

Permaculture Design Course

Final Design Submission

Design Goals

This represents the final submission for Richard Pedley's Permaculture Design Course. The course provided the guidance and basic information to create the designs presented here. The site was chosen to show the evolution of a known site from a Permaculture perspective and how it would be optimized with the application of Permaculture principles. The basic goals with Permaculture are summarized as Earth Care, People Care and Fair share and is aimed at obtaining a yield while optimizing resources through storing energy and utilizing waste and engaging with the community.

Permaculture has generally been for large agriculture sites, but Bill Holmgren recently developed a course and book called *Retrosuburbia* to underscore the need to obtain yields and drawdown resource use and waste even on suburban lots. The aim is to help people become more antifragile with the impact of the increasing climate crisis worldwide. To showcase permaculture principles for a small property, I chose the property we have been renting in a rural beach community in the South Taranaki region of New Zealand.

Ultimately our design should be predominantly perennial and self-seeding annual plants, but especially trees. The aim is to have "cultivated ecologies" which "would be more ecologically balanced and resilient to seasonal variability than those based largely on annual crops."¹

History of Site

The property used for this permaculture design project is at 40 Kawai Rd in Ohawe which is in South Taranaki at the southwest corner of the North Island of New Zealand. This is a rectangular lot, 1272 m², with the south and north borders being the longest and the Waingongoro River at the west border, and the paved Kawai Rd on the east border.

There have been two recent owners. Google Earth still shows the site as configured by the owner prior to the current owner. The current owner made major changes since Google Earth photographed it. The Google Earth photo will be referred to as belonging to the 'original' property owner.

¹ Pg. 245, Holmgren, *Permaculture Principles & Pathways Revised Edition*

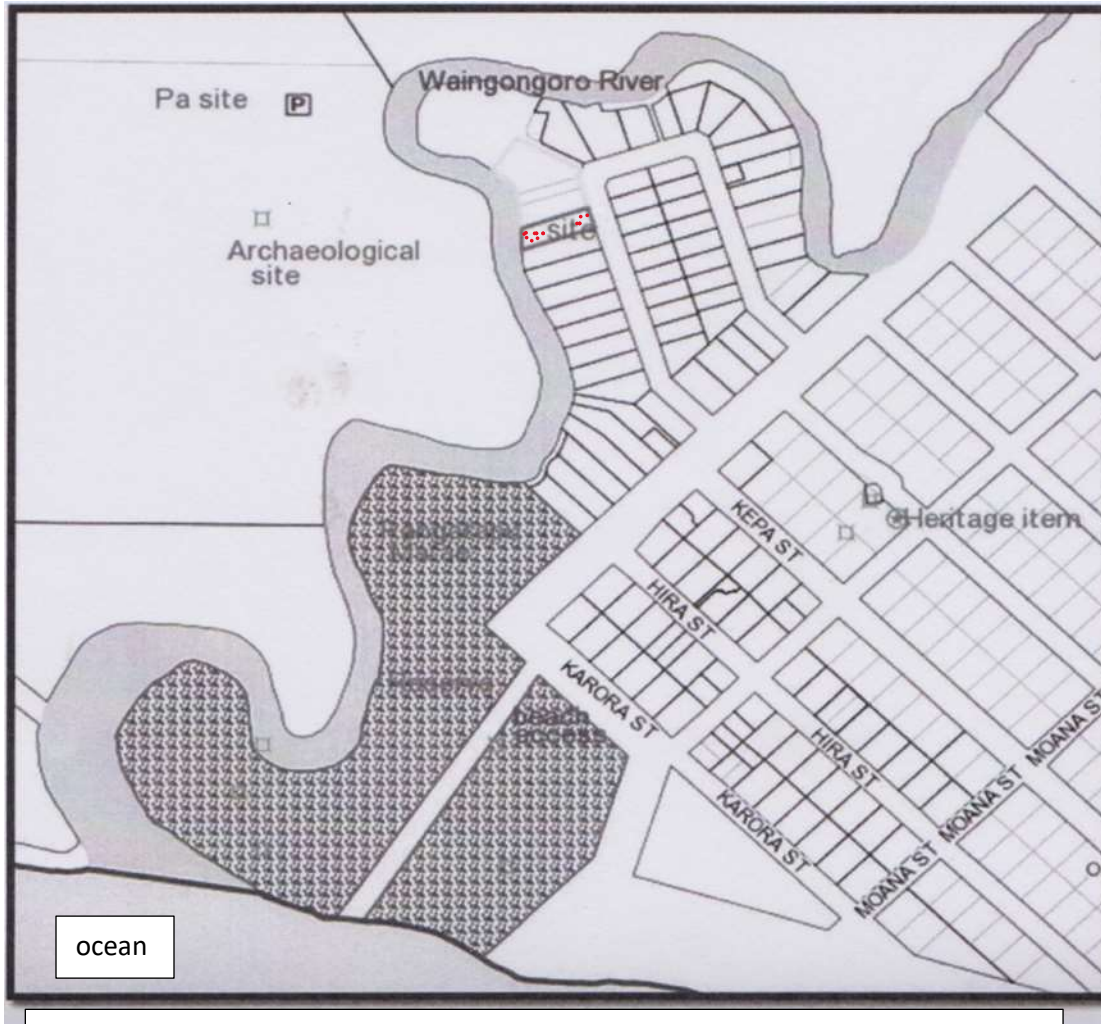


Figure 1: Ohawe Beach Community in relation to Waingongoro River and ocean. Target property has “site” and red dots within its parameters.

Currently about 100 people live in the Ohawe beach community, which is located between Mania and Hawera, with Hawera being the largest town, which is to the east. Ohawe is south and east in the region known as the Waimate plain, which was once one of New Zealand’s most densely populated rural communities. This was the site of much of the struggle between Maori and new settlers in the 1800s which is detailed in the book, *Ask That Mountain*. Ohawe was a moa processing area by Maori around 1300 AD/CE. There is no historical plaque about Maori settlement of this area, but there is a cemetery for the white settlers that died when Maori tried to protect their lands. There is information about the Maori settlements in local museums, namely the Tawhiti Museum in Hawera and the iSite in New Plymouth.

On the map below Ohawe is located at the bottom right corner. The featured property is at the northwest end of the highest loop (streets are in orange.)

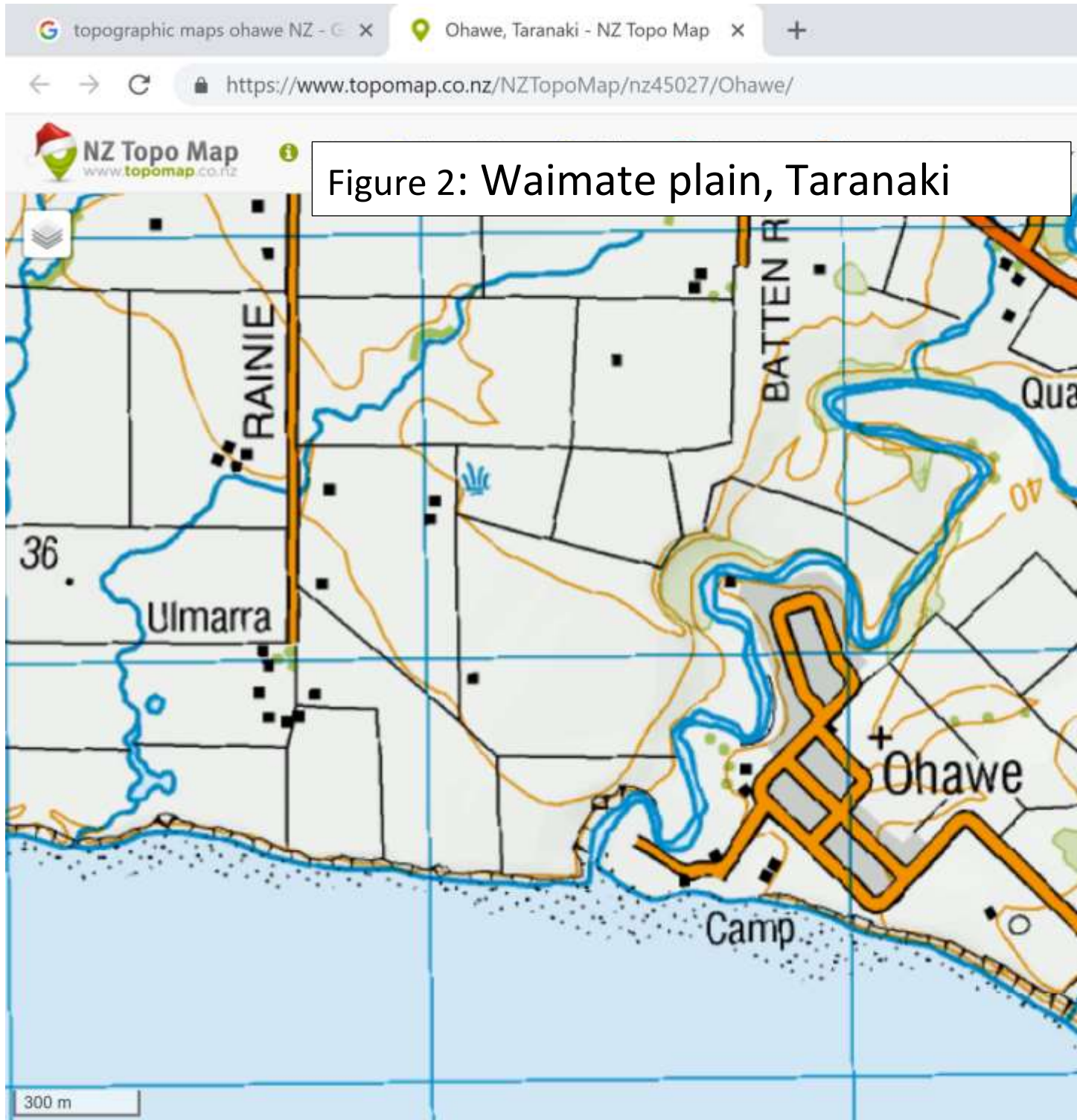


Figure 2: Waimate plain, Taranaki



Figure 3: Adjacent properties. The open area to the north of 40 Kawei is a tennis court. This is not part of 40 Kawei Rd though it is labelled such on this Google map. This is how it looked prior to the changes made by the current owner.

Details about the Taranaki region of New Zealand:

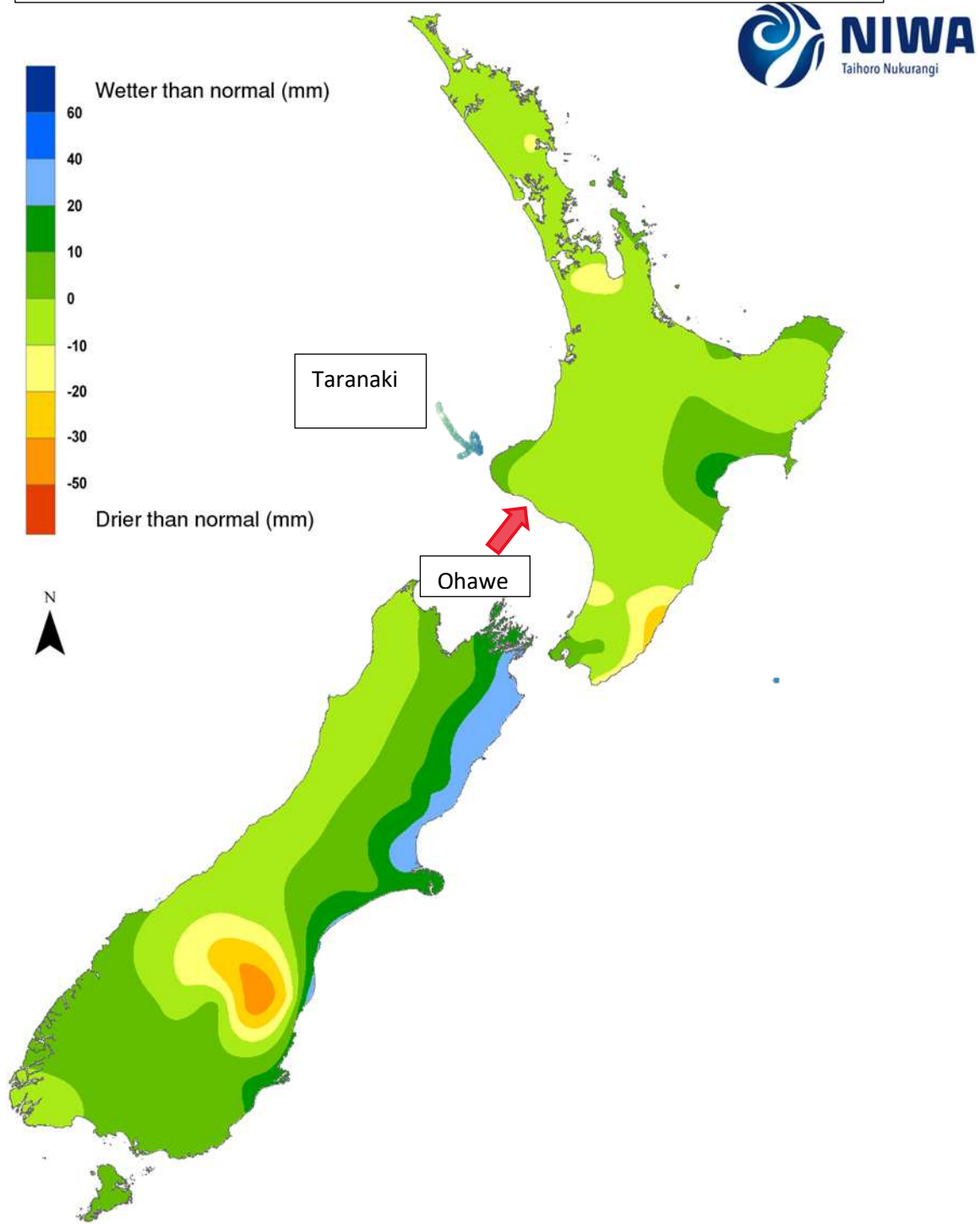
The target property is in Taranaki which is considered to have some of the best soils in New Zealand. An elderly gardener told me this is because of the wind driven salt spray which puts minerals into the soil.

Our area gets around 2000 hours of sunshine per year which helps growing conditions. It is important to note that the neighbor's fence and trees to the north of us can reduce sunlight on our side of the fence especially at low sun angles in winter. Also, because of the large ridge to the West of us, the sun sets sooner in our area than other areas in Ohawe. So, it is important that any wind breaker trees not further shade areas used for production of sun-loving plants.

Figure 4 (below) has a NIWA image which shows that the soils are not that wet around here, despite our high level of rain. This is because of good drainage, which makes flooding less common. The wind that isn't moisture laden dries things out. Well drained soil combined with the drying effects of both wind and salt will effectively increase the need for water.

Soil moisture anomaly (mm) at 9am on 21/09/2019

Figure 4: shows our location on the New Zealand map which details soil moisture.



<http://docs.niwa.co.nz/library/public/NIWAsts64.pdf>

More information about rainfall and wind for the various areas around Taranaki are available at the same website: <http://docs.niwa.co.nz/library/public/NIWAsts64.pdf>

Mount Taranaki dominates the landscape here and creates its own weather patterns. It is now properly called Taranaki Maunga.

Rainfall is heaviest east of the mountain. Temperatures are moderate, especially the closer to the Tasman Sea. We had only two frosts here this winter due to our proximity to the Tasman Sea rather than Taranaki Maunga. There is a tendency towards drought during the summer. The last two summers have not required water rationing though there was talk of the possibility. Watering was necessary to keep plants less stressed and thriving.

The Taranaki area has the windiest conditions in New Zealand due to being exposed to the weather systems originating over the Tasman Sea, so it is predominantly a westerly wind. The property where we are renting gets a lot of westerly winds, but the temperature drops with any southerly airflow which is especially common in the winter. Most every morning the northerly wind blows. The summer has the least intense winds though there has been plenty of very windy days this summer. It is generally less windy in the morning and winds are stronger by afternoon. It is not uncommon to have competing winds especially a northerly and southerly or northerly and westerly or a southerly and westerly, or all three. It is especially windy in the spring, and especially rainy in the winter. Please see Figure 12 on page 15 of the above NIWA document for wind maps in Hawera area, where we live. This area gets less rainfall and generally less intense winds than other areas of Taranaki. See page 17, Table 7.

Severe storms and cyclones occur November to April. We get mini tornadoes, which could be better referred to as gustnadoes, which are associated with gusty weather, which is common here.²

Two of our neighbor's trees were blown down by such gustnadoes, two different times since we moved here. We went without power for three days during one of these intense storms. We are now prepared for a repeat. We got a solar panel, an inverter and a deep cycle battery now to run a small refrigerator and the internet and keep the hot water pump working. We can cook on our gas barbecues during those times. We utilized these methods when a severe thunderstorm knocked out over 60 transformers in a very large area of Taranaki, leaving us without power for two days.

This area is not known to be fire prone. But if there were a fire, high winds would feed it.

² <https://www.skybrary.aero/index.php/Gustnado>

Past and Current site maps (topography, sector analysis, zones)

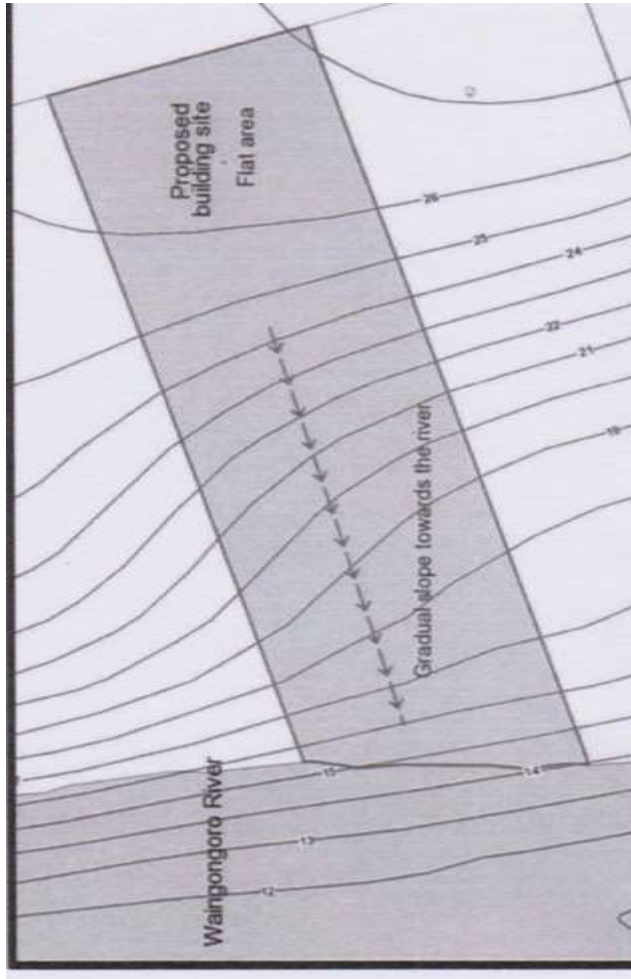
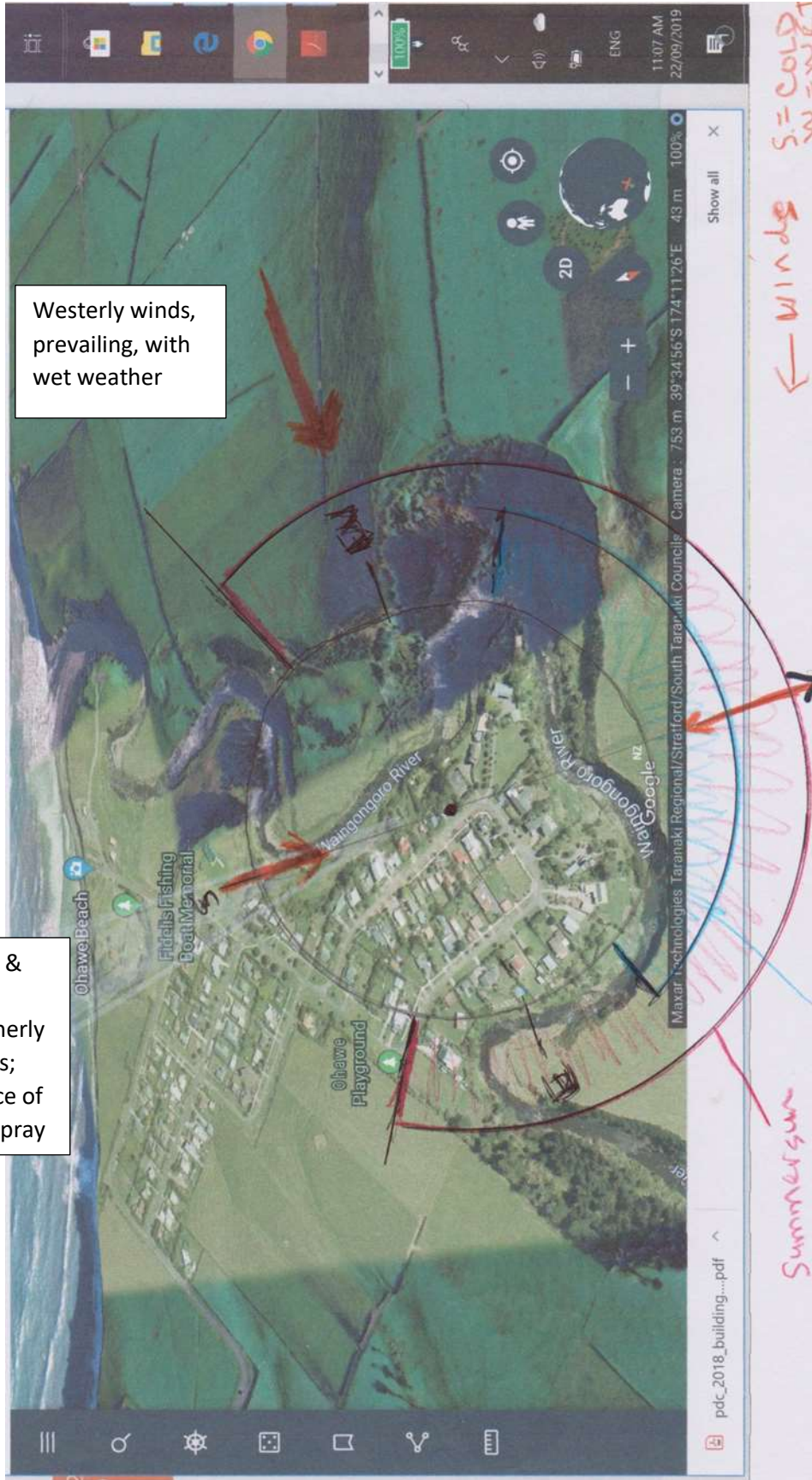


Figure 5: Topographic Map of 40 Kawai Rd, Ohawe

This property is flat adjacent to the road which determines house site and access, and then slopes steeply towards the river.

The next two diagrams show the winter and summer sun arcs and predominant wind directions from an area wide and secondly from the target property. Noise is also included. Although this is a relatively quiet community there is noise from people mowing, the relatively few cars going by, children playing, along with surf and wind noise amplified by the cliffs across the river.



Westerly winds, prevailing, with wet weather

View & cold southerly winds; source of salt spray

Figure 6: Area site analysis:
 Centered on 40 Kawei Rd, Ohawe
 Noise is from road, river and surf.
 The cliffs across the river channel westerly and southerly winds and noise.

Northerly winds, generally in morning and clear skies.

Summer sun arc in red;
 winter sun arc in blue

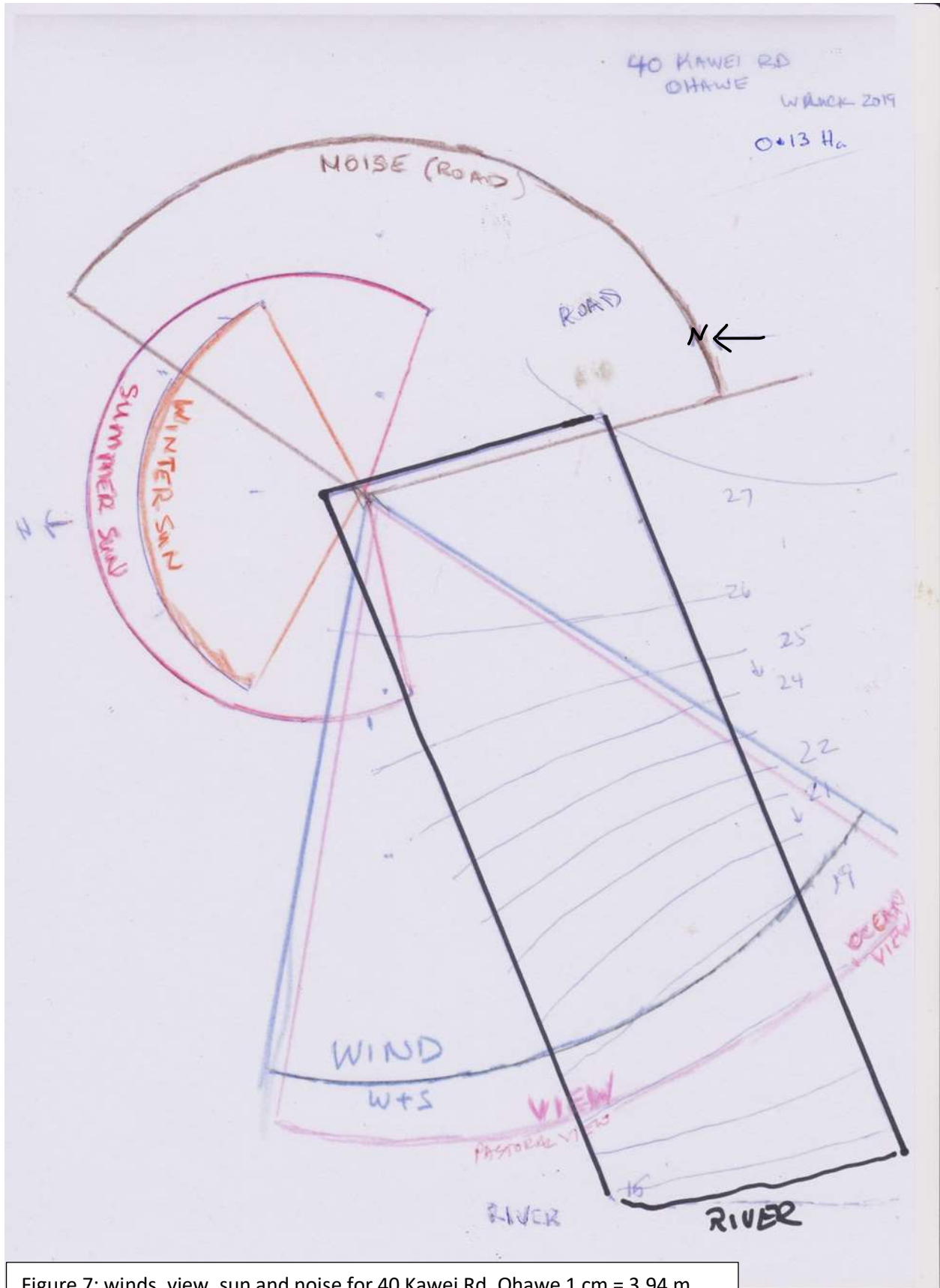


Figure 7: winds, view, sun and noise for 40 Kawei Rd, Ohawe 1 cm = 3.94 m



Figure 8: This is 40 Kawei Rd, Ohawe, before the old house was removed. Notice the high density of trees behind the house, which was done for wind shelter, but resulted in a lot of shade.

Google map shows the property with a former house and former trees. Trees on the original property would block a lot of sun and the fence and some trees on the neighbor to the north's property block the sun primarily when it is at lower angles.

The current owner demolished the original house at 40 Kawei Rd, Ohawe, and cut down all the trees and bushes on the property. This led to a lot of wind exposure and the neighbors were quite upset by this, some losing favorite fruit trees. The neighbor to the north has since cut back vegetation which was around the tennis court. As discussed initially, wind is a significant feature of Taranaki weather and the Ohawe community gets the Southerly winds more directly. This might be desirable to keep summers cooler, but it is not pleasant or ideal for people or plants, especially in winter. Trees from the neighbor to the south of this property help partially block the southerly winds.

Having adequate wind protection is a priority which the current property owner has no plans to address. In permaculture design, wind protection has priority for building protected niches for plants that produce a yield. But trees are the future generations lumbar and are needed carbon sinks right now.



Figure 9: This more recent drone photo shows the new structure on 40 Kawei Rd, before more vegetation was cleared.

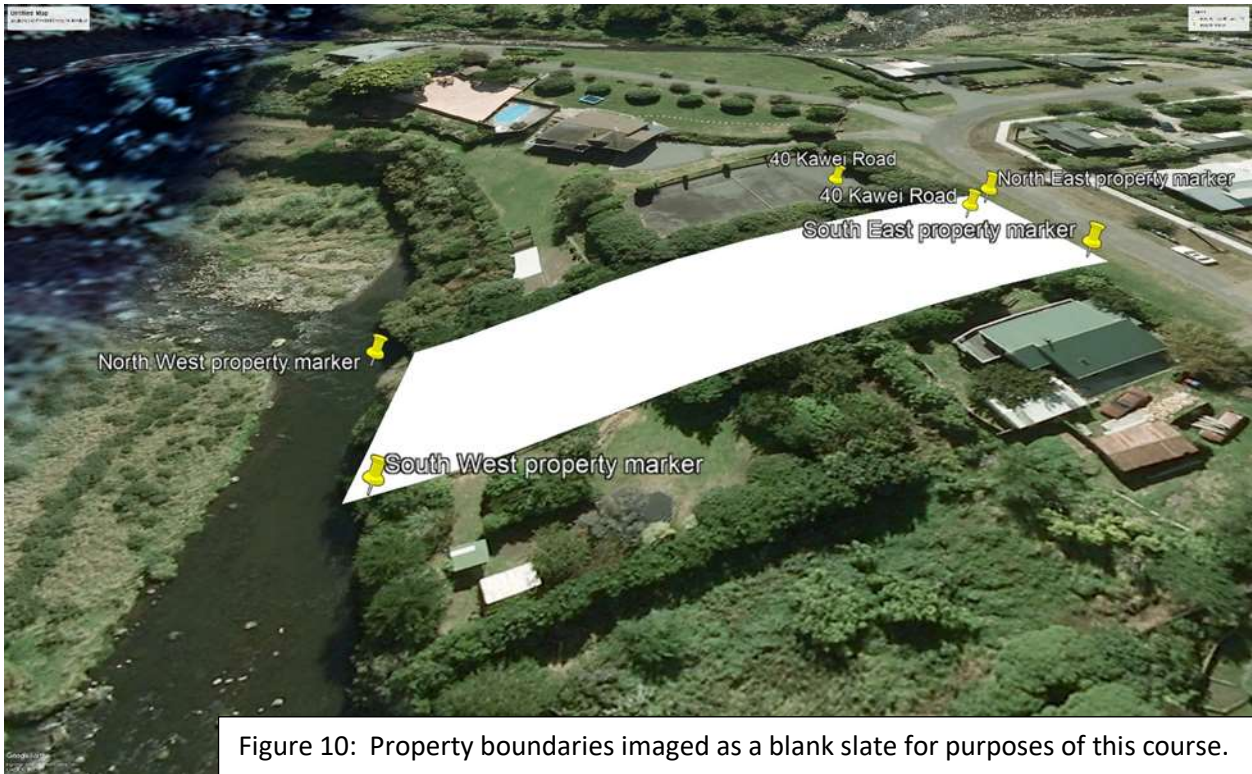


Figure 10: Property boundaries imaged as a blank slate for purposes of this course.

Potential resources and hazards starting with water:

In this area, rain is plentiful except in late January through early March and there have been years when there were rationing of garden and lawn watering due to the town water supply being limited. Flooding has not been an issue yet and not likely due to the steepness of the riverbank along this property. I have never seen standing water or soggy ground here after heavy rains because of the high sand content of the soil causing it to drain well. But that also means it can dry out too readily. As expected in such conditions, weeds on the property tend to have more superficial spidery roots.

The soil test for this property showed about 60% sand and 35% silt with a trace of clay and a bit of organic matter. The only evidence of water erosion is along the dirt road access on the property. There are some small erosions along the driveway that runs on the north side of the property and that shows

drainage to the neighbor's tennis court. There is a little bit of erosion of that driveway as it heads downhill forming a small gully in the dirt drive in very heavy rains.

It would be an intriguing challenge to do an aquaponics system which is included in the final design. Having an aquaponics pond would need rainwater to stay full. This could come from roof catchment. We might also have a grey water system to help during leaner water times. A water tank might be needed in future years if rain is less plentiful, so developing a plan for storage is a good idea. Also working at the community level to increase water security for everyone enhances fair share aspects of community life.

Alternative energy sources are possible, but some aren't practical. This property has a very steep boundary along the river, and it is not a safe area to navigate going into the river because of that. So, a water wheel to generate electricity is tempting but not practical here. Around Taranaki, wind turbines have been destroyed by the mini tornados that happen in this region. We know this from touring several properties that are trying to utilize wind or solar sourced energy. Secured solar panels with a deep cycle battery and an inverter are a practical way to manage through periods of no electricity which has happened twice here, each time for 2 to 3 day stretches. Many people use noisy, polluting and stinky generators during such times in Ohawe.

The septic system on this property is Hynds brand which is an eco-friendly aerated wastewater treatment. The final effluent is drained into hoses that drip onto sloped portion beyond the house. There is no odor to this. I know it could be used to feed a worm farm, but would it possibly feed an aquaponics system if it was filtered through a reed bed? There is some electric component to this, so there should be a solar back-up to keep it operating in power outages, but there isn't such a system yet.

Access to the site is determined by Kawei Road. There is a need for a dirt path to have easier access to the field at the river end of this property. This has been used by 4 wheelers, mowers and small horses. As I went through this course, I realized that the access would have been better on the south side of the property which would thereby really open up the north side of the property for more sun-loving plants. As it is, the area behind the current house is shaded by the house itself, and with a few large trees near the neighboring property line. A way to capitalize on this oversight could be to grow mushrooms there or other shade loving plants.

The **house site** has remained the same for all iterations of this property. Instead of removing all the trees on the property when replacing the house, a better option would have been to selectively thin and use the wood to heat a home on site. [A rocket stove would be ideal.] The replacement house is an older state house which was moved onto the property and then upgraded. One of the better upgrades was a large three paneled sliding glass door that faces north. This helps with passive solar gain, but in the summer, we need a combination of window shades and a shade sail to help keep the house from getting too warm. The source of heat and cooling is a heat pump.

Zones reflect property usage to obtain a yield, store energy and deal with waste, and are affected by the property size.

For **zones**, the following are Richard Pedley's preferred definitions which work well for larger properties:

Zone 0 is the home.

Zone 1 is the vegetable garden closest to the home, 1/8 to 1-acre size.

Zone 2 is orchards, particularly those with high intensity fruit production, 1 acre to 10 acres.

Zone 3 is grazing and paddocks to allow livestock to be moved around.

Zone 4 is timber and nut trees.

Zone 5 is wildlife habitat.

Holmgren has a very similar version of zones with an emphasis on intensity of use rather than actual size.³

Zone 0 is the home;

Zone 1 is a fully irrigated garden with smaller livestock;

Zone 2 is irrigated orchard & small livestock;

Zone 3 is commercial crop, sown pasture & unirrigated plantations, dams & livestock;

Zone 4 is managed rangeland, and

Zone 5 is wilderness & ecological reference.

"Each consecutive permaculture zone is both further from the house, and by implication also larger in area. The question of how large these zones are, like their specific nature, is a matter of design methods that will vary with environment and context rather than principle."⁴

This property is 0.12 hectares, or 0.3 acres. If we went for size only as a parameter, then all of the non-dwelling portion of the property would be zone 1. Since zone 2 is generally confined to 1 acre to 10-acre properties when strictly applying zone designations by size, there should be no zone 2 on this property. But the beauty of permaculture design is to help create niches even on smaller properties so there can be small orchards along with a garden, and small livestock, including aquaponics. One shouldn't expect to have a market garden on a grand scale. There can be small fruit and nut trees grown here along with berry bushes and the yield may exceed the needs of those living on the property.

The small field that is currently kept mowed at the lower section of the property measures approximately 19 by 20 meters with at least a 2-meter grade towards the river following the removal of trees and stumps. This is not big enough to do rotational grazing (zone 3) without it being part of a shared community grazing area and be for smaller livestock. Zones might be expandable to other areas in this small community. For instance, there is a woman in Ohawe has two small pony sized horses and

³ pg. 154, Holmgren, Permaculture: Principles and Pathways

⁴ Ibid, pg. 153.

she rotates her horses around various Ohawe properties and cleans up the nice horse pooh before leaving. She will save the pooh for the property owner if requested. This is rotational grazing that involves numerous property owners. Goats and sheep owned by other neighbors, might be used, but fencing or secure tethering is an issue. There are several residents in Ohawe who have chickens, including our neighbor to the north of us. Trading vegetable waste as chicken feed in exchange for eggs might be one way to barter. Although we might want to have our own chickens, some design ideas that are attractive, wouldn't be practical for this site, such as the 10-meter mandala design shown in Figure 13 primarily because of the slope. Utilizing that design would require flattening out the large amount of slope which isn't economical, and it would also give up what is needed for an adequate shelter belt. There is another version of a chicken mandala which would be more practical and was demonstrated in a Sustainable Backyard Garden at the Taranaki Garden Show in November 2019. This is depicted in photos along with descriptions found on placards, which I also photographed at the Taranaki Garden Show in November 2019.

There is talk of putting in a community garden in Ohawe so that would expand the growing area for any and all of us in Ohawe. If there is agreement about shared zones, Ohawe can be a more resilient community.

There is a need for a timbered area between the house and the river to help provide a wind shelter, so it would serve as a zone 4 conceptually but on a much smaller scale. Timbered areas could be considered even on a scaled down suburban version of zones. A proper wind break for this property should be 3 to 4 rows deep with the closest rows including varieties of nut trees. This would limit the area for a chicken mandala.

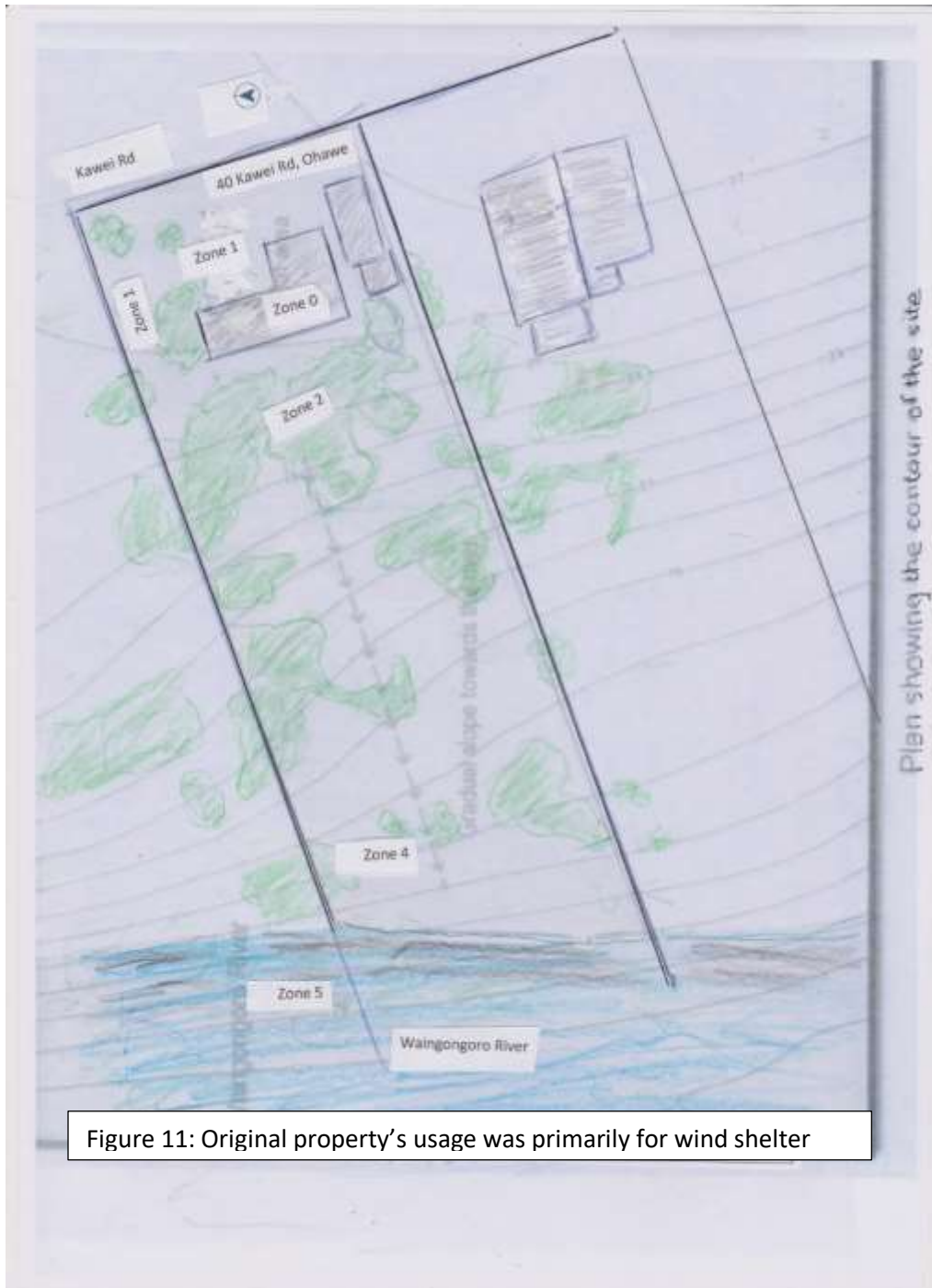
The zone 5 for this property could be envisioned as the river and the undeveloped land on the other side of the river. It is important for Earth care that each property owner have a portion of their property be wild, and for there to be shared areas of a community and regions that are kept wild, as well as providing an area that is timbered for future generations to utilize.

The following is a diagram of zones, or usages, for each version of the target property starting with the original property owner (Figure 11), then the current property (Figure 12) and finally the idealized version of this property (Figure 14).

Zone analysis of the land usage by the original property owner

The first property owner got several things right. He had a generous zone 1 by having the northeast corner open, rather than like now where this corner is covered with garage, carport and access. This area is more sunbathed all day long and close to the house. By planting or leaving a lot of trees behind the house, he made a shelter belt which was more than what was necessary. This shelter was really missed by the neighbors when the current property owner cleared the lot. To hear the neighbors, discuss the changes the current owner made, they never realized how valuable that wind shelter was to their properties until it was gone. There wasn't really road access to the lower portion of the property which reduces its use. But one neighbor described it as a park like atmosphere. Hence, one could call the trees closer to the river zone 4 if using Holmgren's zone concepts. The zones under Pedley's use would only be zone 1 and 2 for this property.

The first owner might have done better using some nut and fruit trees behind the house and then have a wind shelter belt between those trees and the river. Did the first property owner ever think of expanding sun exposure for this property by having fewer trees? This would have increased the areas that could produce more of a yield. Although there might have been potential for raising mushrooms in the timbered areas. There was no plan for recycling waste or for additional water storage. There was no plan to utilize this property for added value to the property owner or the community.



Zone analysis of land usage under the current property owner

The current owner cleared the property of any trees and landscaped all the way around the house with small river rocks over ground cloth. He put the garage and access on the NE corner of the property, leaving a smaller open area partially shaded by the neighbor's tree beside the property line on the SE corner. This corner was utilized for the Hynds wastewater system. With the dirt drive along the northern edge of the property for access to the lower portion, the only area with high sun exposure near the house is the house deck. Using this area, along with the area covered with stones, will require planting in pots and thus more intensive watering and slug control. As discussed above there is a lot of wind through this property because of all the trees cut down and pots have been blown off the deck. I requested a small area to garden, and that is just behind the house on either side of the dirt drive on a steep slope. This is where I also bury my bokashi kitchen waste. I have requested that our landlord use a burner type of weed destroyer for controlling the weeds growing up between the rocks in the area around the house, and on other portions of the property. But instead he uses Round-Up. 😞 Our tenancy contract is that we are paying him to "garden" which is him spraying out weeds and him mowing the sloped pasture below us, having decided the horse grazing wasn't desirable for a variety of reasons. 😞😞 We have also found pieces of foam rubber and other toxic substances in a burn pile he uses near the river edge of the property. 😞😞😞 We have removed these and put them into our trash containers. The area on the south side of the house is quite shaded and covered in small rocks, so we haven't tried to grow anything there. We did try a mushroom log, but we think his Round-Up overspray made that effort unsuccessful. 😞😞😞😞

The Hynd composter for our sewage is aerobic and has a hose to direct the clear effluent along the south side of the house and into the hill behind the house, mostly at the south end. We have avoided planting garden food items in this area. It could grow perennial cover crop for use in composting.

With the current property there is no additional water storage. If the downed trees had been used for both a firewood supply and for hügelkultur berms that would have been a positive for this property. It would have made the steeper portions a bit easier to create swales and terracing. Hügelkultur also reduced watering needs, which is a bonus in the summer here.

There was no plan to utilize this property for added value to the property owner (other than for rental income) and there was no added value for the community or other life forms, in particular bees.

Zone 0 is the house. The small area I garden is zone 1 along with pots on the deck. These pots due hold some herbs, a bit of lettuce and flowers. Zone 2 are the weeds on the steep slope which could be used for composting if they weren't sprayed with Round-Up. I labeled the mowed field near the river as Zone 3 mostly to designate it as an area that is further from the house that gets visited less than zone 2. There is no zone 4 since there are no trees. Zone 5 is the riverbank and river and the area on the other side of the river which has riparian plantings. If applying Richard Pedley's zone definitions, there would only be zone 1 and 2 on this property, with zone 5 still being the river area and beyond.

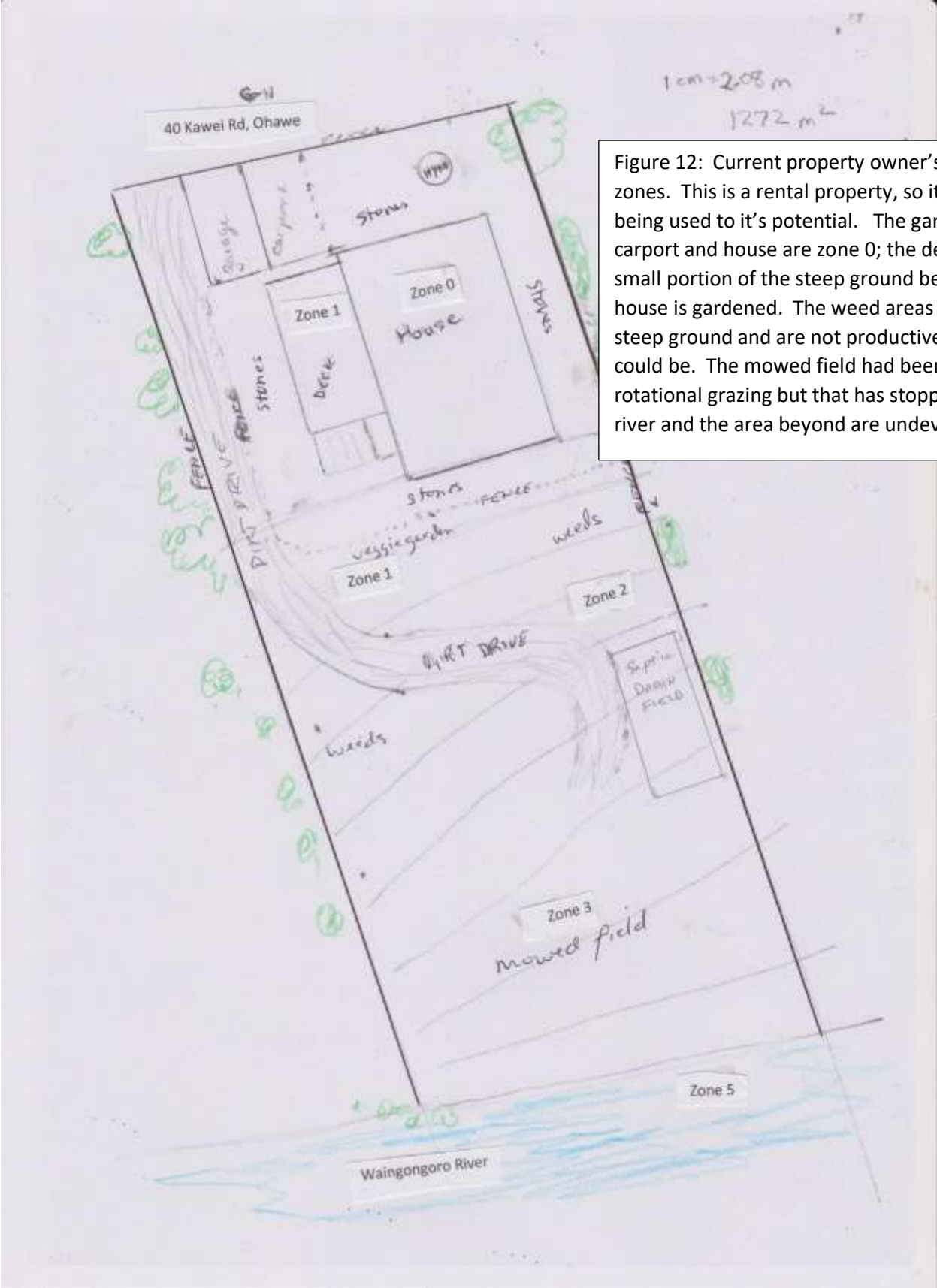


Figure 12: Current property owner’s land use zones. This is a rental property, so it is not being used to it’s potential. The garage carport and house are zone 0; the deck and a small portion of the steep ground behind the house is gardened. The weed areas are on steep ground and are not productive but could be. The mowed field had been part of rotational grazing but that has stopped. The river and the area beyond are undeveloped.

FINAL DESIGN / INTEGRATION

IDEAL PERMACULTURE DESIGN for 40 Kawei Rd, Ohawe (Figure 14, below)

Zone analysis of land usage under idealized permaculture vision of 40 Kawei Rd, Ohawe

By applying permaculture values this property can have greater yields if the garage and carport were moved to the southeast corner of the property, along with the driveway access to the lower portion of the property were moved to the south side, going behind the garage and house. This proposed configuration frees up the area which has more sunshine for production. This configuration isn't possible now but would have been ideal when the old house and garage were removed. I will continue with this "vision" because it shows how to optimize a property's yield, if you plan ahead.

Zone 1 for intensive gardening in this scheme is much larger and could include a walking mandala and an herb spiral. Zone 1 still includes the deck, but the deck can now be dedicated to chairs, table and spa rather than intensive potting. The area north of the deck which was stone filled and dirt drive has become part of an enlarged zone 1. Zone 2 is now the steepest grade which is west of the house and this can include an irrigated orchard which would be best planted with espaliered fruit trees with a hedge for some wind protection just below this area. We will use the Food Forest idea for the Zone 2 in this design, which means including plants such as Russian clumping comfrey, tansy, elephant garlic and phacelia to support the productivity of the fruit trees.



Espaliered fruit trees are especially worthwhile in smaller garden spaces and along driveways or walkways. Notice the clumping Russian comfrey already well established with wood chips over old carpet to suppress weeds. This is **considered Zone 2 due to proximity to the house.**

Korito Education is the source of the information on the signs photographed and used for this discussion.⁵

⁵ <https://permaculture.org.nz/content/korito-permaculture-open-garden>



Food Forest: Plant guilds with full sized fruit or nut trees are considered Zone 3 in this Permaculture Designed back yard garden in New Plymouth because of the distance from the house and the less maintenance input once established. **The food forest will be part of Zone 2 in this proposed design for our rental property.**

The guilds help bring in pollinators and improve soil nutrient availability to the tree. Comfrey helps apples with potassium, tansy protects from coddling moths, elephant garlic to stop blackspot, phacelia to bring in the bees and predatory hoverflies. Weed control is again with a layer of old carpet with wood chips over it.

The white alpine strawberries make a very good ground cover along with varieties of sage. These will also attract bees.

When the most important aspect of the property design is accomplished there will be a smaller “pasture” area because of the need for a larger area for trees and shrubs that block the wind. Thus, if there were to be a chook area, there won’t be room for a large chicken mandala, unless we utilize a few raised round beds. So let’s consider the options for a zone 3. If it is for chickens, it isn’t ideal that it is down a steep grade and further from the home. But on such a small property it wouldn’t work well to have it immediately adjacent to the house due to smell and noise. However, since it is close to the home if considered from a large property perspective, an area down the hill should still be workable. Raised beds would be ideal especially for soil further from the house if using lasagna method to build the soil, since that will hold more moisture due to the high amount of organic matter. There might be a need to use raised beds for a mix of long-term crops and those that would be used in a different way than the chicken mandala depicted in Figure 13.



The Long-Term Beds are further from the house and are designated Zone 3. Carrots, onions, beans and potatoes can be grown here with netting to protect from birds.

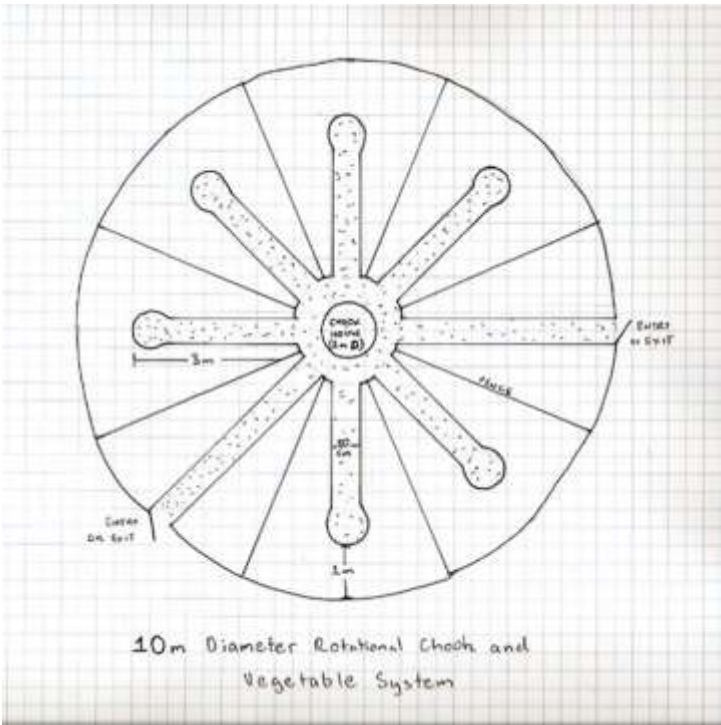


Figure 13: Chicken Mandala from <https://www.pinterest.nz/pin/135248795034944101/>

Although I like this idea a lot, it isn't going to work on a large scale for this property. If scaled down, it can be used as a walking mandala in the northeast corner of the idealized property scheme. This design maximized edges which are the most productive areas of an area designed for productivity.



This is another version of a Chicken Mandala in a back yard in New Plymouth created by Korito Education:

Although it isn't perfectly clear from this photo, there are 7 raised bed circles with stone walls. The cage for the chickens is moveable to each circle. It is the dark dome between the groups of people in the photo. This is more practical on level ground. A more detailed description follows.



“Mandala and Chook Tractor

These 7 circles form a permaculture mandala. There is an in-situ worm farm in the middle of each circle which feeds the plants. The chooks clear up the crop residue, manure and eat all the weed seeds so that as soon as they move on, the next crop can be planted.”³

There is no reason why this idea can't be downsized to 3 to 5 circles or squares or short rectangles as long as the chickens get enough food.

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⁶ <https://www.korito.co.nz/courses/>



This image is from the Korito Education website:
<https://www.korito.co.nz/courses/>

It doesn't show the domed structure built to house chickens that can be moved onto each round raised bed.



“Lasagna Layer Mandala ZONE 1

These beds are built by layering carbon (cardboard and hay) and nitrogen (coffee grounds, animal manure and grass clippings) and then mulched thickly with hay which retains the moisture and suppresses weeds. To stop the sprouting of the hay, turn it at the first sign of grass growth and you will stop all seeding.”

Notice that these Mandalas are labeled zone 1 for the New Plymouth garden due to the proximity to the house. This makes taking care of the area easier. But the lasagna method is not confined to a particular zone in permaculture design.

Zone 4 can be considered a timbered zone that is furthest from the house and requires less input. In the case of this property it will need to be composed as a shelter belt to slow down the wind. Zone 5 is the riverbank, the river and the riparian area on the other side of the river.

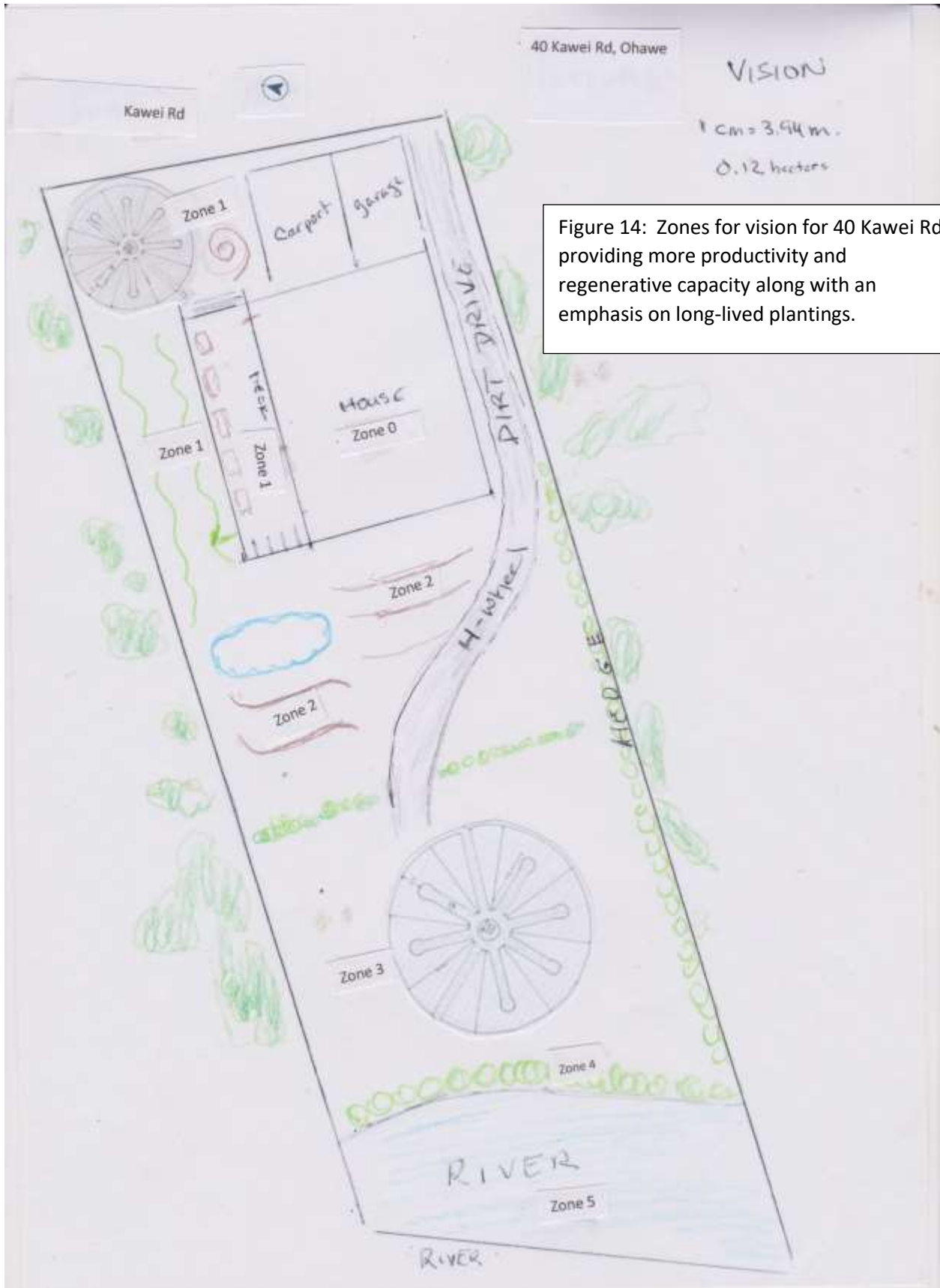


Figure 14: Zones for vision for 40 Kawei Rd providing more productivity and regenerative capacity along with an emphasis on long-lived plantings.

INTEGRATION (Back to Reality)

How to optimize the current property.

First create a shelter belt.

For this very windy property in this very windy region of New Zealand it is important to focus primarily on quality and long-term shelter, not so much short term and fast growing. There are, however, long-term fast-growing options. Without wind protection there won't be much yield from this property. There is little blockage of the sun if the wind barriers are at the west end of the property, which is appropriate for blocking the predominantly westerly winds. When the sun sets, it will go behind a ridge to the north and west on the other side of the river before the trees would shade the lower open area. We must slow the wind down, not block it entirely because the more it is blocked, the more it will move over the shelter belt and then cascade downward, defeating the purpose.

So, when choosing trees and shrubs for wind breaking, they should allow some air passage. Ideally there should be differing heights of growth on the lee side. The best strategy is to plant in multiple rows using a mix of trees, which will not only shelter but provide food for birds and bees. It would be good to include deciduous trees which build soil but don't rob nutrients. I wouldn't suggest eucalyptus because their roots go out and rob other plants of water and minerals.

One mistake to avoid is planting trees too far apart, avoid giving excess space for future growth. What happens if a tree dies or doesn't thrive well? One can plan on thinning trees before they reach full maturity, allowing the strongest to survive. Then filling in gaps with other types of trees or shrubs if need be. There are many options in New Zealand for shelter belt trees. All the species in cultivation discussed here are quite wind resistant, indeed most of them will grow successfully even in severe maritime exposure. Since most of the species can also be grown as hedges, they can provide a superb protection for what would otherwise be windy gardens.⁷

Since there isn't a large area to devote to a shelter belt on this property, choices will be limited, so making ideal choices is most important. I will mention some more choices here as permaculture friendly options. Tagasaste would be a good variety to intersperse with *Elaeagnus ebbingei*. Choose a variety of *Elaeagnus*, also known as Silverberry, which has edible seeds. This plant will grow 40 to 60 cm a year. "All the species have a symbiotic relationship with certain soil bacteria. These bacteria form nodules on the roots and fix atmospheric nitrogen. Some of this nitrogen is utilized by the growing plant but some can also be used by other plants growing nearby. This means that all members of the family are excellent companion plants. When grown in orchards, for example, they can increase the yields of fruit trees by up to 10% (this is especially the case with plums and nuts which respond more to nitrogenous fertilization)."⁸

Common recommendations for shelter belts are for the first row, closest to the river, to be the strongest because it will take the brunt of the wind. New Zealand flax is an option here because of how wind resistant it is and how it will help the second row from being blown over when young. This option is

⁷ <https://thisnzlife.co.nz/forty-shelter-trees-to-grow-your-property-the-best-shelterbelt-in-new-zealand/>

⁸ <https://pfaf.org/user/cmspage.aspx?pageid=61>

easy to obtain and can be taken from root cuttings from established plants. The second row could be pittosporum because it grows fast and tolerates wind and salt spray and doesn't need pruning. But that wasn't readily available in my area. What was growing in the neighbor's yard is Coprosma repens, which is readily available and fairly inexpensive at a local nursery. If we aren't concerned about food production, the third row can be a mix of any Leyland cypress, magnolia grandiflora and Alnus cordata, Italian alder. And a pin oak or scarlet oak should be added if possible.

The last row, furthest from the river might have been a mix of black and Andean walnuts. Since the property is not that wide, and the larger trees will need about 5 meters between them, the maximum number of larger trees will be 6 if planted right beside the North and South property lines.⁹ But the septic drain field is too close for such trees. This narrows the possibilities by a lot.

For this property I have tried to make practical choices that fit the space restrictions of a small non-commercial lot. The first row, closest to the riverbank, or on the riverbank will be New Zealand Flax. These will be planted 1 meter apart since they grow 1 meter wide and up to 5 meters high. We will leave a 1.5-meter gap at each property line for any potential future access to the river. Total NZ Flax to plant will be 15. It would be best to resource this from someone wanting to remove a flax plant and divide it up. The second row in from the river would be Coprosma Repens since it is easily sourced and grows fast in exposed coastal conditions. This can be trimmed into a hedge. We will plant these about 1 meter apart so as not to create too dense of a hedge. Fourteen of these can be planted, but 2 meters away from the row of flax. The third row in will be an Alnus cordata on each end of the row and one in the middle. These should have a spacing of 0.6 m and can grow 5 meters high. Between the three Alnus cordata will be Tagasaste which should be 2 meters apart. There will be room for 6 Tagasaste. I had hoped for hazelnut trees in the final fourth row in, but since there is a septic drain field, that tree variety should be 15 meters away. This means I can't plant a hedge of hazelnuts except have a few at the north edge of the property (two different varieties are needed for pollination). Instead of a hazelnut hedge, I could use Elaeagnus ebbingei, choosing a variety of Elaeagnus, also known as Silverberry, which has edible seeds. Apparently Red Oak - Quercus rubra, can be grown beside the septic field and be useful as a wind break. These need to be about 6 meters apart. Feijoas are shallow rooted and can be pruned to a height reasonable for harvesting, so these will work as a hedge, starting just above the drain field.

There will be several years before the desired wind and sun effect is achieved due to needing the planned varieties to mature. Developing this shelter belt will delay the planting of sensitive fruit trees closer to the house. But it will give time to improve the soil with the addition of organic matter and build some raised beds. The vegetable and herb gardens can be developed while the wind shelter system is being developed. Temporary wind fences might be needed initially to get started with any of these areas. Trellises with perennial berries, such as loganberries and/or elderberries can serve as edible wind breakers in even small areas.

Along the south boundary, a feijoa hedge would do well and can be pruned to a desired height. These should be planted 1.5m apart. This can help shelter from southerly winds and produce a yield. They will get adequate sun in this location and the soil will be well drained. Just be careful not to let them dry

⁹ <https://thisnzlife.co.nz/forty-shelter-trees-to-grow-your-property-the-best-shelterbelt-in-new-zealand/> =source for the four paragraphs above.

out. Rather than have straight lines for everything a scalloped or cloud like pattern would increase the productive boundaries of the planted areas.

Let's go **back to Zone 1 now** that we have discussed the shelter belts.

The sunniest portion of the property is the NE corner, but this has buildings and a driveway in the real-world version of this property. We are left with the pots on the deck which are the most accessible to the kitchen and should be dedicated to the herbs and plants used more frequently. In front of the concrete wall of the deck, a cold frame could be built. It would have to be self-contained since the area there has to be covered with stones per the landlord's design. The cold frame would help with raising seedlings and give a semi-hot-house situation for tomatoes and peppers which is how these plants are successfully and productively grown in the Ohawe area. A water tank situated closest to the back of the garage would be important for a backup water supply. There is the possibility of this water filtering through an above ground reed filtration and then supplying a small rectangular pond for aquaponics. (An idea for later development.) The water tank can be filled with rainwater catchment off the roofs. There is also potential for filtered grey water to feed into the water tank but would need a solar pump to operate, which would only be needed for a few months in the summer.

Between the east side of the house and the fence that borders the road verge, there can be more pots. Some future owner could take out the stones and use the areas between the house and the fence and using these areas for producing a yield.

Because the Hind septic system runs tubes from the east side where it is located, and goes behind the house on the south side releasing small amounts of effluent as it loops on the south half of the steep bank and finally to the septic drain field, it will be necessary to be cautious as to what to plant in these areas of the property. A cover crop that is used for mulching and building soils in other areas would be ideal.

What to plant in Zone 2.

Zone 2 is the steepest part of the property west of the house. I have designed terraces on the south side and swales and hummock the north side. The swale is because water tends to run from the north side of the property down towards the river and the swales would help channel this. These would be a gently wave/stream-line shaped. I am not suggesting irrigating from the river because the riverbank along this property is too steep and hazardous. Between the north and south of the sloped ground runs a dirt road which allows a 4-wheeler access to the area before the river.

The row of trees on the lowest terrace, should be a couple figs planted in washing machine drums which keeps the tree from getting too tall and helps with earlier fruiting. Above this espaliered or dwarf pears would work, since pears are hardier than many apple species. Persimmons can also be planted in these last two rows. Once these are established that more delicate varieties of dwarf fruit trees could be considered, planted after the main shelter belt is more established.

The north side of the dirt drive would be swales. The uppermost one can be a hedge of elderberries which would serve as a partial windbreak in summer. The hedge below this would be a longer one and I suggest using the Silverberry variety of *Elaeagnus ebbingei*.

What to plant in Zone 3.

The lower area that was mowed has about a 2-meter drop over a 20-meter length and is only 19 meters wide. It won't be useful as a grazing since it will shrink in size quite a bit with the establishment of shelter belts. A more ideal use would be raised beds which could be used for more long-term crops such as potatoes, carrots, onions, beans and strawberries. Some raised beds will require covering with nets to protect the yield from birds or predators. Or these raised beds could be a modified chicken mandala that was shown in photos in the previous section. The round raised chicken "coup" that fits over these round raised beds would only hold a couple chickens, but also could be moved easily over the area of the septic drain field and between the red oaks.

Paths between these areas could be made by cardboard covered by wood chips to reduce weeding. Make use of succession planting. Plant cover crops on any bare soil, especially nitrogen fixing varieties in the areas of the septic system.

Soil can be built and amended by trimmings from trees and bushes, adding cuttings of cover crop, and the bokashi method of composting kitchen waste. Leaves from any of the shelter belt or neighbors' trees are a great addition to mulching.

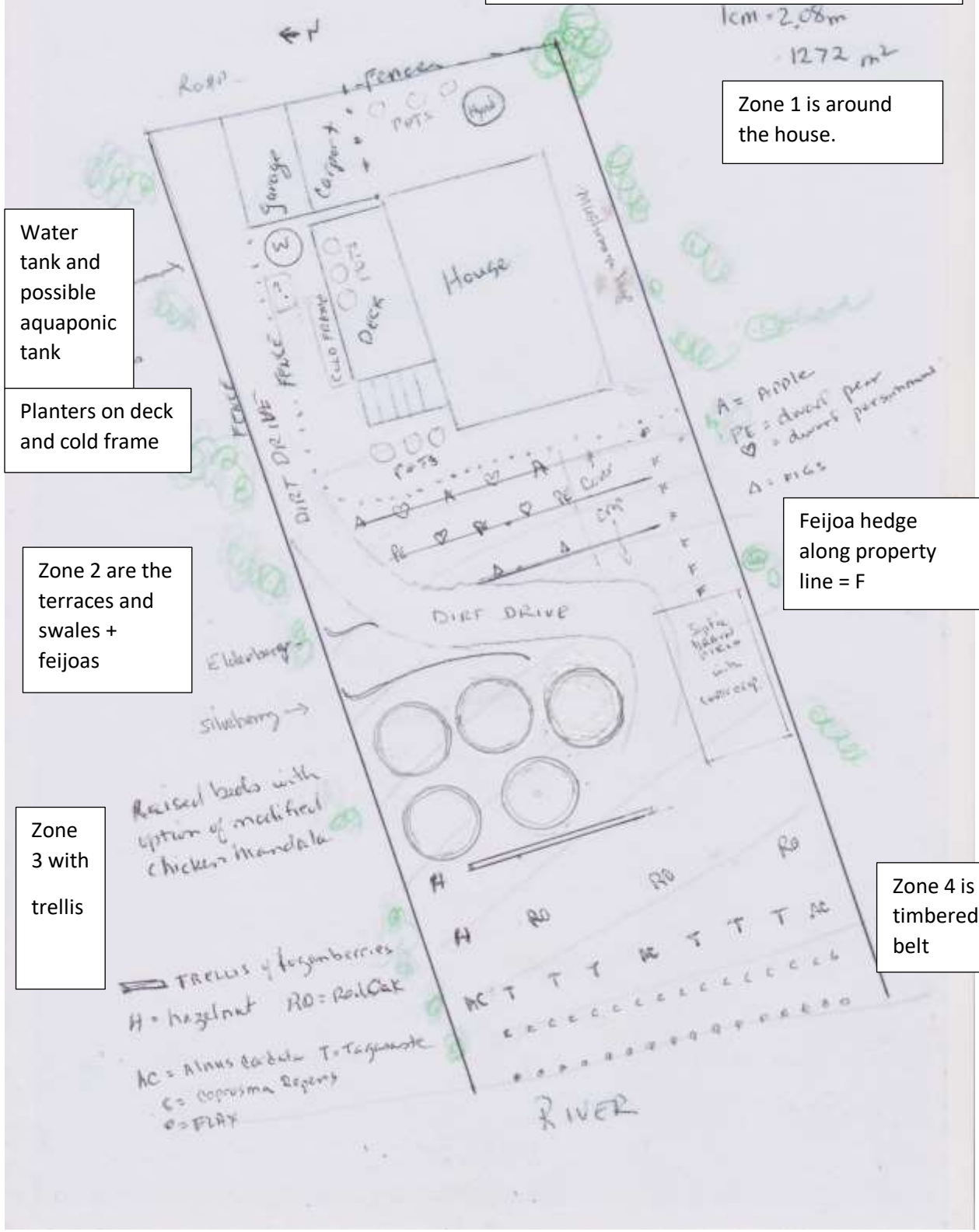
As things mature, new micro-ecosystems will emerge. Some of these will require shade tolerant plants. The choices of what to plant are myriad, but one should favor plants that fix nitrogen and don't rob the plants around them of water or other important nutrients. Comfrey likes nitrogen rich soils so one shouldn't devote large areas to growing it. It does make good compost. Fava beans, also called broad beans, make a good understory crop and are nutritious and self-seeding.

The ideal design will require less energy input, particularly from humans, as it becomes established.

Integration

Figure 15: 40 Kawei Rd. Final Integration PDC

1 cm = 3.94 m 0.13-hectare property



Zone 1 is around the house.

Water tank and possible aquaponic tank

Planters on deck and cold frame

Zone 2 are the terraces and swales + feijoas

Feijoa hedge along property line = F

Zone 3 with trellis

Zone 4 is the timbered shelter belt

Final will never really be final. We must always make observations about what does well and what doesn't, and then utilize this feedback. Review the Permaculture Principles below regularly.

PRINCIPLES: Earth Care, People Care, Fair Share

Consider how the principles can be reflected by the system design and what actions can be taken to further healthy outcomes. Review Holmgren's principles listed below regularly.

The following lists Holmgren's Permaculture Principles and his annotation followed by how they apply to this project.

1. Observe and interact

"Beauty is in the eye of the beholder"

Gathering other people's observations and asking questions is the first principle. What are the potentials each viewpoint brings?

Observe what is on the property and what interactions are currently working or not working. Increasing the interactions is generally a good principle. Consider how things might change. For instance, will a neighbor or errant high wind take some trees out. How can I build resilience on my property that prevents a lot of changes in the future in such foreseeable cases? It is reasonable to assume that Climate Change will bring intense unpredictable weather. What shelters might work best under these circumstances?

Slugs are abundant in the wet spring and they will obliterate seedlings overnight. Build or design a protected area to raise seedlings that keeps slugs away and gives them warmth and sun.

2. Catch and store energy

"Make hay while the sun shines"

There is currently no storage of water on the property. This can change. Catch rainwater in a pond or with rain barrels. Develop a grey water collection system. Feed the effluent of the septic system to a worm farm. Currently there is no sustainable use for high winds, only protection. Catching and storing sunshine needs to also be a priority along with having a wind break.

3. Obtain a yield

"You can't work on an empty stomach"

Once there is adequate and not over the top wind protection and once there is enough sunshine and water storage for dry periods in the summer there is a greater certainty of obtaining a yield on a sustainable basis.

Protect, build and nurture the soil. Start by never leaving any ground bare. Have a variety of cover crop seed accessible all year round.

4. Apply self-regulation and accept feedback

“The sins of the fathers are visited on the children of the seventh generation”

Find way to utilize waste rather than create waste. Only use resources in a way that isn't a detriment to neighboring properties, such as water. When mistakes become apparent, don't let it continue. Discuss on forums and research what solutions could be enacted. (Why can't a township agree to stop using Round-up and the like? Using weeds in composting is more resourceful, less wasteful and won't poison the ground.)

The serious gardeners in Ohawe grow tomatoes and peppers in a green house. Learn from them.

5. Use and value renewable resources and services

“Let nature take its course”

Grow some trees that can be used to fuel a rocket stove in the future. Many people in Ohawe collect wood on the beach to burn and usually there is plenty of wood on the beach, but not always.

Using sunlight for growing crops and even generating electricity would be valuable.

The wind is likely too strong for wind energy devices, but perhaps someday there will be a design that doesn't get destroyed by high winds and isn't too costly to implement.

Avoid plants that require too much water and use mulch to reduce need for watering. Build raised beds for vegetable and herb gardening because it can mean an earlier start in spring and less drying out in summer.

Use open-source seed from seed banks in the area. Collect seed and save for self and others.

6. Produce no waste

“A stitch in time saves nine”

“Waste not, want not”

Recycle kitchen food waste by using the bokashi method and burying it in the garden. Or it can be fed to chickens and then utilizing chicken manure for regenerating the soil. Worm composters for septic system is ideal in areas without required use of public septic systems.

Have a gray water collection system that will be utilized during water shortages.

Avoid buying products packaged in plastic. Reduce consumption, reuse, repurpose and recycle, and help neighbors/community do the same.

7. Design from patterns to details

“Can’t see the forest for the trees”

We can utilize the sloped areas to incorporate terracing and swales and building a pond near the top of the sloped area.

What changes as the wind barrier trees grow up?

The mandala pattern makes good use of space. It will require time and effort to develop.

8. Integrate rather than segregate

“Many hands make light work”

What can I raise that will make the community more resilient and not just create excess surplus? This will guide what is chosen to grow/produce.

9. Use small and slow solutions

“The bigger they are, the harder they fall”

“Slow and steady wins the race”

Building soil is an ongoing concern. Make it a priority to grow cover crops. Start with a smaller garden and then add on. Start with smaller trees and give them adequate space and sun to grow. Take advantage of mutually benefitting plants.

10. Use and value diversity

“Don’t put all your eggs in one basket”

No monoculture. Diversity of plants and micro eco-niches is far more important than growing a lot of one thing.

11. Use edges and value the marginal

“Don’t think you are on the right track just because it’s a well-beaten path”

. Create more and uneven edges for more diverse interactions. Don’t be afraid to try something different especially if it is in line with above principles.

12. Creatively use and respond to change

“Vision is not seeing things as they are but as they will be”

Keep learning. Explore other gardens and designs. Be willing to be sensitive and adapt to changes in climate and market forces.

Thank you, Richard for a valuable learning experience. I look forward to your feedback. Marcia Wruck

END NOTES

Miscellaneous information which I want for potential future use.

Buckwheat is a good production plant for sunny areas.

If there is room, give serious consideration to adding a mulberry tree to the property. “Mulberry trees are a permaculture favorite. Not only do they provide an abundance of berries, but the leaves are also edible and—for the adventurous producers—can be used to rear silkworms for silk production or fish food. Mulberries are beloved for being quick growers for chop-and-drop mulch, heavy producers for food, pest distractors, and hardy plants for growing in any soil and many climates.” [from <https://permaculturenews.org/2017/09/01/10-berries-aware/>] One disadvantage to mulberry trees is how big they can get, shading out other trees.

An elderberry hedge would work below the steep ground, though it will lose leaves in the winter. Elderberries grow well from cuttings so are quite economical.

“Low-vigour varieties [of hazelnut], such as Whiteheart, can remain at 5x 3 spacing for longer. Research work in New Zealand is now looking at even closer-spaced (e.g. 4m x 2m) hedgerow systems for these low-vigour varieties.”¹⁰

¹⁰ <https://treecrops.org.nz/crops/nut/hazels/hazel/>