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Sustainable urban rail integration: the case of the city of Maastricht

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Abstract

Rail integration in the urban setting of medium-sized border cities, as in the case of the old medieval town of Maastricht with its relatively small city centre, raises many challenges. The physical space occupied by underutilized rail tracks in the centre of the city is huge, occupying proportionally a substantial part of the centre city's surface. The "urban rail integration" proposal detailed here can be considered an example of how to implement sustainable mobility transformation in medium to small cities. Up to now, large cities have taken the lead in implementing European Green Deal goals such as decarbonization, renewable energy transformation and circular economy. A smaller city such as Maastricht can add to this "large city" lead in sustainable development by focusing on what is specific, one could say unique, to its own urban development potential: in this case, the particular large availability of so-called non-descript rail space in the centre of the city offering a unique opportunity for sustainable urban rail integration. How to monetize the advantages of such integration is a discussion which takes place in many medium sized cities in Europe. In large cities, the pressure of the densely populated areas in the city is such that rail integration proposals find relatively easily public policy support, even if the complexity in carrying out such urban rail integration involves complex infrastructural interventions. In medium sized cities, the necessity of these more radical interventions is no longer led by rail mobility demand, rather it will have to emerge out of alternative, local funding mechanism such as leaseholds. Maastricht represents an ideal example for such situations.

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Introduction

Much like other historic European cities, the city of Maastricht, situated on the border between Belgium's two core regions: Flanders and Wallonia; and made famous following the signing of the European Treaty on the Economic and Monetary Union in 1992, is characterized by distinctive fault lines all crossing the city from the south to the north in a western and eastern side of the city.

First and foremost, there is nature's fault line: the river Meuse ("Maas" in Dutch) that bisects the city in half and gave Maastricht its name[3]. It is the natural fault line that has shaped the history of the city over the past 2000 years. The flow of water is swifter through Maastricht than through any other Dutch city, symbolizing as it were the dynamic pulse of city life in Maastricht. During periods of hot weather, the Meuse River acts as a natural air conditioning system: a breath of fresh air[4]. Crossing the middle of the city, the river has given the city, like its upstream sister city Liège, a metropolitan charm with two separate urban parts: a left bank and a right bank[5]. The area on the left bank confined between the river and the border represents the city frontier of the Netherlands with Belgium which was established by an earlier Treaty of Maastricht dated 1843. That Treaty stipulated that the Netherlands' country boundary would extend to the range of a cannon shot fired from the city walls of Maastricht: 1,200 fathoms or 2.3 km. The right bank is not clamped and part of the most southern region of the Netherlands: Southern Limburg's "Heuvelland".

The second, historically developed fault line is that of railroad tracks cutting Maastricht's right bank into a western part squeezed between the river and the rail tracks and an eastern part linked to the rest of Southern Limburg. From an aerial perspective and as illustrated in Figure 1, the large amount of rail tracks in Maastricht resembles a river delta as if a "railroad river" coming from the mountainous southern neighbourhood of Wallonia had spread into a "rail delta" starting at Maastricht's Central Station and extending across the northern section of Maastricht's right bank.

***Figure 1*: Areal view of Maastricht's city centre**

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[3] As Wikipedia puts it: "The place name *Maastricht* is an Old Dutch compound *Masa-* (> *Maas* "the Meuse river") + Old Dutch **treiekt*, itself borrowed from Gallo-Romance *TRA(I)ECTU cf. its Walloon name *li trek*, from Classical Latin *trajectus* ("ford, passage, place to cross a river") with the later addition of *Maas* "Meuse" to avoid the confusion with the *-trecht* of Utrecht having exactly the same original form and etymology. The Latin name first appears in medieval documents and it is not known whether **Trajectu(s)* was Maastricht's name during Roman times." https://en.wikipedia.org/wiki/Maastricht

[4] See Jelmer Visser, Maastricht has the most heat stress-resistant inner city in the Netherlands, 22 October 2022, https://innovationorigins.com/en/maastricht-has-the-most-heat-stress-resistant-inner-city-in-the-netherlands/

[5] For some peculiar reason, local citizens refer to the right bank "Wyck" as the 'left bank'. We stick here to the normal definitions.

As explained in a first section, the huge presence of rail tracks in the centre of Maastricht is not based on any geographic or economic logic but purely the result of historical developments. The current long Maastricht Central station[6] was only built at its current location in 1913, as a combination of a terminal end station for rail tracks coming from the northern and eastern parts of the Netherlands and from the western part: the border Flemish region. These combined rail tracks all ended in Maastricht's Central station. Only two rail tracks would pass through the station going south to the newly, in 1987 constructed Maastricht Randwyck station[7] and further into the Belgian/Wallonia region.

A third fault line, now no longer existing but which was located eastward on Maastricht's right bank and which ran parallel to the rail track, was the N2 highway, which again cut the city in two from North to South. Under pressure of growing congestion on this highway and the particularly unhealthy environment for both children in schools and more broadly residents in neighbouring houses, policy action was taken and in 2016, this highway was upgraded into a full-fledged motorway with a 2,3 km long, two-layer tunnel. It allowed for a doubling in the number of vehicles crossing the city, now underground, and as windfall benefit, freed up the area on top of the tunnel "pasting" both sides of the city and becoming a very popular, new walking and biking green road – the "Groene Loper" – increasing dramatically the quality of housing and schooling in that area.

[6] As if the title and first line of the official hymn of Maastricht also explicitly referred to the peculiar structure of the station: "*Mestreech is neet breid meh Mestreech dat is laangk*" (Maastricht is not wide, but long).
[7] Located on the old station, known before as Halte Heer, created in 1861.

Drawing inspiration from the successful tunnelling of the N2 motorway, we presented in 2021 a city plan vision called "**Across the Tracks**" (Boven het Spoor)[8] which proposed a partial tunnelling of the rail tracks transiting Maastricht Central station southwards. The purpose of our proposal was different though from the tunnelling of the motorway. Not so much increasing rail mobility than "pasting", or "healing" as we put it, the urban seizure caused by the railway tracks south of the station. This initial proposal was dismissed by both the Dutch rail infrastructure company ProRail[9] and local city authorities as being too expensive – total costs were estimated at some €1.4 billion – compared to the relatively limited, if non existing advantages for rail travellers and rail mobility in general. The critique and dismissal of our proposal inspired us nevertheless to reflect on a broader analytical framework dealing more explicitly with sustainable urban rail integration and focusing more, as in the case of Maastricht, on the integration in a sustainable fashion of the old, large **rail delta** space in the centre of a border city. In short, mend 150 years later the disintegration past of urban railroads.

In this sense local urban rail integration resonates closely with European Green Deal aspirations at local level[10]. In large metropolitan cities[11], the physical space pressure has resulted in various initiatives to integrate better the centrally located rail station in the urban city tissue improving at the same time public transport facilities, at the expense of private car mobility. In smaller cities, let alone border cities where urban space is sometimes limited by the physical proximity of the country's border, few such initiatives have been taken. Yet, here too, as Lunardon et al. (2023) argue, the railway station can take on the role of urban connector, generating new public linking areas allowing new social interactions. As noted by these authors: "*The existing practice and theory of station development reflects an insufficient comprehension of the location's contradictory nature... But recently, the literature on urban studies has shifted from the idea of the transport infrastructure as an element that produces discontinuity with the urban tissue to an infrastructure that generates places for citizens while still creating urban continuity… railway stations have often fallen in the gap between transport and urban agendas, as well as diverging responsibilities, being overlooked by urban planners and policy makers at local, national, and European level…"*[12]

Our paper presents in other words a pilot case on how to exploit in a mid-sized city the station and its surrounding rail infrastructure as 'urban connector'. We start in section 1 with a historical overview of the

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[8] Coenen, J. and L. Soete (2021), Boven het Spoor: Een Masterplanvisie Stationsgebied Maastricht, see https://cris.maastrichtuniversity.nl/ws/portalfiles/portal/76565488/BB_masterplanspoorzone_2021_definitief2.pdf

[9] See ProRail (2023), Toets haalbaarheid Boven het Spoor: ABC studie Masterplanvisie Stationsgebied Maastricht, 3 juli 2023

[10] See amongst others Schwaag-Serger, Soete and Stierna (2023), The Square: putting place-based innovation policy for sustainability at the center of policymaking, https://s3platform.jrc.ec.europa.eu/en/w/the-square-putting-place-based-innovation-policy-for-sustainability-at-the-centre-of-policymaking

[11] One may think of Vienna or Copenhagen.

[12] Lunardon, A, Vladimirova, D. and B. Boucsein (2023), "How railway stations can transform urban mobility and the public realm: The stakeholders' perspective", *Journal of Urban Mobility*, Vol.3, December, https://doi.org/10.1016/j.urbmob.2023.100047

emergence of railroads in Maastricht. As will become obvious, to understand the current, large physical seizure of space by rail tracks in the centre of a city like Maastricht, history matters. It also explains why, as we argue in section 2, a more radical, urban rail integration process would be welcomed, putting the underutilized rail tracks to use for sustainable urban development and integrating at the same time the divided western and eastern sides of the city. In section 3, we describe briefly the proposed structure of the proposed underground Maastricht Central station. The more technical aspects of our proposal are not detailed here but can be found in formal proposal submission to the city council[13]. Following the critical comments on the huge construction costs of the underground station and rail tracks (estimated at 1 billion euros) compared to the limited rail benefits accruing to rail commuters, we explore in section 4 alternative funding possibilities. The proposed alternative brings us to discuss the possibility for "leasehold" construction as a re-activated sustainable financing instrument for housing in non-descript areas of inner cities such as railyards. Doing so, we present some concrete, practical possibilities for funding the construction of the underground station and the tunnelling of the rail tracks using the annual ground rent revenues. Doing so, the full urban integration of the rail space around Maastricht Central station represents now a realistic opportunity providing a significant amount of additional housing facilities in the centre of the city. In section 5, we reflect on some of the broader opportunities for Maastricht and its central station to become an essential second link for international (high speed) rail connections. Surprisingly, the Netherlands has only one southern cross-border connection with Belgium, namely the Hazeldonk border crossing for all its high-speed train connections to Brussels/Paris/London. From this point of view, the proposal presented in section 3 offers the opportunity to transform Maastricht's Central station to become the Netherlands' second rail window to Europe. In conclusions, we present some broader reflections on how local citizens' initiatives as the one presented here, can contribute to the decision process of local policy makers in developing, new alternative thought on urban planning.

[13] See Coenen and Soete (2025), Across the Tracks 2.0, Implementing sustainable urban rail integration in Maastricht, March 18th, 2025.

1. ***History matters: on the origins of Maastricht's "rail delta"***[14]

The historically grown, **rail delta** in Maastricht represents a typical urban industrial fault line. Characteristic of many old European cities, the industrial railroad revolution of the 19th Century questioned the previous urban development process of continuously expanding city walls which had traditionally been considered essential from an urban security perspective. Furthermore Maastricht, as old medieval military city, became now in the early 19th Century quite suddenly positioned as a Dutch border city and as the regional capital of the province of Limburg which only became much later part of the Netherlands.

The story of Maastricht's current Central Station is from this perspective one of moving places over the last two centuries. One of gradually moving southwards – one could say upstream from the perspective of the current **rail delta** – reflecting how the rail developments in the Netherlands, and in Maastricht in particular, lagged behind that of the two neighbouring countries: Belgium and Germany. Maastricht became even connected with both the Belgian (Hasselt and Liège) and German (Aachen) railway infrastructure before it became connected to the Dutch railway network. The development in Southern Limburg of railways and freight transport in this later phase was intricately tied to that of the mines and coal transport.

Belgium had already established an extensive railway network driven by the impossibility for Belgian river vessels, following the break with the Netherlands in 1830, to use the Dutch waterways any longer which were essential for the port of Antwerp, now cut off from the German hinterland. It was therefore no surprise that it was a predominantly foreign (German) company, the Aachen-Maastrichtsche Spoorweg-Maatschappij (AM) which received the first Southern Limburg railway concession in 1846. The aim was to create a connection between Antwerp and the German industrial area by constructing a Maastricht - Aachen railroad line via Simpelveld.

Since Maastricht was a fortified city with a strong military presence, something which had proven its value following the Belgian independence war, it was an absolute given that the city walls of Maastricht would not be breached. So, the railway station was projected outside the city limits on the right bank of the Maas to the northeast of the Wyck district: the Wijckerveld. For the AM company, the huge costs of constructing a rail track through Southern Limburg because of the significant height differences combined with the company's limited financial resources, meant that the concession application had to be renewed several times before construction eventually started. As a result, the construction of the first Maastricht station only started in 1852. The first train to Aachen ran on October 20, 1853, and the station was completed a year later. In the same year 1853, the Belgian government granted the same AM company the concession for the construction of a railway line between Hasselt and Maastricht. The AM inaugurated the railroad in October 1856. Around the same time, a discussion arose again about the location of the terminal station in Maastricht of the new railway line coming from Hasselt, given the fact that the railway line ran much

[14] Information in this section is based among others on Wikipedia (https://nl.wikipedia.org/wiki/Station_Maastricht), the "Geschiedenis spoorwegen Zuid-Limburg" (https://www.railgoed.nl/historie-13.html) and Spoortijdlijn (https://www.spoortijdlijn.nl/).

closer to Maastricht's left bank city centre and that a bridge over the Meuse was expensive. So, a new second station was built on the left bank: Maastricht Boschpoort.

The first Maastricht station built by the AM company with trains coming from Aachen had only just opened, but it quickly appeared that it was located in a rather inconvenient place. So, following the new line from Hasselt, the station was moved a few hundred meters further south, just east of the Wyck district, from where the new rail line to Hasselt could also be laid in a large arc north around Maastricht's city walls. So, construction of a railway bridge over the Maas did start in 1854 and on October 1, 1856, the Maastricht - Hasselt line was opened. Unfortunately, because the expected transit traffic was not forthcoming, the AM company, like many other railway companies at that time, found itself in dire financial straits.

In 1861, the Liège-Maastricht Railway Company opened a railway line to the south. It required the railway yard at Wyck to be expanded further to the south. The operation was now overseen by Grand Central Belge (GCB), which utilized the same station in Maastricht as AM. As AM continued to struggle with its financial viability it was taken over in 1867 by the Société Anonyme de Chemins de fer d'Anvers à Rotterdam (AR), which fell under the management of GCB. The takeover gave GCB management now the entire route from Antwerp to Aachen, as well as the rail route from Maastricht to Liège[15]. With the arrival of GCB, passenger transport was increased to five trains per day to Aachen and four to Hasselt. Freight transport was concentrated around Boschpoort station and the railway port on the Meuse. In short Maastricht became first connected by railroads to both Germany, Flanders and Wallonia.

It was only in 1860 that Dutch politicians started to recognize the importance of good rail connections. So, in 1865 the first Limburg northern Venlo - Maastricht state line E, operated by the State Railways Exploitation Company (de Staats Spoorwegen) was constructed. The municipality was tasked to build the station, and another, new, second station southeast of the existing one was completed a year later, on the eastern side of the existing ones. Once again, history repeated itself as the station appeared particularly poorly positioned, situated to the east "behind" the existing tracks to the south. As a result, the Maastricht - Aachen and Maastricht - Liège railway lines did not directly connect to this new Maastricht - Venlo railway line. Passengers who wanted to switch from one railway line to another had to transfer to the other station.

Finally in 1898, the operation of all railways in Limburg was taken over by the Staats Spoorwegen. This led to the construction of one Maastricht station making a direct transfer between Maastricht - Aachen and Maastricht - Eindhoven possible. The new Maastricht station was also the first station in the 20th century

[15] In 1864, several private Belgian railway companies started working together under the name Chemins de fer Grand Central Belge (GCB). In 1867, the GCB also took over the operation of the Landen – Maastricht – Aachen railway line, providing a short direct train connection between Antwerp and Aachen. However, in the following years the railway company constructed also the so-called "Iron Rhine" lining Antwerp to the German Ruhr area and preferred the new connection via Weert and Roermond. Through the new Iron Rhine connection, freight trains no longer had to stop in Maastricht.

that was designed not only as a terminal station, but also as a station for through train traffic. The current Maastricht Central train station was officially opened on October 18, 1915[16].

In short, the “rail delta” on Maastricht's right bank, marked by a substantial number of rail tracks north of the station that narrows to just two tracks south of the station, is the outcome of the intricate history surrounding the construction of end stations for railway lines. Subsequently, these locations were found to be less than optimal for the easy interconnectivity of rail transport. It led to a gradual movement southwards of Maastricht’s central station once the city walls were dismantled.

[16] http://www.postvalkenburg.nl/stations.htm

2. ***Urban rail integration: activating “non-descript” space in cities’ centres.***

For most large cities, the location of railway stations in the centre of the city, presents today a unique opportunity for sustainable urban development. Particularly for higher education establishments, but also for offices of (large) companies, for public institutions such as courts, involving each a lot of mobility, the proximity nearby a centrally located station represents an opportunity for the more intensive use of public transport of its employees, students, and clients.

In the case of Maastricht, being a provincial capital with only a couple of headquarters of large companies and, serving as a higher education city both a university and a high school along with large numbers of foreign students and education facilities in neighbouring cities such as Heerlen and Sittard, the proximity to Maastricht Central station represents particularly from the perspective of public rail transport, a significant, underutilized opportunity. Interestingly, the locational advantages of the more recently built, more southwards located, Maastricht Randwyck station[17], were quickly realized both for university students and for patients and staff from the nearby Academic Hospital (MUMC+). One of the main reasons for Maastricht’s Central station having failed to fully exploit this opportunity, is the large amount of physical space taken by the widespread rail track delta in the midst of the city’s centre: in total some 20 hectares. At the same time, the narrower, double rail track barrier to the south of Maastricht Central station, prevents any further integration of the new, popular so-called “Groene Loper” as green mobility track for bikes and pedestrians towards the western parts of Maastricht’s right bank and in particular allowing for quick and easy connectivity with the Céramique and Wyck city areas.

An alternative allocation of the space seized by the large number of rail tracks at Maastricht’s Central Station and the rail delta north of the station corresponds from this perspective to a much-needed new phase of sustainable urban development of Maastricht’s right bank. Given the shortages of space for new housing, there are, also in Maastricht, major trade-offs emerging between citizens’ desire for more green space in and around old and newly constructed buildings and housing associations and building firms’ economic inclination to exploit available building space to the maximum. The result is often reflected in fights and disagreements between the building plans of real estate companies trying to satisfy the local government’s rules and regulations concerning minimum social housing space or maximum building heights and local citizens who feel that the existing quality of living in the relatively small urban centre of the city of Maastricht, is being undermined.

In terms of urban mobility, the large volume of railroads and rail tracks within Maastricht's urban city centre not only bisects the city but also represents a substantial physical occupation of urban, so-called “non-descript” space on Maastricht's right bank as depicted in Figure 1. The large availability of such a “non-descript” rail area in the vicinity of Maastricht’s Central Station provides from this perspective a unique opportunity for urban development. Leaving it as it currently is: an underutilized parking space for rail carriages appears under the present circumstances of major housing needs in the Netherlands, irresponsible. Furthermore, in the context of the need for better access to public transport to Maastricht’s

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[17] Again, with hindsight constructed too much in the northern direction. A more southward location would allow for a direct connection to the MUMC+ and the FHML of the UM.

urban city centre, the large physical barrier presented by the large number of underutilized rail tracks, can also no longer be justified.

***Figure 2*: Maastricht's inner city rail delta**

Hence, the focus in this pilot on a ***Sustainable Urban Rail Integration*** in the city of Maastricht.

For any rail infrastructure company such as the Dutch ProRail company, any alternative use of the rail tracks, will of course not represent an interesting option. On the contrary, ProRail's strategic interest will consists in maintaining a large parking space for rail carriages to serve its Dutch clients. In the case of Maastricht: the Dutch national railway company Nederlandse Spoorwegen (NS) and the regional railway company Arriva. Over the years, the historically grown "rail delta" in Maastricht has even become a local competitive advantage for the maintenance and cleaning of rail carriages even if those, as in the case of the NS Stopping trains are not even in service in Maastricht but only used 80 kilometres further north for the connection between Weert and Tilburg University. From this perspective, ProRail's strategy will consist of trying to maintain the available existing rail track space in Maastricht, even if it is underutilized.

Benefits of any further urban development around the station or of what we have called the "**healing**" of the rail barrier between the eastern and western parts of Maastricht's right bank will primarily accrue to the city and the neighbourhoods around the station, far less to any of the rail commuters. The latter would undoubtedly benefit from additional Intercity train connections between e.g. Maastricht and Brussels but these could be carried out with the existing rail infrastructure.

3. ***Towards an international, underground Maastricht Central Station***

The details of the proposal for an underground Maastricht Central station can be found in the earlier detailed submission report to the Maastricht City Council (B&W) "Across the Rail Tracks 2.0"[18]. In an Annex we present the main figures of the different phases of construction as well as the final outcome.

Here we just summarize the main features of the proposal for bringing the rail tracks and the central station underground. The total area of the rail yard and rail tracks crossing Maastricht is about 269K square yards. Obviously, large infrastructural projects, as the one described here, are likely to involve significant disruptions over a long period. However, there are also possibilities to avoid parts of these disruptions by carefully planning the works in a stage fashioned way. Ultimately, the aim of the operation is to reduce above ground rail transport movements bringing to life the urban ground level around Maastricht's Central station. Despite the huge investment in the tunneling of the N2 motorway into a two-level underground A2-highway, the access e.g. of the new pedestrian and biking "Groene Loper" on top of the highway to the nearby central railway station was largely ignored.

The proposal described here is to "heal" the main remaining discontinuities in Maastricht's city centre and allow the urban fabric of the surrounding parts of Maastricht's station to grow together and become further densified. The different phases can be summarized as follows:

- The **first phase** involves the construction of a new underground Maastricht Central Station on the most eastern border side of the rail track currently used as a four-rail carriage parking space. One could include, if need be, the adjacent bus and car parking space acquired some years ago by the city of Maastricht for the construction of a kiss and ride parking space including the stopover for international buses. Doing so, the current iconic station building of Maastricht will lose its station function and can now be used for other purposes. North of the proposed underground station, there is sufficient space to build a lengthy downward slope for four rail tracks to the underground station. All these construction activities can be carried out without any major disturbances to current rail mobility.

  The construction costs of the underground station will be significantly reduced by combining it with the construction above the new underground station of offices and residential properties. The ground floor will function as entry to the new central hall of the underground station with escalators taking train passengers to the underground rail platforms. Contrary to the case of the Delft station, the underground station will consist of only one underground level directly accessible from the ground level entrance. While building above a railroad is legally still in its infancy and involves additional safety specifications, these can be introduced at the outset and as

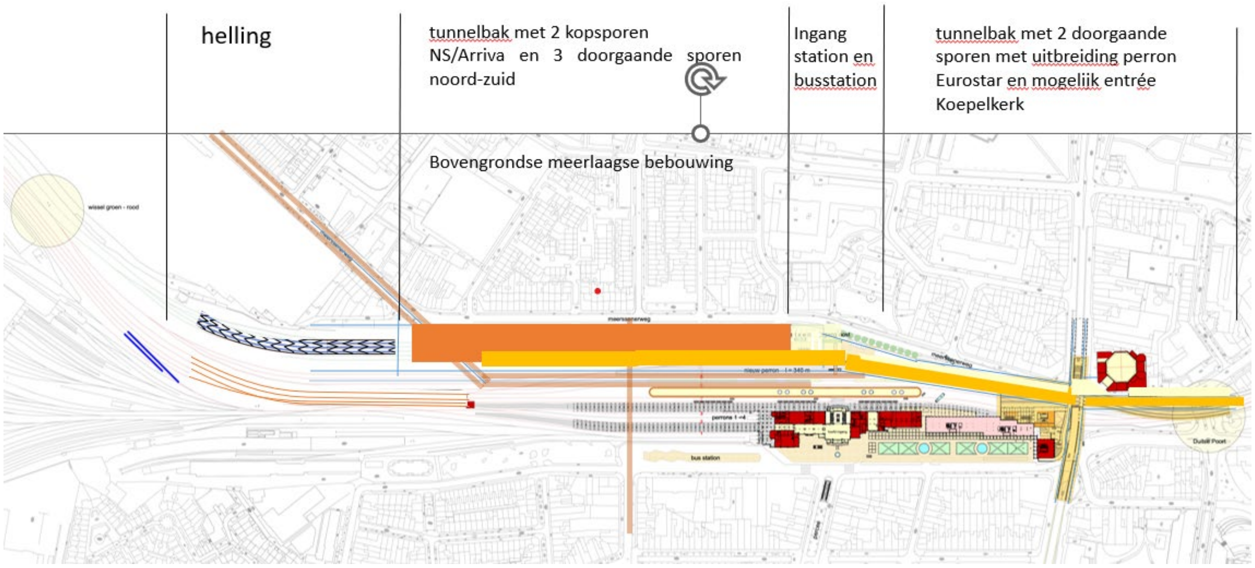
[18] See Coenen, J. and L. Soete (2025), Around the Tracks 2.0: Implementing sustainable urban rail integration in Maastricht, March 18, mimeo

result reduce actual construction costs significantly by combining the two building projects. At the same time the physical pressure of the building on the underground tunnel box will have a positive impact on the stability of the latter.

The precise filling in of the underground station is open for discussion with the different train operating companies (NS, Arriva, NMBS). In its most simplified form, it is suggested that the underground station consists of four rail tracks leading to five/six platforms for trains to allow passengers to get on and off the train. As is the case today, one could also imagine that two of the rail tracks terminate in Maastricht and are earmarked for the fast intercity connections currently operated by Dutch railroad company NS. These intercity trains currently use platforms 1, 2 and 3. The underground rail platforms earmarked for the tracks continuing underground southwards would be used for the regional and international train traffic currently operated by Arriva on platforms 4, 5 and 6. The length of the platforms would be 350 meters allowing for both the arrival and departure of intercity and international trains as well as possibilities with appropriate rail switches between rail tracks, to separate northern and southern parts of platforms into a and b, as is currently the case with respect to platforms 4a and 4b and 5a and 5b.

- The **second** major construction **phase** consists of the building of an underground rail tunnel under the current level-crossing, the so-called “Duitse Poort” formally the Sphinxlunet, south of the station. This level-crossing in the midst of the city epitomizes the way in which rail tracks have divided the city. The railway tunnel will be constructed first fully underground starting from the Sphinxlunet level-crossing and going northwards over some 275 meters along the Koepelkerk until the concrete walls of the Scharnerweg tunnel (formally the Akerstraattunnel) and second southwards over a length of some 925 meters, gradually emerging partly above ground in a semi-sunken position, allowing for an "over-capping" of the rail tracks, shielding both the sight and the sound of passing trains from its surrounding environment.

***Figure 3*: an underground rail tunnel south of the station**



This over-capped part of the rail tracks will continue until the second current level-crossing for cyclists and cars in the city (Bloemenweg/Ariënstraat) which will now also disappear and be replaced by a slightly elevated crossing over the 1.5 meter "concrete hill" of the half underground rail tracks. This new "bike and pedestrian only" link will be elevated as an extension of the current "Groene Loper" so that both pedestrians and cyclists can easily travel over the covered tracks either north towards the underground central station or south to the southern Randwyck part of the city. The half-sunken, over-capped rail track will be further embellished with small trees, plants, flowers and water parties, with on top a green biking and walking road, "healing" the old rail barrier south of the station joining the different eastern and western suburbs of the city.

After the Kennedysingel, the railroad track will be brought back to ground level towards Maastricht Randwyck Station. This will take approximatively 200 meters.

All these construction activities can be carried out on the eastern side of the current rail tracks so that during this whole phase, rail traffic between Maastricht Central Station and Maastricht Randwyck/Brightlands station will not be interrupted.

- The third phase will involve the construction of the railroad tunnel starting from the new underground station until the Scharnertunnel over a length of some 300 meters, the breaking up of the Scharnertunnel whereby the current eastern slope of the tunnel will be used as new entry to the underground station and the current western slope of the tunnel entry as entry for a new two-level car and bike parking space, and the linking up with the underground railway tunnel constructed in the previous phase.

This third phase will require major demolition, and construction works of the Scharnertunnel so that rail traffic between Maastricht Central station and Maastricht Randwyck/Brightlands station will have to be temporarily replaced by buses.

- In the final fourth phase, the 'end situation' can be realized whereby the full marshalling railyard with all its remaining rail tracks has been removed. This would imply the full urban rail integration in the centre of Maastricht enabling now the possibilities for numerous additional office and housing buildings, green park areas on this "non-descript" rail space offering now plenty of bridging and healing opportunities.

Figure 4**: Final end situation**

4. Developing a sustainable financial framework

For large European cities, the central location of train stations in the city centre has often provided unique opportunities for new, sustainable urban development paths that appeal to citizen residents from all walks of life who want to prioritize the use of public transport over car ownership. Particularly for students and staff of higher education institutions, employees of large and small businesses and public institutions such as courts or hospitals, the proximity of a centrally located station offers a unique opportunity for the development of sustainable mobility in the centre of a city.

This obviously applies not only to large cities but also, one could even say more so, to smaller border cities such as Maastricht with a relatively small historic centre, geographically sandwiched between the Belgian border to the west and the hilly countryside to the east. As the provincial capital of the Dutch Limburg province, with a regional courthouse, a number of higher education institutions including Maastricht University and Zuyd University of Applied Sciences, and a proportionally large number of foreign students, much larger than elsewhere in the Netherlands, and numerous educational facilities in the neighbouring cities of South Limburg such as Heerlen and Sittard, an academic hospital (MUMC+) and a so-called "Brightlands" medical campus, there is growing need for sustainable mobility in the city of Maastricht for students, employees, clients and patients alike.

From this perspective, the huge railway delta in Maastricht with its surrounding, abandoned factory sites represents a unique opportunity for urban development. The detailed proposal discussed in the previous section frees an area of 'non-descript' space in the centre of the city of some 22.5 hectares. It offers the possibility to construct at least some 7500 residential housing units and/or office facilities. At the same time, the costs of the proposed infrastructural transformation detailed in section 3, are also likely to be huge. The experience gained in other cities which have addressed the possibility of under tunnelling rail traffic provides some useful insights. At first sight, the relatively recent construction of an underground station in the city of Delft might be considered an interesting example. However, the process of under tunnelling the station and the rail tracks was a particularly complex undertaking given the many historical buildings alongside the rail tracks and the nearby Delftse Schie, part of the Rijn-Schie canal, running in parallel to the rail tracks. The total length of the tunnel was 2.3 kilometre consisting of 4 rail tracks with a total width of 24 meters, expanding to 42 meters at the underground station with two platform islands and a height of 6.5 meter. The station consisted of two layers. Total costs amounted to some €1 billion in current 2025 prices.

One of the characteristic features of the construction of the Delft underground station was the decision to build the underground station not underneath the existing historical station building but in a different nearby location, just east of the old station. This is what is being proposed here too. However, in the case of Maastricht, the actual construction of the underground station will be easier to carry out given the huge 'non-descript' rail space available with no historical buildings in the way. Furthermore, and as detailed in the previous section, the actual underground length of the tunnel will be 850 meters or less than half the one of Delft. It will be followed by a 925 meter over-capped semi-sunken rail track south of the Duitse poort. Finally, the underground station itself will have only one underground layer and its construction will be combined with the construction on top of the station of office and/or housing buildings. In other words, we expect the costs of the proposed urban rail integration in Maastricht as proposed in the previous section to be substantially lower than in the case of Delft.

This being said, and more for the sake of the argument, we "guest-timate" that the total costs of our proposal as specified in the previous section, will be similar to the costs of the underground station in Delft, approximatively 1 billion euros[19]. For a small city such as Maastricht with a total annual budgetary income of some €726 million (figure for the 2026 budget), this represents a huge amount of money which the city cannot afford. Expecting a substantial contribution from the central government is also highly unlikely given the limited contribution the proposal as presented in section 3 makes to actual rail commuting, certainly compared to more urgent rail bottlenecks elsewhere in the Netherlands. Any priority for rail investment support from the central government will be for the more highly dense, centrally located areas in The Netherlands such as the Dutch Randstad or the rapidly growing high-tech Eindhoven Brainport region. For a relatively small, peripheral border city such as Maastricht, there will be little support for providing any financial support from the central government. After all, most if not all of the benefits will accrue to local citizens. In short, the funding of large infrastructural projects in cities the size and location of Maastricht requires new, alternative, out-of-the-box ideas.

"Reinventing" leaseholds would be such an idea. Leaseholds as opposed to freeholds have existed for a long time in particular housing markets such as in England and Wales. The typical residential property ownership would take the form of either a leasehold or a freehold. Only the freehold consists of a perpetual ownership contract; a leasehold provides ownership of the residential property on a long term, temporary base which can be even as long as 99 years, sometimes even 700 years. While the difference between the value of a leasehold versus a freehold contract provides interesting economic insights in long-run discount rates – empirical research illustrating that the present value of the perpetual rental income in case of a 100-year leasehold will be valued more than 10% less than an identical freehold[20] – the notion of leasehold itself has increasingly become abused[21] and as a result subject to policy critique on the leasehold concept itself. Particularly in the UK where the original leasehold system had its origins in medieval times when the rich, land-owning aristocracy used leaseholds for serfs being able to work on a plot of land. As the current UK housing minister Matthew Pennycook put it: "This arrangement has been in place for centuries and is essentially, in some ways, unchanged. It's land owned by someone else who grants the right of use of that land to another person. That is why it's inherently unfair. That is why, in many ways, leaseholders are second-class homeowners – that's what we've got to change."

From a long-term, sustainability perspective, the concept of leasehold represents though a particularly valuable concept. The idea that an individual citizen will not be the perpetual owner of the piece of land

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[19] The detailed costs for the underground station and tunnel including the semi-sunk part were estimated to amount to some €760 million in 2025 prices. Taking into account the cost for relocating the rail yard, we believe that the overall €1 billion represents a realistic guesstimate.

[20] Giglio, S., Maggiori, M. and J. Stroebel (2015), "Very long Discount Rates", *The Quarterly Journal of Economics*, Volume 130, Issue 1, February 2015, Pages 1–53, https://doi.org/10.1093/qje/qju036

[21] Such as in the case of "new homes and apartments have been sold by large housebuilders with a leasehold where the ground rent payable doubles every 10 to 25 years, with consequently a very high price to buy out the lease. (https://en.wikipedia.org/wiki/Leasehold_estate).

on which his/her property has been or will be built, as in the case of a leasehold, contains implicitly the recognition that human beings will never possess in a perpetual sense a part of nature. Rather humans rent on a temporary basis the right to hold land from the landlord ‘earth’. In a certain way, such a view would neatly fit the critique from economists such as Partha Dasgupta that in macro-economic growth analyses one has ignored the contribution to economic growth of ‘Nature’: “So long as Nature’s services are priced at zero in an accounting system, Earth does indeed look as being infinitely bountiful. Bad accounting practices sustain comforting myths… we have no explanation for how and why GDP has assumed prominence as the measure of long-term economic performance. We should be studying the wealth of nations, not the GDP of nations. The idea is not to dismiss GDP from economic reasoning (GDP is useful for short run macroeconomics management), but to create a parallel system of capital accounts, akin to firms’ balance sheets, for judging economic performance over time… we have accumulated produced capital and human capital in the Anthropocene but have degraded natural capital to an extent that we have been endangering our collective futures.”[22] In short, and as Stephen Hill put it in his comments on the current UK debate on leaseholds, we should rather “reimagine leasehold as a way of resisting the financialization of housing markets, as community land trusts now do”[23].

Particularly, in cases when there are local community opportunities for freeing large proportions of “non-descript” rail track space as in the case of Maastricht’s huge inner city rail yard, such an alternative, sustainable financial framework for housing construction appears worthwhile pursuing. Let us briefly elaborate on the practical feasibility of housing development through a long-term lease construction. On the one hand, the site of the railway yard in the middle of Maastricht will be a space, once freed of its railway tracks, that is now becoming available to the local community and has never before had a specific function: neither as agricultural land, nor as an industrial estate, nor as a nature reserve. Selling physical ownership of such a site to developers for housing construction would not do justice to the unique location of this space. It seems more appropriate to grant only the right to use the space through a long-term leasehold arrangement.

Practically in the case of Maastricht, one could imagine that the Dutch state, who is the formal owner of the rail yard, would transfer ownership of this entire site to the local community, i.e. the municipality of Maastricht on the condition that it never privatises this space. The residential units to be built on the site would be sold in the form of a renewable, 80-year leasehold arrangement with an annual “ground rent” that may vary depending on the target group, the size of the housing unit and its function: residential housing or office. In the case of a large city such as Vienna for example, the ground rent for social housing around the station is low: in the so-called “social zoning” area it is only 7 euro per m². In The Netherlands, under leasehold contracts, an annual rent of 5% on the ground value is being paid. The following rule of thumb can be used: construction costs for a typical new house/flat amount currently in the Netherlands to some €5000 per m², including a 25% cost calculation for the ground value. For a typical Dutch house/flat

[22] Dasgupta, P. and S. Levin (2023); Economic factors underlying biodiversity loss. *Philos Trans R Soc Lond B Biol Sci* 17 July; 378 (1881): 20220197. https://doi.org/10.1098/rstb.2022.0197

[23] Hill, S. (107), Leaseholds are not the problem – abuse of them is, The Guardian, August 3rd, 2017, https://www.theguardian.com/money/2017/aug/03/leaseholds-are-not-the-problem-abuse-of-them-is

of 80 m², this implies total costs of some €400K with a ground value of some €100K. The average annual rent on a leasehold construction will be in other words €5000. While this might seem a large amount, it is important to realize that within the current Dutch tax regime, the periodic ground rent payment (annual or in monthly payments) for a privately owned home is tax-deductible, similar to mortgage interest. The net contribution costs will in other words be substantially lower.

Applied to the proposal as outlined and detailed in the previous section 3, would imply that the 'healing' of the current rail barrier in the Maastricht city centre, would amount to a total annual revenue for the city of Maastricht of some €37.5 million in case some 7500 housing units would be constructed, something we considered perfectly feasible. At current interest rates of the BNG, the Bank of Dutch Cities, this would allow the city of Maastricht to borrow without any problems over a 25-year period the total amount requited for the project as proposed under section 3, i.e. €1 billion. In short, the use of leasehold construction would provide the city with sufficient revenues to carry out the construction of the new underground station, offered for free to ProRail and the Dutch state; 'heal' the rail barrier across the city; and even assist ProRail in the displacement of its rail yard to a cheaper location in the neighbourhood. At the same time, the level of the average ground rent can be used by local authorities to diversify between different housing needs allowing also for social housing. Leasehold arrangements enable such differential opportunities.

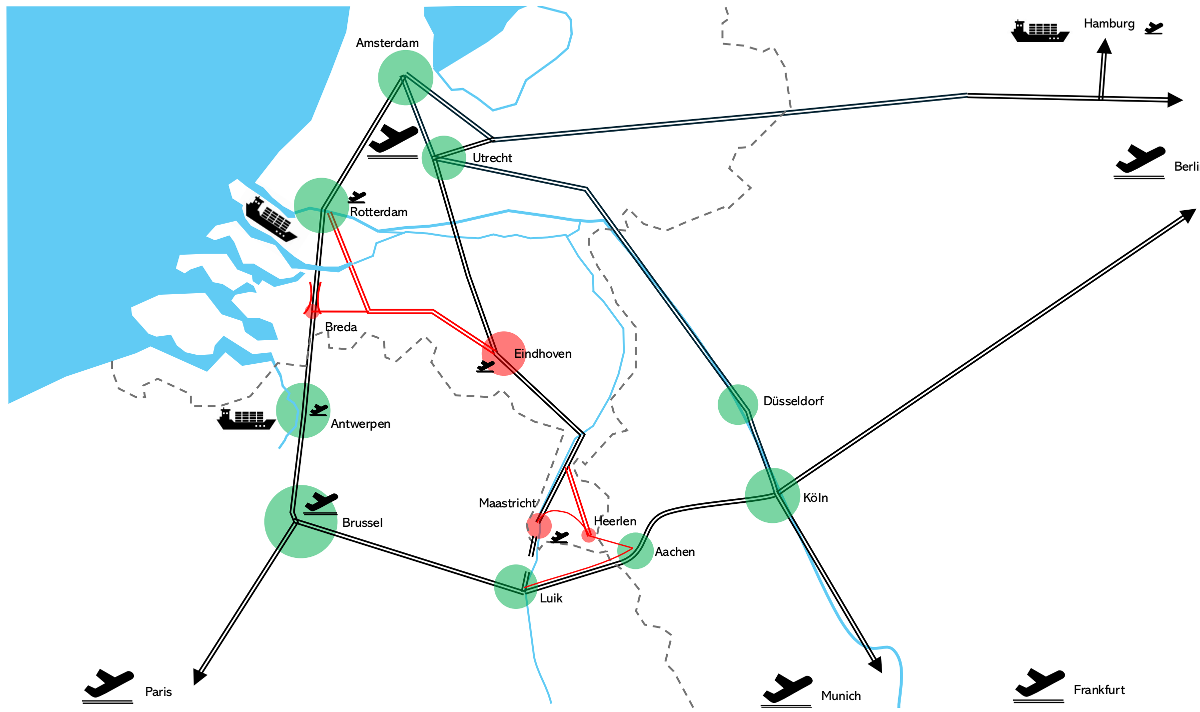
5. Maastricht's Central station as railway window to Europe

As the most southern Dutch border city, Maastricht is close to the high-speed rail connections in both Aachen and Liège. The Arriva "three country train" links Aachen with Heerlen, Maastricht and Liège, operating today primarily as cross-border local train than as an intercity train. At the same time, the current network of high-speed rail connections between the Netherlands and Belgium is dependent on just one high speed rail track. It makes international rail commuting from the Netherlands to the south (Belgium, France and England) in most of the eastern parts of the Netherlands not just cumbersome having to board trains in Rotterdam or Amsterdam but also heavily dependent on possible delays and congestion given the limited cross border rail connection.

On the other hand, the European Commission recently announced its intention to work towards faster (and cheaper) rail transport within Europe. By 2040, for example, it wants to connect all the capitals of the European Union via a modern network of high-speed trains. The EC is counting on a total budget of 500 billion euros for this. In addition to direct "missing links" between capital cities such as Amsterdam/The Hague and Luxembourg, it is also important, particularly in the context of operational safety for rail traffic, to have alternative rail infrastructure available. As mentioned above, the Dutch high-speed network is dependent on a single cross-border rail crossing, namely the Hazeldonk border crossing near Breda, for connections to Brussels/Paris/London. From this point of view, the Maastricht – Liège connection is the most logical second border crossing for Dutch high-speed connections with Belgium and southern Europe. The proposal presented in section 3 offers therefore the opportunity to transform Maastricht's Central station to become the Netherlands' second rail window to Europe.

It is important to realize that the use of international rail tracks in Europe has become opened to other providers of train services – so-called "open access" – than the current ones: Eurostar, the NS and Arriva. It opens up the opportunity to enlarge the supply of international cross-border rail connections to enable rail commuters in the eastern and southern parts of the Netherlands, to travel by high-speed train from Utrecht, Nijmegen and Eindhoven to Brussels/Paris through Maastricht and Liège. Figure 5 illustrates e.g. the possibilities for international rail commuting from Eindhoven. Of the different options indicated in the Figure, the option of using the existing rail tracks between Eindhoven-Maastricht-Liege/Brussels for an IC Direct connection appears the most realistic one and one which can be implemented in a straightforward way. One could e.g. use existing rail ICNG trainsets – which the NS currently operates to connect Eindhoven with The Hague Central station using part of the HSL track between Breda and Rotterdam – for an IC Direct connection between Eindhoven-Maastricht-Liège with no stops in between.

***Figure 5*: international, high speed train connections**



Such an IC Direct connection would fit the international hub aspirations Maastricht has with amongst others the Einstein Telescope ambitions. It also fits neatly with the need to invest in cross-border transport infrastructure in Europe as recently highlighted in the Draghi report ***The Future of European Competitiveness*** (September 2024). To quote from the latter report: **“Massive strategic investment is needed to complete missing links and to modernise transport infrastructure, where major gaps exist in public and private financing**. The TEN-T, which requires an estimated EUR 845 billion in investment by 2040 (of which EUR 210 billion for main cross-border links), is not accompanied by a comprehensive ex-ante plan to secure the necessary financing and investment. EU public funding is expected to cover a minor share of investment (some EUR 87 billion by 2027). Projects submitted under the dedicated EU funding programme for the 2021-2027 period, the Connecting Europe Facility, represented on average three to four times the available budget. Moreover, private financing remains hard to obtain, despite a mature pipeline of TEN-T projects. This is due to their important level of risk, high upfront costs, or lacking short-term profitability. The EU is nearly halfway through completing the major cross-border projects, with the planned road network being by far the most advanced compared to other modes. It is now crucial to ensure the remaining investments within the next decade. Beyond what is planned under TEN-T, the realization of a high-speed rail network connecting all EU capitals and major cities_would enhance rail attractiveness and further increase investment needs."[24]

It explains why we are confident that the proposal detailed here in section 3 could also include the possibility for having high-speed trains connecting Eindhoven with Liège, stopping in Maastricht and fully exploiting the new underground connections made available.

[24] See The future of European competitiveness. Part B | In-depth analysis and recommendations. https://commission.europa.eu/document/download/ec1409c1-d4b4-4882-8bdd-3519f86bbb92_en?filename=The%20future%20of%20European%20competitiveness_%20In-depth%20analysis%20and%20recommendations_0.pdf

Conclusions

Rail integration in the urban setting of medium-sized border cities, as in the case of the old medieval town of Maastricht with its relatively small city centre, as analysed here raises many challenges. The physical space occupied by underutilized rail tracks in the centre of the city is huge, occupying proportionally a substantial part of the centre city's surface. The "urban rail integration" proposal detailed here can be considered an example of how to implement sustainable mobility transformation in medium to small cities. Up to now, large cities have taken the lead in implementing European Green Deal goals such as decarbonization, renewable energy transformation and circular economy. A smaller city such as Maastricht can add to this "large city" lead in sustainable development by focusing on what is specific, one could say unique, to its own urban development potential: in this case, the particular large availability of so-called 'non-descript' rail space in the centre of the city offering a unique opportunity for a sustainable urban rail integration. The variety of urban places in Europe offers different insights into the different ways in which sustainability and climate-neutral urban and regional planning can be achieved.

Sustainable development requires policy makers to recognize the importance of bottom-up initiatives and implementation[25]. Naturally, the extensive urban development operations associated with transformations such as the one proposed here, will take time and can therefore only be carried out gradually in a step-by-step fashion.

The core issue is ultimately, what local society is prepared to invest in such radical sustainable urban developments as the one proposed here. In the case presented here, the total investment is huge, roughly estimated at €1 billion, about five times the cheapest alternative, proposed to the city council[26]. How to monetize the advantages of urban rail integration as presented here with new housing opportunities offered in the direct vicinity of Maastricht's Central station and a better accommodation of public transport, is a discussion which takes place in many medium sized cities in Europe.

In large cities, the pressure of the densely populated areas in the city is such that more radical proposals such as the one presented here, find more easily public policy support, even if the complexity in carrying out such urban rail integration involves complex infrastructural interventions. In medium sized cities, the necessity of these more radical interventions is no longer led by rail mobility demand, rather it is emerging as part of the need for a redesign of the urban development around stations and the often underutilized, historically grown, large rail space in the immediate vicinity of the station. Maastricht represents an ideal example for such situations.

As Bishop puts it: "Railways, like other modern communication and transportation systems, pose a theoretical dilemma. Do they alienate or destroy a sense of place…or enable new connections to be

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[25] See Schwaag Serger, S., Soete, L. and Stierna, J (Eds.) The Square: Putting place-based innovation policy for sustainability at the centre of policy making, Publications Office of the European Union, Luxembourg, 2023, ISBN 978-92-76-59369-0, JRC131244.
[26] Grand MSTRG

made?"[27]. We submit here that the proposed radically, redesigned underground Maastricht Central station will on the one hand evolve into a more effective international rail junction offering new, more easy rail connections while at the same time become not only the focus of new urban development in Maastricht but that the under tunnelling of the core rail tracks will ultimately also "heal" the old east west city divide, railroads created more than one hundred and fifty years ago.

[27] Bishop, P. (2002). Gathering the Land: The Alice Springs to Darwin Rail Corridor. *Environment and Planning D: Society and Space*, *20*(3), 295-317. https://doi.org/10.1068/d329

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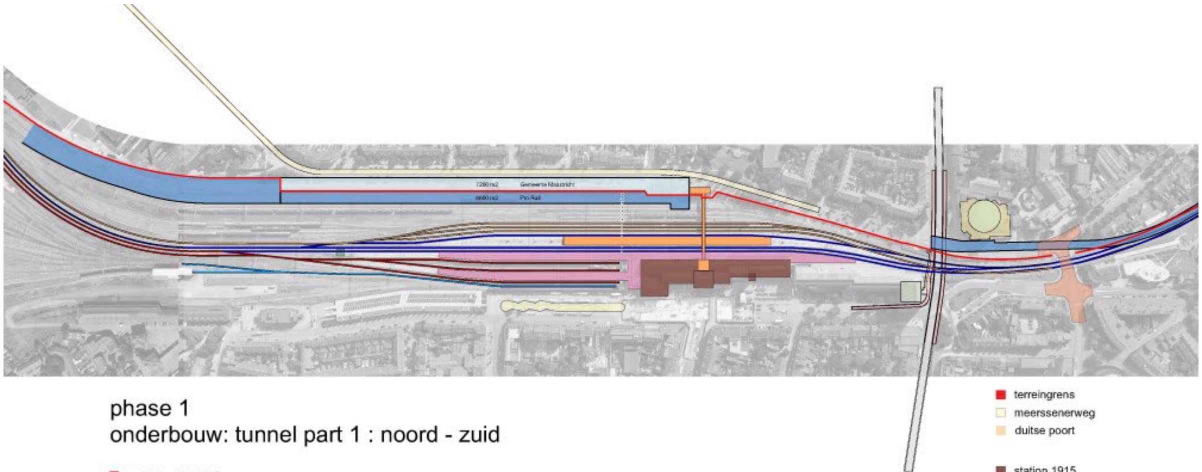
ANNEX

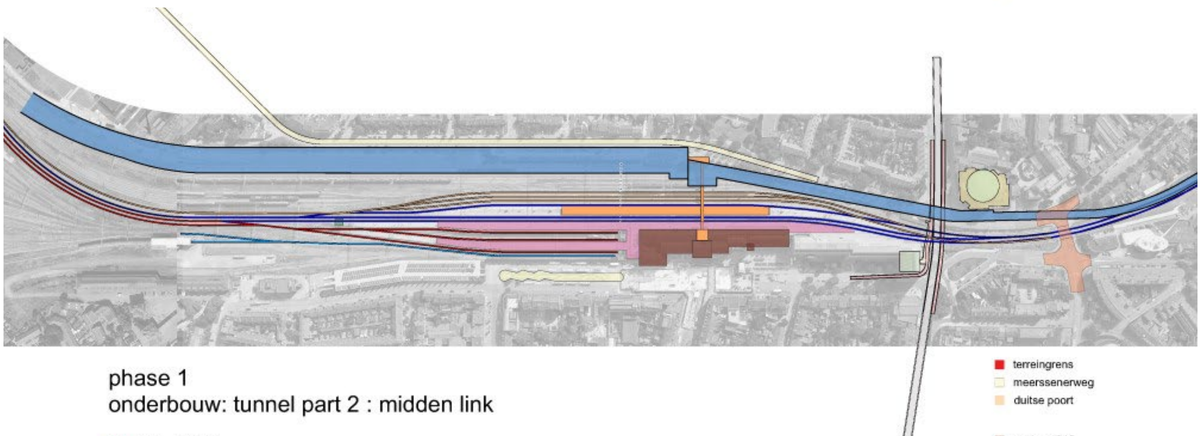


phase 1
onderbouw: tunnel part 1 : noord - zuid

- ■ : intercity NS
- ■ : spoor Arriva en NMBS
- ■ : goederenvervoer

- ■ terreingrens
- ■ meerssenerweg
- ■ duitse poort

- ■ station 1915
- ■ perronkap 1915
- ■ koepelkerk 1923
- ■ seinhuis post T 1933
- ■ tunnel scharnerweg 1962
- ■ passerelle + glashuis 2005
- ■ toren colonel 2005



phase 1
onderbouw: tunnel part 2 : midden link

- ■ : intercity NS
- ■ : spoor Arriva en NMBS
- ■ : goederenvervoer

- ■ terreingrens
- ■ meerssenerweg
- ■ duitse poort

- ■ station 1915
- ■ perronkap 1915
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- ■ tunnel scharnerweg 1962
- ■ passerelle + glashuis 2005
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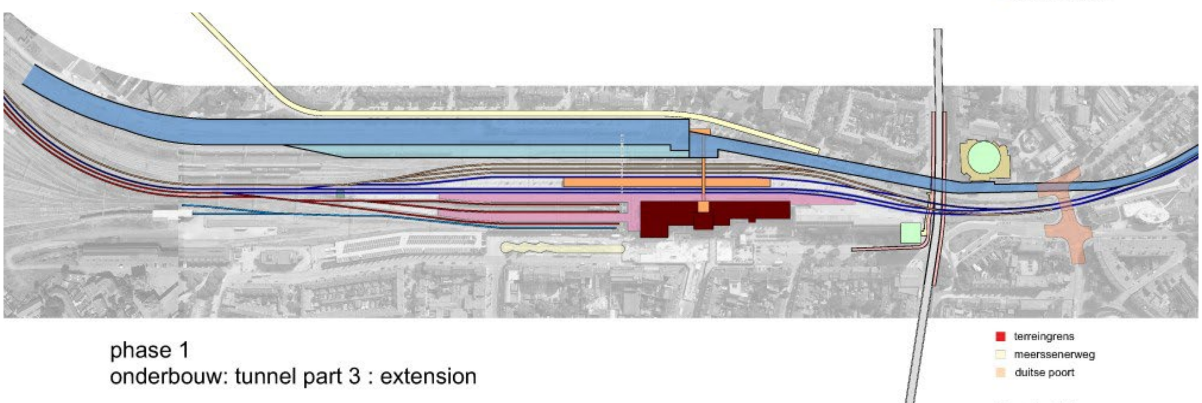

phase 1
onderbouw: tunnel part 3 : extension

- ■ : intercity NS
- ■ : spoor Arriva en NMBS
- ■ : goederenvervoer

- ■ terreingrens
- ■ meerssenerweg
- ■ duitse poort

- ■ station 1915
- ■ perronkap 1915
- ■ koepelkerk 1923
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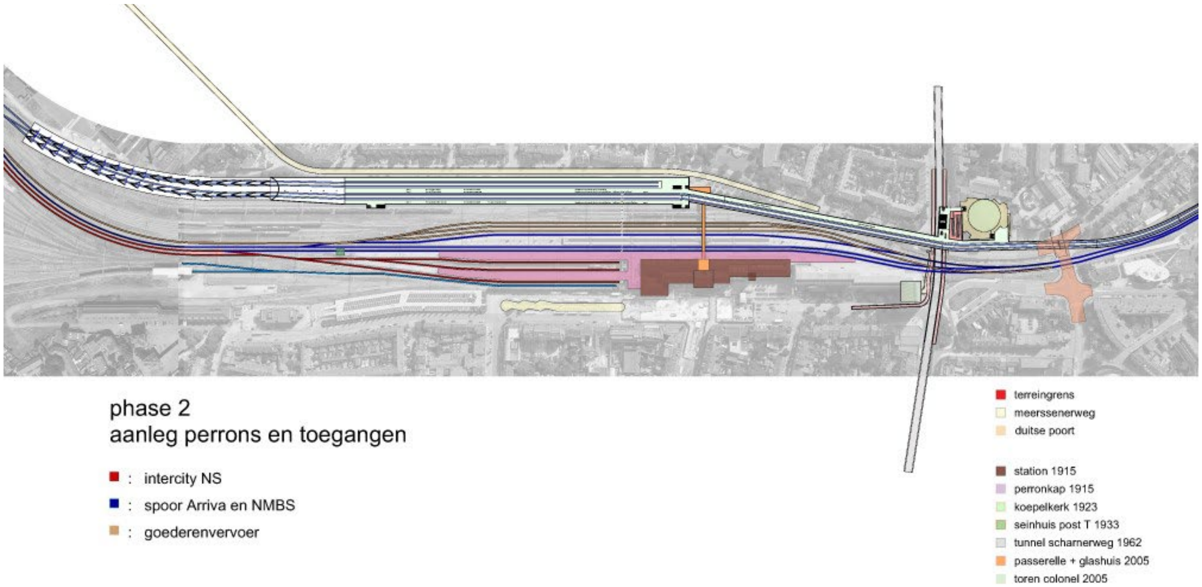

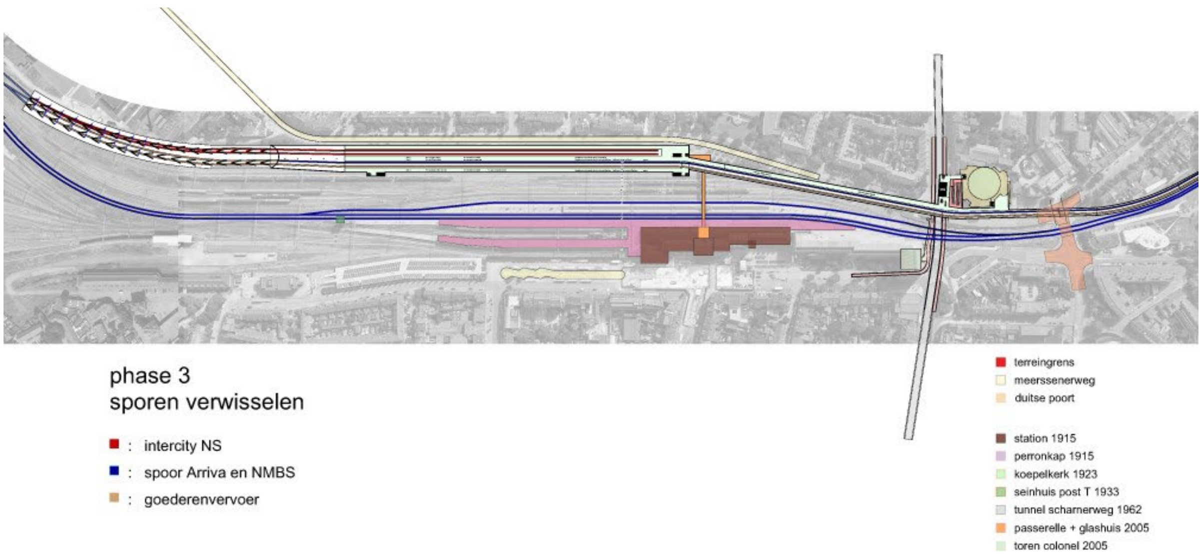

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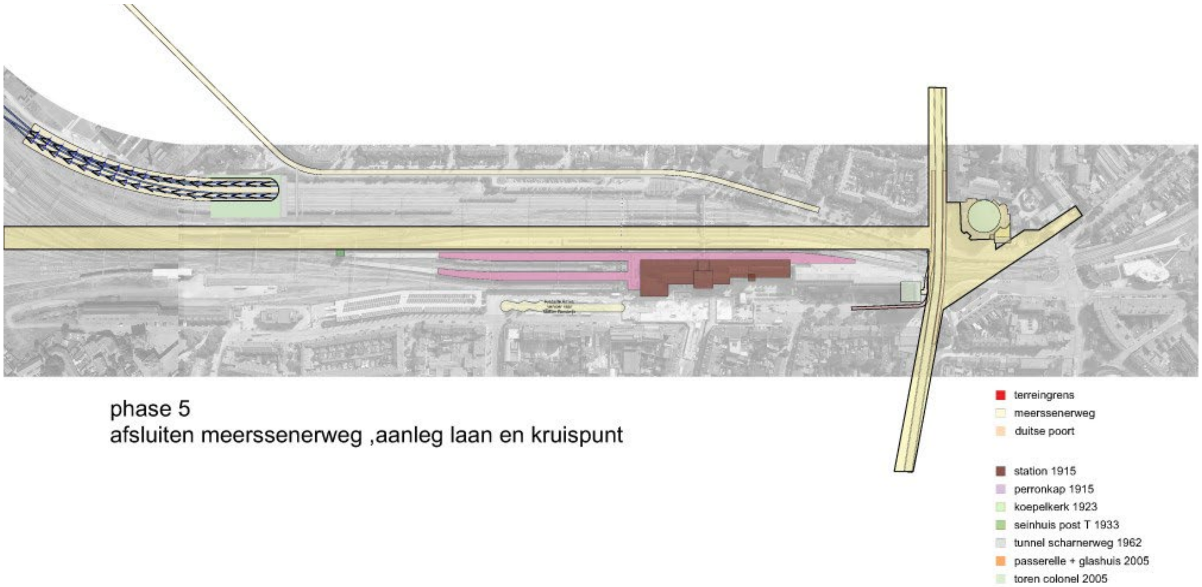

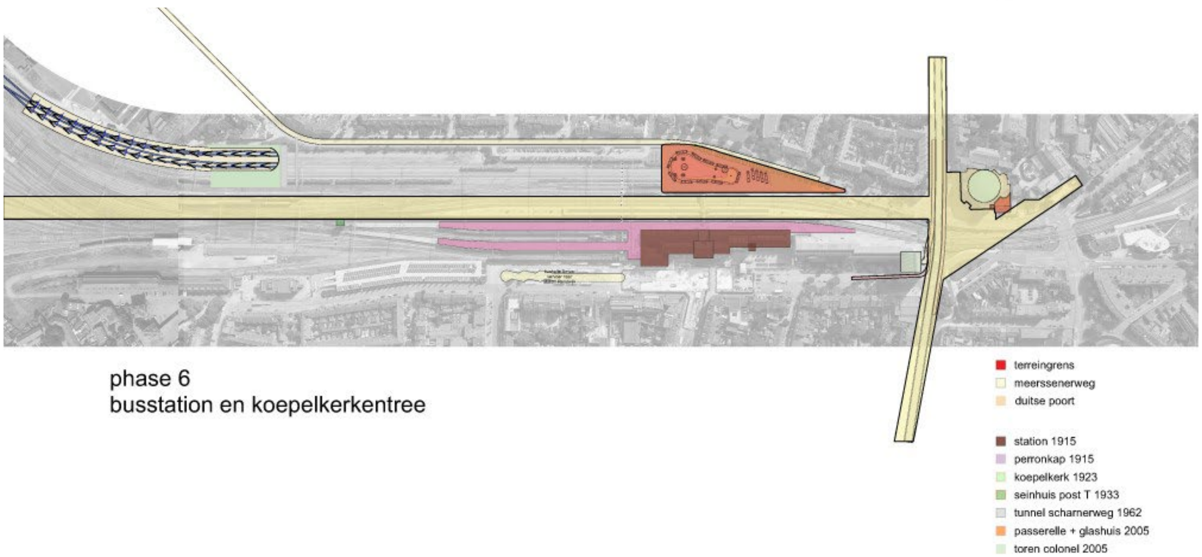

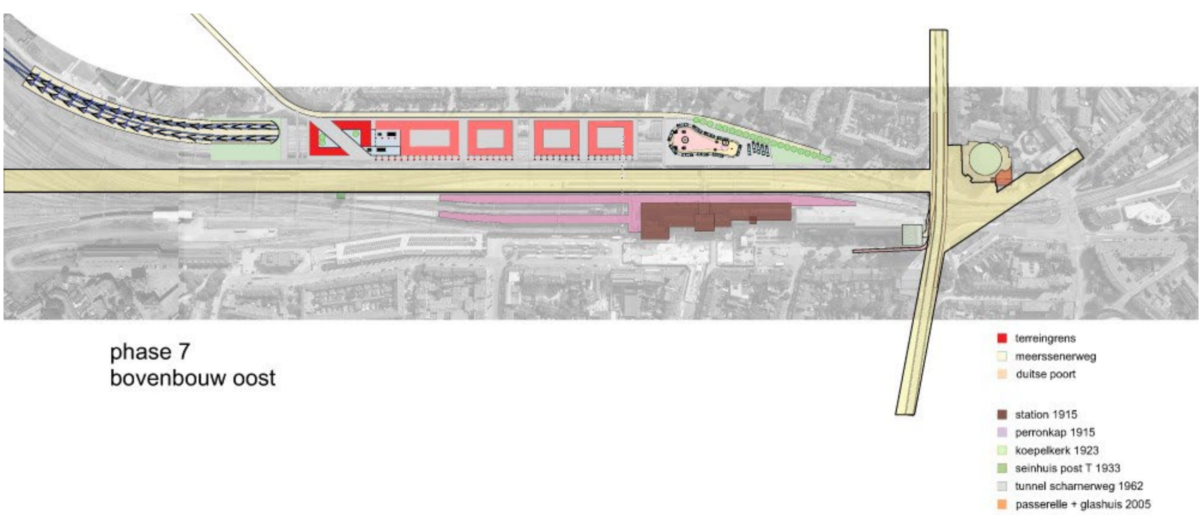

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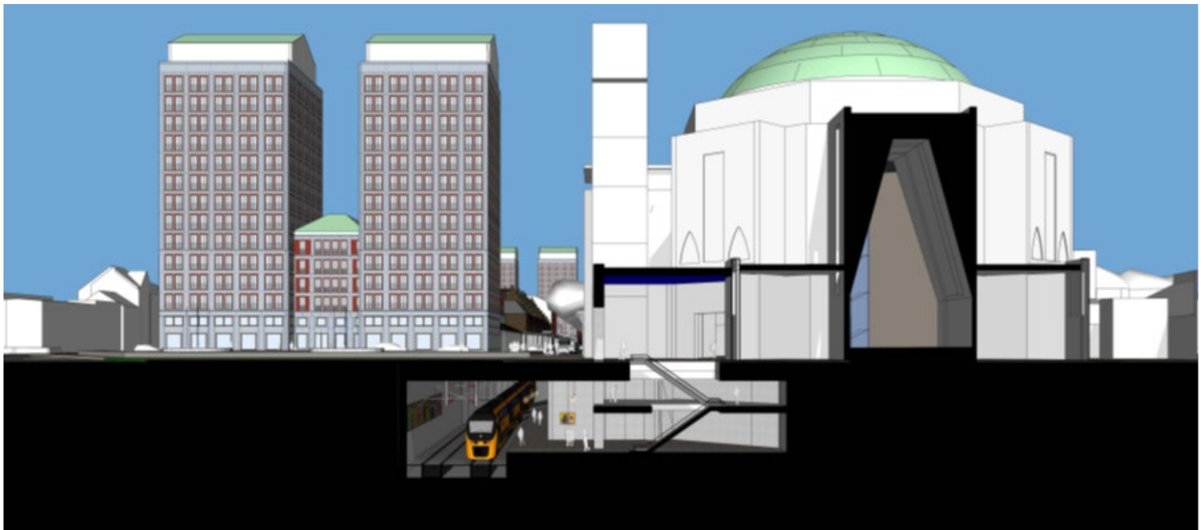

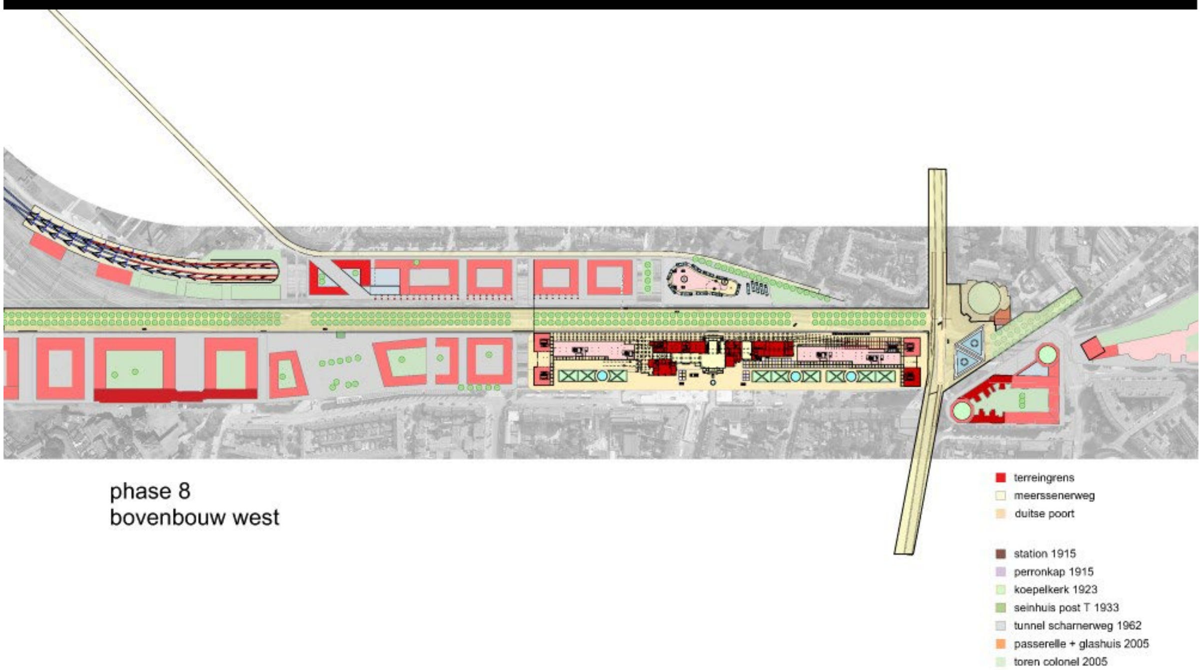

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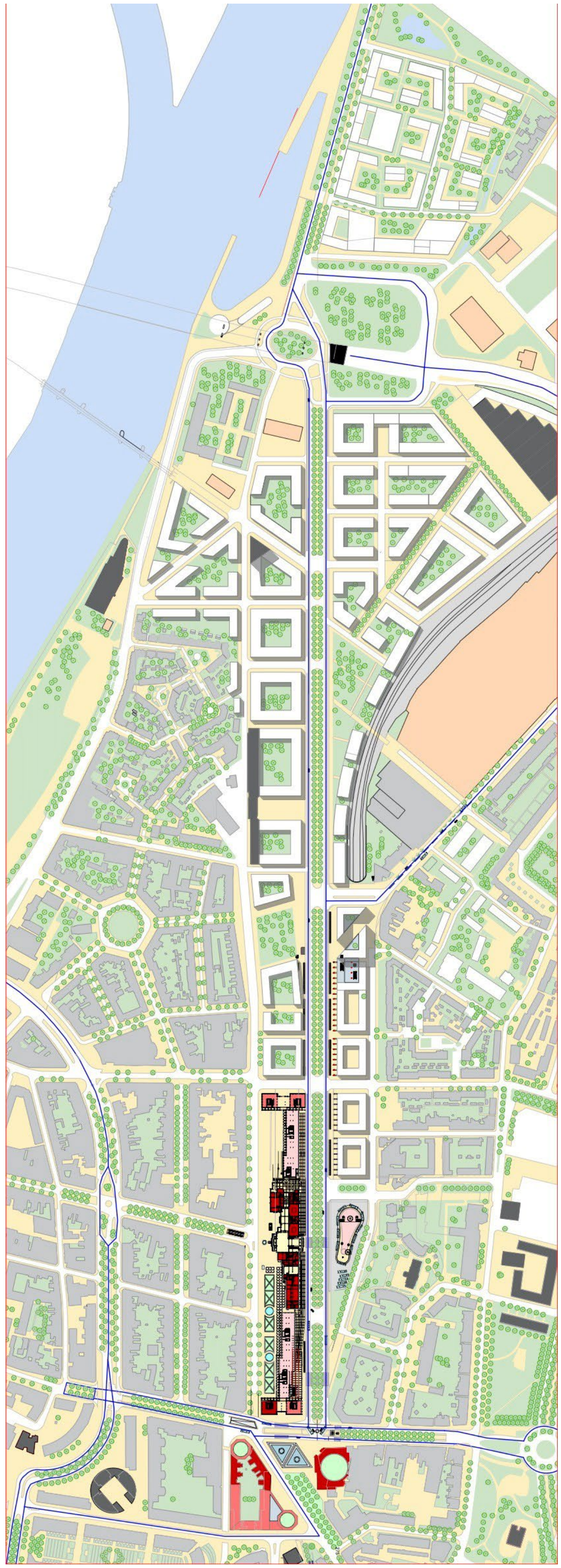

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