

ECOLOGICAL CONTEXT, CONDITIONS and POTENTIALS of INNER CITY CHRISTCHURCH

to INFORM PLANNING and DESIGN that ACHIEVES ECOLOGICAL INTEGRITY

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EXECUTIVE SUMMARY

The future of the city will be judged by what happens at its centre and the messages it projects. For it to make a profound statement to the world, it must build on historical gravitas, be inclusive of all the elements of that history, and must squarely face the world we are heading to with intelligence, compassion, creativity and hope. **Ecology is a key perspective**, a window into our nature, and a methodology for a re-imagined sustainable City. Christchurch can be an **eco-city**. An ecological lens shows us that everything is connected – social (including aesthetics and design), cultural, biological, economic, ethical, philosophical and governance! **Ecological literacy** is derived from direct experience and is the basis for mending broken links.

There are a number of critical considerations for the Christchurch rebuild if the city is to secure and strengthen its second city status in NZ through providing a vibrant lifestyle and economy based on and identifying with its particular natural and cultural attributes. Many of these needs and opportunities have an ecological foundation or relate more broadly to a fresh, bold, aspirational and **joined-up** approach to city planning, design and management that is life-affirming, pedagogical and sustainable.

Scientific evidence points to substantial changes in the material conditions of our existence in the foreseeable future and so we must be prepared and resilient, physically and emotionally. Now is the time to build on our progressive and innovative foundations. We will almost certainly have to **transition** to a different paradigm in business, transport, housing, energy, equity, property, social relations and ecology; we need to find a clear, strong identity and celebrate our unique heritage in all its diverse layers – for groundedness, enjoyment as well as for mere physical and social survival.

Fundamentally and existentially this recovery is about **sense of place** and *tūrangawaewae*; being confident about who we are and where we stand. The *kākahu* or *cloak* is a metaphor about the enveloping security of the *whenua* (earth) and connection to the creator and all the life and mineral elements of this land that were created. Perhaps it is a metaphor, a time and a place for joining up ancient with contemporary, nature-based wisdoms and the experiences of first nation peoples with the western science of ecology.

The pathway (*tē ara*) to re-imagining the city is to energise, engage and inform the citizenry and empower them to co-create bold solutions to issues facing the region. We need to start the

conversation so citizens are prepared. The first steps on this path have been taken by the Government agencies charged with discovering and developing the Christchurch recovery. Yet care will be needed to avoid veering towards populism, since with current levels of community understanding or ecological literacy and a confusing battery of ‘fake news’ there can be a mismatch between what people wish for and what is sustainable!

Whatever measures are adopted, they should be designed to give a sense of hope, inclusiveness, meaning and well-being; ideally they will provide a model in the world for generating strong identity within an historically nuanced place, actively respecting all layers, cultures, religions, and social dimensions. This would seem to be a bottom line for a viable, peaceful future. It needs to be achieved without creating a crippling debt burden on future generations and will depend on governance and operational structures where everyone is pulling together to achieve diverse and respected outcomes, while avoiding costly and meaningless constructions or actions. Our niche is going to be at the ‘small is beautiful’ and ‘in praise of slowness’ end of the spectrum – a paradigm shift from what we have been relentlessly pursuing – where ‘bigger and faster is better’. We have to be smart, innovative, joined-up, and calm, to achieve that - a divine balance between nimbleness and contemplation – ‘more haste, less speed’.

Ecological perspective

Ecology is a key pillar of such a plan, organically and thoughtfully integrated into the fabric of the city, not as a green after-thought or just another, lifeless object of design control. Understanding basic **ecological principles** of niche definition, the stress-disturbance-competition (CSR) triangle (for plants), succession dynamics, predator-prey balance (in the NZ biogeographic context), ecosystem assembly rules, edge effects, landscape function and complex interplay of conservation imperatives with social and cultural drivers are fundamental to design, sustainability and long term affordability. **Biodiversity** is a crucial part of place-making, story-telling, learning, as well as sustenance – it is what provides the unique cloak on the land, that only we can ‘market’ as ours and ours alone.

Key historic layers/components of central city ecosystem

The foundation of a city and of a place is its **history**. The following five overlapping and contemporaneous historical layers of the city have been identified and the tangible presence of these across the city is the basis of **legibility**:

- Geo-tectonic/volcanic/alluvial history
- Gondwanic & Glacial/Post-Glacial era biota (papatūānuku)
- Landforms, soils, drainage, water and sea (whenua, tangaroa)
- Polynesian/Tangata Whenua era (projecting forward from about 1000BP to the present and future) (tangata)
- Colonial era (European and later Asian and further Polynesian migration from about 200BP)
- Contemporary Fusion & Evolution – building on a foundation of deeper historic layers.

The general principles and strategic objectives outlined below dictate what is possible and sustainable in landscaping, what ecosystem services are provided, the revelation and validity of all the historical layers represented in the city, the symbolism of vegetation, plants, and wildlife and

relevance to regional identity or sense of place. This is for NZers at large, for tangata whenua in particular, and to visitors.

From each of the broad Principles below (1-8), the subsequent Responses and Actions provide specific and tangible planning and design protocols, guidelines and/or exemplars.

Principle 1 – General Environment, Urban Ecology & Biodiversity status

- The bio-physical environment is the foundation of provisioning, regulating, cultural and passive/intrinsic **ecosystem services**.
- Nature/life is ubiquitous and irrepressible in some form or other.
- Plant growth, reproduction, competition, succession and development of food webs, in response to the physical environment, takes place according to well understood **ecosystem assembly rules**.
- These ecological principles operate the same everywhere - in cities and wilderness.
- In cities nature typically occupies stressed and disturbed sites. These physical drivers define urban niches (within the **stress-disturbance-competition continuum**) – which mimic various natural environments (cliffs, canyons, riverbeds, coasts, wetlands).
- Urban and rural ecology and biodiversity have been internationally acknowledged disciplines since WWII.
- NZ is both a **biodiversity hotspot and an extinction capital** (Canterbury is especially degraded) and consequently we have a special duty to manage nature back to health. This is both an ecological and socio-cultural issue.
- Failing to understand the **biogeographic circumstances of NZ** and its implications for conservation management is more problematic than in continental environments where the biota is adapted to and can cope with greater extremes of climate and to mammalian disruption. High performing alien species, without careful management, displace our indigenous biota.
- In general, therefore our planning, design and management should **work with nature**, rather than against it, in order that the ecosystem services on which we depend (including the intrinsic values of biodiversity) shall not be compromised.

Response & Actions

- Take care of the physical environment through Low Impact Urban Design & Development (**LIUDD**).
- Incorporate **permeable soft surfaces** that allow soakage rather than run-off.
- Develop water features and **treatment trains** around buildings and through the inner city that mimic a natural catchment – feeding water from roofs and possibly grey water through natural filters, rain gardens and stream traces into the Ōtākaro, and restoring the mauri (cf Matapopore narrative).
- Avoid building long-term infrastructure in **natural hazard zones** such as floodplains and coasts; adopting a 100 year strategic retreat plan for the eastern suburbs.
- The concepts of ‘urban wild’ and ‘biophilia’ have been embraced in European and American model cities (Appendix 3), but here our default maintenance protocols suppress

spontaneous biodiversity. Adopt a more sympathetic approach to design and management in order to cultivate a truly '**clean green**' region and city.

- Explore innovative ways of introducing or **encouraging more indigenous wildlife** into the City, e.g. NZ falcons into high rise buildings to help control rock pigeons and starlings.

Principle 2 – Design for Ecological Integrity

- Apply **ecologically informed landscape designs** that acknowledge that plants are alive, dynamic and susceptible to successional processes.
- Ensure planting design is sensitive to **niche differentiation** (natural or constructed) and successional processes, and therefore easier and less costly to maintain.

Response & Actions

- Provide **pocket parks** that have a strong indigenous element – sanctuaries for people and small wildlife.
- Preserve the natural dynamics of plant successions by allowing pioneer nature to exist in disturbed areas of the inner city – leave some periodically disturbed sites bare or with cracks and rough edges to **accommodate these pioneer or 'weedy' plants**.
- Avoid inappropriate designs that are costly or impossible to maintain – e.g. silver tussock in a forest environment rather than **divaricating or scrambling shrubs** along street edges.
- Use innovative designs to **incorporate nature into and around buildings** – green roofs, living walls, rock gardens, indigenous lawns, swales and rain gardens, etc.
- **Rock gardens** provide customised, stressed habitats for dry grassland species (see below).

Principle 3 – Rebalancing Biogeographic History and Natural Character

- **Visibility and accessibility of indigenous nature** is crucial to avoiding 'extinction of experience' and 'nature deficit disorder'.
- Achieve critical mass of habitat and connectivity and incorporate buffered sanctuaries for both creatures and people.
- Acknowledge and equally represent **all layers of history** in the heart of the city.
- Ensure landscape planting is **legible** (reveals zones and patterns that reflect the appropriate ecological niche within the landform sequences of the city, and tells some story of its history or evolution). The metaphor of the ecological cloak or kākahu fits.

Response & Actions

- Ensure **indigenous noble trees** become, over time, of equal dominance to the imported trees.
- The **NZ trees will provide a rich source of fruit and nectar for native bush birds**, like the nectar bearing kowhai (for kereru, bellbirds and tui). This provides a strong landscape statement whereas the original design was to use English trees which would have left the indigenous oioi (reed) as a token. On the other hand totara, and many other native noble trees, are suitable for streetscapes. Avenues may also be a random mix of native and exotic species rather than a monoculture.

- Establish a **strong, visible living presence** of indigenous nature in Cathedral Square to give it equal status and authority to the colonial elements and references to tangata whenua. An ability to walk and tram through a bush section will create a moment of contemplation, reflection and relaxation, literally transport us back in time, and tell the full story of our land. Sculpture may be used to give us a sense of primeval Aotearoa-NZ.
- Support **interpretation** directly or through art, such as the forest trees represented in the Chalice – telling a story of natural patterns and human history.
- A **Canterbury Bush City** would tick several socio-ecological boxes – need for critical mass and protected habitat, show-casing the rich natural heritage of the province, an opportunity for at least some ‘forest-bathing’, an educational story, connecting to tangata whenua and to Neil Dawson’s Chalice.
- An alternative proposition is a **Cathedral Garden** – incorporating the elements of bush city in a different format – a **cloak** wrapping around the shoulders of the Cathedral.
- A **split image of the Cathedral** from a conventional, formal perspective in the front, and a country church emerging organically, from an increasingly indigenous forest on one side and heritage rubble (Principle 4), on the other, may be the **reconciliation** of what at first appear to be incongruous/incompatible world views.
- Rebuild a new aesthetic that values and understands all layers of heritage while fulfilling our obligations to national and international conventions, and constructing an **authentic and unique image of Aotearoa-NZ-Canterbury**.

Principle 4 – Earthquake Memory

- Capture the **spirit of the earthquake response** (recognising and facing up to its historical reality and significance); acknowledging the ‘gap filler’ and ‘greening the rubble’ movements.

Response & Actions

- Develop a **heritage rock/rubble garden** providing a substrate and refuge for a number of rare and endangered plants, invertebrates and lizards of the Canterbury dry plains and crags.

Principle 5 - Biosecurity

- Avoid exotic species that are **potential weeds** or have allergenic properties.

Response & Actions

- Deconstruct conventional mono-cultural park and streetscapes, that harbour visually dominating and invasive exotic trees and shrubs to, over time, eliminate and engage with plant nurseries to curb the sale, supply and planting of some of our **most serious weed species**.
- Progressively replace exotic **ferns** (and other weed species) along river banks with indigenous species.

Principle 5 – Landscape Dynamics & Integrity

- Landscape **connectivity** and critical mass are necessary for a functional nature.

- Achieve **ecological integrity** involving functional landscapes of stepping stones, corridors, sanctuaries (predominantly on public land), within an ecologically sympathetic matrix.

Response & Actions

- Employ the standard text on landscape configuration and function (Meurk & Hall 2006) to guide the **optimal design and configuration of habitat patches**, spacing, and **corridor connections** via streets, green buildings and naturalisation of water courses.

Principle 6 – Accommodating Perceptions and Attitudes

- It is accepted that in the current culture there is a **tension** between tidy/control and more relaxed attitudes. **Reconciling or achieving a balance between these world views** of mono-dimensional control and acceptance of diversity is critical to ecologically and socio-culturally sustainable futures.
- One manifestation of the order and control approach is a '**safer parks**' policy based on minority perceptions of fear that dictate stripping out undergrowth, transforming the NZ forest into a high light, 'English' temperate woodland.

Response & Actions

- Joan Nassauer's "**cues for care**" provides a way of accommodating 'control' without compromising the biodiversity and life lessons inherent in 'urban wild'. Her "messy ecosystems – tidy frames" concept enables **order and life to co-exist**.
- **Review 'Safer Parks' policies** which are detrimental to natural ecology and seek alternative, evidence-based resources to achieve enhanced citizen perceptions of security – such as surveillance, signage/information, policing, night closure, etc.

Principle 7 – Governance, Policy, Planning & Management

- Build an ecologically and socio-culturally literate, sensitive and enlivened city through enlightened governance, operatives and citizens.

Response & Actions

- Achieve **ecological literacy** at all levels in the city hierarchy.
- Involve **ecological knowledge, review and oversight at every step** of design and implementation processes (as in QBL or the 'ring of sustainability') in a 'collaborative learning' atmosphere. Ecology should be an integral part of decision-making teams through technical advisory groups or appointments. But the key characteristic is that the design process is transparent, iterative and sensitive to a broad cross-section of values and expertise.
- **Train** supervisors and maintenance staff to recognise and differentiate our indigenous and pest species – knowing when to remove, when to leave and when to coax.
- Bring the city together, ensuring everyone is housed, fed, clothed, cared for and is able to do meaningful work – leading to **social cohesion**, respect and well-being – grounded in their history.

- **Revisit the Avon River Precinct development** which deviated from the original plan and concept – symbolically and tangibly interweaving the **strands of the Treaty Partnership** representing its combined strength through individual identity and working together. The original plan for the Avon River Precinct (ARP), which was signed off by government, was to weave strands of ‘English’ and ‘Indigenous’ landscape style, back and forth across the river, representing the treaty partners and the strength of that complementary relationship. This was to be manifest as retained, conventional English Parkland along the inside broad floodplains, whereas dense and diverse indigenous bush would be formed along the steep outside bends. This would provide **continuity of habitat as a corridor for bush birds**.
- Demonstrate tangible connection between historic and present waterways that meets **values of Mana Whenua**.

Principle 8 – Assertion of Leadership in Christchurch & Beyond

- The opportunity is now to **exercise leadership** and innovation, to build on or recreate the ‘buzz’ stoked by ‘share an idea’ and the spontaneous upwelling of community creativity.

Response & Actions

- Importantly, the city’s positive, inspirational message to the world regarding ecology, biodiversity, culture and well-being is **backed up by a visibly caring society**. This fits the International Eco-city Framework & Standards vision (<http://www.ecocitystandards.org/wp-content/uploads/2014/07/IEFS-Brochure-2014-b.pdf>).
- Activate centres of higher learning and enlightenment (science alive, eco hub, science hub, central city campus involving all the universities, ARA, CRIs, TRONT, Medical School, DHB, etc.) around the development of a legible and ecologically functional city that has a clear **common vision** for the future.
- Energise a centre of theory, practice, industry and art that captures the spirit of humanity and biophilia, reaching out to a troubled world. This may be termed a **World Centre for creative transitions to Sustainable Futures**.
- Establish an elevated standing place (plane table) that looks out across the city in all directions to the treasures/taonga of the region, tangibly embracing diversity, tolerance, inclusiveness, enlightenment, revelation and peace. These view shafts would capture the essence of a new wave of enlightenment and inclusiveness – a kind of **beacon of hope** for our community, the city, the country and eventually a model for the world.
- Paradoxically the ‘buzz’ may involve a society that slows down, is creative, comfortable in its own skin, and welcoming.
- Project through *ChristchurchNZ* a multi-dimensional city with bold, vibrant new strength and confidence (**an authentic brand**) that inspirationally messages biophilia (eco-city), creativity, rebirth and peace, providing a beacon of hope, a sense of destiny; a model that becomes a ‘must-see’ place in the world and lives up to the NY Times faith in CHCH being a place to watch.
- **An Eco-Tangata city** – as part of a bold new vision - needs to embrace a brand that lifts it out of a limited time frame of history and projects it into a multi-dimensional, multi-layered space – that is many things to many people. Fundamentally, it should be rooted in its history that is what ultimately defines a place. Furthermore, the history needs to be visible (**legible**)

and unbiased to ensure buy in from the whole community and in particular the Waitangi Treaty partners. What is unique about our place is the fusion of Gondwana, South Pacific Maori, and European (western) culture. This is what people come to NZ to see. Every person in Christchurch should be able to walk through, understand and feel comfortable in their history, every day, wherever they are.

- **Regarding the wider geopolitical role of the city** - How may a small city at the bottom of the world do anything worthwhile in face of the 'wicked problems' facing the planet? Well, we have to just work up from small beginnings, be a model and exemplar, innovative and tolerant, welcoming and fascinating, intelligent and humane, wise and fun! This is one proposal for how Christchurch may contribute.
- How will the vision be funded? It will **attract international interest** from the fascinated public and from intellectuals, researchers, NGOs and governments, and bring investment of ideas and energy as well as material resources. The world will be looking for working models for how to deal with the looming environmental and socio-political crises. This is the one opportunity to contribute something worthwhile to the world stage.

An imperative for developing a resilient city based on universal values arises from the accumulating **evidence for global and regional disruption** to 'business as usual'. These trends are again ecological in origin and in manifestation. The most obvious are climate change, sea level rise (faster than expected), effects on water tables and drainage, ultimate impacts on food production and potable water supply, geopolitical pressures on trade and pricing, exposure of an economy based on a few commodities for elite markets, and degradation of the primary resources (freshwater, land and productive soils). This may in the medium term require scaling back of grandiose plans and importantly avoiding over-commitment to indebtedness. There are many implications for land ownership, insurance, equity, and public works which are beyond the scope of this report, but they will eventually impinge on the whole city. The city has a Resilience Plan (Gillooly et al. 2016) which should address these regional and national matters and be meshed in with the city rebuild. Importantly, we will not be immune from these likely future shocks so we had better do what we can.

Possible responses to these challenges are prefigured in the above abbreviated propositions - energising Christchurch through a creative centre of theory, practice and art gravitating around a city that is comfortable in its skin, recognises all the layers of its history (as visible living entities), cares for and engages all its citizens, conspicuously embraces its cultural and ethnic diversity through sight lines to all the regions cultural and natural treasures or taonga, draws a line in the sand with respect to intolerance, and reaches a hand out to the rest of the world. The recent change in central Government would seem to herald a fundamental rethink of the future, and a commitment to free tertiary education could be a catalyst for a more intellectually expansive culture. Christchurch should get with these opportunities in a collaborative spirit.

Any **city of worth** must be built on its history, equity, humanity, intellect, innovation, leadership, contribution to the nation and the world. It must be joined up to the past, the present and the future. There is a crucial role for ecology here. It must be able to tell this story with confidence and courage and perhaps just a little bit of pride, humour and fun. To do this those responsible for branding and marketing the city need to be more innovative, connected and networked to the fusion and energy of the place.

REPORT STRUCTURE

In order for the client to focus on the results, outcomes and options rather than the supporting discourse the report has been structured so that the theoretical and dialectical background or detail has been presented in appendices. These are nevertheless essential to full comprehension and justification of propositions and recommendations made in the body of the report. The author has chosen to include this material since it is germane to understanding the peculiar ecological and sociological circumstances, interconnections and transitions in which we currently find ourselves. Not only do we live in a unique biogeographical setting, we have suffered a 'once in a century' cataclysmic event and all the portents are that there are more shocks to come over the remainder of this century (natural and geo-political).

Optimistically, we can say that, whereas it will not be enough to follow a tried and tested, business as usual approach, there are exciting, creative opportunities that build on our considerable assets and resourcefulness. These give hope for our personal fulfilment as individuals and as a city, but these learnings may be exported as models or experiments, even a beacon, to the rest of the world. This will not only directly support our own resilience, but contribute to the local economy through attracting interest and investment. As I will show, an ecological lens and a biophilic principle are vital ingredients for re-imagining and designing a positive future.

The organisation of the report follows the contract brief to:

1. Define the basic, underpinning ecological principles;
2. Describe the eco-historical layers of the inner city through to the present day;
3. Derive strategic environmental objectives and potentials;
4. Apply the principles and recommendations for planning, design and action within an overall central city strategy that realise the potentials and imperatives.

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CONTRACT

Regenerate Christchurch has contracted Colin Meurk Consultancy to review and analyse the ecological condition and potentials of the inner city (project area). Key components of this task are:

- Brief overview and summary of existing ecological research, knowledge and issues (this has been interpreted as including at least reference to impact of the wider global context).
- Outline of key historic layers/components of central city ecosystem.
- Outline strategic environmental objectives, and the supporting case or benefits, which will protect existing values and regenerate lost values or ecological potentials within the context of competing demands and land uses, integrated or embedded within cultural perspectives.
- Develop principles that can be applied in actions (planning and design protocols, guidelines and exemplars) that will realise the ecological potentials (regenerate and interpret the ecological layers) within an overall central city development and recovery strategy.

The project area under consideration includes Cathedral Square and surrounding blocks, bounded by Kilmore and Hereford Streets in north and south, and Durham and Manchester Streets in west and east.

Since the contract was formulated the following **objectives/principles** for the inner city were devised by Regenerate Christchurch:

- Breathing new life into the City (this is also one of key concepts of Matapopore/Ngai Tahu Narrative)
- Prioritise small business, creativity, activate
- Improved access and experience
- Strengthened ecological integrity
- Show-case bi-cultural aspect
- Capture spirit of response to EQ

The following **Key Moves** are intended (paraphrased):

- Reshape square so it becomes a more lively public space
- Frame the Square [cathedral?] with structures & buildings [landscape?] that stimulate arts, creativity, enterprise, knowledge & education
- Improve connectivity through and around the Square
- Upgrade streets and lanes between hubs of activity
- Integrate water and indigenous ecosystems in streets and public spaces
 - Natural, structured, playful
 - But organic – pergolas, green roofs, living walls, heritage rubble
 - Note native trees/shrubs have distinctive look – texture/form/shape/colour

PREAMBLE – THE CONTEMPORARY CONTEXT

Thinking first about the local circumstances of Christchurch - David Killick (The Press, 4th August, 2017) recently wrote of the “threat to NZ’s future” posed by the ‘colossal’ over-dominance of Auckland. Meanwhile, Katie Brennan found Christchurch “depressing and desolate” (The Press 19th August, 2017). I have heard other young people living in the city suggest that whereas ‘locals’ think it is exciting and cool, outsiders are more like Katie. And today Anake Goodall spoke of Christchurch missing the boat by rebuilding yesterdays’ city (The Press, 26th August, 2017).

There is one view that Christchurch is a closed shop driven by an ‘old boy’s network’. Are we really that disconnected and unwelcoming to the outside, especially younger, world? I remain somewhat sceptical about how much worse the city is than other places (The Press, 26th August, 2017 reported “Race worries at Auckland University as students fear for safety”). There are positive stories too and many (olders?) seem to like Christchurch. A recent immigrant from Auckland has nothing but praise

for the warmth and friendliness of locals. These are not objective analyses, but suggest that it all depends on the individual experience that people have. A reputation is hard to gain and to lose. Whatever the real situation, there is little doubt the City needs to up its game - increase its vibrancy index, with a higher density of good stuff and a greater probability that more people will intersect with that side. Apart from any inherent tendencies among the local population, there is the opportunity to promote positive messages, images and symbols in public spaces and in events run by local government that reinforce inclusive attitudes and behaviour. The newly minted *ChristchurchNZ* marketing arm of local government clearly has a critical role to play here and needs a serious review of its conventional thinking about our brand and what to promote.

There is a lot that can be done there in an exemplar or role model capacity, and this report hopefully contributes to viewing the city as a 'place to be' with meaning, greening, wilding, purpose and vision – all ingredients of physical and emotional well-being, and contributing to or generating a confidence about our place. This will be necessary if the city is serious about promoting and projecting a positive, sophisticated, historically rich, caring and attractive image.

There is another equally important context that cannot be ignored – that of an increasingly dysfunctional wider world. Suffice to say; whereas the NZ 'sub-continent' has been biologically isolated from mainstream evolution for 80 million years, we are no longer protected from what is happening in the rest of the planet. I will come back to the historic role we may yet play in this global theatre. But it is no time to be timid. We can be aspirational and inspirational, and lead by example with intelligence, respect, frugality, modesty, humility ... and ecology.

The following report addresses the four broad requirements of the contract while being cognisant of the objectives and key moves developed by Regenerate Christchurch as outlined above.

ECOLOGICAL PRINCIPLES – THE BASIC UNDERPINNING OF THE REPORT

Ecology is one of the four pillars of sustainability recognised in New Zealand – alongside business/economics, social well-being, and cultural integrity. The long-adopted rhetoric of **quadruple bottom line** (QBL) claimed to be essential to sound decision-making. However, ecology, this most fundamental component of sustainability, is invariably treated as the junior partner as evidenced in the typical make-up of boards, executives, and committees. There is no legal or statutory requirement to have representation of ecology in these roles, only that it be a consideration (RMA 1991), one that has been continually challenged through case law, in contrast to strong protection of biodiversity in Europe (Appendix 5). Accordingly, unlike the other three pillars that are invariably represented by professional business, social or cultural ambassadors, the 'environment' is treated as common knowledge and therefore doesn't merit specialist advocates at the board table. It is qualitatively differentiated, as being subjective, biased and with 'an axe to grind', from the other professions and therefore not recognised as having specialised insights into say the intricacies of ecological dynamics, biodiversity, sustainability, natural processes, risks, ecosystem services, global interactions, business and branding opportunities, etc. But the point of QBL was not that representatives of the four dimensions were somehow 'objective' or neutral but rather one had four contrasting lenses that covered all values focused on the issue or task at hand. It

ensured all points of view were more likely to be defended from the outset rather than as an afterthought – resulting in better decisions.

So what is ecology? It has the same Greek root word ‘oikos’, meaning the home, as does ‘economics’. That is, they are kindred, holistic disciplines; one dealing ultimately with the domestic balance of payments and the other (ecology) with habitat (as home), and all the physical, biological and sociological inputs and outputs that support the inhabitants. In current ‘recombinant’ ecosystems (Meurk 2011) that dominate the cultural landscape, the species are invariably a mix of indigenes and aliens. The indigenous species are those that constitute our biodiversity. **Biodiversity** (Appendix 1) is not the same as **species richness** (inventory of all species regardless of origin) but is the part of our flora, fauna and mycota that is unique (**endemic**) or natural to our place (**indigenous**) and for which we alone are responsible – morally, and by international agreement (Convention on Biological Diversity, Rio 1992).

Ecology is our knowledge about biological species (native, exotic and pest), their interactions with each other and the physical environment, and the processes that form or define those interactions (Appendix 2). Ecology is scalable from physiology to niche, to populations, communities, ecosystems and landscapes or catchments and then also embracing the socio-ecological milieu. That is where we as humans and our living spaces come in. **Ecological integrity** is achieved, as far as the indigenous species and communities are concerned, when all species of local ecosystems (structural elements, trophic levels) are viably regenerating and interacting and there is some steady state across the trophic network. Furthermore, viability is a function of reproduction within populations and across **meta-populations** (that is those that are spatially separated but still functionally connected through periodic dispersal or foraging events). It is acknowledged that just about every ecosystem in the world now combines indigenous and exotic species – some associations are almost entirely exotic, apart perhaps for a few microbes or invertebrates. Various terms have been applied to these new systems – novel, **recombinant**, and ‘ragamuffin’ (Meurk 2011). Certainly all Christchurch ecosystems are recombinant! The critical factor for the survival of the indigenous component relates to ecological integrity – can they coexist with the exotic species or are the latter completely dominant and invasive, out-competing and suppressing the regeneration of the indigenes? There are ways of managing the environment to maximise the indigenous component (CSR model below).

This brings us to the somewhat subjective notion of **natural character**. It is important in the context of cultural landscapes and may be contrasted with an industrialised or totally artificial form dominated by hard, straight edges and species alien to the locality. This is the antithesis of comfortable place-making. Natural character may be said to exist in a landscape when there are soft or feathered edges (but ‘tidy’ following Nassauer’s ‘cues for care’); there is some kind of natural looking sequence, zoning or hierarchy of stature and form that reflects an underlying environmental gradient (as one might find in nature); there is a strong indigenous component to the vegetation; plants/trees are healthy and functioning (flowering/fruitletting); and they are being visited by insects and birds.

Such landscapes may be symbolically demarcated in an urban environment by **signature plants** which are characteristic of local ecosystems, although in landscaping may be recombined in novel ways, not entirely represented in nature. A classic example of natural character is the English countryside where multi-species hedgerows, river banks, stone walls, all occupied by local native

plants and wildlife, meander around farm fields; while copses or woods are dotted through the landscape, and which tell some history of the locality (Rackham 1986). Urban natural character is typically found also in Europe where there is a hierarchy of grand noble (usually deciduous) trees, shrubs, vines and forbs in parks and streets, hedges, walls, cottage gardens, climbers, some urban wild, and now green roofs and living walls, again with strong elements of indigenous or at least northern temperate species. Some of these concepts will be elaborated later. But NZ is quite different biogeographically and ecologically, and if we are to preserve our national and regional identity alongside our imported history (in its place) then our structural, compositional and spatial design must reflect and carefully balance that. It will require a subtle change to the convention of the past 150 years of uncompromisingly following an English model rather than selectively borrowing, from the 'motherland', classic landscape structure but populating it with a strong native component so that it feels 'Aotearoa-NZ' and feeds native wildlife.

Urban ecology and latterly 'urban wild' has been at the forefront of international ecological thinking and environmental quality since WWII (Appendices 3, 4, 6). Explicitly Incorporating ecology into urban planning has however been patchy in NZ with notable advances made here (The Waterway Enhancement Programme in Christchurch during the late 1990s to early 2000s contributed directly to the city gaining both the Bertelsmann's Prize and the River Prize – the late Christine Heremaia was a notable champion for these initiatives). The acquisition of Travis Wetland in 1997 and land along the Styx River were high points. Whereas this leadership has to some extent been relinquished, there is a community initiative to revitalise biodiversity protection in the city by establishing a CHCH Biodiversity Partnership (modelled on an original London version) to formally engage Council with local experts to co-create more ecologically sound, consistent and required outcomes through policy, design and practice.

Ecology tells us that everything is connected (e.g. Fig. 1). Furthermore, we are not immune from geo-political and other global phenomena (Appendix 5). In economically straightened times, one may argue that biodiversity is a 'nice-to-have', but in fact it is inextricably linked to our social and economic well-being through sense of place, interactions with green space and life, tourism (built on show-casing our unique natural and cultural attributes), and cultural strength – through traditional links to these species, not to mention **ecosystem services**. It has long been known that these other values are in the end more important to 'happiness' than pure monetary wealth. We should not dismiss the intrinsic value of nature in all its complexity. We are all linked through whakapapa and our destinies are interwoven. Most major religions of the world, revere the creatures with which we share the planet – indeed the word 'creature' derives from the word 'creation'. Apart from all the ecosystem services provided by biodiversity and natural ecosystems (Dymond 2013, Meurk et al. 2013), the learnings and insights from observing natural environments and their workings are relevant to our wider understanding of the planet, the processes and actions that are fundamental to life and its limits. Perhaps the most important lesson of all is humility - that we are inter-dependent with, subservient to, and a part of nature and natural processes. From this comes an acceptance and willingness to learn from the structure and function of nature, to live with it rather than just control and exploit it. This is the wisdom we associate with traditional or indigenous cultures.

Accordingly ecological processes need to be a visible part of our landscape and daily experience in order to achieve their pedagogical value, and as such are a part of or equated with the notion of

legibility (distilling historical and functional meaning). It is going to be increasingly important to transition from an anthropocentric view of the universe in which ecosystems are a resource serving the economy to one in which the economy is seen as nested within the social sphere and in turn within the biosphere (Herman Daly 2016). Nature and ecology is not just a 'nice to have' – but is an essential ingredient of a sustainable future – physically, emotionally, socially, culturally AND economically (in terms of efficiencies and waste, and of marketing our city as modern, sophisticated, authentic, grounded and sensitive).

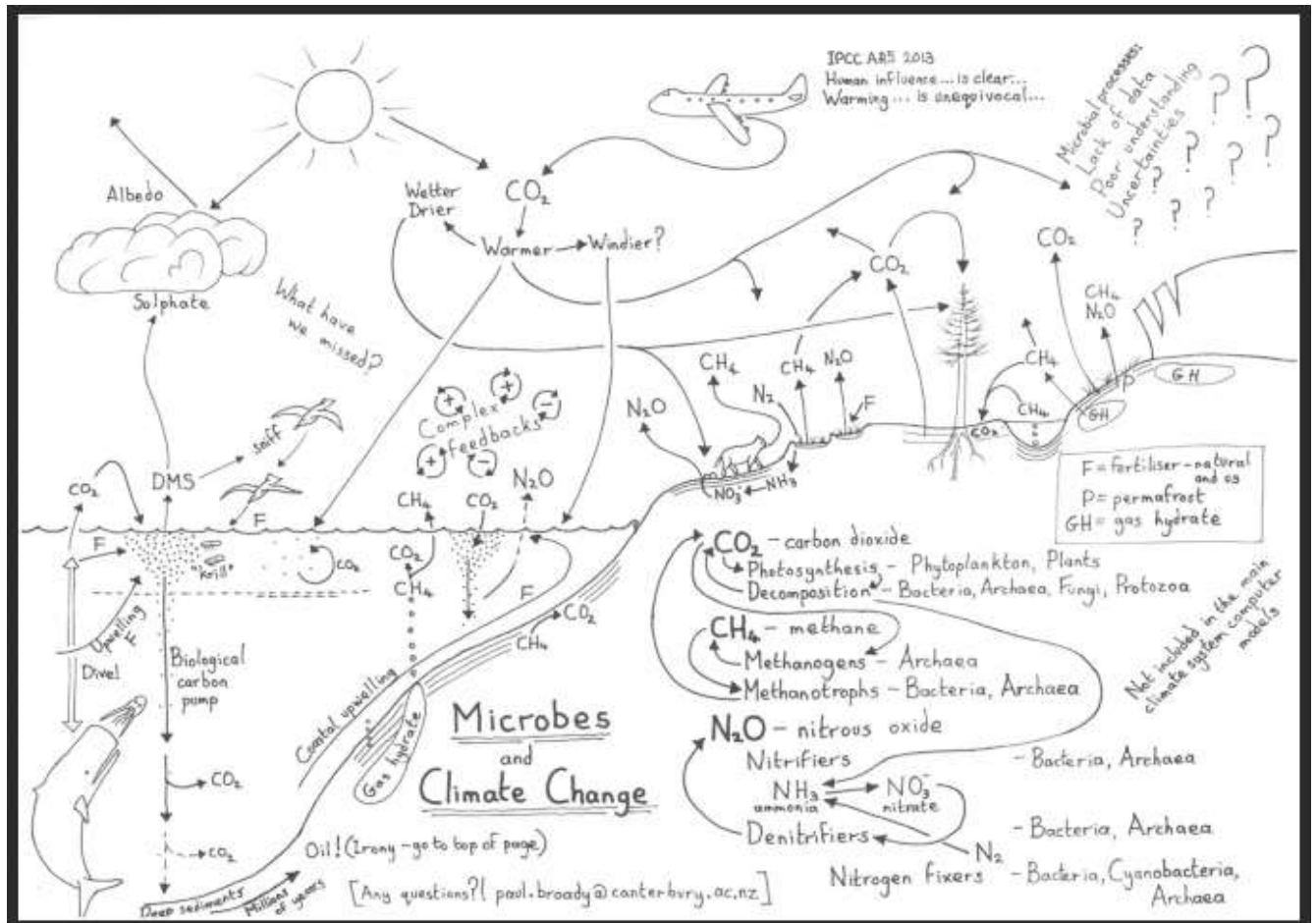


Fig. 1: The ecological complexity and interconnectedness of global ecosystems and especially the role that (unseen) microbes play – from a lecture by Dr Paul Broadby (pers. comm. 2017).

Ignoring ecological realities in design, subliminally undermines the public's understanding of natural patterns and processes and is costly. We observe that many developments and the way they are managed are not only counter-productive in terms of narrative and messaging, but are costing us hard cash due to poor understanding of life processes and drivers (Fig. 2). This may be attributed to the increasing control of land-based development projects in NZ by five main professions – engineering, economics/business, landscape architecture (in NZ dominated by design criteria that often impose unnatural and unworkable expectations of nature), town planning (which here is often hampered by ecologically ineffectual legislation), and generic project managers. The key missing ingredient is 'ecology' and ecological integrity within the resulting plant communities!



Fig. 2: Median strips along Johns Rd showing how quickly the popular silver tussock design element changes, in substrates that are too 'kind', from looking sharp and well-formed (upper right) to becoming degraded by weed encroachment and careless herbicide control. Eventually this failed design will have to be replaced. Note also how disruptive and costly it is to partially close a busy highway to allow maintenance crews into these narrow installations on a too frequent basis. Part of the answer is applying a CSR understanding of indigenous plant ecology (Fig. 3).

The basic ecological framework that should be applied to designing, building and managing (urban) developments is neatly described by Philip Grimes **CSR model** that defines niches within stress-disturbance space (Fig. 3 and Appendix 2). Understanding and applying this model would hugely improve the efficiency, sustainability and cost-effectiveness of what we do in cities. There is an overdue need to include ecology in the mix – not just at the end but integral to the whole planning process from the beginning, through the project management and post-construction maintenance phases (Hostetler et al. 2011).

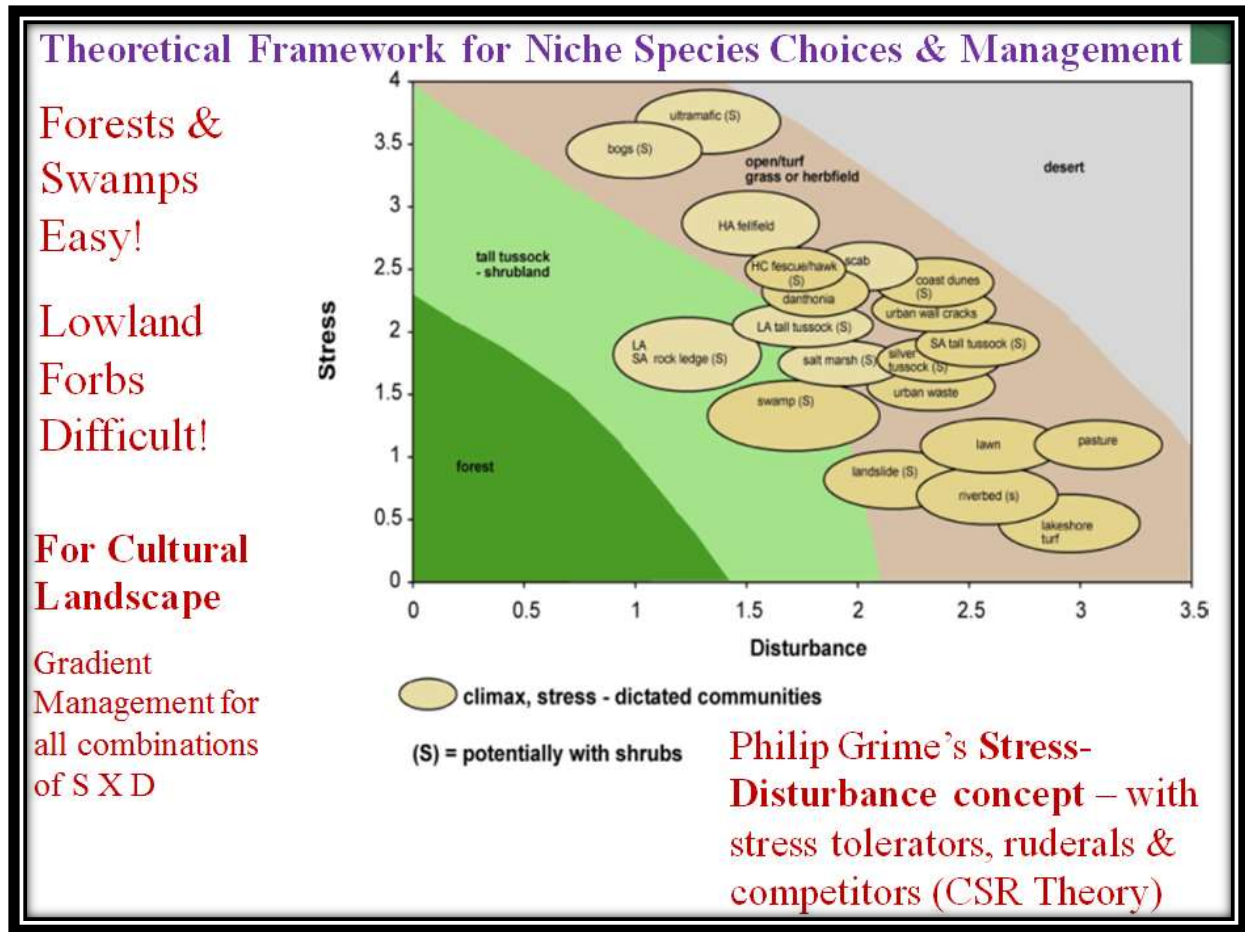


Fig. 3: Grime's (1979) stress x disturbance matrix (adapted). Regions with low disturbance and stress are potentially forested (lower left of graph), whereas environments that are either highly stressed or frequently disturbed tend towards desert (upper right). The bubbles between these extremes are where urban environments typically sit (intermediate stress and disturbance). A specific design/management implication is that in order to maintain generally desired short vegetation in an otherwise forest environment, one must impose artificial stress (e.g. salinity or porous, drought-prone substrate) or disturbance (mowing, gardening, grazing, or flooding) or a combination of both.

The **landscape dimension** of ecology relates to the importance of connectivity across space and between habitat patches (Appendix 2, Figs 51, 52). The viability of species is dependent on a suitable environment, a suitable habitat and competitive niche (e.g. particular position in the edge-interior continuum), large enough patch for a population or territory, presence of a range of seasonal foods within foraging range (of fauna), and interaction with a wider network of sub-populations of the species (in separate habitat patches) that together make up a viable meta-population. Good reserve design takes account of size and shape (Fig. 53).

BIO-CULTURAL GEOGRAPHY & ECO-HISTORICAL LAYERS

New Zealand is a temperate micro-continent with idiosyncratic physical, biological and historical circumstances. It has had a long 80MY isolation (Gibbs 2006) from mainstream evolution

(particularly the highly influential absence of land mammals, Meurk 1995) and hence has a very high proportion of endemism and in some cases ancient lineages of organisms found nowhere else. Because of the ecological naiveté of these rare creatures they are extremely vulnerable to introduced predation and competition.

Swaffield, Meurk & Ignatieva (2009) recognised 5 historical layers in NZ, and these have been teased out a little further below. In some senses, the complex of Riccarton Bush (Putaringamotu), homestead and associated parkland encapsulates all these overlapping layers. Each provides its own unique foundation, structure and continuity to what follows. Being able to see (and interpret) each of these layers as one traverses the city is a key to legibility. 'Fun and games' can be superimposed as ephemera but the heritage in all its dimensions should be the rock on which the city's identity is built and which it embraces, understands and celebrates.

Key layers of the central city ecosystem for consideration in legible design (whakapapa)

- Geo-tectonic/volcanic/alluvial history
- Gondwanic & Glacial/Post-Glacial era biota (papatūānuku)
- Landforms, soils, drainage, water and sea (whenua, tangaroa)
- Polynesian/Tangata Whenua era (projecting forward from about 1000BP to the present and future) (tangata)
- Colonial era (European and later Asian and further Polynesian migration from about 200BP)
- Contemporary Fusion & Evolution – building on a foundation of deeper historic layers.

Geology and Land

The Christchurch flats sit on a recent **outwash plain** of stony to fine silty **alluvium** derived from greywacke sandstone eroded from the Southern Alps and carried down through historic Waimakariri River flood events. These not only built up the plains against the northwest side of the eroded volcanic cones of Banks Peninsula (Port Hills) but periodically devastated the developing vegetation south of the river. Hence at the time of European settlement there were only two remnants of ca. 1000 year old primary forest at Putaringamotu (Riccarton) and at Papanui. Other previous forests had been buried by layers of alluvium and singed by fire; and the Chalice Sculpture in Cathedral Square depicts the foliage and flowers of probably 1-5000 year old forests buried beneath. Accordingly the formation of **soils** in this alluvium is very recent and is reflected in the weak structure, high fertility and predominant influence of the hydrological conditions – dry, raw sand, mottled occasionally saturated loam, gleyed permanently saturated subsoil, and organic peat soils permanently saturated up to the surface.

The hydrology of the Plains is an interplay of surface waters (braided rivers arising in the mountains) and subterranean aquifers each separated by more or less impervious (fine textured) aquitards with surface springs feeding the streams that cross the city. As we have discovered, these superficial alluvial deposits have hidden **Fault lines** that have lain dormant in the deep underlying hard rock. Especially the wet alluvium (and recent landfill) was known to be prone to liquefaction and lateral displacement near rivers, but this was expected to be activated only in the event of movement on the Alpine Fault. However, these sediments were destructively mobilised by the subterranean faults under the city. Uplift and subsidence also occurred respectively south and north of the Avon-Heathcote Estuary.

Links to Gondwana

The NZ micro-continent was a part of the **Gondwana** super-continent 80 million years ago (Gibbs 2006). The size of *Zealandia*, as our emergent sliver has been termed retrospectively, has waxed and waned as land was uplifted and eroded away and as sea level rose and fell. Up until a few million years ago, the land was subdued through a long phase of warm temperate to subtropical climate. The soils would have been old and leached and the biota more like that of Australia and Africa today. Then 5 million years ago a change towards colder and eventually glacial conditions enveloped the country, and it became tectonically active with volcanism and mountain building along the Indo-Pacific plate boundary. Much of the subtropical biota was extinguished and rapid evolution of an alpine or tundra ecosystem took place. In the post-glacial (Holocene) era – from about 10 000 years ago – NZ continued to develop in relative isolation with some Gondwanic elements surviving and intermingling with recent arrivals by long-distance dispersal. The one missing component of this ecosystem for most of Zealandia's history was land mammals. This had a profound (and retarding) effect on evolution and on the natural ecosystem processes associated with unusual traits in NZ's flora, fauna and fungi. Apart from well-known ancient lineages, such as tuatara, we have ancestors of mainstream groups such as the passerines (song birds). Together these elements are loosely part of our Gondwanic heritage (*Flight of the Huia* – Kerry-Jayne Wilson 2004; *Ghosts of Gondwana* – George Gibbs 2006) represented by podocarps, southern beeches, tree ferns, tuatara, *Leiopelma* frogs, moa, kiwi, rock wren, rifleman, galaxid fish, micro-moths). Our unique assemblage of ancestral types contributes to our special status in the world as a biodiversity hot spot. Along with this goes a special duty to look after this precious cargo ... and we haven't started well having also the unenviable record as an extinction hotspot.

Landforms, Soils and Vegetation

The Christchurch soil map is based on Smith, Webb & Trangmar (1990). The soils in and around the central city are all classified as members of the **Recent** Soil Order (that is weakly developed soils less than 5000 years old, derived from alluvium). The sequence of soils in the inner city on younger to older terraces include *Waimakariri deep fine sandy loam* (well-drained, coarse-textured or shallow soils, loosely along the floodplain of the Avon River, through to North Hagley Park and out to the airport) and *Kaiapoi deep silt loam* subject to winter wetting. Nearby or included are some *Taitapu gleyed deep silt loam soils* of floodplains – with high water table and more or less permanently saturated subsoil, and *Waimairi* moderately deep peaty/organic loam – with only small pockets within the CBD. There are also *Waikuku deep loamy sands* (west of Linwood Avenue) – a remnant of a former coastal dune sequence.

This unconsolidated alluvium with moderately shallow aquifers proved to be prone to liquefaction and suffered considerable disruption and differential movement during severe earthquakes. The 2010-12 earthquake sequence revealed new fault lines near to or under the city. Similar shaking and liquefaction can be expected when the Alpine Fault ruptures.

Polynesian entry

The late arrival of humans on the scene, less than a millennium ago, with fire ('Fires of Tamatea') and introduced predatory mammals led to many native birds becoming extinct – moa within a century of occupation. The phenomenon of megafauna extinction follows a familiar pattern of first

human contact with pristine lands no matter where that has occurred (Flannery 1994, Wilson 2006, Wood & Wilmshurst 2017).

The arrival firstly of Polynesians, and later Europeans in the early 1800s, together with their cargoes of plants and animals from their respective homelands has devastated the indigenous biota. Canterbury Plains is now one of the worst affected areas (Walker et al. 2007) ostensibly because of its flatness and therefore ability to be cultivated from one end to the other. More recently even naturally dry stony soils, that had hitherto fortuitously protected native grassland associations under low intensity sheep grazing, have been ploughed with more powerful machines and irrigated (Meurk 2008) thereby further contracting the range of biodiversity on the Plains. Some, now rare species of these dry plains are fortuitously suited to the stressed/disturbed environments of urban Christchurch but its precarious survival requires an understanding of first their presence and then their carefully defined substrate and management requirements. Again, this awareness by managers and citizens contributes in subtle ways to the legibility of the city and to a culture of sensitivity, knowledge and respect.

European Settlers make a town – the Colonial era begins

It was into this historically dynamic environment, prone to flooding due to low gradient and poor drainage, that European settlers from the 1840s onwards floundered. Land clearance continued by fire, but with additional technologies of cultivation and draft animal (later mechanical) traction – all developed through the full swing of the industrial revolution. As with all colonising powers, there was a strong belief that they were there to ‘improve’ the land - and any pre-existing peoples. To them the centre of civilisation was Europe, if not Britain, and they set about ‘perfecting’ the land in the image of their homeland. They flooded the land with countless new, continentally evolved plants and predators that were more competitive in this transformed and relatively benign environment (often devoid of their natural bio-controls) - for pastoral farming, timber, amenity (grass and hedges), animal protein, nostalgia, and mis-placed biocontrol of pests which in turn added further environmental pressure on the indigenous wildlife. This process, that completely ignored the locally unique biogeography, is still not fully played out – that is, many potential pest species are still realising their full capacity. Interestingly, Leonard Cockayne, the father of NZ ecology, in the early 1900s endeavoured to have remnant vegetation preserved and native trees planted in schools so everyone would grow up with familiarity towards their own flora. However, in the drive for development and breaking in of land, these high principles were largely forgotten until they re-emerged well into the 1970s and 80s.

The default landscape style had become English-based gardenesque and ‘Capability Brown’-style parkland with countryside elements of fields, hedgerows, and woodlots – all dominated by the faster-growing and familiar English or northern temperate species. This inherited and reinforced aesthetic became the norm with generations of park managers continuing (probably inadvertently) to promote this Anglicisation of even our natural forests such as Riccarton Bush which was mown, litter-raked, had regeneration suppressed, and planted with non-local species. The forest was slowly dying until ecologist Brian Molloy joined the Board in the 1980s and redirected the management back to a more naturally functioning condition in keeping with a NZ forest environment.

Street trees and the floodplains of the Avon River have followed the model of spaced parkland of English noble trees (oak, elm, plane, sycamore, alder, horse-chestnut, linden, willow, poplar, now

fastigiate oaks) but also American or Asian dawn redwood, oaks, swamp cypress and increasingly magnolia appear to be a newly layered fashion.

RECENT AND CONTEMPORARY ECOLOGY

Baseline Ecological condition of inner city

The Black Maps (Fig 4a & b) were drawn up by the first surveyors in the 1850s and are our first written account of the state of the land in and around the now city of Christchurch. They reveal the locations of natural swamps and water courses in the vicinity of the central city. These are overlaid as traces in the following maps (Fig 5a & b).





Fig. 4 a, b: Christchurch Black Maps – showing location of waterways, seepages and broad vegetation categories in the 1840s.





Fig 5 a, b: Rivers, streams and seepages from Black Maps superimposed on current satellite images.

A modern interpretation of the vegetation from the Black Maps is given on the Lucas Associates website (<http://lucas-associates.co.nz/>) (Fig. 6). It shows the inner city as grassland (probably dominated by silver tussock on *Waimakariri* soils), fernland (probably bracken on *Kaiapoi* soils), flax and grassland on *Taitapu* soils and swamp on *Waimairi* soils. It is important to note however, that this doesn't represent the potential or prehistoric vegetation as this pattern had already been greatly modified by Polynesian fires over the past millennium and periodic (catastrophic) flooding of the Waimakariri River. Most restoration plantings now in the city are carried out on the basis of that pre-disturbance, ecological potential.

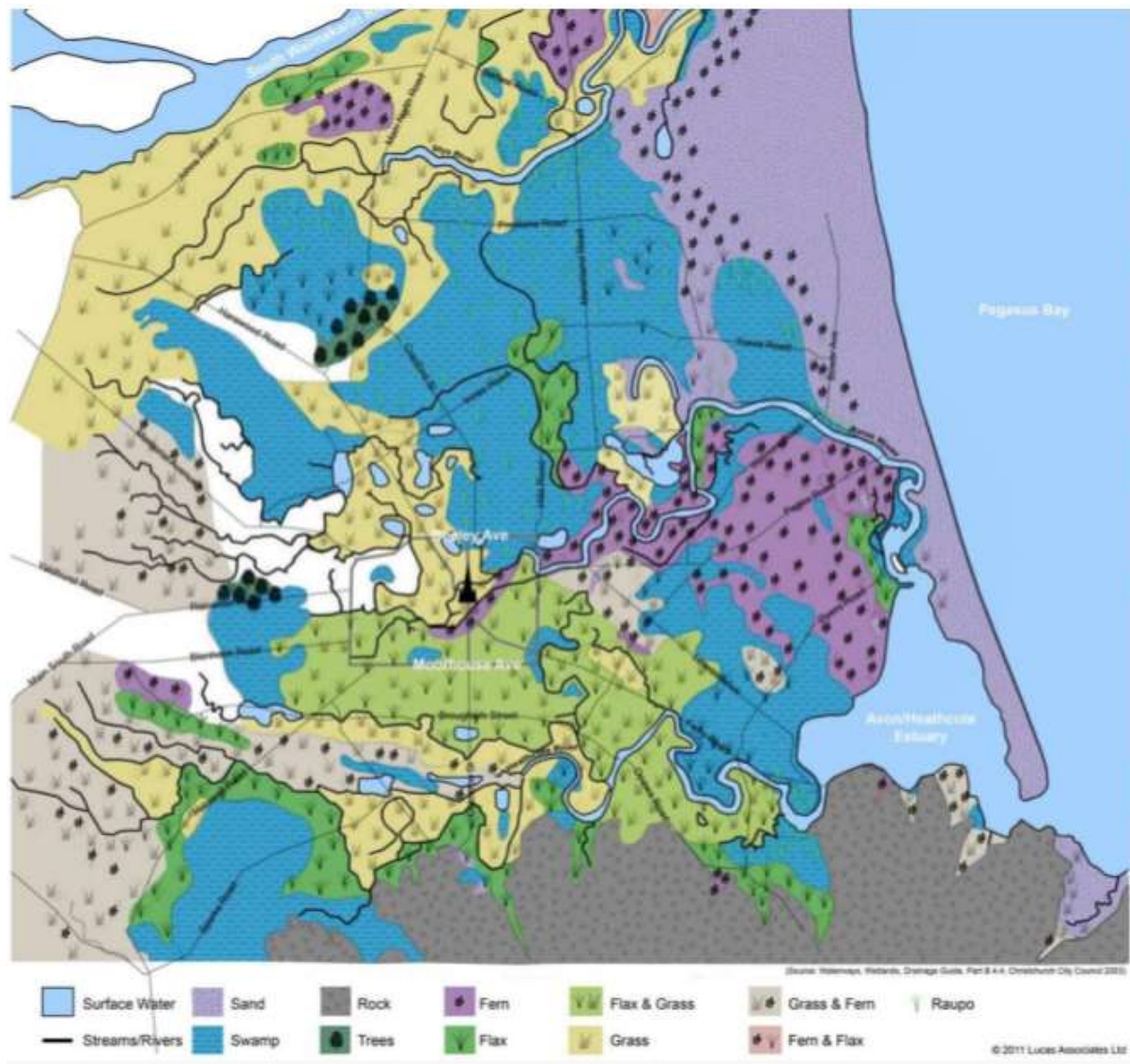


Fig. 6: Modern interpretation of 1840s vegetation derived from Black Maps, showing fire-induced grass, fern and flax as being the predominant types in the vicinity of Cathedral Square. Note the only substantial reference to trees at the time was at Riccarton Bush (Putaringamotu) and Papanui Bush (logged early on to provide timber that was otherwise scarce, for the growing town). There were no doubt small pockets of regenerating native trees (like cabbage trees, karamu, kohuhu) through the drier parts of the city.

Ecosystem Maps

Ecosystem Maps (Fig. 7; Lucas, Meurk & Lynn 1995/6) were developed by CDM and soil scientist Ian Lynn (both of Landcare Research) based on the underlying natural soils of Christchurch and to some extent the far distant Black Maps, but more from extrapolation from Canterbury Plains vegetation remnants on related soil types. So they therefore reflect more the potential 'climax' vegetation/ecosystem or mature vegetation that is several centuries old. This is usually the basis for habitat restoration in the city. The Chalice sculpture in Cathedral Square is incidentally formed around silhouettes of flood-buried podocarp forest under the Square.

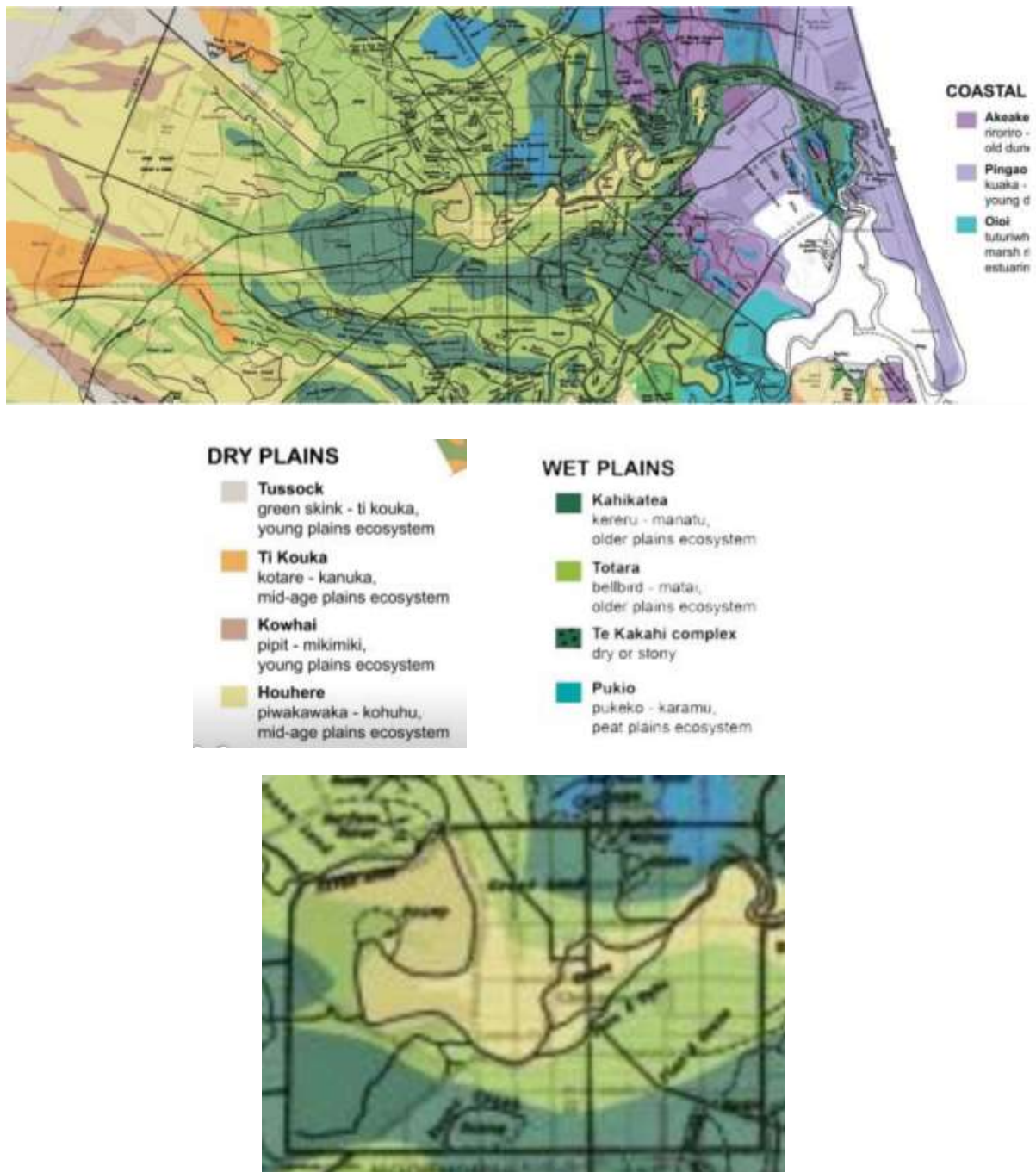


Fig. 7: Potential vegetation based on soil maps, Black Maps and extrapolation from remnants on similar landforms/soils in Canterbury (from Ecosystem Maps: Lucas, Meurk, Head & Lynn 1996-7).

Modern soil conditions broadly reflect the above data, but have been variously (and sometimes substantially) modified by channelization or straightening of water courses, forced drainage of wetlands, filling of seepages and floodplains, deposition from occasional major floods, and most recently by earthquake movement of land. Water tables are not far below ground and that is only about 12-15 m above sea level. 6000 years ago, the eastern coastline extended much further inland than present, between what is now Linwood Avenue and the CBD. It can be seen as ancient sand dunes in these suburbs with elevated houses perched on them.

Current (post-earthquake) vegetation and fauna

Before returning to design considerations we look at what nature has done spontaneously in the central city over the past 6 years. It is a different lens to that which our Mayor used recently to describe the messy, untidy and weedy state of the city. Another way of looking at it is to follow the fascinating natural processes that have been released by the catastrophic disturbances and subsequently by a more (fortuitously) relaxed maintenance regime due to financial and practical/safety constraints. There have been a number of ongoing studies and inspections of the post-earthquake vegetation in the red zone and following collapse and clearance of buildings in the inner city. Some of these observations are documented in the natural history recording website (<http://naturewatch.org.nz/>). Despite the concern about tidiness and reminder of tragic destruction, people and visitors are in fact fascinated by the sign of former disaster (Fig. 26). It mimics the post-war rubble of European cities which ironically spawned the modern study of urban ecology (Appendix 6). Many erstwhile rare species turned up in these ruins. I have commented on the sociology of tidiness (Appendix 3, 4) and note that at least for a period in Berlin, there was a ban on herbicide spraying of footpath 'weeds'. There is also the Kew Gardens wilderness experiment that should be contemplated when believing we are faithfully copying some other culture to somehow raise our status.







Fig. 8 a, b, c: Berlin 2013, showing urban wild and no-spray policy along footpaths. Note that Germany has been awarded 3rd most beautiful country in the world; and think 'bermaculture' (Jonathan Hall pers. comm.); see recent Press article by Liz Worsnop - Let's grow a healthy city in Christchurch, the Garden City. Photo Credits: Wendy Hoddinott.

The same disruption happened in Christchurch – essentially a 'war zone'! Many exotic herbaceous pioneering species (often called weeds – Figs 17-19) have colonised these sites – fleabanes, grasses, butterfly bush, grey willow, pampas grass, etc. However, there has also been the appearance of

some plants seldom seen in the city for decades: 3 species of native groundsel, cudweed, willow-herbs, native oxalis, pennywort, cabbage tree, karamu, bracken fern, koromiko and notably the wind grass (*Lachnagrostis*) (Figs 9-15). Unfortunately, in the effort to 'tidy' up the city, some of these locally rare species are now being sprayed out. These rubbly sites do have an ecological value and if for no other reason than managing stormwater, there is a point in retaining some of these as impervious surfaces for onsite soakage. And where there are plants there is wildlife (Figs 20-24).

Spontaneous Native plants from the inner city (largely from NatureWatch.org.nz website)



Fig. 9: Cut leaf NZ groundsel: <http://naturewatch.org.nz/observations/4478287>



Fig. 10: Cotton groundsel: <http://naturewatch.org.nz/observations/3784783>



Fig. 11: Jersey cudweed and sowthistle: <http://naturewatch.org.nz/observations/1112658>



Fig. 12: Pennywort: <http://naturewatch.org.nz/observations/4910809> in association with broom rape.



Fig. 13: Bracken fern: <http://naturewatch.org.nz/observations/4472227>



Fig. 14: Wind grass (*Lachnagrostis*): <http://naturewatch.org.nz/observations/2468835>



Fig. 15: Cabbage tree/ti kouka and karamu – spontaneous regeneration outside nave of Cathedral.

Some other spontaneous indigenous plant species reported in the inner city include spleenwort ferns: <http://naturewatch.org.nz/observations/6464267> ; and Hairless cotula: <http://naturewatch.org.nz/observations/4945882> .

Even on the exotic tree trunks there is life (lichens and mosses, differentiated on shady and sunny bark) and in the frequently disturbed (sprayed bare) ground around the trunk are various native and exotic pioneer species – including NZ groundsel (Fig. 16).



Fig. 16: Deciduous street tree in Cathedral Square showing pioneering plants in spray zone around trunk and lichen growth on trunk – an indicator of moderately clean air!

‘Weeds’ (exotic pioneering plants) in the inner city

The ecological meaning of ‘weed’ is a pioneering species which characteristically has rapid reproduction, rapid growth, likes fertile soils and is short-lived. In Grime’s nomenclature these are termed ‘ruderals’. The majority of NZ weeds are exotic species and many are naturalised and vigorously invade natural habitats or production systems (a vacant niche). These are termed ecological weeds. Only a few native species can be regarded as typically ‘weedy’ in the ecological sense (e.g. Figs 9-14 above). Below is a selection of exotic weeds that have taken advantage of the disturbed and to some extent stressed ground conditions in the disrupted city (Figs 17-19).



Fig. 17: Pampas grass: <http://naturewatch.org.nz/observations/5101193>



Fig. 18 a,b: Gorse, broom and butterfly bush in the Square – who'd have thunk it.



Fig. 19 a,b: Male fern: <http://naturewatch.org.nz/observations/4472226> on wall, and female/bucklers fern common along the river banks – needs to be replaced with native species.

The invasive weeds should be controlled, whereas the indigenous and some benign exotics may comfortably co-exist (recombinant or novel ecosystems). We should also establish a ban on all potentially invasive exotic species – especially considering likely changed dynamics with climate change. They are otherwise costly time bombs in the landscape.

Wildlife observed in the inner city

A surprising number of native birds, insects and instream aquatic species have been anecdotally reported around the inner city, especially along the river precinct (Figs 20-24). We can expect more species once there are more protected habitats available as patches or as connecting corridors.



Fig. 20: Putakitaki: <http://naturewatch.org.nz/observations/1645972> on Captain Scott's plinth.



Fig. 21: Kereru: <http://naturewatch.org.nz/observations/4808581> frequently travel between the resident population in The Botanic Gardens, Riccarton Bush, St Albans and suburbs immediately north and east of the CBD.

Also regularly observed currently in the inner city and along the Avon corridor are scaup: <http://naturewatch.org.nz/observations/4861117> , fantail, red-billed gulls, black-backed gulls, cormorants, grey warblers, silver-eyes, and spur-winged plover. With a more fully functional green corridor leading back to the Botanic Gardens we can expect more kereru, bellbirds and in due course tui.

Instream Life

The recent constriction of the low flow channel of the Avon River Precinct has increased the velocity of the instream flow and improved the habitat for wildlife. Recently an eel as been observed at the Oxford St steps (Fig. 22).



Fig. 22: Short-finned eel: <http://naturewatch.org.nz/observations/3631134>

Other random observations are Brown trout: <http://naturewatch.org.nz/observations/4861117>, flatworms: <http://naturewatch.org.nz/observations/2451107>, and the terrestrial wildlife: the endemic red admiral <http://naturewatch.org.nz/observations/954023> (Fig. 23), and magpie moth <http://naturewatch.org.nz/observations/3366452> (Fig. 24). But perhaps of more optical interest are occasional sightings of seals and penguins in the inner city!



Fig. 23: Red admiral butterfly, endemic to NZ, here in the Christchurch Botanic Gardens. Their caterpillars feed on the NZ groundsels pictured earlier.



Fig. 24: Magpie moth caterpillar feeding on wild NZ groundsel (*Senecio glomeratus*) in Moorhouse Avenue road edge.

The contemporary influence

In the 6 years since the earthquakes, progress has been made to demolish unsafe and unrepairable buildings, allow temporary businesses and pedestrians back into parts of the central city, and provide some beautification of public spaces. This has been mainly in the form of planter boxes with signature trees broadly representing different Canterbury habitats (Fig. 25).



Fig. 25: Planter box in Cathedral Square with kowhai, ti kouka, kanuka and scrubby prostrate kowhai and silver tussock, signature species of the drier Canterbury Plains. The planter boxes have provided an immediate quick fix for landscaping the Square but are temporary and must be replaced with permanent trees and ground covers that are formed in natural, interpretable settings.



Fig. 26: A common sight of people fascinated by destructive forces revealed by ruins of the Cathedral.

The author also submitted an award-winning exhibit to the 2012 Ellerslie International Flower Show in Christchurch which was designed to represent a pocket park – entirely of indigenous species (Fig. 36 a,b).

SOCIAL DIMENSIONS and OPPORTUNITIES

Cities are by definition places where people interact with the environment. The environment is largely built but nature is ever present – as formal (pocket) parks, lawns, gardens, walls, gutters, streams and street trees, but also through natural plant succession and occupation of space by insects, lizards, birds and small mammals. These human interactions or observations may be spontaneous, serendipitous or planned, but are known to be physiologically and emotionally beneficial.

All these elements are potential transformative learning opportunities. Not only are observed interactions and processes (water flowing, leaves falling, insects visiting flowers) instructive about nature and ecology they all contribute to the world view of the observer with regards to where we fit into the bigger ecosystem.

Learning experiences can be from observing real life, absorbing material from interpretation boards and signs, from sculpture and increasingly from social media or Q signs. One obvious teaching venue was exploited by Birmingham Water at their visitor's centre at the hill reservoirs feeding the city. There in the public conveniences were murals depicting the water cycle and where ones contribution or extraction fitted (Fig. 27a, b).

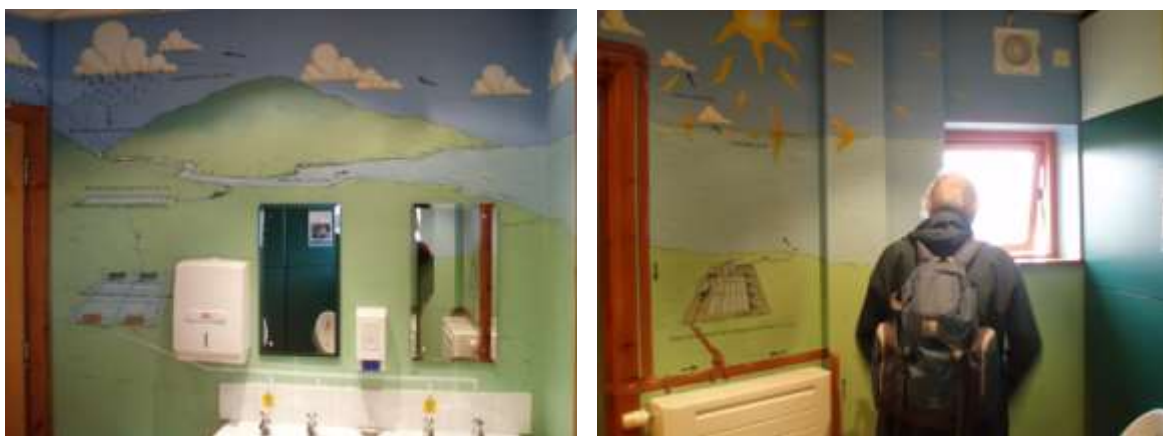


Fig. 27 a, b: Birmingham Water – using facilities as a learning opportunity – to convey information about the water cycle.

Sculpture is also a powerful interpretation medium (Fig. 28). There is opportunity here to do something transformational in the Square – to bring to life the history only a short distance from the bustle of the Cathedral forecourt; creating a very yin yang experience of the city.



Fig. 28: moa viewed from a bush tram behind the Cathedral transporting the traveller back in time.

FUSION SOCIETY AND CREATIVE CONFUSION

The post WWII era has seen the rapid diversification of cultures and ethnicities in the City, and also the globalisation of social movements and fashion. This included the development of environmental consciousness. Coming out of the Euro-standard that had held sway from the mid-1800s there was a challenge to that belief from a new found self-confidence as a nation with its own identity.

The Waterway Enhancement programme of the CCC Water Services Unit, for a decade from the early 1990s, changed its course from being preoccupied with drainage by introducing a 6 values approach (Culture Heritage Ecology Recreation Drainage Landscape). More traditionalist sectors opposed these changes (famously the Merivale Precinct Society in relation to the Avon River edge in Little Hagley Park) on grounds of loss of river visibility, safety, undermining 'English Garden City' image, uniformity of a native green 'wall', and popular preferences. Analysis by safety officers, landscape architects, and a survey of users demonstrated that these arguments were unsubstantiated. Opinion survey demonstrates that there is in fact public support for naturalising the city (Appendix 4).

Strangely, in recent decades the traditionalist defence of the 'English Garden City' sobriquet for Christchurch has not been matched by an authentic portrayal of English landscapes. This suggests a weak understanding of the historic meaning behind garden cities and English ones in particular. The mix of species and biogeographic regions represented is a hotchpotch – derived from Eurasia, North and South America, Australia and Africa – that one could only call it globalised, cosmopolitan devoid

of any attached story or theme. One must ask how that sets us apart. It is true that Lancelot (Capability) Brown – one of the founders of the school of grand scale English landscape design in the late 1700s did incorporate plant material from temperate north America, but this was only a minor component and still the dominant tree cover was firmly English or at least European. What we see in Christchurch are American oaks, swamp cypress, magnolia, maytens, tulip tree, redwood, Monterey pine and cypress, Douglas fir, plane, maples and black locust; Scandinavian or Mediterranean spruce, fir, cedars, poplars, arbutus, phoenix palm and weeping willow; Asian ginkgo, dawn redwood, cherry blossom, maples, foxglove tree, tree of heaven, windmill palm, and tamarix; and Australian wattles, gums, and bottle brush. Few of these have anything to do with England or New Zealand; indeed their continuing dominance undermines the natural character and ecological integrity of our city and region. One may make a case for the Australian elements to be regarded as surrogates of vegetative cover of the subtropical Tertiary era – prior to the onset of Glacial cooling. Ancestors of modern eucalyptus, proteas, and casuarina were widespread then in NZ. They are generally not so invasive but are obtrusive.

Urban New Zealand and CHCH in particular, is almost unique in the world in that it has subjugated its own history. That is today's visible layers are often devoid of local natural meaning – the landscape has lost its legibility. Most recent examples are the eucalyptus dominance along ANZAC Drive (Fig. 29), and the plan to line Manchester St with American magnolias (Fig. 30). On the one hand we still have some unique natural treasures (taonga), albeit in often tiny refugia or under extreme management, but generally the community is unaware of the natural diversity and opportunities in the native flora (Fig. 31). This disconnected phenomenon has been termed 'extinction of experience' (Miller 2005) – so complete has been the displacement of visible indigenous nature by exotic species for production, shelter, amenity and landscaping.



Fig. 29: A strange socio-cultural inversion where, on NZ soil, the Australian representative (gum trees) of the sacred ANZAC coalition dominates this main highway street frontage with the smaller NZ trees and shrubs hiding in the background. What does this say about NZ identity. The subliminal message inherent in this symbolism is staggering! The author has seen ANZAC roads in Australia with out any NZ trees to be seen!



Fig. 30: Unexpected consequences of highly productive and showy exotic trees – they drop large volumes of leaves and/or petals or fruits creating a significant maintenance cost and impact on drainage and waterways.

Surprisingly however, there are almost as many indigenous flowering plants growing in the ‘wild’ around Christchurch, albeit in hidden recesses, as there are in some of our National Parks. And habitats within a day’s easy reach of the city are richer in native bird species as anywhere in the country. New Zealand nature is however recognised by a few standards – cabbage tree, pittosporums, hebe, broadleaf and lancewood. On the other hand, the introduced biota, not only dominates the landscape and sense of place, but continues to pose a mortal threat (through competition and predation) to the indigenous plants and wildlife. Furthermore, this undermining of natural heritage as a foundation of local identity (and therefore city and regional branding) also diminishes our tangata whenua heritage as their origins, struggles, stories, survival and creativity are inextricably linked to that near extinct original cloak of the land (whenua).



Fig. 31: A range of colours, textures and forms among indigenous shrubs, trees and tussocks showing the greater range of diversity than is popularly understood. The lower right middle shows an avenue of the noble native tree – totara in Auckland. There are similar, older statuesque plantings of totara in the Barker Gardens.

Many popular English species like alders, birch, sycamore (introduced to Britain in Roman times), yew, holly, ivy, ash, willow, hawthorn, horse chestnut, plums, cherry laurel and spindle tree are regarded as invasive and pose an ongoing and long term threat to the integrity of wild forests. The reason is that these include some of the few introduced species that are evergreen, somewhat shade-tolerant and/or are bird dispersed. In some notable cases dispersal is by wind (sycamore) or water (alder and horse chestnut). In these respects they mimic indigenous trees from our typical evergreen forests. This poses an extreme danger to the integrity and natural character of the Canterbury landscape as the spread of such favoured or fashionable species is exponential – which means we tend not to perceive a problem nor do anything about them until it is too late. This is despite the wisdom of English culture “one year’s seeding, seven year’s weeding” and “a stitch in time saves nine”. Other introduced species have yet to demonstrate their invasiveness, but history shows that many species (even if they start as single sex clones and don’t produce seed) eventually find a mate and explode across the landscape. Current examples are grey willow and South American maytens.

So apart from rebalancing the tree stocks in the city, there is a very practical long term economic argument for curtailing further planting of these species. They will just become too expensive to control. Despite common claims from arborists that NZ trees are not suitable for city environments, this view is gradually being eroded by theory and practice, especially outside of Christchurch (Figs

31, 32, 33, 34, 35). It does require us to have a more flexible attitude to what constitutes a 'tree' – but this is what makes us different. This is the time to promote our difference as a virtue, a biodiversity imperative and a marketing hook.



Fig. 32: Totara – the potentially predominant noble NZ tree of lowland Canterbury. There is a widespread belief that NZ trees are not suitable as street trees, but there are many podocarps (such as this), kowhai (following), tarata, ribbonwood, lacebark and lancewood (below) that are performing suitably in street and park situations.



Fig. 33: A perfectly good and richly coloured kowhai in a street situation. The flowers begin in mid winter and continue through to spring at which time the red NZ flax (harakeke) flowers take over as the main nectar supply for the honey-eating bellbird and tui.



Fig. 34: Brougham St, Sydenham Park demonstrating that mixed avenues and use of indigenous species can add seasonal colour without the massive leaf fall and drain blockages associated with deciduous trees.



Fig. 35: NZ cedar and lancewood – slow-growing but indigenous vertical elements for parks and streets. Narrow-leaved lacebark (houhere) also provides this street-savvy form.

What we seem to have now is a dynamic debate going on between several world views – a traditionalist reference to mother Europe, an indigenous awakening of both culture and nature and interplay between them (in the past this has been acted against both, but is increasingly regarded as an accepted positive), and an indifference from residents and recent immigrants who are economically impoverished – they have other more pressing concerns.

This appears to be reflecting a struggle for identity and national independence – not politically, but culturally. It mirrors an earlier, self-conscious debate or struggle, early to mid-last century, to characterise a definitive NZ art and literature. There is still a somewhat schizophrenic attitude to it as evidenced by newspaper letters, but it is important to understand that this is a small minority, elevated for the sake of controversy, demonstrated by recent random polling of Christchurch citizens (see Appendix 4) .

THE SOCIO-BIO-GEOSPHERE FUSION – A SUMMARY OF GLOBAL CONNECTIONS

It is not intended here to dwell on these wider contexts within which Christchurch and New Zealand sit, but neither can we dismiss them when talking about even medium term sustainability and resilience. More detail is found in Appendix 5, but a brief summary follows.

According to various authorities, the human impact and demand on the globe is approaching or exceeding critical thresholds (Costanza et al. 2015). This is in the context of humanity having caused a new geological era – the ***Anthropocene***. Particular consequences are climate change, storminess, sea level rise, acidification of the oceans and effects on fish stocks. In terms of resources and production, there are serious problems with emerging shortages of potable water, soil loss or contamination, and shortages of key (cheap) minerals or energy sources. As far as the Canterbury economy is concerned there is a problem with near mono-cultures of elite products, maintained by unsustainable practices, being over-exposed to economic shocks and dependence on a few large foreign clients who can turn off the money stream at will. We are more dependent on them than they are on us. The global economic environment is precariously dependent on the problematic notion of perpetual economic growth. But, perhaps the most worrying challenge facing the world at present is the geo-political stand-off between nations, ideologies, cultures, ethnicities and religions. In reality many of these conflicts boil down to competition for catastrophic decline of key resources and population imbalances. The point is we in NZ are not immune to these global problems. Resilience of our city will depend on anticipating the cascading effects of these irruptions elsewhere, and have a 'Plan B & C' just as we do with civil defence. But these will need to incorporate socio-cultural responses based on protection of deeper values, and in particular capitalising on our advantages to maybe contribute to solutions world-wide. Do we have the will to take this ambitious step?

A New Destiny – will we be BAU or a Beacon?

What can a small town in a small country at the bottom of the world do about these converging crises? One could make an argument that Christchurch is in the unique position of potentially leading a humanitarian and bio-centric movement to reverse all these trends. Because we had our

own tragedy, at least for the moment, it changed our world and gave us time for reflection about our future and purpose. We had the shake up, but theoretically we also have advantages of being a relatively affluent city with a well-educated and informed population, moderately inclusive and open-minded, and for the time being physically isolated from the worst conflicts. We maybe have a breathing space. We are privileged. Do we use this creatively to assist our fellow humans on life-boat earth, or do we pull the blanket over our heads and hope the awful world will go away? I think we know that this tactic only works for a while.

This report concludes with a consideration of the inner city as a once-only opportunity to learn from this experience and project our learnings and hope through a bright new vision, not only for the city, the province, the South Island, the Nation but to the world – a beacon. But first we must get our own house in order and support bold new changes in an open-minded and open-hearted manner. If we fail with that we will have no mandate from the community to be more ambitious and aspirational.

What is the relevance of this analysis for the inner city? To reiterate, everything is connected. We are not immune from any of these individual crises and shocks, as we have discovered, nor the inevitable economic consequences. I will pick up this theme later (Principle 8) of how we project a grand alliance between ecology, socio-cultural needs (Maslow's hierarchy of needs), geo-political considerations and economics; but it must first encompass the direct ecological conditions and potentials of the place, and specifically the role these play in one of the central tenets of cultural strength – place-making (Eric Pawson, pers. comm.).

STRATEGIC ENVIRONMENTAL OBJECTIVES & TANGIBLE EXPRESSIONS of the PRINCIPLES

The following is an integration of the key outputs of the report – an expression of **Strategic Ecological Principles and Objectives** that underpin a rejuvenated city and **Tangible responses, expressions and actions around these Principles** - to realise the ecological potentials.

The general principles and strategic objectives outlined below follow from the previously discussed broad ecological imperatives. These dictate what is possible and sustainable in landscaping, what ecosystem services are provided, the revelation and validity of all the historical layers represented in the city, the symbolism of vegetation, plants, and wildlife and relevance to regional identity or sense of place. This is for NZers at large, for tangata whenua in particular, and to visitors. From each of the broad Principles below (1-8), the subsequent Responses and Actions provide specific and tangible planning and design protocols, guidelines and/or exemplars.

Principle 1 – General Environment, Urban Ecology & Biodiversity status

- The bio-physical environment is the foundation of provisioning, regulating, cultural and passive/intrinsic **ecosystem services**.
- Nature/life is ubiquitous and irrepressible in some form or other.

- Plant growth, reproduction, competition, succession and development of food webs, in response to the physical environment, takes place according to well understood **ecosystem assembly rules**.
- These ecological principles operate the same everywhere - in the heart of the city as well as in distant wilderness that is experienced by only a subset of the population.
- In cities nature typically occupies stressed and disturbed sites. These physical drivers define urban niches (within the **stress-disturbance-competition continuum**) – which mimic various natural environments (cliffs, canyons, riverbeds, coasts, wetlands).
- Urban and rural ecology and biodiversity have been internationally acknowledged disciplines since WWII, but conventional NZ urban planning has been slow to reconcile the divide between nature (as something relegated to mountainous National Parks) and culture (people's world).
- NZ is both a **biodiversity hotspot and an extinction capital** (Canterbury is especially degraded) and consequently we have a special duty to manage nature back to health. This is both an ecological and socio-cultural issue.
- Failing to understand the **biogeographic circumstances of NZ** and its implications for conservation management is more problematic than in continental environments where the biota is adapted to and can cope with greater extremes of climate and to mammalian disruption. High performing alien species, imported to a now highly disrupted but relatively benign NZ environment, then invade and dominate, and without careful management displace our indigenous biota.
- In general, therefore our planning, design and management should **work with nature**, rather than against it, in order that the ecosystem services on which we depend (including the intrinsic values of biodiversity) shall not be compromised.

Response & Actions

- Take care of the physical environment through Low Impact Urban Design & Development (**LIUDD**) to achieve clean air and water, naturalised storm-water management, carbon-neutrality, reduced waste stream and environmental footprint, natural wind shelter, and perhaps reinstate passenger commuter train services to Rangiora, Rolleston, Darfield and Ashburton and light rail to Lincoln and Ilam campus.
- Incorporate **permeable soft surfaces** that allow soakage rather than run-off.
- Develop water features and **treatment trains** around buildings and through the inner city that mimic a natural catchment – feeding water from roofs and possibly grey water through natural filters, rain gardens and stream traces into the Ōtākaro, and restoring the mauri (cf Matapopore narrative).
- Avoid building long-term infrastructure in **natural hazard zones** such as floodplains and coasts; adopting a 100 year strategic retreat plan for the eastern suburbs.
- The concepts of 'urban wild' and 'biophilia' have been embraced in European and American model cities (Appendix 3), but here our default maintenance protocols are 'neat and tidy' suppression of spontaneous biodiversity and the potential experience of it. Adopt a more sympathetic approach to design and management in order to cultivate a truly '**clean green**' region and city.

- Explore innovative ways of introducing or **encouraging more indigenous wildlife** into the City, e.g. NZ falcons into high rise buildings to help control rock pigeons and starlings.

Principle 2 – Design for Ecological Integrity

- Apply **ecologically informed landscape designs** that acknowledge that plants are alive, dynamic and susceptible to successional processes.
- Ensure planting design is sensitive to **niche differentiation** (natural or constructed) and successional processes, and therefore easier and less costly to maintain.

Response & Actions

- Provide pocket parks that have a strong indigenous element – sanctuaries for people and small wildlife. **Pocket Parks** (Fig. 36) were a device that figured in the first effort by CCC to develop new ideas for re-greening the city and responding to the desire for ‘green’ from *Share an Idea*.
- Preserve the natural dynamics of plant successions by allowing pioneer nature to exist in disturbed areas of the inner city – leave some periodically disturbed sites bare or with cracks and rough edges to **accommodate these pioneer or ‘weedy’ plants**.
- Avoid inappropriate designs that are costly or impossible to maintain – e.g. silver tussock in a forest environment rather than **divaricating or scrambling shrubs** along street edges and median strips (Fig. 2).
- Use innovative designs to **incorporate nature into and around buildings** – green roofs, living walls, rock gardens, indigenous lawns, swales, rain gardens, court yards, etc. (Figs 36, 37, 38) (see Ignatieva et al. 2011).
- **Rock gardens** (Fig. 39) provide customised, stressed habitats for dry grassland species (see below).

Principle 3 – Rebalancing Biogeographic History and Natural Character

- **Visibility and accessibility of indigenous nature** is crucial to avoiding ‘extinction of experience’ and ‘nature deficit disorder’.
- Achieve critical mass of habitat and connectivity and incorporate buffered sanctuaries for both creatures and people.
- Acknowledge and equally represent **all layers of history** in the heart of the city.
- Ensure landscape planting is **legible** (reveals zones and patterns that reflect the appropriate ecological niche within the landform sequences of the city, and tells some story of its history or evolution), and is therefore ecologically and culturally meaningful and sustainable. The metaphor of the ecological cloak or kākahu fits comfortably into place-making.

Response & Actions

Ensure **indigenous noble trees** become, over time, of equal dominance to the imported trees (that are still being replaced and added to, locking in place more centuries of alien dominance). That is the native species become part of the narrative and not something to be erased.



Fig. 36 a,b: Views and habitats of award-winning 2012 Ellerslie Flower Show pocket park composed entirely indigenous species.



Fig. 37: Novel and fanciful ideas for using green roofs and living walls for rare plants and micro-wildlife



Fig. 38: interior courtyard habitat



Fig. 39: Rock gardens during development with coarse substrate providing stable (stressed) environment for rare dry grassland and crag-inhabiting species like the Lyttelton forget-me-not (lower right)

- The **NZ trees will provide a rich source of fruit and nectar for native bush birds**, like the nectar bearing kowhai (for kereru, bellbirds and tui) along Oxford Tce (Fig. 40). This provides a strong landscape statement whereas the original design was to use English trees which would have left the indigenous oioi (reed) as a token - a popular design feature which is suitable for rain gardens but of little or no value to charismatic wildlife! On the other hand Fig. 31 includes a view of an avenue of totara, and many other native noble trees are suitable for this purpose (Figs 32-35). And avenues don't have to be all the same species and may be a random mix of native and exotic species – now there's a radical idea (Fig. 34)!
- Establish a **strong, visible living presence** of indigenous nature in Cathedral Square to give it equal status and authority to the colonial elements and references to tangata whenua. This is essential to reverse the overlay of monocultural landscape elements that are borrowed from the other side of the world, to overcome extinction of experience, and indeed to turn the tide on biodiversity loss – which requires both ecological and cultural sustainability. An ability to walk and tram through a bush section will create a moment of contemplation, reflection and relaxation ('forest bathing'), literally transport us back in time, and tell the full story of our land. Sculpture may be used to give us a sense of primeval Aotearoa-NZ (Fig. 28).
- Support **interpretation** directly (acknowledging the bracken fern - 'the Fires of Tamatea' - colonising brickwork and bridges – Fig. 13), or through art, such as the forest trees represented in the Chalice (Fig. 43) – telling a story of natural patterns and human history.



Fig. 40 a, b, c: view of kowhai in rain gardens along Oxford Tce underlain with stands of the oioi reed; the upper picture (a) show reversion to type – some standard deciduous trees that will deposit large masses of leaves in autumn. I am informed by reliable sources that there was quite a struggle to even get the kowhai accepted.

- Bush City is a concept borrowed from the Wellington City waterfront beside Te Papa (Fig. 41). The notion is an island incorporating a wide range of NZ natural terrestrial habitats. A **Canterbury Bush City** (Figs 42, 43) would tick several socio-ecological boxes – need for critical mass and protected habitat, show-casing the rich natural heritage of the province, an opportunity for at least some ‘forest-bathing’, an educational story, connecting to tangata whenua and to Neil Dawson’s Chalice (representation of the buried forest) (Fig. 43) [Neil Dawson is ok with this].
- An alternative proposition is a **Cathedral Garden** – incorporating the elements of bush city in a different format – a **cloak** wrapping around the shoulders of the Cathedral (Figs 44, 45, 46).
- A **split image of the Cathedral** from a conventional, formal perspective in the front, and a country church emerging softly, organically, from an increasingly indigenous forest on one side and heritage rubble (see below), on the other, may be the **reconciliation** of what at first appear to be incongruous/incompatible world views (Figs 45, 46).
- Rebuild a new aesthetic that values and understands all layers of heritage while fulfilling our obligations to national and international conventions, and constructing an **authentic and unique image of Aotearoa-NZ-Canterbury**.

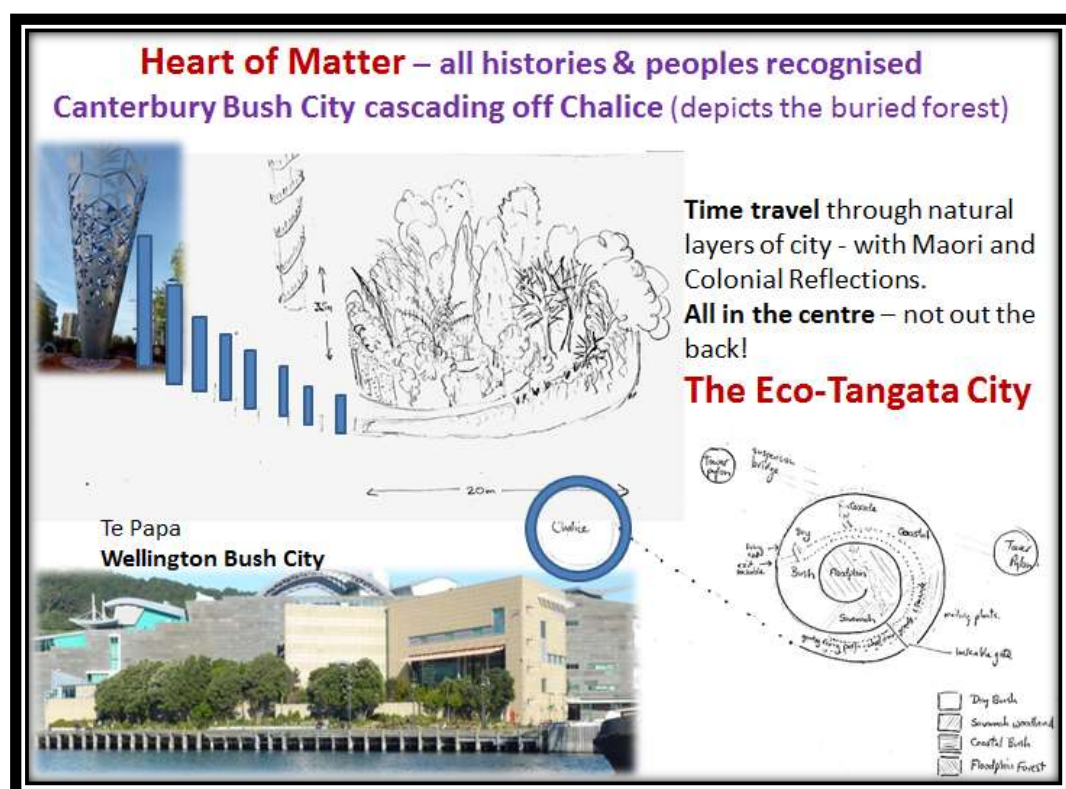


Fig. 41: a stylised idea of how a Canterbury Bush city of Canterbury habitats would peel off the Chalice.

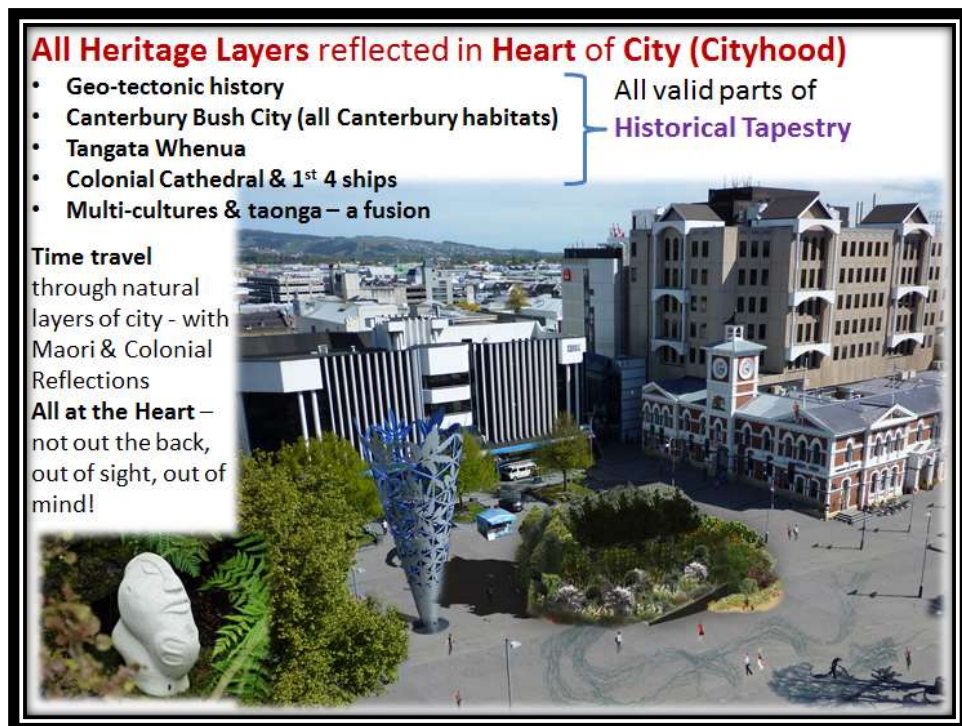
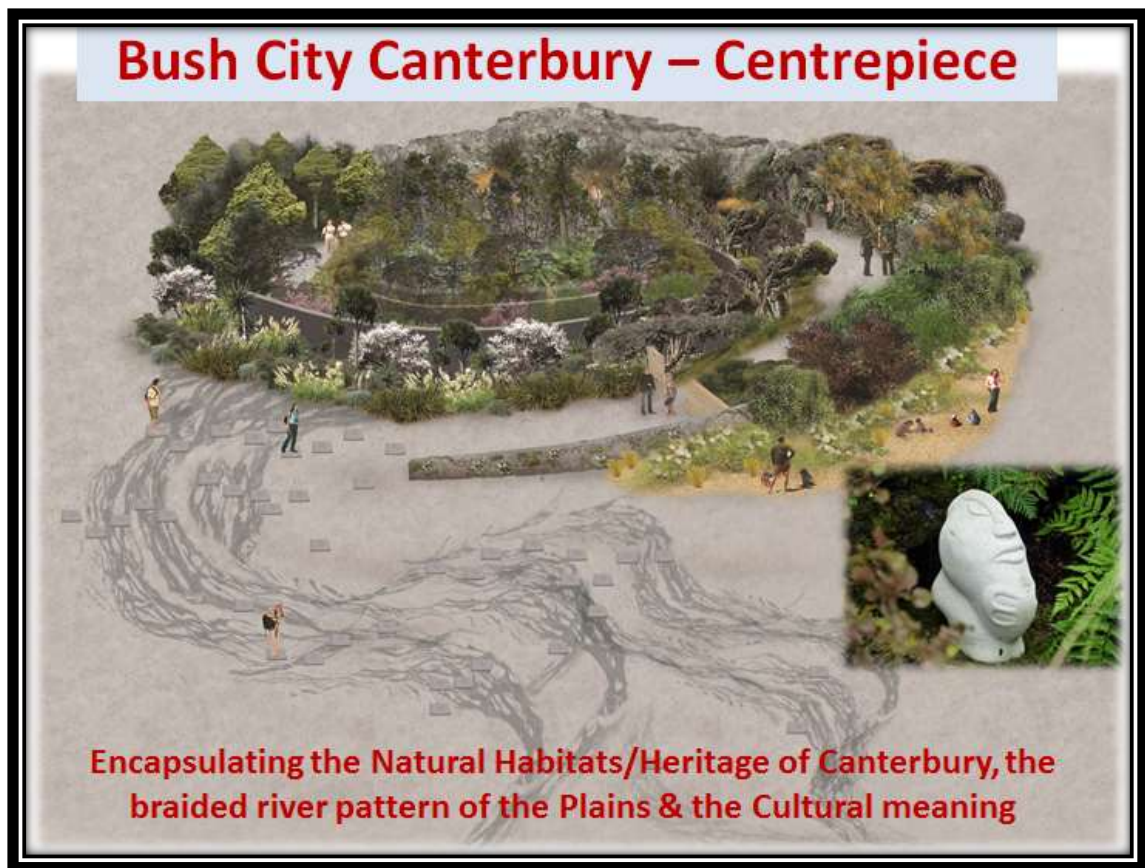


Fig. 42 a,b: Bush City as a focal point in The Square balancing the cathedral and colonist references and Maori representation. The sculpture that might be viewed in a window into the forest, nestling on moss and fern, is carved by Rewi Couch of Rapaki. Note also the imprint of braided channels meandering across the ground – like the rivers from the mountains.



Fig. 43: View of Chalice from near the western edge of putative Bush City. The distance from the Chalice to the traffic cones is about 15 m. Then to the position of photographer is about 20 m (the maximum diameter of the Bush City node). From the photographer to the nearest corner of the old Post Office building is another 15-20m.

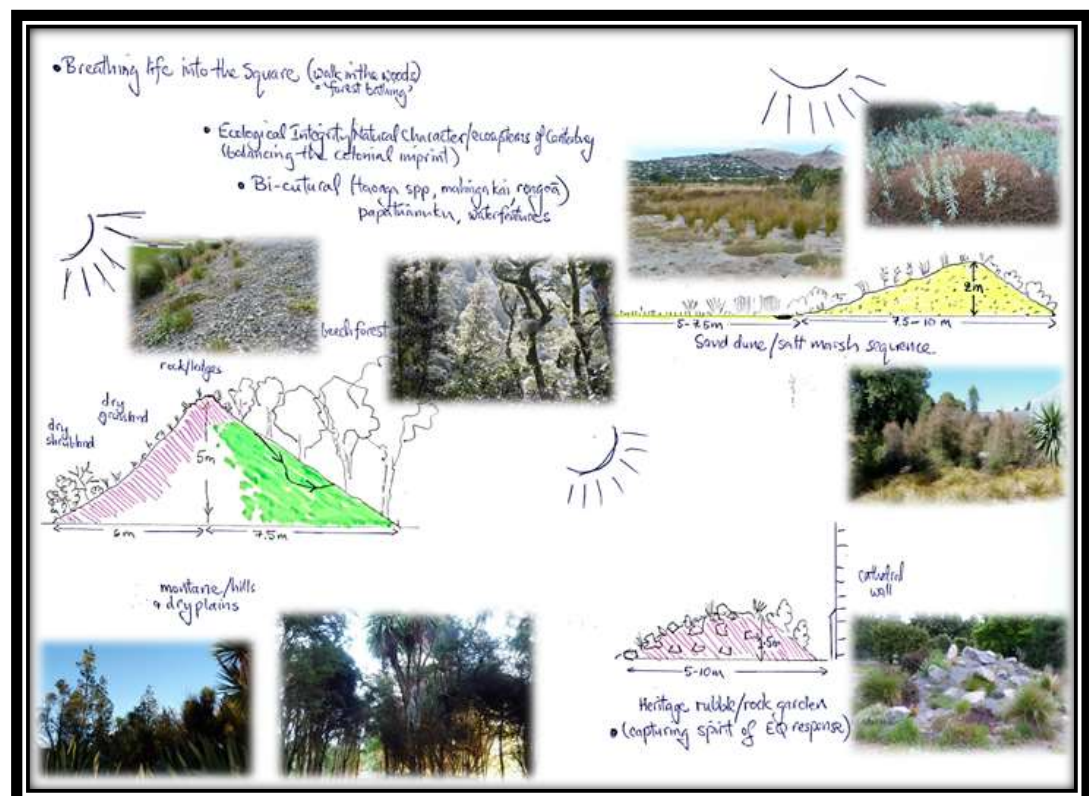
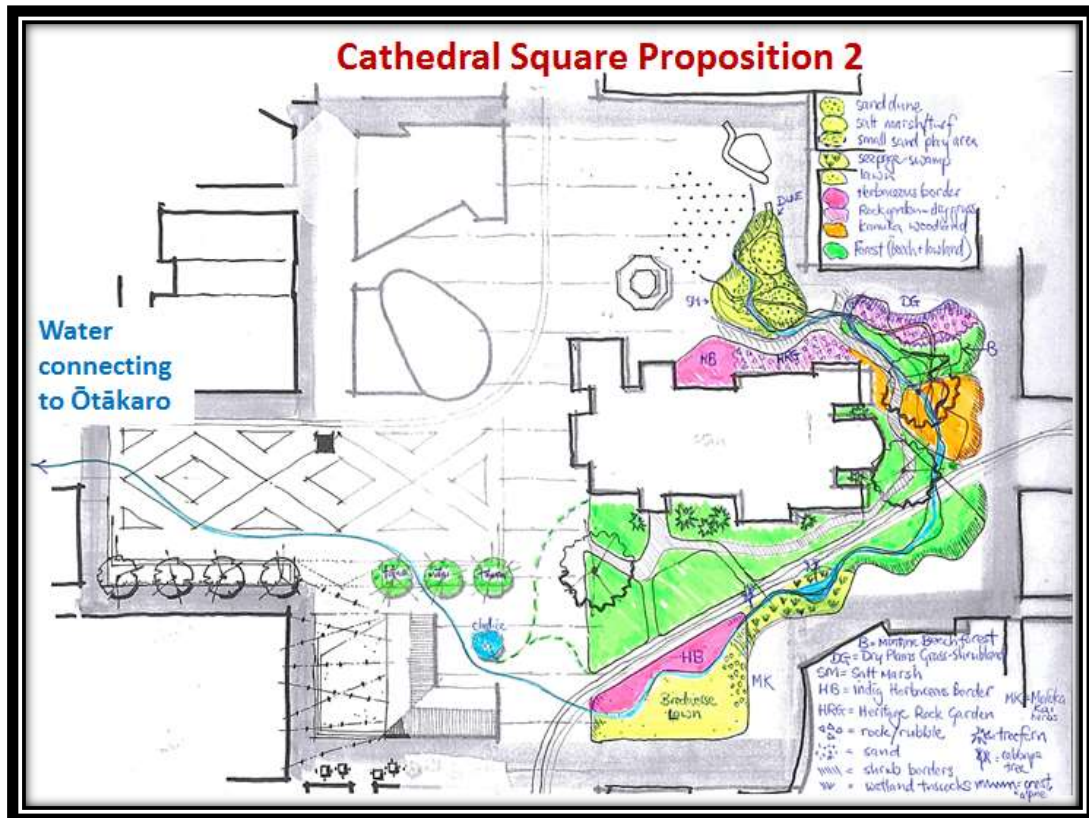


Fig. 44 a,b: A redrawn concept of elements of a Bush City in line with some recent plans. Note the elevated dunes (2 m high), mock mountain (5 m), and heritage rubble/rock garden (1.5 m) designed to bring in some of rare grassland, coastal and mountain species to the heart of the city, and to relate it to earthquake disturbance (rubble) and to known favourite play surfaces (sand).



Fig. 45: Concept of country cathedral emerging from a forested countryside – John of God chapel from Canterbury Park.





Fig. 46, a,b,c,d: Further examples of countryside churches in England showing a rustic flavour of steeples rising from or through forest, the last in Nottinghamshire.

Principle 4 – Earthquake Memory

- Capture the **spirit of the earthquake response** (recognising and facing up to its historical reality and significance); acknowledging the ‘gap filler’ and ‘greening the rubble’ movements.

Response & Actions

- Develop a **heritage rock/rubble garden** (modelled on the 2012 Ellerslie exhibit 'Transitions') providing a substrate and refuge for a number of rare and endangered plants, invertebrates and lizards of the Canterbury dry plains and crags (Figs 36a, 39).
- A rock garden offers a tilt at the **ruins and rubble** (even if the Cathedral building is reinstated) – and a reference to the 'greening the rubble' movement, one of attractants of international attention.

Principle 5 - Biosecurity

- Avoid exotic species that are **potential weeds** or have allergenic properties.

Response & Actions

- Deconstruct conventional mono-cultural park and streetscapes, that harbour visually dominating and invasive exotic trees and shrubs to, over time, eliminate and engage with plant nurseries to curb the sale, supply and planting of some of our **most serious weed species**: sycamore, plane trees, birch, alder, holly, ash, horse chestnut, maytens, wild plum/cherry trees, grey willow, ivy, gunnera, yellow-flag iris, blackberry, male fern, and exotic succulents (that are invading rock and dryland habitats)
- Progressively replace exotic **ferns** (and other weed species) along river banks with indigenous species – swamp kiokio, prickly shield, matata, pig fern, etc.

Principle 5 – Landscape Dynamics & Integrity

- Landscape **connectivity** and critical mass are necessary for a functional nature.
- Achieve **ecological integrity** involving functional landscapes of stepping stones, corridors, sanctuaries (predominantly on public land), within an ecologically sympathetic matrix as far as private and corporate land owners can be encouraged.

Response & Actions

- Employ the standard text on landscape configuration and function (Meurk & Hall 2006) to guide the **optimal design and configuration of habitat patches**, spacing, and **corridor connections** via streets, green buildings and naturalisation of water courses, across the whole city.

Principle 6 – Accommodating Perceptions and Attitudes

- It is accepted that in the current culture there is a **tension** between tidy/control and more laissez faire or relaxed attitudes/personalities. **Reconciling or achieving a balance between these world views** of mono-dimensional control and acceptance of diversity is critical to ecologically and socio-culturally sustainable futures.
- One manifestation of the order and control approach is a '**safer parks**' policy based on minority perceptions of fear that dictate stripping out undergrowth, transforming the NZ forest into a high light, 'English' temperate woodland. The city has these aplenty, but the

authentic NZ experience of textured shrubs and ground ferns is confined to only a few seldom-visited parks.

Response & Actions

- Joan Nassauer's "**cues for care**" provides a way of accommodating 'control' without compromising the biodiversity and life lessons inherent in 'urban wild'. Her "messy ecosystems – tidy frames" concept enables **order and life to co-exist**.
- **Review 'Safer Parks' policies** which are detrimental to natural ecology and seek alternative, evidence-based resources to achieve enhanced citizen perceptions of security – such as surveillance, signage/information, policing, night closure, etc.

Principle 7 – Governance, Policy, Planning & Management

- Build an ecologically and socio-culturally literate and sensitive city that generates a buzz through enlightened governance, operatives and citizens, thereby becoming a '**beacon**'.

Response & Actions

- Achieve **ecological literacy** at all levels in the city hierarchy through a field-based workshop on biodiversity and ecological function for all governors, boards and executives, and down through schools – as part of their usual curriculum.
- Involve **ecological knowledge, review and oversight at every step** of design and implementation processes (as in QBL or the 'ring of sustainability') in a 'collaborative learning' atmosphere. Ecology should be an integral part of decision-making teams through technical advisory groups or appointments. But the key characteristic is that the design process is transparent, iterative and sensitive to a broad cross-section of values and expertise.
- **Train** supervisors and maintenance staff to recognise and differentiate our indigenous and pest species – knowing when to remove, when to leave and when to coax. Train the maintenance people to recognise our rare indigenous species.
- Bring the city together, ensuring everyone is housed, fed, clothed, cared for and is able to do meaningful work – leading to **social cohesion**, respect and well-being – grounded in their history.
- **Revisit the Avon River Precinct development** which deviated from the original plan and concept (through failing to adhere to bullet 2 above) – symbolically and tangibly interweaving the **strands of the Treaty Partnership** representing its combined strength through individual identity and working together. The original plan for the Avon River Precinct (ARP), which was signed off by government, was to weave strands of 'English' and 'Indigenous' landscape style, back and forth across the river (Fig. 47), representing the treaty

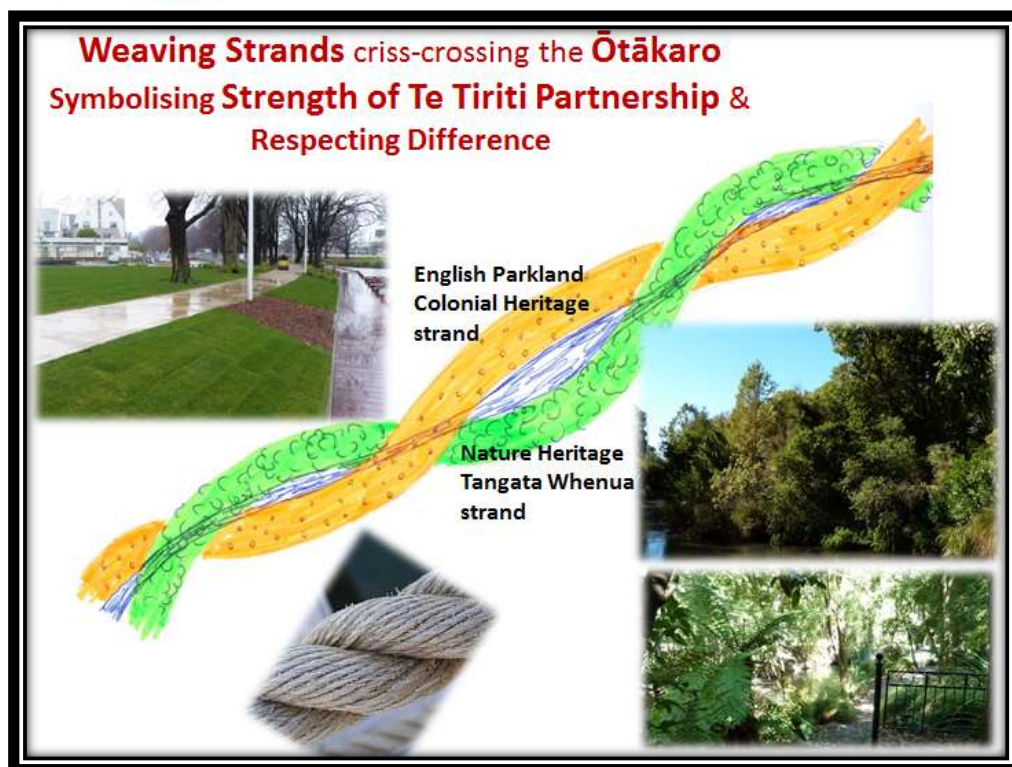


Fig 47 a, b: A representation of Te Tiriti enduring strength in symbolic landscape design weaving along the Ōtākaro. The metaphor of woven strands giving strength to a rope fits neatly along the flat floodplain with existing 'English' parkland of exotic trees over grass and the opposite steep banks with a dense corridor of diverse native forest. This almost certainly does not interfere with either existing or planned recreational uses, nor with flood levels (see Appendix 7).

partners and the strength of that complementary relationship. This was to be manifest as retained, conventional English Parkland along the inside broad floodplains, whereas dense and diverse indigenous bush would be formed along the steep outside bends. This would not interfere with existing recreational use of the river but would provide **continuity of habitat as a corridor for bush birds** to follow from Ilam gardens, Riccarton Bush, Botanic Gardens along the ARP to the Avon Loop and on down the river. The concept was however dismembered by hydrological modellers who claimed any dense vegetation would raise the

risk of flooding due to increased roughness (water flow impedance). This was not able to be challenged at the time and so this inspirational narrative about cultural and natural heritage was replaced with an illegible landscape makeover that is devoid of story-line. It is the time and place to revisit this concept. A further analysis of this issue is contained in Appendix 7.

- Demonstrate tangible connection between historic and present waterways that meets **values of Mana Whenua**.

Principle 8 – Assertion of Leadership in Christchurch & Beyond

- The opportunity is now, but slipping away, to **exercise leadership** and innovation, to build on or recreate the ‘buzz’ stoked by ‘share an idea’ and the spontaneous upwelling of community creativity.

Response & Actions

- Importantly, the city’s positive, inspirational message to the world regarding ecology, biodiversity and culture and well-being is **backed up by a visibly caring society** where everyone is being brought in from the cold, taken care of (social housing) and provided with ecologically or socially meaningful work – perhaps some activity involving interaction with the public in one of new buildings in the square for hitherto homeless people. Everyone must have a sense of belonging, self-worth, and working together. This fits the International Eco-city Framework & Standards vision (<http://www.ecocitystandards.org/wp-content/uploads/2014/07/IEFS-Brochure-2014-b.pdf>).
- Activate centres of higher learning and enlightenment (science alive, eco hub, science hub, central city campus involving all the universities, ARA, CRIs, TRONT, Medical School, DHB, etc.) around the development of a legible and ecologically functional city that has a clear **common vision** for the future.
- Energise a centre of theory, practice, industry and art that captures the spirit of humanity and biophilia, reaching out to a troubled world – to contribute in whatever positive way it can through building respect around ethical behaviour, mediation, conflict resolution and collaborative learning. This may be termed a **World Centre for creative transitions to Sustainable Futures**.
- Establish an elevated standing place (plane table) that looks out across the city in all directions to the treasures/taonga of the region, tangibly embracing diversity, tolerance, inclusiveness, enlightenment, revelation and peace. These view shafts would capture the essence of a new wave of enlightenment and inclusiveness – a kind of **beacon of hope** for our community, the city, the country and eventually a model for the world. We have to be ambitious yet humble (Fig. 48).
- Paradoxically the ‘buzz’ may involve a society that slows down, becomes laid back (speed is often inefficient), embarks on material de-growth, is creative, comfortable in its own skin, and welcoming.

Project through *ChristchurchNZ* a multi-dimensional city with bold, vibrant dramatic new strength (gravitas) and confidence (**an authentic brand**) that inspirationally messages biophilia (eco-city), creativity, rebirth and peace, providing a beacon of hope, a sense of destiny; providing a model that becomes a ‘must-see’ place in the world and lives up to the

NY Times faith in CHCH being a place to watch ... not just another place to bungee jump, jet boat ride, mountain bike, and drink latté ... although these may all be good but not as the basis of a remarkable and worthy place!

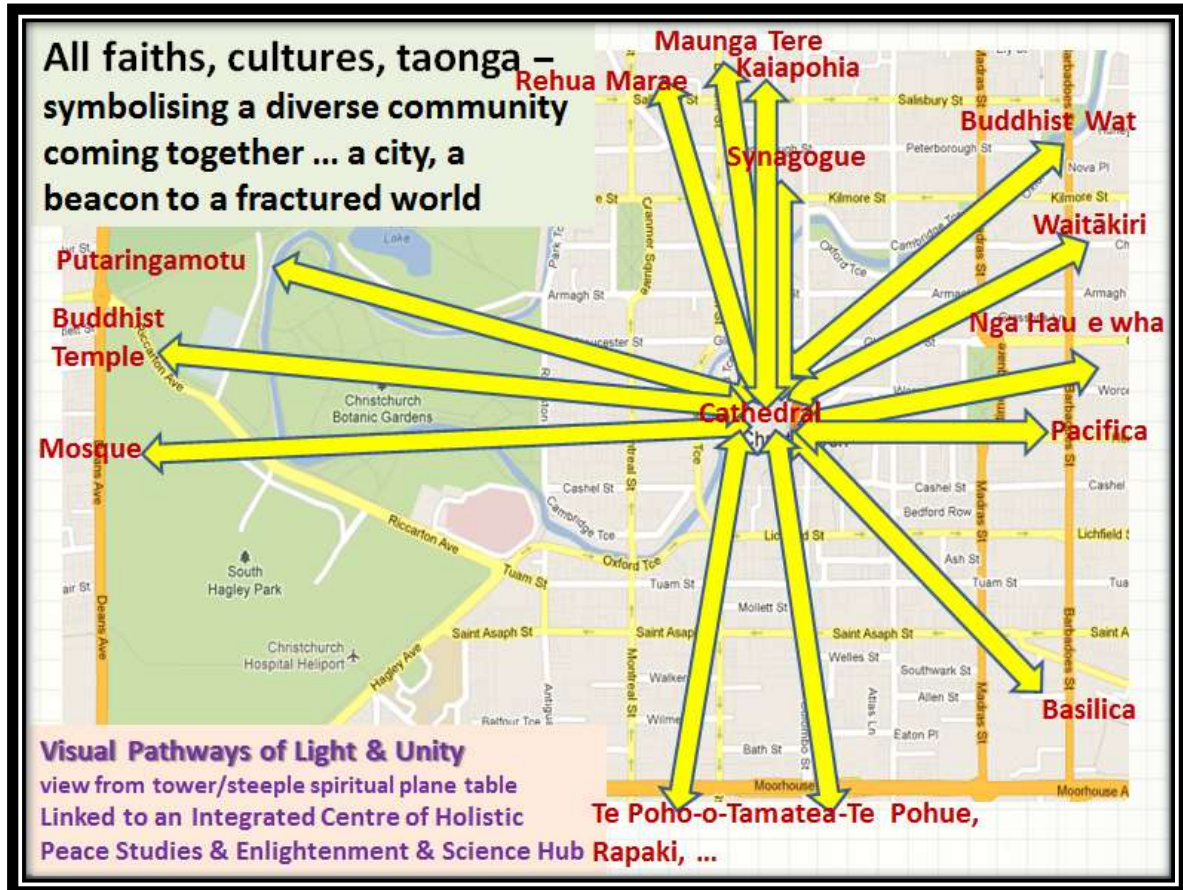


Fig. 48: Symbol of unity, joined-up society and environment, and intellectual endeavour and synergy directed at co-creating solutions to the wicked problems of the region, the nation and the planet.

- **An Eco-Tangata city** – as part of a bold new vision - needs to embrace a new brand that lifts it out of a limited time frame of history and projects it into a multi-dimensional, multi-layered space – that is many things to many people. Fundamentally, it should be rooted in its history that is what ultimately defines a place. Peripheral and fashionable devices can provide some momentary excitement and entertainment (also needed) but do not create a sense of gravitas, longevity and permanence. Furthermore, the history needs to be visible (legible) and unbiased to ensure buy in from the whole community and in particular the Waitangi Treaty partners. This is what is unique about our place – that fusion of Gondwana, South Pacific Maori, and European (western) culture. This is what people come to NZ to see, not some pale imitation of what they have in abundance at home. But this means that the story has to be told – vividly, solemnly, honestly, authentically, and with passion. This can be done by information boards, QR codes, symbolism, sculpture, theatre, plants, earth and water. Every person in Christchurch should be able to walk through, understand and feel comfortable in their history, every day, wherever they are.

- **Regarding the wider geopolitical role of the city** - How may a small city at the bottom of the world do anything worthwhile in face of the wicked problems facing the planet? Well, we have to just work up from small beginnings, be a model and exemplar, innovative and tolerant, welcoming and fascinating, intelligent and humane, wise and fun! This is one proposal for how Christchurch may contribute.
- How will the vision be funded? It will **attract international interest** from the fascinated public and from intellectuals, researchers, NGOs and governments, and bring investment of ideas and energy as well as material resources. The world will be looking for working models for how to deal with the looming environmental and socio-political crises. This is the one opportunity to contribute something worthwhile to the world stage.

DISCUSSION

Recently the prestigious Fleming lecture series, following on from 'The Crazy and Ambitious' conference for innovative science ideas, was addressed by Professor Bruce Clarkson of Waikato University and at both lectures he spoke of his revelation that urban environments should not be seen as a problem for biodiversity but rather an opportunity. This is important because it demonstrates consensus with the exact same sentiments expressed nearly 15 years previous at a Banks lecture (Meurk 2003, 2005). Indeed the loss of biodiversity in NZ's rural hinterland is so extreme that paradoxically urban environments are just about the only opportunity now for its long term survival. It is therefore crucial that this opportunity be grasped and along with it the ability to weave the stories of the land and its cultures into the narrative of the city in tangible and symbolic ways. This needs to be done boldly and inclusively acknowledging all layers and partners and in an evidence-based way – employing the most astute wisdom of cultural history, landscape ecology and design.

If this is successful – and it has to be – then the city can stand proud and provide a model for the country and beyond – as a clean, green city facing up to future problems with intelligence and humanity.

Some space has been devoted to socio-political contexts and concepts. This might be seen as outside the purview of 'ecology' in the narrow sense, but as I said at the beginning, 'everything is connected' and the landscape of the mind is very much influenced by the ecology of the external landscape. It conditions our world view, our awareness of processes and relationships, and therefore has a bearing on how we understand and deal with human and cultural relationships – and suffering. All are related. So, one of the imperatives for developing a resilient city based on universal values is a realisation that there will be global and regional shocks to come – both natural and human. These are again often ecological in origin and/or in manifestation. The most obvious are climate change, sea level rise (faster than expected), geopolitical pressures on trade and pricing, economy being exposed to a few commodities for elite markets, and denaturing of the primary resources (freshwater, land and productive soils). This may in the medium term require scaling back of grandiose schemes to something more modest and affordable which avoids becoming dangerously indebted to an uncertain future's market.

The city needs to be bold, adventurous and stand tall on its achievements (culturally, music, sports, intellectually, technologically, environmentally – a long way to go there, progressiveness (Kate Shepherd et al.)), project these both to ourselves and visitors (Figs 47, 48, 49, 50), and see how we can integrate our intellectual, cultural and spiritual assets. We have to be mindful of what people come here to see. By and large they come to see what is unique and different from their own place (unless they are told otherwise!). If we are not authentic, the bad news will eventually get out and our image and brand will suffer.

Note, these ideas and concepts presented in this report are not ‘out of the blue’ but have evolved over the past 6 years and have been tested with a variety of community groups throughout the city through numerous public lectures – many chapters of Rotary, U3A, WEA, F&B, University students, CRIs, Matapopore, community groups, international audiences (in China, Florida, Louisville, Panama City), etc. The overwhelming response has been positive endorsement!



Fig. 49: View from Smash Palace, upper floor showing a vibrant and rich side of the city. We need images like this or stunning views from the CHCH360 Trail across Pegasus Bay, like that below, branded across TV and social media, linked to other initiatives like those discussed in this document, to lift the spirits and profile of the city.



Fig. 50: View across Pegasus Bay from the CHCH360Trail segment on the Port Hills.

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- enhancement of biodiversity in medium to high-density urban developments*. 99pp. UCD Urban Institute Ireland. [diversity of habitats in close proximity; most people live in them; monitoring and enforcement]
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APPENDICES

Appendix 1: Biodiversity

Biodiversity is not the same as species richness (Ignatieva et al., 2008). It is a global concept and pertains to each region's contribution to the global total. As an example, there are about 2500 indigenous plant species in NZ, of which about 75% are endemic. This contrasts with about 30 000 alien species of which about 2500 are naturalised (that is are self-reproducing in the wild). So plant species richness for the country is about 32 500, but biodiversity (our contribution to global species) is 2500. If we eliminated our indigenous species we would still have a species richness of 30 000 but zero biodiversity!

The world is facing a biodiversity crisis, with species extinction at 1000-10 000 times the background rate, largely as a consequence of human activity - habitat loss and fragmentation, introduction of exotic species

(http://www.biologicaldiversity.org/programs/biodiversity/elements_of_biodiversity/extinction_crisis/), and climate change. NZ and Canterbury are at the forefront of significant habitat loss and extinctions which drastically undermines our claims to being a 'clean, green' nation and province. This has a direct bearing on marketability of our region and city as a progressive model for urban and rural development for both residents and visitors. Just being a South Pacific coffee culture and adventure playground will not set us apart from other competing destinations for tourism around the world and even within NZ – which is (was) our second largest income earner for the province. Now we are regarded very much as a transit stop rather than a destination, when in fact the NY Times was mesmerised by the creativity born of the tragic earthquakes and identified Christchurch as a place to watch. I wonder if they are still watching!

Although the Canterbury Plain has the most depleted natural character in the country (Meurk 2008), Christchurch (the peripheral plains and peninsula) retains a surprising amount of semi-natural habitat and species, albeit invisible to most people. Indeed, there are almost as many native plants growing in the 'wild' around Christchurch as in some of our national parks. And the range of bird habitat in close proximity to the city gives Christchurch one of the richest bird-watching venues in the country. These habitats and small remnant populations are under continual threat from land use change, poor maintenance protocols, training and supervision, inadequate regulation, etc. A number of locally rare species are essentially 'out of sight, and out of mind', therefore could be inadvertently eliminated at any time. These biodiversity elements are showcased in the CHCH 360 Trail (<http://christchurch360trail.org.nz/>) which encapsulates the highlights of our natural heritage in a 140 km trek around the periphery of the city.

Appendix 2: Ecological Processes

Ecological patterns and niches as a foundation for design

The Grime matrix (Meurk 2004) (Fig. 3) –provides a framework for defining biotopes of natural or engineered urban environments, their restoration and management. Basically it predicts and prescribes the distribution of species in a spatial continuum of disturbance (flooding, scraping,

treading, gardening) on the one hand and stress (shallow or coarse-textured soils producing drought) on the other. This knowledge is the basis for ecologically informed landscape design, and can be manipulated to encourage certain desired growth forms and slow or accelerate succession. For example, adding water and fertiliser will encourage growth towards forest, whereas a rock garden will provide a holding pattern for herbaceous plants including rare local species like the Lyttelton forget-me-not (Fig 39).

This also explains why failure to heed these basic ecological principles results in unsustainable design (Fig. 2). It is wasted energy and money to grow short vegetation (like silver tussock) en masse in a forest environment, and is not legible.

Understanding and managing successional trends for biodiversity

The observations of ‘weedy’ plants and associated insects on disturbed or stony (stressed) ground are examples of classic terrestrial succession from bare ground, to moss and lichen, to grass and forbs (non-graminoid herbaceous species), to shrubland, and ultimately to woodland and forest. These are the same processes that were observed in the bombed out rubble of European cities after WWII. Essentially they are species of riverbeds, crags and coasts – where there is natural stress or disturbance. Many of the species here, within the inner city, are in fact the same as those of Europe, however there are also some indigenous species as revealed in the Results section. A few are even quite rare. Unfortunately, the maintenance regime does not recognise these nuanced plant communities and are accordingly managed by ‘scorched earth’ methods. In particular it has been noted that wind grass (*Lachnagrostis*) had over the past few years spread into some of these wastelands and along footpaths and road median strips of the inner city. But recently a major spraying episode wiped out many of these fine grasses. One of the characteristics of species that occupy this niche is rapid and prolific seeding, so it is hoped that they will recolonise these spaces – and be tolerated. Maintaining these natural landscape processes will take some intelligent effort, but it will be novel and informative, and be part of an eco-city narrative. Although there has been a call from Council to ‘tidy up’ the place, befitting a garden city image, care must be taken to not destroy the serendipitous presence of biodiversity.

Spatial Ecology

‘No plant is an Island’ – in the sense that all are connected physically (corridors) or across the matrix (stepping stones). The connectivity between trees or patches is critical to the population viability of both the plants themselves and the wildlife that depends upon them. And one could also say that it is critical for people to see their natural heritage on a regular basis (visibility) to prevent the onset of ‘extinction of experience’. The graphic (Fig. 51) encapsulates this in terms of empirically derived evidence (Meurk & Hall 2006) based on dispersal distances (aided by birds or wind) of established seedlings from parent trees in source areas. But it also shows the included connectivity between people and nature – that is, people live, work and play in the spaces between the habitat patches and occasionally visit them – for ‘forest bathing’.

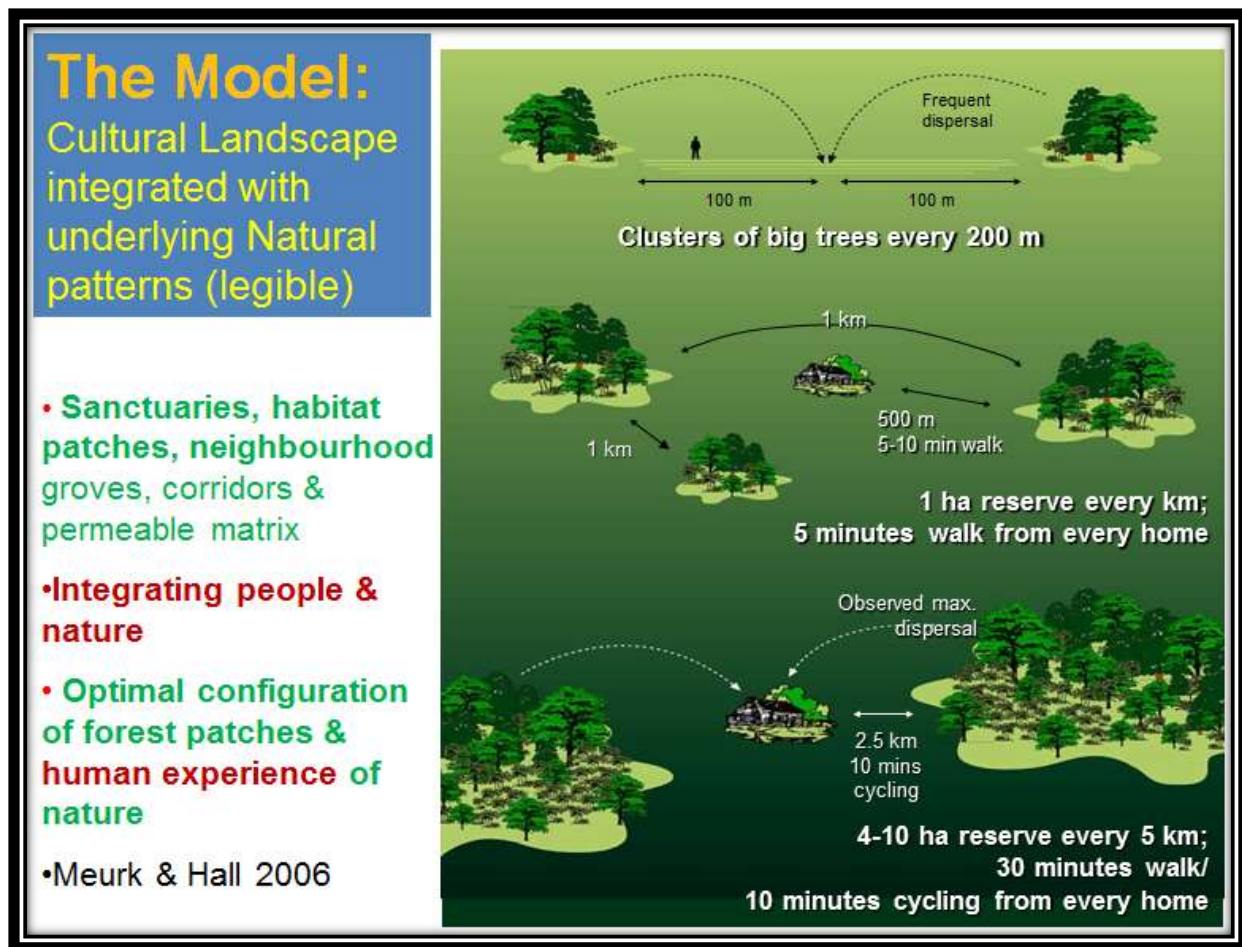


Fig. 51: Ideal spatial configuration of forest patches of different sizes within a cultural landscape (urban or rural) in which the matrix is suburbia or pasture respectively. Connectivity is maintained by proximity of patches, physical corridors (streams, avenues, railway lines), and/or a 'friendly' neighbourhood matrix.

The social needs for accessibility and visibility of nature has been codified in England where there are town planning requirements for maximum distances between people's dwellings and the nearest park or green space as well as some level of wilderness (Harrison et al. 1995, Barker 1990s, Box & Harrison 1993). Similar principles have now also been embraced by followers of Richard Louv's "Last Child in the Woods – saving our children from nature deficit disorder", "the Nature Principle", "Vitamin N" and the international movement it has inspired – *The Children and Nature Network*. Their vision and mission are as follows:

Vision: A world in which all children play, learn and grow with nature in their everyday lives.

Mission: The Children & Nature Network is leading the movement to connect all children, their families and communities to nature through innovative ideas, evidence-based resources and tools, broad-based collaboration and support of grassroots leadership.

The important thing here is that it applies to children AND their families and need not be compartmentalised, but is visible, feelable and smellable all around. We are not separate from nature and more than ever we need to understand our relationship with it.

When this concept is superimposed on top of the real world of Christchurch City (Fig. 52) we see that there are actual or potential habitat patches (if all the named parks have at least some part of their area dedicated to indigenous bush habitat) within dispersal range of each other (and to provide access to

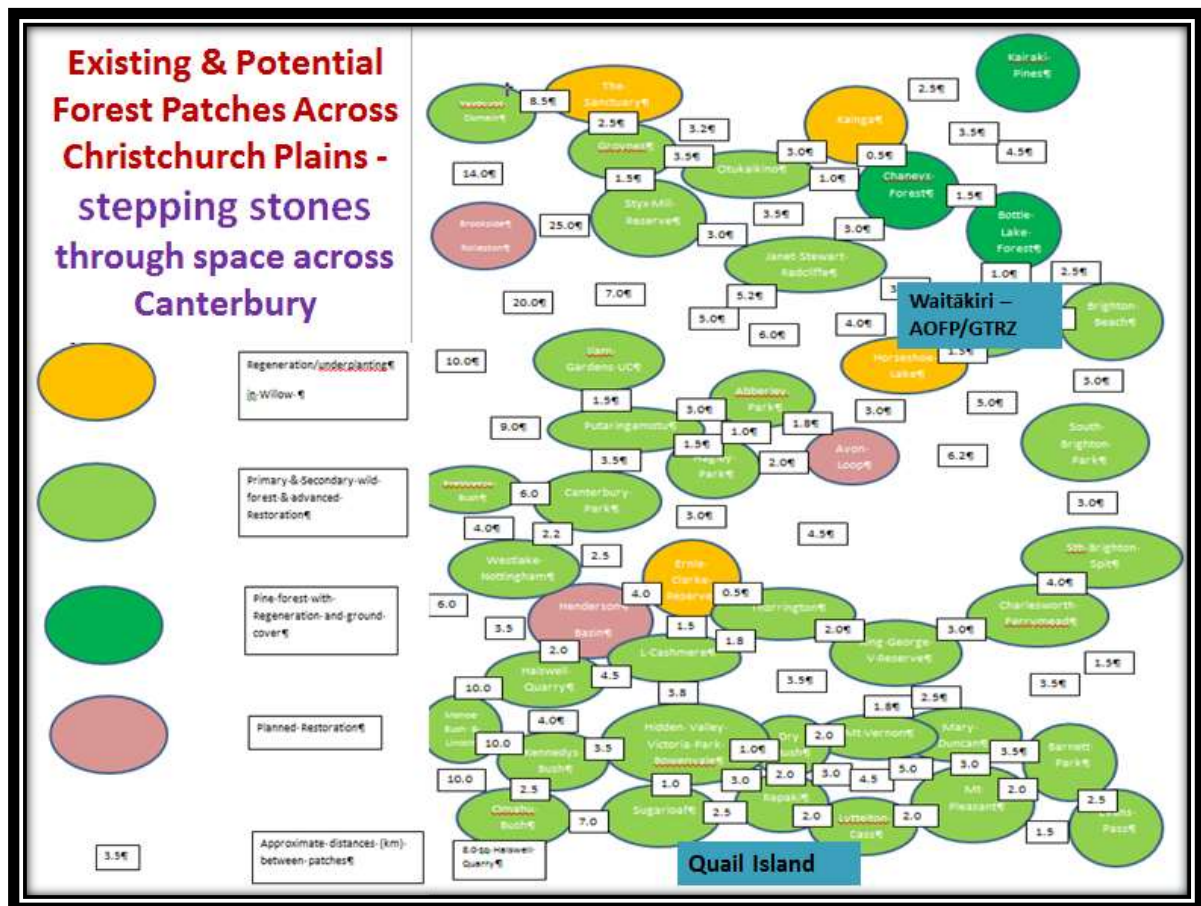


Fig. 52: Relative positions of key green spaces or parks across Christchurch and distances (km) between them demonstrating that most fall within the model optimal distances between forest patches prescribed by Meurk & Hall (2006). Many of these are (large) conventional parks dominated by sports grounds with a perimeter of exotic deciduous trees over mown grass. Fulfilment of their role as stepping stones will be creation of ecological patches (the ecological pocket park concept).

all residents). It also shows critical gaps for which there is a reasonable expectation that they could be filled from existing public lands. One of these spaces affecting the central city is the **Avon Loop**. The proposed Woolston urban forest will fill another important gap in the southeast.

There are three fundamental requirements for functioning, connected forest biota (supporting both edge and interior species). First is that at least some patches are large and compact enough to reduce edge effects and provide sufficient sheltered, sanctuary environment in the interior for sensitive species to feed and breed (Figure 53). Second, in the NZ special case, the presence of introduced, mammalian predators needs to be eliminated or controlled at very low levels. Our most sensitive wildlife have zero-tolerance of introduced predators. Thirdly the network of patches through the landscape must be close enough to each other, and/or strongly linked (physical

corridors), to enable wildlife meta-populations to maintain contact and/or provide stepping stones through the landscape enabling birds to forage for seasonal foods and meet other birds (insects).

In this sense, providing sanctuaries (fulfilling the first two roles above) is not only creating a source for the halo effect and the stepping stones through space out across the wider city and region, but

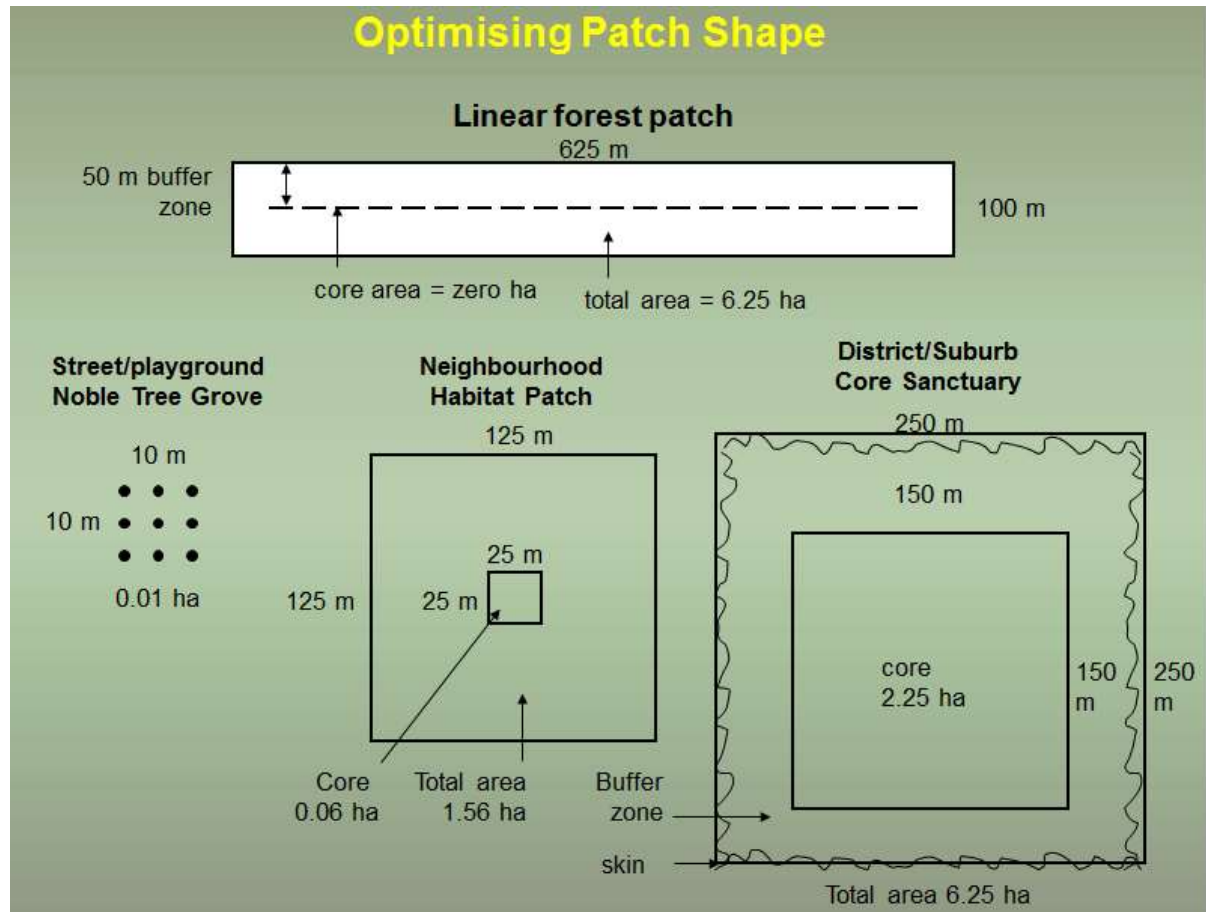


Fig. 53: Diagram showing the difference in core/interior habitat within patches of the same area (6.25ha) but with different shape (linear versus compact). The former is all edge, based on the empirically determined penetration of micro-climatic edge effect 50 m into forests.

sanctuaries are also like stepping stones through time to a future (introduced) predator-free NZ. If and when this is achieved, fenced sanctuaries will have done their job as holding pens (and making charismatic, endangered species accessible to the public) and will be redundant.

Appendix 3: Urban ecology – the fusion

Urban ecology gained ascendancy in the world, led by Europe, in the aftermath of WWII. The rubble of the bombed cities had a tragic origin, but was fascinating habitat for pioneering, early successional species, some of which had not been seen in cities like London for decades. Theories of plant ecological patterns and processes were tested in these circumstances, and 'wasteland' became a respectable phytosociological category in which distinctive plant communities assembled (Sukopp

1997). There is now a large amount of contemporary urban research specifically related to NZ urban ecology and that of Christchurch (see reference list).

There is a world-wide movement promoting a softer approach to urban environments sometimes referred to as 'urban wild' and adopting the Japanese concept of improving health through frequent walking in the woods ('forest-bathing'). 'Forest bathing' was popularized by the Japanese after the World Health Organization Health Promotion initiative (Ottawa Charter for Health Promotion, 1986), which advocates, among other things, conservation of natural resources as a global responsibility. The W.H.O.'s subsequent Bangkok Charter (2005) makes health promotion the responsibility for all of government through influencing local natural environments, among other commitments. Health-promoting, or salutogenic environments are places where people interact with others and healthy environments. Proximity to nature increases happiness levels, with a multitude of positive implications (Montgomery, C. 2013, *Happy City*, Penguin Books, UK; *Healthy Parks Healthy People* <http://www.hphpcentral.com/?s=urban+planning+and+the+importance+of+green+space+in+cities+to+human+and+environmental+health>). A W.H.O./Europe review of evidence (http://www.euro.who.int/_data/assets/pdf_file/0005/321971/Urban-green-spaces-and-health-review-evidence.pdf?ua=1) noted improved physical fitness, mental health and pregnancy outcomes, while incidence of cardiovascular morbidity and mortality, obesity, and type 2 diabetes risk was decreased. Mechanisms include the relaxing effects of nature, exposure to air pollution, noise and heat, and increased exercise.

A prerequisite for those benefits to be realised is for there to be woods and pocket parks (Fig. x) within easy reach of anyone at any place or time.

From a broader perspective there are also well-established international initiatives promoting Eco-cities (<https://www.ecocitybuilders.org/ieffs/#ieffs-overview> whose four pillars are: *urban design, bio-geo-physical, socio-cultural, and ecological*; Biophilic Cities Network (<https://www.thenatureofcities.com/2013/12/04/launching-the-global-biophilic-cities-network/>); TNOC (<https://www.thenatureofcities.com/>), and Transition Towns (<http://www.transitiontowns.org.nz/node/1667>)

BiophilicCities Pledge

We hereby commit our city to becoming a Biophilic City, and to joining together with other cities in the global network of Biophilic Cities.

We understand that a Biophilic City is

- a city of abundant nature, where citizens, young and old, have rich daily (if not hourly) contact with the natural environment; where citizens have nature nearby, where larger natural areas and deeper nature experiences are an easy walk, bike or transit ride away; and where the urban environment allows for and fosters connections with a diverse flora, fauna and fungi;
- a city where citizens recognize, are curious about, and actively care for the nature around them; a city where citizens spend extensive time outside, learning about, enjoying, and participating in the natural world;
- a city where leaders and elected officials place nature at the heart of their decisionmaking, and where every major planning and development decision is judged by the extent to which nature is restored and connections with the natural environment enhanced

With respect to softer, wilder, more organic green spaces, even Kew Gardens (the epitome of English park design) lets the grass grow 'untidily' and recognises that habitat and life needs space to breathe (note the connection to the Matapopore slogan). There is in fact a long tradition of naturalistic gardening (<http://noels-garden.blogspot.co.nz/2014/07/telling-story-of-uk-naturalistic.html>) in Britain. But there has evolved amongst risk-averse planners, especially in NZ and Christchurch, a sanitised, lifeless concept of urban vegetation and safer parks. It seems to equate with an almost anal-retentive attitude to control and power – a subconscious need to suppress life forces and demonstrate who is in charge. It should be noted that the concept of ecological parks arose in Western Europe in the post-war era of enlightenment but we seem not to have heeded this naturalistic attitude. Rather we have adopted a polarised approach to nature and culture – quite at odds with the classic English countryside and with Maori philosophy. Indeed planning policies from the late 1990s/early 2000s was explicit about nature belonging at the extremities of the built city. It hasn't escaped some commentators that there is an underlying racism inherent in these notions.

The symbolic meaning of landscape should always be carefully considered. Obsessive order may be a metaphor for control, power and even fascism. The word fascism comes from fasces (or bundle of tree branches). This potent symbol derives from the fact that fasces were carried by the Roman legions to enable them to swiftly cross unbridged rivers in their quest to conquer Europe. It was pointed out to me some years ago by a geographer colleague in Estonia that one of Adolf Hitler's intended legacies was to form avenues of series rows of Lombardy poplars (Fig. 54) across Europe – a symbol of order, power and control (Professor Hannes Palang pers. comm.). It does seem to instil a regimented approach to life, character, style and landscape and yet, the dire need in the world now is to better understand natural processes and complexity of life with a free mind. There is a solution

though – and this is the theme of this whole work – to be inclusive and encompass the wide breadth of values, styles and attitudes – to reflect all layers of history. Anything less than this will create ongoing tension and sense of being excluded among a substantial and growing group within the community (Appendices 5, 6). This will be detrimental to the need to celebrate diversity in all senses.



Fig. 54: Avenue of Lombardy poplars along Thompsons Track – imposing and ordered but not Aotearoa-NZ

There needs to be an acceptance that our universe is not always ‘perfect’ and tidy. Order is important for much of what we do but untidiness (in desks and minds) is also regarded as important for creativity and the production of novel ideas to adapt to changing circumstances (<http://www.apa.org/monitor/2013/10/messy-desk.aspx> ; <https://mic.com/articles/103954/the-science-of-why-the-most-creative-people-have-the-messiest-desks#.liMalfhpR>). It is not too great a leap to see how ultra-tidy landscapes (everywhere) instil and train convention rather than novelty. Nature is ‘messy’ yet orderly, both at the same time. That is what is instructive about it. There needs to be a balance between order, control and going with the flow of nature – not the perfection of automatons (Figs. 55, 56). Order can become obsessive-compulsive and nature sanitised. We are already hearing how this is not necessarily a good thing – paradoxically even from a hygiene and infection point of view. Recent and periodic debate about Christchurch losing its much vaunted ‘garden city’ status (Leader and Editorial, The Press May 2017) seems to be premature. Gardening and tidy parks are alive and well in the city, and I have already reviewed more modern ideas about urban wild – even in the heartland of mother England. This status has stood us in good stead for a century, but it was never what some people make it out to be. The British colonists and their opinion leaders (Deans, Cockayne, Ell, Barker, Ernle and most original homesteads incorporated grand indigenous species) all valued the indigenous (primitive) nature of Canterbury, incorporated it around their landscaped dwellings, and preserved it as best they could. They could also be pessimistic about it, but they did not seek deliberately to (nor could barely imagine) eliminate the natural environment.

Diversity of course generates conflict among those who wish to exert absolute power. To some extent, in a civil society, there are researched and applied approaches to defusing antagonism

towards styles that generate resentment. That solution was developed by the renowned landscape ecologist Professor Joan Nassauer in North America – “messy ecosystems, tidy frames”. Specifically this involves providing a sense of control and order along habitat edges that interface with human traffic (providing a sense of comfort and safety), yet permitting nature to go wild at a safe distance behind the neat edge. Allowance for those who wish to exercise their curiosity and explore the ‘wild’



Fig. 55: Two paradigms in hedging – on the left is the indigenous scrambling pohuehue (that has displaced the original gorse) forming a fuzzy but periodically controlled boundary. It provides food for NZ indigenous butterflies, lizards and birds. On the right a similar hedge was recently replaced by a manicured shelterbelt of leyland cypress. It represents overseas control, maintenance is more energy intensive and it provides nesting places for exotic birds and perhaps insects for grey warblers and fantails.



Fig. 56: A mixed species (indigenous) shelter planting that shows complexity and a sequential range of foods for wildlife and different times of year. This biodiverse style was actually the preferred option in a survey of attitudes to mono-cultural and mixed hedgerows (Landcare Research Report).

can use pathways that take them into the interior. This also accommodates the opportunity for children to safely experience nature in the heart of the city to show that we are a part of nature and not separated from it. This addresses what Richard Louv (2006) described as 'Nature Deficit Disorder'. We have gone too far in trying to control the environment (now it's largely neat, tidy, virtual and larger than life itself on a tiny screen) and thus depriving children (and the adults they grow into) of the feel, smell and sound of real nature. This has serious consequences for the kind of society we grow up into and our understanding of the processes and limits of the real world and our tolerances of it.

Governance is always going to be about balance, but governors need to know what there is to balance. This is why I have attempted here to unravel some of the history, theory and circumstances of the Christchurch situation. It is not self-evident as the plight of our natural heritage has been buried for a long time beneath what was believed to be the received wisdom from the 'civilised' world. But in fact was mis-interpreted and distorted to be used against the indigenous.

Accept also that the world is dynamic – there is continual change, and “the more things change, the more they stay the same!”

Appendix 5 – survey results of attitudes

Cultural/Land ownership/Planning constraints – coming to terms with post-colonial Fusion and Enlightenment

Whereas the ecological challenges for rebuilding our fragile ecosystems are quite enough on their own, the reality is that the socio-cultural barriers are equally daunting. There is a strong groundswell of support for green planning for our cities and wider landscape (see p. x), but it is easy for this to be overtopped by a vociferous minority. Planners must ensure their proposals are evidence-based, inclusive and fare but also with an eye to our international and national legal and moral obligations. Only we have the power to protect and manage our unique natural heritage back to health. And we are the ones who can benefit from the long term place-making and the marketing of this for tourism (selling the success story) and for selling our produce. Nevertheless the complexities involve fitting into the constraints of private land ownership, artificially inflated land values, market pressure from inside and outside the country, extinction of experience, conventional values imported from elsewhere, and tendency for the silent majority not to be heard by decision-makers.

The reality is that the pertinent random Christchurch Citizen Survey of a decade ago (2003) revealed that 58% of residents wanted more native plants in their neighbourhood, 72% wanted more native birds in their neighbourhood and around 3-6% wanted fewer. Surveys conducted in Little Hagley Park revealed that 88% of walkers and bikers wanted the 10 year old native forest planted along the Avon River retained as opposed to a very vociferous Merivale Precinct Society who wanted them removed. Again this latter position was only supported by 6% of the park users. This is a similar response to other natural areas surveyed around the city over the past 20 years (King George Vth Reserve; Canterbury Park; Ernle Clark Reserve). The same CCC survey revealed also that 82% wished to increase the indigenous component within or even dominating the 'English style'. But iconic natural and cultural heritage destinations such as Riccarton House/Bush did not figure at all when asked where they would take visitors to the city. Furthermore, an online guide to Christchurch attractions and activities listed trams, punts, gondola, bus tours and Botanic Gardens in 16 items

whereas the remaining 22 items were all about things to do by leaving Christchurch. One has to ask, where are the museum, Riccarton bush/house (living encapsulation of NZ's whole history), Travis wetland, Sumner, New Brighton, Brooklands/Spencer park, Lyttelton, Akaroa, Hinewai, Little River/Birdlings/Ellesmere, Willowbank kiwi house and Kotane, Orana, Port Hills walks, Sign of Kiwi, Ferrymead, 360Trail, Estuary birds, rail trail, Smash Palace, C1, the ruins, the gap filler, the historic rubble and fascinating plant succession? This seems to be devoid of any nature experiences and at odds with the potential tourist interest. For instance it is estimated that 35% of American adults are engaged in some kind of bird watching and this is the fastest growing outdoor activity in the US. Billions of dollars are spent annually on this activity in USA and Europe (http://www.responsibletravel.org/resources/documents/birdstudyreport_71615.pdf) and “The UNEP Green Economy Report shows that global spending on all areas of ecotourism is increasing by about six times the industry-wide rate of growth²⁵”.

The post-earthquake ‘Share an Idea’ exercise showed an overwhelming support for green space and on the strength of this the city planners proposed the concept of pocket parks through the city (small sanctuary areas for people and nature). The 2012 Ellerslie International Flower Show exhibit ‘Transitions’ (Fig. 36) was a rendition of such a pocket park comprising entirely indigenous plant species (about 100) and a dozen or so distinct habitats (Figs 31, 37, 39). The exhibit received the supreme award for horticultural excellence from the international panel of professional judges. But somewhat surprisingly, given the generally more conservative or conventional older demographic of attendees, the exhibit was only 6 votes away from being the popular choice. Several factors, unrelated to the exhibit itself, conspired to prevent ‘Transitions’ being dubbed the popular choice. The exhibit was disassembled and moved to a temporary CCC office frontage in the aftermath of the earthquakes. It became a popular attraction to the office workers until it was prematurely bulldozed to make way for a new plan virtually overnight!

It has just been drawn to my attention (Andrew Crossland, CCC pers. comm. August 2017) that the latest citizen survey indicated over 90% of respondents wished to see more biodiversity in the city!

Finally, two other observations seem pertinent. First, as one of the instigators of the Travis Wetland Nature Heritage Park it is heartening to see increasing numbers of the public using this wetland and swamp forest reserve. Family groups, mothers with push chairs, joggers, bird watchers, couples and individuals are using the trails there on a frequency of one every few minutes, every day of the week. The same could be said of the Ernle Clark Reserve for which there are statistics. It is also interesting to note that walking (forest-bathing?) through Riccarton Bush has become a popular activity for local members of the Asian community. This seems to reflect something to do with the tranquillity and separation from the busy world outside.

The ecological circumstances described earlier must in the end dovetail with these socio-cultural values and expectations, notwithstanding that there is an inherent bias towards conventional colonial values among especially older, conservative factions in the city. This is changing and needs to be reflected in the future development and imagining of the city. This is not the time to lock in another century of colonial symbolism (even Boris Johnson enjoyed his moments with NZ nature – he wasn't shown oak trees in CHCH). Indeed Dr David Bellamy (celebrated naturalist and TV personality) visited the city 25 years ago and while being driven in to town with the then Mayor, asked where were the native trees. The cultural landscape and social geography disciplines have the terminology that defines the debate: visibility, legibility, sense of place and identity. We need to pick these up and apply them.

The key now is the need to accommodate all these layers, not eliminate some arbitrarily and create another era of subjugation and discontent that will leave some groups (and especially Mana Whenua) symbolically disenfranchised. Indeed the above statistics demonstrate that large majority are clamouring for this change in emphasis in the city. Many still want a reference to Garden City, but this can be interpreted in many ways, and it has to be said, is probably largely irrelevant to the coming generation unless they have been conditioned to cherry blossoms and magnolias by design fashion - which have no resonance with England at all if that is the purpose. The question is, where did the mandate come from to transition from an English Garden city to a cosmopolitan city without contemplating a NZ option?

Two critical issues arise with habitat or wilderness in urban environments is the minority perception of danger and untidiness or loss of control. Although this represents a minority, more anxiety-prone subset of the population there are nevertheless techniques of design that can cater for this group. In particular is work of Joan Nassauer – landscape ecologist from USA – who developed the concept of ‘messy ecosystems and tidy frames’. In other words, by ensuring the edges that are exposed to the public are tidy with hedges, herbaceous borders or trimmed grass then the need for control is catered for. This should not however, interfere with the majority desire to explore, satisfy curiosity and to be able to enjoy forest interior and get the health benefits – through meandering paths that have sufficient surveillance and walk through traffic to deter anti-social behaviour.

Design also has traditionally been expressed through rigid rules derived from another part of the world and which are antagonistic to the NZ natural species. There is a belief that native trees are not suitable as street trees but indeed many are used throughout NZ and now in the city and Behrens (2011) championed biogeographic and ecologic criteria for choosing street trees. They don’t necessarily conform to the arborist’s idyll of clean tall trunks, spreading deciduous canopy and rapid growth. Unfortunately the deciduousness generates a vast fall of clogging leaves in autumn, and the rapid growth when joined with prolific reproduction is a recipe for pest invasiveness.

Appendix 6: Socio-Geo-Eco Political Context

Geo-climatic context

It is difficult to properly define the likely effect of global warming on Christchurch. The conventional wisdom is that there will be increased westerlies leading to drier overall conditions and possibly warmer winter minima (fewer frosts). Increased storminess and high intensity rainfall like we have recently experienced seems set to continue.

The Government’s guidelines on sea level rise and coastal erosion, and consequent development restrictions, are to plan for a metre rise by the end of the century. However, this figure is looking increasingly conservative, and it may be that we could be looking at 2-3-5 metres by end of century if there is run-away warming due to positive feedback loops. This will have an impact on water tables, salinity and surface flooding.

With 0.2 m rise in sea level since the beginning of the 20th century, and a projection of 1 m from Antarctica alone this century with up to 15 m over several centuries (without considering the effects on water tables, salinization, and storm surges), there is likely a medium to long term effect even on the inner city (12 m asl).

The total carbon emissions that humanity can emit over the next few decades has been calculated (1000 giga-tonnes of carbon); and the total known (corporate-owned) reserves of fossil fuel in the ground (without further exploration) is five times what is estimated can be extracted and 'burnt' while staying within the 2°C threshold for climate change (Mark Campanale's Carbon Tracker).

Construction of greater flood detention capacity in upper catchments, vegetating ephemeral water courses in the hills (to hold back stormwater and erosion), and planning a long term retreat from the present coast will all be part of resilience planning for the city and should be meshed in with the CCC Resilience Plan and reviewed frequently and adaptively as further information comes to hand.

The trajectory of the transport industry seems clear – towards ecars, ebikes and public transport (light rail) and even driverless vehicles. This trend will necessarily, substantially reduce the requirement for private car parking space despite the strong BAU lobby for this now. There seem to be two options here. First is to take action now and force these changes more quickly and thereby significantly decrease the magnitude of construction and infrastructure investment required for the private car. Second, ensure any capacity for private transport is convertible in the next 10-20 years to other uses.

Fire could also become more prevalent in future climates – interacting with social factors including alienation and pyromaniac behaviour. We already see how cabbage trees are favourite targets for fire bugs.

More engagement of the community with regards dangers and solutions, and surveillance may be required in future.

Changes in the global value of ecosystem services - from Costanza et al. 2014.

Constanza was associated with the first major analysis of ecosystem services provided by planet Earth. A brief summary of his latest findings and prognostications are as follows:

- Global loss of ecosystem services due to land use change is \$US 4.3–20.2 trillion/yr.
- Ecoservices contribute more than twice as much to human well-being as global GDP.
- Estimates in monetary units are useful to show the relative magnitude of ecoservices.
- Valuation of ecosystem services is not the same as commodification or privatization.
- Ecosystem services are best considered public goods requiring new institutions.

Geo-political Context

No one can be unaware of the grave socio-political dangers stalking the planet. And it is increasingly understood that what is fundamentally driving conflict, is not religion, language, nationality, culture, or colour but ecology (or its limits) – the basic laws of supply and demand for resources, biological imperatives and in particular the nature of logistic growth curves. Everyone has the same basic needs (Maslow's hierarchy of needs) of food, shelter, family, purpose, work, fairness, security and personal comfort. Only alienated people with no other alternatives seek violent recourse for their unhappiness, and unscrupulous leaders are always ready to exploit these situations and manufacture or provide scapegoats that can take attention away from their misery and its causes.

What is also sobering is that NZ, hitherto physically distant from such conflict and relatively peaceful, educated and affluent, has therefore regarded itself as immune from these global ills. But we are absolutely not.

All these issues are interwoven and interconnected – a Global context of biodiversity decline and resource wars can lead to interminable conflict – the litany of impending challenges include: climate change, SL rise (see Al Gore “An Inconvenient Sequel”), freshwater decline, peak oil, soil degradation, marine acidification and depleted fish stocks, shrinking timber/carbon resources, increase of toxins/poisons, pandemics and anti-biotic resistance, biodiversity extinction, consequent reduction in ecosystem services and consequent decline in equity, well-being and basic sustainability.

As we have seen elsewhere, part of well-being is connectivity to nature (Louv, 2006) which teaches us about natural order, beauty and balance of diversity, natural processes and limits, and how we are part of nature. Yes, we can harness it by being aware of natural laws and working with those, but we cannot control it or alter those laws.

What can a small town in a small country at the bottom of the world do about these converging crises? One could make an argument that Christchurch is in the unique position of leading a humane movement to reverse all these trends. Because we had our own tragedy that at least for the moment changed our world and gave us some time for reflection about our future and purpose. We can sympathise with those around the world who are also suffering. We had the shake up, but theoretically we have advantages of being a relatively affluent city, a well-educated and informed population, moderately inclusive and friendly (although there is a danger of media demonising the city despite its progressive legacy), but do we have humility?

We even have a serious thesis on a new New Zealand – Max Harris’ (2017). His book “The New Zealand Project” has received some acclaim although a review by Danyl McLauchlan (April 2017) soberly comments that “Talking about what must be done is easy ...meaningful progressive political change is really hard”. Already there is discussion, without much knowledge, of peak cow, and ‘pick a number’ for our human population, like it was some game without any consequences. But it is actually deadly serious.

Christchurch is in a position to do some radical things on a pathway of things that ‘must be done’ – and thereby gain the advantage of ‘early adopters’... or not! We can choose to plan a ‘soft landing’ because business as usual (BAU) is surely not going to work.

This report endeavours to look at the inner city as a ‘once only’ opportunity to learn from this experience and project our learnings and hope through a bright new vision, not only for the city, the province, the South Island, the Nation but to the world – a beacon. But first we must get our own house in order and support bold new changes – walk the talk!

What is the relevance of this analysis for the inner city? Everything is connected. We are not immune from any of these many individual, humanitarian and ecological crises and the inevitable economic consequences. The messages we project about ourselves to ourselves and to the world are an important aspect of identity, well-being, pride, learnedness, strength and indeed resilience to the anticipated shocks. Only then do we have something to offer the world.

We may envisage two immediate responses relating to resilience. The first is a planned and orderly transition from business as usual to a new reality. This may be represented symbolically in a way that informs, offers reassurance, and draws a road map. One such idea revolves around visually connecting the diverse elements, values and treasures of our society through some feature like an elevated plane table that embraces this diversity along view shafts signifying tolerance and enlightenment (Fig. 48). This is akin to the powerful symbolism of peace bells around the world (and in the Christchurch Botanic Gardens). Secondly, there is talk of a science hub and Science Alive to bring modern learning to the people. With our recent experience of shocks (earthquakes, fires, floods, rebuilding) and anticipation of more in future, driven both by nature and international trends or pressures, and with the stiff competition among universities, it would seem that scholarship represented in our local centres of higher learning and research (universities, ARA, hospital/medical school, CRIs, Ngai tahu) should be able to offer something unique to the world, both theoretical and practical, in the fields of conflict resolution, mediation, collaborative learning, co-creation, physical and emotional health, identity, disaster engineering, resilience design, equitable resource allocation, innovation (thinking outside the square), and new economic models within an ecological framework. In particular are the internationally acclaimed longitudinal studies of human development begun in Otago, and the innovative diagnostic research, 'duck therapy', youth suicide and Post Traumatic Stress Syndrome experience in Canterbury. The purpose will be to target integrated research, raise awareness of locals and visitors, achieve universal ecological literacy, and provide living demonstrations that inspire and cascade beyond Christchurch.

We can be a part of the problem, or we can be part of the solution - grabbing the opportunities through a joined-up approach to the recovery – one based on ecology, economics (in the holistic sense), on culture and on human well-being. This could be an historic role for the city – providing inspirational, innovative and aspirational leadership, running forums, giving people a good time (e.g. Travis educational centre can provide a low key venue for medium size forums in natural surroundings) rather than passively receiving whatever the world dishes up to us. We have to react to the challenge but in a way where we define our own terms – imposing our reality on the world rather than the other way around.

We need a clear vision of our destiny, planning changes to reflect that, develop initiatives and events to attract people into the city immediately, tell our story in music, art, theatre, demonstrations and reinforce a positive, integrated image of a future city.

Economic context

Christchurch's business future has been pinned to industrial dairying in the hinterland, however apart from service industries much of the profits from this increasingly unsustainable activity leaves the region, either for the North Island or overseas. Furthermore, regional and national assets are being sold off, and this could become more prevalent if the current specialised uses become financially marginal, leaving the country vulnerable to future economic shocks. Recent changes in Government may hold the line here. It seems that major trading nations are able to 'play' with NZ's economy when it is based on a few (luxury) commodities and when it suits them. Homogenising the landscape and compromising the precious water resource for uncertain future gains seems to not only be risky from a purely economic perspective, but also in terms of identity - which may become more important during times of adversity. Resilience planning is about preparing for bad times not good!

An emerging concern is the robustness of the 'clean green' NZ Inc brand. It has carried us through in the past, however it appears that this carefully nurtured trust built up over many decades is in danger of unravelling. Regardless of the truth of these now international assertions (Box) they will damage the brand and therefore the regional economy. It will have implications for continuation of premium prices for our primary products.

New Zealand: Polluted Paradise

Al Jazeera English investigates New Zealand's freshwater crisis

New Zealand's sparkling and abundant rivers and lakes are fundamental to its image as a land of outstanding natural beauty – key features of a supposedly clean, green environment brand that attracts visitors from around the world.

But in a new two-part, year long, documentary investigation, Al Jazeera's **People & Power** series discovers a murkier reality hidden in the depths: a disturbing tale of polluted and dried-up waterways, questionable irrigation schemes, an over-mighty farming lobby and claims of undue government interference.

And this doesn't even address the environmental impacts of this activity on water quality and quantity. With impact on water condition becoming more visible and debated, there is a general appetite to see the industry being kinder to the land and the 'clean green' image.

The Herman Daly (2015 - <http://greattransition.org/publication/economics-for-a-full-world>) model shows that the environment is not a part of the economy as conventional wisdom would have us believe, but it is the other way around – the economy is a subsystem of the Ecosphere and, significantly, the planet in which this drama plays out is not an empty world – as it may have seemed prior to the industrial revolution. Daly proposes 10 policies designed to move towards a sustainable, steady state global economy in which economics is operating within a larger ethical, sociological and ecological context. This same theme was applied by SANZ (2009) specifically to the NZ situation.

With our rebuild and recovery we have an opportunity to lead the world in facing up to these realities which are treated by society very much as inconvenient truths or with complete denial.

Appendix 6: vegetation history of Berlin, Germany – from Sukopp 1997. The following excerpts demonstrate the classic development of urban ecology in one of the European capitals – the diversity of nature in cities contrary to popular beliefs, the coexistence of indigenous and exotic species (recombinant ecosystems), the comprehensive conservation planning and management for that urban biodiversity (abandoning outmoded ideas about separation of nature and urban culture), and the role plants can have in mitigating urban environmental effects - in Berlin.

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HISTORY OF THE FLORA AND VEGETATION OF BERLIN AND THEIR CONSERVATION

Herbert SUKOPP®

ABSTRACT – The Berlin area was formed during the Quaternary and is mostly covered with Weichselian and Holocene sediments. The primeval vegetation, as reconstructed by pollen analysis, soil conditions, historical reports and recent vegetation patterns, has totally changed due to the large city development since the second part of the 19th century. Today about 3.5 million people are living in the city of Berlin on 889 sq km. To understand the relationship between the plant species and the environment, it is necessary to see the present flora and biotopes as a result of the historic development. Plants can exercise a positive influence on both the climate and the air in the surroundings. Through transpiration, humidity is increased (it is often too dry in towns), and the heat required for evaporation avoids excess temperatures. Thus green areas can help to produce cool air, which is a necessary compensation in highly built-up areas. In addition, plants in vegetation belts help, to some extent, to absorb noise. Arguments for the conservation of wild plants in the cities also lead to some remarks concerning nature conservation practices in Berlin.

In spite of difficulties in carrying out research into the often repeated assumption that cities are generally ecologically imbalanced, results indicate that, surprisingly, man-made habitats can offer environments for characteristic combinations of plant and animal species. The species combinations in environments such as industrial areas, railways, ports, and refuse and rubbish dumps, often vary considerably from those found in more natural environments.

Natural scientists and landscape architects are playing an important role in protecting nature and reintroducing it into cities. The system of subject planning and strategic planning required under the Berlin Nature Conservation Act of 1979 is described. Landscape architects have helped to elevate nature conservation to a strategic planning level and to make it part of political thinking. The procedure used to develop the Nature Conservation Programme, which is one of four types of programmes included in conservation subject planning, is outlined. The Nature Conservation Programme, which is part of the strategic plan for Berlin, is a good example of how a natural approach can be achieved in urban planning.

Plants growing on buildings influence the climate in the building positively. Extensive investigations reported by DARIUS & DREPPER (1984) confirm the considerable benefits to microclimate and air hygiene of climbing plants on walls. A cover of plants on roofs can reduce the surface temperature, filter the air, fix harmful substances and reduce heat losses during the winter (DARIUS & DREPPER, 1984).

To understand the relationship between flora and environment, it is necessary to see present biotopes as a result of historic development. From the beginning, towns have been places of shelter against nature and its dangers, and nature was only tolerated for ornamental purposes. Historically, cities have fought nature back, creating a cultural – artificial – environment as opposed to the more natural environment prevailing outside (TREPL, 1993).

In the course of city historic development, site conditions have been altered by humans, intentionally or unintentionally. Thus urban open spaces represent modifications of older ones. The similarity between former and present site conditions decreases with time and along a gradient from the periphery to the center. Within the built-up area the original ecosystems are destroyed and many species become extinct, but simultaneously new organisms and new biotic communities become established in all areas of the city (Fig. 1).

The history of plant geography and plant ecology in Berlin

The 18th century saw the development of the fundamentals of natural history, the precursor of plant geography and ecology. Natural history was concerned with the description and classification of living organisms, and with their distribution. Zoological and botanical investigations on all continents led to the “discovery of diversity” (MAYR, 1982).

History of Berlin flora and vegetation

Towns and cities are normally thought of as “opposites” of nature. On this basis, it may be surprising that the species richness of many plant taxa in cities is greater than in the surroundings. Larger cities have higher numbers of species than smaller ones. In Central Europe, the number of plants species growing in towns and cities, is correlated to the number of inhabitants (see Table 1).

Table 1: Approximate numbers of plant species (ferns and flowering plants) in Central European towns (data from SUKOPP & TREPL, 1993)	
Town size	number of species
Small and medium towns	530-560
Cities with 100.000-200.000 inhabitants	650-730
Cities with 250.000-400.000 inhabitants	900-1000
Cities with more than 1 million inhabitants	> 1300

For Berlin, the change of vegetation, species composition and site conditions from the ice-age to the present has been thoroughly investigated (*e.g.* SUKOPP *ed.*, 1993). The number of fern and flowering plant species for Berlin (889 sq km, today's area) was 822 in 1787 (WILLDENOW, 1787), 1130 in 1864 (ASCHERSON, 1864) and 1936 in 1991 (BENKERT *et al.*, 1996).

The numbers given above refer to spontaneously occurring species only. In addition, there is a large number of cultivated plants in parks, gardens and churchyards, in small patches of ornamental green, as street trees or even on balconies or in flower pots. Their number – in species as well as in individuals – far exceeds that of the spontaneous plants.

Urban green enhanced by city dwellers had either the function of symbolizing the superiority of humans over nature – as in baroque gardens – or to represent the dream of a natural rural life – as in landscape gardens. In both cases, “green” stands for the contrast between nature and city.

Spontaneous urban vegetation on the other hand – as a type of nature

adapted to the specific urban conditions and capable of developing under them – symbolizes the city. This is an opportunity for greening design that does not accentuate the contrast between nature and city, as used to be the case.

Although cultivated plants serve important functions in cities, e.g. with respect to climate and air hygiene or as living space for animals, the focus of the following is on spontaneously growing plants.

One unexpected result of early studies on plants in cities brought out the fact that they do not co-grow accidentally, but form distinct patterns of co-occurrence and plant communities in the same way as plants do in more natural environments. Typical urban vegetation of Berlin is represented by the Prickly Lettuce-association (*Conyzo-Lactucetum serriolae*) and the Viper's Bugloss-Melilot-association (*Echio-Melilotetum*).

One of the characteristic pioneer colonizers is the summer annual

1 - Species immigrated before 1500 AD (SCHROEDER, 1969).

2 - Species immigrated after 1500 AD.

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History of the flora and vegetation of Berlin and their conservation

Chenopodium botrys (SUKOPP, 1971) (Fig. 2). This southern Eurasian-Mediterranean plant has expanded its range due to human influence into broad areas of central and western Europe, North America and Australia. Introduced in 1889, it is now a characteristic and specific ruderal plant for the heat island of inner Berlin. Natural habitats of the plant are sandy and stony soils near river banks, rubble footpaths and at the foot of rocks, i.e. special habitats with little competition. Accordingly, roadsides, cultivated areas and fallow fields are colonized as secondary habitats. Under natural conditions the area covered by such open, low-competition habitats in Central Europe is quite small. The open calcium-rich sandy to gravelly habitats which have been created by man have allowed the appearance of *Chenopodium botrys*. Nonetheless, large and lasting populations of this species are found north of the Alps only in Berlin, Manheim, the Ruhr area and Lille. The colonies in Stuttgart, Saarbrücken and Leipzig are unstable or have disappeared.

After the War an intensive and spontaneous development of vegetation began on the rubble, proceeding in more or less rapid succession from short-lived and perennial stages of herbaceous vegetation to shrub and forest-like stands. The variety of species on such inner-city wasteland is surprisingly large. Thus a site at Berlin's Lützowplatz in Berlin-Tiergarten accommodates one hundred and forty seed plants and at least two hundred types of insect.



H. SUKOPP

The carefully maintained lawns and bushes of the nearby Tiergarten Park have at the most a quarter as many insect species on the same area. This natural succession was generally disrupted by clearing then reconstruction work. The areas cleared of rubble or destined for redevelopment, which have often been recolonized by woody plants, are gradually disappearing in the course of ongoing construction.

Among the woody plants on inner city vacant land in Berlin, *Robinia pseudo-acacia* L. stands cover the greatest area. On rubble-mortar substrate, a calcium-containing loose syrosem develops into a refuse pararendzina under *Robinia* in the course of vegetation and soil development.

Among the numerous neophytic woody plants, not only the variety of species but, in particular, their lush development is surprising. Besides *Robinia pseudo-acacia* L., the tree of heaven [*Ailanthus altissima* (Miller) Swingle] is spreading on innercity vacant land (KOWARIK & BÖCKER, 1984). This vigorous drought-tolerant tree settles on extreme habitats such as railway and land adjacent to buildings, but is also frequently found in green open spaces (Fig. 3). In derelicts areas *Ailanthus* is able to establish large polycormons through suckering.

A particularity of urban flora is the fact that it is richer in non native species than the surroundings of cities. The proportion of non natives in the floras of regions of the world is between 5 % and 25 %, on islands it is often higher (JÄGER, 1988). In Berlin, the proportion of non native species varies from 28.5 % in the outer fringe – zone 4 – to close to 50 % in the inner city – zone 1– (KUNICK, 1974, 1982) with an average of 41 % for the whole city (KOWARIK, 1990). These numbers are in sharp contrast with a mere 20-25 % of non natives in surrounding districts. Of these species it is especially the neophytes that are more frequent than in the environs, whereas the proportion of archeophytes is not significantly higher than in rural areas. Native and naturalized alien woody species in Berlin are given in Table 3.

Table 3: Native and naturalized alien woody species in Berlin (KOWARIK, 1992)			
	Natives	Introduced aliens	Established aliens
Trees	30	68	25
Shrubs	57	109	29
Woody climbers	2	5	2
Sum	89	182	56

Altogether one hundred and forty-five species form the woody flora of Berlin. The most frequent spontaneous tree species, ranked according to their frequency on natural and man-made sites in Berlin (KOWARIK, 1992) are:

Natives	Aliens
<i>Acer platanoides</i> L.	
<i>Betula pendula</i> Roth.	
<i>Quercus robur</i> L.	
<i>Acer pseudoplatanus</i> L.	<i>Robinia pseudo-acacia</i> L.
	<i>Acer negundo</i> L.
<i>Sorbus aucuparia</i> L.	<i>Prunus serotina</i> Ehrh.
<i>Pinus silvestris</i> L.	<i>Aesculus hippocastanum</i> L.
<i>Crataegus monogyna</i> Jacq.	
<i>Salix caprea</i> L.	<i>Quercus rubra</i> L.
<i>Ulmus glabra</i> Hudson	
<i>Acer campestre</i> L.	
<i>Tilia cordata</i> Miller	<i>Ailanthus altissima</i> (Miller) Swingle
<i>Populus tremula</i> L.	
<i>Fraxinus excelsus</i>	

Fraxinus excelsus

Carpinus betulus

Due to the high level of human influence on urban ecosystems many native species are in danger of becoming extinct there, or are already extinct.

levels is shown in Table 5. From the above it is clear that the aim of urban nature conservation is not so much the prevention of extinction of species but rather the preservation of diversity. A main group of reasons focusses on the need which people have for contact with nature. The recognition of this need is also a basic feature of urban nature conservation strategies which were developed in Britain.

Nature Conservation practice (Berlin examples)

Many European states develop programs for nature and nature conservancy in towns and cities. The chief aspects are contained in the Global Biodiversity Strategy (WRI, IUCN, UNEP, 1992).

The Berlin species protection programme describes measures for the conservation of the flora and fauna for fifty-four types of biotope, thirty-six biotope development areas and eighteen groups of organisms. The cartographic part comprises the following maps and plans : Value of the biotopes, care and development measures for types of biotope, protected areas, priority areas for nature conservation, biotope development areas (ARBEITSGRUPPE ARTENSCHUTZPROGRAMM 1984). In the description of the various types of biotope a short history is followed by details of the number, size and distribution of the individual biotopes and site conditions. The stocks of animal and plant species are described. After naming threats and their origin, the important structural and sub-structural elements for species stocks are listed. They are followed by recommendations for their protection, care and development. The current type of use will not be questioned, with a very few exceptions. The aim is rather to integrate nature conservation into existing land use as much as possible. The functions of a given type in terms of nature conservation are listed under the heading "specific values of types of biotope". Finally particularly valuable types of biotope are listed, together with a summary of the features which warrant this classification. Recommendations may be made for some biotopes to be classified as protected areas.

In built-up areas recommendations for biotopes might include: No cutting of hedges ; no hoeing of leaves and ruderal plants ; no removal of dead leaves, twigs or dead wood from wooded areas ; transformation of close-mown lawns into grassland ; development and encouragements of spontaneous vegetation; planting of appropriate woods typical for the area ; reduction of tree surgery; on-site composting ; measures to encourage typical local fauna e.g. creating flight access to undisturbed, unheated cellars and attics ; climbing plants for facades or grassing over roofs.

The traditionally developed system of parks and green areas can be expanded by a system of existing, ecologically functioning areas, which have not yet been "planned": areas resulting from war damage or demolition which are spontaneously settled by animals and plants.

In the school system, school gardens (WINKEL, 1979), which provided plants for school lessons have developed into environmental centres over recent years. Their function in environmental education is described by WINKEL (1986) as:

- Developing an emotional link to nature through personal experience;
- Learning details and interconnections ;
- Evaluating such interconnections from an individual, social, ecological or economics point of view; and
- Acting (or not acting) in the environment according to this evaluation.

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History of the flora and vegetation of Berlin and their conservatio

With the unification of Berlin in 1989, natural landscapes came together again, which – despite wall and barbed wire – were never completely divided from each other and from their hinterland. But land use and laws had been different for more than forty years. With the decision for Berlin to resume as the capital of Germany, a second “Gründerzeit”, a time of rapid expansion, started. To guide the expected urban development in a sustainable way for the nature and the environment, the planning system for nature conservation and landscape management in Berlin was completed for both parts of Berlin in 1994.

CONCLUSION

With the existing inadequate adaptation of society to its environment, many problems can only be solved if due consideration is paid to the ecological views and the social needs. Ecological criteria should serve primarily to make plain the consequences of actions for the environment, the society, and for the individual.

Nature must develop in close relationship with local inhabitants and their customs.

Organisms and biological communities should be conserved to allow people direct contact with the natural elements of their environment. Only such open spaces can lead to the experience of natural beauty which permits coexistence between a nature existing in its own rights and people who are free to determine their own actions in this space.

Urban development needs reliable knowledge of the environment and the conditions of its protection. Two models of the relationship of science and policy exist. In a normative model, the role of science is “speaking truth to power”. Policies shape aims, strategies and tools. But in reality there is often an uncertainty of problems and an uncertainty of knowledge.

Appendix 7: Rationale for allowing a dense forest vegetation on the steeper outer curves of the Ōtākaro river bank.

The planned woven partnership model for the Avon River Precinct (Water Mark, Fig. 47) was abandoned on the basis of concerns about high flood risk from dense vegetation along one (steep) bank of the river, but changing from side to side. There was no opportunity at the time to challenge this view, but a rational ground-truthing of flood characteristics during recent storms demonstrates a quite different risk.

A recent (July 2017) 5-10 year flood shows that the main obstruction to water flow would appear to be the bridges. In the Heathcote, the level near the height of the flood was about 30 cm below the bridge arch (Fig. 57) whereas on the Avon in central Christchurch it was perhaps a metre from the apex (Fig. 58). If flood levels had risen by that further amount, the bridge span would become a dam and surface water on the periphery would almost come to a standstill (as seen in Fig. 57b). In such circumstances, any dense vegetation along the banks (and it would only be on the one steep side of the river) would not impede flow, but would only take out the passive stem volume from the static capacity of the river profile (< 1% of total volume).

The first picture (Fig. 57a) is of the Fisher Rd Heathcote Bridge showing flood level within 30 cm of arch and looking upstream at the lateral spread of water backed up behind the bridge (Figs 57b). The third picture (Fig. 58) is of the Montreal St Bridge on the Avon. It shows a metre freeboard below the top of arch and the increasing damming effect of the lower limbs of the arch that would result from a further river rise. Again the steep scarp on the true right, if vegetated, would either be above the flood level or would only have a passive influence on flood levels. This would especially be the case if trees along the foot slope (narrow floodplain) were spaced, clean trunked specimens of cabbage tree (ti kouka), kahikatea and pokaka – as would be intended. Furthermore, if this vegetation pattern were continued further upstream to the source, there would be an overall cumulative detention effect from source to sea which is the best way of limiting downstream flooding – releasing water



Fig. 57a,b: Heathcote River (Tennyson St Bridge) in a 5 year flood.

from the upper catchment more gradually. Failing that, some minor stop banking could be contemplated or the construction of detention ponds in North Hagley Park by lowering the sports fields a metre or two.



Fig. 58: Avon River in 5 year flood (Montreal St Bridge).

Another hydrological consideration is the connection of a stream trace through the back of the Square meandering out to the west and connecting up to the Otākaro.