Abstract
The Australian government predicts that Perth’s population will increase from 1.5 million people to 3 million by 2050. Demand from China for Western Australia’s massive mineral resources has caused the local economy to boom and over 700 newcomers are entering the state each week. The Australian Bureau of Statistics predicts that Perth will grow from its current population of 1.5 million to a total of 3 million by the year 2050. If current rates of migration into Perth continue, this figure will be reached before 2029.[2] Notwithstanding the possibility that predictions can be wrong, this research is conceived to help a community manage growth creatively by recognising the opportunities and constraints for urban development that emerge from a fundamental appreciation of the city’s landscape conditions.

If the current population of Perth doubles by 2050 as predicted, then 631,978 new freestanding homes (calculated at 2.3 people per home) or 788,427 apartments (calculated at 3 people per unit) will need to be built in the next 42 years. The mass housing industry in Perth claims it can deliver 20,000 homes per annum, but this housing is almost entirely in the form of orthodox low-density suburban sprawl. As well as doubling the present residential mass of the city, logic dictates that the entire infrastructural system of the existing city will have to also double in the next 42 years. This situation represents a significant opportunity for landscape architecture to apply its unique capacity to accommodate a city holistically in terms of its regional landscape and, rather than just delineate where development should not occur, creatively set out ways in which the city can grow to achieve a more sophisticated synthesis between urbanism and landscape.

The highly regarded Australian scientists Dr Tim Flannery has said that because of water shortages associated with climate change, “Perth will be the 21st century’s first ghost metropolis.”[3] In the very long term Flannery may be right: this old, arid landscape is not suitable for large-scale urban planning. This means that urban planning now involves a synthesis of what is traditionally meant by landscape planning on the one hand and urban design on the other. Wherever relevant, each scenario is related to classic models such as Ebenezer Howard’s Garden City, Le Corbusier’s Radiant City and Frank Lloyd Wright’s Broadacre City. Although focused specifically on the metropolitan region of Perth, the research methodology leads to the production of seven scenarios: four of them spread the city further into its landscape (horizontal scenarios) and three present infill development (vertical scenarios) within the existing city boundary. Thus the study even-handedly addresses both sides of the international sprawl debate. These development scenarios are related to the existing city from a regional landscape perspective. The horizontal scenarios are placed in situ according to guidelines derived from a McHargian sieving mapping analysis of existing land use conditions. The vertical scenarios are placed in situ according to where the landscape of the existing city offers significant amenity value to offset the reduced personal living space that would otherwise lead people to prefer freestanding homes in the conventional suburban sprawl. The paper also briefly compares Ian McHarg’s planning method to the contemporary work of the Dutch design practice MVRDV, for it is these two practices that inform the horizontal and vertical scenarios respectively. By occupying a space between these two practices it is suggested that this research represents an appropriate method for large-scale urban planning. This means that urban planning now involves a synthesis of what is traditionally meant by landscape planning on the one hand and urban design on the other. Wherever relevant, each scenario is related to classic models such as Ebenezer Howard’s Garden City, Le Corbusier’s Radiant City and Frank Lloyd Wright’s Broadacre City. Although focused specifically on the metropolitan region of Perth, the research methodology leads to the production of seven scenarios: four of them spread the city further into its landscape (horizontal scenarios) and three present infill development (vertical scenarios) within the existing city boundary. Thus the study even-handedly addresses both sides of the international sprawl debate. These development scenarios are related to the existing city from a regional landscape perspective. The horizontal scenarios are placed in situ according to guidelines derived from a McHargian sieving mapping analysis of existing land use conditions. The vertical scenarios are placed in situ according to where the landscape of the existing city offers significant amenity value to offset the reduced personal living space that would otherwise lead people to prefer freestanding homes in the conventional suburban sprawl. The paper also briefly compares Ian McHarg’s planning method to the contemporary work of the Dutch design practice MVRDV, for it is these two practices that inform the horizontal and vertical scenarios respectively. By occupying a space between these two practices it is suggested that this research represents an appropriate method for large-scale urban planning.

Introduction
The research project[1] summarised in this paper determines and clearly depicts various growth scenarios for the city of Perth in Western Australia. The Australian Bureau of Statistics predicts that Perth will grow from its current population of 1.5 million to a total of 3 million by the year 2050. If current rates of migration into Perth continue, this figure will be reached before 2029.[2] Notwithstanding the possibility that predictions can be wrong, this research is conceived to help a community manage growth creatively by recognising the opportunities and constraints for urban development that emerge from a fundamental appreciation of the city’s landscape conditions.

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ed 2032 population, Network City recommends that 60% be built within the existing city limits, and 40% (150,000 homes) be assigned to peri-urban areas of the city that have been designed as service nodes for cars, not people. Consequently blend scenarios […] to generate hybrid policies […] Used in this way MVRDV’s proposals tend to hybridise natural and cultural systems into ingenius new growth trajectories. Although similar to McHarg insofar as it also believes in initially basing the design process on empirical data sets, MVRDV departs from McHarg’s singular use of data to arrive at one masterplan by using the data (as we have done) to produce multiple development scenarios (11). The following scenarios demonstrate the results of combining the methods of both McHarg and MVRDV.

Horizontal Scenarios

Food City

The concept of Food City stems from the North American architect Frank Lloyd Wright’s 1936 Broadacre City. Intended as a complete reversal of urban conglomeration, Broadacre City depicted dispersal and interweaving of urban, suburban, industrial and rural landscapes across the breadth of the North American continent. Fed by superhighways and set on a one-mile grid, Broadacre took everything that comprised the modern metropolis and spread it thinly across the landscape, a condition that landscape urbanists would describe and theorise as SCAPe some 70 years later. Based on a density of 1.5 homes per hectare, Wright’s Broadway City, although intended as an urbanisation of agrarian virtue, can thus be read as a proponent of wasteful sprawl.

Both McHarg and MVRDV advocate for low-grade sprawl and thereby destroying the very landscape he sought to commune with, Wright envisions buildings that were organically of their place: critical regionalism was left well wide before the term was invented. According to Wright, all the infrastructure of Broadway was to be “built in symmetry with nature […] that a deep feeling for the beauty of the terrain would be a fundamental qualification in the new city-builders.” (Kroes 1995: 6). By today’s reckoning however, Broadway is problematic: its density is, as Paul Zygadlo says, “scandalously low; it is impossibly car dependent; it is expensive to service; it is hard to reconcile with existing land ownership and, given the choice, most people would not work surrounded by agricultural fields.” (Zygadlo 1995: 28).

Certainly in the past (and today where large backyards still permit) Australians have always supplemented their diets with home grown produce (Toms 2006: 129-147). Although such do-it-yourself alternatives to the global agribusiness necessary to sustain contemporary cities are probably parochial, there is growing interest in what Andre Viljoen and Katrin Bohn refer to as ‘Continuous Productive Urban Landscapes’ as a core component of sustainable urbanism (Viljoen and Bohn 2005). Wright’s ecological footprint is currently 2.7; 1.5 million hectares, almost half of which is related to global food production systems (EPA 2006: 12). In terms of reducing a city’s ecological footprint as well as physically reconnecting people

such regionalism is part of a tradition in planning that can be traced back to the 1920s when Lewis Mumford advocated that planning proceed with a holistic sense of a hierarchy so that “… all its sites and resources, from forest to city, from highland to wa- ter level, may be soundly developed, and so that the population will be distributed so as to utilise, rather than nullify or destroy, its natural ad- vantages.” (Regional planning) says people, industry, and the land as a sin- gle unit.” (Huff 2002: 161).

Four decades later, this was almost precisely the vision upon which Ian McHarg based his ecological method (McHarg 1969). It also influenced George Seddon’s 1972 study of Perth, A Sense of Place, which galvanised and underpinneD Australian landscape architecture in the late 20th century. But apart from one sentence in the conclusion of A Sense of Place warning against the rumoured possibility of 10 million people settling in the Perth region by 2027, Seddon only described the landscape as it was, not as it might become. (Seddon 2004: 258)

For McHarg, the pure logic of landscape systems as described by sci- entists provided the master narrative to correct what he perceived to be a civilisation built on habitation. By putting predominantly ecological data in one end, McHarg arrived somewhat artlessly at the other with an an- swer – one definitive masterplan. For McHarg, the limits of the existing landscape were absolute guidelines, and to dwell within their limits was, for him, the highest are. Despite postmodernist critiques of McHarg’s de- terminism, his method is still so good at determining where, on a large scale, we simply shouldn’t build. In particular, existing developed areas, reg- ulation, wetlands, flood zones, riparian buffers, aquifer recharge zones and slopes greater than 25% have, according to McHargian logic, been ex- empted from development potential (Fig. 4). Along with subtracting these ‘no-go’ areas, we have added a network of public open space and habitat corridors that weave throughout the entire Perth metropolitan Region to create a Landscape Structure Plan for the city. (Fig. 3). When the habitat matrix and the other no-go areas are subtracted from the Perth Metropol- itan Region there remain 118,000 hectares of currently undeveloped land suitable for suburban growth, enough land for 1,445,866 dwellings or an additional 2,865,984 people should the city decide to continue sprawl- ing. Almost all of this land is degraded rural land with little to no current agrarian productivity (Fig. 4).

While McHarg’s methods is still effective at a regional scale for iden- tifying where not to develop, it is not necessarily good at determining how or what to develop. In this regard we have been concerned to avoid what James Corner referred to as the “synonym of postivism” in regard to McHarg’s methodology, by not expecting the method to do any more than identify large scale obstacles from certain natural systems. (Corner 1991: 117) (10) We have, therefore, attempted to find not only constraints but also cre- ative opportunities in large-scale landscape assessment. Theoretically and methodologically we have tried to operate on the threshold between what is more traditionally thought of as the utilitarianism of landscape plan- ning on the one hand and the creativity of urban design on the other, and it is the Dutch practice MVRDV that offers inspiration for the latter (9).

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Using contemporary (high technology) European farming methods, it is possible to produce much of the food consumed by a population of 3 million on 60,000 hectares of land. (MVRDV 2005: 288-289) Subtracting 60,000 hectares from the 118,000 hectares of degraded rural land that we have identified as suited to suburban growth leaves 58,000 hectares of land on which to house 1.5 million people. The density of Food City therefore becomes 33 homes per hectare, 4 times denser than Wright originally envisaged, 2.5 times denser than Perth’s average overall density and only marginally denser than existing suburban developments (Fig. 5). If, however, we test this scenario on a suburban scale and set aside enough land to feed the given number of people that would normally be accommodated on that land in orthodox suburban development, we conclude that residential density must increase to approximately 46 dwellings per hectare (Fig. 6).

Whereas Wright in 1930s America envisaged an automobile utopia, the 21st century is likely to see the car’s demise. While there will probably always be some form of individual people movers (for those who can afford them), public transport systems could become the dominant mode of mass movement through the future city. Consequently Food City (as depicted in Figure 6) is structured around an 800-metre grid of public transport. The 800-metre graticule ensures that nobody lives more than five minutes’ walk from public transport. We are also examining ways in which this public transportation grid can be retrofitted in existing suburbia.

Garden City (PODs)
Where the American Frank Lloyd Wright saw the dispersal of urbanism across limitless petro-chemical horizons, the Englishman Ebenezer Howard saw compact villages surrounded by agrarian greenbelts. First published in 1898, Howard’s original proposal for a Garden City was conceived as a revolutionary social system, an embodiment of equity and a spiritual and material union of the country and the city (Howard 1898). Land was held in common ownership and nourished by recycled human waste. Not to be confused with garden suburbs (of which Perth has its own tradition), the Garden City contained 32,000 people living at a density of about 40 homes per hectare on 404 hectares surrounded by a rural estate of 2020 hectares. These ‘cities’ were to be linked via rail to others in a vast decentralised mosaic.

For Perth’s projected population increase of 1.5 million people we would require 48 such Garden Cities (PODs) (Figures 7 & 8). Sited at advantageous points within the 118,000 ha of available land and linked by new light-rail public transport, the collective footprint of these Garden Cities would be 19,392 hectares. This leaves a land bank of 98,608 hectares, which could become parkland, agricultural land and reforestation zones to offset carbon emissions and as reinstated habitat. The land between the various Garden Cities would contain civic institutions, industrial zones and recreation facilities shared by the otherwise morphologically distinct communities.

‘POD’ is an acronym for Performance Orientated Development, meaning that these new towns would be not only be transit oriented (TOD), but their overall ecological performance would be the rationale behind their masterplanning and their development codes. In what would be an unprecedented international design event, a cast of multi-disciplinary teams could be short-listed to work on competing concepts for the 48 new PODs of Perth.

Seachange City
While all Australia’s cities have expanded dramatically over the last 35 years, during this period more than a million people have also left them for a slower life in sleepy coastal hamlets. This is known as the ‘seachange effect’ (Burnley and Murphy 2004). This scenario asks what would happen if the future 1.5 million people coming to live in Perth seachanged? This scenario is then based on three simple facts: one, the vast majority of Australians want to live as near the coast as possible; two, they also generally prefer a free-standing home and garden in a low-density suburban milieu; and three, no citizen should live further than a 25-minute walk from the beach – so that this city would never reach more than two kilometres inland from the first-dunes.
Consequently, if spread out at the orthodox low-density of 12 homes per hectare, Seachange City becomes too kilometres long, reaching from Dongara in the north to Dunsborough in the south (Figure 9). This linear city would be serviced by bullet trains and hydrofoils and its water supply supplemented by small wind-powered desalination plants. This coastline is one of the windiest in the world, and wind power would be its main energy source. In the spirit of early 20th-century linear cities, Seachange City can be divided into corridors of different land uses punctuated by transport and retail nodes. A greenbelt and agricultural land form a buffer to prevent inland sprawl. Seachange City derives its final form by only developing above a contour height of +2, an urban Plinian line that anticipates rising sea levels associated with climate change (Fig. 10).

Treechange City

Just as many Australians have left major cities for a life in coastal hamlets, so others have left for inland rural landscapes, close to but not directly within reach of the city. This phenomenon has become known as the ‘treechange effect’. This scenario suggests that a bandwidth of land within 1.5 hours of the city centre would be inhabited by 327,500 people from the 2050 projection of 1.5 million people to be accommodated by infill development (376,173 free standing homes or 445,368 apartments) (Fig. 13). As already noted, there are currently 23,000 hectares of land on the periphery of Perth zoned for residential development. This land alone will accommodate 865,200 new residents at an average orthodox density of 12 homes per hectare. For the purposes of the vertical development scenarios we assumed that a hypothetical urban growth boundary is applied to the city once these 23,000 hectares are developed. Subtracting these 865,200 people from the 2050 projection of 1.5 million leaves 865,200 people to be accommodated by infill development (376,173 free standing homes or 445,368 apartments) (Fig. 13).

Often, in local debate, the very people who dislike new suburban developments (sprawl) on principle also defend their own low-density residential neighbourhoods against infill development. Accepting this inherent resistance to development, we have developed infill (vertical) scenarios that concentrate development in certain areas. By couching development in terms of the whole city’s collective future and its entire landscape, we hope that one of the effects of this research will be a more open-minded attitude to infill development.

To demonstrate the need for concentrations of vertical development to the community we have firstly conducted some basic infill development tests. For example, by distributing 376,173 homes evenly across the existing city we find that an additional three homes have to be added per hectare of existing urban fabric. Or, if we add these 376,173 homes to just the inner ring of older suburbs where there is good public transport and good cultural and landscape amenity, then we need to add ten new homes per hectare of existing fabric. Alternatively, if the additional 865,200 people were to be accommodated within walking distance of the ‘activity centres’ identified in the government’s Network City plan, then we need to add another 90 homes per hectare to those sites.

Mathematically, these distributions do not seem problematic, but when one examines the addition of three, ten, or 90 homes per hectare to the existing suburban fabric one finds, in most situations, that there is simply no opportunity to meet these quotas without wholesale demolition and reconstruction of the existing urban fabric. And even if it were possible to increase density, the question arises of whether the aforementioned distributions are the best places for infill development? Adding three homes per hectare across the whole city could, for example, be seen as simply adding to an already sprawled and potentially unattainable form of development. Adding 90 homes per hectare to the inner ring of older suburbs could be seen as detracting from their existing quality and might overload existing infrastructure. Adding 90 homes per hectare around the sites identified by the government as activity centres is, as suggested earlier, unlikely because many of these centres are untractable for people to live near.

Somehow contrary to Peter Calthorpe’s notion of TODDs (Transit Oriented Developments) Perth’s most desirable residential areas are close to the ocean, the river and, increasingly, the central business district. Given this, we have established three vertical development scenarios that attempt to capitalise on these major landscape attractors: Sky City, River City and Surf City. While it is beyond the scope of this research to test these scenarios at the level of detailed architectural design, they behave our architects to explore more urgently ways of producing high-density mass housing that is attractive and able to compete economically with the current cost of conventional, low-density suburban housing.

Sky City

High density housing, particularly in the form of high rise buildings, is uncommon in Perth and generally not the favoured form of housing in Australia. The ultimate proponent of such development was, of course, Swiss architect Le Corbusier, whose original Radiant City model was conceived to house 3 million people, precisely the projected 2050 population of Perth (Le Corbusier 1933). Despite its well known utopian ideals, when the principles of Radiant City were translated into generic development it produced some of the twentieth century’s worst urbanism. Implicit in the model of Radiant City was a separation of work and living, a lack of public transport, low quality public open space, the obliteration of existing fabric, a mechanistic aesthetic and ultimately a disregard for human frailty. However, if designed with attention to the users’ real needs and to public space, transport networks, microclimate, view-sheds and domestic details, then high-rise developments close to good cultural and or natural amenity can be a successful method of housing for certain types of people. As a rule then, Sky City only proposes high-rise infill development in areas of high amenity.

Planning by Design Richard Weller
The images we put forward of high rise development are not to be misunderstood as designs, they are simply datascapes that register a density of 250 units per hectare, the density which Jane Jacobs, a staunch critic of Radiant City, suggested as ideal for a vibrant urban community (Hall 2002: 225). We propose three mini-cities: one located in the Perth central business district (Fig. 14), a second at Fremantle and a third south of the city at Rockingham. These locations offer excellent landscape amenity and can together accommodate up to 450,000 people if developed with 20-storey buildings (Fig. 15).

River City
Perth has over 140 kilometres of riverside and most of it is expensive low-density suburbia flanked by underused open space. Ideally, the way to effect greater density along the river would be to rezone a bandwidth of approximately 500 metres (the distance of a 5 minute walk, including a 100 metre riparian zone) from the river to permit intense infill development. However, our local knowledge of how existing communities (particularly in premium real-estate areas) resist infill development and a detailed search for realistic development opportunities on the river front have persuaded us that significant development on the riverfront is unlikely and in some cases impossible. Consequently, we have pulled back from the river edge and propose developing linearly along two major north-south aligned roads which are parallel with, but some distance from, the river (Figs. 16, 17).

It is feasible to develop the land adjacent to these arterial roads because the existing building fabric is generally of poor quality. As an incentive to development, land along these roads is relatively cheap and housing costs could consequently be kept low. Residents in high-rise apartments built adjacent to these two roads would have good access to public transport and services and also have views of the river. If the entire bandwidths of these arterial roads were developed at a density of 250 units per hectare they could accommodate up to 500,000 people.

Two additional components of the River City scenario are high-density residential finger wharves and ‘living’ bridges: 6-storey residential developments built into or across the river. These elements help to reconnect the city to the river and increase traffic and pedestrian flows through the city, but are exceptionally expensive forms of development and could not be expected to accommodate more than about 50,000 people (Figs. 18 & 19). We have rejected the possibility of building residential islands in the river for two reasons: the significant ecological impact on the estuary and the unstable geotechnical conditions of the riverbed.
Although the scenarios described here do not specifically address water in walking distance of existing public transport systems. In this way the elite preserve of the city coastline could become more dem-
ocratic and accommodate significant numbers of people with spectacular
views of the ocean. The numbers of people these coastal bands of develop-
ment could accommodate would support new public transport systems, al-
though people living in these new developments would generally be within
walking distance of existing public transport systems.

Conclusion

Perhaps what Tim Flannery really meant when he said that Perth, because of the water crisis, would become the 21st Century’s first great metropo-
lis, was that unless we design our future carefully there will be no future. As the scenarios described here do not specifically address water management issues (as improved water management would be implic-
ating in any new development) they each, in their various ways, respond to
landscape limitations and opportunities and provide a community with chal-
genches about how to develop.

None of the scenarios has been created as a singularly correct answer to
the problem of housing 1.5 million people. However, they have been
presented as singular extremes – not for any dramatic purpose, but be-
cause in their singularity they help clarify the potentially positive and
negative consequences of certain planning directions. We have also inten-
tionally avoided utopianism and the simplicity of the mega-structure as
an instant, but ultimately unrealistic, fix for the problem of large-scale
urban growth. All the scenarios strive to work within the limitations of
the existing construction industry and an appreciation of the local cul-
ture and the local economy.

Idi/ally the city of Perth should now test fragments of all the scen.
arios at the human scale. Only through such a detailed process of design
and construction can we learn how the scenarios perform socially, en-
vironmentally and economically, and only then can we assess which could
genuinely thrive in the marketplace and provide genuine alternatives to
orthodox suburban sprawl. Until then, the scenarios are currently fulfilling
their primary purpose by opening up public local debate about the future
of the city [15] This body of work might also indicate a lead role for
landscape architects in the face of large-scale urban challenges.

Acknowledgements

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Notes

1 This research is funded by the Australian Research Council and

2 Pedro Baceta, Luquin Melgarejo, River City: Towards a Sustainable

vol. 10 pp 115-133.

Desire for Landscape: Topology and Regional Development in Switzerland In-

11 A good example of MVRDV’s scenario methods available in

10 For MVRDV see: www.mvrdv.nl/ —v2/In addition, for critical

9 Two texts which explore the history of the Garden City and

canvass its ongoing relevance are: Freestone, R. 2002. ‘Green-

8 Two texts which explore the history of the Garden City and

7 Robert McHarg’s seminal book, Design with Nature was

6 For a community of 40,000 people and projections for the city of


4 For a community of 40,000 people and projections for the city of

3 Professor Richard Weller teaches landscape architecture as

2 Professor Richard Weller teaches landscape architecture as

1 See; www.abs.gov.au/australia/media/publications/social-costs-

Figure 20 Surf City

Figure 21 Surf City: A birds-eye view of high-rise development on

the first ridge line set back from the coast.

For MVRDV see: www.mvrdv.nl/ —v2/In addition, for critical

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