Let there be water...
A lifetime study by an Upper Hunter Farmer

Last November a disparate group crowded around a large table at Tarwyn Park farm in the Bylong Valley in the Upper Hunter. There hadn't been any rain for quite some time, Australia was enduring one of the worst droughts it had experienced in a hundred years, and yet, through the window, the group could see nothing but lush pastures. Difficult to believe, for

most of them had driven a long way and had seen the devastation caused by the drought, semi deserted paddocks, empty dams and cattle depending on imported feed. Indeed, the surrounding country looked so bare that the contrast was all the more impacting. The group had come to Tarwyn Park to listen to a visionary farmer who had for years been arguing in favour of dismantling flood control works and reestablishing landscape ecostructure. The group around the table, which Peter Andrews had invited to see what he had achieved, included amongst others, the Deputy Prime Minister, John Anderson, Gerry Harvey the successful retailer, representatives from the CSIRO, the University of Sydney and ATSIC. It is worth noting that the Sydney Morning Herald tells us that ten years ago the CSIRO produced a positive report on Peter Andrew's methods but that nothing further came of it.

Peter, who has toiled in obscurity for twenty years spreading his message, says that we are already in the midst of an unfolding ecological disaster that if unchecked will not only erode our river systems by sweeping away our topsoil, generating extensive salinity problems, exacerbating the effect of droughts, as we have recently seen, but also directly threaten the productivity of the land, and the supply of produce to the marketplace.

Peter believes in the natural way, the natural sequence. This leads to the greatest biodiversity, he says, because nature is constantly looking to achieve its own balance. This is particularly relevant in our dry continent where we should be making the most of our water resources, employing them judiciously, instead of letting them slip out into the ocean.

And the best way to do this is by letting nature provide the retention mechanisms to keep the water on the land. It has been demonstrated, he says, that watershed catchments can provide reliable and sustainable water supplies, even in a dry continent such as ours. You have to, however, ensure that the health of the natural network linking the different elements of the catchment, such as aquifers, river banks, wetlands habitats, and others, are maintained. Vegetation retention is of prime importance.

Peter Andrews has achieved a lot at Tarwyn Park and he would like to see the process replicated on a giant scale across the whole of Australia, following the above principles.

A paradigm shift

What Peter Andrews proposes is in fact a complete paradigm shift; he wants to revert the whole hydrological network to pre-European times. Instead of creating incisions in the landscape, such as deeper rivers and irrigation channels, instead of artificially manipulating the landscape, he says, we should be regenerating the remarkable hydrology to move water that Australia had developed over thousands of years before the arrival of white man. When there was hardly a river running to the sea in the whole of the continent, except in years of high rainfall when all the natural reservoirs in the landscape began to overflow. Where the water ran into the plains from the river, not the current system of drainage that empties the plains into the river.

Australia had floodplains defined by slow running meandering rivers and countless billabongs with easily flooded banks, almost flush with the countryside, where water flow was captured by filtration zones that kept the sediment on the landscape and created a gradually built up plain. "During floods, fresh water would flow to the plains, soaking into the soil. In the pre-European period, during a drought, most of the water that is now depleted by evaporation used to be perched, sitting above the system, in narrow wetlands which actually served as steps, and which allowed the water to fall about a metre at a time. The system produced clay beds which stored huge amounts of water. It just stayed there, between one and

two metres from the surface, like a lateral dam."

A report by the explorer Charles Sturt tends to support Peter's vision. He wrote, in the 1820's, of coming upon beds of river grass 12 feet high and extending for 50 miles in places in the Murray Darling basin. "These are not rivers as we know them in England," he said, "they appear to be a series of channels joining the wetland areas." And in reference to slow meandering rivers, Joseph Cross measured the distance of the Hunter River between Maitland and Morpeth in 1828 as 27 kilometres. The same river distance today is only 9 kms. By straightening out water systems we have speeded them up, creating an irresistible erosive force.

Peter Andrews recently visited the Maitland area invited by the Hunter Biodynamic Group and gave them an overview of his project. He started by saying that he liked to speak about natural sequence, or perhaps, natural sequence farming. The reason why the term was picked was that despite Australia being one of the driest continents, it achieved in those conditions the greatest biodiversity, placing it in a unique category world wide. The reason it was able to do this was because it had created within the landscape the most efficient use of watering facilities. We had river estuaries free of sediment, he said, in fact, there was a custom house at Bourke, which tells us that the rivers were totally different then; today they are full of sediments. One of the reasons for this change is that we copied the European model, where the hotter and drier it gets the more the snow and the glaciers melt, filling the rivers with water. What happens though, when it gets hotter and drier, and there is no similar water source? How did the Australian environment survive? How did it manage to become the most biodiverse in the world and how did it look after the rivers and keep them free of sediment?

The original settlers did not ask those questions, they simply adopted European solutions; look at the devastation this false step has created, he said.

"As our rivers created a series of inland wetlands which acted as filtration zones that allowed the sediments to be retained in the landscape, they efficiently managed the return side of the cycle. It's vitally important to realise that the natural cycles that bring fertility from the sea to the highest point in the landscape have an opposite or downside component, as with all processes within the environment. What we've never done is factor this downside function into our regular management plans. Now, every time it rains, many vital nutrients are leached into the deeper soil or into the river system, and I don't see too many examples of people that have actually managed that process. The natural sequence is about identifying how that function matters and how we can make it work as it used to."

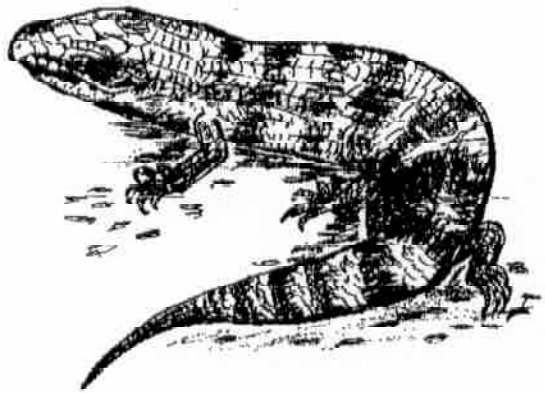
Restored flood plain
photo by David Mason-Jones

When we look at river systems and go back into a catchment, there are a series of live sponges on the top of the catchment which fill up very quickly in the storm cycle and then trickle feed the rest of the river system, replicating what the snow melt does in Europe. It is triggered by every rain event, requiring the biodiversity to compensate for the extremes of the situation. In Europe you have a thaw depending pretty much on the hours of sunlight. The plants at the lower end of the system, at the bottom of the valley, are really active by the time the thaw is higher up in the hills. So, the nutrient retention in the surface layer is very efficient under those conditions. What we have to recognise is that when the process is just treated by a rain event and the plants are depleted, there is a massive loss of nutrient into the subsoil and to the sea - and we've been experiencing that very severely during these last three or four years. Also, it's happened in a number of cycles during the last fifty years.

The indications are that salinity results from the lack of natural balance - we talk about a whole series of processes involved in salinity. We talk about lowering th water table to stop salt rising, for example. "I never heard of this happening," says Peter. If you war to test this put some salt water in the bottom of a glass and fresh water and some dye in the top, separated by some gladwrap. Pierc the membrane and you will see tha the salt water stays at the bottom and the fresh water on top. That's fundamentally how it works in Australia. We had this water landscape in the biological layer, h points out, which accumulated the salt that comes in every time it rains, in the sub-soil. Then we had the floodplain river systems which were like grass covered dams and storage areas of fresh water. Without considering this magnificently efficient system, we just started shifting water around and doing all sorts of things with it and now wonder why the salt that was once stable in the landscape is ending up in the rivers.

Peter Andrews wants to return irrigation to the natural flood plain set before the European disruption. The only managers we can rely on, he says, are the people living on th land, the farmers. They should be rewarded for environmental management, rather than subsidisir production. The Wentworth Group agrees; they are a group of leading environmental scientists who have formed a task force to mobilise a

national response to a landscape crisis of salt, dust, drought, silt, algae and erosion. Last November the Group issued Blueprint for a Living Nation, a paper raising the alarm on the state of the Australian environment. It states that the land practices of the last 200 years have left a landscape in which freshwater rivers are choking with sand, where topsoil is being blown to the Tasman Sea, where salt is destroying rivers and the landscape like a cancer, and where many of the native plants and animals are heading for extinction. Our continent, they warn, is slowly falling apart. They issued five major recommendations:



Blue-Tongue Lizard.

1. Clarify water property rights.
2. Restore environmental flows to stressed rivers.
3. Immediately end broadscale land clearing of remnant native vegetation.
4. Pay farmers for environment services.
5. Incorporate fibre, water and hidden subsidies currently borne by the environment into the cost of food.

The Wentworth Group advises the Federal Government on soil and water depletion. John Williams, the head of the CSIRO's Land and Water Division, and Tim Flannery, the director of the South Australian Museum and author of The Future Eaters are members of this group. Tim Flannery observed that the nation has set a new direction on the issues of soil and water management, although they still have not realised the gravity of the fire situation. There is a huge amount of inertia built into the system, he added.

As expected, not everyone agrees with Andrew's views although there is a general awareness that changes have to be made to retain a sustainable agriculture. "A reversion of the Australia that has been created in the past 200 years cannot provide us with a quality of life we want" says Alan Moran, an economist, director of the Deregulation Unit at the Institute of Public Affairs, in the latest IPA review. "The Wentworth group offers us little useful guidance for the future, it harks back to an Arcadian Australia in the 45,000 years before European settlement" he adds, though he does admit that there are problems in the agricultural sector. He does not, however, provide any concrete alternative remedies to deal with those problems. This is not difficult to understand, the root of the problem is, that dealing with conservation, biodiversity or sustainability issues is incredibly difficult. It affects numverous interest groups and idividuals.

Yet treating biodiversity as a market commodity is not the solution. Actors in the market are impatient. They have a hard time reconciling long term issues (global warming, AIDS pandemic, resource scarcity) with their daily bottomline foci.

Eds

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Catchment Habitants and Landscape Ecosystems

Haikai Tane
Director - Centre for Catchment Ecology
Watershed Systems Ltd.
Waitaki Basin

Overview: Haikai Tane's paper deals, primarily, with watershed catchments. The function of these catchments is to act as natural suppliers of fresh reliable water to the surrounding environment. In the driest continent on earth, this function becomes critical. Haikai is Adjunct Professor in Landscape Ecology for the Chinese Academy of Sciences and previously Adjunct Professor of Sustainable Development at the Unitec Institute of Technology in Auckland. His expertise researching and developing geospatial[1] systems for watershed catchments has attracted international recognition and awards. He has been directly involved in a research and development program with Peter Andrews at Tarwyn Park in the Upper Hunter as well as in many other projects in both Australia, New Zealand, China, Canada, USA and India. He has strong opinions on what organics is all about: for him it is like surfing nature - a system of sustainable development based on cultural intelligence, like Tao (China), Watora (Maori) or Dreaming (Koori).
What follows are excerpts of Haikai's paper on Catchment Habitats and Landscape Ecosystems. Due to its technical nature and use of terms probably new to some readers a glossary has been provided (pps 24,25). Haikai explains that, provided the natural networks interconnecting near surface aquifers with riparian[2] habitats and floodplain ecosystems[4] are functioning and maintained, a reliable supply of water is assured.
The results of recent riparian research and development in Australia and New Zealand indicate that natural hydraulic processes linked to catchment habitats and landscape ecosystems control critical land and water relationships in watershed catchments. Natural networks linking habitats and ecosystems in functional ways are called ecostructures[4]. These were well known in traditional Pacific and

Aboriginal cultures, from long experience. In science, however, they are a new discovery. Mapping and modelling watershed catchments, using specialised technologies like three dimensional digital photography, were instrumental in identifying key catchment habitats, watershed ecosystems and their connecting networks or ecostructures.
Haikai notes that you may wonder why he uses both watershed and catchment terms. Watershed is an ecostructure term referring to natural river basins that store, filter and supply living (clean, fresh) water. Catchment is an infrastructure term from engineering and planning that is dominated by the plumbing and drainage view of supplying raw, usually polluted, water.

Watershed perspectives

Water is life according to ancient wisdom. Yet in the industrial societies of the western world, the very watershed processes and catchment ecosystems relied upon to replenish aquifers, streams and rivers, are degraded and dysfunctional. Clean fresh water has become polluted, raw water.

In industrial societies conventional attitudes and perspectives towards watersheds are governed by the plumbing and drainage paradigm. References to the role of biophysical[3] processes, riparian habitats and catchment ecosystems are conspicuous by their superficiality. Polluted waters and gullied farms are now so common in Australian watershed catchments, they have become part of the landscape iconography. Many people and communities now see them as natural, normal conditions. In these unquestioning attitudes and perceptions towards current catchment habitats and ecosystems lies the dilemma. At odds ecologically, and alienated culturally from the environment they inhabit, the dominant Anglo/US industrial societies of Australia and New Zealand are unable to see that they are destroying the integrity of their watershed catchments, while spending millions of dollars annually treating the symptoms of degradation.

The Editors would very much like to hear what you think of this Special Edition of Hunter Organics. Let us have your thoughts, comments or suggestions

Catchment Habitats

Catchment Habitats constitute the unique building blocks of landscape ecosystems. They are natural geographic units with unique patterns and ecological processes. Catchment habitats are identified by their characteristic topological[10] signatures and described by their physical structure as well as by their function. A floodplain bog-flush swale habitat for example, implies both physical structure and biophysical performance. It is worthy of note that catchment audits in Australia show that the performance of riparian habitats depends largely on the integrity of the landscape ecological structures.

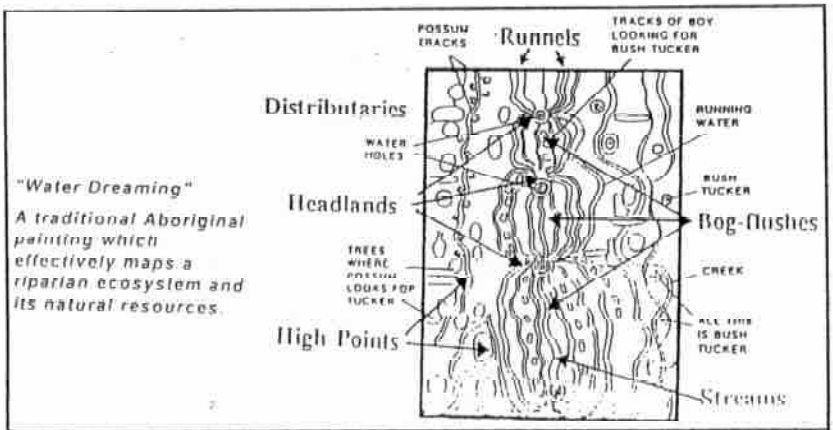
By industrial logic, catchment habitats have become economic resources whose integral parts are valued separately in the market place. These separate parts are licensed and sold off like individual products: soil, water, minerals, vegetation, animals and sites. Instead of integrated resource management, industrial society in Australia has achieved ecological disintegration of watershed catchments.

This is well known since it was realised that soil erosion, water pollution and landscape degradation are related to land use and other cultural activities. Aldo Leopold, a wildlife ecologist, speaks of "soils and landscapes that are sustained by circuits. When change occurs in one part of the circuit, many other parts must adjust themselves to it. Evolution is a series of self induced changes, the net result of which has been to elaborate the flow and lengthen the circuit". These circuits linking sites, habitats and ecosystems, are environmental infrastructure network systems called landscape ecostructures. They are complex networks connecting land and water systems both above and below the landscape.

Finding watershed catchments with intact and healthy ecostructures is a challenge. Diagnosing the underlying causes of catchment degradation is even more so. The main methods used include geospatial[1] mapping and modelling using remote sensing with other established methods. Ecography, an integrated landscape assessment method of mapping habitats and modelling landscape ecosystems, is now integral to the modern science of landscape ecology[4].

Landscape ecosystems

The connectivity and special patterns of catchment habitats help create landscape ecosystems. They are multidimensional living geographic units



Ecography of Australian Natural River Sequence from Haikai 1999, derived from sketches by Peter Andrews

adapting and evolving over time in response to environmental influences, including human settlement. Their role and function within stream catchments depends on linkages between sites, habitats and land use activities. Their sustainability depends on the status and condition of the natural environmental networks, that is, the watershed ecostructures.

The mapping of landscape ecosystems requires yet another level of integration through progressive ecological synthesis, one that includes the infrastructure and the land use activities of human settlement. In other words, shifting from catchment habitats to landscape ecosystems involves integration through geospatial systems. Usually, though not necessarily, this takes place in a geographically informed system (GIS).

Bylong Creek Case Study

There is an interesting discovery of profound importance to integrated catchment planning and management behind this methodology. It makes an interesting story, one that builds on the landmark results of a Banker's Trust privately funded R&D program initiated by a visionary farmer at Tarwyn Park in the Bylong Valley in the Upper Hunter in NSW. The name of this farmer, conservationist and self taught hydrologist is Peter Andrews (see separate article: "Let There be Water").

The Tarwyn Park R&D project investigated the nature, flows and storage capacities of flood plain aquifers and their recharge cycles through natural sequences of flooding. Hydrogeological[5] investigations were linked to soil and vegetation surveys, catchment habitat mapping and land use systems.

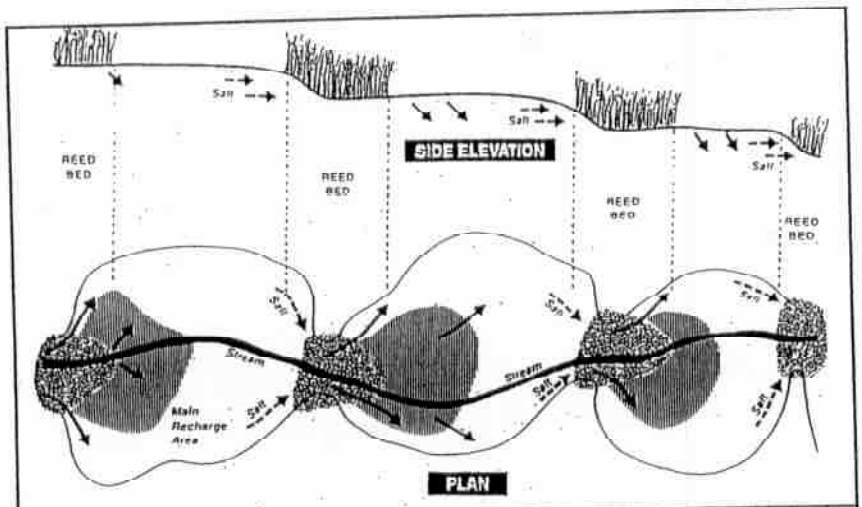
In the 1970's soil erosion, salinity and serious gullying characterised Bylong Valley at Tarwyn Park. Bylong Creek was deeply entrenched, ephemeral and prone to damaging floods and debris. Farming became unprofitable and Tarwyn Park, an historic thoroughbred horse stud, went into liquidation. Before the introduction of environmental engineering programs that dismantled flood control works and re-established landscape ecostructure, the Tarwyn Park floodplain was in a serious state of degradation.

The distinct roles and functions of the catchment habitats and landscape ecosystems in the floodplain were restored through adaptive strategies that simulated natural seasonal flooding, notably stalling and storing floodwaters through induced recharge. Suites of seepage weirs and infusion swales discouraged accelerated runoff and flood drainage.

The floodplain at Tarwyn Park was restored from a water-drainage dominated system with a low water table and annual water deficit, to a floodwater-storage system with high water tables and annual water surplus.

In addition, upward and lateral aquifer pressure at discharge sites, generally located above natural headlands on the floodplain, helped ensure positive movement of groundwaters and near surface aquifers, maintaining their freshness while preventing water logging problems normally associated with stagnant waters. The performance of the dryland pastures under these conditions is similar to bog-flush meadows, rich in species and productive throughout the dry summer season. Given that Tarwyn Park is in a low rainfall zone prone to soil and water degradation, it came as a surprise to those involved in the project, that the restoration of the floodplain habitats and landscape ecosystems corrected the land degradation problems and converted Bylong Creek into a perennial stream. Essentially, the restoration strategy was based on re-establishing floodplain habitats and landscape ecosystems, and letting natural

Male frogs exposed to even very low doses of atrazine (used to control weeds in forestry, horticulture, the grain and cotton industry) can develop multiple sex organs, sometimes both male and female, researchers in California have discovered. Doses as small as 0.1 part per billion were found to affect the frogs. As the dose increased as many as 20% of frogs exposed during their early development produced multiple sex organs and many had small, feminised larynxes. Those males exposed after reaching maturity had a decrease in testosterone levels equivalent to that found in females. The team concluded that the effect, results from atrazine causing cells to produce the enzyme aromatase which is present in vertebrates and converts the male hormone testosterone to the female hormone oestrogen. The study involved exposure at levels more than 600 times lower than the dose that has been seen to induce aromatase production in human cells. Atrazine is the most commonly-found pesticide in groundwater throughout Australia.
The Living Soil June/July 2002



Hydrography of Australian Natural River Sequence from Haikai 1999, derived from sketches by Peter Andrews

processes rebuild landscape ecostructures.

Landscape Ecostructures

Landscape Ecostructures are natural networks of habitats and ecosystems. As was mentioned before, they are natural phenomena recognised by Aboriginal and Pacific cultures for millennia. Industrial science has recently discovered their existence and has yet to fathom their full meaning. In the Pacific region, serpent mythologies, paintings and sculptures are commonly used to describe landscape ecostructures.

Among the Polynesians and Melanesians, serpent spirits and demons living in the landscape are the diligent spiritual protectors guarding the integrity of the land and water systems. Aborigines use a combination of sand painting, song lines and ceremonial dance to represent habitats, ecosystems and their network ecostructures. One of these sand paintings showing floodplain ecography[11], including ecostructures, was immensely helpful in interpreting the results of the R&D project at Tarwyn Park.

The Upper Billabong Catchment

The scientific nature and role of landscape ecostructures is well illustrated, says the author, by a recent (1998) audit he undertook of the Upper Billabong catchment perched on the western slopes of the Great Dividing Range in southeast Australia. The catchment has been occupied for millennia by aborigines and settled by Europeans in the nineteenth century. The audit found that human activities transformed the normally aggrading[6] streams and floodplains in the Upper Billabong into actively eroding landscapes. In particular, accelerated runoff and soil drainage resulting from burning, grazing, poor resource management and depleted vegetative cover have seriously damaged ecostructures and catchment processes which manage the flows, yields and quality of water resources.

Confining drainage, channeling streams and clearing riparian areas of wetland vegetation has increased storm water velocities and flood flows. As a result, gullying, streambed and bank erosion are commonplace. The gullies rapidly drain surrounding landscapes, depleting their soils, drying out near surface aquifers and cracking confining clay bands. The soils have become surfaces and the resulting gullies have become in effect storm water and ground water drains.

Catchment ecology

The way landscape ecosystems operate in watershed catchments is usually determined culturally. In the watershed catchment of both the Billabong and Waitaki Basin, quaternary basins operating as natural aggradational[9] systems for millennia have been converted to degradational systems by cultural activities.

Healthy distributary river systems have braided floodplains with a rich tapestry of forest, woodlands, shrublands, bogs and flushes. Today the aquifers, discharge springs, surface streams and pools are only some of the myriad habitats that are now memories. Sand and gravel-choked floodplains and deep, unstable drainage channels are replacing them.

Conservation Myths

In industrial societies depending on scientific mythologies, catchment consciousness is lost when governments carve up the environment into separate administrative empires. Departmentalism is the antithesis of integrated catchment management. Connectivity of catchment ecosystems through landscape ecostructures are unknown or ignored, while drainage schemes imposed on degraded watershed ecosystems cleared of their forests and woodlands ensure fresh waves of gravel with each flood.

Comments: When it comes to contemporary society in Australia, the medium is the message. The medium is our evolving landscape and the message is not good. For deep gullies and gravel riverbeds everywhere are draining the lifeblood from our land. Our upland, watershed catchments and gravel riverbeds are an environmental mess with failing ecostructures. Environmental programs, regulatory controls and special grants are more often than not ad-hoc attempts at restoring damaged stream catchments.

Despite the numerous projects treating the symptoms of long term degradation of catchment habitats and landscapes it is clear that overall strategies are lacking or inadequate.

GLOSSARY OF TERMS

1. geo = word element meaning the earth; geospatial= earth space including water
2. riparian = relating to or situated on the bank of a river or other body of water
3. bio = living system, life, as in biology; biophysics = study of biological processes in terms of their underlying physical principles, physics as applied to biology
4. eco = from the Greek ecos meaning house or habitat is the prefix denoting ecology - ecology= a separate discipline that studies the interrelationships between organisms and their natural environment - ecosystem = an integrated system of habitats and their communities
5. hydrogeology = a synthesis of hydrology and geology concerned with the utilisation of surface and ground water and with the function of water in modifying the earth, especially by erosion and deposition - hydrology= the scientific study of terrestrial water, in particular inland water, before its discharge into the oceans or evaporation into the atmosphere,

6. aggrade = to fill with detrital material - build up by aggradation - opp to degrade

7. geophysics = relating to the physics of the earth, including hydrology, geodesy & others - geodesy - the science concerned with surveying and mapping the earth's surface

8. biophysics = the biology of physical systems; the application of biological principles and methods to geophysical problems

9. aggradation = the process of modifying the earth's surface in the direction of uniformity of grade or slope by deposition, as of detrital material on a river bed, as opposed to degradation

10. topology = the dynamic structure of a landscape or region as indicated by its topographical, geomorphic and hydrological patterns; topography = the detailed description of a particular locality; geomorphology = landscape systems and their evolutionary processes; hydrology = water systems.

11. ecography = an integrated landscape assessment method for mapping habitats and modelling landscape ecosystems

land ethics. We have the collective knowledge, technology and resources to restore watershed catchments to full functionality and productivity. However, it seems that we do not have the necessary driving force of a unified community to enact appropriate public policy.