Climate and Bioregional Analysis - Presented by Terra Perma – Charles Otway

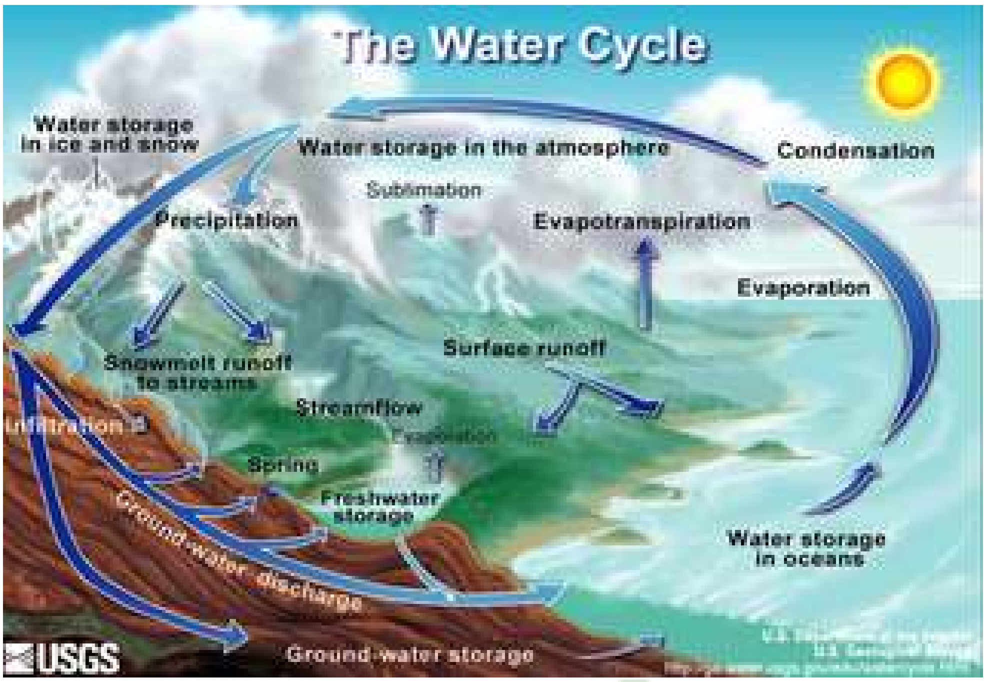
The Hydrological Cycle

The water cycle, also known as the hydrologic cycle or H2O cycle, describes the continuous movement of water on, above and below the surface of the Earth. Water can change states among liquid, vapor, and ice at various places in the water cycle. Although the balance of water on Earth remains fairly constant over time, individual water molecules can come and go, in and out of the atmosphere. The water moves from one reservoir to another, such as from river to ocean, or from the ocean to the atmosphere, by the physical processes of evaporation, condensation, precipitation, infiltration, runoff, and subsurface flow. In so doing, the water goes through different phases: liquid, solid, and gas.

The hydrologic cycle involves the exchange of heat energy, which leads to temperature changes. For instance, in the process of evaporation, water takes up energy from the surroundings and cools the environment. Conversely, in the process of condensation, water releases energy to its surroundings, warming the environment.

The water cycle figures significantly in the maintenance of life and ecosystems on Earth. Even as water in each reservoir plays an important role, the water cycle brings added significance to the presence of water on our planet. By transferring water from one reservoir to another, the water cycle purifies water, replenishes the land with freshwater, and transports minerals to different parts of the globe. It is also involved in reshaping the geological features of the Earth, through such processes as erosion and sedimentation. In addition, as the water cycle also involves heat exchange, it exerts an influence on climate as well.

The sun, which drives the water cycle, heats water in oceans and seas. Water evaporates as water vapour into the air. Ice and snow can sublimate directly into water vapour.



Evapotranspiration is water transpired from plants and evaporated from the soil. Rising air currents take the vapour up into the atmosphere where cooler temperatures cause it to condense into clouds. Air currents move water vapour around the globe, cloud particles collide, grow, and fall out of the sky as precipitation. Some precipitation falls as snow or hail, and can accumulate as ice caps and glaciers, which can store frozen water for thousands of years. Snowpacks can thaw and melt, and the melted water flows over land as snowmelt. Most water falls back into the oceans or onto land as rain, where the water flows over the ground as surface runoff. A portion of runoff enters rivers in valleys in the landscape, with stream flow moving water towards the oceans. Runoff and groundwater are stored as freshwater in lakes. Not all runoff flows into rivers, much of it soaks into the ground as infiltration. Some water infiltrates deep into the ground and replenishes aquifers, which store freshwater for long periods of time. Some infiltration stays close to the land surface and can seep back into surface-water bodies (and the ocean) as groundwater discharge. Some groundwater finds openings in the land surface and comes out as freshwater springs. Over time, the water returns to the ocean, where our water cycle started.

Precipitation - Condensed water vapor that falls to the Earth's surface . Most precipitation occurs as rain, but also includes snow, hail, fog drip, etc.

Canopy interception - The precipitation that is intercepted by plant foliage and eventually evaporates back to the atmosphere rather than falling to the ground.

Snowmelt - The runoff produced by melting snow.

Runoff - The variety of ways by which water moves across the land. This includes both surface runoff and channel runoff. As it flows, the water may seep into the ground, evaporate into the air, become stored in lakes or reservoirs, or be extracted for agricultural or other human uses.

Infiltration - The flow of water from the ground surface into the ground. Once infiltrated, the water becomes soil moisture or groundwater.

Subsurface Flow - The flow of water underground, in the vadose zone and aquifers. Subsurface water may return to the surface (e.g. as a spring or by being pumped) or eventually seep into the oceans. Water returns to the land surface at lower elevation than where it infiltrated, under the force of gravity or gravity induced pressures. Groundwater tends to move slowly, and is replenished slowly, so it can remain in aquifers for thousands of years.

Evaporation - The transformation of water from liquid to gas phases as it moves from the ground or bodies of water into the overlying atmosphere. The source of energy for evaporation is primarily solar radiation. Evaporation often implicitly includes transpiration from plants, though together they are specifically referred to as evapotranspiration.

Condensation - The transformation of water vapour to liquid water droplets in the air, creating clouds and fog.

Transpiration - The release of water vapour from plants and soil into the air. Water vapour is a gas that cannot be seen.

Water in the Landscape

"The water cycle and the life cycle are one" – Jacques Cousteau

Water is one of the few inorganic liquids, and the only substance that occurs naturally as a solid, liquid and gas. It is the most universal solvent, has the highest surface tension of all liquids other than mercury, and is a rare mineral, in fact the world's most critical resource

Only 3% of earths water is fresh - rest is ocean. Of the planets total fresh water supply:

- 75% -Glaciers and ice sheets
- 11% -Available ground water (to 600m)
- 14% - Deep ground water and aquifers (below 600m)
- 0.3% -Lakes and ponds
- 0.06% - Soil moisture -forests
- 0.03% - Rivers
- 0.035% -Atmosphere

In designing a system we aim to:

- Procreate life (growing organisms)
- Develop productive water systems (aquaculture)
- Use water as many times as possible before it passes out of the system.
- Increase surface storages
- Most efficient water storage is in the ground.
- Reduce run off
- Decrease evaporation
- Increase residency time – slow it, spread it, sink it
- Locate and keep water as high as possible on the land
- Manage watersheds and catchments
- Use water related earthworks
- Develop hydraulic uses for energy production

The key strategies for increasing water storage in soil involve building up humus and organic matter levels in soil, and mechanical methods of decompaction for soils that have been seriously compacted through overgrazing and the use of farm machinery.

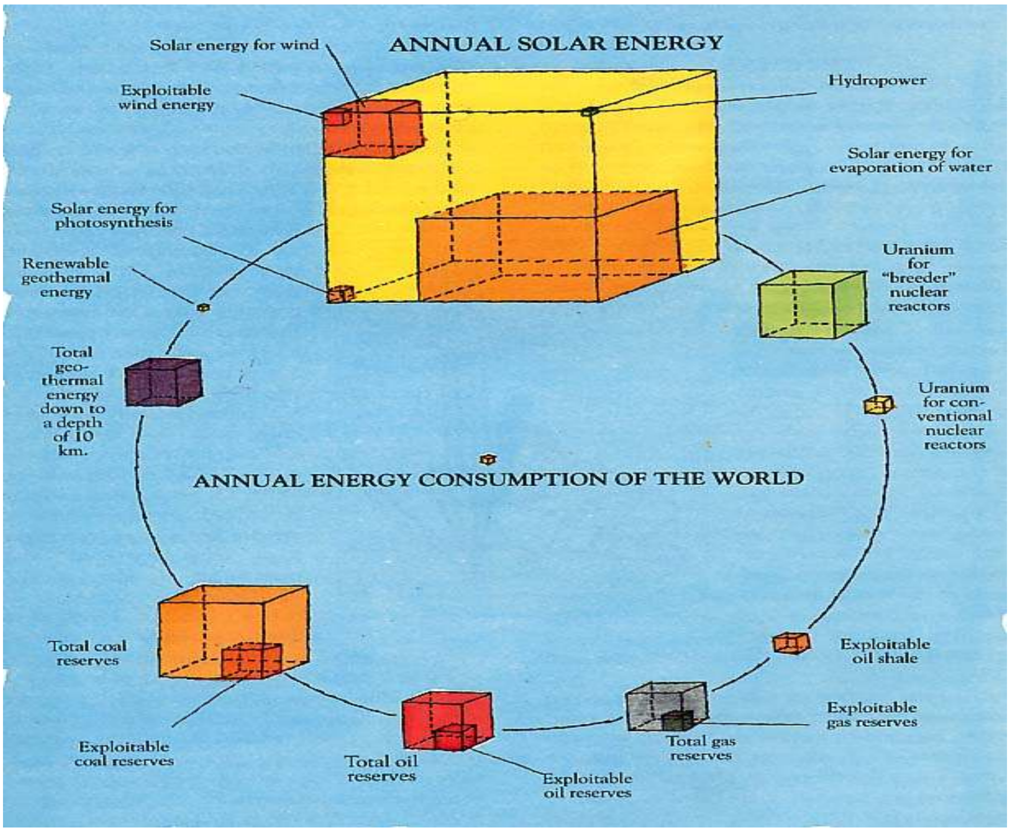
We can rehabilitate compacted soils by contour and keyline methods, using soil reconditioning ploughs which break up deep compaction, allowing water and air to re-enter the soil, e.g. Wallace SRU - Soil Reconditioning Unit, Agroplow, and Yeoman's Slipper-Imp Shakerator, deep ripping and chisel ploughing.

A common feature of these implements is they do NOT turn the soil, and therefore minimise topsoil disturbance. There are hand implements for soil reconditioning; a broadfork is designed for market garden and small acreage where tractors are not appropriate. In small gardens, a standard garden fork can be used to break up compaction with minimal disturbance

Climate and Seasons

Sun's Energy and Influence

The sun is the source of all our energy in one way or another be it current solar radiation, warmth, photosynthesis, solar evaporation, old solar energy oil, coal and gas. It is therefore useful for us to understand its seasonal availability to maximise the energy for ecological system banking.



If we used 1% of the unused land on the earth to harness solar radiation with solar pannels we could produce 4 times what is currently produced by fossil and nuclear power. Ref - Nieslen R, 2005.

So now that we know the sun causes everything, lets just check our basic understanding of some concepts. Day and Night is caused by the Earths daily rotation about its own axis (23.5 angle). Yearly seasons are caused by the earths yearly rotation around the sun.

Lets see some examples of this online - Day and Night – How and Why

http://www.climatechangematters.net.au/LOTS/Earth/sub/daynight/flash2.htm

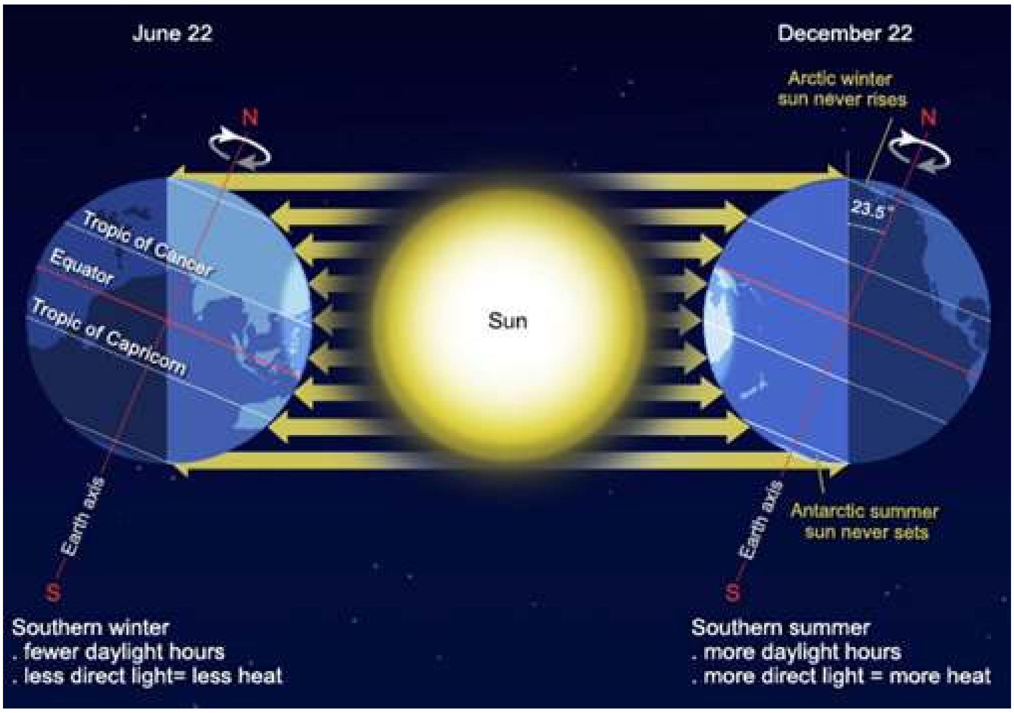
Seasons – A years rotation around the sun NOTE: it doesn't show daily rotation of the earth.

http://www.climatechangematters.net.au/LOTS/Earth/sub/seasons/flash2.htm

Diagrams of the suns rays on the earth at Equator, Northern and Southern Hemispheres.

http://www.windows2universe.org/earth/climate/sun_radiation_at_earth.html

The suns light and heat are most intense on areas of the planet directly facing it. Below and above this zone the light is spread over greater areas so the resultant heat and energy availability is less intense.



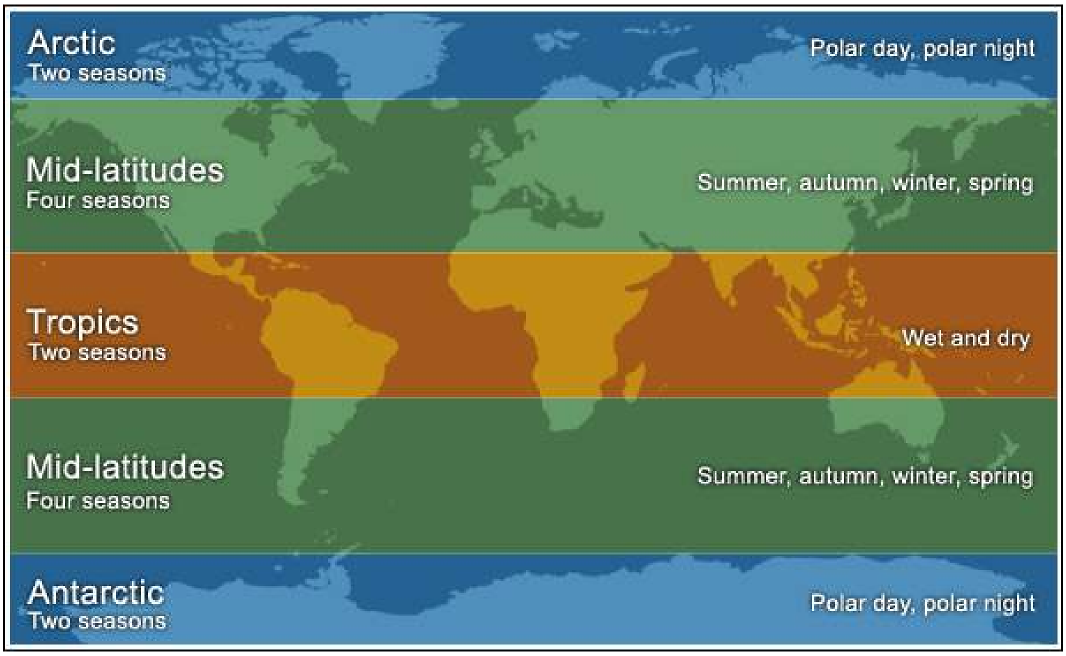
The tilt also affects the daily amount of light, without the tilt the planet would have 12 hour days and nights all year. The longest day in the Southern Hemisphere occurs when the planet is tilted directly towards the sun (shown as the right hand globe and December 22) and naturally this is the shortest day in the Northern Hemisphere.

Another factor is that in summer the sun travels a longer path through the sky. This means that the Sun is in the sky longer and has more time to heat the ground (and the ground has less time at night to cool down).

Seasons at the equator and the poles

The intensity of sunlight varies according to where you are on Earth. The Sun is almost always directly overhead at the equator. This means that light from the Sun covers a small surface area. At other places further north or south of the equator, the angle of the Sun decreases, spreading the sunlight over a larger surface area. The light also travels a greater distance through the atmosphere and more of the light is absorbed or reflected before it reaches the ground. Therefore, places further north or south of the equator do not experience temperatures as hot as places closer to the equator, and as the Sun is always up for about 12 hours at the equator the year is divided into the wet season and the dry season (rather than spring, summer, autumn and winter at mid latitudes).

The seasons are more extreme at the poles, and it is no surprise then that plant diversity and density falls as we move from the warmth and sun rich equator to the poles.



The elements making up weather and which are also essential to sustain life on earth are:

- heat from the sun (solar radiation)
- the atmosphere
- water

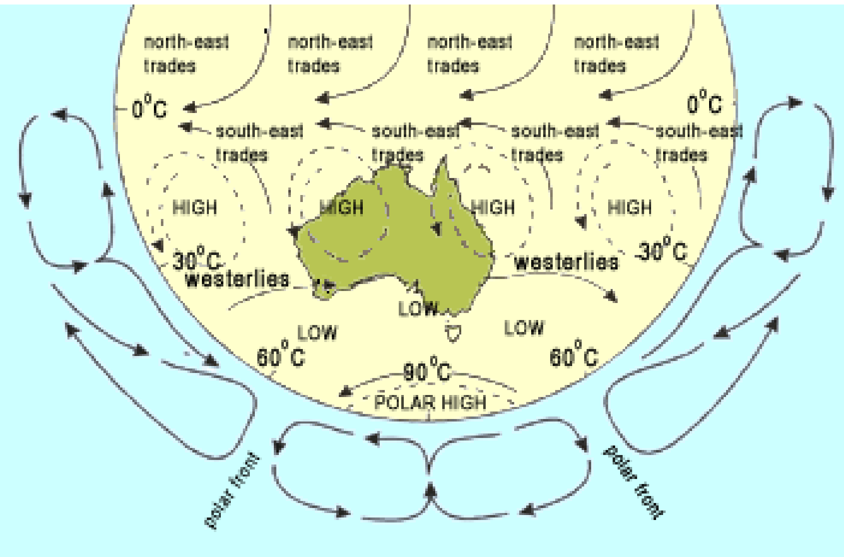
Weather occurs in the troposphere, the layer of air about 10-15km deep, above the surface of the earth.

Sun, Water and Rainfall

70% of the earth is covered with water so in the hot tropics all this water is constantly evaporating and condensing in the atmosphere into rain. Hence in these areas Wet Season is the hot season and Dry Season is the cooler season. Again the Sun is the driving force. Countries in the tropics have so much rain they have to build their houses on stilts, cyclones and hurricanes occur regularly and cause severe damage. All of these conditions on earth are caused by the effect the sun has on the earth.

The air itself is a gas which can be mixed with water and this is what happens as parts of the earth get warm and then cold, depending on the time of day and the season. When the sun's rays fall on a cold river, it warms it. Moisture from the warmed water rises into the air (like steam from a kettle). The air containing the water vapour gets warm too, making it lighter. Because it's lighter, it rises and cold air must rush in to take its place. This is what causes wind. Unsettled weather is caused by areas of warm and cold air clashing with each other. When air is trying to rise, the pressure on the earth is light – low pressure.

The driving force producing our weather is the general circulation of the atmosphere caused by unequal heating of the earth's surface. By looking at the main circulation patterns in the southern hemisphere we can begin to understand the seasonal changes of climate in Australia.



Again it's the sun driving the system. Remember the basic principle: warm air rises and cool air falls. This principle applies on a global scale. Energy from the sun causes uneven heating of land and sea surfaces near the equator and evaporation from tropical oceans. The heated air rises to the top of the troposphere and moves slowly away from the equator. On the way it gradually loses heat and starts to sink back towards the earth's surface at around 25°-30° of latitude

When air which is full of moisture rises, it begins to cool down. High above the earth, the temperature is lower and this makes the water vapour in the air turn back into tiny droplets of water. These droplets join together and form clouds. When a cloud gets really heavy it drips – and we get rain. Some of the rain falls into the seas, oceans, lakes and rivers. That is why, after heavy rain, the water levels rise. When the sun warms the water again, the water vapour will rise into the air again and the cycle continues over and over.

Areas near the coast have more rain because the air over the land is warmer than the air over the ocean. The water vapour from the sea is lifted higher on the warm air and is turned back into water drops more quickly. Different parts of the earth have varying amounts of rain. It rains daily in rainforests and is also very hot, so plants grow well there. Deserts are hot and dry and few plants survive there. Those that do, have adapted so that they can store water within themselves.

Perth Climate

Western Australia has four main climactic types: Mediterranean, Semi-Arid Grassland, Hot Desert and Monsoonal. Permaculture designs in Perth, and the South-west of WA will be in a Mediterranean type climate, similar to that of countries bordering the Mediterranean Sea (like Greece, South Africa, and Italy). The summers are hot and dry, and the winters are cool and rainy. Most of the rain falls between May and August, and as this is winter the rainfall is not lost to evaporation and so is available for use by native plants and people's crops.

The key design issue for Perth is that it only has 3 months of the year when precipitation (rain) exceeds evaporation, and as the soil is poor we must focus heavily on harvesting and storing this water for the remaining 9 months. Thus without intelligent design, mulching, and water storage mechanisms we will not have water to grow our polycultures. Creating water wise, water recycling, forest mimicking food systems is critical to the success of truly sustainable food production and agricultural in a continually drying climate in WA.

Perth's climate is vary variable currently and we are experiencing more of an arid/sub tropic rainfall/temperatures currently. This heavily influences system designs as choosing sub tropic plant species can be a great option for summer proofing your system , as extra effort needs to be made to conserve and bank water already, these sub tropic species have advantages of being able to survive 40oC days in summer, unlike some Mediterranean species. Between micro climates, a lack of frost most things can be grown it is just a case of having good diversity and self sustainable systems so that the gradual drying and intensity of summer heat can be more effectively utilised by your system.

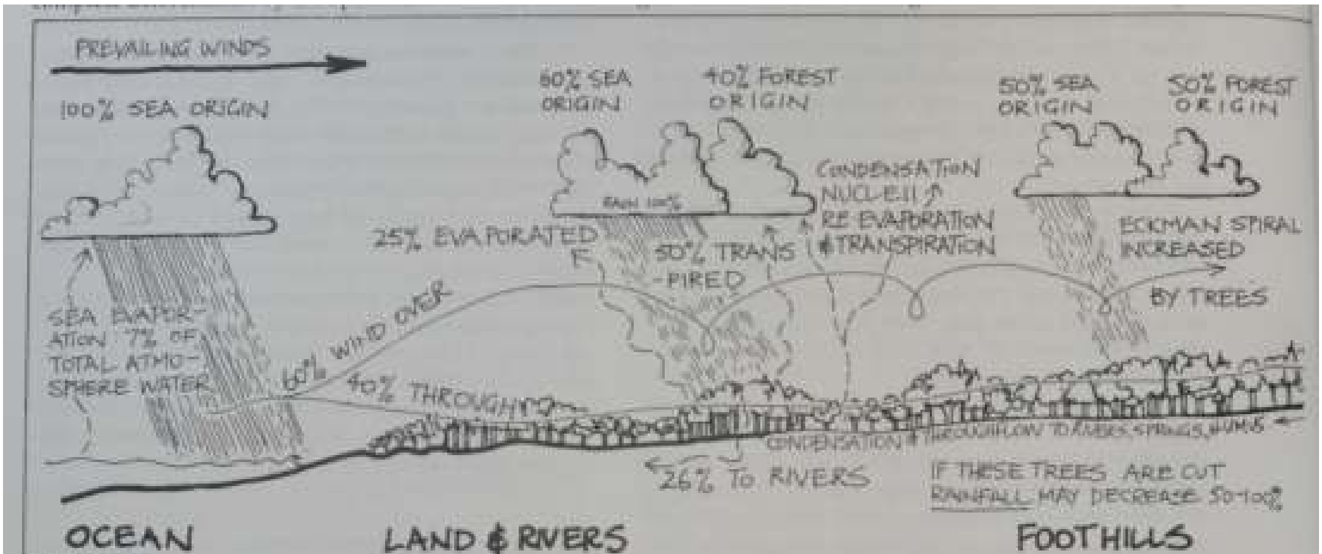
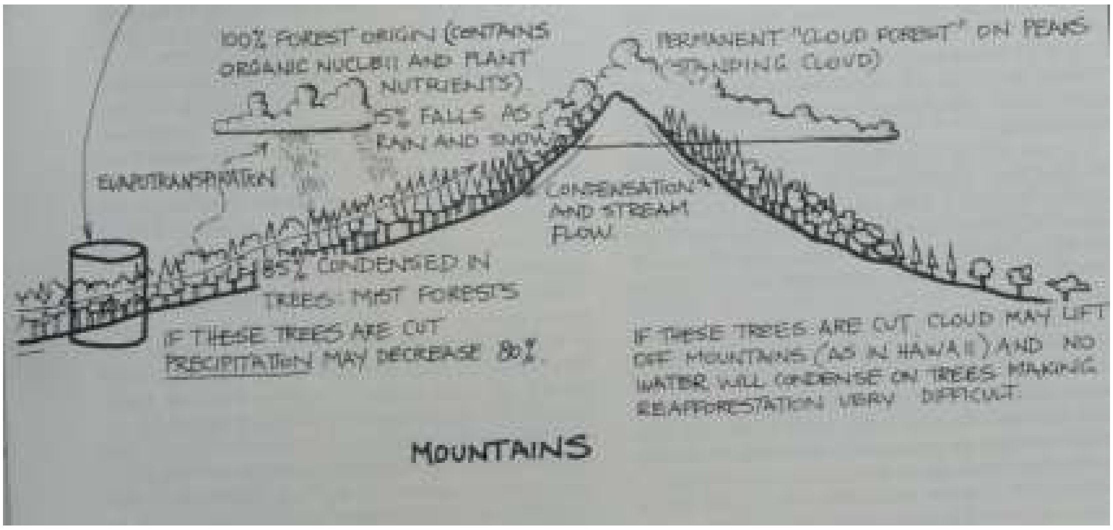


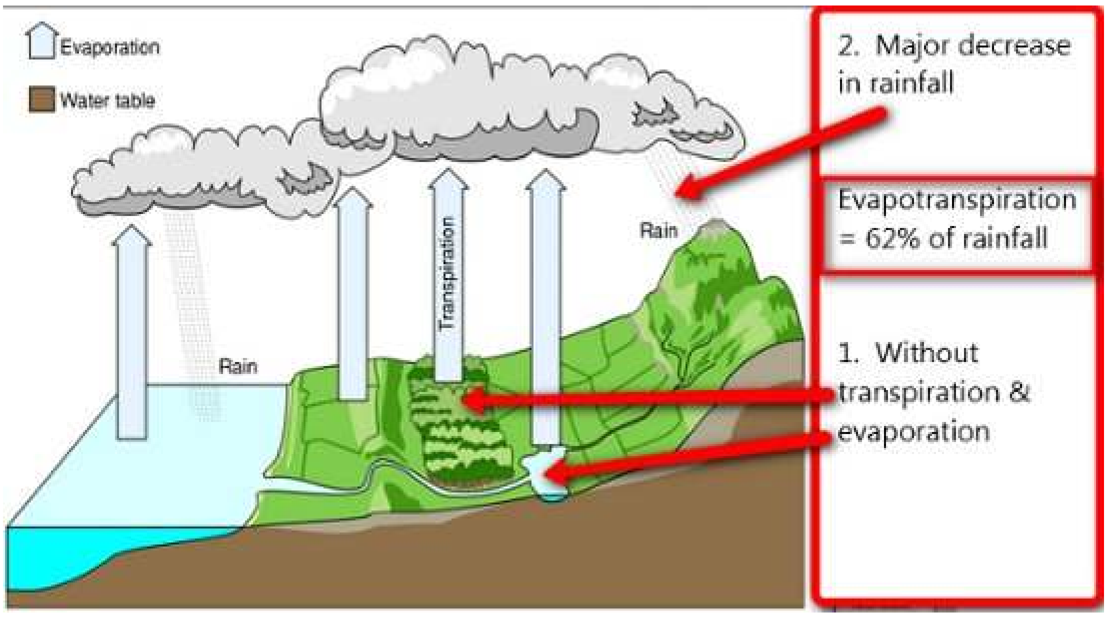
FIGURE 6.5
FOREST INTERACTIONS WITH CLIMATE. (Based on work in Brazil).

Forests inland produce most of the water for subsequent rainfall; recycled water is repeatedly transpired to the airstream.

We are suffering an unprecedented dry period such that most of the South West area is in drought conditions. Tree harvesting and land clearance has removed much of the forest that covered the area prior to white man's clearing for farming pursuits, and it is likely a strong contributing factor to the loss of rainfall. Trees tap water stored in the land, bring t up into the trunk and leaves which are a high percentage water, this moisture is in turn evaporated, perspired out of the tree back to the local cloud systems, seeding the rain which falls and continues the cycle. Without these heavy vegetation one of the key elements in the water cycle is lost, from research by Nick Nyttal around 62% of the precipitation that occurs over land is due to evapo-transpiration from lakes, rivers, wetlands and dense vegetation.



IN SUMMARY

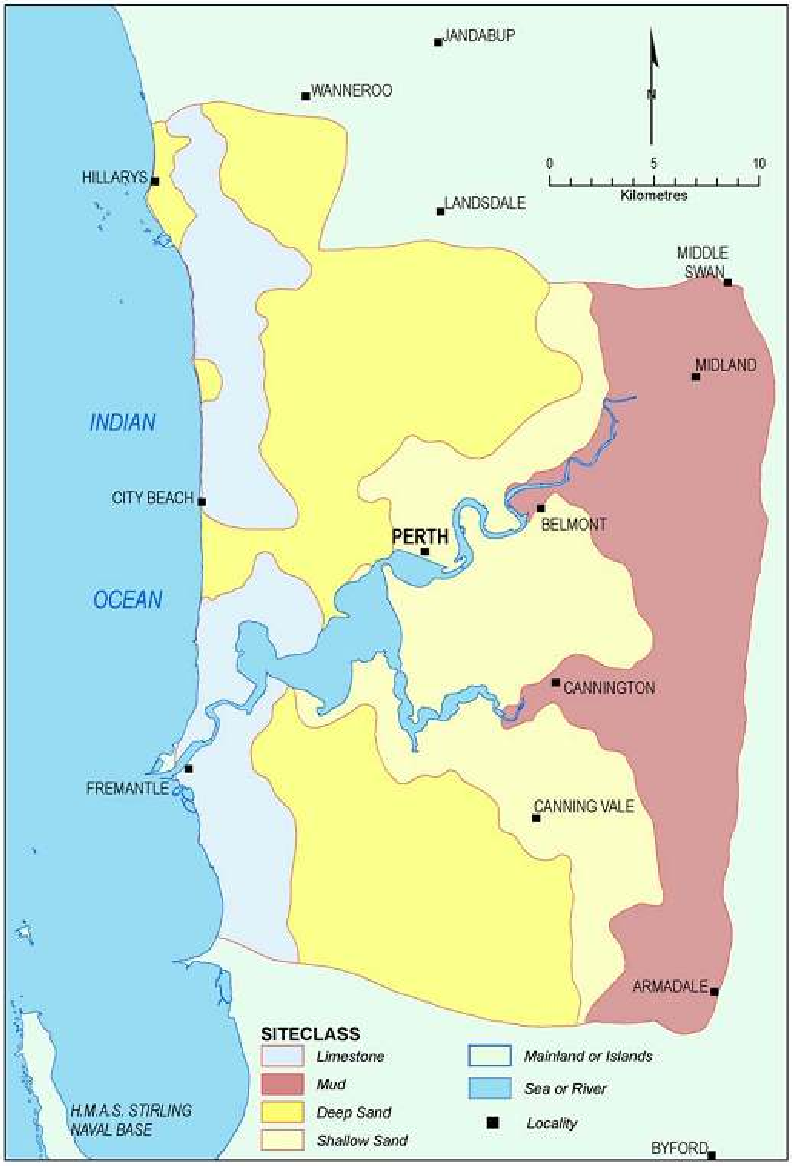


It is no supprise that as we clear and drain these features the inland rainfall is ceasing.

Soil Formation and Perth Soils

The Swan Coastal Plain

The Swan Coastal Plain stretches from Gingin Brook in the north to Dunsborough in the south, with the eastern boundary being the Darling Scarp and Gingin Scarp. Most of the Perth metropolitan area is located on the Swan Coastal Plain. Detailed local information can always be sourced from local government agencies.



Quindalup soils are the white limey sands which occur near the coast, such as those found at Rockingham, Scarborough and Quinns Beach. Quindalup soils form the most recent dunes along the coastline.

Cottesloe soils are brown or yellow sand with limestone close to the surface, often breaking through to form an outcrop. Fremantle and Neerabup are examples of where this occurs.

Karrakatta soils are yellow sands. Kings Park and Tuart Hill are examples of where you can see this soil type.

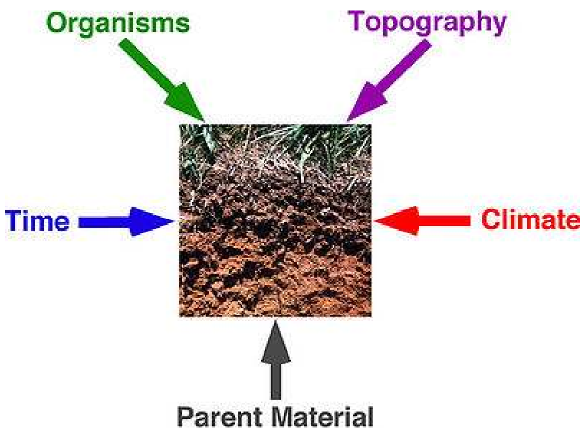
Bassendean soils are pale grey.

Herdsman soil is found around a series of wetlands and swamps within the Cottesloe, Karrakatta and Bassendean soil types. They are found in low –lying areas where the groundwater is close to the surface, even breaking through in places such as the lakes in Yanchep National Park, Lake Joondalup and Star Swamp in the suburb of North Beach.

Guildford soils are found in flat terrain and comprise sandy loams over a layer of clay. Kenwick and Middle Swan provide examples.

Beermullah soils are comprised of sand, which is occasionally saline, and loam over clay, which become waterlogged in winter. They are typically found in flat terrain.

Pedogenic Processes



Pedogenesis can be defined as the process of soil development. This idea was based on the observation that comparable soils developed in spatially separate areas when their climate and vegetation were similar. The development of a soil is influenced by five interrelated factors: organisms, topography, time, parent material, and climate.

Climate plays a very important role in the genesis of a soil. On the global scale, there is an obvious correlation between major soil types and the Köppen climatic classification systems major climatic types. At regional and local scales, climate becomes less important in soil formation. Instead, pedogenesis is more influenced by factors like parent material, topography, vegetation, and time. The two most important climatic variables influencing soil formation are temperature and moisture. Temperature has a direct influence on the weathering of bedrock to produce mineral particles. Rates of bedrock weathering generally increase with higher temperatures. Temperature also influences the activity of soil microorganisms, the frequency and magnitude of soil chemical reactions, and the rate of plant growth. Moisture levels in most soils are primarily controlled by the addition of water via precipitation minus the losses due to evapotranspiration. If additions of water from precipitation surpass losses from evapotranspiration, moisture levels in a soil tend to be high. If the water loss due to evapotranspiration exceeds inputs from precipitation, moisture levels in a soil tend to be low. High moisture availability in a soil promotes the weathering of bedrock and sediments, chemical reactions, and plant growth. The availability of moisture also has an influence on soil pH and the decomposition of organic matter.

Living organisms have a role in a number of processes involved in pedogenesis including organic matter accumulation, profile mixing, and biogeochemical nutrient cycling. Under equilibrium conditions, vegetation and soil are closely linked with each other through nutrient cycling. The cycling of nitrogen and carbon in soils is almost completely controlled by the presence of animals and plants. Through litterfall and the process of decomposition, organisms add humus and nutrients to the soil which influences soil structure and fertility. Surface vegetation also protects the upper layers of a soil from erosion by way of binding the soils surface and reducing the speed of moving wind and water across the ground surface.

Parent material refers to the rock and mineral materials from which the soils develop. These materials can be derived from residual sediment due to the weathering of bedrock or from sediment transported into an area by way of the erosive forces of wind, water, or ice. Pedogenesis is often faster on transported sediments because the weathering of parent material usually takes a long period of time. The influence of parent material on pedogenesis is usually related to soil texture, soil chemistry, and nutrient cycling.

Topography generally modifies the development of soil on a local or regional scale. Pedogenesis is primarily influenced by topography's effect on microclimate and drainage. Soils developing on moderate to gentle slopes are often better drained than soils found at the bottom of valleys. Good drainage enhances an number of pedogenic processes of illuviation and eluviation that are responsible for the development of soil horizons.

Under conditions of poor drainage, soils tend to be immature. Steep topographic gradients inhibit the development of soils because of erosion. Erosion can retard the development through the continued removal of surface sediments. Soil microclimate is also influenced by topography. In the Australia, north-facing slopes tend to be warmer and drier than south-facing slopes. This difference results in the soils of the two areas being different in terms of depth, texture, biological activity, and soil profile development.

Principal Pedogenic Processes

A large number of processes are responsible for the formation of soils. This fact is evident by the large number of different types of soils that have been classified by soil scientists. However, at the macro-scale we can suggest that there are five main principal pedogenic processes acting on soils. These processes are laterization, podzolization, calcification, salinization, and gleization. Within WA we will briefly look those that are more characteristic to our climate.

Laterization is a pedogenic process common to soils found in tropical and subtropical environments. High temperatures and heavy precipitation result in the rapid weathering of rocks and minerals. Movements of large amounts of water through the soil cause eluviation and leaching to occur. Almost all of the byproducts of weathering, very simple small compounds or nutrient ions, are translocated out of the soil profile by leaching if not taken up by plants for nutrition. The two exceptions to this process are iron and aluminum compounds. Iron oxides give tropical soils their unique reddish coloring. Heavy leaching also causes these soils to have an acidic pH because of the net loss of base cations. .

Calcification occurs when evapotranspiration exceeds precipitation causing the upward movement of dissolved alkaline salts from the groundwater. At the same time, the movement of rain water causes a downward movement of the salts. The net result is the deposition of the translocated cations in the B horizon. In some cases, these deposits can form a hard layer called caliche. The most common substance involved in this process is calcium carbonate. Calcification is common in the swan coastal plain.

Salinisation is a process that functions in the similar way to calcification. It differs from calcification in that the salt deposits occur at or very near the soil surface. Salinization also takes place in much drier climates.

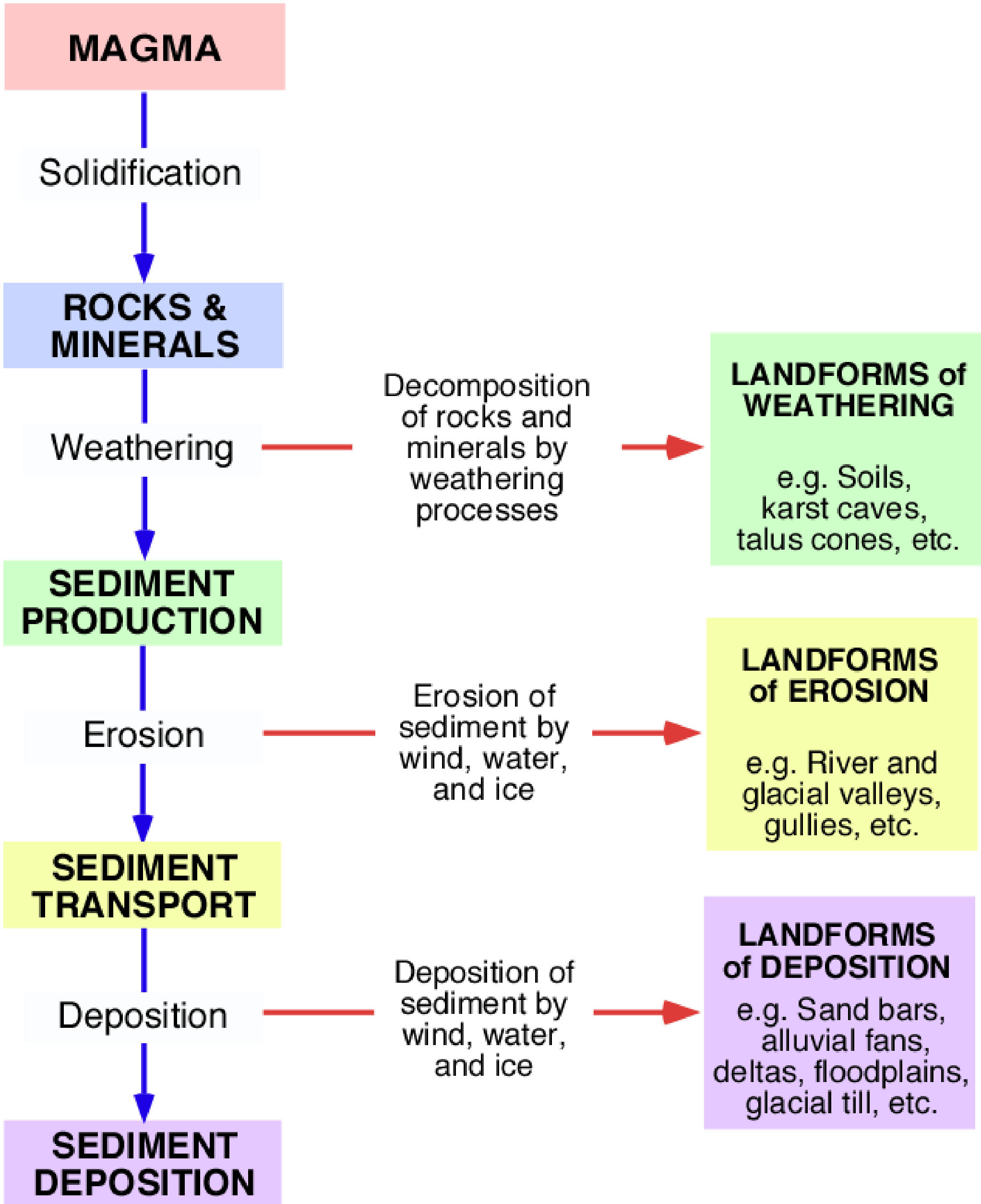
Natural Vegetation and Soil relationships of the Swan Coastal Plain

Without going into detail this information can be found on the internet and local environmental books. Every design will have it own location and particular soils and evolved native vegetation, so research of local systems is always required.

One resource for WA: http://www.anra.gov.au/topics/vegetation/extent/wa/ibra-swan-coastal-plain.html

Landforms

Creation



We need to know all this because we are designers, modelling on natural systems, some things we cant change and for those things we need to understand there impacts. So we need a little tool to help us.

Scale of Permanence

When observing and understanding any area prior to any design and consultation it is critical to look at the climate, landscape and other factors that you cannot change on the large scale of the site.

Climate - Land shape –Water – Roads – Trees – Buildings - Subdivision - Soil

P.A. Yeomans wrote four books; The Keyline Plan, The Challenge of Landscape, Water For Every Farm and The City Forest, and his son followed with Priority One. The Yeoman books are an excellent method of understanding the significants of this 'patterns to details' planning.

Scale of Permanence checklist – Have we covered all this yet?

Adapted from P.A. Yeoman's by Dave Jacke

Climate

- plant hardiness zone
- predicted future climate change status
- annual precipitation
- seasonal distribution
- latitude
- wind directions prevailing, seasonal variations, storm wind directions
- growing degree days (important for ripening nuts)
- average frost-free dates
- chilling hours (important for fruit tree dormancy)
- extreme weather potential: drought, flood, hurricane, tornado, fire
- heating/cooling degree days

Landform

- slope (steepness, rise/run in percent)
- topographic position (i.e., mid-slope, hill crest, valley floor, etc.)

- bedrock geology: permeability, depth, nutrient content, acidity
- surficial geology: type of parent material, permeability, depth, stoniness,
- nutrient content, acidity, suitability for various uses, etc.
- estimated seasonal high water table depth
- estimated depth to bedrock, hardpan or impermeable layers of soil
- elevation
- landslide potential

Water

- existing sources of supply: location, quantity, quality, dependability, sustainability,
- network layout and features (spigots, pipes, filters, etc.)
- watershed boundaries and flow patterns: concentration and dispersion areas, including
- roof runoff patterns, gutters and down spouts
- potential pollution sources: road runoff, chemical runoff from neighbors, etc.
- flooding, ponding and puddling areas
- possible sources of supply: location, quantity, quality, dependability, sustainability, cost
- to develop
- location of all on-site and nearby off-site culverts, wells, water lines, sewage lines,
- septic systems, old wells, etc.
- erosion: existing and potential areas

Access/Circulation

- activity nodes, storage areas
- pedestrian, cart and vehicle access points, current and potential patterns
- materials flows: mulch, compost, produce, firewood, laundry, etc.

Vegetation and Wildlife

- existing plant species: locations, sizes, quantities, patterns, uses, poisonous,

- invasiveness, weediness, what they indicate about site conditions, etc.
- ecosystem architecture: layers and their density, patterning and diversity, resultant
- habitat conditions, light/shade, character, quality
- habitat types, food/water/shelter availability

Microclimate

- define various microclimate spaces
- slope aspects (direction slopes face relative to sun)
- sun/shade patterns
- cold air drainage and frost pockets
- soil moisture patterns
- precipitation patterns
- local wind patterns

Buildings and Infrastructure

- building size, shape, locations doors and windows, exist. and possible functions
- permanent pavement and snow piles from plowing it
- power lines (above and below ground) and electric outlets
- outdoor water faucet, septic system, well locations
- location of underground pipes: water and sewer line, footing drain, floor drain and down
- spout drain lines, tile drains, culverts, other
- fences and gateways

Zones of Use

- property lines, easements, rights-of-way
- existing zones of land and water use
- well protection zones, environmental and other legal limits (e.g. wetlands regulations,
- zoning regulations, building setbacks)

- current uses by neighbors and passersby
- use history and impacts on land, current or future uses

Soil Fertility and Management

- soil types: texture, structure, consistence, profile, drainage
- topsoil fertility: pH, % OM, N, P, K, Ca
- soil toxins: lead, mercury, cadmium, asbestos, etc..
- management history
- soil testing: where to get it done, how to do it

Aesthetics/Experience of Place

- outdoor rooms, walls: define spaces (walls, ceilings, floors), qualities, feelings,
- functions, features
- arrival and entry experience: sequencing, spaces, eye movements, feelings

Managing the Macro and Micro Climate Elements.

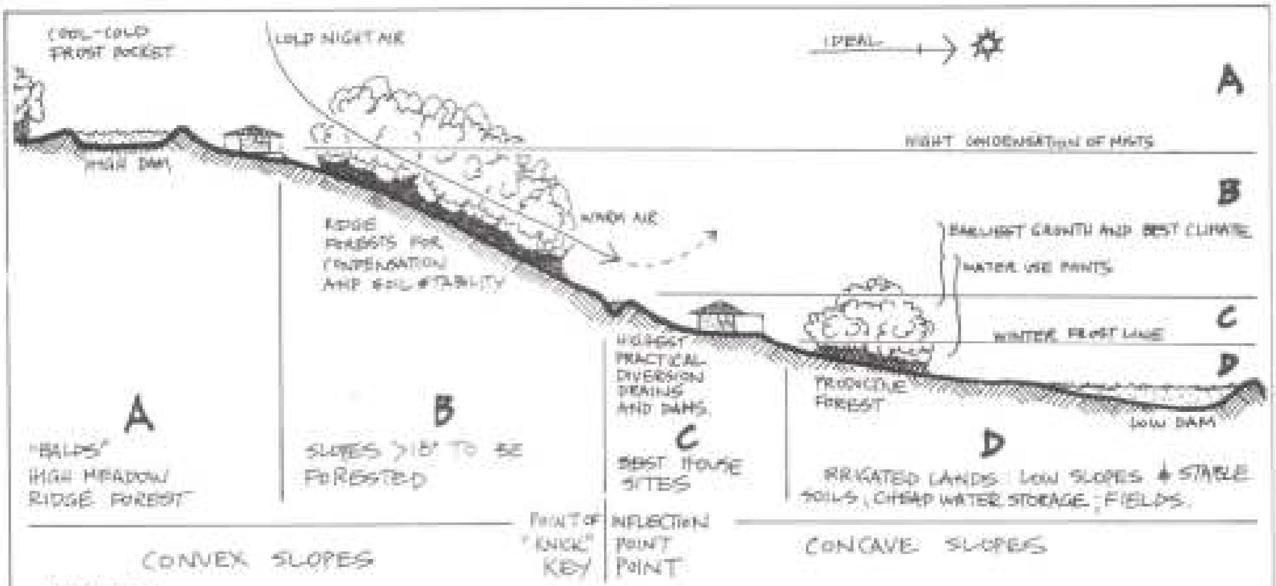


FIGURE 3.11
BROAD HUMID LANDSCAPE PROFILE.
Slope analysis and site planning in relation to aspect largely decide the placement of access, water supply, forests, and cropland. Here we supply such analysis to a cool, humid region.

This landscape profline from Mollison's Design book explains many of the more important elements of a microclimate and how we can best use these intelligently when setting up a home and ecosystem.

Cold night air falls down from the top of the slope, structures that trap it on its decent become cold pockets, while we don't want this in winter around our house we may want it to help high chill fruit trees bear. Understanding this also allows us to plant and direct this downward flow away from cold sensitive plantings and the home. Trees and soil exhibit a warming influence so this can be used to moderate the effect if required. Eventually this cool air will pool in the low areas and that may want to be avoided as well as it causes frosts and other growth limiting factors.

Between the most exposed high areas and low zones there is a point of optimum or moderated temperature and micro climate. This is best for growing food crops and establishing the house site.

Slope is a key also as in the Southern Hemisphere, including Australia the sun shines from the North, that means the North facing slopes receive the most heat and sunlight for plant and soil biological activity. Similarly this is most useful for solar and other sun utilizing aspects we might have in the home. It does however mean that the drying/evaporative aspects of this increased sun load need to be managed and understood, foresting, dams, swales, and keyline contour cultivation all help to keep moisture in the land and need to be planned based on consideration of slope, drainage and other factors.

Local wind patterns are important to research and experience in order to set up microclimates to best deal with the advantages and problems seasonal winds changes bring. Perth has a helpful South Westernly in summer called the Fremantle Doctor, this brings cool wind after midday to wash away the built up heat of the long hot mornings, it may be brief and the day end in still hot air. Harnessing these cooling breezes in summer to vent hot air out of your house and yard is managing and designing for winds/breeze. In winter the squally winds and storms come from specific directions, in summer hot winds and associated bushfire fronts follow that pattern, hence the sector planning of your property will allow you to manage many of the beneficial and detrimental energy sources in your permaculture design.