Permaculture Design Course
For Cool Temperate South-eastern Australia

Course Notes and Reading Guide

This collection of topic summaries is provided to guide your reading during the course, supplemented by notes that cover material that is not readily available from the standard Permaculture texts. The course structure follows Permaculture Melbourne's *A Syllabus for Permaculture Design in Cool Temperate South-eastern Australia* (George, 2012). This syllabus incorporates the standard Permaculture Design Course curriculum as provided by *Permaculture: a Designers' Manual* (Mollison 1988) expanded to include more detail of the ecological processes that underpin permaculture design, with examples drawn from the local bio-region.

For those who are not familiar with Permaculture concepts *Introduction to Permaculture* (Mollison and Slay 2000) is recommended as preliminary reading.

These notes may be supplemented by additional handouts during the course.

Contents

Topic 1 - **History of the Permaculture Concept**

Permaculture was developed in Tasmania as a collaborative effort between Bill Mollison and David Holmgren during the 1970's. They coined the word Permaculture to describe their integrated system of perennial plants and animals useful to man (Mollison and Holmgren 1977, p 1). In that publication they say "*It is recognised that annnual cultivation is an integral part of any self-supporting system, but annual crops are not condisered here ..... It is taken as understood that normal gardening for annuals is part of a permacultural system*". For a long time this has been overlooked and Permaculture has been viewed essentially as a perennial, tree-based cropping system.

See Appendix 1 for a summary of the most important publications that led to the development of Permaculture and a list of the milestones in its history. Holmgren (1991c) discusses historical land-use practices that preceded and influenced Permaculture.

Some of the **key concepts** used in Permaculture are listed in Appendix 2.

Topic 2 **- The Ethical Principles of Permaculture**

Moral codes guiding decision making are widespread culturally-evolved mechanisms that have enabled traditional cultures to survive in balance with their environments far longer than any civilisations have managed. Permaculture has adopted the following ethics, in varying combinations, along with many other like-minded groups. They are usually summarised as ***Earth Care, People Care, Fair Share***

CARE FOR THE EARTH

- accepting the Gaia hypothesis of the Earth as a self-organising system (Lovelock 1987).
- caring for the soil as the basis for life on land and of water as the basis for life in our rivers and seas.
- repair of damage that has already been done.
- respect for biodiversity and the sanctity of life.
- the concept of **stewardship** rather than ownership.

CARE FOR PEOPLE

- caring for self: developing self reliance and personal responsibility.
- caring for others: maintaining and improving the environment, supporting others to obtain their physical and social needs, developing resilient communities.
- focussing on non-material values and benefits: improving the **quality** not the **quantity** of life.

SHARING OF SKILLS, KNOWLEDGE & SURPLUS PRODUCTION

- the redistribution of surplus resources derives from the first two ethical principles.
- sharing resources develops the links that build **social capital**.

SETTING LIMITS TO POPULATION GROWTH & CONSUMPTION

- recognition that the Earth has a **carrying capacity** that we have already exceeded.
- the problem of **Exponential Growth**
- reducing consumption must go hand in hand with reduction of population numbers to a level that is sustainable.

- reduction of our **Ecological Footprint**: that amount of land needed to support each individual person in the provision of resources and disposal of waste. 2.2 ha are available world-wide at present population levels, the USA uses 12.2 ha per person, Australia uses 8.5.

The above ethics are discussed in chapter 1 of Mollison's *Designers Manual* (Mollison 1988, pp. 2-6), *Introduction to Permaculture* (Mollison & Slay 2000, p. 3) and by Holmgren in Chapter 1 of *Permaculture Principles* (Holmgren 2002, pp. 1-11).

Topic 3 **- Energy Laws and Processes**

An understanding of the Laws of Thermodynamics and the concept of Embodied Energy (Emergy), is critical to energy efficient design, but these fundamentals are often ignored by those promoting technical fixes to problems.

The energetics involved in successful design are covered by principle 3 *Catch and Store Energy* (Holmgren 2002, pp 28-53, and are explored by Mollison (1988, pp 12-16). Holmgren's paper on Energy and Permaculture (Holmgren 1992) in the collected papers provides a good introduction .

Physicists recognise two fundamental laws that govern the behaviour of thermodynamic energy (light and heat):

(1) **The First Law of Thermodynamics** - *The Law of Conservation of Energy:* Energy is neither created nor destroyed, energy entering a system is either stored in the system or flows out.

(2) **The Second Law of Thermodynamics** - *The Law of Degradation of Energy:* In all natural processes energy is degraded in quality, with systems moving inevitably towards a state of entropy, or chaos as heat is dissipated.

An understanding of how these laws operate was fundamental to the development of the original permaculture concept (Holmgren 1991c, 2002).

A third "law", The **Maximum Power Law**, which underpins the evolution of biological systems, also has implications for the design of resilient and sustainable permaculture systems. *Natural systems (plant and animal populations, ecologies) which capture the most energy and use it most effectively tend to prevail over less efficient systems with which they compete.* In designed systems we aim to maximise productivity while minimising inputs. Under this law there is an optimum balance between effort put in and yields produced (Holmgren 2002, p 56-57).

Photosynthesis captures the electromagmnetic energy of sunlight and stores it as chemical energy in the bonds of organic molecules. This energy is unlocked and used by organisms in the reverse process of **respiration** and in the combustion of organic compounds. The principle *Catch and Store Energy* is about utilising this natural process to build energy stores in our landscapes - timber, food, soil humus.

Energy exists as **potential energy** (stored) and in various forms as **kinetic energy** (in use)**.**

Embodied Energy (Emergy) The energy that has been used up in the growth, manufacture or processing of any particular item is said to be embodied in that item, and is not recoverable. See Mollison (1988, pp. 24-25) for a graphical representation of the way an industrial egg is produced in comparison with a Permaculture one. Holmgren has incorporated Howard Odum's work on energy in natural systems in his development of Permaculture. Holmgren's thinking can be followed from his papers *Energy and Permaculture* (Holmgren 1992), *Energy and Emergy:*

Revaluing our World (Holmgren 1997b) and discussions of emergy evaluation in *Permaculture Principles* (Holmgren 2002, pp. 45, 65-68).

Global Oil Peak and Energy Descent. The theme of *Permaculture Principles* (Holmgren 2002), is one of planning for energy descent over coming human generations, from a peak of energy usage at the present time, to a stable low-energy state at some time in the future. We need to develop systems that run on renewable energies with our capital resources invested wisely in systems that will be self-maintaining. Fisher (2002) discusses the role of renewable energies in this process and argues the case for conservation of energy, rather than the wholesale replacement of fossil fuels with renewables.

Richard Heinberg (2003, 2004, 2006) has written extensively on Peak Oil and strategies for energy descent. Holmgren has a website (www.futurescenarios.org) devoted to the discussion of climate change and peak oil and the likely responses to these twin challenges. Adam Grubb's Energy Bulletin (www.energybulletin.net) is devoted to Global Oil Peak issues, publishing news, research and analysis.

Topic 4 **- Gaia and Ecosystems**

Although Permaculture is based on ecological principles, you will usually need to consult biology texts for a discussion of these concepts. Appendix 4 provides definitions of frequently encountered ecological terms and concepts - the Gaia hypothesis of Lovelock (1987), the Greenhouse Effect, Ozone Layer, Biosphere, Biomes, Ecosystems, Communities, Plant associations. *Edible Forest Gardening* (Jacke and Toensmeier 2005) provides the most detailed discussion of ecological concepts as a foundation for establishment and maintenance of productive systems.

Biodiversity: occurs at four levels. (1) Genetic diversity in individuals depends on allelic variation of the genes on the chromosomes that produce heterozygosity and impart fitness. (2) Diversity within species (gene pool) provides populations with the allelic variability to cope with environmental challenges, which leads to evolutionary development. (3) Diversity within ecosystems is provided by the number of different species that interact to provide complexity and stability. (4) Diversity among ecosystems provides varying response to environmental conditions.l

Succession: pioneers, seral stages and climax vegetation. Succession occurs in the absence of disturbance events, but periodic disturbance can prevent a climax community from developing. Mollison (1988, pp 64-65) briefly discusses plant succession, Holmgren (2002 pp 244-264) examines succession and its applications in much more detail in discussing Principle 12 *Creatively Use and Respond to Change.* Costermans (1981) discusses the biological process with an example of sand dune stabilisation in coastal systems.

Jacke and Toensmeier (2005 pp 239-290) devote a chapter to a detailed discussion of succession and vegetation dynamics as background to their ideas on forest gardening in temperate climates.

The Carbon (C) Cycle - carbon chemistry is the basis of life, C cycles through ecosystems via photosynthesis and respiration, sinks lock up excess C (Mollison 1988 p 204, Holmgren 2002, pp 31, 156).

The Nitrogen (N) Cycle - atmospheric N is fixed by bacteria in root nodules and soil, nitrification and de-nitrification bacteria maintain a balance of N in soil ecosystems (Mollison 1988, PP 190, Jacke and Toensmeier 2005).

The Phosphorus (P) Cycle - P accumulates in manures, sediments, guano deposits. Soil fungi are important suppliers of P to plants (Mollison 1988, Jacke & Toensmeier 2005). Mollison & Slay (2000) mention the traditional practice of keeping pigeons as a source of P in manure. King (1911) catalogues traditional chinese farming practices of harvesting manures and recycling canal mud to retrieve P.

Food Chains, Food Webs and Trophic Pyramids - These depict energy flow in ecosystems. A **food web** shows the relationships of organisms in an ecosystem as a series of interlocking **food chains** which start with the **primary producers** followed by several **trophic levels** of **consumers**. An **ecological niche** is the place of an organism in a food web, and refers to the role the organism fills in the ecosystem, not the physical space it occupies in a habitat. Ecosystems are much more complex than can be easily shown in a graphical food web and include **decomposers** which recycle nutrients through the system.

Mollison (1988, pp. 28-30) discusses food webs but doesn't take into account the **energy losses** that occur during metabolism, which are a major contributor to the decreasing biomass towards the top of the trophic pyramid. Holmgren (2002) makes much use of the trophic pyramid as an analogy in various models.

Biomagnification occurs when pollutants, which are not metabolised or excreted, are passed up the food chain, becoming increasingly concentrated in the higher-order consumers (eg mercury in predatory fish).

Topic 5 - Trees and Forest Ecology

The emphasis on trees in permaculture cropping and landscape systems is due to their critical importance in natural systems. See Chapter 6 *Trees and their Energy Transactions* (Mollison 1988, pp. 137-151) for a discussion of the ecological role of trees in the landscape. Functions of trees include -

- using the energy of sunlight to convert CO2 to carbohydrates
- accumulation of nutrients in plant biomass
- modifying temperatures and humidity
- modifying the energy of winds
- pumping soil water through transpiration, contributing to rainfall
- condensing humid air in their foliage
- delaying rain run-off and reducing erosion
- contributing to soil formation through root activity and litter fall
- providing wildlife habitat - food, shelter
- modifying the micro-climate, enabling guilds of other plants and animals to establish

Competition for light is an important characteristic of tree growth in forests with implications for tree management in plantations.

Propagules can be dispersed by wind, water, animals, shattering of seedpods. Many Australian species are fire tolerant or dependant on fire for regeneration - release of seed from woody pods, scarification of dormant seed by fire, smoke triggers.

Management of native vegetation in Australia requires an understanding of the intrinsic characteristics of our forests. See handout for a summary.

Some species become invasive when grown outside their natural range and become **environmental weeds**, eg *Pinus radiata*, Sweet Pittosporum in Victoria.

Topic 6 **- Climates**

Climates are determined by:

- **latitude**: tropical, temperate, polar regions
- **altitude**: lowlands, highlands, montane, alpine
- **topography**: mountain ranges & rain shadows, maritime effects near coasts, continental effects inland
- **global wind and ocean current circulation patterns**, wet equatorial belt, dry sub-tropical latitudes
- **sea surface temperatures -** El Nino & La Nina,

and can be modified by **vegetation** (see Mollison 1988, Ch 6 "*Trees & their Energy Transactions"*). Mollison (1988, Chapter 5 "C*limatic Factors"*) discusses climate zones, global weather patterns, precipitation, radiation, wind, landscape and latitudinal effects.

Seasons are determined by the earth's tilt on its axis - varying day-length and sun angles.

Weather is determined by the movement of **High** and **Low pressure cells** See Mollison (1988, p 112) for a diagram of global wind patterns.

Rainfall is of 3 types -

- **Convective -** moist air rising to produce thunderstorms
- **Orographic -** precipitation caused by moist air being lifted to cooler altitudes by mountains.
- **Frontal** - moist air associated with a cold front

Macro-climates - Australian climatic zones are influenced by three rainfall gradients:

- an E to W gradient influenced by the Great Divide (mostly orographic rain)
- a N to S gradient influenced by the summer monsoons from the NW (convective rain)
- a S to N gradient influenced by winter rains coming off the Southern Ocean (frontal and orographic rain).

The combination of latitude and rainfall patterns produces a mosaic of climate zones across the continent with corresponding vegetation types.

Meso-climates - local topography, vegetation and aspect can modify broad climatic patterns - daytime **valley winds**, night-time **downslope winds**, **frosts**, **fogs**, **sea breezes**, dry northern slopes, wetter southern slopes.

Micro-climates - Micro-climatic conditions (shade of a tree, sunny spot against a fence or wall, thermal mass provided by a water body or rock outcrop) can influence the choice and success of plantings. Micro-climatic conditions are most easily modified by design.

Gardening books often publish climate zones based on **growing seasons**, eg Diggers Club, Dromana. A range of climate maps can be viewed on the Bureau of Meteorology website (www.bom.gov.au). Particularly useful is the one on climatic zones on the *Climate Education* pages. For a guide to your **local climate** see the *Climate Averages* page for your nearest weather station.

For further information on Australian climates see **-**

- Bureau of Meteorology, 1989. *Climate of Australia*, Aust. Gov. Publishing Service, Canberra.
- Colls, K & Whitaker, R 1990. *The Australian Weather Book.* Child & Ass, French's Forest, NSW.

Topic 7 - Soil Ecology

Soils provide a medium for plant growth, habitat for organisms and a storehouse for nutrients. Biologically active soils are composed of mineral particles, organic matter, micro-organisms, air and water. The Cation Exchange Capacity (CEC), dependant on the clays and organic matter present, is a measure of soil fertility. Fungi are important in nutrient availability. Elaine Ingram has researched the soil food web as a sustainable basis for agriculture (see www.soilfoodweb.com.au).

Soil biota and general soil management are discussed by Mollison (1988, pp 182-226). Jacke & Toensmeier (2005) discuss soil horizons (pp 75-83) soil ecology and the soil food web (pp 214-235). The CSIRO *Soils* series of booklets are very useful. The author of these has replaced them with *Gardening Down Under* (Handreck 2001). See also Bennett (1995, pp 61 - 72).

Topic 8 - Design Principles

These have evolved over time. Mollison (1988) discusses general principles in chapters 2 (Concepts and Themes in Design) and 3 (Methods of Design). A set of guidelines for sustainable small farm design were published by American teacher John Quinney in 1984 (Quinney 1984). These were incorporated as a set of design principles in the first edition of *Introduction to Permaculture* published in 1991 (Mollison & Slay 2000) and have been used in various forms by Permaculture teachers since then. Quinney's guidelines and design methodology and the Mollison & Slay set of principles had a focus on small-scale agricultural systems. Holmgren has subsequently reviewed the fundamental principles underlying sustainable system design and published these as new, inter-related, statements (Holmgren 2002). These are briefly summarised below for ready reference. Many of the traditional design "principles" are now best seen as "strategies" for the implementation of Holmgren's new principles (See Appendix 3).

Principle 1: **OBSERVE AND INTERACT**. Designing through observation of, and thoughtful interaction with nature to move society towards a sustainable future with low energy and resource use.

Principle 2: **CATCH AND STORE ENERGY.** Systems need to return to dependence on renewable energies to build natural and human capital and to save and reinvest the wealth created from our exploitation of the earth's stores of non-renewable resources.

Principle 3: **OBTAIN A YIELD.** Systems should provide for self-reliance at all levels. Without useful yields systems will wither and be replaced. Rewards encourage success, growth and replication.

Principle 4: **APPLY SELF-REGULATION AND ACCEPT FEEDBACK.** Design for self-reliance rather than large-scale external controls, with feedback controlling inappropriate behaviour.

Principle 5: **USE AND VALUE RENEWABLE RESOURCES AND SERVICES.** Systems should be designed to use renewable energies for management and maintenance, even though we may use non-renewable energies for system establishment.

Principle 6: **PRODUCE NO WASTE.** An output of a system that isn't used elsewhere in the system causes pollution. Appropriate connections enable us to utilise all outputs productively to increase the total system yield.

Principle 7: **DESIGN FROM PATTERNS TO DETAILS.** Pattern recognition is the necessary precursor to the process of design, focussing on the bigger picture before getting involved in detail. Complex systems that work tend to evolve from simple systems that work.

Principle 8: **INTEGRATE RATHER THAN SEGREGATE.** The importance of relationships in the design of self-reliant systems is emphasised by the statements "*Each element performs many functions*" & "*Each important function is supported by many elements*".

Principle 9: **USE SMALL AND SLOW SOLUTIONS.** Systems should be designed to function at the smallest scale that is practical and energy efficient. Human scale and capacity should be the yardstick. This includes support for local business and community issues.

Principle 10: **USE AND VALUE DIVERSITY. .** Diversity can be genetic, spatial and temporal. Use polycultures rather than monocultures, as well as diversity between systems reflecting appropriate site, situation and cultural contexts.

Principle 11: **USE EDGES AND VALUE THE MARGINAL.** The edge of any thing, system or medium is where the most interesting events take place, See edges as opportunities, rather than problems.

Principle 12: **USE AND RESPOND TO CHANGE CREATIVELY.** Acceleration of succession within cultivated systems. Permanence and durability depend on capacity to change over time and applies to social and organisational ability to cope with change.

Topic 9 - Pattern Recognition and Reading the Landscape

Patterns in Space, Time and Human Culture. Chapter 4 of the *Designers Manual* (Mollison 1988) covers a wide range of pattern phenomena and their relationship to design. Principle 7 *Design from Patterns to Details* (Holmgren 2002, pp 127-152) explores pattern understanding as a basis for good design.

Patterns as Outcomes of Environmental Influences. Stream patterns reflect the underlying geology of the bedrock. Vegetation associations are determined by soil type, climate and aspect. Altitudinal & latitudinal sequences in plant & animal communities reflect the influence of rainfall and temperature. Symbiotic associations, eg mushrooms under pine trees reflect the interdependence of these organisms. Stratification in natural communities, such as vegetation layers in a forest, bands of shellfish on rocks in the littoral zone of seashores and zonation of pond life reflect specialisations for particular conditions.

Pattern Languages for Design. Christopher Alexander and associates developed the first pattern language for architecture (Alexander et al 1977). Holmgren (220 pp127-128) discusses the development of a pattern language for permaculture. Jacke and Toensmeier (2005) describe 57 patterns for use in Forest Garden design.

Reading Landscapes as a Design Skill. Holmgren's Principle 7 *Design from Patterns to Details* (Holmgren 2002, pp.127-154) emphasises the importance of understanding the dynamics of a situation before attempting to re-design. The holistic approach of Permaculture can be compared with the traditional farmers understanding of a specific site, and the scientist's understanding of a broad range of facts in a limited field. Developing literacy in reading landscapes is about combining skills of identification and classification, with the natural history skills of observation and recording, the use of intuitive or contemplative understanding and the use of indicators or rules of thumb. Skilled observation can reveal underlying patterns, past histories and future possibilities (Holmgren 1984).

Principle 1 *Observe and Interact* (Holmgren 2002, pp. 13-25) demonstrates the importance of pattern understanding in the design process. Costermans (1981, Chapter 2) discusses vegetation patterns in south-eastern Australia and their relationship to geology and climate.

Topic 10 - Landforms and Water Cycles

Water in the Landscape. Mollison (1988, pp 153-154) discusses some aspects of the water cycle in landscapes as a prelude to the design of systems for water capture , storage and usage.

Fresh water is a very limited resource on our planet (3% of all water) and needs to be used wisely. Fresh water occurs as surface water in ponds, lakes and streams, as groundwater below the water table, as artesian water in deep rock strata. The water in our streams comes from precipitation as rain or snow, as seepage from the water table via springs and from glacial and snow melt. Removal of vegetation in catchment areas changes the hydrology of landscapes and can induce salting as water tables rise in saline areas. See Mollison (1988, pp. 401-409) for a discussion of dryland salting and strategies for reversing the damage done by past land management practices.

Peter Andrews (2006) provides insights into the hydrology of flood plain landscapes based on his experiences in the Upper Hunter Valley. His Natural Sequence Farming techniques aim to restore rivers and floodplains to the chain-of-ponds situation that he believes prevailed in the Australian landscape prior to European settlement (www.nsfarming.com)

Humid (high rainfall) Landscapes. Sherbon Hills' *Physiography of Victoria* (Hills 1975) provides an excellent and detailed account of the processes at work in landscapes where water is the dominant eroding factor. See the course notes on Landforms of Victoria for a summary of humid landscape features.

Arid Landscapes. Wind is the dominant eroding factor resulting in sand dunes, scarps, mesas and buttes, stony deserts (gibber plains in Australia). Low rainfall and high evaporation rates produce dry stream beds, claypans, salt pans and salt lakes. Wadis and oases provide access to ground water. See Mollison (1988, pp 316-336) for landscape features in deserts and van Oosterzee (1991) for a description of the geological and natural history of the central Australian deserts.

Tropical Landscapes. High rainfall, high humidity, with fertility in the biomass, not the soils. Landforms are variable. Climate varies from tropical to alpine as altitude increases.

Coral Islands. Coral islands and atolls, built up with coral debris, are a feature of the South Pacific, fragile and threatened by rising sea levels. See Mollison (1988, pp 304-306) for details.

Volcanic Islands. Mollison (1988), pp 277-278) discusses land management practices on Hawaiian islands, relevant to steep oceanic islands of volcanic origin.

Wetlands. Large-scale wetlands support human populations in Mexico and southern Iraq. Sago Palm swamps in SE Asia - New Guinea provide traditional staples.

Topic 11 - Geology and Soil Patterns

An understanding of the geological origin of soils can assist in designing appropriate systems that use them. Soils derived from volcanic lava flows and ash deposits can be very fertile. Those derived from granites and granodiorites tend to be both gravelly and clayey, but also leach nutrients quickly, so are usually not as fertile. Sedimentary rocks, derived from the deposition of eroded materials are less fertile. Alluvial soils built up from regular deposition of silts on river flood plains can be very fertile, those derived from beach blown sand in coastal districts are

usually very free draining and infertile. In the northern hemisphere glacial soils formed from pulverised rocks provide productive agriculture.

See Gray & Knight (2001) for a map and description of the soils of the greater Melbourne area and the typical vegetation associations that develop on them. These are summarised in course notes. Descriptions of common Victorian soil types using a modern classification (ferosols, podosols, etc) can be viewed at www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/soil_vic_contenders.

Topic 12 - Vegetation Patterns

Vegetation can be classified by its structure (closed (rain) forest, open forest, woodland, etc) or by its dominant species (box-ironbark forest, ash forest, etc). Read (1994) covers vegetation formations across Australia. Osterzee (1991) describes the ecology of arid zone communities. Costermans (1981) and Gray and Knight (2001) provide information on local plant associations.

Vegetation is a good indicator of underlying patterns relating to soil, drainage and meso-climate. Victorian botanists have developed an Ecological Vegetation Class system to describe these associations. The EVCs can be can be viewed at www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/vegetation.

Broad Victorian vegetation associations can be tracked over several environmental gradients -

- increasing altitude from coastal dune scrubs to alpine plains
- increasing aridity from mixed eucalypt forest to mallee
- increasing rainfall from mixed eucalypt forest to ash forest and Myrtle Beech Rainforest
- increasing waterlogging from riverine Red Gum and Manna Gum, through Swamp Gum woodlands to Melaleuca swamps.

On a continental scale increasing aridity changes vegetation from eucalpypt forest to Mallee and Chenopod Shrublands in the south, to Casuarina and Callitris Woodlands, Brigalow and Mulga Woodlands in NSW and Qld,to Spinifex Grasslands towards the arid centre (Read 1994 , Oosterzee 1991). In high rainfall climates latitude gives us a gradient from Cool Temperate Rainforest (Myrtle Beech) in the south, through the complexes of Warm Temperate, Sub-tropical and other rainforest associations that make up the Gondwana Rainforests of the escarpments of northern NSW and southern Queensland to Tropical Rainforest and Monsoonal Rain forest further north.

Topic 13 - Design Processes

Strategic Planning - sets the conceptual framework for system design -

- **Aims** - vision (what you **see** ahead), mission statement (**why** you are there - statement of purpose), goals (**where** you want to get to, in general terms.
- **Objectives** - specific targets, **what** you want to achieve in a stated time-frame.
- **Strategies** - **how** you plan to achieve your objectives.
- **Action plans** - **who** is going to do the work.
- **Time-frames** - **when** the work is to be done

Strategic planning involves periodic review of progress made towards goals and objectives with appropriate adjustment (feedback) of plans.

A Strategic Plan can be a useful precursor to a Permaculture Design, especially if funding is required for a community project.

Planning at the appropriate **scale**: landscape planning, site design, component design. Development streams comprise landscapes, homestead, infrastructure, commercial operations, social structures (Holmgren 1991b).

The Five Phases of Permaculture Design - (1) Site Description, (2) Site Analysis, (3) Conceptual Design, (4)Detailed Design (with specifications and costings), (5) Design Implementation & Management.

Gathering and Recording Data. An inventory of resources and constraints will include:

- physical attributes of site: location, area, boundaries, ownership
- observation & deduction from nature: slope, aspect, soils, climate, vegetation & wildlife, history of use, existing patterns and connections
- existing infrastructure: roads, buildings, services, etc
- external influences, eg shade from neighbouring buildings, trees
- structure of social unit to be serviced: household, village, school, etc
- available material and human resources and skills.

See Holmgren (1995a) for a classic case study of site design of his Hepburn property “Melliodora”.

Mapping. Putting your information on paper will require:

- use of conventions: N to top of page, symbols, keys/legends , appropriate scales
- interpreting contours and taking levels: surveying instruments, line levels, water hose (bunyip level), A-frame & plumb bob
- preparation of a base plan showing all relevant features
- use of overlays for zone and sector analysis and planning, and to present design options and choices

Topic 14 - Spacial Design Tools

Zone Planning places components according to their need for management and space. Zone planning is based on **relative distance** from an activity node and is related to function and accessibility. See Mollison (1988, Chapter 2), Mollison (2000, pp. 9-13), Holmgren (2002, pp. 138-142). The attached extract from Permaculture Melbourne's Syllabus illustrates zone placement of elements appropriate to our bioregion (Appendix 5). See also George (2007) in the collected papers for a discussion of zoning in permaculture. Zones form a nested pattern, but rarely conform to a concentric one.

Sector Planning identifies and manages wild energies (sun, wind, fire, etc) that enter our system and hence is **directional**. See Mollison (1988, pp. 54-55), Mollison (2000, pp. 13-14) and Holmgren (2002, pp. 142-143). Holmgren's site analysis plan is a real-life analysis of his Hepburn property. Note that the wildlife corridor shown in Mollison's sector diagram is relevant to sector planning only where there is a directional problem of invading pests.

Slope Planning is about using gravity to work for us, as a free energy. Water storage and reticulation, movement of warm and cold air, siting of access and service roads to facilitate material handling involve consideration of slope.

These are used initially as assessment tools in the second phase of Pc design, then as design tools at the Conceptual Design step.

Topic 15 - Functional Design Tools

Functional Analysis This tool is used to identify the needs, functions and products of elements to be incorporated in a designed system and to ascertain the intrinsic characteristics which influence choice. The domestic chook provides the classic model for the Functional Analysis tool (Mollison 1988, Chapter 2), Mollison & Slay (2000, p 7). Functional analysis is carried out by listing information to facilitate appropriate choices in design. This listing is most usefully done under the following three headings.

Needs - the inputs necessary to allow an element to function efficiently and must be provided, preferably from the resources available on-site. "Needs" are different to "Wants".

Functions - The work performed by an element in a system is distinguished from what it produces. One **function** of chooks is to provide food for humans. The **products** of this function are the eggs and meat that we eat. Another function of a chook is the recycling of food scraps. In this case the products are manure, meat and eggs. Scratching is a behavioural characteristic of chooks that can be utilised functionally in the free-range situation to provide us with a **service**. Behavioural characteristics, such as scratching and weeding, are an important part of the yield, or work performed.

Products - These are the outputs of a system which provide us with our yields. Outputs of one element are either harvested or used as resources for other elements elsewhere in the system, increasing the total system yield. Unused products of one element in a system that are not used elsewhere build up and cause pollution.

The needs, functions and products of a domestic species in a system will vary according to the **intrinsic characteristics** of the breeds used. In the case of chooks characteristics such as being *light* (egg-layers, non-broody, flighty) or *heavy* (meat birds, broodiness), will also influence choices that are made according to whether meat, eggs, or weed and pest control are the major outputs. Light breeds also require higher fences as they are flightier.

In the technological area the same process would apply in choosing between solar, wind and hydro options for power generation. A functional analysis enables us to choose the best option for the site. It can also reveal additional opportunities for secondary yields, increasing total yield. See Holmgren 2002, p 160.

Network Analysis Introduced by Holmgren (1991b) to facilitate planning on sites with more than one activity node, such as an eco-village. On many commercial farms the homestead may be physically separate from the operational infrastructure and the nested zonal pattern of activities doesn't apply. In these cases we need to recognise more than one activity node connected by roads and services such as water supply. Basing our zone and sector planning on more than one focal point enables us to locate elements in relation to each of these nodes to achieve maximum efficiency.

Topic 16 - Design Features of Landscapes

Different landscapes require different design strategies. See Mollison (1988, chapters 7-12) for detail which is summarised below.

Humid Young Landscapes - coping with steep terrain involves

- Pole-framed housing to avoid excavation
- excavated benches for access to slopes for management and harvesting of tree crops
- terraced gardens
- potential for hydro-electric power generation

Humid Mature Landscapes - undulating foothills, preferred settlement sites. Features are -

- high point: cold plateau air/frosts
- upper slopes: water collection sites, forests
- the Key Point & Keylines: change of slope from convex to concave
- lower slopes: cultivation areas
- flatlands: cold air drainage/frosts
- the mid-slope thermal belt, ideal site for homes

Humid Old Landscapes - valley terraces and floodplains requiring -

- siting of buildings in relation to flood threats
- levees and embankments to control flooding of assets
- access to high ground for livestock
- planting to reduce frost and waterlogging on valley bottoms
- avoiding salination through use of trees and appropriate irrigation

Andrews (2006) provides insight into the restoration of natural hydrologies on flood plains.

Arid Landscapes - low rainfall, high evaporation rates require -

- retention of natural vegetation
- trapping and storing water in soil or underground storages
- moisture barriers: stones, mulches, etc
- swales & collection pans to concentrate water at planting sites
- accessing groundwater via planting ditches, etc
- planting to slow sand drift and wind

Minor Landscapes

- volcanic plains: fertile soils from lava and ash, need for windbreaks
- coastal sand plains: planting to cope with wind erosion, salt spray, sandy soils
- coral islands: windbreaks & foreshore plantings, building soils, water harvesting
- wetlands: high productivity, chinampa systems
- estuaries: very productive, fish traps, shellfish racks, etc.

Topic 17 - Design of Fire-prone Landscapes

Much of Australia is fire-prone and fire-adapted. Mollison (1988, pp 451-456) discusses design against fire in general terms. Webster (2000**)** covers fire behaviour, risk factors and safety more specifically in the Australian context. Fire-safe design includes -

- sector planning to assess direction and degree of risk
- planting of fire resistant species as fire shields
- placement and maintenance of open space (fire-breaks, roads, grazed paddocks/lawns, water bodies), in fire sector to protect buildings, livestock etc

- a reliable water supply
- reduction of hazards: wood piles, eaves and gutters, sub-floor spaces that collect embers
- the need for a fire plan for emergencies

Topic 18 - Designing Kitchen Gardens for Zone 1

Functions of Food Gardens. Supplying fresh fruit and vegetables is the primary function. Gardens can also supply animal fodder, medicinal herbs, eggs and meat, recycle household wastes, provide recreation for children & adults, maintain cultural links with traditional foods, preservation of heritage varieties, conserve habitat for useful birds, frogs, lizards, etc. The role of gardens in society is discussed by Holmgren (2002) under Principle 8, *Integrate Rather than Segregate,* Principle 10, *Use and Value Diversity*, and Principle 12, *Creatively Use and Respond to Change*. See also Holmgren (1991a) for a perspective on gardening as a legitimate form of agriculture. An important strategy to cope with a low energy future will be the development of efficient food production systems in urban areas.

Meeting Needs with Natural Systems in the Garden. Soil fertility is built through manuring, mulching & composting, supplemented with other organic and mineral fertilisers to maintain nutrient balance. See Mollison (1988, pp 182-226) and Handreck (2001) for soil management recommendations. In Permaculture plants are stacked to maximise use of available sunlight, intercropped and time stacked. Diversity is promoted and monocultures avoided. Weed control and soil preparation is achieved with animal "tractors" (chickens, guinea pigs, rabbits, etc). Earthworms and biological activators such as BD 500, Lactobacillus cultures, proprietary bacterial cultures (EM, OMX), and compost teas can enhance biological activity.

Spatial Arrangements for Zone 1 Kitchen Gardens. Cool climate strategies to make best use of space in gardens are covered by Mollison (1988, pp. 417-423). Other applicable strategies used in tropical climates are discussed in Chapter 10 pp. 250-300, including mandalas. Dryland gardening strategies are covered in Chapter 11 pages 371-385. A boxed example on pages 270-271 illustrates garden design integrated with a household in Brazil, the principles of which have wide applicability.

Strategies for increasing yield and for managing pests and diseases need to be incorporated in the design. Bennett (1995) provides a comprehensive guide to organic gardening in southern Australia.

Topic 19 - Designing Zone 2 Systems

Zone 2 design involves a change of scale, with different strategies. See Principle 7, *Design from Patterns to Details* (Holmgren 2002) for a discussion of appropriate scale. Most fruit trees, which yield large amounts of fruit seasonally, are best suited to zone 2, though dwarf and espaliered trees may be used in a zone 1 garden.

There are emerging patterns for zone 2 food production systems, but not all authors distinguish between food forests and orchards.

Food Forests/Forest Gardening - integrated production from perennial trees, shrubs and ground covers, in self-maintaining systems. Robert Hart pioneered temperate Forest Gardening in Shropshire, based on tropical systems (Hart 1991). Patrick Whitefield developed this for UK conditions (Whitefield 1996) describing roles for wildlife in forest gardens, but not domesticated animals. Forest gardening in north-eastern USA is treated in great depth by David Jacke in the exhaustive two volume treatise *Edible Forest Gardening* (Jacke & Toensmeier 2005).

Mixed Orchards. Increased management can produce higher yields using more domesticated cultivars. Animals, rarely appropriate in a forest garden, can be used in orchards for grazing of weeds and pest control. Mollison (1988 p 423) recommends the establishment of mixed herb layers to replace grasses, but also advocates the use of grazing animals and even pigs as trees mature which would not be compatible with a productive ground layer.

Market Gardens. Small scale mixed cropping systems fit between kitchen gardens for zone 1 and large scale commercial farms at zone 3 scale (Holmgren 2002, p 140). A useful criterion is the function - a market garden that provides supplementary income, would be a zone 2 element, irrespective of its size. A zone 2 Market Garden is ideally sized to supply local Farmers Markets.

Community Gardens. At the landscape scale, urban and suburban Community Gardens are a scale up from backyard kitchen gardens. As well as food production an important function is social and skills development. The Australian City Farms & Community Gardens website is a great resource (www.communitygarden.org.au).

Urban Agriculture as a Zone 2 activity. Food production in urban areas can take advantage of much under-utilised space - rooftop gardens, restaurant gardens, School Kitchen Gardens, etc.

Topic 20 - Genetic Diversity in Food Crops

Holmgren's Principle 10, *Use and Value Diversity* discusses how diversity applies to system design. Diversity can be genetic, spatial and temporal. Permaculture, from its inception, has emphasised the value of integrating a wide variety of productive species and the use of diversity in space and time to increase system yields.

Mollison (1988, pp. 417-419) stresses the importance of saving and sharing our seed resources. The genetic resources in our food plants are the result of thousands of years of selection and improvement by countless communities around the world. Commercialisation of seed sources has greatly reduced this accumulated diversity. Holmgren (2002, pp. 42-43) discusses the role of seed-saving under Principle 2, *Catch and Store Energy*.

See the *Seed Savers Handbook* (Fanton & Fanton 1993) and the *Complete Book of Fruit Growing in Australia* (Glowinski 1991) for information on vegetable and fruit diversity for Australian gardens.

Topic 21 - Trees in Permaculture

Trees provide useful products (fuel, food, forage, structural materials, water, mulch), perform important ecosystem functions (photosynthesis, climate modification, soil stability, wildlife habitat, etc), and can be used for a wide variety of functional purposes in the landscape (shelterbelts, windbreaks, shade trees, animal barriers, fire shields, dust barriers, frost diversion, salinity control). Tree plantings can be multi-functional, performing useful services as well as yields of useful products.

Mollison's chapters 10, 11 and 12 discuss ways in which trees can be used as the basis for productive systems in tropical, dryland and cool temperate climates. Holmgren (2002) discusses the role of trees under Principle 5, *Use and Value Renewable Resources* (pp. 97-100), Principle 7, *Design from Patterns to Details* (p 130-137), Principle 9, *Use Small and Slow Solutions* (p 193-196), and Principle 11, *Use Edges and Value the Marginal* (p. 231). Holmgren (1994) provides detailed advice on the use of trees in the volcanic landscapes of central Victoria.

Topic 22 - Animals in Permaculture

Animals are an integral part of natural ecosystems and are thus important in the cultivated systems of permaculture. Animals provide food, fibre and manure, control weeds and invertebrate pests, convert waste to useful products, can be used for soil cultivation, for haulage and transport. Bees pollinate crops, dogs and alpacas can be used for stock control and protection from predators. The horse is aptly used as the icon for Holmgren's Principle 5, *Use and Value Renewable Resources and Services.*

To include animals in designed systems, their intrinsic behaviours and specialised needs require a good understanding, as there are welfare issues involved as well as environmental and energy considerations. Just as a healthy soil produces healthy plants, animals that have their full range of needs met will be more contented and productive than those that are stressed.

For Permaculture systems animals need to be chosen for their ability to contribute to system yield. Hardy varieties that are able to fend for themselves will perform much better than many modern breeds that are only productive with lots of external support (Holmgren 2002, p 59). The roles of animals in Permaculture systems are discussed by Mollison (1988) in chapters 10, 11 and 12. An innovative use of animals in managing garden and agricultural systems is provided by the "animal tractor" concept (pp. 299-300).

Animals for Zone 1 will generally be limited to small animals housed in fixed or portable caging, with limited free-range access to the garden. Animals selected for zone 2 will be those that can free range in the orchard or cope with pens and small yards. Paddock animals for Zone 3 will be the more traditional livestock breeds with scope for trialling newer species. As with plants, the use of old and rare breeds should be considered as a contribution to genetic diversity in farm stock. Coleby (1991) provides practical advice on maintaining healthy animals.

Rangeland animals for Zone 4 can be traditional livestock species provided they are ranged at low stocking rates. Harvesting wildlife and feral animals as a resource and as a population management technique needs to be seriously considered as a replacement for traditional rangeland pastoralism in Australia.

Topic 23 - Harvesting and Storing Water

Freshwater is a relatively scarce commodity (Mollison 1988, pp. 152-153) and will increasingly become a limiting factor in agriculture and urban expansion, particularly as climate change begins to affect long-term rainfall patterns. It is an essential ingredient in life processes: nutrient exchange, transpiration in plants, water balance and excretion of toxins in animals. It is used as a medium for food production (aquaculture), a source of energy, a modifier of local climates and in combination with other functions can be used for recreation.

Water as a resource and form of energy is discussed by Holmgren (2002) under Principle 2 *Catch and Store Energy*, water purification under Principle 5 *Use and Value Renewable Resources and Services*, and water supply under Principle 8, *Integrate Rather than Segregate*. Mollison (1988, Chapter 7) discusses the water cycle, earthworks for water storage in the landscape. Water harvesting strategies for coral islands are discussed in Chapter 10 and for drylands in Chapter 11.

Mollison's chapter on water includes Yeomans' keyline system (Yeomans 1965) for water harvesting and management on farms, which has been widely adopted in Permaculture as a strategy for sustainable water use. Lancaster's 3 volume *Rainwater Harvesting for Drylands and Beyond* (Lancaster 2008) is a comprehensive resource text with wide applicability.

Peter Andrews' Natural Sequence Farming advocates the restoration of natural hydrologies on floodplains rather than dam storage and pumped irrigation systems. See www.nsfarming.com/principles for an excellent summary of this approach.

Topic 24 - Water Conservation and Recycling

See Mollison (1988 pp 170-180), for techniques for recycling waste water including reed-bed treatment. Mobbs (1998) describes an intensive inner-city system that he developed in Sydney. Natural swimming pools that use biological filtration are described by Mollison (1988 pp 170-181). Windust (2003) describes a range of water-wise strategies and lists drought tolerant plants for garden use. See also Gray (2004) and Ludwig (1994) on greywater treatment and re-use. Jenkins (1994) is the definitive reference on composting toilets.

Topic 25 - Aquaculture

Mollison (1988, Chapter 13) points out the energetic advantages of growing food in a water medium. Holmgren (2002) refers to the ecological efficiency of nutrient-rich, shallow water aquacultures in his discussion of Principle 2, *Catch and Store Energy.*

Freshwater Aquaculture. Mollison's chapter 13 discusses the factors that affect yields in aquatic systems, strategies for designing ponds and systems for farming invertebrates as fish food. Aquatic systems can range from backyard frog ponds producing small harvests of aquatic plants to farm dams growing yabbies and introduced fish fingerlings to full-scale integrated production systems. Limiting factors are the water supply and the ability to grow the producer organisms at the base of the aquatic food chain.

Fish farming has a long tradition in south-east Asia, but techniques that work in that environment cannot necessarily be applied in Australia without modification. Many of the productive species used there are also not available here. Romanowski (1994, 2007) provides a very comprehensive guide to freshwater systems suitable for Australian conditions. Furuno (2001) describes a productive integrated rice and duck farming system in Japan.

Mariculture. Our utilisation of our marine resources is no longer sustainable. We need to invoke permaculture design principles to ensure sustainable harvests. Traditional harvesting techniques are equivalent to zone 4 harvesting of wildlife on land. Declaration of no-fishing marine reserves is equivalent to a zone 5 conservation area on land. Shellfish cultivation on racks is equivalent to zone 3 farming. Farming of sea fish in marine cages requires high inputs of food and medicinal compounds. Farming of marine fish in saline inland ponds has potential.

Topic 26 - Agricultural Strategies for Zone 3

A thorough understanding of the relationship between our agricultural landscapes and the human settlements that they support will be crucial to the development of sustainable societies as we design our way to a low energy future. This may well prove to be Permaculture's biggest contribution to society. In the early days of Permaculture the emphasis was on small-scale systems. Permaculture has been widely accepted in Third World countries where traditional landholders have retained their rural skills. In industrialised countries farmers have become increasingly reliant on massive energy inputs and chemical fixes. Permaculture has not yet made a significant impression on the agricultural sector in developed economies, but keyline techniques, cell grazing and regenerative agriculture concepts are beginning to gain the attention of mainstream agriculturists. Examples of classic rural design, such as The Food Forest at Gawler in SA are few and far between (see Brookman 2010, www.foodforest.com.au).

Mollison (1988, pp. 4-7) provides a schematic view of the transition from contemporary agriculture to a sustainable system based on forage farming. In Principle 7 *Design from Patterns to Details,* Holmgren emphasises the importance of working at the appropriate scale when designing broadacre systems. Thus, one cannot simply apply techniques that are applicable to a backyard garden to a larger scale, as many idealists who have moved from the city have tried to do, unsuccessfully. Mollison's table on page 50 illustrates how various factors can change as one moves from zone 1 to zone 4, but with an emphasis on forest gardening which is not so applicable to zone 3 agriculture.

In chapters 10, 11 and 12 of the *Designers Manual*, Mollison discusses strategies for agricultural systems in different climates. The prior chapter 9 covers strategies for carrying out earthworks in rural landscapes, from measuring levels and slope, establishing benches and drains for roads, building sites and terraces, and the use of appropriate machinery. Good planning and design will ensure that energy expended in earth-shaping is repaid manyfold to comply with Holmgren's

Principle 3 *Obtain a Yield*. Holmgren (2005b) explores permaculture design as a basis for an organic agriculture in a low energy future.

Whole Farm Planning recognises 8 land classes based on vulnerability to degradation from cropping and grazing practices. Holmgren (1991b) extends this to recognition of land systems.

Emerging patterns applicable to broadacre farming include alley cropping and keyline cultivation.

Topic 27 - Strategies for Zones 4 and 5

Good rural property design requires a balance of zones 3, 4 and 5 elements, representation of all Ecological Vegetation Classes, structural diversity in retained vegetation, wildlife corridors, attention to patch size effects.

Zone 4 Pastoralism. Pastoral agriculture has had drastic affects on Australian rangelands, with changed fire regimes, replacement of natural vegetation with unproductive woody weeds and massive species extinction. Sustainable use of our rangelands will require changes to the way we manage these landscapes and harvest resources from them. Mollison (pp. 300-303) discusses strategies for grassland and range management in tropical climates, with suggested interventions to improve productivity. Strategies for harvesting wildlife, discussed in chapter 12 (pp. 442-446), are applicable to zone 4 situations, where natural habitat is retained and managed to produce a sustainable yield.

Zone 4 Forestry. Timber production in State-owned forests is a major land-use in humid Australia. Most discussion of forestry in Permaculture is related to shelter belts, orchards, agroforestry and plantations where timber is grown as a crop, rather than being harvested from a natural forest and should be considered a zone 3 activity. Holmgren (2002) discusses a range of forestry issues under Principle 2, *Obtain a Yield* (pp. 41-42), Principle 5, *Use and Value Renewable Resources and Services* (p 105), Principle 7, *Design from Patterns to Details* (pp. 131-133), and Principle 9, *Use Small and Slow Solutions* (pp. 194-196). These all relate to zone 4 management. Holmgren (1995b) presents some forthright views about forest management in a submission to the Victorian Government on the Wombat State Forest.

Zone 5 Strategies. At the property level issues to be considered include -
- the management of environmental weeds - managed zone 4 vegetation can be a buffer
- linking habitat patches with neighbours to increase patch size and connectivity
- use of fire to encourage regeneration and succession
- protection of zone 5 patches to provide refuges in arid zones during droughts.

At the landscape level Permaculture concepts can be applied to National Parks and reserves -

- campgrounds and ski lodges as a zone 1 land-use.
- fuel-reduction in buffer zones around assets (zone 4), unmanaged wilderness in remote areas.

Topic 28 - Community Strategies

Individuals within communities must have their basic social needs met by other members of their community. In turn individuals have a responsibility to provide for the needs of others. Communities where individual needs are not met become dysfunctional. Functional communities are structured in ways that allow individuals to contribute according to their capabilities. "Right Livelihood" ensures that work is available for everyone to provide for creativity, diversity and satisfaction.

Mollison discusses the ethical basis for an alternative society in chapter 12 (p 507). Holmgren (2002) discusses social relationships under Principle 3, *Obtain a Yield* (pp. 61-62),
Principle 4, *Apply Self-regulation and Accept Feedback* (pp. 73-87) and Principle 12, *Use and Respond to Change Creatively* (pp. 255-257).

Community-based land-use and conservation models include Commonworks (Mollison 1988 p 549-550), Ecovillages (Mollison 1988, pp 519-530), the Tilbuster Common (Williamson, et al. 2003), Landcare (Holmgren 1995c). Community based enterprises include City Farms, Community Gardens, Community Supported Agriculture, Friends Groups, WWOOFing, Seed Saving Networks (Fanton & Fanton, 1993).

Topic 29 - Bioregional Organisation

Bioregions are based on geographical or ecological criteria that help to define boundaries and hence a sense of community or "place". Phil Gall and Cam Walker (Gall and Walker 1998) trace the the concept back to the work of Peter Berg and Raymand Dassman, in North America in the 1960's. Berg and Dassman started by mapping biomes to relate communities to the ecosystems in which they lived and with which they interacted.

Mollison (1988, pp 510-514) discusses bioregional organisation and provides a framework for developing a Bioregional Resource Index - a systematic identification and listing of all the resources available in the region. He believes that the successful mobilisation of bioregional resources depends on a core of people with vision and initiative to organise enough others to develop the functional links within the community and to recognise its boundaries. The Community Harvest Project in the Yarra ranges is an example of this working (www.communityharvest.org.au).

The development of local seasonal calendars and the organisation of local festivals are two strategies to enhance the sense of bioregional community.

Holmgren discusses rebuilding of communities under Principle 8, *Integrate Rather than Segregate,* and sees a return to bioregional architecture as we move back to the use of locally-avaliable recources (p 150). Mollison's chapter 14 covers strategies for community organisation and explores a range of options for land access.

Decision-making processes in community groups and enterprises include strategic planning, Resource Management (Savoury 1988), de Bono's Six Thinking Hats, See Mollison (1988, pp 530-533) for forthright views on effective working groups. The Scandinavian Natural Step process aims to shift an organisation's thinking away from the piecemeal management of immediate problems to the creation of a long term and strategic plan towards sustainability (www.naturalstep.org).

Topic 30 - Economic Systems and Communities

Economics is about the way people in societies trade with each other. Money, developed as an exchange medium in economic transactions, in recent years has become a commodity. The Centre for the Advancement of the Steady State Economy is advocating a move away from the current paradigm of continuous economic growth (http://steadystate.org). A steady-state economy has a stable population, is based on ecological limits and balances production and depreciation.

Holmgren's views on the current state of our economic system are discussed under Principle 12, *Use and Respond to Change Creatively.* Mollison discusses formal and informal economies, LETS, and local currencies. Margrit Kennedy (1995) reviews the function of money, the effect that interest-based systems have on economies and historical moves to change the system. She sees the interest-based system that we operate in as a mechanism to direct the wealth generated by the producers in society to those who have the wealth to finance the productive enterprises. Thus the rich continue to get richer and the poor get poorer.

Western banking systems create further wealth through the creation of debt via the fractional reserve system.

Topic 31 - Strategies for Economic Reform

Mollison (1988, pp 533- 545) discusses alternatives to our current economic system - development of the informal economy through bartering and L.E.T.S. and use of the formal economy through community-based credit unions, revolving loan funds and ethical investment. The Grameen Bank in Bangladesh and the Community Bank model of Bendigo Bank in Australia , in different ways, orient banking towards local communities.

Kennedy (1995) advocates reform at three levels - replacement of interest with a usage fee on money, abolition of freehold title for land and tax reform. Strategies for effecting change through bottom-up action are discussed by Holmgren under Principle 4, *Apply Self-regulation and Accept Feedback.*

Topic 32 - Urban Settlement Patterns

Settlements provide social, economic, service and cultural functions for the communities that inhabit them. The range of functions depends on the scale of the settlement, which can be ordered hierarchically from houses, to clusters or hamlets, villages, townships, towns, regional cities and metropolitan centres.

Urban Patterns *A Pattern Language* (Alexander, et al, 1977) provides very useful models for urban design at three levels - arrangements of buildings in the landscape, orientation and function of buildings at the site level and design of the buildings themselves. The patterns, which serve as models for design, are based on satisfying human needs and behaviours. Strategies for the appropriate design of settlements in tropical, arid and cool temperate climates, are discussed by Mollison in chapters 10, 11, and 12.

Holmgren is a strong advocate for retrofitting the suburbs for sustainability (Holmgren 2005a).

Topic 33 - Intentional Comunities and Rural Settlements

Co-housing in urban situations and Eco-Villages in more rural areas are forms of intentional communities that provide communal lifestyles with a strong ecological base. They mix private allotments with shared community space and services and are being widely promoted by Permaculture designers. Mollison (1988, pp 519-530) discusses village development in chapter 12, providing a range of criteria for use in their design. Holmgren argues for eco-villages based on body corporate/strata titles as a land tenure model, and discusses his own experiences developing the Fryer's Forest community in central Victoria, under Principle 8, *Integrate Rather than Segregate.* See also Holmgren (1997a) re Fryers Forest and www.crystalwaters.org.au for information on Crystal Waters Permaculture Village at Maleny in southern Queensland.

Topic 34 - Patterns in Housing Design

Housing provides environmental, social and economic functions. The design features of housing in different climates are discussed by Mollison in chapters 10, 11 and 12, and by Holmgren (p 150) in relation to bioregional architecture. Mollison provides some precautionary notes about house foundations in chapter 8 (pp. 221-222).

In the tropics high humidity requires housing with good cross ventilation and insect screening. Exploded designs are appropriate. Insulation and shade are required in hot desert areas. Orientation and thermal mass for passive solar gain are important features in cool climates, while compact lightweight construction and good insulation may be the most appropriate in cold areas.

In Permaculture design housing is an integral part of the system that it supports, be it urban or rural. Management of solar energy, water supply and waste disposal need to be integrated with the design of the landscape in which the house is situated. Alexander's *Pattern Language* (Alexander et al 1977) emphasises the concept of the house being embedded in its landscape. Emerging patterns for Permaculture house design include clerestory windows, attached greenhouse and mud-room entrances.

Design considerations in siting houses include site selection as the hub of activities, pedestrian and vehicular access, cost of excavations on slopes, aspect and exposure to wind, sun, rain and frosts, cost of connections to power, water and drainage services if required, the risks of fire and flood and the aesthetics of privacy and views.

Topic 35 - Building Materials

Choice of materials involves consideration of their functionality, availability, affordability, durability, recyclability and the environmental effects of their production, transportation and use. The conventional timber-framed brick veneer suburban house in southern Australia is not the best model, despite regulatory efforts to enforce energy performance standards.

Although Mollison (1988) emphasises design in his discussion of housing in humid climates (pp 261-266), drylands (pp 359-368) and cool climates (pp 414-415), he also touches on some aspects of material selection. His Bioregional Resource Index outline includes construction materials (p 512). Holmgren (2001, pp 45-46) addresses the embodied energy in the built environment and under Principle 7 (pp 150-151) discusses the use of local materials in the development of bioregional architectures.

Lawson (1996) gives a thorough coverage of the issue of embodied energy in building materials, “describing manufacturing processes and their environmental impacts” supported by embodied energy ratings of a range of Australian materials.

The Forest Stewardship Council runs a sheme for the certification of forest timber to aid consumers in their choice of ethical products (www.fscaustralia.org).

Topic 36 - Design of Functional Buidings

Designing for Energy Efficiency in Temperate Climates. Hollo (1995) covers the five principles of passive solar design - orientation, glazing, thermal mass, insulation and ventilation - and gives architectural examples for different climates. Orientation to sun needs to take account of winter and summer sun angles. Thermal mass in internal walls and floors provides heat storage and slow release. Venting systems provide cool air inflow and warm air outflow in hot weather. Holmgren (1995a) and Mollison (1988) provide more detail of innovative solutions - warm air inflow from attached greenhouses in winter, cool air venting from sub-floor tunnels, and shade houses, clerestory windows to allow deep light penetration and heating of rear rooms, planting around buildings provide shade, insulation, cool air mass, etc. Fencing, trellising and pergolas to modify winds, block summer sun, etc. Double glazing of windows and use of boxed pelmets and drapes can minimise heat loss from rooms in cold climates. The mud room can serve as an airlock as well as utility entrance.

Designing against Termites. Understanding termite biology and behaviour is necessary. Selection of durable timbers, visual access, ventilation, and exposed slab construction can limit attack and aid surveillance. Physical barriers can be provided with ant caps, granitgard, termimesh. Minimising nesting sites near buildings is advisable.

Designing Against Catastrophe. The Flywire House (Holmgren 2009b) provides a case study of design in a fire prone bushland environment. Specific building techniques and styles will apply when building in areas subject to flooding, cyclones in tropical areas, tsunamis in coastal areas, earthquakes along fault lines, high rainfall areas subject to landslips.

Designing with the Health & Well-being of Occupants in Mind. The widespread recognition of “sick building” syndrome has given rise to a new discipline of Building Biology, with many parallels to Permaculture. Responsible design will involve alternatives to toxic laminates, paints, treated timber, the avoidance of radiation and electric fields, minimising dust mites. Designing using harmonic proportions for living spaces can make occupants more comfortable. Alexander's *Pattern Language* (Alexander et al 1977) provides patterns for the functional design of buildings that satisfy basic human needs and behaviours.

Topic 37 - Appropriate Domestic Technology

Holmgren’s Future Energy Scenarios (Holmgren 2009) are based around the choices we face in a transition to a low energy society. That will entail appropriate, but not necessarily alternative, technologies.

We use technology to enhance our use of the built environment, to harvest energy and to dispose of our wastes. Much new technology is sophisticated and high in embodied energy. Permaculture seeks out the simplest technologies that will function with minimum maintenance - passive rather than active systems. Good design will avoid the seduction of high-tech solutions that are costly in terms of embodied energy in manufacture, energy for them to operate and use of non-renewable resources.

Permaculture Design operates at three scales - landscapes, sites and components. Most technology applies to components of systems. Mollison's Designer's Manual focuses on site design, but some aspects of technology associated with house design are covered in chapters 10, 11 and 12 (cool air tunnels, solar chimneys, etc).

Holmgren discusses the pros and cons of technology under Principle 5, Use and Value Renewable Resources and Services, giving an example of an appropriate choice in the design of a filtering system at storm-water outlets on page 108. Magazines such as Earth Garden and Grass Roots are sources of ideas.

Domestic Technologies. We need to seek out and use appropriate technologies for lighting, space heating and cooling, cooking and storing of food, hot water, clothes washing, drying and ironing, water conservation. Many of these are traditional systems, such as the kitchen clothes drying rack on a pulley known as a “fleek” in Yorkshire. See Mollison and Slay (2000 pp 92-94).

Composting Toilets. These recycle waste nutrients to develop closed systems. Availability of water may determine choices between dry and wet-composting systems. Jenkins (1994) provides the most comprehensive coverage of the subject.

Topic 38 - Power Generation and Transport

Pumping Water. renewable sources of energy are wind (windmills), water (hydraulic rams, Glockerman pumps), solar cells.

Biogas from Methane Digesters. Low cost systems can process manure in hanging or floating plastic bags with gas piped off for domestic use. Fixed systems combine a digester with a floating storage tank to pressurise gas.

Power Generation. Although there is no mention of renewable electricity generation in Mollison’s Designer’s Manual, it has always been of concern to those seeking to live sustainably. Options include photo-voltaic arrays, wind turbines, micro-hydro plants, solar-thermal chimneys, steam boilers. Grid interactive systems are favoured where there is access, battery storage in remote areas. Sources of further information are - The Alternative Technology Association's journal "ReNew", Rainbow Power Co Catalogue "Energy from Nature" (Pedals 2000) and the "Earth Garden Book of Alternative Energy" (Gray 1966). Energy conservation, rather than replacement with renewables, is advocated by Fisher (2002)

Transport and Fuels. Good design will minimise the need to travel or transport goods. Bicycles and public transport for personal travel. Rail and shipping for transport of goods. Biofuels (vegetable oil, bio-diesel, alcohol) require conversion of agricutural land. Electric and hydrogen vehicles require a renewable source of power. Compressed Natural Gas needs specialised tanks for storage. High embodied energy in hybrid vehicles.

Topic 39 - Working as a Design Consultant

Aspects of working professionally as a design consultant are covered at the end of Mollison's chapter 3 (p 68). Most chapters also have a concluding section "Designer's Checklist". Important steps in the consulting process are the assessment of client needs and the production of a design that can be "owned" by the clients. The best design in the world will fail at the implementation stage if the clients have not been adequately involved in its preparation. It is also important to identify roles for specialists.

Developing Your Expertise. Graduates of a PDC are regarded as Trainee Designers. Basic skills need to be developed through practical application - voluntary projects eg Permablitz,

working with a mentor, school and community gardens, talks to garden clubs, teaching in areas where you have experience.

Design work can be a simple as a table top sketch of a garden layout to get a home-owner started or a full-scale design and establishment project for a commercial system or municipal system.

Topic 40 - Business Strategies

Farm-based Business. Yields from your system can be sold via:

- Farmgate sales & roadside stalls (local regs may apply)
- Wholesaling to local retailers: crafts, garden produce, etc
- Farmers markets, stalls at festivals and field days, etc
- Community Supported Agriculture - weekly supply of boxed lots to households

Urban Consultancies. Opportunities are developing in Local Government in food security and landcare, in Event Management, home and Community Garden planning and development, waste-water treatment, energy generation.

Demonstration and Training in Pc. Good demonstration sites are popular for organised tours, training workshops, teaching venues and can supplement income from productive enterprises.

Legal options and structures for enterprises. These can be Sole Proprietor, Partnerships, Cooperatives, Companies, Trusts. Mollison(1988 pp 551-520) discusses various forms of trust in detail.

Topic 41 - Strategies for Change

Change starts at home - be green and practical, grow your own, support organic agriculture, Slow Foods, support the local economy., adopt the 5 “R” of waste minimisation - Reject, Reduce, Re-use, Repair, Re-cycle. Join and support environmental and social action groups.

Strategies that derive from Holmgren's Principle 12, *Use and Respond to Change Creatively,* include:

- Seeing change as an opportunity to develop new ways of doing things
- personal outlook and commitment, recognising that **we** are both the problem and the solution
- working from the grass-roots up, not the top down
- coping with bureaucracy: use of precedents to get a favourable decision, establishing monitored trial systems
- Use the ecological principle of succession

Topic 42 - Beyond the Design Course

Graduates of the Design Course are deemed to be members of the "College of Graduates", with rights to use the word "Permaculture" in professional activities. Permaculture Institutes are teaching facilities. Permaculture Academies to award higher degrees have long been a goal of Mollison's, but the development of accredited Permaculture courses within the TAFE system and degree level subjects at University level may make Permaculture academies redundant.

Permaculture journals have flourished overseas, but local publications - *Permaculture International Journal, The Permaculture Edge* and *Green Connections* - have all ceased after making major contributions to the development of Permaculture in Australia. Permaculture International Ltd (PIL) has become the National body representing the Permaculture movement in Australia.

Autonomous local Permaculture associations operate in all States. These organisations run various gatherings, conferences, site visits, workshops, regular talks and publish newsletters, run email networks, etc. Periodical Convergences are held to enable PDC graduates to discuss matters of mutual interest. The Oceania chapter of the Global Eco-village Network (GEN) is administered from the Crystal Waters Permaculture community in Queensland.

Workshops and Field Days provide opportunities to gain in-depth experience. Several educators offer advanced courses. Graduates who successfully complete at least two years work applying Pc can apply for a Diploma from Mollison's The Permaculture Institute in Tasmania.

The Australian Pc movement has established an Accredited Permaculture Training package (APT™) registered with TAFE. This is owned and administered by PIL and provides recognised competency-based training via Certificates I - IV and Diploma (level V). PDC holders can claim some credits towards these courses.

Tertiary level courses are available through Charles Sturt University, Orange (Bachelor in Ecological Agriculture), University of Western Sydney, Hawkesbury (Social Ecology), Gaia University (online courses)

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Appendix 1 - History of the Permaculture Concept

Permaculture was developed in Tasmania during the 1970's by Bill Mollison and David Holmgren (Mollison & Holmgren 1978) as a response to the energy crisis of the early 70's and growing concern at world population growth and resource depletion. It had its origins in the concept that self-sustaining cultivated ecologies could be assembled in ways that mimic natural ecosystems.

Some milestones along the path to Permaculture have been -

- Jan Smuts developing Holistic Resource Management in the 1920's in South Africa. Alan Savoury further refined this for agricultural application in the 1980's (Savoury 1988).
- In 1924 Rudolph Steiner prescribed agriculture techniques which became the Biodynamic system of agriculture, Germany.
- J. Russell Smith (1953) suggested permanent agriculture based on tree crops.
- 1962 Rachel Carson's *Silent Spring* alerted the world to the dangers of modern synthetic pesticides (Carson 1965).
- P A Yeomans (1965) development of Keyline water management techniques in the Kiewa Valley.
- The Club of Rome Report *Limits to World Growth* (Meadows et al 1972) demonstrated the interaction of population size, non-renewable resources, industrial output per capita, food production and pollution.
- Schumaker's *Small is Beautiful* (1974) advocated human-scale systems.
- Ecologist Howard Odum pioneered studies of energy and ecosystems in the 1970's (Odum & Odum 1981).
- Masanobu Fukuoka's *One Straw Revolution* (1978) inspirational work on low maintenance cropping systems.

Major steps in the development of Permaculture have been -

- 1972-76: Trials of low-maintenance guilds of productive plants and animals by Mollison & Holmgren in Tasmania.
- 1976 - first publication of ideas in *The Organic Farmer and Gardener*.
- 1978 - publication of *Permaculture One* (Mollison & Holmgren 1978), which brought Pc to the attention of the world. *Permaculture Two* (Mollison 1979) followed. After Holmgren finished his studies in Tasmania he and Mollison went their separate ways with David moving to Melbourne first then settling at Hepburn in 1985 to establish "Melliodora".
- 1981 - first Permaculture Design Course held in Victoria at Buchan in January.
- 1984 - first International meeting and award of diplomas in October.
- 1988 - publication of the Designer's Manual (Mollison 1988).
- 1991 - publication of *Introduction to Permaculture* (Mollison and Slay 1991, 2000).

During the 1990's many other texts on Permaculture appeared (see recommended reading list) and Holmgren wrote many papers for conferences, submissions to Govt bodies, magazine articles, etc. These were published on CD-ROM as "Collected Writings" in 2002 (updated with extra papers 2006).
In late 2002 Holmgren published his landmark re-definition of Permaculture - *Permaculture Principles & Pathways Beyond Sustainability* (Holmgren 2002) - the first fundamental review of Permaculture since the principal texts were published, setting the scene for its wider implementation in the 21st century.

In 2004 an Accredited Permaculture Training (APT™) package was registered with the National TAFE system by Permaculture International Ltd on behalf of the Australian Pc community.

Holmgren summarises Permaculture as it is today in the Introduction chapter to *Permaculture Principles* (Holmgren 2002, pp. xix-xxx).

Appendix 2 - Key Permaculture Concepts (from Mollison 1988)

Self-managed Systems. Permaculture design aims to develop productive systems that are low-maintenance, long-lasting and provide for their own needs as well as the needs of those who construct them. Over their lifetime these systems must produce more energy and resources than are used in their construction, ie, they must yield a surplus.

Personal Responsibility. An ethical decision to take responsibilty for our own actions. We can make a difference as individuals. Every decision/action we make/take has an ecological, social or economic consequence. Change from the grass roots up, not from the top down.

Cooperation not Competition. Another ethical position to advance through co-operation with other individuals in communities and with nature. In nature competitive advantage is achieved through co-operation within species and between species.

Order and Harmony ---> Surplus Energy. Order occurs when elements in a system work beneficially together to produce energy for other uses, whereas **disorder** consumes energy. Neatness, tidiness, uniformity and straightness can signify disorder that is controlled by unproductive energy inputs.

Yields, System Yields. System yield is the sum total of all the **surplus** energy produced, stored, conserved, re-used or converted by good design. Most systems in industrial society are consumers of energy and resources, not nett producers.

Resources, Responsible Resource Management. Resources can be renewable - sunshine, wind, rain, biomass; non-renewable - minerals, fossil fuels; ordered - information, skills, technology. Responsible resource management ensures that resources continue to be available to future generations - the essence of **sustainability**.

Oversupply of Resources Creates Disorder. A system or organism can only accept that quantity of a resource that it can use productively. Any excess throws a system or organism into disorder or chaos. Oversupply or under-utilised resources create **pollution**.

Niches as Opportunities in Space, Cycles as Opportunities in Time. Ecological niches in a complex environment provide opportunities for specialisation and reduced competition, increasing system yield. Cyclic events increase the opportunity for yield. Ecological niches can be represented as a **food web** which depict the opportunities for recycling at each trophic level in an ecosystem.

Permitted and Forced Functions. Good design utilises natural functions that can be performed without stress. Forcing additional/un-natural functions invites collapse.

Stability Depends on Useful Connections, not Diversity per se. Beneficial connections between elements in a system enhances stability, whereas increasing the diversity in a system without useful connections between the elements leads to competition and disorder.

From Source to Sink. Energies and resources enter a system from their **source** and cycle through the system before leaving it or entering a **sink** where they become unavailable. Good design provides opportunities to store those energies or resources and recycle them as much as possible while they remain available.

Guilds. Combinations of animals and plants that work beneficially together to increase yields. These may not be combinations that occur naturally. Permaculture seeks new combinations that can enhance productivity.

Appendix 3 – Traditional Design Strategies now incorporated in Holmgren's Principles.

The following set of design strategies, incorporates the principles taught on most PDC's, based on the guidelines developed by Quinney (1984) and incorporated in Mollison and Slay (1991, chapter 1).

(1) **WORK WITH NATURE RATHER THAN AGAINST IT**. Information from the observation of natural processes is applied to restore health and maximise yields within a land area's capabilities. Biological resources and natural energies are used to do work, and promote the evolution of more productive varieties, combinations of species and productive ecologies.

(2) **DEVELOP & PROMOTE USEFUL CONNECTIONS.** The relative location of elements within a system determines their yields. Efficient function is achieved by the placement of elements (components) to interact and form useful connections. Under-utilised products produce pollution.

(3) **CHOOSE ELEMENTS TO PERFORM MANY FUNCTIONS**. Multi-functional elements are more useful than single-function ones, enhancing useful connections.

(4) **USE MORE THAN ONE ELEMENT TO SUPPORT EACH IMPORTANT FUNCTION**. Important basic functions (such as water supply, fire protection and household fuel) are provided for in more than one way.

(5) **PLAN FOR EFFICIENT ENERGY USE**. Energy efficiency is achieved through zoning (to conserve human energy), sector planning (to manage wild energies), slope planning (to utilise gravity) and by making the least change for the greatest possible effect.

(6) **STORE NATURAL ENERGIES.** Nutrients and energies are harvested, stored and used as close to their source as possible and are used repeatedly, where appropriate, to avoid wastage, pollution or degradation before flowing off-site or becoming unusable (source to sink). Sustainable systems accumulate more energy for later use than they require for their establishment or maintenance.

(7) **USE SMALL SCALE INTENSIVE SYSTEMS**. Good design makes maximum use of minimal space; uses productive human labour, hand tools and animals, rather than large machines and fossil fuels; and is multi-dimensional, utilising vertical space (two-storey housing, plant stacking & trellising) and overlapping successional crops (time stacking). Start small and expand areas of activity as low maintenance is achieved.

(8) **PROVIDE FOR DIVERSITY IN SPACE AND TIME**. Appropriate species diversity increases productivity and stability, using polycultures, not monocultures; appropriate species stacking; patterning; orderliness rather than tidiness; and guilds of elements that work harmoniously together. Both the built and planted environments have flexibility of use and change over time, including successional replacement of elements and species.

(9) **USE EDGE EFFECTS.** Extending and exaggerating the boundaries between adjoining systems provides additional contributions from the resources of both systems, increasing productivity.

(10) **TURN PROBLEMS INTO SOLUTIONS.** Good design turns disadvantages into advantages moderating all exaggerations. Everything can work both ways, the problem can be the solution. Unusual and abundant features, which may indicate system imbalance, are turned into resources, providing opportunities for restoration and extra yields.

(11) **USE INFORMATION AND IMAGINATION TO INCREASE YIELDS**. Permaculture uses information and creative design to minimise inputs and maximise resource connections, flows and outputs, to increase efficiency, system health and productivity. Wasteful inputs of energy, labour and capital are not sustainable.

(12) **THINK GLOBALLY, ACT LOCALLY.** Permaculture maintains international links and a global perspective, but needs are satisfied from local resources wherever possible, before looking further afield; earth-friendly lifestyles start in the home and make maximum use of bio-regional resources.

Appendix 4 - Ecological Concepts and Terminology

Gaia concept: the Earth as a self-regulating system, with feedback mechanisms maintaining stability (Lovelock 1987).

Greenhouse Effect: the moderating effect of the atmosphere where greenhouse gases, particularly CO2 and methane (CH4) trap heat. Burning fossil fuels and clearing vegetation accelerates the effect, producing climate change.

Ozone layer: Provides a UV shield, ozone depleting chemicals produce the "hole" over polar regions in summer.

Biosphere: the oceans and other water bodies (hydrosphere), the land (lithosphere) and atmosphere that support life on earth

Biomes: major global vegetation types - rain forests, deciduous forests, woodlands, grasslands, deserts, taiga, tundra, etc. Biomes are structural responses to climatic conditions, with species composition varying from region to region.

Ecosystems: communities of organisms interacting with one another and their environment

Communities: groups of plants and/or animals that occupy specific habitats

Plant Associations: associated species characteristic of particular climates, soils and aspect. In Victoria these are mapped as Ecological Vegetation Classes (EVCs).

Plant Succession: the serial replacement of groups of plants with another as conditions change, from pioneers, through several seral stages. to an end state or climax. Regular disturbnace events may prevent a plant community from reaching a climax state.

Biomass: the total material, living and dead, produced by living organisms.

Canopy: the tallest continuous layer of trees in a plant association (overstory in the USA). Isolated trees that reach beyond the canopy are **Emergents**, eg Hoop Pine in Australian rainforests**.**

Understorey: Layers of smaller trees and shrubs that can exist below the canopy (understory in the USA)

Mycorrhiza: A symbiotic association between the mycelium of a fungus and the roots of a plant, where the fungus receives root exudates from the plant and the plant receives mineral nutrients, particularly phosporus, from the fungus. A **mycorrhyzal** fungus is one that forms mycorrhyzal associations.

Allelopathy: chemical inhibition of one plant by another.

Noxious Weed: A plant declared to be an agricutural pest under Government legislation.

Environmemtal Weed. An invasive plant that is not indigenous to an area and deemd to have detrimental effects on the original ecology. Environmental weeds can be native or exotic.

Appendix 5 - ZONE DESCRIPTIONS FOR COOL TEMPERATE SOUTH EASTERN AUSTRALIA

Zone Planning: is about where to place elements in a system to conserve time & energy. Conceptual Zones are based on **distance**, with elements placed according to:

- Intensity of use (the frequency of your need to visit and the element's need for you to visit
- The space required for the element to function.

ZONE 0 - The Home - Living space, Centre of Activity (may be an office)

ZONE 1 – Kitchen Garden and Utilities Elements which support the household

- vegetables, culinary & medicinal herbs for home consumption
- the lemon or lime tree
- compost heap and/or worm farms
- propagation aids: cold frames, greenhouse and/or bush house (may be attached to house)
- garage/toolshed/workshop
- fuel storage: woodshed, gas or liquid fuel tank
- clothes line
- water tanks, ponds and/or pools
- small caged animals: bantams, pigeons, quail, rabbits, guinea pigs
- barbecue/outdoor cooking area

ZONE 2 - Intensive Production Areas (Elements that provide surplus for sale or barter - hand tools, small animals & light machinery)

- Food Forests: multi-layered fruit & nut trees, vines, berries, herbs
- Orchards, with animals for weed and pest control
- Market Gardens: row crops: vegetables, herbs, etc
- Small scale vineyards
- Shedded and penned animals: goats, poultry, ducks, geese, house cow, pigs (sheds adjoining Zone 1 for convenient monitoring), (bee hives), managed access to orchard and gardens.
- Hayshed and/or barn (adjoining Zone 3 to service paddock livestock)
- Small scale fish ponds, etc

ZONE 3 - Extensive Production Areas (Commercial farming activities - draught animals or heavy machinery)

- large scale fruit or nut orchards, vineyards, broadacre crops
- pasture and forage plots for grazing and browsing livestock
- agroforestry: combining tree crops with livestock
- large scale fish ponds and stocked dams
- planted woodlots and timber plantations (outer zone 3, sometimes shown as a zone 4 activity)

ZONE 4 - Managed Habitat (Local species, existing or re-established, managed to produce sustainable yields, buffer between cultivated areas and zone 5 wilderness)

- firewood
- structural timber & poles
- brushwood, stakes & mulching materials
- harvested wildlife (where permitted), rabbits, etc
- seasonal bees
- ranged stock at low density (ie at levels that do not degrade habitat)

ZONE 5 - Natural Habitat (managed only to restore or maintain original biodiversity)

- conservation of fauna & flora
- inspiration & recreation
- study & observation of natural processes
- catchment protection