Growing Indoors to Promote Food Sovereignty

by

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Submitted in partial fulfilment of the requirements
for the degree of Master of Architecture

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SCHOOL OF ARCHITECTURE

The undersigned hereby certify that they have read and recommend to the Faculty of Graduate Studies for acceptance a thesis entitled "Growing Indoors to Promote Food Sovereignty" by Carolyn Anne Hocquard in partial fulfilment of the requirements for the degree of Master of Architecture.

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ABSTRACT

This thesis proposes a destination restaurant, near Tatamagouche, Nova Scotia, Canada, that serves as an informative showcase of common food plants grown indoors, and allows visitors to experience the food cycle of growing, processing, cooking, eating, and composting, from soil to table.

Throughout the building, the line between architecture and agriculture is blurred, as program areas incorporate food plants.

The environmentally-conscious design, built primarily of re-used wood and locally sourced sandstone, inspires visitors to start growing food at home by being a living example of a variety of growing methods, most of which could be adopted at home on a smaller scale.

ACKNOWLEDGEMENTS

This project would not have been possible without the guidance of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this study.

I would like to thank my supervisors and advisors for their patience and guidance, in particular thank you:

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CHAPTER 1: INTRODUCTION

Many challenges face the global food system today, that make food less nutritious, harm the environment, and threaten food security. This project is an architectural response to these problems in which I propose a destination restaurant that will take visitors on a tour of a healthy cycle of food production from seed to table, including various architectural forms of agriculture, and many types of food preservation such as canning and dehydrating. The goal is to empower visitors with the knowledge to make better food choices and inspire them to start growing some of their own food at home, thus counteracting the damaging effects of current commercial agriculture.

Thesis Question

How can combining architecture and agriculture promote food sovereignty?

The Challenges

The Broken Cycle

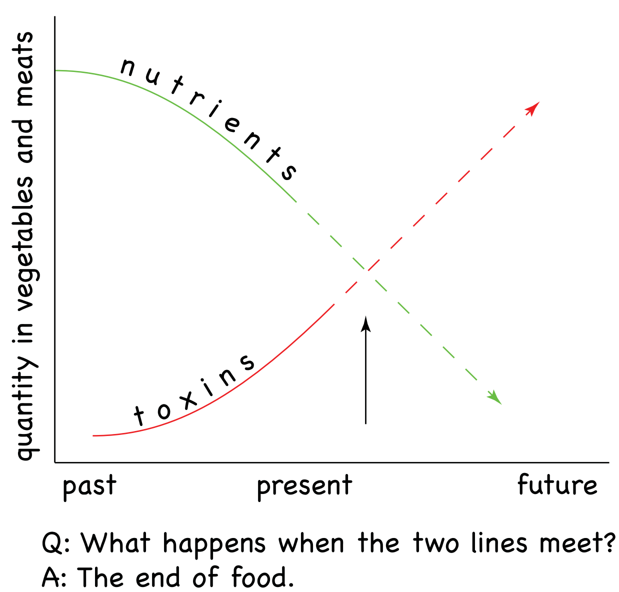
Monoculture is the conventional method of agriculture in most of the world today, and it is a terrible practice that is detrimental to the environment and produces inferior quality food. These vast fields of a single crop that are often never rotated, are prone to diseases and pests, and they need increasingly more pesticides because they are so vulnerable. The consequences of this widespread practice are summarized in the following table.

Conventional Monoculture	The Problem
Fewer choices	Heirloom varieties, and regional flavours of many foods, are being lost.
Less flavourful food	Foods are mass-produced for durability and shelf-life, not flavour.
Pollution	Fertilizers and pesticides leach into the groundwater, extending the pollution to well beyond the borders of the field.
Genetic pollution	GMO seeds are spread by the wind, pollute organic farms, and could cross-breed with wild plants leading to weeds that are resistant to pesticides.
Dependence on fossil fuels	Once upon a time, agriculture used free energy from the sun and human labour and converted it into calories we could eat, resulting in a net positive energy gain (Pollan 2006, 46). Now, the input that farming requires from fossil fuels is so enormous, and it takes more energy to produce the food than the energy that we get out of it. Now, we use fuel for the machinery, the petro-chemical-derived fertilizers, and the processing, transportation and storage of the food, resulting in a loss of energy compared to the calories of food we get out of the process. If we continue with this method of farming, we will run out of food when we run out of fuel. (Peters 2010, 209)
Soil depletion/erosion	As the soil is depleted and eroded, the land becomes destertified, and unable to support life without significant human intervention. This desertification is very difficult, if not impossible to reverse.
Farmers dependent on vertically integrated seeds and chemicals	Industrial agriculture is bad for farmers as well as their fields. They have small profit margins, go into great debt each year to pay for massive equipment and tons of chemicals, and take on all the risk if the crop fails. If prices fall, they must force more yield out of the same field, using still more chemicals or genetically modified seeds, making them rely on the seed and chemical companies year-after year. Seed companies get richer and farmers get poorer.
Pathogen risk	Centralization and mass-production increase the risk of widespread illness caused by one contaminate batch. Smaller operations tend to be cleaner because they focus on quality rather than speed.
Less nutritious food	“Plants grown in synthetically fertilized soils are less nourishing than ones grown in composted soils; 1 such plants are more vulnerable to diseases and insect pests; 2 polycultures are more productive and less prone to disease than monocultures;3 and that in fact the health of the soil, plant, animal, human, and even nation are, as Howard claimed, connected along lines we can now begin to draw with empirical confidence. We may not be prepared to act on this knowledge, but we know that civilizations that abuse their soil eventually collapse.” (Pollan 2006, 151)
Food is artificially cheap and the price doesn’t account for the environmental cost	“. . .whenever I hear people say clean food is expensive, I tell them it’s actually the cheapest food you can buy. That always gets their attention. Then I explain that with our food all of the costs are figured into the price. Society is not bearing the cost of water pollution, of antibiotic resistance, of food-borne illnesses, of crop subsidies, of subsidized oil and water-of all the hidden costs to the environment and the taxpayer that make cheap food seem cheap. No thinking person will tell you they don’t care about all that. I tell them the choice is simple: You can buy honestly priced food or you can buy irresponsibly priced food.” (Pollan 2006, 243)
Processed, grain-based foods are subsidized	Very simply, we subsidize high-fructose corn syrup in this country, but not carrots. While the surgeon general is raising alarms over the epidemic of obesity, the president is signing farm bills designed to keep the river of cheap corn flowing. guaranteeing that the cheapest calories in the supermarket will continue to be the unhealthiest. (Pollan 2006, 108)

Problems with modern, conventional agriculture.

The End of Food

The problems with agriculture are numerous, but the heart of the matter is that they are unsustainable. Since sustainability most simply means "the capacity to endure," then unless we drastically change our farming practices, it will mean the end of food. As melodramatic as that sounds, it is a possibility. The end of food is not only a risk because of the environmental damage, but because food is becoming more toxic and less nutritious, and if the trend continues, we will be left with nothing truly edible. Food will become more harmful than nutritious.



To aid visualization of a concept found in Pawlick 2006.

The current food industry is controlled by corporations which seek to endlessly produce more commodity from the same amount of land and do not replenish the nutrients taken from the soil. As a result, the land is less able to support its crops and more chemicals are needed to force the crops to grow, making them less nutritious.

Not only is food now less nutritious than it was 50 years ago, even fresh, raw foods are also saltier, fattier, and more fibrous (i.e. less flavourful) than they were as a result of efforts to increase shelf life and durability. One of the many examples of this is the modern tomato, which has 23% less protein, 31% less vitamin A, 17 % less Vitamin C, 61% less calcium, and has 200% more sodium than its traditionally grown ancestors (Pawlick 2006, 5-7).

This project will be an example of various types of positive agricultural practices, showing that food can be nutritious, non-polluting, minimally processed, beneficial to the soil, delicious, and accessible to many people to get involved at home.

The Solutions: Addressing the Problems of Agriculture with Architecture

A Sustainable Food Cycle Inspired by Nature

A sustainable food cycle would be similar to one found in nature, since nature is a self-sustaining, closed loop system in which a balance of diverse organisms work together. Since nature is already a successful, sustainable system, all we need to do to solve many agricultural problems, is to learn from it to re-create a similar balanced system with plants that are useful to us.

> A much more appropriate model for the agriculturist, scientist, or farmer is the forest, for the forest, as Howard pointed out, “manures itself” and is therefore self-renewing; it has achieved that “correct relation between the processes of

> growth and the processes of decay that is the first principle of successful agriculture." A healthy agriculture can take place only within nature,, and in co-operation with its processes, not in spite of it and not by "conquering" it. Nature, Howard points out, in elaboration of his metaphor, "never attempts to farm without live stock; she always raises mixed crops; great pains are taken to preserve the soil and to prevent erosion; the mixed vegetable and animal waste are converted into humus; there is no waste [my emphasis]; the process of growth and the processes of decay balance one another; ample provision is made to maintain large reserves of fertility; the greatest care is taken to store the rainfall; both plants and animals are left to protect themselves against disease." (Berry 1972, 97)

In nature, plants grow in mixed groups, benefiting each other and feeding animals whose waste goes back into the soil in a loop of GROW>EAT>COMPOST. When humans are added to the cycle, two more stages are added to increase longevity and digestibility of foods: processing and cooking.

The building demonstrates six stages of the food cycle: growing, processing, cooking,[1] eating, composting and selling. Each stage of the cycle is represented by a program area (or more than one), and they are organized into a tour that takes visitors through a processing kitchen, cooking show, baking kitchen, composting area, restaurant, and several growing habitats, some of which are separate, and some that interlock with the program areas like puzzle pieces.

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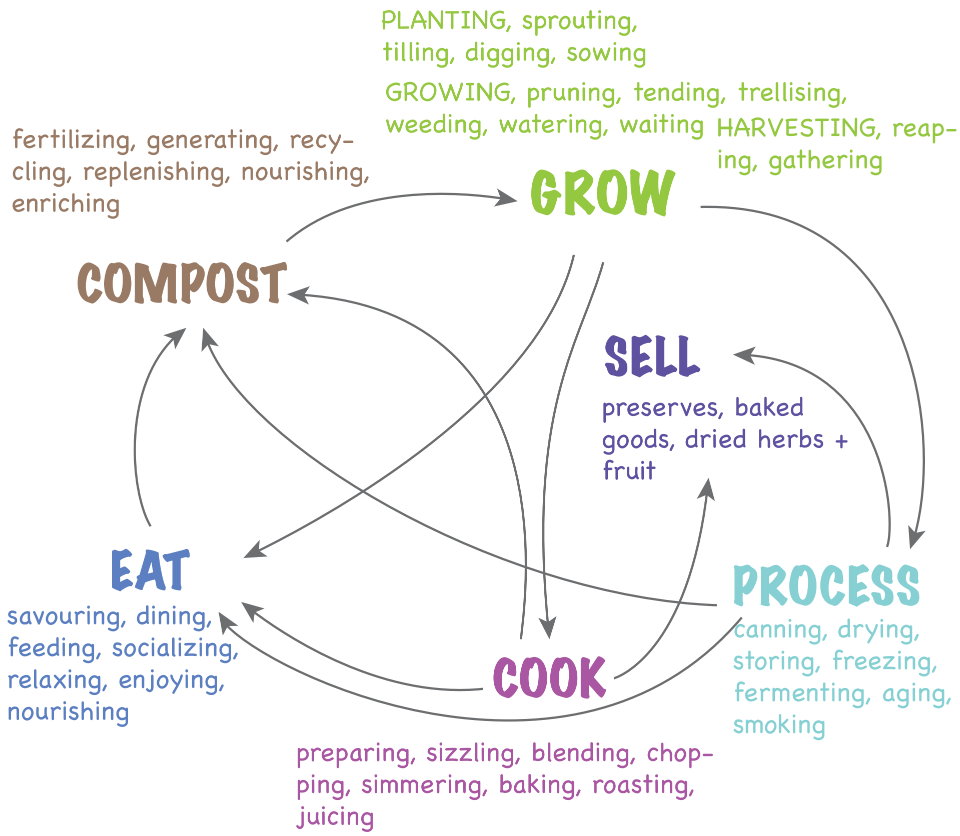
1 In this project, "cooking" means preparation of food just prior to eating and does not necessarily involve heat, whereas "processing" is an optional step before cooking that either adds monetary value for the farmers, or allows the food to be eaten for more months of the years (proper storage or preservation)



The complete food cycle, as demonstrated in this project.

To explore the possibilities for a restaurant and tour based on this cycle, I chose an example meal that incorporated elements from each stage and expanded on the food cycle. The meal is a sandwich with sprouts and tomatoes made with bread from the bakery, a dill pickle from the processing kitchen, and potato salad. I chose a simple, common recipe, so as to highlight the local ingredients rather than the culinary skills necessary to prepare it. The stages in the cycle it represents are growing (tomatoes, sprouts, cucumbers, wheat), processing (baking bread, pickling, root vegetable storage), and cooking (assembling potato salad).

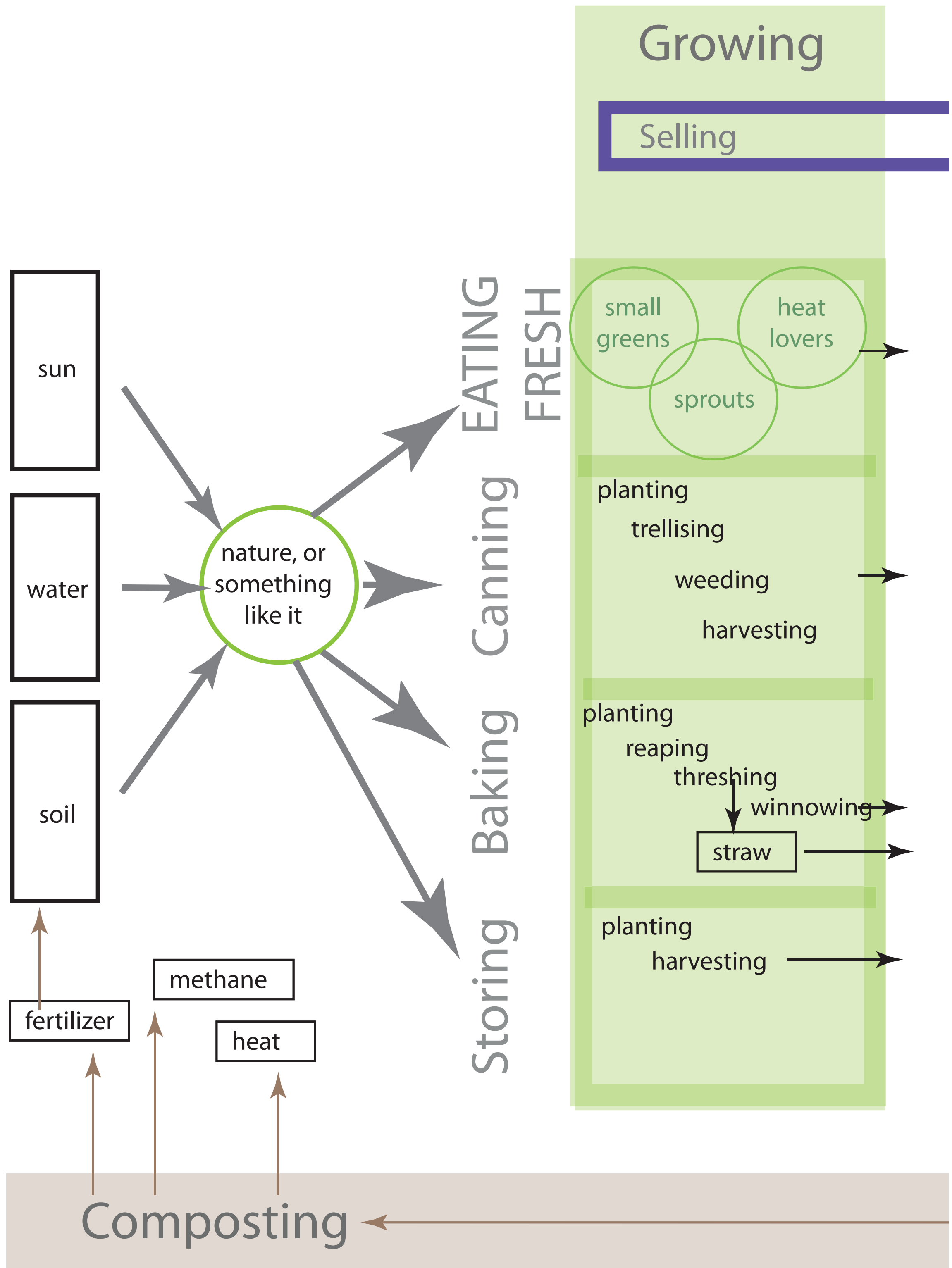
It's not the recipe that is outstanding, it is the ingredients that will make a simple lunch into something memorable. The flowchart on the following three pages shows the process of making the sandwich lunch from starting with growing the plants.

Architecture to the Rescue

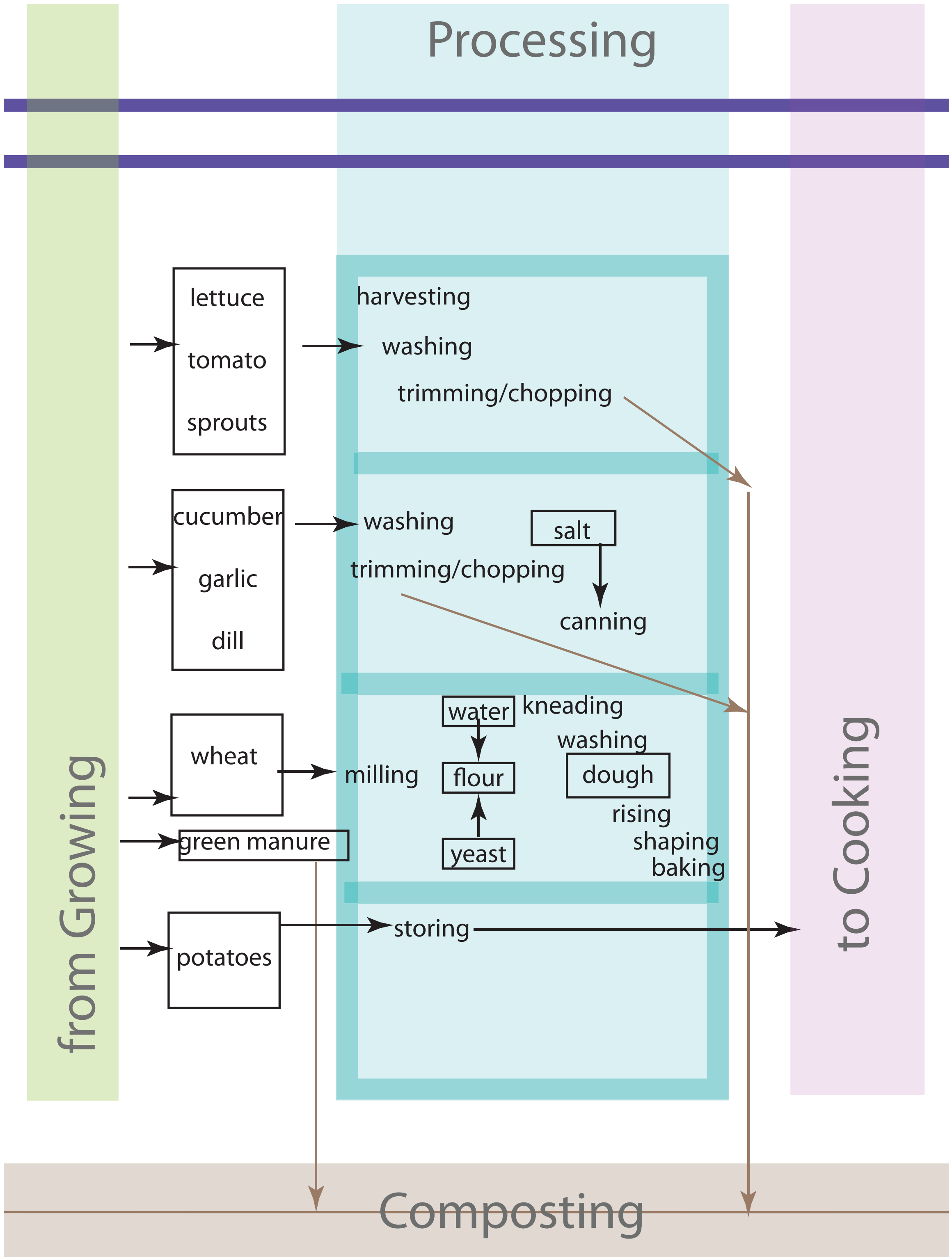
Architecture has an opportunity to address the current agriculture crisis by evolving to incorporate food-growing facilities in appropriate niches within buildings. Living walls and green roofs are becoming more and more popular, but they only address environmental issues, while they could be doing double-duty as food-providers. There are also many ways, other than green walls, in which food plants could be incorporated into regular living and working areas.

Since starting this thesis project, I have encountered more and more projects that combine plants and architecture, but most either have plants "pasted on" in the form of living walls or green roofs, or they are vertical farms solely dedicated to production, and not habitation.

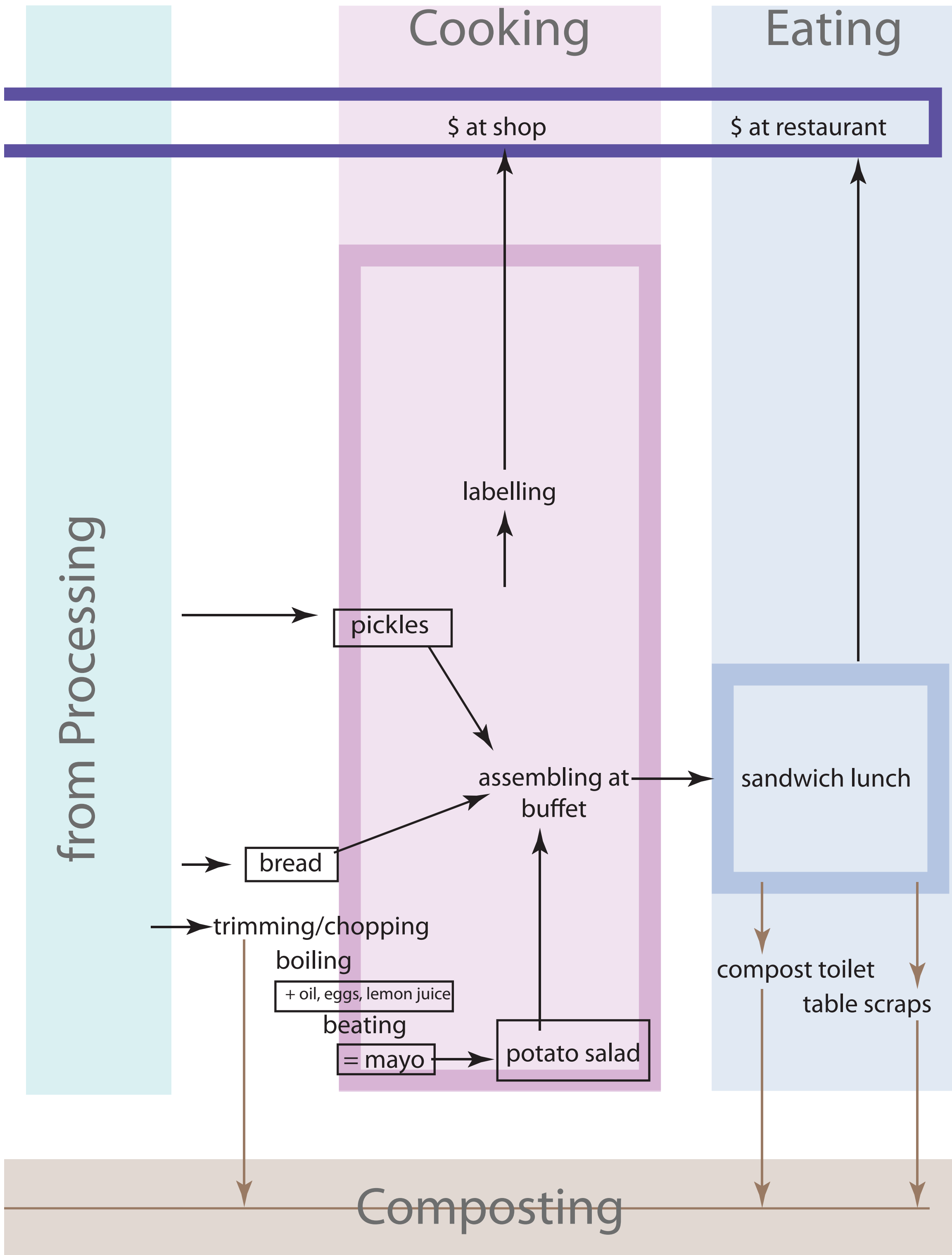
Two examples of a buildings that stand out by more closely integrating growing space and program are is MVDRV's Flowerbed Hotel and NL Architects Sanya Block 5. These two projects use green space to add to the tenants comfort or enjoyment throughout the buildings, and I think principles like this could be easily adapted to use these growing areas to produce food.



Sandwich Flowchart (Part A)



Sandwich Flowchart (Part B)



Sandwich Flowchart (Part C)

MVDRV's Flowerbed Hotel, a hotel that fosters the growth of flower beds throughout. From Zimmer 2011.

NL Architect's Sanya Block 5, an apartment complex with individual garden plots for each apartment that help to shade the interior. From Meinhold 2012.

Early vernacular houses were simple structures that merely demarcated space and sheltered us from the elements. The first structures just had small holes in them for ventilation and a little light. Then, with the discovery of glass, we could make larger openings that let in a lot more light and we could even open and close them to vary the amount of air circulation.

Later, we added pipes to bring water in and take sewage out. Soon enough, buildings were able to provide mechanical ventilation, heating, and air conditioning. We have come to take for granted that a building will at least provide air and water, and these days, most new buildings are even expected to provide internet access, having communication closets full of cables.

Light, air, water, sewage removal are indispensable components of our modern lifestyles that are unquestioningly provided by modern buildings, but we still have to go to the supermarket to get an organic apple, which most likely comes from New Zealand, even though apples grow in this climate.

Given the many issues threatening our food security (see table, p.2) and the impending unavailability of affordable fossil fuels, the next step in the evolution of architecture should be to help us produce food. Food production is a new frontier in ecological architecture, and if we start to look for more opportunities, many new details will emerge that integrate food more fully in architecture.

Education

Besides growing food in the building, the program of this project suggests two other solutions to today's agriculture problems: education and growing food at home. In order for people to take back the power from corporations that regulate small-scale farming out of existence, they first need to be aware of the problem.

> In the very short span of about fifty years, we've allowed our politicians to do something remarkably stupid: turn America's food-policy decisions over to corporate lobbyists, lawyers and economists. (Waters 2006, 21)

Control needs to be put back into the hands of the eaters, and the first requirement of this is awareness and education. It is too easy to forget where food originates and how it is made, when all you see is the box from the supermarket, and all you have to do is put it in the microwave. A long chain of processing is hidden from the consumer, and education is urgently needed so that eaters can "vote with their forks" for healthier, more sustainable food.

> Knowing where our food comes from helps us:
>
> *eat from as close to home as possible;
>
> *chooser exceptional freshness and flavour;
>
> *support our local community/economy;
>
> *increase revenue for farmers (selling direct provides a higher return to farmers) so that they, and future generations, continue producing food;
>
> *be more connected to seasonality, place, and varieties of foods that are grown in our region. (Costa 2010, 12)

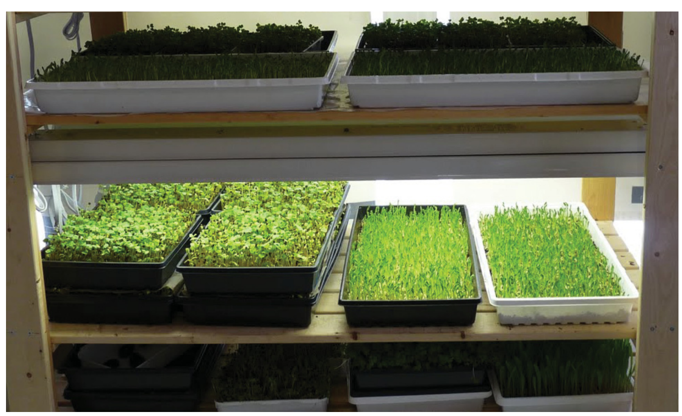
Industrial agriculture disconnects us from the food supply by bringing quantity, not quality, to packages in the supermarket, so we are not aware of the origins of what we are eating, perpetuating a "cultural amnesia" that makes us uncritical of the sad reality of conventional farming (Berry 1990, 146). The problems caused by conventional agriculture can be reduced by choosing unprocessed foods, local, organic produce, and, if possible, by starting to grow some food at home.

It seems that the only way we can be sure of the content and quality of our food is to grow it ourselves. This is seen by most as difficult and time consuming, but, with a little investment, anyone can benefit from fresh produce leading to better health, and the satisfaction of knowing exactly where your food came from and how it was grown.

> Odd as I am sure it will appear to some, I can think of no better form of personal involvement in the cure of the environment than that of gardening. A person who is growing a garden, if he is growing it organically, is improving a piece of the world. He is producing something to eat, which makes him somewhat independent of the grocery business, but he is also enlarging, for himself, the meaning of food and the pleasure of eating. The food he grows will be fresher, more nutritious, less contaminated by poisons and preservatives and dyes than what he can buy at a store. He is reducing the trash problem; a garden is not a disposable container, and it will digest and re-use its own wastes. If he enjoys working in his garden, then he is less dependent on an automobile or a merchant for his pleasure. He is involving himself directly in the work of feeding people. (Berry 1972, 82)

In and around the building, visitors will encounter various growing ideas that could be used on a smaller scale in their own homes, such as sprouting jars, micro-greens, companion planting, and square-foot gardening. Some examples are shown below, but there are many more similar ideas.

Vermicomposting kitchen planter system. From Dieckmann 2011.



Home micro-green farm. From Ferdzy 2010.

Pallet garden. From Fern 2011.

Aquaponic columns. From Tclynx 2011.

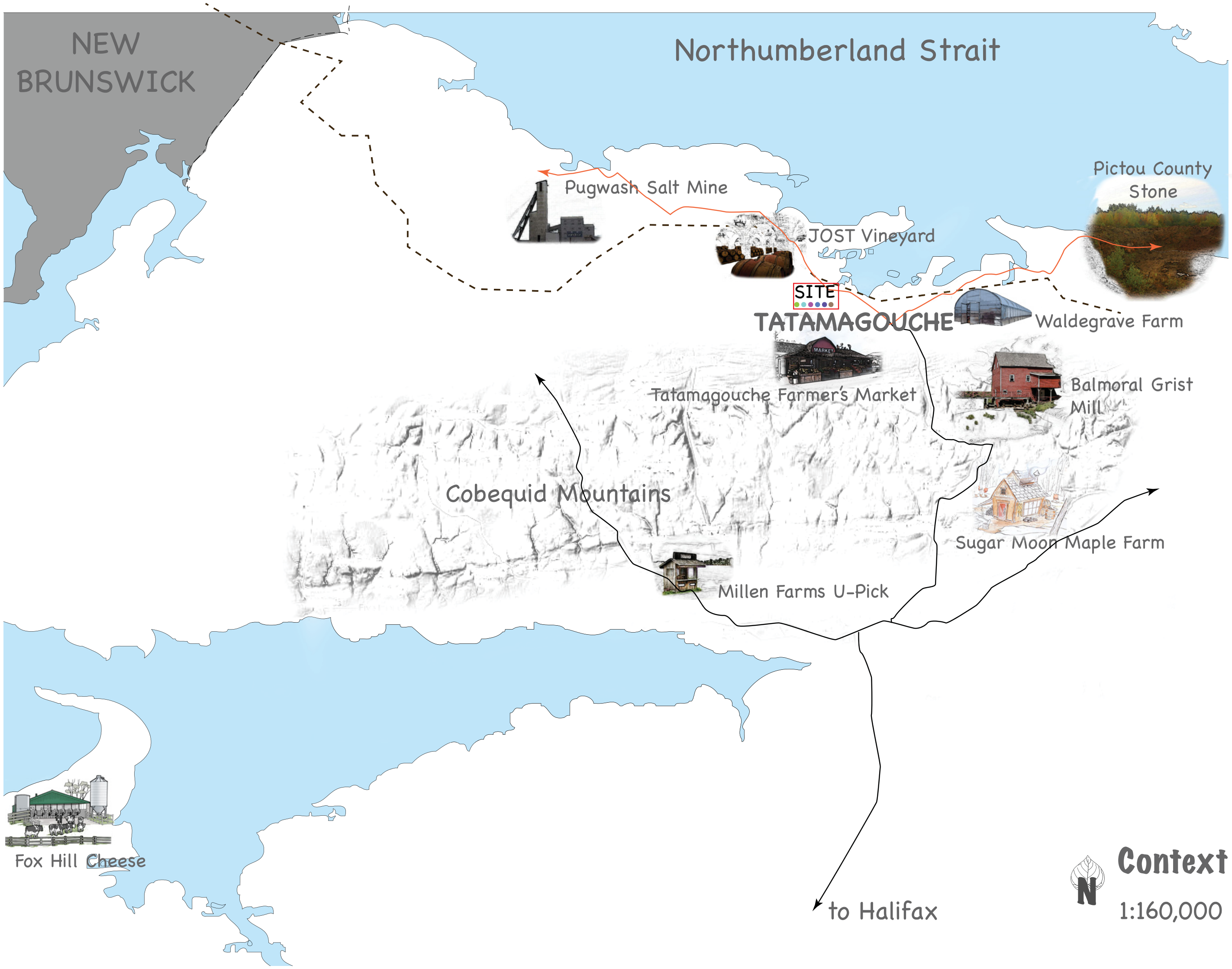
Tatamagouche welcome sign. From McGowan 2009.

Site

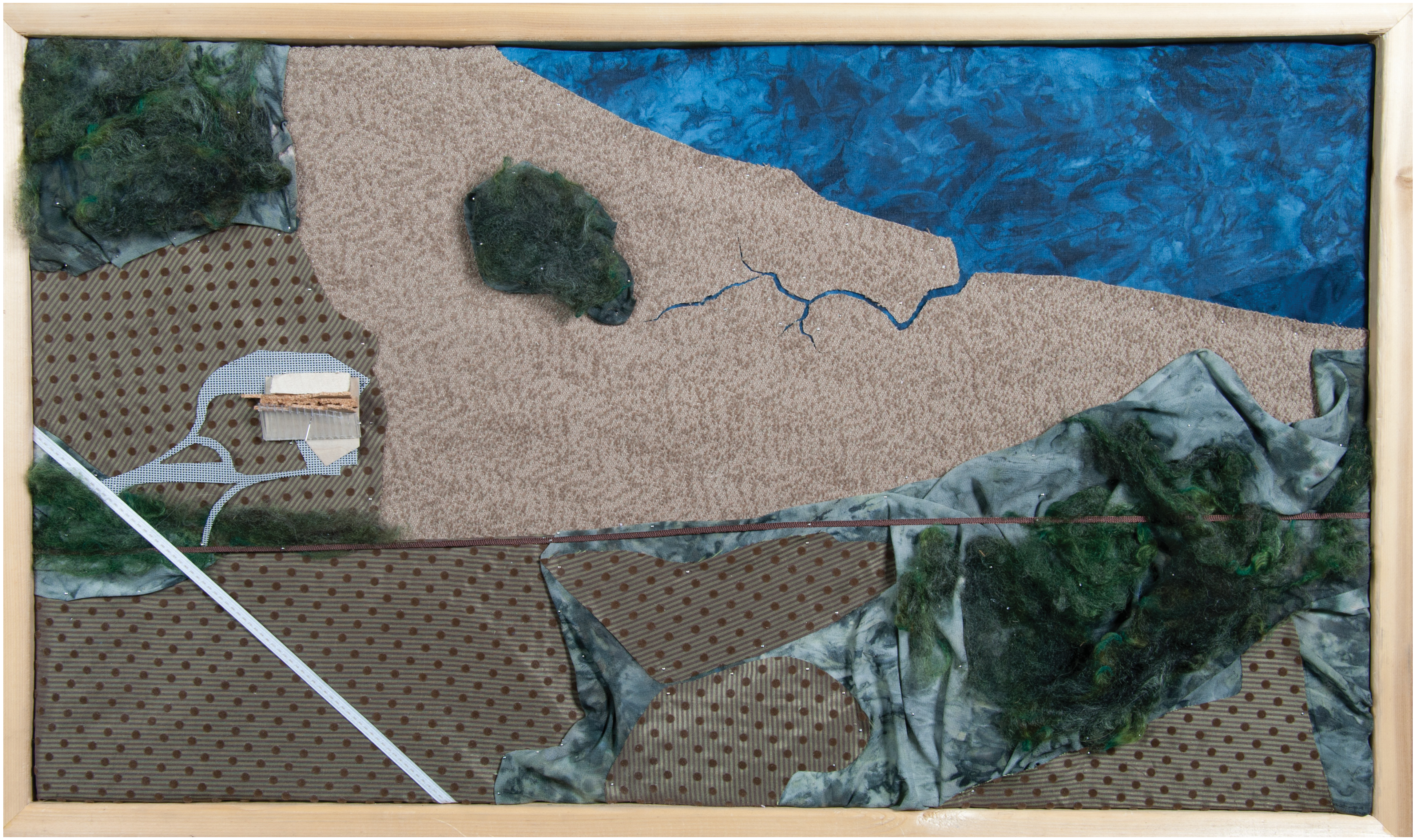
The project is located near Tatamagouche, Nova Scotia, a town of about 700 people on the Northumberland Shore. It is one of the few towns in Nova Scotia to grow between the last two censuses, which a local told me is because the area is a popular place for “back-to-the-landers” to settle. It is on a publicized Nova Scotia Tourism route called the Sunrise Trail, and there are many tourist attractions in the area, such as Creamery Square and Sugar Moon Farm, and some of the attractions have gatherings of very large groups for multi-day retreats, such as the Tatamagouche Centre and Dorje Denma-Ling Shambhala Centre. It is about a two-hour drive from Halifax, making it a good destination for a day-trip tour of food production, with a few stops at other local food businesses along the way.

Sugar Moon Farm’s maple syrup evaporator. From Sugar Moon Farm 2010.

One of these other stops on the day tour might be at Sugar Moon Farm Maple Products and Pancake House, a programmatic precedent for this project. Sugar Moon also grows and processes an edible product, includes a retail area, provides an educa-



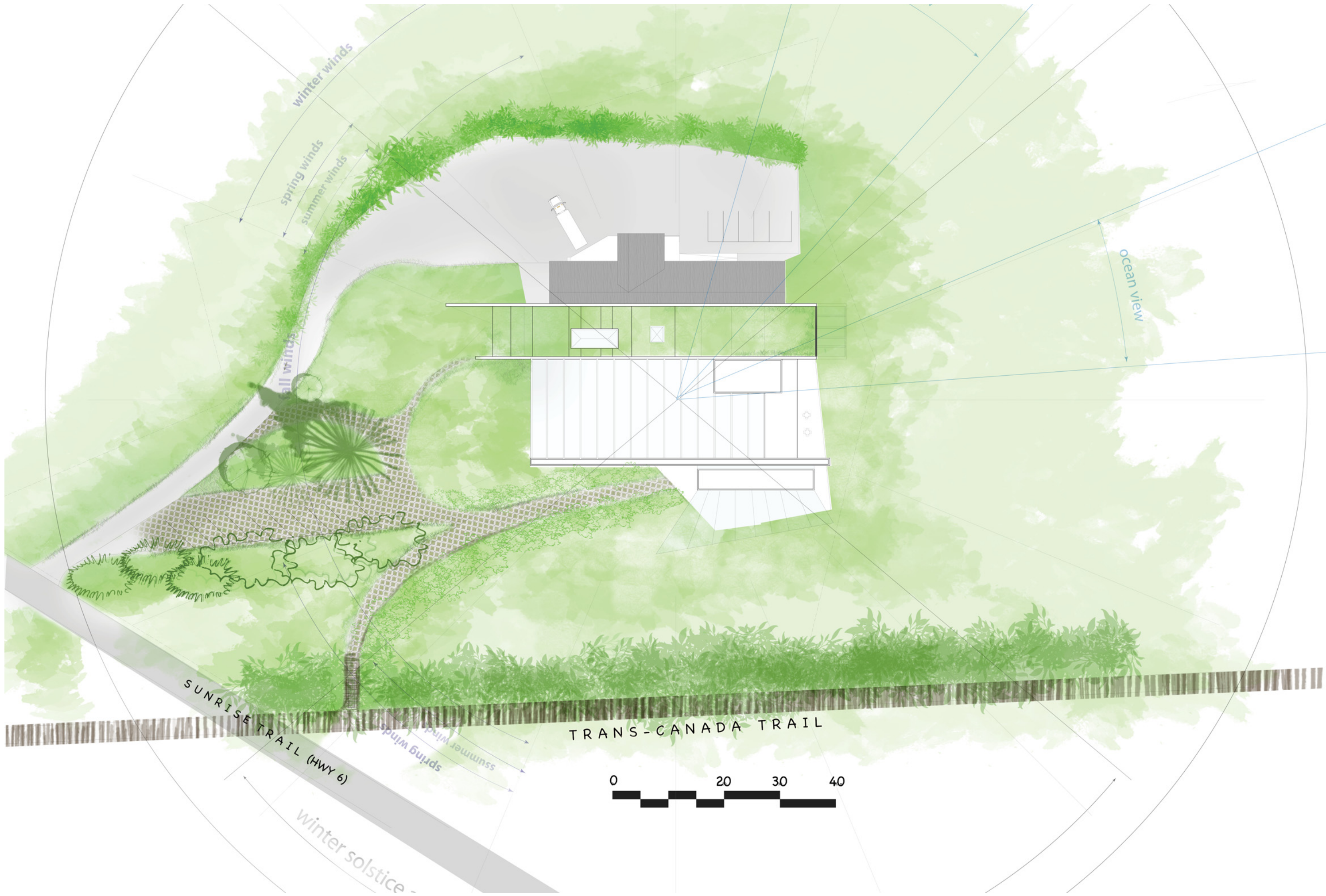
Other local-food related businesses in northern Nova Scotia.



Photograph of site model, showing relationship of site to the shoreline, and textures in the immediate surroundings: marshland, domesticated land, and forest.


Site, Tatamagouche, NS, looking from Highway 6 to the water. From Google Maps 2012.


Site, Tatamagouche, NS, showing the intersection of the Sunrise Trail and the Trans-Canada Trail. From Google Maps 2012.



Site plan showing access from the Trans-Canada Trail, visitor and staff parking lots.

tional tour of its processing equipment, and has an adjoining restaurant that serves local food including the maple syrup they produce.

My site criteria were as follows:

- large enough to accommodate the program
- easy to find / on a main road to accommodate tourists and educational visitors
- not forested, i.e. existing agricultural land
- close enough to the town to be convenient for locals
- preferably with good soil, south-facing slope, and possibility of creating micro-climates

The site is at a crossing of the Trans-Canada Trail, and the Sunrise Trail tourist route, making it easy to get to, and highly visible from the road.

It is quite flat and low, and has a view of the Strait. The south border is lined with low trees, separating the site from the Trail, and to the east the site melds into a marsh between it and the Strait.

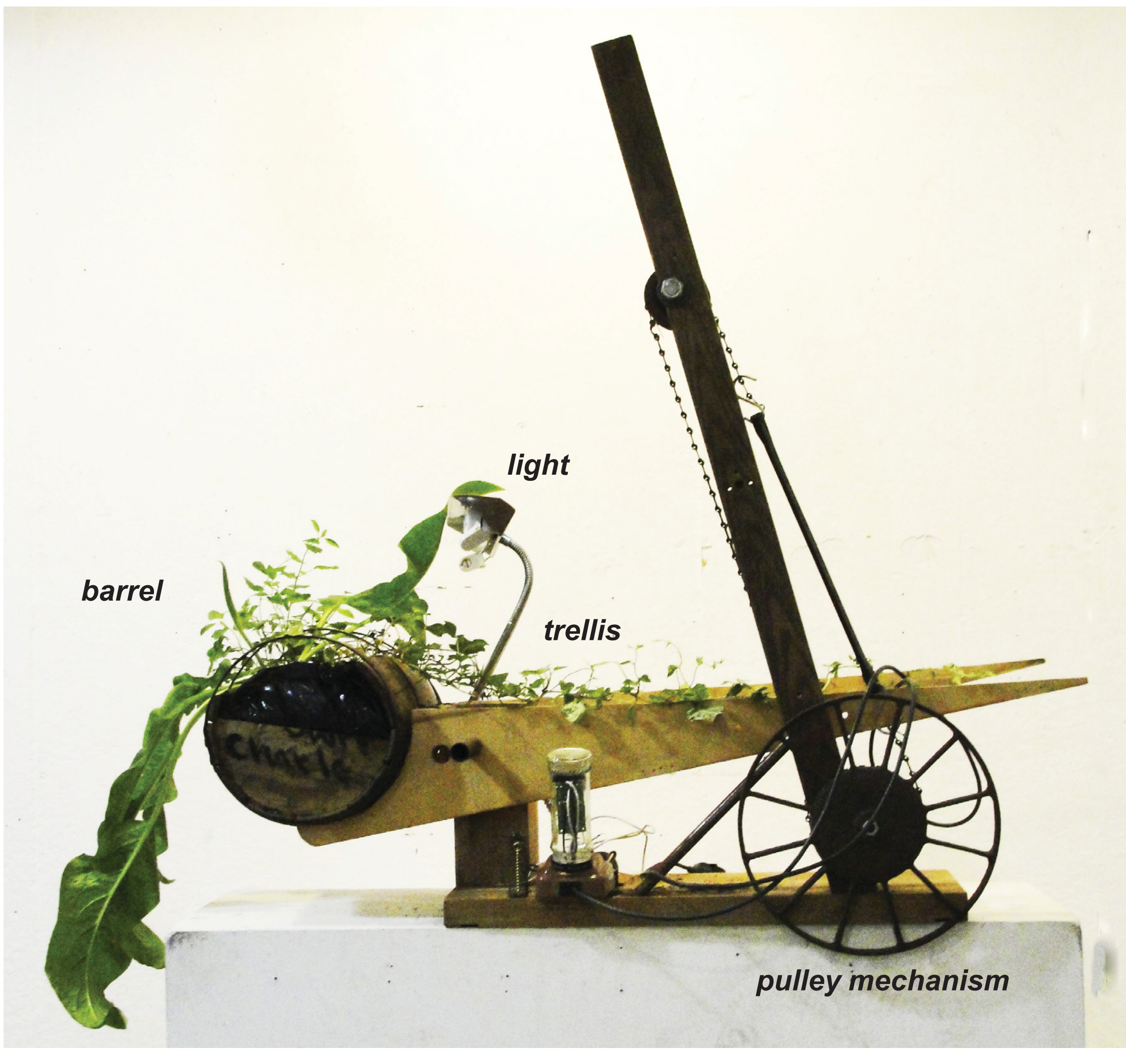
The site is located about a five minute drive from Tatamagouche town centre. From Vinneau 2007.

Tatamagouche main street.

CHAPTER 2: DESIGN

Conceptual Maquette

My first model for this project is a planter contraption that demonstrates a couple of the main ideas driving the design.

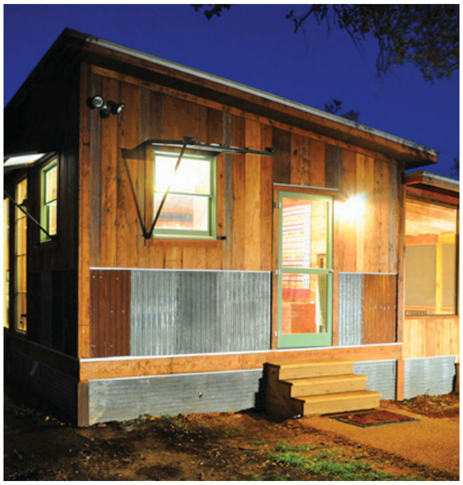


Conceptual model of planting contraption.

First, it is an example of a man-made structure that supports the growth of food plants and assists the farmers. The barrel that holds the roots is attached to a horizontal trellis that pivots on an axis. The gear mechanism moves the trellis from horizontal to about 45°. Imagine it on a much larger scale: You are having lunch in dappled sunlight created by a vine laden with ripening passion fruit. Nearby you hear chains start to clatter and as you look over, the vine trellis over the empty tables next to you is slowly lowered within reach as a couple of staff members begin to harvest. The planter contraption creates a pleasant atmosphere below it, adding to the visitors' experience, and produces something edible. This is the kind of symbiosis between agriculture and architecture that I believe could be commonplace.

Detail of the planter contraption made from an old barrel, a locker door, a table leg, a jam jar, a broken lamp, and some rusty pieces of old farm equipment.

Second, the planter is made of salvaged materials. Since this project is partly borne out of a concern for the environment, as many of the materials as possible will be recycled with their varied surfaces displayed in a collage of textures.



Material precedent for salvaged materials. From Dailey, 2012.

Typical abandoned maritime barn.

Also, there are many old barns falling into disuse across Nova Scotia and New Brunswick, so a primary source of the recycled building materials could be lumber for timber framing from nearby barns.

Masonry Hearth Complex

Another element of the design that demonstrates many ideas in the program is the multi-purpose masonry hearth. It is almost a microcosm of the rest of the program, reaching out to a different program area on each side.

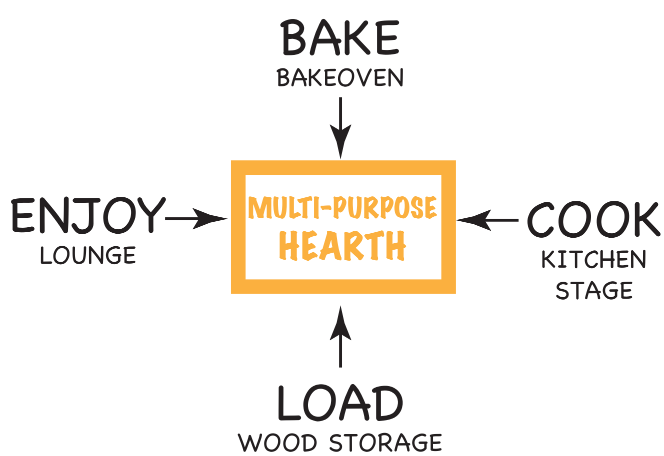


Diagram of program in masonry hearth complex.

Program diagram. Boxes are proportional to space dedicated to each activity.

Example of a masonry hearth accessible from more than one side. From De Decker, 2008.

The preliminary design for the hearth was based on the idea of a temperature gradient (see Appendix A) cutting vertically through the building, with cool storage beneath the hearth, people working at room temperature on the ground floor, and warming and dehydrating shelves overhead.

Masonry complex showing a cooking area on one side and a lounge on another.

Program

The main program areas are a buffet-style restaurant with a greenhouse eating area, and three associated kitchens (cooking, baking, and processing), which are all part of an informative tour of the food cycle. There is also a basement that houses two mushroom growing areas, cellars, and composting.

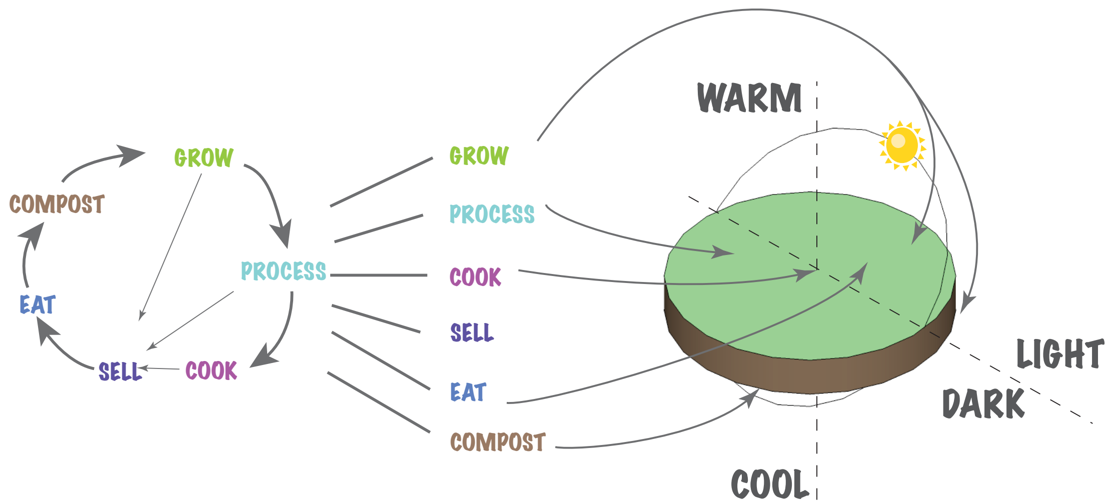
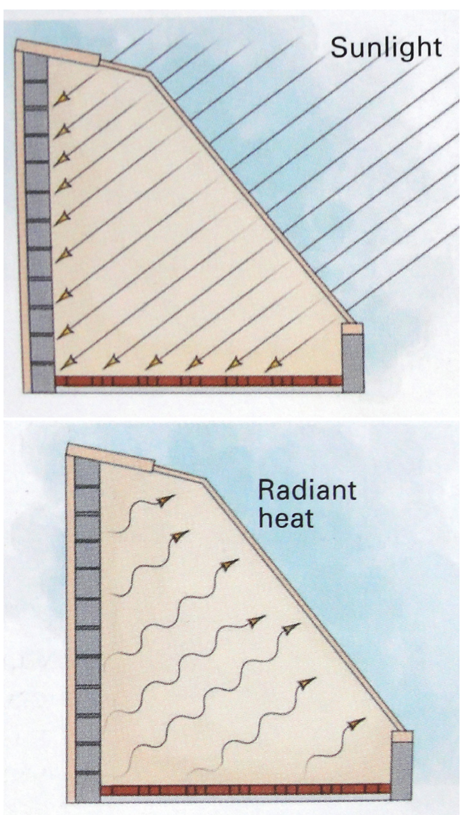


Diagram of placement of program elements on site.



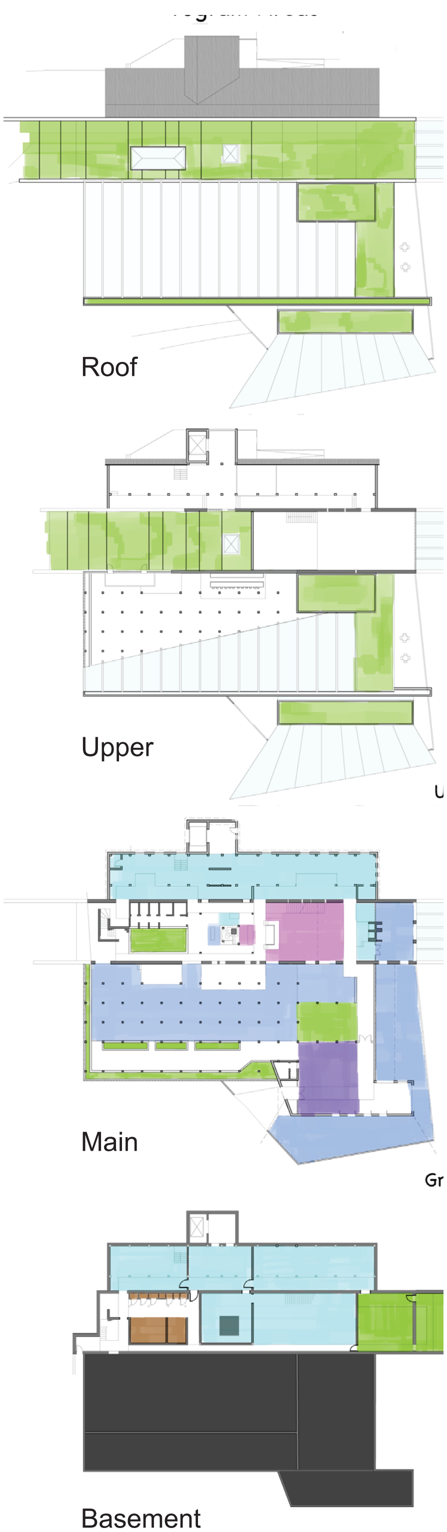
Thermal mass greenhouse that stays warmer by absorbing heat in the daytime and releasing it at night. From Ortho Books 2001.

One of the central ideas represented in the project is that food plants and people can coexist happily in an indoor environment, so the plant and people programs were arranged conveniently and the plan program areas found their niches according mainly to their size requirements.

The basic program areas relating to each stage of the food cycle were arranged on the site according to their light and temperature needs, following the simple rule that the south side of the site is lighter than the north side, and that underground is cooler than above ground.

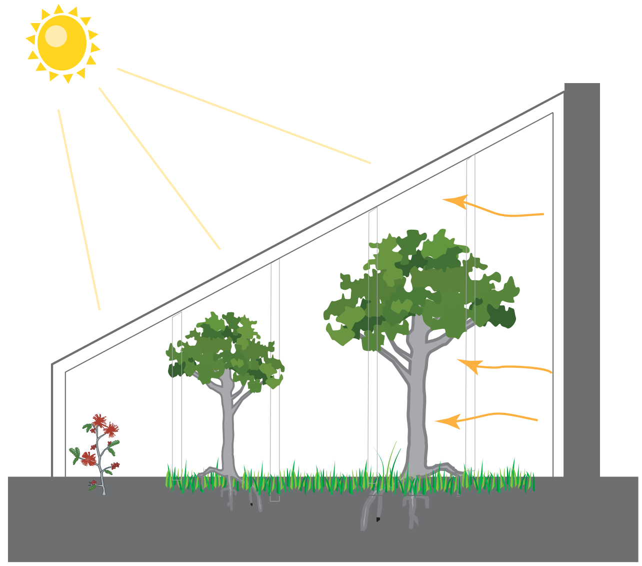
Growing

The main growing area is based on a typical thermal mass greenhouse idea, where the sun shines through a sloped roof onto a large thermal mass



Program area diagrams.

which regulates the temperature. In this case, the thermal mass is local sandstone.



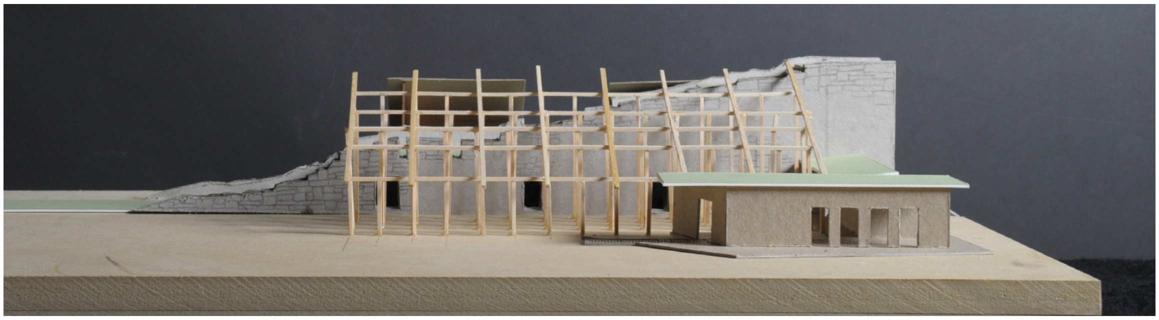
Simplified thermal mass greenhouse.

Processing

“Process” encompasses all the things that happen to preserve or store fresh produce before it is prepared for a meal, including baking, fermentation, dehydrating, canning, smoking and proper storage over winter.

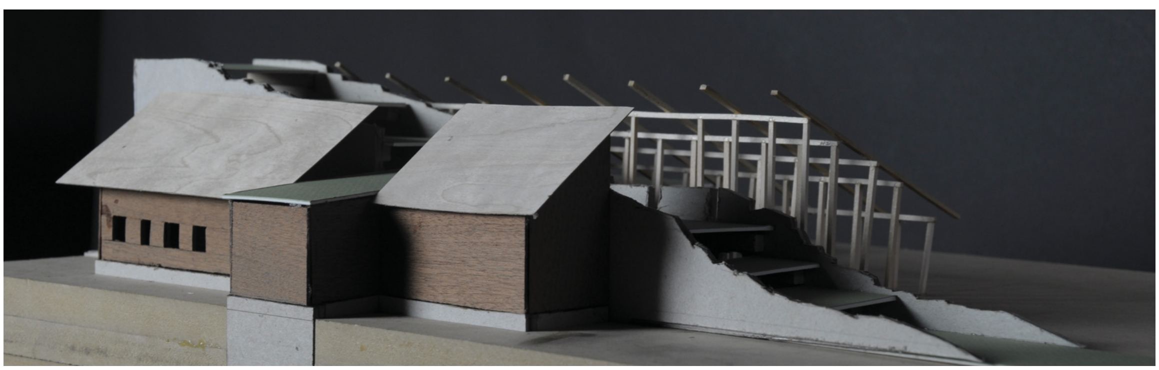
There are two kitchens (baking and canning), a smokehouse, and cellars dedicated to processing in this project.

The use of recycled materials as pictured on p. 24 will be most evident in the processing areas because these areas have the most built-in features (shelves, cabinets, etc.) and the least glass.

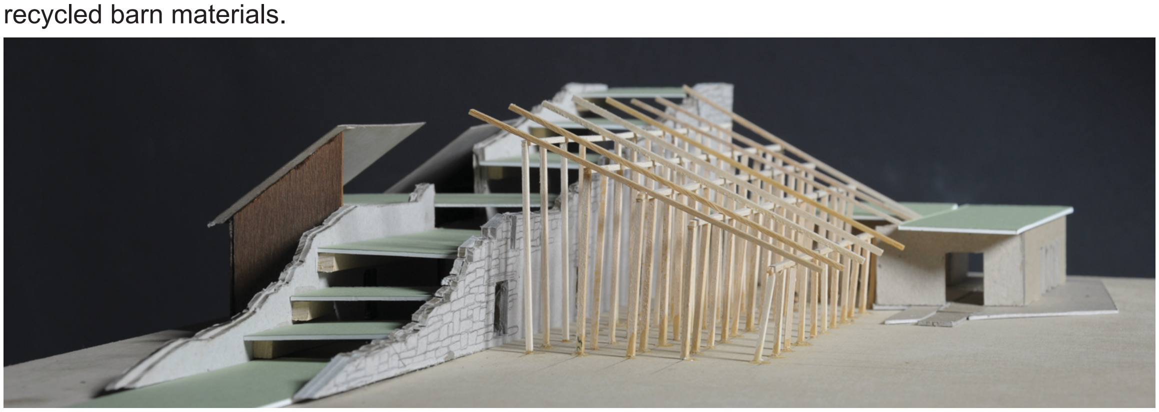


South side: The cafe/market in the foreground serves as the entrance area.   The greenhouse area encloses restaurant seating throughout the orchard.

East side: Most of the east walls are glass to take advantage of the view to the water.

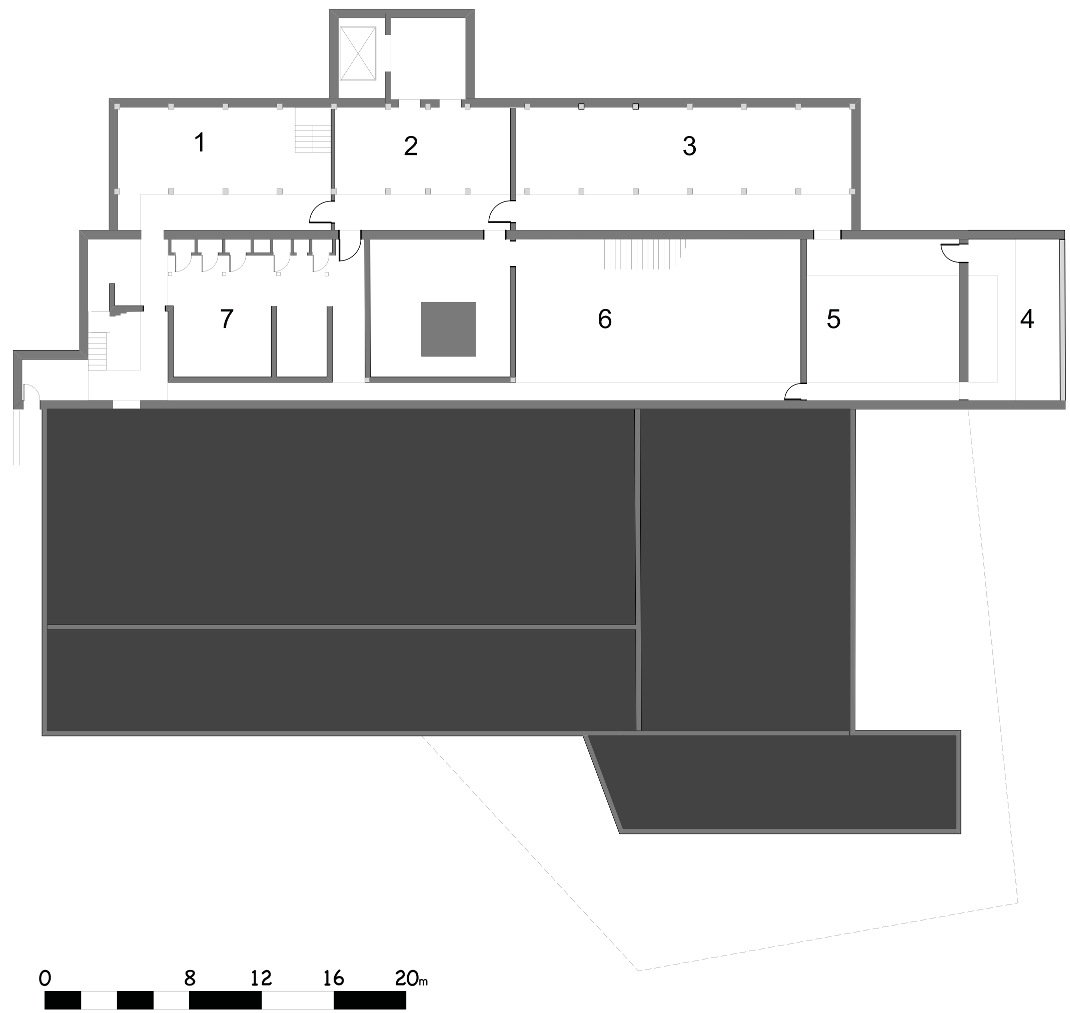


North side: The processing kitchen and baking kitchen are in the more enclosed area made of recycled barn materials.



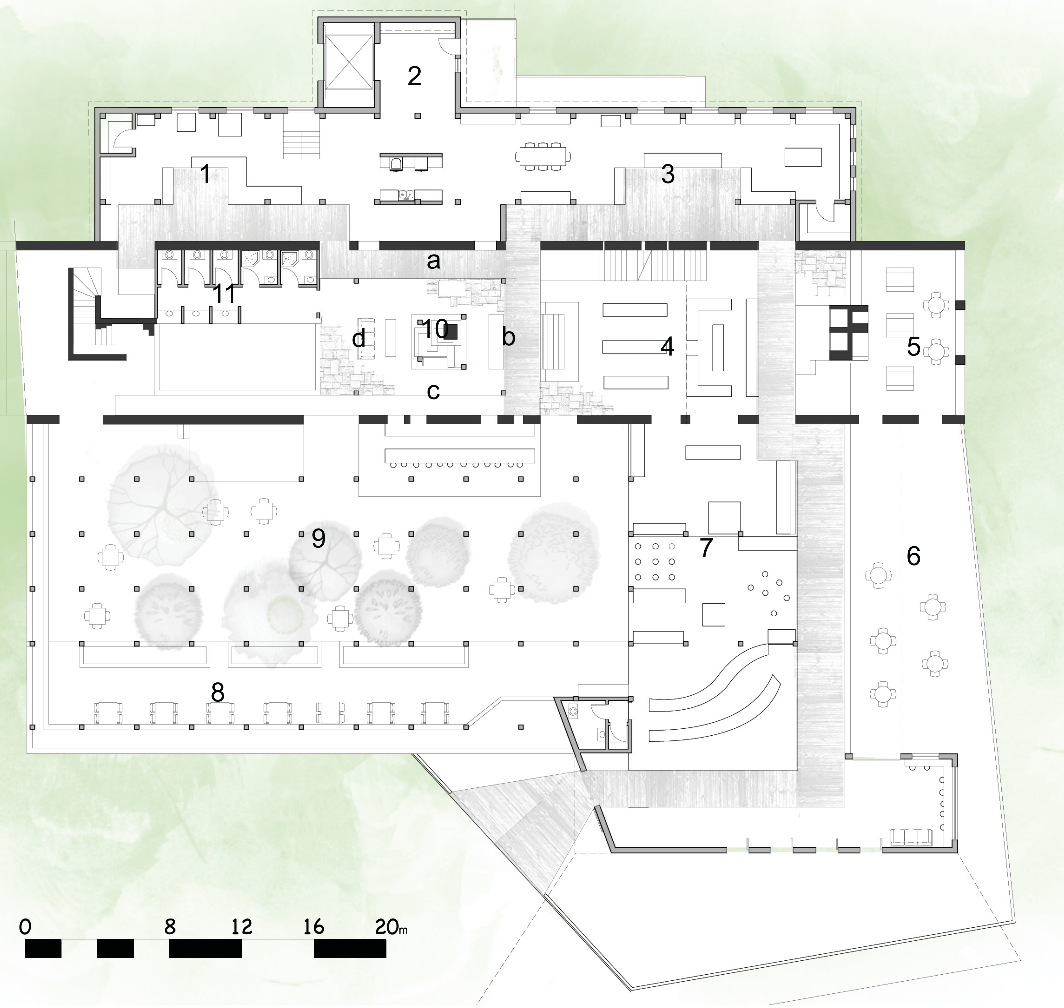
West side: The stepped green roof leads visitors up toward a panoramic view of the Northumberland Strait.

1. dry storage
2. receiving (temporary storage)
3. humid storage
4. photo-sensitive mushrooms
5. photo-insensitive mushrooms
6. kitchen overflow storage, freezer
7. compost



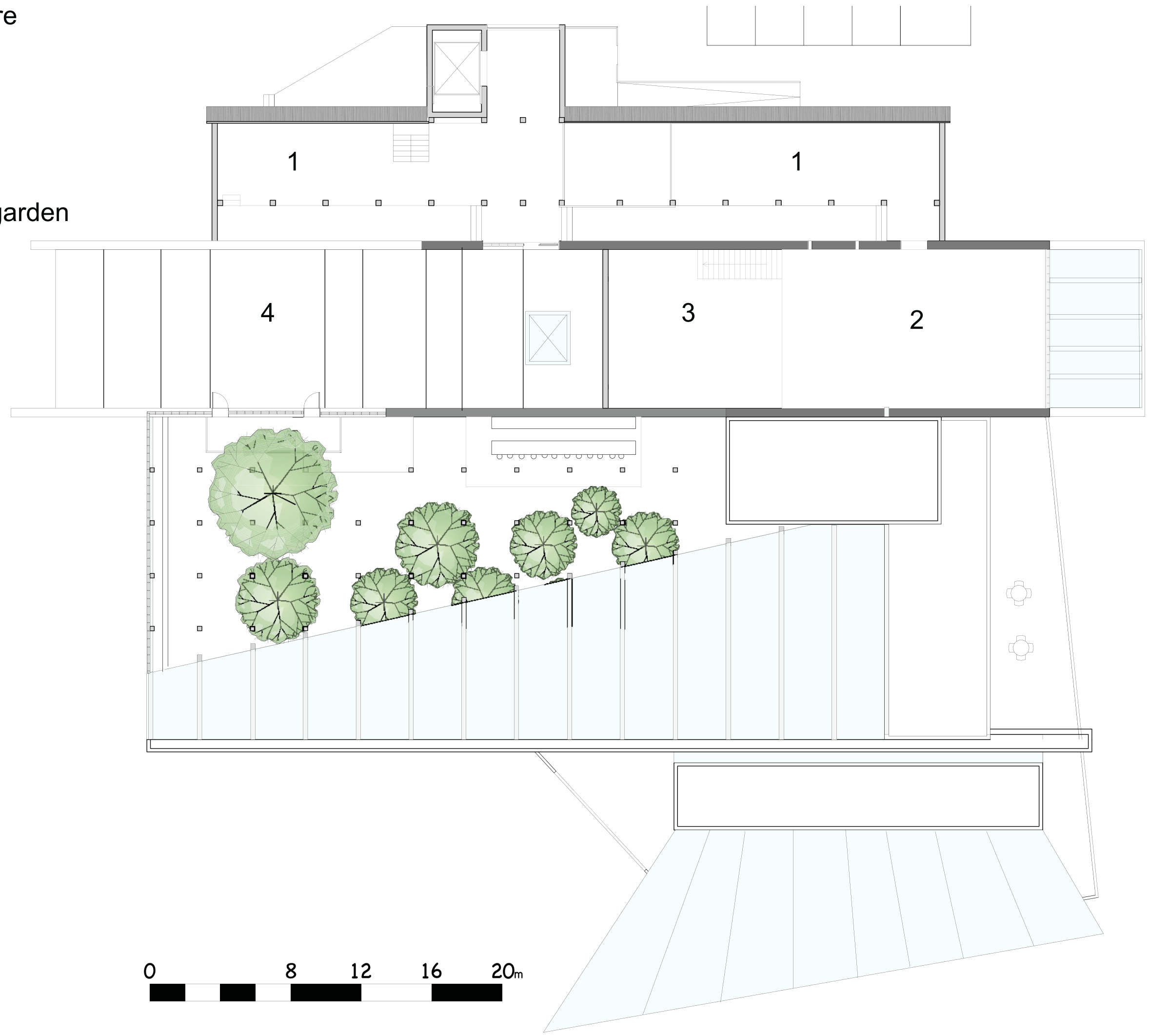
Basement plan.

1. baking kitchen
2. receiving
3. processing kitchen
4. cooking kitchen
5. BBQ patio
6. cafe outdoor seating
7. buffet
8. seating under climbers
9. orchard seating
10. masonry hearth
    - a bakeoven
    - b cooking stage
    - c wood storage
    - d lounge
11. composting toilets

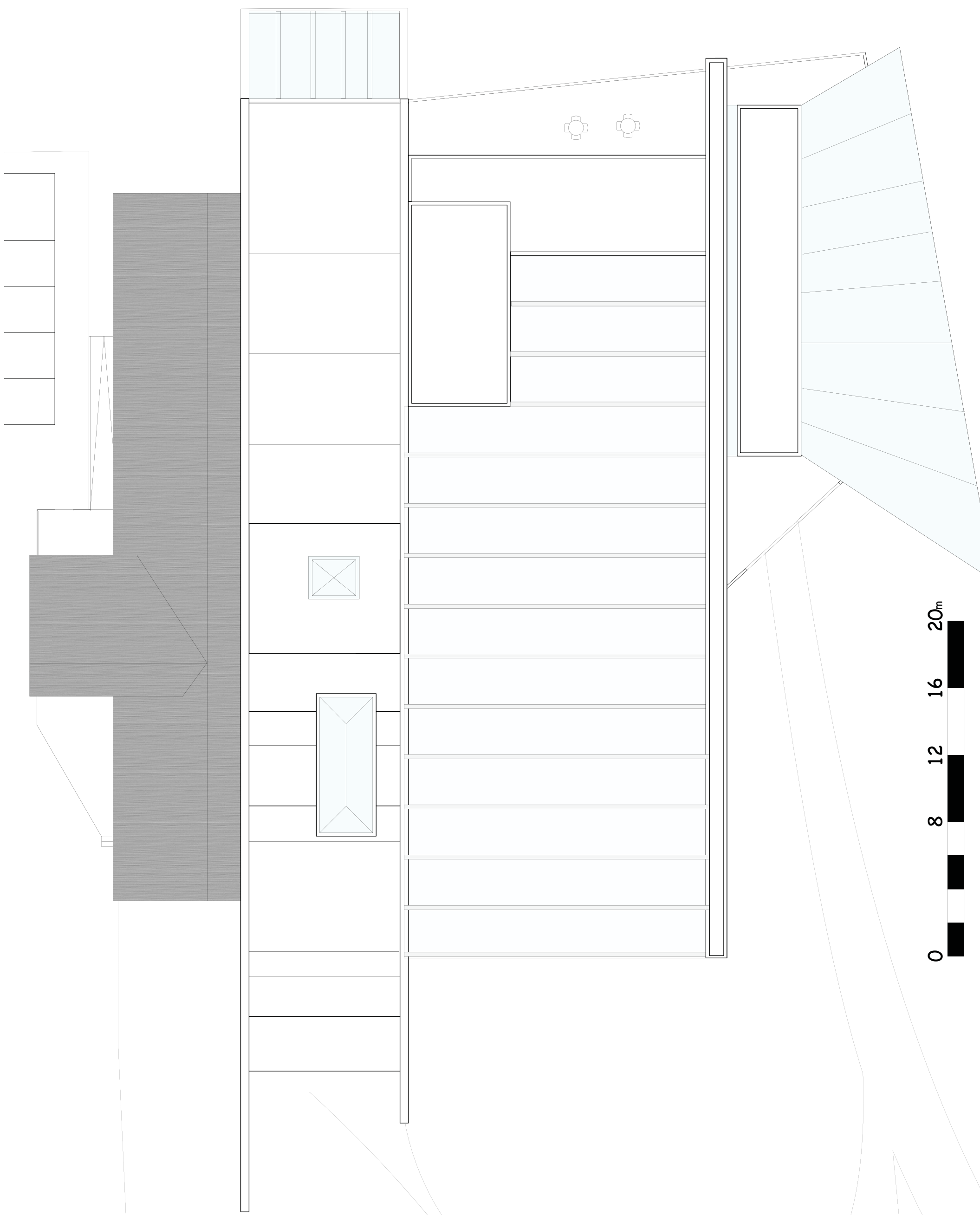


Main floor plan.

1. resource centre
2. meeting room
3. open to below
4. stepped roof garden



Upper floor plan.



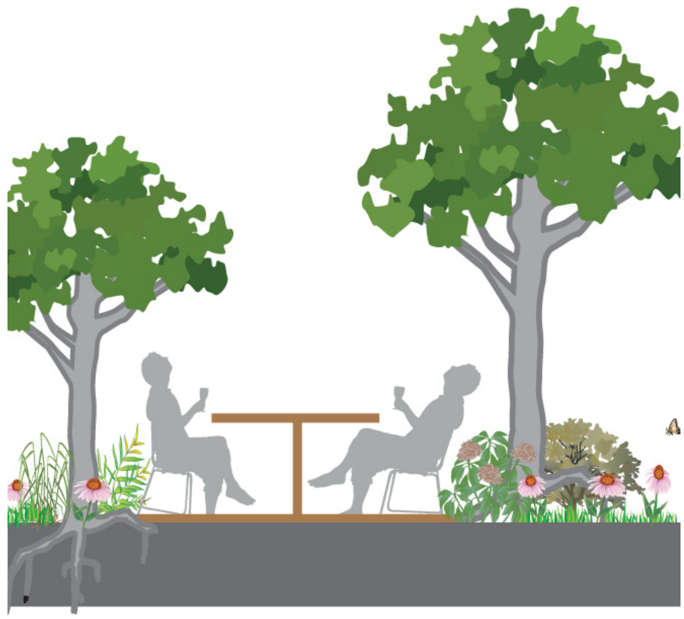
Roof plan.

Cooking

The cooking kitchen is between the canning kitchen and the buffet area, and it is near the cooking stage area of the masonry hearth complex.

Eating

The main eating area is in the greenhouse, on the south side.

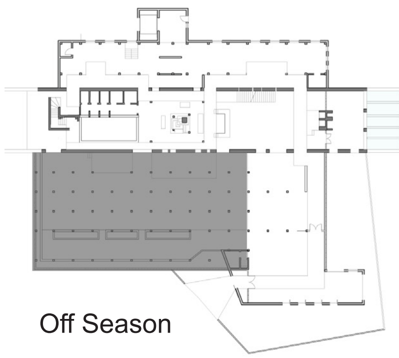


Eating in the greenhouse.

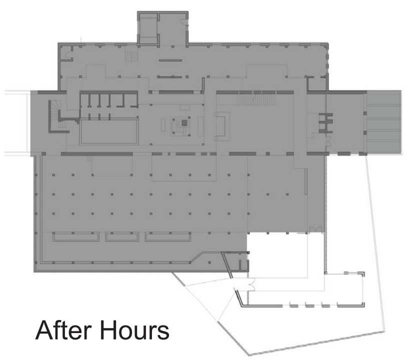
Composting

Composting is an important part of the cycle that is often overlooked. This project has composting toilets, compost chute receptacles in the cellar under the kitchens, and divided composting bins. Decomposing materials are what mushrooms feed on, so certain things such as green manure, and coffee grounds can be separated to feed certain kinds of mushrooms. Conveniently, the compost and the mushrooms both prefer darkness, and are located

Peak Season



Off Season



After Hours

Diagrams of open and closed areas depending on the time and season. Greyed-out areas are areas that can be closed separately during certain seasons or times of day, while the cafe and/or kitchens remain open.

near each other in the cellar.

Selling

An essential part of the cycle, even though it doesn't fit neatly in the loop, is making money at different stages, so that the cycle is economically feasible.

The restaurant includes a combination cafe and small market. This opens up the possibility of serving a wider range of visitors who might not want a whole buffet, but just want to have a coffee or a sandwich and gather with friends. The service counters are flanked by the cafe on one side, and the buffet area on the other, so that buffet customers can also purchase extras not included in the buffet, like smoothies, or separately-priced desserts.

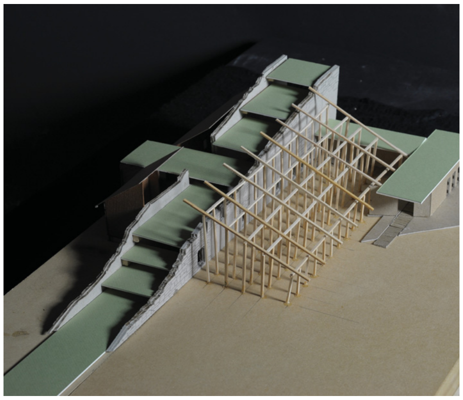
The small market could sell value-added products produced by the processing areas, such as jams and pickles, cookies and other baked goods, and dried fruit.

The cafe and market area can also be partitioned from the rest of the program, allowing it to stay open longer hours with minimum staff, increasing revenue opportunity.

Tying It Together

The sandstone for the wall in the greenhouse was emphasized with another parallel sandstone wall. The two walls separate and link in series the program areas, as the tour path weaves through them. Each time the path crosses a wall, the visitors are

Building materials: recycled woods, locally sourced sandstone, wood-frame greenhouse.



Aerial view from the southwest..

entering a new program area, and a new stop in the tour.

Both walls slope down on the west side, tying the building to the landscape, and creating an accessible stepped green roof. Visitors can ascend the roof and be rewarded with a view to the Northumberland Strait to the east.

The sandstone was also carried through the project to form the cellar walls.

To tie together three areas with very different material characteristics (greenhouse, stone corridor, wood kitchens) I looked to Himalayan architecture as a precedent of wood and stone interlocking. The stone became the base, and timber framing is the thread that pierces it to sew the wood and the greenhouse areas to it.

Vernacular architecture in Leh, Ladakh, India. The image on the left is analogous to the timber-frame kitchens on the north tied to the sandstone walls.

Inspiration for the prominent sandstone walls. There is an accessible green roof between them.

The Plant Program

What to Eat

What grows in the restaurant is what will be served there. Since the program is about demonstration as much as agriculture, there is a good opportunity to promote healthy eating. Therefore, the restaurant emphasizes minimally processed food, especially raw foods, sprouts, and fresh fruit.

Ideally, the most sustainable choice would be to only eat food that grows natively in the climate that we are in, and we would eat it fresh and in season, or minimally processed to make it available in winter. Indigenous peoples managed for centuries, but now we've become so accustomed to having a variety of tropical fruits at the supermarket that many people are reluctant to give up these new exotic foods in favour of local eating. In fact, many of the problems of conventional agriculture stem from the demand for uniformity at the dinner table, rather than variety, because our culture has forgotten the possibilities. Of the 30,000 edible plant species that have been discovered, only 7,000 have been cultivated or collected for food, and of those, only 15 species make up the majority of the world's food supply (Agriculture and Agri-Food Canada 2011).

The restaurant is not necessarily vegan, but it will emphasize a plant-based diet for two reasons. One, because I want to inspire at-home food production and plants are much more accessible for most people to participate in than raising livestock, and two, because most people's diets in North America today have too much meat and not enough plants, and the restaurant is an opportunity to expose visitors to possibilities of local, diverse produce that they would never find at the supermarket, such as lemon cucumbers or Sugar Pie pumpkins.

> Eat mostly plants, especially leaves.
>
> There are scores of studies demonstrating that a diet rich in vegetables and fruits reduces the risk of dying from all the Western diseases; in countries where people eat a pound or more of vegetables and fruits a day, the rate of cancer is half what it is in the United States. Also, by eating a diet that is primarily plant based, you'll be consuming far fewer calories, since plant foods—with the exception of seeds, including grains and nuts—are typically less "energy dense" than the other things you eat. (And consuming fewer calories protects against many chronic diseases.) Vegetarians are notably healthier than carnivores, and they live longer. (Pollan 2009, Chapter 22)

The Plants

Encouraging sustainable food choices is one of the primary reasons for educating people about the food cycle. Two strategies in which food could be dramatically more sustainable are: a) popularizing edible native plants, and b) growing non-native plants locally, in a sustainable manner. The first strategy is important, but would mostly be implemented by education, since the plants already grow happily outdoors in this area.

The second strategy, on the other hand, could have an architectural solution that works by increasing the growing season of plants that do grow here, and making it possible to grow plants that are not able to grow outdoors in this climate.

I have grouped common food plants in categories based on the goals for them (such as extend the season or store over winter) and their growing or storage requirements. Then I found a niche for each category that best suits the group. Lettuce and tomatoes, for example, are typical representatives of two of the growing groups: "Small Greens" and "Heat Lovers". The goal for both tomatoes and lettuce is to extend the growing season. Lettuce is delicate and doesn't store well, and although tomatoes can be easily preserved, fresh tomatoes are always in demand. Lettuce and tomatoes are also good examples because they are popular and almost exclusively imported from California and Florida, so they are exactly the kind of unsustainable produce for which I want to provide alternatives.

Although the goal is the same for both the lettuce and the tomatoes, they are in different groups because of their sizes and growing requirements. There are six growing groups and two storage groups; for a complete list of the plants considered for this project, see Appendix B.

Program Clusters with Plant Habitats

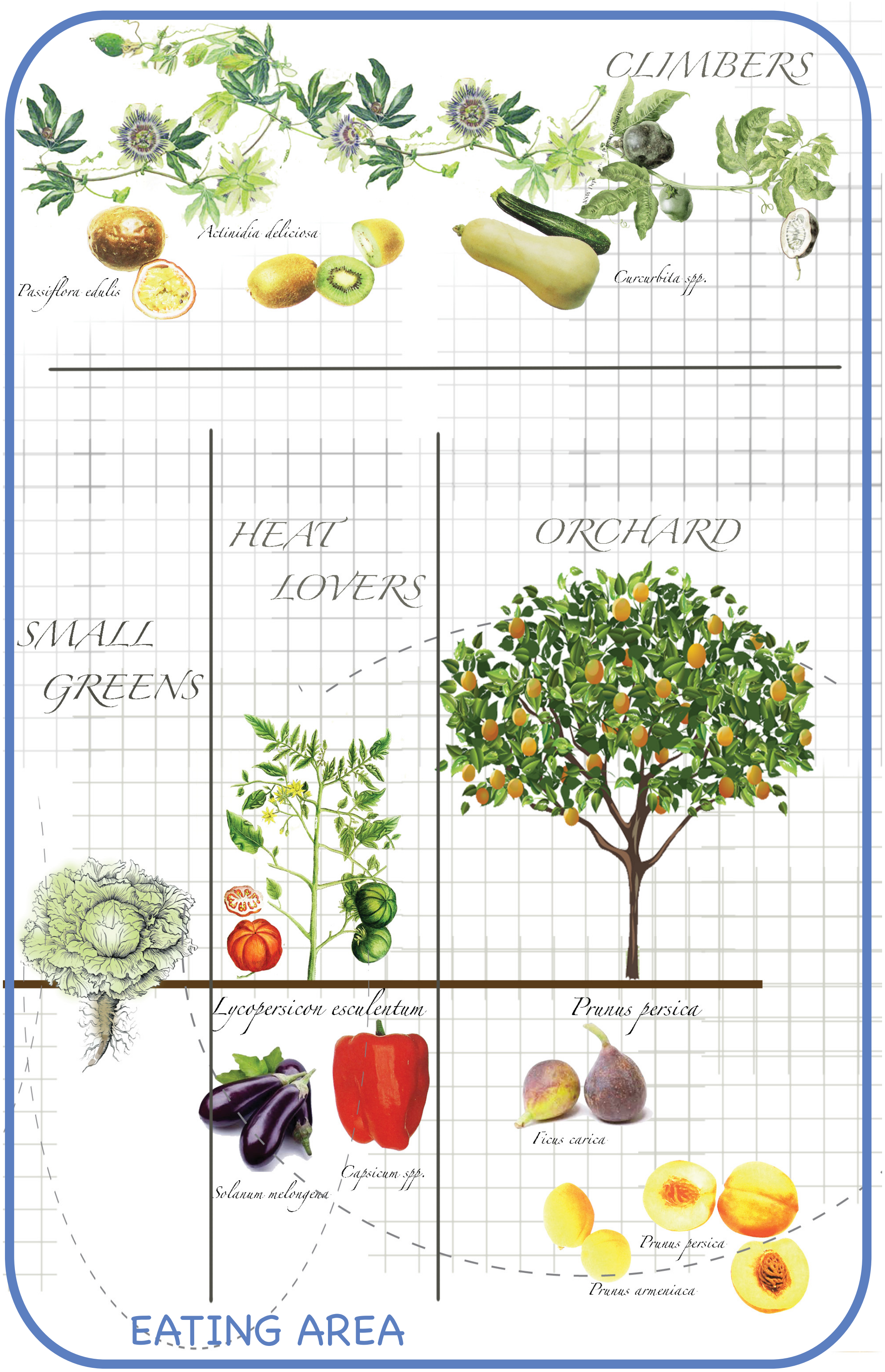
Restaurant Seating

The restaurant seating is intermixed with three plant habitats: the Heat Lovers, the Orchard and the Climbers. The main seating area is throughout the Orchard, and there is a line of tables along the south wall that are lined by the Heat Lovers, and shaded by the Climbers.

The orchard/seating area is warmed by the sun, and optionally by the masonry complex adjacent to it. The mass of the sandstone wall will help to regulate the temperature. Ventilation is provided by louvres on the glass wall between the top of the stone wall and the roof of the greenhouse. This is not meant to house tropical plants — only plants that just barely can't survive this climate, such as peaches. This way, the greenhouse does not require as much heating in the winter, as these plants can tolerate some cold.

The Heat Lovers

Plants	annuals including tomatoes, eggplant, bell peppers
Conditions	full sun, easy access for maintenance, staking
Plant Size	1m tall, 2m deep roots
Goal	extend the growing season



Plants groups in the Eating Area program cluster.

Diagrams: Temperature and Plant Program.

The Heat Lovers are annual plants that can grow in this climate, but have a short season because they thrive in the heat of mid-summer. They need full sun, but often need to be staked upright because they will lean against the glass and burn themselves.

Their habitat is along the south-facing greenhouse wall in the restaurant seating area. They will be flanked by a masonry wall to provide thermal mass that will help maintain a warm temperature.

Lucky diners seated in the tables next to the Heat Lovers might be able to pick tomatoes right off the vine.

The Orchard

Plants	fruit trees such as peach, apricot, fig
Conditions	tolerant to -24°
Plant Size	3m to 9m high, up to 3m ø canopy
Goal	harvest seasonally

The orchard will specialize in growing fruit trees that are not hardy in this climate, which also have a chill requirement, and therefore are not tropical, including peach, apricot and fig. Each tree will be surrounded by smaller plants that benefit the micro-ecosystem around it, forming a “guild” which is a term that comes from permaculture, but is an ancient farming technique based on observation of the forest that goes at least as far back as the Mayans.

Guilds are a harmonious assembly of a diverse mixture of plants whose elements all have a purpose beneficial to each other, making it similar to companion planting. A typical permaculture guild in an orchard is a triangle in plan, with the main fruit tree at one point, and small fruit bushes at the other points. The space within is planted with smaller perennials and mushrooms that are chosen to attract insects, increase pollination, reduce pests, fix nitrogen, and increase fertility through mycorrhizal association. Each guild is an island that is similar to a forest edge (Fisher 2011).

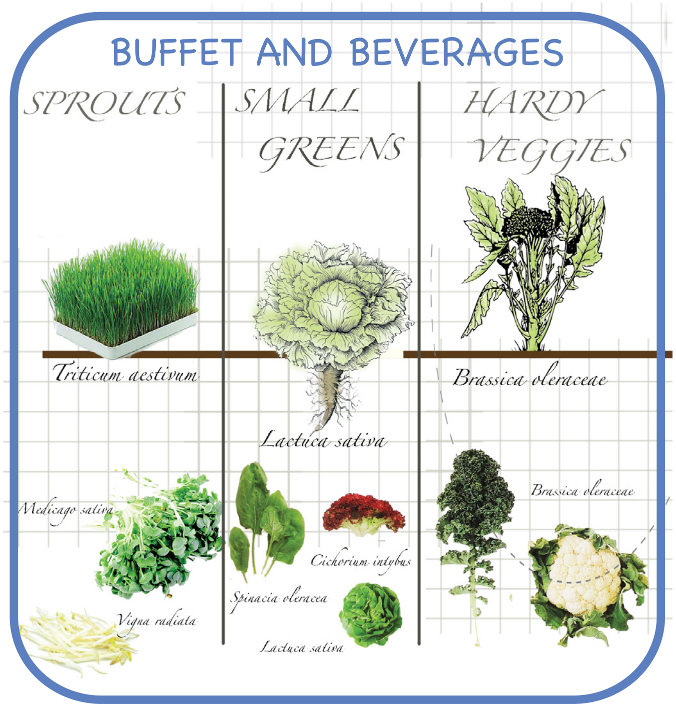
Climbers

Plants	kiwi, passion fruit, could also include tomatoes, cucumbers, some squash
Space Requirements	something to climb on
Goal	extend growing season OR grow all year

Above the tables along the south wall, there is a pivoting trellis for vines to climb up. One side of the axis has a trough to hold the roots, and the other side has an overhead trellis that can be lowered to within easy reach at pruning and harvest times. (See p. 22.)

Buffet and Beverage Area

One unique feature of the restaurant is that the buffet includes fresh greens and sprouts that diners can pick themselves right from the buffet line.



Plants in the Buffet and Beverage program cluster.

Small Greens

Plants	herbs, spinach, lettuce, salad greens
Conditions	some in complete dark, some in light
Plant Size	< .5m high
Goal	grow all year

The Small Greens includes the leafy plants with edible leaves that are either small plants or that will be eaten before they grow to maturity. They can be cultivated densely and have shallow roots.

Sprouts

Plants	various, harvested within 1 week
Conditions	some complete darkness, some in light
Space Requirements	trays, jars, high humidity, good ventilation
Goal	grow all year

The Hardy Veggies

Plants	annuals including kale, broccoli, chard
Conditions	full sun to part shade, easy access for maintenance
Plant Size	.5 m h, up to 1 m ø
Goal	extend the growing season

These veggies can tolerate cooler weather. They grow in this climate, but they do not store well like potatoes and carrots.

The Cellars

The tour ventures underground into the storage cellars, which are divided into a humid and a dry cellar, and also into two mushroom growing habitats.

The basement is only under the northern part of the building since the tree roots in the greenhouse go directly into the ground.

The material language is that of the stone walls, being primarily stone, but with timber columns coming down from the timber-frame barn structure above, and timber beams overhead.

The Cellar program cluster.

Mushrooms

Species	various mycorrhizal and saprophytic species
Conditions	dappled northern light to full dark
Space Requirements	bags or trays of decomposing material or logs
Goal	grow all year

Of all the crops that will be grown in this building, mushrooms have the widest variety of possible growing conditions. They can be grown in many different media like straw, sawdust, logs or coffee grounds, and those media can be arranged in many configurations, such as compressed blocks, jars, bags, or trays. To provide the most adaptable spaces for the widest variety of mushrooms, I have divided the mushroom world into two architectural categories: the photo-sensitive primary decomposers and the photo-insensitive secondary decomposers.

The first group is on the eastern end of the stone walls and it projects beyond the rest of the building, thus able to receive natural light and ventilation. The mushrooms grown here will be grown in a low-tech way, mimicking the way mushrooms grow in nature, which is the easiest method for visitors to duplicate at home.

In contrast, the second mushroom habitat will be in an enclosed, climate-controlled environment. The basement is perfect for this, since it has no windows, and is a low-traffic area. This is how most commercial mushrooms are grown. Since condensation and temperature change are harmful to masonry walls, this room is formed by interior walls only: the north stone wall (flanked on the other side by the humid veggie storage) and three partition walls that also provide a vapour barrier.

Humid Storage

Plants	cabbage, turnips, beets, apples, potatoes, carrots
Conditions	90-95% relative humidity shelving and bins
Goal	store all winter

Dry Storage

Plants	onion, garlic, winter squash
Conditions	good ventilation, low humidity shelves, bins, hooks for mesh bags
Goal	store all winter

The Tour

The tour through the building will take visitors through the kitchens, up into the treetops, and down into the cellar. Visitors will see produce growing, the processing and cooking areas, and finally eat a delicious meal in the attached restaurant among fruit trees and berry bushes.

The entrance area into the cafe and market.

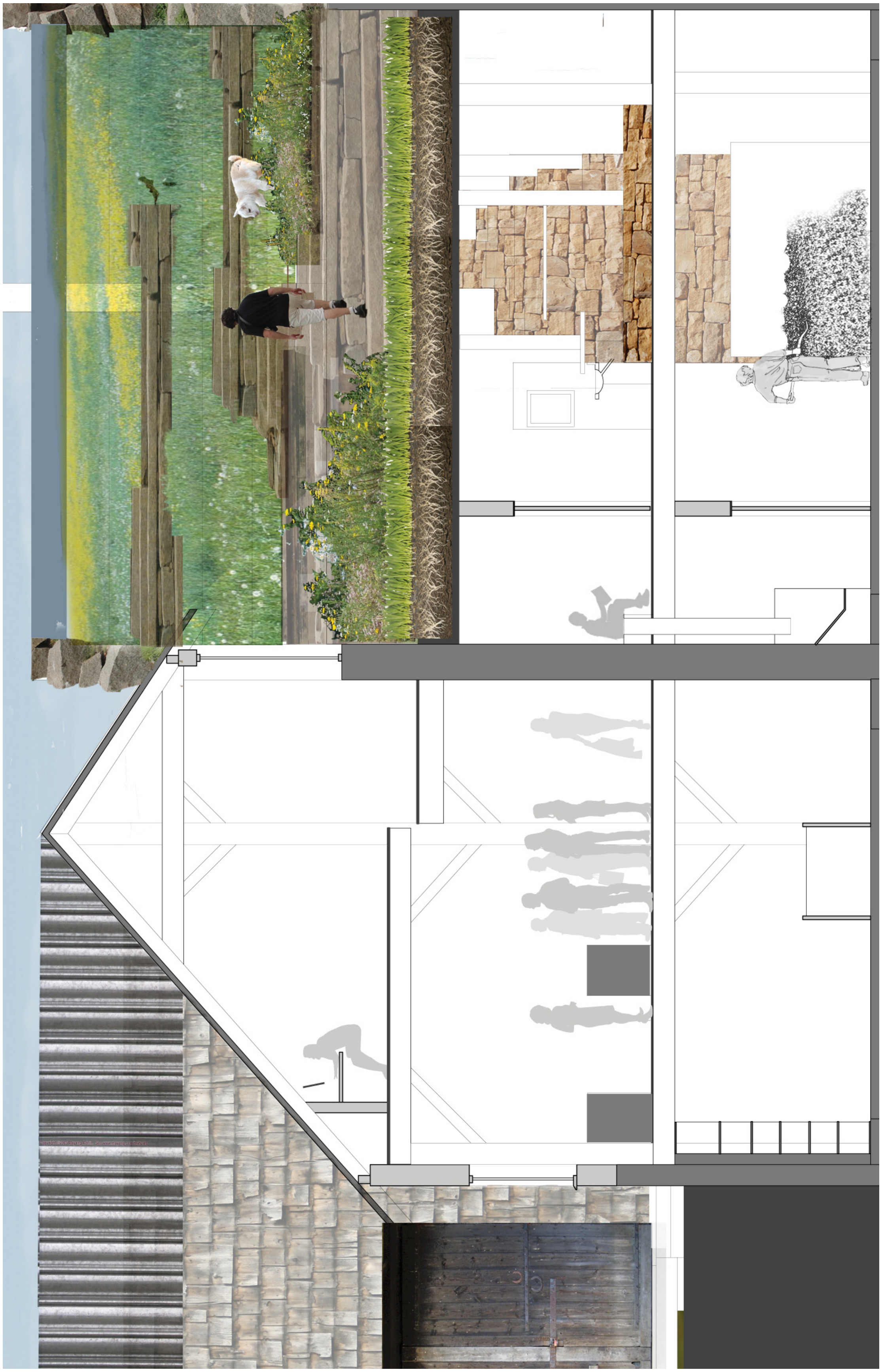
The “living buffet” area at the start of the tour, showing aquaponic towers, microgreens, and sprouting jars.

Central stone wall with a herb garden, facing the entrance to the cooking kitchen.

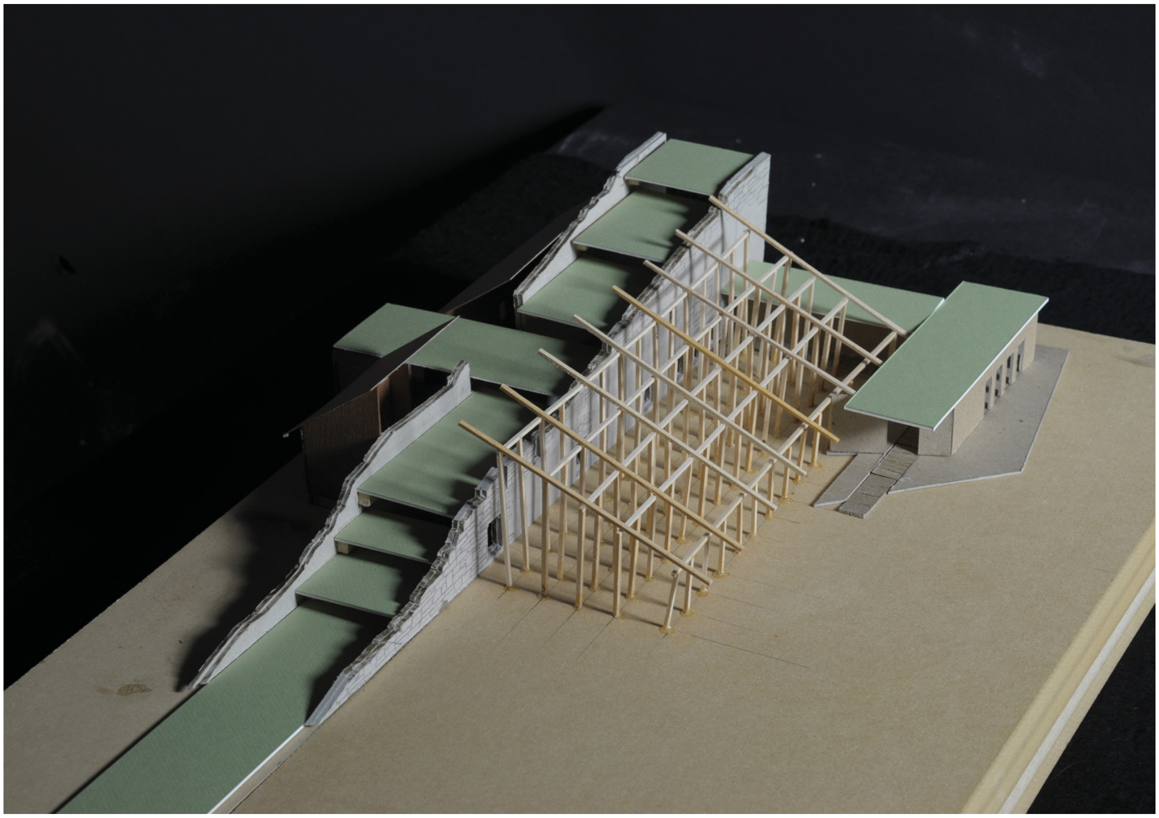
Cooking Kitchen.

Section. See next page for detail.

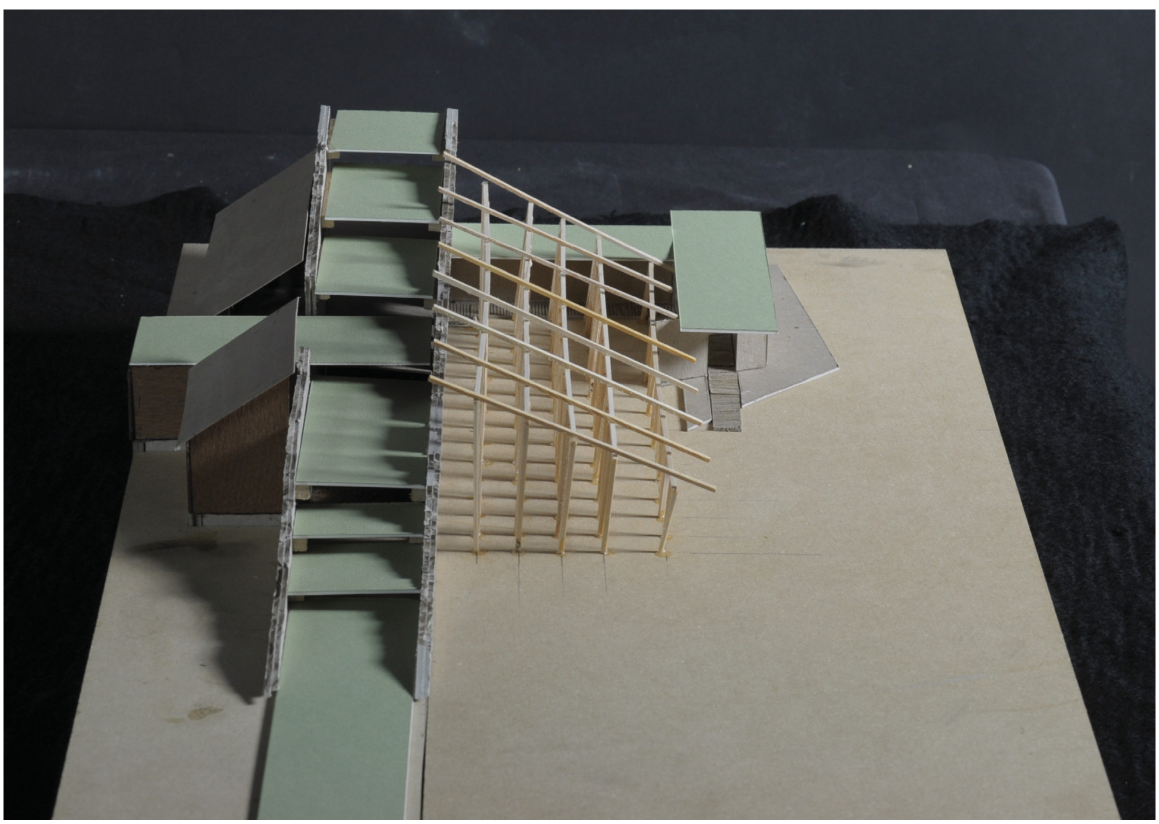
Detail of section.



Detail of section.



Aerial view from the southwest



Aerial view from the west.

CHAPTER 3: CONCLUSION

> "Eating is an agricultural act," as Wendell Berry famously said. It is also an ecological act, and a political act, too . (Pollan 2006, 11)

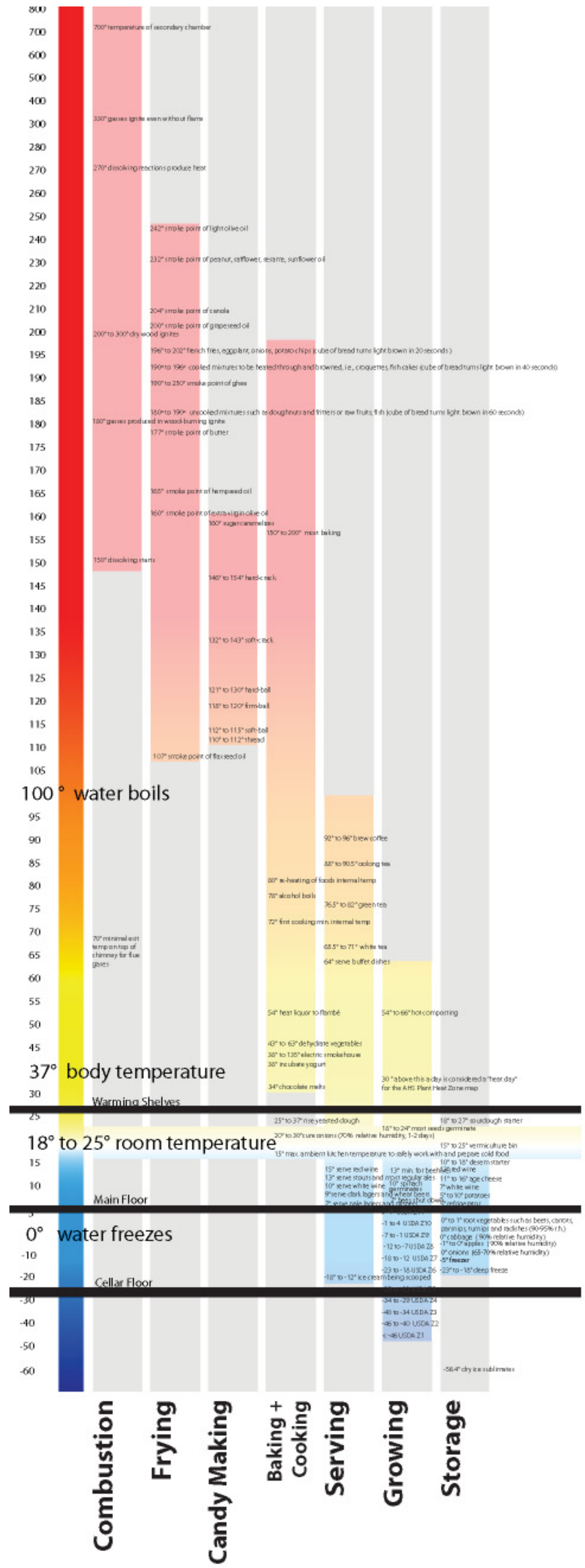
This project blurs the line between agriculture and architecture by demonstrating growing methods in many different program areas.

In retrospect, the issue of food production as an evolutionary step in the future of architecture would have been much more effectively explored in a building with a common program unrelated to food, such as an office building. My enthusiasm about food education as much as food architecture muddied my intention to really show how growing areas can integrate into an "everyday" building with regular programming.

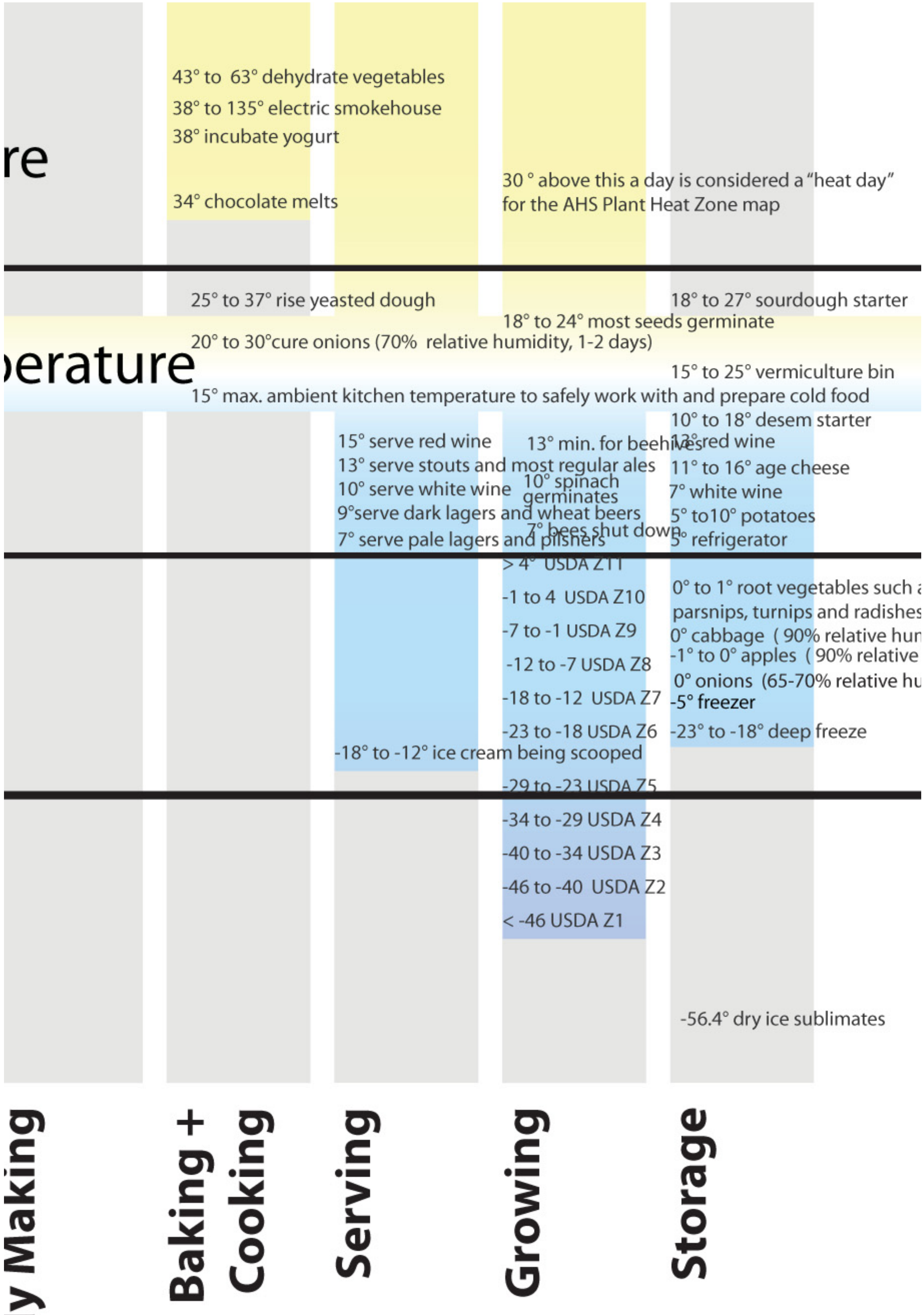
It succeeds, however, in the education aspect, being a unique destination, and a compelling tour that takes visitors from a lush living buffet, to dark mushroom caves, to a lookout in the treetops. I hope that in the future, I hope that more people will be as motivated as I am to learn everything they can about what they eat, because knowledge is, in this case, not only power, but health as well, and in a time when the economy and the climate present a real challenge for agriculture, knowledge can be peace of mind as well.

> Knowing how to grow food leads to food. Knowing how to grow food in the best ways leads to a dependable supply of food for a long time. (Waters 2006, 17)

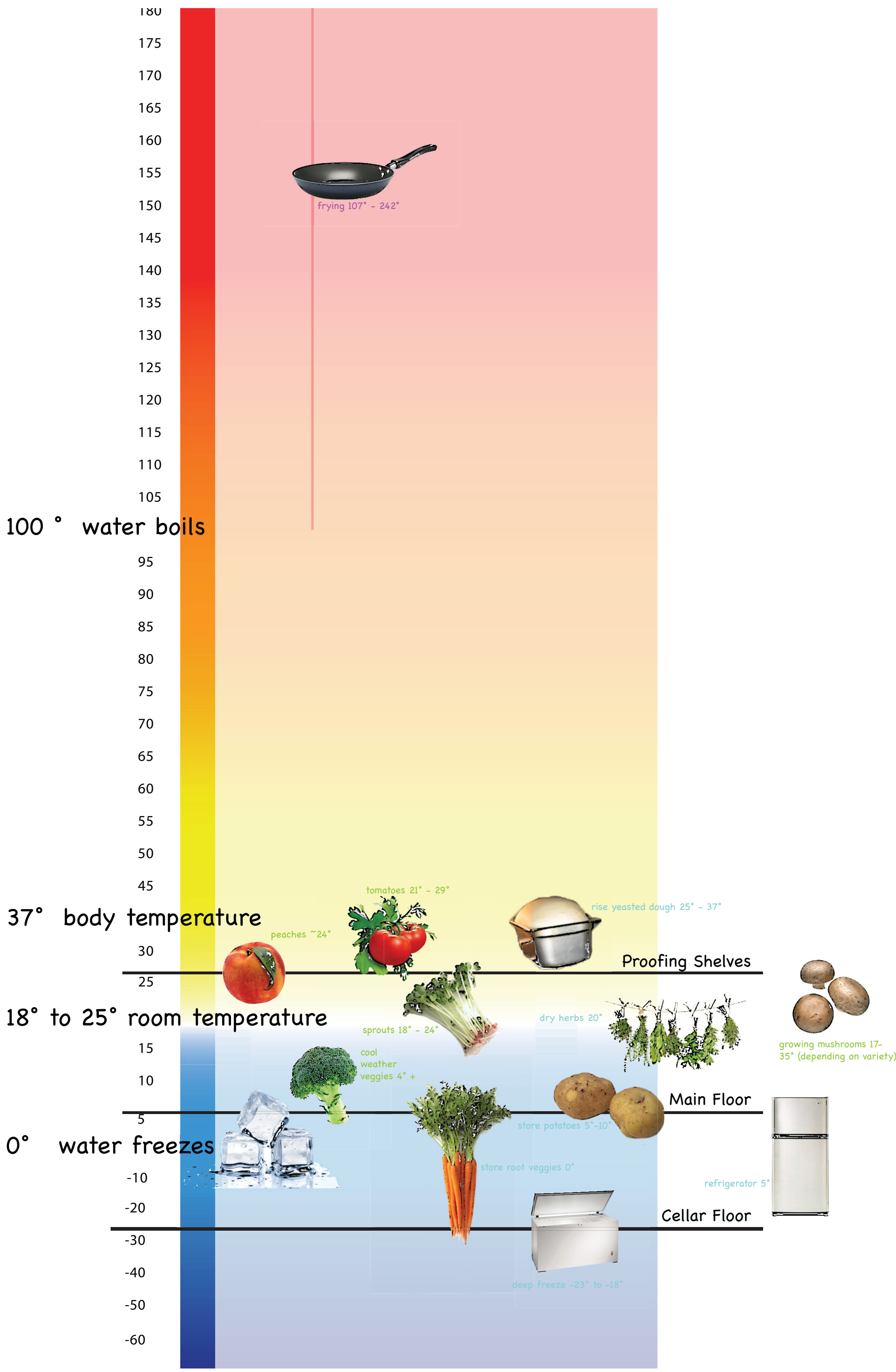
APPENDIX A: KITCHEN TEMPERATURES



Overview of temperature gradient study for masonry hearth. (See next page for a detail)



Detail of temperature gradient study for masonry hearth.



Simplified temperature study.

APPENDIX B: PLANT GROWTH AND STORAGE REQUIREMENTS

The following tables show the information that was used to arrange the plants into “architectural categories.” The tables show selected growth requirements such as height, root depth, and growing temperature, and omit requirements such as nutrients and preferred soil. Soil and nutrients are not integral to the architectural choices because soil can be amended or replaced, and can easily be different in different areas without affecting the permanent structure.

	Size (cm)	Root Depth (cm)	Planting Soil Temperature	Growing Temperature or Zone	Light	Notes
Amaranthaceae						
Swiss chard: *Beta vulgaris* subsp. *cicla*	15-50 h x 25-75 w	90-120	10-29°C	4-27°C	full sun to part shade	
spinach: *Spinacea oleracea*	8-20 h x 5-20 w	45-90	10-18°C	16-21°C	full sun to part shade	
Amaryllidaceae						
chives: *Allium schoenoprasum*	30 h x 30 w		2-18° C	Zones 3-10 -40-29°C	full sun to part shade	
Apiaceae						
dill: *Anethum graveolens*						
chervil: *Anthriscus cerefolium*		.5m tall, .4m w			part shade	
cilantro: *Coriandrum sativum*	12-60 h x 10-25 w				full sun to part shade	
Asteraceae						
frisee: *Chicorium endivia*	30 h x 30 w	45-90	10-29°C	10-27°C	full sun to part shade	
Belgian endive, radicchio: *Chicorium intybus*	15-30 w	45-90	10-29° C	USDA 8+ 7-24 C		
lettuce: *Lactuca sativa*	5-25 x 5-20 w	45-90	4-24°C	7-24°C	full sun to part shade	
dandelion: *Taraxacum officinale*	45cm rows 40m apart	> 15				

Plants to grow year-round: salad greens, potherbs, and herbs.

	Size (cm)	Root Depth (cm)	Planting Soil Temperature	Growing Temperature or Zone	Light	Notes
Brassicaceae						
mustard greens: *Brassica juncea*						
collards: *Brassica oleracea* Acephala Group	60-90 x 45-90		10-29°C	7-24°C	full sun to light shade	
mizuna: *Brassica rapa*	35 - 40 high					
arugula: *Eruca sativa*	20 - 100 h x 15 w	shallow			full sun to part shade	dry, disturbed ground
Lamiaceae						
mint: *Mentha* spp.	30-120 h x 30-120 w			Zones 4-10	full sun to part shade	
basil: *Ocimum basilicum*	30-90 h x 30-90 w				full sun	
Polygonaceae						
sorrel: *Rumex acetosa*	60 h	deep				
Valerianaceae						
mache, Lamb's lettuce, corn salad: *Valerianella locusta*	5-10 x 10-20 w	shallow		USDA 5+	full sun to part shade	

Plants to grow year-round, cont'd: salad greens, potherbs, and herbs.

	Size (cm)	**Root Depth (cm)**	Planting Soil Temperature	**Temperature or Zone**	**Light**	**Other**
Apiaceae						
celery: *Apium graveolens*	60 x 30	45-90	10-18°C	16-21°C	light shade	
Brassicaceae						
collards: *Brassica oleracea* Acephala Group	60-90 h x 45-90 w		10-29°C	7-24°C	ful sun to lt. shade	
kale: *Brassica oleracea* Acephala Group	30-45 h x 30-90 w		13-24°C	7-24°C	full sun to lt. shade	
cauliflower: *Brassica oleracea* Botrytis Group	8-12” x 18-36”	45-90	18-29°C	7-24°C, optimally 15-18°C	full sun to lt. shade	
broccoli: *Brassica oleraceae* Italica Group	60 x 60	45-90	10-29°C	7-24°C	full sun to part shade	
Cucurbitaceae						
summer squashes: *Cucurbita* spp.	60 h x 300 w	90-120	16-29°C	16-24°C	full sun	

Goal: Extend the growing season.

	Size (cm)	**Root Depth (cm)**	Planting Soil Temperature	**Temperature or Zone**	**Light**	**Other**
Solanaceae						
bell peppers: *Capsicum annuum*	15-75 x 15-60	90-120	18-32°C	18-27°C *no lower than 15 at night	full sun	
tomato: *Lycopersocon esculentum*	70 - 200 h 45 apart	48+	13-29°C	min. 15 at night 18-29° day	full sun	-train on wire .15-.2m from glass --sandy loam
eggplant: *Solanum melongena*	30-90 h x 30-60 w	20 - 40	18-29°C	18-32° degrees-night not below 18°C	full sun	-most sensitive to temper-ature --can't have sudden temp. changes

Goal: Extend the growing season, cont'd.

	Size (m)	Temp. or Zone	Light	Notes
Actinidaceae				
kiwi *Actinidia deliciosa*	2.7-3.6 h x 5.5-9 w	Zones 8-11	full sun to part shade	
Moraceae				
fig *Ficus carica*	3-9 h x 3-9 w	Zones 7-9	full sun	
Passifloraceae				
passion fruit *Passiflora edulis*	to 15 long	Zones 10-11	full sun	
Rosaceae				
peaches, nectarines *Prunus persica*	1.8-6 h x 1.8-6 w 5m spread for espalier	Zones 4-8	full sun	perennial
apricot *Prunus armeniaca*	1.8-9 h x 1.8-9 w	Zones 4-9	full sun	
almond *Prunus dulcis*	3-9 h x 2.5-8 w	Zones 8-10	full sun	
Rutaceae				
citrus *Citrus* spp.	3-12 h x 3-12 w space 7.6m apart	Zones 8-11	full sun	
Zingiberaceae				
ginger *Zingiber officinale*	0.6-1.2 h x 0.6-1.2 w	Zones 7-10	full sun to part shade	

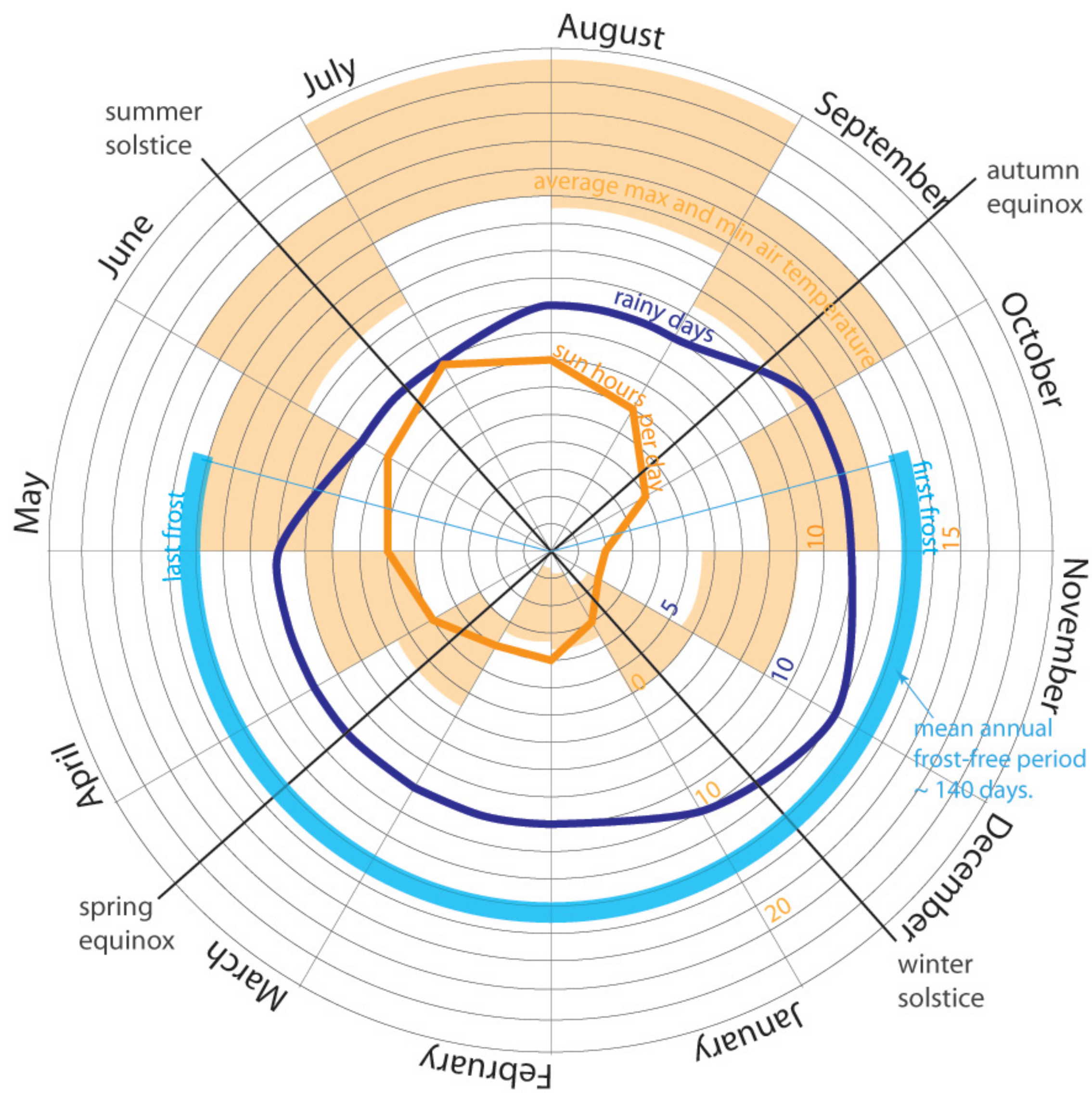
Goal: Make it possible to grow in this climate.

	Storage Temperature	Storage Humidity
Alliaceae		
onion *Allium cepa*	2-12°C	dry
garlic *Allium sativum*	2-12°C	dry
Apiaceae		
carrots *Daucus carota* subsp. *sativus*	0-1°C	-pack in damp hard-wood chips in cool, dark place
Brassicaceae		
rutabaga *Brassica napus*	1°C	90-95%
cabbage *Brassica oleracea* Capitata Group	0°C	90%
turnips *Brassica rapa* Rapifera group	1°C	90-95%
Chenopodiaceae		
beets *Beta vulgaris*	1°C	store in damp sawdust
Convolvulaceae		
sweet potato *Ipomoea batatas*	12-15°C	dry
Cucurbitaceae		
winter squash *Cucurbita* spp.	cool	dry
Rosaceae		
apples *Malus* spp.	-1-0°C	90%
Solanaceae		
potatoes *Solanum tuberosum*	2-4°C	humid, well-ventilated

Goal: Store over winter.

APPENDIX C: CLIMATE INFORMATION

Tatamagouche is a fertile agricultural area, it gets plenty of snow in the winter, and greenhouses are essential for successful farms to lengthen the growing season and protect sensitive plants. Tatamagouche is on the Northumberland Shore, north of the Cobequid Hills, which shelter it from storm winds from the south and east.



Climate cycle.

Sun	mean annual % of total daylight hours w bright sunshine	40 %
	mean annual total hours of bright sunshine	2000 hours
	winter solstice azimuth	110 degrees
	summer solstice azimuth	

Snow	max. snow load on the ground	60lb/sq ft
	mean annual total snowfall	203 cm
	mean date of first snow cover of > 1”	Dec 6
	mean date of last snow cover of > 1”	April 10
	mean annual # of days with snow cover > 1”	120 days
	mean annual max. depth of snow	51 cm

Frost	mean date of the 1st occurrence of a T of 32F	October 15
	mean date of the last occurrence of a T of 32F	May 15
	mean annual frost-free period	140 days

Wind	prevailing winter wind direction	WSW
	prevaiing summer wind direction	SSW

Precipitation	mean annual total precipitation	102 cm
	mean growing season precipitation	15
	variability of growing season precipitation	25%

Growing	mean annual length of growing season	200
	mean annual # of degree days above 42F	3000
	soil	podzol
	USDA Zone	5A -26.2 to -28.8
	Canada Plant Hardiness Index	5b

Mean Daily Temperature	January	-6.7 C
	April	4.5 C
	July	18.3 C
	October	10 C

Tatamagouche climate data.

REFERENCES

Agriculture and Agri-Food Canada. 2011. Agricultural Biodiversity. http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1273696657004&lang=eng (accessed July 2012).

Albert, Stephen. 2008. *The Kitchen Garden Grower's Guide: A Practical Vegetable and Herb Garden*. BookSurge Publishing.

Alvarado, Paula. 2011a. Creative Vertical Garden Built with Dozens of Hanging Flowerpots in Brazil. *Treehugger.* August. http://www.treehugger.com/files/2011/08/creative-vertical-garden-built-with-dozens-of-hanging-flowerpots-in-brazil.php?campaign=th_rss&utm_source=feedburner&utm_medium=feed&utm_campaign=Feed:+treehugger site+(Treehugger) (accessed October 2011).

———. 2011b. Lush Garden sprouts from Living Room Soil at Brazilian House. *Treehugger.* August. http://www.treehugger.com/files/2011/08/lush-garden-sprouts-from-living-room-soil-at-brazilian-house.php (accessed October 2011).

———. 2011c. Urban Rainwater Collector Saves Water in the City, turns into A Green Wall. *Treehugger* May. http://www.treehugger.com/files/2011/05/urban-rainwater-collector-saves-water-in-the-city-turns-into-a-green-wall.php?campaign=th_rss&utm_source=feedburner&utm_medium=feed&utm_campaign=Feed:+treehuggersite+(Treehugger)&utm_content=Google+Reader (accessed 10/25/2011).

Baraban, Regina S., and Joseph F. Durocher. 2010. *Successful Restaurant Design*. Hoboken, N.J.: John Wiley & Sons.

Berry, Wendell. 1972. *A Continuous Harmony: Essays Cultural and Agricultural.* New York: Harcourt Brace Jovanovich.

———. 1990. *What are people for? Essays*. San Francisco: North Point Press.

———. 2002. Readings - The Idea of a Local Economy. *Harper's Magazine*. April. 15-20.

Bunte, Frank, and J. C. Dagevos. 2009. *The Food Economy: Global Issues and Challenges*. Wageningen: Wageningen Academic Publishers.

Capon, Brian. 2005. *Botany for Gardeners.* Portland, OR: Timber Press.

Chater, John, Vicente Franco, Edward Gray, Kiran Kiki Kapany, Frances McDormand, Michael Pollan, Michael Schwarz, et al. 2009. *The Botany of Desire*. Arlington, VA: Distributed by PBS Distribution.

Cohen, Marc J., Jennifer Clapp, and Centre for International Governance Innovation. 2009. *The Global Food Crisis: Governance Challenges and Opportunities*. Waterloo, Ontario: Wilfrid Laurier University Press.

Corre77. 2009. This Just Inbox: One Planter for Many Plants. *Core77.* August. http://www.core77.com/blog/object_culture/this_just_inbox_one_planter_for_many_plants_14374.asp (accessed October 2011).

Cosier, S. 2007. Attempting the 100-mile Diet. *E: The Environmental Magazine* 18 (5): 42-3.

Costa, Temra. 2010. *Farmer Jane: Women Changing the Way We Eat.* Layton, Utah: Gibbs Smith.

Dailey, Jessica. 2012. We Talk With Tracen Gardner of Reclaimed About Prefab Building and Salvaging Materials. *Inhabitat.* April. http://inhabitat.com/we-talk-with-tracen-gardner-of-reclaimed-space-about-prefab-building-salvaging-materials/.

De Decker, Kris. 2008. Sunbathing in the Living Room: Oven Stoves and Heat Walls. *Low Tech Magazine* December. http://www.lowtechmagazine.com/2008/12/tile-stoves.html/.

De la O, Jose. 2010. Window Agriculture: An Alternative Way to Practice Urban Agriculture Where there are No Gardens or Balconies Around. Any Window can be Transformed Into a Personal Parcel. http://www.josedelao.info/Jose_de_la_O/winacri.html (accessed October 2011).

De la Salle, Janine M. 2004. Growing Cities: Cuba's Experiment with Urban Agriculture During the "Special Period". Master of Arts Thesis, Dalhousie University. http://www.cityfarmer.org/cubaThesis.html/.

Deutscher, Jeremiah. 2010. Farming the Box. Master of Architecture Thesis, Dalhousie University.

Dieckmann, Charlotte. 2011. Parasite Farm. http://charlottedieckmann.de/en/parasite-farm/ (accessed July 2012).

Dolezal, Robert J. 2000. *Vegetable Gardening: Your Ultimate Guide*. Minnetonka, MN: Creative Pub. International.

Dunnett, Nigel, and Noël Kingsbury. 2004. *Planting Green Roofs and Living Walls*. Portland, Or.: Timber Press.

Ferdzy. 2010. Micro-Greens from a Micro-Farm. *Seasonal Ontario Food*. http://seasonalontariofood.blogspot.ca/2010/02/micro-greens-from-micro-farm.html (accessed July 2012).

Fern. 2011. How to Turn a Pallet into a Garden. *Life on the Balcony.* March. http://lifeonthebalcony.com/how-to-turn-a-pallet-into-a-garden/ (accessed October 2011).

Fisher, Mark. 2011. *Plant Guilds - Plant Communities with a Purpose*. http://www.self-willed-land.org.uk/permaculture/plant_guilds.htm. (accessed June 2011)

Gimenez, E. H., and A. Shattuck. 2011. Food Crises, Food Regimes and Food Movements: Rumblings of Reform or Tides of Transformation? *Journal of Peasant Studies* 38 (1): 109-44.

Google Maps. 2012. Tatamagouche, NS. https://maps.google.com/

Grindley, P. C., and M. Hutchinson. 1996. The Thermal Behaviour of an Earthship. *Renewable Energy* 8 (1/4): 154.

Grover, Sami. 2009. Permaculture Principles: Clearing Up the Ambiguity. *Treehugger.* September. http://www.treehugger.com/files/2009/09/permaculture_principles_ambiguity.php?dcitc=th_rss (accessed October 2011).

Hahlbrock, Klaus. 2009. *Feeding the Planet: Environmental Protection Through Sustainable Agriculture*. London: Haus.

Hannum, Hildegarde, and E. F. Schumacher Society. 1997. *People, Land, and Community: Collected E.F. Schumacher Society Lectures*. New Haven, Conn.: Yale University Press.

Heschong, Lisa. 1979. *Thermal Delight in Architecture*. Cambridge, Mass.: MIT Press.

Hightower, Jim. 1975. *Eat your Heart Out: Food Profiteering in America*. New York: Crown Publishers.

Hinrichs, C. Clare, and Thomas A. Lyson. 2007. *Remaking the North American Food System: Strategies for Sustainability*. Lincoln: University of Nebraska Press.

Hylton, William H. 1980. *Build Your Harvest Kitchen*. Emmaus, PA: Rodale Press.

Iverson, Stuart L., Daniel R. Prowse, Joseph D. Campbell, and Whiteshell Nuclear Research Establishment. 1976. *An Assessment of the Utilization of Waste Heat in Greenhouses.* Pinawa, Man.: Whiteshell Nuclear Research Establishment, Atomic Energy of Canada Ltd.

Jeavons, John. 2006. *How to Grow More Vegetables: And Fruits, Nuts, Berries, Grains, and Other Crops than You Ever Thought Possible on Less and than you can Imagine: A Primer on the Life-Giving Grow Biointensive Method of Sustainable Horticulture*. Berkeley, Calif.: Ten Speed Press.

Kennedy, Joseph F. 2001. *The Art of Natural Building: Design, Construction, Resources*. Gabriola Island, BC: New Society Publishers.

Leung, Mark, Daragh Karkairan, Alex Keenan, and Ecology Action Centre. 2009. *Nova Scotia Green Roof Manual*. Halifax, N.S.: Ecology Action Centre.

Levenston, Michael. 2009. Vertically Integrated Greenhouse. http://www.cityfarmer.info/2009/12/28/vertically-integrated-greenhouse/ (accessed October 2011).

Lowe, Lezlie. 2007. The Farming Industrial Complex: Why Food Trucked in from All Over the Continent gets Priced Lower than Nova Scotia's Organic Strawberries. *The Coast.* September. http://www.thecoast.ca/halifax/the-farming-industrial-complex/Content?oid=961362 (accessed October 2011).

Madigan, Carleen. 2009. *The Backyard Homestead*. North Adams, MA: Storey Pub.

Magdoff, Fred, John Bellamy Foster, and Frederick H. Buttel. 2000. *Hungry for Profit: The Agribusiness Threat to Farmers, Food, and the Environment.* New York: Monthly Review Press.

McCullagh, James C. 1978. *The Solar Greenhouse Book*. Emmaus, PA: Rodale Press.

McGowan, Maria. 2009. Tatamagouche: The Day the Women Went. Part 1. *NS Blogs.* August. http://www.novascotiablogs.com/2009/08/-last-weekend-my-sister.html.

Meinhold, Bridgette. 2009. The Incredible Edible House of the Future. *Inhabitat.* April. http://inhabitat.com/the-incredible-edible-house-of-the-future/rchs-edible-house-5/ (accessed OCtober 2011).

———. 2012. NL Architects' Sanya Block 5 is a Lush Garden Hotel for China. *Inhabitat* .February. http://inhabitat.com/nl-architects-sanya-block-5-is-a-lush-garden-hotel-proposal-for-china/.

Mollison, B. C. 1996. *Permaculture : A Designer's Manual*. Tyalgum, Australia: Tagari Publications.

———, and David Holmgren. 1987. *Permaculture One: A Perennial Agriculture for Human Settlements*. Tyalgum, Australia: Tagari.

Municipal Planning Strategy. 2001. Village of Tatamagouche http://www.google.ca/search?sourceid=chrome&ie=UTF-8&q=tatamps.pdf (accessed May 1, 2011).

Murphy, Catherine, and Institute for Food and Development Policy (Oakland,Calif.). 1999. *Cultivating Havana : Urban Agriculture and Food Security in the Years of Crisis*. Oakland, CA: Food First Institute for Food and Development Policy.

Nash, Michael John. 1978. *Crop Conservation and Storage in Cool Temperate Climates*. Oxford [Eng.]; New York: Pergamon Press.

Nearing, Helen, and Scott Nearing. 1977. *Building and Using our Sun-Heated Greenhouse: Grow Vegetables All Year-Round.* Charlotte, Vt.: Garden Way Pub.

Nestle, Marion. 2002. *Food Politics: How the Food Industry Influences Nutrition and Health.* Berkeley: University of California Press.

———. 2007. Eating Made Simple - How do you Cope with a Mountain of Conflicting Diet Advice? *Scientific American* 297 (3): 60.

Nordahl, Darrin. 2009. *Public Produce: The New Urban Agriculture*. Washington, DC: Island Press.

Ortho Books. 2001. *Ortho's all About Greenhouses*. Des Moines, Iowa: Meredith Books.

Osmundson, Theodore. 1999. *Roof Gardens : History, Design, and Construction*. New York: W.W. Norton.

Pawlick, Thomas. 2006. *The End of Food*. Vancouver, B.C.: Greystone Books.

Peck, Steven W. 2008. *Award-Winning Green Roof Designs: Green Roofs for Healthy Cities*. Atglen, PA: Schiffer Pub.

———, Monica Kuhn, Ontario Association of Architects, Canada Mortgage and Housing Corporation. 2003. *Design Guidelines for Green Roofs*. Toronto; Ottawa: Ontario Association of Architects ; CMHC.

Peters, K.A. 2010. Creating a Sustainable Urban Agriculture Revolution. *Journal of Environmental Law and Litigation* 25 (1): 203-47.

Pinola, Melanie. 2011. Turn a Filing Cabinet into a Rolling Container Garden. *LIfehacker.* April. http://lifehacker.com/5797135/turn-a-filing-cabinet-into-a-rolling-container-garden (accessed October 2011).

Pollan, Michael. 2006. *The Omnivore's Dilemma: A Natural History of Four Meals*. New York: Penguin Press.

———. 2008a. Farmer in Chief. August. http://michaelpollan.com/articles-archive/farmer-in-chief/ (accessed October 2011).

———. 2008b. *In Defense of Food: An Eater's Manifesto.* New York: Penguin Press.

——— 2009. Wendell Berry's Wisdom: Today's Food Conversation Was Started by Dot-connecting Writers Like Berry in the '70s. *The Nation*. 289 (8): 29.

Robinson, G. M. 2008. *Sustainable Rural Systems: Sustainable Agriculture and Rural Communities*. Aldershot, England; Burlington, VT: Ashgate.

Salatin, Joel. 1998. *You Can Farm: The Entrepreneur's Guide to Start and Succeed in a Farm Enterpri*se. Swoope, Va.: Polyface.

———. 2007. *Everything I Want to Do is Illegal*. Swoope, VA: White River Junction, Vt.: Polyface. Inc.

Schlosser, Eric. 2001. *Fast Food Nation: The Dark Side of the All-American Meal*. Boston: Houghton Mifflin.

Schrock, Denny, and Janna Beckerman. 2005. *Guide to Growing Delicious Vegetables, Fruits & Herbs*. Des Moines, Iowa: Meredith Books.

Schumacher, E. F. 1973. *Small is Beautiful: Economics as if People Mattered.* New York: Harper & Row.

Smith, Alisa Dawn, and J. B. MacKinnon. 2007. *The 100-Mile Diet : A Year of Local Eating*. Toronto: Random House Canada.

Stamets, Paul. 2000. *Growing Gourmet and Medicinal Mushrooms*. Berkeley, Calif.: Ten Speed Press.

———, and J. S. Chilton. 1983. *The Mushroom Cultivator: A Practical Guide to Growing Mushrooms at Home*. Seattle, WA: Agarikon Press.

Sugar Moon Farm. 2010. (photograph). http://www.facebook.com/photo.php?fbid=430391972710&set=a.430390457710.232397.256761977710&type=3&theater (accessed July 2012).

Tclynx. 2011. Tower Flow. February. http://www.aquaponiclynx.com/tower-flow (accessed July 2012).

Turner, Chris. 2011. The Farms are Not all Right. *Walrus Magazine.* October. http://www.walrusmagazine.com/articles/2011.10-food-the-farms-are-not-all-right/1/ (accessed October 2011).

Vienneau, Jeff. 2007. Tatamagouche Aerial (photograph). *Wikipedia.* http://en.wikipedia.org/wiki/File:Tatamagouche_Aerial.jpg (accessed July 2012).

Waters, Alice, ed. 2006.One Thing To Do About Food: A Forum. *The Nation* 283 (7): 14.

Weis, Anthony John. 2007. *The Global Food Economy : The Battle for the Future of Farming.* London; New York: Zed Books.

Whitaker, James H. 1979. *Agricultural Buildings and Structures*. Reston, Va.: Reston Pub. Co.

Wilk, Richard R. 2006. *Fast Food/Slow Food: The Cultural Economy of the Global Food System.*

Yoneda, Yuka. 2011. Live Screen: A Modular Vertical Garden that Adds Patches of Green to Your Interior. *Inhabitat* April 2011, http://inhabitat.com/live-screen/ (accessed 10/25/2011).

Zimmer, Lori. 2011. MVRDV's Stunning Flowerbed Hotel is a Giant Greenhouse. *Inhabitat.* November. http://inhabitat.com/mvrdvs-stunning-flowerbed-hotel-is-a-giant-greenhouse/.