Architecture_MPS

UCLPRESS

Research article

Mapping the lifelines: how the design of infrastructure networks impacts on transformation in dispersed territories

Sophie Leemans,[1,*], Erik Van Daele,[1] and Maarten Gheysen[1]

[1] Department of Architecture, KU Leuven, Belgium
* Correspondence: sophie.leemans@kuleuven.be

Submission date: 24 August 2022; Acceptance date: 17 October 2022; Publication date: 27 September 2023

How to cite
Leemans, S., Van Daele, E. and Gheysen, M. 'Mapping the lifelines: how the design of infrastructure networks impacts on transformation in dispersed territories'. *Architecture_MPS* 26, 1 (2023): 1. DOI: https://doi.org/10.14324/111.444.amps.2023v26i1.001.

Peer review
This article has been peer-reviewed through the journal's standard double-blind peer-review process, where both the reviewers and authors are anonymised during review.

Abstract

Besides compact cities, Western Europe is characterised by low-density dispersion, resulting in a landscape with elements of both *city* and *land*. These dispersed territories offer an alternative to a traditional urban–rural dichotomy framework and have been put forward as twenty-first-century cities. However, these territories are currently facing urgent and complex socio-economic and ecological challenges. One such territory is the Eurometropolis Lille–Kortrijk–Tournai, a transnational region on the border of Belgium and France. The hypothesis is that the evolution of the Eurometropolis territory is closely intertwined with its infrastructure networks. The structure of this article is threefold. First, it describes the non-binary condition in which the Eurometropolis is situated. Second, it analyses the evolution of infrastructure networks in the Eurometropolis from the late eighteenth century to today through case studies. Third, it highlights the potential future role of infrastructure networks in providing answers to large-scale challenges. The

research presented in this article demonstrates that transformation in dispersed territories is closely related to the evolution of their infrastructure networks. Moreover, infrastructure – such as waterways, railways and roads – has enabled an urban condition without urban form in the Eurometropolis dispersed territories. In the light of these findings, the article shows that the inherent nature of dispersed territories can be influenced by rethinking these infrastructures to proactively address the collective challenges at stake.

Keywords lifelines; infrastructure networks; mapping; dispersed territories; urban design

Introduction

European territories that cannot be classified as either urban or rural[1] (Figure 1) have often been brought together under the title *sprawl*, in reference to the post-war suburban sprawl typically found in North American cities. However, despite similar spatial characteristics, these European territories are not the result of a *spillover* of compact cities, but emerged from a long tradition of dispersed occupation, forming a network of hamlets (small- and medium-sized agglomerations). This constellation is thus not only older than, but also fundamentally different from, the sprawl described and studied in the predominantly North American context. Using the often negatively connotated term *sprawl* to describe these European networked territories (which also differ from each other) could therefore be an oversimplification and hinder potential productive discussions and design on the future of these territories.[2] These European territories, not fitting the traditional-city versus European-Environment-Agency-nature dichotomy, will therefore be referred to hereafter as *dispersed territories*.

Dispersed territories in Europe have been criticised due to their 'environmental, social and economic [negative] impacts for both cities and countryside'.[3] Detrimental effects such as the rapidly increasing occupation of open space, loss of biodiversity, high costs for maintaining extensive infrastructure networks and resource-intensive lifestyles of inhabitants present complex design questions for architecture, planning and landscape design.[4] Despite awareness of the major effort required, few of the answers provided take advantage of the specific opportunities these dispersed territories offer, due to the dominant compact city discourse. While dispersed territories are distinctively different from traditional cities like Paris, London or New York, certain elements, such as local cultural centres, supermarkets, package-to-door delivery and commuting by train to universities and offices, are reminiscent of a modern urban lifestyle. Consequently, design concepts meant to address these urban problems are often simply transferred from a compact city context and applied to dispersed territories,[5] resulting in expensive and qualitatively inferior solutions.

The importance and particularity of these dispersed territories cannot be neglected as they represent a substantial part of the economy and population. For example, West Flanders, a highly dispersed region in Belgium, has been called 'Europe's vegetable garden', producing as it does almost half of Europe's frozen vegetables.[6] Furthermore, in Flanders, Belgium's northern region, only 24 per cent of the population lives in a dense city context, as opposed to 76 per cent in more dispersed surroundings such as 'villages, fringes, ribbon development and allotments'.[7] Since the 1990s, because of the cultural significance of these territories, they have received increasing attention in academic literature – with characterisations such as *città diffusa*,[8] *Zwischenstadt*,[9] *ville-territoire*[10] and *patchwork metropolis*[11] – in an attempt to describe their unique and local qualities. Overall, the traditional compact city framework is not adapted to the reality of the non-binary urban–rural condition of these dispersed territories,[12] and thus further exploration of their mechanisms of development is necessary.

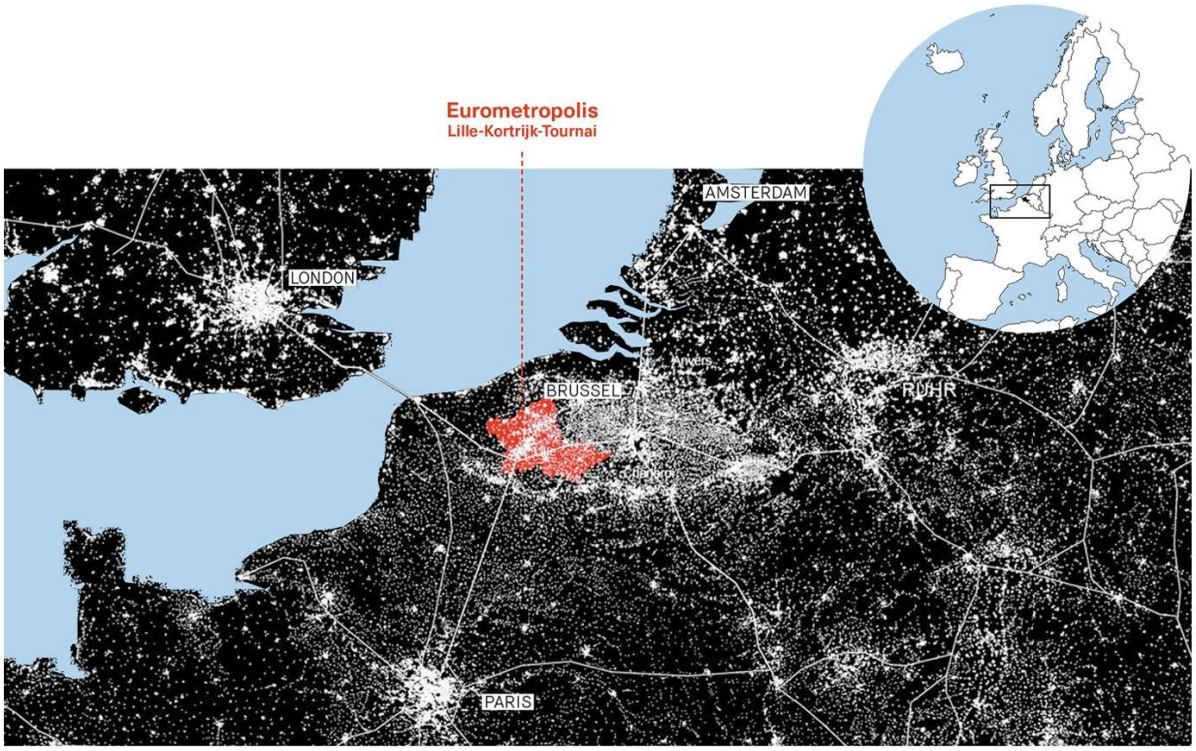
This article focuses on the dispersed territory of the Eurometropolis Lille–Kortrijk–Tournai (EM). The EM is a 3,500 km^2 French–Belgian cross-border region of 2.1 million inhabitants (for comparison, Paris has a similar number of inhabitants in 105 km^2) situated within one of the major clusters of dispersion in Europe (Figure 1).[13] The EM was established as the first European Grouping of Territorial Cooperation (EGTC) in 2008 with the aim of promoting and facilitating cross-border cooperation. The

https://doi.org/10.14324/111.444.amps.2023v26i1.001

grouping of South-West Flanders, Picardy Wallonia and the Lille metropolitan area is deliberate as these three regions share a rich history and culture, of which the constant shifting of the administrative boundary is characteristic.[14] The EM provides an excellent opportunity to explore the elements shaping a cross-border dispersed territory by examining its ongoing transformation and potential to respond to large-scale socio-economic and/or ecological challenges.

These large-scale challenges could potentially be tackled in dispersed territories by rethinking infrastructure networks. These networks are closely intertwined with past development and transformations and are therefore crucial to the future of these territories. To address the breadth of these issues, the structure of this article is threefold. First, it describes the All City/All Land condition within which the EM is located. Second, it provides the historical trajectory of existing infrastructure networks in the area as well as the contemporary context for the existing urban condition of this dispersed territory. By giving a broad history on a larger scale, using three local cases, the articles reframes these infrastructure networks as *lifelines*. And third, it highlights the potential of these lifelines to provide solutions to large-scale challenges such as the decline in biodiversity.

Figure 1. The dispersed territory stretching from Rotterdam (NL) to Lille (F) is distinctly different from the rather compact cities of Paris and London (Source: from Sophie Leemans, based on Studio 010, Secchi and Viganò, 'Bruxelles et ses territoires', 31)



All City/All Land: a non-binary urban condition, a twenty-first-century city?

The dispersed territory of the EM is composed of intermingling open and built-up space, containing residential, industrial, agricultural and ecological elements (Figure 2). Consequently, it does not have the traditional form of a compact city that distinguishes a dense centre from its open hinterland. This non-binary condition, roughly reaching from the south of the Netherlands to northern France has been called *All City/All Land* (AC/AL).[15] This term, coined in reaction to the dominant city versus land paradigm, positions this dispersed condition under a new understanding that is independent from a relationship

https://doi.org/10.14324/111.444.amps.2023v26i1.001

tied to a dominant urban centre. Such dispersed territories have been put forward as twenty-first-century cities, highlighting the importance of dealing with this type of settlement pattern as a crucial aspect of the future evolution of the whole territory.[16]

Figure 2. All City/All Land: a non-binary urban condition with both urban and rural elements (Source: Gheysen and Van Daele, 'All City/All Land')

The current AC/AL territory stems from a historically dispersed occupation of this region, as depicted on the Ferraris maps in the eighteenth century.[17] Over time, it has grown into a semi-urban environment with a modern countryside lifestyle. At the individual level, the affordability of housing,[18] the proximity of open space[19] and the lack of 'typically metropolitan problems' such as overpopulation[20] attract inhabitants from a wide range of social backgrounds, potentially resulting in a more 'democratic city'.[21] At a more collective level, this environment facilitates a more equal production and distribution of food,[22] and provides opportunities for large-scale renewable energy production.[23] Additionally, despite the consumption of open space, these territories potentially provide more species richness than densely populated areas do.[24]

At the same time, AC/AL faces large-scale challenges of 'changing environment, mobility problems, and social inequalities'.[25] These challenges are not unique to AC/AL, nor to dispersed territories in general; however, solutions taking this specific spatial configuration into consideration are scarce. Negative impacts found in dispersed territories range from the environmental – such as soil sealing, changes in microclimate, water and air pollution and loss of native species' habitat – to the economic – including increased car use, higher cost of public transport infrastructure, higher rates of energy use and less food self-sufficiency – to the social – such as greater segregation, reduced social interactions and higher proportions of single-person households.[26] Because of this, proactive solutions are needed, especially since current policy and design frameworks tend to project existing design concepts borrowed from compact cities onto this non-binary, dispersed context. The sewerage system provides an excellent example of this type of contextual mismatch.

In highly dispersed areas, sewage collection and treatment are organised in the same way as is typically found in urban centres, that is, a collective drainage-piping system running underground in front of the houses. Because of the low population and building density, this type of collective sewerage system is much more expensive and practically less feasible than in a city.[27] This cost discrepancy is reflected in the sewage rates (SR) and purification rates (PR) in low-density municipalities such as Heuvelland in South-West Flanders, Belgium (84.8 inhabitants/km^2, SR: 55.14 per cent and PR: 34.23 per cent) as opposed to within cities such as Ghent (1,584.6 inhabitants/km^2, SR: 96.60 per cent and PR: 96.08 per cent).[28] In most of the houses that are not (yet) connected to a sewerage system, untreated wastewater ends up in a nearby creek, causing pollution locally and over large distances downstream.[29]

https://doi.org/10.14324/111.444.amps.2023v26i1.001

A similar situation manifests itself in the construction and maintenance of road and mobility infrastructure in Flanders, Belgium. Despite the higher average weekly travel time per person per car (3.3 h for city centres as opposed to 4.8 h–5 h for more dispersed contexts) and the higher societal costs, significantly more travel journeys are made by car (49 per cent for city centres as opposed to 74–77 per cent for more dispersed contexts).[30] Again, public transport systems are more efficient in city centres due to population density. Beyond this, there also exists a parallel system contributing to car dominance: the company car, that is, a free or heavily subsidised vehicle available to employees and exchanged every few years.[31] In 2021, 59.7 per cent of all newly registered cars and 22 per cent of all cars in Belgium were company cars.[32] Inevitably, despite readily available public transport alternatives, these underlying systems sustain a car-based lifestyle resulting in negative economic and ecological impacts.

The two abovementioned examples illustrate how adopting design and policy principles from compact cities for AC/AL leads to negative consequences, such as high financial costs and ecological degradation.[33] An often-proposed solution centres on selective infill of the territory, which aims at densifying existing villages and hamlets and reversing dispersed settlements.[34] However, this strategy reinforces the problematic framing of built-up versus open-space logic and fails to acknowledge the need to address the necessary interventions in underlying processes.[35] These challenges require bespoke design solutions to address the unique underlying processes in AC/AL, an urban condition without an urban form.

One possibility to address the underlying processes found within AC/AL is to intervene in its infrastructure networks as underlying systems of urbanisation. Leveraging infrastructure as lifelines of urban prosperity is not new, and neither is the knowledge that improving these infrastructures is key to creating resilient cities.[36] In Belgium specifically, the historical relationship between transportation infrastructure and the politics of dispersal has been extensively studied,[37] and it is clear that it successively played a role 'to steer the expansion of a city, colonize a province, unify a region, regenerate an area or as a way to frame local developments'.[38] However, local relationships between different types of infrastructure are understudied and their potential for the future development of the territory remains largely unexplored.

Mapping lifelines: a multi-scalar method

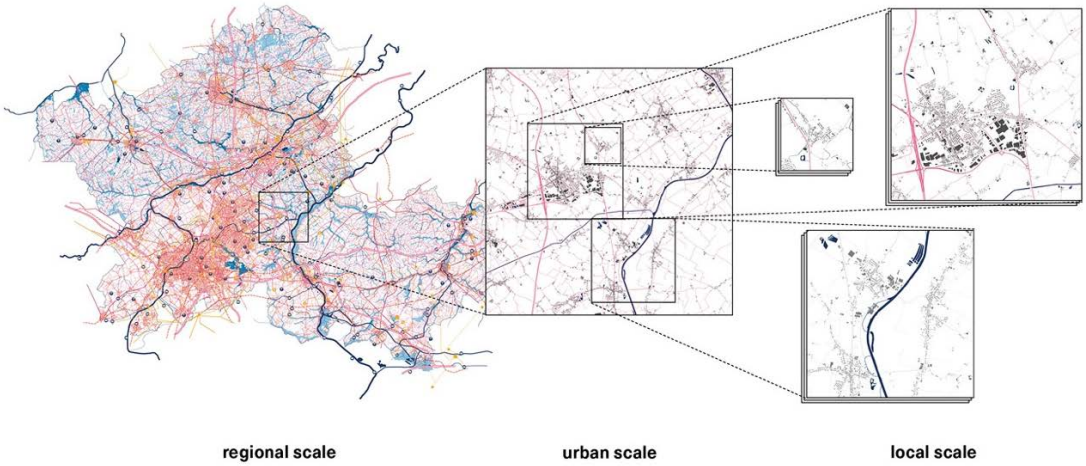
In this article, three local cases are used to examine the relationships between water, railways and road infrastructures within the territory. Observations and reflections are based on strategic mapping of the area to document the relationship between the development of infrastructure and the territory. Infrastructure networks are categorised based on their physical characteristics and functional purpose. The resulting atlas consists of a set of topographic and topological maps, sections, schemes and (historical) photos with extended captions for four different timeframes (approximately 1750, 1850, 1950 and 2020). These timeframes are based on the availability of territorial-scale maps, on both the Belgian and French sides.[39]

Topographic maps are created at a territorial scale (50 × 50 km) to examine large-scale effects and at the urban scale (10 × 10 km) to provide insight into the transformation of dispersion. This multi-scalar mapping method (Figure 3) is based on, and adapted from, the Horizontal Metropolis project.[40] The urban-scale cases are selected based on their representativeness of the EM territory and their cross-border character (Flanders–Wallonia, Flanders–France, France–Wallonia), and in consultation with the EM agency, academic partners and local municipalities.[41] Relevant cases at this scale are examined in more detail, exploring the impact of the large-scale network transformations on the regional context.

These cases, situated in the area surrounding the villages of Kooigem, Pecq, Warcoing and Dottignies – between the E403 highway and the Scheldt River on the border of Flemish and Walloon territory, and close to the French border in the west – provide examples of different border conditions and states of urbanisation. A small-scale focus allows for the examination of the interrelation between (the succession of) different infrastructure networks in more detail and their influence on the evolution of the dispersed territory.

https://doi.org/10.14324/111.444.amps.2023v26i1.001

Figure 3. The multi-scalar mapping methodology in this article demonstrates the spatial impact of the networks in the EM (Source: from Sophie Leemans, based on data from Google Earth; OSM; Geopunt Vlaanderen; Géoportail de la Wallonie; NGI/IGN Belgium; IGN France, 2020)



Infrastructure networks and large-scale transformation in the Eurometropolis Lille–Kortrijk–Tournai: a brief history

> The intricate system of water and land roads had structured the region for centuries. From the late eighteenth century onwards, new layers were added. The region was integrated in a supra-local infrastructure network of successively paved roads, railways, canals, motorways, air traffic and high-speed train lines. Each infrastructure layer had its own economic, social, and political logic and brought new spatial dynamics. Due to the superposition of infrastructure, the landscape underwent strong metamorphoses. New infrastructure always led to new activities and development opportunities.[42]

This quotation describes the Kortrijk region and can be considered typical for the EM. Consistently, the introduction of new infrastructure networks and the adaptation of existing ones became embedded in the socio-economic and political context of that time. These infrastructure networks are thus closely related to the development of (an urban) society. Below, a brief history of transportation infrastructure networks in the EM territory is outlined as a starting point for a more detailed local investigation.

At the beginning of the eighteenth century, the first paved roads (*steenwegen*) were constructed under Austrian rule to connect emerging cities such as Ghent, Bruges and Kortrijk. These paved roads not only facilitated trade and the transportation of goods, but also created opportunities for mobilising people over land through a collective system. At the turn of the nineteenth century, the stagecoach pulled by horses (*diligence*) made its appearance and grew in popularity. The *diligence* was the first land-based alternative to sailboats and small boats pulled by horses on towpaths (*trekschuiten*), a system that had existed since the fifteenth century (Figure 4). During the first half of the nineteenth century, Lille had frequent stagecoach services to Paris, Tournai, Ghent and Kortrijk, amongst others, and thus connected French territory with what was at the time the Southern Netherlands.

The nineteenth century was dominated by the construction of railways, initially horse-powered and later mechanically operated thanks to the steam engine (Figure 5). At the same time the booming textile industry in the region industrialised, resulting in large-scale factories. The network of railways and roads was part of a conscious, socio-economic project to turn the newly established country of Belgium into a 'modern nation-state'.[43] At that time, no other country in the world had such an extensive network of railways.[44] The centralised network of regional railways was complemented with a more isotropic local tramway network, a phenomenon also present in France (Figure 6). On the Belgian side in particular, ubiquitous train and tram stops in combination with specific laws and policies, enabled

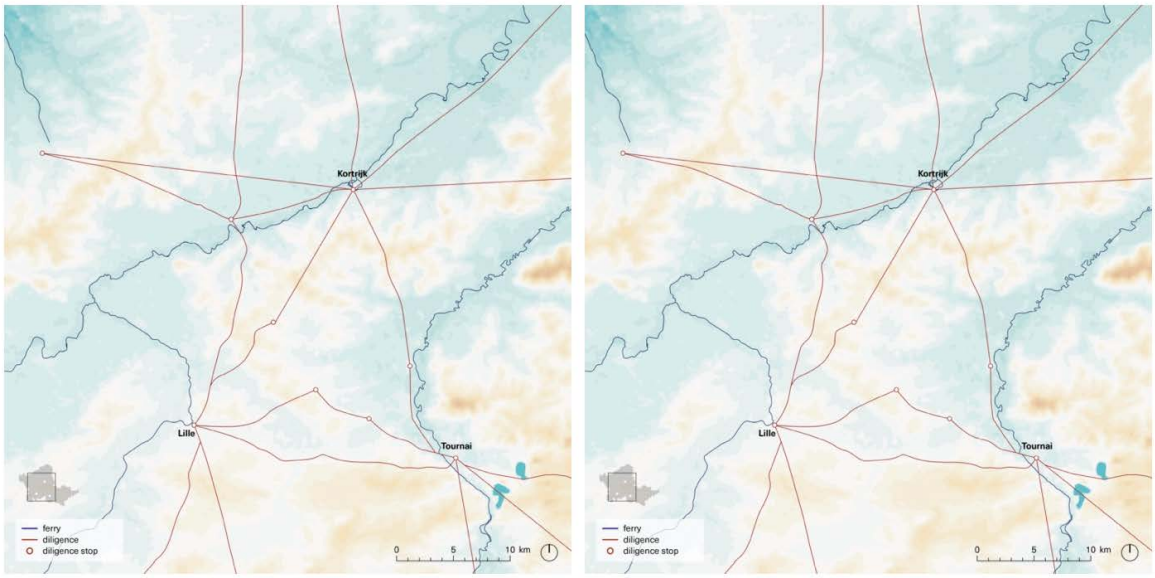
https://doi.org/10.14324/111.444.amps.2023v26i1.001

extensive accessibility across the country and stimulated population growth and housing construction in more dispersed surroundings.[45]

During the second half of the twentieth century, the construction of highways and the rise in popularity of the automobile in addition to the high maintenance cost of the extensive railway network led to a shrinking of the latter. Most former railway routes were replaced by bus lines from the 1930s onwards.[46] However, most people living in their detached houses in 'the countryside' began commuting by car, eventually resulting in heavy traffic congestion from the mid-twentieth century onwards – Belgium became, for instance, 'Europe's most congested country'.[47] Meanwhile, rivers and canals were intermittently widened and deepened to facilitate the passage of increasingly larger ships for goods transportation.

Over time, the dispersed pattern made up of agricultural typologies such as the moated farmstead,[48] already visible in the eighteenth-century Ferraris maps,[49] grew into a territory with the transportation infrastructure of a modern city, creating an urban condition without a traditional urban form. Thanks to the ubiquitous access to drinking water, electricity, highways, railways, commerce or communication services, people living and working in this territory could live an urban lifestyle by taking advantage of an ecology of choice, 'a spectrum of possibilities assembled within the spatially differentiated field of the city'.[50] The relationship between the evolution of the EM and the consecutive transformation of infrastructure networks on a larger scale invites investigation into how these territories unfolded on a smaller scale to understand the future role of these infrastructure networks.

Figure 4. *Diligences* (stagecoaches) and *trekschuiten* (horse-pulled ferries) in the EM territory in the eighteenth century were the first modes of public transportation between larger settlements such as Lille, Kortrijk and Tournai (Source: from Sophie Leemans, based on Royal Library of Belgium [KBR] – Ferraris map [1771–8]; IGN France, Cassini map [1744])



https://doi.org/10.14324/111.444.amps.2023v26i1.001

Figure 5. The tram and railway network in the EM at its most extensive point in the mid-twentieth century was mainly used by labourers to commute daily between their houses – often situated in an open, dispersed context – and their workplace – often situated in close proximity to a city (Source: from Sophie Leemans, based on NGI Belgium, Topographic map (1969); IGN France, SCAN 50®Historique (1950); De Block and Polasky, 'Light railways')

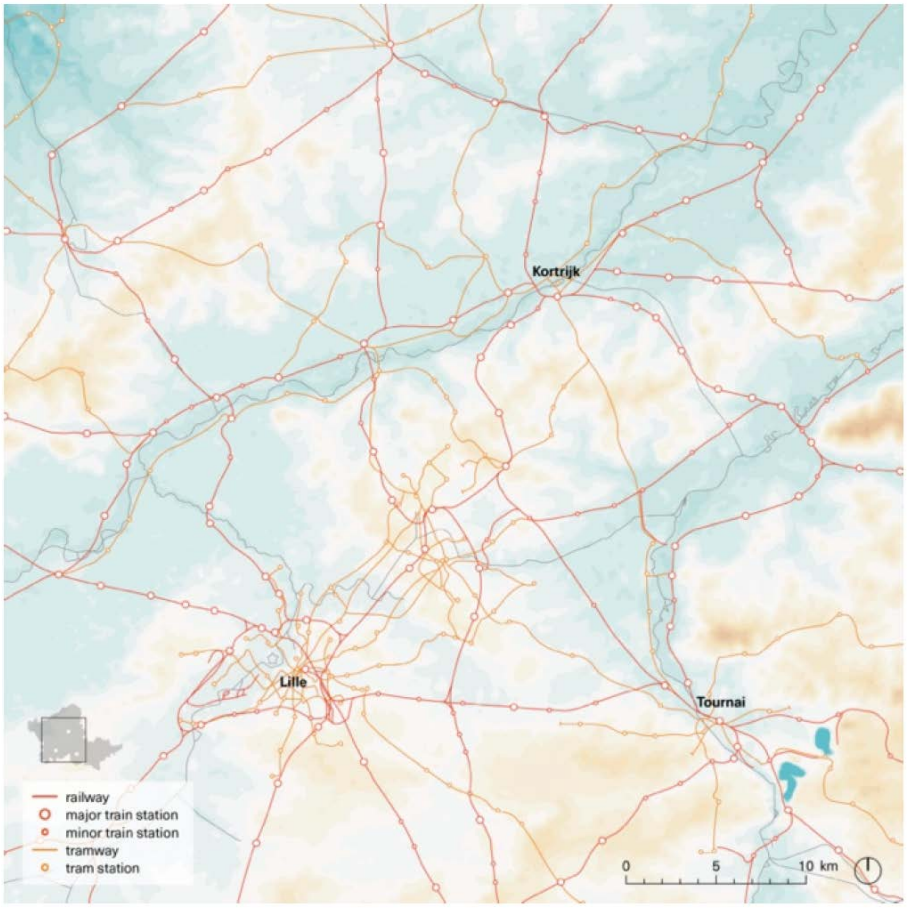
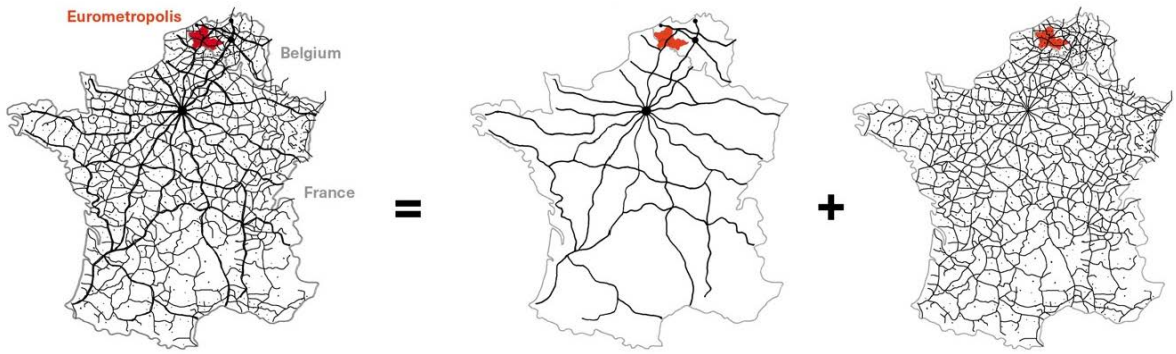


Figure 6. The railway networks in Belgium and France of the eighteenth and nineteenth centuries were both organised simultaneously around a hierarchical and isotropic logic. In France it was centred around Paris and in Belgium around linking the capital, Brussels, to the centre with Antwerp in the north, Ostend in the west and the mining regions in the south-east (Source: from Sophie Leemans, based on De Block and Polasky, 'Light railways' and Thévenin, Schwartz and Sapet, 'Mapping the distortions in time and space')

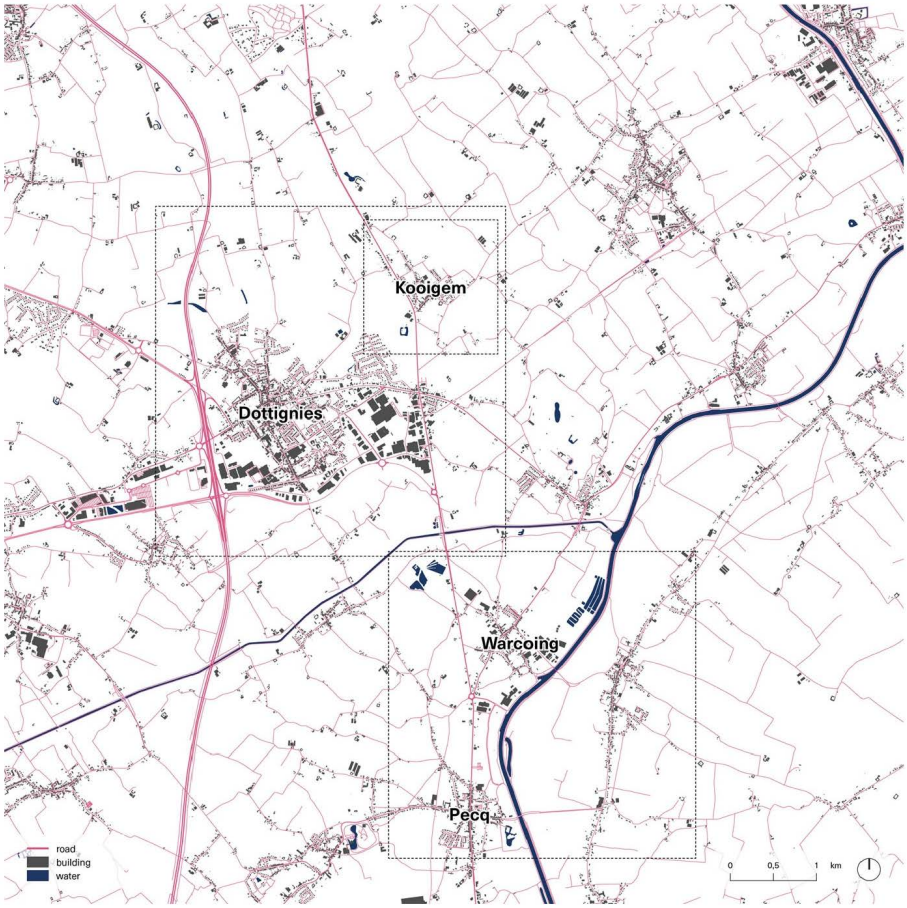


https://doi.org/10.14324/111.444.amps.2023v26i1.001

Infrastructure and small-scale transformation in the Eurometropolis Lille–Kortrijk–Tournai: a mapping exercise

The local impact of the evolution and configuration of water, individual and collective mobility networks and territorial development is examined using three cases (Figure 7). These cases are in proximity to each other, and each represents a different type of infrastructure network coming together within these surroundings. The first case examines the water networks on the Scheldt River between Pecq, Warcoing and Hérinnes as trade and production corridors; the second case uses the village of Kooigem to examine the evolution of public transportation along National Road N50; and the third case reviews the industrial development of Dottignies along Highway E403.

Figure 7. The location of the three cases (Source: from Sophie Leemans, based on data from Google Earth; OSM; Geopunt Vlaanderen; Géoportail de la Wallonie; NGI/IGN Belgium; IGN France, 2020)



The Scheldt River: rationalisation and revaluation of water networks

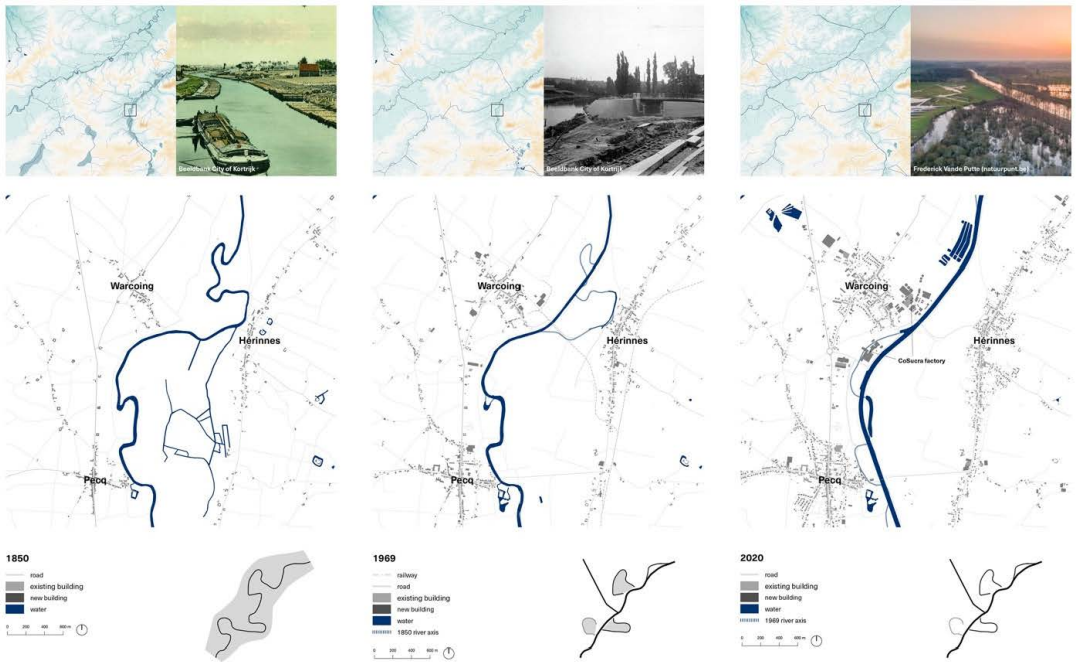
The Scheldt River runs along the Flemish–Walloon border north of Tournai between the villages of Pecq, Warcoing and Hérinnes (Figure 8). Until the early nineteenth century, the Scheldt followed a predominantly natural course carved into the landscape with meanders and marshlands. These *meersen* were rarely built upon due to their soggy, flood-prone character; however, they were ideal for agricultural and later for proto-industrial activities such as drying clay bricks (Scheldt River) or retting (soaking) flax (Lys River). These activities contributed enormously to the wealth and growth of the Scheldt and Lys river valleys in the nineteenth century. During the second half of the twentieth century, these sectors rapidly declined due to increasing international competition and the depletion of raw materials.[51]

https://doi.org/10.14324/111.444.amps.2023v26i1.001

From the late nineteenth until late in the twentieth century, this entire region was characterised by large-scale infrastructure projects such as river straightening and canal construction to facilitate larger ships transporting goods across the region. As part of this initiative, the Scheldt River was straightened, widened and deepened multiple times between the end of the nineteenth century and today. Regular dredging prevents silt accumulation and narrowing over time. As a result of such waterway interventions, meanders and marshlands were cut off, often drained and then ultimately eliminated.[52]

The combination of the decline of marshland activities, the widened river, the opening up of space on former meanders and the Industrial Revolution resulted in increasing industrial activities emerging along the Scheldt River. One example is the Cosucra factory in Warcoing, established in 1852, that extract sugar from sugar beets. After the second straightening of the river, Cosucra extended its production site on a former river meander (Figure 8). Today, because Cosucra no longer produces sugar and focuses on specialised food ingredients, the former sugar-decantation structures north of the factories are being redeveloped into an ecological park – an example of the recent reappraisal of the ecological value of these meanders and the river valley in general.

Figure 8. The evolution of the Scheldt River valley between Pecq, Warcoing and Hérinnes between 1850 and 2020. Built-up meanders and an increasingly straight and wide river demonstrate the rationalisation of the water network (Source: from Sophie Leemans, based on data from Google Earth; OSM; Geopunt Vlaanderen; Géoportail de la Wallonie; NGI/IGN Belgium; IGN France, 2020)



Kooigem and National Road N50: the bundling and reinterpretation of collective mobility

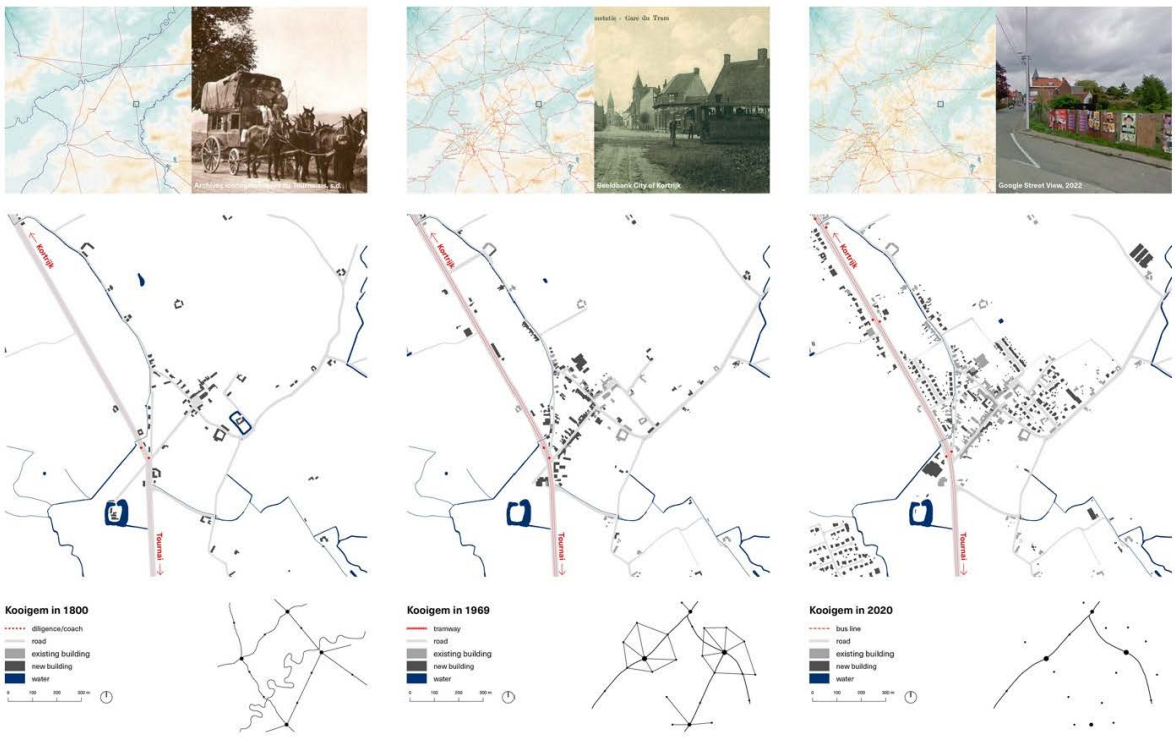
The village of Kooigem is located about 5 km north of Pecq and Warcoing along the N50. This national road forms part of the first paved road system in the region, which dates back to Roman times.[53] Between the early nineteenth and twenty-first centuries, Kooigem tripled in size under the influence of three successive types of public transportation, or collective-mobility, technologies: a horse-drawn stagecoach network, a local tramway network and a bus network (Figure 9).

In the early nineteenth century, two collective mobility systems operated: small boats pulled by horses (*trekschuiten*) and horse-drawn carriages or stagecoaches (*diligences*). The latter were of particular importance for Kooigem, as it was situated along the route between the cities of Kortrijk in the north and Tournai in the south. Due to the deplorable state of the road and the limited capacity of

https://doi.org/10.14324/111.444.amps.2023v26i1.001

the animals, travelling between the cities could take up to several days and required stopovers in towns such as Kooigem, which benefitted from its position along the way.[54]

Figure 9. The evolution of the village of Kooigem, Belgium between 1800 and 2020 through the perspective of its collective-mobility networks. The successive horse carriages, tramways and bus lines enabled Kooigem to expand over time (Source: from Sophie Leemans, based on data from Google Earth; OSM; Geopunt Vlaanderen; Géoportail de la Wallonie; NGI/IGN Belgium; IGN France, 2020)



These *diligences* increasingly lost significance with the introduction of the railways in the 1830s, which made long-distance mobility much more efficient. The development of the dense rail and tramway networks (*buurtspoorwegen*) across Belgium was part of an infrastructure policy to create an 'rural-urban continuum'.[55] Cheap train subscriptions for factory labourers allowed for the purchase of an affordable house in 'the countryside' and a daily commute to work over distances too far for foot or bicycle. This transportation shift can be seen in the expansion of Kooigem in the mid-twentieth century, when this rail-based network was at its most extensive (Figure 9). The Kooigem tram stop was situated along Tramway 372, connecting Kortrijk, Bellegem, Kooigem and Pecq with the Cosucra factory in Warcoing.

During the second half of the twentieth century, the rail and tramway networks thinned out largely due to high maintenance costs and the rise of private vehicle ownership.[56] Many of the former train and tram lines were replaced by bus services beginning in the 1930s. In this case, bus line 15 now connects Kortrijk with Kooigem; however, the service frequency is very low (four buses per day on weekdays and none on weekends) and could thus be a contributing factor to the strong car-oriented mobility. Today, the Flemish bus company De Lijn is moving increasingly towards a more selective and hierarchical system on a larger scale, prioritising central locations with nodal value based on building density and development opportunities.[57]

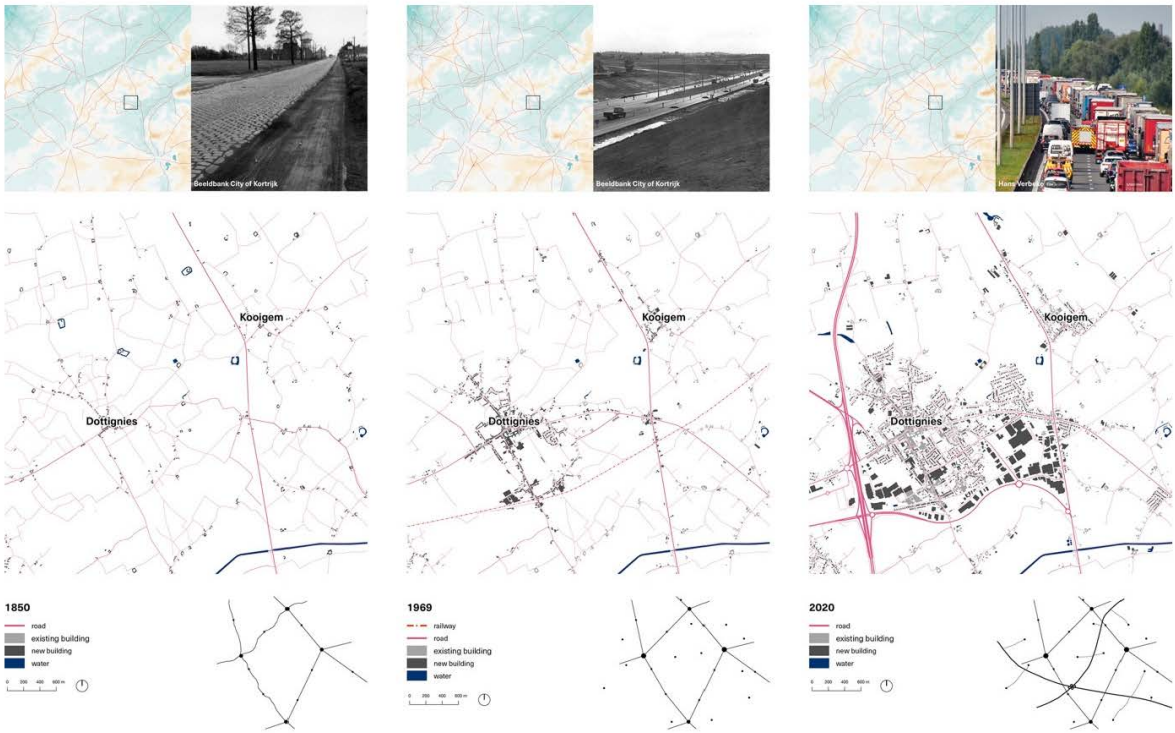
Dottignies and Highway E403: layering and complexity in individual mobility

The third case involves the development in and around the villages of Dottignies (Wallonia, Belgium) and Kooigem (Flanders, Belgium), east of the former industrial city of Roubaix (France) and along the parallel

https://doi.org/10.14324/111.444.amps.2023v26i1.001

E403 highway and N50 national road connecting Kortrijk and Tournai (Figure 10). Besides profiting from the collective-mobility infrastructure as described above, development in this area was also influenced by individual mobility and its related infrastructure.

Figure 10. The evolution of the territory around Dottignies (Wallonia) and Kooigem (Flanders) between 1850 and 2020 through the perspective of individual-mobility networks. While initially, paved roads were rare, the introduction of highways and the increased asphalting of local roads facilitated the development of residential allotments and an industry park with good accessibility (Source: from Sophie Leemans, based on data from Google Earth; OSM; Geopunt Vlaanderen; Géoportail de la Wallonie; NGI/IGN Belgium; IGN France, 2020)



Initially, individual mobility was limited to walking and cycling distances, though paved roads were rare and mostly used by carriages with horses due to their cambered design with cobblestones. This was also the case for the N50/Doornikserijksweg passing Kooigem, which, as an ancient Roman road, has played an important part in the regional infrastructure between Kortrijk and Tournai. However, the rapid development visible in Figure 10 between 1969 and 2020 only came after the nearby construction of a new infrastructure for individual mobility.

Because long-distance mobility in 1850 was still dominated by train and tram, individual motorised mobility only emerged with the rise of car ownership and the construction of highways from 1935 onwards. The introduction of the E403 highway in the 1980s stimulated the development of an industrial park in Dottignies between the highway and the national road. With the increasing traffic in the street and asphalt paving, pavements were introduced to protect pedestrians from fast-moving vehicles. At the same time, ribbon development emerged along the N50 featuring urban housing block typologies against a backdrop of open landscape, a typical phenomenon along national roads. A similar development pattern occurred along the existing wide-mazed agrarian road structure, which filled in with residential allotments and terrace-type houses.[58] An example of this can be seen between Dottignies and Kooigem, west of the N50 (Figure 10).

Despite the existing abundance of roads – occurring as the result of a historical layering of local roads, national roads and highways – these infrastructure bundles are confronted with significant traffic

https://doi.org/10.14324/111.444.amps.2023v26i1.001

congestion resulting from long-distance commuting and high rates of frequent road construction and maintenance.[59] This is especially true in and around cities such as Brussels and Antwerp, whereas around towns such as Kooigem and Dottignies traffic congestion remains rather limited.

Infrastructure and the future evolution of the dispersed territory

Tying infrastructure to the evolution of a territory seems self-evident – for example, water structures have always played an essential role in the location of human settlements as providers of agricultural irrigation and transport of goods. This is also the case for the EM, where the omnipresence of water (in combination with the lack of topographic constraints) has been one of the major contributing factors to the early dispersed human-habitation patterns of this territory. The abundance of rivers and creeks provided irrigation and productive soil for agriculture cultivation across the territory, while the Scheldt and Lys rivers became important trade routes. This thriving area was strongly influenced by natural characteristics – for example, the Lys River was naturally poor in lime and iron, which played a major role in the growing flax industry because the mineral content of its waters was ideal for flax retting. This flourishing industry, along with agriculture, was one of the major contributors to the expanding settlement of the territory.[60]

For Pecq, Warcoing, Kooigem and Dottignies, the story centres on large-scale infrastructural interventions in the landscape from the Industrial Revolution onwards, rather than the exploitation of existing natural elements. For these four communities – with a spatial composition made up of small towns, hamlets and industrial fabric, and veined with local and regional mobility infrastructure – their organisation is emblematic of many places within the EM. In these types of settlements, the succession, upgrading and renovation of different types of infrastructure networks spurred urban development under different conditions. For example, the sugar factory in Warcoing was built close to the Scheldt River because of its need for water in industrial processes and ship transport. At the same time, factory labourers (from both Belgium and France) could easily reach their workplace from their single-family dwellings by tram or train from towns such as Kooigem or Pecq. Later, commuting over longer distances became possible due to the construction of the E403 highway (exit) close by. The presence of this highway then facilitated the development of other industries and logistics in Dottignies, creating jobs and leading to new residential allotments, and so on. The interaction and exchange between these infrastructure networks stimulated the evolution of this dispersed territory from an agricultural landscape in the late eighteenth century to AC/AL today, a fundamentally different development pattern from the compact city paradigm.

Today, many of these lifelines are ageing or being abandoned while the territory faces large-scale challenges and 'urban questions' tied to 'environment, mobility and social inequalities'.[61] Approaching these issues will determine the future configuration of the dispersed territory. Despite the existing link between infrastructure and urban development, 'the perspective of the un-built' deserves further research.[62] In the EM, and to a larger extent the overall AC/AL condition, rethinking this unbuilt space can provide answers to the large-scale challenges that this dispersed territory is facing. From this perspective, architects and designers must start reasoning and designing from conditions rather than form – as a response to the reality of the urban condition or 'urban realm' present in this dispersed territory.[63] A design shift must be made from intervening in the urban form to intervening in underlying systems.[64]

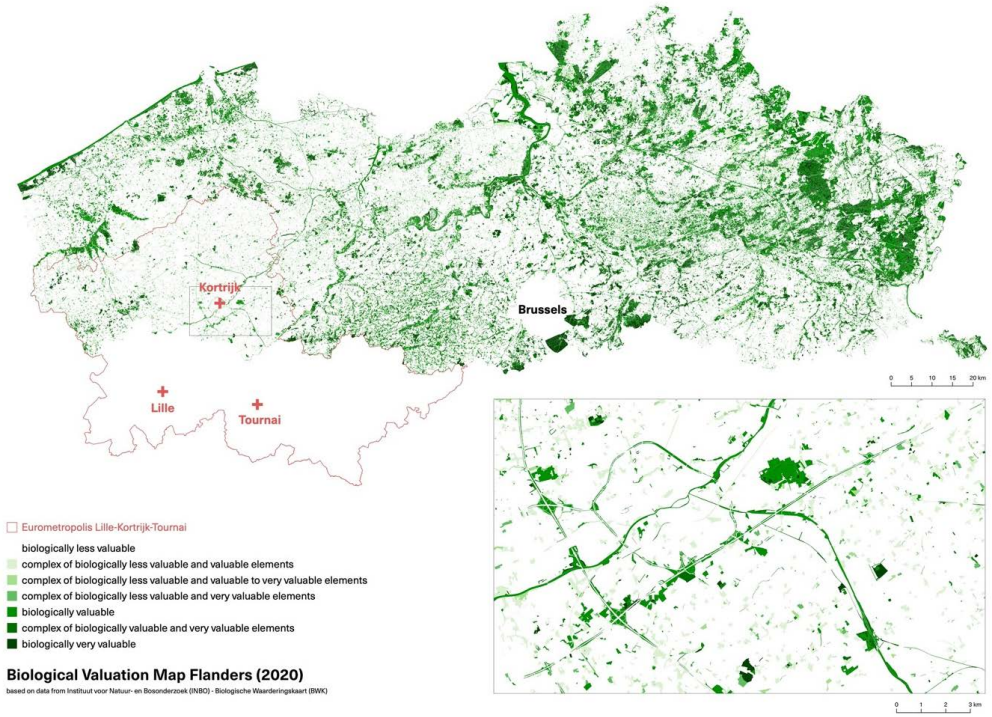
Small-scale design projects intervening in the underlying infrastructure systems offer an opportunity for research-by-design experiments, breaking away from the prevailing framework of the compact city. One existing example is the Leaudegem project in Ledegem, Flanders. Here, the wastewater from 14 houses in a dispersed area has recently been connected to a decentralised small-scale water-cleaning facility located on their street which purifies the water on site with bacteria and plant roots.[65] Previously, wastewater was discharged into a nearby ditch, causing groundwater contamination and odours. This solution addresses the immediate local problem without the expensive construction of pipelines tied to a centralised sewerage network. Despite their seemingly small-scale impact, these types of projects have the capacity to become catalysts responding to the individual nature of this territory rather than projecting centralised systems of the compact city onto dispersed territories.

Similarly, infrastructure networks that previously played a lifeline role in the development of AC/AL and are now abandoned can be reimagined to provide solutions for current large-scale challenges such as the biodiversity crisis.[66] Interestingly, the verges of highways, railways, canals and rivers are biologically

https://doi.org/10.14324/111.444.amps.2023v26i1.001

the most valuable zones of the dispersed territory of South-West Flanders (Figure 11), and ecological verge maintenance is not new – especially in this territory.[67] While many former railways are being redeveloped as recreational cycling routes, reflecting a modal shift from motorised mobility to more sustainable forms of transportation, this leaves much of the potential of these networks underutilised. Embedded in a regional network, these structures could offer new ecotypes and landscape structures, providing answers to the ongoing biodiversity crisis (Figure 12).

Figure 11. The biological valuation map of Flanders shows how, especially in dispersed territories such as South-West Flanders, the (verges of) infrastructures such as highways and waterways are crucial habitats for fauna and flora in ecologically poor areas (Source: from Sophie Leemans, based on data from INBO – Biologische Waarderingskaart [BWK])



Conclusions

This article explores the evolution of infrastructure in dispersed territories in its wider socio-economic context from the late eighteenth century until today. This case-study research on the EM using Kooigem, Pecq, Warcoing and Dottignies examines villages with between 800 and 8,000 inhabitants situated on the Flemish–Walloon border and close to the French border within the Lille–Kortrijk–Tournai triangle. This research highlights how the construction and adjustment of, and interaction and exchange between, infrastructure networks such as waterways, railways and roads enabled an urban condition without an urban form in the dispersed territory. Here, the urban–rural dichotomy is obsolete as the territory has elements of both city and land and is thus part of AC/AL.

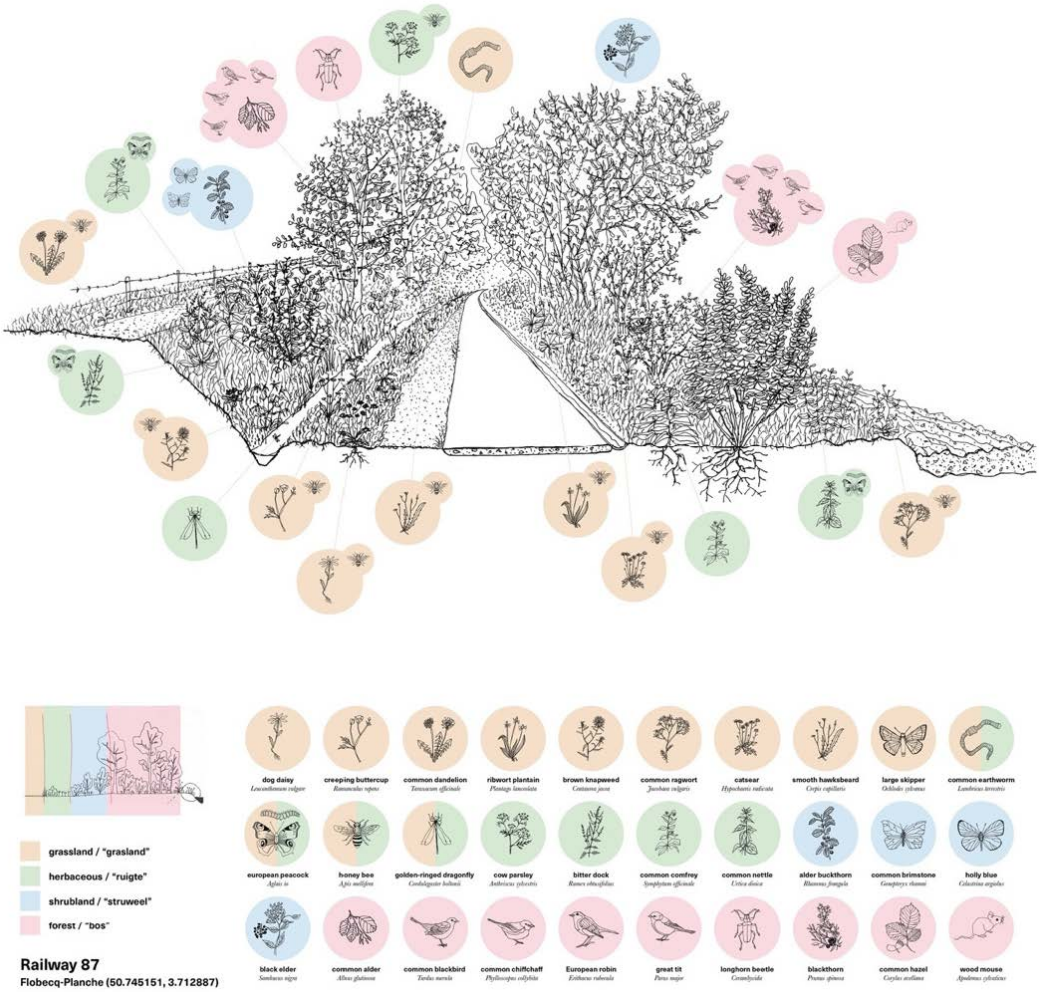
Today, this territory is faced with questions and collective challenges also found in urban centres such as declining biodiversity and a changing climate. This article argues that one way to address these challenges is by reframing the infrastructure networks as lifelines for the future of the territory. This requires intelligent design solutions that go beyond form design and that rethink underlying systems. In reference to AC/AL, a shift from object-thinking and form design to process-thinking and system design is necessary.

Overall, there is a need for tools, frameworks and approaches that fit this non-binary condition and take advantage of the existing qualities of this territory. There is already an existing move towards

https://doi.org/10.14324/111.444.amps.2023v26i1.001

more decentralised infrastructure networks such as sewerage, electricity production and car sharing. However, rethinking existing networks on a large scale could also provide answers to challenges of sustainability, environmental impact and climate change – for example, the abandoned railway network could become a new type of landscape. Additionally, small-scale design interventions can take on an exemplary role and become catalysts for this change. However, as long as the underlying systems are organised and understood only in reference to the compact city framework (such as a centralised sewerage system, a bus-service system at low frequency and car commute subsidies), design solutions in this highly individualised context will remain ineffective.

Figure 12. When planted and maintained in the right way, former railways have the potential to become ecological corridors, providing an answer to the biodiversity crisis in dispersed territories (Source: Leemans et al., *Eurometropolis*)



Notes

[1] Studio 010, Secchi and Viganò, 'Bruxelles et ses territoires'.

[2] Bogart, *Don't Call It Sprawl*; Wandl, *Territories-in-between*.

[3] European Environment Agency, 'Urban sprawl in Europe: The ignored challenge'; European Environment Agency, 'Urban Sprawl in Europe. Joint EEA-FOEN Report'

[4] European Environment Agency, 'Urban sprawl in Europe. Joint EEA-FOEN Report'.

[5] Van Broeck, 'Expertenadvies Sensibilisering Bouwcultuur'.

https://doi.org/10.14324/111.444.amps.2023v26i1.001

[6] Vanhaverbeke, Larosse and Winnen, 'The Flemish frozen-vegetable industry'.
[7] Vermeiren et al., 'Monetariseren van de Impact van Urban Sprawl in Vlaanderen'.
[8] Indovina, Matassoni and Savino, *La Città Diffusa*.
[9] Sieverts, *Zwischenstadt*.
[10] Corboz, 'Vers la ville-territoire'.
[11] Neutelings, *Patchwork Metropolis*.
[12] Gheysen, Scheerlinck and Van Daele, 'Opposing oppositions'.
[13] Secchi, 'A new urban question 2'; European Environment Agency, 'Urban sprawl in Europe. Joint EEA-FOEN Report'.
[14] Grosjean, 'Wallonie picarde'.
[15] Gheysen and Van Daele, 'All City/All Land'; Gheysen, Van Daele and Scheerlinck, 'Alles Stad/Alles Land', 32–5; Gheysen, 'Unlocking the potential of collective spaces'.
[16] Secchi, 'A new urban question 2'; Studio 010, Secchi and Viganò, 'Bruxelles et ses territoires'.
[17] Ferraris, 'Ferraris map'.
[18] Immoweb sa/nv, 'Real estate prices in Belgium'.
[19] Secchi and Viganò, *Habiter le grand Paris*.
[20] De Decker, 'Ruimtelijke verrommeling à la belge'; De Meulder et al., 'Patching up the Belgian urban landscape'.
[21] Gheysen, 'Which democratic city?'.
[22] Mead, 'Urban issues: The sprawl of food deserts'.
[23] Deshaies, 'La transition énergétique'.
[24] Concepción et al., 'Impacts of urban sprawl'.
[25] Secchi, 'A new urban question 2'.
[26] European Environment Agency, 'Urban sprawl in Europe. Joint EEA-FOEN Report', 26–8.
[27] Vlaamse Milieumaatschappij, 'Kosten Voor Riolering'.
[28] Vlaamse Milieumaatschappij, 'Zuiverings- En Rioleringsgraad in Vlaanderen (1992–2022)'. SR = the ratio of the number of dispersed residents to the total population of a municipality; PR = the ratio of the total number of inhabitants connected to a sewage-treatment plant to the total number of inhabitants of the municipality.
[29] Riolering, Nu, *Pano*.
[30] Vermeiren et al., 'Monetariseren van de Impact van Urban Sprawl'.
[31] Moens, 'Belgium's company car conundrum'.
[32] Febiac, *Analyse van de Belgische Automarkt in 2021*.
[33] Vermeiren et al., 'Monetariseren van de Impact van Urban Sprawl'.
[34] Van Broeck, 'Expertenadvies Sensibilisering Bouwcultuur'.
[35] Allen, 'Environmental planning and management of the peri-urban interface'.
[36] Hallegatte, Rentschler and Rozenberg, *Lifelines*.
[37] De Block, 'Designing the nation'; Peleman, 'The quest for the good road'; De Decker, 'Ruimtelijke verrommeling à la belge'.
[38] Van Acker, *From Flux to Frame*, 418.
[39] Cassini and Cassini, 'Cassini map'; Ferraris, 'Ferraris map'; Vandermaelen, 'Vandermaelen map'; Österreichisches Staatsarchiv, 'Topographic map of France'; Militair Geografisch Instituut, 'Topographic map of Belgium'; Institut géographique national, 'SCAN 50 Historique'; OpenStreetMap, www.openstreetmap.org.
[40] Cavalieri and Viganò, *HM – the Horizontal Metropolis*.
[41] Leemans et al., *Eurometropolis*.
[42] De Meulder et al., *Metamorfosen*, 21; author's translation.
[43] De Block, 'Designing the nation'; De Block and Polasky, 'Light railways'.
[44] Rowntree, *Land and Labour*, 301.
[45] De Decker, 'Ruimtelijke verrommeling à la belge'.
[46] De Block, 'Planning rural-urban landscapes'
[47] INRIX, 'Traffic Scorecard 2015'.
[48] Gheysen and Leemans, 'Change in the dispersed territory'.
[49] Ferraris, 'Ferraris map'.
[50] Dehaene, *Tuinieren in het stedelijk veld*.
[51] Demasure, 'De industriële ontwikkeling in Midden- En Zuid-West-Vlaanderen'.

https://doi.org/10.14324/111.444.amps.2023v26i1.001

[52] Leemans et al., 'Mapping lifelines'.
[53] Cattoor et al., *Figures, Infrastructures*.
[54] Stad Kortrijk, *Paarden in de Heulebeek*.
[55] De Block and Polasky, 'Light railways'; De Block, 'Planning rural-urban landscapes'.
[56] Jacobs, 'De uitdaging van de mobiliteit'.
[57] Verachtert et al., 'Ontwikkelingskansen'.
[58] De Meulder et al., 'Patching up the Belgian urban landscape'.
[59] Vermeiren et al., 'Monetariseren van de Impact van Urban Sprawl'.
[60] Demasure, 'De industriële ontwikkeling in Midden- En Zuid-West-Vlaanderen'.
[61] Secchi, 'La nuova questione urbana'; Secchi, 'A new urban question 3'.
[62] Van Acker, *From Flux to Frame*.
[63] Webber, 'The urban place and the nonplace urban realm'.
[64] Allen, 'Environmental planning'.
[65] Vlaamse Landmaatschappij, 'Ledegem Wordt L'Eaudegem'.
[66] European Commission and Directorate-General for Environment, 'Environmental Implementation Review 2022'.
[67] Team Milieu-Integratie Infrastructuur, Departement LNE and Grontmij Vlaanderen nv, 'Leidraad Natuurtechniek'; Delbaere, 'La forêt linéaire'.

Funding

The research published in this article was financially supported by KU Leuven and the Research Foundation Flanders (FWO), grant number 1103522N.

Declarations and conflicts of interest

Research ethics statement

Not applicable to this article.

Consent for publication statement

Not applicable to this article.

Conflicts of interest statement

The authors declare no conflicts of interest with this work. All efforts to sufficiently anonymise the authors during peer review of this article have been made. The authors declare no further conflicts with this article.

References

Allen, Adriana. 'Environmental planning and management of the peri-urban interface: Perspectives on an emerging field'. *Environment and Urbanization* 15, no. 1 (2003): 135–48 [CrossRef]
Bogart, William T. *Don't Call It Sprawl: Metropolitan structure in the 21st century*. Cambridge: Cambridge University Press, 2006.
Cassini, César-François and Jean-Dominique Cassini. 'Cassini map'. 1/86.400. France. 1744. Accessed 31 August 2023. https://www.geoportail.gouv.fr/donnees/carte-de-cassini.
Cattoor, Bieke, Bruno De Meulder, Peter Mason and Lucy Klaassen. *Figures, Infrastructures: An atlas of roads and railways*. Amsterdam: SUN Architecture, 2011.
Cavalieri, Chiara and Paola Viganò. *HM – the Horizontal Metropolis: A radical project*. Zurich: Park Books, 2019.
Concepción, Elena D., Martin K. Obrist, Marco Moretti, Florian Altermatt, Bruno Baur and Michael P. Nobis. 'Impacts of urban sprawl on species richness of plants, butterflies, gastropods and birds: Not only built-up area matters'. *Urban Ecosystems* 19, no. 1 (2016): 225–42. [CrossRef]

Corboz, André. 'Vers la ville-territoire'. In *Sonderdruck Aus Ergänzungen Ergebnisse Der Wissenschaftlichen Tagung Anlässlich Der Einweihung Des Ergänzungsbaus Der Hochschule St. Gallen*, edited by Matthias Haller, Heinz Hauser and Roger Zäch, 631–5. Bern and Stuttgart: Verlag Paul Haupt, 1990.

De Block, Greet. 'Designing the nation: The Belgian railway project, 1830–1837'. *Technology and Culture* 52, no. 4 (2011): 703–32 [CrossRef]

De Block, Greet. 'Planning rural-urban landscapes: Railways and countryside urbanisation in South-West Flanders, Belgium (1830–1930)'. *Landscape Research* 39, no. 5 (2014): 542–65 [CrossRef]

De Block, Greet and Janet Polasky. 'Light railways and the rural–urban continuum: Technology, space and society in late nineteenth-century Belgium'. *Journal of Historical Geography* 37, no. 3 (2011): 312–28. [CrossRef]

De Decker, Pascal. 'Ruimtelijke verrommeling à la belge: Zit Alfred De Taeye terecht in de beklaagdenbank?' [Urban sprawl à la belge: Is Alfred De Taeye rightly in the dock?]. *Ruimte* 45 (2020): 78–81.

De Meulder, Bruno, Steven Hoornaert, Karina Van Herck and Bieke Cattoor. *Metamorfosen, een ruimtelijke biografie van de regio Kortrijk*. [Metamorphoses, a spatial biography of the Kortrijk region]. Brussels: Intercommunale Leiedal & Dexia, 2010.

De Meulder, Bruno, Jan Schreurs, Annabel Cock and Bruno Notteboom. 'Patching up the Belgian urban landscape'. *OASE Journal for Architecture*, no. 52 (1999): 78–113.

Dehaene, Michiel. *Tuinieren in het stedelijk veld [Gardening in the Urban Field]*. Ghent, Belgium: A&S/Books, 2013.

Delbaere, Denis. 'La forêt linéaire: Un paysage en projet pour l'Eurométropole Likoto'. [The linear forest – A landscape in the making for the Likoto Eurometropolis]. *Projets de Paysage*, no. 22 (2020). [CrossRef]

Demasure, Brecht. 'De industriële ontwikkeling in Midden- En Zuid-West-Vlaanderen (1890–1950). Een sectorale analyse aan de hand van industrietellingen'. [Industrial development in Central and South-West Flanders (1890–1950). A sectoral analysis based on industry censuses]. *Handelingen van Het Genootschap Voor Geschiedenis* 148, no. 2 (2011): 427–66. [CrossRef]

Deshaies, Michel. 'La transition énergétique offre-t-elle de nouvelles potentialités aux bassins d'exploitation du charbon et du lignite en Allemagne ?' [Does the energy transition offer new potential for coal and lignite mining areas in Germany?] *Bulletin de l'association de géographes français* 93, no. 1 (2016): 46–61. [CrossRef]

European Commission and Directorate-General for Environment. 'Environmental Implementation Review 2022. Country Report – BELGIUM'. In *Environmental Implementation Review (EIR)*. Brussels: European Union, 2022. Accessed 31 August 2023. https://environment.ec.europa.eu/law-and-governance/environmental-implementation-review_en.

European Environment Agency. 'Urban Sprawl in Europe. Joint EEA-FOEN Report'. EEA Report. Copenhagen and Bern: European Environment Agency & Swiss Federal Office for the Environment, 2016. Accessed 31 August 2023. https://www.eea.europa.eu/publications/urban-sprawl-in-europe.

European Environment Agency. *Urban Sprawl in Europe: The ignored challenge*. Copenhagen and Luxembourg: European Environment Agency and Office for Official Publications of the European Communities, 2006. Accessed 31 August 2023. https://www.eea.europa.eu/publications/eea_report_2006_10/eea_report_10_2006.pdf/view.

Febiac. *Analyse van de Belgische Automarkt in 2021 [Analysis of the Belgian Car Market in 2021]*. Brussels: Febiac, 2022. Accessed 31 August 2023. https://www.febiac.be/public/pressreleases.aspx?ID=1398&lang=NL.

Ferraris, Joseph de. 'Ferraris map'. 1/11,520. Austrian Netherlands: Royal Library of Belgium (KBR), 1778 1771. Accessed 31 August 2023. https://www.kbr.be/nl/projecten/kaart-van-ferraris/.

Gheysen, Maarten. 'Unlocking the Potential of Collective Spaces in All City/All Land'. Doctoral dissertation, KU Leuven, Leuven, Belgium, 2020.

Gheysen, Maarten. 'Which democratic city?' In *Racines Modernes de la Ville Contemporain*, edited by Panos Mantziaras and Paola Viganò, 87–103. Geneva: MetisPresses, 2019.

Gheysen, Maarten and Sophie Leemans. 'Change in the dispersed territory: (Proto)Types for a new urban paradigm'. *Urban Planning* 8, no. 1 (2023). [CrossRef]

Gheysen, Maarten, Kris Scheerlinck and Erik Van Daele. 'Opposing oppositions, All City/All Land'. *MONU*, no. 26 (2017): 62–67.

Gheysen, Maarten and Erik Van Daele. 'All City/All Land, Collectivity and Landscape as Design Strategies'. Presented at 'Beyond -ism, the landscape of landscape urbanism', Malmö, Sweden, 19–21 October 2016.

Gheysen, Maarten, Erik Van Daele and Kris Scheerlinck. 'Alles Stad/Alles Land, ontwerpend onderzoek voorbij de tegenstellingen'. [All City/All Land, designing research beyond the contradictions]. *Ruimte* 40 (2019): 32–5.

Grosjean, Bénédicte. 'Wallonie picarde: La construction d'un territoire'. [Wallonia Picardy: The construction of a territory]. In *Guide d'architecture moderne et contemporaine 1899–2017. Tournai & Wallonie Picarde*. edited by Charlotte Lheureux and Bernard Wittevrongel, 13–35. Brussels: Mardaga, 2017.

Hallegatte, Stephane, June Rentschler and Julie Rozenberg. *Lifelines: The resilient infrastructure opportunity*. Sustainable Infrastructure Series. Washington, DC: World Bank Group, 2019.

IGN France (Institut national de l'information géographique et forestière). 'SCAN 50 historique'. 1/50.000. France. 1950. Accessed 31 August 2023. https://geo.data.gouv.fr/fr/datasets/73701883657fbdadd3ebb421f5b383a81be2fdf4.

Immoweb sa/nv. 'Real Estate Prices in Belgium'. Interactive map. Immoweb.be. 2022. Accessed 31 August 2023. https://price.immoweb.be/en.

Indovina, Francesco, F. Matassoni and M. Savino. *La Città Diffusa*. Venice: DAEST-IUAV, 1990.

INRIX. 'Traffic Scorecard 2015'. Accessed 31 August 2023. https://inrix.com/wp-content/uploads/2016/11/INRIX_2015_Traffic_Scorecard.pdf.

Jacobs, E. 'De uitdaging van de mobiliteit: Een aktueel probleem'. [The challenge of mobility: A timely problem]. *West-Vlaanderen Werkt*, no. 4 (1976): 154–9.

Leemans, Sophie, Maarten Gheysen, Erik Van Daele, Chiara Cavalieri and Bénédicte Grosjean, eds. *Eurometropolis: A blue space in transition*. Ghent: KU Leuven Faculty of Architecture, 2022.

Leemans, Sophie, Micaela del Puerto Fernandez, Tessa Hulsmans, Ar-tit Markshom, Maureen Piers and Yamina Sommereyns. 'Mapping lifelines and tracing tendencies in the dispersed city – ATLAS'. unpublished internal document, KU Leuven, Ghent, 2021.

Mead, M. Nathaniel. 'Urban issues: The sprawl of food deserts'. *Environmental Health Perspectives* 116, no. 8 (2008): A335. [CrossRef] [PubMed]

Militair Geografisch Instituut. 'Topographic Map of Belgium'. 1/25,000. Belgium: NGI/IGN Belgium, 1969.

Moens, Barbara. 'Belgium's company car conundrum'. Politico.Eu. 3 December 2021. Accessed 31 August 2023. https://www.politico.eu/article/belgium-company-car-conundrum/#:~:text=The%20company%20car%20has%20long,zero%2Demission%20cars%20after%202026.

Neutelings, Willem Jan. *Patchwork Metropolis*. Rotterdam: Maaskant Foundation – 010 Publishers, 1990.

Österreichisches Staatsarchiv. 'Topographic Map of France'. France: Arcanum Adatbázis Kft. 1836. Accessed 31 August 2023. https://maps.arcanum.com/en/map/france-1836.

Peleman, David. 'The quest for the good road: A short history of road infrastructure and the public sphere in Belgium'. In *Infrastructural Urbanism: Addressing the In-Between*, edited by Thomas Hauck, Regine Keller, and Volker Kleinekort, 203–15. Berlin: DOM Publishers, 2011

Riolering, Nu [Sewerage, Now]. *Pano*, vrt. 4 November 2020. Accessed 31 August 2023. https://www.vrt.be/vrtnws/nl/2020/11/04/live-pano/.

Rowntree, Benjamin Seebohm. *Land and Labour: Lessons from Belgium*. London: Macmillan, 1910.

Secchi, Bernardo. 'A new urban question 2'. Presented at the Swiss Spatial Sciences Framework Symposium (S3F), Zurich, Switzerland, 18 November 2009.

Secchi, Bernardo. 'A new urban question 3: When, why and how some fundamental metaphors were used'. In *Metaphors in Architecture and Urbanism: An introduction*, edited by Andri Gerber and Brent Patterson, 123–33. Bielefeld: transcript Verlag, 2013. Accessed 31 August 2023. https://www.transcript-verlag.de/chunk_detail_seite.php?doi=10.14361%2Ftranscript.9783839423721.123.

Secchi, Bernardo. 'La nuova questione urbana: ambiente, mobilità e disuguaglianze sociali'. [The new urban question: Environment, mobility and social inequalities]'. *Crios*, no. 1 (2011): 83–92. Accessed 31 August 2023. https://www.rivisteweb.it/doi/10.7373/70210.

Secchi, Bernardo and Paola Viganò. *Habiter le grand Paris*. Paris: Atelier international du grand Paris, 2013.

Sieverts, Thomas. *Zwischenstadt: zwischen Ort und Welt, Raum und Zeit, Stadt und Land [In-between City: Between place and world, space and time, city and countryside]*. 3. Bauwelt-Fundamente Stadtplanung/Urbanisierung 118. Braunschweig: Vieweg, 1999.

Stad Kortrijk. *Paarden in de Heulebeek [Horses in the Heulebeek]*. Picture. 1906. Accessed 31 August 2023. https://beeldbank.kortrijk.be/erfgoed/index.php/image/watch/a0e2e060b9754cb08f259cc1a36baec615e37538dca840ac9ce45eab95114563556b6dd5a3bf4ec78cb79eef93eddd5b?s=642042a4a20be&c=1.

Studio 010, Bernardo Secchi and Paola Viganò. 'Bruxelles et ses territoires: Plan régional de développement durable. Elaboration d'une vision territoriale métropolitaine à l'horizon 2040 pour Bruxelles'. [Brussels and its territories. Regional plan for sustainable development. Drawing up a metropolitan territorial vision for Brussels by 2040]. Brussels, 2012. Accessed 31 August 2023. https://stedenbouw.irisnet.be/pdf/studio010.

Team Milieu-Integratie Infrastructuur, Departement LNE and Grontmij Vlaanderen nv. 'Leidraad Natuurtechniek. Ecologisch Bermbeheer'. [Guideline on natural technology. Ecological verge management]. In *Guideline*. Brussels: Departement Omgeving – Afdeling Partnerschappen met besturen en maatschappij, 2015.

Thévenin, Thomas, Robert Schwartz and Loïc Sapet. 'Mapping the distortions in time and space: The French railway network 1830–1930'. *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 46, no. 3 (2013): 134–43. [CrossRef]

Van Acker, Maarten. *From Flux to Frame: Designing infrastructure and shaping urbanization in Belgium*. Leuven: Leuven University Press, 2014.

Van Broeck, Leo. 'Expertenadvies Sensibilisering Bouwcultuur En Ruimtelijk Rendement'. [Expert Advice to Raise Awareness of Building Culture and Spatial Efficiency]. Study report. Vlaamse Overheid – Ruimte Vlaanderen. 2014. Accessed 4 September 2023. https://archief.onderzoek.omgeving.vlaanderen.be/Onderzoek-1822290.

Vandermaelen, Philippe. 'Vandermaelen map'. 1869 1795. 1/20,000. Accessed 31 August 2023. https://www.kbr.be/nl/projecten/de-cartotheek-van-philippe-vandermaelen/.

Vanhaverbeke, Wim, Jan Larosse and Wouter Winnen. 'The Flemish frozen-vegetable industry as an example of cluster analysis: Flanders vegetable valley'. In *Pathways to High-Tech Valleys and Research Triangles: Innovative Entrepreneurship, Knowledge Transfer and Cluster Formation in Europe and the United States*, edited by Willem Hulsink and Hans Dons, 249–74. Dordrecht: Springer, 2008. Accessed 4 September 2023. https://library.wur.nl/ojs/index.php/frontis/article/view/1569.

Verachtert, Els, Inge Mayeres, Lien Poelmans, Maarten van der Meulen, Marie Vanhulsel and Guy Engelen. 'Ontwikkelingskansen Op Basis van Knooppuntwaarde En Nabijheid Voorzieningen – Eindrapport'. [Development Opportunities Based on Nodal Value and Proximity of Facilities – Final Report]. Study report. Vlaamse Instelling voor Technologisch Onderzoek. 2016. Accessed 4 September 2023. https://archief.onderzoek.omgeving.vlaanderen.be/Onderzoek-1827504.

Vermeiren, Karolien, Lien Poelmans, Guy Engelen, Steven Broekx, Carolien Beckx, Leo De Nocker and Karolien Van Dyk. 'Monetariseren van de Impact van Urban Sprawl in Vlaanderen' [Monetising the Impact of Urban Sprawl in Flanders]. Study report. Brussels, 2019. Accessed 4 September 2023. https://archief.onderzoek.omgeving.vlaanderen.be/Onderzoek-1834057.

Vlaamse Landmaatschappij. 'Ledegem Wordt L'Eaudegem. Lancering Eerste Water-Land-Schap 2.0 Project' [Ledegem Becomes L'Eaudegem. Launch of the First Water-Land-Scape 2.0 Project], Vlaamse Landmaatschappij, 2022. Accessed 31 August 2023. https://pers.vlm.be/s/177aeb73-e7e2-4469-af38-19c5e430f29d.

Vlaamse Milieumaatschappij. 'Kosten Voor Riolering – Een Blik Vooruit' [Costs for Sewerage – A Look Ahead]. Study report. Vlaamse Milieumaatschappij, 2018. Accessed 31 August 2023. https://www.vmm.be/publicaties/kosten-voor-riolering-een-blik-vooruit#:~:text=Voor%20de%20volledige%20uitbouw%20van,opzichte%20van%20het%20huidige%20inkomstenniveau.

Vlaamse Milieumaatschappij. 'Zuiverings- En Rioleringsgraad in Vlaanderen (1992–2022)' [Purification and Sewage Rate in Flanders (1992–2022)]. Database. Vlaamse Milieumaatschappij. 2022. Accessed 31 August 2023. https://www.vmm.be/water/riolering/zuiveringsgraad.

Wandl, Alexander. *Territories-in-between: A cross-case comparison of dispersed urban development in Europe*. A+BE Architecture and the Built Environment. Delft: BK Books, 2020.

Webber, Melvin M. 'The urban place and the nonplace urban realm'. In *Explorations into Urban Structure*, edited by Melvin M. Webber, 79–153. Philadelphia: University of Pennsylvania Press, 1964. [CrossRef]