SACE Stage 2 Earth and Environmental Science

Science as a Human Endeavour Investigation:

Using geophysics to identify sources of salinity in the River Murray

A NOTE FOR TEACHERS:

This investigation uses the work of Dr. Mike Hatch (University of Adelaide) who designed and used a water-borne geophysics method to successfully identify specific sites where salinity enters (via groundwater), along the South Australian section of the River Murray. (PhD thesis)

Mike might be able to provide a short talk (face to face) for some class groups, however he is developing a package of information that will be freely accessible on the Geoscience Pathways Project website: ([www.geosciencepathways.org.au](http://www.geosciencepathways.org.au) )

**Lessons/research/ discussion prior to this investigation might include:**

a brief overview/review of the **water cycle** (Year 7), with a particular focus on groundwater, the interface between surface water and groundwater and the inherent interaction between the *atmosphere, hydrosphere* and *geosphere*,

a discussion of contemporary water sustainability issues in South Australia, with a particular focus on the Murray River,

and/or a practical demonstration (or experiment) to investigate how the electrical properties of water vary with increasing salinity.

(This could be a ‘design prac.’)

SACE Stage 2 Earth and Environmental Science

**Using geophysics to identify sources of salinity in the River Murray**



**The water of the River Murray is the life-blood of South Australia**.

There is justifiable public concern about salinity levels in the river and, hence, a need to better understand the source(s) of that salinity. In response to this need Mike has applied a Transient Electromagnetic (TEM) geophysical technique , based on systems used in mining exploration, to map the electrical resistivity and conductivity of the shallow sediments in the river bed. In this setting it has been shown that there is correlation between zones in the river bed that are conductive with the presence of saline groundwater and when the conductive unit is close to the base of the river the saline groundwater is likely to be adding salty water to the river. The measuring antenna is mounted on a floating frame that is towed behind a boat cruising along the river at 5 to 6 km/h. Continuous measurements have been made over more than 2500 km of the river (and some of the smaller rivers that branch off of the Murray) between Lake Alexandrina in SA to the Torrumberry Weir (near Echuca in NSW).

**Interaction between science and society** can be illustrated by investigating the nature of the salinity problem in the river, its importance for society and the response of this particular research scientist.

**REPORT**

Based on your investigation you should prepare a scientific report of no more than 1500 words in length or the equivalent in multimodal form)

Your report must include:

 the use of appropriate *scientific terminology*,

 an *introduction* that clearly identifies the *focus* of the investigation and the *key concept(s)* of science as a human endeavour that it links to,

 *explanation* of how the focus of the investigation illustrates the interaction between science and society

relevant earth and environmental science *concepts* or *background*

 *discussion* of the potential *impact* or *significance* of the focus of your investigation, e.g. the effect on quality of life, environmental implications, economic impact,

a *conclusion*, and

 citations and referencing (Harvard system preferred)

Your report could take the form of, for example:

an article for a scientific publication

 a letter to the editor

 a talk.

**Your report should include a discussion of *one or more* of the following key concepts:**

**DEVELOPMENT**

*Development of complex scientific models and/or theories often requires a wide range of evidence from many sources and across disciplines.*

*New technologies improve the efficiency of scientific procedures and data collection and analysis. This can reveal new evidence that may modify or replace models, theories, and processes.*

**INFLUENCE**

*Advances in scientific understanding in one field can influence and be influenced by other areas of science, technology, engineering, and mathematics.*

*Scientific knowledge, understanding, and inquiry can enable scientists to develop solutions, make discoveries, design action for sustainability, evaluate economic, social, cultural, and environmental impacts, offer valid explanations, and make* *reliable predictions.*

*The acceptance and use of scientific knowledge can be influenced by social, economic, cultural, and ethical considerations.*

**APPLICATION and LIMITATION**

*Scientific inquiry can enable scientists to develop solutions, make discoveries, design action for sustainability, evaluate economic, social, cultural, and environmental impacts, offer valid explanations, and make reliable predictions.*

*Science informs public debate and is in turn influenced by public debate; at times, there may be complex, unanticipated variables or insufficient data that may limit possible conclusions.*

You might use the following links, as a starting point for your investigation:

 **Mike Hatch’s Information Package:** [www.geosciencepathways.org.au](http://www.geosciencepathways.org.au)

This package contains an overview of the work done, with photographs and examples of data sets.

 **Historical Salinity Data:**

<https://www.mdba.gov.au/river-information/river-flows-salinity-reports>

Reports on this website summarise what's happening with the storage levels, flows and salinityof the River Murray.

 **Exploration Geophysics:** [www.zonge.com.au](http://www.zonge.com.au)

Based in Adelaide, the award winning *Zonge Engineering and Research Organisation*  provides a wide range of electrical geophysical services, including field surveys and data interpretation. Their website is a useful resource to understand the broad range of geophysical techniques offered, in particular the method used in this case (search for the NanoTEM system).

**** **Brian Barrett’s honours thesis:**

This is a link to an article that Brian Barrett wrote as part of his honours thesis in 2004, that led directly to the system developed for the mapping the Murray work:

<http://zonge.com.au/docs/environmental/river_sediment_salt_load_detection.pdf>

**ASSESSMENT**

This is one of seven required school assessments.

Your work will be assessed using the performance standards for Stage 2 Earth and Environmental Science on the next page:

|  | Investigation, Analysis, and Evaluation | Knowledge and Application |
| --- | --- | --- |
| **A** | Designs a logical, coherent, and detailed earth and environmental science investigation.  Obtains, records, and represents data, using appropriate conventions and formats accurately and highly effectively.  Systematically analyses and interprets data and evidence to formulate logical conclusions with detailed justification.  Critically and logically evaluates procedures and their effect on data. | Demonstrates deep and broad knowledge and understanding of a range of earth and environmental science concepts.  Develops and applies earth and environmental science concepts highly effectively in new and familiar contexts.  Critically explores and understands in depth the interaction between science and society.  Communicates knowledge and understanding of earth and environmental science coherently, with highly effective use of appropriate terms, conventions, and representations. |
| **B** | Designs a well-considered and clear earth and environmental science investigation.  Obtains, records, and represents data, using appropriate conventions and formats mostly accurately and effectively.  Logically analyses and interprets data and evidence to formulate suitable conclusions with reasonable justification.  Logically evaluates procedures and their effect on data. | Demonstrates some depth and breadth of knowledge and understanding of a range of earth and environmental science concepts.  Develops and applies earth and environmental science concepts mostly effectively in new and familiar contexts.  Logically explores and understands in some depth the interaction between science and society.  Communicates knowledge and understanding of earth and environmental science mostly coherently, with effective use of appropriate terms, conventions, and representations. |
| **C** | Designs a considered and generally clear earth and environmental science investigation.  Obtains, records, and represents data, using generally appropriate conventions and formats with some errors, but generally accurately and effectively.  Undertakes some analysis and interpretation of data and evidence to formulate generally appropriate conclusions with some justification.  Evaluates procedures and some of their effect on data. | Demonstrates knowledge and understanding of a general range of earth and environmental science concepts.  Develops and applies earth and environmental science concepts generally effectively in new or familiar contexts.  Explores and understands aspects of the interaction between science and society.  Communicates knowledge and understanding of earth and environmental science generally effectively, using some appropriate terms, conventions, and representations. |
| **D** | Prepares the outline of an earth and environmental science investigation.  Obtains, records, and represents data, using conventions and formats inconsistently, with occasional accuracy and effectiveness.  Describes data and undertakes some basic interpretation to formulate a basic conclusion.  Attempts to evaluate procedures or suggest an effect on data. | Demonstrates some basic knowledge and partial understanding of earth and environmental science concepts.  Develops and applies some earth and environmental science concepts in familiar contexts.  Partially explores and recognises aspects of the interaction between science and society.  Communicates basic earth and environmental science information, using some appropriate terms, conventions, and/or representations. |
| **E** | Identifies a simple procedure for an earth and environmental science investigation.  Attempts to record and represent some data, with limited accuracy or effectiveness.  Attempts to describe results and/or interpret data to formulate a basic conclusion.  Acknowledges that procedures affect data. | Demonstrates limited recognition and awareness of earth and environmental science concepts.  Attempts to develop and apply earth and environmental science concepts in familiar contexts.  Attempts to explore and identify an aspect of the interaction between science and society.  Attempts to communicate information about earth and environmental science. |