Green-Networks

Integrating alternative circulation systems into postindustrial cities

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Introduction: Open Space Network

The history of modern urban visions routinely includes off-street circulation systems that aspire to forge non-vehicular and/or ecological connections between cities and peripheries. Levitating off the ground plane, Ludwig Hilbersheimer's early twentieth century vision for a "Vertical City" implied abundant pedestrian connectivity through the new metropolitan landscape, albeit with private vehicular transport dominating ideas for mass transit. Later in the century, articulated elevated mega-structures featured prominently in the deconstructivist proposals of Coop Himmelblau, Peter Eisenman, Zaha Hadid and others. More recently, green roofed 'mega-matrices' have come to characterize the speculative eco-techno agenda of contemporary urban design culture.

Although aerial visions were rarely realized beyond occasional fragments in practice, grade separated networks have gradually accreted above and below the urban cores of many cities with extreme climates. Examples include the downtown Minneapolis Skyway system of overpasses and corridors and the network of trussed skywalks that increasingly leapfrog the street-level melee of Mumbai (figure 1). From the point of view of traditional urbanism, these types of off-street circulation systems are widely critiqued for diminishing the role of the street, privatizing public space and perpetuating socio-economic inequalities (Boddy, 1992).

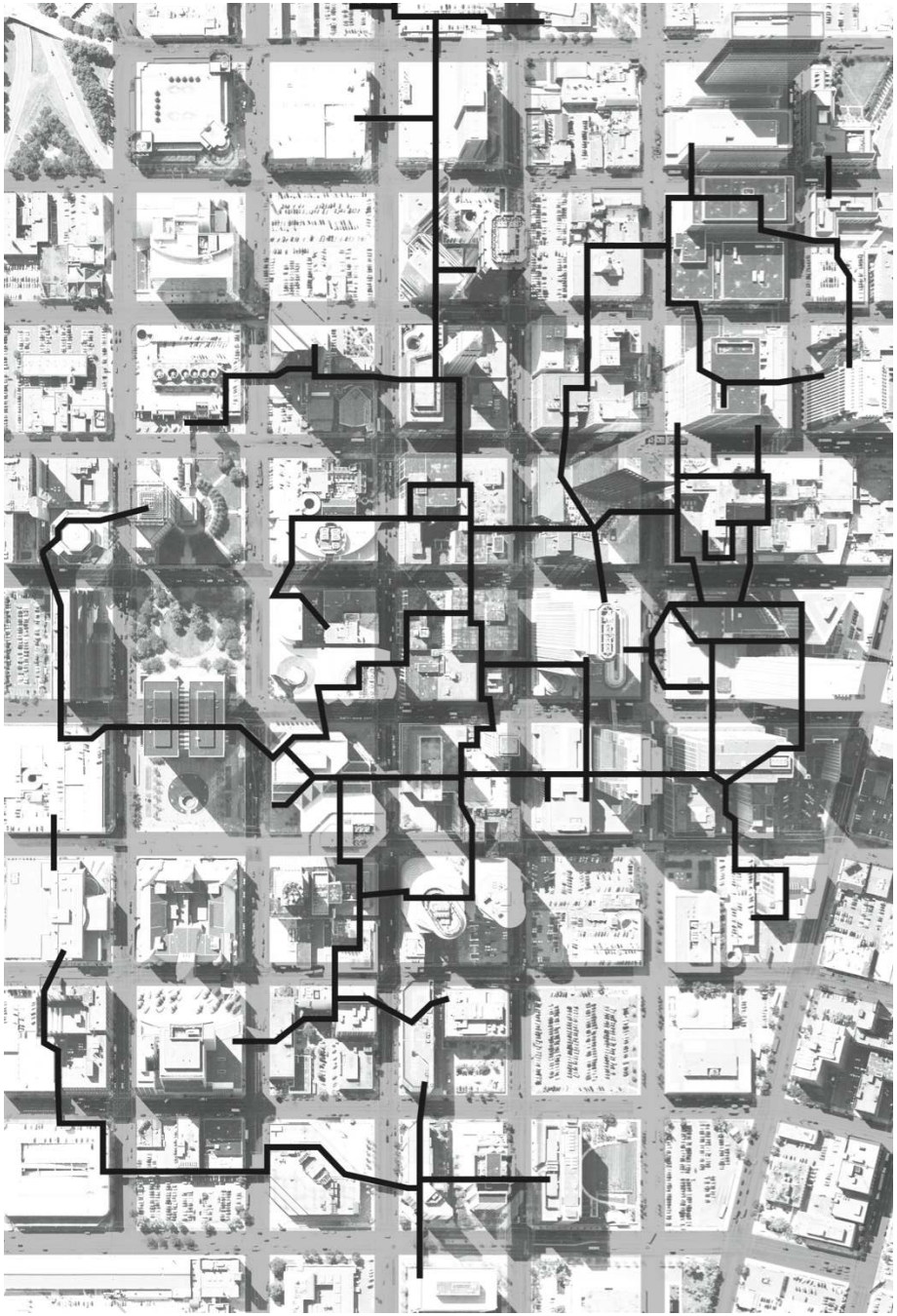

Figure 1. Extents of the Minneapolis Skyway

Despite these assessments, the motivation to weave alternative threads of egress through, over, and under cities remains a recurrent idea in urbanism.

Kevin Lynch (1981, p. 441) briefly examines a more grounded variation on this theme. The "open space network" urban model evenly disperses an interconnected open space system throughout the urban fabric. In its most legible rendition, Lynch interprets the model as comprising an open space grid that complemented the street grid through an offset grid that bisected street blocks (figure 2). In theory, the benefits of an alternating open space network include a high degree of accessibility from anywhere within the city and the potential for extensive non-vehicular connectivity once on the green infrastructural matrix. However, given the overlay of conventional streets and linear open space points of circulation conflict are inevitable throughout the system. Indeed, it is at these problematic junctures that the elevated matrices of vertically stratified circulation that characterized the more utopian twentieth century visions offer an apparently more sophisticated solution than the ground hugging open space network model. Anticipating this issue, Lynch prefigures the problem of overlap in the real world, surmising that grade separation and other controlling strategies may be required where streets and linear open space intersect.

Mirroring the dearth of realized twentieth century grade-separated network visions, few examples of the open space network model as an intentionally planned and embedded system exist in established cities. With the exception of rare new-world modernist experiments such as Chandigarh, derivatives tend to be stand-alone experiments on the suburban periphery. Examples range from the inverted hierarchy of vehicular and pedestrian circulation of Radburn through to less notable suburban developments oriented around recreational systems such as linear parks or golf courses. Nonetheless, although premeditated off-street networks may be rare, opportunities for assembling networks from adapted existing urban sites are plentiful.

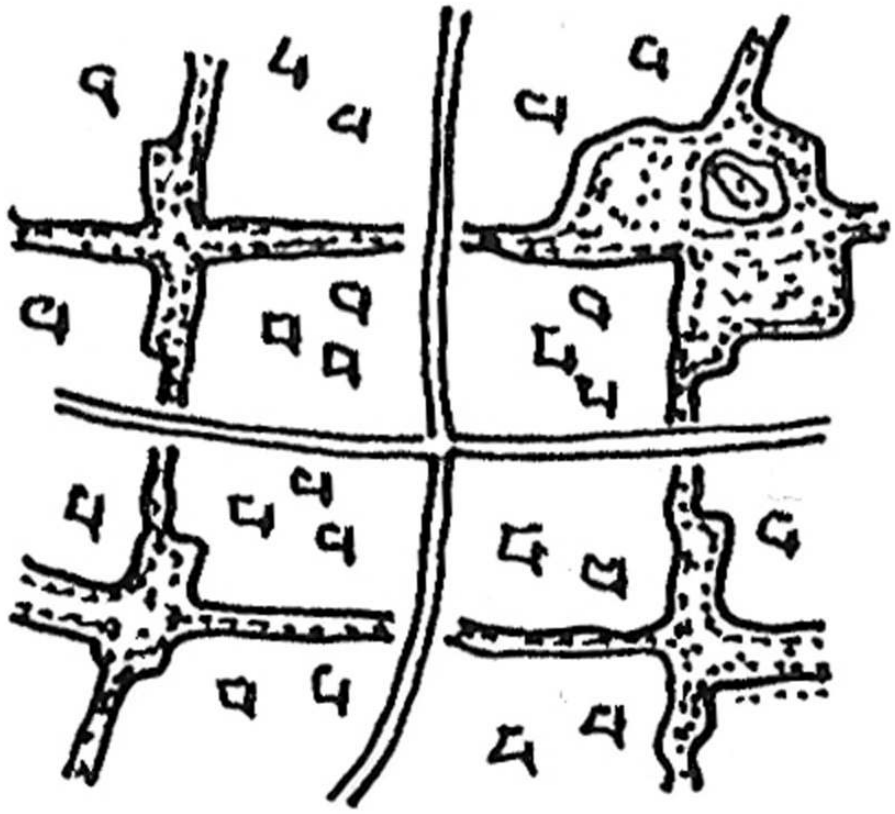

Figure 2. Open network urban model. Source: Lynch 1981: 441.

Indeed, many postindustrial cities (1) are laced with readymade webs of linear voids that often result from industrial era infrastructure. Examples include active, redundant or dormant transport and energy easements, political boundaries, postindustrial waterfronts and highly modified urban rivers (figure 3). As William Whyte notes:

> "Our metropolitan areas are crisscrossed with connective strips. Many are no longer used; old aqueducts, abandoned canals, rail road rights of way, interurban trolley ways, future express ways, former streams the engineers have put in concrete troughs" (Whyte, 1968, pp. 13/163/175).

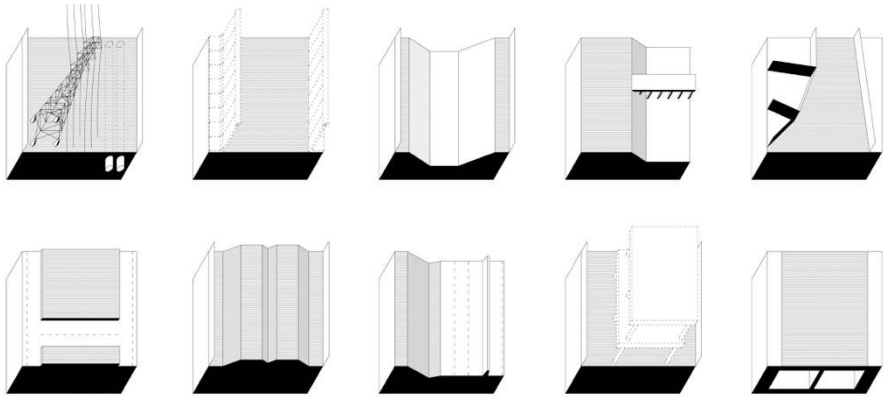

Figure 3. Typical potential greenway site typologies, (top left to bottom right): utilities easement; political or post-political; urban river; postindustrial waterfront; suburban setback; planned linear space; decommissioned railroad; freeway shoulder; unrealized or demolished freeway; freeway bury.

Later in the twentieth-century through to the present, the greenway movement focused on initiatives to reinvent these fissures, with 'rails to trails' most vividly capturing the public's imagination. Driven by grass-roots resourcefulness and the prevalent late twentieth-century design and planning paradigm of 'connectivity', metropolitan greenway visions became commonplace. An example is Johnson Fain & Pereira Associates' early 1990s greenway vision for Los Angeles that proposes converting the extensive abandoned network of rail, streetcar and flood control easements into a web of cycle routes and linear parks (figure 4). The design community's reception of this speculative project was typically polarized. On the one hand, William Mitchell positively describes it as providing Los Angeles with "another [alternative] system to restructure the city" (P/A Awards 1994, p. 55). However, on the other, Andrés Duany ridicules it as "nothing but an extended venue for crime" that perpetuates the shortcomings of suburbanism, despite a lack of evidence that greenways actually contribute to an increase in adjacent crime rates (Crewe, 2001).

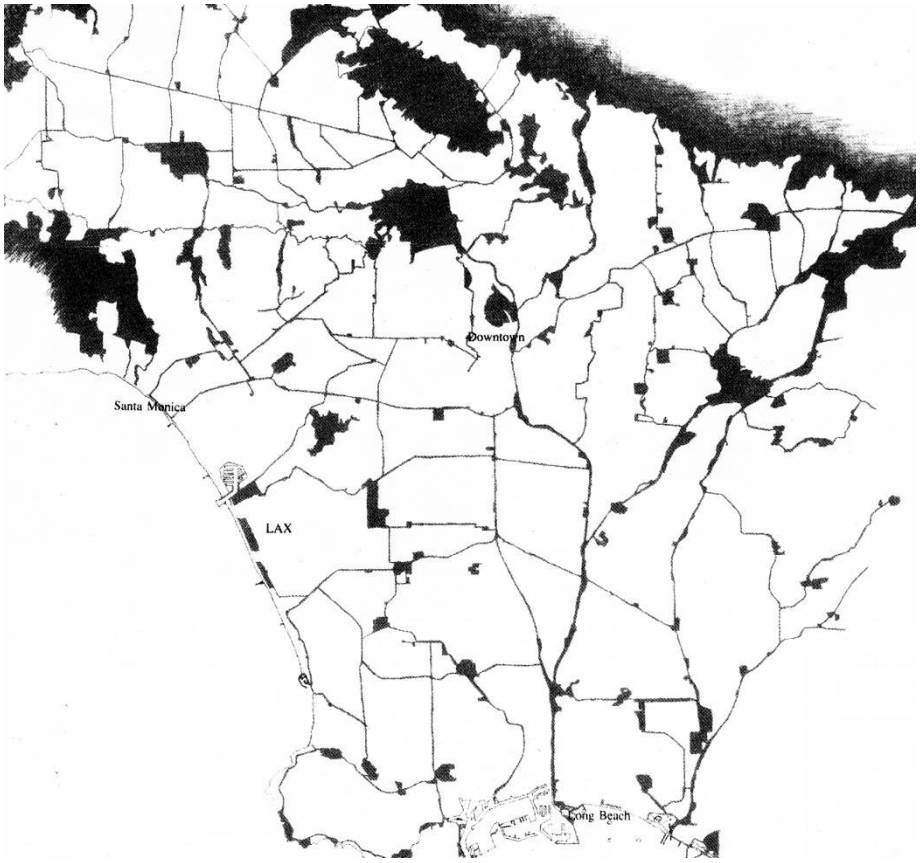

Figure 4. Greenway Plan for Los Angeles. Source: Johnson, Fain & Pereira Associates. P/A Awards. 1994: 55.

With its focus on converted rail corridors laid out in a net that criss-crosses the floodplain upon which the city is built, Johnson Fain & Pereira's Los Angeles example privileges artificial infrastructure alignments over the underlying hydrological system. In this sense the proposal differs from most green linkage opportunities, where the dendritic drainage network of creeks and rivers forms the backbone, with railway easements forming cross-links. Although greenway strategies across the US typically follow this pattern, variations to this template also exist. In the Bay Area of California, strips associated

Figure 5. Sample of linear easements and voids in the East Bay Area, California.

with creeks cut straight through the suburban fabric and down to the bay with little dendritic convergence. From over the hills, gas and electrical utility easements mimic this alignment at first, before deviating to a more oblique configuration in the built up area. Tracking at right angles to these fibres, abandoned rail easements and active rail and freeway shoulders contour along the 'flat-lands' that form a concaved apron around the bay (figure 5).

In cities that have neither dendritic hydrology nor abandoned infrastructure, the challenge of retro-weaving green-networks into the urban fabric often presents an impasse. Perth Australia illustrates the particular problem of forging connectivity in a setting without both postindustrial infrastructure surface runoff water lines. Due to the underlying sandy geomorphology, water infiltrates down to a water table, which sporadically breaks the surface in isolated pockets to form wetlands. In this 'city without creeks' the green link morphology is necessarily entirely different, necessitating stepping stones rather than true contiguous terrestrial interconnectivity (see Tingay, 1998).

Irrespective of the geomorphologic or infrastructural underpinnings of a city, significant challenges remain with the conversion of easements (associated with active or decommissioned infrastructure) to integrated open space networks. Firstly, linear fissures often don't align with the desire-lines of the cities inhabitants. Alignments that were efficient for freight trains and high pressure gas lines do not necessarily equate with the goals of pedestrians and cyclists who generally seek the same destinations as motorists albeit with their own specific needs (see Forsyth & Krizek, 2011). Secondly, the typically epic scale of these easements operate to an infrastructural logic that is very different to the fine grained city-block by city-block green matrix that Lynch considered with the open space network model. Finally, as Lynch foresaw, the intersections between these retrofitted systems and established street systems are often problematic.

In light of these constraints, this article considers how designers and planners might reconcile the aspirations of the green-network (2) with the actual opportunities on the ground as typically found in postindustrial cities in the US and elsewhere. Although much of the

literature on this topic dates from the late twentieth century, a new wave of interest in networked green-infrastructure is increasingly visible in contemporary design culture. Often attributed to landscape urbanism, these burgeoning urban visions aim to recalibrate existing cities and drive the formal agenda for new urban areas, essentially substituting structures and streets with landscape and ecology as the primary building blocks of urbanism (Allen, 2009; Waldheim, 2002).

Integrated Green-Infrastructure

Set amidst the resurgent greenway interest of the mid 1990s, Robert Searns (1995, pp. 67-73) defines three generations of greenways and their objectives. From the 18th century up until approximately 1960, the first generation comprises axes, boulevards and parkways such as those designed by George Kessler for Kansas City and numerous other mid-west cities (Walmsley, 1995; Brown, 2007). While these examples tended to adapt existing spaces (such as river flood plains) and pre-empt the layout of new development, generation one greenways were also retrospectively cut into the urban fabric as per Haussmann's Parisian boulevards. From the start of the post-industrial era in the 1960s through to the mid 1980s, trail oriented conversions of abandoned rail lines and previously inaccessible urban creeks and rivers typify generation two. This familiar epoch is personified in the emergence of the rails-to-trails and canal tow-path movements. Building on this base from the mid 1980s through to the mid 1990s, Searns categorizes the third generation as "multi-objective greenways" where ecological linkage, water quality, recreation and education are woven into a multifarious set of performance objectives. Although assigned numerous names, the greenway or green-link visions that have been drawn up in the past decade and a half for many cities around the world fall into this latter category.

Extending Searns' rubric, a fourth generation that spans the mid 1990s to the present establishes the greenway as *integrated green-infrastructure*. This generation is focused on complete webs to rival the grey infrastructure of the existing city fabric. It includes the objectives of the second and third generations of greenways, and is characterized by a focus on active (rather than abandoned) infrastructure. In addition, generation four harbours the nostalgic undercurrent that the streets may be reclaimed for this totalizing network. While utilizing active infrastructure evidently includes functioning utility easements (e.g. gas and electricity) and transportation shoulders (e.g. freeways and railways), it has also come to include the streets themselves. The definition of greenway is stretched to resemble its very first generational origins as boulevards and parkways. As the City of Portland's current practice of rebranding as "neighbourhood greenways" local streets that were until recently known as "bicycle boulevards" illustrates, the threshold for greenway status can be as low as stencilling green paint onto local streets.

As Anthony Walmsley (1995) notes in critique of Charles Little's (1990) influential *Greenways for America*, left-over and in-between sites assembled piece by piece would go some way towards constituting a "partial green framework." However, additional connections are required to constitute a truly complete system:

> "missing in ... an all encompassing green-infrastructure was the notion of recovering the most immediate public open space of all – the principal streets of the city – as tree-lined routes, appropriately sized and scaled, a branching articulated system of ways including boulevards and parkways, braiding into the broader strands of linear parks and trails…" (Walmsley, 1995, p. 82).

The majority of generation two and three greenways occur in the suburban or peri-urban contexts found on the peripheries of cities in the US and between the interwoven village-metropolis of the Ruhrgebiet in Germany. In these contexts, greenways tend to be reactionary, either appropriating strips and fragments on a largely opportunistic basis, or repelling future development in the manner of

mini-greenbelts. Greenways remain a negative condition, or shadow form, standing in contradistinction to their metropolitan context. This in turn contributes to their romantic allure. Conversely, generation four aims for integration into the urban fabric. The greenway—like the street it aspires to be—claims agency in the establishment of urban structure.

Lynch acknowledges the capacity for continuous and concentrated green-networks to influence urban structure. Nevertheless, unless tracking and amplifying an existing significant geomorphological feature such as "an ocean, a mountain range, or a great river" Lynch questions the effectiveness of green-networks (Lynch 1981 p. 437). In the less topographically expressive urban environments that characterise most cities, Lynch favours small parks "widely dispersed throughout the city fabric." In contrast to an "experience in contrast to city life" that continuous networks provide, Lynch's patchwork pattern makes open space more integral to everyday life. Essentially claiming the best of both of these alternatives, fourth generation greenways aim to be both *continuous* (influencing the shaping of urban fabric) and *integral* (part of the urban fabric).

The most visible urban structure for deploying the dual ambition of both continuous and integrated green-networks is the very street system that generation four greenways seek to rival. Precedents for grey and green-networks cohabitating are found in neoclassical cities where generous boulevards articulated arboreal links, and granted hierarchy to the urban environment whilst simultaneously operating at a finer grained local level. Invoking this generation one greenway characteristic, Walmsley (1995) recalls the "historic tradition of greenways shaping cities by laying out a pattern in advance of urbanization" (p. 84). By reinventing "the primary public space, the street" as boulevards, Walmsley essentially proposes reviving this practice.

Given the generous dimensions normally associated with boulevard type greenways, fourth generation greenways are more radically transformative than Jane Jacob's (1961) celebrated recapturing of the street from the assault of post-war modern planning. With the notable exception of new-town construction in China, laying out a green pattern in advance of urbanization is presently restricted to expanding (sub)urban peripheries. However, as Tom Turner observes, introverted green systems enclosed within housing developments "are not 'ways' in the historic sense of routes (and) ...go nowhere and do little" (Turner, 1995, p. 269). Conversely, enacting a green-infrastructure pattern within an already urbanized area (in the spirit of Haussmann's boulevards) would open raw wounds from the post-war epoch of urban freeway building that tore apart the cores of cities throughout the developed and developing world.

Although reinterpreting the existing street system forms a component of integral/continuous fourth generation green-networks, its ability to be transformative is limited. As a substitute, infrastructure potentially reframes the hierarchy of elements that structure cities, and by extension, green-networks. Referencing a more civic-minded era of engineering, Gary Strang (1996) argues that existing infrastructure systems hold the potential for shaping urban form. Strang views the "inherent spatial and functional order" of infrastructure as potentially influencing a design clarity that articulates its significance to society by "creating new layers of urban landmarks, spaces and connections" (p. 10). William Morrish and Catherine Brown (1995) echo this sentiment, bemoaning the modern split between the form and function of infrastructure, which "came to be viewed as utilitarian, having no civic value" (p. 52). Morrish and Brown champion a renaissance of the web of infrastructures that:

> "… need to be more broadly conceived of as not only service systems but as armatures for culture which … has three functions: to provide a repository for collective memory, to establish an orientation and pathfinding network and to provide a curriculum of civic instruction on how to use and value this investment" (Morrish & Brown, 1995, p 52).

Although the call to re-imbue infrastructure with civic meaning is a noble idea, it reveals a nostalgic yearning for nineteenth century neoclassical edifices. In the twentieth century, railways and aqueducts that contoured around mountains and vaulted across valleys to form legible and reassuring datums in the landscape were replaced with pressurized pipelines and electrical gantries that paid no head to the lie of the land and gave little leeway for civic presence.

More recently, infrastructure retreated from the surface altogether; either buried underground or contracted into nodes within virtual nets of airports, distribution centres, mobile phone towers and geostationary satellites (see Varnelis, 2009). These types of infrastructures are typically superimposed onto the contemporary city rather than granted exclusive territory in the manner of hardwired older systems. This in turn significantly reduces the capacity for reinvesting civic value, and as a consequence, diminishes the capacity for contemporary infrastructure to act as instruments of urban structure. For example, although a mobile phone tower set atop a hill or grafted onto a building is likely to be highly visible, it is unlikely to become codified as a civic landmark for urban cognition (as the inventive attempts to camouflage telecommunications infrastructure exemplify).

Although imparting the civic value of contemporary infrastructure may be problematic, *ruins* do have clear recognized civic value (see Jackson, 1980). Moreover, this significance is not restricted to crumbling stone structures, with Duisburg Nord in Germany and Gasworks Park in Seattle demonstrating the capacity for re-envisioned industrial era ruins to become culturally valued. Given that the majority of the infrastructural easements that green-network visions covet for conversion are redundant, it follows that these may also tap into the emerging civic acceptance of the industrial ruin. This acceptance is essential for green-networks to integrate both spatially and culturally into the city and catalyse other fragments (such as active infrastructure and the streets themselves) within the legibility of the overall alternative green-network.

The notion of investing in the infrastructural ruin as a mechanism for green-network building raises the issue of retaining *contrast* in integral-continuous greenway networks. While certainly fulfilling practical requirements for non-vehicular urban circulation and ecological connectivity, green-networks articulate the city dweller's psychological desire for proximity to an alternative network; one that could potentially take them all the way away from their entrenched urban habits if they so chose. The green-network embodies a desire to be both within and separated from the city, to imagine that a parallel universe coexists alongside the everyday that can be hypothetically entered at any time. Likening the effect to urbanites who feel enlightened by the proximity of cultural institutions that they rarely patronize, Whyte (1968) concludes "that most people do not get around to the exploration," so that the "promise is more important than the fulfilment" (p. 172).

Nevertheless, the psychology of "existence value" (Hellmund & Smith 2006) does not necessitate an endlessly extensive green-network running in parallel to the street network. As disconnected fragments of repurposed railroad viaducts, Paris's Promenade du Plantee and New York's High Line leverage the impression of freedom from the city. Both examples offer a novel position that delivers the visitor to another part of the city that they did not necessarily need to go to. The result is a visceral but sanitized experience that triggers similar proprioceptive impulses as a canopy walk above a forest, or a catacomb journey beneath a city. In these instances the heightened

experience of 'tunnelling' incises perceptions that originate from afar into the composition of local space (Massumi, 1998, pp. 23/4). The High Line in particular indulges this effect, moving the visitor above the street life in novel offset and oblique alignments, at times punching right through buildings, creating apertures reminiscent of artist Gordon Matta-Clark's building cuts.

Greenways that lead out beyond the city limits operate on the promise of bringing the distant close to hand. Although greenway fragments that do not actually connect with the hinterland may also create this impression through spatial, thematic and material novelty, the romance of 'other' is also at risk of dilution through proliferation and integration. As a predominantly functional network, green-infrastructure without 'otherness' becomes a direct competitor to the street in the manner of the privatized aerial and subterranean downtown pedestrian networks repeatedly identified as so problematic. The challenge is to establish mechanisms that enable the proliferation and normalization of greenway networks without the trade-off of diminishing their exotic appeal in the minds of users.

The second half of the paper develops four themes central to this objective: speed and slowness, intersection and grade separation, the concept of interwoven green/grey space, and the greenway network model versus the stand alone circuit.

Part II – Cases, Ideas, Discussion

Fast and Slow

The expectation that green-networks facilitate efficient passage increased with each greenway generation. With gentle grades and generous geometries, the second-generation conversion of rail corridors and canal tow paths set the foundations for the conception of the greenway as a conduit for rapid non-motorized transport. The notion of a greenway journey as an efficient goal-oriented undertaking represented a significant departure from the promenading typically associated with the boulevards of generation one, where a journey was just as likely to be undertaken as a flâneur for pleasure then as for a quantifiable result. For generation four greenways, integration into grey infrastructure amplifies efficient goal-oriented passage that rivals, and in certain examples even surpasses the streets themselves.

However, a counteractive motivation also underpins this desire for physical speed and efficiency in greenway systems. As an open space typology with significant overlap with greenways, linear parks present an alternative position to the rapid conduit characteristics of many greenways. By virtue of the intricacies of site layout and event programming, the cultural imperative to provide for multiple uses typically calibrates linear parks at a slower pace than greenways. In this spirit, Ian Baldwin describes the High Line as a "slow corridor" hybridized from city, park, and infrastructure. Baldwin (2009) sees potential for a combination of both *goal* and *journey* oriented traversal, observing "the line allows you to move through the city with purpose as well as contemplation, enjoying the visual backdrop of the city while playing a role in its vitality."

Speed differential is also at the forefront of Lynch's (1981) refinement of the "open space network" into the speculative ideal model of the "alternating net." Laid out as a loose offset grid, the alternating

matrix of thoroughfares comprises a “fast” arterial of commerce and vehicular traffic, bisected by a “slow” grid to be “restricted to pedestrians, cyclists, horsemen, boaters and other slow ... travellers” (p. 286). For Lynch, this model presents a mechanism for offsetting the seemingly insatiable acceleration of the postmodern metropolis that Fredric Jameson (1984) identifies around the same time. Reacting to instantaneous communications, information saturation, and ubiquitous capital exchange, Jameson observes that urban actors progressively struggle to stay abreast and make historical sense of global phenomena. Jameson concludes that increasingly, the individual human body is losing the capacity “to locate itself, to organize its immediate surroundings perceptually, and cognitively map its position within a mappable external world” (p. 83). Echoing this sentiment, Paul Virilio (1997) flags a loss of orientation as a new phenomenon facing contemporary urban dwellers, where in the face of progress, “the markers of position and location are disappearing one by one” (p. 62).

Slowness, as proposed by Lynch and observed by Baldwin, is an antidote to the pace of the city. The slow network becomes an orienting device that counterbalances the increasingly disorienting city that Jameson and Virilio identify (3). It represents the best of both worlds, being away from, but still proximate to the accelerating pace of contemporary urban life. The question is, just how far might a greenway be slowed down before it ceases to function as a ‘way?’ Non-vehicular movements of the modes that Lynch proposes (pedestrians, cyclists, horsemen, boaters) are the target audience of most greenways and certainly represent a step down from the mechanized locomotion that typifies conventional streets. With programmatic distractions and choreographies, linear park-type greenways typically function at an even slower pace. Slower still, and the greenway becomes less a ‘way’ than an impediment to passage, or a ‘thicket.’

Urban agriculture is one example of a familiar program that exhibits a high degree of ‘resistance’ to rapid movement through intimate plot scales and layouts. There exists a history of undertaking urban agriculture in linear easements and fragments. Examples range from the self-reliant ‘victory gardens’ of the world wars, for which railway companies availed their rights of way (Bischoff, 1995, p. 321), to the contemporary ‘food security’ movement on abandoned easements and other fallow lots. A citywide application of this idea is found in the European context where the authors of *Continuous Productive Urban Landscapes* (Viljoen ed., 2005) argue that urban farming has greatest import and legibility as a continuous linear structuring element within the urban milieu. In each of these examples, however, linear urban agriculture is not positioned as exclusionary, with through-access normally maintained despite the compressed spatial environment. Indeed, as Whyte (1968) notes, there is ample room for multiuse planning in greenways since “rights-of-way can support a lot of uses and still be good walkways” (p. 175). The linear park—which by the necessity of being a park manages to fit many programs into a compressed space—indicates richer alternatives to the single use / single vision greenways that have become the default model for green-network development.

The slowest of all scenarios is the complete elimination of through-access along the length of a greenway. Ostensibly, this lack of access appears counterproductive to the cause of greenways, which have appropriately focused on opening up public access to off-limit easements mired in chain-link fences and bureaucratic red tape. However, it is conceivable that there is a role for the ‘way-less’ greenway within a green-network as a complementary, rather than disruptive, typology. The greenway constituted as a linear thicket or land bank that taps in the romantic impulse for the urban wild is one example, as per Alan Sonfist’s late 1970s *Time Landscape* project in Manhattan.

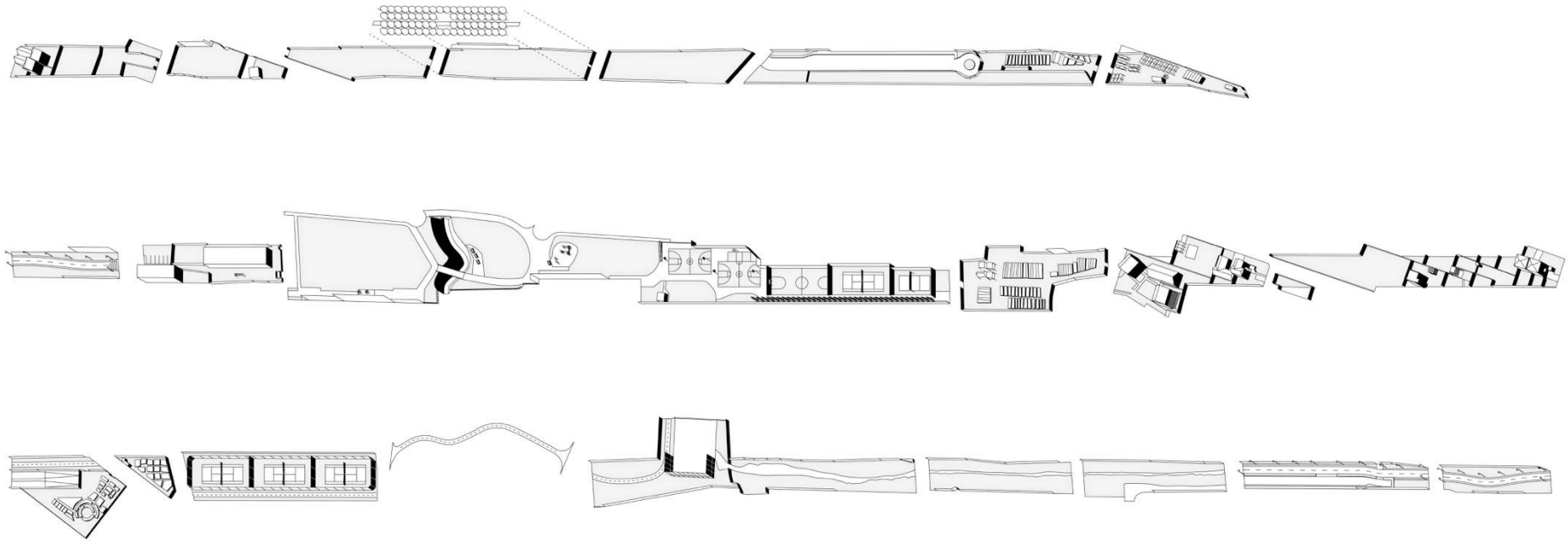

Figure 6. Assemblage of opportunistic colonizing land uses along the abandoned Santa Fe Rail Road easement, Berkeley, California (note: the three segments in the diagram form a single continuous linear easement).

Less absolute is the example of the old Santa Fe Rail Road easement in Berkeley California, which through lack of a coherent municipal vision was allowed to transform in a piecemeal manner along its length (figure 6). With many uses preventing linear thoroughfare, community facilities, playgrounds, urban farms, orchards, groves, sports courts and housing interchange for several miles. By some measures, accretion by default along this particular section of old rail road results in a more vibrant environment than the mono-cultural cycle-ways found elsewhere along the same rail easement. Moreover, it arguably remains a greenway in the sense that even though the nature of programmatic diversity often excludes access and conveys a complex patchwork identity, it retains contrast from its surroundings. Although the visitor cannot move seamlessly along its length, they do interact with the easement at each intersection with the grey street grid. This essentially transforms the greenway to an urban orienting element that is encountered transversely rather than longitudinally so that the greenway becomes less a conduit than a catching feature in the urban matrix. The greenway is comprehended at the points at which it intersects with the grey street network; although even here—in the case of a very slow network—it illuminates the key issue of overlap between the two systems.

Grade Separated Intersection

Where two different systems overlap, the nature of the intersection becomes a point of contention. When this overlap occurs repeatedly—as is the case between overlaid green and grey networks—the issue is compounded. In critique of the 'open space network' model, Lynch (1981) anticipates the problem of overlap, concluding that grade separation and other controlling approaches

may be required where streets and linear open space intersect (p. 442). Whyte also recognizes the problem, noting "almost any linear strip of open space that extends for any distance in an urban area is bound to be severed in one or more places by highway construction." Whyte (1968), however, was less convinced of the value of grade separation, commenting that while "in some cases pedestrian overpasses and tunnels are the answers, … they are enormously expensive" (p. 179).

Using the beautifully executed bridges in the overlaid circulation systems of Central Park as precedents, modern lightweight construction techniques potentially enable minimalist and cost effective overpasses to span greenways (or 'green-carpets') over existing streets (figure 7). Nonetheless, in the cold reality of their construction, bridges rarely embody lifted up green ribbons or land bridges. Rather, they fit a third 'linking' condition—neither green nor grey—that further obfuscates the typological continuity of the green system.

Beyond the elevated skyway matrices that are found from Minneapolis to Mumbai, several retrofitted examples worth analysing. Although only fragments rather than saturated networks, three differing urban rail-to-trail corridors cover many of the issues associated with connectivity, continuity and grade separation in the urban milieu. The first example, the Ohlone Greenway in the East Bay area of California, is a recreation and commuter path built into a rail easement (figure 8a). While the original ground level freight rail has been removed, the path shares the space with an elevated commuter rail line. In this instance, the rail is grade separated, but the path—with no room to piggyback onto the elevated structure—is not. The result is frequent mid-block intersections with the transverse street grid, resulting in a statistical flashpoint for conflict and accidents between the green and grey systems (see Forsyth & Krizek, 2011, p. 541). Giving credence to the paint-onto-streets greenway typology, cycling on parallel local streets actually affords safer sight lines and

Figure 7. Gothic pedestrian bridge over bridle trail, Central Park. Source: Jet Lowe, 1984, Library of Congress; Historic American Engineering Record. Image in public domain.

involves fewer stops, since in many instances these roads have right of way.

The second example has not yet been converted, although the abandoned rail pedestal remains in a state of decay. Inspired by the High Line in New York and Promenade Plantee in Paris, the Bloomingdale Trail in Chicago will sit atop a massive wall-like plinth of masonry backfilled with earth (figure 8b). Set at regular intervals, established cuts into this megalith allow most cross-streets to pass through at grade. Once up on top, passage on the greenway will be unimpeded, although access points are far more limited than the Ohlone Greenway, and there is always the intractable urban imposition of the blank façades of the plinth itself. If this were a potential model for proliferation into a comprehensive green net, it would depend on a construction technique that permits the façades to be activated, essentially converting the greenway into a rooftop.

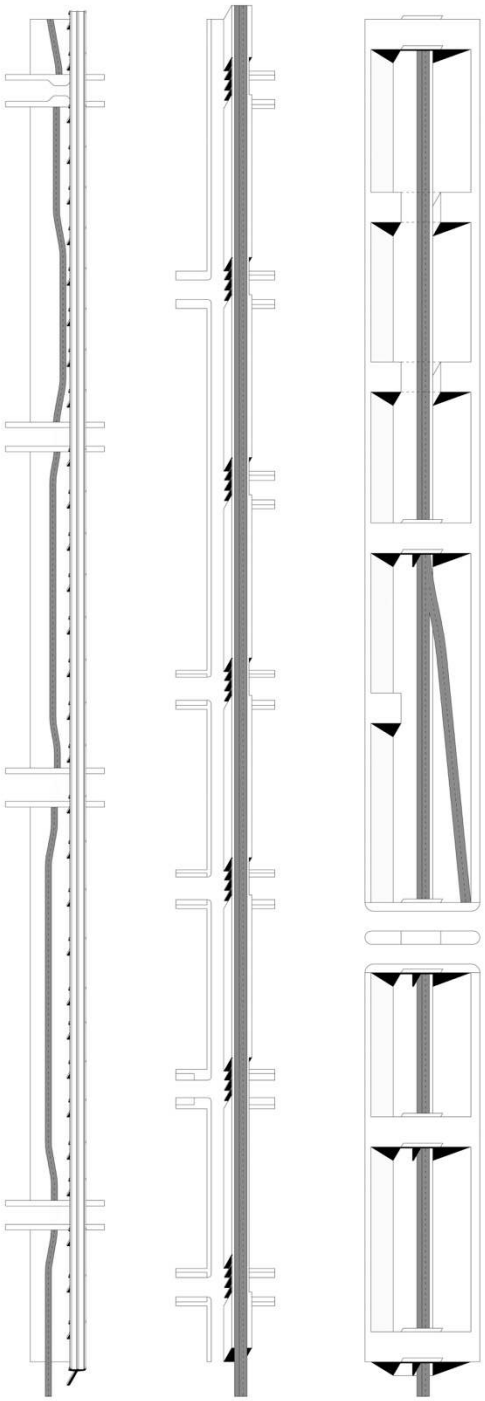

Figure 8. Three greenway typologies (left to right): (a) Ohlone Greenway, Berkeley California; (b) proposed Bloomingdale Trail, Chicago; (c) Dequindre Cut Greenway, Detroit.

In this regard, the elevated four-track rail line that bisects Berlin is a topical precedent and hypothetically ideal model for conversion. The vaulted spaces beneath the length of the operational line are used for anything from cross streets to restaurants to music rehearsal.

Example three is situated below the surface level of the surrounding city. The sunken Dequindre Cut trail conversion in Detroit occupies an abandoned rail cut with cross streets linking via grade level bridges (figure 8c). The morphology is akin to an industrial era rendition of the ancient hollow-ways (sunken lanes) incised into the landscapes of Europe through centuries of traversal by foot, cart, and beast. Of those hollow-ways that still exist and function as trails, the vertical separation literally embodies the temporal partition between the ancient and modern worlds. The two systems occupy the same landscape but in different archaeological layers, one beneath the other. In a contemporary city, it is not difficult to imaging the green-network fulfilling this 'grounding' role.

As a retrofitted ruin, the Dequindre Cut exhibits this primeval sunken path morphology. However, as a model for extensive green-network integration it is limited since it remains a one-off condition that is not repeated elsewhere in Detroit. The most intact example of a dense grade-separated urban network, which truly rivals the orthodox grey network, is not green but blue. In the canal network of old Amsterdam, the 'blueways' now serve a similar purpose as a greenway network, representing the romance of connectivity to an alternative system (figure 9). Rather than forging a conduit of green carpet out beyond the city limits and the visceral potential of the wild, the blue carpet connects with the ultimate freedom of our collective impulses; the sea itself. Incised below street level and grade separated by bridges, the canals are an aquatic version of the Dequindre Cut (figure 10). Indeed, on the rare occasions that the canals of Amsterdam freeze over and become traversable, the two typologies are drawn closer still.

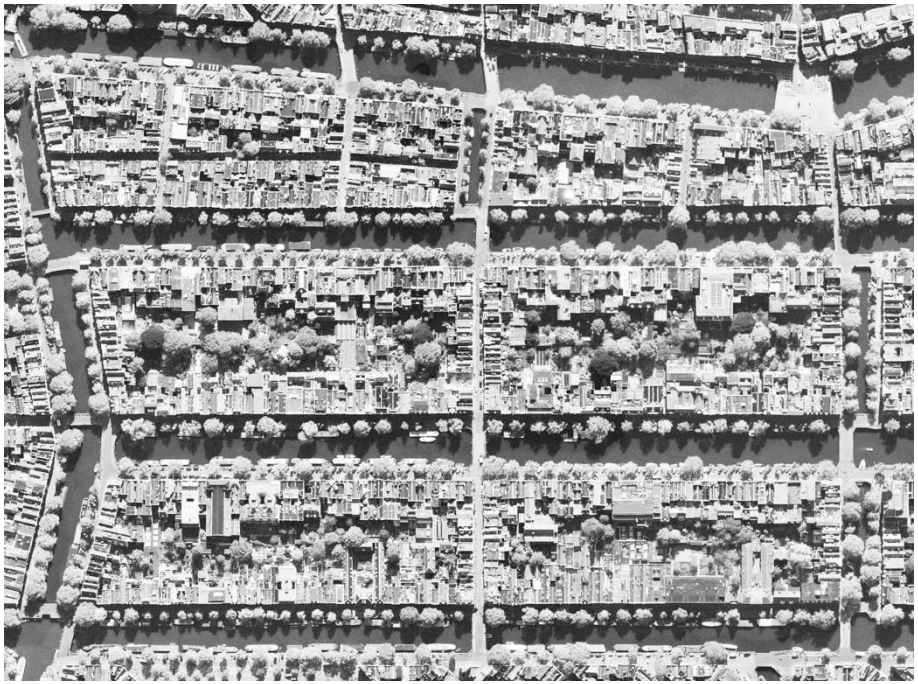

Figure 9. Urban canal network, Amsterdam.

Figure 10. Dequindre Cut Greenway, Detroit.

While it would be possible to imagine the Detroit/Amsterdam 'hollow way' sunken network laid under a *new* city layout, sufficient space for retrofitting into existing cities is unlikely. There is a fine line between the exotic sensation of being on an alternative network that slips below grade, and that same network becoming repressive and enclosing when the dimensions start to approach those of trenches and tunnels. In this regard, the green overlay is more favourable—certainly as retrofitted ruined viaducts, but also as new walkways—if positioned sparingly in novel spatial locations and integrated with the inevitable compromise of a ground level network.

Grounded Interweaving

A ground-hugging speculative example of Lynch's open space network model involves re-envisaging every second street in the downtown area of Portland, Oregon as converted to greenways, thus forming the offset green-network that Lynch considered. In this location, the diminutive city blocks commonly support single buildings, significantly reducing the potential issue of street frontage and access to private property. Under this model each 'grey-way' of the existing street network interlinks with the 'green-carpets' of the implanted system. Depending on one's point of view, either the grey or green systems frame a 'superblock' of four regular city blocks, bisected on each cardinal axis by the alternate (green or grey) system. As with all green-networks, the intersections between the two systems remain a challenge. In order to avoid creating grade-separated 'skyways', the green and grey systems must 'splice' together evenly at every junction (figure 11a). Alternatively, at every second intersection one system might be prioritized over the other, resulting in the effect of an over-under interweave where each system extends for a minimum of two blocks before being interrupted (figure 11b).

The extensive pedestrianization of entire downtown 'precincts' in the 1970s and 80s is probably the closest approximation of this improbable act of urban retrofitting. To be sure, under the expanded greenway definition, cities such as Portland are already rolling out

Figure 11. Downtown grid Portland Oregon, with every second street converted to form part of a green grid (shown as green lines) (left to right): (a) with intertwining intersections; (b) with overlapping intersections; (c) offset to form asymmetrical boulevards.

bicycle-boulevards-come-neighbourhood-greenways that exhibit a similar layout to the example just considered. However, even in instances of total green-network integration, paint on asphalt is not sufficient to invoke the full effect of the romance of the greenway; a clearly identifiable 'otherness' associated with the green system is required. The popular allure of light rail, even as rubber tired buses offer more rapid and comfortable service on the same route, illustrates this phenomenon. When approaching from afar, there is a tangible sensation associated with seeing the tracks and feeling reassured that this is exactly where the street car will pass and not someplace nearby. To use Lynch's (1960) nomenclature, the infrastructure becomes at once an edge and a landmark.

In the context of exiting urban situations (as opposed to new cities), what are the opportunities for reconciling the pedestrianized street at the one extreme and the painted cycle greenway at the other? In essence, the street is a compromise where too many programs are required in too smaller space. Room must be found for traffic, cyclists, pedestrians, utilities, planting, infiltration, signage, street furniture and more. Historically, there are two divergent coping strategies for this programmatic overload. At one extreme, the boulevard model allocates an exclusive easement for every program; fast traffic, slow traffic, parked traffic, cyclists, pedestrians, and planting strips are designated sovereign use of boulevard territory. While the more humble proportions of baroque boulevards kept the overall width in check (Jacobs 2002: 1993) the up-scaled lane dimensions and turning boxes of modern traffic engineering has bloated into the mega-boulevards that are now common in China. At the other end of the spectrum is the traditional European example of

shared space, where on a single undesignated street or piazza surface numerous programs coexist in a constant act of negotiation.

Combining these two creates the hybrid 'asymmetrical boulevard.' Part boulevard, part shared street and part retrofitted green-carpet, an asymmetrical arrangement involves displacing the greenway to one side of the street, while regular grey street activities are compressed into the opposite side (figure 11c). Essentially constituted as an oversized road shoulder, this greenway model has the advantage of not eliminating vehicular access when required, whilst also enabling the often-advantageous direct frontage to the green-carpet (in the case of cafés for example). In compressed situations, an asymmetrically arranged boulevard is more spatially efficient than a centrally symmetrical one, since there is less repetition of services. De-centring the green section of the boulevard is therefore a method for shoehorning in street level greenways where space is insufficient for a traditional boulevard arrangement without resorting to damaging the city fabric by widening streets. The design that is currently being developed for Bell Street in Seattle is an example of the asymmetrical boulevard.

Line Versus Loop

Despite frequently enjoying high rates of patronage, journeys on greenway networks tend be of the out-and-back type typically associated with exercise and leisure, as opposed to the specifically destination oriented mode of travel associated with needs based commuting. Whyte (1968) considers full continuity of the network not critical to the performance of the system, since even in instances of uninterrupted systems, people tend to use only parts in a localized manner; "save for a few hearty souls, … the beaten path does not go very far. … Few would ever traverse the whole system or be aware of its extent" (p. 180). Turner (1995) reinforces this sentiment, noting "even recreational users on highly scenic routes will not travel far in one direction unless they are enthusiasts who wish to boast of their achievement" (p. 269).

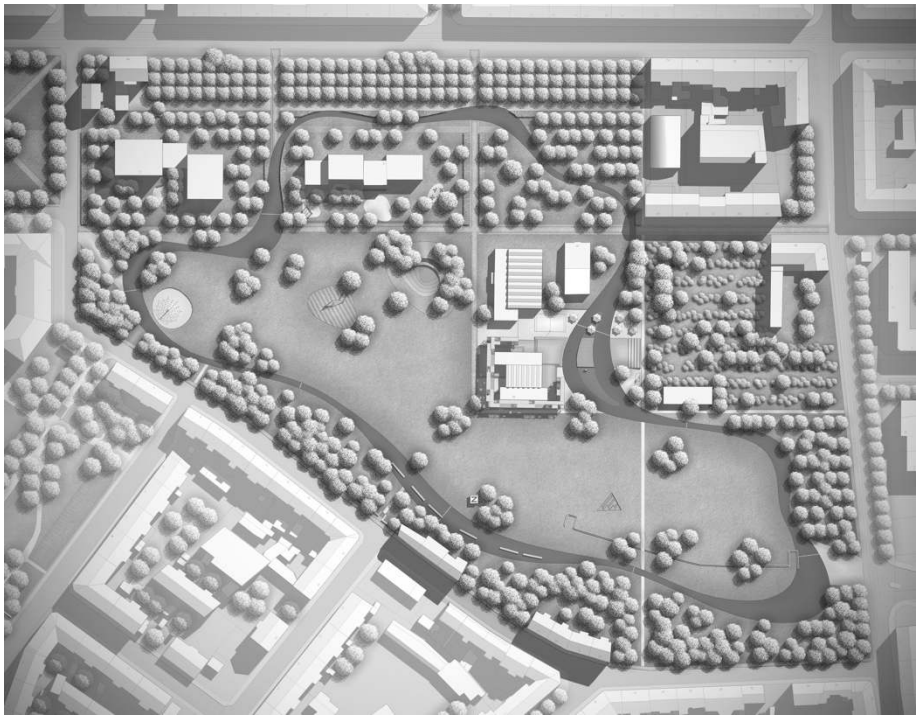

Figure 12. Concept plan of Park Rabet, Leipzig, with 1km exercise track (courtesy of Lützow 7).

The linear greenway trail is not alone in attracting enthusiastic but localized patronage. Circuit paths are typically even more alluring, as the popular 10km loop around Central Park in New York, or the 1km *laufband* (exercise track) that encircles Park Rabet in Leipzig Germany illustrates (figure 12). The circuit has the advantage of being finite, easily calibrated and quantifiable. It automatically returns the user to their point of origin, without any of the cognitive decision-making regarding when to turn around typically required on extensive linear greenways. Reduced or absent interactions with the hard reality of orthodox transportation infrastructure are an additional advantage of circuits.

The primary disadvantage of the circuit is that it is typically not explorative. Circuits encapsulate complete known worlds, while greenways have an expansive reach as they extend into unknown territories. To appropriate Jaques Derrida (1986) when on a greenway we are always "on the way." However, when on a greenway, one must continually ask and reaffirm to oneself: *how far am I prepared to go?* If the greenway happens to be the 1500km Gondwana Link ecological corridor in south Western Australia, the 5000km East Coast Greenway between Florida and Maine in the US, or the 6000km European Green Belt along the old Iron Curtain alignment, the answer is quite possibly a very long way indeed.

Can the security and legibility of the loop be reconciled with the explorative extension of the network? As was consistent with his preference for evenly distributed stand-alone neighbourhood parks, Lynch (1981) took the observation that "few people make continuous journeys from one open space to another" to imply that "linking open spaces together [is] unnecessary" (p. 437). Whyte (1968), on the other hand, anticipated an ideal hybrid condition whereby the network operates at both the local and the regional scales; the whole is ideally constituted from interlinking "networks of locally useful spaces" (p. 180). To be sure, a network of loops is quite different from simply manufacturing a circular journey by navigating the smallest unit of a regionally scaled network (by turning in the same direction at each intersection). Each loop interlocking with its neighbours is like the inner structure of a sprung mattress, satisfying the dual impulse of neighbourhood scale sojourns and the possibility of regional exploration.

But there is also a third potential effect; where loops rub up against one another, they potentially interdigitate (4), presenting the opportunity for a mode of exchange other than the 'migrating matter' of people on foot and bicycles. Just as ecological corridors typically facilitate genetic exchange amongst extant populations rather than individual organisms roaming the extensive network, greenway networks may not actually require users to traverse the entire system to function. Rather, at its best, a "network of locally useful spaces" facilitates fluid interpenetration between communities, one adjacency at a time. Where genes instead of individuals flow along functioning ecological corridors (Forman, 1995, p. 151), functioning green-infrastructure may be described as conveying memes (units for carrying cultural ideas) throughout the network.

There is an almost medieval undertone to the concept of translation of cultural knowledge solely one adjacency at a time, akin to forming an opinion about the hamlet two villages away by second-hand word-of-mouth but never actually visiting it. To offset this, also constituting the green-network as a 'tunnel' that links the near and far—allowing one to leapfrog localized adjacencies—remains a critical counterbalance. A hypothetical example of this balancing act between localized interdigitation and regional connectivity is the fusion of Frederick Law Olmsted's Emerald Necklace in Boston and Park Rabet in Leipzig. That is, local circuits formed as 'knots' or 'entanglements' loop off from the larger regional greenway system so as to form a more moderated alternative to a fully interlocked matrix of local loops.

Conclusions: "Show Me Your Rivers…"

Green-networks exhibit a continuing role as a counterbalance to the rational structure of the grey street networks and the city fabric as a whole. This implies that the 'otherness' and 'visibility' of green-networks be consciously maintained as an instantly recognizable green structure rather than being seamlessly integrated into the materiality of the existing city. Although very useful in the context of urban mobility, increased efficiency of passage along green-networks should not be viewed as the sole metric of green-network viability. In appropriate instances, a finer calibration of slowness allows the green-network to act as a spatial and existential orienting device in the urban fabric.

Moreover, points of intersection between green-networks and the adjacent grey street networks of the existing urban fabric are often problematic. Notwithstanding a deservedly tarnished reputation from mass vehicular systems, grade separation at the finer green-network scale remains an effective mechanism for improving interaction between systems. In addition to using existing infrastructural ruins to separate grades, new lightweight engineered structures may be carefully inserted where existing opportunities do not exist.

Green and grey networks need not be mutually exclusive, with the potential to co-inhabit the same easement. Historically, the boulevard has fulfilled this role, using the stratification of modes of mobility and strips of green space to interweave green and grey together. However, the traditional boulevard has limitations in the spatially confined easements typically associated with retrofitted green systems. By utilizing an exaggerated road shoulder for the green-network in place of one or two lanes of traffic, the 'asymmetrical boulevard' provides a viable alternative. Finally, green-networks should ideally be conceived of the as a series of interlocking neighbourhood loops that interdigitate with the local urban fabric, but also simultaneously 'tunnel' so as to bring the near and far closer together.

This discussion has been primarily oriented towards the opportunities and constraints associated with threading integral and continuous green-networks through *existing* post-industrial cities. However, what if we were building a *new* city with a blank canvas? Would a variation on the offset green-network model—with or without grade separation—be a valid template? With few extant examples from the twentieth century beyond suburban Radburn and the much-maligned downtown skyways to reference, there is little evidence to draw on for the affirmative. This is compounded by the inherent value that retrofitted infrastructural ruins have provided for existing cities by creating effective and meaningful armatures for supporting larger green-networks. New cities are unlikely to possess the advantage of the ruin, and in instances where relics do exist they are unlikely to be made of the city, but rather a mere casualty of its expansion into new territory. The pattern of twentieth century urban experimentation being largely enacted in arid and tropical climates further compounds the difficulty of quantifying the potential effectiveness of green-networks in new cities. In these environments, the grounded green-network idea needs substantial local adaption to be effective.

The danger associated with planning a city with a clean slate is that like streets, green-networks risk becoming obese, much in the way that the streetscapes of 'traditional urbanism' inspired developments have become over-specified, over-stratified and over-width. Furthermore, current debates regarding whether green-networks dilute the integrity of the city and risk suburbanizing it also carry substance. That is to say, more room is not always better, and in this regard, the retrofitting of green-networks into existing cities actually benefits from the inherent restrictions of the existing city fabric. If it is to work in new cities, the green-network requires variation built into the system and an understanding that the greenway is not singular cure-all mechanism for something as complex as a city.

Just as grey networks exhibit variety, so too should green-networks. Like the Sami peoples of northern Scandinavia who have hundreds of words for different variations on snow, we have developed a nuanced nomenclature for streets; for example, a "crescent" is patently different to a "tollway." A similarly expanded lexicon also needs to be reflected in greenways. Turner's (1995) proposal for subcategorizing and diversifying the increasingly stretched typology of the greenway into the "blueway," "paveway," "glazeway," "skyway," "ecoway," and the "cycleway," (pp. 277-81) is a beginning. Critically, the greenway that is painted on to street, for example, should not be presented in the same light as the greenway that is meticulously threaded along an old viaduct. The key to distinguishing between these expressions is to develop a stronger distinction between modes of egress on

greenways that are understood in more nuanced terms than simply in a blanket singular opposition to the (perceived and real) ills of the motorized grey network. That is to say, walking, promenading, rambling, fitness cycling and commuting each involve a distinctive set of passive/active relationships with the physical environment into which a given greenway is embedded.

Meanwhile, in existing cities, the momentum of fourth generation green-networks is clear. Issues of nomenclature notwithstanding, it is fitting that the green-network should target the streets, since for so much of the post war era the opposite has been true, where green-networks have been appropriated for grey transport and infrastructural needs. One of the most overt examples was the 1980s proposition to convert the concrete riverbed of the Los Angeles River into a freeway during the dry season to relieve traffic congestion (Rogers, 2003, p. 38). If the old modern planner's maxim was "show me your rivers and I will show you your future freeways," (5) generation four green-networks would proffer: "show me your underperforming streets and infrastructural ruins and I will show you your future green-network." A green infrastructure that is important for ecological connectivity, but also for existence value. We do, after all, tend to revere the lone coyote that outruns mere genetic migration (6) and roams the entire green-network, symbolizing that the romance of the urban wild is embedded within the cultivated city.

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Notes

1. "Postindustrial city" is used here to refer to all contemporary western cities which have moved beyond the industrial era. Even if never heavily industrialized with manufacturing and other industrial facilities, such cities typically contained industrial-era infrastructure.

2. "Green-network" is used here according to Cynthia Girling & Ronald Kellett's (2005) definition as: open spaces such as parks, greenways, natural areas, parkways, green streets, and utility and drainage corridors that serve human and environmental purposes.

3. The more recent proliferation of digital 'reality-augmenting' orienting devices such as satellite navigation and GPS enabled mobile phones further complicates this issue, although it could be argued that this technology tells the user where they 'are,' but not necessarily where their 'place' is.

4. "Interdigitation" is a term used in ecology to describe the interlocking fingers between ecological zones (see Forman, 1995).

5. Precise origin of quote unknown. Sighted by the author in an unpublished 1970s conservation planning document for Perth, Western Australia.

6. “Genetic migration” is a term used in ecology to describe the movement of genes (as opposed to a single organism) through an ecosystem via reproduction (see Forman, 1995).

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