

SECONDARY SCHOOL STORMWATER NCEA RESOURCES

SUPPORT MATERIAL

AS 90811: 'WHAT'S HAPPENING?'

STUDENT FIELD TRIP WORKSHEET 1

Name: _____

Date: ____/____/____

Name of stream: _____

Meaning/history of name, if available: _____

- **Human activity** has an effect on stormwater.
- Stormwater changes the stream's biophysical **environment**.
- These changes affect a **sustainable future** in terms of the environment, society, economy and culture.

Explaining the main idea – stormwater

Words	Definitions I need	Activities
Catchment		<p>Use a map to:</p> <ul style="list-style-type: none"> describe the location and size of the catchment locate on the map the roads which (roughly) follow the boundaries of the catchment locate on the map the features near your stream, e.g. school, shops, industry locate and label the harbour and/or estuary where the stream ends locate any tributaries. <p>Write the title 'Key features of catchment' above your map.</p>
Stormwater		
Impervious		
Pervious		
Run-off		
Flow		
Channel		
Harbour		
Estuary		
Substrate		
Tributary		
Stagnant		
Riparian margins		
Sewage overflow		

Describing the physical environment of the stream.

- **Draw** a bird's eye view of the stream. Include a scale.
- **Label** the stormwater outlets, banks, flow direction and any other features.
- **Describe** the banks, water, bottom of stream, plants and any litter.

Bird's eye diagram of: _____



Explaining how stormwater picks up pollution which then affects the culture of the local community

Words	Definitions I need	Activities
Habitat		Explain how stormwater affects the stream habitat in the catchment. Use the words from the list provided.
Pollution		
Catch pits		
Hydrocarbons		
Cadmium		
Zinc		
Copper		
Heavy metals		
Sediments		
Sampling		
Accumulate		
Pathogens		
Outlet		
Shellfish		
Mud banks		
Mangroves		

Words	Definitions I need	Activities
Mahinga kai		Add to this flow diagram that begins with some human activities that affect stormwater and ends with the loss of 'mahinga kai.'
Urbanisation		('Mahinga kai' refers to indigenous freshwater species that have traditionally been used as food, tools, etc.).
Construction		
Eroding		
Flood		
Marine		
Explain how stormwater can affect the marine environment.		

AS 90811: 'WHAT'S HAPPENING?'

STUDENT FIELD TRIP WORKSHEET 2

Name: _____ Date: ____/____/____

Words	Definitions I need	Activities
Macroinvertebrates		Add words or phrases below to the timeline to describe the water quality of a typical stream.
Habitat		Include: forest streams, urban streams, farming, urban growth, tolerant macroinvertebrates, sensitive macroinvertebrates, high biodiversity, low biodiversity.
Urban		
Adaptation		Timeline:
Agriculture		
Tolerant		
Sensitive		
Biodiversity		
Species		

Words	Definitions I need	Activities
Food webs in the stream community		
Producers		
Herbivores		
Carnivores		
Decomposers		
Bacteria		
Fungi		
Algae		
Snails		
Shrimps		
Mosquito larvae		
Pest fish		
Interdependence		
Exotic		

In your group, draw a simple stream food web using the species you have identified and other resources. Bracket the scientific names and use arrows to show the energy flow from producers to top carnivores. Use the foodweb cards provided to help you.

Explain how the parts of the food web are connected and depend on each other (interdependence). Give examples, using the species names.

Explaining the main idea: how our stormwater changes the biophysical nature of the stream

Words	Definitions I need	Construct a table of the data you collected at the stream
Temperature		
Flow rate		
pH		
Nitrates		
Phosphates		
Turbidity		
Oxygen		
Substrate		
Heavy metals		
Rainfall		
Contaminants		
Nutrients		
Eutrophication		

Explain the health of the stream based on the results you have collected:

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Name three of the measurements you have collected and explain how they have been changed by stormwater, using the diagram below:

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How water quality

is
affected

by stormwater

For example, temperature of the stream increases.



Stormwater comes off heated roads and roofs in summer.

Source: Thanks to Julia Tuineau.

AS 90811: STUDENT CHECKLIST FOR ASSESSMENT

EFS 2.2 Explain how human activity in a biophysical environment has consequences for a sustainable future

	Explain what sustainability means:	Check
Sustainability	<p>Give a clear and comprehensive definition of sustainability using these four aspects of sustainability (environment, society, economy, culture).</p> <p>Describe the stream ecosystem.</p> <p>Explain how people are part of ecosystems and depend on them (interdependence).</p> <p>Explain how people should take responsibility for their impact on nature.</p> <p>Describe a sustainable future in relation to stormwater.</p> <p>Discuss personal and social responsibility.</p>	
Biophysical environment	<p>Describe the biophysical environment you are studying:</p> <p>On a map be able to show and identify the main features. This includes an outline of the borders of the biophysical environment, its size, location and other factors.</p> <p>Describe the biophysical environment you are studying using annotated diagrams, flow charts or diagrams. These may include:</p> <ul style="list-style-type: none"> • a description of a stream or waterway including temperature, climate, light, shelter and the stream profile • drawing of the stream and the banks showing the direction and strength of the current, the makeup of substrate (stream bottom) as well as plants on the banks, indicating their size • any in-stream plants or animals that are found • the location of the stream or waterway. 	Check

	Describe the biological nature of the waterway using annotated diagrams, flow charts or pictures. These may include:	Check
Ecology	<ul style="list-style-type: none"> • listing the scientific names of some key species • showing the main producers • showing the decomposers • showing the main consumers • drawing the stream food web using species names of key organisms • indicating the role of the producers in the waterway. <p>Explain the terms species diversity and abundance in relationship to the waterway you are studying.</p> <p>Explain interdependence (relationships) in terms of this ecosystem.</p>	Check
Physical system	<p>Describe the physical nature of the stream using annotated diagrams, flow charts, graphs or tables. These will include:</p> <ul style="list-style-type: none"> • the water quality • the water flow. <p>Identify the main threats to water quality.</p> <p>Describe the causes of sedimentation, if applicable.</p> <p>Describe the effect of sedimentation on water quality.</p> <p>Describe any erosion.</p>	Check

	Explain impacts of human activity on stormwater:	Check
Human activity	Explain the impact of stormwater on the stream environment and water quality.	
	Explain how stormwater has affected the biodiversity of the waterway visited for example:	
	<ul style="list-style-type: none"> • number of species • types of species • food web structure. 	
	Explain how stormwater could impact the future. This may include an explanation of:	Check
Consequences for a sustainable future	<ul style="list-style-type: none"> • the possible impact on the wider marine environment in the harbours • how stormwater can affect the environment and ecosystems • how stormwater affects society • how stormwater affects different cultures in the local community, including specific tangata whenua issues • the impact of stormwater on the economy of the region. 	

Source: Thanks to Antje Kleinmans.

AS 90811: STORMWATER CONSEQUENCE MATRIX

Summary sheet – physical changes

Name physical changes because of stormwater	Drawing	Describe what has happened	How or why has this affected the stream?	So what? What does this mean for the future? (Include aspects of sustainability)
1.				
2.				
3.				

Summary sheet – ecological changes

Name ecological changes because of stormwater	Drawing	Describe what has happened	How or why has this affected the stream?	So what? What does this mean for the future? (Include aspects of sustainability)
1.				
2.				
3.				

AS 90832: STUDENT ACTIVITY

Future focus planning

Efs 3.5 Develop a strategy for an organisation that will contribute to a sustainable future.

The table on the next few pages was created at a hui organised by the World Wildlife Fund (WWF) following the release of the Hauraki Gulf Forum Report 2011. The table that follows provides an example of collaborative thinking about issues and solutions for the Hauraki Gulf Marine Park.

Students can work in groups to explore future thinking and use criteria to make decisions. They can then use the model matrix template at the end of this document when developing ideas around a strategy with their organisations.

Students could work in groups of three and work with the information for one threat (chosen from the five threats – stormwater, sedimentation, nitrification, plastic debris and overfishing). Each group would then complete the worksheet on the following page. The groups could share their understanding with the other groups in the class to look at possible solutions, as well as to reflect on the process of using decision making matrices.



AS 90832: STUDENT ACTIVITY

Future focus planning

Efs 3.5 Develop a strategy for an organisation that will contribute to a sustainable future.

Purpose: To explore solutions to issues in Auckland's waterways and use a decision matrix.

Student instructions

- In groups of three read through the matrix about one threat for the Hauraki Gulf Marine Park.
- Write a title on the worksheet based on the threat.
- Work together to build understanding. Draw a sketch of the present and the future for the Hauraki Gulf Marine Park.
- Use the actions outlined to trial using a matrix to decide which action would have the best outcome.
- Criteria have been suggested based on successful environmental strategies. Add your own criteria in the last column, e.g. time frame, long-term cost/benefit.
- As a group, decide which action you would choose first.
- In your group choose one key message and plan how you would get the message across to the public, e.g. poster, video, song.

Hauraki Gulf Marine Park (HGMP) decision matrix for action

Threat	Source of threat	Desired outcome	Action required for desired outcome	What's currently happening? Who's working on it?	Action still required	Key message to address required action
Stormwater contaminants	Urban, e.g. road and roof run-off. Industrial.	No contaminants entering HGMP via stormwater, i.e. a return to natural stormwater runoff systems. (Note: This has been achieved successfully, e.g. Whaingaroa/Raglan Harbour). Increased ecosystem services/functions.	'Only drain rain' initiatives. Polluter pays. Consumer knowledge, i.e. better consumer choice, e.g. organics. Alternatives – information on fertiliser substitutes. Compliance enforcement. Action through Auckland Spatial Plan with an emphasis on prescriptive plans. Maintain integrity and reinstate natural water barriers, e.g. more Waataruas.	Clean Streams Accord (but low uptake due to voluntary nature). Adopt a stream. Stream fencing by farmers.	More restoration and protection projects. Riparian planting. Linking of sedimentation to HGMP. Show links with clear definitions. Better council decisions on development. Transport design changes. Better urban design to reduce travel demand.	Only rain goes down the drain. Linkage of heavy metals and other contaminants in HGMP to cars, roofs, roads. Sediment kills cockles. Get involved in restoration projects. Slow it down/slow the flow (need understanding that the speed of flushing makes a difference). Explain what is meant by 'sedimentation'.

Threat	Source of threat	Desired outcome	Action required for desired outcome	What's currently happening? Who's working on it?	Action still required	Key message to address required action
Stormwater contaminants			Protection and restoration of waterways, e.g. via riparian planting.			<p>Connection of physical changes in the HGMP with nitrification, i.e. the reason why you can't swim.</p> <p>De-normalisation of closed beaches.</p> <p>The water should be 100% safe (within natural limits) for swimming and taking kaimoana.</p> <p>Urgency of required action.</p>
Sedimentation	Affected by land use – clearance (sometimes historical), agriculture, subdivision, urban sprawl, coastal development. Extreme weather, e.g. climate change.	Cleaner, clearer water. Functioning ecosystem. Key species restored. Less sedimentation. Decreased fine sediment. Improved urban planning.	Action through the Auckland Spatial Plan with an emphasis on prescriptive plans. Maintain integrity and reinstate natural water barriers, e.g. more Waatarauas.	Various restoration projects, many catchment based, e.g. Project Twin Streams.	More restoration and protection projects, including riparian planting. Linking of sedimentation to HGMP, showing links with clear definitions.	<p>Sediment kills cockles.</p> <p>Get involved in restoration projects.</p> <p>Slow it down/slow the flow. (Need understanding that the speed of flushing makes a difference).</p>

Threat	Source of threat	Desired outcome	Action required for desired outcome	What's currently happening? Who's working on it?	Action still required	Key message to address required action
Sedimentation			Protection and restoration of waterways, e.g. via riparian planting.		Better decisions on development.	Explain what is meant by sedimentation.
Nitrification	Agriculture (i.e. fertilisers). Aquaculture, i.e. fish farms. Forestry. 'Dogs, stock and ducks', i.e. poo.	No more algal blooms due to nitrogen (N) pollution. Reduce N entering the HGMP. Substitution to natural fertilisers and 'closed' systems. Compliance.	Polluter pays. Consumer knowledge, i.e. better consumer choice (e.g. organics). Suggest alternatives, e.g. information on fertiliser substitutes. Compliance enforcement.	'Clean Streams' accord (but low uptake due to voluntary nature). Adopt a stream. Fencing by farmers.	More restoration and protection projects, including riparian planting. Linking of sedimentation to HGMP, show links, with clear definitions. Better decisions on development.	Connection of physical changes in the HGMP with nitrification, i.e. the reason why you can't swim. De-normalisation of closed beaches. The water should be 100% safe (within natural limits) for swimming and harvesting kairimoana. Urgency of required action.

Threat	Source of threat	Desired outcome	Action required for desired outcome	What's currently happening? Who's working on it?	Action still required	Key message to address required action
Plastic debris	<p>80% of debris in HG is from land-based sources, 20% marine-based. Then breaks down into three areas:</p> <ol style="list-style-type: none"> 1. Industry (material design, i.e. packaging, and cost of lifecycle). 2. Household (users of products). 3. Community, i.e. sorting, collection, disposal. 	<p>No more marine debris ending up in the HG food chain.</p> <p>Cradle to cradle.</p> <p>Stewardship.</p>	<p>Prevention.</p> <p>Clean up.</p> <p>Find out 'What's currently out there.'</p> <p>Cradle to cradle.</p> <p>Stewardship.</p>	<p>Beach clean ups (but has this normalised the idea that there is marine debris?)</p>	<p>Prevention, i.e. consumption patterns.</p> <p>Cradle to cradle.</p> <p>Stewardship.</p> <p>Suggestions of specific actions: take plastic back to source, i.e. supermarkets legislation, e.g. provision of covered rubbish bins encourage less use of disposables, e.g. consumer/producer awards.</p>	<p>80% is from the land i.e. you.</p> <p>Buy less packaging.</p> <p>Look at how much packaging you are buying.</p> <p>Connection of product use to the environment.</p> <p>Use data specific to the HG. Is there anything in the Ministry for the Environment's 'State of the Environment' report?</p> <p>Map of 'hot spots' for marine debris.</p>

Threat	Source of threat	Desired outcome	Action required for desired outcome	What's currently happening? Who's working on it?	Action still required	Key message to address required action
Fishing pressure	<p>Management, i.e. Quota Management System (QMS) has a single-species focus with a Total Allowable Catch set too high.</p> <p>Recreational and commercial impact.</p> <p>Fishing technology (e.g. bottom trawling).</p>	Restoration of functioning ecosystem, leading to increased fish stocks.	QMS (Quota Management, System) changes.	Some lobbying.	<p>Switch to ecosystem-based management system.</p> <p>Ten per cent of HGMP set aside as marine reserve (in line with government's pledge to have 10% of the Exclusive Economic Zone set aside as Marine Protected Areas).</p> <p>Lobby government to have HGMP considered as having special status under the QMS, i.e. to have fishing management aligned with the HGMP vision.</p> <p>Look at upper size limit for each fish caught.</p>	<p>There is a cost in keeping stocks at 20-30% and there is value in abundance.</p> <p>Tell stories from older generations of what the 'normal' fish stocks and abundance was for HGMP.</p> <p>Good fisheries management equals abundance.</p> <p>What's the gain compared to what you're giving up?</p> <p>HGMP is in a profoundly altered state with respect to marine biodiversity.</p>

Worksheet using the matrix on the previous pages

Title: _____

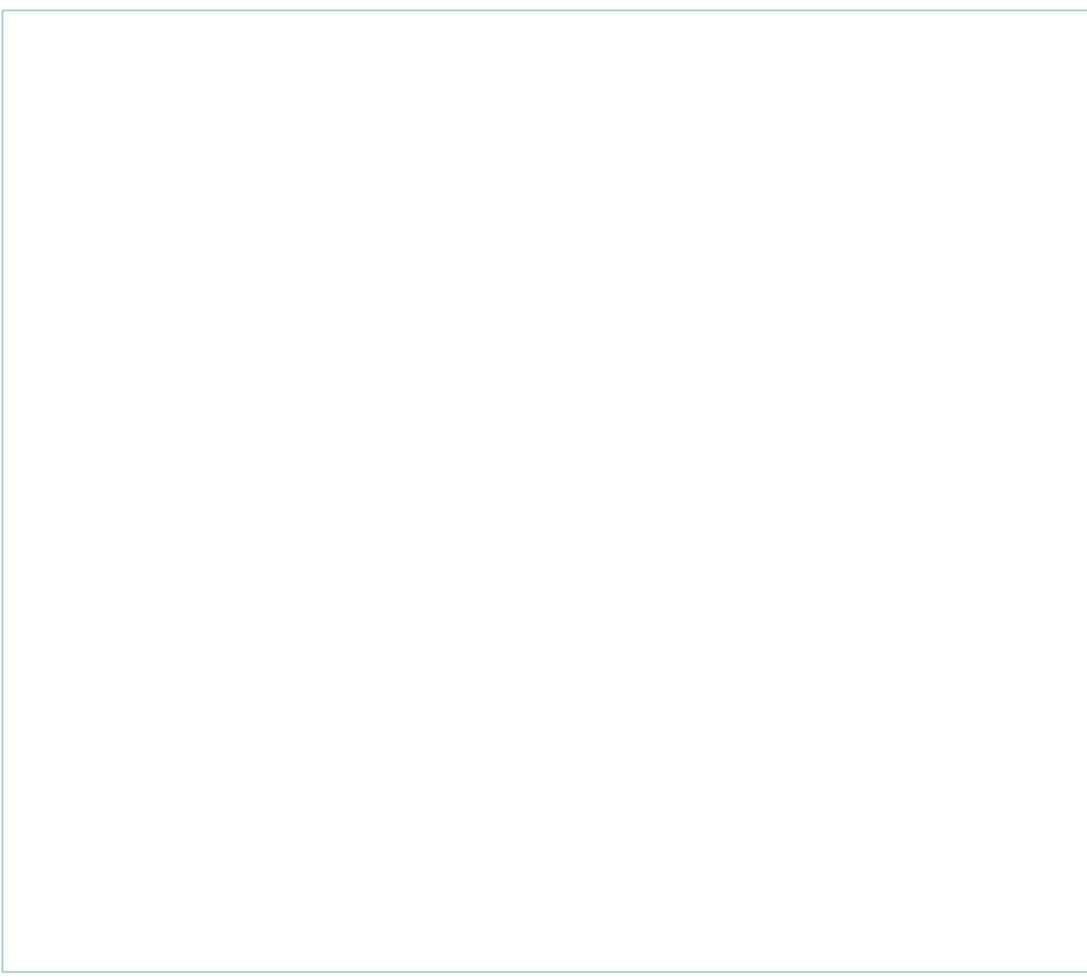
Identify any terms or statements that you have not heard of. Discuss in your group and follow up with any research:

Share ideas and explain what the threat you are investigating is:

Draw a sketch to show the relationships between the source of the threat and the sea. Annotate or add sketches to illustrate 'what's currently happening':



Draw another sketch showing the actions still required:



Look at all the actions required now/in the future and fill out the decision matrix below:

Actions	Does the action have a permanent or long lasting benefit?	Does the action include lots of people doing something small?	Will the action impact on society, cultures and/or the economy? Describe how	Choose a success criterion

Which action would you choose? _____

Model matrix template – to use when working with your organisation

Threat	Source of threat	Desired outcome	Action required for desired outcome	What's currently happening? Who's working on it?	Action still required	Key message to address required action



**Auckland
Council**

Te Kaunihera o Tāmaki Makaurau

