Stormwater 'Snapshot'

Students estimate the amount of stormwater flowing through their school, identify the main pollutants entering the stormwater and consider how they can be managed.

Curriculum Links:	S&E	(ICP, Place and Space, Active Citizenship)
	Science:	(Investigating, Earth and Beyond, Life and Living)
	Mathematics	(Measurement)
	English:	(Writing)

Outcomes: In completing this task, students will understand that:

- human activities have planned and unplanned impacts on natural systems and features of a particular landscape
- the interaction between people and the environment can be measured
- natural features and built features combine to form landscapes
- natural resources and human activity create spatial patterns
- natural and human systems are interdependent
- ecological sustainability relies on a variety of living things, their relationship with each other and between themselves and the non-living environment
- findings are applied when they are used to develop an informed opinion, shared with others acted on and/or used to solve a problem or issue.

Students will develop skills related to:

- strategies to protect and regenerate local environments
- ways to protect and regenerate a natural environment
- measurement – students decide what needs to be measured and carry out measurements of length, capacity/volume, mass, area, time and angle to the needed levels of accuracy
- writing – students write a formal report to initiate action on local environmental issue for an audience of key decision makers
- recording and organising data in a systematic manner while undertaking an investigation (eg. tables, charts).

Background Information

Algal blooms are a naturally occurring phenomenon normally resulting from nutrients being flushed into the river system or building up in the waterway. The blooms are the proliferation of algae. These are macro algae such as seaweed or micro algae which appear as surface scums, or discoloured water. Some algae are harmless, but some species are toxic to marine life or humans. An algal bloom in 2003 killed an estimated 300 000 fish in the Swan / Canning Rivers.

Pollution from human activities increases the amount of nutrients entering our waterways as stormwater to feed the algal blooms.

Preparation:

- Pedometer or long tape measure
- Map of local catchment
- Diagram showing a cross section of the school if required

Class Activities:

PART 1 (3 – 5 sessions)

Getting to grips with the scale of the problem – mapping the school grounds, calculating how much water falls on the school, and estimating how much goes where.

Explain to students that they are going to investigate how much of the pollution which comes from their school could eventually end up in the local river, creek, wetland or groundwater (discuss problems such as algal blooms that are affecting our rivers).

The first thing they need to do is estimate how much water falls on the school, and which surfaces it falls on (e.g. roof, paths, car parks, grass).

Task 1: Placing the school in the catchment

(this activity should be done as part of the first section of the 'Stormwater' Unit).

Obtain a map of your local catchment (from your local council or catchment group). Students locate their school on the map. With the class, find stormwater drains on the roads next to your school. Ask your local council or the Water Corporation to tell you where those drains go to, and how that system connects to the river / waterway.

Task 2: Mapping the school. (Group work)

1. Students use a pedometer (or long tape measure) to measure the area of school grounds. They need to record:
    - Total area
    - Area of:
        - Buildings
        - Paths / Paved areas
        - Car parks
        - Grass
        - Garden beds
        - Sand pits (play grounds)
2. Students draft a map of their school (either a class map on a large piece of butcher's paper or a group map on an A3 sheet). Secondary students might be required to make this a scale drawing.

Task 3: Calculating the amount of water falling on your school.

One millimetre of rainfall per one square meter of area = one litre of water.

The average annual rainfall for Perth is 835 mm (you can get local information from the Bureau of Meteorology www.bom.gov.au or your school's weather station).

- Students use the total area of the school and the rainfall data above to calculate how may litres of water pass through the school grounds each year. For example, if your school grounds are 500 m long by 300m wide (assuming it is totally flat), the total amount of water falling on your school in one year is: 300 x 500 x 835 = 125 250 000 litres.

- Now students need to estimate how much water lands on each surface of the school (Rooves will enlarge the area depending on their pitch. This can be ignored and the final estimate be described as greater than xyz).

To work out how many litres of water fall on each type of area multiply the total amount of water by the proportion for that area eg. if 25% of the grounds are buildings and the total is 125 250 000 litres then the amount on buildings is 0.25 x 125 250 000 = 31 312 500 (or 125 250 000 ÷ 4).

- Students complete the table found at the end of Part 1 'Rain water in our school' (use a calculator).
- Ask the students what that amount of water looks like? How much water is in:
  a) a backyard swimming pool (*around 40,000 – 60,000 litres*)?
  b) an Olympic swimming pool (*roughly 2,500,000 litres*)?
- Ask the question –"Where does the water go?" Students think about:
  - How much water is returned to the atmosphere over the year? (*In a naturally vegetated catchment up to 95% returns to the atmosphere as evaporation or transpiration. In a catchment cleared for agriculture, about 90% goes to evapotranspiration. In an urban catchment this is much less, as up to 80% of rainfall can go to drains as surface runoff*)
  - How much (approximately) infiltrates into the soil in your school?
  - What happens to this water? (*it goes into the soil to be used by plants or becomes part of the groundwater and flows very slowly to waterways - around 50 – 150 metres per year in the sandy soils around Perth*).
  - How much (approximately) runs off to drains in your school?
  - Where do those drains go to? (See Task 1 where the place of the school in the catchment is discussed).

Task 4. How does it compare to the nature?

- On the board, draw a cross section of your school grounds, showing the proportion of each type of 'land use'. Have the students copy the diagram into their workbooks – or more able students may be asked to draw the diagram themselves from the data collected to date. Diagram should be labelled with where the water goes (for a maths extension activity this could be done to scale).
- For the same area have the students draw a cross-section of what this landscape would have looked like before European Settlement (some research on the native plants in this area maybe necessary).
- Ask the students to think about the water cycle. They should consider:
  - the cross-sections showing the situation now (the actual).
  - the cross-section showing the natural situation (before clearing).
  - how the water cycle might be different for each one.
- Students should now consider each of the following parts of the water cycle.
  Will they be:
  a) greater, b) about the same, or c) less.
  They should record their answers in their note books. (Answers given in italics).

  - Precipitation (*the same*)
  - Evaporation (*less as less water is intercepted by vegetation held by leaves*)
  - Transpiration (*less as there are fewer plants growing in the area*)
  - Surface run-off (*much greater, particularly if there are lots of hard surfaces leading to drains*)
  - Infiltration (*less as there are more hard surfaces*)
  - Groundwater flow to waterways. (*less as there is less infiltration*)

- Compare how water moves in the two landscapes (ask your Ribbons of BLue coordinator about 'Raining Tennis Balls'. This would be a good activity to do between activities 3 & 4.)
- Which would have the greatest runoff?
- Which parts of the school are most similar to the natural state?
- Which parts of the school are designed so water runs off as quickly as possible?
- Why is this important?

(This is important to reduce flooding - most stormwater systems are designed to remove water as quickly as possible to the nearest waterway. This can be a disaster for the environment so a compromise is needed, and new developments are being built according to principles of Water Sensitive Urban Design – see www.watercorporation.com.au)

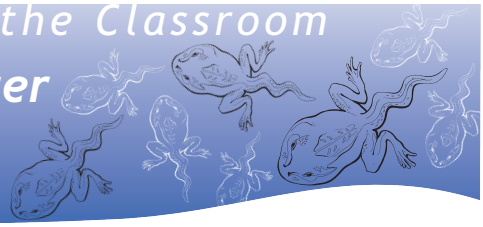
- As a class, discuss what problems could this cause? Students add relevant notes/observations to the note books.

(There is more runoff crossing surfaces where pollutants can be picked up, and that runoff goes directly to waterways, resulting in more algal blooms and fish kills. In natural catchments surface runoff only occurs after heavy rain. In a built urban catchment, runoff occurs after 1 mm of rain).

- **Extension Idea**

Students could empty a nine-litre watering can (the same amount of water that would fall over 3m^2 after 1 mm of rain) on different surfaces and observe what happens to the water. (Refer to the Water Corporation's Water Is Our Future Teacher Resource File for full instructions).

"Priceless"
Erin Godley (Newton Moore SHS). Leschenault Regional Winner and State winner (High School) Photo competition 2007.
This photo was taken at a site re-vegetated by the students of Newton Moore.



Part 1 Worksheet: Rain water in our school

	Area m^2	% of school grounds	Litres of water falling as rain on this surface	Where does it go?
Buildings				☐ Infiltrates into soil ☐ Runs off to drain
Paths				☐ Infiltrates into soil ☐ Runs off to drain
Car Parks				☐ Infiltrates into soil ☐ Runs off to drain
Grass / Oval				☐ Infiltrates into soil ☐ Runs off to drain
Garden Beds				☐ Infiltrates into soil ☐ Runs off to drain
Sand Pits / Playgrounds				☐ Infiltrates into soil ☐ Runs off to drain
Total		100		

If teachers wished to integrate this table activity with use of fractions, then convert decimals to fractions and use same procedure.

PART 2 (1-2 sessions)

Identifying what pollutants can get into the water.

1. Walk around the school with the class and have a close look at the areas being studied, complete Part 2 Worksheet. For each area, students as a class, in groups or individually, decide which of the pollutants on the worksheet (found at the end of Part 2) could get into the water after it falls to the ground as rain. For each one decide if the amounts could be 'lots', 'some', 'a little' or 'none'.

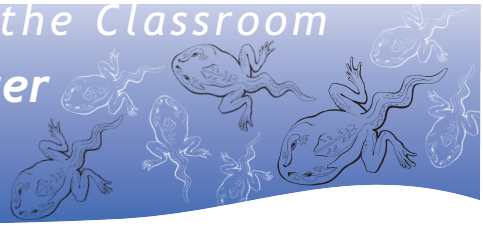
2. Looking at the survey results, ask the students:
   - "Do you think much 'pollution' enters the drains from our school?"
   - How could you find out how much? (The only actual way would be to measure water in drains after rain, and this is impractical).
   - How could you tell if your school was harming near-by creeks / rivers / wetlands / groundwater?
     (Students might undertake long-term monitoring of their waterway using Ribbons of Blue activities. For example water samples could be measured, upstream and downstream of drain outlets to see if they are having an impact, as well as at the outlet itself. Entering the actual drain is illegal, dangerous and unnecessary.)
   - What level of pollution do you think is safe for your river (lots, some, a little, none)?
   - Which types of pollution do you need to reduce from your school?
     (Basically any of the above pollutants is harmful – apart from native leaves – so the aim would be to reduce the rest to as close as possible to zero).

*A good place for information is the **Water Corporation's** web site www.watercorporation.com.au, click on Water Topics and then go to Drainage and Stormwater. **Melbourne Water's** site is also extremely useful: www.melbournewater.com.au. The **Swan River Trust's** Resource Sheet 3 on Waterways Pollution will also be helpful and can be found on their web site: www.environ.wa.gov.au/srt/sccp.*

Extension Ideas

1. Students could research each of these types of pollutants (from the worksheet) and find out where they come from and why they can be a problem in the environment. This could be done as a group jigsaw exercise. (**Proforma for jigsaw activity included at the end of Part 2**).

2. Students could put samples of things they find on different surfaces in glass jars filled with water, and leave them in sunlight – on a window sill, for example, and see how they affect the water. Examples could include soil from garden beds, sediment from playground, oil from car park, leaves, grass clippings.



Part 2 Worksheet: How much pollution enters the water from our school?

Area	Pollutants	Lots	Some	A little	None
Buildings	Leaves - native				
	Leaves – non native				
	Sediment (soil, dust)				
	Fertiliser				
	Pesticides / Insecticides				
	Oil / Petrol				
	Detergent / Cleaning chemicals				
	Litter				
	Dog / Animal Poo				
Paths / Paved areas	Leaves - native				
	Leaves – non native				
	Sediment (soil, dust)				
	Fertiliser				
	Pesticides / Insecticides				
	Oil / Petrol				
	Detergent / Cleaning chemicals				
	Litter				
	Dog / Animal Poo				
Car Parks	Leaves - native				
	Leaves – non native				
	Sediment (soil, dust)				
	Fertiliser				
	Pesticides / Insecticides				
	Oil / Petrol				
	Detergent / Cleaning chemicals				
	Litter				
	Dog / Animal Poo				
Grass areas	Leaves - native				
	Leaves – non native				
	Sediment (soil, dust)				
	Fertiliser				
	Pesticides / Insecticides				
	Oil / Petrol				
	Detergent / Cleaning chemicals				
	Dog / Animal Poo				
	Litter				
	Leaves - native				
Garden areas	Leaves – non native				
	Sediment (soil, dust)				
	Fertiliser				
	Pesticides / Insecticides				
	Oil / Petrol				
	Detergent / Cleaning chemicals				
	Litter				
	Dog / Animal Poo				

Jigsaw Activity Proforma Pollutants

TASK:

- Working together, research the pollutants from the table allocated to your group.
- Decide your task allocations quickly or you will not have time to complete the task.
- Make brief notes, to enable you to present the facts to others.
- Present your findings to your group and discuss implications, facts other group members can add. You are now the "Experts" in this area.
- Re-form into "expert" groups. Each "expert" relates the information, facts, opinions gained from their research and discussion in the original group.
- While listening to the other "experts", make notes of the key facts for each topic.
- Write up a summary of the topic presented and a list/summary of the information obtained as a listener.

READING

3.1 Re-tell and discuss interpretation of the text, with attention to key facts (main ideas) and supporting details.

SPEAKING AND LISTENING:

3.1 Reports to new group on discussion / information gained in initial group.

3.1 Listens to obtain specific information from group reports.

WRITING:

2.1 Lists several items of information for each topic.

2.2 Records information and ideas.

3.1 Writes a summary of the original topic including information on several aspects.

KEY:

ACHIEVED 

ATTEMPTED 

NOT EVIDENT X

COMMENT

PART 3 (1-2 sessions)

What are people doing that might affect our water?

- Invite the school cleaner and gardener to visit the class or assign groups to ask them:
    - What cleaning products do you use? (cleaner)
    - What garden fertilisers / chemicals do you use? (gardener)
- The students need to find out what they do that might be important for the stormwater.
- Ask them to help the students to complete the table "Interviewing the cleaner and the gardener" (found at the end of Part 3).

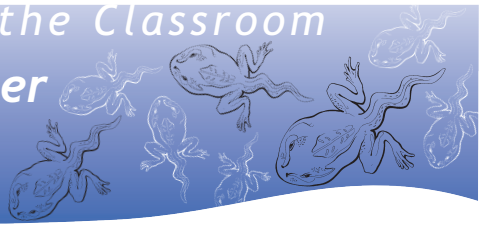
Students should:

- Classify the actions in the table as 'good' or 'bad' for water in their school.
- Highlight / Shade "good" actions in blue and "bad" actions in red. (See answers below).
- Decide which actions their school needs more of? Which do you need less of?
- Think about what happens at their school to dispose of left over art paint. Does the type of paint make a difference?
- What happens at home after someone in the family has finished painting the walls, changing the oil in the car, pruning the garden etc.

Students should be encouraged to wipe excess paint onto paper, before rinsing brushes in a bucket to be disposed of in the garden or inside sinks if absolutely necessary.

Good actions are:

- *Cleaners: Use low phosphate detergents, Empty buckets / used cleaning products into sewer 'drains', Clean gutters, Take precautions to prevent spilling chemicals / detergents.*
- *Gardeners: Use slow release fertilisers, Add compost / soil improver to garden beds, Collect soil / dirt off paths and return to gardens, Apply fertiliser in Spring / Autumn, Mulch leaves / lawn clippings, Pick up dog / animal poo, Apply soil wetter / water holding stuff, Take precautions to prevent spilling petrol / fertilizer.*



Part 3 Worksheet: Interviewing the cleaner and the gardener

	Actions (Some of these are good, some bad for stormwater)	Always	Sometimes	Never
Cleaners Do you...?	Use low phosphate detergents			
	Use 'normal' detergents			
	Empty buckets / used cleaning products into sewer 'drains'			
	Empty buckets / used cleaning into stormwater drains			
	Empty buckets / used cleaning onto pavements, gardens, lawns			
	Clean gutters			
	Take precautions to prevent spilling chemicals / detergents			
Gardeners Do you...?	Use slow release fertilisers			
	Use 'traditional' chemical fertilisers			
	Add compost / soil improver to garden beds			
	Collect soil / dirt off paths and return to gardens			
	Collect leaves / grass clippings and return to garden beds			
	Blow dirt off pavements into drains / onto roads			
	Blow leaves off pavements into drains / onto roads			
	Apply fertiliser in Spring / Autumn			
	Apply fertiliser in Summer / Winter			
	Mulch leaves / lawn clippings			
	Pick up dog / animal poo			
	Apply soil wetter / water holding stuff			
	Hose down car parks			
	Take precautions to prevent spilling petrol / fertiliser			
	Grow native plants that need less fertiliser			

PART 4 (1 -2 sessions)

Making our stormwater cleaner

There is a range of things we can do to make the stormwater entering our rivers, creeks, wetlands and groundwater cleaner. These include:

- Reducing pollutants entering the stormwater.
- Increasing the amount of water that infiltrates into the soil (slowing down the journey of the water from the sky to the river), making it closer to the natural situation.
- Educating people on what they can do.

1. Brainstorm in groups or as a class

- The students look at the things they talked to the cleaner and gardener about, and any other issues with pollutants that have been identified in their investigations to date, and decide what can be done to improve the stormwater coming off the school.
- There are also some long-term actions the class could ask your principal or P&C to consider such as:
  - installing rainwater tanks
  - installing permeable pavements (special pavers that allow water through)
  - gardens that require less fertilisers (such as native plants) and
  - bio-filtration systems (plastic pipes buried under ground with slits in them that allow water to enter and take it away)
  - revegetating areas where water collects / flows (such as a stormwater sump near the school).

Students could research what these things do and how they can help prevent stormwater pollution. See http://www.melbournewater.com.au/content/publications/fact_sheets/drainage/water_sensitive_urban_design.asp.

2. Draw up an Action Plan

- As a group or whole class, students list as many actions as possible and consider who is responsible for the project and when it could be done.
- Be sure the class includes actions that could be managed by themselves (with assistance) . Don't allow the fobbing off of the problem to "Everyone Else"
- Students draw up a table as below or something similar.(Template page 52)

Action Plan for Cleaner Stormwater		
Action	Who should do it	When should it be done

3.What will it cost?

Some of the suggestions the students have brainstormed, may involve big changes that could cost quite a lot of money.

There are some places where funding is available to help people do things to help the environment.

Allocate groups to research what funding is available from the following.

- Community Water Grants – www.communitywatergrants.gov.au
- Mitre 10 Landcare Grants – www.mitre10.com.au/landcare/grantapply.asp
- Australia Post Junior Landcare Grants – www.austpost.com.au
- Lotteries Commision Community Grants – www.lottery.wa.gov.au
- Westpac Operation Backyard – www.westpac.com.au.

Share the information around the class or use the ligsaw technique.

For classes with limited time or younger classes see the "Caring for your Catchment" activity in the catchment section of this file.

Action Plan for Cleaner Stormwater

Part 5 (2 sessions)

Preparing a report: (a rubric is included in this section of the file)

- Using the research action plan, and what they have learnt about helping improve stormwater the students need to tell the people who make decisions about it.
- Ask: "Who do you think that will be?"
- Explain to the students, that usually environmental managers present a report called a Management Plan to the relevant people. They can prepare a similar report that covers:

Background

- What is the problem?
- Why is it important?

Key Findings

- What did you learn from your research?

Recommended Actions

- Include your table from Part 4. Explain the main steps in implementing your key actions.

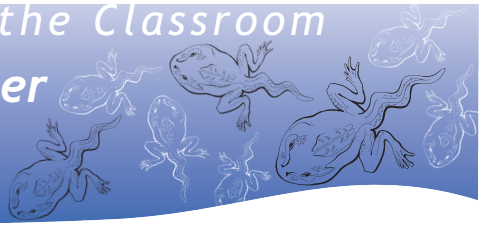
Conclusions

- Ensure your report is accurate, provides evidence to back your assertions and an outline as to how your suggestions could be funded / implemented.
- Present your work as a typed report with cover page and relevant diagrams or illustrations. Use tables and dot points as appropriate.

Extension:

Now that the class has developed a plan for the school, what other places do they think need to have cleaner stormwater? What about their homes, sporting ovals, shopping centres?

Complete the survey over the page at home by questioning parents or neighbours.



At home

	Actions (Some of these are good, some bad for stormwater)	Always	Sometimes	Never
When cleaning Do you...?	Use low phosphate detergents			
	Use 'normal' detergents			
	Empty buckets / used cleaning products into sewer 'drains'			
	Empty buckets / used cleaning into stormwater drains			
	Empty buckets / used cleaning onto pavements, gardens, lawns			
	Clean gutters			
	Take precautions to prevent spilling chemicals / detergents			
In the Garden Do you...?	Use slow release fertilisers			
	Use 'traditional' chemical fertilisers			
	Add compost / soil improver to garden beds			
	Collect soil / dirt off paths and return to gardens			
	Collect leaves / grass clippings and return to garden beds			
	Blow dirt off pavements into drains / onto roads			
	Blow leaves off pavements into drains / onto roads			
	Apply fertiliser in Spring / Autumn			
	Apply fertiliser in Summer / Winter			
	Mulch leaves / lawn clippings			
	Pick up dog / animal poo			
	Apply soil wetter / water holding stuff			
	Hose down driveways			
	Take precautions to prevent spilling petrol / fertiliser			
	Grow native plants that need less fertiliser			

Stormwater Snapshot Integrated Assessment:

Task: Write a management report for the school decision makers on "A Proposed Stormwater Management Strategy" for the school. Use the given headings and present a typed report with cover page, subheadings, diagrams, etc as required.

Submit your research notes with your completed assignment

Name:_____ Due Date:_____

	Level 2	Level 3	Level 4
S&E (ICP, Place & Space, Active Citizenship)	Writes a report to share/apply findings. Suggests ways school's use of the landscape can affect the water quality. Given the focus questions, identifies some of the factors to be considered and makes limited, factual notes/ observations.	Typed report includes tables and diagrams to support proposed actions. Identifies that the impact of groups of people on the landscape can have an effect on others. Includes information from more than one source and makes simple predictions/ conclusions based on personal experience.	Findings are presented using a combination of forms, contains an informed opinion and presents alternative solutions. Identifies the changes in people's activities which can have a beneficial affect on the landscape. Identifies the types of observations, data and sources appropriate to the investigation and collects accurate information from a variety of sources. Presents an informed opinion.
English Writing Presentation	Writes a report which presents information in logical sequence, uses simple past tense and joining words. Uses mostly simple sentences and few conjunctions. Uses full stops and capital letters correctly. Typed copy but errors apparent and format inconsistent.	Writes a report with logically organised paragraphs (main point / elaboration and concluding /linking sentence) and technical language. Uses complex sentence structures and more varied conjunctions. Uses full stops, capitals, commas, apostrophes and direct speech correctly. Typed text using subheadings. Few errors. Text formatting correctly used (title in bold, consistent margins and spacings).	Information report structures and language conventions apparent (thesis, statement, supporting ideas, elaboration and examples) and organises text and graphics in various ways for effect. Uses linking devices to link sentences and paragraphs which signal relationships (e.g. "due to" / "in addition to" etc). Uses all forms of punctuation correctly (including colons semicolons in place of conjunctions, dot points etc). Uses common processing tools (justification, bullets, numbering, tables, drawings etc) and defined layout scheme. No errors.
Comments:			

NB. Rubric boxes can be altered to suit individual teacher's assessment and reporting requirements.

Action Plan for Cleaner Stormwater

Action	Who should do it?	When should it be done?

Ribbons of Blue Integrated Evaluation Assignment

Task: Produce an advertisement – either a script (radio/TV) OR print version (newspaper/magazine) to promote the importance of healthy wetlands. You can promote the general need to care for wetlands OR specific action/s which help keep wetlands healthy.

Your advertisement must clearly demonstrate the concept promoted or the action proposed, why it is desirable and how it will make a difference.

You also need to indicate the intended audience and suggest suitable timetable slots or publications for your proposed advertisements.

	Level 2	Level 3	Level 4
Science E&B	Identifies that it is important to care for/ protect a local resource (wetland).	Identifies/suggests strategies for protecting local waterways.	Demonstrates an understanding of the relationship between human impact on the environment and ecological sustainability.
English Viewing	Recognises the importance of colour in advertisements or posters. Identifies the significance of music in TV or radio script or colour in print media	Suggests sound effects relevant to sequence of shots or events in script (radio/TV) OR recognises information may be portrayed in different forms (graphs, diagrams, pictures for print media). Links commercial to target Audience.	Recognises that narrative is the principal structural element in most media texts. Links commercial to target audience and identifies best screening time or print type.
S&E Place & Space	Suggests ways to conserve or improve resource use (local wetland).	Demonstrates an understanding of how and why caring for the environment is important.	Demonstrates an understanding that human impacts on the environment are important. Links valuing of the local resource to sustainability of that resource.
T & E Information	Records and presents information and ideas, using graphics, words and/or symbols to convey key information re. proposal(s).	Considers the target audience when using techniques which will maximise the effectiveness of a simple but significant message related to local wetlands.	Prepares an advertising/promotional campaign which reflects a variety of forms and combines modern and traditional technologies.
Teacher's comment:			
Alter / add / delete boxes as required.			