RIVERINE ENVIRONMENTS: PROCESSES, CHANGE and MANAGEMENT Part 1

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GTANSW
Annual Conference
2017

https://www.usgs.gov/media/videos/effects-urbanization-stream-ecosystems-extended-part-i-introduction

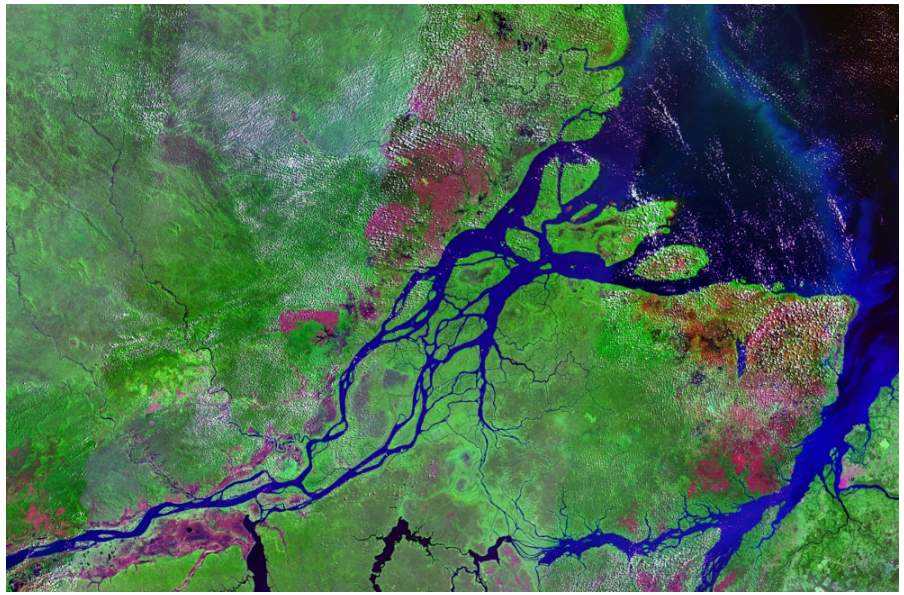
An OPTIONAL STUDY
Environmental change

Riverine environments offer a wide range of contemporary issues for study

The management of issues in riverine environments necessitates an understanding the processes and functioning of riverine environments in different places

There are plentiful and contemporary resources to support this optional study

This is not a study of riverine landforms – it is an investigation of changing the living environment of rivers and their associated environments



https://upload.wikimedia.org/wikipedia/commons/6/6f/Mouths_of_amazon_geocover_1990.png

Environmental change and management

"The World Rivers Review in 2011 claimed " *Earth's rivers are dying from a thousand cuts*", a reference to human impact on the environmental processes essential for healthy river functioning.

Declining river health is reflected in high extinction rates for freshwater biodiversity, up to six times higher than for marine and terrestrial ecosystems. An estimated 20% of total freshwater species are endangered or extinct.

Only 64 of Earth's 177 longest rivers (over 1000 km) remain unregulated and just 21 still flow to the sea, evidence of unsustainable water use. Sound ecological knowledge is essential for the sustainable management of riverine environments."

Source: GeoWorld 10 NSW Chapter 5: Inland water: processes, change, management

First some GEOSTORIES ….
Worldviews are changing

New Zealand – legal status of rivers

The Netherlands – Flood management

USA – dam removal

Asia & South America – Dams vs biodiversity

Australia – environmental & cultural flows, river restoration

http://www.dailymail.co.uk/travel/travel_news/article-3471121/Nature-s-masterpiece-Incredible-images-reveal-stunning-beauty-braided-rivers-look-like-inky-watercolour-paintings.html

In 2016 in New Zealand …….

RIVERS HAVE LEGAL STATUS …

AT THE SAME TIME ….. A BLAME GAME TAKING PLACE OVER WHO IS RESPONSIBLE FOR THE DECLINING QUALITY OF NZ RIVERS

(Comparative study)

Maori worldview …
Are worldviews changing globally …. ?

SEE Loraine's Scoop.it Environmental Change for articles and video links related to NZ
http://www.scoop.it/t/year-10-environmental-change-and-management

Why New Zealand is granting a river the same rights as a citizen

Tuesday 6 September 2016 2:53PM

Kathleen Calderwood

IMAGE: THE WHANGANUI RIVER ON NEW ZEALAND'S NORTH ISLAND WILL SOON BE GIVEN LEGAL PERSONHOOD. (FLICKR/KATHRIN AND STEFAN MARKS/CC BY-NC-ND 2.0)

The New Zealand government is planning on giving the country's third largest river the same rights as a citizen. It's part of a legal revolution recognising the Maori connection to the environment and shifting assumptions about human control of the natural world.

They are recognised in law now as having their own presence, their own needs and their own well being.

PROFESSOR JACINTA RURU, UNIVERSITY OF OTAGO

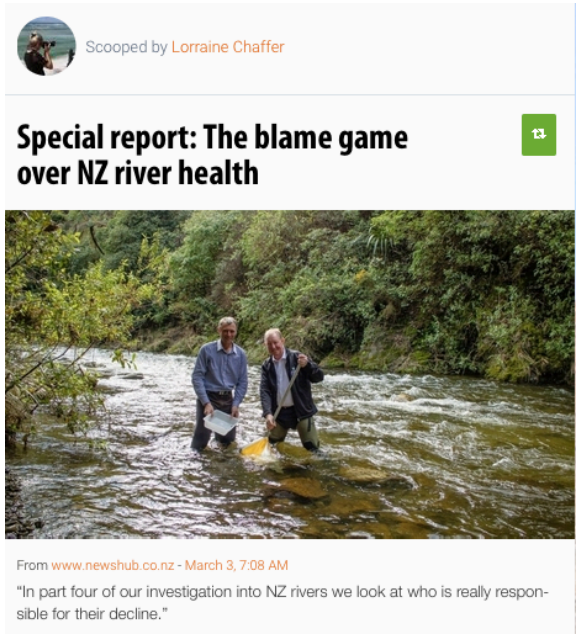
Until 2014, Te Urewera in the Hawkes Bay region of New Zealand's North Island was a national park.

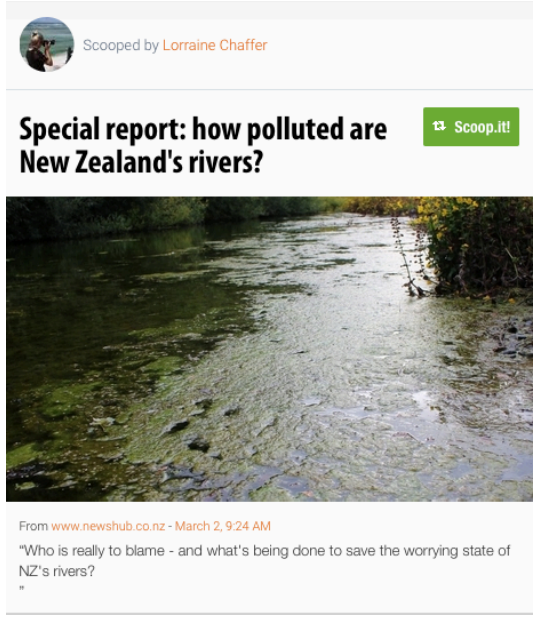
The Act removed the land's national park status and granted it legal personhood, giving it the same rights as any citizen.

http://www.abc.net.au/radionational/programs/sundayextra/new-zealand-granting-rivers-and-forests-same-rights-as-citizens/7816456

New Zealand – Comparative study

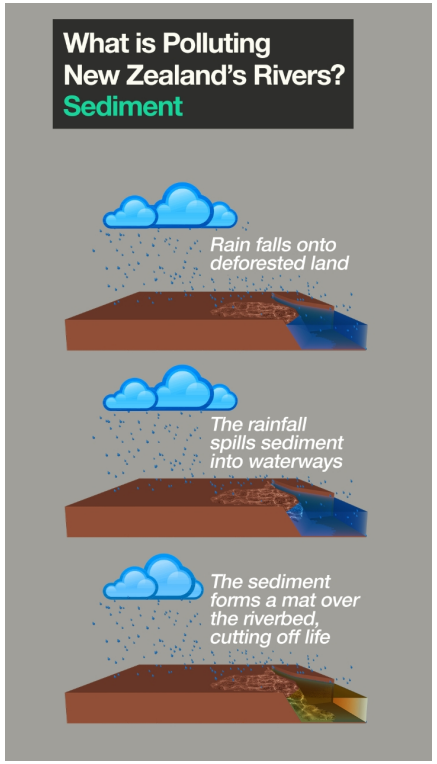
See the Word Document summarising this recent media series and images from the articles in resources attached to this PPT on the GTANSW Website.

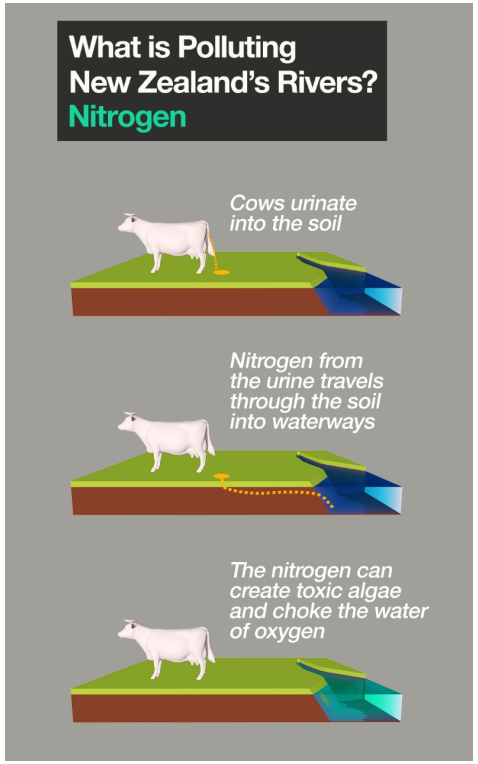


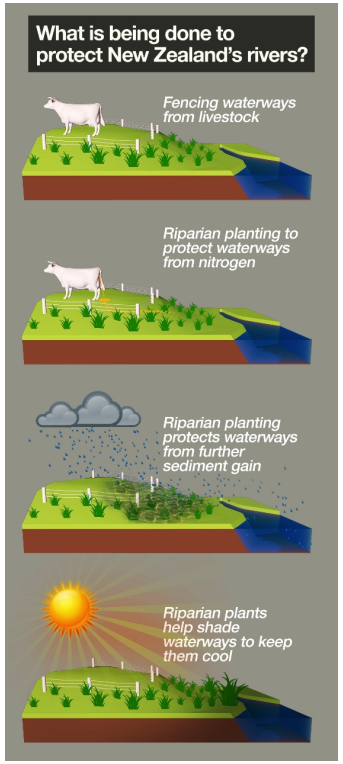


http://www.newshub.co.nz/home/new-zealand/2017/03/special-report-will-climate-change-kill-off-nz-s-rivers.html

New Zealand ..... Selected images from the series





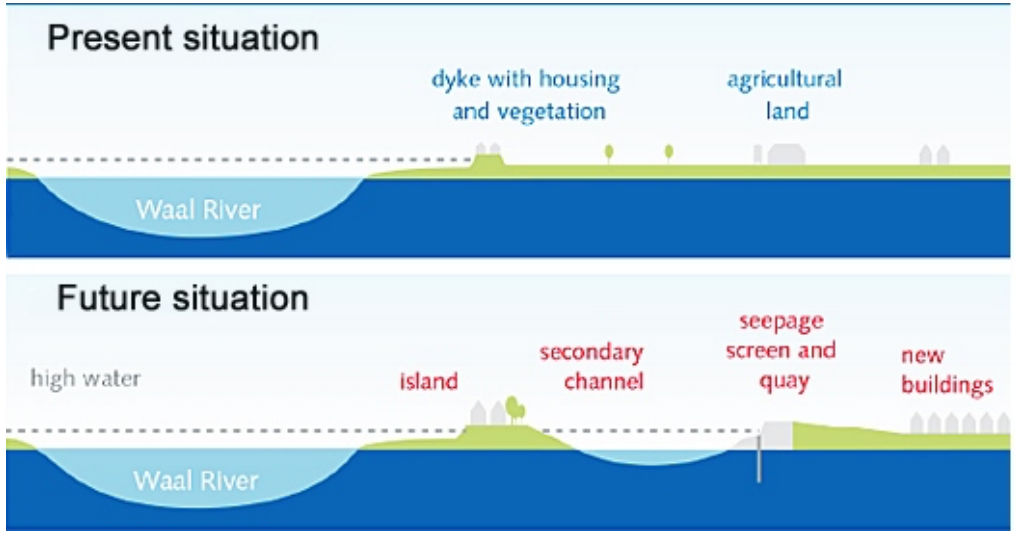


http://www.newshub.co.nz/home/new-zealand/2017/03/special-report-will-climate-change-kill-off-nz-s-rivers.html

In the Netherlands……

After thousands of years of building hard structures to protect property from floods, particularly in the Spring snow thaw season, the Dutch government have implemented a Room for the River program, that gives the river back the space it needs to flood ……an initiative that reconnects a river with its floodplain

Why the change?



http://www.dutchwatersector.com/news-events/news/4986-groundbreaking-ceremony-biggest-room-for-the-river-project-a-3-km-long-side-channel.html
https://www.royalhaskoningdhv.com/en-gb/projects/room-for-river-waal-dike-relocation-lent-nijmegen/945

NIJMEGEN

A Dutch city makes room for its river — and a new identity

LETTY REIMERINK MAY 14, 2015

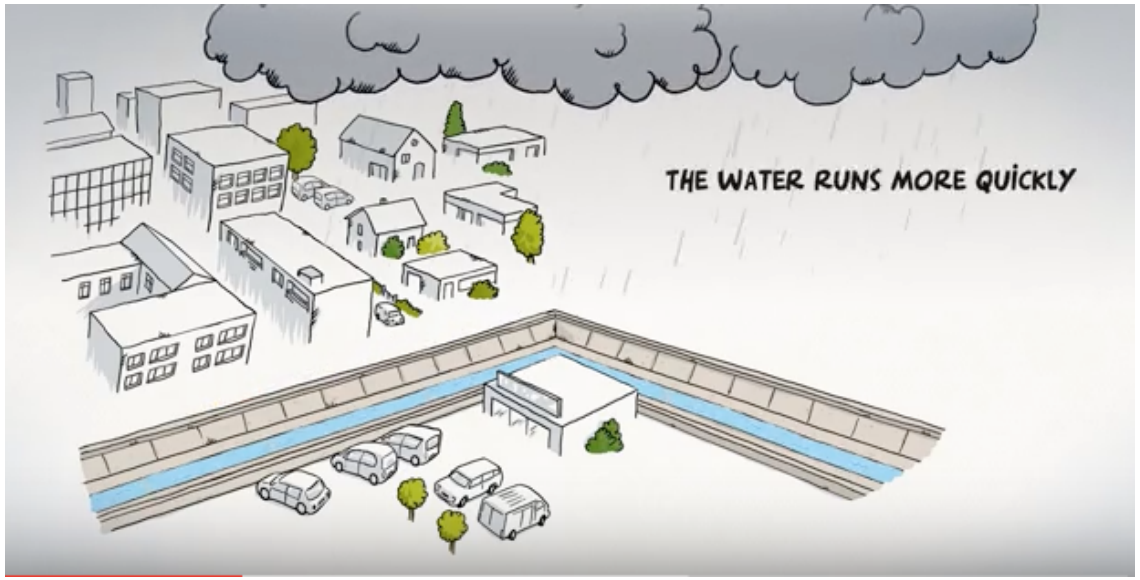
The Dutch city of Nijmegen is building a flood-control channel for the River Waal (left). In the process, it is also creating an island for recreation as well as prime property that can be developed into a new heart of the city. (Room for the River Waal)

Flooding is a natural riverine process …. Management depends on understanding natural processes and human change to those processes.

http://citiscope.org/story/2015/dutch-city-makes-room-its-river-and-new-identity

River management change ….animation

https://www.youtube.com/watch?v=21YAP8RF_sw&sns=em



In Brazil… anti dam protests

http://www.bbc.com/news/world-latin-america-12399817

https://www.google.com.au/search?q=room+for+the+river&source=lnms&tbm=isch&sa=X&ved=0ahUKEwj96MvX8tXSAhUBS7wKHb_gAaMQ_AUIBigB&biw=1297&bih=1252#tbm=isch&q=Belo+MOnte+dam+Brazil+protests&*&imgrc=pN-TeFxZ25-xYM

More than 400 hydroelectric dams are already in operation, being built or planned for the Amazon basin and its headwaters.

Protesters say the 6km Belo Monte dam will threaten the survival of a number of indigenous groups and could make some 50,000 people homeless, as 500 sq km (190 sq miles) of land would be flooded.

In the USA….. Dam removal – Why?

https://thehound2.files.wordpress.com/2015/05/glines-removal.jpg

http://dels.nas.edu/dels/resources/static-assets/besr/images/NPS_Glines%20Canyon%20Dam%20Removal.jpg

June 2, 2016 - Conservationists can now point to the largest dam removal project in the U.S. as a success story.

The ecosystem of Washington's Elwha River has been thriving since the removal of its hydroelectric dam system.

Recent surveys show dramatic recovery, especially in the near shore at the river's mouth, where the flow of sediment has created favorable habitat for the salmon population.

A new generation of salmon species, some of which are endangered, are now present in the river.

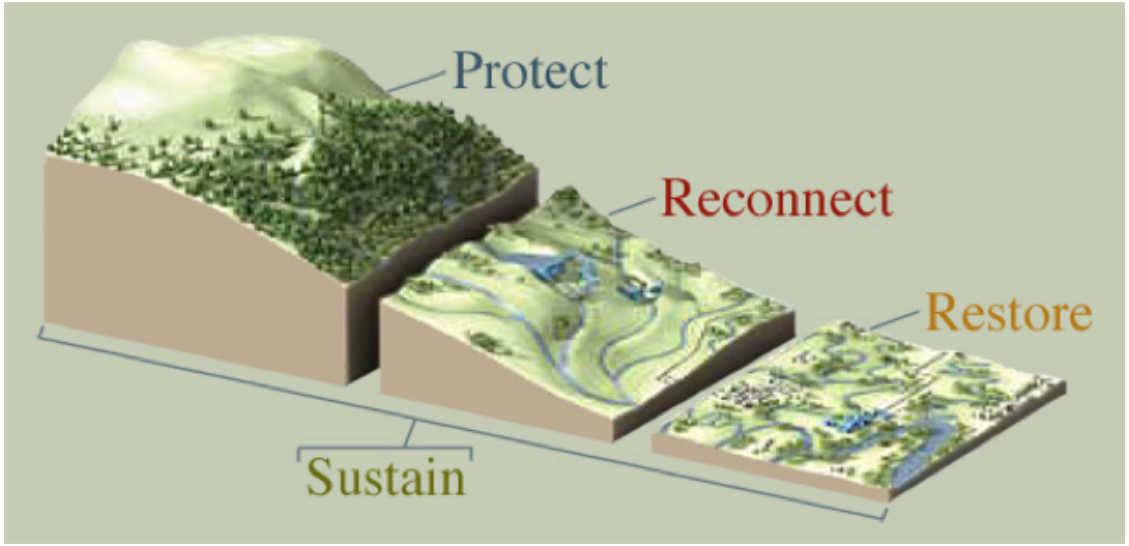
https://www.youtube.com/watch?v=VipVo8zPH0U

http://dels.nas.edu/dels/resources/static-assets/besr/images/NPS_Glines%20Canyon%20Dam%20Removal.jpg

Learn more at American Rivers
https://www.americanrivers.org/threats-solutions/restoring-damaged-rivers/

USA ….. other river restoration efforts

Protect , Reconnect, Restore – efforts to restore rivers (from source to mouth) that support wild salmon and indigenous peoples



Reconnecting floodplains

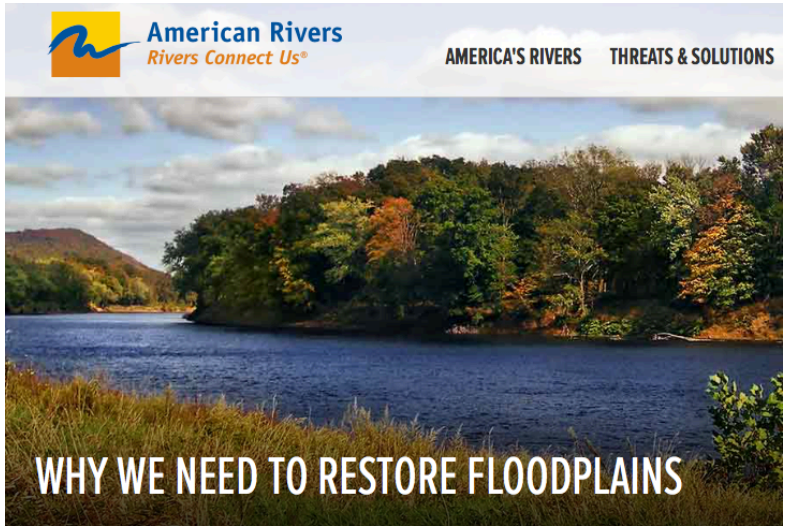
"Reconnecting Rivers to Floodplains; Returning natural functions to restore rivers and benefit communities"

"Across the United States floodplains have been disconnected from rivers and modified on a massive scale resulting in a loss of floodplain benefits.

But floodplains and their benefits to people and nature can be restored by getting water on the floodplain at the right time, in the right amount, and for the right duration to support natural floodplain habitats".

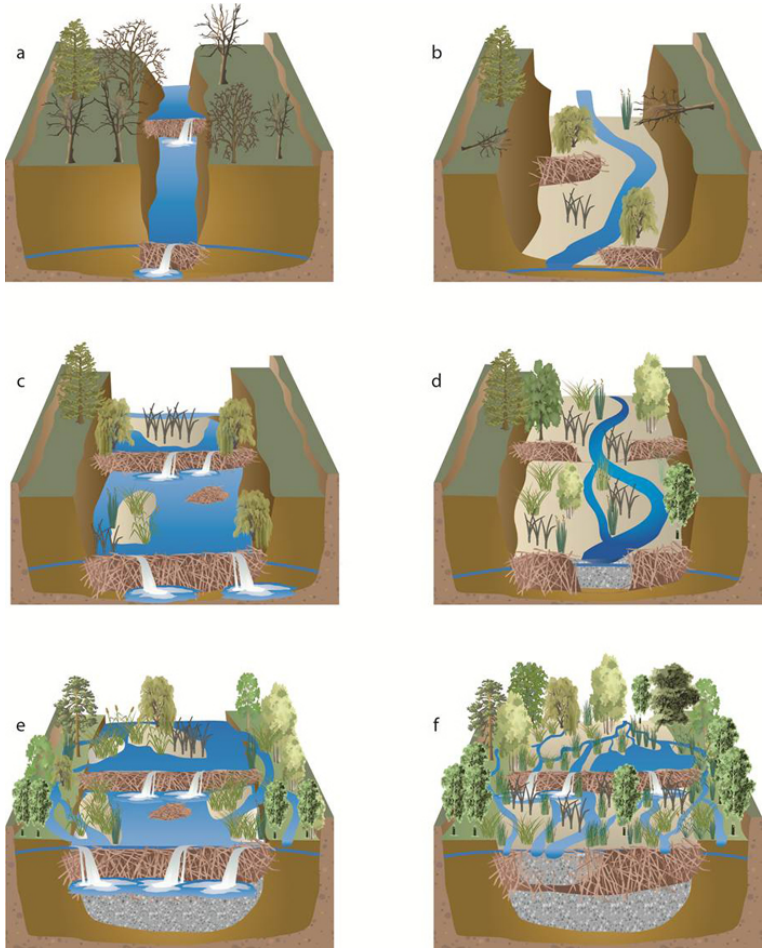
Riverine floodplains are dynamic systems that play an important role in the function and ecology of rivers. Where floodplains are connected to a river and periodically inundated, interactions of land, water, and biology support natural functions that benefit river ecosystems and people"

https://www.americanrivers.org/conservation-resource/reconnecting-floodplains/



See: American Rivers
https://www.americanrivers.org

USA …
Working with beavers … river restoration

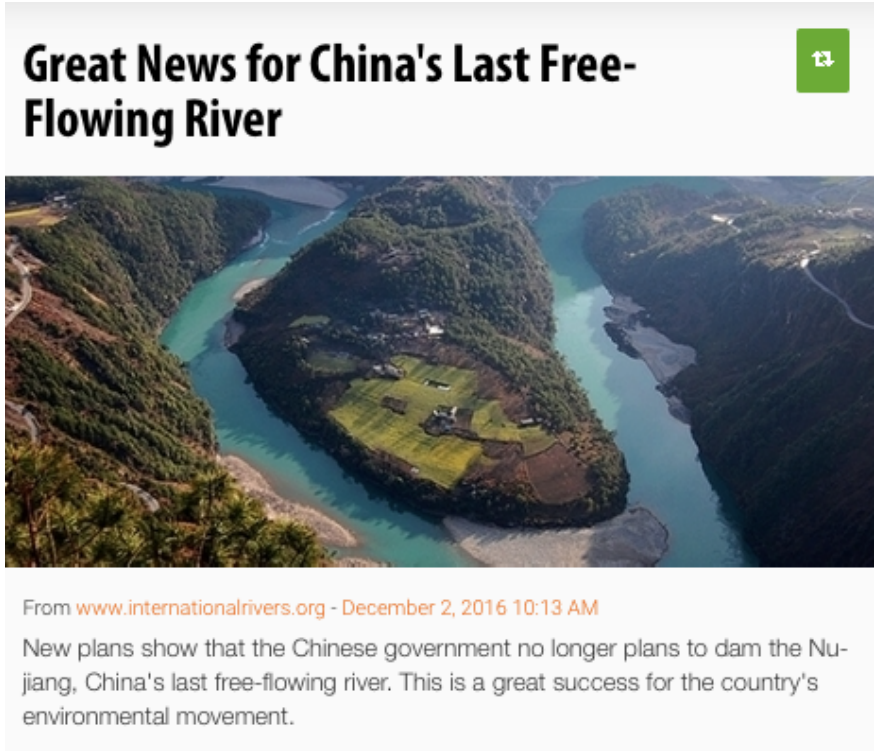


https://www.nwfsc.noaa.gov/research/divisions/fe/wpg/beaver-assist-stld.cfm

http://creation.com/beavers


Science Unwrapped
Leave it to Beavers
Lessons from Nature's River Restoration Engineers
JOE WHEATON
USU Department of Watershed Sciences
USU Ecology Center
FRIDAY, SEPT. 11
7 pm
Eccles Science Learning Center Auditorium (ESLC 130)
Free Admission
2015 THE YEAR OF WATER
College of Science
UtahStateUniversity
www.usu.edu/science/unwrapped
http://beaver.joewheaton.org

In China …. Wild river protection



"The Nu River - known as the Salween in Thailand and the Thanlwin River in Burma - is a treasure of biodiversity and China's last free-flowing river.

Through great educational efforts, China's budding environmental movement managed to stave off dam building plans on the river in 2004 and 2009. In 2013, the Chinese government announced new plans to build five hydropower plants on the undammed river.

Since then, NGOs like Green Watershed, Green Earth Volunteers and International Rivers have worked hard to document the unique ecological value of the Nu River and the serious environmental and geological risks of the proposed dam cascade.

The Power and Hydropower Development Plans for the 13th Five-Year plan period (2016-2020) no longer include any dams on the Nu River"

https://www.internationalrivers.org/resources/press-release-great-news-for-china-s-last-free-flowing-river-11602

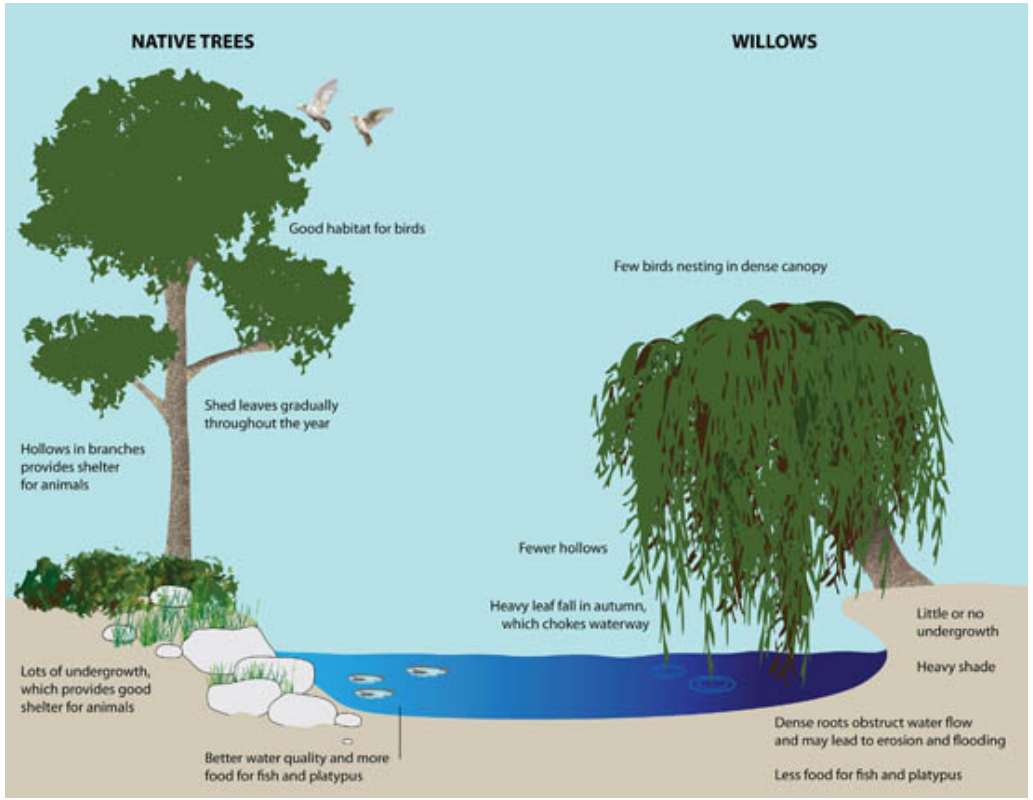
In Australia …….

- Environmental flows – MDB Plan
- Removal of willows along water courses (pests)
- Management or introduced aquatic species
- Riparian rehabilitation / fencing
- Reef Water quality Protection Plan – protecting GBR (Interconnections to riverine water)
- Fish ladders and fish hotels on inland rivers and re-snagging

https://site.emrprojectsummaries.org/category/fish/

http://www.lgnsw.org.au/events-training/local-government-environment-awards/previous-winners

EXOTIC PLANTS and ANIMALS … willows



http://www.angfaqld.org.au/aqp/blog/2013/06/19/landline-war-of-the-willows/

There are other exotic plants and animals that threaten Australia's riverine environments

See Geography Bulletin Edition 3 2016

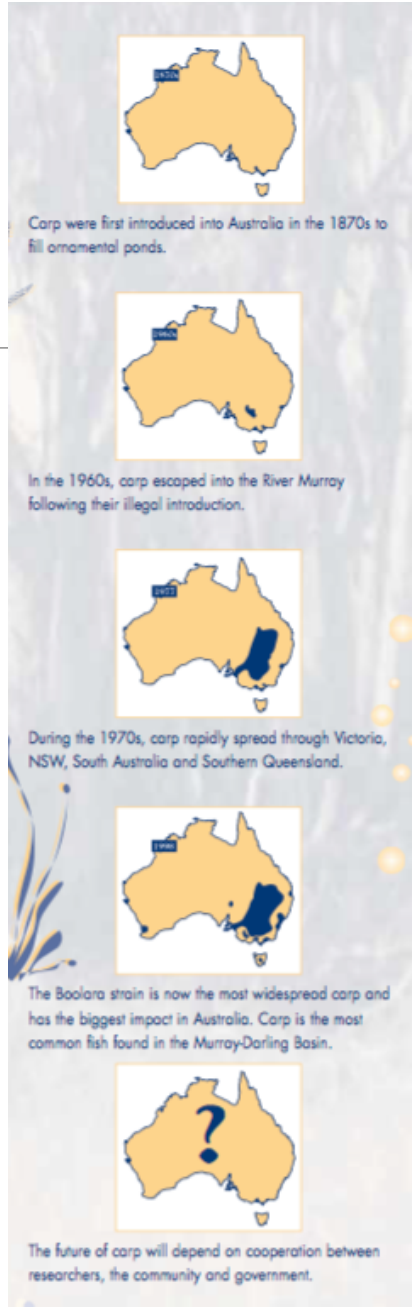
Carp...

Carp were first introduced to Australia in 1859, but numbers exploded in the 1960s after an adapted fish-farming strain was accidently released into the wild.

It's estimated carp make up around 80-90% of the fish biomass within the Murray-Darling Basin, Australia's most important agriculture region.

The carp are prolific breeders that compete with native fish.

Their toothless jaws mean they need to feed at the bottom of rivers, which causes erosion and makes the water turbid, reducing water quality.



http://www.abc.net.au/news/2016-01-13/murray-darling-carp-plague-release-fish-virus-farmers-scientists/7084586
http://www.mdba.gov.au/sites/default/files/archived/mdbc-NFS-reports/2195_factsheet-Carp_Villian_or_Victim.pdf

Carp eradication … electronic fishing, herpes virus

http://www.bbc.com/news/world-australia-36189409

https://www.google.com.au/search?q=willows+BAD+for+rivers&source=lnms&tbm=isch&sa=X&ved=0ahUKEwil16XkyNDSAhUMybwKHf4PC0EQ_AUIBigB&biw=1297&bih=1250#tbm=isch&q=impact+of+carp+on+AUstralian+rivers+&*&imgrc=TCg46mL67fT6zM

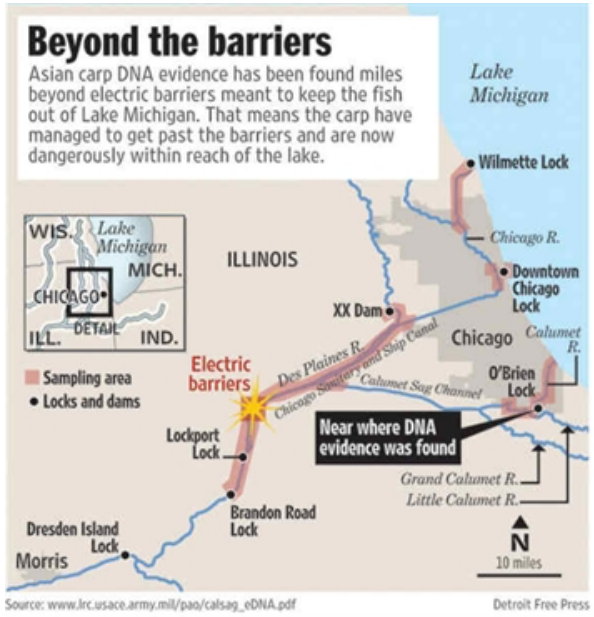
See my article on introduced aquatic species in the Geography Bulletin August 2016

https://www.google.com.au/search?q=willows+BAD+for+rivers&source=lnms&tbm=isch&sa=X&ved=0ahUKEwil16XkyNDSAhUMybwKHf4PC0EQ_AUIBigB&biw=1297&bih=1250#tbm=isch&q=impact+of+carp+on+AUstralian+rivers+&*&imgrc=8FJxDz1UqOMV6M

NATIONAL CARP CONTROL PLAN

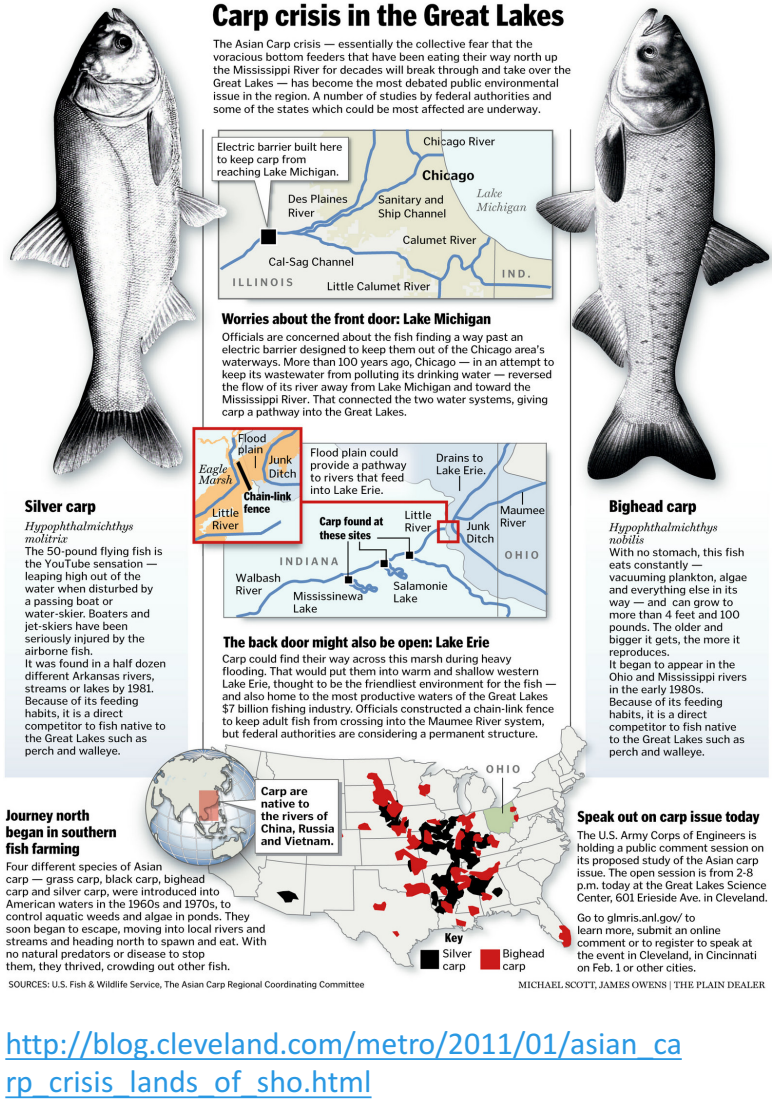
RESTORING NATIVE BIODIVERSITY

http://www.frdc.com.au/knowledge/news_and_media/media_releases/Pages/carp.aspx



http://lincolncountynevada.com/wp-content/uploads/2016/03/carp-rodeo-300x234.jpg

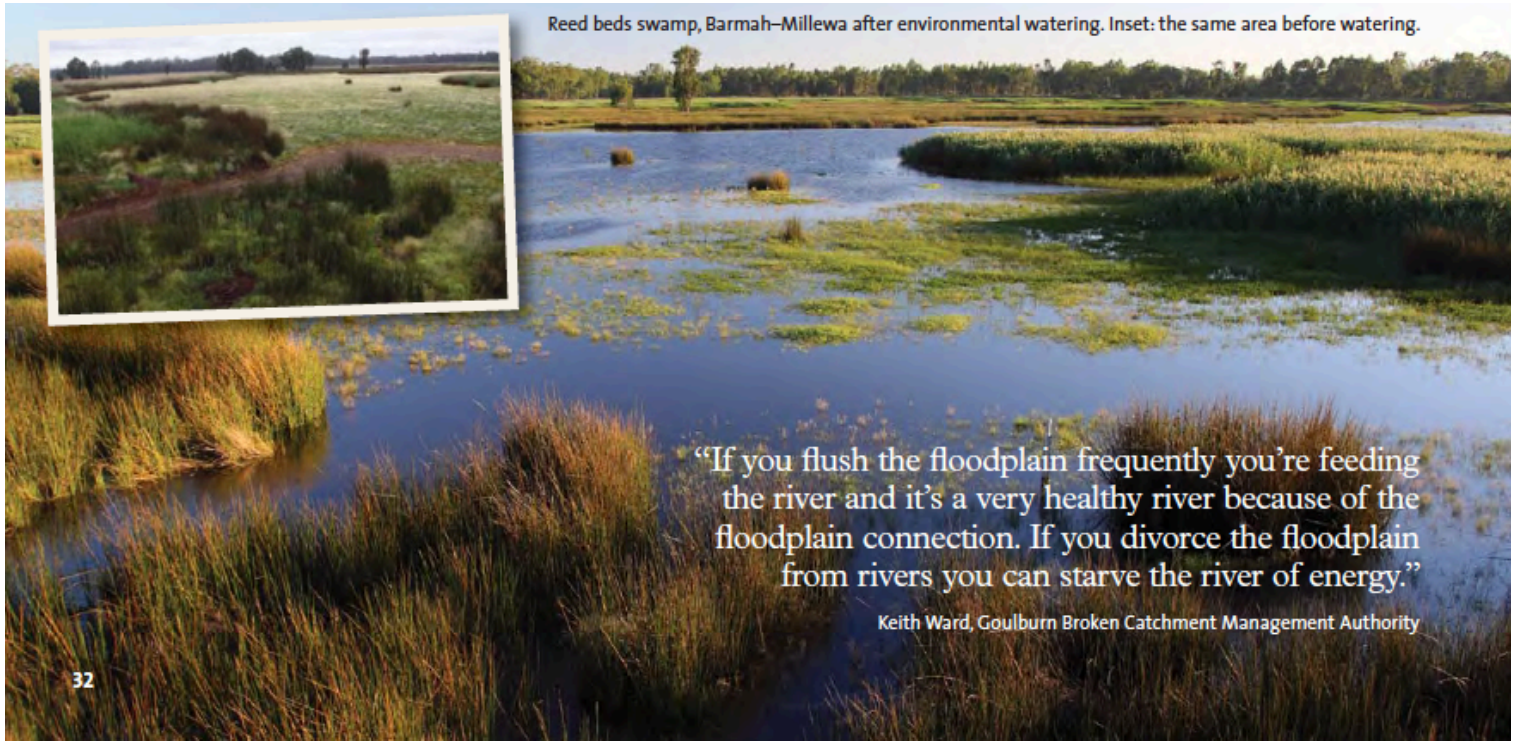
USA : Potential comparative study



http://blog.cleveland.com/metro/2011/01/asian_carp_crisis_lands_of_sho.html

In the USA Asian Carp are a similar threats – carp rodeos are held regularly along the Mississippi River

Environmental flows



Fish movement & habitat (biodiversity)

Down in the Coorong – helping fish find their way… | Finterest – Native Fish Strategy

From www.finterest.com.au - January 23, 3:59 AM

Lorraine Chaffer's insight:
Management of riverine environments to protect and enhance biodiversity and maintain environmental linkages

Fish Moving Freely at Katfish Reach | Finterest – Native Fish Strategy

From www.finterest.com.au - December 16, 2016 3:47 AM

Taking Down Dams and Letting the Fish Flow

From www.nytimes.com - December 8, 2016 8:44 AM

On the Penobscot in Maine and other rivers in the U.S., several endangered species are rebounding with the reopening of spawning areas.

Recent articles from Lorraine's Scoop.it page for Environmental Change & Management
http://www.scoop.it/t/year-10-environmental-change-and-management

Why are attitudes to riverine environments changing ….. are our values changing?

Understanding how riverine environments function holds the answer to this question

LETS GO TO THE SYLLABUS

Source
Fresh water
Biodiversity
Orographic rainfall
Nutrients and sediment for soils

Sink
Wetlands e.g. peat bogs absorb CO_2 and sediment, store water and recycle nutrients

Spiritual
Sacred rituals, meditation, worship, sacrifice, pilgrimage, inspiration, challenge
Wilderness, aesthetic values

Service
Clean water
Recharge aquifers
Store water
Sustains habitats and Biodiversity
Creates valleys & floodplains

Shamans perform a soul-cleansing ritual at Peguche Falls in Ecuador. The water is believed to give a person power to work and courage to dance for the fiesta.

From Geoworld 10 NSW

CONSIDER WORLDVIEWS / values

SYLLABUS

CONTENT FOCUS

Students develop an understanding of the **functioning of environments** and the scale of **human-induced environmental change** challenging sustainability.

They **explore worldviews** influencing approaches to environmental use and management.

Students undertake **an investigative study** of the causes and consequences of environmental change in an environment in Australia and another country.

They **compare and evaluate the management responses** in both countries and propose ways individuals can contribute to environmental sustainability

SYLLABUS

KEY INQUIRY QUESTIONS

- How do **environments function**?
- How do **people's worldviews** affect their attitudes to and use of environments?
- What are the **causes and consequences of change** in environments and how can this change be managed?
- Why is an **understanding of environmental processes and interconnections** essential for **sustainable management** of environments?

Introduction to Environmental Change

Environments

Students investigate the role and importance of natural environments, for example

- identification of the **function of natural environments in supporting life** eg maintaining biodiversity

Environmental change

Students investigate **human-induced environmental changes across a range of scales**, for example:

- brief examination of types, and extent, of environmental change

Environmental management

Students investigate **environmental management, including different worldviews and the management approaches of Aboriginal and Torres Strait Islander Peoples**, for example:

- discussion of varying environmental management approaches and perspectives

Investigative study
Riverine Environments

Select **ONE type of environment in Australia** / **a comparative study with at least ONE other country**.

Students investigate the **biophysical processes** essential to the **functioning of the selected environment**

Students investigate **the causes, extent and consequences of the environmental change (in each country)**

Students investigate the **management of the environmental change**

We have already seen the enormous potential for comparative studies with other countries

Riverine environment :What are my option?

Rivers at different stages (mountains to sea) LONGITUDINAL

- issues include climate change, glacial melt, pollution, damming

River channel and riparian zone (Traverse)

- issues include land clearing, agricultural pollution, habitat losses

River and its floodplain (Traverse) OR Wetlands connected to a river / river floodplain

- issues include disconnection between river & floodplain, flooding , wetland losses

River and its catchment (Traverse & longitudinal)

- cover a range of issues

Estuaries – where rivers meet the sea

…… there are many more possible environments at a local scale

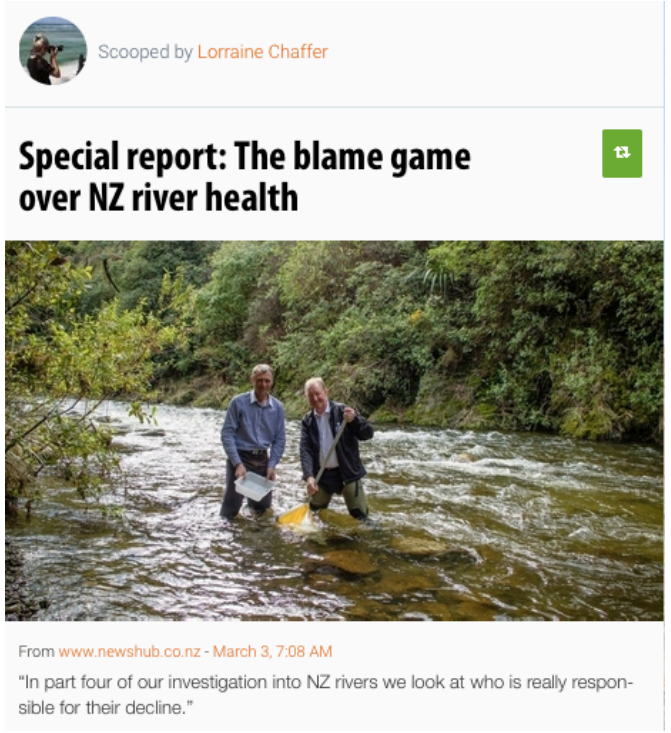
NOT JUST LANDFORMS!

Use the NZ case study- find Australian comparative studies

MUST LINK TO HUMAN INDUCED CHANGE

LINK TO CHANGES TO RIVERINE HABITATS, RIVER / WETLAND / FLOODPLAIN FUNCTIONING

- Dam building
- Flood controls
- Climate change
- Pollution
- Urbanisation & industrialization
- Agriculture
- Climate change



BIOPHYSICAL PROCESSES

APPROACH 1 LONGITUDINAL STUDY

SOURCE TO MOUTH (mountains to sea)

Where does river flow come from? SOURCE

Downstream changes

Downstream changes in habitat

Why is river flow important – river ecosystems and floodplain linkages

http://www.panoramio.com/photo/87882501

MOUNTAINS TO SEA

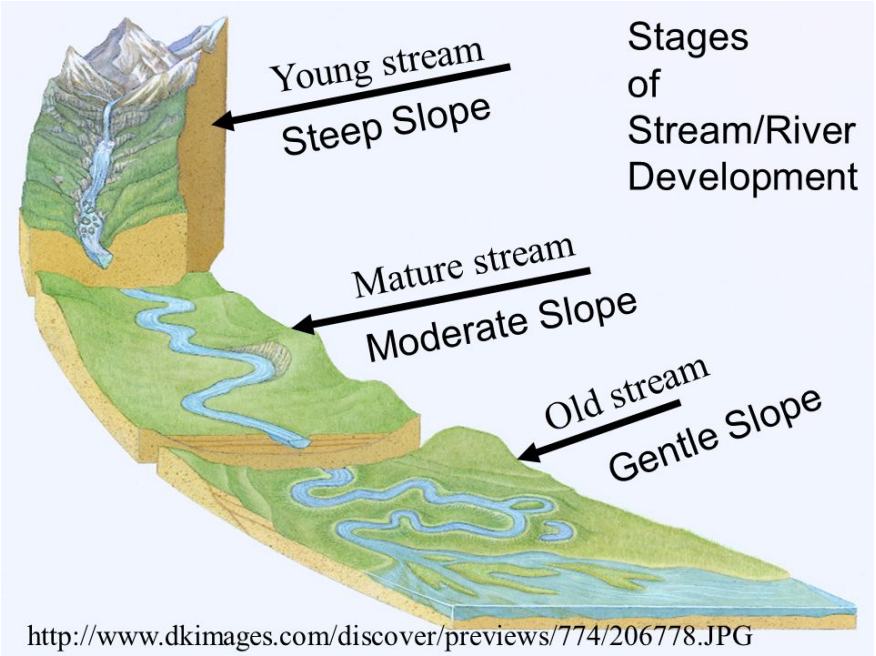
“The ages of a river

We can divide each river up into three ages, comparable to the life phases of human beings: youth, maturity and old age.

These three phases roughly correspond to the regions the river runs through.

The river’s course is its life, its entire journey from source to mouth where it sheds its banks and merges with the water of the sea”

http://www.unesco.org/fileadmin/MULTIMEDIA/FIELD/Venice/pdf/special_events/bozza_scheda_DOW01_1.0.pdf



http://www.dkimages.com/discover/previews/774/206778.JPG

Source to mouth

“Rivers, blood of the earth

Along its entire route, a river is a fundamental resource not only for human life but for fauna and Flora too. Each and every river is crucial to the equilibrium of the environment and biodiversity. That is why rivers must be considered a most precious good, to be guarded and protected from all forms of pollution or excessive exploitation.

In some cultures, like the U’wa Indians of Colombia, quite unlike western culture, the river itself is seen as a “living organism”: it is the blood that nourishes the earth.”

(WORLDVIEWS)

http://www.unesco.org/fileadmin/MULTIMEDIA/FIELD/Venice/pdf/special_events/bozza_scheda_DOW01_1.0.pdf

Okavango Delta
“The abundance of life is mind boggling: more than 530 bird species, thousands of plant species,160 different mammals,155 reptiles, scores of frogs, countless insects”

http://news.nationalgeographic.com/news/2014/06/140624-okavango-delta-unesco-heritage-site-botswana/

Living environments … change downstream

"Rivers are complex and dynamic environments adapted to natural variations in river flow (including droughts and floods) and availability of nutrients and sediment.

In the upper reaches rivers erode vertically creating deep valleys while downstream, where gradients are lower, they erode horizontally to create wide floodplains on which sediment is deposited.

Erosion and deposition create **different river habitats** and provide sediment and nutrients for freshwater species".

http://www.unesco.org/fileadmin/MULTIMEDIA/FIELD/Venice/pdf/special_events/bozza_scheda_DOW01_1.0.pdf

Rivers as living environments

“The energy base of the food chain

Vegetation in the river leads organic material to become caught and trapped. The outcome of this process is that an extensive quantity of organic material (like branches and leaves) is, as it were, stored up, and this is the energy base for the food chain of all creatures living along rivers

The river as an ecological highway

Rivers might well be seen as “green highways” which **link up a succession of natural zones**. Even where human action and presence is marked, the river and its ecotones are still vital areas, used both by plants and animals for movement and reproduction.

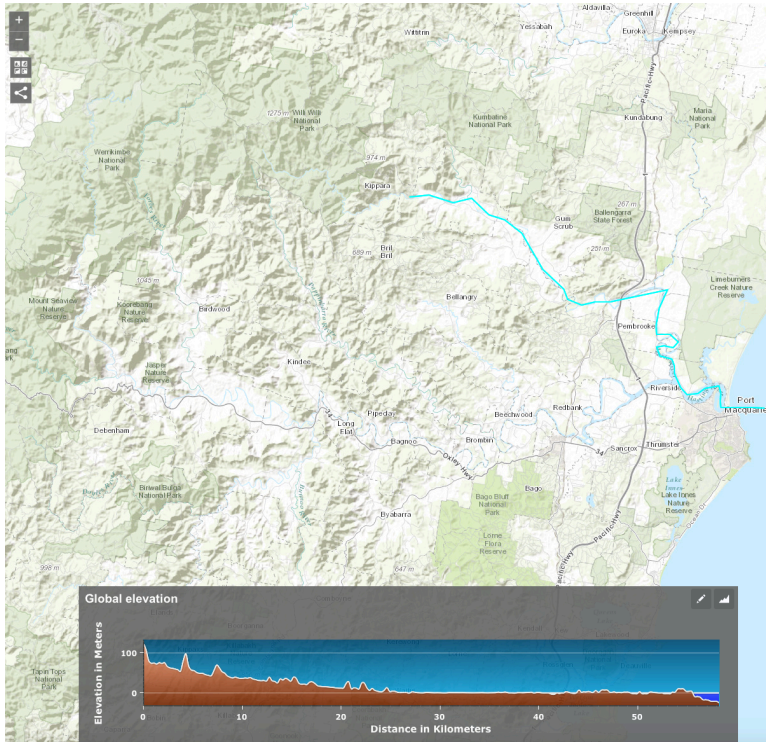
The migration of birds, for example, generally follows paths marked by rivers, and some trees, especially in the ecotones, use the owing water to disperse their seeds. Rivers are thus extremely important interlinking passageways in a wider network, the ecological network itself.”

http://www.unesco.org/fileadmin/MULTIMEDIA/FIELD/Venice/pdf/special_events/bozza_scheda_DOW01_1.0.pdf

DRAW a river profile - longitudinal or cross valley

Find a tributary, create a path downstream to see the general profile from start to finish.

Ignore rises as sometimes your li9ne will cross over a ridge or spur – it is the overall profile you are looking at



ESRI Global elevation tool

Also use Google maps and Google Earth for profiles

Example from Port Macquarie NSW

Works equally well on local creeks an inland rivers.

Global elevation
http://esriukeducation.maps.arcgis.com/apps/Profile/index.html?appid=f0a2a2a3e1964129b22c715e31282f6c

Integrate spatial technologies

INTERCONNECTIONS – downstream connections to other environments

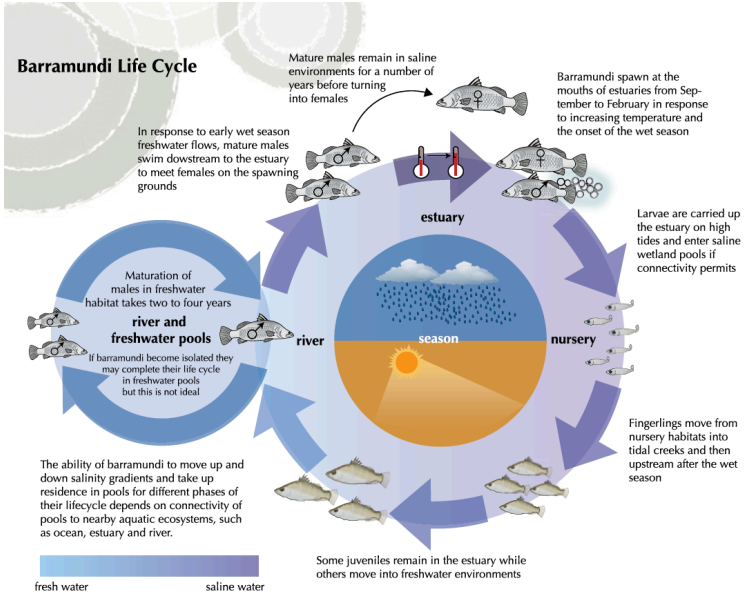
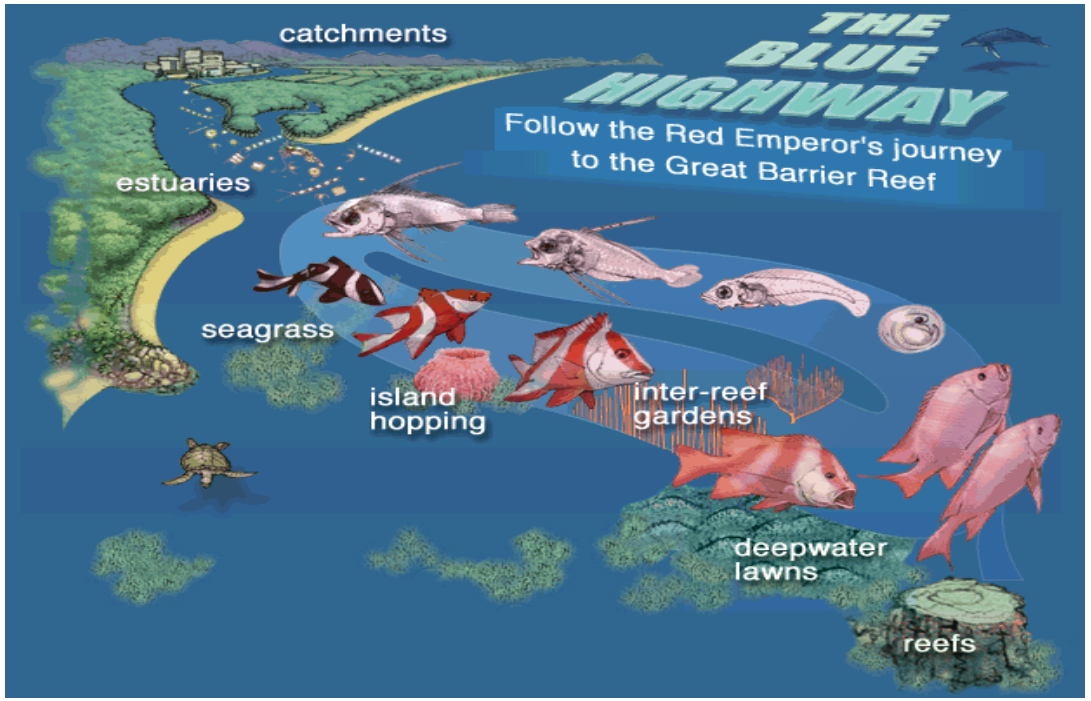


Figure 2.1 – A pictorial conceptual model of the barramundi lifecycle. Not all pictorial conceptual models are drawn on landscape bases (from the Fitzroy Coastal Floodplain Wetlands guide, DERM 2011).

https://wetlandinfo.ehp.qld.gov.au/wetlands/resources/pictorial-conceptual-models.html

LINKS BETEEEN RIVERINE & MARINE ENVIRONMENTS

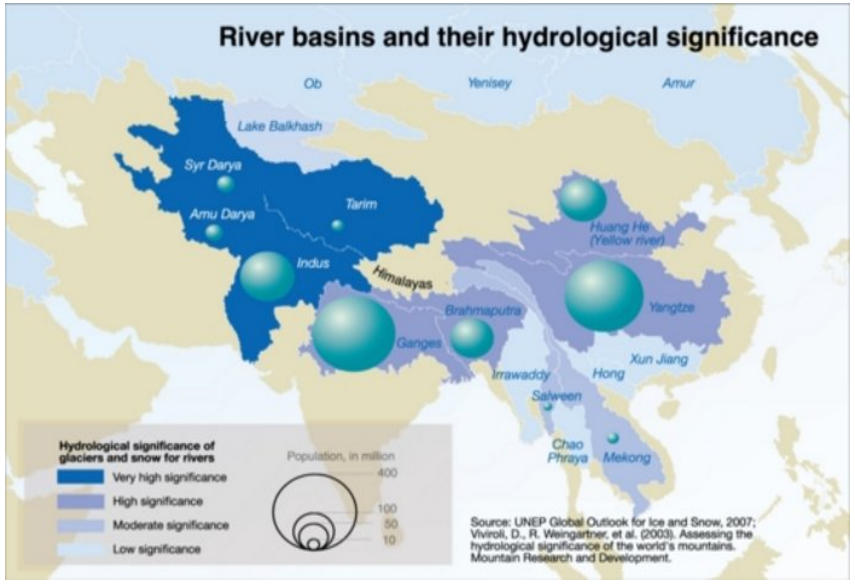


Use conceptual diagrams

Source The third pole: Climate change implications for processes

Melting ice / glaciers

- Downstream flooding e.g. (Link to Room for the River)
- Future water flows reduced as ice disappears
- Environmental implications downstream



https://commons.wikimedia.org/wiki/File:Glacial_melt_water_carving_the_ice,_river_source_Himalayas_India.jpg
UNEP 2007 report on significance of ice (glaciers) & snow for riverine environments

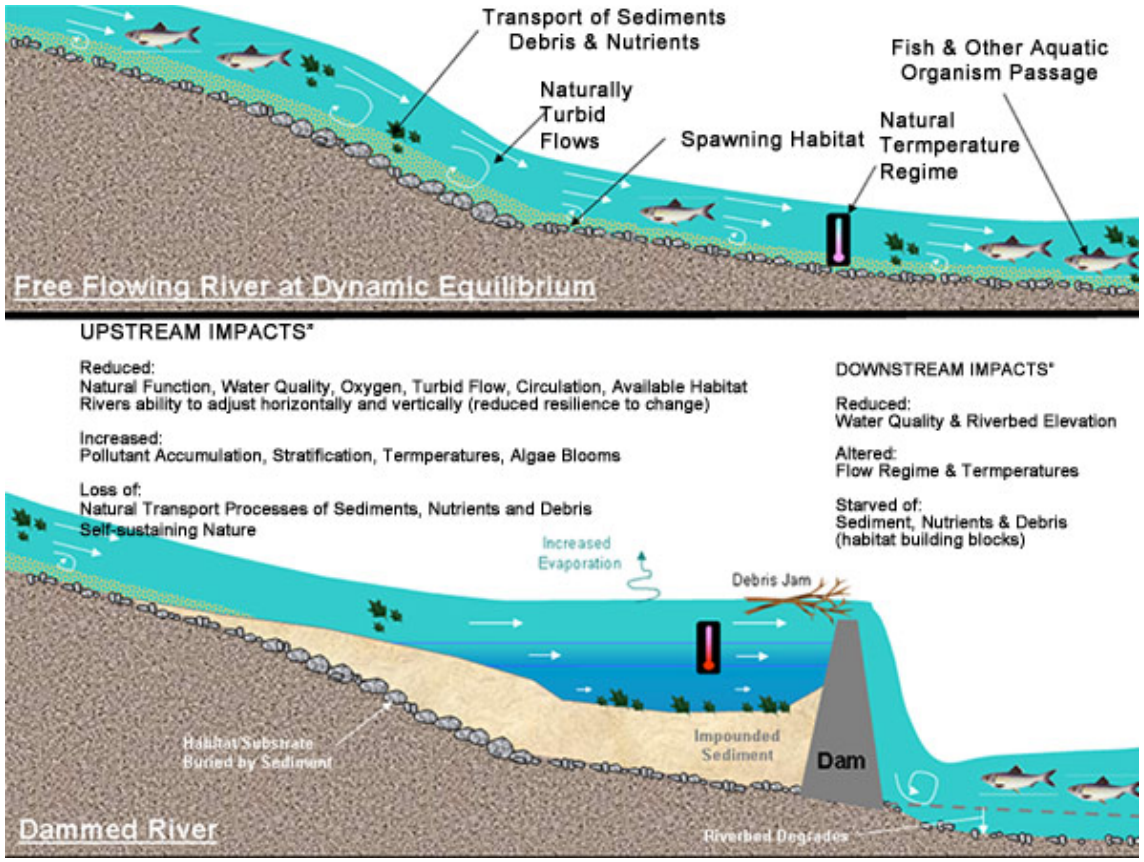
What happens when we build a dam?

National Geographic:

Glen Canyon Dam USA

Comparative study in Australia
(Snowy River)

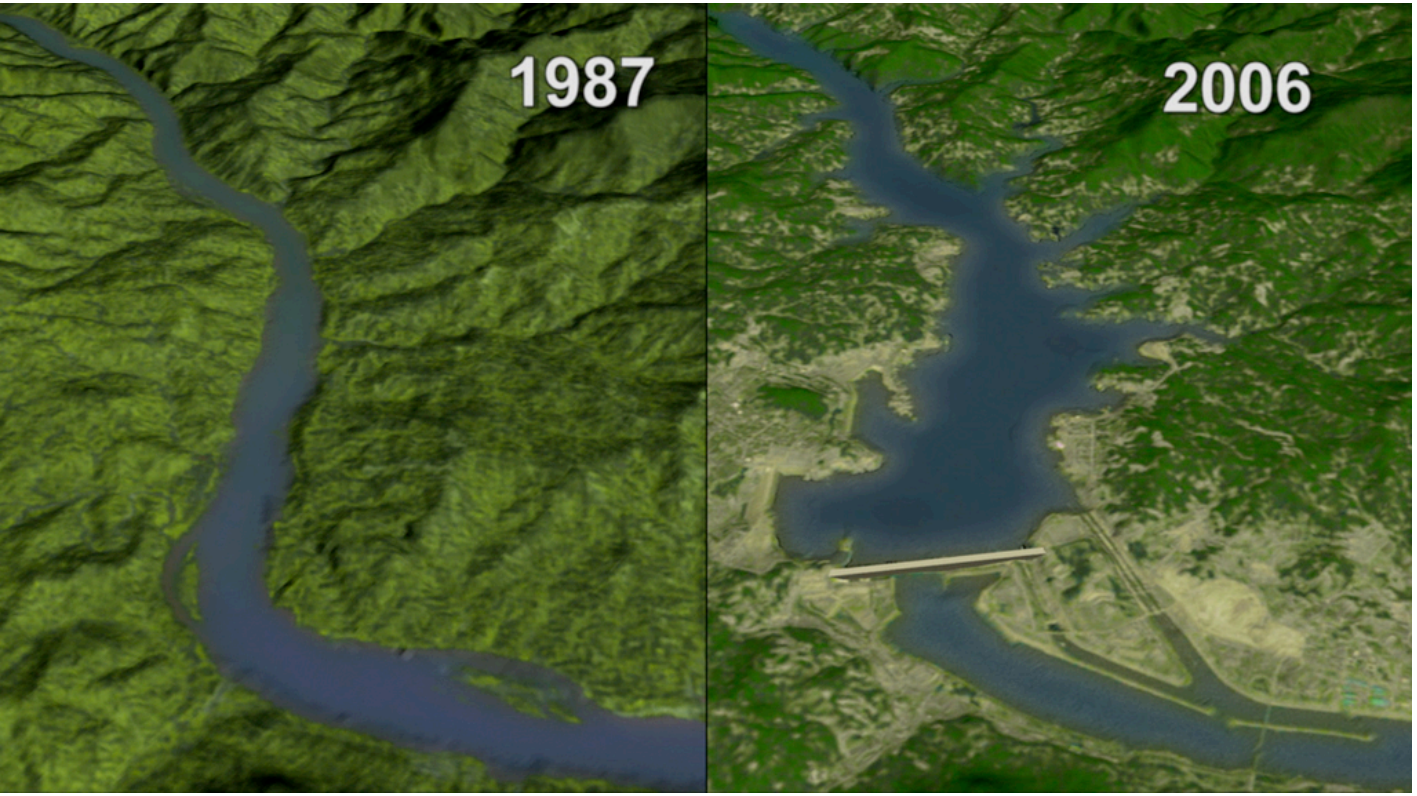
Dams change rivers



- Reduction of downstream flow > contraction of inland lakes and seas e.g Aral Sea
- Reduction of nutrients at mouth of river > negative impact on commercial fisheries at coast
- Nutrients trapped behind dams > loss of mangrove forests in coastal areas
- Unnatural flow pattern of the river > riverbank erosion downstream > disruption to riverine species of birds and mammals
- Fewer floods downstream > increased urbanisation on floodplain
- Disruption to migratory patterns of river fish

http://www.geo41.com/dams-and-reservoirs/

There are lots of images showing change ….



[3 GORGES DAM IN CHINA](http://www1.american.edu/ted/ICE/china-dam-impact.html)
http://www1.american.edu/ted/ICE/china-dam-impact.html

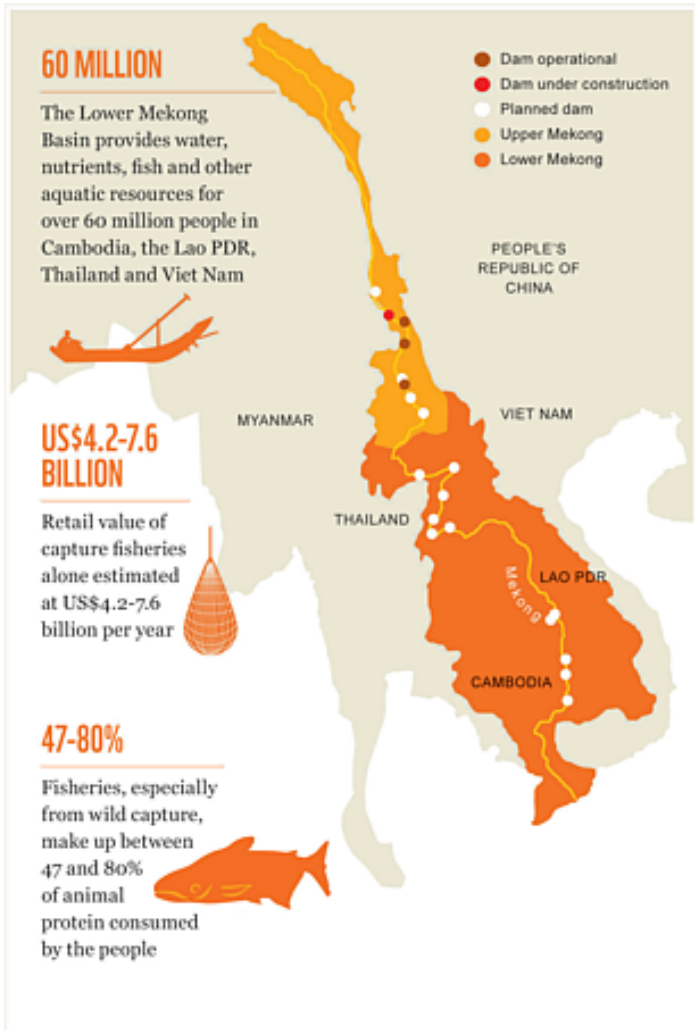
MEKONG DAMS: BENEFITS VS IMPACTS

http://www.nature.com/news/2011/111019/images/map850.jpg

http://s.ngm.com/2015/05/mekong-dams/img/china-xiaowan-dam-615.jpg

Incorporate ASIA

Impact of dams on fisheries and biodiversity



http://d2ouvy59p0dg6k.cloudfront.net/img/mekong_dams_and_fisheries_478605.png

http://www.smh.com.au/content/dam/images/g/h/y/n/8/y/image.related.articleLeadwide.620x349.ghobvi.png/1436243078122.jpg

https://i.guim.co.uk/img/static/sys-images/Guardian/Pix/pictures/2015/5/6/1430916783608/423cc180-6b06-4d2b-b0e2-b3e5a130d4db-620x372.jpeg?w=700&q=55&auto=format&usm=12&fit=max&s=ce72d2f9627985f902c5f998acf0e72d

A tricky balancing act. BBC REPORT

http://www.bbc.com/future/story/20120627-dammed-if-you-do

"Of all the ways we have engineered Earth in the Anthropocene, the Age of Man, surely nothing rivals our audacious planetary-wide re-plumbing of the world's waterways. But is our control of Earth's arteries causing dangerous clots?"

http://ichef.bbci.co.uk/wwfeatures/wm/live/1280_720/images/live/p0/0v/dc/p00vdc2b.jpg

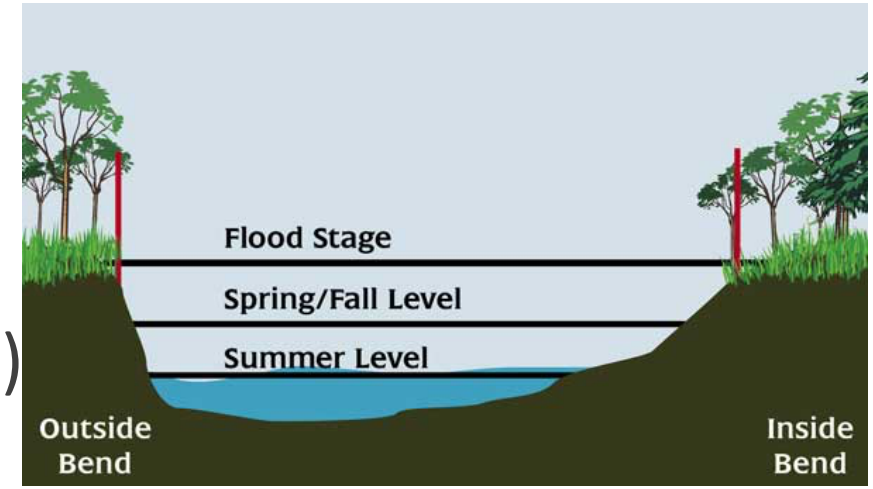
BIOPHYSICAL PROCESSES

APPROACH 2 : TRAVERSE STUDIES

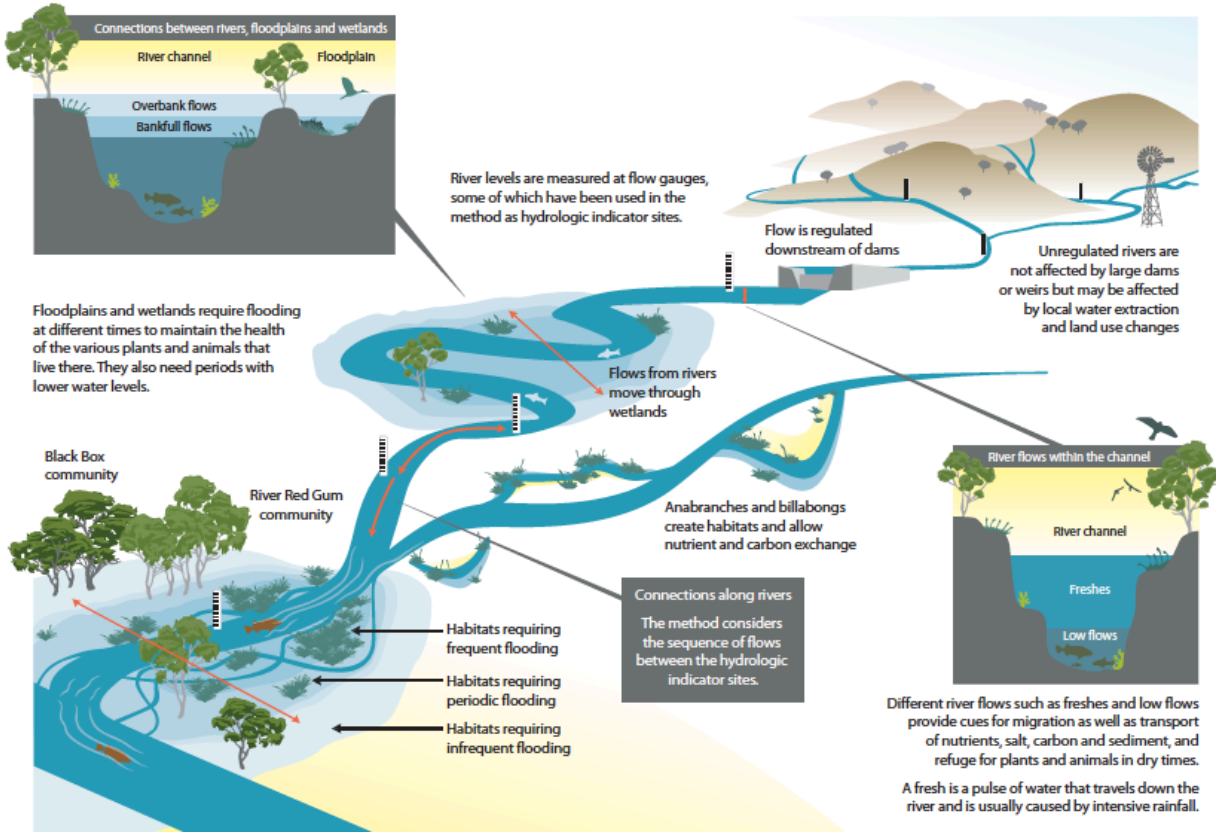
Bank to Bank (Channel & riparian zone)

River, wetland and floodplain Interconnections)

Whole catchment (Ridge to ridge)

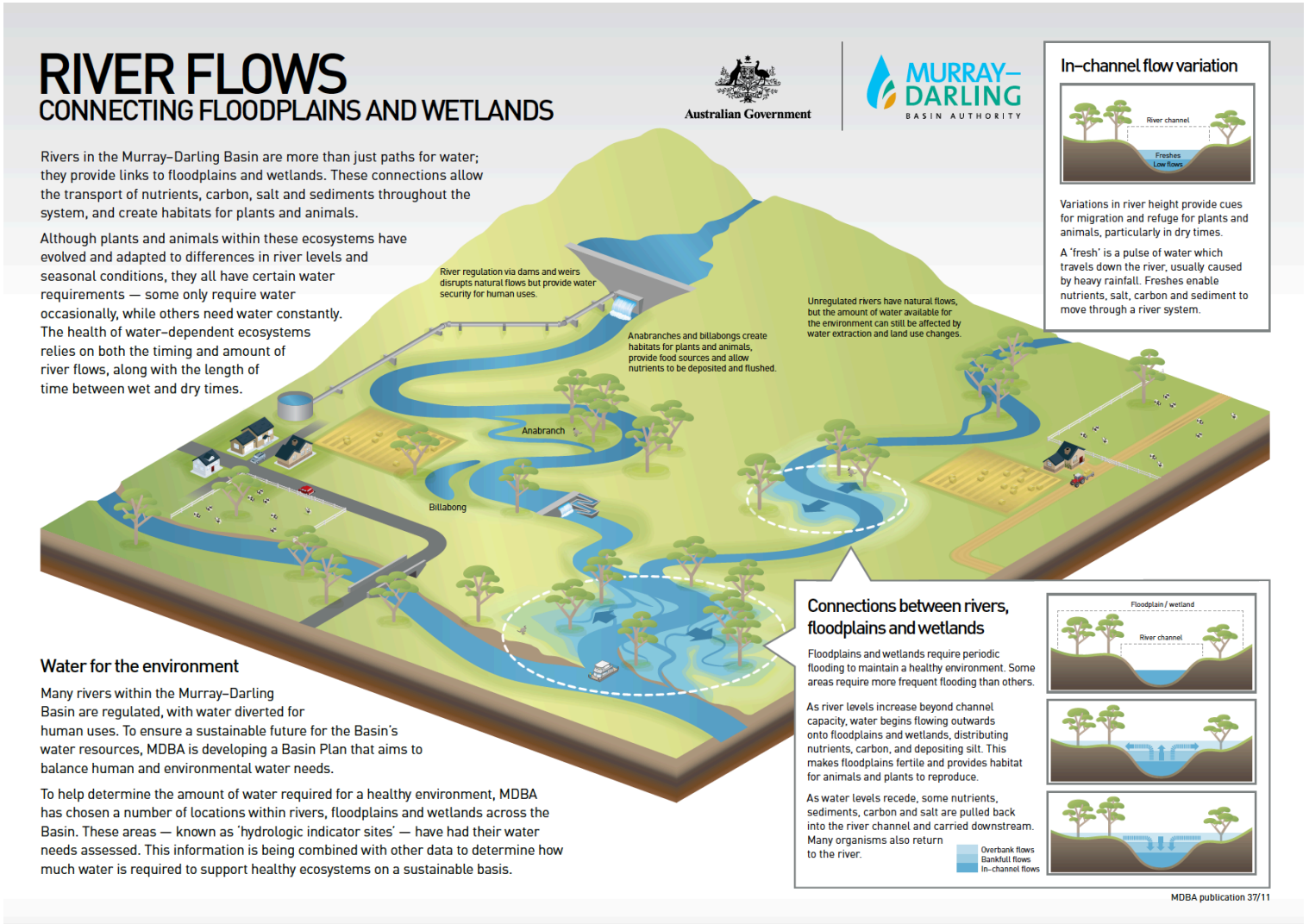


River / wetland /floodplain connections



Excellent resources for MDBA
http://www.mdba.gov.au/discover-basin/environment/rivers-wetlands-floodplains

Murray Darling Basin Authority



Excellent resources for MDBA

http://www.mdba.gov.au/discover-basin/environment/rivers-wetlands-floodplains

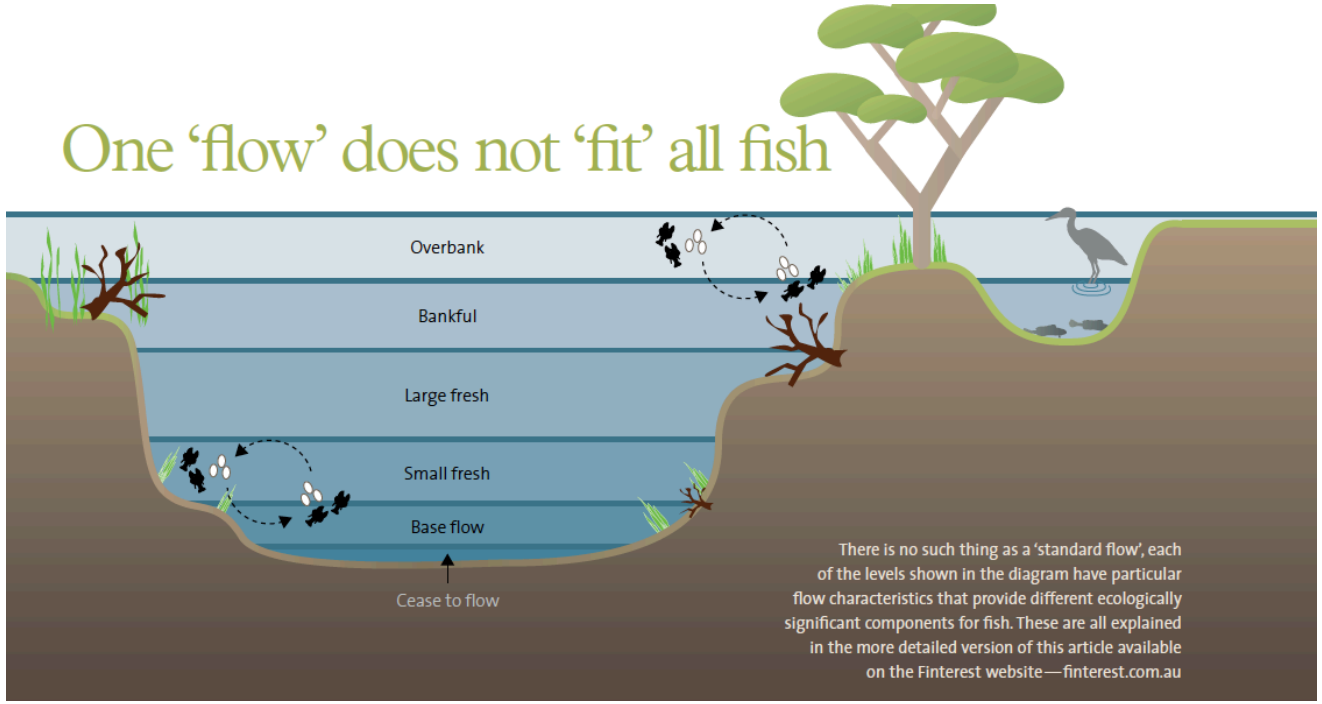
http://www.mdba.gov.au/publications/products/river-flows-connecting-floodplains-wetlands

Murray Darling Basin POSTER

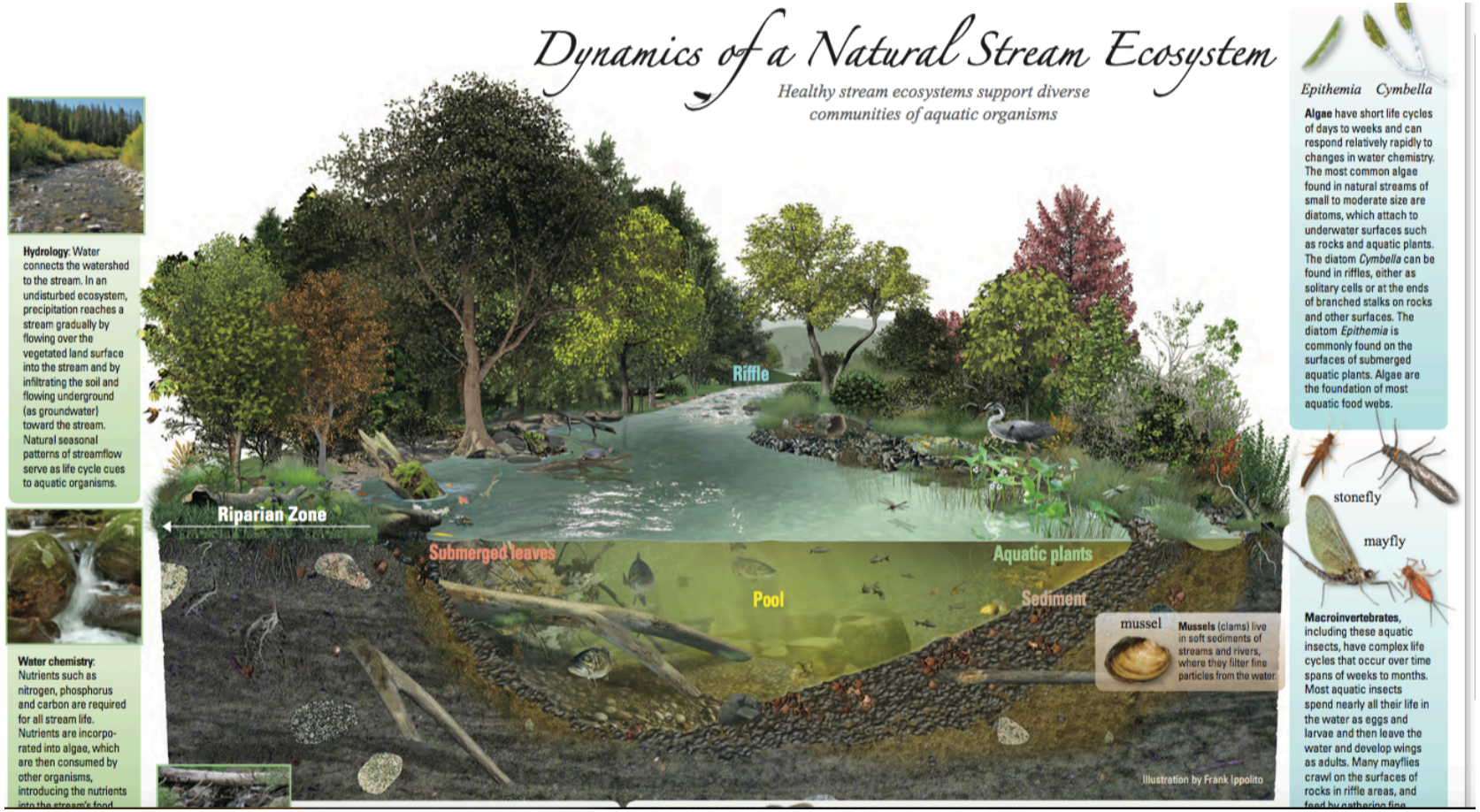
Wetlands with riverine connections e.g. Macquarie marshes

http://www.mdba.gov.au/publications/products/macquarie-marshes-poster

A rivers and riparian zones



Features / functions of a natural stream



https://water.usgs.gov/nawqa/ecology/pubs/cir-1391/images/NaturalStream.pdf

https://water.usgs.gov/nawqa/ecology/pubs/cir-1391/images/NaturalStream.pdf

SIMPLE RIVER FOOD WEB

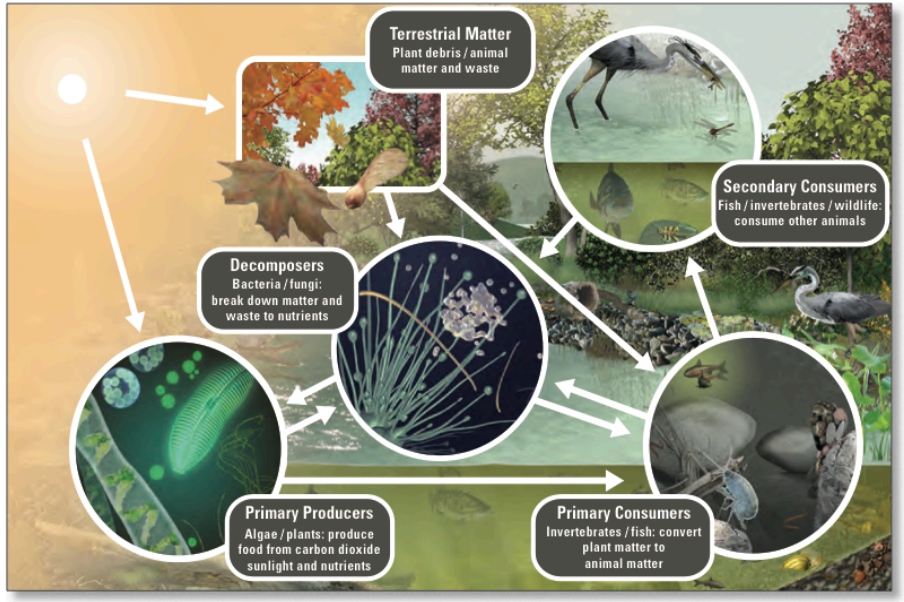


Figure 2–3. A simplified foodweb in a stream ecosystem, showing the interaction between energy coming from the sun and the biota, which include primary producers (diatoms and green algae), primary consumers (caddisflies, amphipods, and minnows), secondary consumers (herons, bass, dragonflies, and stoneflies), and decomposers (bacteria and fungi). (Drawing by Frank Ippolito, Production Post Studios, 110 North Fulton St., Bloomfield, N.J.)

Environmental functioning

https://water.usgs.gov/nawqa/ecology/pubs/cir-1391/images/NaturalStream.pdf

RIVERINE HABITATS

Riverine habitats vary from deep pools to shallow, fast flowing rapids, protected riverbanks and riverbed sediments such as gravel and rocks.

Within each habitat aquatic plants, sediment and nutrients support complex *food webs.*

Debris such as tree branches is an essential source of food, habitat and surfaces for small aquatic plants to grow on (biofilm).

Aquatic species are adapted to stable water *temperatures* within rivers

The *lifecycle* of fish species such as salmon and barramundi involves *migration* between different river habitats.

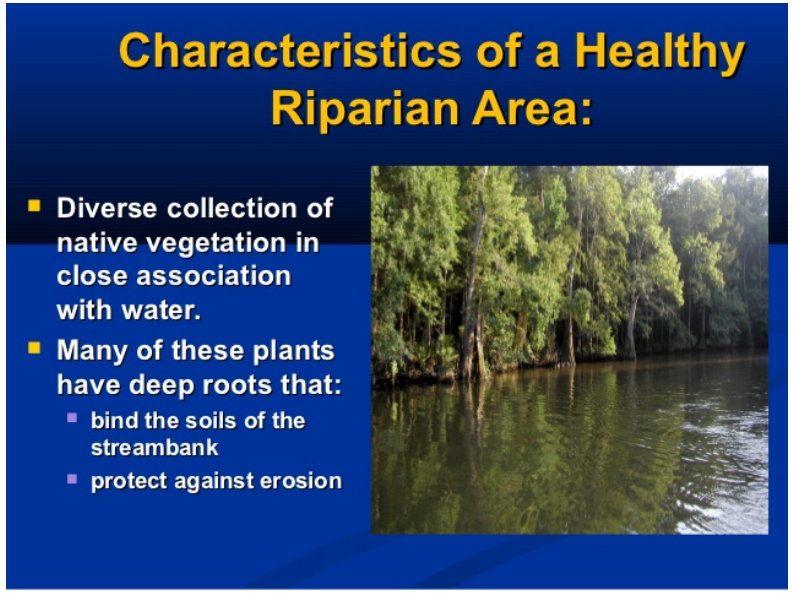
RIPARIAN ZONE

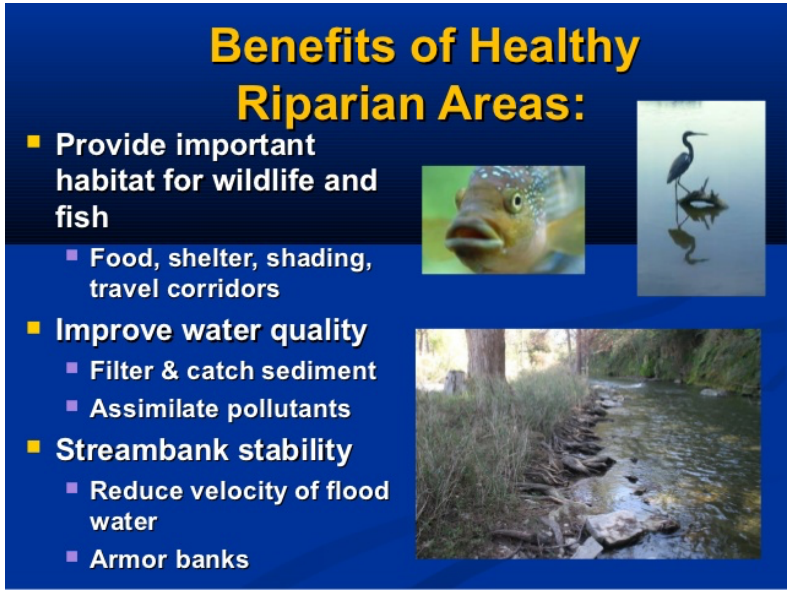
The riparian zone plays an important role in healthy river functioning by stabilising riverbanks, slowing the runoff entering channels, trapping sediments, reducing water temperatures and providing food and habitats, such as snags, for aquatic species.

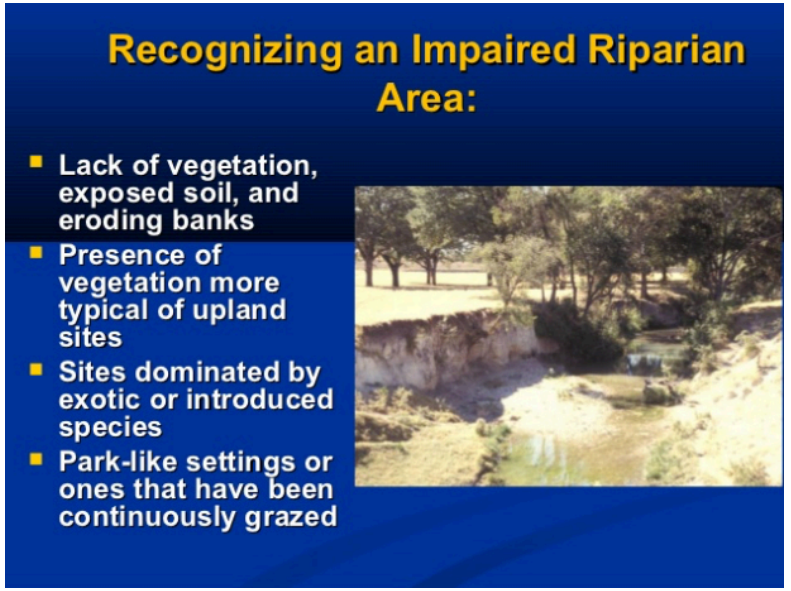
In healthy river catchments vegetation cover and wetlands slow runoff, remove pollutants and allow water to percolate slowly into aquifers, which recharge streams with clean water.

http://aubreyshepherd.blogspot.com.au/2012_06_01_archive.html

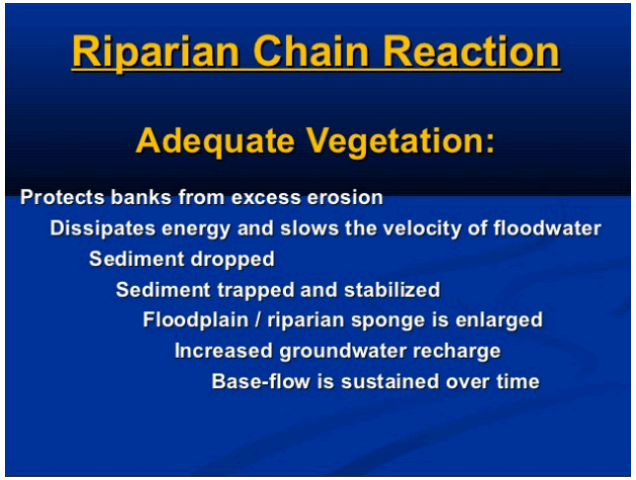
Importance of riparian zones







https://www.slideshare.net/BosqueRiver/riparian-stream-restoration-bosque-river-stephenville



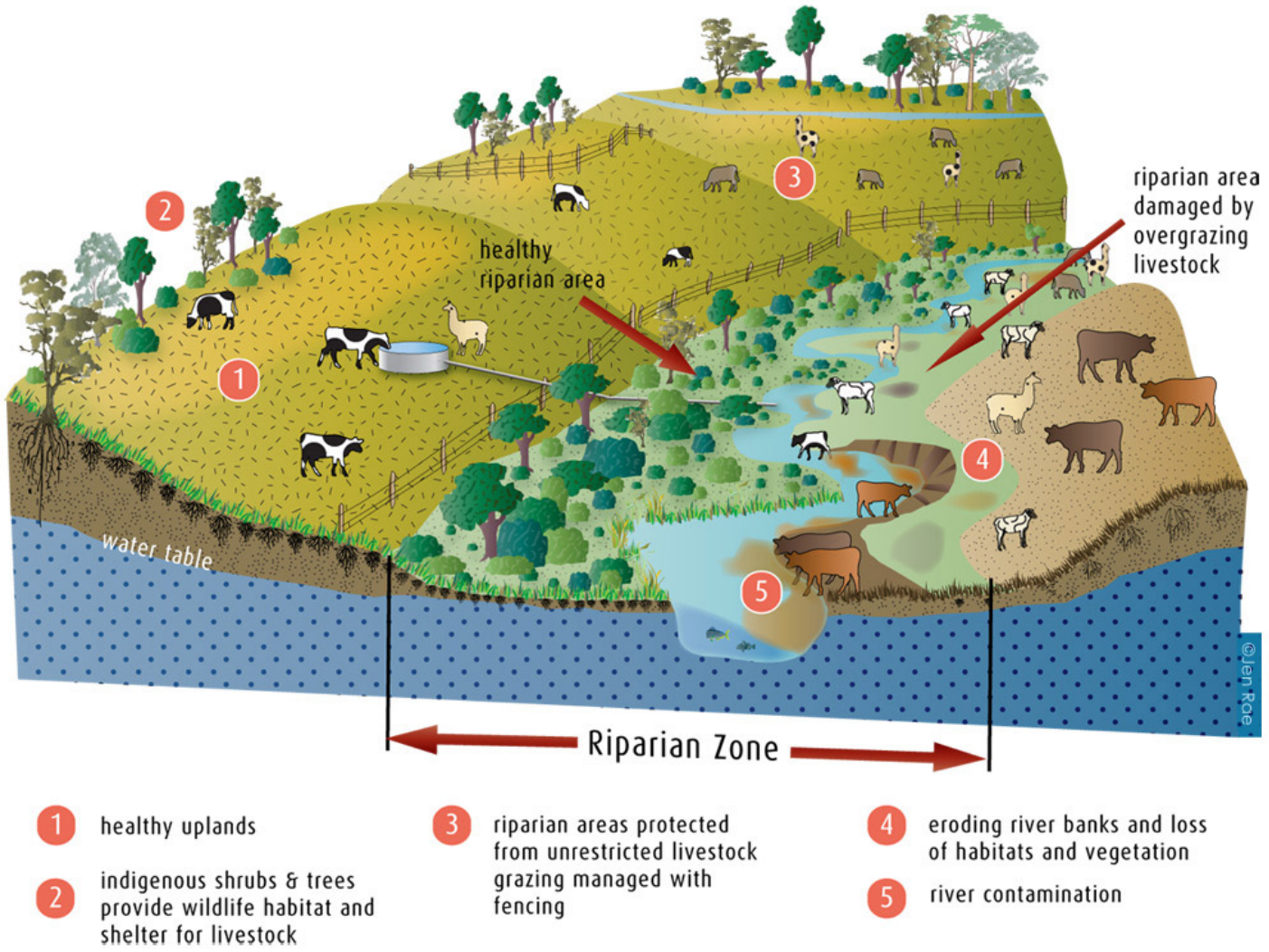
https://www.slideshare.net/BosqueRiver/riparian-stream-restoration-bosque-river-stephenville

Another great Slideshare PPT: Understanding your remarkable riparian area

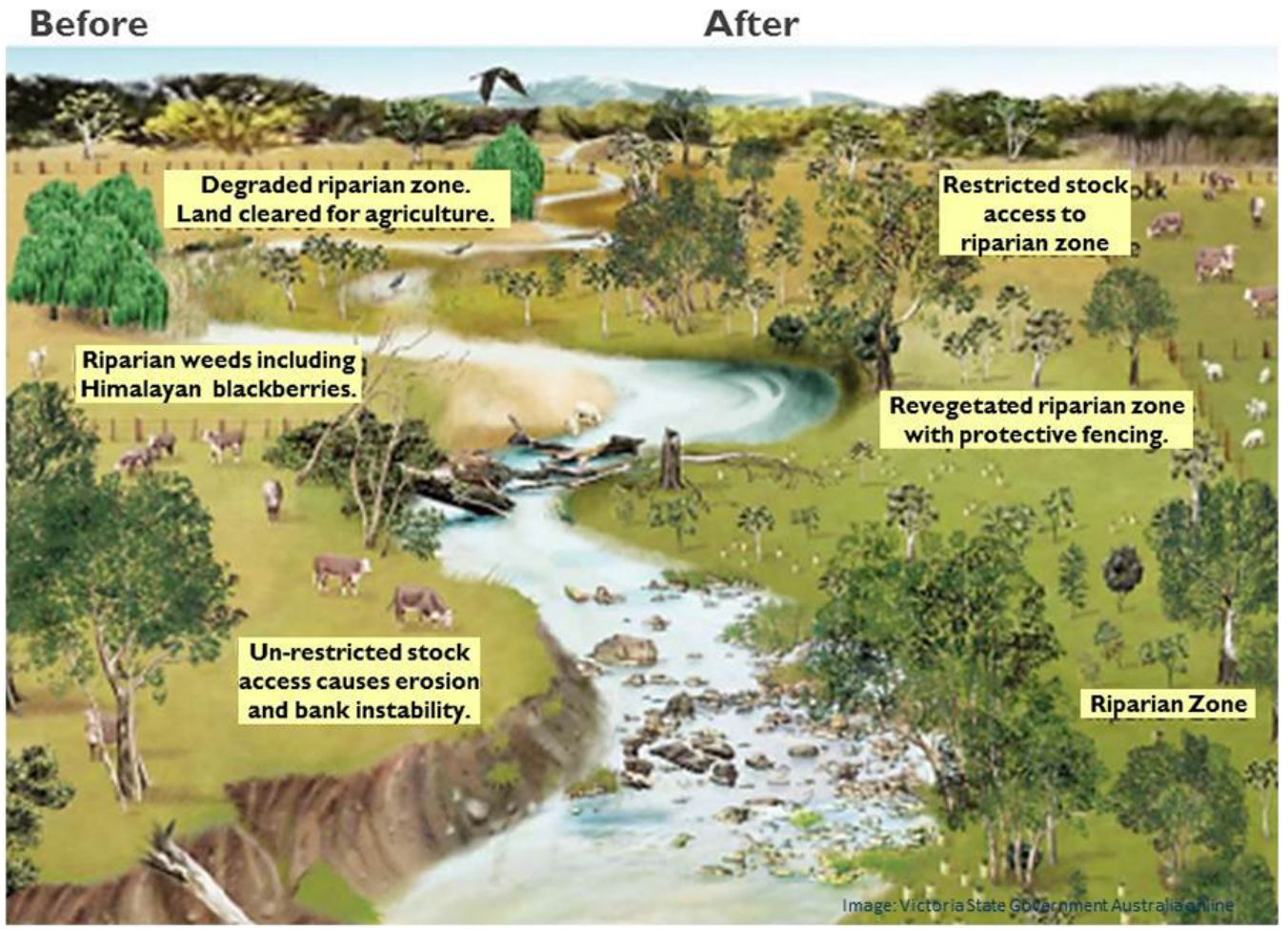
https://www.slideshare.net/mulebarn/riparian-area-management-sky-joneslewey-nueces-river-authority-resource-protection-and-education-director-president-hill-country-alliance?next_slideshow=1

Threats and management

http://theriparianproject.com.au/about



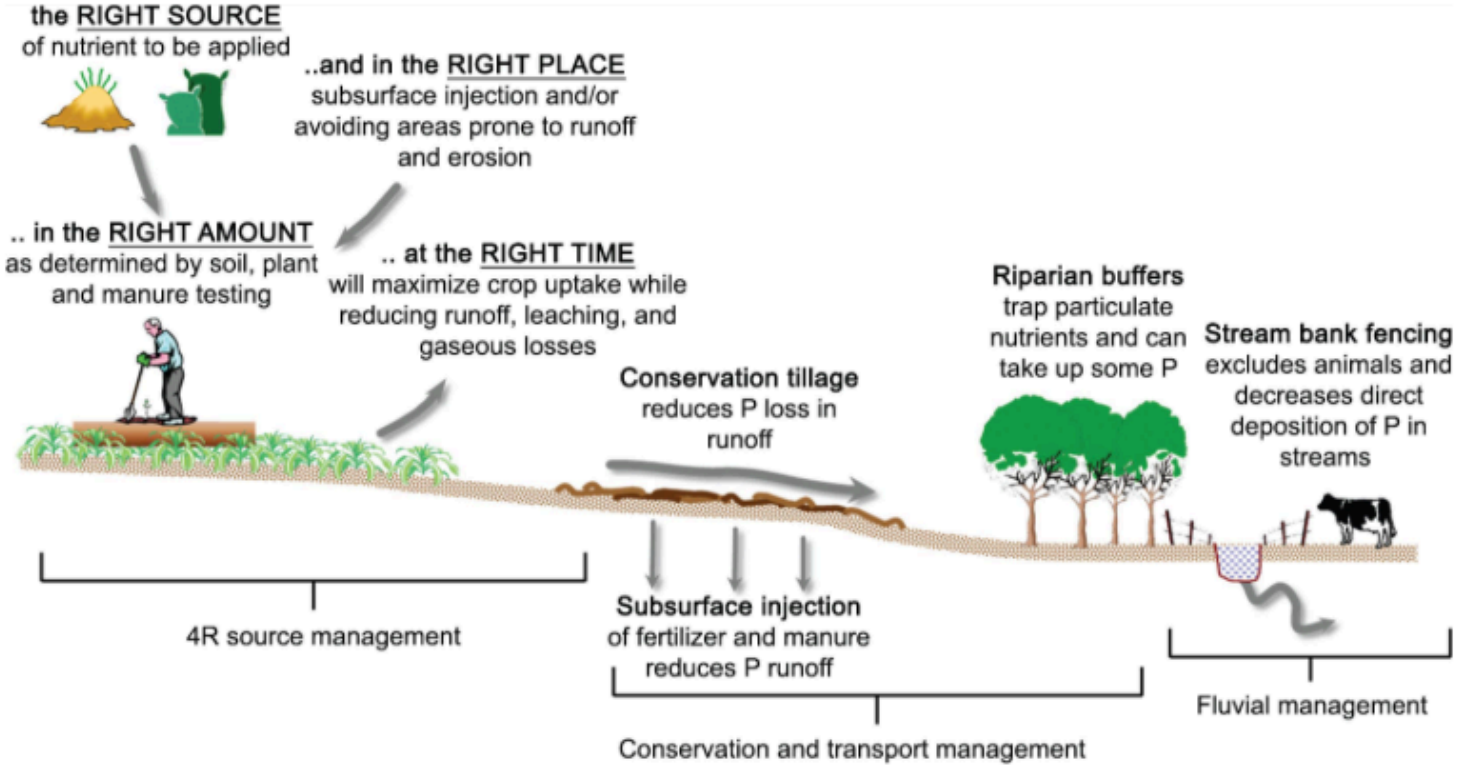
Use conceptual diagrams



https://www.google.com.au/search?q=river+cross+section+diagram&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiPo5GphtbSAhVHO7wKHXRrBr0Q_AUIBigB&biw=1297&bih=1252#tbm=isch&q=river+and+riparian+zone&*&imgrc=ZGDmHnuSciiKxM

Impact of agriculture

See NZ example.



http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-90162016000100001

Link to sustainable biomes topic

DROUGHTS & FLOODS

When there is too much or too little water, rivers suffer the consequences.

Today we are frequently taken aback at how frequently droughts and floods occur in certain parts of the world.

A riverbed can carry only so much water and when there is too much it literally bursts its banks and floods the surrounding land.

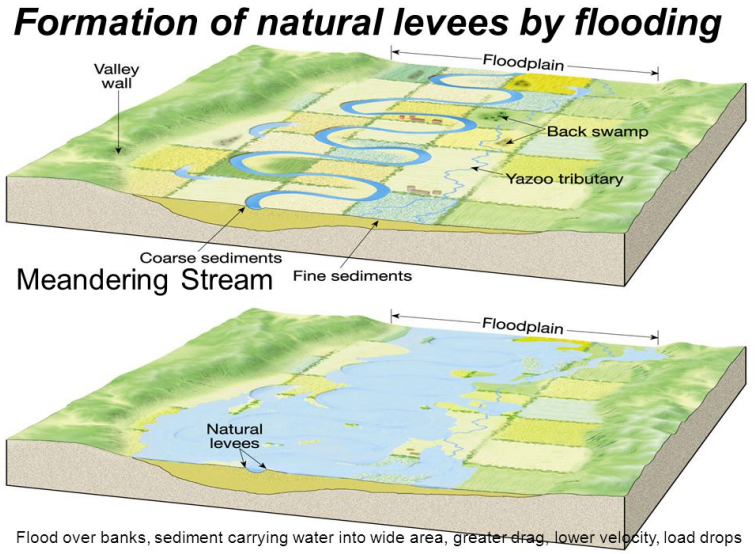
http://www.unesco.org/fileadmin/MULTIMEDIA/FIELD/Venice/pdf/special_events/bozza_scheda_DOW01_1.0.pdf

The importance of flooding

Floods transfer water, sediment, nutrients such as Nitrogen and organic matter (leaves, bark) between rivers and floodplain environments including wetlands, swamps and old river channels (billabongs). Each year Europe's rivers deposit an estimated 250 tonnes of sediment and 96 tonnes of fine organic matter per hectare onto floodplains.

Floods renew alluvial soils and nourish rivers, stimulating terrestrial and aquatic plant growth and wildlife breeding cycles.

Many native species use high flow and flood events to migrate between habitats. Golden Perch in the Murray River migrate as far as 1000 kilometres upstream to spawn and the Red Emperor fish on Great Barrier Reef begins its life cycle in Queensland's rivers.



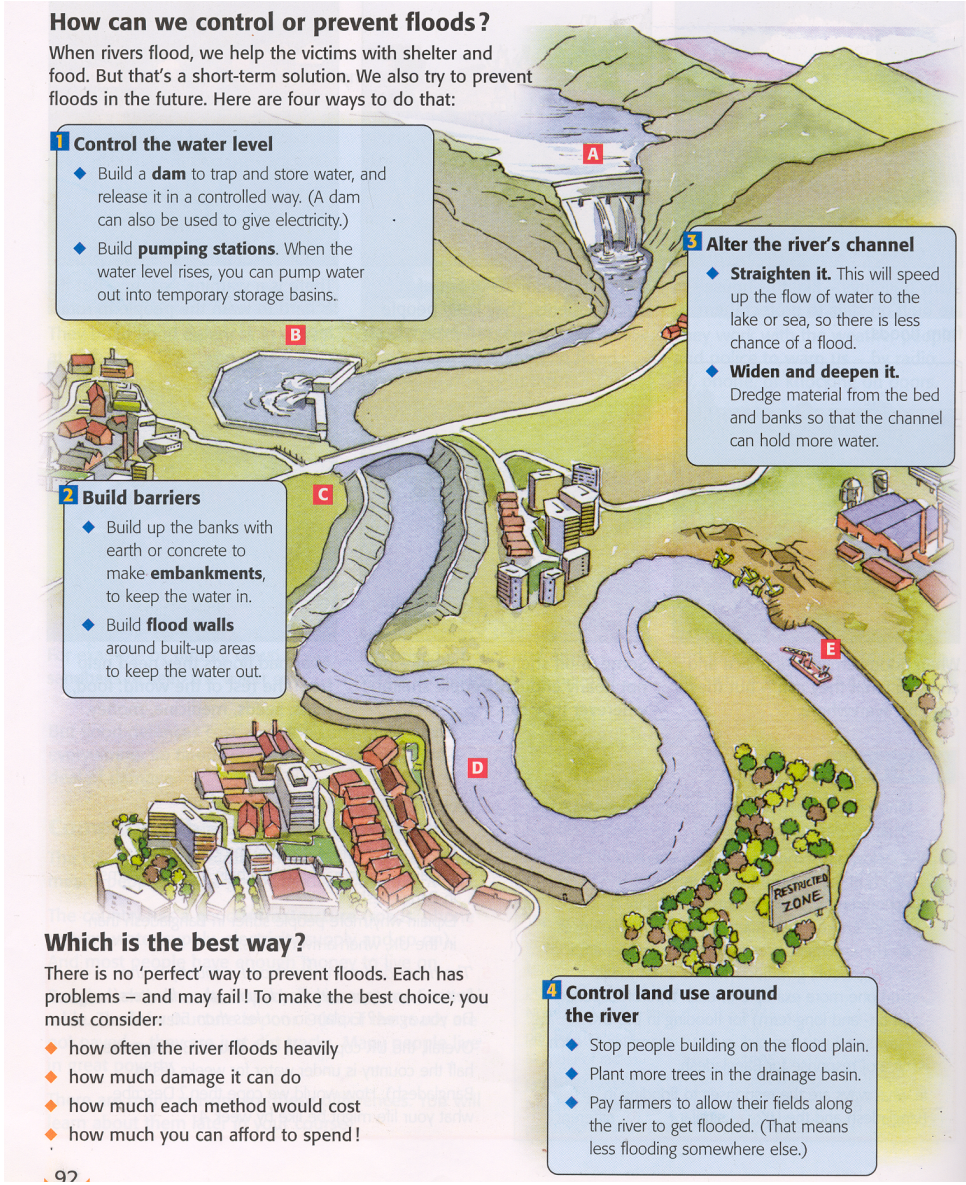
National Geographic slideshow on Floodplains http://www.nationalgeographic.org/encyclopedia/flood-plain/

FLOOD MANAGEMENT HARD & SOFT OPTIONS

"Managing development of flood plains is a critical responsibility for regional and urban planners. The benefits of flood plains, including prime agricultural land and desirable housing locations, must be balanced with the personal and economic threats posed by floods."

National Geographic
http://www.nationalgeographic.org/encyclopedia/flood-plain/

https://thegeographyofblackwoodgcse.wikispaces.com/The+Flooding+of+Bewdley

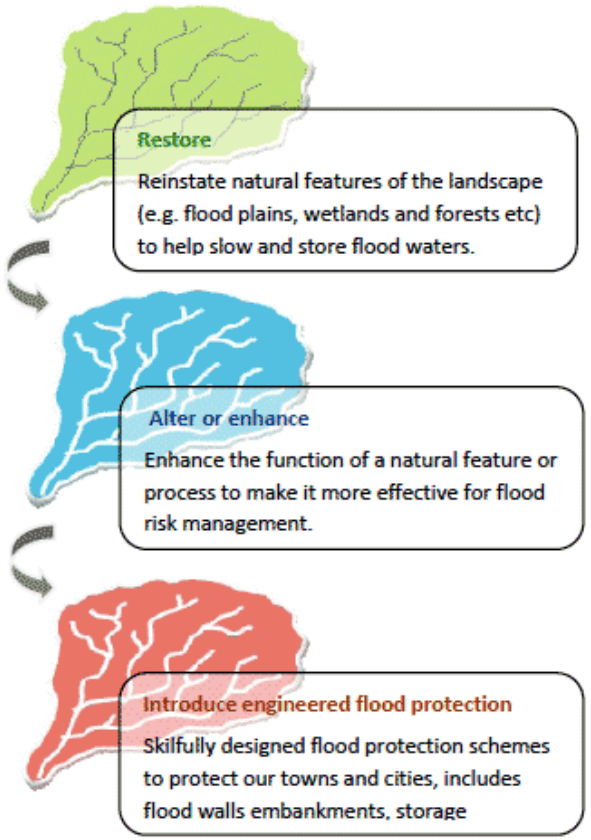


NEW APPROACHES

http://www.anforme.co.uk/images/products/zoom/1284652220-90429000.jpg

Where does ROOM FOR THE RIVER FIT?

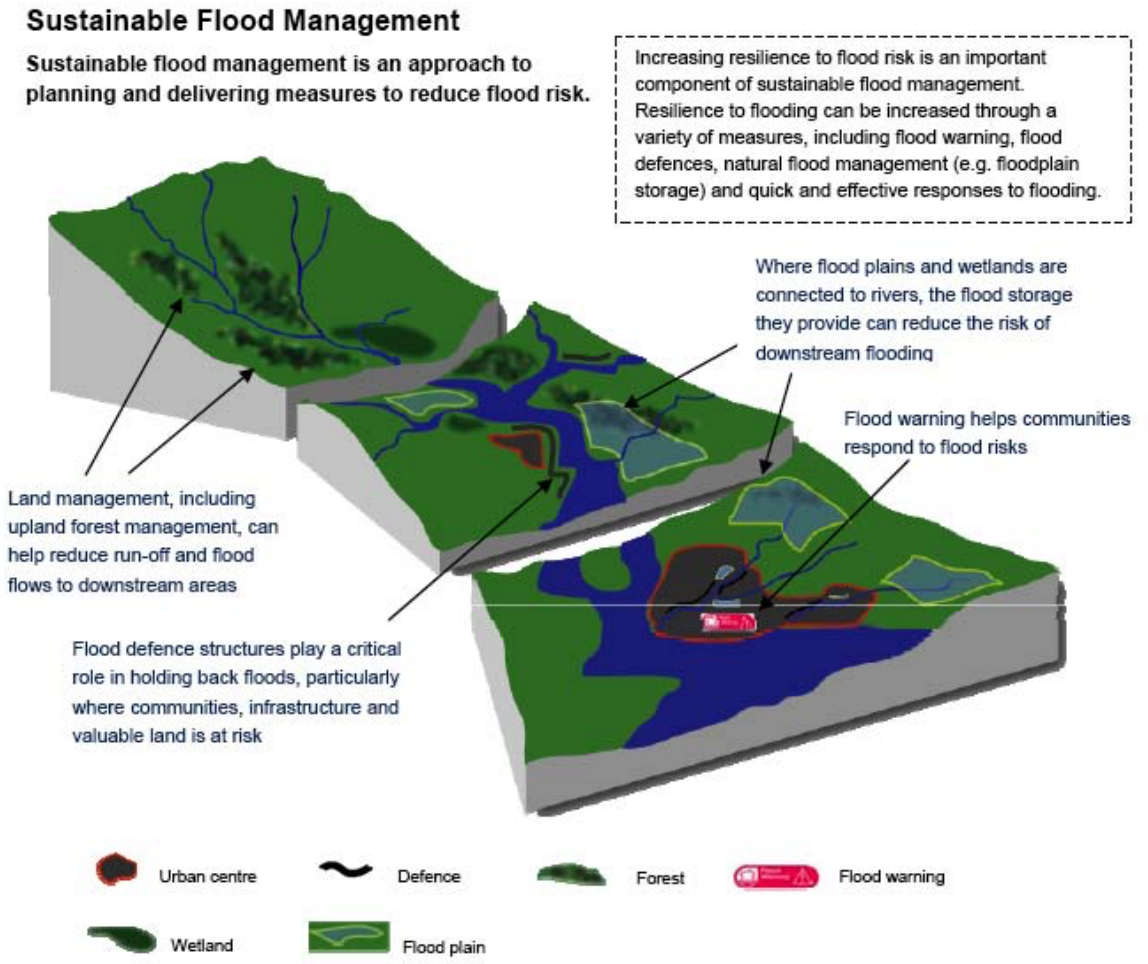
What options are used in Australia?



http://www.gov.scot/Publications/2011/06/15150211/9

REMEMBER

Protect,
Reconnect,
Restore
Sustain

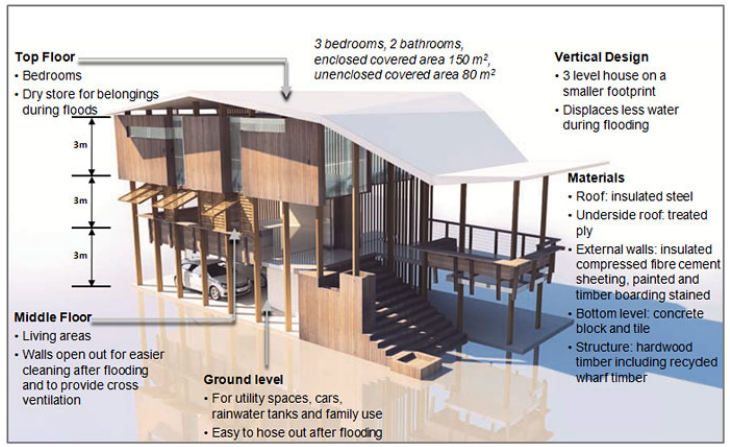


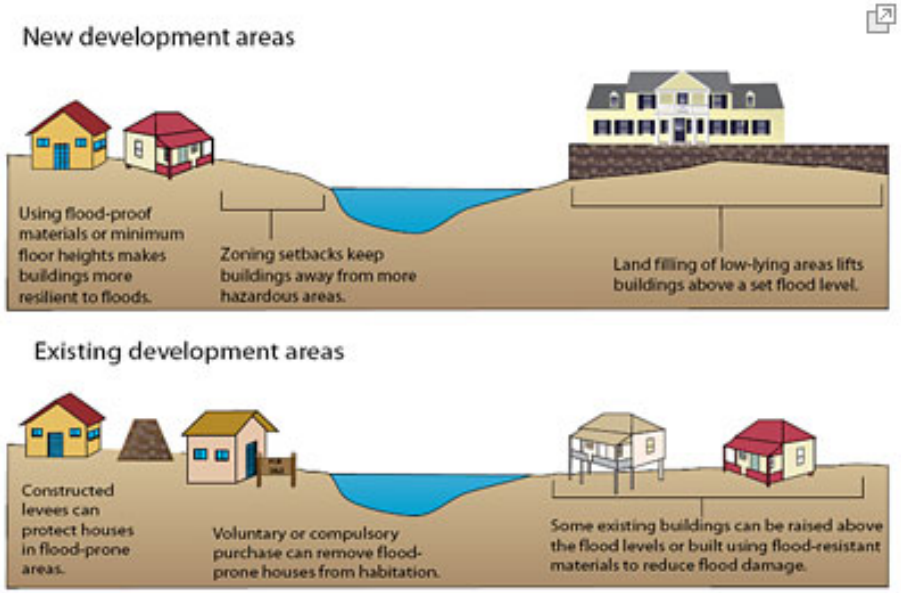
http://www.gov.scot/Publications/2011/06/15150211/9

LANDUSE PLANNING & DESIGN

http://www.wstuk.com/surveys-data-management

http://www.chiefscientist.qld.gov.au/publications/understanding-floods/managing-flood-risks

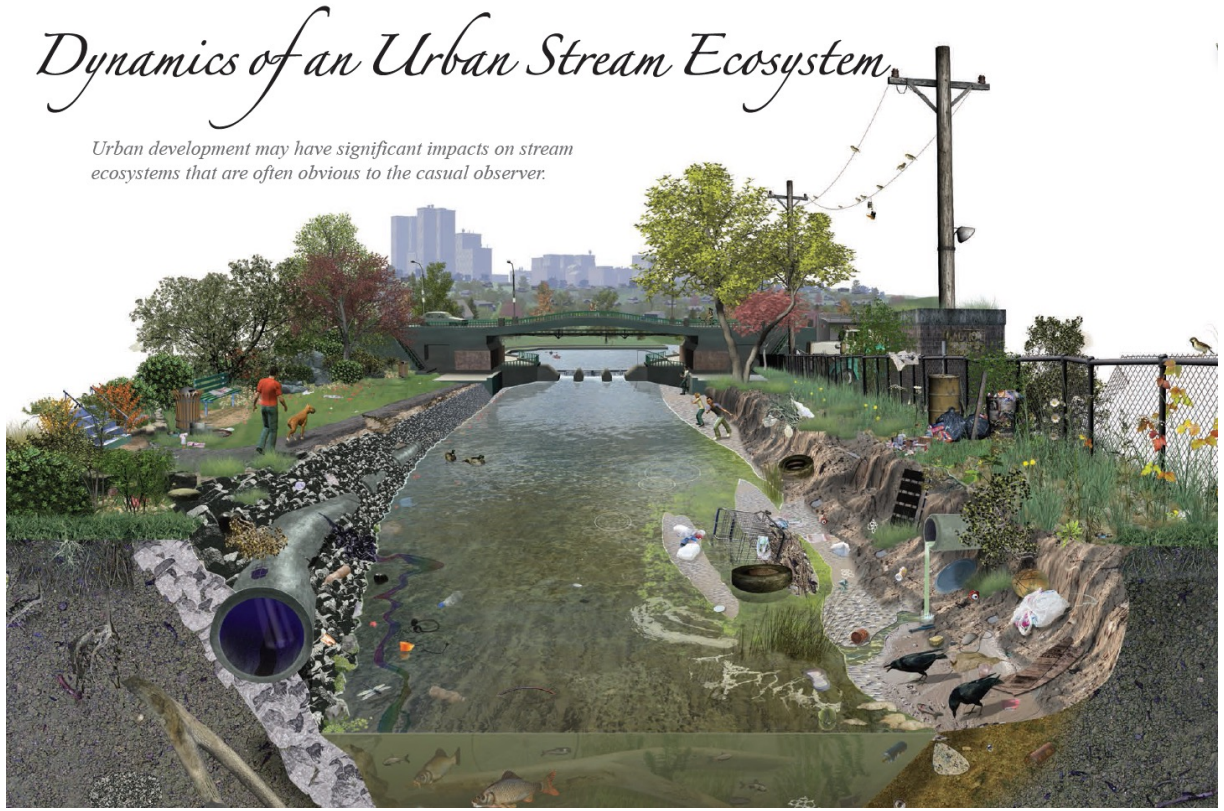




Pollution

“In natural freshwater environments water quality is maintained through environmental processes. Nutrients are recycled through food chains and sediments filtered and diluted by vegetation and natural flows. Aquatic species are adapted to cyclical changes in water flows, food supplies and temperatures and can adapt to natural events such as droughts.”

SOURCE: Macmillan GeoWorld 10 NSW Chapter 5. Inland water



https://water.usgs.gov/nawqa/ecology/pubs/cir-1391/images/NaturalStream.pdf

5 minute video

Impacts of urbanisation on stream ecosystems

"Part one of a three part series on how development can have negative effects on streams in urban and suburban areas. As a watershed becomes covered with pavement, sidewalks, and other types of urban land cover, stream organisms are confronted with an increased volume of storm water runoff, increased exposure to fertilizers and pesticides, and dramatic changes in physical living spaces within the stream itself."

https://www.usgs.gov/media/videos/effects-urbanization-stream-ecosystems-extended-part-i-introduction

The healthy condition of the physical living space in a natural stream—defined by unaltered hydrology (streamflow), high diversity of habitat features, and natural water chemistry—supports diverse biological communities with aquatic species that are sensitive to disturbances.

In a highly degraded urban stream, the poor condition of the physical living space—streambank and tree root damage from altered hydrology, low diversity of habitat, and inputs of chemical contaminants—contributes to biological communities with low diversity and high tolerance to disturbance.

https://pubs.usgs.gov/gip/143/pdf/GIP143.pdf

PRINT THIS POSTER AS AN A3 SIZED PLACEMAT RESOURCE

https://pubs.usgs.gov/gip/143/pdf/GIP143.pdf

Drivers of change to water quality

Pollution, land (habitat) clearing, water extraction, invasive species and climate change contribute to declining freshwater quality.

Cultural eutrophication – increased nutrient loads (Nitrates, Phosphates) from industrial waste, agricultural run-off and human waste cause algal blooms that block light, deplete oxygen levels and create dead zones.

Bioaccumulation –toxic substances build up in food chains impacting on aquatic organisms and human health.

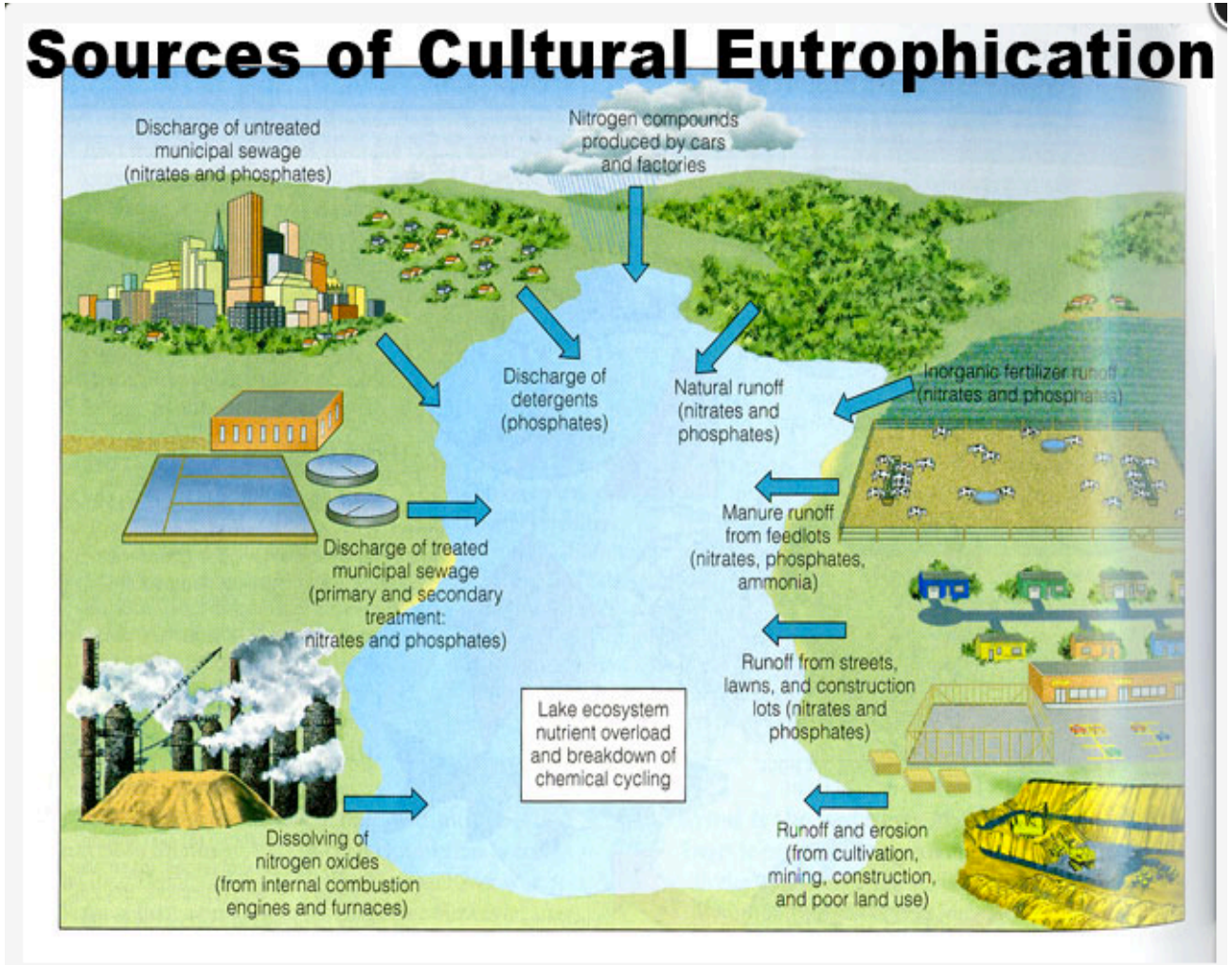
Turbidity –suspended sediment comes from increased erosion and invasive species such as Asian Carp blocks light and suffocates aquatic organisms.

Water extraction increases nutrient concentrations and temperatures

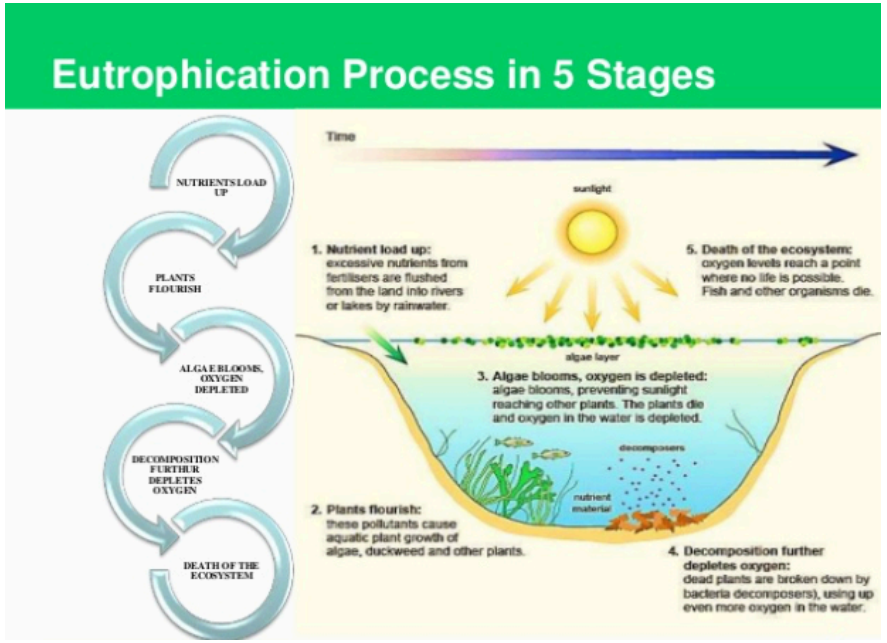
Acidification: air pollutants such as Sulphur Dioxide dissolve in waterways increases pH (acidity) to levels lethal killing aquatic species.

Infiltration of chemicals and nutrients degrades groundwater sources

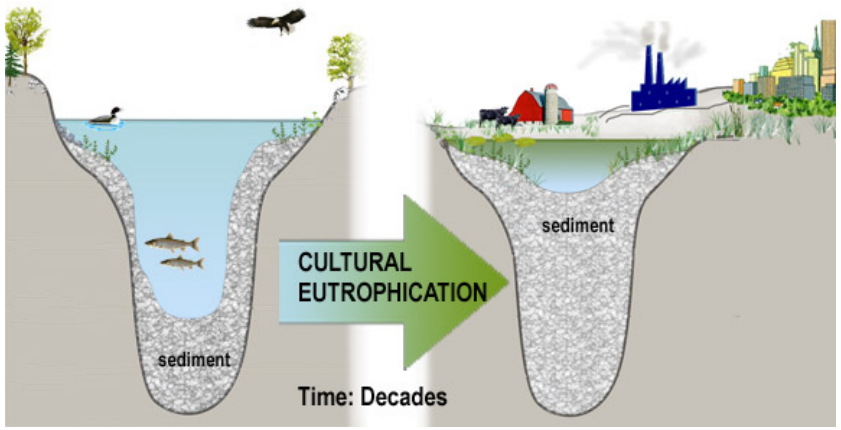
IMPORTANT CONCEPTS
Deep understanding



http://www.econatics.co.za/?page_id=750



https://www.slideshare.net/PanthoSarker/eutrophication-it



https://creeklife.com/blog/cultural-eutrophication

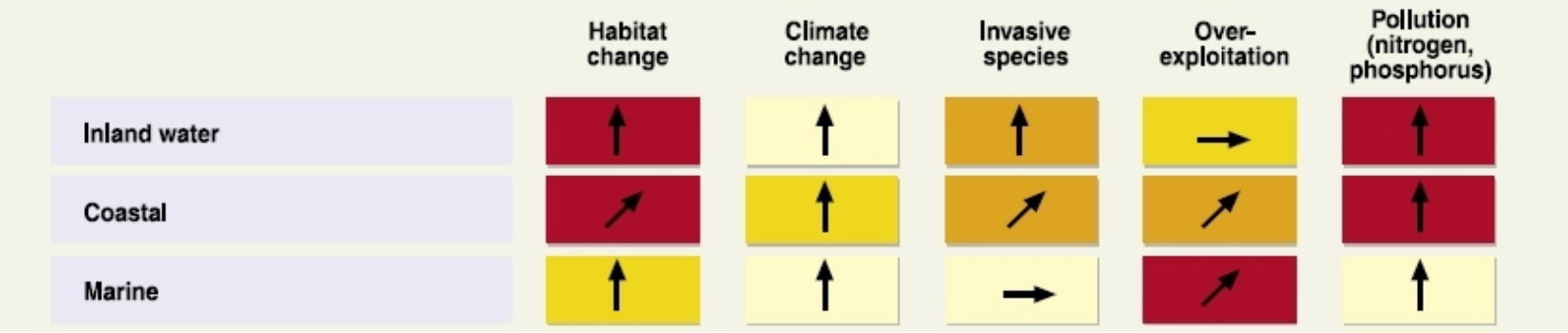
Industrial waste

“Industrialisation, commercial agriculture and urbanisation put pressure on freshwater environments in developed countries. In the USA the Mississippi River transports over 1.5 million tonnes of nitrogen from farmlands in 31 states causing algal blooms and a dead zone in the Gulf of Mexico.

In Italy, Europe’s most polluted river the Sarno suffers pollution from industrial waste from over 1200 illegal toxic waste dumping sites. Highly developed waterways in Europe such as the Danube have poor water quality”.

Source Macmillan GeoWorld 10 NSW Chapter 5

Drivers of change and trends to inland water



World Resources Institute

Macmillan GeoWorld 10 Chapter 5

River restoration

Broadly speaking river restoration is deemed necessary or worthwhile where there is a legacy of human river modification.

This modification could be direct such as dredging, or indirect such as agricultural practices increasing sediment delivery, but generally the river in question has been altered in some way from its “pre-human” state.

Previous river modification may have altered the processes within the river such that the way the river looks, behaves, or functions is not meeting societal expectations (e.g. local people, river uses, legislators, etc).

https://therivermanagementblog.wordpress.com/2013/07/03/what-is-river-restoration/

ROLE OF TECHNOLOGY IN RIVERINE MANAGEMENT

Satellites (GIS)

Flood risk maps

Drones

Water quality Monitoring stations

Innovations e.g. robotic fish

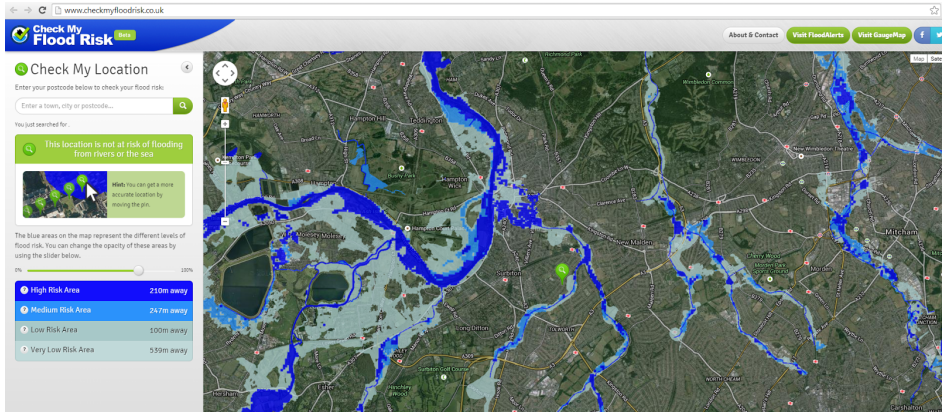
Artificial wetlands

Fish ladders

1. Robotic fish: Life-like creatures, move like real fish, have chemical sensors to find pollutants, swim independently around water bodies and automatically return when batteries need recharging

2. Floating islands: Manmade biomimic floating islands made create a "concentrated" wetland effect and a natural habitat for birds. Dense fibers and a porous texture encourage microbes – biofilm- cleaning the water and turning nutrients into fish food.

Examples from Macmillan GeoWorld 10 NSW Chapter 5



http://mapperz.blogspot.com.au/2015/01/check-my-flood-risk-map.html

New Zealand

http://www.doc.govt.nz/about-us/statutory-and-advisory-bodies/nz-conservation-authority/publications/protecting-new-zealands-rivers/02-state-of-our-rivers/river-physical-processes-and-functioning/

“Effective river management requires a holistic view of the river system, including its geology, fluvial morphology, sediment transport, biological habitat, riparian conditions, flow regime, and water quality.

Rivers are linear systems connecting headwater areas to the coast. This connectivity allows the movement of organisms, energy and matter throughout the catchment system.

Human activities can change and disrupt this system and affect river functioning:

Land disturbance in a catchment, such as cultivation, vegetation removal, and the introduction of browsing animals, can accelerate soil erosion and increase rivers’ sediment load.”

Go to Part 2 : Resources

TEXTBOOKS

Macmillan GeoWorld10 NSW Chapter 5 (Comparative: USA, Netherlands, China) pp134-160

Jacaranda GeoActive 2 Chapter 214 Inland Water pp 294-322 (Comparative : Dams)

Pearson Geography Stage 5 Chapter 11 pp. 274-302 (Comparative s : Groundwater Great Artesian Basin / Pangani River Basin)

Cambridge Stage 5 Online Chapter Inland water

Oxford Insight Stage 5 Chapter 6 pages pp 230 – 237

http://www.newshub.co.nz/home/new-zealand/2017/02/special-report-how-polluted-are-new-zealand-s-rivers.html