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INFRASTRUCTURES AND ECOSTRUCTURES

ENVIRONMENTAL PLANNING FOR SUSTAINABLE SETTLEMENT - ONE OF THE GREAT CHALLENGES FOR POST-INDUSTRIAL SOCIETY

Nature does nothing uselessly, noted Socrates. Why then are some societies continually at war with Nature, degrading and destroying environmental systems? Why do so many communities accept the destruction of landscape ecosystems on which they so greatly depend in the guise of developing infrastructure for human settlement? Understanding the reasons why involves a journey into the landscape ecology and settlement strategies of post-industrial society. Along the way you will discover a wealth of new concepts including cultural intelligence. Remarkably, the English language is deficient in words and phrases that describe the dynamics, energetics and evolving structures of landscape habitats and human settlement. They are not part of the English cultural or scientific paradigm. That says lots. The concepts are profoundly simple, though difficult to grasp at first. In this short review, I seek to show why certain landscape ecosystem relationships are necessary prerequisites for sustainable societies. These natural "infrastructure circuits" underlying and linking habitats and ecosystems in functional ways (Leopold 1949) are called landscape ecostructures, (Warshall 1998). They are the ecological equivalents of man-made infrastructure.

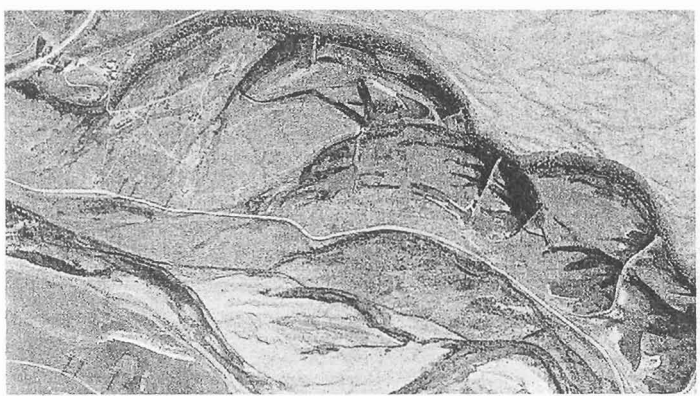
THE DILEMMA

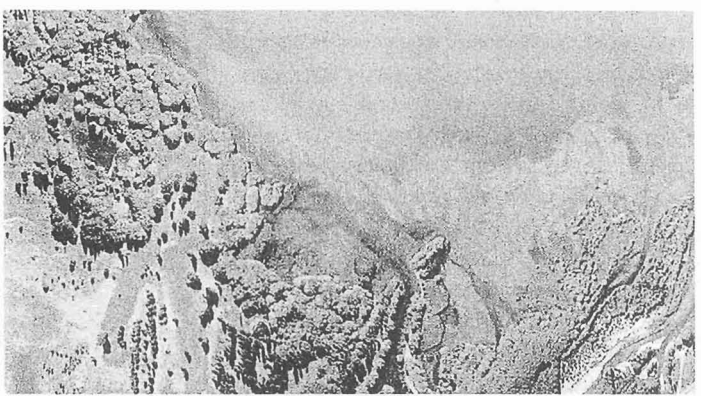
It is commonplace in industrialised societies for landscape ecostructures to be sacrificed for the purpose of installing settlement infrastructure. With the benefit of hindsight, this might not have been the best choice. As the transition from post-industrial to information societies progresses, it is timely to consider the prospects for restoring landscape ecostructures while retrofitting industrial infrastructures in environmentally friendly ways. Over extensive landscapes however, fundamental habitat structures and ecosystem relationships are being rendered dysfunctional by settlement infrastructure. One of the main reasons is misplaced, poorly designed and inappropriate infrastructure that disrupts and degrades essential environmental systems. Pieced together, the jig-saw puzzle of local environmental destruction from poorly planned infrastructure emerges into a regional and global picture that is a frightening and depressing scene.

As societies emerge from the dark ages of industrialism they are being confronted with a set of seemingly intractable problems including dysfunctional environmental processes, rapidly changing social systems and deteriorating settlement infrastructure. In some cases, like Melbourne, Sydney and along the River Murray, infrastructure audits have exposed a serious problem. The cost of replacing aging infrastructure systems is often prohibitively expensive.

By restoring landscape ecosystems however and reconnecting them with landscape ecostructures, we can enable Nature to restore and manage the key environmental systems sustaining life in the biosphere.

Restoring the integrity of landscape ecostructures while at the same time, making sure





Left: Riparian ecostructure rendered dysfunctional by engineering infrastructure and right: healthy riparian ecostructure operating adjacent to Lake Avieinore.

that infrastructure systems are supportive not destructive, sums up a major challenge for environmental planning for sustainable societies in a post-industrial world.

LANDSCAPE PATTERN - SETTLEMENT STRUCTURE

The key structures sustaining human settlements are uniquely geospatial, fundamentally interrelated and ideally, they should be based on principles of mutuality[2]:

Ergostructures are the energy systems that link to support living landscapes, including human settlement. They operate synchronously and mostly perform as integrated systems however for the most part they are studied separately as heat, light, radiation, wind, water, gravity and geomagnetics.

Ecostructures are the environmental networks linking and uniting sites, habitats and landscape. They are mapped and studied by landscape ecologists, environmental planners, ecological designers and traditional peoples who commonly use cultural ecography for managing their resources.

Infrastructures are the man-made networks of roads, railways, telecommunications, services, utilities, facilities and buildings. They are designed and built by architects, engineers, surveyors, technicians and corporations.

It may help to visualize infrastructure as engineering networks built of concrete, steel and manufactured materials; and ecostructures as habitats and ecosystems evolving with and energized by complex ergostructures.

INDUSTRIAL, INFRASTRUCTURES

Few people would dispute that industrial society and its infrastructure degraded environmental systems at an unprecedented rate and scale. Taking a prime example, it was normal for industrial cities to dispose of their toxic wastes to rivers and streams. Waterways were reduced to contaminated drains, deficient in the basic biota and habitats necessary to maintain potable water supplies.

In industrial society, environmental health becanie a contradiction in terms. Visions of dark satanic mills were not just poetic metaphors; they were an accurate description of historic conditions. It seems industrial societies excel at the politics of exploitation, waste and misuse, all touted as progress, growth and development.

Meanwhile, as underlying landscape ecostnlctures decayed, they wasted away and became dysfunctional over large areas. Consequently, industrial societies generate environmental health hazards, costly to treat and even more expensive to remedy.

Today, most infrastructure systems installed for human settlements follow the industrial model. They are designed and developed as separate, specialized systems. Generally, when completed they are managed by separate agencies or corporations. Their independently designed components, the roads, dams, bridges, buildings, power stations, pipes, towers and tunnels, frequently work at cross-purposes while conflicting with and degrading landscape ecostructures.

Expressed another way, industrial society first defines the engineering infrastructure required for settlements and then transforms the landscape and environment to comply. Rarely do they consider impacts on landscape ecostnlctures, choosing instead to assess impacts on separate components of the system. By this approach the underlying integrity of environmental processes does not have to be considered.

The resulting damage to environmental systems and the continuing destruction of underlying ecostructures result in serious cumulative, long-term effects on environmental resources. This is the very opposite of sustainable development as defined by international law (UN Agenda 21).

LANDSCAPE ECOSTRUCTURES

Landscape ecosystems are complex suites of sites and habitats naturally organised and linked in particular ways to function as self-regulating systems. They are fundamentally open, organic systems, not industrial facilities nor machines. They evolve and adapt in ways that help ensure environmental health and reliable resources, including stable ecosystems and clean fresh water.

Mapping and modelling landscape ecosystems is a relatively recent development in the western world. In the Asia-Pacific region however, it has a long and remarkable heritage dating back thousands of years.

Ecography, the integrated art and science practised by the Murri and Koori aboriginal people of Australia for more than 10,000 years is a sophisticated and intelligent representation of habitats, ecosystems, ecostructures. infrastructures, resources and how to manage them sustainably. Viewed as artworks in the west, they are highly prized by international galleries and museums. Few purchasers however, understand the cultural intelligence and information systems on which they are based.

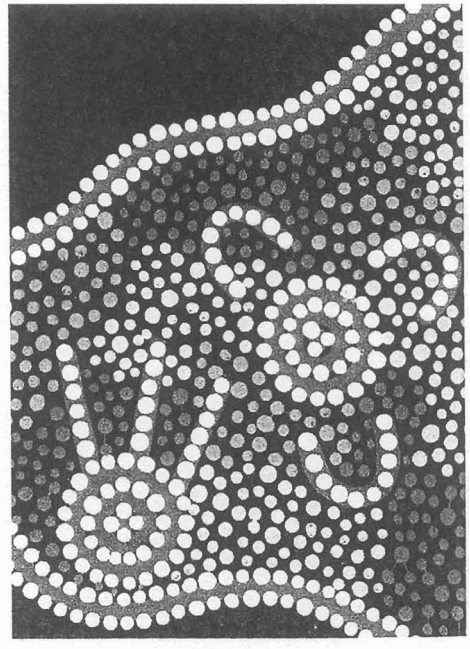
It takes a small, important step from ecographic mapping to identifying ecostructures and guiding ecosynthesis: the process by which nature adapts, changes and evolves landscape ecosystems in the presence of human settlement (Tane 1993).

The complex dynamics of adaptation and change in landscape ecosystems is beyond the capabilities of simple, sequential models of ecological succession. The more robust, co-evolutionary model of ecosynthesis recognizes the on-going evolution of new landscape ecosystems is continually taking place in response to human settlement. Fascinatingly, some surviving cultures in the Asia-Pacific region have successfully integrated settlement infrastructures with landscape ecostructures, lifting ecological productivity well above its natural potential without exogenous inputs like imported energy (Ruddle et al 1988).

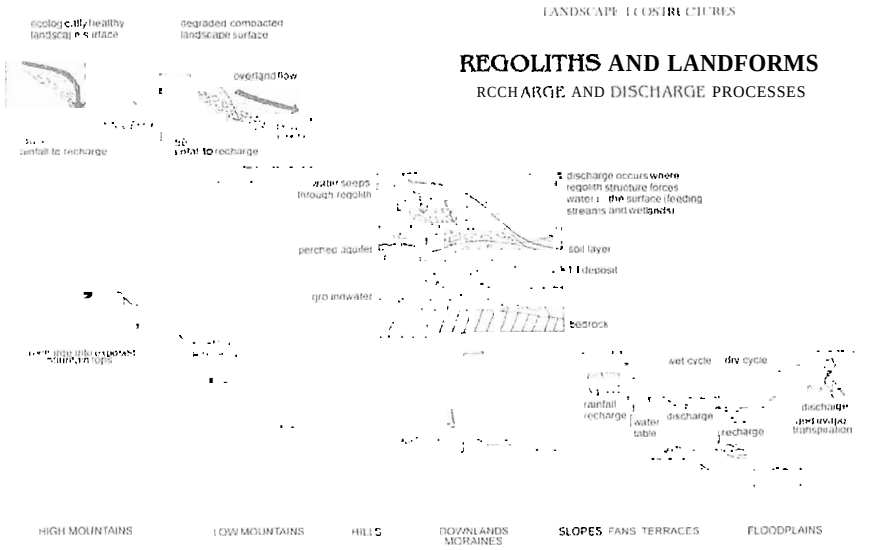
Ecostructures are identified from characteristic networks and topological patterns created by functional relationships of sites, habitats and landscape ecosystems'. These structured patterns reflect the environmental dynamics of manifold life forms interacting continuously. Their topological signatures are keys to understanding environmental processes and relationships, however being non-linear open systems; they are best represented by heuristic processes and gaming systems rather than deterministic, predictive or statistical models.

ENVIRONMENTAL HEALTH

Many of the traditional principals of



Right: Landscape Ecostructures as Cultural Art (Source:Water Dreaming Painting by Kevin Tjungarryi.)



Mapping landscape ecostructures is a multi-stage process that involves integrating regoliths, habitats and energetic systems: the maps and diagrams above illustrate parts of regolith mapping undertaken by an international team for the Waitaki Basin 25th Anniversary Watershed Audit © CfCE 2002.

environmental health are relatively simple and well known from practical experience to traditional Asian and Pacific peoples whose settlements have endured for millennia. They are also appreciated by some foresters and farmers who operate organic land use systems. It becomes part of their cultural intelligence (as opposed to recorded knowledge) that environmental health depends on the integrity and performance of underlying environmental processes. Today these words are popular platitudes without real import for their meaning is misunderstood.

Environmental planners engaged in planning sustainable settlements are caught in a difficult dilemma because of this. They can often see the profound common sense in the cultural intelligence of traditional peoples, however they are obliged to defend their design solutions using the disparate subject oriented, scientific technologies as if they were the only valid knowledge based system. The integration of cultural ruts with science and technology through environmental planning for sustainable development is effectively prevented by dogmatic beliefs in the superiority of science and technology.

To scientifically trained hydrologists and engineers, water is H:0 with a few minor elements and niicrobes. Until sterilised, water harvested from a drainage catchment is considered unfit for drinking. Today, chemical sterilisation of waters is considered protection against germs and other pathogens that should not be there. Natural, fresh water has become industrial raw water requiring treatment. Some bugs however, like protozoa (eg Cryptosperidium and Giardia), do not care to play by the technical rules of the water industry. They require slow sand bed filter systems complete with microbiota and mimicking natural floodplain processes to be removed reliably and inexpensively (Curds 1992).

To watershed ecologists, however, naturally flowing waters are living waters comprised of mobile habitats with communities of organisms thriving in terraqueous habitats. Specific habitat progressions involving specific ecological processes remove the pathogens, toxins and other unpleasant stuff to produce clean, fresh water, (Tane 1996). It has worked fine for as long as humans have been on earth.

Rains, mists and fogs end up seeping, flowing, surging and spreading moisture above, below and through the ground. These waters are processed through organic systems while moving slowly through forests, soils of seasonal floodplains, new surface aquifers, watershed basins and other riparian habitats. No one habitat or landscape ecosystem can do the job alone. Proper connectivity and sequencing through riparian habitats are necessary for integrity (Hammond 1997). For this reason, reed bed and wetland filters are only short-term solutions. It is necessary to organize habitats and ecosystems ecologically for long term success and environmental sustainability.

In environmental planning for sustainable development I have found that the integrity of riparian ecostructures is an important key. Their greatest social, economic and environmental benefit is healthy, functioning riparian ecostructures. They ensure the ecological capability of landscapes to purify water while maintaining habitats for healthy life. including human settlement. They provide the necessary spatial framework aid operational system for integrating energy regimes. environmental resources and ecological processes for myriad life forms.

On the contrary, the control of natural processes by technological means appears to be the preoccupation of professionals serving the infrastructure industry. Perhaps nowhere is this more evident than in the misguided and futile attempts at "flood- proofing" floodplains by drains and levees. The history of human civilization (Hillel 1991, Hyiuns 1952) documents and demonstrates repeatedly that human cultures and civilizations that do not respect the fundamental principle of watershed management that "floodplains are for flooding" are destined to be destroyed by incremental environmental degradation.

While modern society has tlie technology, skills and resources to repair degraded environments, regrettably they mostly lack the cultural intelligence to do so. Important social skills and cultural attitudes are lacking or absent. This vexed issue is addressed in another paper (Tane 2000). Here we are considering the nature and role of landscape ecostructures. Signiticantly, no word or concept within the English idiom captures the meaning or significance of these Fundamental entities that have been recognized for millennia in enduring Asia-Pacific cultures.

INFRASTRUCTURE IMPEDIMENTS TO SUSTAINABLE SETTLEMENT

Human settlements are tending to rely more and more on engineering infrastructure to supply services such as treated water and costly energy. Industrial societies seem incapable of addressing the central issue that their infrastructure technology often degrades and destroys key environmental systems that supply fresh water and free energy while sustaining flora, fauna and human settlement.

Retrofitting aging industrial infrastructure and restoring landscape ecosystems through environmental planning for sustainable development are now urgent needs and requirements for sustainable societies in Aotearoa and Australia. Scientific knowledge and infrastructure technology are unable to accomplish these tasks. The key to success is changing the dominant cultural paradigm

from the western industrial model to one befitting the post-industrial, Asia-Pacific region. While reviving traditional wisdom is a good start, new social gaming systems for sustainable human settlement and cultural iconography for restoring cultural intelligence are probably more fundamental.

We should begin while we still can. by restoring landscape ecostructures that ensure reliable supplies of clean, fresh water in our streams and rivers. aquifers and lakes. Restoring watershed ecostructures through engineering technologies is just not practicable for we are dealing with self-regulating environmental systems. We need to first restore society's cultural intelligence for respecting the integrity of environmental processes that support life on earth. On the basis of past experience, and with the benefit of hindsight we know now that specialized sciences and narrow problem oriented mentalities are incapable of addressing the overall situation creatively or effectively.

One reason for this is western science's inability to reliably model or measure complex, non-linear, organic systems that interact continually with human settlement. Scientific analysis not only fragments dynamic temporal processes, it breaks things into smaller disconnected components that disguise the fundamental importance of system synergy. Chemistry, biology and economics, atoms, elements, species and genes are studied in detail, related subjectively through the magical power of numbers (statistics) and then predictions are duly made under the mistaken assumption that the accumulation of knowledge has some connection with commonsense or cultural intelligence.

When scientific specialists study separate parts analytically in minutiae, then attempt to predict the performance of much larger systems, they are behaving like fleas on an elephant predicting the future of life on savanna landscapes.

Specialists said Marshall McLuhan, cannot see the forest for the trees; they rarely make small mistakes while heading towards the grand fallacy.

It appears the most promising path for environmental planners is to focus more on restoring ecosystem functionality and then reconnecting them through natural evolutionary processes of ecosynthesis. Unfortunately, these is a cultural attitude common among western societies that inhibit this commonsense approach. They seem unwilling or unable to accept the continuing, dynamic evolution of Nature.

Environmental conservation and dynamic ecosynthesis require that we recognise people as integral parts of natural ecosystems. This assumption however, is anathema to people trapped in the Humans versus Nature mindsets. This mindset is particularly strong among Nativists and similar conservation cults seeking to lock up land, exclude human activities and prevent resource development in the cause of nature conservation.

Indigenous peoples in the South Pacific have named this paradigm eco-colonialism (Cox & Elmqvist 1991). Further international law for sustainable development (UN Agenda 21) denies the validity of this approach adopting instead the environmental conservation model that integrates conservation and development.

For environmental planners the message is clear. When planning human settlements and designing developments, including their open spaces and natural areas, the design and development of settlement infrastructure and the protection of environmental ecostructures should be based on mutuality, not exclusivity.

CONCLUSION

In a world of tumultuous change and international conflict, crimes against humanity are front-page news. Everyday, equally serious offences against Nature, involving the use of industrial technology to "develop and protect" infrastructure are carried out with the support of governments around the world.

Environmental policy and practices by which infrastructure systems are permitted to undermine and destroy environmental ecostructures are not only short sighted, they are delinquent. Unfortunately, in this age of scientific specialisation, infrastructure systems are rarely designed by environmental planners with overall responsibility for settlement systems.

By disregarding the ecological integrity, cultural heritage and environmental systems of traditional peoples, infrastructure industries are particularly inclined to ignore the cultural basis of landscape ecosystems. They frequently misinterpret what is natural, all the while destroying environmental ecostructures with misplaced and inappropriate infrastructure.

Recognizing the destruction of landscape ecoshuctures by industrial infrastructures and how they can be restored through environmental planning is one of the great challenges of post-industrial society. This begs the question: who can teach this to the next generation of environmental planners?

FOOTNOTES

1. About the Author: Haikai Tane is an honours graduate in geography and a graduate in law from the Australian National University, Canberra, and obtained his Master of Science, (ecology and planning) from the University of British Columbia, Canada. He has surveyed, mapped and modelled watershed catchments using geospatial technologies such as remote sensing and GIS since the early 1970s. Prof Tane's expertise researching and developing geospatial systems for watershed catchments has attracted international recognition and awards.

2. Traditional Chinese landscape designs for human settlement dating back 2200-3000 years (the Zhou Dynasty) known colloquially by Taoist philosophers as long-feng, feng- shui are based on identifying and mapping ergostructures, ecostructures and infrastructures as a unified system using cultural iconography. This ancient method should not be confused with contemporruy feng-shui.

3. Like many design skills, identifying and mapping ecostructures is a cultural skill requiring extensive field experience under expert guidance rather than a technical skill that can be learnt in academic classrooms.

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