safe for human consumption?
4. What applications could you use the groundwater for in this location? (If your school is located in a city, choose an area nearby that could be used for agricultural purposes)