PDC design project

Design for a movable greenhouse

For Richard Pedley

PDC Design Project

Introduction

Season extension is just one of the advantages gained from growing in a greenhouse. Protection from the rain, and wind create an optimum growing condition for the crop and can improve yield.

The disadvantage of a greenhouse is that the measures taken to minimise foliar disease, aphids, and whiteflies can produce an undesirable build-up of salts in the soil over time.

This PDC design project describes the way we at Permakai plan to eliminate this problem by building a movable greenhouse.

(The icons in the left margin indicate the permaculture ethic or principle concerned.)

Background

In late 2015 we moved onto our property with a view to living as self-sufficiently as possible. We had chosen the property with this in mind:

- North facing aspect
- Own water
- No cropping in vicinity
- Favourable prevailing winds
- Shelter belts
- Orchard
- Stream
- etc.

Before we moved in we started on our design following the principles of permaculture and taking into account the (very few) restrictions the existing layout presented. Here is the zone map we worked from. It shows the part of the property in the immediate vicinity of the dwelling.

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Upon moving in we had a good idea where we wanted most of the important items to go. However taking into account the principle of observe and interact we decided to only press ahead with the minimum of disturbance until we had seen the property in different situations. We developed a few vegetable beds and started growing food for ourselves and so obtained a yield

We also set up the compost bays and started the first of many cubic metres of compost.

To start with we made our beds on contour to trap and hold the water. This was not necessary and indeed undesirable as the first of the winter deluges swamped the beds. We rescued these by digging a drain to move the water away from the beds.

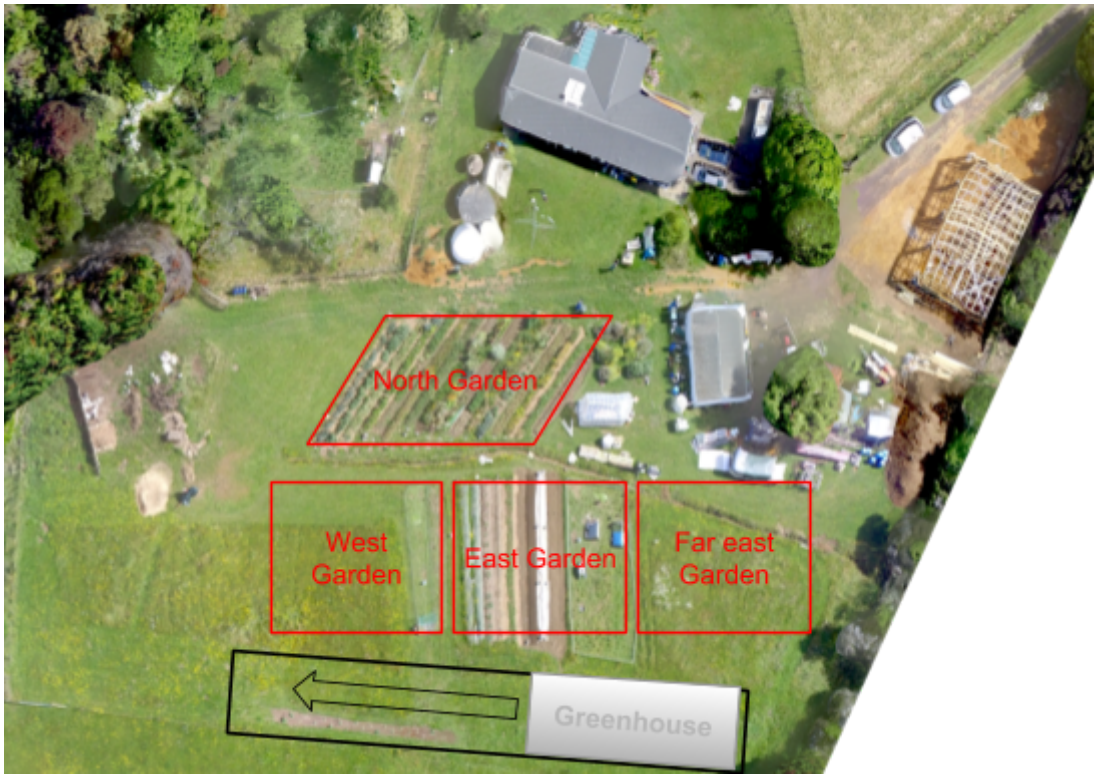
SInce then we have applied some self-regulation and accepted feedback and dug the rest of our beds in the N-S direction to maximise exposure to the sun and shed the water.

We grow our vegetables according to the bio-intensive method and have integrated bio-dynamic practices to further improve the the soil fertility.

By the end of this year we will have over 500m^2 of productive beds growing a diverse range of vegetables and carbon crops supplemented by chickens for eggs and meat.

We are also managing to share our surplus with a growing number of families through our online sales and market stalls.

The time has now come to expand our growing season and use the southern edges of the garden plot to maximum advantage by the addition of a greenhouse.



Movable greenhouse

The role of the greenhouse is to extend our growing season for selected crops while keeping to a minimum the build-up of salts, the chance of disease, and the infestation of pests.

We have decided to go movable so we can:

- move it to cover multiple crops in a year.
- minimise pest pressure and soil problems by exposing the soil to the purifying effects of sun, rain, wind, and varying temperatures on rotation
- eliminate the expense of cooling the greenhouse when planning for autumn/winter harvestable crops. While summer crops are in the greenhouse we can start other crops outdoors in the field, over which the greenhouse will move.
- harvest crops up to six weeks earlier and/or six weeks later thus extending the length of the marketable season by as much as 3 months.
- Provide a windbreak for the gardens to the north of its location.

There are different ways to move the greenhouse:

- Pipe skids - whereby the greenhouse is pulled to a new location on skids - https://www.smallfarmtools.com/pipe-skid-tunnels - good for a smaller greenhouse
- Removable wheels - when removed the greenhouse sits on the ground - https://www.milkwood.net/2013/09/09/why-movable-greenhouses-are-a-great-idea/ - low cost and ideal when the grenhouse is only moved a few times each season
- Rails - where the greenhouse rolls over a rail - https://www.rimolgreenhouses.com/greenhouse-series/rolling-thunder - robust solution, ideal for frequent movement of the greenhouse.

Our farm is is classified as poor draining and indeed wet winters show this to be true. Skids and wheels do not work in boggy conditions so rails are the only possible option. Also, the steel wheels are readily available as they are used for automatic gates.

Greenhouse location

The greenhouse will be located to the south of the gardens on an east-west axis. The reasons for this are:

- It is in Zone 2, not too far from the house. Although in our original design we had not envisaged a movable greenhouse.
- The orientation is slightly skewed from East-West to catch more of the early morning sun. This ensures any overnight dampness is burnt off as quickly as possible.
- The prevailing winds are from the NE and SW so the greenhouse will afford some shelter for the beds - this is shown in the following image from THE CLIMATE AND WEATHER OF AUCKLAND, 2nd edition P.R. Chappell, NIWA SCIENCE AND TECHNOLOGY SERIES, NUMBER 60, ISSN 1173-0382

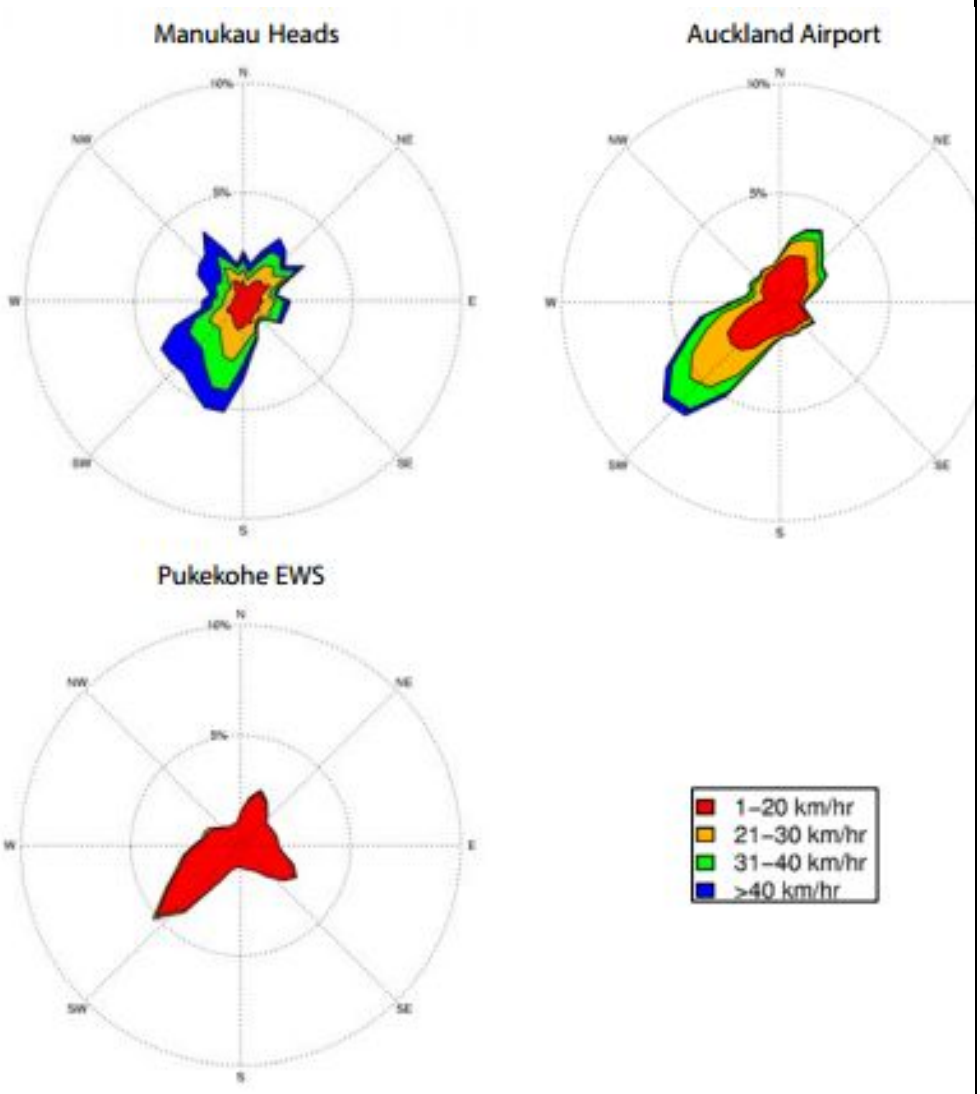


Figure 7. Mean annual wind frequencies (%) of surface wind directions from hourly observations at selected Auckland stations. The plots show the directions from which the wind blows, e.g. the dominant wind direction at Auckland Airport is from the southwest.

Pukekohe has on average 13.9 days of frost each year, the greenhouse will help mitigate the effect of this frost. *(Note: this is based on data up to 2010 and may no longer be completely accurate)*

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Greenhouse size

Our beds are standardised at 16m long and .75m wide with an aisle between them of .45m. Our crop rotation is on a 4 beds cycle. Allowing for a 1m space at either end and at the sides then the dimensions will be 18m x 7m.

Buy or build

Internet research suggests that a popular greenhouse in the US is the Rimol Rolling Thunder from and GrowSpan Rolling Premium High Tunnels

Unfortunately the cost of importing these into NZ makes it not feasible. There appears to be no ready-made options in New Zealand so the best option is to build one.

Design aspects

Movable greenhouses are typically covered by fabric to allow for flexibility while moving.

Hoop or gothic arch

The shapes in common use for movable greenhouses are: the hoop design, the gothic arch, and the hybrid.

The gothic arch is higher and stronger and more suited to our needs. Sourcing the pipe connections may prove difficult and it is harder to construct.

The hoop design is easier to construct and uses readily available pipe joining fittings but requires more bracing. The hoop design is also lower and less exposed to winds. This is important for us as we have strong winds.

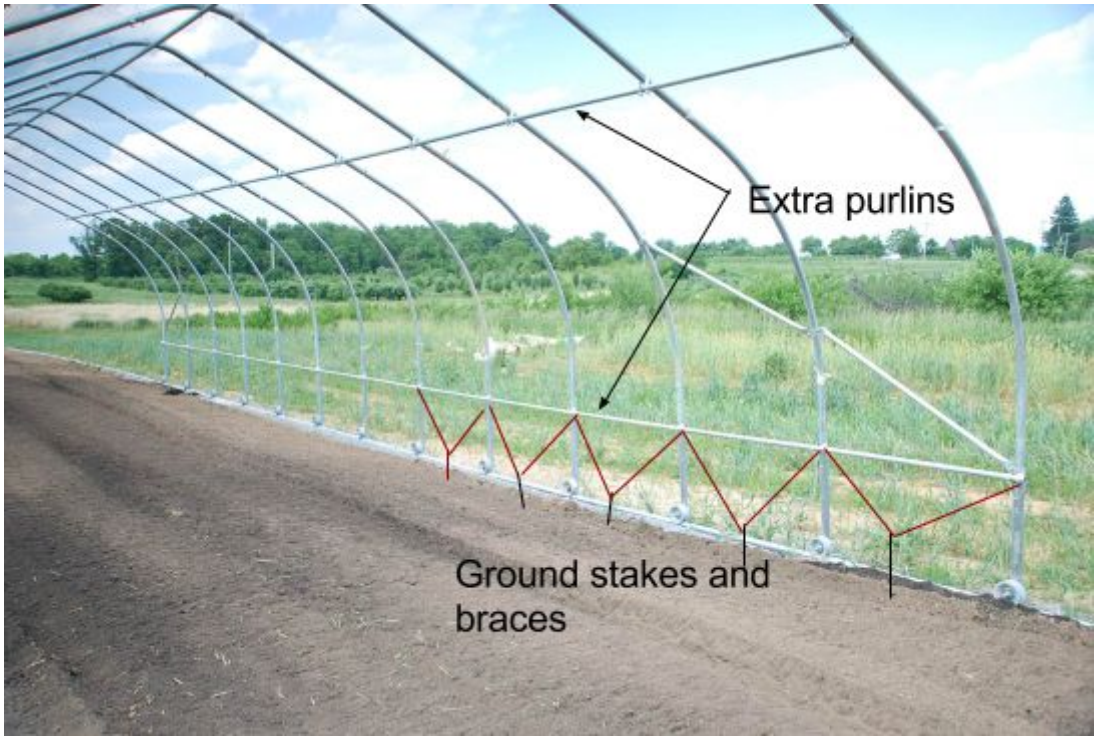
There is also a hybrid design with vertical walls and straight rafters - shown in the picture below. Although it has fewer bends they have to be very exact which for an inexperienced builder can be time consuming.

The next stage of this project is develop a detailed design for each option, cost out the materials for these, decide upon the final design, and build it.

A movable frame has the following additional design elements :

- Extra side purlins for longitudinal strength - 17 gauge
- Heavier rafters (uprights) - 16 gauge
- Heavier ridge purlin - 17 gauge e.g. chain link fence top bar

- Extra cross bracing at the apex
- Skirt to seal at ground level
- Removable panels at the ends to enable the house to move above growing crops
- Ground stakes between each upright with braces - 16 gauge



(Picture shows a hybrid design with extra side purlins and ground stakes)

Wheel detail

The wheels we will choose are standard electric gate wheels. With one at the end of each rafter. The will run on a rail.

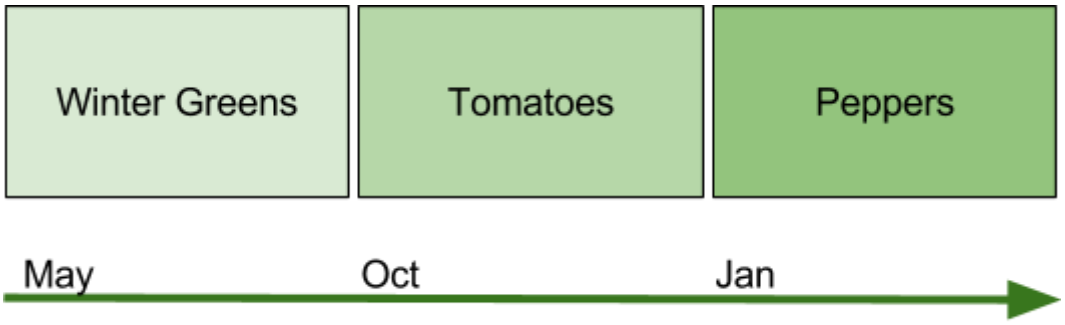
The rail does not have to be pinned or staked, but will be set on solid base of stone dust or rubber edging to prevent sinking into the soil.

Pipe and pipe connectors

We will use a selection of 16 and 17 gauge galzanised pipe and regular fittings such as Masterklamp

Using the greenhouse

The greenhouse will be used for extending the growing season. For instance, we cover winter greens in Field A from late May through mid September. Then in early October, once the weather has warmed up enough that the greens will be fine without covering, we drag the greenhouse down the tracks to Field B and get a jumpstart on our tomato crop by planting the seeds in the ground under the plastic. Once the ground has heated up sufficiently, we slide the greenhouse to Field C where we plant seedlings of a heat-loving crop like peppers or melons. The greenhouse stays over them for the summer, then we move it again in autumn to cover a crop of greens.



Conclusion

In this design we have attempted to explore the multiple functions of each element connected to the movable greenhouse and show the favourable connections between these elements. We have tried to illustrate how the design builds on patterns to arrive at details.

By using the greenhouse we will:

- increase the efficiency of our production i.e. feed more people from the same amount of space while minimising the effect on the soil
- enhance our use of natural resources - sun, wind and rain.
- make good use of the edge of our gardens
- have even more surplus to distribute
- allow us to grow more high value crops through an extended season

References

David Holmgren

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Icons taken from https://permacultureprinciples.com/principles/

Elliot Coleman:

- The Winter Harvest Handbook: Year Round Vegetable Production Using Deep-Organic Techniques and Unheated Greenhouses
- The New Organic Grower: A Master's Manual of Tools and Techniques for the Home and Market Gardener, 2nd Edition (A Gardener's Supply Book)
- Four-Season Harvest: Organic Vegetables from Your Home Garden All Year Long, 2nd Edition

John Jeavons:

- How to Grow More Vegetables, Eighth Edition: (and Fruits, Nuts, Berries, Grains, and Other Crops) Than You Ever Thought Possible on Less Land Than You ... (And Fruits, Nuts, Berries, Grains,)

John Marshall

- How to build your own greenhouse : designs and plans to meet your growing needs

Darrell Frey

- Bioshelter market garden : a permaculture farm

Lindsey Schiller

- The year-round solar greenhouse : how to design and build a net-zero energy greenhouse