April 2008

To the teacher

Sustainable Land Management

This unit focuses on the issues associated with sustainable land management, particularly in the Taranaki hill country where vegetation clearance may lead to accelerated erosion difficulties.

The unit offers background information and practical activities to enable teachers to raise student awareness of our local environment. The information in the unit is aimed at Levels 5 and 6, but with a little creativity and judicious choice can be adapted to suit all class levels. The curriculum links offered are not intended to be comprehensive but are provided to demonstrate the cross-curricular nature of environmental education.

The material within this unit is sourced from a variety of references and from the expertise within the Taranaki Regional Council. It is not necessary for classes to do all of the activities suggested, nor do they need to be undertaken in any particular order.

It is hoped that you will find this unit of use and we welcome feedback. Please feel free to photocopy the material within the unit. If you require assistance with any aspect of this unit please don't hesitate to contact the Education Officer (Environmental Education) at the Taranaki Regional Council.

Yours faithfully
B G Chamberlain
General Manager

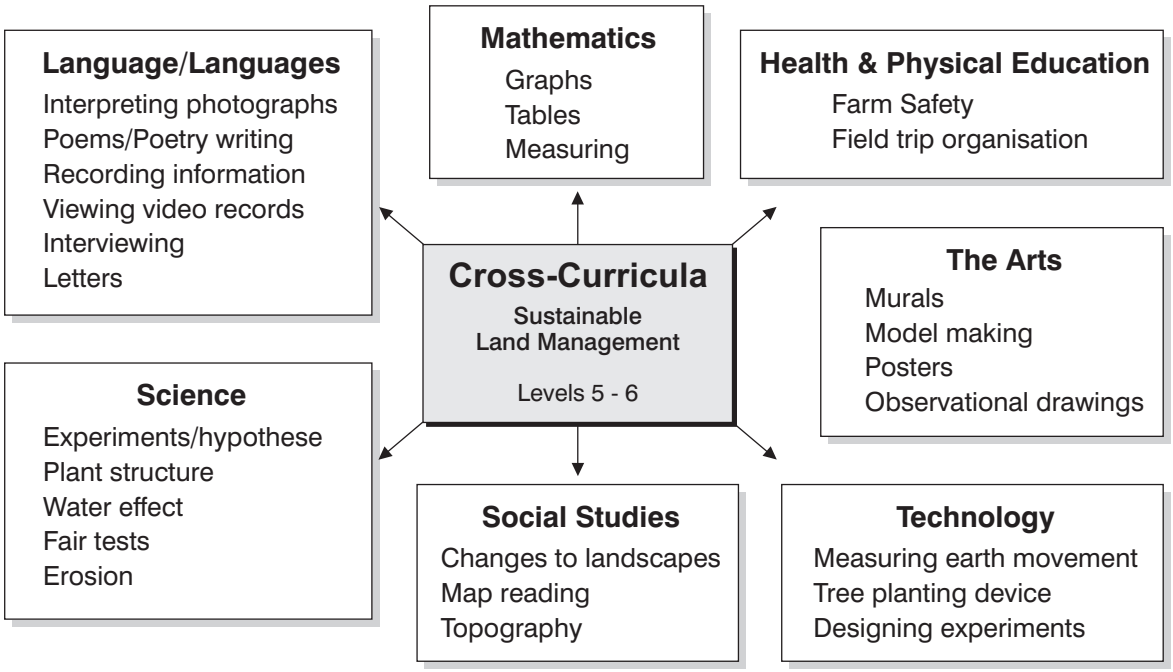
per: R J Ritchie
Senior Information Officer

Table of Contents

Cross Curricula Links 2
Study One
Setting the Scene 6
Study Two
Soil Composition 8
Study Three
Erosion 11
Study Four
Forms of Erosion 13
Study Five
Accelerated Erosion 19
Study Six
Erosion Control 22
Study Seven
Riparian Management 26
Benefits of Riparian Management to the Environment 27
Study Eight
Land Management Options 29
Study Nine
What Can We Do? 33
Appendix 1
Brainstorming sheet 37
Appendix 2
Identifying erosion on a farm 38
Appendix 3
Changing river banks 39
Appendix 4
Community erosion effects 40

Cross Curricula Links

This unit will involve activity in all curriculum fields. Skilled teachers will find ways to link the ideas together to enable students to work across curriculum boundaries to gain deeper understandings of the issues. Listed below are some of the activities the students will be undertaking. This list is not designed to be exhaustive and you are encouraged to add to it wherever possible.



Links with the New Zealand curriculum statements

Science

Making Sense of the Living World

In their study of the living world, students will use their developing scientific knowledge, skills and attitudes to:

- gain an understanding of order and pattern in the diversity of living organisms, including the special characteristics of NZ plants and animals
- investigate and understand the relationship between structure and function in living organisms
- investigate local ecosystems and understand the inter-dependence of living organisms, including humans, and their relationship with their physical environment

Making Sense of Planet Earth and Beyond

In their study of planet Earth and beyond, students will use their developing scientific knowledge, skills and attitudes to:

- investigate the composition of planet Earth and gain an understanding of the processes which shape it
- investigate the geological history of planet Earth and understand that our planet has a long past and has undergone many changes
- investigate how people's decisions and activities change planet Earth's physical environment, and develop a responsibility for the guardianship of planet Earth and its resources.

Earth Science features of local and national significance should be emphasised

Social studies

Place and Environment

From their study of place and environment, students will understand:

- peoples interaction with places and the environment
- the ways in which people represent and interpret place and environment

Time, Continuity and Change

From their study of time, continuity, and change, students will understand:

- relationships between people and events through time
- interpretation of these relationships

Resources and Economic Activities

From their study of resources and economic activities, students will understand:

- peoples allocation and management of resources
- peoples participation in economic activities

English

Oral Language

Students should be able to:

- engage with and enjoy oral language in all its varieties
- understand, respond to, and use oral language effectively in a range of contexts through : group and class discussion; presenting reports; conducting interviews etc

Written Language

Students should be able to:

- engage with and enjoy written language in all its varieties
- understand, respond to, and use written language effectively in a range of contexts through : reading information texts; writing reports; writing instructions etc

Visual Language

Students should be able to:

- engage with and enjoy visual language in all its varieties
- understand, respond to, and use visual language effectively in a range of contexts through : reading tables, graphs ; viewing video/film ; interpreting pictures etc

Mathematics

Mathematical Processes

The mathematics curriculum intended by this statement will provide opportunities for students to:

- develop the knowledge and skills to interpret written presentation of mathematics

Number

The mathematics curriculum intended by this statement will provide opportunities for students to:

- develop an understanding of numbers, the ways they are represented, and the quantities for which they stand

Measurement

The mathematics curriculum intended by this statement will provide opportunities for students to:

- develop knowledge and understanding of systems of measurement and their use and interpretation
- develop confidence and competence in using instruments and measuring devices

Geometry

The mathematics curriculum intended by this statement will provide opportunities for students to:

- develop spatial awareness and the ability to recognise and make use of the geometrical properties and symmetry in everyday objects
- develop the ability to use geometrical models as aids to solving practical problems in time and space

Statistics

The mathematics curriculum intended by this statement will provide opportunities for students to:

- recognise appropriate statistical data for collection, and develop the skill of collecting, organising, and analysing data, and presenting reports and summaries
- interpret data presented in charts, tables, and graphs of various kinds

Technology

Technology education involves students in:

- investigating, using, and understanding the technological products, systems and environments that have developed in their society
- identifying and exploring needs and opportunities which may be met through technological activity
- creating and evaluating ideas to improve or modify technology in relation to these identified needs and opportunities
- designing their own technological solutions
- recognising the inter-relationship of technology and society – now, in the past, and in the future

Sustainable land management

Study One

Setting the Scene

On a whiteboard or large sheet of paper discuss and record the students' ideas about the following questions:

What is soil?

Where does it come from?

What is erosion?

What causes it?

Why do we plant trees?

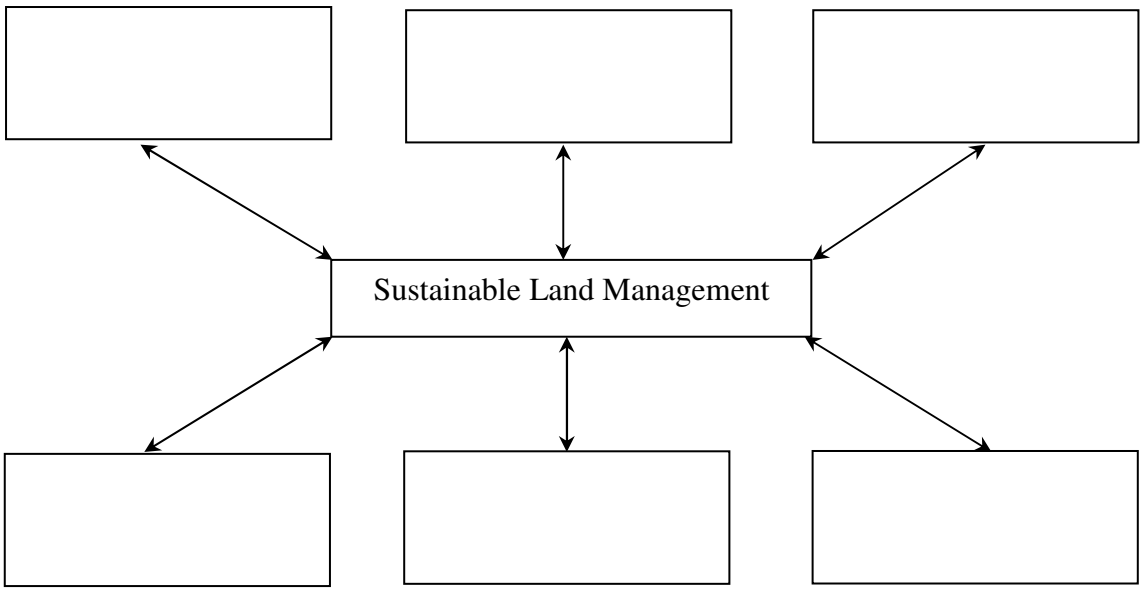
What effect does water have on the soil?

What can we do about erosion?

What makes rivers dirty during storms?

Design a cover page for this study.

Have the students copy the diagram below (or copy from the appendices) and write a question they would like to find information about in each blank space.



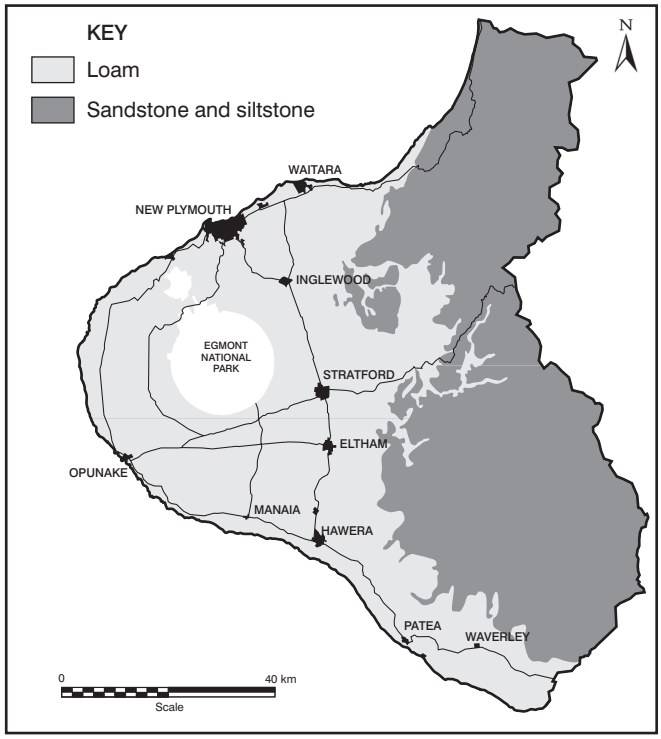
Study Two

Soil Composition

The Taranaki landscape is made up of two predominant soil types.

The ring plain surrounding Mt Taranaki/Egmont consists of materials emanating from a volcanic source. These are mainly rich ash and fine andesitic materials that provide an excellent base for pasture growth.

The north and south Taranaki coastal terraces and the central high country beyond the ring plain have been formed through sedimentary action during the uplifting of New Zealand over millions of years and at different times. The predominant component of this section of our region are **sandstone and siltstone**.



Each of these separate soil compositions has features that determine the type of land use that can be sustained in that particular area.

The base ingredients of the soil type are then combined with other components that make up all soil. These other components are present in different amounts and provide different functions to ensure the soil is alive and healthy.

These components and their importance are: -

Minerals	Formed from the breakdown of rock material.
Water	Essential for plant growth. Helps dissolve the minerals for plants to use.
Air	Pervades the spaces in the soil. Essential for survival of organisms which break down the plants.
Living Organisms	These creatures decompose plant matter and aerate the soil.
Humus	Dead and decaying plants and animals.
Nutrients (trace elements)	Provide the link between plant and animal components.

Soil – A living resource!

A good soil is full of life and empty spaces. Pore space is one of the most important things about soil because pores hold a mixture of water and air, both of which are essential for plant and animal life.

Activity One Sedimentation

Pre – Activity preparation: -

Have five ice-cream containers with material from different sources in each, such as soil, mud, silt, sand, small gravel.

Have enough large beakers for each group of three students.

Method

Half fill the beaker with water

- Add a teaspoon of each particle source from the ice-cream containers.
- Stir the mixture in the beaker.
- Store the beaker in a safe place and allow the mixture to settle.

Ask the pupils to predict what they think will happen to the material in the beaker. Encourage them to consider: -

What will it look like?

How long will it take?

After a suitable time (one or two days) re-examine the beakers and record the results. Each group should develop a conclusion that explains the final result.

Results

The largest (coarsest) particles should settle on the bottom, with the finest particles taking the longest time and therefore ending up on the top of the settled material. Note that it may take several days for the very fine particles to settle completely.

Groups could present their results in a table or graph.

Study Three

Erosion

Erosion is the process of wearing away of the land surface and the transportation of eroded material to another place.

Erosion is one of the natural processes that creates landforms such as valleys,beaches and plains. Natural erosion is slow and continuous, but occasional events like large storms or earthquakes can quicken the rate of erosion in a very short time.

Gravity, wind and water are all major contributors to erosion.

Gravity soil naturally moves from the top of hills to the bottom. This slow and continuous process of soil creep causes soil to end up at the base of hills.

Wind small particles of soil, which are not protected by roots of plants are exposed to the wind and may be picked up and transported considerable distances by the wind. Moving sand dunes are a typical example.

Water Rain: - raindrops falling on bare earth wash the soil away. The rain soaks into the soil making it heavier and causing it to sometimes slip away.

Sea: -waves crash against the coast, grinding rocks into sand and cutting back the edge of the coast. Coastal drift carries the sand along the coast to calmer water where it builds beaches.

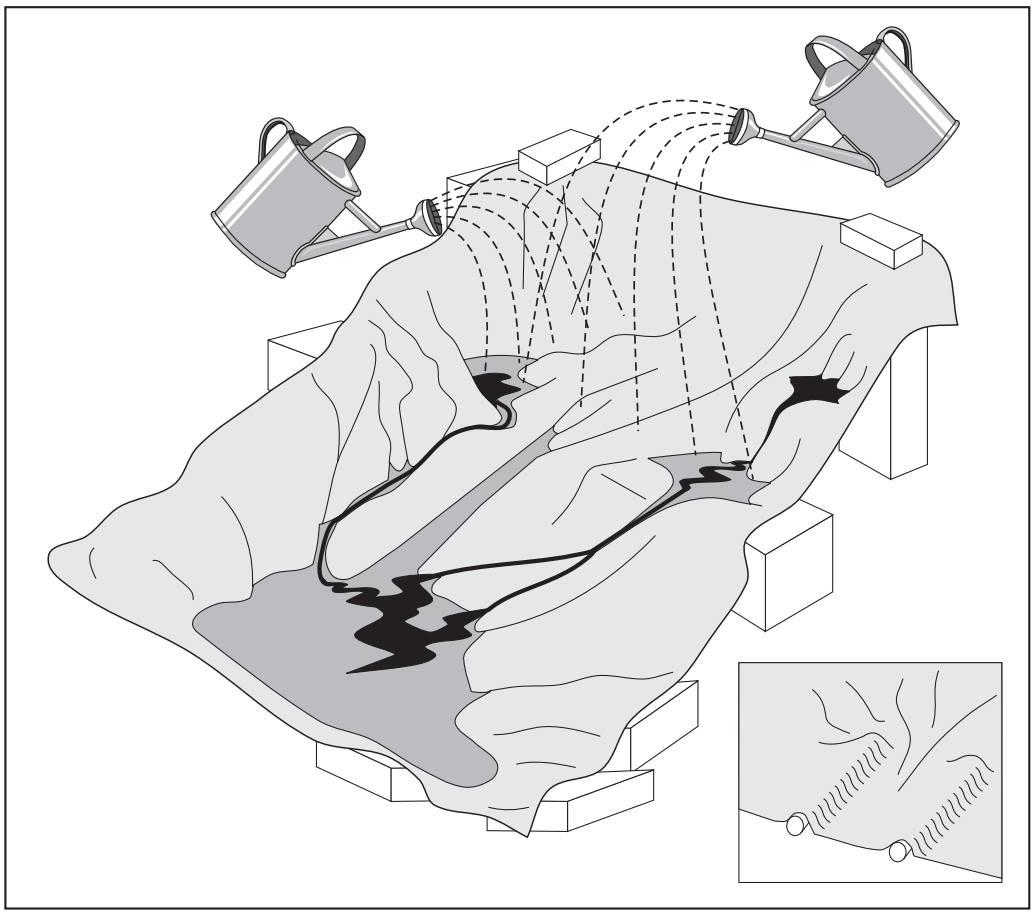
Rivers: - the force of the flow cuts away at the banks of the river causing them to become undercut and fall into the flow. Loose material is then transported down the river and deposited in quieter flow zones.

Activity Two The Power of Water

Create an artificial landscape using a sheet of polythene and props such as boxes, blocks, bricks and screwed up pieces of paper. Put some different grade particles (soil, sand, gravel) on the bottom of some of the hollows.

Ask the students to predict what will happen when you gently pour water from the watering can onto the artificial landscape.

Pour the water onto the landscape to simulate rain.



Observe closely, and then record your observations.

Focus questions: -

What happens to the water?	(pools, then runs downhill, smaller rivulets combine)
What happens to the particles?	(some get carried downstream by the water)
Where are they deposited?	(some in the next pool down, some at the bottom)

Liken this to a river catchment and the associated scale of erosion.

Study Four

Forms of Erosion

Erosion takes many forms and the type of erosion is often determined by the composition of the country and the conditions that exist at that particular time.

Water is often the common factor in the cause of erosion. The five basic stages of **erosion involving water** are :

Sheet Erosion

Water flowing across the ground in a uniform sheet picks up loose particles of soil and transports them away. This occurs on most areas of bare land during heavy rainfall.

Rill Erosion

Water moving in sheet erosion will begin to form small channels that are called rills. Small rills eventually flow into dominant rills and this may be the beginning of gully erosion.

Gully Erosion

As dominant rills form, a large volume of water starts to flow through the channels at high speed. The channels begin to scour out and may deepen enough to become gullies. Gullies have bare sides and the head of the gully is constantly being eroded

away by the flowing water. Gully erosion usually occurs in streams with soft beds and a steep grade.

Streambank Erosion

This covers slumping of banks as well as deposits from floodwaters. Deposits are called **sedimentation** and may comprise silt or larger particles such as gravel or rocks. Streambank erosion causes damage to the existing pasture by either eating away the fertile topsoil or burying it under sediment and debris.

Tunnel Gully Erosion

This is a compound form of erosion. It usually occurs on more gentle slopes where a soft soil sits on top of a hard rock layer or a compacted water resistant layer. Water percolates through the soil during rain and hits the hard layer underneath. As it cannot penetrate the rock it will move downhill on top of the rock layer and beneath the topsoil. Eventually the water will find its way back to the surface in places where the top soil is thin and patches of seepage will be evident. Over time this seepage will carry soil away and develop a tunnel. Eventually the tunnel becomes so large it collapses.

Mass movement erosions include: -

Slip Erosion

This, as the name suggests, is when earth slips or slides and is normally most severe when long dry spells are followed by prolonged heavy rain.

Soil Slip

This is a rapid sliding slip that is parallel to the slope and is usually less than one metre deep.

Earth Slip

This is also a rapid sliding slip that covers a large area and is deeper than one metre.

Slump

A slump is a downward and rotational movement. The head of the slump has cracks and large drops. At the centre of the moving area there is a distinct backward tilt. The toe of the slump is uplifted and domed. Erosion at the toe keeps the slump moving.

Subsidence

This is the movement where land drops vertically downwards.

The final major form of erosion is that caused where the water content in the soil is high. This contributes to rapid soil movement. **Flow erosions** are: -

Earth -flow

Movement may be slow or fast. Usually the flow has a bulge at the top, ripples and hummocks on the surface of the movement and cracks at the head. This type of erosion occurs on gentle slopes and has a lumpy appearance similar to porridge. The grass cover is usually intact and there is little, if any, bare ground.

Mudflow

A very fast type of movement, mudflows often occur in former stream beds or gullies especially where there is bare ground. A large area of soft ground will suddenly collapse down the slope and flow into lower areas.

Debris Avalanche

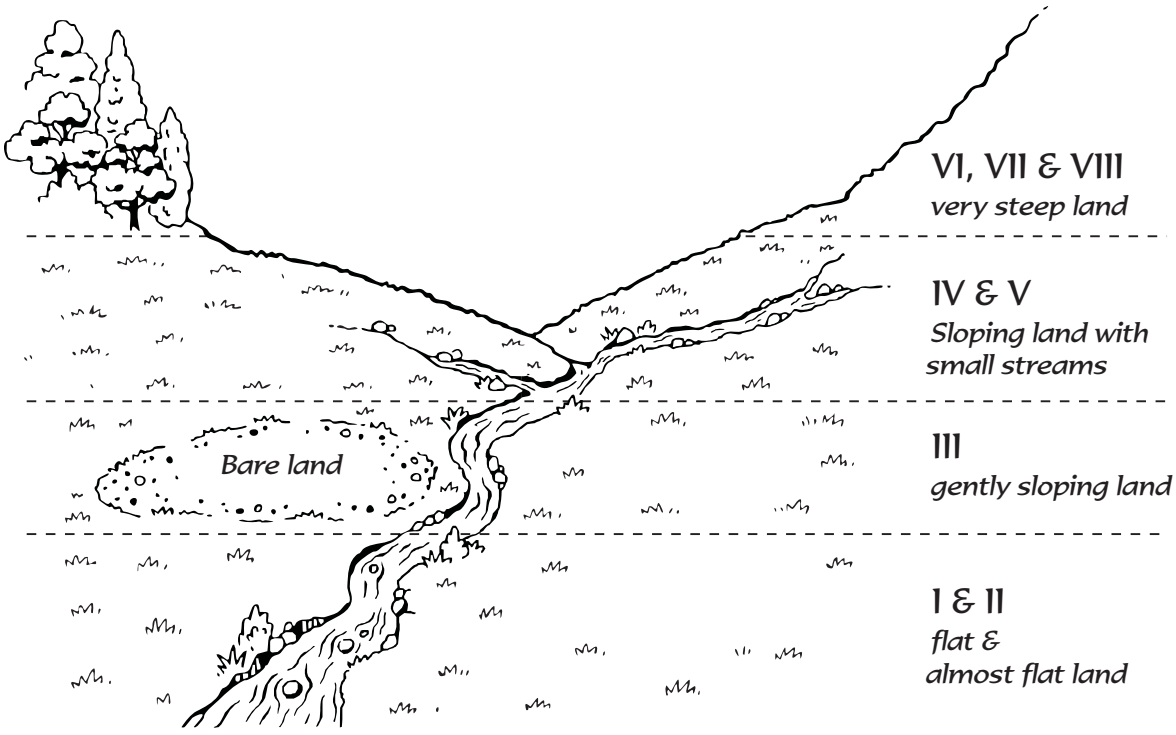
This occurs in bush, particularly on steep slopes, and consists of a very fast slide of both soil and vegetation. The slip area usually runs most of the way down the hillside and is often quite narrow.

Activity Three Identifying Erosion on a Farm.

On the diagram below write the number of the type of soil erosion you would expect to see on each different part of the land. There may be more than one place where that type of erosion might occur. (Blank diagram included in appendices)

1 sheet erosion 2 rill erosion 3 gully erosion

4 stream bank erosion 5 tunnel gully erosion



Activity Four Identifying local erosion.

Erosion causes considerable damage when it occurs. Walk around your local community and take photos of examples of erosion.

- Explain why the erosion is occurring.
- Suggest ways to control the erosion.

Activity Five Erosion Experiment

Equipment 2 square troughs or boxes cut down and lined with plastic
Watering can
2 litre milk container
Electric fan

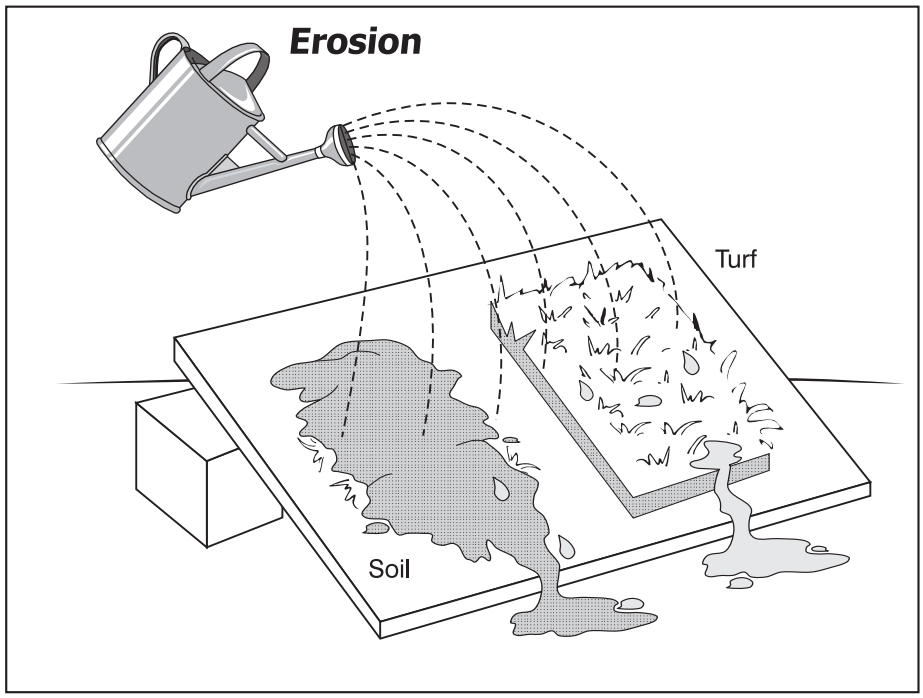
Method

- Cut a square of grass to fit into trough 1
- Fill trough 2 with loose soil
- Set up each trough on an angle to simulate a hill
- Pour 2 litres of water from the watering can onto each trough just like heavy rain
- Observe what happens to each trough.

Does erosion occur? Why?

Do the same experiment with a fan blowing on the troughs (don't add the water)

What happens to the exposed soil?



Try and invent other experiments to show erosion.

Study Five

Accelerated Erosion

Accelerated erosion is that which is occurring at a faster rate than it can occur by weathering. Accelerated erosion is mostly caused by and contributed to by people. It means that the most fertile soil – the topsoil – is lost. The most common agent of accelerated erosion is **water.**

Accelerated erosion is most likely caused by such activities as: -

- forest clearance - especially on land which is too steep for grazing.
- poor practices - too many stock units on a farm causing overgrazing which make the grass cover too thin and exposes the soil to rain and animal hooves.

When vegetation cannot protect the soil from raindrops or there are no tree roots to hold it together, accelerated erosion will start. When the raindrops hit the exposed soil they break the particles up and are transported from the site. The build up of water then runs off the surface and in doing so picks up particles of soil and carries them away – the start of soil erosion.

Without trees, there are no deep roots to hold the soil together and bind it to the underlying rock. If the soil becomes too wet it breaks away from the rock causing land- slips or landslides – another type of erosion.

Animals walking on affected areas can accelerate erosion eg unfenced sections of streambank can quickly disappear into the stream as the weight of animals impacts on the bank itself.

Activity Six Changing river banks.

(This experiment can be done either in sand trays, sand pits or more suitably at a river mouth where there is a wide sandy expanse.)

Equipment

Buckets

Watering Cans

Clipboards for each group

Copy of changing river banks worksheet from appendices

Method

In groups of about three, have each group construct the first shape in the sand.

The group predicts what they think will happen when they simulate rain at the top of their river.

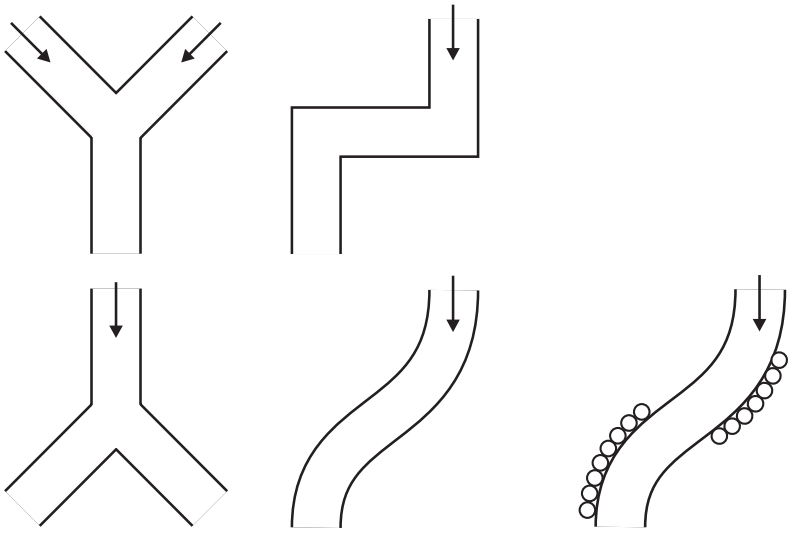
Draw their prediction in the centre column of the worksheet.

Begin simulating rain with the watering can at the top end of the river and observe the effect.

Draw in the last column what actually happened.

Follow the same procedure with each of the other shapes. Remember to predict before beginning the rain.

Shapes to try: -



Study Six

Erosion Control

Controlling erosion is the process of stopping the erosion and repairing the damage that has been done to the land. It usually involves getting a strong protective cover of vegetation – grass or trees – on top of the exposed soil to ensure that wind and water cannot continue to wear away the surface.

Trees provide an effective fight against both wind and water erosion because they: -

break up the wind force to prevent it carrying soil away.

provide a root network to hold the soil in place.

transpire water from their roots to their leaves and remove it from the soil.

Sheet and Rill Erosions

These can be controlled by replanting areas where the vegetation cover has been broken. This forms a protective cover for the soil and provides a root network to hold the soil in place.

Gully Erosion

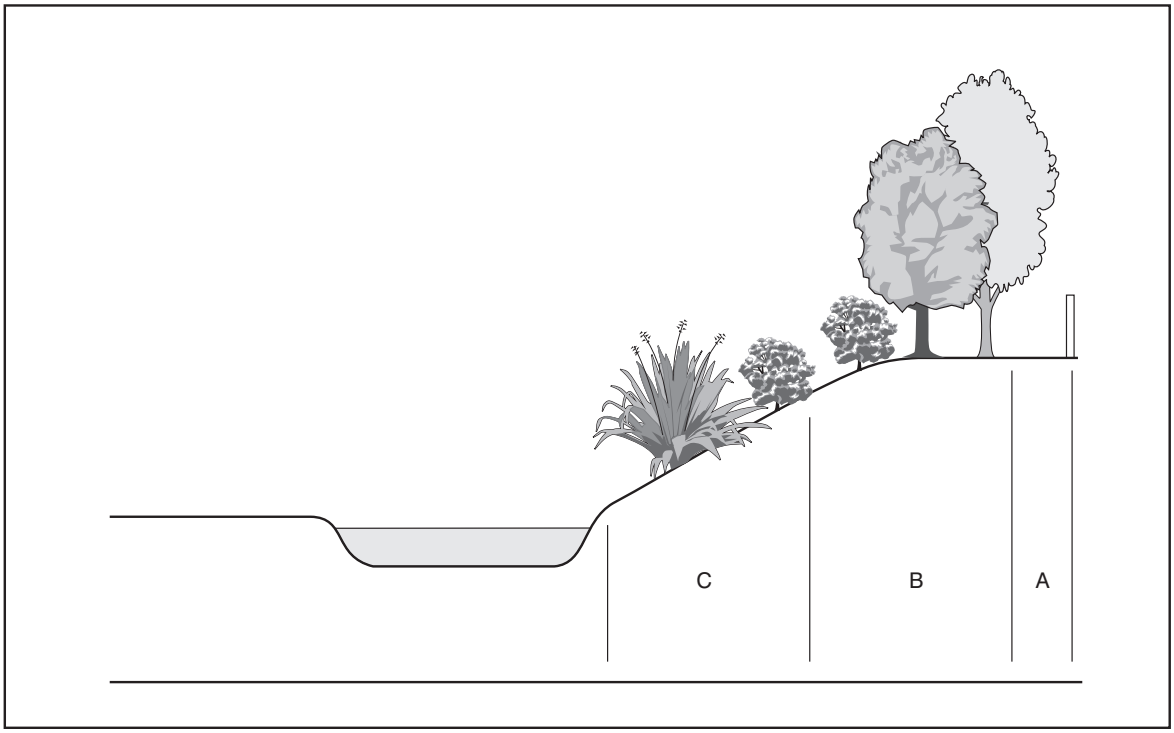
Gully erosion is more difficult to control because the water causes the gullies to cut further uphill and deeper down. The first step is to keep the surface water out of the top of the gully. Trees are then planted in pairs along the sides of the gully. Trees with fibrous roots, such as poplar and willow are best for this purpose because they bind the soil and also remove excess water by transpiration.

Tunnel Gully Erosion

Tunnel gully erosion is best controlled by planting trees in the holes to prevent the water entering the top of the tunnel. The roots of the trees reduce the flow of water under the ground and help to bind the soil.

Stream Bank Erosion

This requires fencing the stream banks to prevent stock from damaging the area and then planting it with varieties that will stabilise the bank but not restrict the river flow during periods of high flow.



A **=** 1m grass strip between fence and plants

B **=** Tree and shrub species

C **=** Species that tolerate wet or flood conditions

Flow Erosion

This type of erosion is best repaired by establishing an unbroken grass cover over the exposed area. To achieve this we need to smooth out the area, plant trees and prevent animals from further damaging the area with their sharp hooves. When the cover is firmly established the stock can return to graze among the trees.

Serious cases of erosion, especially on steep land, may best be fenced off and 'retired' – planted in native trees and not used for agricultural purposes again.

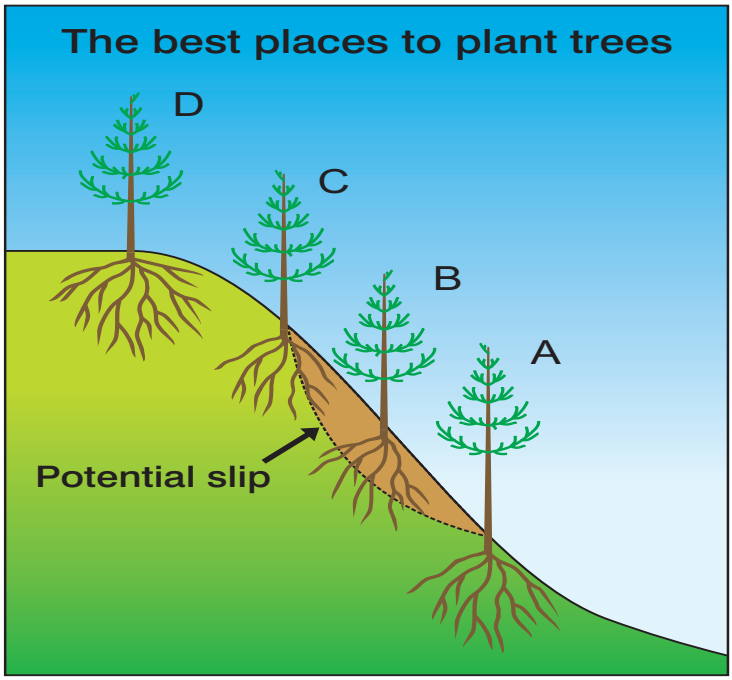
Planting to Control Erosion

The best places to plant trees(in order)

A = Toe of the slip
This is potentially the best place to plant trees, because a tree will dry out the soil, put out roots which slow soil movement, and act as an anchor.

B = On the area likely to slip
It is a good place to plant a tree (unless the slip has already gone). If the land is moving, the tree may not grow fast enough to hold it. The roots must grow through the soil to find the solid ground beneath before the slip will stop. However, the roots will dry the soil and slow the movement.

C= Head of the slip
The third best place to plant trees. Tree roots will help to hold the soil at the top of the slope but the weight of the tree may make the slip collapse along the line of the cracks.



D = At the top of the hill

The only use the tree will have is to reduce the amount of water which reaches the slip. In some cases, where there is very thin soil at points A, B and C, this is the only planting possible.

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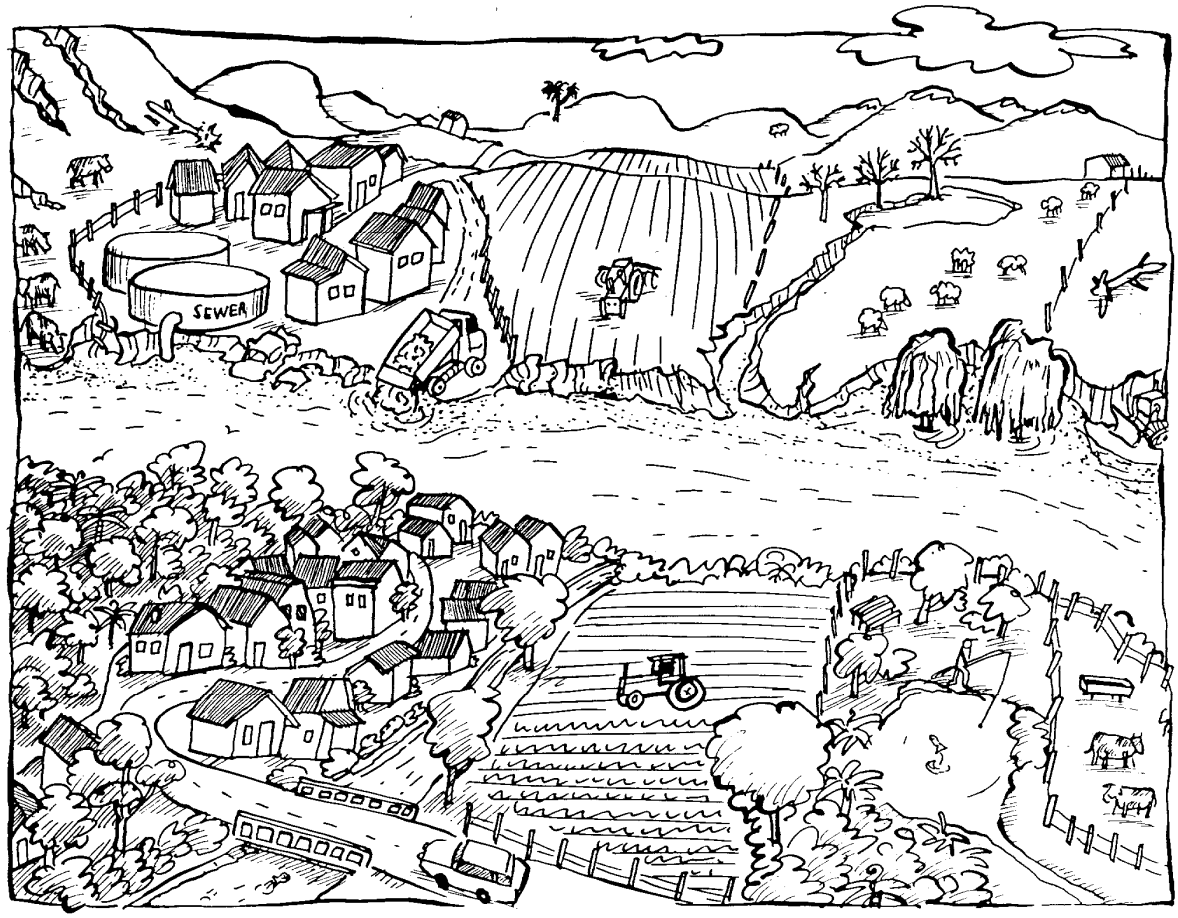
Activity Seven Community erosion effects

Closely examine the accompanying diagram showing communities on either side of a river.

Identify the types of erosion that are likely to occur on the land surrounding each community. Number each separate type of erosion you can find and suggest ways the effect can be minimised.

Also list all the likely pollution incidents you can identify.



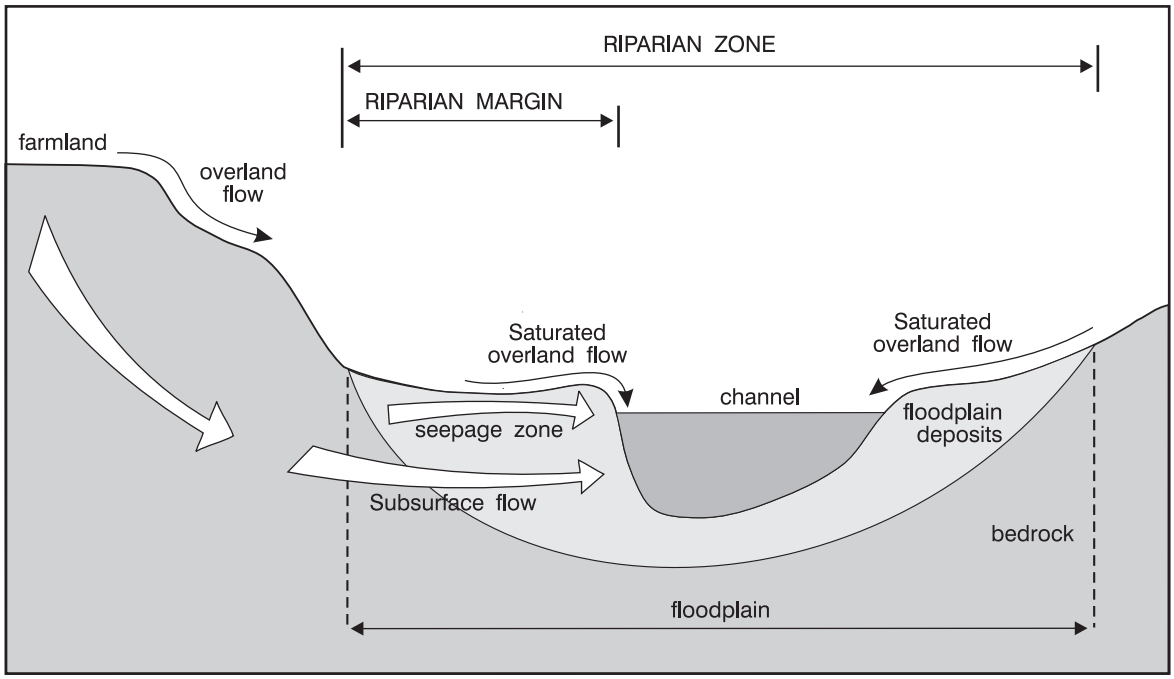
Study Seven

Riparian Management

The many waterways that flow across the Taranaki landscape have significance to our communities historically, culturally, recreationally, and economically.

The future sustainability of these waterways is directly related to how they are managed now. It is important that today's uses are recognised and the resource carefully managed to maintain adequate water quality and quantity to fulfil the future needs of the region.

Riparian margins are the strips of land adjacent to waterways. They extend from the edge of the floodplain to the waterway itself. The width of the riparian margin depends on the channel shape and how it relates to the groundwater movement through the surrounding soil components. An important part of the riparian margin is the vegetation contained within it. The composition of the vegetation greatly influences the functions of the riparian margin.



Riparian Management is the term that describes how land users look after the margin of the river, stream, lake or swamp. It doesn't entail surveying off a fixed width of land next to a waterway to create an esplanade or reserve. Riparian management is simply something land users undertake themselves on land that remains under their private ownership.

Benefits of Riparian Management to the Environment

Improved Water Quality

Dense cover on or near stream banks assists water quality by: -

- Filtering sediment out of surface runoff.
- Removing nutrients from surrounding groundwater.
- Eliminating animal waste from waterways.
- Reducing the effect of sunlight on water temperature.

Controlling Streambank Erosion

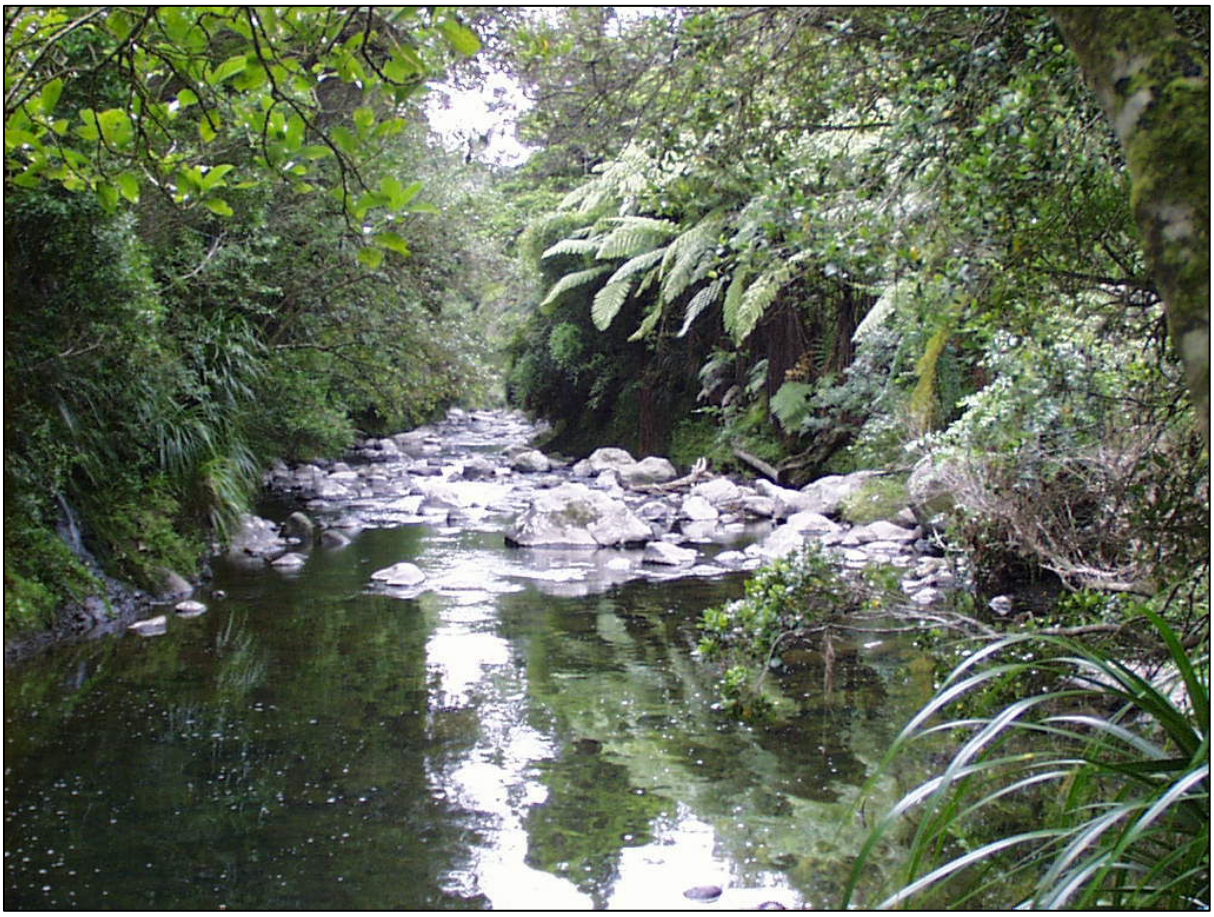
Shrubs and trees with extensive fibrous root systems help stabilise banks and prevent bank collapse. They also trap silt and soil and store it on the riverbank until it is eventually scoured away by large floods.

Reducing Flood Impact

Well-maintained riparian margins enable free passage of water through the waterway. This reduces the flooding and silt build-up on nearby land.

Enhancing Habitats

Restoring riparian vegetation – whether native or exotic – provides enhanced habitats for wildlife. Corridors for bird and fish migration from the mountain to the sea can be formed with continuous riparian development. Food, shelter and seclusion are created for waterfowl, fish, crustaceans and insects.



Other Benefits

- Downstream neighbours will have cleaner water.
- Upstream neighbours will have less flooding.
- Neighbours on opposite banks will have less erosion.
- Recreational users will have more pleasant, healthier conditions.

These issues don't arise everywhere on Taranaki waterways but they are sufficiently widespread to indicate a need for better riparian management to further enhance the region's environment and economy.

Study Eight

Land Management Options

The purpose of any agricultural base activity is to provide a livelihood for the participant families. One of the significant issues that constantly confront farmers in this region is the issue of sustainable land management. As we have already discovered the problem of erosion is an ongoing issue which requires constant cost and commitment to rectify.

All land, regardless of its location, has features that determine the type of use that it is best suited to, and so it may not be wise to outlay resources on land uses that are not sustainable

The Taranaki Regional Council Land Management section has adopted a process that enables the farmer and Council staff to consider the individual land types of each farm, the aspirations of the farmer, and a realistic budget and combine these to develop a plan that considers all these factors.

Farmers in the Taranaki region can access four different types of land management plans to address their individual needs. These are: -

Comprehensive Farm Plan

This is a detailed plan that takes account of all the land features and develops options for the farmer to make the best use of the property.

Agroforestry Plan

This plan identifies the land that is best removed from grazing and would be better suited to forestry production.

Conservation Plan

This plan identifies a particular problem and deals with remedial action for that site.

Riparian Plan

Covered in previous study.

A major component in the fight against erosion is the planting of trees to provide a bond between the soil and the underlying rock layers. In steep land the need to prevent erosion is greater as it is much more difficult to arrest once started. Farmers with areas of steep marginal land need to decide which of the following three options best suit their needs: -

Open Planting

Trees are planted at wide intervals so as to allow normal grass growth under and between the trees. This allows continued grazing once the trees have become established. Open planting is most useful on land on the lower half of the slope. It provides the farmer with a continued income from the stock units as well as an income in the longer term from the timber produced by the trees.

Production Forestry

Trees are planted at close intervals and are then maintained as a forestry block with the sole intention of milling the trees when they are mature. This type of planting has a long term return for the farmer but requires additional outlay for pruning and thinning to ensure the best return for the investment. Land that is steep and slightly unstable is best for this option.

Retirement

For land that is unsuitable for either of the above options it is recommended that the farmer retires the land and allows natural re-vegetation to occur. Steep hill country is best suited to this option.

It must be remembered that on any one farm there might be elements of all three types of planting options. This demonstrates that various land compositions may lend themselves to different sustainable options.

Activity Eight Field Trip

Arrange a bus excursion into your local environment to see at first hand examples of issues that affect your local community in terms of sustainable land management.

It could be a good idea to talk to: -

Taranaki Regional Council

Federated Farmers

Stock and Station Agents

Young Farmers Clubs

to get them to help suggest possible places to visit.

Ideally you would want to see examples of: -

Erosion prone land

Silt laden waterways

Riparian planting

Slip control work using poplars, willows

Open planting area

Agroforestry area

Retired farm area

Farm that has implemented a comprehensive farm plan

Ring plain and hill country rivers

Take a camera and record the examples seen. Perhaps you could interview a local farmer to help understand the effects of these various issues.

Study Nine

What Can We Do?

A significant part of the conclusion of this study should involve the students in recognising the issues raised by this study.

Students could be encouraged to undertake an activity such as those listed below and work through a process of addressing the issue, developing plans and processes to overcome the issue, and if appropriate actually performing the plan in the chosen location. This pre-supposes that the students have gone through the consultation and approval stages.

Some suggestions could be: -

- Visit a nursery. Observe the propagation stages, talk to the nursery staff, discover the most suitable species for various conditions, learn how to transplant out, develop skills for caring for plants, etc.
- Organise a planting day. In conjunction with your local council (regional or district) offer to plant out an area of reserve or wasteland. Develop the plan to enable this to occur from arranging permission, to arranging the plants, to the actual planting and maintenance of the trees.
- Adopt a local stream. Develop a riparian plan for a local waterway. This would include such things as: -
    - establishing baseline data about the stream health
    - on-going monitoring procedure
    - permission of landowners
    - plans for future maintenance
    - planning for preparation of the ground
    - procedures for the actual planting.

- Establish a plant propagation unit. Set up and operate a plant propagation unit within the school environment Develop ideas about the types of plants to be grown, where they can be planted, how to propagate native trees, necessary maintenance programme to gain optimum growth etc.
- Visit a local farm. Interview a local farmer with erosion problems and, in conjunction with the Land Management Officer, develop a plan to address the problem area. This could involve the whole process from plan drawing through to the actual planting of the area.

Students should be encouraged to think of other options that could be used to further enhance their understanding of the processes of sustainable land management.

Additional Activities

1. Write a poem or an imaginative essay related to soil formation, landform development, accelerated erosion or soil conservation. Choose another related topic if you wish.

2. Create a display about erosion problems and effects and the soil conservation techniques that solve them. This could be done with photographs, posters, models or anything else you can think of. Try to think of interesting captions for each part of your display.

3. Design a poster that could be distributed to all landowners in your region that highlights an aspect of erosion control. Try to think of a catchy slogan for your poster.

4. Make up a 'Trivial Pursuits' type quiz. Think of questions about erosion and conservation and put them in a box. Choose a compere, then take turns drawing a question out of the box and answering them. This could be a team competition.

5. Be the media. Select an aspect of sustainable land management you have gained knowledge in and write an article for a newspaper about that aspect. Edit this article into a radio or television news item.

6. Erosion Control in the School Grounds
    a) Obtain or draw a map of the school grounds showing fences, buildings, playing fields, gardens and lawns, car parks, and other paved areas.
    b) Do a site inspection; walk around the grounds and look at areas where soil erosion has occurred.
    c) Mark these areas on your map and label what type of erosion has occurred.
    d) Find the likely cause of each area of erosion and develop ways the erosion could be prevented.
    e) Present your findings to your teacher who could then forward them on to the Principal, the Property Manager and the Board of Trustees.

7. Growing Plants in Different Soil Types
    a) Fill three containers with different composition soils. (one with sand, one with clay and the last with gravel).
    b) Plant radish seeds in each container.
    c) Water them all regularly with the same amount of water.
    d) Measure the growth of the plants at regular intervals
    e) Graph your results. Write an explanation.

8. Raindrop Erosion

For this experiment you will need a spade, watering can, metre ruler, splashboard (heavy card 15cm wide x 30 cm high), stake to attach the splashboard to, collection of leaf litter, grass and hay.

Find a place in the school grounds where you can cut a 30cm square turf out of the ground to expose the bare earth. Save this turf for replacing later.

Drive the stake in the ground beside the cut square and attach the splashboard to it.

A Pour water from the watering can from a height of 80 – 90 cm onto the bare earth. Measure the splash heights on the board. Record your observations.

B Wipe the splashboard clean and dry. Place some of each of the protective material in the bottom of the cut square in turn. (Leaf litter, grass, hay). Again, pour water onto the protective layer from the same height. Measure the splash heights and record your observations. Repeat with the other protective materials.

Present your results in a table or graph.

Questions

What was the height of the highest splash?

Did any of the splashes contain soil?

Which ones did? Which didn't?

What will happen to these tiny soil particles when they land back on the ground?

What was the most effective cover for preventing splash erosion?

What use would this information be to farmers? When?

Make a list of all the different ways you could reduce the amount of soil disturbed by splash erosion.

Bibliography

The following texts and activity packs have provided invaluable information during the formation of this unit.

Living with the Land Towards Sustainable Agriculture	Ministry of Agriculture and Fisheries
Saving Our Soils	Trees for Survival Trust
Information Sheets	Taranaki Regional Council Land Management Section

Appendix 1

Brainstorming sheet

Questions I would like to find answers to

Sustainable land management

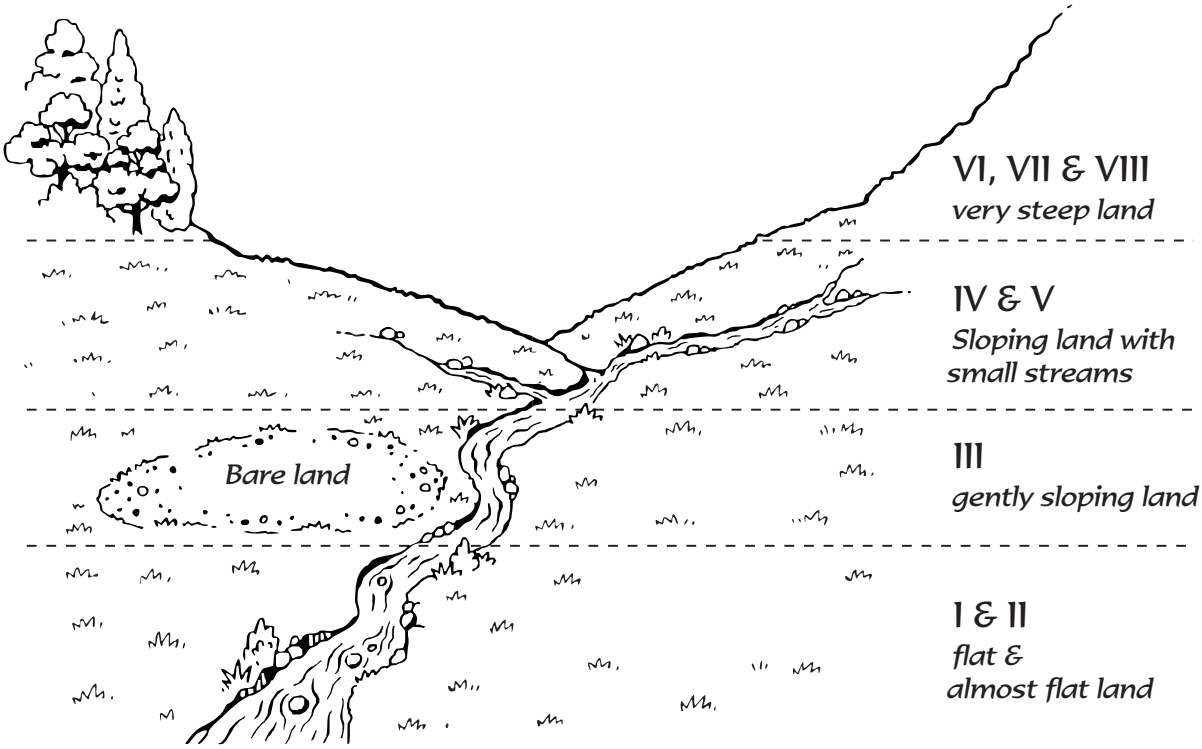
Appendix 2

Identifying erosion on a farm

On the diagram below write the number of the type of soil erosion you would expect to see on each different part of the land. There may be more than one place where that type of erosion might occur. (Blank diagram included in appendices)

1 sheet erosion 2 rill erosion 3 gully erosion

4 stream bank erosion 5 tunnel gully erosion

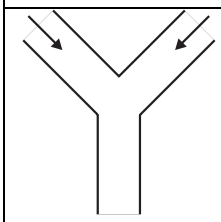
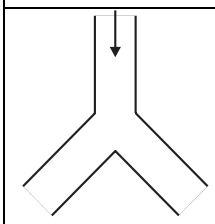
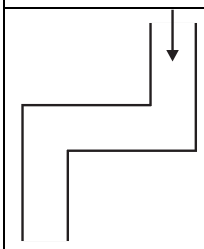
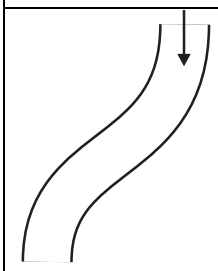
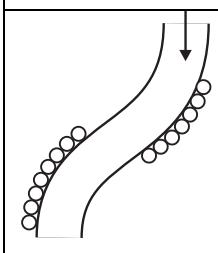


Appendix 3

Changing river banks

In your group of three:-

- construct the first shape in the sand
- predict what you think will happen when you fill the river with water
- draw your prediction in the centre column
- pour the water to simulate rain
- draw in the last column what actually happened

Shape	Predict the changes	Draw the actual result
		
		
		
		
		

Appendix 4

Community erosion effects

Closely examine the accompanying diagram showing communities on either side of a river.

Identify the types of erosion that are likely to occur on the land surrounding each community. Number each separate type of erosion you can find and suggest ways the effect can be minimised.

Also list all the likely pollution incidents you can identify.