GREENING THE URBAN ENVIRONMENT

A STRATEGY FOR CHRISTCHURCH CENTRAL CITY

By Matt Durning

Contents Page.

2.0 Overview.

The Christchurch City Plan aims to increase the city center's population to from the current 2000 to 30,000 by the year 2041, possibly jeopardising the Garden City character that Christchurch lives up to. The increase in population will create a livelier town centre, but will it be an attractive town centre? At present there is no strategy as to how we can green the city to make it more attractive for visitors and the people who dwell there.

This study aims to review the current City Plan regarding the greening component for the city. This study will review methods from around the world on urban greening and how we can incorporate greening methods into the city.

3.0 Study Area.

Christchurch 's location and the way the city lies in the landscape brings a level of immediate quality to the city. To the east lies the open ocean and Banks Peninsula, featuring sheltered bays, sandy beaches, bush clad valleys, and rocky coastline. To the west, beyond fertile plains and braided rivers lie, the Southern Alps, strung out parallel to the coastline. East of the study area lies Hagley Park and the Botanic Gardens and in the heart of the city centre is the meandering Avon River which contrasts nicely against the grid pattern of the City (Gehl, 2009).

The main focus of the study is the city centre with the boundaries being Kilmore Street (north), Saint Asaph Street (south), Rolleston Avenue (west) and Madras Street (east). These streets encompass the most intensely used areas in the city. Having a coherent study area allows for a study of the network and coherence as well as connections to the bordering areas.

This research report aims to critique the existing Christchurch City plan in regard to the greening component of the Central City. At current the Christchurch City Plan and Open Space Strategy only acknowledge a number of methods of how to green the Central City such as Open space, Street Tree's and setback as means of greening the urban environment.

Figure 1. Study Area , Christchurch Central City

4.0 Objectives.

Objective One
Identify the benefits of introducing green elements to the central city and how these green elements affect the city on a biophysical, physiological, social and economical scale.

Objective Two
Identify the existing elements that contribute to the green character of the central city. This includes an analysis of policies set in place by the Christchurch City Council under the City Plan and other city council documents such as the Open space Strategy, The Central City Revitilisation strategy and recently published Public life study produced by Gehl Architects.

Objective Three
Identify greening methods on an international scale; how they have been incorporated into the urban setting and policy and the benefits they have on their surroundings.

Objective Four
Using the methods learned from international cities and applying these examples to Christchurch Central City providing a number or recommendations.

5.0 Research Methodology

I intend to undertake the research methodology in 3 sections - policy analysis, critique and comparative case studies. By undertaking policy analysis first it will allow me to gain an understanding of Christchurch's current situation in regard to 'greening'. This knowledge will allow me to go on and critique the current methods used in Christchurch. From here I will analyse a number of case studies from around the world, which in the end will allow me to make a number of recommendations for Christchurch.

6.0 Why is urban greening important?

Studies show that urban greening is integral to the ecological, economic, and societal well being of our communities. Our green and open spaces provide a number of valuable services to the environment, including cleaning our air and water, providing homes and food for wildlife, and saving energy through shade. They also offer economic and social benefits such as raising property values, rekindling neighborhood pride, improving health and well being, and providing places for children to play. When planned, implemented, and managed properly, urban greening can significantly improve the quality of our lives for decades to come.

Water.

Urban greening can play a significant role in providing healthy, reliable water systems. During heavy storms, urban greening can reduce the number of pollutants and contaminants that reach our waterways as well as reduce soil erosion, runoff, and flooding (Farr, 2007). Urban greening projects can provide a reliable local water source, by collecting stormwater for on-site use and groundwater replenishment (ReLeaf, 2009). Without these greening projects, communities would need to increase sewage and stormwater drainage systems and waste-treatment capacities to handle increased runoff as they increase development.

2,800 litres of rainfall can be collected annually in the canopy of one large tree,(ReLeaf, 2009).

Energy and Air Quality

Urban greening plays an important role as a natural, "green" solution to energy conservation and air quality improvement, both of which contribute to mitigating climate change. In addition to sequestering carbon, trees and other green infrastructure can modify temperatures, filter air pollutants, and conserve energy. Shade and cooling provided by trees, green roofs, and other green infrastructure reduces the energy needs on site for air conditioning. This also results in reduced demand for energy production at power plants, thereby reducing gases that produce ozone, a major component of smog, greenhouse gases, and other air pollutants. Surface temperatures of urban structures are 10- 20 degress higher than ambient air temperatures. Increased surface temperatures result in raised temperatures in urban settings. This phenomenon, known as the urban heat island effect, can increase air temperature 2 to 8°F (ReLeaf, 2009). When temperatures are increased, there is a higher demand for energy. Urban forests, green roofs, and other green infrastructure help to keep the temperature down through shading and evapotranspiration.

25-40% is saved on summer cooling costs by the shade of a mature tree (ReLeaf, 2009)

Public Health and Community Benefits

Urban greening provides parks, shade, and healthy places for children and adults to recreate. Active people are healthy people. Studies show that being outdoors results in more physical activity. Regular physical activity can help reduce the risk of heart disease, type 2 diabetes, metabolic syndrome, and certain cancers. Community gardens are also an important part of urban greening. Research suggests that community gardens provide numerous health benefits, including access to food, improved nutrition, increased physical activity, and improved mental health. In addition, community gardens promote social health and community cohesion. Natural shade reduces exposure to UV radiation, which may help reduce the risk of skin cancer. Natural settings are also known to increase healing rates and improve patients' moods during recovery and hospital stays (Ulrich, 1984).

Young children living in areas with more street trees have a lower prevalence of asthma (ReLeaf, 2009)

Psychological and Economical Benefits.

Urban forests, parks, and open space are key factors in creating sustainable communities that attract new business and residents. Urban greening can increase residential property value, attract consumers, reduce crime, and enhance pedestrian-friendly amenities. Studies show that people living in buildings with trees and greenery outside know their neighbors better, socialize with them more often, and have stronger feelings of community. Views of nature have also been shown to increase the rate of stress recovery in children and adults, increase recovery rates after surgery, as well as enhance attention and improve concentration (Farr, 2007).

Property shaded by trees can be up to 10% more valuable than unshaded lots . Customers are willing to pay up to 11% more for the same products when shopping in "greened" business districts (ReLeaf, 2009)

Overall urban greening provides benefits in water conservation, water quality, air quality, energy conservation, climate change, public health, and economic vitality. By cost-effectively providing multiple benefits to urgent problems, urban greening can free up resources when compared to traditional approaches that often cost more money.

7.0 Central City Policy Analysis

The central city contains a highly varied environment where different areas exist with particular combinations of open space, natural features, buildings, and activities. These characteristics define the environmental quality of areas within the central city, therefore it is important to reflect and respect these qualities by influencing the shape, scale and physical form of the built environment in these areas. Accordingly, development standards are set for new buildings to ensure that the development of sites over time defines and enhances an appropriate urban form for the central city. The main areas identified for these purposes are as follows:

The existing central city policies towards greening are minimal to say the least. Little provisions are given for anything else except street trees and general setback rules. These policies within the City Plan are very vague and generalised and in some instances seem viewed by the City Council as being an unnecessary element to incorporate into the city plan. Due to the lack of acknowledgment towards greening, there is also a lack of appreciation towards maintaining the vegetation within the city.

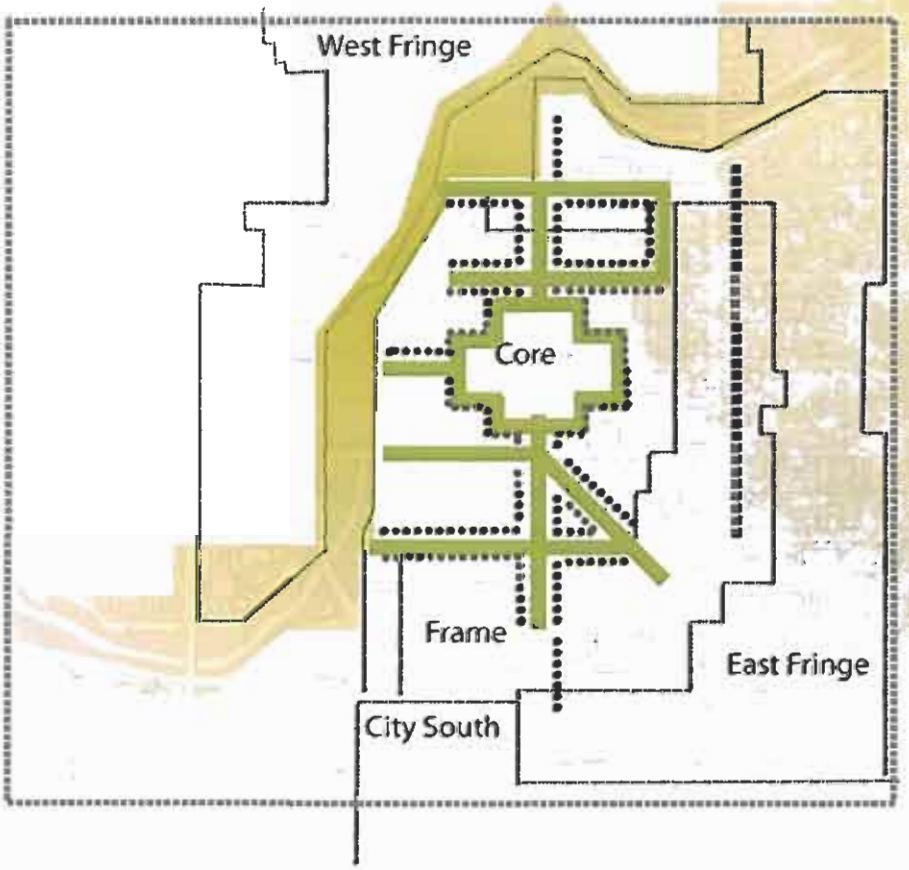


Figure 2. Special Requirements, Central City

Figure 3. Site Coverage

7.1 Site Coverage.

The central city is dominated by the footprint of building space and hard surfaces. Within the selected site, the footprint of the buildings takes up approx around 50 %.

Entire site = 838,000 sq. M.,

Building footprint = 421,616. 206 sq. M.

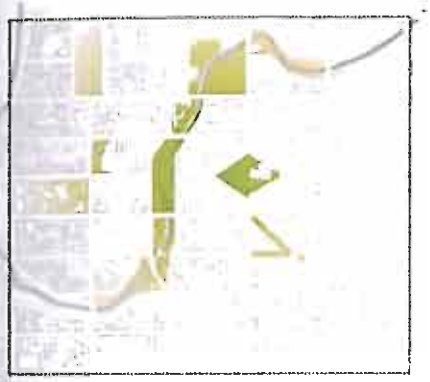


Figure 4. Green Space

7.2 Green + Open Space

The existing green space is dominated by the Avon River, Latimar square, Cranmer square and also Victoria Park. The contributing public spaces such as Cashel mall and the square contribute little greenery as the sites are predominantly hard surfaced. Green space and open space make up a minimal 16% of the site area.

Entire site = 838,000 sq. M,

Green open Space = 139,802 sq. M..

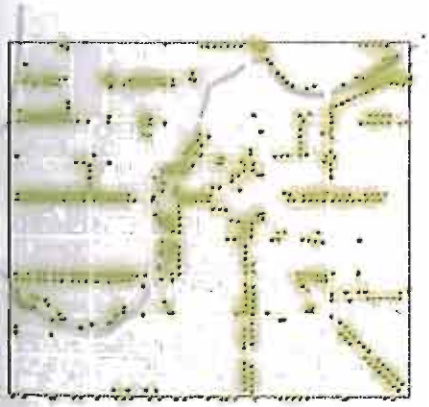


Figure 5. Street trees

7.3 Street Tree's.

Street trees are generally located in the east-west streets while north-south connections have not been planted. The exceptions are the southern parts of Colombo Street and High Street. Viewed in terms of ecological function, Christchurch's street trees represent an incomplete system with many gaps (Gehl, 2009). Street tree planting in the city centre is difficult for a number of reasons; the streets generally have narrow footpaths covered by verandas, shade from large buildings, and limited root space adds to the difficulties. The general effect of these difficulties is that Christchurch is not experienced as a green city. Street trees tend to be in either a poor shape or of a tall and slender nature with limited impact on the streetscape (Gehl, 2009).

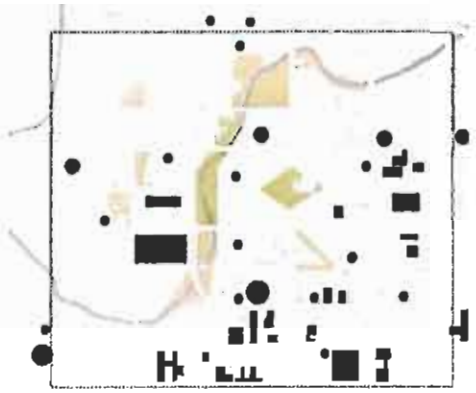


Figure 6. Carparks

7.4 Carparks + Unused Space.

Christchurch has a very high number of parking spaces in the city centre offering good conditions for cars but also increasing the problem of traffic in the city centre. Where the concentration of on-street parking and parking structures is at the highest it becomes dominant and lowers the quality of the pedestrian environment. The overall amount of unused space and carparks makes up aprox 10% of the site.

Entire site = 838,000 sq. M..,

Carpark and unused space = 51, 034 sq. M

8.0 Central City Policy Analysis

8.1 The Core.

The traditional heart of the City centred on the important public space areas of Cathedral Square, City Mall and the Avon River. It contains many of the important central city heritage buildings and pedestrian dominated precincts, as well as a substantial amount of the City's retailing activity.

The built form within the Core is characterised by a consistency of buildings along street frontages. While some exceptions do exist for sites or parts of sites, it is desirable that in respecting the predominant character of the built form in this area, consideration is given to the impacts of building removal and/or the creation of open space along the street frontage.

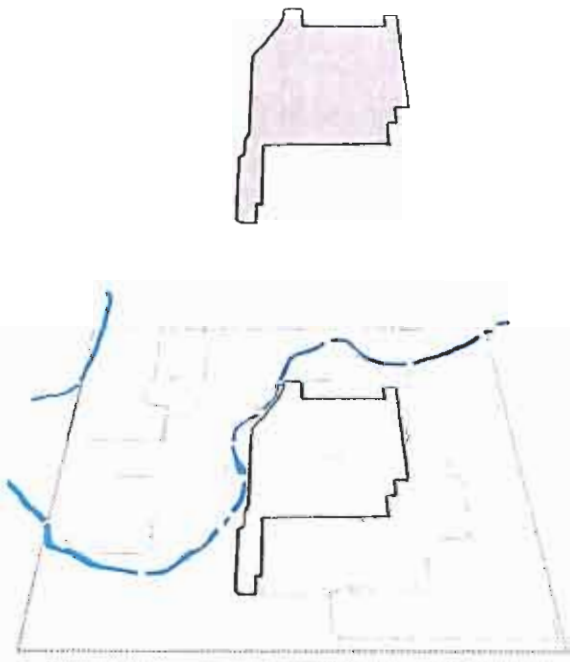


Figure 7. The Core

All activities shall include buildings along the full frontage of the site. These buildings shall be built up to the road boundaries of the site except that:

(i) Buildings shall be setback a minimum of 2.1 metres from road boundaries at ground level only along those parts of Colombo Street as shown on figure 2. This setback shall be paved for pedestrian use; and

(ii) Buildings shall be setback a minimum of 3.0 metres from the road boundary, and the setback landscaped, along the eastern side of Manchester Street as shown on planning map figure 2. In this case the landscaping shall consist of paving for pedestrians and trees at a rate of 1 tree for every 10 metres of road frontage. Any trees required by this rule shall be of or species capable of reaching a minimum height at maturity of 8 metres and shall be not less than 1.5 metres high at the time of planting.

With the core being described as 'the traditional heart of the City' and containing many of the important central city heritage buildings and pedestrian dominated precincts, it is only necessary to make this space as pleasant and green as we can.

The weak north to south street tree arrangement needs to be strengthened and made more consistent.

The requirements of street frontages and facades allows for the opportunity to green these built structures.

The large hardscape publics areas such as Cathedral square, Cashel mall and High street increases water runoff which needs to be provided for, possibly through storm water planters

8.2 The Frame

Surrounding the Core to the north, east and south, with fewer important open spaces and heritage buildings, and less emphasis on pedestrian and retail activities. The Frame is more significant for office activities and has emerged as an area where taller, bulkier buildings are located. While some exceptions do exist for sites or parts of sites, it is desirable that, in respecting the predominant character of the built form in this area, the creation of open space along the street frontage is generally avoided.

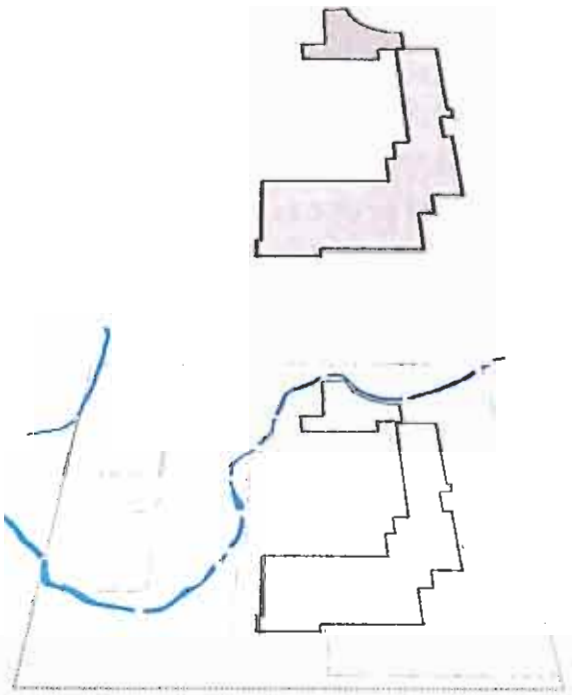


Figure 8. The frame

All activities shall include buildings along the full frontage of the site. These buildings shall be built up to the road boundaries of the site except that:

(i) Buildings shall be setback a minimum of 2.1 metres from road boundaries at ground level only along those parts of Colombo Street as shown on planning map figure 2. This setback shall be paved for pedestrian use; and

(ii) Buildings shall be setback a minimum of 3.0 metres from the road boundary, and the setback landscaped, along the eastern side of Manchester Street as shown on planning map figure 2. In this case the landscaping shall consist of paving for pedestrians and trees at a rate of 1 tree for every 10 metres of road frontage. Any trees required by this rule shall be of or species capable of reaching a minimum height at maturity of 8 metres and shall be not less than 1.5 metres high at the time of planting.

Surrounding the Core to the north, east and south, the frame has less important open spaces and heritage buildings, and less emphasis on pedestrian and retail activities and more significance for office activities and can be described as an area where taller bulkier buildings are located.

The harsh built environment of this space creates harsh edges and solid walls, which provides the opportunity for vertical greening.

These bulky buildings also provide the opportunity to green the rooftops. Predominantly all the buildings in this area are for business use, which if greened the rooftops could possibly act as public spaces or community gardens benefiting the office and the environment.

It is described in the city plan that the core and frame share the same setback and street tree policies, as described above yet there are multiple areas within the frame that do not meet these requirements.

It is also stated that in respecting the predominant character of the built form in this area, the creation of open space along the street frontage is generally avoided. This needs to be reconsidered as if the central city gains a population increase of 30,000 then the streetscape and neighbouring spaces need to be pedestrian orientated.

8.3 East Fringe

Located on the eastern side of the central city, the East Fringe is an area of transition from the intensive commercial development of the Core and Frame, to the adjoining central living areas. Development potential on sites is less than the Core and Frame areas, in recognition of a more open street environment. Consequently, pedestrian and retail activity is not as prominent. There is no setback requirement for buildings in the East Fringe

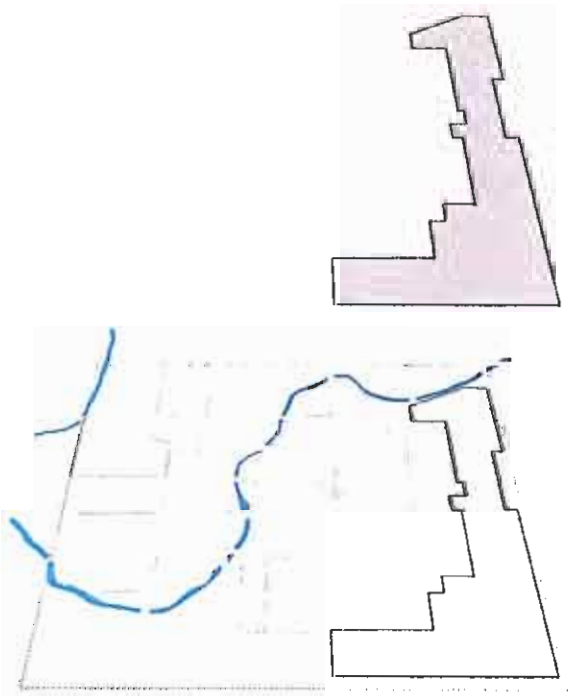


Figure 9. East Fringe

The east fringe has no setback provisions which in result has created an unhealthy street environment caused by buildings overcrowding the streetscape allowing little to no room for street tree planting and landscaping

Due to this no setback rule, there are numerous spaces dominated by continuous wall structures that provide the opportunity for vertical greening. There are also a number of car parks and unused spaces that completely hard surfaced accompanied by no greenery to help slow storm water runoff or any type of street tree to provide cooling in the summer.

There are a number of laneway systems that could possibly be designed as green linkages throughout the city that connect into other developed lanes. The idea of greening the lanes such as Poplar Lane could provide opportunities through green roofs providing those who live within the lanes with community gardens.

The continuation of High street needs to be developed more as a pedestrian street with wider footpaths and greater catchments areas for runoff. At the moment existing street trees have a very minimal soil catchments zone with poor soils and no accompanying plants.

8.4 West Fringe

Similarly an area of transition, this area of the central city to the west of the Avon River has a comparatively open character, where the scale of buildings is modest compared to the Frame and where there is greater scope for planting.

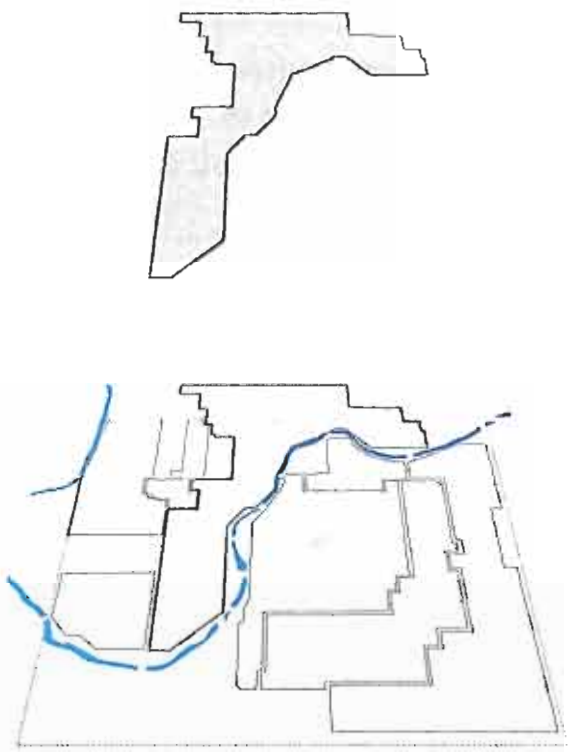


Figure 10. West Fringe

Buildings, and the use of any part of a site not undertaken in a building, shall be set back a minimum of 4.5 metres from road boundaries and the setback area landscaped except that:

(i) Buildings shall be built up to road boundaries along the full frontage of the site on sites fronting Colombo Street, between Kilmore and Salisbury Streets; and

(ii) For sites fronting Victoria Street, between Kilmore and Salisbury Streets there shall be no setback requirement.

Due to the west fringe having an open character and having a subtle building scale, there is a much greater scope for greening than the previous zones discussed.

The policy states that buildings, and the use of any part of a site not undertaken in a building, shall be set back a minimum of 4.5 metres from road boundaries and the setback area landscaped allow for the addition of greening to occur primarily through street planting and turf strips.

In comparison to the rest of the city this area would be the greenest due to its prominent cultural spaces which is home to mature street trees, ivory covered structures, and multiple green spaces such as the art gallery and arts centre which have good examples of public turf spaces.

Once again the north to south street tree system seems to be very weak especially along Cambridge terrace

Within this zone there are a number of large car parks, which have the potential to be turned into public spaces such as the Central City Police car park.

Worcester Street has the potential to use permeable materials due to its pedestrian orientated function and lack of vehicle movement.

8.5 City South

An area of comparatively low scale, space extensive building development and few notable buildings or open spaces, the City South area has development opportunity to a lower scale and bulk than other areas in the central city.

Buildings, and the use of any part of a site not undertaken in a building, shall be set back a minimum of 4.5 metres from road boundaries of sites fronting Durham, Manchester, Madras, St.. Asaph and Tuam Street , and Moorhouse Avenue and the setback area landscaped.

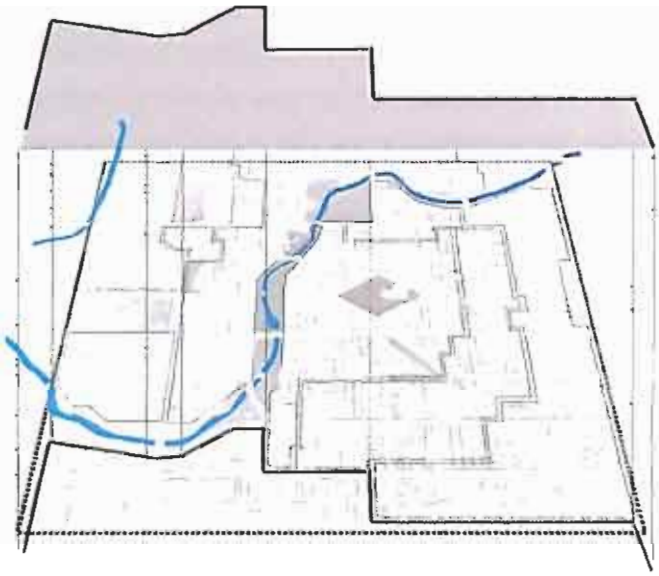


Figure 11. South City

South City.

The current urban environment of south city is tired and run down and seems unconnected to the public realm. In response to this the Christchurch city council has recognised this zone of the city to be the next stage in the central city revitilisation strategy.

The recommendation for this area looks at establishing an internal system of mews, lanes and alleys connecting one to the other across city blocks.

Overall the south city ward has the least amount of existing greenery and has the prominent hardscaped spaces such as car parks, shopping centres and large scale building coverage, all of which are accompanied by minimal to no street greening methods.

Street trees are rare and incomplete, pedestrian footpaths are narrow and exposed due to lack of verandas within the area and street planting is a rare find.

Photo 29. Continous hard surface wall with minimal setback along Bath st.

Photo 30. Unused space along Bath street.

Photo 31. Poor street scene along Colombo st. Narrow footpaths

Photo 32. Poor street scene along St. Asaph. Minimal setback provides no room for vegetation of any kind.

Photo 33. Dwell and structures on Bath street, opportunities for greening on facades.

Photo 34. Industrial carpark space with no street trees or vegetation to break up the hard surfaces

8.6 Street Tree Policy.

Where the use of any part of a site is not undertaken in a building, that part of the site; With a road frontage of at least 10 metres shall be planted with a minimum of one tree, plus one additional tree for every 10 metres of road frontage (e.g. 10 metres frontage - 2 trees , 20 metres frontage - 3 trees , etc.)

Where three or more trees are required these trees shall be planted no more than 15 metres apart, or closer than 5 metres apart.

Any trees required shall be planted along the road frontage.

In addition to the above, one tree shall be planted for every 5 parking spaces provided on the site. Trees shall be planted within or adjacent to the car parking area.

Any trees required by this rule shall be of a species capable of reaching a minimum height at maturity of 8 metres and shall be not less than 1.5 metres high at the time of planting.

Protection of street trees and landscaping.

Any trees required under Clause (e) above shall be located within a planting protection area around each tree, with a minimum dimension or diameter of 1.5 metres.

No more than 10% of any planting protection area shall be covered with any impervious surfaces.

Planting protection areas and landscaping adjacent to a road boundary or adjacent to or within a car parking area shall be provided with wheel stop barriers to prevent damage from vehicles. Such wheel stop barriers shall be located at least 1 metre from any tree.

Maintenance of landscaping

Any landscaping or trees required by these rules shall be maintained, and if dead, diseased, or damaged, shall be replaced.

8.7 Christchurch Central City Summary.

Currently the Central City is divided up into 5 zones, the core, the frame, the west fringe, the east fringe and also south city. Each zone has different provisions required for the street scene, setback, and site coverage and planting which is designed around the primary land use of each zone e.g. business, mixed use or residential.

In summary the Christchurch City Plan has very minimal provisions for greening the city. Currently setback provisions throughout the city provide little space for greening, and if present the greenery is minimal with no environmental function.

One other thing that is mentioned in the city plan is the provision of street trees which make up an incomplete system throughout the urban environment. Each Street tree that is present has little supporting soil at the base in which it needs to gain nutrients. The City council needs to provide large catchment areas for these street trees's to enable them to grow and become susceptible to the harsh urban environment.

The street scene is vehicle prioritised due to narrow footpaths. The large hardscaped areas are not catered for which could be through providing rain gardens that will create a healthy pedestrian environment and also benefit the environment through capturing runoff and increasing biodiversity.

Also in regard to the dominant hard surfaces in the city, there are no provisions for permeable surfaces which ideally could be used for cap parks or even to the extent of the tramways which run throughout the city.

There are so many other greening possibilities that the central city has not even considered within the city plan.

9.0 Greening Methods.

9.1 Introduction

If the objective of getting 30,000 into the central by 2040 succeeds then there are going to be a number of environmental effects that will need to be accounted for such as the urban heating affect, the increase in pollution and also the increase of stormwater runoff due to the large amounts of hardscaping in the central city.

In response to this there are a number of greening methods that can be incorporated into the urban landscape to prevent these problems and also providing a number of benefits as mentioned early.

Currently Christchurch has minimal green elements incorporated into the central city landscape. Among those used, many provide no ecological function towards the environment and are in place purely for the attempt at creating aesthetics such as raised planter boxes and corner garden patches that have no interaction with drainage systems.

There are so many possibilities for greening not only on the ground plane but more notably vertical structures. The following examples discussed are taken from a wide range of countries, internationally and locally giving some insight into how these methods can be mitigated into the Christchurch urban environment.

9.2 Green Walls

Green walls have historically been used for ornamental rather than functional purposes, but if designed properly they can benefit the natural environment, building performance and aesthetic qualities of a space. While green walls are currently not a common landscape element, their range of costs and ability to promote green design without reducing a building's footprint means they may be selected for many projects in the future. There are a series of methods of you can green a wall:

Photo 38: [illegible]

Photo 39: [illegible]
Source: [illegible]

Plants on Facade

Vines growing on or overhanging a building facade qualify as a green wall. A well-established vine can produce many of the same benefits as a more expensive engineered system, including evapotranspiration, stormwater slowing and aesthetic improvement. However, providing for the needs of the plant does require some important design considerations. Most vines require some additional support to climb a building facade (Newton,1993).

Plants on Cable System

Cable systems can provide support for climbing plants, and allow for a wider range of design flexibility. Cable systems can be aesthetically striking because the component parts are usually of high quality, and are adaptable to a variety of design styles. Budget should be a consideration in the design of a commercial system due to possible high costs. Custom built systems are an option which can be much lower in cost and provide even more flexibility in design, but may not be able to work in larger scale applications. Plants which are able to climb a facade without support should not be specified for use with a cable system (Greenfactor, 2007). Plants which use twining and tendrils for support are appropriate.

Photo 40. Jakob Wall green wall system.
Source: www.ecobuild.co.uk

Modular Trellis System

Modular trellis products come in a variety of sizes and shapes to fit almost any project. Their design creates support for a wide range of plant types, and they can be installed as a freestanding structure or next to a building facade. Both sides of a freestanding green wall can be counted, as long as there is 12cm of clearance with any adjacent walls (Newton,1993).. Their modular nature makes them easy to combine with cables or other climbing mechanisms. Being able to support a variety of plants allows a higher degree of flexibility in planting design. This means that shorter plants can be combined with more vigorous growers, for a higher level of coverage and seasonal variety. Plants which support themselves through twining, tendrils and some scrambling plants can grow on most modular trellis systems.

Photo 41. Green Wall at Musee du quai branly, France.
Source: www.quaibranly.fr/

Modular Green Wall

Modular green walls consist of a support framework populated by pre-planted trays. The functional and aesthetic benefits of green walls are near their maximum the day they are constructed. Though they do provide "instant green", the associated maintenance and resource usage, as well as the high cost, should be considered when designing a modular green wall. They provide the benefits of cooling the surrounding areas and can be adapted to use stormwater in their irrigation system. A growing variety of plants are available for use in these systems, including native, fragrant and flowering plants. As these systems have only recently begun to be constructed, their long term viability and maintenance requirements are still being assessed.

9.3 Green Roofs

Roof gardens, are not a new phenomenon, many have existed atop buildings for decades, however, such (intensive) roof gardens are expensive to build, and require a lot of modification of roofs to support the increased weights associated with soil and plants. The new paradigm is for (extensive) roof systems. The principle involves providing a very thin layer of soil over the roof structure that supports low growing vegetation. Extensive green roofs are the lightweight, modern versions of the sod roofs that are a centuries-old tradition in Scandinavia. Extensive roofs do not necessarily require flat roofs and can be installed on roofs with slopes of up to thirty degrees if provided with a raised grid structure to hold the growing medium in place, Ignatieva et al (2007). They are not intended to be walked upon and generally do not feature pedestrian access. In contrast to conventional roof gardens, that require irrigation systems, fertilisation and frequent maintenance, extensive green roofs require little or no irrigation or fertiliser (Simcock & Whitelaw, 2006).

Benefits of a Green Roof?

Green Roofs are a key Low Impact Urban Design technology to lower the impact of stormwater runoff in urban areas with high roof coverage – the roofs store rainfall, working like sponges to reduce and slow runoff into stormwater pipes, cumulatively helping lower downstream impacts of flooding, stream bank erosion, and stream degradation (Newton,1993).

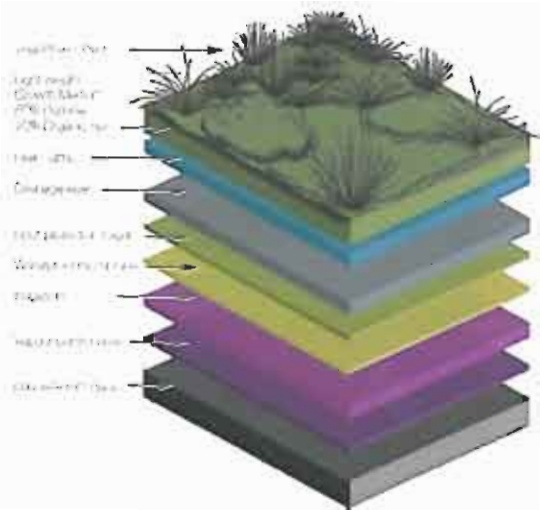


Figure 12. Extensive green roof profile for a New Zealand house. Design: Lucas Adam, 2007.

Extensive (thin) Green Roof

Extensive green roofs feature drought-tolerant plants growing in a thin layer (50–150 mm) of lightweight soil (<150 Kg per m2). They are too fragile to be accessible to the public. The main function of this type of green roof is stormwater reduction, retention and filtration, moderation of the urban heat island effect, and creation of habitats for insects, plants, birds, and even lizards. In northern continents the most commonly used species for extensive green roofs is stonecrop, Sedum spp., but these are weeds in New Zealand, so we need to consider local alternatives, Ignatieva et al (2007).

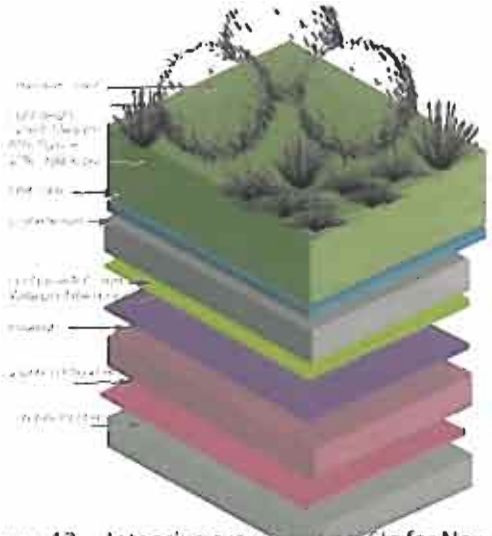


Figure 13. Intensive green roof profile for New Zealand houses. Design: Lucas Adam, 2007

Intensive (partial) Green Roof

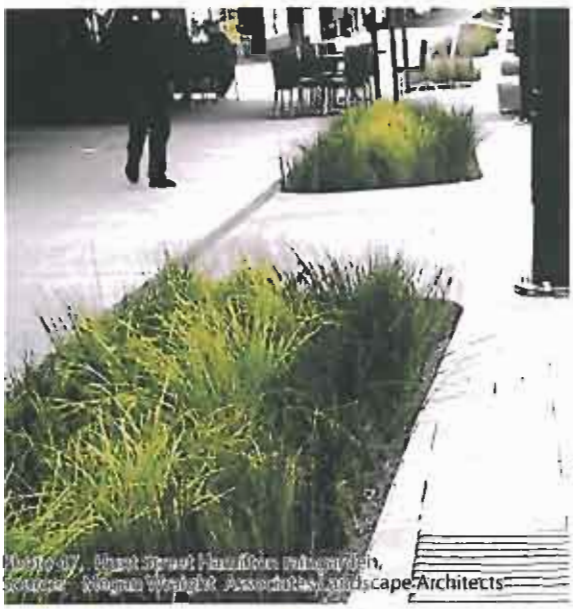
Intensive green roofs usually consist of irrigated containers of deep soils, allowing the growth of shrubs and even small trees. They require intensive maintenance in terms of watering and weeding. They are usually designed to provide accessible amenity space. Because they require considerable structural support they are much more expensive than extensive roofs, and impractical in most domestic situations, Ignatieva et al (2007).

Plants for Christchurch green roofs (dry southern)

Crassula sieberiana, Zoysia minima*, Oxalis exilis*, NZ St.. John's wort*, Acaena buchananii*, A. microphylla*, Cotula australis, Carex breviculmis, C. resectans*, Geranium sessiliflorum*, Gnaphalium audax, NZ iceplant*, onion-leaved orchid, sun orchid, sand convolvulus*, Convolvulus verecundus, Epilobium cinereum, E. nummulariifolium, E. rostratum, sea spurge, Haloragis erectus, Lachnogrostis spp.*, Leptinella minor*, L. serrulata*, NZ linen flax, blue tussock, Deyeuxia avenoides, plume grass*, blue wheat grass, rice grass, Poa lindsayi, P. imbecilla*, danthonias*, Dichondra brevifolia*, D. repens, adders tongue fern, Gonocarpus aggregatus, knobby clubrush, Stackhousia minima, Stellaria gracilenta, NZ iris, scabweeds (Raoulia australis, R. monroi, R. tenuicaulis)*, Pyrrosia eleagnifolia, Einadia spp., Helichrysum filicaule, holy grass, NZ groundsels, silver tussock, Festuca actae*, F. novae-zelandiae, F. coxii, mat pohuehue*, leafless pohuehue*, Coprosma atropurpurea, C. petriei and Leucopogon fraseri.

9.4 Rain Gardens

Bioretention facilities promote high factors that reflect the functional benefits of stormwater cleansing and volume reduction, habitat creation, aesthetic improvement, and education opportunities that come with the construction of well designed bioretention areas.



Courtesy, [illegible] Landscape Architects

Photo 48. Los Angeles Green Street planters, Source: www.lastormwater.org

Photo 49. Filtration planters, Warren park sydney Source:

Photo 50. Stormwater planters, Portland.

Rain Gardens and Bioswales

Rain gardens and bioswales are typically vegetated depressions located on grade. Their main functional value is the retention and infiltration of stormwater. Acting as a filter for runoff from permeable surfaces, they reduce pollutants which enter storm systems. Often simple in design and construction, they create a high level of function for a low cost. Larger space on grade, with properly draining soils are required for the construction of these features.

Stormwater Planters

Stormwater planters are containers designed to capture and either retain or infiltrate stormwater based on their design. The amount and frequency of water captured depends on storm events, so they should be populated with a variety of plants adapted to both wet and dry conditions. Visually they can be striking landscape features providing a high functional value. While more expensive than bioswales, stormwater planters provide many benefits and are appropriate for areas with space constraints or on structure (Greenfactor, 2007).

Native plants for raingardens

Plant species are separated into those suited to 'high' and 'low' rainfall climates. 'Higher rainfall' species are also suitable for gardens in drier climates where there is imperfect drainage and have a relatively large catchment, such that even 1–2 mm of rain delivers considerable water to the rain-garden. Conversely, low-rainfall species should be considered in 'wet' climates if the raingardens are very large, sandy (low water storage), or in areas with infrequent, but high-volume rainfalls , Ignatieva et al (2007).

Carex virgata, C. flagellifera, C. comans, C. testacea, other short tussock sedges, NZ iris, inkberry, rushes, oioi, Chiono-chloa flavicans, knobby clubrush, wind grass, sea spurge, sand convolvulus, Coprosma propinqua, sand coprosma, korokio, shrub pohuehue, scrambling pohuehue, tauhinu and mat pohuehue.

9.5 Street Trees

Christchurch's street tree situation at present is incomplete and unfunctional. The street tree's that are present are small and narrow due to thin walkways providing little shade in the summer and add minimal greenery to the central city.

More than any other component, street trees provide the functional benefits needed to create livable cities. Fresh air, shading and cooling all enhance the feeling of areas near trees. Their use in defining space can bring the urban experience down to human scale and make everyday places more interesting. Plus, all of their functional benefits increase with age. Growing and maintaining an exceptional urban forest can be achieved by including trees in every project (ReLeaf, 2009). The introduction of tree's can be categorized into small trees, medium tree's, large tree's and also the preservation of existing trees (Greenfactor, 2007) and can be grouped to create urban forests or groves forming small areas of biodiversity acting as stepping stones to the wider environment.

Photo 51. A stand of kauri near Britomart Auckland City.
Source: Robyn Simcock

Photo 52. Rock garden. The Bush City, Te Papa, Wellington
Source: Maria Ignatieva

Photo 53. Native Cabbage tree grove Wellington
Source: [illegible]

Photo 54. Existing exotic tree in Christchurch Central City Manchester St, one of few existing.

9.6 Permeable Ecological Surfaces

One of the most effective means of slowing rapid stormwater runoff is to minimise hard surfaces and use only permeable materials for hard wearing or vehicle standing. Typical examples are paths, decks, driveways and car parking areas. Permeable paving is best used where there is low traffic loading, light vehicles (cars, not trucks), and relatively clean stormwater – this limits compaction and sealing of the surface with sediment. The most effective materials have a moderate to high infiltration rate (or permeability, at least 10 mm/hour and up to 1000 mm/hour) and water storage volume Ignatieva et al (2007). Coarse materials such as gravel and wooden decking generally have the highest infiltration rates. The volume of water that can be temporarily stored is increased by thickening the depth of sand that often forms the stable base for permeable surfaces.

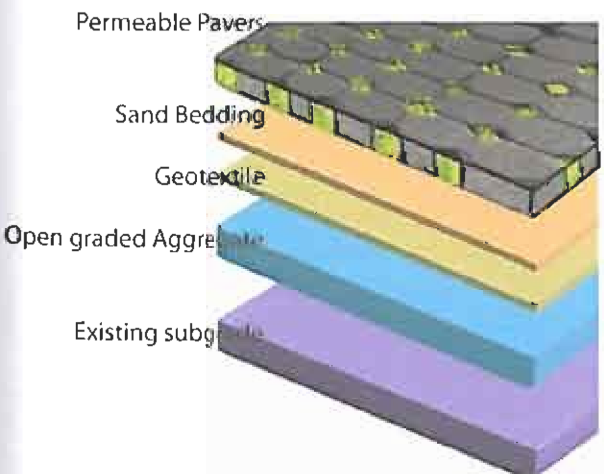


Figure 14. Permeable Paver Profile, Source : www.seattle.gov/dpd/

Permeable Concrete

Permeable concrete can be used in place of impervious concrete in many non-driving situations. Its use in parking lots can help reduce the amount of stormwater runoff and non-point source pollution reaching our streams. Its design and use is in some ways more complex than traditional concrete and it is not always appropriate in some situations. However, the high functional benefits should be considered along with the higher complexity and cost.

Permeable Asphalt

Permeable asphalt can be used in some cases to replace traditional asphalt and allow for infiltration of stormwater.

Permeable Pavers

An overflow drain must be installed in storage areas to allow capacities which exceed the storage area to escape. Permeable paving should not be used in areas which store or process hazardous waste (Greenfactor, 2007).

9.7 Summary

In order to achieve greater significant improvements within the urban environment, there is the need for greater greening interventions from a holistic concept which includes the recently discussed green walls, green roofs and green streetscape elements.

The greening methods discussed are all very applicable to the Christchurch environment, all of which can be applied to a commercial, residential, public or infrastructural development.

It is easy to express the benefits of integrating these green elements into the urban environment, but it's the way we go about it that is the difficult part. With there being no existing requirements for these green elements in the city plan, the idea of integrating green features into developments would prove difficult due to the extra costs.

10.0 International Development Provisions

It is all well and good explaining the methods of greening that we can integrate into the urban environment, but it is more important to take note on how we can incorporate these greening methods into the Christchurch City Plan.

There are a series of international examples that have turned greening methods into policy within their own city plans using a scoring like system. This scoring system requires each new development to incorporate these methods into their proposal, requiring for example 30% of the site to be greened through the use of the elements discussed earlier.

The following examples come from Berlin, Seattle and Singapore.

10.1 Berlin Biotope Area Factor.

An important goal of urban development in Berlin is the reduction of the environmental impact in the city center. Improving the ecosystem's functionality and promoting the development of biotopes, while maintaining the current land use. Similar to the urban planning parameters used in development planning, such as the gross floor area, the site occupancy index, and the floor space index, which regulate the dimensions of use structures, the BAF expresses the area portion of a plot of land that serves as a location for plants or assumes other functions for the ecosystem.

The BAF contributes to the following environmental quality goals:

Safeguarding and improving the micro climate and atmospheric hygiene,
Safeguarding and developing soil function and water balance,
Creating and enhancing the quality of the plant and animal habitat,
Improving the residential environment.

Areas of application

The BAF covers urban forms of use - residential, commercial, and infrastructural - and formulates ecological minimum standards for structural changes and new development. All potential green areas, such as courtyards, roofs, walls, and firewalls, are included in the BAF.

The BAF values listed in the table below are applicable to the various development and use structures.

$$\text{Biotope area factor (BAF)} = \frac{\text{ecologically-effective surface areas}}{\text{total land area}}$$

Figure 15. The BAF expresses the ratio of the ecologically effective surface area to the total land area.
Source : www.stadtentwicklung.berlin.de

Types of surfaces and weighting factors:

	Sealed surfaces 0.0	Surface is impermeable to air and water and has no plant growth (e.g., concrete, asphalt, slabs with a solid subbase)
	Partially sealed surface 0.3	Surface is permeable to water and air; as a rule, no plant growth (e.g., gobi block, mosaic paving, slabs with a sand or gravel subbase)
	Semi-open surfaces 0.5	Surface is permeable to water and air; infiltration; plant growth (e.g., gravel with grass coverage, wood-block paving, honeycomb brick with grass)
	Surfaces with vegetation, unconnected to soil below 0.5	Surfaces with vegetation on cellar covers or underground garages with less than 80 cm of soil covering
	Surfaces with vegetation, unconnected to soil below 0.7	Surfaces with vegetation that have no connection to soil below but with more than 80 cm of soil covering
	Surfaces with vegetation, connected to soil below 1.0	Vegetation connected to soil below, available for development of flora and fauna
	Rainwater infiltration per m^2 of roof area 0.2	Rainwater infiltration for replenishment of groundwater; infiltration over surfaces with existing vegetation
	Vertical greenery up to a maximum of 10 m in height 0.5	Greenery covering walls and outer walls with no windows; the actual height, up to 10 m, is taken into account
	Greenery on rooftop 0.7	Extensive and intensive coverage of rooftop with greenery

Figure 16. Types of surfaces and weighting factors Source : www.stadtentwicklung.berlin.de

10.2 Seattle Green Factor.

The first of its kind in the US, the Seattle Green Factor provides a flexible approach to building the city's green infrastructure through development regulation.

The Green Factor is a landscape requirement designed to increase the quantity and quality of planted areas in Seattle while allowing flexibility for developers and designers to meet development standards. It currently applies to new development in commercial and neighborhood commercial zones outside of downtown, and is proposed for multifamily residential zones and the South Downtown planning area (Greenfactor, 2007).

Permit applicants in affected zones must demonstrate that their projects meet the Green Factor by using the Green Factor Score Sheet a system that has been copied and manipulated from the Berlin BAF system. The scoring system is designed to encourage larger plants, permeable paving, green roofs, vegetated walls, preservation of existing trees, and layering of vegetation along streets and other areas visible to the public. Bonuses are provided for food cultivation, native and drought-tolerant plants, and rainwater harvesting. As designers add landscape features, the score sheet automatically calculates a project's Green Factor score, allowing the applicant to easily experiment with different combinations.

Green Factor helps maintain and improve livability in growing neighborhoods. In addition to being attractive, green elements in the landscape improve air quality, create habitat for birds and beneficial insects, and mitigate urban heat island effects. The strategy also reduces stormwater runoff, protecting receiving waters and decreasing public infrastructure costs.

Comparative Points and Costs

Each blue bar represents relative unit cost factor (2008 approximation)

Each green bar represents .1 Green Factor score

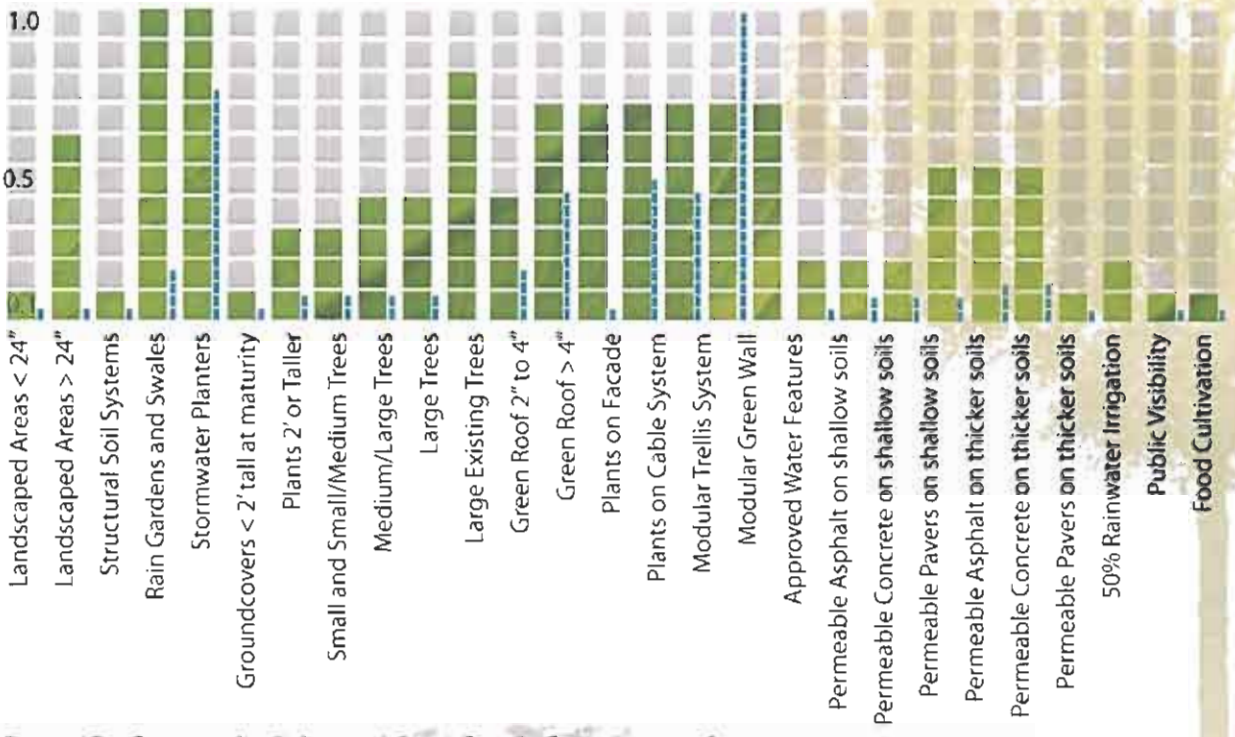
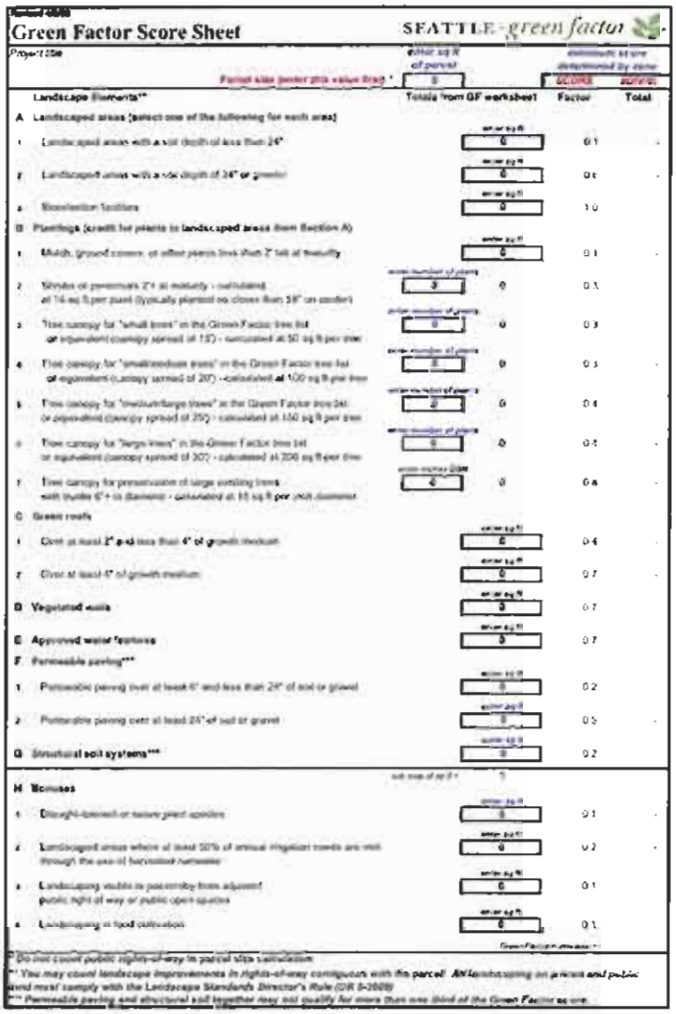


Figure 17. Comparative Points and Costs, Seattle Green Factore: Source : www.seattle.gov/dpd/greenfactor/



Green Factor Score Sheet — SEATTLE green factor

Landscape Elements**	Totals from GF worksheet	Factor	Total
A Landscaped areas (select one of the following for each area)			
1 Landscaped areas with a soil depth of less than 24"	0	0.1	-
2 Landscaped areas with a soil depth of 24" or greater	0	0.6	-
3 Bioretention facilities	0	1.0	
B Plantings (credit for plants in landscaped areas from Section A)			
1 Mulch, ground covers, or other plants less than 2' tall at maturity	0	0.1	-
2 Shrubs or perennials 2'+ at maturity - calculated at 16 sq ft per plant (typically planted no closer than 18" on center)	0	0	0.3
3 Tree canopy for "small trees" in the Green Factor tree list or equivalent (canopy spread of 15') - calculated at 50 sq ft per tree	0	0	0.3
4 Tree canopy for "small/medium trees" in the Green Factor tree list or equivalent (canopy spread of 20') - calculated at 100 sq ft per tree	0	0	0.3
5 Tree canopy for "medium/large trees" in the Green Factor tree list or equivalent (canopy spread of 25') - calculated at 150 sq ft per tree	0	0	0.4
6 Tree canopy for "large trees" in the Green Factor tree list or equivalent (canopy spread of 30') - calculated at 200 sq ft per tree	0	0	0.4
7 Tree canopy for preservation of large existing trees with trunks 6"+ in diameter - calculated at 15 sq ft per inch diameter	0	0	0.4
C Green roofs			
1 Over at least 2" and less than 4" of growth medium	0	0.4	-
2 Over at least 4" of growth medium	0	0.7	-
D Vegetated walls	0	0.7	
E Approved water features	0	0.7	
F Permeable paving***			
1 Permeable paving over at least 6" and less than 24" of soil or gravel	0	0.2	
2 Permeable paving over at least 24" of soil or gravel	0	0.5	-
G Structural soil systems***	0	0.2	
H Bonuses			
1 Drought-tolerant or native plant species	0	0.1	-
2 Landscaped areas where at least 50% of annual irrigation needs are met through the use of harvested rainwater	0	0.2	-
3 Landscaping visible to pedestrians from adjacent public right-of-way or public open spaces	0	0.1	
4 Landscaping in food cultivation	0	0.1	

* Do not count public rights-of-way in parcel size calculation

** You may count landscape improvements in rights-of-way contiguous with the parcel. All landscaping on private and public land must comply with the Landscape Standards Director's Rule (DR 9-2009)

*** Permeable paving and structural soil together may not qualify for more than one third of the Green Factor score

Figure 18. Green Factor Evaluation Sheet,
Source: www.seattle.gov/dpd/greenfactor/

Green Factor Worksheet* — SEATTLE green factor

		Planting Area 1	2	3	keep adding columns as needed			TOTAL**
A1	square feet							0
A2	square feet							0
A3	square feet							0
B1	square feet							0
B2	# of plants							0
B3	# of trees							0
B4	# of trees							0
B5	# of trees							0
B6	# of trees							0
B7	# of trees							0
C1	square feet							0
C2	square feet							0
D	square feet							0
E	square feet							0
F1	square feet							0
F2	square feet							0
G	square feet							0
H1	square feet							0
H2	square feet							0
H3	square feet							0
H4	square feet							0

* See Green Factor score sheet for category definitions

** Enter totals on the Green Factor score sheet

Figure 19. Green Factor Score Sheet,
Source: www.seattle.gov/dpd/greenfactor/

10.3 Singapore Skyrise Greening

There has been a growing interest in sky rise greenery. Rooftop gardens, especially in newer housing estates and have become integral to the lifestyles of many people in Singapore. New and upcoming developments are also featuring sky rise greenery as premium elements in their developments. Sky rise greenery has been given more emphasis in recent years. The government has been actively promoting sky rise greenery through the following ways:

Demonstration sites (e.g. Living Walls in Hortpark, green roof at Punggol HDB multi-storey carpark) Publications (e.g. books on sky rise greenery and plants for green roofs) Research (e.g. research on green roofs and vertical green walls) Incentives (e.g. incentives to promote sky terraces, sky bridges, rooftop pavilions and balcony planting), Authority, U. R. (2009).

There is huge potential for sky rise greenery to change the way cities work and operate, and especially so in a responsible, sustainable and renewable manner. Aesthetic Greening up our city as opposed to the harsh artificial urban environment Environmental Thermal insulation / cooling (countering the urban heat island (UHI) effect) Enhancement of urban biodiversity in the form of additional habitats right in the city Cleansing and anti-pollution in the form of dust particles in the air, as well as for water sources Therapeutic Using greenery and roof gardens as places of calm, tranquillity Pragmatic Optimised land use by freeing up land when we go high-rise
Economic Added value of greenery on properties

The challenge now is to continually devise creative and sustainable landscape solutions to match changing architectural and environmental aspirations. In response to this the Urban Redevelopment Authority (URA) and National Parks Board (NParks) are introducing a series of initiatives to promote sky rise greenery for a lusher, greener Singapore to continue . These initiatives support the Government blueprint for sustainable development launched on 27 April, and contribute toward the Sustainable Development Blueprint target of an additional 50 hectares of sky rise greenery by 2030 (Authority, U. R. 2009).

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The greening of Singapore will literally move to greater heights with the launch of URA's programme, LUSH. NParks is also introducing a pilot incentive scheme to encourage existing building owners to green up their rooftops. Together, these initiatives will encourage greening of urban high-rises and contribute to the vision of Singapore as a City in a Garden. They will also reinforce Singapore's image as a tropical Garden City', an image which will distinguishes Singapore from many other cities. In URA's Concept Plan and Master Plan, land has been set aside for parks and nature areas. We are also extending our park connector network and aim to eventually link up the whole island in a 150 km round island route .

URA actively encourages the provision of greenery within the private realm by encouraging developers to incorporate both ground greenery and sky rise greenery in the form of sky terraces and rooftop gardens. This is increasingly important as Singapore becomes more built up with higher intensity of development. By encouraging and guiding the provision of more greenery, on the ground and vertically, we enhance our living environment through innovative use of our resources, capitalising on our unique identity and enhancing the quality of life of our people.

LUSH is a comprehensive programme that synergises significant new guidelines with existing guidelines which have been fine-tuned, to encourage extensive yet lush greenery for a conducive, aesthetically pleasing live, work and play environment. LUSH will literally take greenery to new heights as the guidelines will further strengthen URA's ongoing efforts to green our city by encouraging developers to provide greenery at both the ground level and the upper levels of high rise buildings. Many people place a premium on having greenery at their doorstep. Hence, the comprehensive programme is a response to enhancing the liveability and aesthetics of our high density physical environment (Authority, U. R. 2009).

The guidelines under programme LUSH will ensure that the urban environment will become even greener. This innovative policy ensures that even as new developments are built, the greenery and landscape areas equivalent to the area of the development site will be replaced either at the ground level, or vertically. As more land is taken up by buildings in high density areas, the mopre singapore wants to encourage the replacement of greenery that is lost to building footprints.

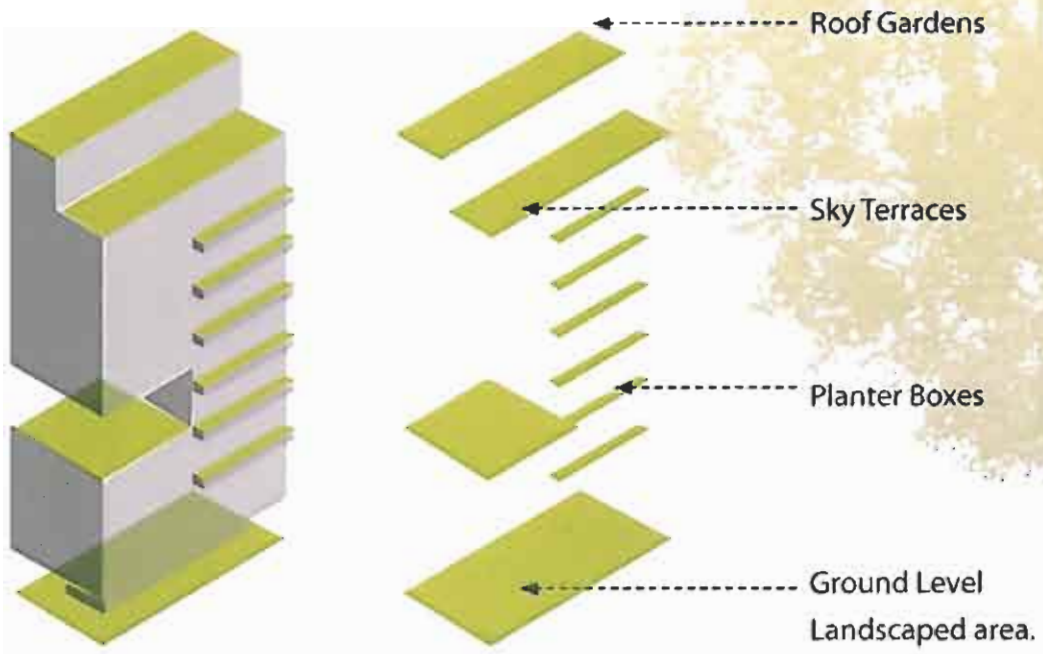
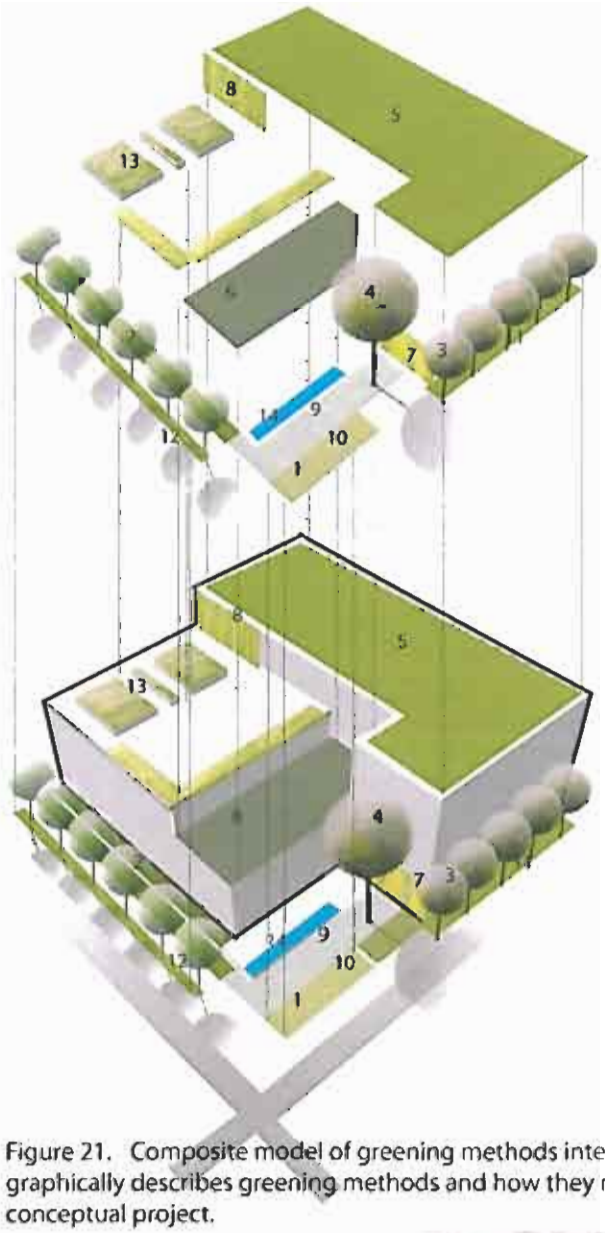


Figure 20. Lush programme Singapore, Diagram showing the various types of Landscape Replacement Areas that could be incorporated within a development As a guide, 40% of these areasare to consist of permanent planting
Source : www.nparks.gov.sg

11.0 Recommendations for Christchurch

The adoption of a legislation similar to the Berlin Biotope factor, the Seattle green factor or the Singapore Lush programme or an amalgamation of all 3 would provide a better urban environment for Christchurch due to cleaner air, cleaner water, greater energy conservation and an all round healthier and more attractive place to live work and play.

Ideally the areas of application would cover residential, commercial, infrastructural and public developments and also take into account structural changes to existing developments. As a guide residential would require 60% greening, commercial developments would require 30% greening infastructural (roads and carparks) would require 30% and public areas would require 60% greening. The wards within the central city would all have the same provisions regarding the amount of green space needed.



1. Landscaped Area
2. Small Tree
3. Medium Tree
4. Large Existing Tree
5. Green Roof Intensive
6. Green Roof Extensive
7. Green Module Wall
8. Green Trellis wall sytem
9. Permeable Paving
10. Drought Tolerant/Natives
11. Stormwater planters
12. Biorention strips
13. Food Cultivation
14. Water Feature

Figure 21. Composite model of greening methods integrated into a new development. This composite model graphically describes greening methods and how they might relate spatially to a building and landscape in a conceptual project.

Figure 22. Laneway network, green coridor concept throughtout south city.

Figure 23. Addition of native trees and module greens through Poplar Lane.

Figure 24. Introduction of Trellis green walls and stormwater planters down Kivers Lane.

Figure 25. Rain gardens and permeable pavers integrated into Worcester st.

Promote the laneway networks and the proposed south city lanes as green corridors throughout the city through green walls, storm water planters, planter boxes and permeable surfaces.

The introduction of permeable surfaces into car parks, street parking and large civic areas to reduce runoff.

Integrate permeable surfaces into the proposed tramway network throughout the city.

The addition of vertical greening onto the existing and proposed developments, through either module green walls or trellis systems.

Introducing pocket parks and urban groves within the urban environment integrating in the laneway network

To promote the idea of green roofs in urban residential areas such as Poplar Lane and Lordships lane. These rooftop areas would act as community civic areas and also possible food production spaces.

Providing a greater soil area around the base of street trees through widening the pedestrian footpaths and accompanying these areas with supporting ground covers.

Increase the introduction of native plants into urban design to increase biodiversity back into the central city.

Figure 26. Permeable paving for streetside parking and greater consideration for street trees and their foundation

Figure 27. Opportunites to introduce pocket parks and urban tree groves into the central city.

Figure 28. Greening vertical elements such as the new Christchurch City Council building.

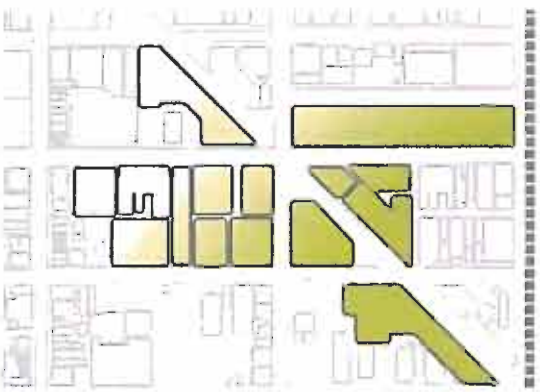


Figure 29. Opportunites to green mixed residential rooftops, introducing community gardens and civic spaces.

12.0 Implementing to the Christchurch City Plan.

Ideally a greening strategy similar to the Berlin biotope factor and also the Seattle green factor would be incorporated into the City Plan and Resource Management Act requiring each new development to abide by its provisions. This legislation would work with the Christchurch City Plan under Volume 2, Policies, objectives and issues and also Volume 3: Part 3 Business zones, which look specifically at five main elements, including the setback of buildings from the street, minimum facade height, outdoor storage, and scale of buildings in relation to streets, and trees and Landscaping.

Alongside these provisions would be a supporting Landscape Management Plan that looks specifically at the maintenance and survival of the green elements introduced. This document would require each new development to maintain its green environment in a healthy manner and also to replace any damaged or dead green elements or otherwise face certain penalties. The management plan would cover aspects such as :

Landscape Management Approach
An overview of priorities and special considerations for the landscape. This section may vary widely from one project to the next; a design may place an emphasis on security, for example, or address how the site minimizes impacts on a nearby creek.

Landscape Management Schedule
A detailed schedule of regular upkeep tasks.

Landscape Management Areas
A summary of important issues for the landscape, organized by type of landscape element.

Integrated Pest Management
Approved methods for preventing or controlling unacceptable levels of weed, pest, or disease damage.

Irrigation
Annual and monthly inspections, scheduling and maintenance.

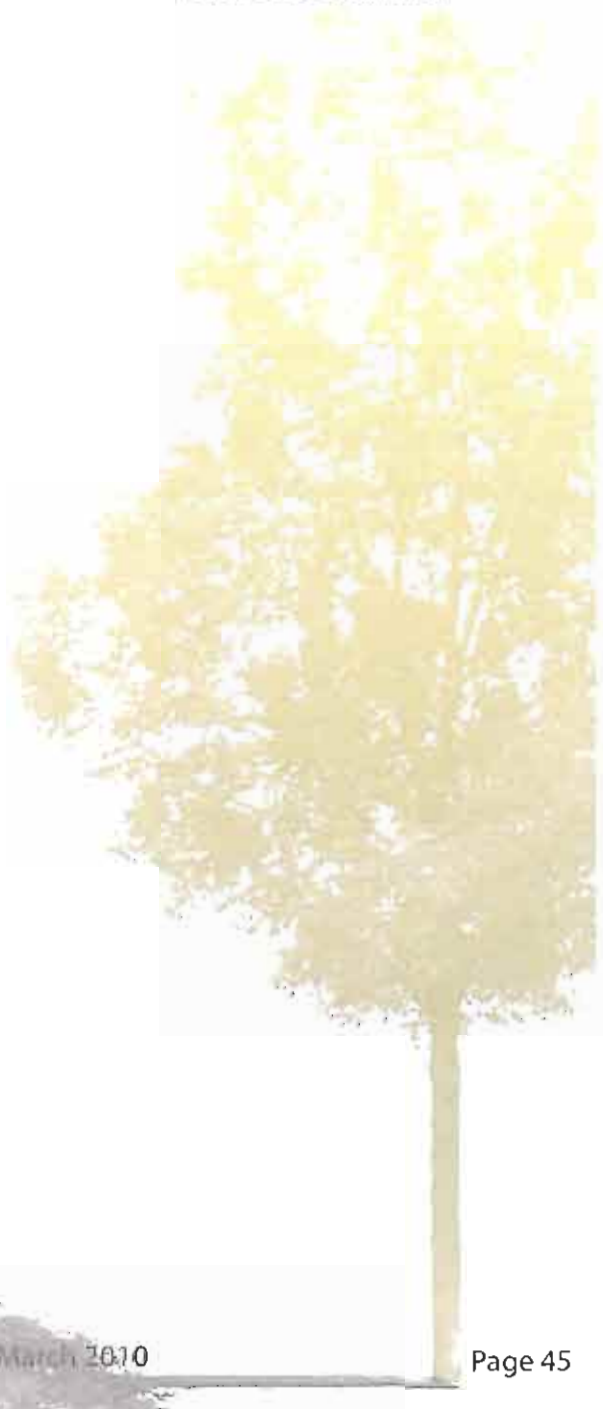
Special Landscape Areas
Street trees, green roofs, swales, pervious paving,

Conclusion

This research shows the potential methods of how the city can be greened. It emphasizes the need for proposing holistic green interventions in order to achieve significant contributions towards improving existing urban environments. However, the research highlights the need for a more in-depth study of how Christchurch can incorporate greening methods into policy.

As a result, the research focuses directly on what existing methods are currently used in Christchurch and what potential methods could be incorporated into the city whilst giving insight into how other international cities have incorporated these elements into building regulations.

The research also suggests the need for a maintenance document which would discuss environmental management issues of each selected green factor.



Research Refelction

The research topic of achieving greater green and the methods used to achieve this was suggested to me through Di Lucas and Associates.

The first stage of the research process would be structuring how to undertake the project through completing a research proposal. This would require a number of related tasks to explain how the report would be carried out; these tasks can be described as identifying the question, the literature review, the research methodology and also the research design stage.

The first part of the proposal stage was to identify the research question followed by the literature which would discuss the relevant areas of information to the project. The research methodology would discuss the approaches one would use throughout the project which would be further described in the research design section which looked more specifically at how one would structure the experiment. I found this idea of writing a brief for one's self difficult, as it was hard to create constraints which may have made the scope of the assignment too large to feasibly finish within the time given.

Coming from a designed based background which is very visual thinking, I found it difficult to structure the project into an experiment-like scenario. I found that the idea behind the research project is to treat it like a scientific experiment. For example, by stating the question, we can come up with an hypothesis for the project, and then state a number of methods of how this predicted hypothesis would be solved which would be described within our research methodology section. From here we would describe the experiment itself, also known as the research design stage.

Methodology of the Report.

The first stage of my proposal took shape through the structuring of my methodology. In my proposal I stated that within my methodology I would use three types of methods to carry out my research which would be: policy analysis, critique and comparative case studies. My methods were to undertake policy analysis first, as it would allow me to gain an understanding of Christchurch's current situation in regard to 'greening'. This knowledge would allow me to go on and critique the current methods used in Christchurch which would lead me to analyse a number of case studies from around the world, which in the end will allow me to make a number of recommendations for Christchurch. The idea behind this strategy was to start very broad in terms of research, learning from the existing local methods and also international methods, and from here provide an-depth and detailed strategy for Christchurch city

Critique Existing Green Methods within Christchurch.
policy analysis and critique.

Compare International Studies.
comparative case studies.

Strategy For Christchurch City.

This enabled me to shape the objectives for my research which would look at:

Identifying the benefits of introducing green elements to the central city and how these green elements affect the city on a biophysical, physiological, social and economical scale.

Identify the existing elements that contribute to the green character of the central city. This includes an analysis of policies set in place by the Christchurch City Council under the City Plan and other city council documents such as the Open Space Strategy, The Central City Revitalisation strategy and recently published Public Life Study produced by Gehl Architects.

Identify greening methods on an international scale; how they have been incorporated into the urban setting and policy and the benefits they have on their surroundings.

Using the methods learned from international cities and applying these examples to Christchurch Central City providing a number or recommendations.

Scope of the Report.

I first noticed the unwieldy process of research when I found that my methodology and the design of my research were possibly too large for the amount of time given.
Time, and keeping up with what I had proposed within my timeline, seemed not feasible by the time I had finished my proposal. This was made even more apparent when undertaking Stage 3 of my objectives which was to:

"Identify greening methods on an international scale; how they have been incorporated into the urban setting and policy and the benefits they have on their surroundings."

The amount of work which would have to be undertaken to come up with an in-depth strategy which could be implemented into the city plan would be large enough for a separate research document where one would look at aspects such as the percentage of greening each new development would need depending on its size, development type, and where it is located within the city. How much each greening element such as green walls and street trees would be worth towards

the provisions required and also the cost within a New Zealand budget. If this strategy was to be undertaken then ideally it would be overlooked by a planner at the city council who has a greater knowledge of legislation and how one would go about implementing a development regulation of this nature into the city plan.

Another topic which I was unable to go into any research detail due to lack of time, was the idea of maintenance and the survival of these green elements within the urban environment. If undertaken, this idea would be in the form of a landscape management strategy for the central city, and possibly look at incentives or penalties for developers who have not met the specific green provisions for the selected proposal.

Literature Review

Overall I found my literature that I gathered throughout my proposal stage to be very general and quite often not applicable to my report. Literature that I did find to be relevant came to my attention later through in the research process, possibly due to my own understanding of what I wanted to achieve and my understanding that what was feasible in regards to time was much greater than it was at the proposal stage.

From the very start of my proposal, the city plan was always going to be one of the main pieces of literature I would use to carry out my report. The city plan was the most complex literature to understand in terms of finding relevant information, policies and objectives and also the location of where these polices were applicable within the city centre.

Other literature that I would not use again if I was to repeat this report would be some of the City Council documents such as the Open Space Strategy which at first I recognised as being an influential document which could support my research, but later found that document to be very vague, and broad with no insight into the approaches the city council are using to green the city. This document could possibly be integrated into the open space strategy making up for its lack of acknowledgement towards actual greening.

The literature I reviewed for gaining examples from international cities was very useful to see how international cities have turned greening elements into building regulations. All three examples provided very in depth analysis of how their own individual systems worked. Optimistically at the start of my proposal I assumed I would get to the stage of coming up with similar strategies or an amalgamation of all three for Christchurch, but as my research carried on, I found there was not enough time to do such an in-depth strategy which would be worthwhile.

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