A CONCEPT OF STRONG SUSTAINABILITY

Working towards a circular economy wherein it is acknowleged that natural capital's limits prevent infinite growth, but growth can be achieved in a healthy way if a holistic approach is taken on all aspects of human and natural systems and how they can complement each other, towards a human-created nature, or "second nature" which has a generative effect on nature, ensuring that future generations and natural ecology thrive. Designing architecture for sustainability means producing environmental gains which may translate into benefits for the inhabitant, and teach them to live in a way which is sustainable, rejecting their reduction to their capacity to exist unchanged in a changed built environment. A sustainable ethos must be democratised rather than alienated from inhabitants, making sustainable practise second nature.

RADICAL SUSTAINABILITY

(Radical as derived from Latin *Radix*, "root" - address fundamental causes rather than symptomatic manifestations.) If architecture is to be sustainable it must teach inhabitants control over the consequences of their actions in relation to the environment. This means self-sufficiency of food, water, energy and waste management on a decentralized, local level, in order to avoid the rebound effect, and produce and reproduce a mindset of self-sufficiency and independence from cities' most destructive dominant systems that would otherwise be seen as a "necessary evil."
(Kellogg, Pettigrew xiii, xvi)

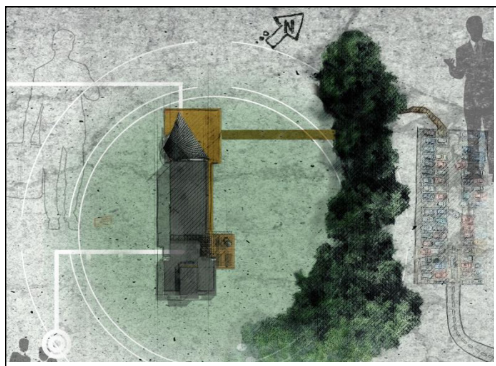


fig 1.1: Site plan provided by client, used for estimate size of car park

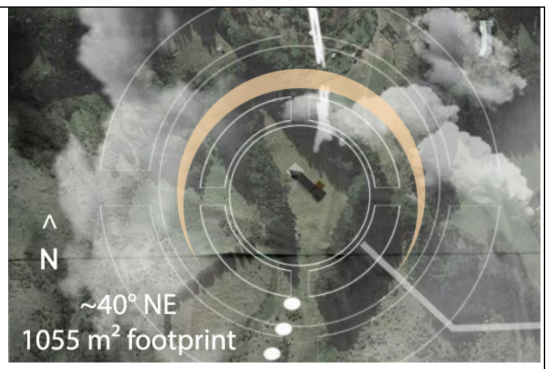


fig 1.2: Context plan provided by client, edited to contain sun path, north point, orientation and footprint

ENSPIRAL EVENTS AND RETREAT CENTER:
CREATING AN AUTONOMOUS, SUSTAINABLE COMMUNITY

CAR PARK: EXPLORING ALTERNATIVES

The current proposal asks for a car park roughly 20 x 50m in size. Asphalt can be replaced with more permeable materials which allow the potential for ecosystems to coexist as plants take root to absorb nutrients and water promotes good soil.
Crushed granite: This requires less maintenance than asphalt, which requires periodic resealing - the maintenance of a negative environmental effect. Crushed granite requires a new layer every one or two years. Unlike gravel it does not easily wash away & has more aesthetic appeal.
Permeable Concrete Pavement: Green Infrastructure which aims to reduce stormwater runoff and peak flow, reducing water that reaches sewers with benefits such as reducing sewer overflows and localised flooding. There has also shown to be a marked increase in the quality of stormwater runoff, with reductions in mean concentration of nitrite, ammonia and organic-nitrogen and loading of suspended solids, biochemical oxygen demand, ammonia, hydrocarbons, and mineral oil. (Drake et. al) It is also noted that especially in cold climates such as Wellington, colder months should be isolated in assessing water quality performance. A study conducted in Chicago, Illinois compared permeable asphalt and paver stones, as well as performance after degradation over four years and found that after one year degradation accelerates due to particle clogging and shear stress but after four years infiltration rates were still four to five times higher than asphalt. (Kumar et al.) Ultimately permeable material is the most ecological option, with material depending on budget.
Bike racks: These should be made available, as biking is the most feasible sustainable alternative to vehicle transport to site. (walkscore.com) See *Mist Showerhead* section for further info.

INTERIOR APPLIANCES

These are employed for conservation at the point of use, without inherently straying from dependency on water infrastructure but saving on occupational costs. There is a secondary aim of producing, as put by (Spurling et al.), "a new social, cultural and spatial context which underpins behavior, creating what the "new normal" of sustainability looks like."
Normally, water is taken for granted, but if the process of collection, purification and return is localized appreciation can be built.
Bidet: Replacing Enspiral's toilet with a bidet will ensure huge savings in water, and ask inhabitants to break from the cultural norms of the english-speaking West. The average toilet flush for new toilet models is 7.3 L, whereas Biolife Technologies state that the typical bidet uses 0.57 L per use (Scientific American). Toilet paper will be almost eliminated - overwhelmingly made from second-grade sustainably managed timber, its main impact is water used in production; 168.2L of water per roll (Alter).
Mist Showerhead: This is especially important if people choose to bike to site, as the New Zealander expends 227L of water a day, with showers generally using 12 to 15L per minute. Using The Netherlands as an example for what this means, (De Decker) estimates that the impact of an average shower equates to that of driving 3-7km. For reference, the drive to site from Trentham proper is 6.5km. Mist showers decrease water flow by reducing droplets to < 10 microns each. The Canadian Minimum Housing Group tested a mist shower which cleaned the body to the same degree as a normal shower, but used 30 to 40 times less water (Morse). Mist showers use about half the energy as normal showers – energy savings aren't as drastic because water must be brought to a higher temperature. The degree of efficiency will be great but ultimately depends what suits Enspiral inhabitants best. Mist shower systems are easy to adapt by adding or removing nozzles, attaching to systems on or off the water grid, and opening nozzles in cold months to decrease heat lost at the cost of water flow. Inhabitants should also take much shorter-than-average showers.

RAINWATER COLLECTION

The roof's footprint is 579.3 sq.m, with Wellington's average rainfall being 1098mm. (climate-data.org) Using watercache.com's calculator, 6235.54 sq ft x 0.6 gallons per inch* of rainfall means the average 2.98mm a day will provide 2071.56 L of water. This can be filtered through a window screen into barrels as shown in fig. 2.3, which can then be stored or, if elevated can be ran through a hose without the use of a pump. Potential applications of water are explored on page 2.

*imperial units used for the purpose of calculation, metric for presentation

fig 2.1

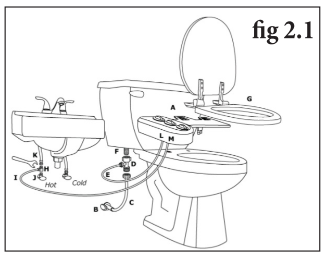


fig 2.2

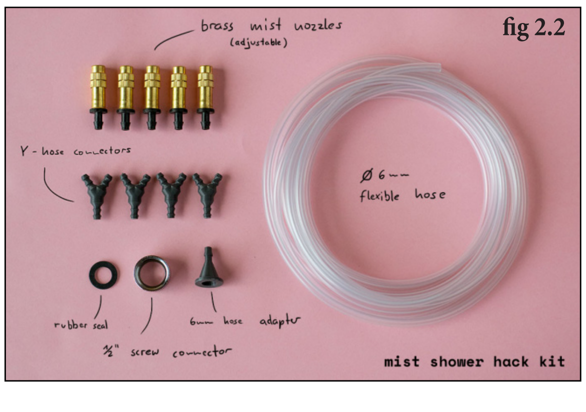


fig 2.3

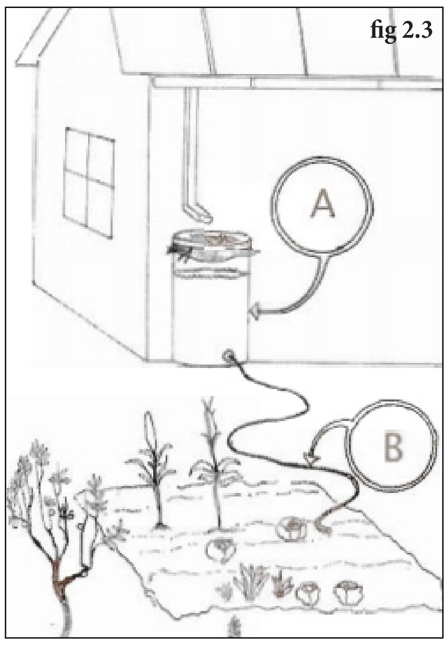


fig 2.1: Exploded diagram of bidet attachment on toilet (getdrawings.com)
fig 2.2: Materials suggested for DIY mist shower-head (lowtechmagazine.com)
fig 2.3: Simple rain barrel (barrel, window screen + tyre tube). Rain flows from roof into barrel, filtered by window screen (A) and utilises gravity for pressure (3 PSI) for transportation (B) Image retrieved from (Kellogg, Pettigrew p.67)

SHIFTING FROM EFFICIENT SYSTEMS TO SUSTAINABLE INHABITATION

Efficient systems in isolation do not constitute sustainability. The advent of LED lighting, which is six times more efficient than incandescent, resulted in a societal demand for six times more light. (Tsao et al.) Overall, the use of energy is rising at twice the rate of population growth. (Sheffield) Treating efficiency as an end in itself doesn't account for societal transformations that lead to an increase in demand, producing and reproducing behaviour which is not sustainable in the long term. (Shove 3)

Garden: Water conserved doesn't just have to mean lower operational costs and independence from infrastructure. It can also feed into systems of food autonomy - a garden is something which will demand a level of involvement from Enspiral's inhabitants, and in return become the foundation for community building around sustainable practise. One will be far less likely to pour harmful chemicals down the drain if it leads to their vegetable gardens, where the effects are immediately noticeable. The Enspiral foundation collectively owns the building so they have the perfect opportunity to become more rooted there.

Compost: Compost and the use of worm boxes instead of bins bring inhabitants closer to the processes at the later end of the life cycles of their food. To create compost a 30:1 carbon:nitrogen balance is required, and Enspiral's inhabitants will gain an intuitive sense of the building's balance of waste. Creating compost requires maintenance (turning) 5 times over 15 days - longer if too much carbon-based material is present. The use of compost and filtered rainwater should be more than enough to maintain the garden.

Cardboard	400–563:1
Coffee grounds	20:1
Corn cobs	56–123:1
Corn stalks	60:1
Farm manure	90:1
Fish scraps	3.6:1
Food scraps	15:1
Grass clippings	19:1
Humanure	5–10:1
Tree leaves	35–85:1
Newspaper	170:1
Pine needles	60–110:1
Poultry carcasses	5:1
Rotted manure	20:1
Sawdust weathered two months	625:1
Sawdust weathered three years	142:1
Straw	80:1
Telephone books	772:1
Urine	0.8:1
Vegetable produce	19:1
Water Hyacinth	20–30:1
Woodchips: hardwoods (Avg.)	560:1
Woodchips: softwoods (Avg.)	641:1

Sources: Humanure Handbook & University of California Cooperative Extension[3]

Fig. 3.1: Chart for carbon: nitrogen ratio of common waste materials, as arranged by Kellogg et al.

LONG TERM PROJECTS

Once inhabitants are confident in maintaining the garden and have broken from the societal norms which fuel our unsustainable status quo, they should look to longer term projects to expand Enspiral's tapestry of autonomous ecosystems with the aim of becoming a sustainable, autonomous community.

CHICKENS

A chicken coop can be constructed to be populated by pullets and hens, with one rooster per 8 hens. Inhabitants will take on the tasks of opening and closing houses, constructing flashes on trees for roosting (fig 4.1), making sure broody hens are managed, supplying bugs via leaving scrap plywood on grass to attract them, and relocation for soil tending (fig 4.2). As well as creating autonomy in food, chickens contribute to soil health, and their manure will provide nitrogen for compost. Other potential benefits are detailed in *Bioshelters.*

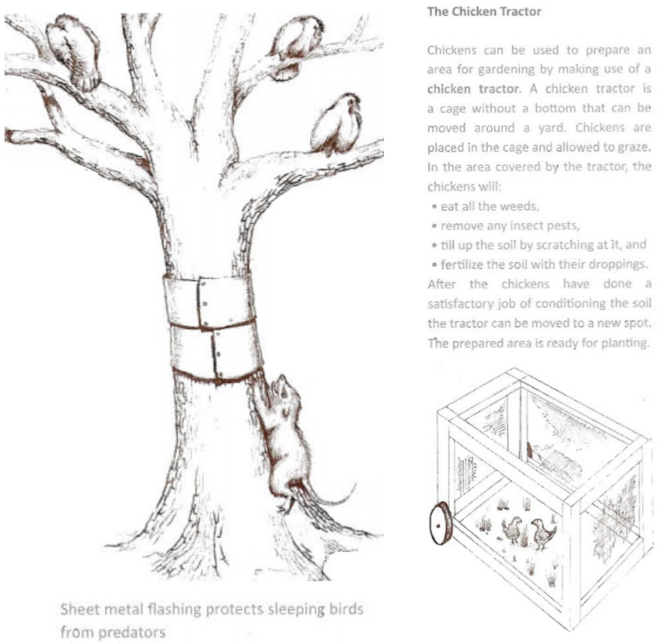
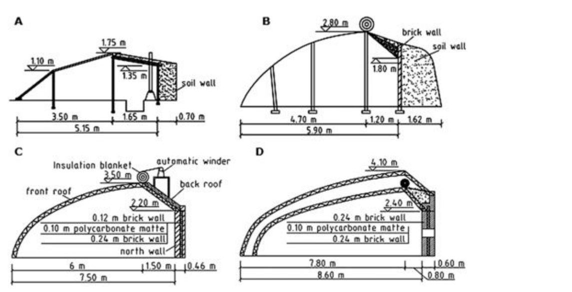


Fig. 4.1, 4.2: Means of managing inhabitation of chickens illustrated by Kellogg et al. (9 & 7)



A: The original design from the 1980s with a glass canopy. B: An improved design from the mid-1980s, with plastic foil, a night curtain, and better insulated walls. This design is the most widespread. C: An improved design from 1995. The walls are thinner because they are insulated with modern materials. Automatic handling of the night curtain. D: The most recent design from 2007, which has a double roof for extra insulation.

Fig. 4.3: Comparison of bioshelter construction methods. Retrieved from https://www.lowtechmagazine.com/2015/12/reinventing-the-greenhouse.html

BIOSHELTERS

A bioshelter is a greenhouse that makes use of solar heating with the explicit aim of permaculture and ecology rather than monoculture. This means using warmer conditions to grow a diverse range of plants, using architecture in the same way that the existing building does - being oriented along north/south axis, to the north of the building so as to be protected from cold southerly winds, axis and using the abundance of open space on site to capture sun and utilise thermal mass of objects inside. (fig 4.4) This can mean rocks, sand, bricks and water - water particularly can be used to store and release heat over longer periods depending on the size of container it is stored in, ranging from a bottle or bucket to barrel or pond. If containers are painted black and placed along the north-facing wall they will soak up even more heat. This level of understanding of thermal mass enables inhabitants to be aware of control of heat in a building, which will lead to a more informed degree of interaction with systems such as blinds and HVAC.

Bioshelters are an ideal nexus of symbiotic relationships with other living ecosystems -If both chickens and compost are kept in the shelter, they will in turn serve as space heaters and provide CO_2 for plants. (Brown)

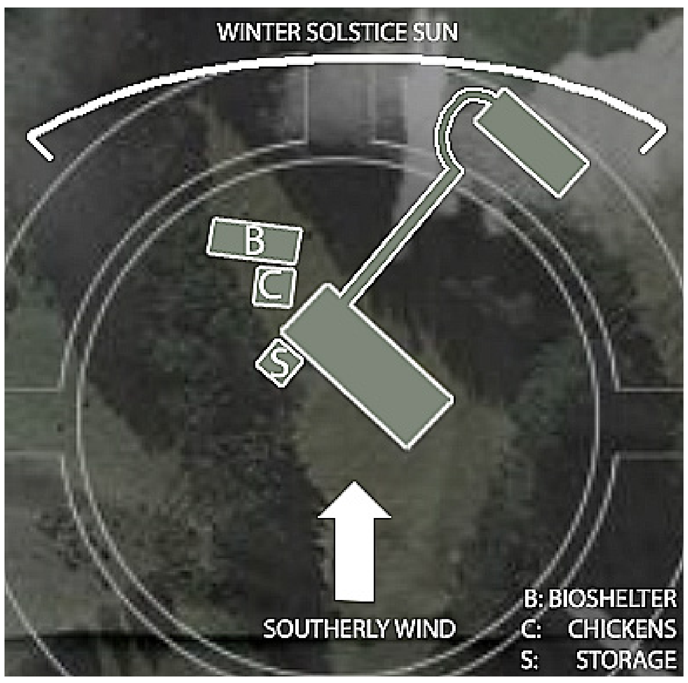


Fig. 4.4: Potential locations for proposed long-term projects.

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