

Michael’s Farm – Permaculture Design Report

Table of Contents

1. Identification of parties & property	2
a. Client	2
b. Designer	2
c. Property	2
2. Scope of the report	3
a. Purpose of the Design	3
b. Client consultation	3
3. Property description & analysis	5
a. General attributes	5
b. Site history	6
c. Landscape data & analysis	6
i. Physical Attributes – Data Records	6
ii. Seasonal Attributes – Data Records	10
iii. Existing Landscape Map & Sector Analysis	12
4. Proposed design & work	14
a. Component Analysis & Appropriate placement of elements	14
b. Upgraded landscape (proposed concept design)	18
c. Proposed job list & estimated budget	21
d. Task Prioritisation	21
e. Plan of development stages / Gantt chart	21
f. Maintenance Plan	21
5. Land uses (including chosen species)	21
a. Areas	21
i. Fire shelter belt	21
ii. Vegetable & Herb gardens	21
iii. Food forests	21
iv. Water Systems and Aquaculture	21
v. Native forest & Wildlife corridors	21
b. Themes	21
i. Permaculture Community	21
ii. Productive farm to sustain the needs of the community	21
iii. Artistic Garden	21
6. Appendices	21
a. Appendix 1 – Sun sectors	21
i. Summer Sun Sector	21
ii. Winter Sun Sector	21
b. Appendix 2 – Wind sectors	22
i. 9am Wind Rose	22
ii. 3pm Wind Rose	23
7. References /Bibliography	24

1. Identification of parties & property

a. Client

For privacy reasons, we have here deleted the client's details.

b. Designer

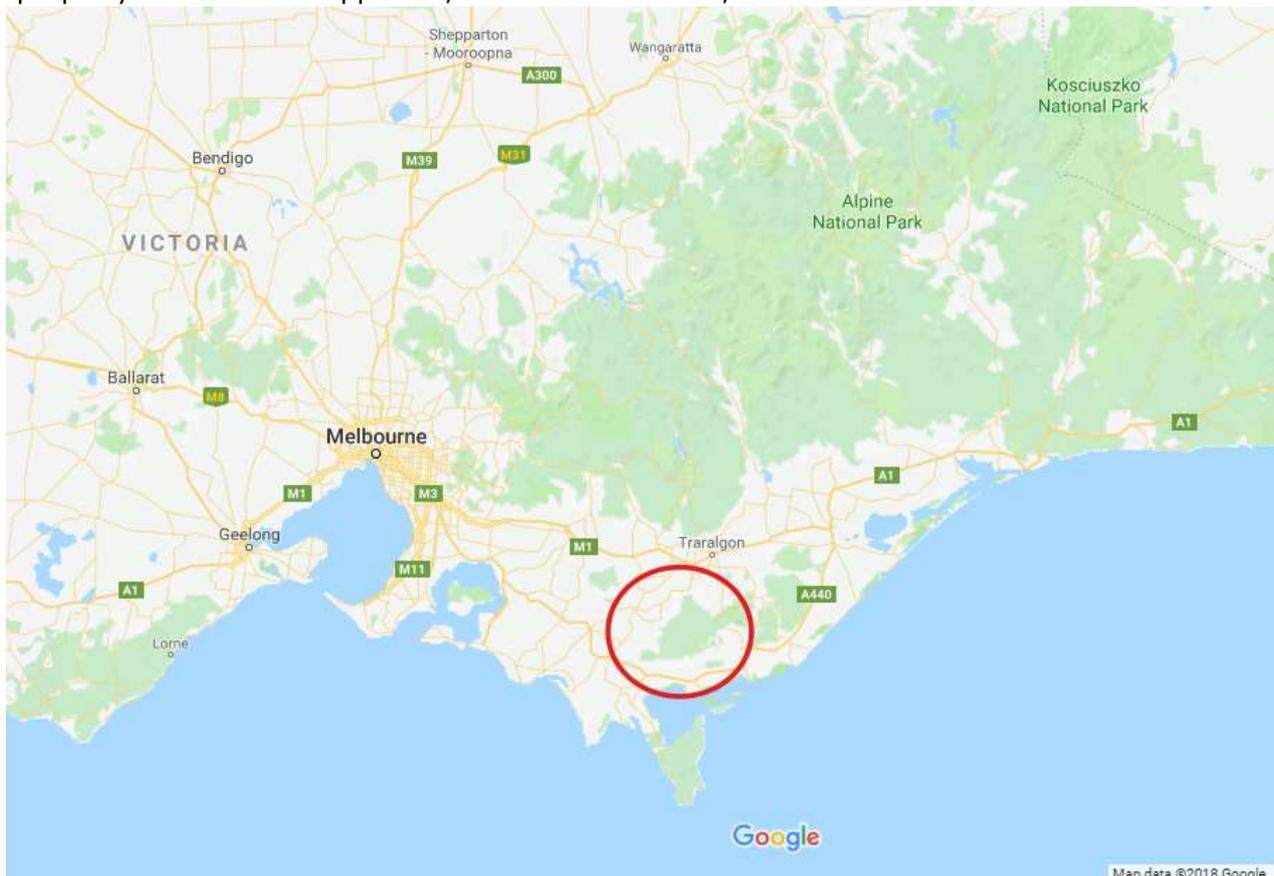
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c. Property

For privacy reasons, we have here deleted the property's address.

The property is located in Gippsland, South East Victoria, AUSTRALIA.



Source: Google Maps

The following picture shows the 2015 landscape and approximate boundaries of the property:



Permaculture Journeys Design in Inkscape based on Google Earth

2. Scope of the report

a. Purpose of the Design

The purpose of this design is to develop a **self-sufficient permaculture farm** that can be home to a **community of 10-12 people** in the event of a major economic and/or ecological **collapse**. Michael is currently the only permanent resident and is on site only part-time so the work should realistically progress slowly and focus on providing the basic functions of **food and shelter** with irregular maintenance (summer). Michael has some building and handyman experience and is capable of doing most construction work, and can also do garden work with some guidance.

The client doesn't have access to finances for the development of the farm but many **material resources** have been collected over the years and are available for free use on site. It includes some heavy machinery such as back hoe, bulldozer, crane, and excavator/tree harvester that can be used once repaired.

Any legal implications relating to community infrastructure and welcoming visitors are to be considered. They are out of the scope of this concept phase, but will be assessed during the detailed phase.

b. Client consultation

Client Profile

Note: The profile of the client here below is to be used as a guideline rather than a strict basis for the design as other community members may join the farm and have different needs, expectations and interests. This will be an ongoing ever-evolving project as more people join in.

- Occupation & Income: Retired. Some real estate assets but no cash availability.
- Time spent on site & general availability: At least half the time spent on site, generally for a few days to a few weeks at a time. Almost full-time presence in summer and almost full availability when onsite. Intend to move permanently to the farm in Q3'19.
- Main mean of transportation: Van, can easily transport materials.
- Hobbies / Interests: Conservation of natural ecosystems and native plant and animal species, minimal footprint living, food security, resilience from economic and ecological collapse, self-sufficiency, hoarding and re-purposing of waste resources diverted from landfill, artistic / fantasy gardens, healing environment.

- Eating habits, allergies and/or health issues: Cheap and convenient eating, no cooking. Flexitarian. Eats meat when given (e.g. hunting friends).
- Visitors (type, purpose, frequency): The property is intended as a community space and welcomes visitors and helpers who are interested in off-grid living, teaching others, and can stay from a few days to a few years and contribute to the development of the farm.

Desired Components

- Site components:
 - o Communal structures including an office, kitchen, lounge space, outdoors toilet and shower, as well as tool shed / workshop.
 - o Individual dwellings for temporary or permanent residents which are natural, non-toxic and built in line with the artistic / fantastic / medieval / style and atmosphere of the farm. These shall be built by the residents who want to live onsite.
 - o Greenhouse, nursery, as well as seed saving storage, and food preservation / drying hut.
 - o Bunker and Hobbit house as underground fire shelters.
 - o Accesses to infrastructures will be through the 3 main roads (the ring road and centre road on first bridge, and southern road on second bridge). Additional pathways originating from those 3 roads can be cleared-out as needed to access private dwellings.
- Energy components:
 - o Composting facility
 - o Solar panels
 - o hydro-power (alternative to solar in case of nuclear winter)
 - o Bio-digester
 - o reed bed (greywater treatment system for shower / laundry)
 - o Possibly aquaculture
 - o Food forest
 - o Tree logging in specific areas, with a strong focus on tree preservation and erosion management elsewhere, especially slopes and waterways.
- Social components:
 - o Artistic community, fantasy garden & forest with topiary (animal-sculpted hedges).
 - o Meditation temple / tea house / pagoda on centre road.
 - o Straw bale Thai temple classroom to run classes & workshops (residents teaching others).
 - o Creative & interactive space such as museum of all things.
 - o Animals: small animals (bantam chicken), maybe working ponies or horses.
- Abstract components (e.g. time):
 - o Keep some time available for teaching, healing, creativity and repairing collected resources.
 - o No personal animal killing, but open to other members raising animals for meat.
 - o Objective of a financially sustainable business through re-investing any income to the farm or to buy new farms; no need for personal profit.
 - o No concrete building (except for the underground fire shelters), must be in line with medieval, fantasy style as per the values of the farm.
 - o No pesticides are to be used on the property.

Client Needs & Wants Table

Needs (Must have)	
Communal Infrastructures	
Communal office	Small office space for 2 desks and computers.
Communal kitchen	Industrial kitchen bench and sinks with food and wine fridges and stove tops.
Communal lounge space	Small indoor lounge space for cold nights, with dining table & seating up to 20 people.
Communal outdoors toilet	Composting toilets with saw dust.
Communal outdoor shower/laundry	Solar shower with privacy setting + washing machine & greywater treatment system .
Communal tool shed & workshop	Sheltered from rain and large enough to store most common tools & a working bench.
Classroom	Thai temple style, to run classes and workshops. Capacity of up to 20 people.
Access	Earthworks to optimise main road (2% grading) and setting paths on the property.
Food Security	

Vegetable garden	Temperate climate, clay soil, regular rainfall, shade-tolerant, low maintenance. Companion planting & crop rotation for annuals, mix with perennials. 'Pick and eat' preference over varieties that require preparation and cooking.
Food forest	Successional stages, 7 layers, integrated in native bush forest on clay soil with tea trees and gums. Syntropic agroforestry.
Greenhouse & plant nursery	For small tropical fruit trees and ongoing seed sowing prior to planting in garden. Greenhouse is to be 1.5m underground and 1m above ground with another section about 4m high for lemon trees and taller species.
Seed bank storage & food drying hut	Underground root cellar, protected from fire hazard, constant temperature & air flow.
Energy Security / Self-Sufficiency	
Solar system	3-5kWh per building, providing power to computers, fridges, washing machine, power tools & lights.
Hydro-electric power	Alternative to solar in case of nuclear winter. Materials available for approx. 5Wh. Water wheel 3-4m diameter available with 2kwh generator.
Composting facility	About 5m ³ to feed the nursery / greenhouse, kitchen garden and support the establishment of the food forests.
Resilience against natural hazards	
Bushfires: Underground bunker & hobbit house	Made of concrete, clay and non-burning materials with air flow, 100L water storage (6.5L*15 ppl = water for 5 days) and food for 3-5 days.
Erosion / loss of top soil: Tree preservation & planting	On slopes & waterways (spring & creek bank), as well as addition of permanent cover crops and rooting species if can't avoid to cut-down a few trees as part of fire resilience strategy (consider willows, bamboos and fire-retardant trees by the creek and spring).
Drought: Water Security	Dams, ponds, creek, spring, roads with swales and roof gutters over shower/laundry, kitchen & individual dwellings with water tanks / drums.
Healing & Spirituality	
Artistic / fantasy garden & forest	Fantastic and medieval style with metal frames, sculptures, odd things and topiary (animal-sculpted hedges).
Abstract needs	
Financial sustainability	Re-investing profit for the farm or to acquire and develop more farms. Tree logging in specific areas (wattles in the valley & blue gums on top of centre road).
Wants (Nice to have – non-essential)	
Individual dwellings for residents	Self-built by residents as they come (temporary accommodation and help provided). Style in line with the essence of the farm and which may include basic shelter over tent, caravan, shipping container, wood cottage, tepee, natural building (e.g. earthship, straw bale, adobe...), tiny home, underground hobbit house, etc.
Biodigester	Turn kitchen food scraps into methane to fuel gas stove.
Aquaculture	Natural pool (if fish can be there) or pond (aquaponics considered in case required earthworks would be too extensive).
Reed beds / Greywater treatment	For shower and laundry/washing machine (place next to each other).
Chickens	Bantam chicken (if adapted to climate), mobile chicken coop.
Meditation temple	In the shape of a tea house / pagoda on centre road.
Museum of all things	Museum as per residents' creativity.
Other animals	Animal sanctuary, working ponies or horses (consider species least damaging to the environment), cattle and milking animals if desired and to be managed by residents.

3. Property description & analysis

a. General attributes

- Surface area: 116 acres
- Sun exposure: Farm area has a westerly aspect
- Lowest & highest altitudes: 150m (at the creek) – 370m (top of Mount Beta) above sea level
- Climate: Mild temperate
- Land coverage: > 95% trees
- Average annual rainfall: About 1,000mm
- Power to site: available but not connected (no intent to connect)
- Wi-Fi / Internet: Optus network 3G only
- Existing infrastructures:
 - o Buildings: None
 - o Roads & pathways: 3 main roads / 2 cross-over bridges

- Water points: 1 permanent creek running on the west boundary of the property and under the 2 privately owned bridges. Another permanent creek is on the east boundary (not in scope of the farm). 2 temporary creeks (north of the fire pit and north of ring road) and spring (running for about a week after rain). 4 little ponds retaining rainwater.

b. Site history

Previous Ownership and Usage

- Native forest until 1930's, then sheep farm for 40 years until 1970's; then pine trees planted and then logged in the ring area in 2009 to do a clearing, sell timber and build a family house; then it all burnt from major fire hazard in 2009. Since then, the ring is predominantly a regrowth of tea trees, wattles, pines and 5-10 different types of gums including but not limited to mountain ashes, blue gums, shiny gums and messmates.
- The spring is used as a small water source and the creek as water source and for recreational purpose on hot days. The majority of the property is zone 5 with steep slopes. The property is located in a cold temperate climate and receives regular rainfall.
- It is believed that no pesticides were ever used on the property.

Hazard Records

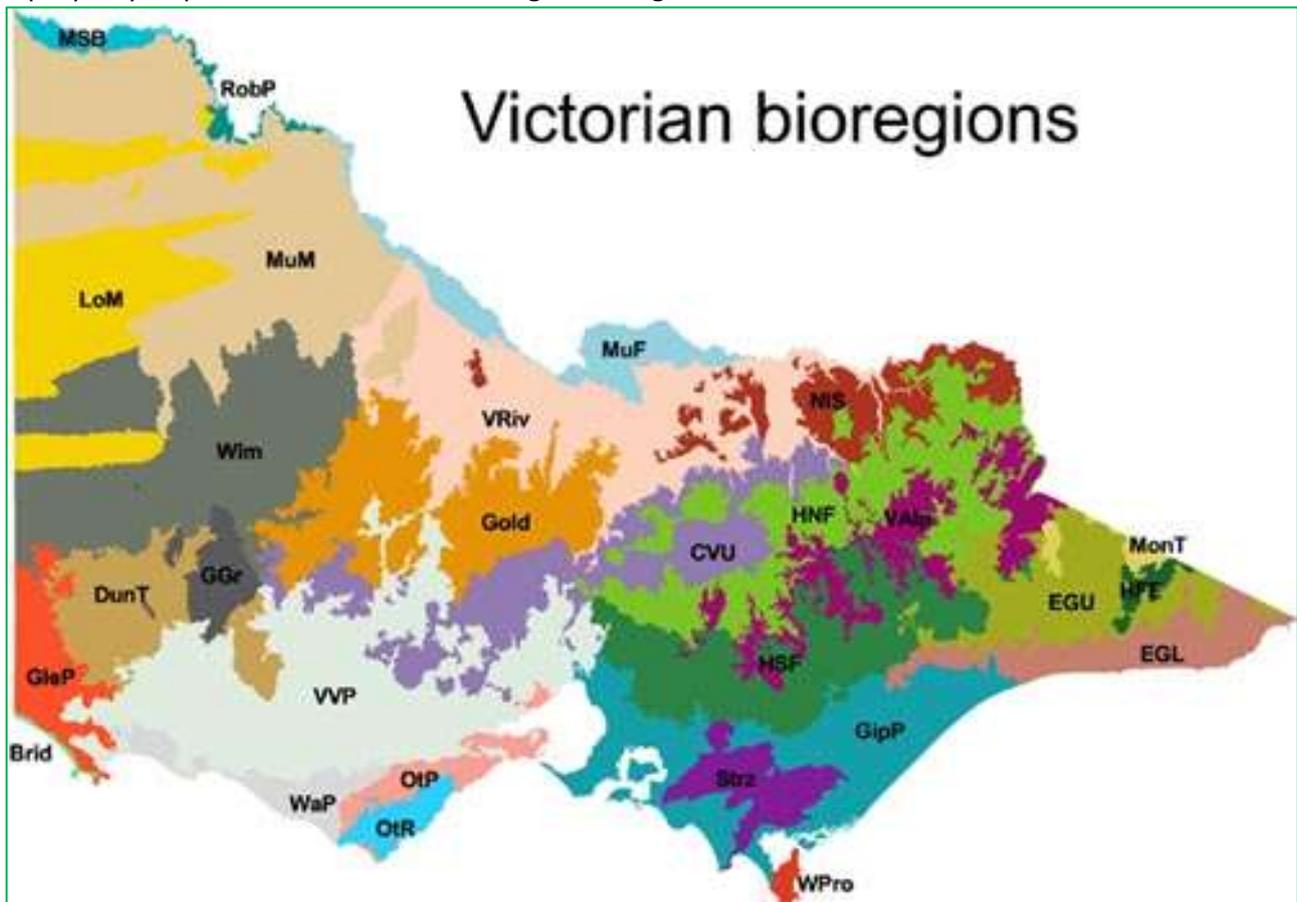
- Flooding: There once was a flooding of 8m above creek, believed to be the biggest record (unknown year). A few other flooding events were recorded about 1.5-2m above creek for a few years after the 2009 bushfires, then no more flooding since then (more vegetation and drier weather).
- Fire: Historical 2009 bushfires burnt the entire property. There is a major risk of reoccurrence sometime in the future as the weather gets hotter and drier because of climate change.

c. Landscape data & analysis

i. Physical Attributes – Data Records

Bioregion:

The property is part of the Strzelecki Ranges bioregion.



LoM	Lowan Mallee	GipP	Gippsland Plain	WPro	Wilson's Promontory
MuM	Murray Mallee	OtP	Otway Plain	HSF	Highlands - Southern Fall
Wim	Wimmera	WaP	Warrambool Plain	HNF	Highlands - Northern Fall
GleP	Gleneig Plain	Gold	Goldfields	OIR	Otway Ranges
Brid	Bridgewater	CVU	Central Victorian Uplands	Strz	Strzelecki Ranges
VVP	Victorian Volcanic Plain	GGr	Greater Grampians	MonT	Monaro Tablelands
VRiv	Victorian Riverina	DunT	Dundas Tablelands	HFE	Highlands - Far East
MSB	Murray Scroll Belt	NIS	Northern Inland Slopes	VAip	Victorian Alps
RobP	Robinvale Plains	EGL	East Gippsland Lowlands		
MuF	Murray Fans	EGU	East Gippsland Uplands		

Source: VIC Government, DELWP

The Strzelecki Ranges, located in south east Victoria, consist of moderate to steep slopes, deeply dissected blocks of alternating beds of sandstone, siltstone and shales, and swampy alluvial fans in the lowlands.

- The geology is of Mesozoic non-marine deposits covered with a veneer of younger Cainozoic deposits including newer basalts.
- The soils are mainly gradational textured acidic soils (Dermosols), together with friable red earths (Ferrosols).
- The dominant vegetation is Wet Forest and Damp Forest on the higher slopes; and Shrubby Foothill Forest and Lowland Forest on the lower slopes.
- The climate is temperate with rainfall of 1000mm, mostly in winter and spring.
- The Strzelecki Ranges are a deeply dissected range of hills that form the headwaters of several river.

Source: VIC Government, DELWP

The *Bioregion Benchmark for Vegetation Quality Assessment* prepared by the Department of Sustainability and Environment (VIC Government) describes the Ecological Vegetation Classes (EVC) that characterise the Strzelecki Ranges.

Four of them particularly fit the ecosystems observed on the property:

- EVC 16: Lowland forest (near the herb spiral and firepit area)
- EVC 18: Riparian forest (near waterways)
- EVC 29: Damp forest (hills)
- EVC 30: Wet forest (creek beds)
- EVC 31: Cool temperate rainforest (near waterways)

More information can be found here: https://www.environment.vic.gov.au/Strz_EVCs_combined.pdf and here: <http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit>

Climate:

Temperate zones experience the distinct four seasons. Mild Temperate Zones share many of the features of the Warm Temperate Zone, except for rainfall which is predominantly in winter with a low summer rainfall.

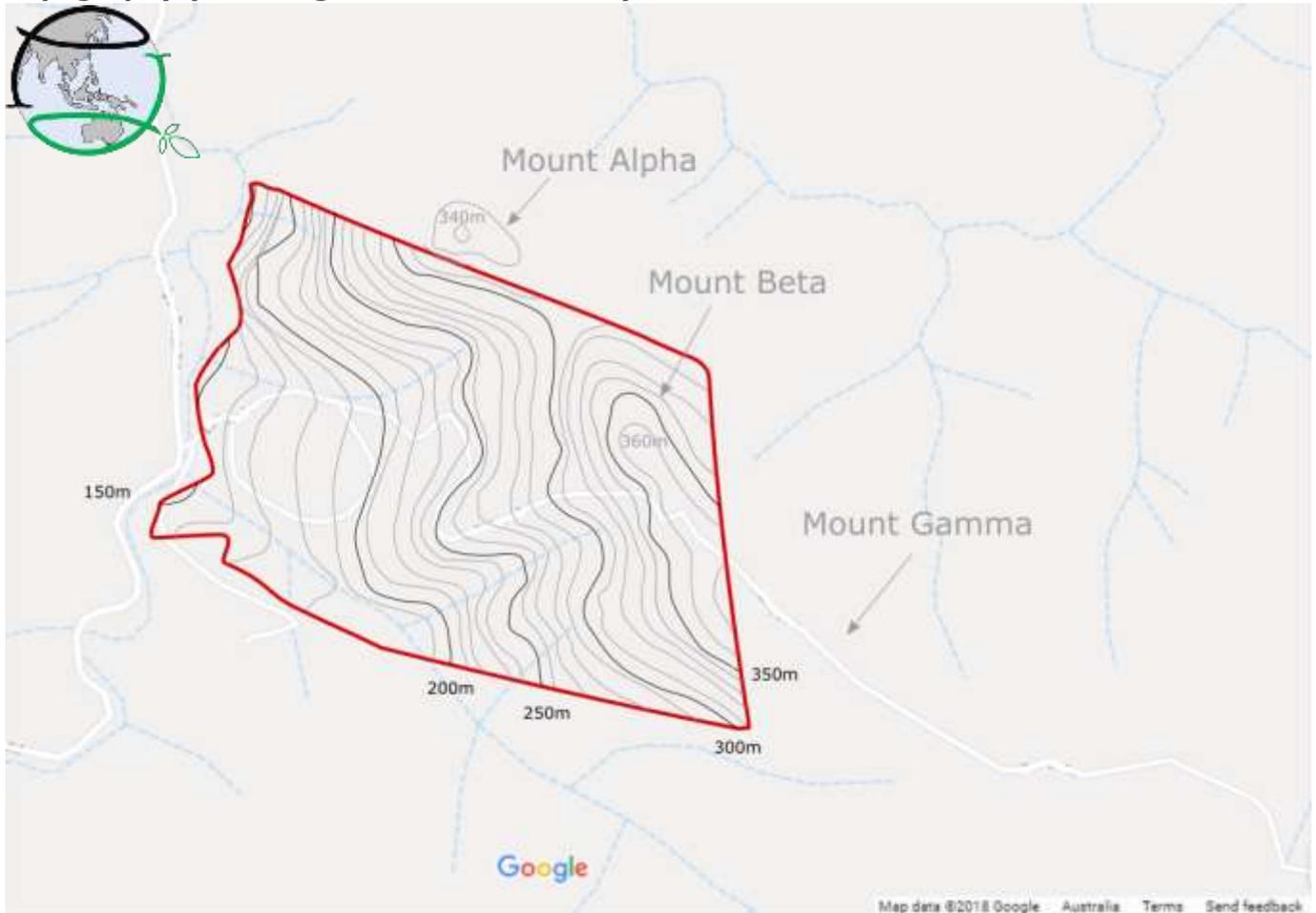
The ocean moderates temperatures, allowing coastal zones in warm temperate zones to grow a range of plants including subtropical ones.

The summers are warm with an average January maximum less than 30°C but with a low humidity, which favours the growing of grapes and figs that are damaged by moisture and prone to fungal disease in wetter areas.

The winters are cool with light frost, and with an average annual lowest temperature of about 5°C.

Where frost does occur, it can have a significant effect of reducing pest numbers of fruit flies, etc. Frost is also said to sweeten certain vegetables such as parsnips and cabbage. A true winter induces dormancy of plants including herbs such as comfrey and the plants seem to do better for the rest of the year. A winter chill factor allows for successful growing of fruit trees that require this (e.g. cherry and apple).

Topography (including roads & waterflows):



Permaculture Journeys Design in Inkscape based on Google Earth, Google Maps and VIC TopoMaps

Soil Types:

- Bioregion soil pH: strongly acid (5.0-5.5) to moderately acid (5.5-6.0)
- Bioregion soil type:
 - o Atlas of Australian Soils: Map Unit Code Mh4

Mh4 Mountainous: Steep hill slopes of brown friable porous earths (Gn4.31) in association with mottled friable porous earths (Gn4.51) and minor, localized, areas of red friable porous earths (Gn4.11) and other (Gn) soils; dissected by narrow, incised, stream valleys of undescribed soils

Source: ASRIS CSIRO

- o Australian Soil Classification Mapping: Dermosol

Dermosols do not have strong texture contrast. They have a well-structured B2 horizon containing low levels of free iron. The parent materials of dermosols range from siliceous, intermediate to mafic in composition. The soils are found in imperfectly drained sites (yellow and grey dermosols) with rainfall between 550mm and 1350mm and in well-drained sites with rainfall between 450mm and 1200mm. Dermosols generally have high agricultural potential with good structure and moderate to high chemical fertility and water-holding capacity with few problems.

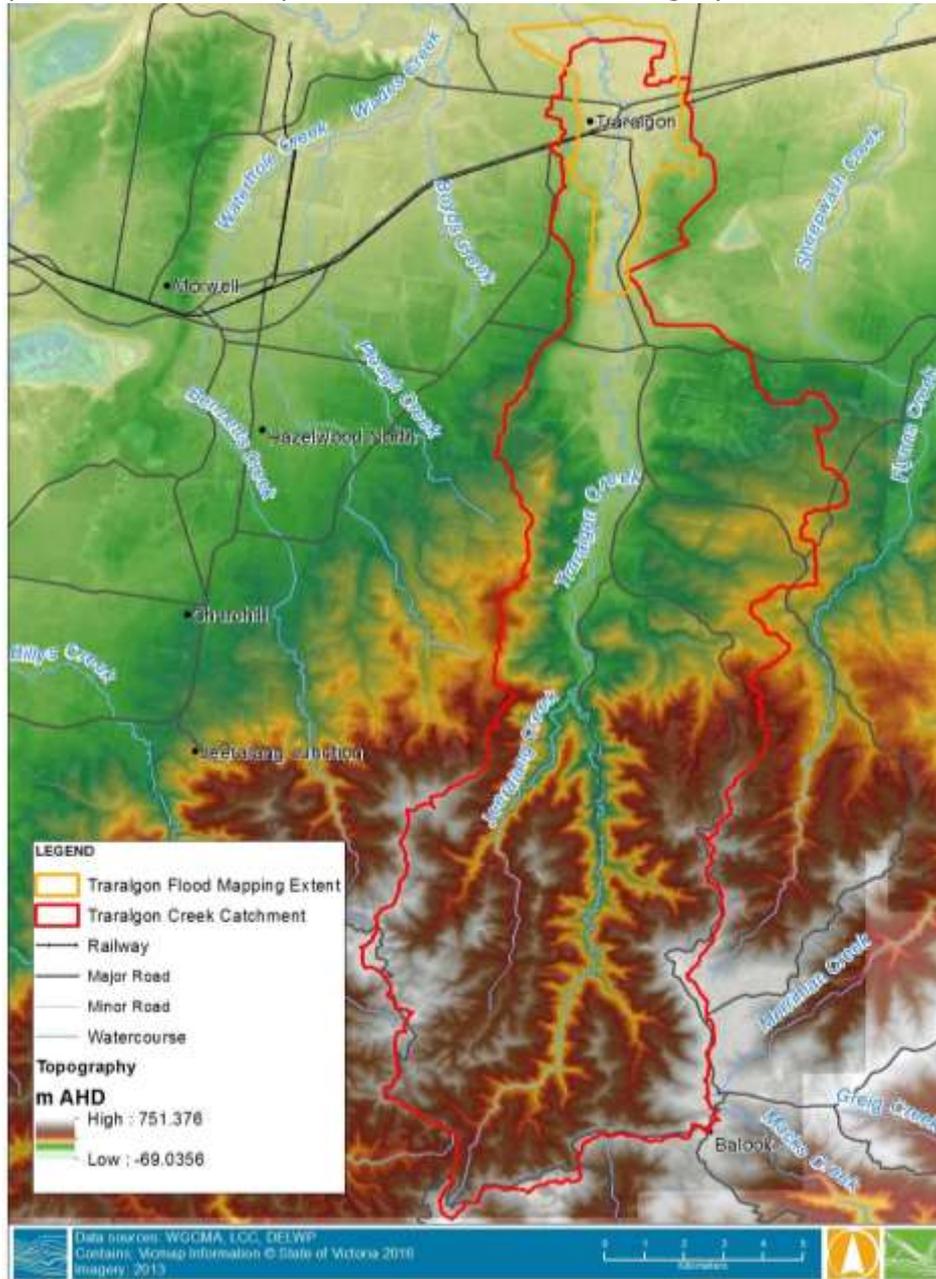
Source: Australian Soil Club

- Property: It is believed that no pesticides were ever used on the property. The soil is mostly clay, with a pH of 6-7. The structure is: thin layer of top soil, then clay for about 1-1.5m, mudstone underneath (porous, retaining water, full of minerals and soft enough for tree roots to penetrate), and finally granite about 5m deep.

Floods (periodic) & floodplains:

The property is wholly located within the Traralgon creek catchment.

There are no floodplains but Traralgon creek itself is subject to flooding in case of extreme weather events. Erosion prevention must be planned to conserve the integrity of the creek and for resilience.



Source: VIC Government, DELWP

Existing infrastructures & features:

- Mobile structures only: 1 small building (Styrofoam and steel, can be moved), 1 caravan, 5 shipping containers
- Timber plantations for logging: Wattle trees in the valley on the southern boundary around the 170m elevation line approximately; Blue gums on ridge road between Mount Beta and Gamma

Niches (opportunities in space and/or time):

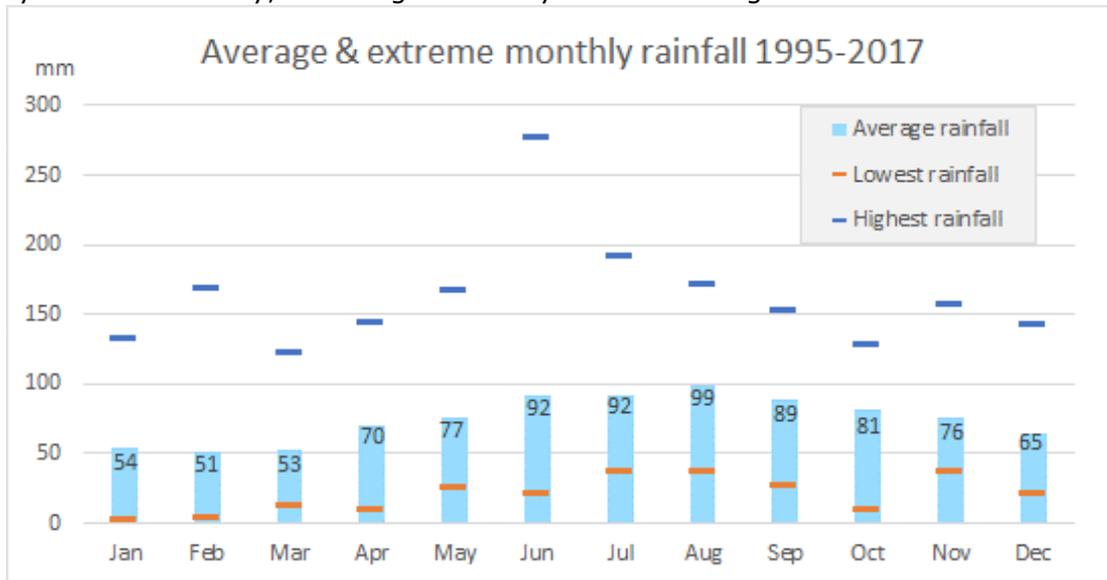
- Edges on the banks of waterways (creek, spring), offering land and water habitat
- Heaps of tree stumps (hügelkultur) gathered after the 2009 bushfires, slowly decomposing
- Natural ditches around the ring, ideal for collecting and spreading water
- Amplitude of elevation from foothills to hilltops, offering warmer areas on the hillsides and colder areas on the foothills and hilltops

ii. Seasonal Attributes – Data Records

Rainfall:

Average & extreme monthly rainfall:

75-100 days of rain annually, including 50-75 days with rainfall greater than 3mm

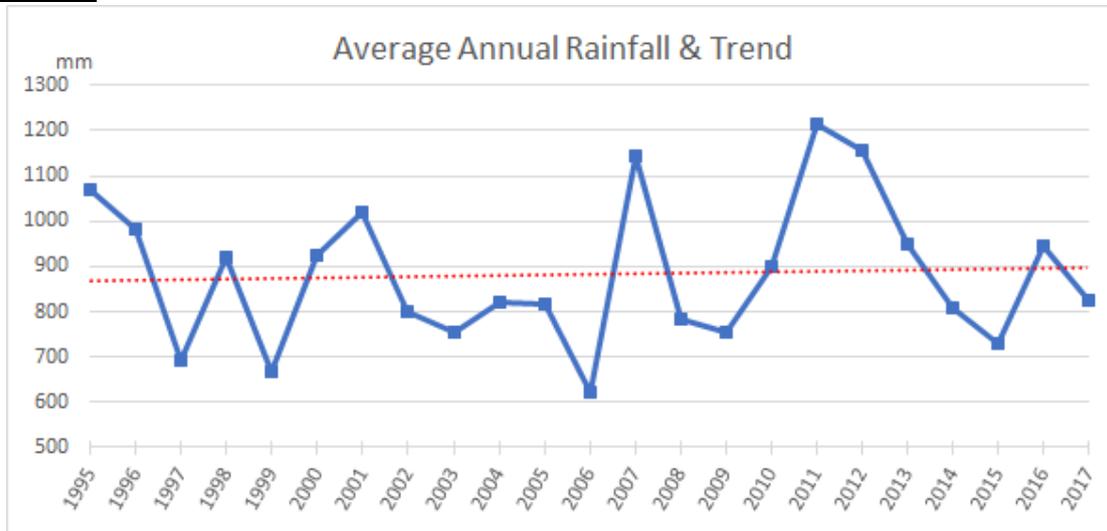


Permaculture Journeys graph created from BOM data (Bureau of Meteorology)

Highest rainfall record:

Highest in a day: 130.2mm (28.Jun.2007)

Trend overtime:



Permaculture Journeys graph created from BOM data (Bureau of Meteorology)

Humidity:

Relative humidity: 70-80% average daily 9am relative humidity annually (80-90% in July), and 60-70% average daily 3pm relative humidity annually (50-60% in January)

Evaporation (i.e. from soil, ocean and other surfaces): 0-1,000mm avg per annum (the lowest range), with 400-500mm in summer and 100-200mm in winter

Evapotranspiration (i.e. from soil, ocean, other surfaces, AND plant transpiration): 600-700mm actual ET avg per annum, with 90-100mm in January and 20-30mm in July

Sunshine:

Sun sectors: (refer to appendix 1 and/or sector analysis below)

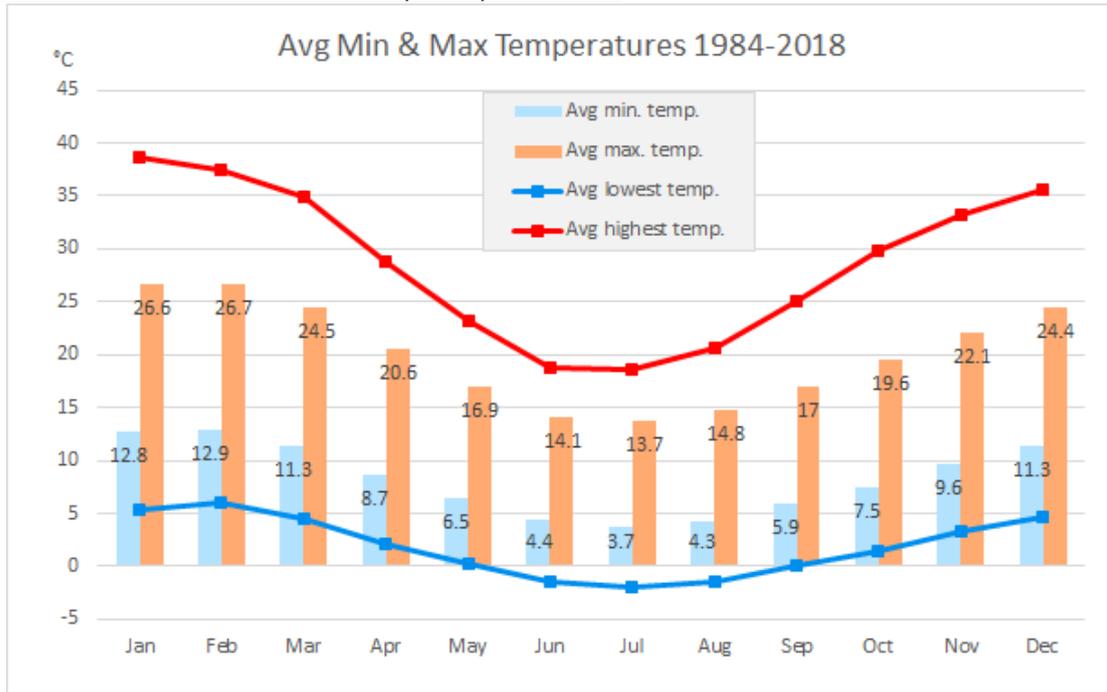
Sunshine: 6-7 hours of average daily sunshine annually, with 4-5 hours in the winter months from May to September, and 7-8 hours from October to April

Solar exposure: 4.1kWh/m² of average sun exposure daily, with 1.5-2kWh/m² in winter from May to August (lowest at 1.3 kWh/m² in June 1991), and 5-7 kWh/m² hours in summer from November to February (highest at 8.1 kWh/m² in January 2009). Exposure for most of the day in winter is on the south-east part of the ring only. North-west area is shaded part of the day from Mount Alpha.

Clear days annually: 31 clear days (0-2 cloud cover scale), 170 cloudy days (6-8 cloud cover scale), and the rest (164 days) in between (3-5 cloud cover scale)

Temperatures:

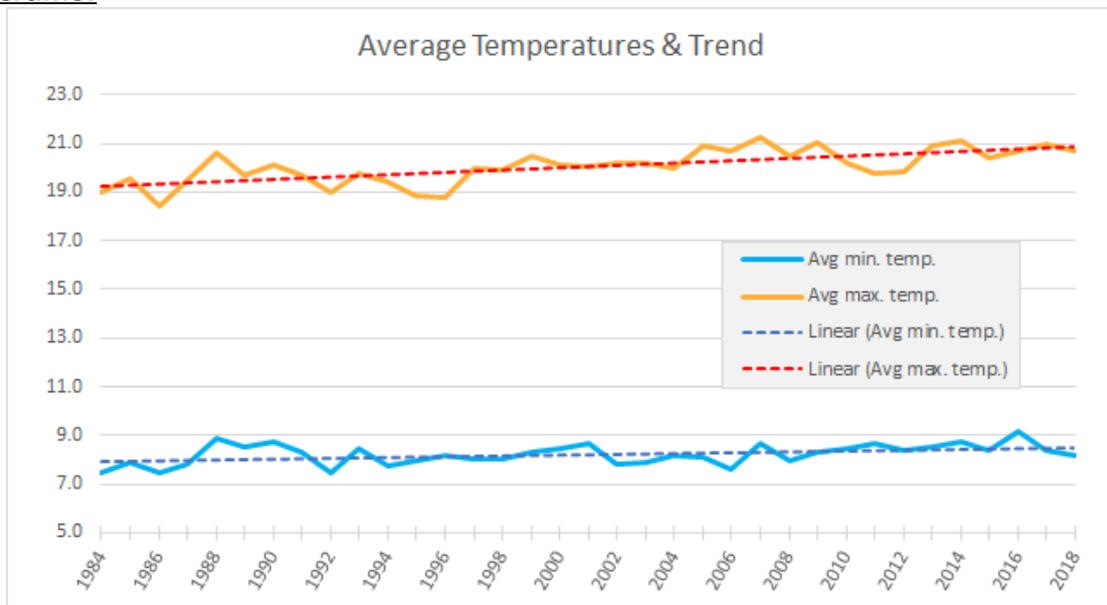
Average minimum & maximum monthly temperatures:



Permaculture Journeys graph created from BOM data (Bureau of Meteorology)

Lowest & Highest Temperature Records: Lowest: -4.8°C (3.Jul.2017); Highest: 46.3°C (7.Feb.2009)

Trend overtime:



Permaculture Journeys graph created from BOM data (Bureau of Meteorology)

Weather systems & wind patterns:

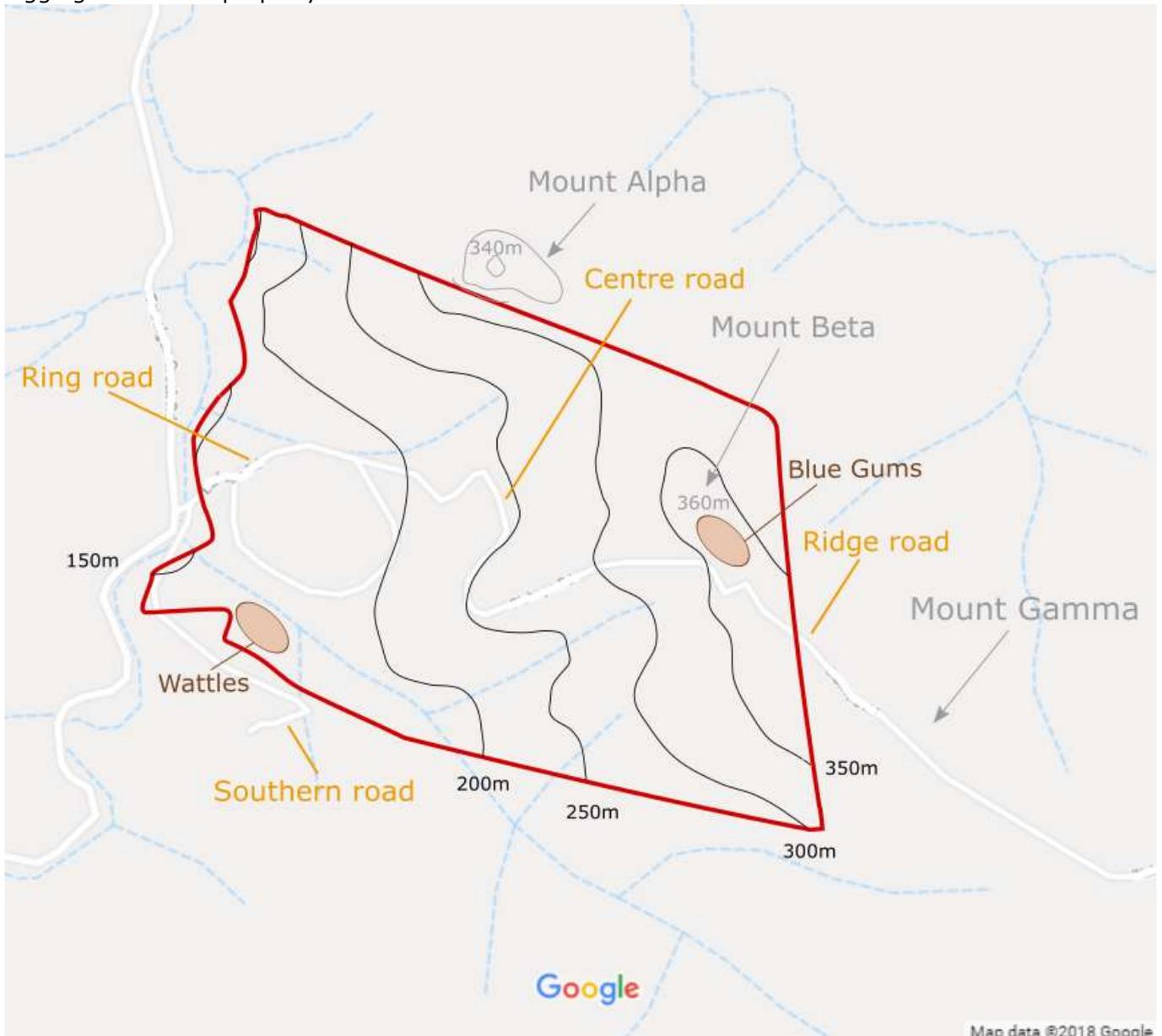
Weather systems: Hot and dry weather from January to March, wet and rainy weather in winter and spring, cold weather from June to August

Winds: Winds are mostly westerly in the region, with also north-westerly mostly in winter, and westerly in the morning and easterly and south-easterly in the afternoon in summer. The velocity is higher in the winter months (refer to appendix 2). However due to the topography of the landscape on the property, which is surrounded by hills on the north-east, east and west side (and south-east to a certain degree), winds mostly come from the north-west and south-west of the property, following the natural corridor of Traralgon Creek in the valley.

iii. Existing Landscape Map & Sector Analysis

Existing Landscape map

The existing landscape map shows the main contour lines, as well as existing roads, creeks and tree logging areas. The property has a tree cover >95%.

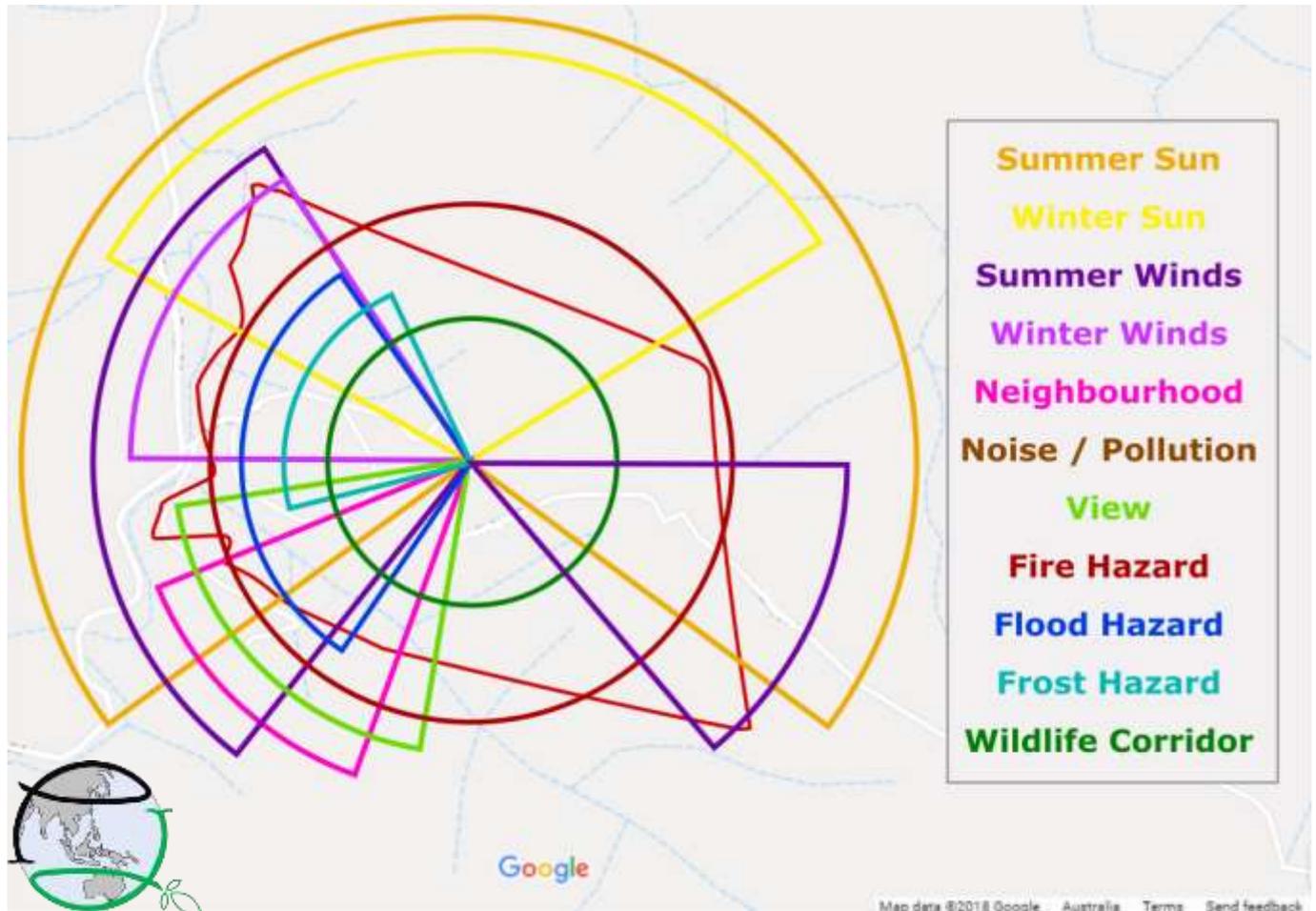


Permaculture Journeys Design in Inkscape

Sector Analysis

The sector analysis looks at the environmental factors such as climatic factors studied in the sections hereabove and their influence on the property.

This analysis of sun, wind, hazards and other sectors helps plan for a better design to place elements according to the natural characteristics of the landscape and work with (rather than against) Nature.



Permaculture Journeys Design in Inkscape

Plan for Resilience

- **General:** The property is to be designed in line with the 3 ethics and 12 principles of permaculture as well as ecological attributes defined in the sections 3.c.i. and 3.c.ii. in order to plan for resilience and preserve the current natural ecosystems, as based on the sector analysis hereabove.
- **Fires:** Bushfires at present could come from anywhere given the highly forested landscape that constitutes a tremendous amount of fuel as well as the absence of firebreaks anywhere near the property. They are however most likely to come from the northwest and southwest (as with the 2009 Black Saturday bushfires) due to the westerly prevailing winds (including northwest and southwest) and topography of the landscape (the creek in the valley follows a south-north axis on the western boundary of the property). In addition, fire travels uphill and the steeper the slope, the faster the fire can run it; hence, dwellings are best be built on the downslope flatter areas of the ring with ponds placed on the fire side of homes as permanent firebreaks. At least 2 or 3 fire-resistant dwellings should be constructed (underground bunker and hobbit house, as well as shipping containers that can fairly easily be restored after surface burning and reused within a few days to a few weeks; and designed with fire-resistant features such as leaf-shedding gutters). Further information on bushfire-proof houses can be found here: <https://www.theguardian.com/sustainable-business/2016/feb/09/bushfire-proof-houses-black->

saturday-innovations. Zones 1 and 2 should be mainly cleared from trees and protected with fire-retardant and fire-resistant plants. The area should be 40-50m in radius divided in concentric circles with a defensible zone at its centre, then a reduced-fuel zone, then a semi-wild managed zone, and then a fire-retardant shelterbelt as the last zone before the wild or forested areas. <https://permaculturewest.org.au/fire-site-design-by-vicki-boxell/>

- Floods: Swales to slow, spread and sink water. Creek erosion management is to be planned through planting of strong rooting water-loving species, such as weeping willows, bamboos, reeds, vetiver grass on stream banks, scutch grass as lawn / pasture / anti-erosion cover (impact of those species is to be assessed prior to planting). Gabions are not recommended unless to spread water onto natural floodplains, which is not the case here. Floods won't be a risk to dwellings as long as these are built above the 200m elevation line.
- Frosts: Dwellings are to be built mid-slope around the 220m elevation line where it is warmer than on foothills and hilltops. Cold temperate species resistant to and benefitting from frost such as cherry trees can be planted at lowest elevations where the frost is most likely to occur and on southern slopes to delay blooming and reduce the chances of frost exposure in early spring. Ensure north aspect and mid-slope planting of the less frost-tolerant species such as lemon and avocado trees and possibly construct a protective fence or wall upslope from the crop to divert the cold airflow around it. Please refer to the following link for further advice on passive frost protection methods: <http://www.fao.org/docrep/008/y7223e/y7223e0c.htm>
- Winds: There is a higher velocity in winter so it is more suitable to plant evergreen (but fire-retardant) species on the western side. Low to medium height and far enough from the ring as to not reduce further the amount of sunlight.
- Nuclear winters: Usually last 1-2 years. Any species that can survive with minimum daylight / no sunlight / heavy fog or LED lights? (to investigate for detailed design)

4. Proposed design & work

a. Component Analysis & Appropriate placement of elements

Component Analysis Table

The objective of this table is to identify the inputs, outputs and relevant placement zone of each element in order to create closed loop systems where the output of one element becomes the input for another, as well as to identify flows of movement between elements within or in between zones.

Component	Primary Input	Secondary Input	Primary Output	Secondary Output	Zone
Infrastructures / Site Components					
Individual Dwellings	Building materials & furniture	Electricity and water	Shelter	Rainwater collection, solar, greywater	1
Community Kitchen	Building materials, benches & cooking appliances	Electricity, gas, water & food produce	Cooked meals	Rainwater collection, solar, greywater, food waste & social space	1
Community Office	Building materials, furniture & digital appliances	Electricity	Work & entertainment space	Rainwater collection, solar	1
Dining Lounge	Building materials & furniture	Electricity & cooked meals	Dining & social space	Rainwater collection, solar	1
Community Compost Toilet	Building materials & collecting bins	Human waste & carbon material	Fertiliser	-	1
Shower / Laundry	Building materials & washing appliances	Electricity & hot water	Greywater	Rainwater collection, solar	1
Tool Shed / Workshop	Building materials, working benches and hand & power tools	Electricity	Storage, working & building space	Rainwater collection, solar	2

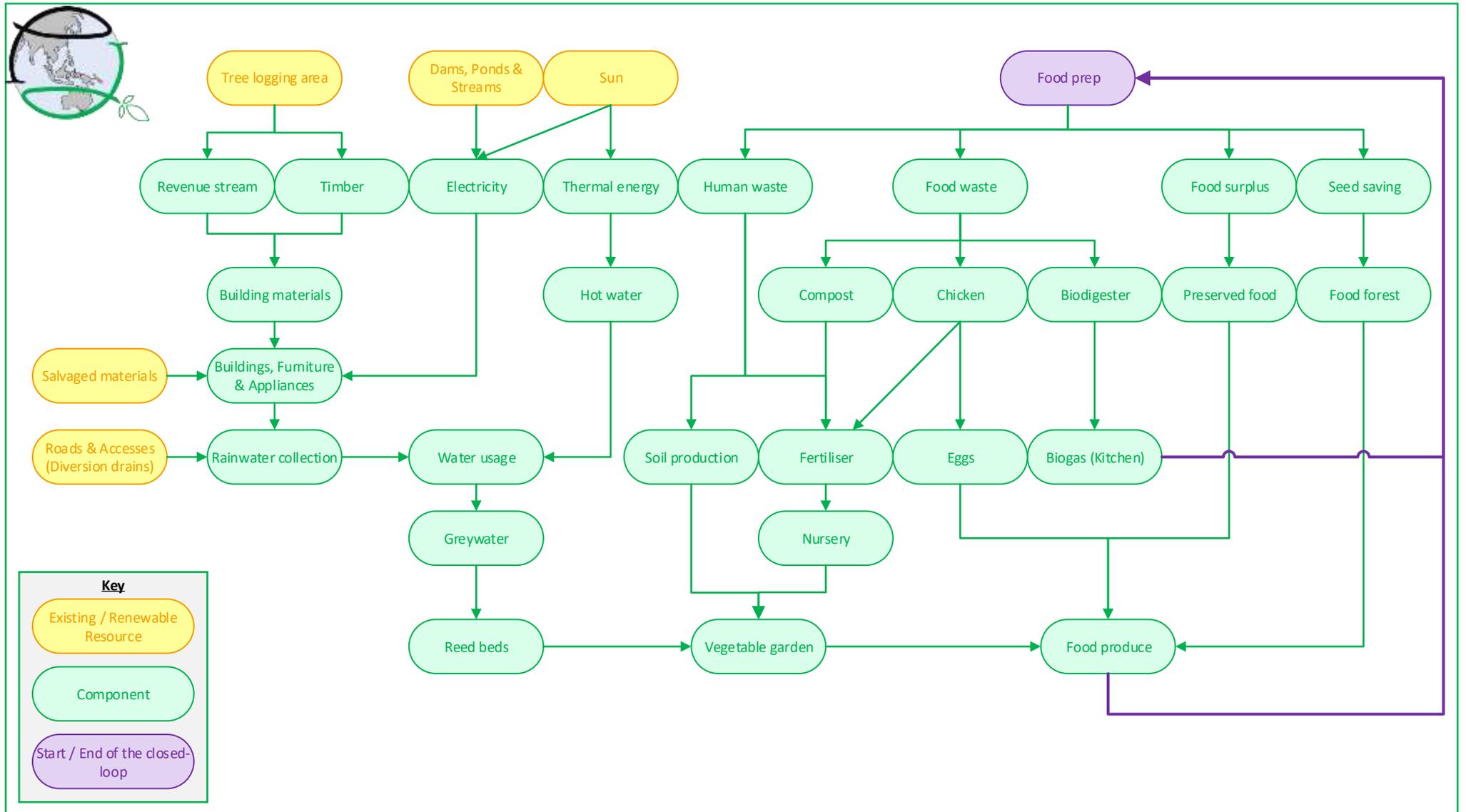
Underground bunker	Building materials	Food & water supplies	Protection against bushfires	-	2
Roads	Machinery, equipment, gravel	-	Access	Water catchment through diversion drains	1 to 5
Food Production Systems					
Vegetable Gardens	Soil, seeds & seedlings	Fertiliser & water	Food production	Plant materials & chicken feed	1 to 3
Food Forest	Seeds & seedlings for each of the 7 layers (edible, native & support species)	-	Food produce (fruits & nuts)	Habitat & food for wildlife	3 & 4
Greenhouse / Nursery	Building materials, benches & irrigation pipes	Seed trays, pots, seeds & seedlings, sun, soil, compost & water	Strong seedlings ready for planting outside	Microclimate for subtropical species Rainwater collection, thermal energy	3
Seed Bank & Food Drying Hut	Building materials & storage benches	Seeds & food surplus	Preserved food & new seeds for planting	Thermal energy	2
Aquaculture (dam & ponds)	Excavator, tools & lining materials, rainwater	Micro-organisms, algae, plants, fish	Water storage, food (fish & plants), Hydro-electric power	Pest control, aesthetics	3 & 4
Energy Components					
Solar system	Sun	Solar panels, charge controller, batteries & inverter	Electricity & Thermal energy	-	1 & 2
Hydro-Electric Power	Falling or flowing water	Turbine blades, shaft & electricity generator	Electricity	-	4
Composting space	Food waste	Water & turning	Soil & Fertiliser	-	1 & 2
Biodigester	Food waste	-	Biogas	-	1
Greywater Treatment System	Greywater	Plants (reeds), gravel & sand	Recycled water for garden irrigation	-	3 & 4
Tree logging area	Wattles, pines & blue gums already there	-	Timber / Building materials	Revenue stream	4
Social Components					
Artistic Garden	Salvaged materials of fantasy or medieval style	Creativity	Relaxing space, Inspiration & Well-being	-	2 & 3
Meditation Temple	Building materials & cushions	-	Calming & reflective space	Rainwater collection	4
Classroom	Building materials & furniture	Electricity	Education	Rainwater collection, solar, social & interactive space	1
Museum of all things	Building materials & display features	Display elements	Education & Entertainment	Revenue stream	4
Chickens	Food, shelter (chicken coop), water	Space, dust, hiding places, companions	Eggs, scratching, pest control, fertilising	Companionship & Entertainment, Chicken coop water collection (roof & gutters)	2

Connection of components / closed-loop systems

Each tangible output from the table hereabove is identified as an input to another component to create a closed-loop system and ensure circulation of nutrients. Some elements may not be included, such as natural or abstract inputs and outputs; these may comprise living elements of natural ecosystems, social space, education, revenue stream, etc.

Below is the diagram of closed-loop systems.

Diagram of closed-loop systems



Permaculture Journeys Design in Visio

Connection of Components

- The rainwater collected by the roof and gutters of each building and through diversion drains alongside roads and accesses can be used in the kitchen, shower and to irrigate gardens and nursery and provide water to the chicken.
- The greywater generated from the dwellings, community kitchen and shower / laundry is directed to the reed beds where it is cleaned and reused to irrigate the vegetable gardens.
- The vegetable garden as well as nursery, seed bank / drying hut and food forest provide food produce; and so do the chicken who produce eggs.
- Food consumed will become human waste that is collected in the compost toilet and turned into soil and fertiliser over a 6-12 months period (not to apply in direct contact with edible parts).
- Food surplus is preserved in the drying hut for later consumption and seeds collected throughout the year are stored for later planting.
- The food waste produced in the kitchen and vegetable garden is placed in the biodigester for gas production that is reused for cooking, added to the compost pile for soil and fertiliser production, and/or distributed to the chicken as supplementary feed.
- The soil and fertiliser produced from the compost toilet and compost pile can be used in the vegetable garden and the nursery. Chicken also fertilise the soil in preparation for crop rotation or new garden beds.
- Dams, ponds and streams can produce falling or flowing water to generate hydro-electric power; and sun provides thermal energy and electricity. These forms of energy are then used to light the buildings, power tools and appliances, and heat-up water.
- The tree logging area provides timber as a source of building materials and/or revenue.

Appropriate placement of elements

Elements should be placed relatively to each other according to both the diagram of closed-loop systems hereabove and the physical and seasonal attributes of the landscape, in order to use passive energy sources such as sun and gravity, and maximise conservation of energy.

- Rainwater is collected using gravity through grading of the roof spaces and access roads (2% grading is sufficient) which directs the water from the rooftops in gutters and then into water tanks, and from the roads to diversion drains and then into gardens. Therefore, the input pipe of water tanks is to be lower than the gutters and the output pipe is to be higher than kitchen and shower taps. Likewise, reedbeds for greywater treatment are at lower elevation than the lodgings where the water is used, and crops can be planted downslope from the reedbeds and from the roads' diversion drains.
- Where water use may be required upslope from the water source (e.g. shower higher up than creek bed), a RAM pump can be placed in a stream and supply water uphill while allowing the waste valve to open and release excess water back in the stream. 1-3m of head space enables energy use and power and every 30cm drop can push water 3-9m into the pipe without further energy input.
- Again using gravity but also varying distances to minimise effort / conserve energy, we shall place herbs and kitchen garden next to the house, followed by compost pile and chook pen where food scraps can be disposed of on the way. The biodigester will also be next to the kitchen to supply the biogas. Additional crops can be planted downslope from the chicken coop as nutrients will be brought by gravity, and any yield from the garden and eggs can be brought back home on the way back. Seed bank / food drying hut shall be placed at reasonable distance from the kitchen, veggie garden and greenhouse / nursery (and underground for protection against bushfires).
- Sun exposure should obviously be considered when selecting plants, opting for sun-loving plants on the northwest side of the house and shade-tolerant plants on the south and east side. Similarly, crops that are sown the closest to the creek beds should be frost and flood-tolerant.
- Solar panels should be oriented north, and hydro-electric shaft and turbines placed at the bottom of steeper inclines. Dams are placed at specific points in the landscape, most often on hilltops, in valleys and at mid-slope when the grade changes from convex to concave. An adequate system of dams, ponds and swales at various elevations and throughout the property ensures water security and ongoing hydration of the landscape, plus protection of zones 1 and 2 (see below).

- Meditation temple should be in a calm area without much activity, maybe near a food forest to provide an opportunity to collect nuts and fruits on the way back.
- Other structures like the office, workshop, classroom and artistic garden are open to more flexibility in terms of placement.

Multi-functionality

Each element serves several functions and each function is served in several ways (please refer to the diagram of closed-loop systems there above).

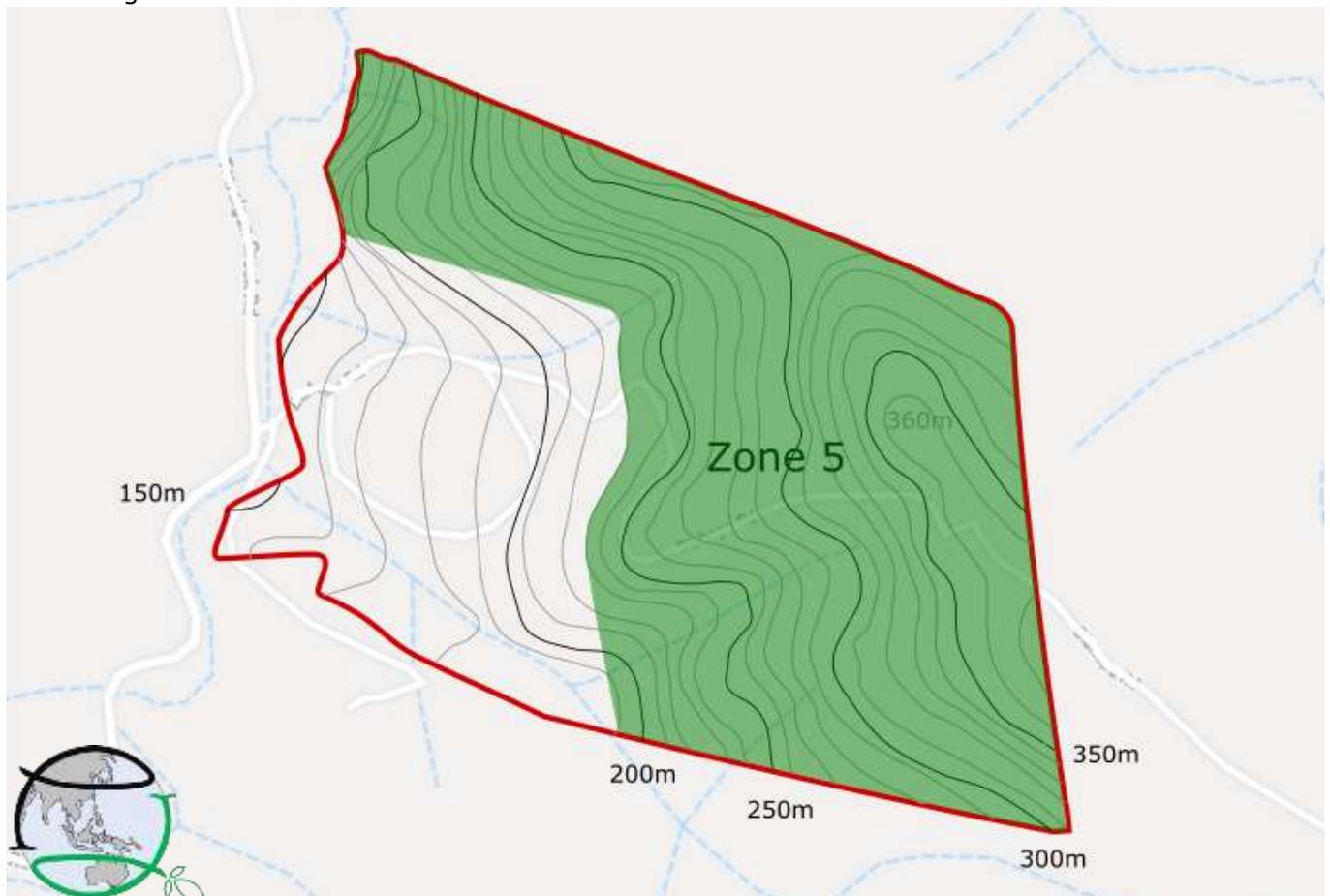
- Electricity is produced by hydro-electric and solar system. Sun also provides thermal energy.
- Food is produced by vegetable garden, food forest, preservation hut, chicken and aquaculture.
- Water is supplied by rainwater collection, system of ponds, dams, creeks & swales, and RAM pump.
- Fertiliser & nutrient cycle is provided by cover crops, compost, chicken and humanure.
- Chicken produce eggs, fertilise garden beds and act as pest controls.

b. Upgraded landscape (proposed concept design)

Zones are areas of use defined by the frequency of visits, the primary function of the elements they contain and the space required for these elements to function. As a general rule:

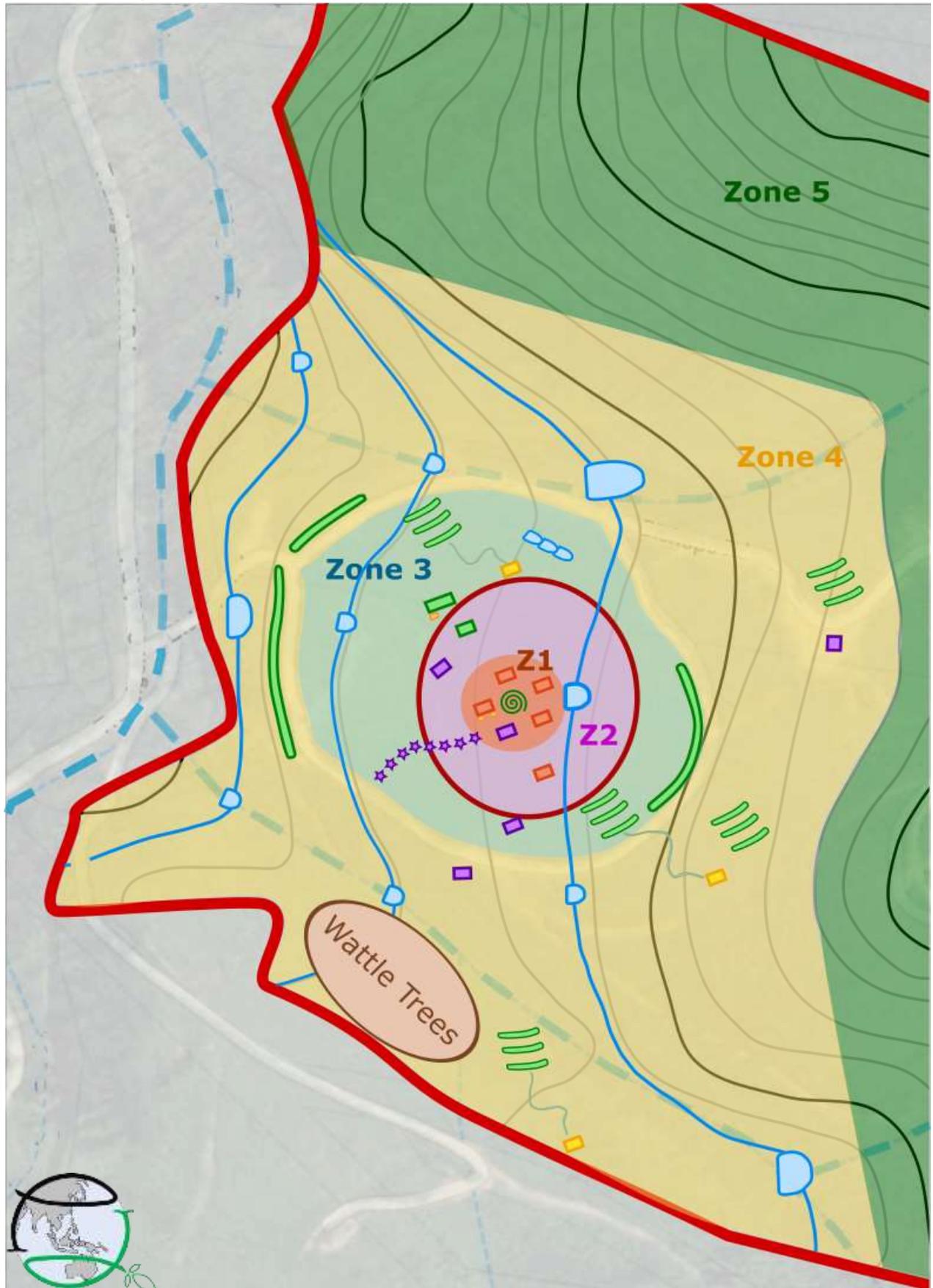
- Zone 1 is visited multiple times a day; it contains the household and immediate support utilities
- Zone 2 is visited once a day to once a week; it contains intensive production & usage areas
- Zone 3 is visited once a week to once a month; it contains extensive production & usage areas
- Zone 4 is visited once a month to once a year; it is a less managed / semi-wild habitat
- Zone 5 is visited once a year or less; it is the natural habitat or wilderness

There are about 30-35 acres of gentle to moderate slope in and around the ring on the west and south boundaries of the property and up until the 230m elevation line, which can be developed for the farm. The rest of the property is on steep incline and should be left as zone 5. The surface area of the ring itself is about 20-25 acres.

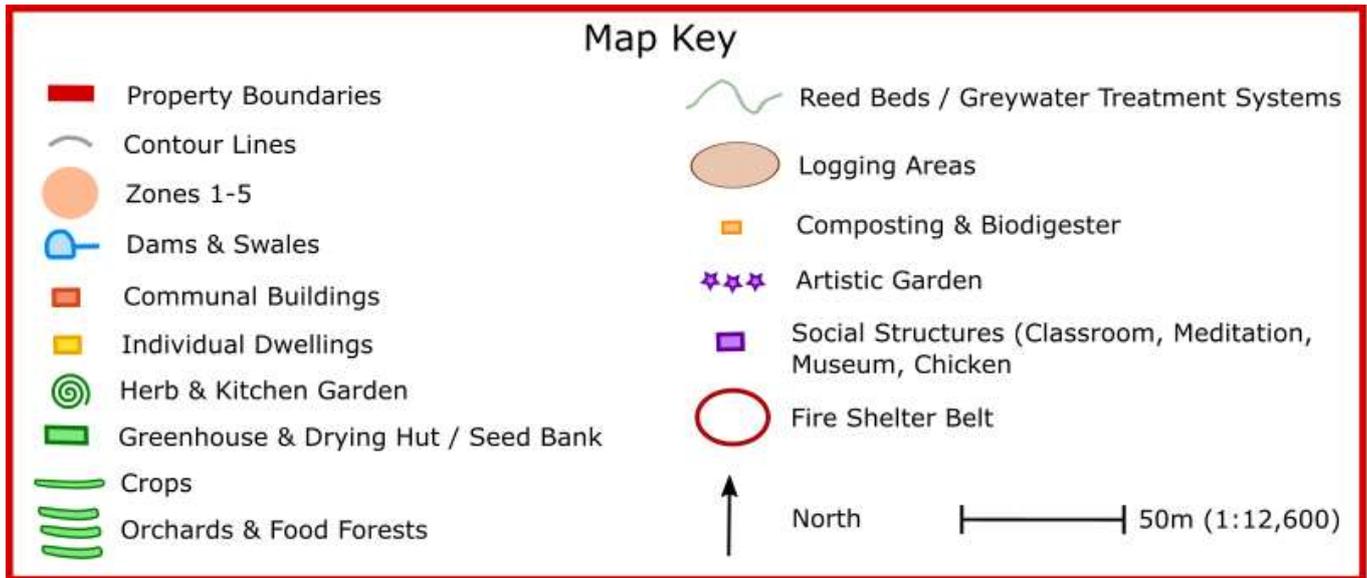


Permaculture Journeys Design in Inkscape

Refer to section 4.a. for the component analysis that determines the appropriate placement of elements relatively to each other.



Permaculture Journeys Design in Inkscape



Permaculture Journeys Design in Inkscape

The first structure on the outer edge of the south part of the ring is the museum, open to visitors and outside the community space to respect privacy.

The path marked by stars from the south-west part of the ring road to the community space goes through the artistic garden (already under development).

The community space constitutes our Zone 1 and comprises turning clockwise and starting at 9 o'clock the community kitchen on the west side, the dining / lounge room on the north side, the laundry / shower room on the north-east side, the office on the south-east side (all in red), and finally the classroom (in purple) on the south side. The herb & kitchen garden is placed in its centre.

In zone 2 on the south area is the tool shed / workshop (in red), and on the north-west area are the chicken coop (in purple) and the drying hut / seed bank (in green).

Zones 1 and 2 form the fire-shelter belt as described in the 'plan for resilience' paragraph of section 3.c.iii (pages 12-13). An additional underground bunker can be built in this area to be used in case of emergency (or using the underground seed bank), and a fire-resistant hobbit house is also planned on the hillside above the ring. Zone 3 is mostly used to grow annual crops and fruit and nut trees, which are fire-retardant plants and constitute an additional factor of protection. The system of dams and swales is also strategically placed both according to the topography and to protect zones 1, 2 and the major part of zone 3. Also, any bushfires that might come from the west side will be slowed-down by progressing downhill from the west mount, then facing the road, the creek and our first system of dams and swales before attaining the ring. This combination of design elements will vastly increase the defensibility of the communal structures and seed bank while protecting the people and chicken. Greywater treatment systems in the form of reed beds depart from the shower / laundry area and individual dwellings as needed, travel in zig-zag and end in orchards and food forest areas to provide regular irrigation to fruit and nut trees.

Crops comprised of a mix of edible and pollinator-attractive species can be planted along the roads where they will be watered via the diversion drains and contribute to erosion prevention.

The meditation temple is proposed in zone 4 on centre road where it will benefit from the peace and quiet of the forest, the attractive view of the valley south-east, and the proximity of a perennial food forest (syntropic agroforestry).

There are 2 areas that can be used for logging / timber in zone 4: one area of wattle trees near southern road (ready in about 5 years) and one area of blue gums on top of centre road near mount beta (longer-term).

The detailed design of the ring (zones 1-2-3) as well as the following report sections are to be prepared following client's review and approval of the concept design.

- c. Proposed job list & estimated budget
- d. Task Prioritisation
- e. Plan of development stages / Gantt chart
- f. Maintenance Plan

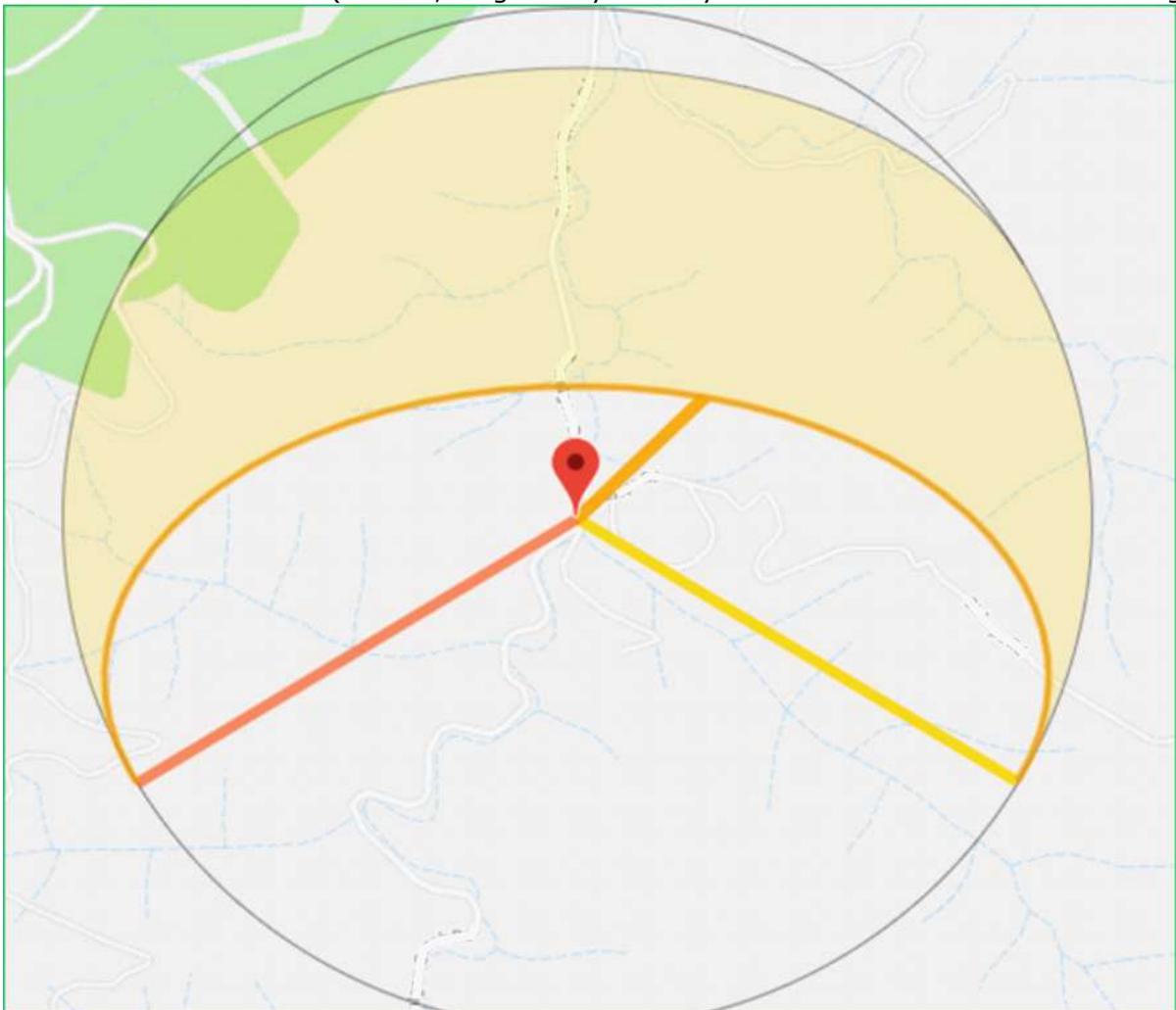
5. Land uses (including chosen species)

- a. Areas
 - i. Fire shelter belt
 - ii. Vegetable & Herb gardens
 - iii. Food forests
 - iv. Water Systems and Aquaculture
 - v. Native forest & Wildlife corridors
- b. Themes
 - i. Permaculture Community
 - ii. Productive farm to sustain the needs of the community
 - iii. Artistic Garden

6. Appendices

- a. Appendix 1 – Sun sectors
 - i. Summer Sun Sector

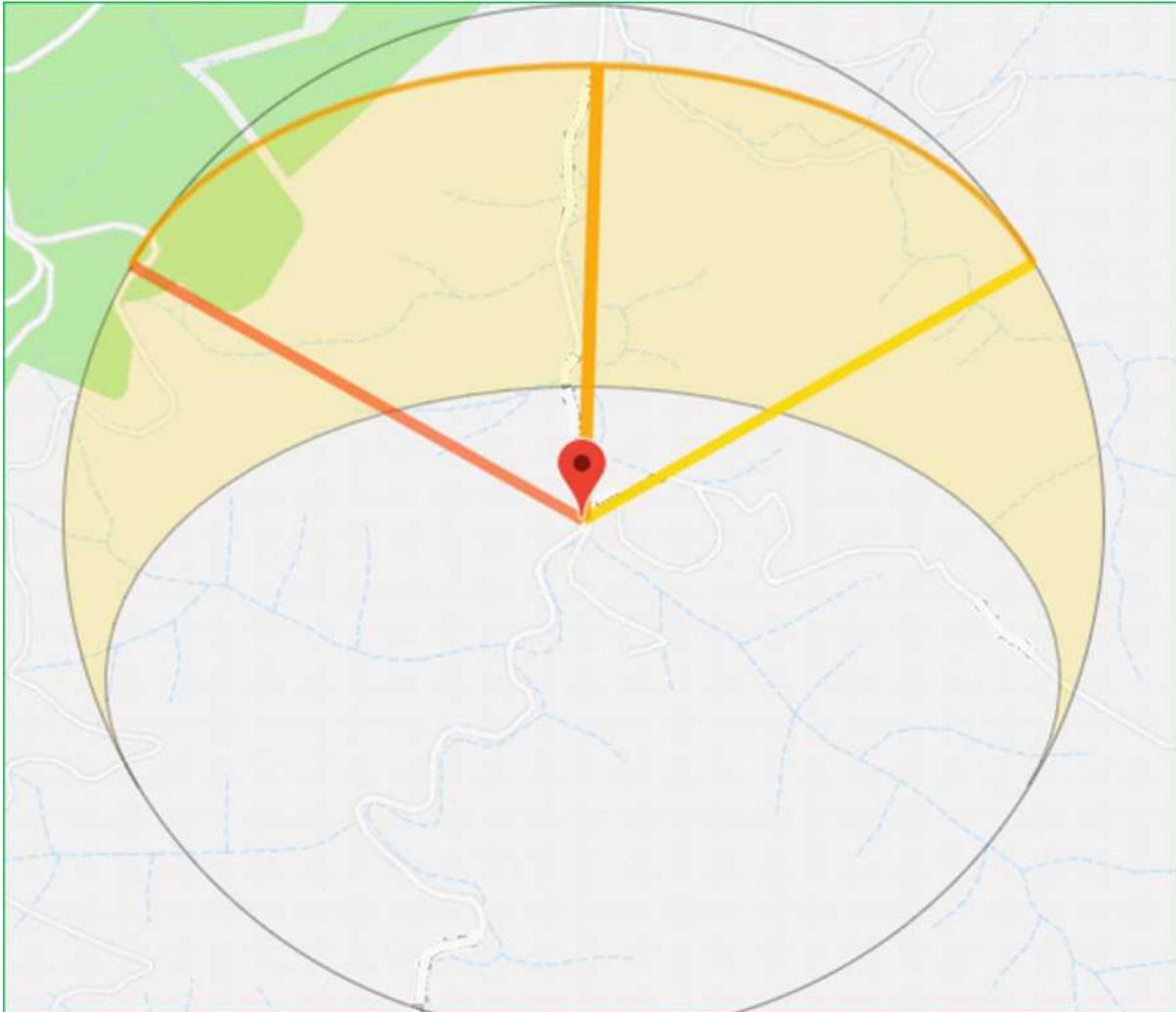
Sun sector at summer solstice (21.Dec, longest day of the year with the most amount of sunlight):



Source: Suncalc

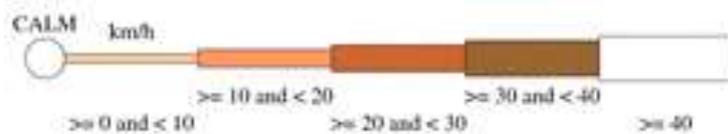
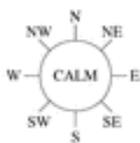
- ii. Winter Sun Sector

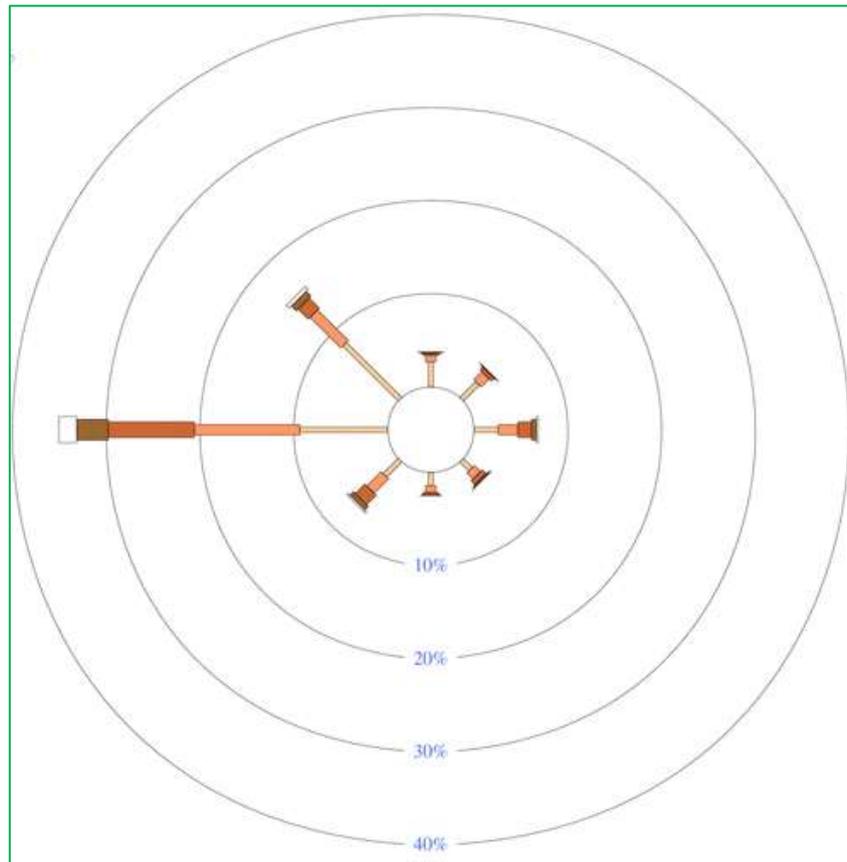
Sun sector at winter solstice (21.Jun, shortest day of the year with the least amount of sunlight):



Source: Suncalc

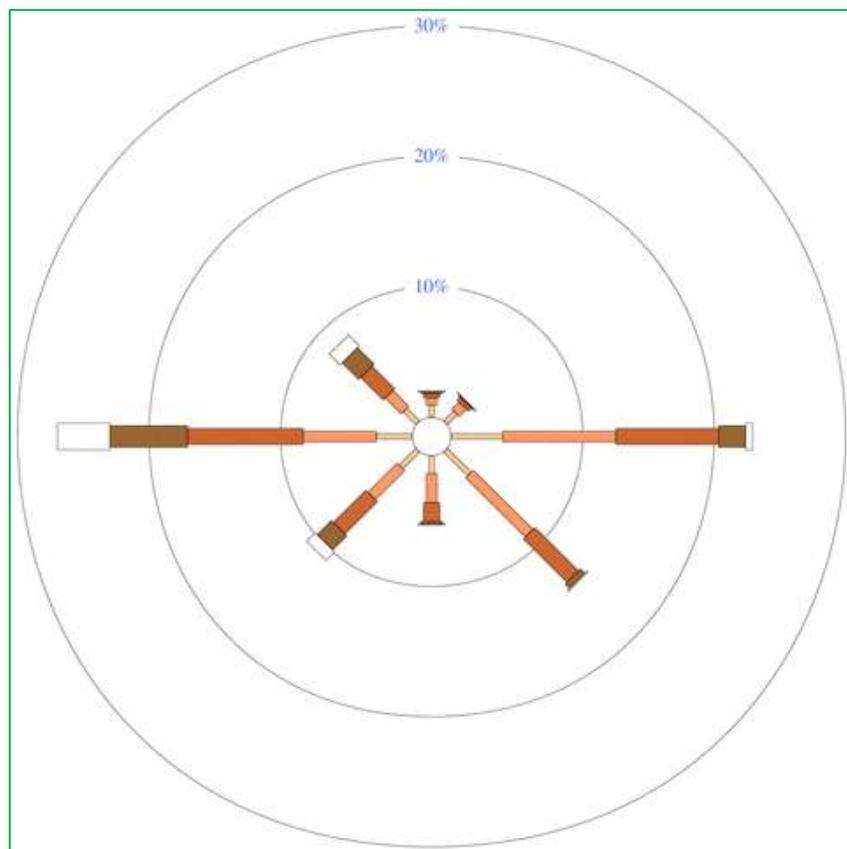
b. Appendix 2 – Wind sectors
i. 9am Wind Rose





Source: BOM (Bureau of Meteorology)

ii. 3pm Wind Rose



Source: BOM (Bureau of Meteorology)

7. References /Bibliography

In addition to the references provided for each graph, are the following resources:

- Australian Soil Club: <http://www.soil.org.au/soil-types.htm>
- Traralgon Creek Catchment Map: https://www.wgcma.vic.gov.au/wp-content/uploads/2016/08/Traralgon-Flood-Study-Summary-Report-3569-01_R05FINAL.pdf
- Wind roses: http://www.bom.gov.au/climate/averages/wind/selection_map.shtml