Konseptet Urban Walkable Unit, en ide for å omstrukturere den spredte byen og skape gangbare, blågrønne og bilfrie områder

Asker som eksempel

Agustin Sebastian Rivera and Elisabeth Sjødahl

Agustin Sebastian Rivera and Elisabeth Sjødahl: The Urban Walkable Unit as the basic element composing the water sensitive and car-free redefinition of the dispersed city: The case Asker center

KART OG PLAN, Vol. 78, pp. 145–160, POB 7030, NO-5020 Bergen, ISSN 0047-3278

This work explains the application of a design and planning concept, the *Urban Walkable Unit,* that could lead to abandonment of car-dependent mobility and reverse the effects of urban sprawl: territory fragmentation, deterioration of the qualities of the built environment and reduced possibilities for social interaction. The concept proposes to transform cities, reorganizing them as aggregations of a basic element, the *Urban Walkable Unit -UWU-*, which is structured following the logics of both water and human walking mobility.

In the present study the concept is applied to the Norwegian city of Asker. The challenge is how the application of the *UWU* concept can not only regenerate the city center, consolidating it around collective transport and inserting water as a fundamental value instead of a risk, but also redefine the dispersed peripheries. The resulting integrated polycentric city will then promote a vibrant and intense urban life.

Keywords: green mobility, blue-green infrastructure, sustainable planning, resilience, stormwater management

Agustin Sebastian Rivera, Associate Professor, School of Landscape Architecture, NMBU.
E-mail: agustin.sebastian@nmbu.no

Elisabeth Sjødahl, PhD Fellow, Institute of Urbanism and Landscape, AHO.
E-mail: elisabeth.ulrika.sjodahl@aho.no

Introduction

Car-dependent mobility, which has dominated transport throughout the second half of the twentieth century, has enormously transformed our cities and territories in several ways. By favoring dispersion of settlement, an extended and dense network of asphalt and infrastructures has fragmented the territory, reducing porosity and continuity. The role of local topography and waterways in structuring landscape has been compromised (Viganò 2008). Car-dependent mobility and dispersion have also contributed significantly to deterioration of the quality of the built environment. They cause pollution and noise, increase urban segregation and reduce possibilities for social interaction.

This work explains the application of a design and planning concept, the *Urban Walkable Unit* that could lead to abandonment of use of the private car, reversing the effects of urban sprawl. The *Urban Walkable Unit* concept has been developed by Agustin Sebastian and Elisabeth Sjødahl in the practice *Worksonland Arkitektur og Landskap* and in research case studies at the School of Landscape Architecture at NMBU and Institute of Urbanism and Landscape at AHO. It is a fundamental planning tool used by the authors in different contexts and scales in Norwa.

The concept proposes to transform the cities, reorganizing them sequentially as aggregations of a basic element, the *Urban Walkable Unit -UWU-*, which is structured following the logics of both water and human walking mobility. The approach thus regards landscape as the fundamental structure for urban planning, as water and soft mobility correspond to the ground layers (Tjallingii 2015). The greater infrastructures and future land-use are then adapted to these layers.

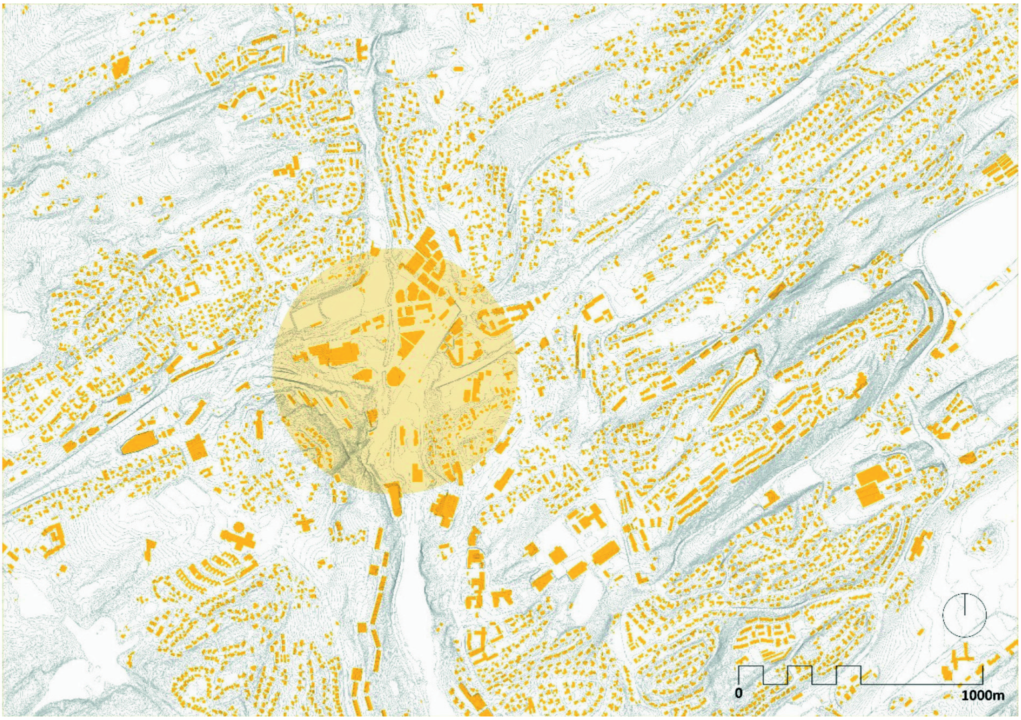

Fig.1 Urban dispersion around Asker center has been favored by car-dependent mobility during the second half of the twentieth century. The plan shows a 500 meters radius circle in the central area, the reference walkable distance around collective transport for this study.

In the present study the concept is applied to the Norwegian city of Asker, a good example of a car-dependent city where urban sprawl and the mentality of driving from door to door has generated a city center dominated by asphalt roads and parking spaces, surrounded by dispersed single family housing areas (see Fig.1). The new regional plan of Oslo already favors urban expansion in relation to public transport, with densification of areas around train stations. This demands a sensibility in planning that interweaves other aspects to the high usage of the ground in terms of built square meters, including essential factors such as stormwater management, quality and connectivity of green areas and local climate.

Here we want to explore how application of the *UWU* concept can not only regenerate the city center, consolidating it around collective transport and inserting water as a fundamental value instead of a risk, but also redefine the dispersed peripheries. The resulting integrated polycentric city will then favor a vibrant and intense urban life.

Asker: challenges created by car-dependent mobility

Located in the Oslo region, the municipality of Asker suffers some of the effects of car-dependent mobility and dispersion of population that many Norwegian cities have experienced in the second half of the last century. The intensity of car-dependent mobility is reflected in the fact that most of Asker residents who work outside the municipality use a private car to get to work, 13.750 out of 18.000. Only 3.100 take the train, 900 the bus and 250 the boat. In addition, the great majority of people working in Asker who live outside the municipality – 13.200 out of 14.800 – use a private car. Only 1.300 use the train and 300 other collective transport, mainly the bus (Asker Kommune 2014. Kommuneplan 2014–2026). Car-based mobility has favored urban sprawl and very low housing density in Asker. 80% of the 22.000 existing units are single family and row houses dispersed around the municipality (Asker Kommune 2014. Kommuneplan 2014–2026).

One main environmental impact of car-dependent mobility is the huge amount of CO2 released. It is estimated that of a total emission in Asker in 2009 of 150.000 tons, 75 % or 113.000 tons came from transport and that two thirds of this was due to private cars (Asker Kommune 2014. Kommuneplan 2014–2026).

The impervious city

New infrastructures often disregard the waterways, as in the case of Asker. Waterways were once the main structure crossing and organizing landscape (see Fig.2), following the natural conditions of the topography and the soil, integrated into and bringing life to the cities. In many places the waterways have lost the connectivity and capacity they require to guide water from the mountains to the fjord. The dense network of infrastructures (train line, motorway, main road systems) in Asker center lacks porosity. They are specialized for speed and efficient transport, but become detached from the local conditions, dividing and fragmenting the territory.

Today the center of Asker is under risk of flood with a return period of 50 years (Asker kommune 2017. Kommunedelplan vann 2018–2029). Densification of the city center will aggravate this situation if special attention is not paid to the question.

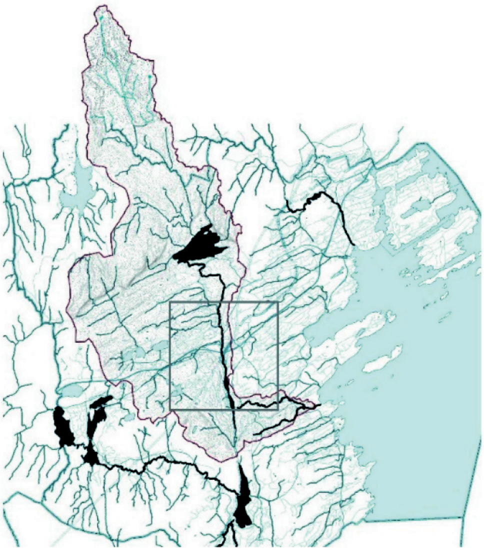

Fig.2 Water structure within the Asker territory. In black the main rivers and in blue the secondary creeks. The square shows the position of Asker center within its watershed, which covers 37 km2 and is shown with a red border. Source: Kommunedelplan vann 2018–2028 Asker kommune combined with map from Norge digital.

The water system of a dispersed city is a challenge. The system is considered territorial rather than urban, and the areas to be served require a considerable amount of installations (Picon 2005). The municipalities need to upgrade an aging pipeline system. In Asker, 50 km of pipelines were installed before 1970. The capacity of this pipeline system is also an issue, as increased loads are expected both from new urban developments and from more severe rainfall due to climate change (European Environment Agency 2017). The effects of short heavy rain events impact the tube system and creeks primarily, while the heavy rains that last over a longer period of days have the greatest impact on the capacity of the rivers (Asker kommune 2017. Kommunedelplan for vann 2018–2029).

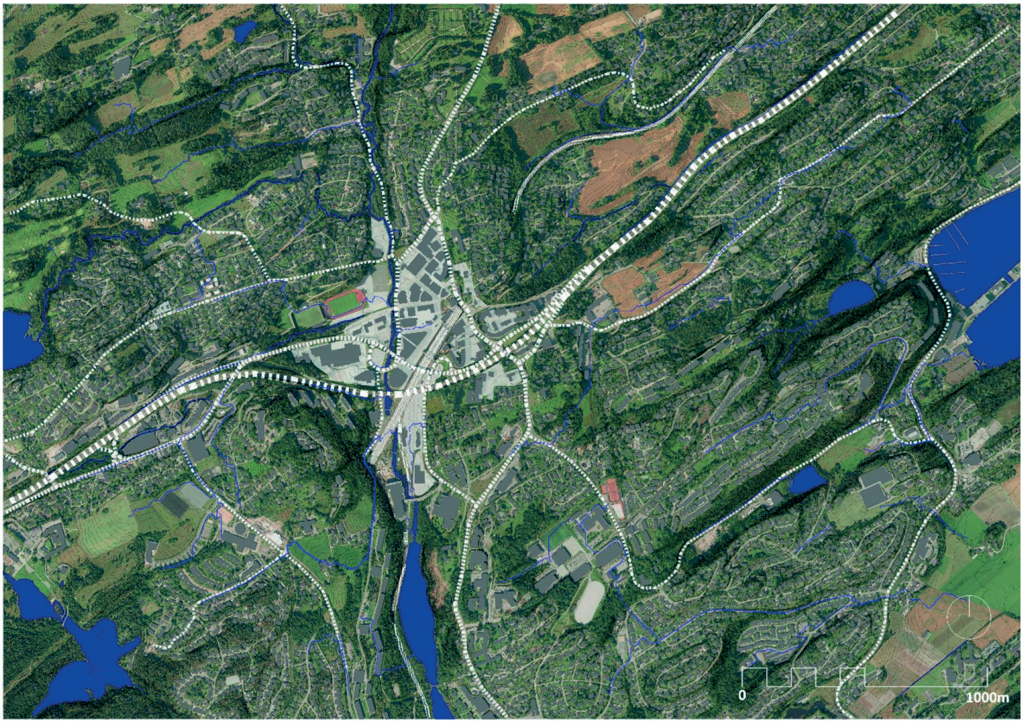

Fig.3 The city center of Asker is positioned in the crossing of two valleys. The river Asker runs along the north-south valley and passes through the city center. Here, the great infrastructures fragment this natural waterway, breaking its continuity and compromising its capacity. The white and grey surfaces show asphalt roads, parking areas and built masses that reduce the permeability of the ground.

Another important factor that limits the possibilities for water management is the high proportion of asphalt and parking areas in the city centers. Together with the impermeable built masses (Dunne and Leopold 1968) this leaves very small amount of green area capable of retaining water in episodes of extreme rainfall. In Asker approximately 2.000 parking spaces are located in the center, 800 of these located just outside the train station (Asker kommune 2014. Strategi for innfartsparkering og tilgjengelighet til kollektivsystemet). The southern part of the train station is an area that is very sensitive to flooding, as the river runs under the train tracks with a small margin. The parking facilities here consume a large and valuable area that could be used for water management.

Inefficient transport: Traffic congestion

Car-based mobility in Asker center causes congestion of the road system. It becomes difficult to access the city center and the primary road system in the peripheries, the bus lanes become blocked, the buses no longer connect efficiently to the train station and time spent travelling to and from work increases.

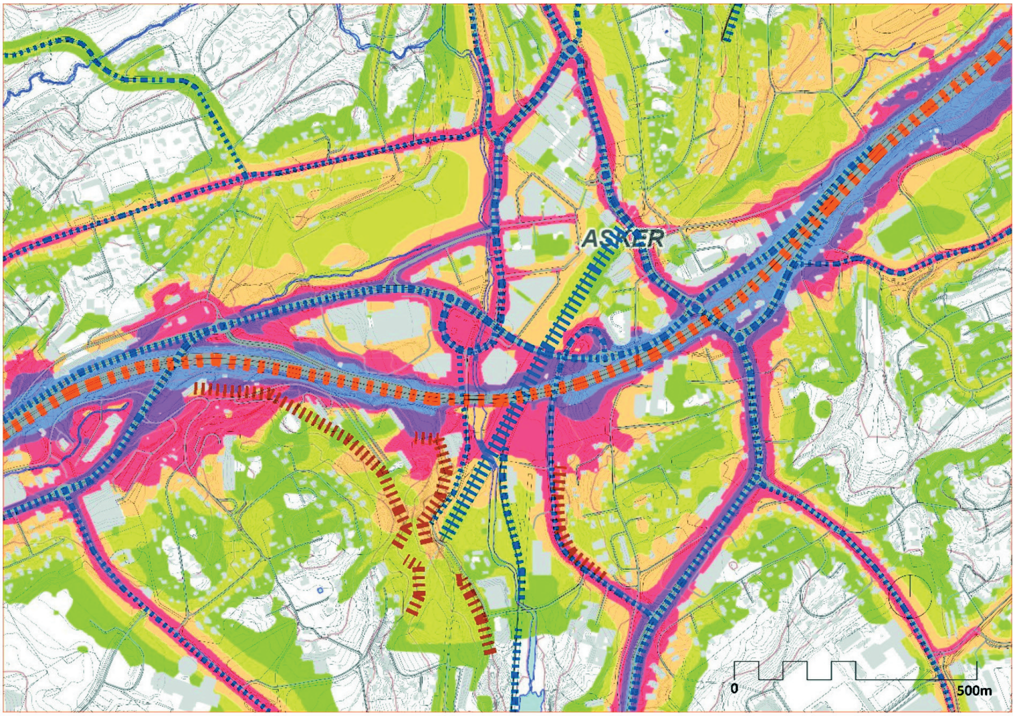

Fig.4 Noise and fragmentation of territory in Asker. Here a noise analysis from the municipality is combined with an analysis of traffic and topographical barriers in Asker center. Red areas are significant noise impact of the motorway E18 and the main roads in Asker center. The discontinuous lines show the fragmentation of the territory due to infrastructure and the topography.

The motorway E18 crosses Asker center, connecting it to Drammen and to Oslo. This infrastructure acts as a major barrier that fragments the city center, causes noise and air pollution and significantly impacts the possibilities for urban development (see Fig. 4). Both this motorway and the primary local road system have experienced an increase in traffic and are heavily congested, especially in the rush hours. In 2010, E18 had an average daily traffic of 68.600 and the prognosis for 2024 is that it will increase to 79.600. From 1991 to 2010, the average daily traffic on Røykenveien, one of the main roads traversing the city center, has increased 50%, from 11.500 to 17.200 vehicles. In the same period, Drammensveien experienced a 40% increase, from 7.500 to 10.500 (Asker Kommune 2014. Kommuneplan 2014–2026). These highly trafficked roads become also barriers that fragment the neighborhoods surrounding the center.

Impoverished urban life

Use of the motor car and the process of urban dispersion has dissolved the once close relationship between living and working. Dissociation of functions has led to development of unstructured city centers designed for the car. These are characterized by large asphalt areas and they lack urban qualities, city life and identity. The centers are surrounded by undefined mono-functional, low density, car-dependent housing areas, spread outwards in the territory (Newman et al. 2017).

The former permeability of a network of streets, small roads and paths has been compromised by the specialization of the motor roads. Those streets, small roads and paths not only served longitudinal movement but were also connected transversally, generating activity and bringing life *along* the movement. Speed and efficiency have won over local connectivity and living qualities.

The regeneration of Asker center: The central *Urban Walkable Unit*

The prognoses for Asker for the period 2014 to 2026 show an economic growth of 1.5% per annum and population growth of 882 inhabitants per year. Today's 58.000 inhabitants will have become 68.000 in 2026 (Asker Kommune 2014. Kommuneplan 2014–2026). In order to meet the goal of reducing CO2 emissions 85 to 95% by 2050 in relation to the reference emission levels of 1990, (Klima- og Miljødepartementet 2017) the municipality wants to direct this growth into areas with good public transport capacity. Thus, most of the growth in housing and jobs will happen in Asker center. Together with this growth, a plan to build a new tunnel for the motorway E18 where it crosses Asker center (Statens vegvesen 2016) opens up an opportunity to regenerate the urban structure in Asker, making it more sustainable and resilient. The *Urban Walkable Unit* concept applied in this study aims to reshape Asker following three fundamental premises:

– to recover water as the main structural element in the urban landscape, re-integrating what we refer to as logic of water, integrating the natural water cycle into the built environment to provide the capacity and space needed to absorb and respond to increased amounts of water, a challenge that climate change will bring.
– to abandon the private car as the dominating means of transport, searching for configurations that could enable car-free cities by effectively combining public transport and individual soft mobility. This transition will liberate space needed for management of surface stormwater.
– once the main structures water and mobility are in place for the necessary capacity and connectivity, to improve various qualities in the built environment and urban life in order to ensure the success of the model.

Integration of these three pillars has led to the definition of the *Urban Walkable Unit - UWU-*, a basic element (see Fig. 5) of urban design. Aggregation of these units would allow a low-carbon, highly resilient, intense and lively urban configuration. The *UWU* covers a somewhat circular area of approximately 500m radius around a public transport node. The dimension of the *UWU* relates to human walking mobility. Estimating an average moderate speed for walking of around 50 m/min, the proposed 500m radius implies a maximum 10 minutes' walk from the border to the central node. The limits of this circle adapt to the topography of the site, integrating as much green areas and natural waterways as possible and seeking a maximal slope of 1:15 to enable universal design.

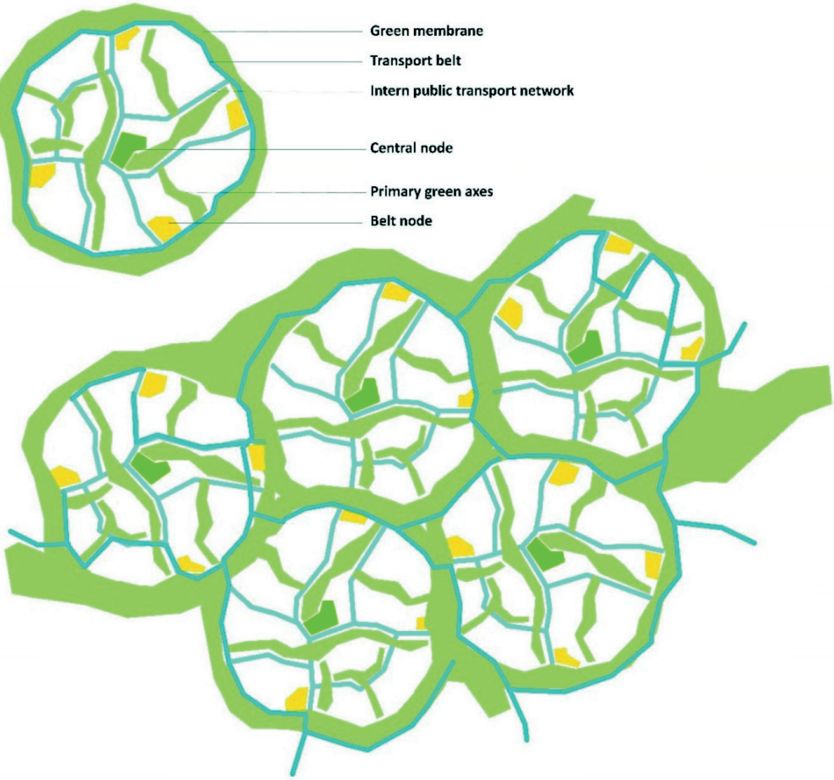

Fig. 5 The Urban Walkable Unit is designed and structured following the logics of water and human walking mobility. It aims to recover the capacity and permeability that water needs as it crosses the city and to ensure an efficient combination of collective transport and soft mobility that can offer an alternative to use of the private car.

Recovering the logics of water

The *UWU* recovers water as the main structuring element organizing the city. The blue-green structure functions in each *UWU* in three levels (see Fig. 6):

i. *Green membrane around the unit*. A ring system defines the outer borders of the *UWU*. It is a permeable membrane that regulates the exchanges of the unit with adjacent units or not-yet-transformed areas. The green membrane develops important functions, such as shaping the contours of the unit, controlling excessive outward growth and size that would compromise the walkability of the unit, or favoring biodiversity as it retains and develops its natural character, suitable for a rich and varied plant and animal life.

ii. *Primary green axes*. These include the main waterways and green spaces inside the *UWU*. Together with the green membrane, they form the main blue-green structure, providing the required space for water management, purification basins, floodways and floodable parks.

iii. *Secondary green structure*. Rainwater collected on roof gardens of buildings and on semi-private courtyards is guided over the surface as a landscape element. This fine-grained blue-green network supplies a very high capacity to absorb and manage the water. It also provides high connectivity, as it ensures that from any point in the *UWU* the primary recreational green areas are reached in less than 5 minutes of walking through high quality pedestrian areas.

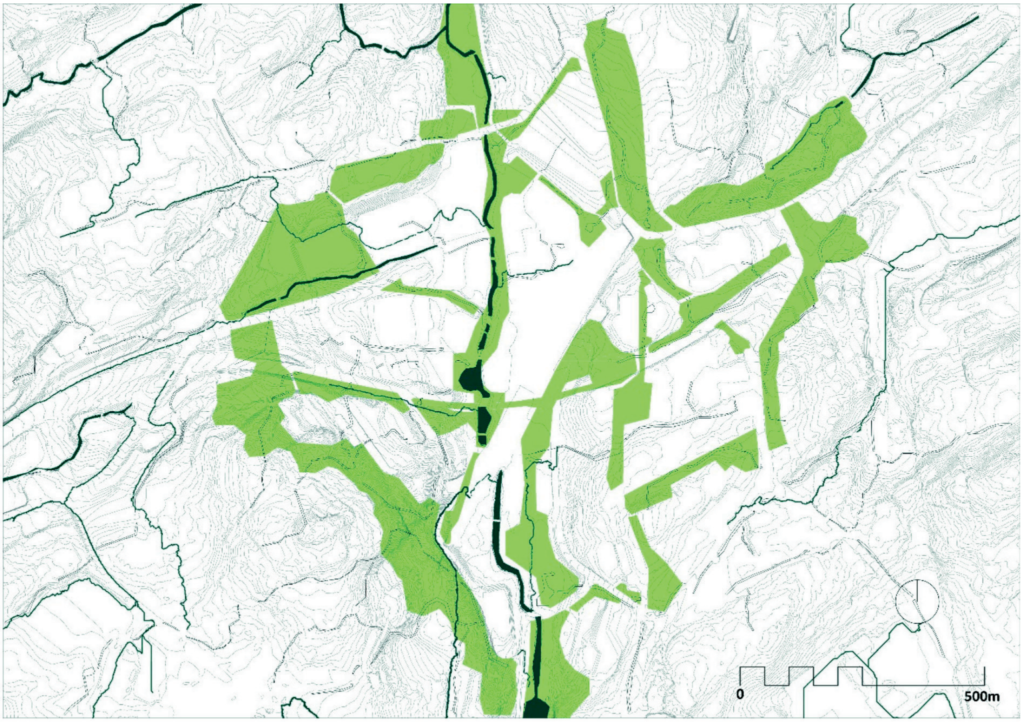

Fig.6 Blue-green structure in the central UWU in Asker. The green membrane defining the form of the unit is in principle a circle 500 meters radius from the train station, but bends to adapt to changing topography and include water structures and existing green areas.

Green mobility

Improvement of public transport alone cannot substitute for use of the car in our cities, as it would be inefficient to cover the entire area in the unit. It needs to be complemented by some degree of individual soft mobility: walking or cycling. The *UWU* mobility system functions on three levels (see Fig. 7):

i. Transport belt around the unit. A ring system defines the limit for the use of the private car. The belt is an essential part of the public transport system, containing special lanes for buses circulating constantly. In order to avoid attracting cars inside the *UWU*, parking spaces are removed from the center and located in strategic points of the ring system, the *belt nodes*. These facilities also contain car pools where it is easy to rent a car for special needs, and other uses that activate the public space. The nodes will function as important generators of activity, as people who use the car outside the *UWU* will leave them at these points and start walking.

ii. Internal public transport network. This internal structure, together with the belt system, forms the public transport network. It is high frequency, effective set of bus and microbus lines that connect all the areas of the unit with each other and with surrounding units. Use of private cars is highly restricted inside the *UWU*. Instead, the geometry and dimensions of the public network ensure that from any point in the *UWU* a person can reach a bus stop in this primary public network in less than 2 minutes, that is, 100 meters. The design of the stops offers an effective exchange between the bus lines.

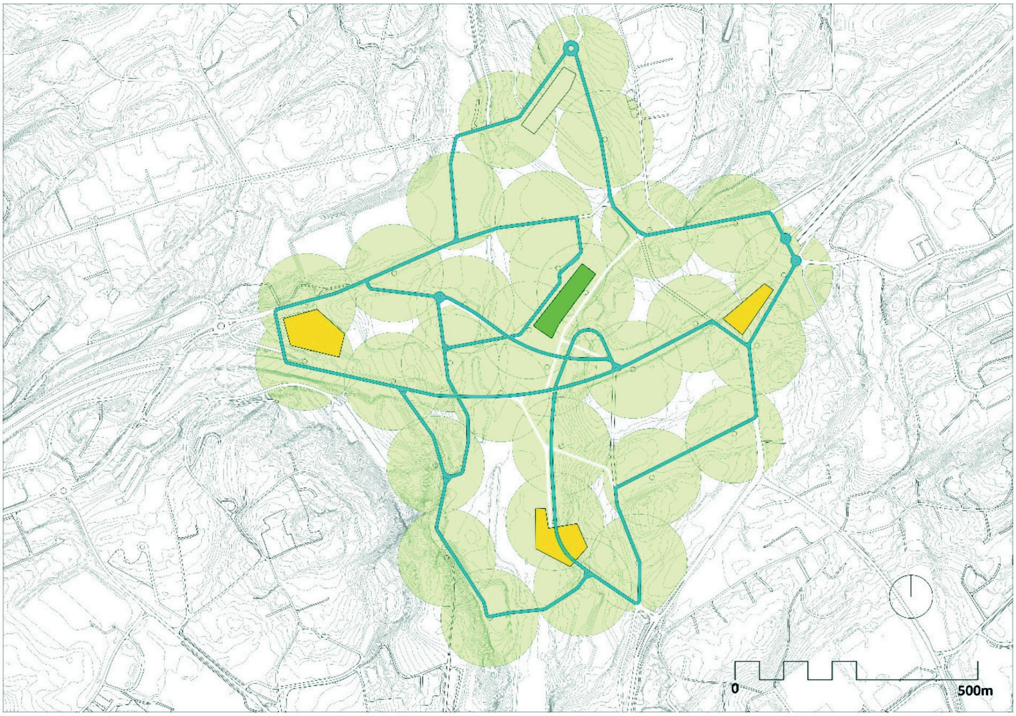

Fig.7 Public transport network in Central UWU Asker, showing in yellow the belt nodes for parking, and in green the central location of the train station – within 10 min. walk from any point in the UWU. The 100m radius circles around the bus stops show that they can be reached by 2 minutes' walk from any point in the UWU.

The *central node* is the heart of the *UWU*, containing the bus terminal, and in this case, the train station also. This point establishes an important hierarchy in the unit, connecting it efficiently with other central nodes in surrounding units or other cities in the territory.

The central node is an enormous attractor, holding the walking city together around its intense urban life and the high connectivity it offers both locally and externally. The central node will control dispersion and catalyze in its place a phase of inwards urban growth, favoring densification and increase of activity around its gravitational force.

iii. Secondary soft mobility network. Quick access to the main public transport network is essential. A high quality, fine-grained pedestrian and bicycle path system (see Fig. 8), including universally designed shortcuts between buildings, adapted to the topography and to the local conditions and qualities, ensures connectivity to the bus stops.

Fig.8 Fine-grained soft mobility. The removal of many of the present asphalt areas in Asker will allow design of a well-connected high quality pedestrian and bicycling path network.

Intense Urban Life

Once the main structures for water and collective transport are defined, the *UWU* is suitable for a densification process of inwards growth that will progressively fill the gaps left by former parking spaces, the interstitial residual fragments between infrastructures. This urban regeneration will integrate new built structures that will re-connect isolated areas, creating overlapping functions that will support a vibrant urban life. We can distinguish three intensities within the *UWU* (see Fig. 9):

i. Natural free areas along the green membrane. Nature is a high priority along the membrane and it is high accessible, both towards the inside of the *UWU* and to outside areas, being very well served by collective transport. Thus these areas are appropriate for uses that demand large outdoor areas, such as schools, sport facilities, recreation and agricultural production. Special generators of activity in the membrane are the *belt nodes*, that combine car-pool and parking with offices, commercials and housing.

ii. High intensity urban life along the public mobility structure. The *UWU* ensures that distances to green areas and collective transport are walkable. The urban fabric can then be densified, allowing an overlap of functions that can reduce the distance between different uses such as housing, offices, shopping, cultural activities, meeting places, recreational uses and sport areas. This will allow soft mobility. High density and mixed use is an opportunity to bring more people together, increasing the intensity of urban life and social exchange and developing high quality design of urban spaces.

iii. Lower intensity areas. It is important that some of the areas maintain their medium or even low density, enriching the unit with variation in scale, intensity or character. Some may contribute, for example, high quality historical housing environments, farming or agricultural fields that add a social integrating value – or areas that keep their low density until future densification.

Fig 9. Blue-green structure and an effective public transport network, ensuring capacity for water management and connectivity, set the qualities of urban life and the premises for future inwards densification. The natural free areas of the green membrane and green axes will provide recreational uses, sport facilities and schools. The high intensity, mixed-use generators and the highly activated areas between them in yellow (where the most vibrant urban life takes place) coexist with other, lower-intensity areas.

Toward a water-sensitive and car-free redefinition of the dispersed city

Strategies to date for sustainable regeneration around public transport nodes, the transit-oriented developments, have been mainly focused on densification of central areas. The main approach has been to substitute low density areas with built structures that increase the square meter ratios, fill former parking spaces, and transform abandoned industrial terrains. This strategy alone will not solve the main impacts of urban sprawl: the separation between the city center and the dispersed mono-functional housing peripheries, and the strong dependence on cars as the means to connect them.

The application of the *UWU* concept ensures basic urban qualities such as permeability and capacity for water, and the possibility of car-free mobility. These units are designed as elements which can be aggregated to structure more complex urban settlements (see Fig. 5). The challenge in the case study of Asker has been to investigate how peripheral *UWUs*, linked to the central *unit*, can enable a redefinition of the dispersed city as well, bringing new life. Integration of the surrounding and often unstructured tissues with regeneration of central areas aims to overcome the center-periphery dichotomy. It evokes an understanding of the city as a continuous, well-connected whole system (Fraker 2013) binding together different urban intensities.

Recovering the permeability and capacity that waterways need

The urban system has to be managed as a whole. In particular the hydraulic system must be integrated into its landscape and act as a guide for future urban development. "In summary, water is now, more than ever, a strategic aspect of urban development" (Picon 2005, p.99).

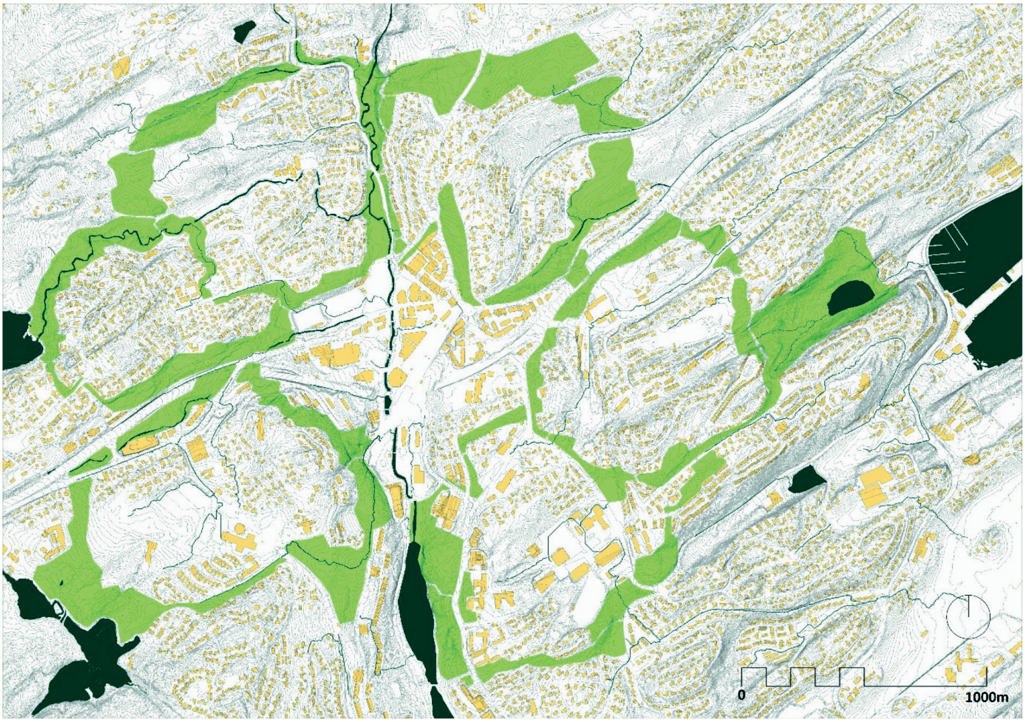

Fig.10 Aggregation of UWUs, each one designed following the logics of the water, creates a blue-green structure that recovers the permeability and capacity that waterways need, provides the resilience necessary to resist the challenges of climate change, and binds the city to surrounding landscape values.

An alternative system in which the storm water is handled on the surface within the proposed green areas of the *UWU* system would lessen the pressure on the old pipe system and reduce the quantity of storm water before it reaches the densified city center. The form of the waterways should provide capacity to store rainwater for local usage and to accommodate periods of heavier rain. Infiltration of storm water where it falls permits variation in the vegetation, as well as a basis for greater biodiversity. Diversity in the green areas gives an aesthetic visual richness that adds qualities to the built environment and stimulates walking and biking. The structure that follows tributaries creeks and their winding geometric ways through the topography takes the form of the landscape, changing and enriching the view at each step.

The isotropic green mobility network

In order to overcome dependence on the private car, a new model for transport is needed. If the model is to change the prevailing mentality it must be proven advantageous for the people using it. The habit is now to drive from door to door, from the private parking space to the parking located just outside the jobs, the train station or the shopping center.

An alternative mobility system, combining collective transport and individual mobility, has to explore the functional limits of both systems in order to find a balance between them. How long are people willing to walk, and when does the distance become so long that they would rather take their car? How fine-grained can public transport cover the city before it loses efficiency, making it economically impossible to provide the expected frequency and quality of service?

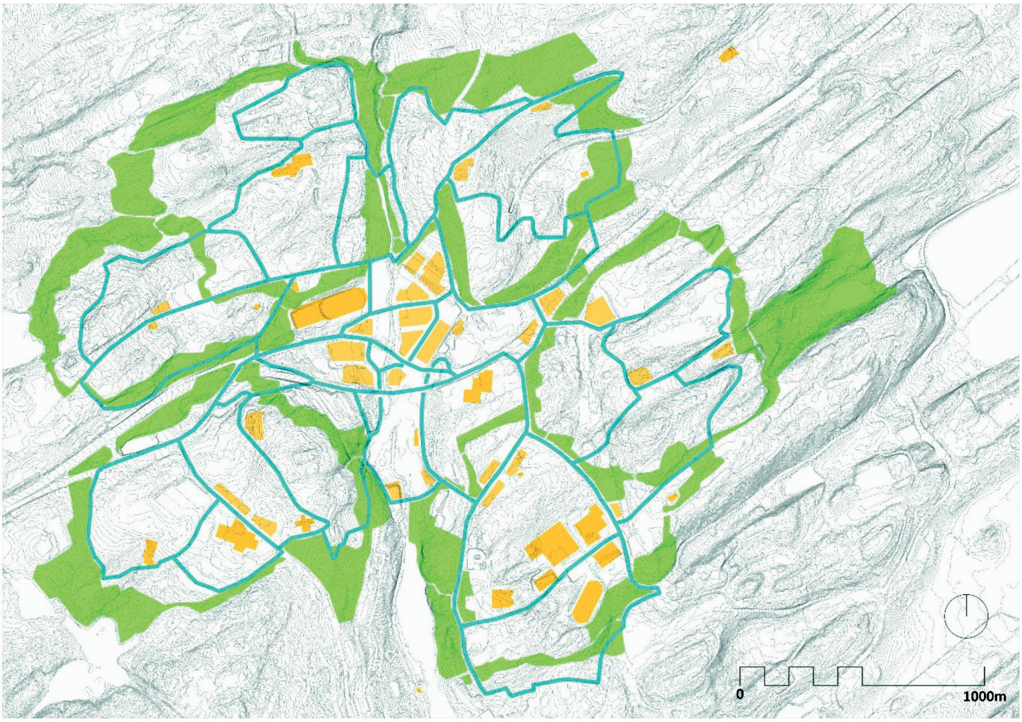

Fig.11 The public transport structure binds effectively all the different UWUs in Asker, not just radially toward the central unit, but creating an isotropic network that also relates each peripheral unit with the others.

The public transport network needs a high degree of flexibility, not just to adapt its size and frequency to changing conditions, but also to function in the complex Norwegian topography (see Fig. 11). The bus and microbus, powered by renewable fuel, offer the most effective possibilities.

It is also essential that the transport network itself is permeable transversally (see Fig. 12), so that it does not become a barrier that fragments the urban areas it crosses. The design of the network will not just connect longitudinally from one point to another; it needs to be porous to allow walking and cycle paths to cross it. The green mobility structure will thus maintain the connectivity, favoring urban activity and interaction along it.

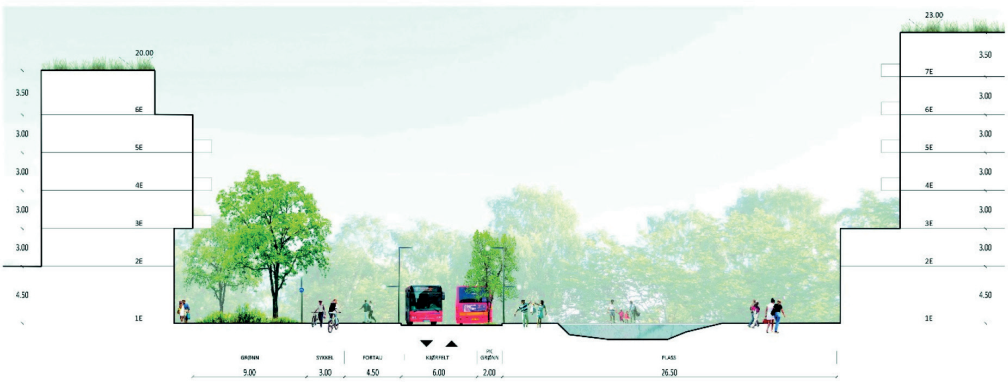

Fig.12 Permeability along the transport network. In the design of the street system it is essential to allow transversal porosity and stimulate urban activity along it.

The new polycentric city

In the case study Asker, some of the *UWUs* that surround the central unit already have functions that could enable in each of these a new hierarchy, a *central node* (see Fig.13). Some of them are existing schools and kindergartens, other contain important sports facilities, concentration of office buildings or old farms with historical value that could also become social meeting points.

In some of the peripheral *UWUs* there is not yet any special function other than private single family housing and private gardens. Then a seed for the genesis of the public domain has to be inserted, beginning for example with small incentives such as a playing ground, a new sports facility, a public meeting place or public garden. This node should have a good connectivity or a view to the landscape, complementing the visual experience and perception of the internal qualities of the *UWU*.

Consolidation of the central node in each of these peripheral *UWUs* could be further catalyzed by frequent public transport in these nodes, crossing and interchange of different microbus lines, and attractive design of their outdoor spaces. These qualities will favor the locatization of new office and mixed-use buildings, daily local shopping and cafés that will increase urban life at these points.

In order to start integrating the dispersed city it is necessary to consolidate these surrounding *UWUs*, connecting them not just radially to the central unit but also with each other (see Fig.11). Each one should maintain its identity and character, exploiting the values of its particular orientation, topography, vegetation, urban density and characteristic mix of uses, thereby generating a polycentric city that offers variation and diversity (see Fig.13).

Fig.13 Redefinition of the dispersed city of Asker as an aggregate of well-connected UWUs enables a variety of different urban structures to be developed and integrated, allowing areas with high intensity to coexist with other less intense neighborhoods.

Concluding remarks

Introduction of the regional plan for Oslo and Akershus county (Akershus fylkeskommune, Oslo kommune 2015), promotes densification of selected nodes of public transport, of which Asker is one. These areas are meant to take 80–90% of the urban growth in the years to come. We propose here a water sensitive and car-free redefinition of the dispersed city of Asker. It radiates out from the defined center at the train station and includes already existing built areas where the main car-dependency is found.

Planning needs to take into account on one hand the landscape structures and its waters, if it is to actively guide future urban development and densification toward the goal of becoming a resilient system. The challenge is to recover the permeability and capacity that waterways need in a period of heavy densification. The *UWU* permits development of larger areas upstream, releasing pressure on the city center. The space liberated from the cars is used to benefit storm water management and soft mobility.

Abandonment of use of the private car demands a profound change in our mentality regarding transport. Awareness of the strong impact that it produces in the environment, being one of the main factors contributing to climate change and having experienced the lack of qualities in the outdoor spaces that car-based urbanism has generated, makes necessary the search for more sustainable transport models for our cities.

Development of the knowledge economy has renewed peoples' interest in living closer to work and having quick access to public transport and to the intensity and possibilities of urban life, culture and recreation. In order to attract talented people, more and more jobs are being located in central areas of the walkable city, catalyzing regeneration of the cities.

This change in mentality is only possible if urban planning is able to define an alternative to the use of the private car that can demonstrate clear advantages. These advantages will include time-efficient transport between living and working activities and many qualities that a regenerated built environment can provide: resilience in the water system (in terms of capacity and storm water management), health benefits and perceived well-being, increased biodiversity and a more vibrant urban life.

References

Akershus fylkeskommune, Oslo kommune, 2015. Regional plan for areal og transport i Oslo og Akershus.

Asker kommune, 2014. Kommuneplan for Asker 2014–2026.

Asker kommune, 2017. Kommunedelplan for vann 2018–2029.

Asker kommune, 2014. Strategi for innfartsparkering og tilgjengelighet til kollektivsystemet.

Dunne, T., Leopold, L.B., 1968. Water in environmental planning.

European Environment Agency, 2017. Climate change, impacts and vulnerability in Europe 2016.

Fraker, H., 2013. The Hidden Potential of Sustainable Neighborhoods. Lessons from Low-Carbon Communities.

Klima- og Miljødepartementet, 2017. Lov om klimamål.

Newman, P., Beatley, T., Boyer, H., 2017. Resilient Cities. Overcoming Fossil Fuel Dependence. Island Press.

Picon, A., 2005. Constructing Landscape by Engineering Water, in: Landscape Architecture in Mutation. Gta Verlag, Zurich, pp. 99–114.

Statens vegvesen, 2016. E18-korridoren i Asker.

Tjallingii, S., 2015. Planning with water and traffic networks. Carrying structures of the urban landscape. Research in Urbanism, 3 57–80.

Viganò, P., 2008. Water and Asphalt: The Project of Isotropy. Veneto Region, Italy, in: Water Urbanism, UFO. SUN, Amsterdam, pp. 20–27.