

## A LANDSCAPE FRAMEWORK FOR THE DISPERSED OSLO METROPOLIS

Master thesis, AHO, spring 2017 | Roger Stemsrudhagen

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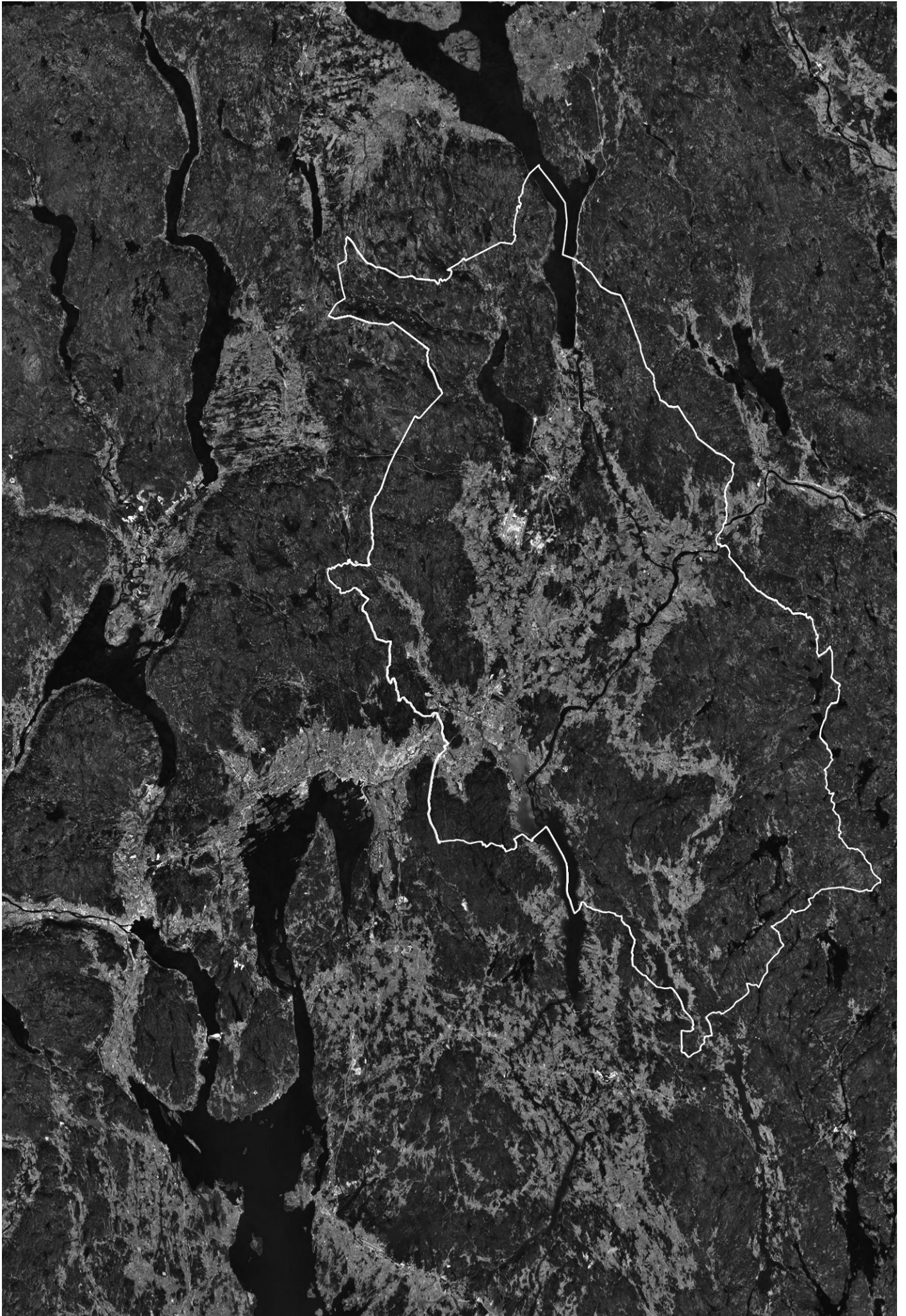
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Institute of Urbanism and Landscape

All material including photographs and maps,  
unless otherwise stated, is by the author.

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## Introduction



The dispersed, metropolitan region of Romerike, located east of Oslo, has experienced a substantial population growth the past 20-50 years. This growth is expected to continue in the future, and the population projections towards 2040 predicts an additional 400.000 individuals in the region<sup>1</sup>.

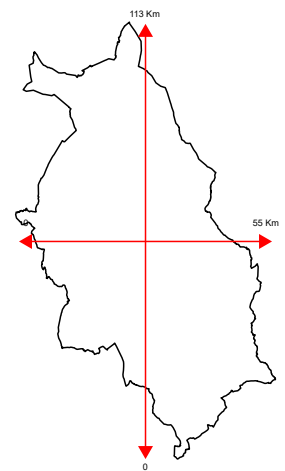
To accommodate this growth, the railway system is upscaled throughout the region, and according to the Regional Plan of Land Use and Transportation in Oslo and Akershus, 80-90% of the growth will be directed to a few selected nodes within the framework of a polycentric, transit oriented development model.

45 000 people commute from the region to Oslo on a daily basis. Depending on the destination within Oslo, the share of private cars lies between 32 and 85 per cent<sup>2</sup>. The road traffic contributes to severe congestions in the road network during rush hours, where traffic counts reaches an annual average daily traffic (AADT) of close to a 100 000 vehicles on the approach roads to Oslo. This yields high levels of pollution and socioeconomic stresses.

Local buses in the dispersed areas are slow due to large geographical coverage and a hierarchical mobility network. As a consequence, people choose the private car over public transportation.

The regional plan has a strategy for absorbing growth in a few regional cities, but it seems to lack a strategy for the dispersed areas, other than adhering to a maintenance growth of 10-20 per cent to maintain a stable living environment.

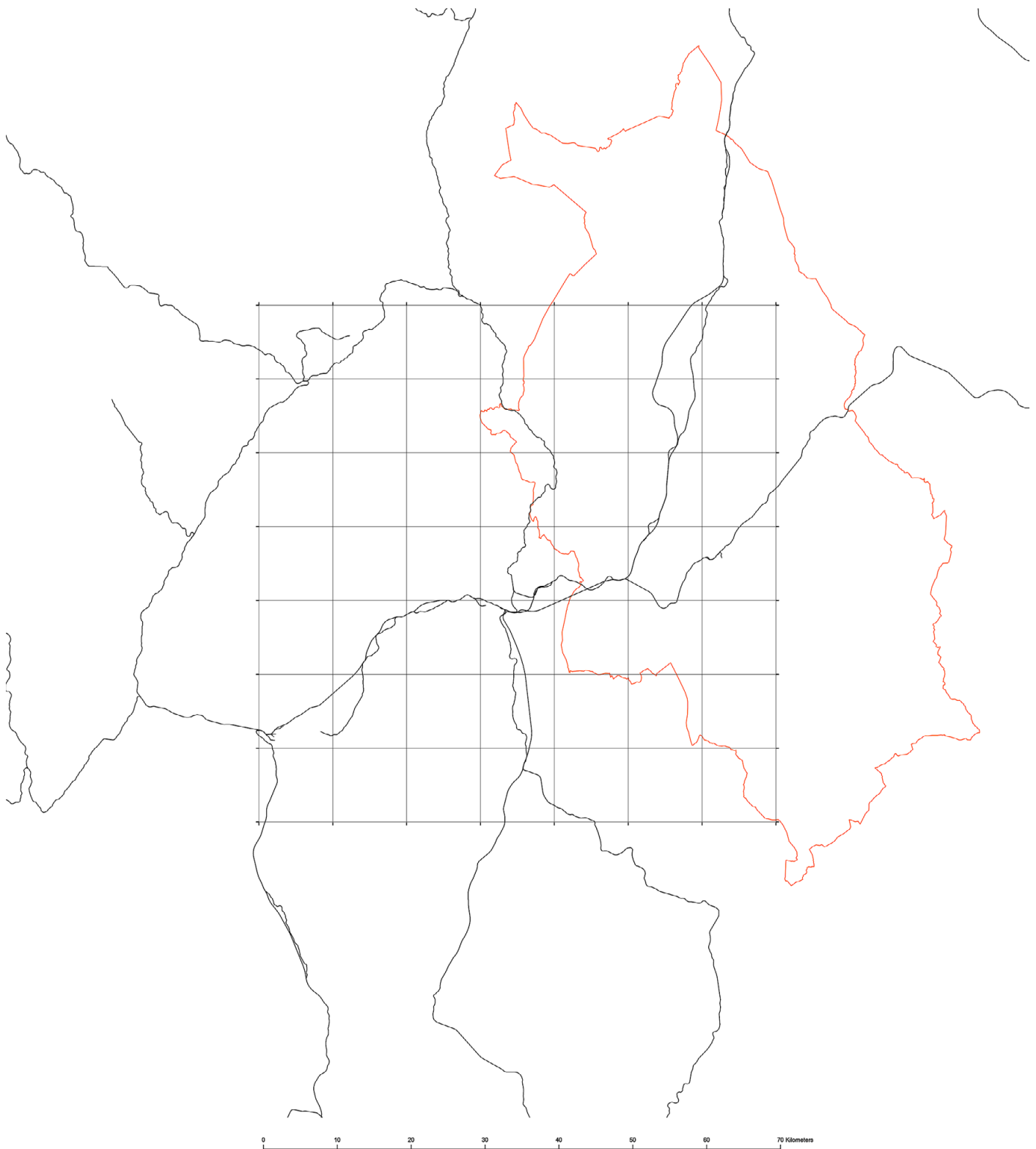
The dispersed settlement structure of the Romerike region has ancient roots, and the territory has sought after qualities for main groups of newcomers. This thesis use the dispersed model as a premise to explore how the landscape of the dispersed areas can accommodate a new paradigm of public transportation by autonomous vehicles (AV), and how a continuous model of dispersion may be anticipated through a strategy which is anchored in the logic of the landscape.



The metropolitan region of Romerike is a 3740 km<sup>2</sup> territory to the east of Oslo. It holds the Oslo International airport, the main north-south, and east-west bound communication lines of train and highway, and a dispersed population of approx. 275 500 inhabitants divided among 13 municipalities.

1 Statistics Norway, High estimate for 2040: 412.863 persons

2 Hjorthol, R., Engebretsen, Ø., Uteng, T.P., 'Den nasjonale reisevaneundersøkelsen 2013/14', TØI Rapport 1383/2014, Oslo, 2014.



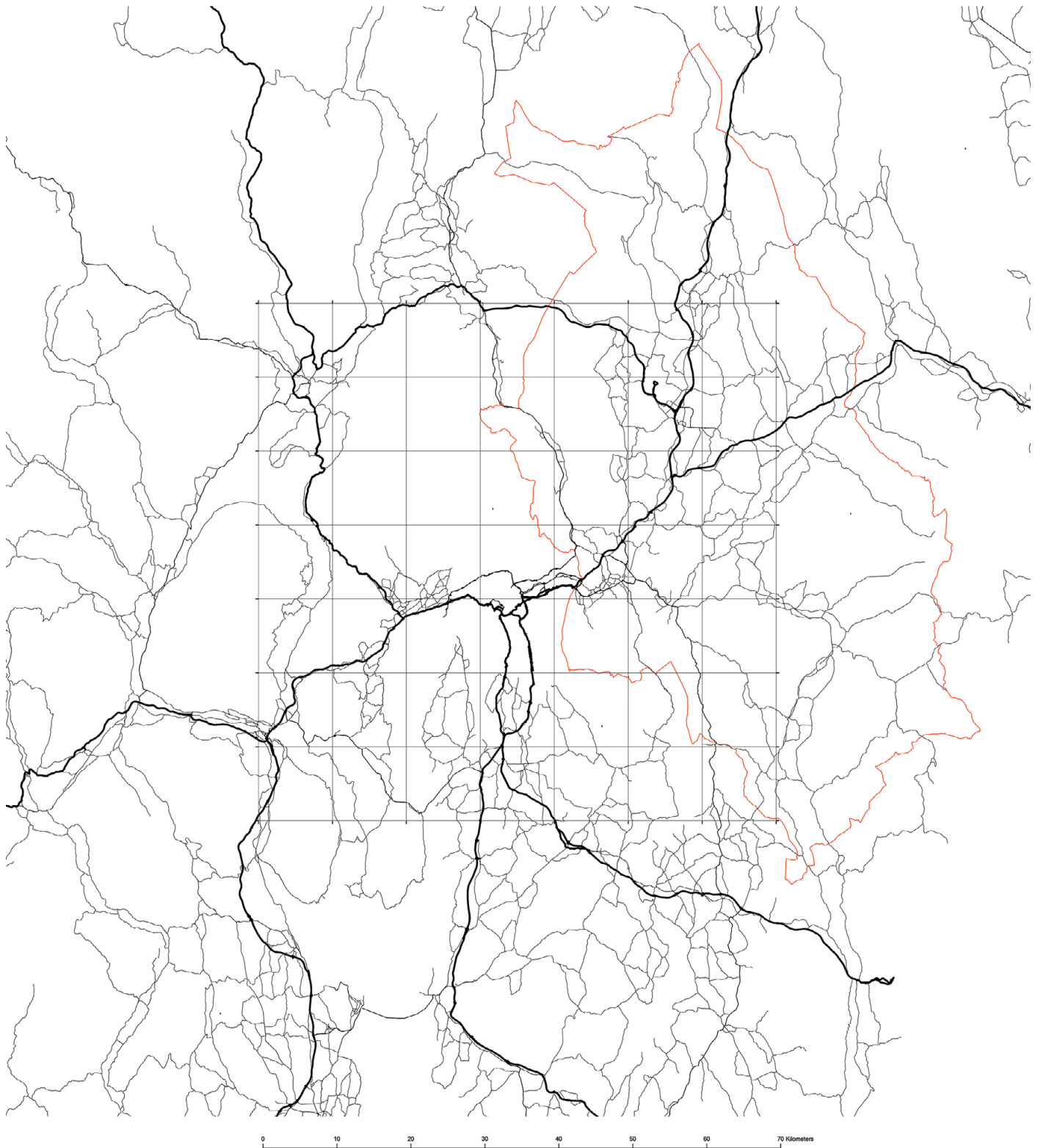
## GREATER METROPOLITAN OSLO – RAIL NETWORK

Spatial layout of the rail network. The network is characterized by a hierarchical structure, with Oslo as a dominant element.



Fig.1. Planar graph representing the structure of the railway network.





## GREATER METROPOLITAN OSLO – ROAD NETWORK

Spatial layout of the road network. The network is characterized by a hierarchical structure, with Oslo as a dominant element.

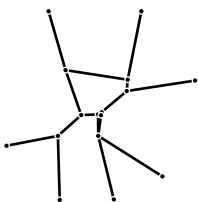
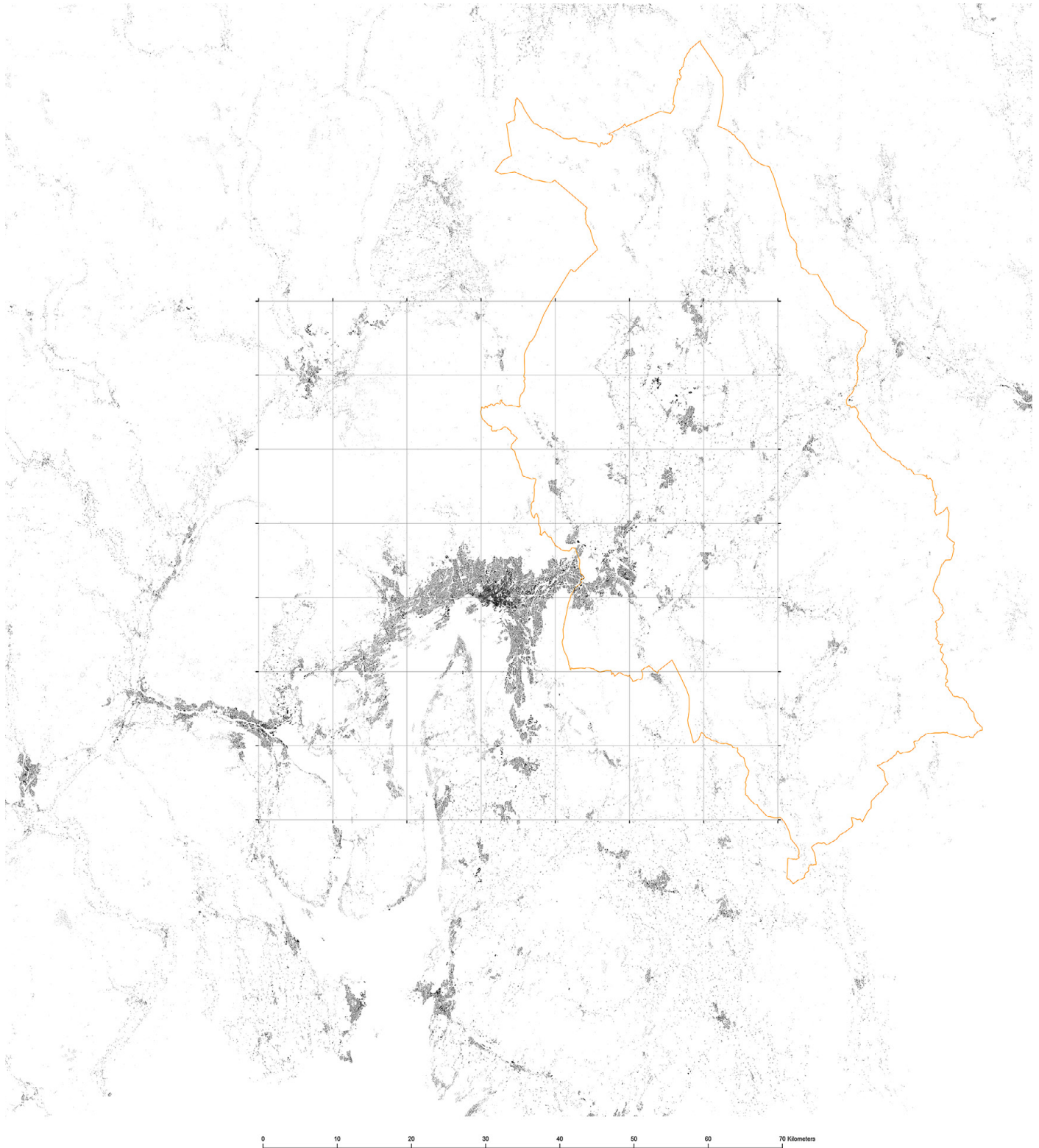


Fig.2. Planar graph representing the network structure of the road network..



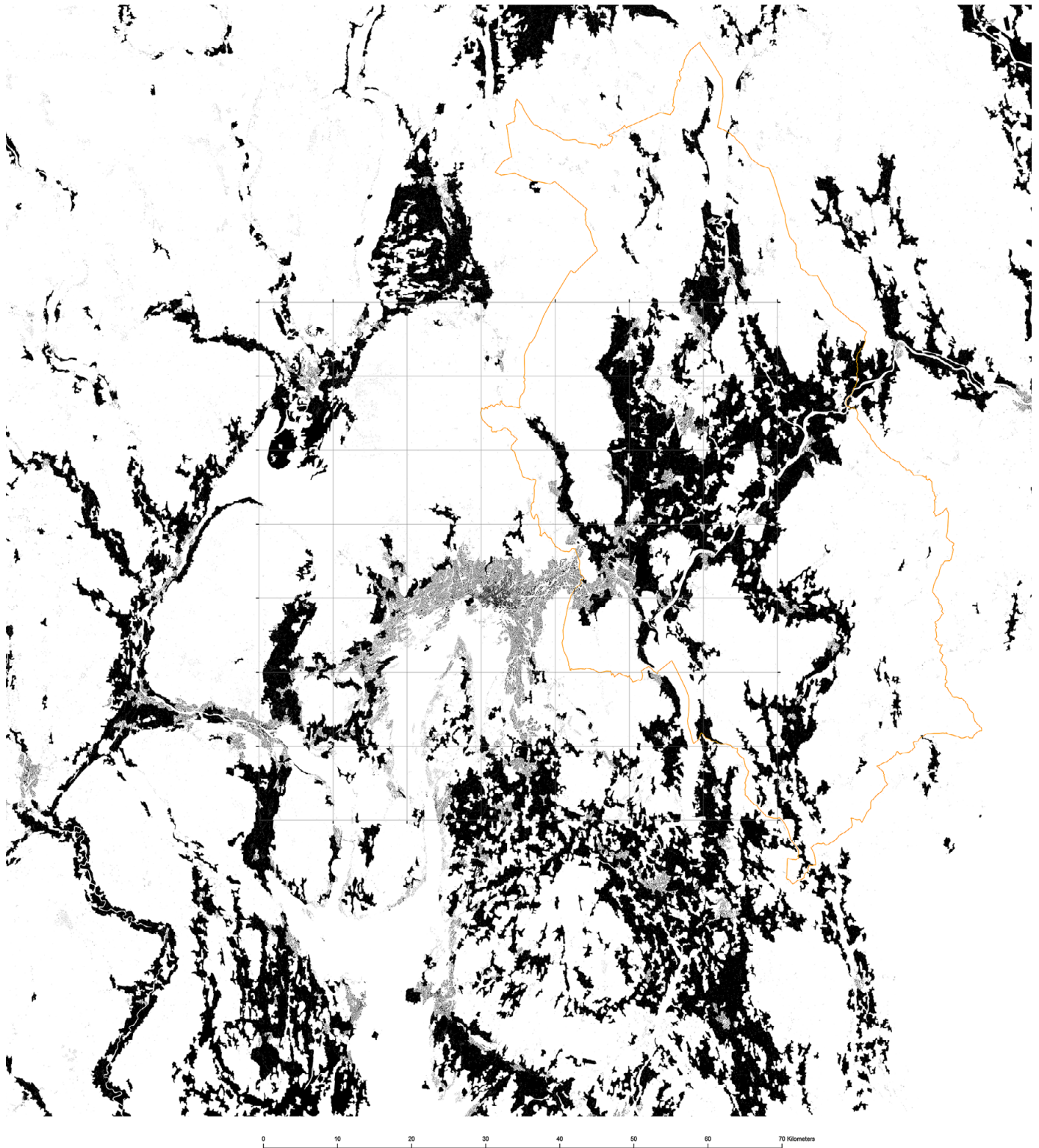
## GREATER METROPOLITAN OSLO – BUILT UP SPACE

The greater metropolitan region of Oslo is characterized by a dispersed settlement structure – referred to as a norwegian '*Città Diffusa*'<sup>3</sup>. Among the spread structures are villages, towns and patches of detaches houses in vast areas of agricultural land.

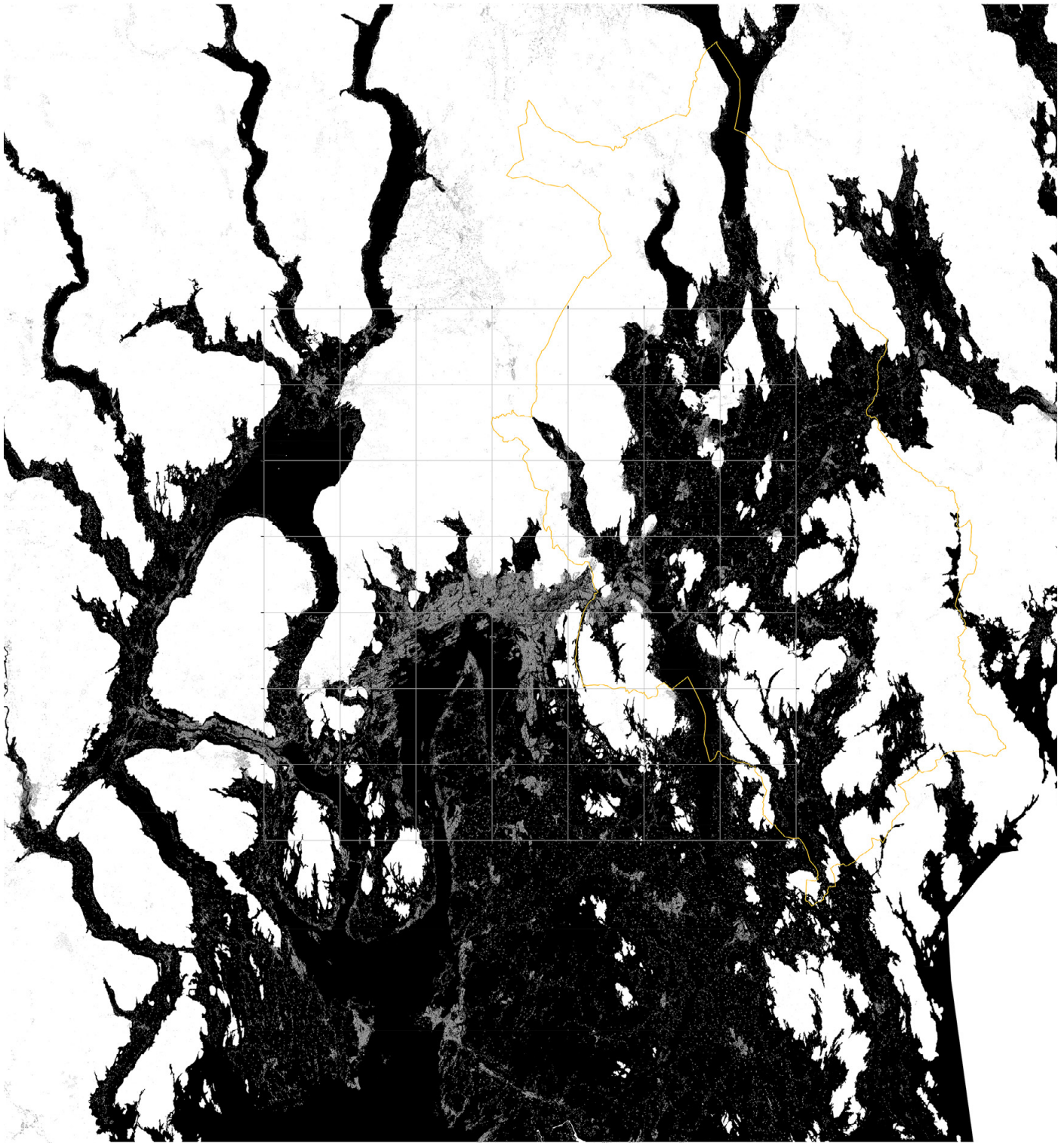
includes Oslo municipality, Akershus county, and several municipalities in the counties of Buskerud, Oppland, Vestfold and Østfold. The region has a shared work- and housing market with Oslo. The work market largely gravitates towards Oslo.

The region has a population of approx. 1.5 m, and

3 Ellefsen, K.O., 'Città diffusa - den nye urbane tilstanden', *Morgenbladet*, 5 November 1999, <https://morgenbladet.no/1999/11/citta-diffusa-den-nye-urbane-tilstanden>, (accessed 24 April 2017).



The built up areas (represented in grey) coincides to a large extent with the agricultural layer (represented in black).



The agricultural landscape occupy the areas of marine depositions (black) originating from the end of the last ice-age, approx. 9500 years ago. In this period, the land was covered by the ocean, and as the ice cap retreated, the land slowly rose, exposing rich, fertile soil consisting of clay, silt and sand.



The agricultural landscape of Romerike. Photo: Kai Krog Halse.



The Romerike plain.



A growing region



Housing development in Jessheim. Photo: Kai Krog Halse.

The Romerike region is steadily growing. Since 1986 the population growth in the northern parts of the region was 61.7%, and 49.8% in the southern parts<sup>4</sup>. This growth is expected to continue. The population projections for 2040 expects an additional 400.000 inhabitants.

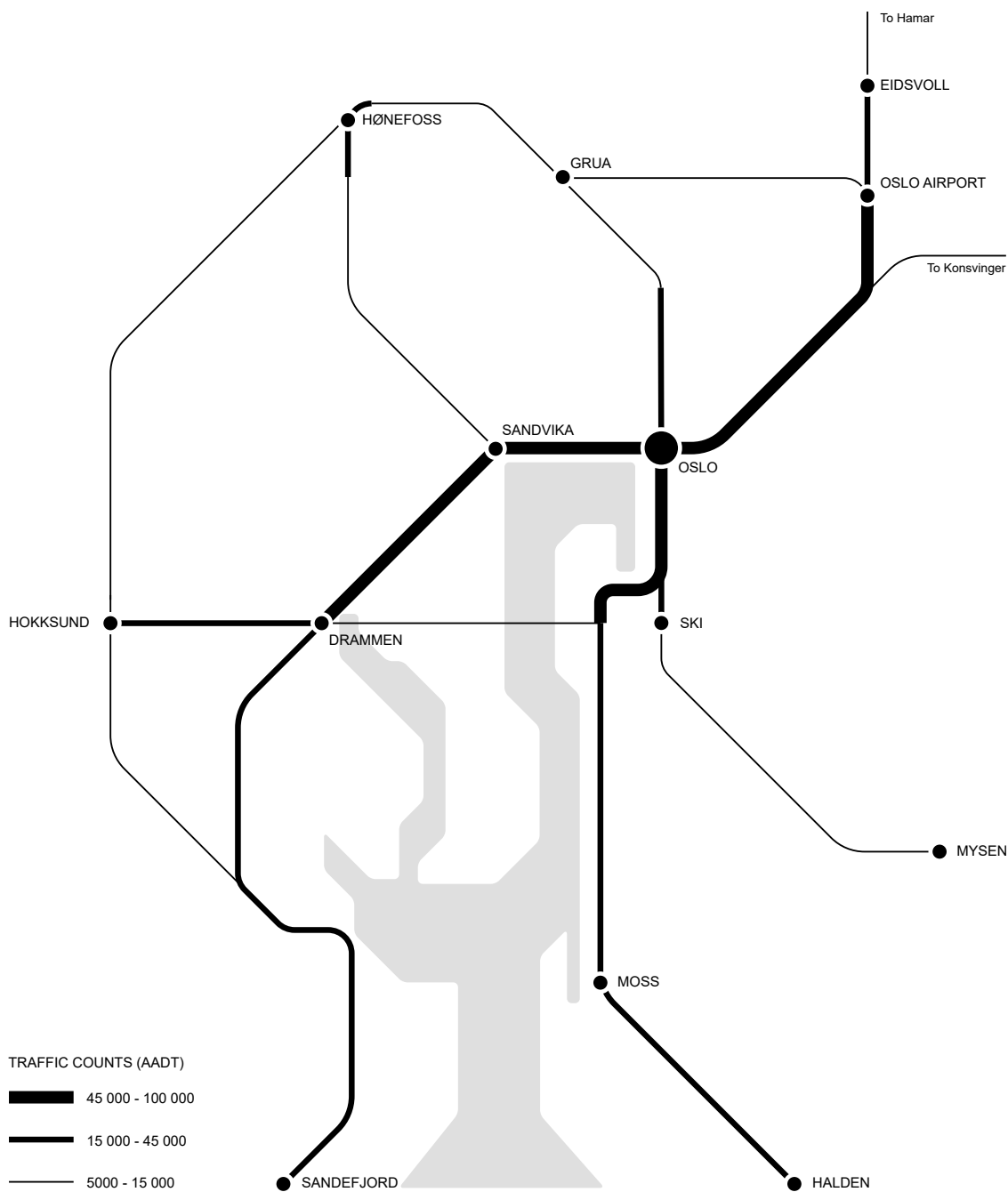
Romerike is a popular area to move to, especially for families with children. Here they can fulfill the dream of a detached house with a private garden for a relatively low cost, and with a comfortable travel distance to Oslo. This is in conflict with how the authorities wants to organize the settlement structure. The Regional Plan for Land Use and Transportation in Oslo and Akershus states that the region should be organized according to a transit oriented, polycentric model, with densification of a few nodes served by the railway.

Dispersion has been the dominant mode of urbanization in the region and has ancient roots. The landscape has been scattered with farms for more than a thousand years, setting the premise for the continuous dispersed development throughout the centuries.

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<sup>4</sup> Akershus Fylkeskommune, 'Befolkningsutvikling', <http://www.akershus.no/ansvarsomrader/statistikk-og-kart/statistikkomrader/befolkningsutvikling/>, (Accessed 22 April 2017).





### Traffic flows and car ownership

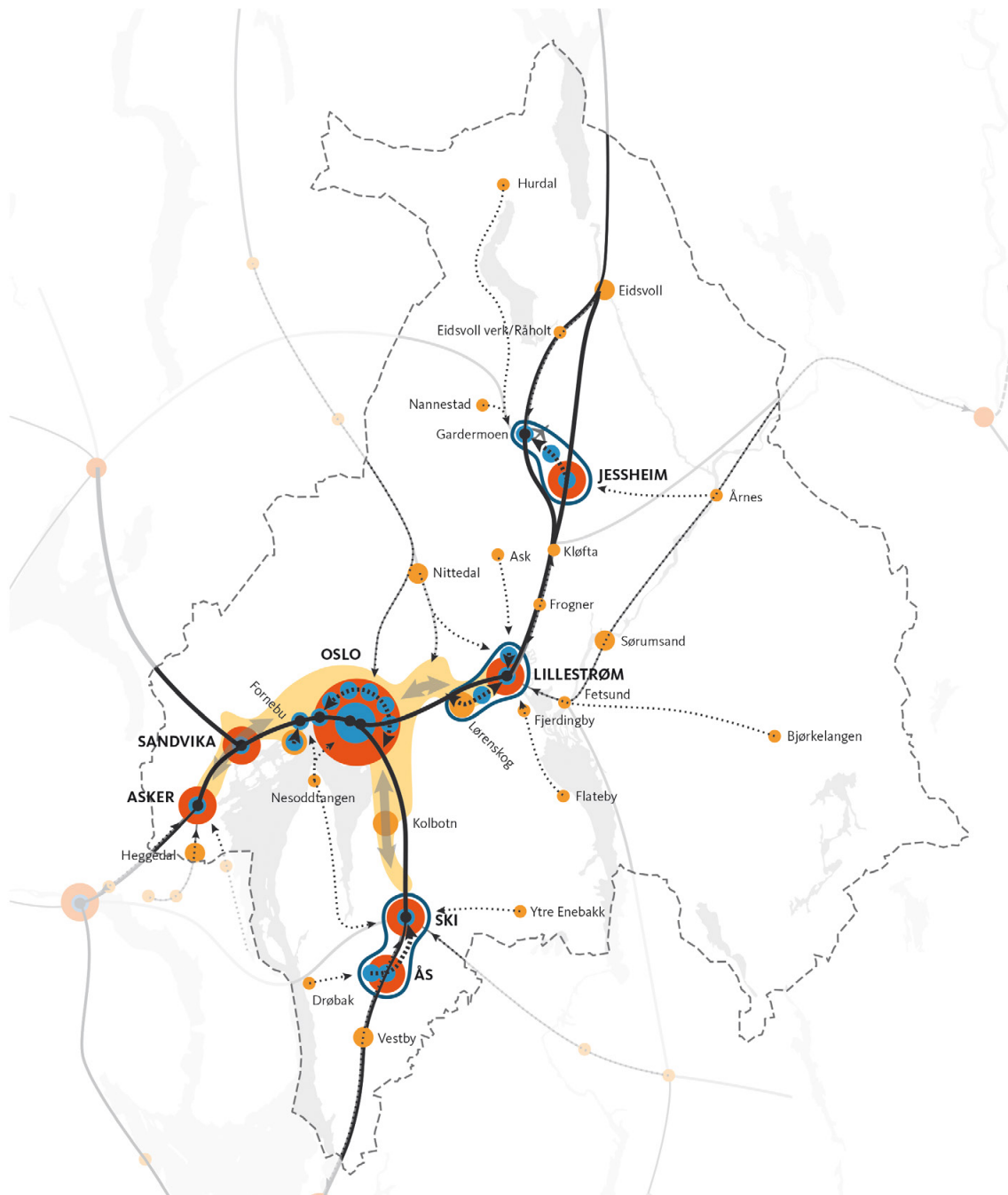
While the population increased by 23% in Akershus county between 2003 and 2016, the amount of cars increased by 46%<sup>5</sup>.

5 SSB, 'Bilbestand og folkemengde', 2016



**Traffic congestion**

Press clippings from regional newspapers portraying the critical traffic situation.



The regional plan for land use and transportation in Oslo and Akershus.

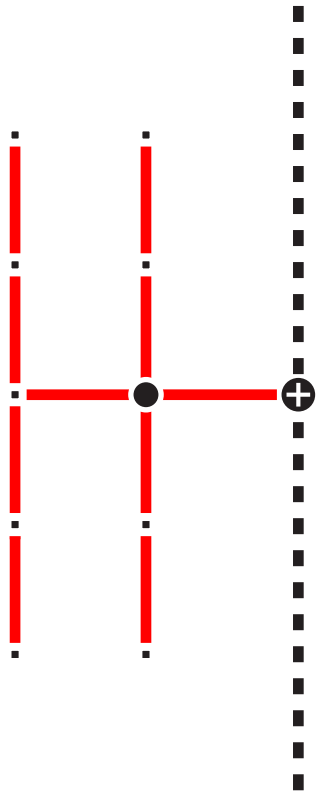
## The regional plan for land use and transportation in Oslo and Akershus

The region is currently under a polycentric, transit oriented planning regime, where the main strategy is to concentrate up to 90 per cent of the population growth in a few nodes served by the railway.

Even though the fast network of the railway is up-scaled, it will still remain poorly accessible for the population of the dispersed areas due to slow and

poorly accessible bus-connections, and low parking capacity in the nodes.

In the wake of densification some local centers experience demographic polarization. This renders local centers as mere utilitarian amenities, with stagnant social and economic activity.



- LOCAL CENTER
- ⊕ RAILWAY NODE
- ■ FAST NETWORKS (RAILWAY / FREEWAY)
- EXISTING TRAFFIC NETWORK (HIERARCHICAL)

### Current model of mobility

- Hierarchical network structure
- Low connectivity
- Slow public transportation on local level



Photo: Kai Krog Halse

## The commuters dream

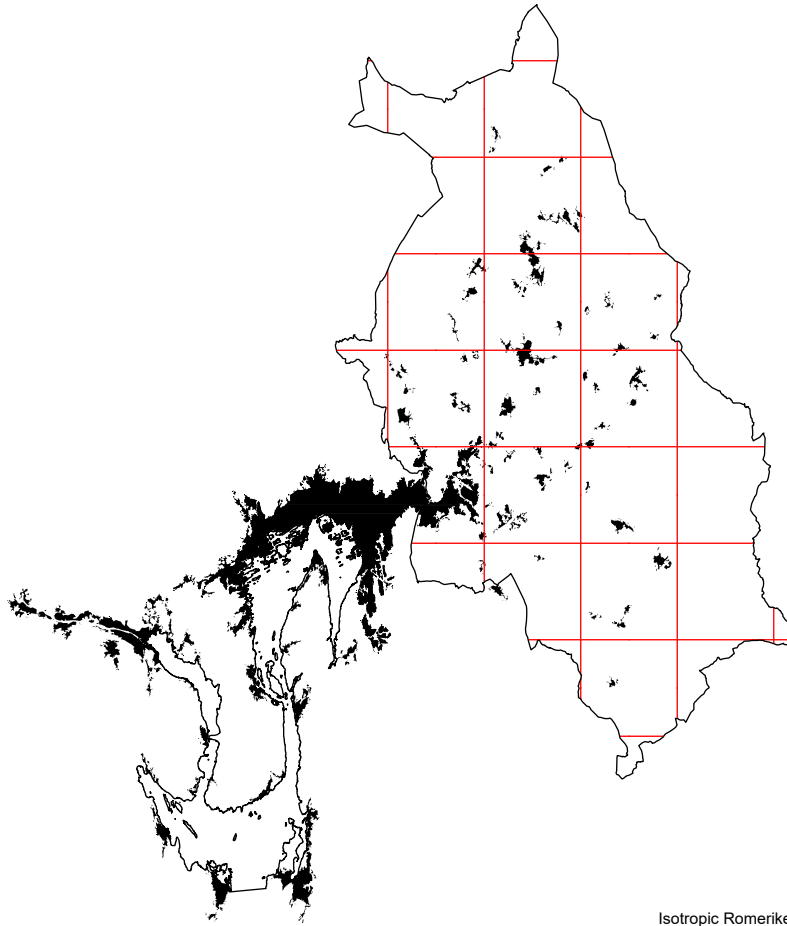
A detached house with a private garden within a comfortable travel distance from Oslo. Research on housing preferences<sup>6,7</sup> has shown that up to 86% of the population between the age of 30-39 prefer detached housing.

6 Løwe, T., 'Boligpreferanser og livsfase', *Statistics Norway, Notater 2002/59*, 2002

7 Wessel, T., 'Byfamiliene vil ikke bo der boligene bygges', *Forskning.no*, 31 January 2017, <http://forskning.no/2017/01/urbanisering/produisert-og-finansiert-av/universitetet-i-oslo>, (accessed 30 April 2017).



Hypothesis



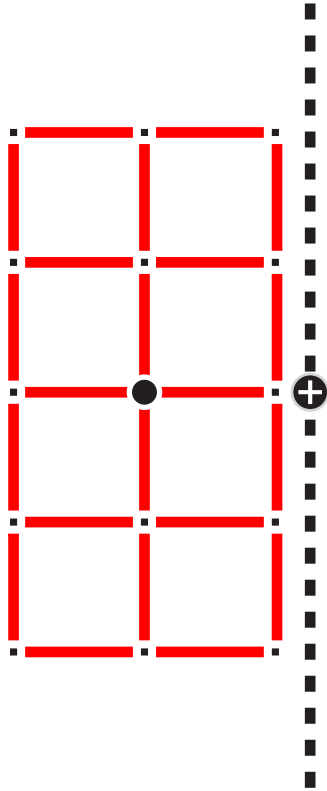
Isotropic Romerike.

The dispersed condition of the greater metropolitan region of Oslo is a growing reality, and needs to be approached with this as a premise. This thesis utilize dispersion as a positive model by the facts that it is there, It will grow, It has sought after qualities for major groups of newcomers.

The thesis takes the dispersed and isotropic condition of Romerike (of almost equal conditions in all directions) as a point of departure for a “horizontal“ non-hierarchical model of landscape transformations, which fits the physical and cultural potentials of the region. Key to the landscape hypothesis is the network layer of mobility for a new type of public transportation by autonomous shuttles.

A isotropic and dense network of linear design structures (such as the Gutu, field service routes or water edges) is already present, but hardly visible and not conceptualized in its great potentials. The network of mobility is conceptualized as a multi-functional carrier that combines traffic, ecology and aesthetics,

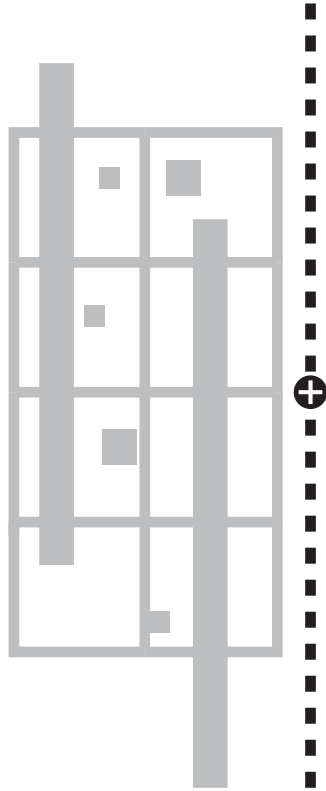








- LOCAL CENTER
- ⊕ RAILWAY NODE
- - - FAST NETWORKS (RAILWAY / FREEWAY)
- PROPOSED NETWORK (ISOTROPIC AND MULTIFUNCTIONAL)

### Proposed model of mobility

- Isotropic/mesh network structure
- High connectivity
- Fast and dynamic routing of autonomous shuttles



-  RAILWAY NODE
-  FAST NETWORKS (RAILWAY / FREEWAY)
-  FORESTED NETWORK
-  EXISTING FOREST STRUCTURE

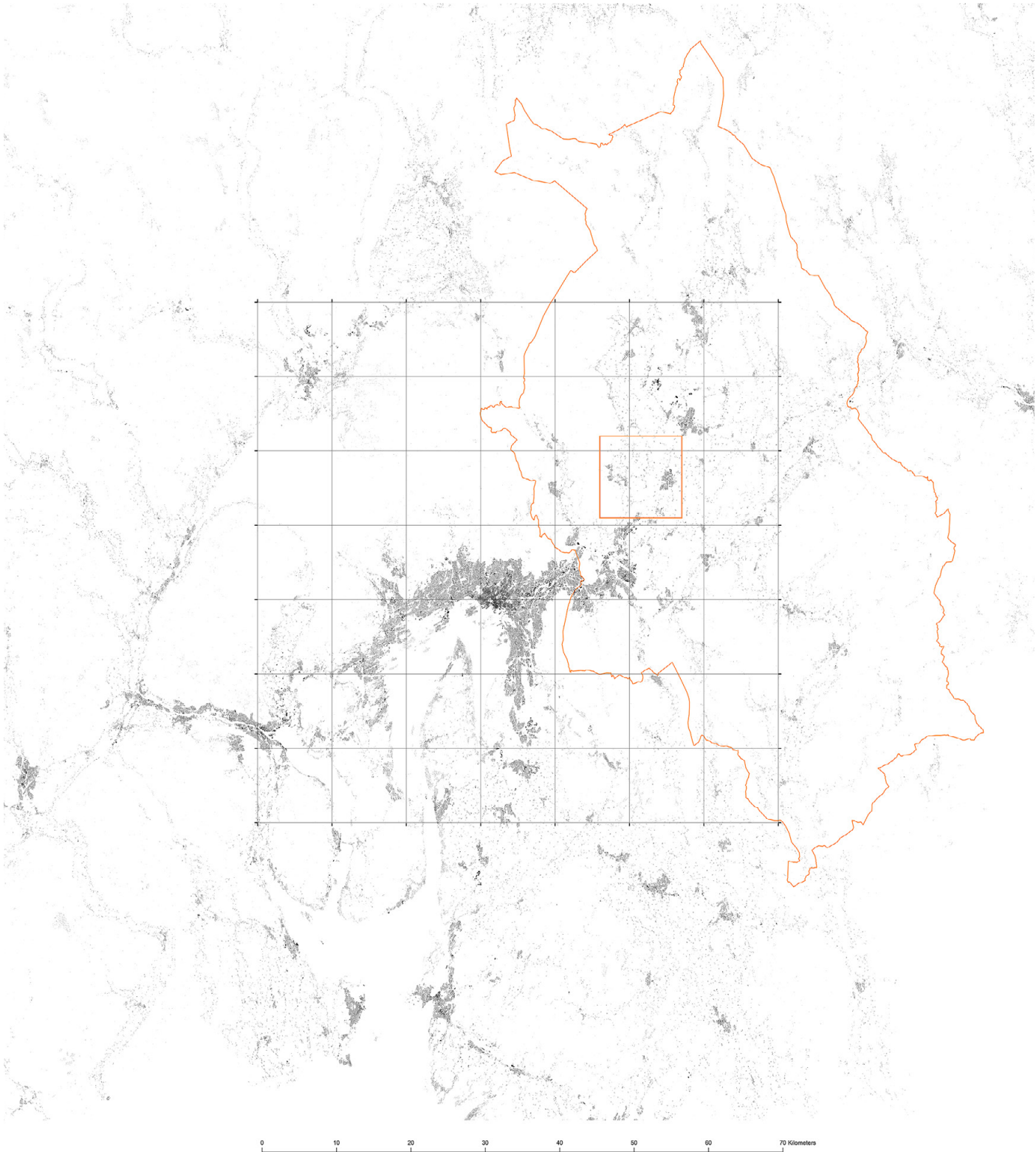
### A multifunctional spatial network

By utilizing agroforestry concepts and tools, the network is also capable of functioning as a multifunctional space which integrates aesthetics, ecology, hydrology and mobility.

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Case study area: Gjerdrum – Kløfta



Case study area marked by red square.



Ask, the administrative center of Gjerdrum municipality. Photo: Kai Krog Halse.

## GJERDRUM MUNICIPALITY<sup>8</sup>

Gjerdrum municipality (Pop. 6 147) makes up the south-western parts of the Romerike Plains. The municipality is located west of river Leira towards the Romerike Hills.

The eastern parts are covered by mighty layers of marine depositions of clay from the last ice age 9500 years ago, when the region was covered by the ocean. The Gjermåa river, a tributary to Leira, runs through the municipality from the north-west to the south-east.

Prior to the 1950's the gully landscape prevented rational farming, but since then, the terrain has been mechanically leveled out. 80 per cent of the agricultural land is comprised of fields and meadows whereof most is cultivated with grains. In the 1950's agriculture had twice as many employees as the industry, but today agriculture plays a modest role in terms of employment. In 2001 75 per cent of the workforce commuted out of the municipality, 34 per cent to Oslo, 16 per cent to neighboring municipality Skedsmo and 9 per cent to Ullensaker. Highway 120 bisects the municipality.

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<sup>8</sup> Thorsnæs, G., and Askheim S., Romerike, Store Norske Leksikon, 2016, <https://snl.no/Gjerdrum>, (accessed 15 April 2017).



0 1 Km



## GJERDRUM - KLØFTA

Source: Geovekst



## NATURAL RESOURCE BASE<sup>9</sup>

Gjerdrum municipality is a typical forestry- and agricultural area with typical coniferous forest above the marine border<sup>10</sup>, and a mosaic of cultivated areas and forest below the marine border. Area above and below marine limit is about equally divided. The total area of the municipality is 83 km<sup>2</sup> whereof 2 km<sup>2</sup> is mire, 1 km<sup>2</sup> water, 50 km<sup>2</sup> forest, 27 km<sup>2</sup> agricultural land, and 3 km<sup>2</sup> of infrastructural land use (approximate numbers). The municipality rises from the river Leira in the east (105 MASL) and towards the south-western Commons where the Prekestolen makes up the highest point at 410 MASL.

The lower parts of the municipality (up to 350 MASL) belongs to the South Boreal vegetation zone, while the higher parts of the Commons belongs to the Hemiboreal zone. Boundary species can be the Black Alder (*Alnus glutinosa*), which is present in the south Boreal zone up to the higher parts of the municipality, in lush micro valleys. The Hemiboreal zone can be characterized as the most typical coniferous zone with dominant coniferous forest, mire and elements of temperate deciduous and alpine vegetation (Moen 1998).

The climate is typical for Romerike, with cold winters and relatively warm summers. The mean temperature throughout the year is 3.8°C. Mean precipitation level is approx. 800 mm, with peaks in August-November.

The topography in the coniferous areas above the marine border is typical for this region with its north-southbound valleys in a relatively hilly landscape divided by mires and small lakes.

The most prominent rock occurrence is gneiss, which covers the whole area except from some areas around the higher grounds where there are occurrences of syenite and granite (Berthelsen et al. 1996). Areas below the marine border is covered by marine depositions (Bargel 1997).

Differences in vegetation reflects the sharp divide between the areas

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9 Blindheim, T., and Olsen, K.M., 'Kartlegging av naturtyper. Verdisetting av biologisk mangfold i Gjerdrum kommune', *Siste Sjanse – Rapport 2005-1*, 2005.

10 The marine border is situated between 200-210m above the present sea level, and marks the level of the sea at the end of the previous ice age.

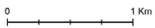
above and below the marine border. In the Commons there is poor bedrock conditions, and somewhat richer deposits which results in a mainly poor flora. The marine depositions however, is richer and holds moisture well. Here are larger areas with Grey Alder / Hackberry forests, tall grass and fern and richer populations of low herbs in the dry gully hillsides.



Dry gully with obvious signs of leveling of the tops.



Dispersion as a character of *longue Durée*



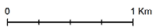
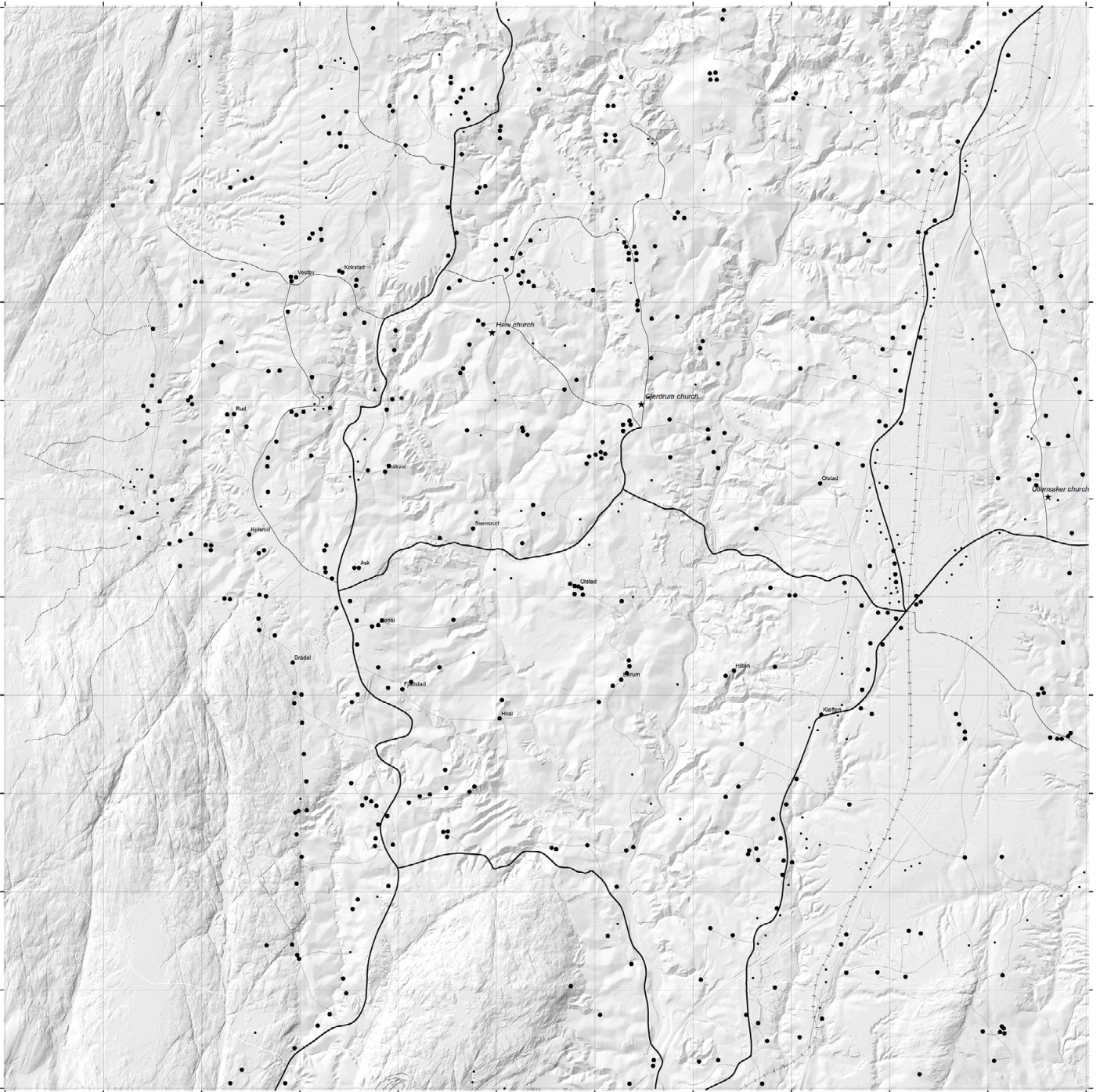
**GJERDRUM - KLØFTA, SETTLEMENT STRUCTURE AND MOBILITY NETWORK 1850**

Source: Kartverket, own mapping

- Farms
- Secondary building
- Primary road
- Secondary road

Four years prior to the establishment of the first railroad in Norway - hovedbanen between Oslo and Eidsvoll in 1854.

The settlements mainly consist of scattered farms.  
The road network ties the farms together.

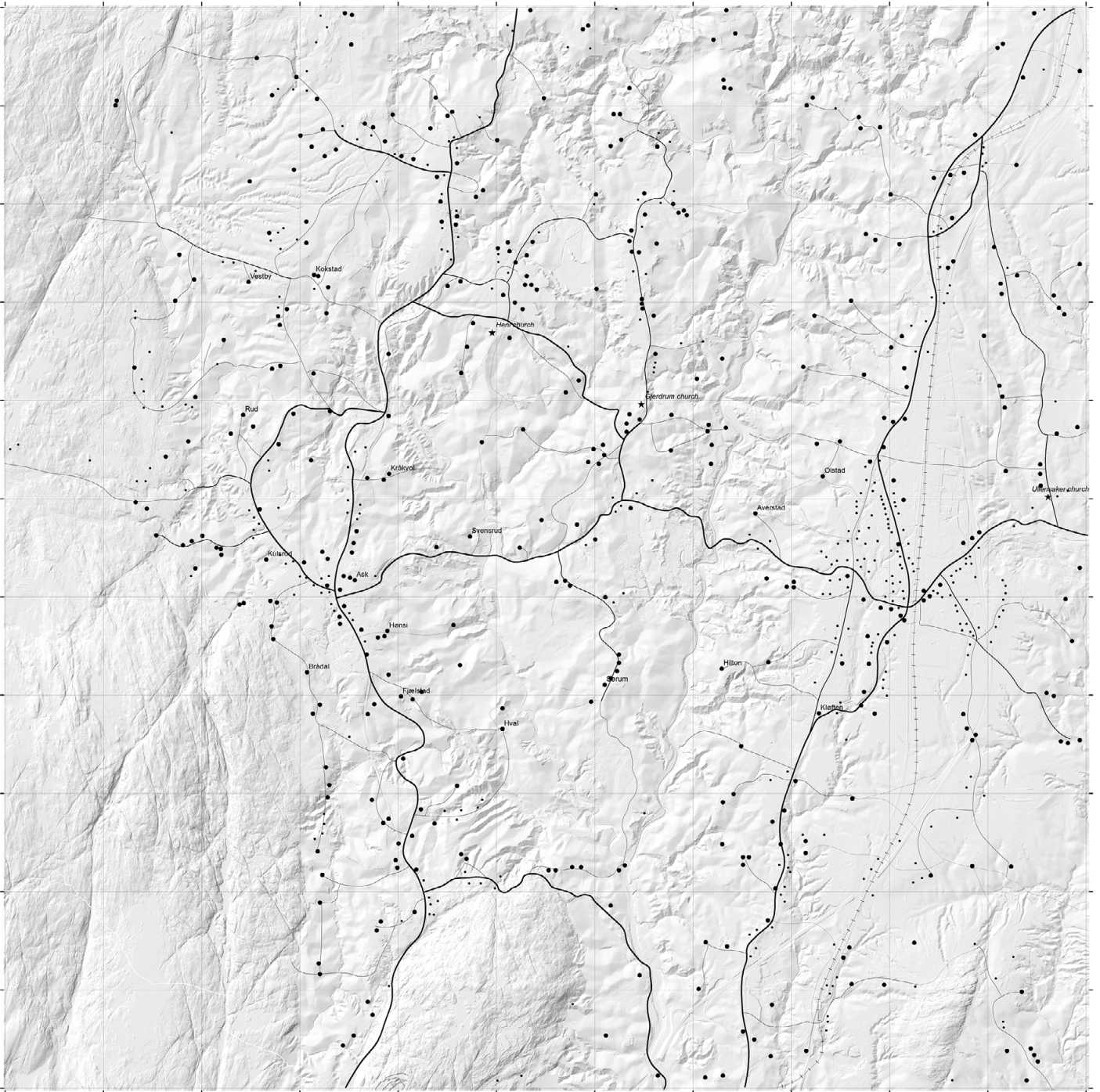


**GJERDRUM - KLØFTA, SETTLEMENT STRUCTURE AND MOBILITY NETWORK 1882**

Source: Kartverket, own mapping

- Primary building
- Secondary building
- ▲ Factory
- Mill
- +— Railway
- Primary road
- Secondary road
- Tertiary road
- ..... Trails

28 years after the establishment of the railway, we start to see a densification of settlements in proximity to Kløfta railway station. Changes in the road network reflects the establishment of the station. The region establishes dairies to serve the capital of Oslo with milk and cheese delivered by train.



0 1 Km



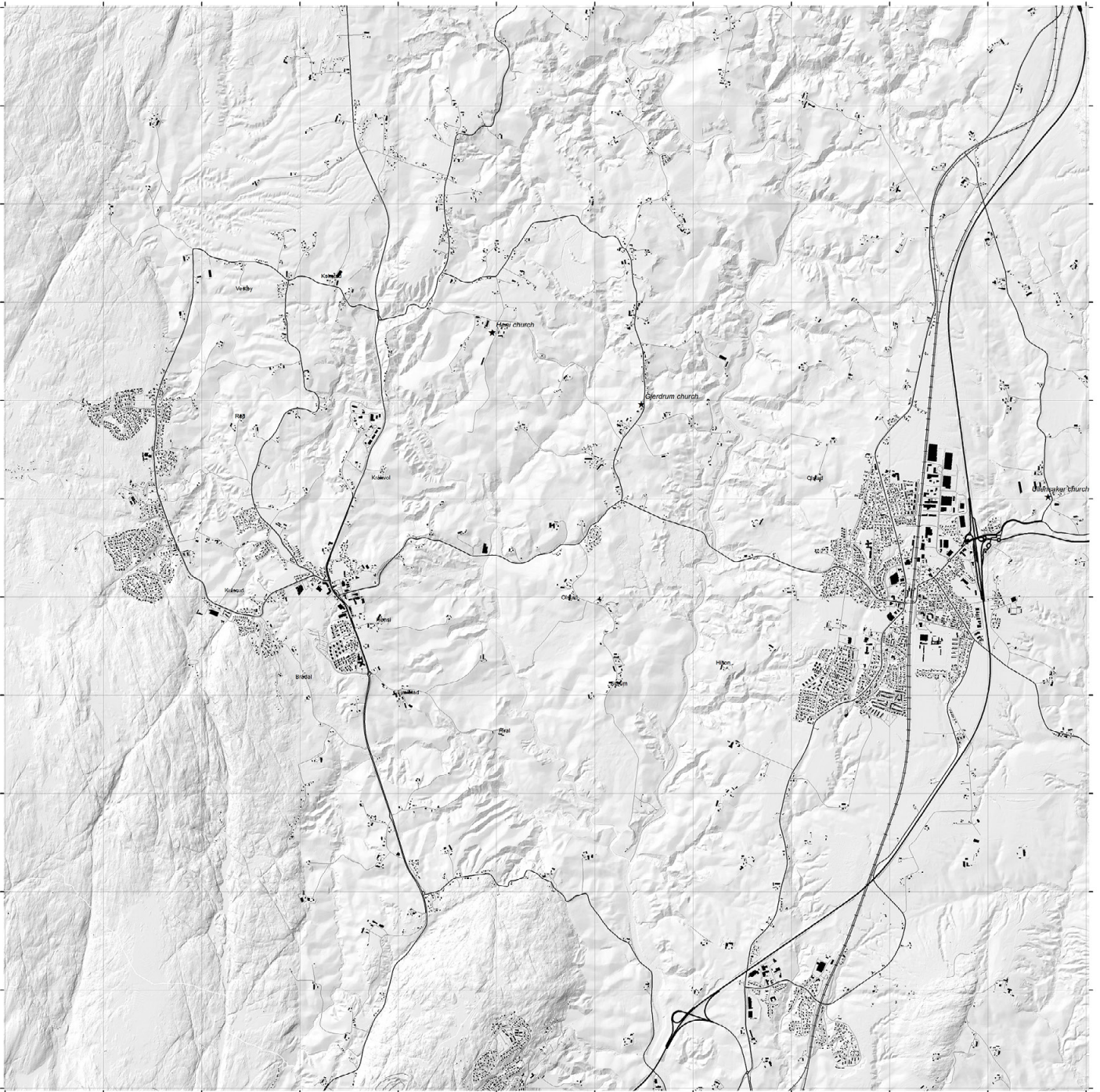
**GJERDRUM - KLØFTA, SETTLEMENT STRUCTURE AND MOBILITY NETWORK 1949**

Source: Kartverket, own mapping

- Primary building
- Secondary building
- Primary road
- Secondary road
- Tertiary road
- Quaternary road
- + Railway

Up-scaling of road network and further densification of settlements.





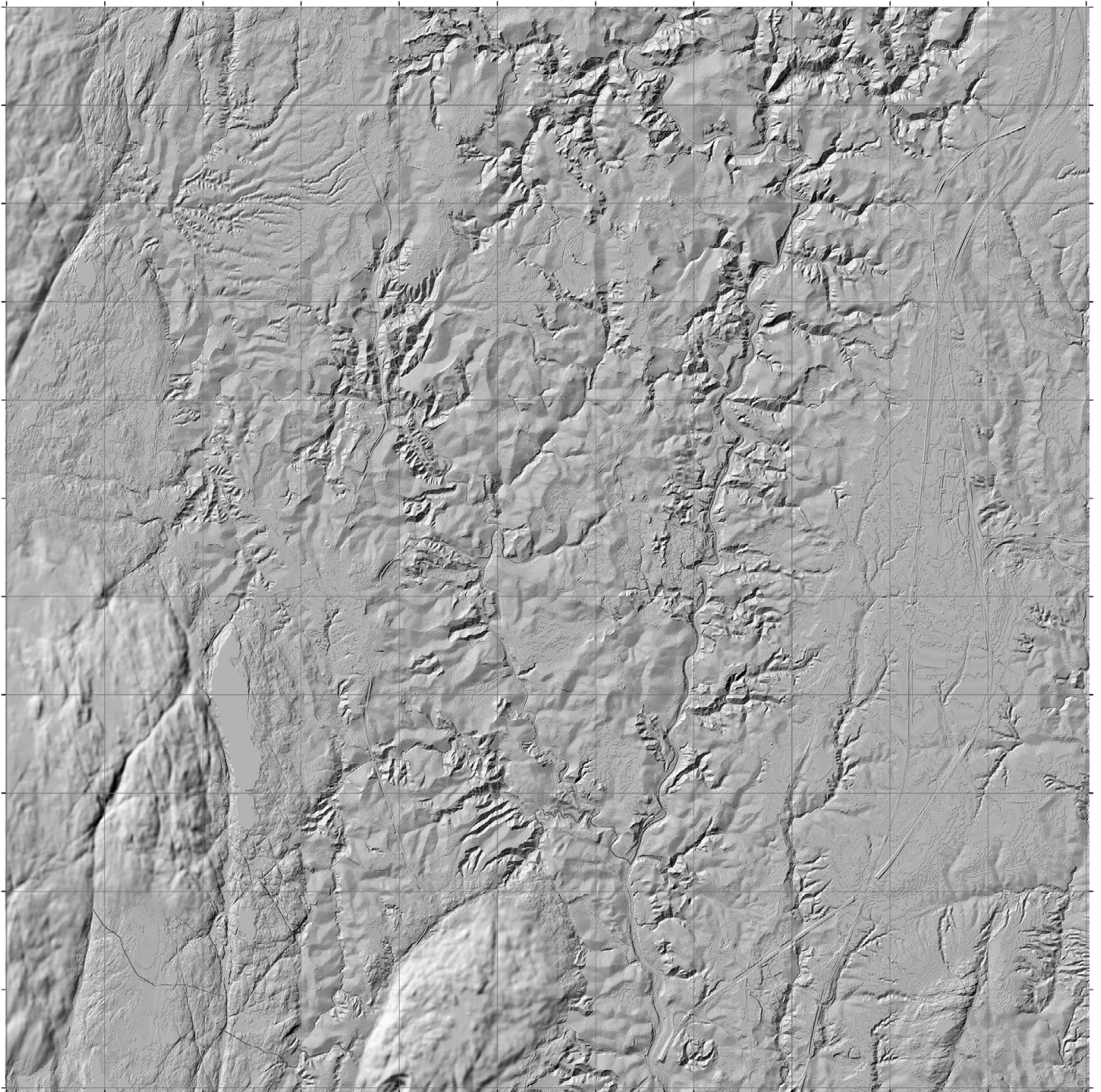
**GJERDRUM - KLØFTA, SETTLEMENT STRUCTURE AND MOBILITY NETWORK 2015**

Source: Kartverket, Geonorge, Bane Nor

Small villages develop along the western forest edge.

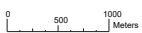


## Landscape types



**GJERDRUM - KLØFTA, LANDFORM**

Source: Kartverket



**Gjerdrum – Kløfta, Geological transect.**

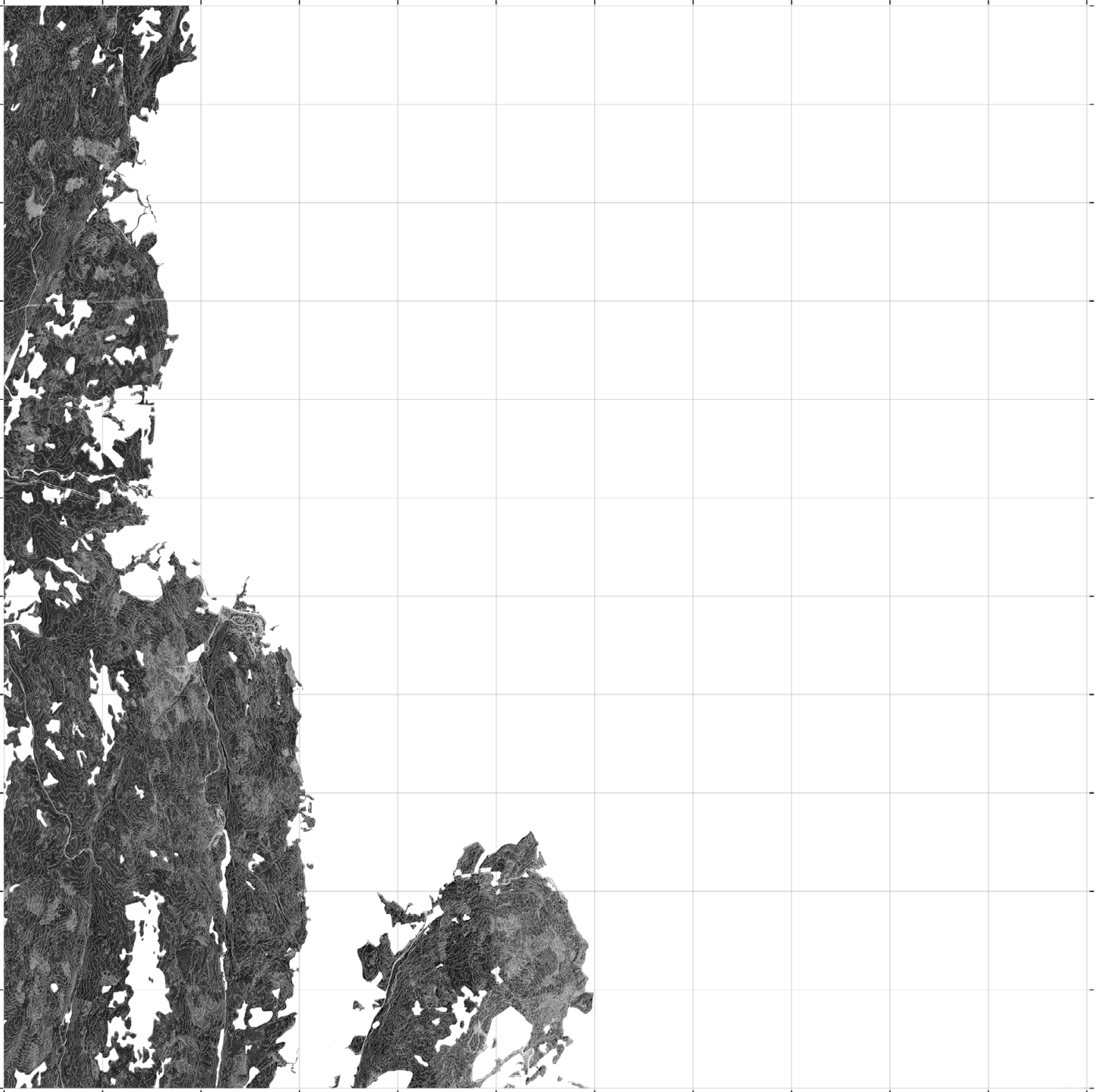
Gneiss bedrock. Thin sliver of marine depositions comprised of clay, silt and sand reaching depths of 1-35m within the section. Deepest clay deposit in the region is approx. 100m.



The forested hills. Photo: Kai Krog Halse.

## 1. THE FORESTED HILL

The forested hills west of Ask center used to belong to certain farms, and were often inhabited by crofters. Since these plots were sold to the municipality between 1967 and the early 1980's, several villages have developed along the Fjellvegen road (former Asvegen, built in 1967).

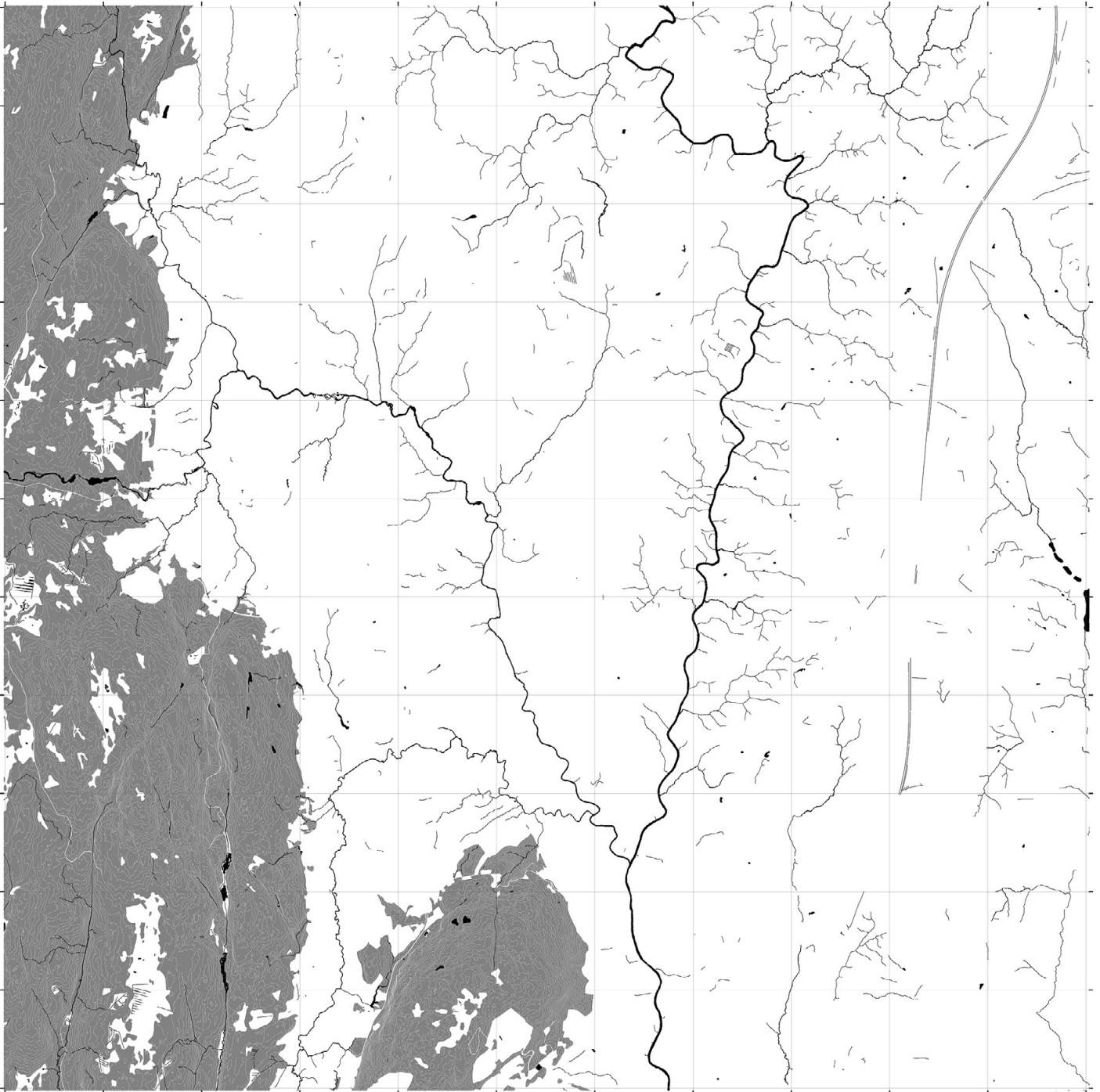


0 1 Km



## GJERDRUM - KLØFTA, FORESTED HILLS

Source: Geovekst





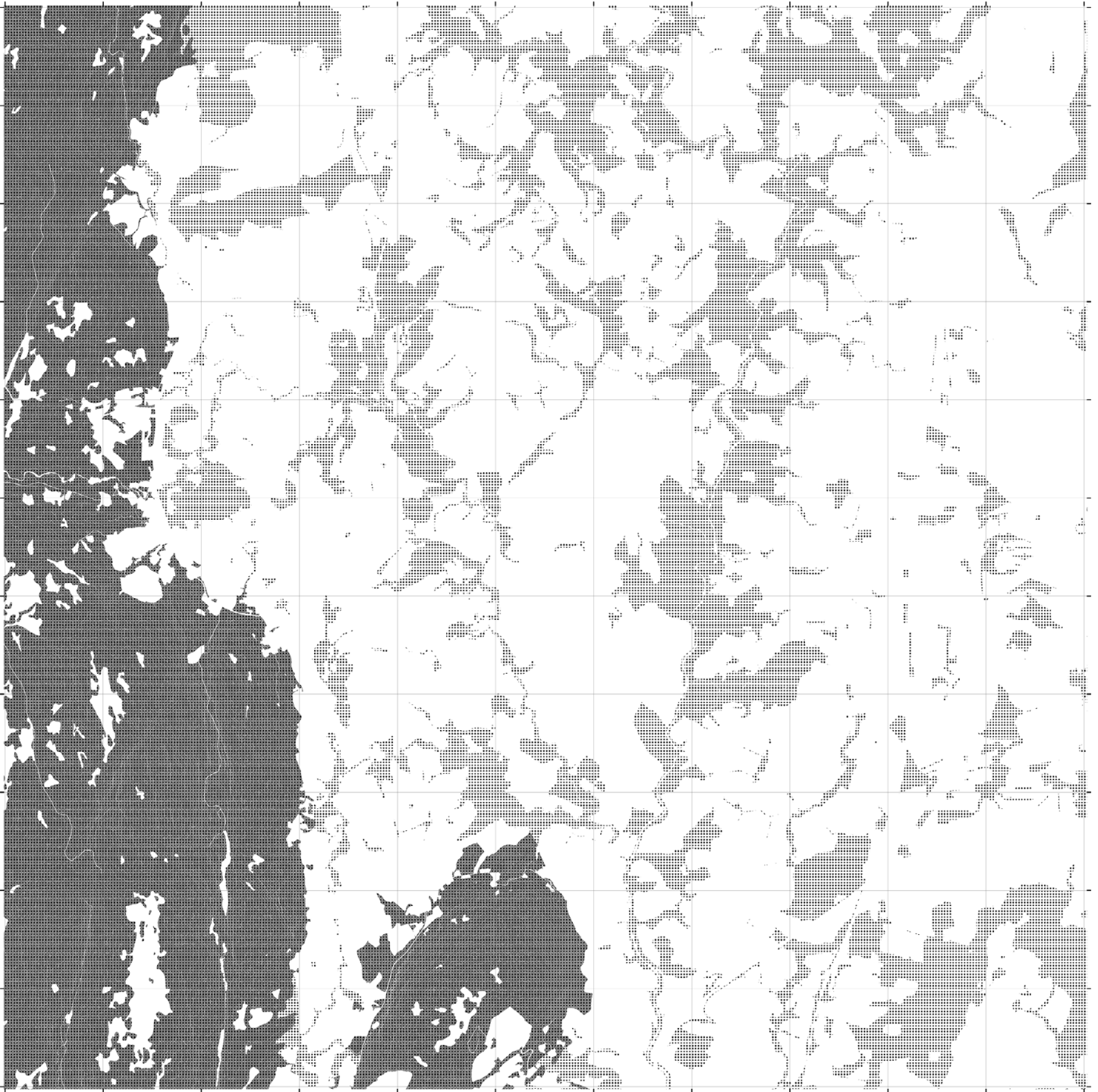
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### GJERDRUM - KLØFTA, FORESTED HILLS / HYDROLOGICAL NETWORK



Source: Geovekst

-  Hydrological network
-  Wooded hills

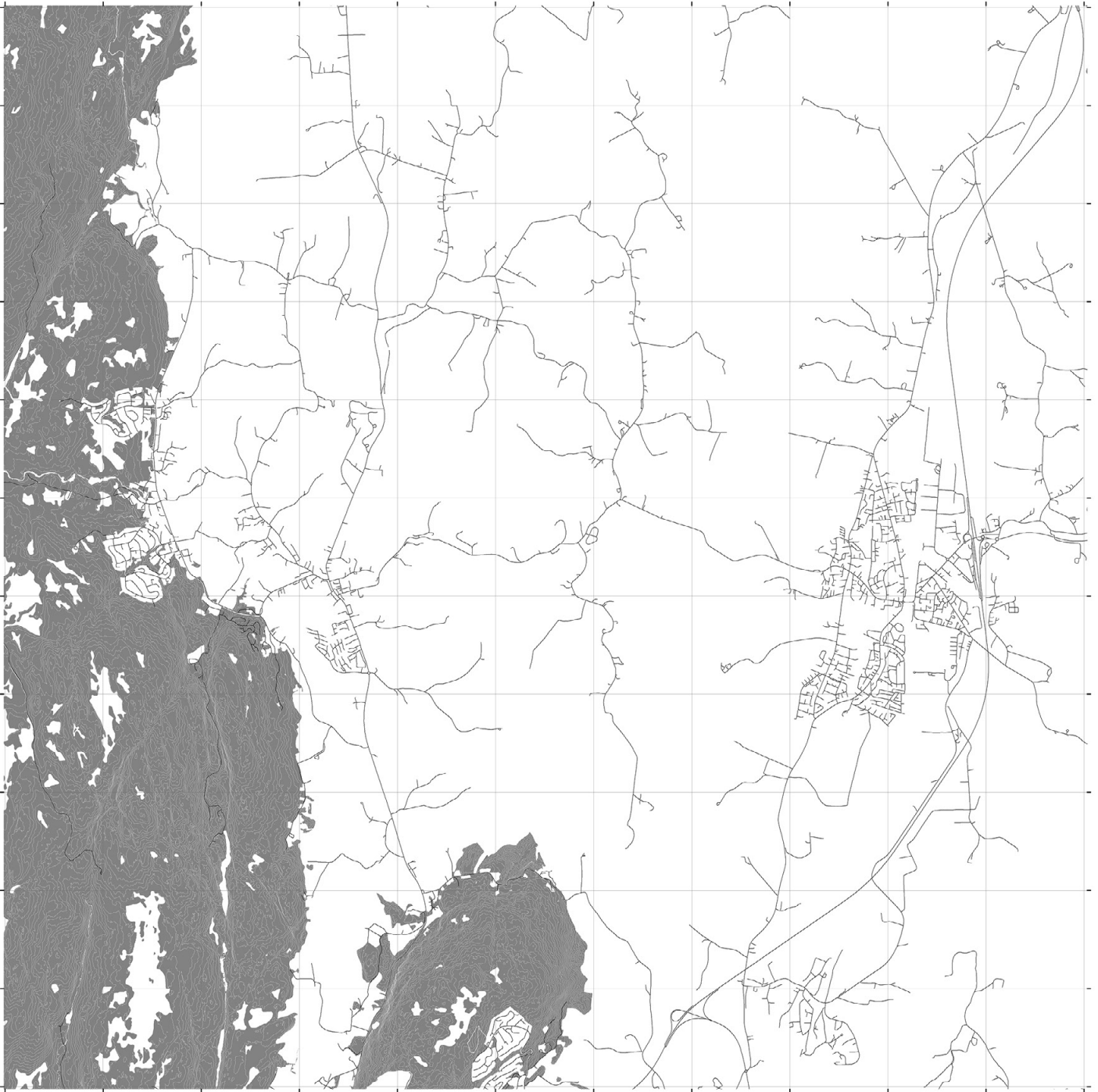


**GJERDRUM - KLØFTA, FORESTED HILLS / FOREST (SOUTH BOREAL)**

Source: Geovekst, Blindheim, T., and Olsen K.M., 'Kartlegging av Naturtyper: Verdssetting av biologisk mangfold i Gjerdrum kommune', Siste Sjanse - Rapport 2005-1, 2005

-  South Boreal forest
-  Wooded hills





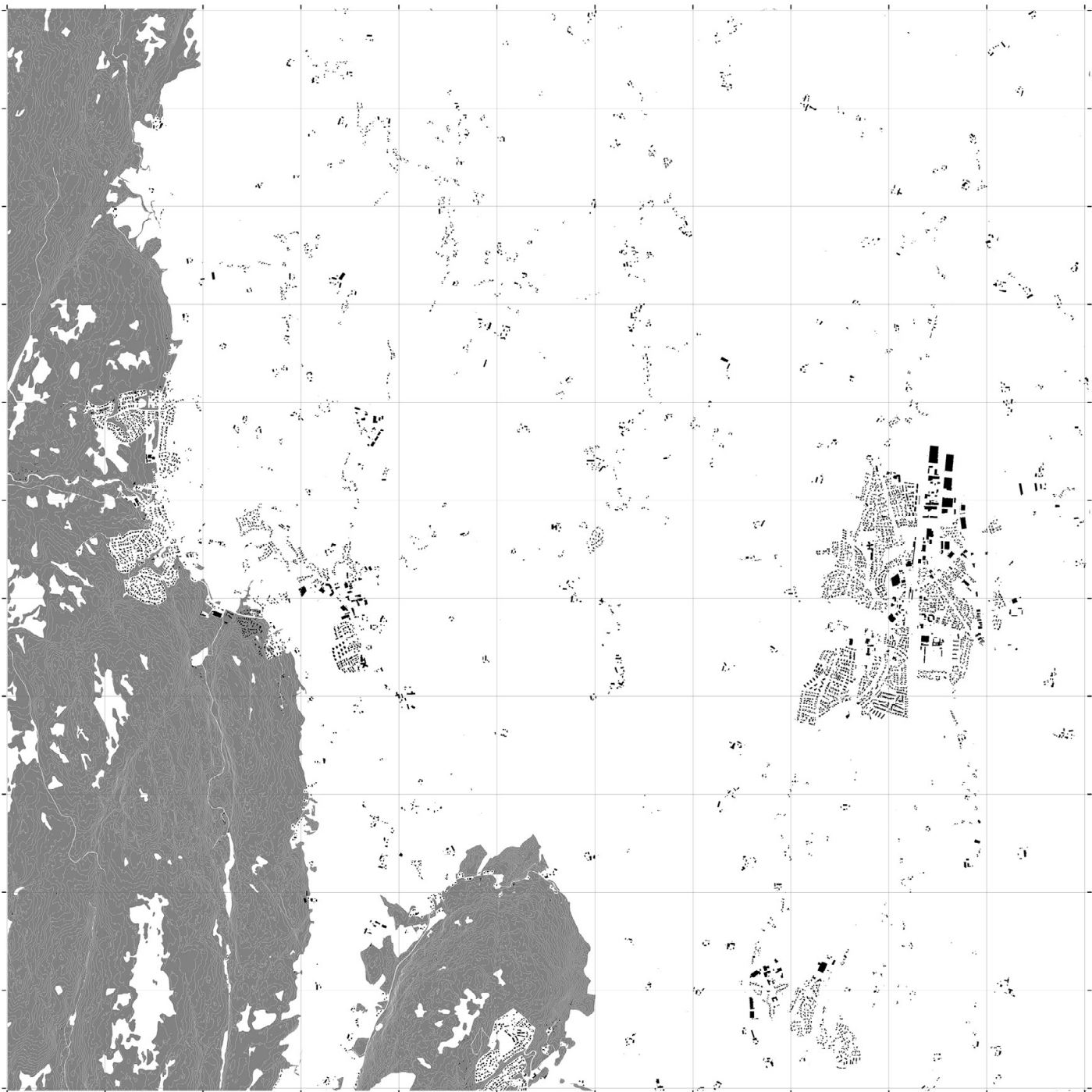
0 1 Km



## GJERDRUM - KLØFTA, FORESTED HILLS / MOBILITY NETWORK

Source: Geovekst

- Mobility network
- Wooded hills



0 1 Km



## GJERDRUM - KLØFTA, FORESTED HILLS / SETTLEMENT STRUCTURE

Source: Geovekst

-  Building
-  Wooded hills



Before and after leveling. Photo: Unknown

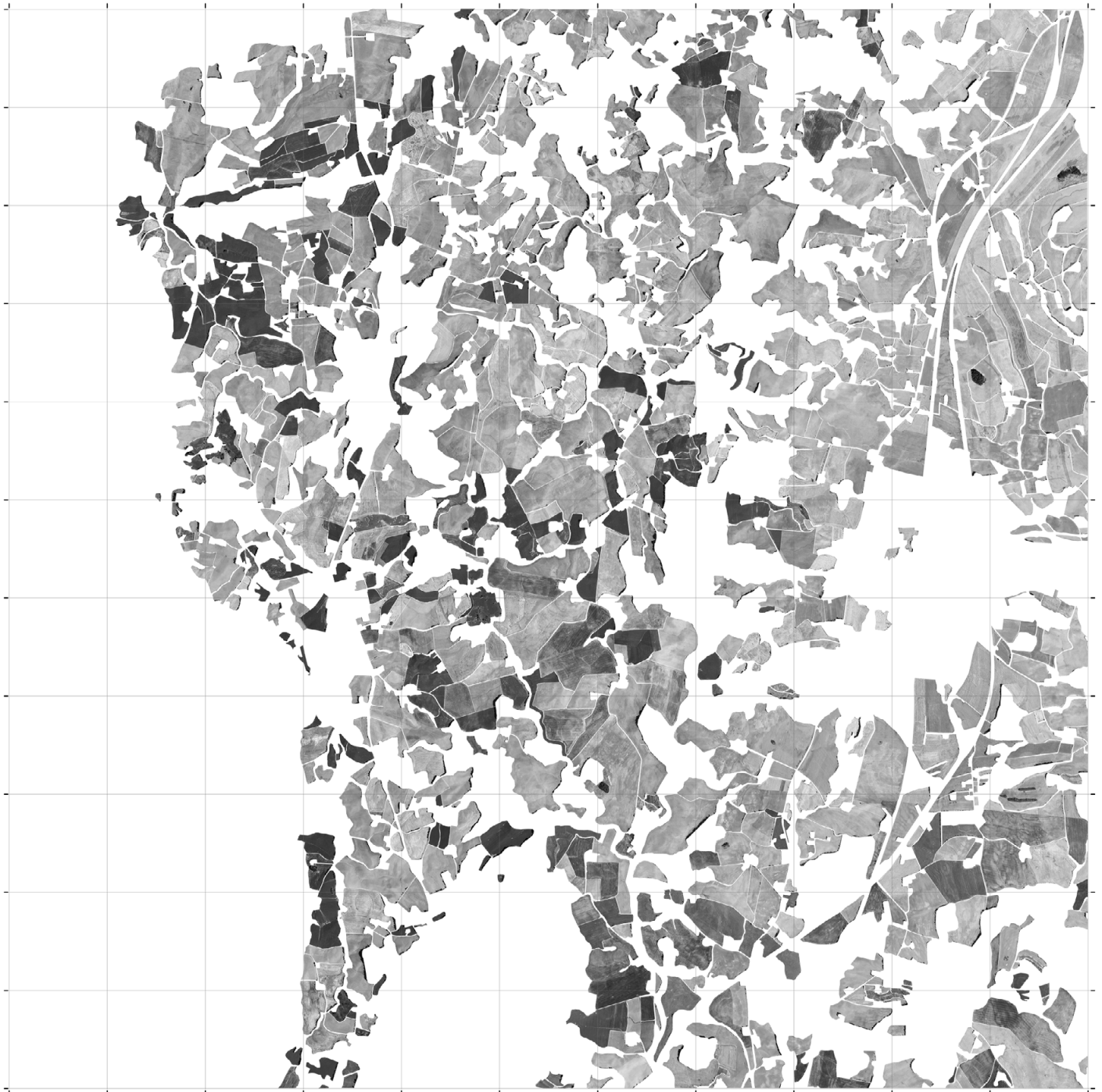
## 2. THE FIELD

Prior to the Green Revolution<sup>1</sup>, what is now the agricultural fields of the Romerike region, was mainly ravine/gully landscapes. In order to accommodate modern agricultural methods of production, the ravine/gully landscape was mechanically levelled out by means of bulldozers from the 1950's and up until recent years.

Prior to this radical intervention, however, the gully structured the layout of farms across the region. Farms would be situated on top of the gullies to avoid running water, while the fields would benefit from nutritious manure running from the barns, down to the fields by means of gravitation<sup>2</sup>. Still today there are mainly farms to be found on hill tops and ridges amidst the agricultural landscape.

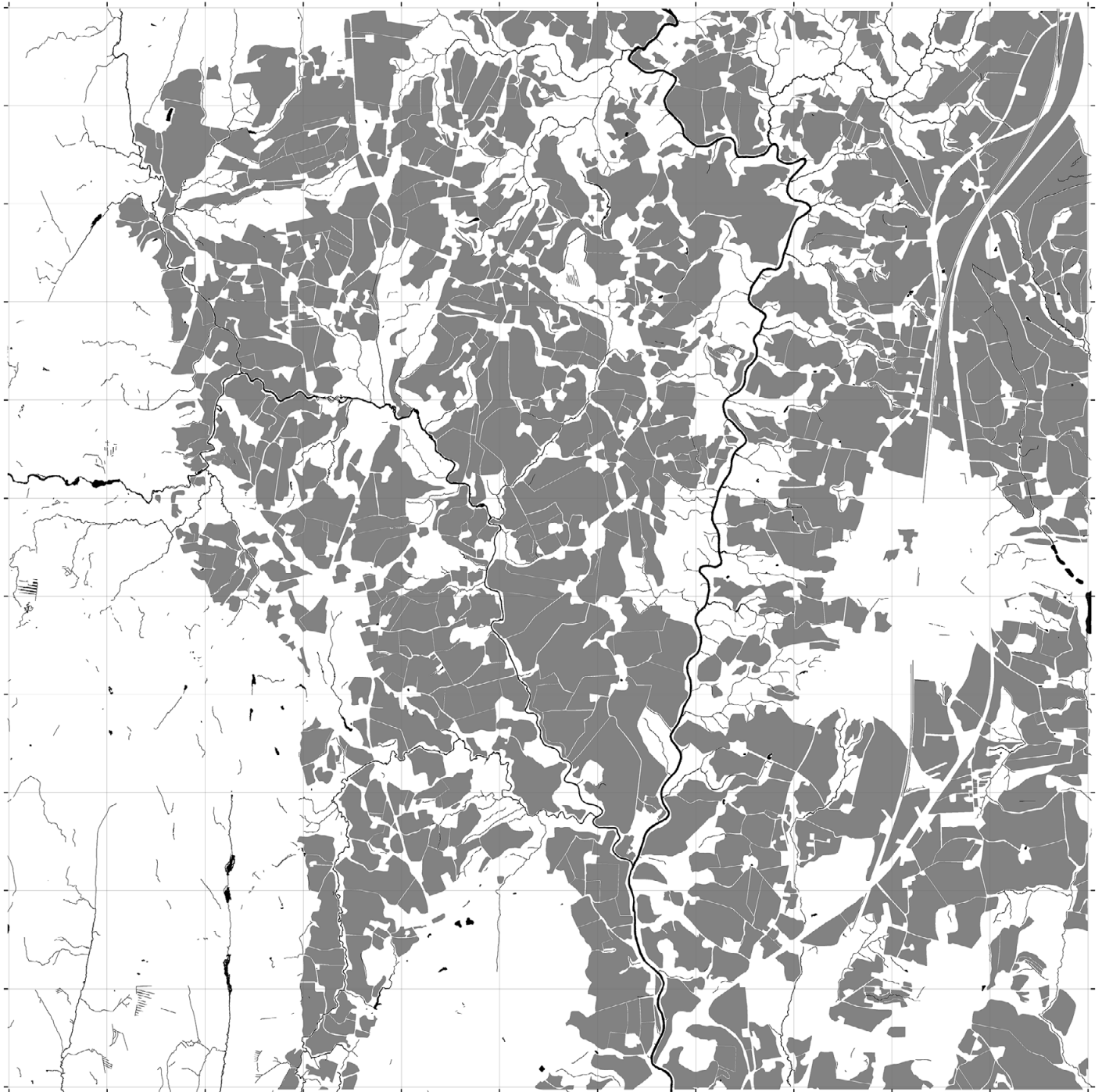
<sup>1</sup> [https://en.wikipedia.org/wiki/Green\\_Revolution](https://en.wikipedia.org/wiki/Green_Revolution) (Accessed 6 March 2017).

<sup>2</sup> H. Aall, et al., '*Norske Bygder Romerike III*', Bergen, Norway, John Griegs Forlag, 1934 p. 14.



**GJERDRUM - KLØFTA, AGRICULTURAL FIELDS**

Source: Own mapping





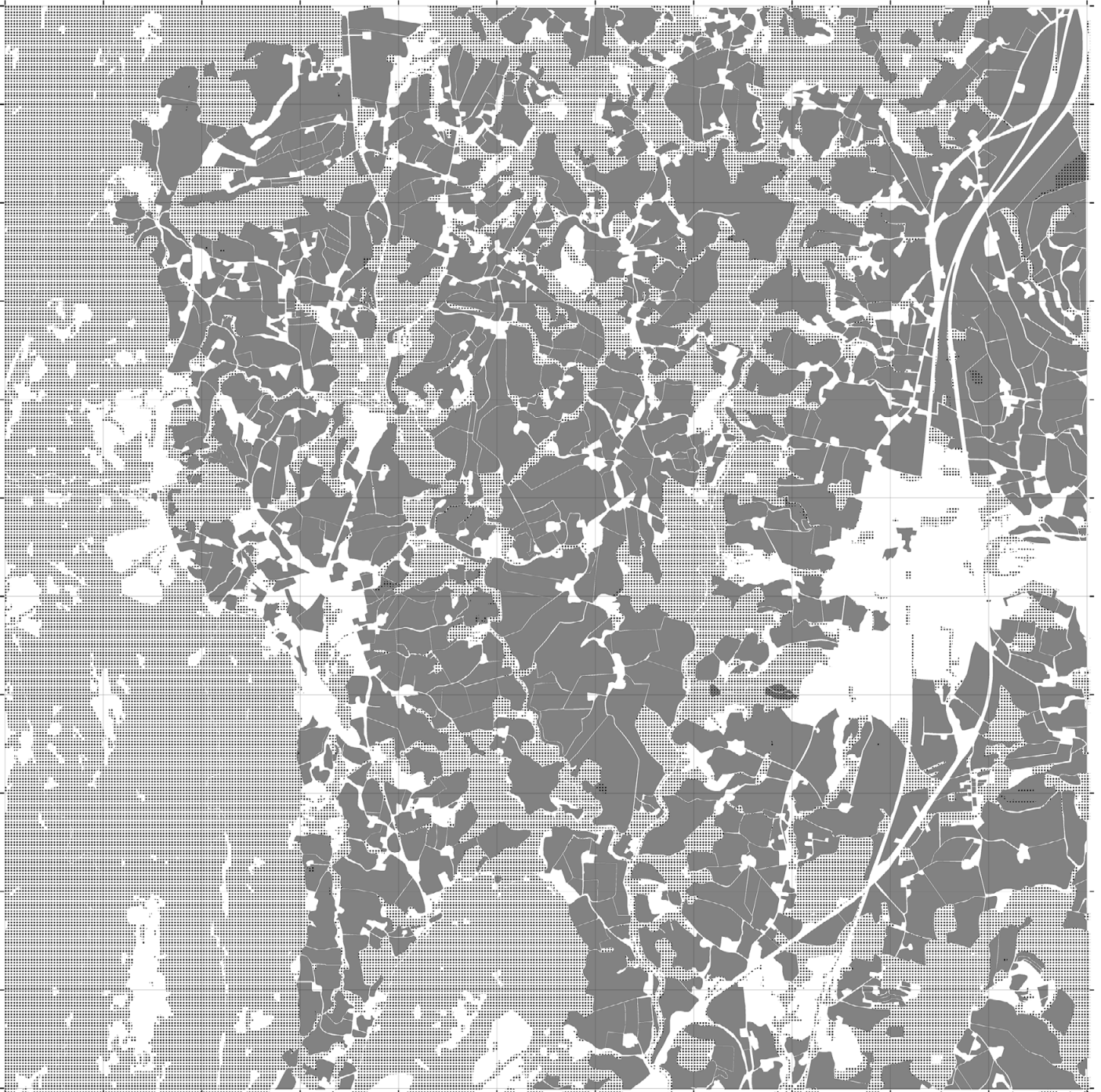
0 1 Km



## GJERDRUM - KLØFTA, FIELDS / HYDROLOGICAL NETWORK

Source: Geovekst

-  Hydrological network
-  Agricultural fields



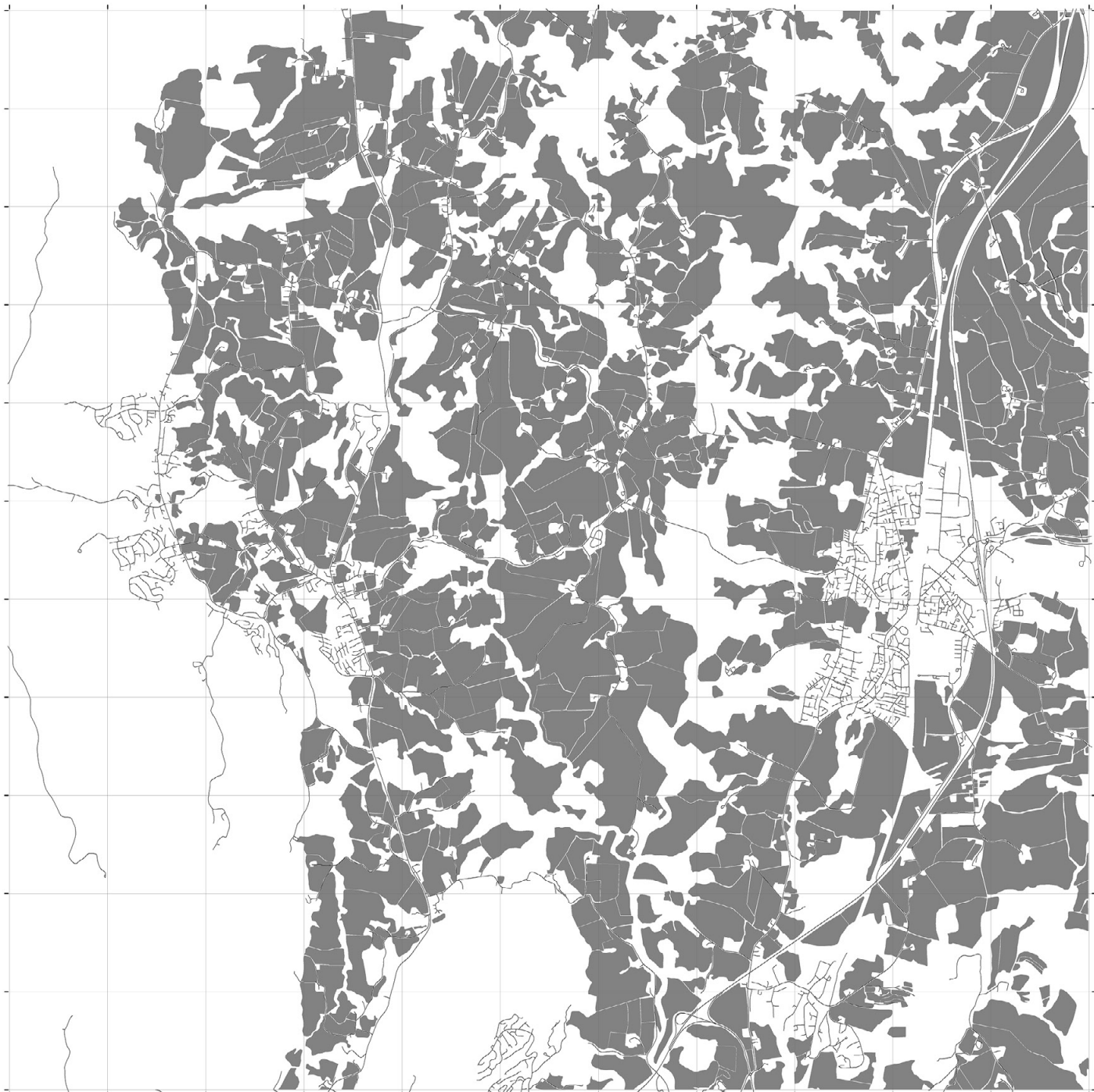
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### GJERDRUM - KLØFTA, FIELDS / FOREST (SOUTH BOREAL)

Source: Geovekst, own mapping

- South Boreal forest structure
- Agricultural fields



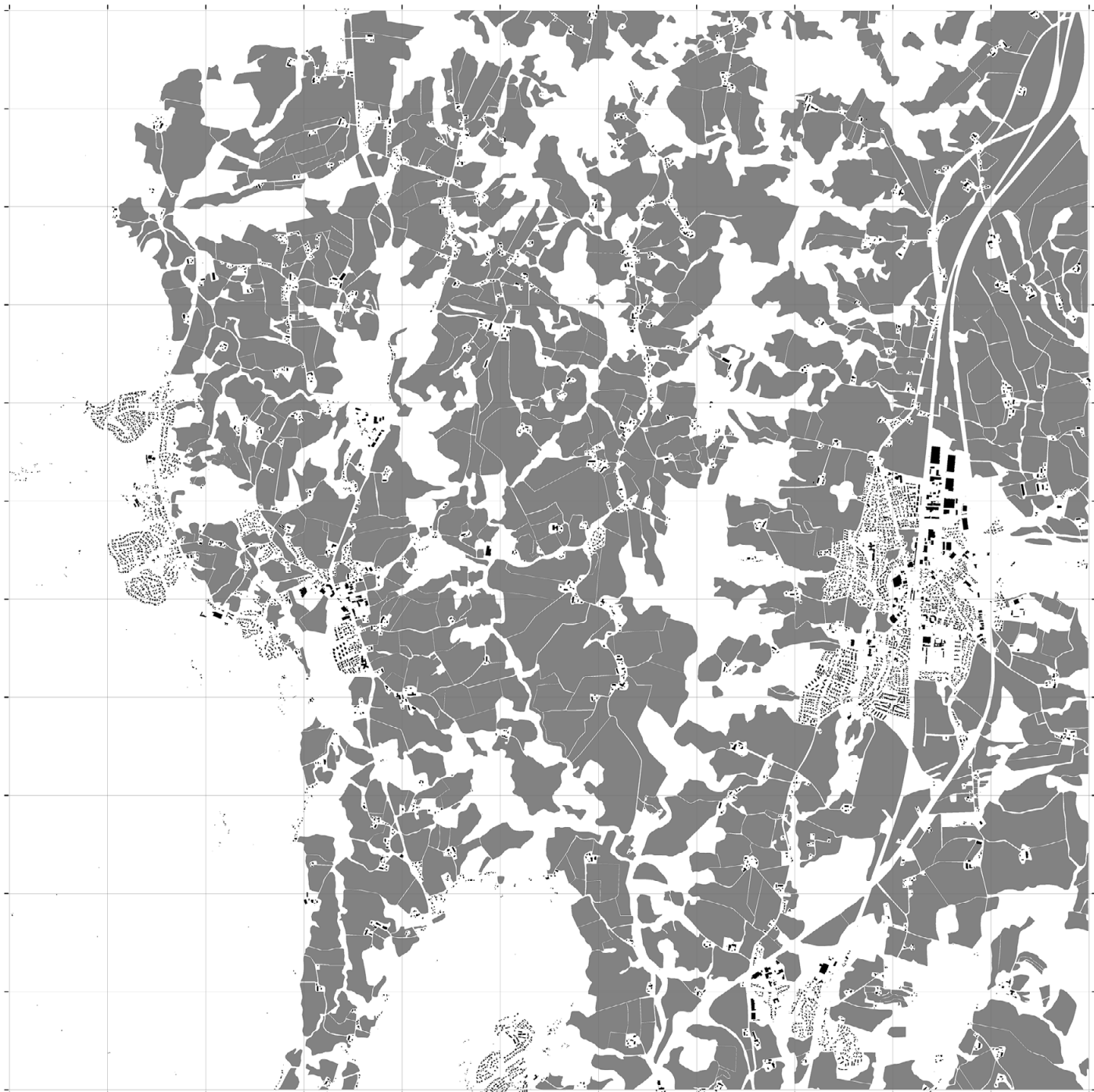
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### GJERDRUM - KLØFTA, FIELDS / MOBILITY NETWORK

Source: Geovekst, own mapping

- Mobility network
- Agricultural fields



0 1 Km



### GJERDRUM - KLØFTA, FIELDS / SETTLEMENT STRUCTURE

Source: Geovekst, own mapping

-  Building
-  Agricultural fields

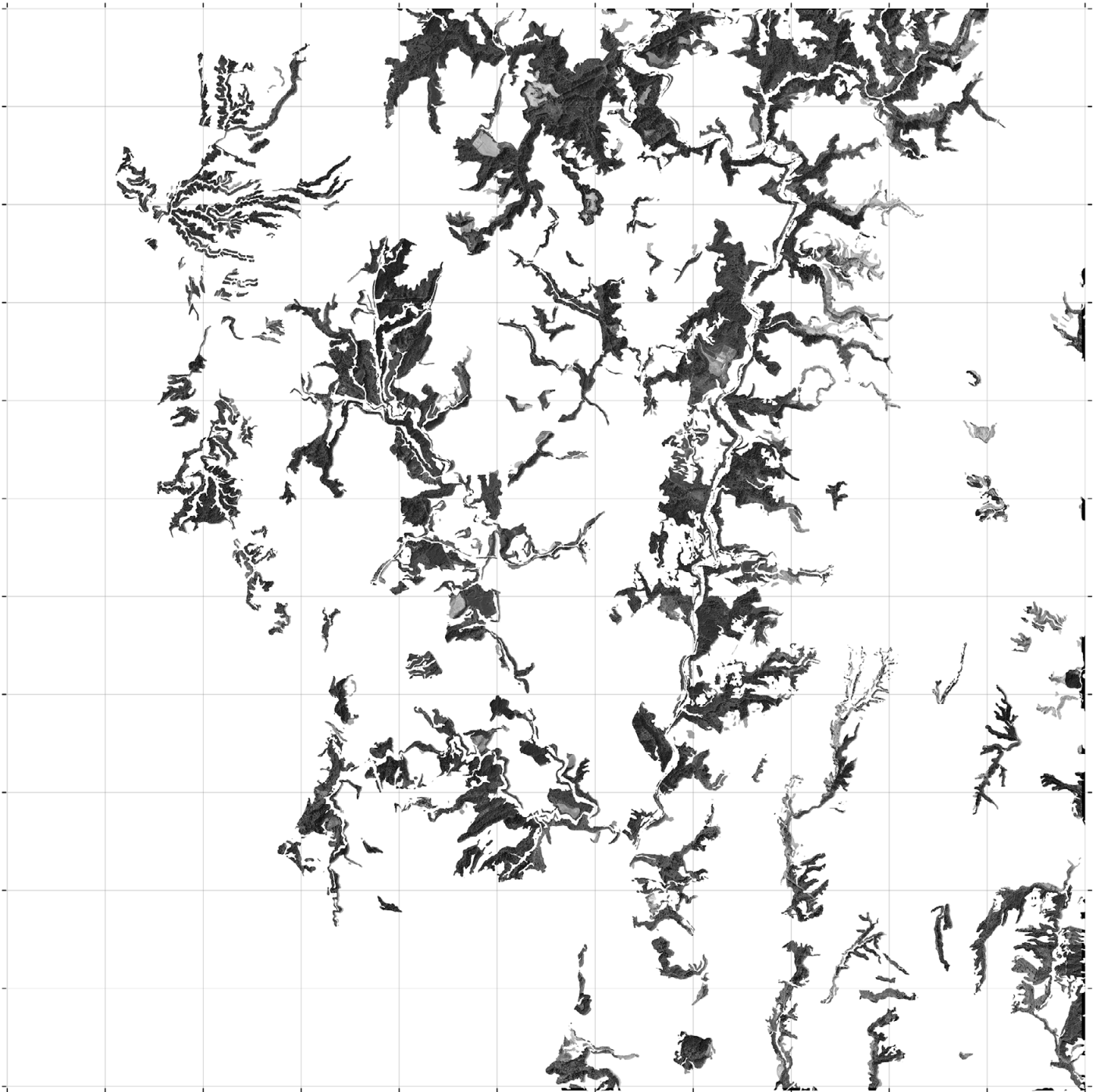




Gully. Photo: Giambattista Zaccariotto.

### 3. THE GULLY

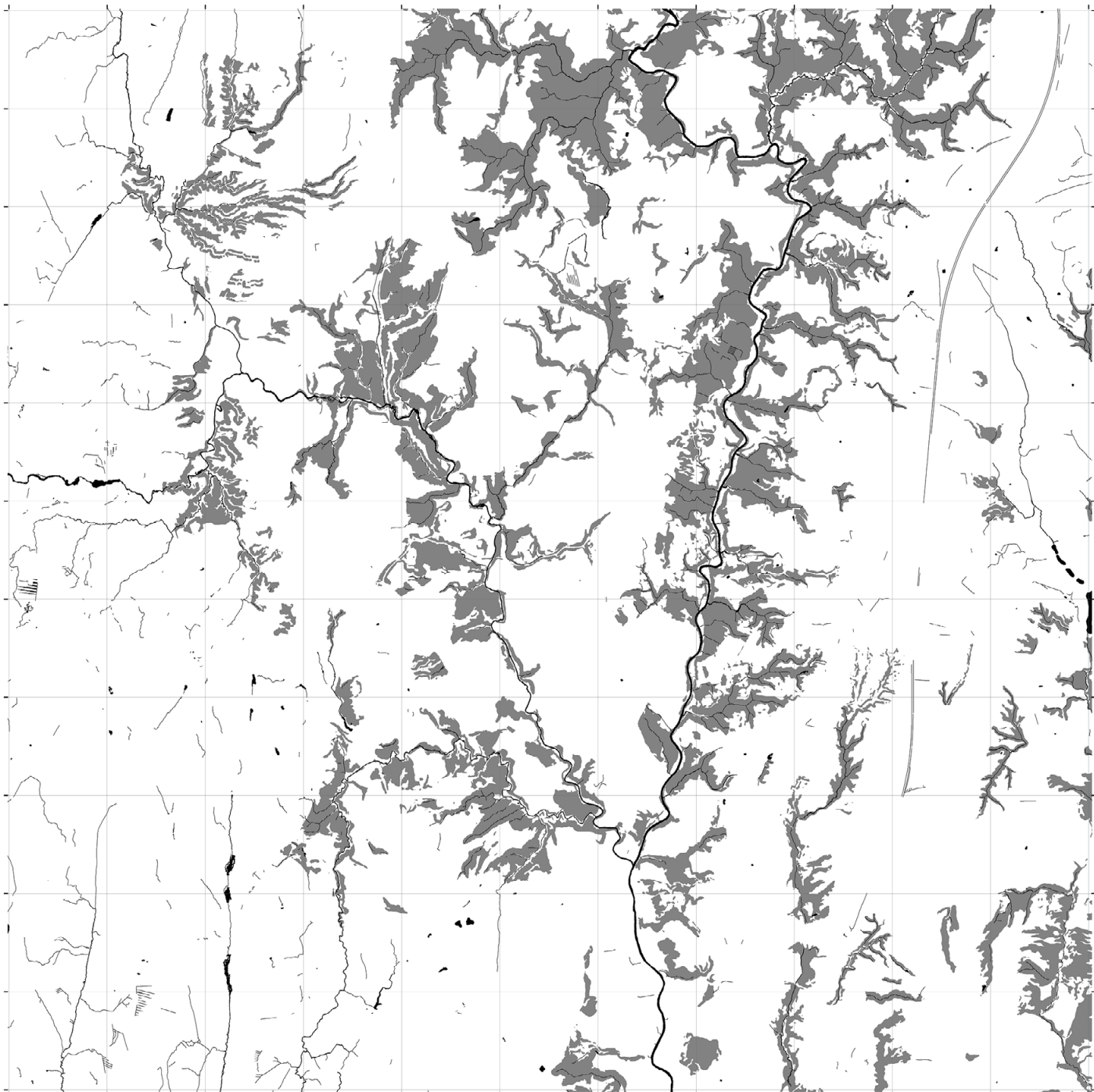
Small V-shaped valley carved out of clay-rich soil by rivers and streams. Clay-rich soil is the dominating substrate below the marine border (200 m.a.s.l.) in the region.



0 1 Km

**GJERDRUM - KLØFTA, GULLIES**

Source: Own mapping




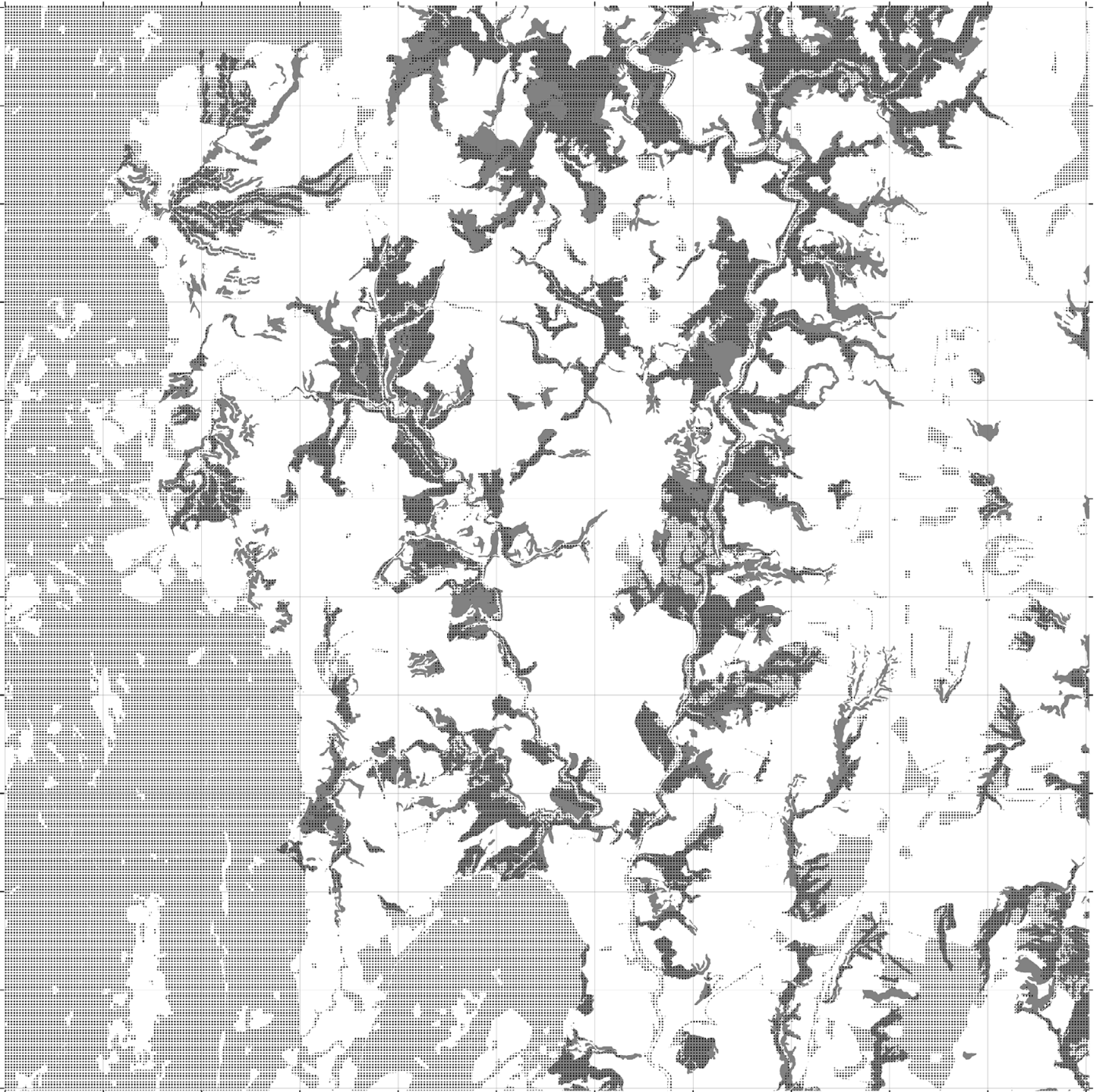
0 1 Km



### GJERDRUM - KLØFTA, GULLIES / HYDROLOGICAL NETWORK

Source: Geovekst, own mapping

-  Hydrological network
-  Gullies





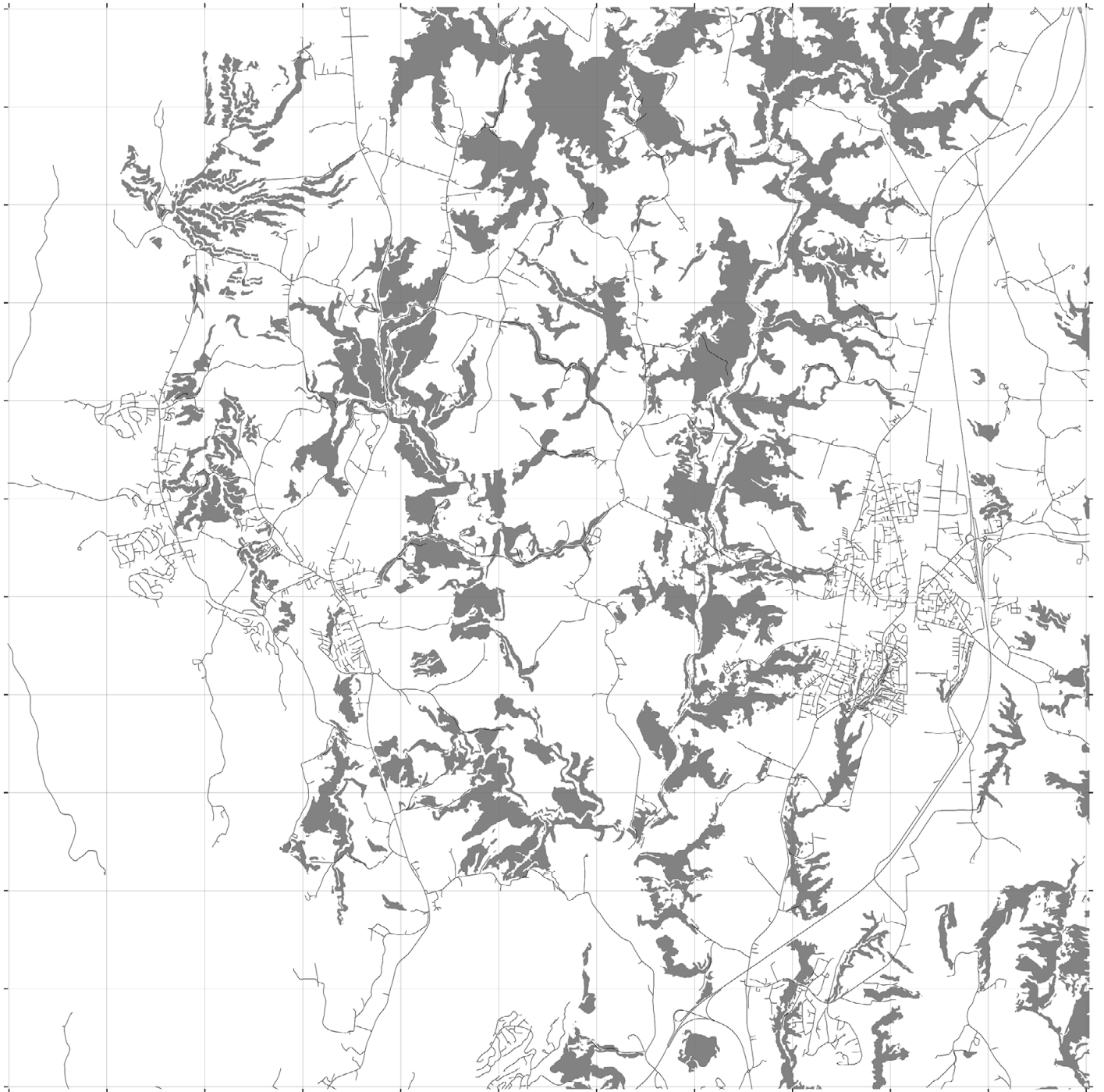
0 1 Km



### GJERDRUM - KLØFTA, GULLIES / FOREST (SOUTH BOREAL)

Source: Geovekst, own mapping

-  South Boreal forest structure
-  Gullies



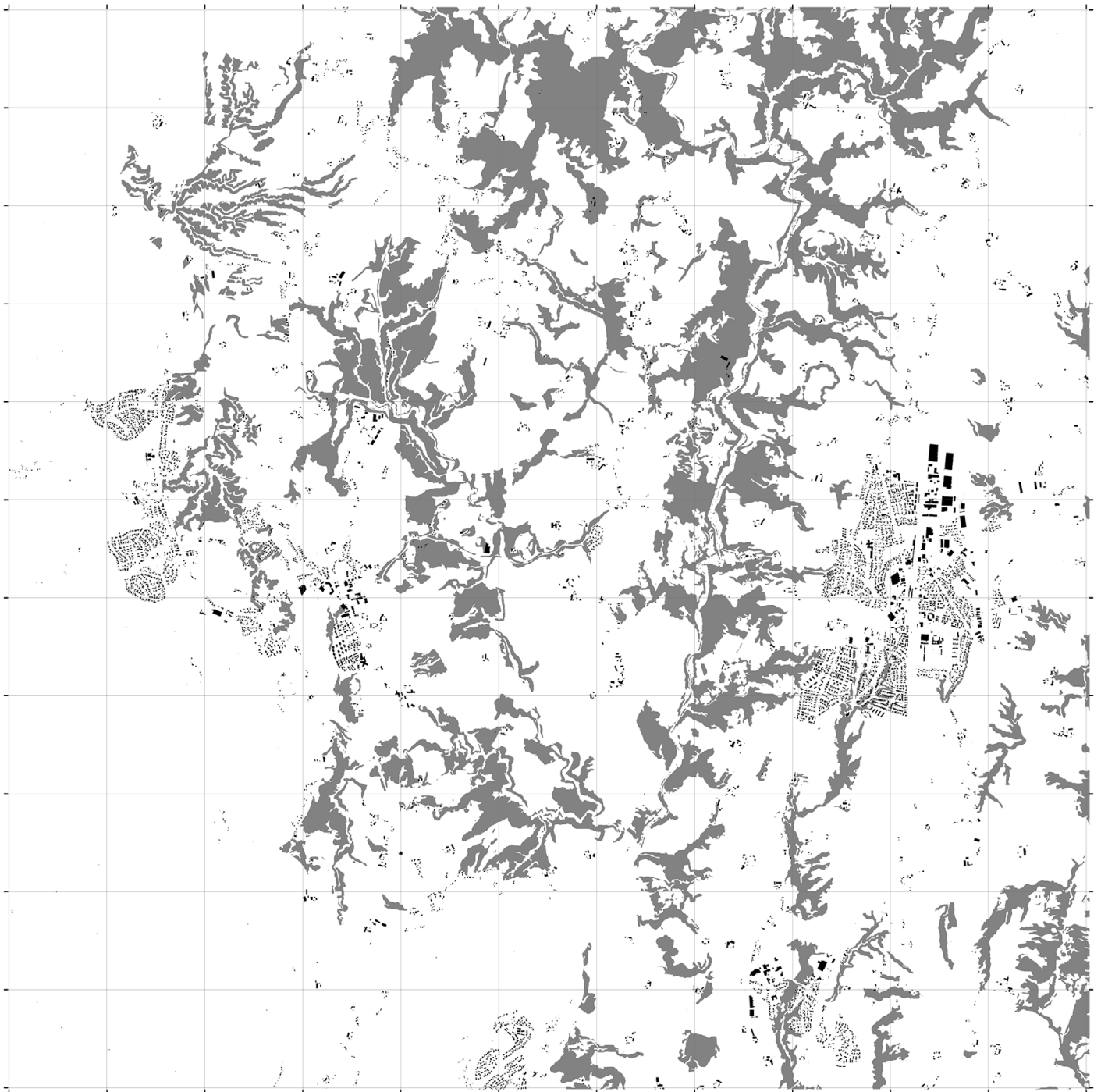
0 1 Km



## GJERDRUM - KLØFTA, GULLIES / MOBILITY NETWORK

Source: Geovekst, own mapping

— Mobility network  
■ Gullies



0 1 Km



## GJERDRUM - KLØFTA, GULLIES / SETTLEMENT STRUCTURE

Source: Geovekst, own mapping

- Building
- Gullies

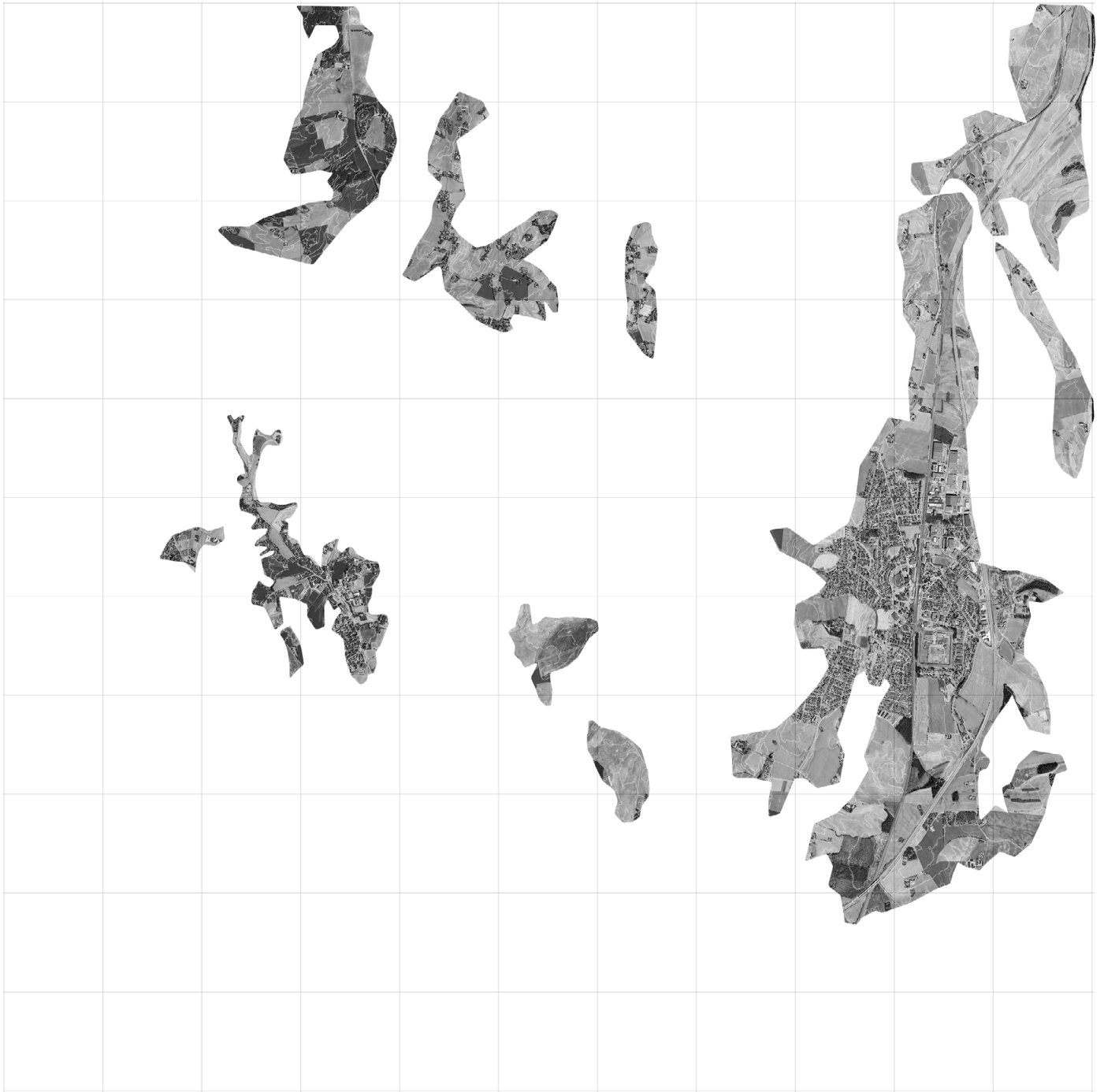


Ask center. Photo: Kai Krog Halse.

### 3. THE PLATEAU

The plateau is where all the major roads intersect. This creates a condition of centrality, and was the location of the dairy, mail service and general store in the late 19th century. This is also where the first larger housing development (Askjordet) was built in the 1950's.

Ask is the administrative center of the municipality and is subject to continuous housing development.



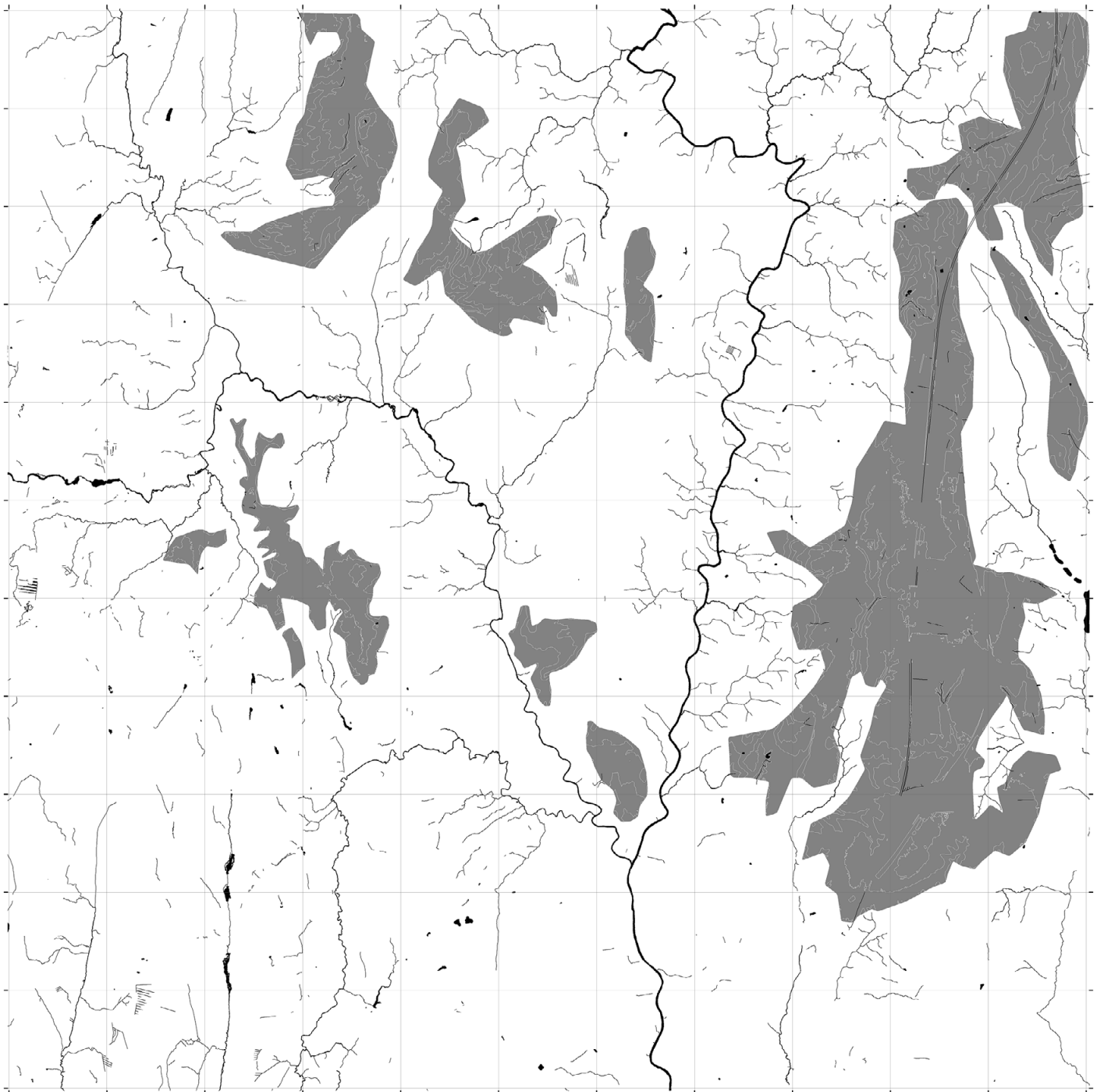
0 1 Km



## GJERDRUM - KLØFTA, PLATEAUS

Source: Own mapping







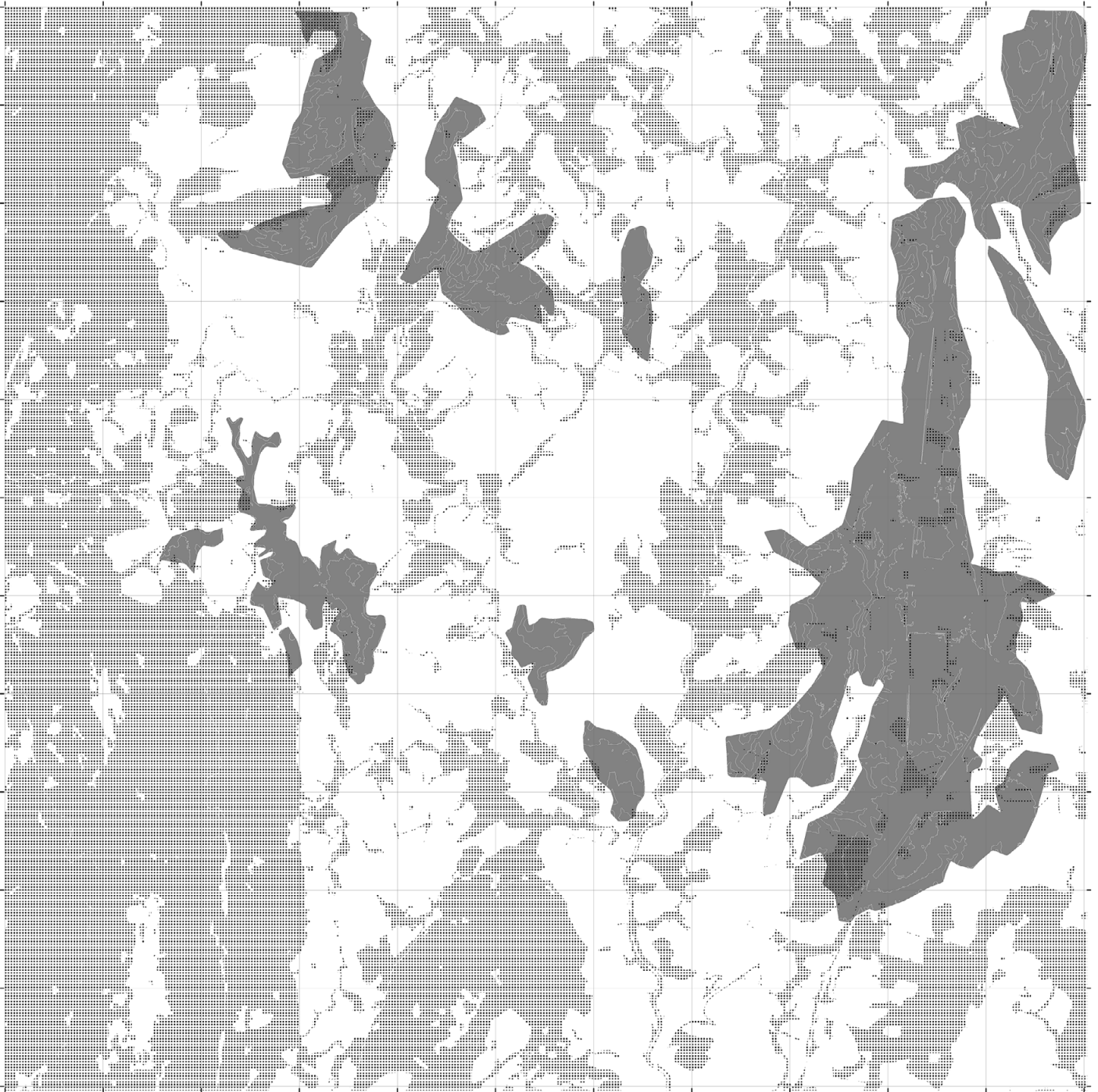
0 1 Km



### GJERDRUM - KLØFTA, PLATEAUS / HYDROLOGICAL NETWORK

Source: Geovekst, Own mapping

-  Hydrological network
-  Plateaus



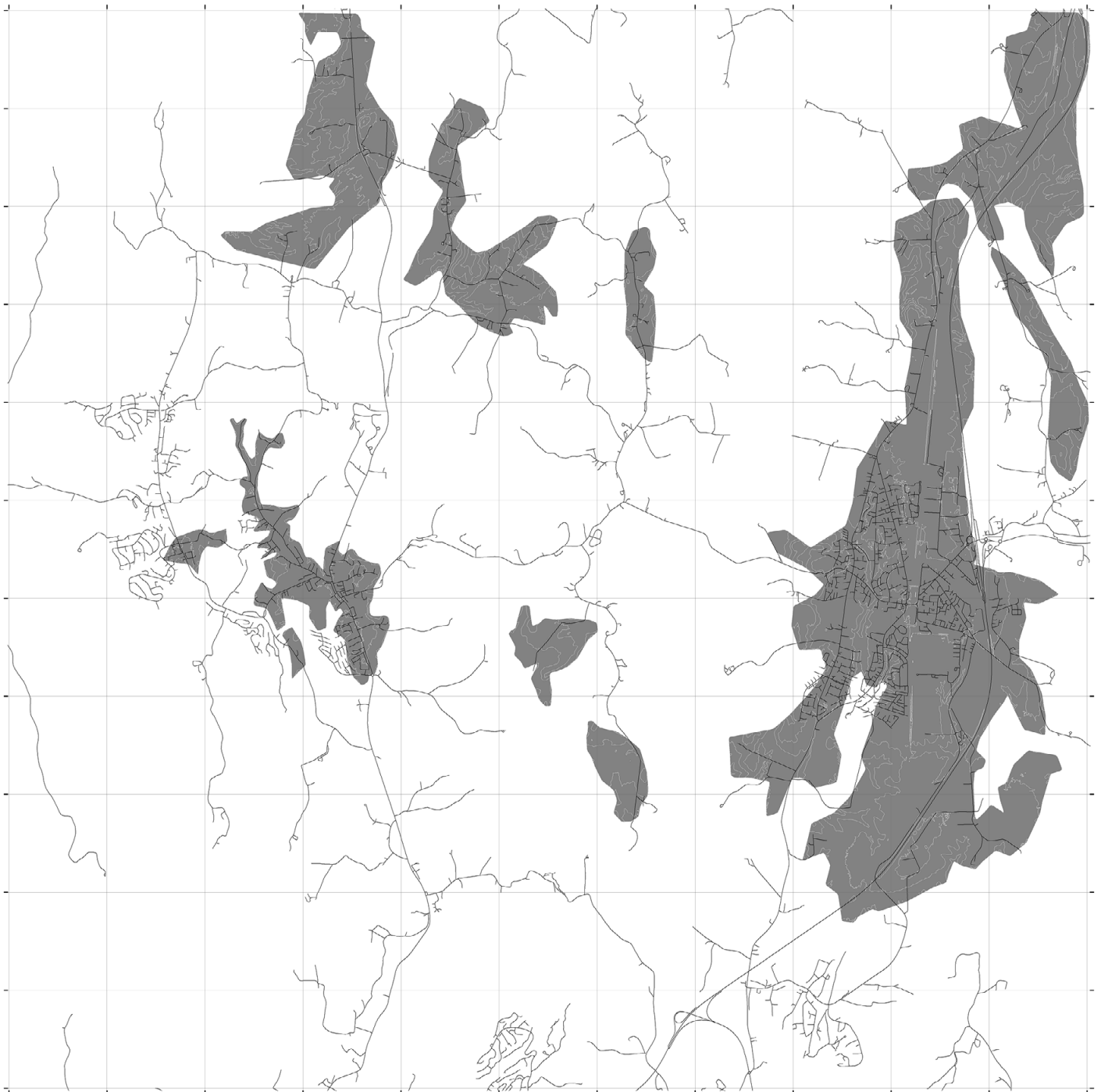
0 1 Km



**GJERDRUM - KLØFTA, PLATEAUS / FOREST (SOUTH BOREAL)**

Source: Geovekst, Own mapping

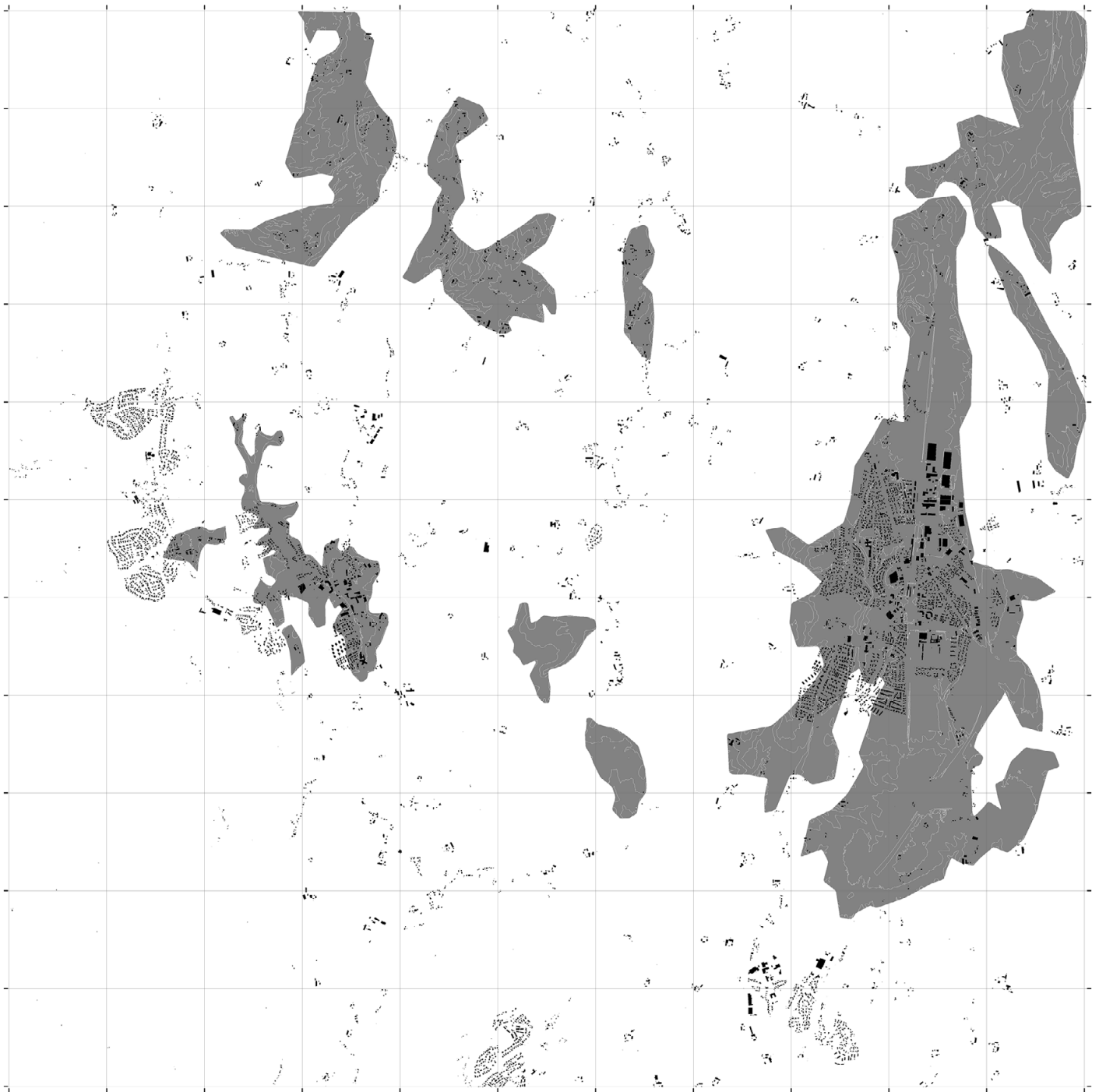
-  South Boreal forest structure
-  Plateaus



## GJERDRUM - KLØFTA, PLATEAUS / MOBILITY NETWORK

Source: Geovekst, Own mapping





**GJERDRUM - KLØFTA, PLATEAUS / SETTLEMENT STRUCTURE**

Source: Geovekst, Own mapping

- Building
- Plateaus

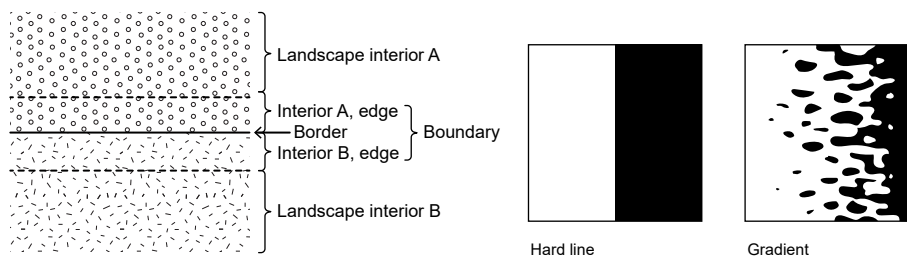


The Ask plateau in Gjerdrum. Photo: Kai Krog Halse.



Edges and boundaries

## DEFINITIONS



Spatial relationship of boundary, border, and edges.  
Adapted from Forman (1995).

Adapted from Van Leeuwen (1981).

Edges are interfaces between spaces, for example between agricultural field and forest, between ravines and fields.

From an ecological perspective, edges are of two types:

- Edge as a gradient (ecotone) and edge as hard line (ecoline).
- Edge as a gradient shows a fine-grained pattern of transition supporting high biodiversity and high dynamics.

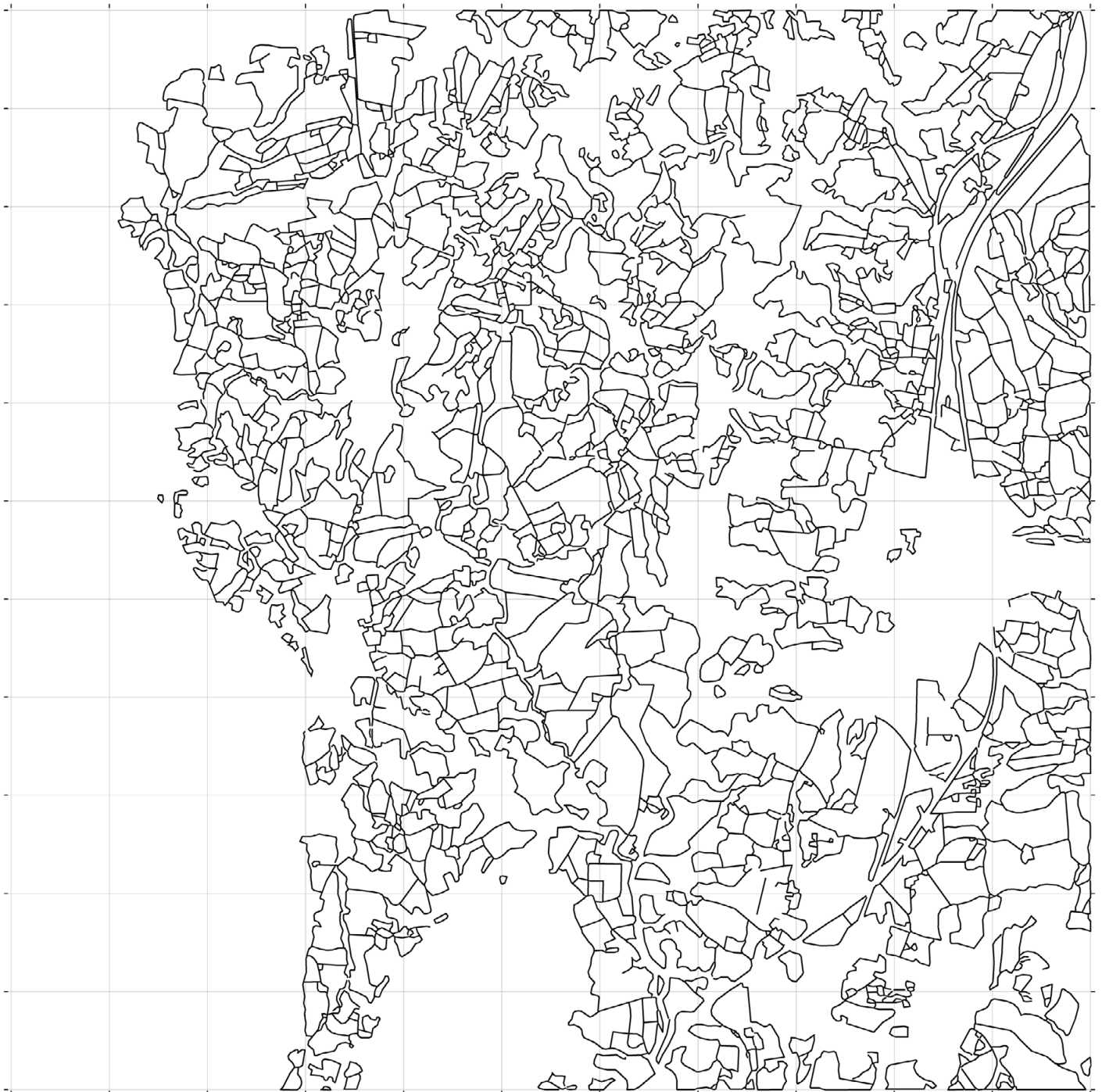
Edge as hard line shows a coarse grained pattern supporting low biodiversity and high dynamics.

Edges and boundaries ties the region together. The fields of the study area comprise a total edge length of nearly 1000 km. Criss-crossing the territory, these edges are but a isotropic network waiting to be found.





## 1. FIELD BOUNDARIES



0 1 Km



**GJERDRUM – KLØFTA, FIELD EDGES**

Source: Own mapping

Typical sections:

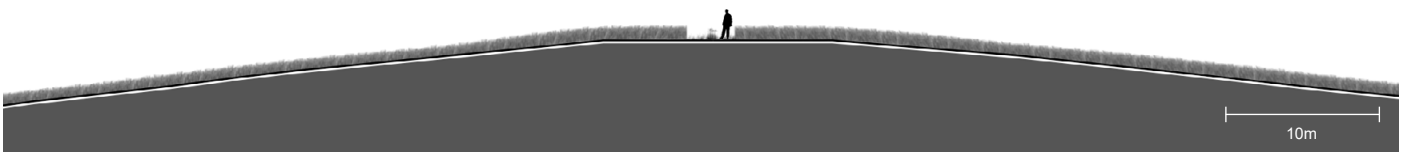
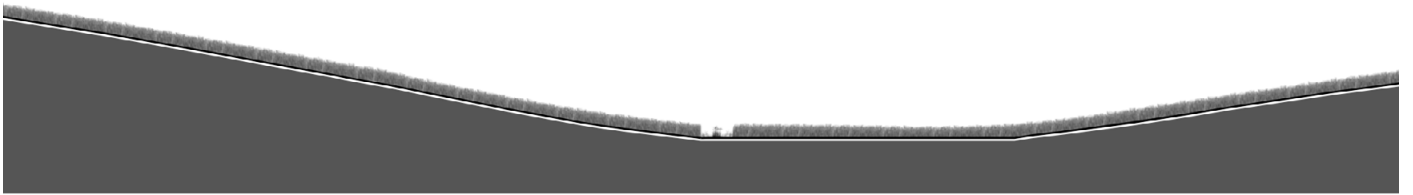
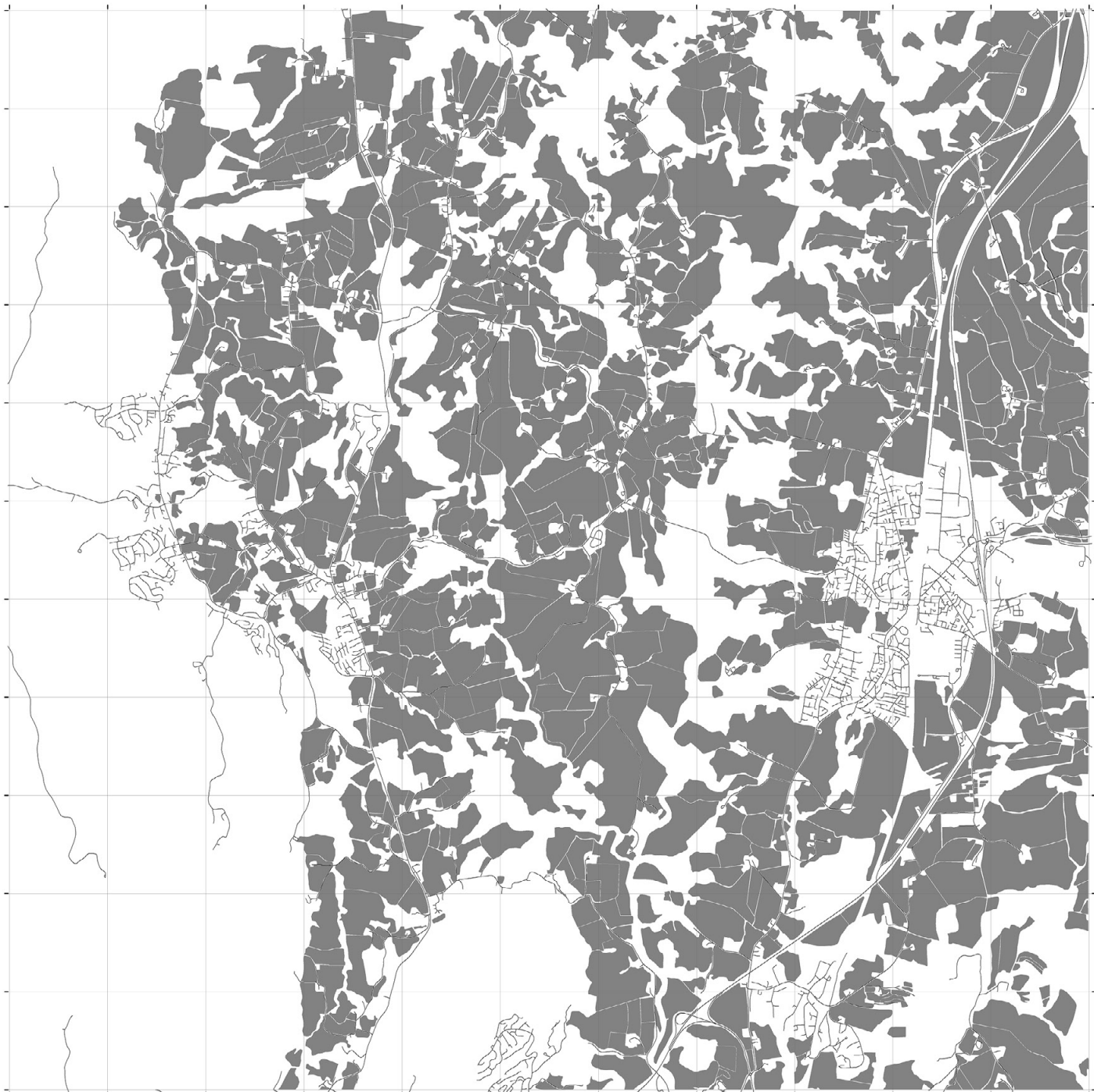






Photo: Kai Krog Halse.

## 2. FIELD/ROAD BOUNDARIES



0 1 Km



### GJERDRUM - KLØFTA, FIELDS / MOBILITY NETWORK

Source: Geovekst, own mapping

- Mobility network
- Agricultural fields

Typical sections:

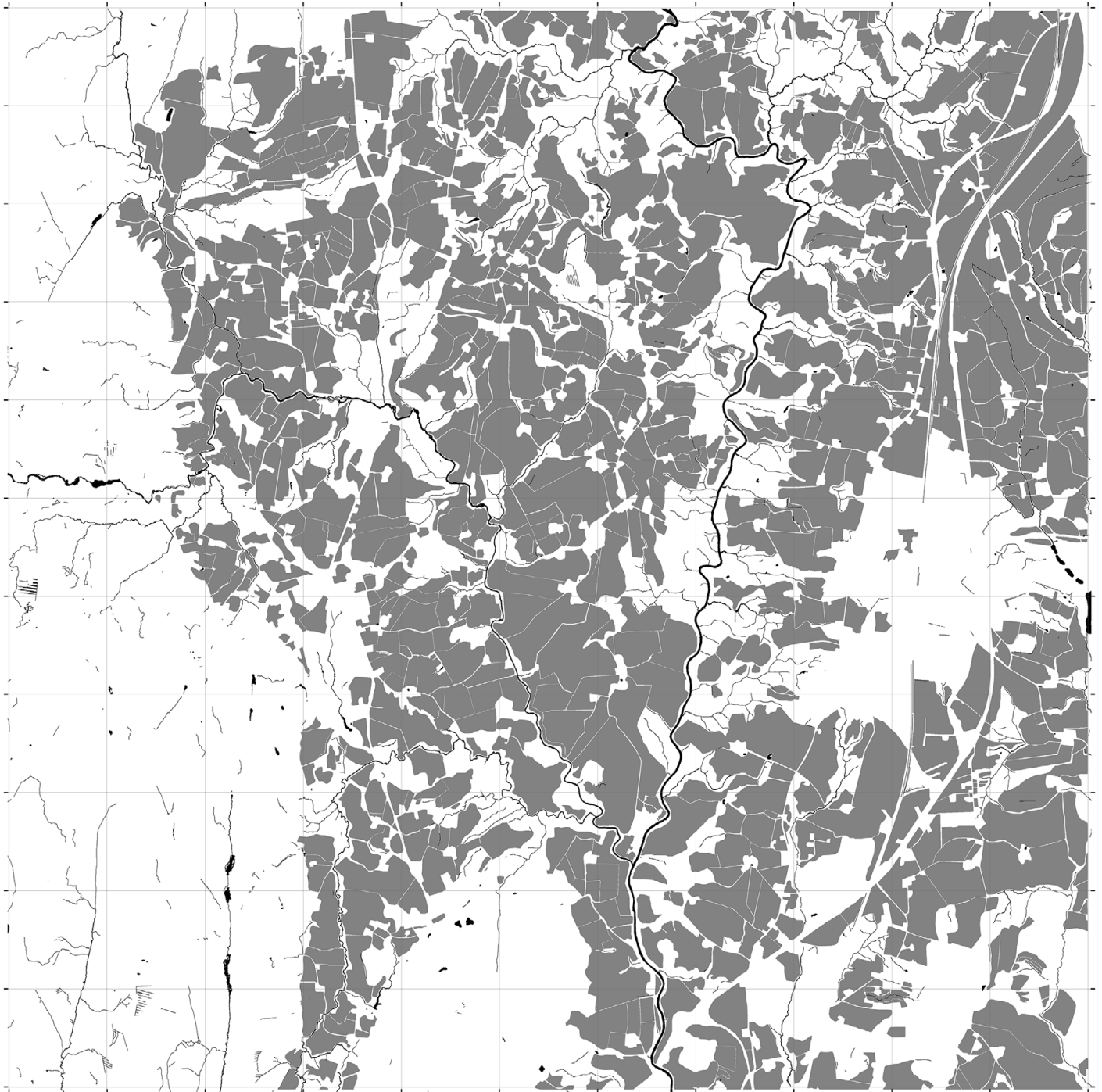








3. FIELD/HYDROLOGICAL CORRIDOR BOUNDARIES





0 1 Km



### GJERDRUM - KLØFTA, FIELDS / HYDROLOGICAL NETWORK

Source: Geovekst

-  Hydrological network
-  Agricultural fields

Typical section:

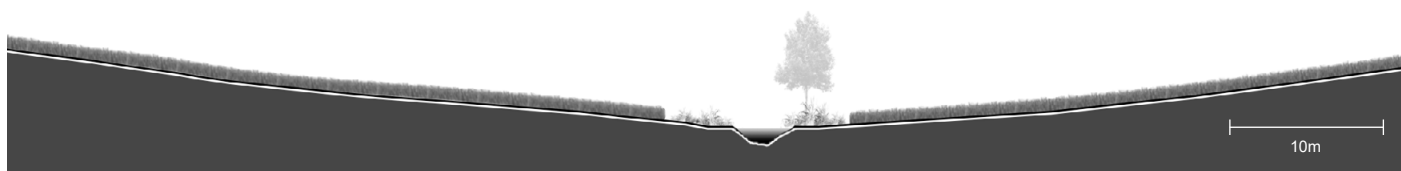
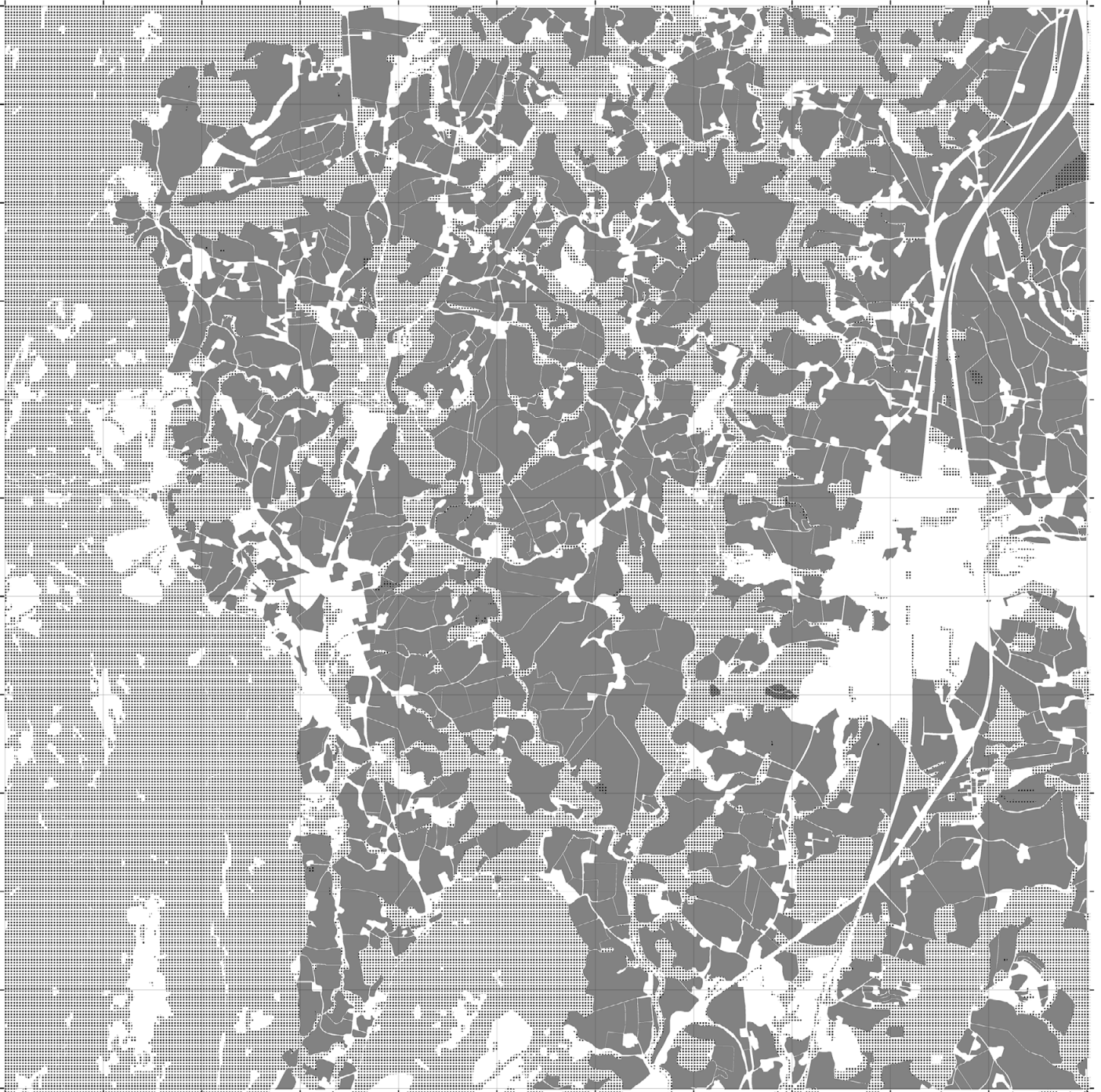






Photo: Giambattista Zaccariotto.

#### 4. FIELD/FOREST BOUNDARIES





0 1 Km



### GJERDRUM - KLØFTA, FIELDS / FOREST (SOUTH BOREAL)

Source: Geovekst, own mapping

-  South Boreal forest structure
-  Agricultural fields

Typical section:



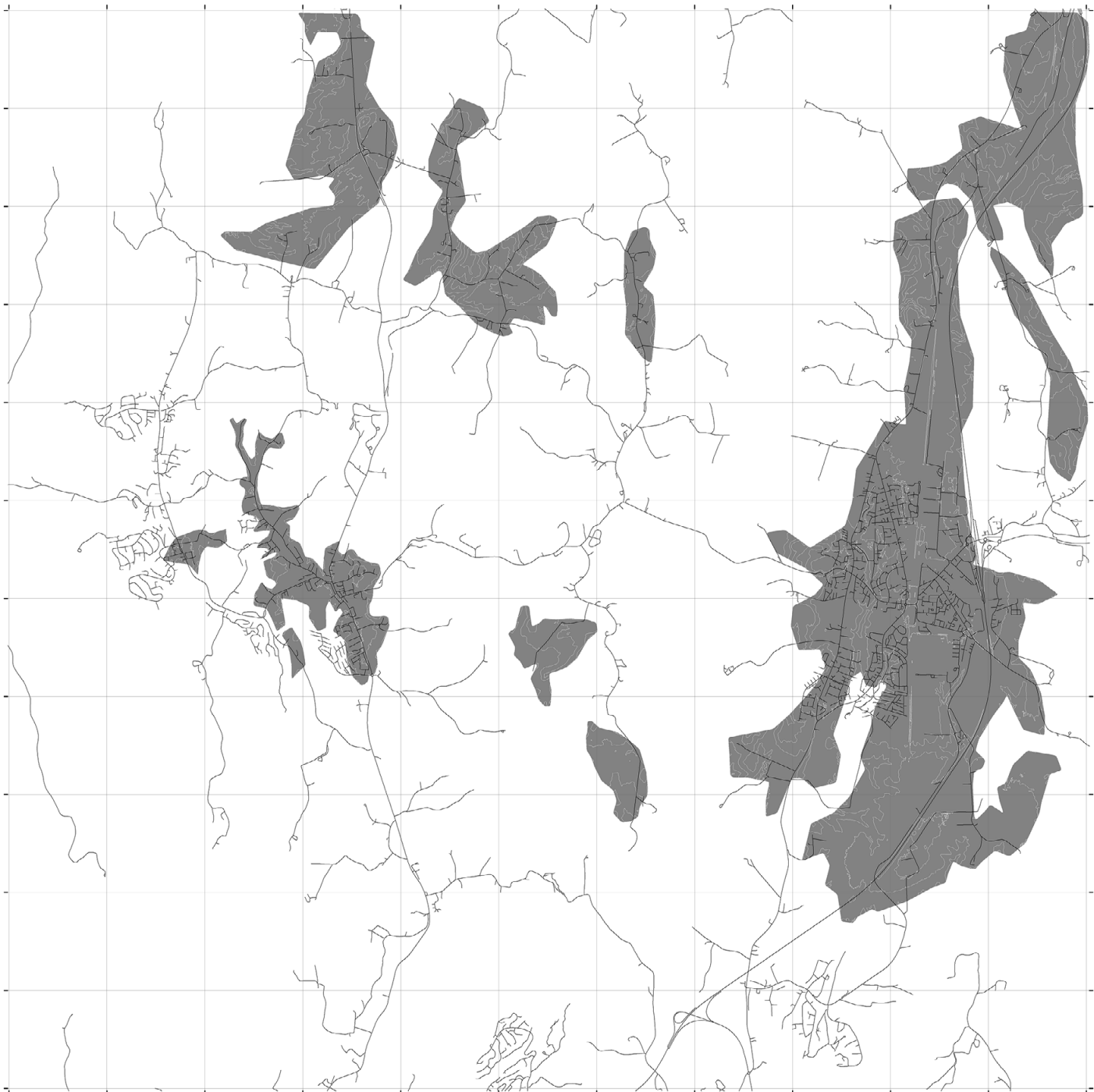






Photo: Giambattista Zaccariotto.

## 5. PLAIN BOUNDARIES

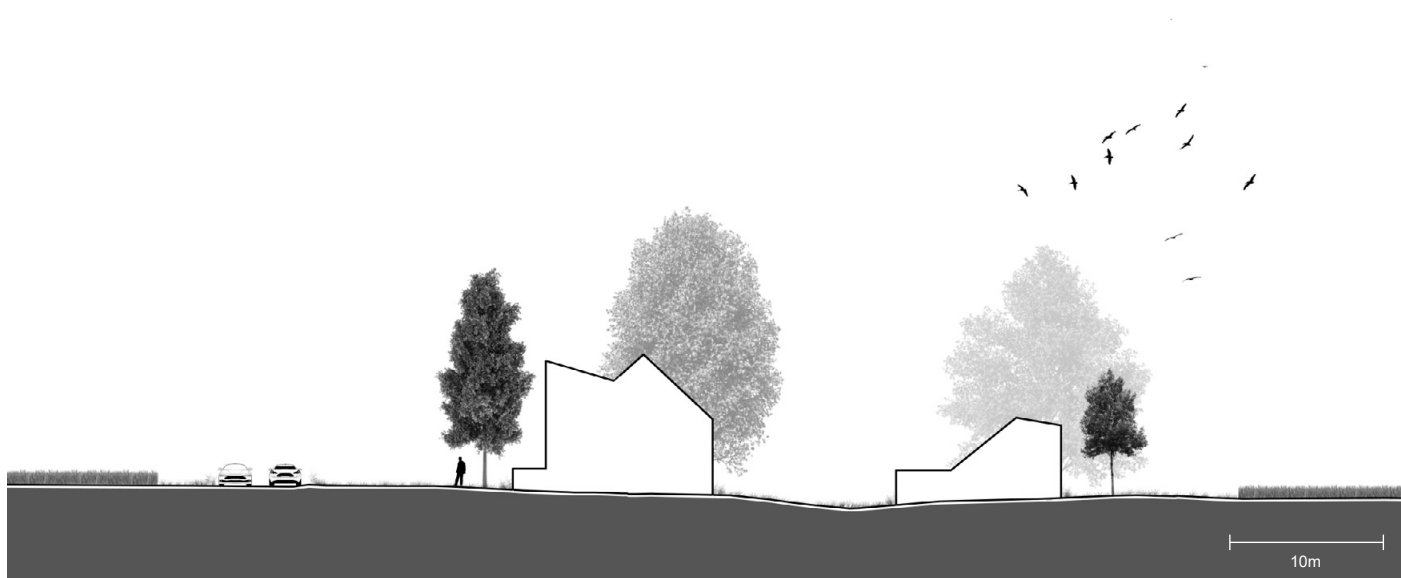


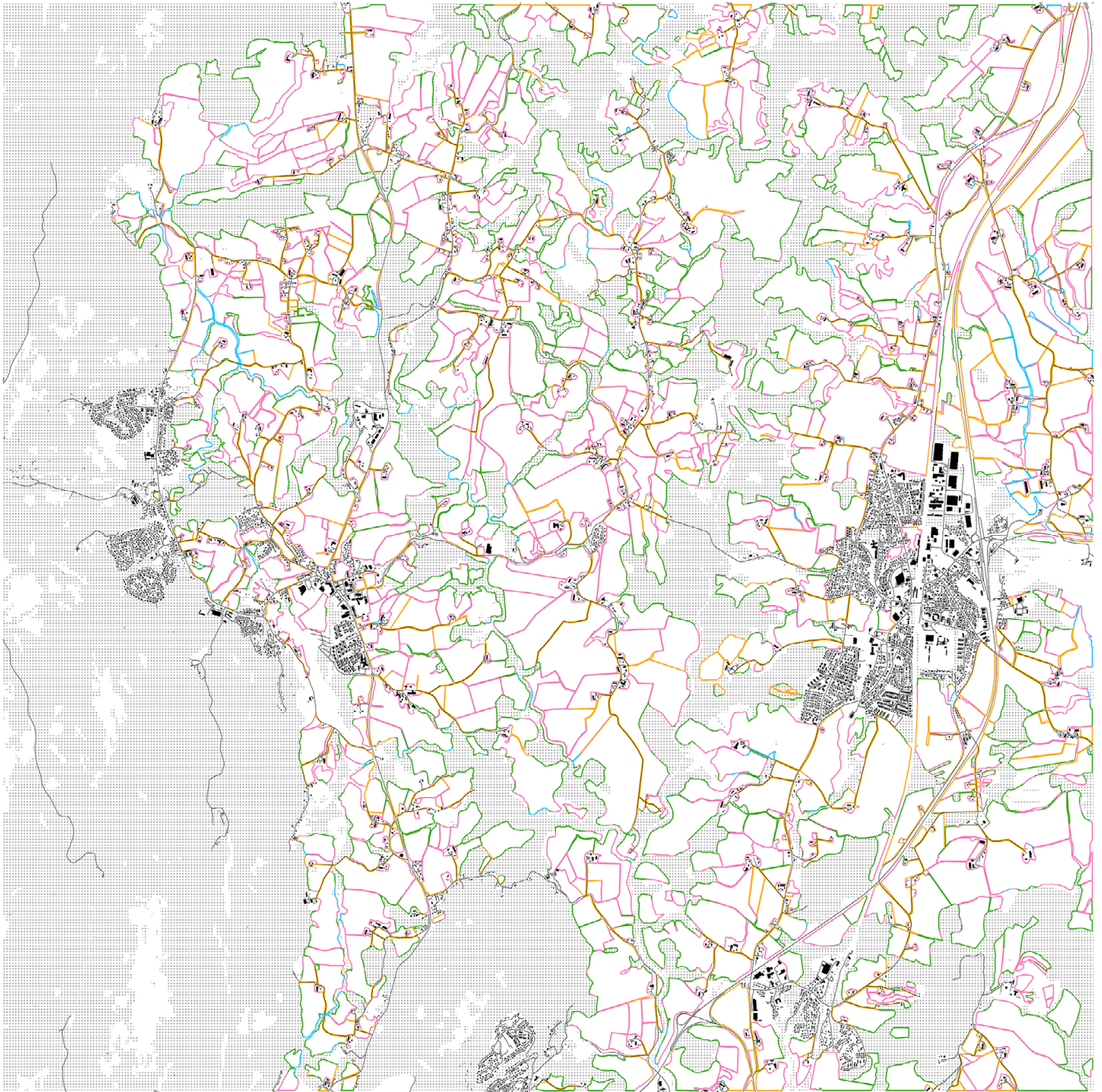
## GJERDRUM - KLØFTA, PLATEAUS / MOBILITY NETWORK

Source: Goovokst. Own mapping

- Mobility network
- Plateaus

Typical section





0 1 Km



## GJERDRUM – KLØFTA, EDGE SITUATIONS

Source: Geonorge, own mapping

- Edges along water
- Edges along existing roads
- Edges along forest
- Edges along fields
- Existing mobility network
- ⋯ Existing forest

### Edge potentials

Four edge conditions has been identified as possible carrying structures for the isotropic network. In the study area the field edges alone represents nearly 1000 Km edge length.

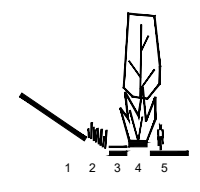
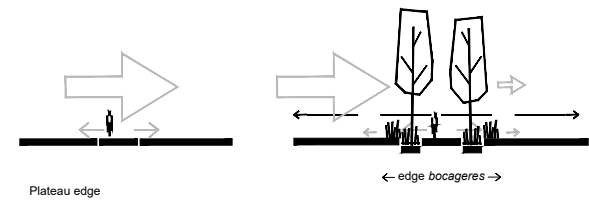
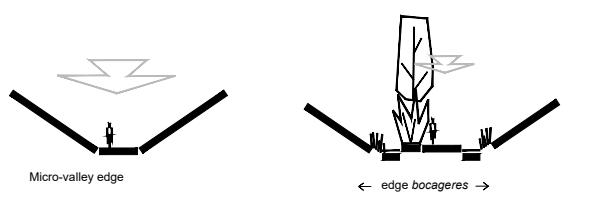
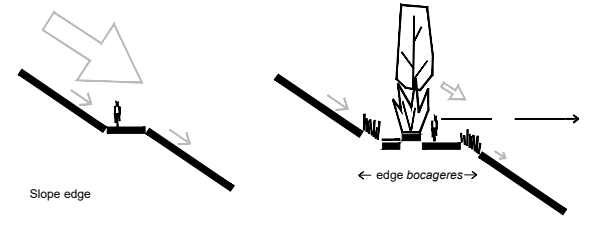


Field boundary. Photo: Kai Krog Halse.

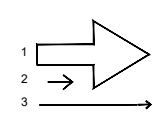


Toolbox

# GUIDING MODELS

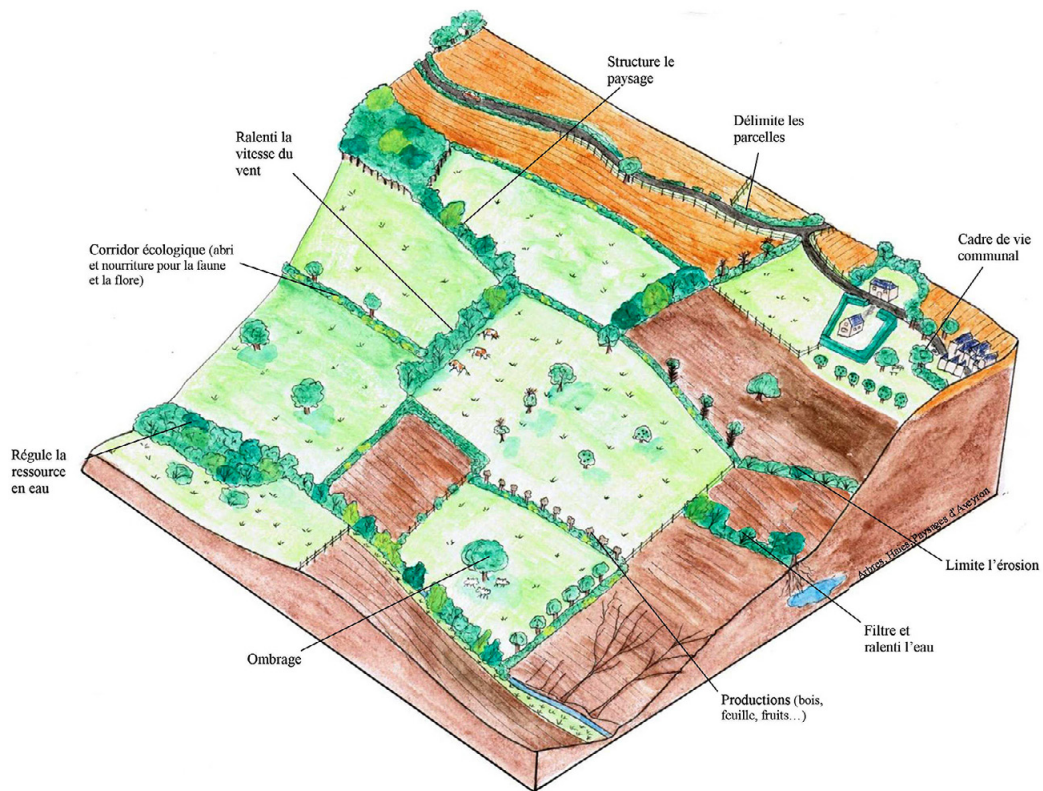


- Edge bocageres structure:
1. Existing land-use ground
  2. Verge of wild-grass
  3. Water-drainage storage and cleaning (dry or wet ditch, wadi...)
  4. Talus(embankment) or wall with layered vegetation
  5. Traffic corridor



1. Wind-flow direction and magnitude
2. Run-off water flow direction and magnitude
3. View direction





Bocage landscape. Adapted from Arbres Haies Paysages d'Aveyron.

## AGROFORESTRY IN A LINEAR ARRANGEMENT

"Lines are a common feature of many agricultural landscapes, be they in a field, on its border or along communication routes. Trees can easily be integrated in those lines, such as in hedges, contour lines or soil conservation hedgerows, alley cropping (regularly spaced hedgerows in crop land), living fences, boundary plantings, roadside plantings, windbreaks, shelterbelts, woody strips. Ecological interactions between trees and crops are different across these examples, from very present in alley cropping or windbreaks, to less so in boundary or roadside planting.

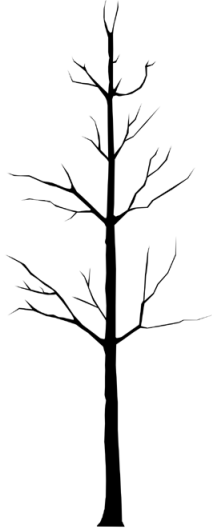
A very good reason to plant trees in a linear arrangement is often related to the limited space

available, and to reduce competition problems between trees and crops, such as in alley cropping. A clear structural characteristic of agroforestry in a linear arrangement is that trees and crops appear side by side, not one above the other".<sup>1</sup>

In particular "bocageres structures" combined, in linear arrangements, micro-topographical structures (such as embankments and ditches) for layered vegetation (bushes, cepee, trees..) and water storage along with parallel service corridors. Therefore "bocageres structures" provide a multiplicity of functions (ecological, productive, esthetical) taking relatively small space.

1 Torquebiau, E. F., 'A renewed perspective on agroforestry concepts and classification', Comptes Rendus de l'Academie des Sciences-Series III-Sciences de la Vie, 2000.

# Elements



High stem tree, 15-20m

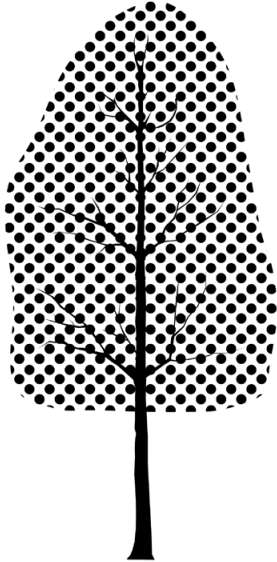


Multi-stemmed tree, 6-10m

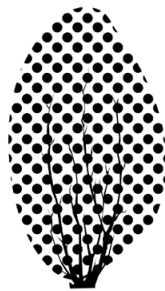


Bushy shrub, 1-5m

# Density



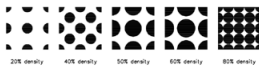
High stem tree, 20% density



Multi-stemmed tree, 40% density

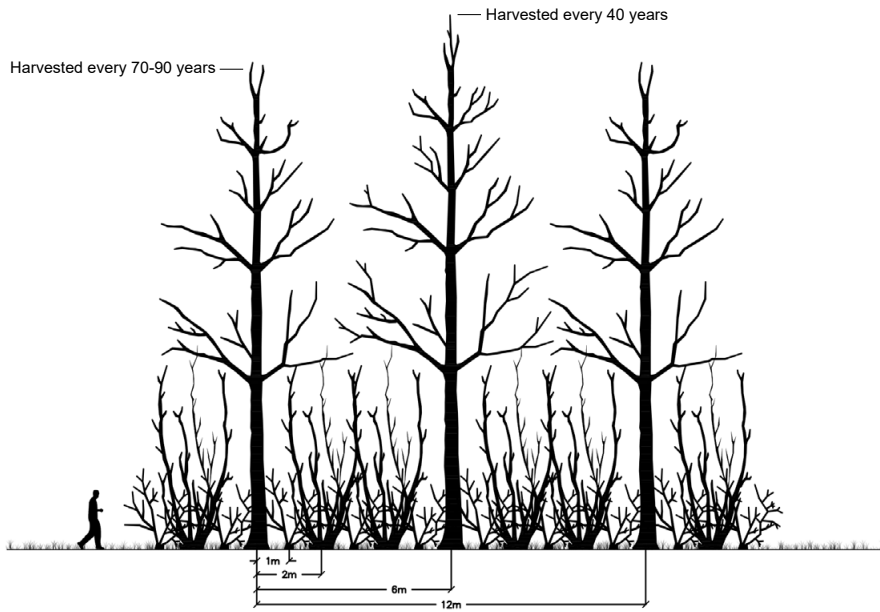


Bushy shrub, 20% density

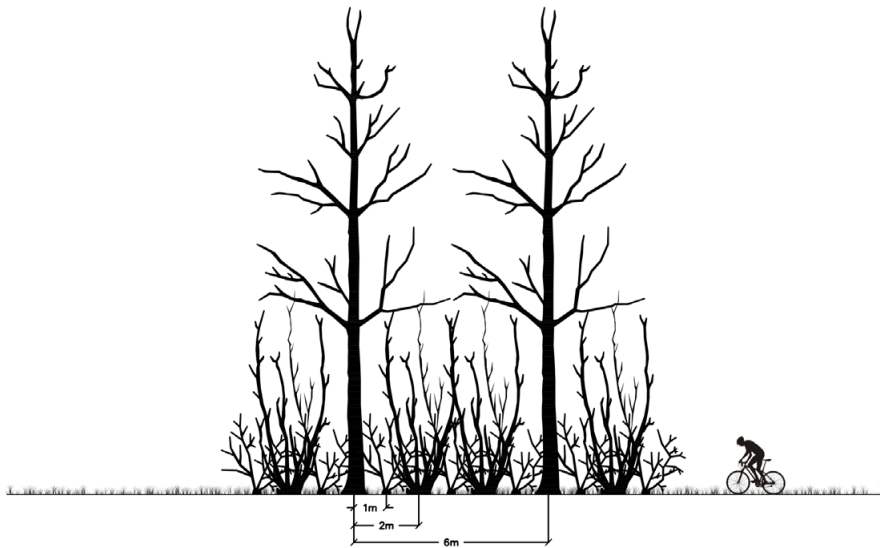


# Composition

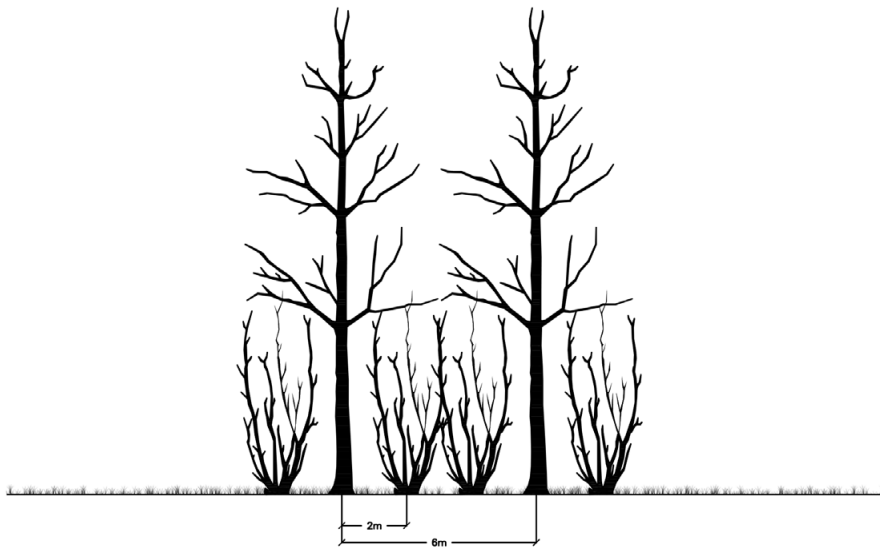
## 4 ELEMENTS



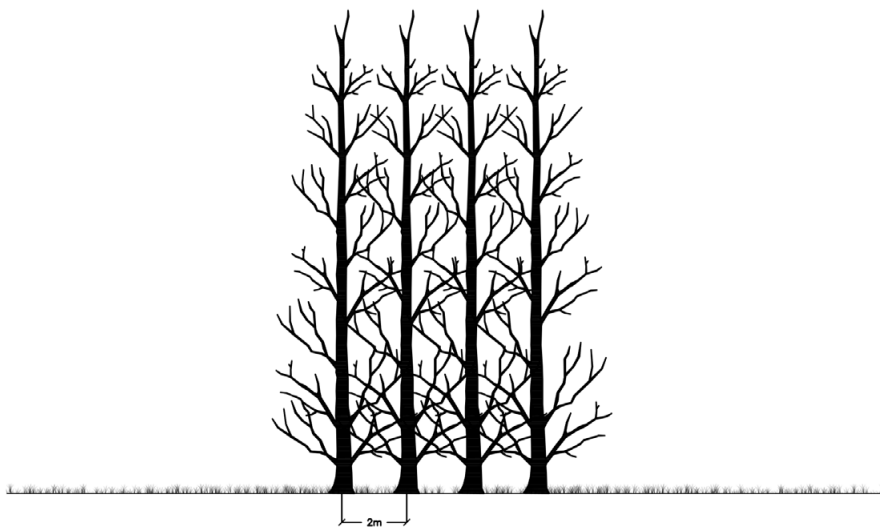
## 3 ELEMENTS



2 ELEMENTS



1 ELEMENT

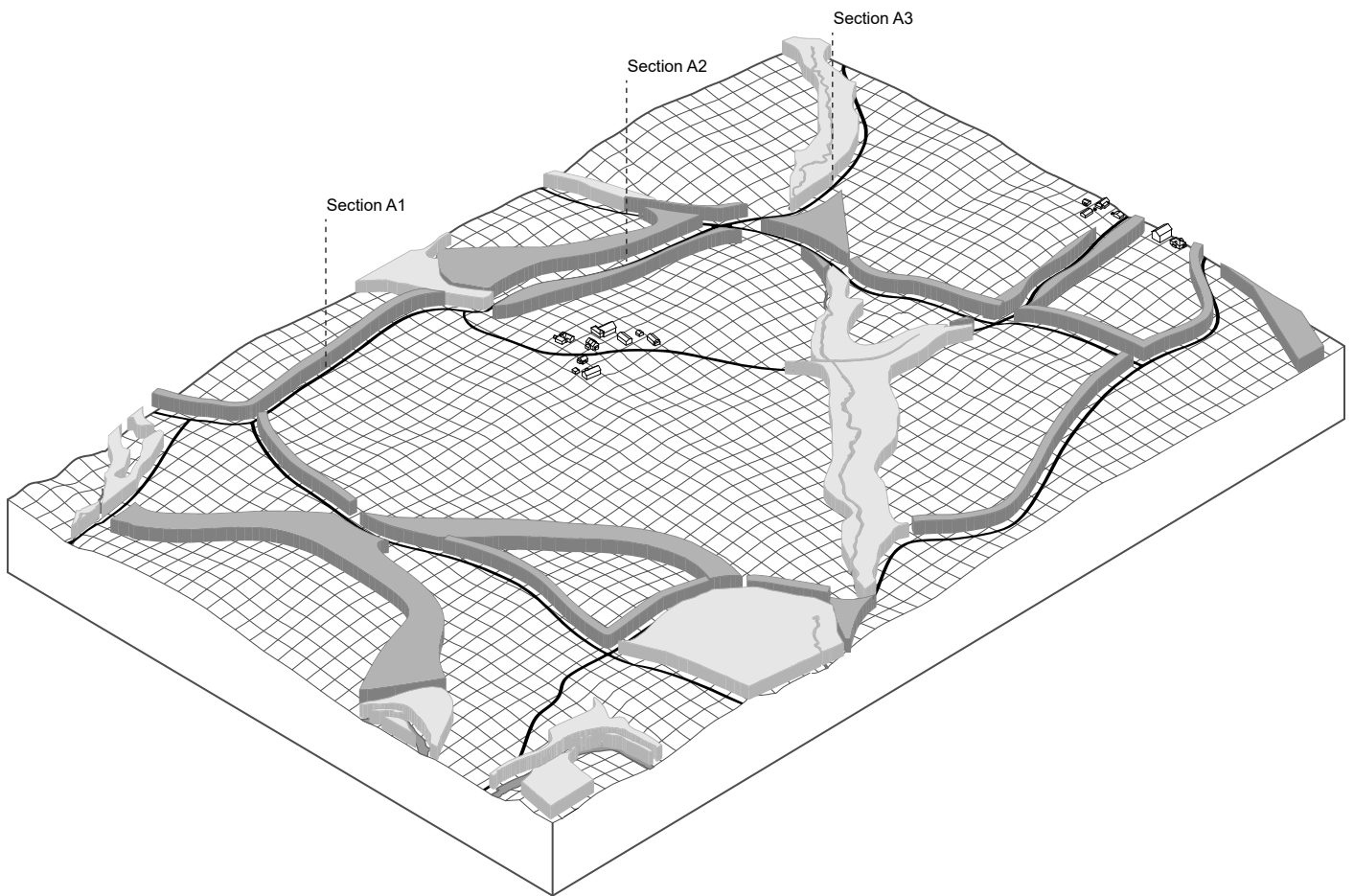
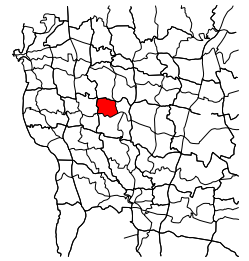




Windbreak. Photo: Wikimedia.

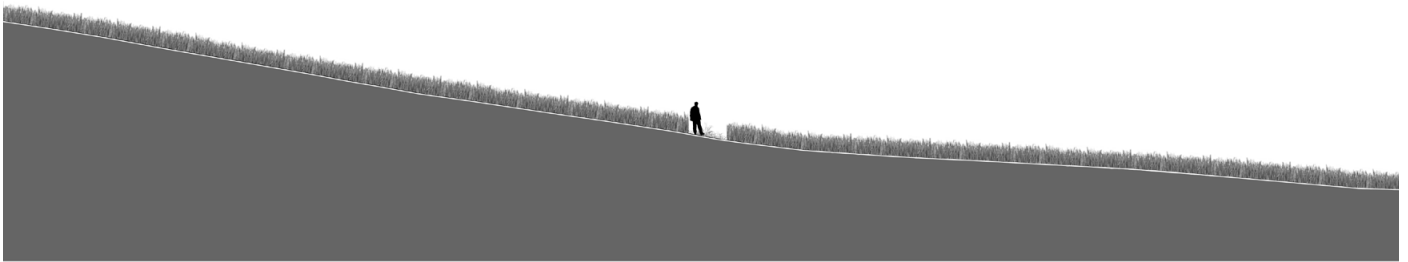
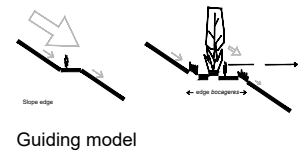


## A Landscape framework for urbanization





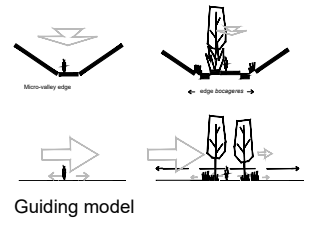
**A1**  
Existing situation



Proposed intervention



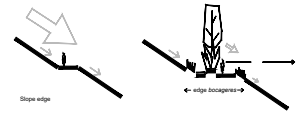
**A2**  
Existing situation



Proposed intervention



**A3**  
Existing situation



Guiding model



Proposed intervention

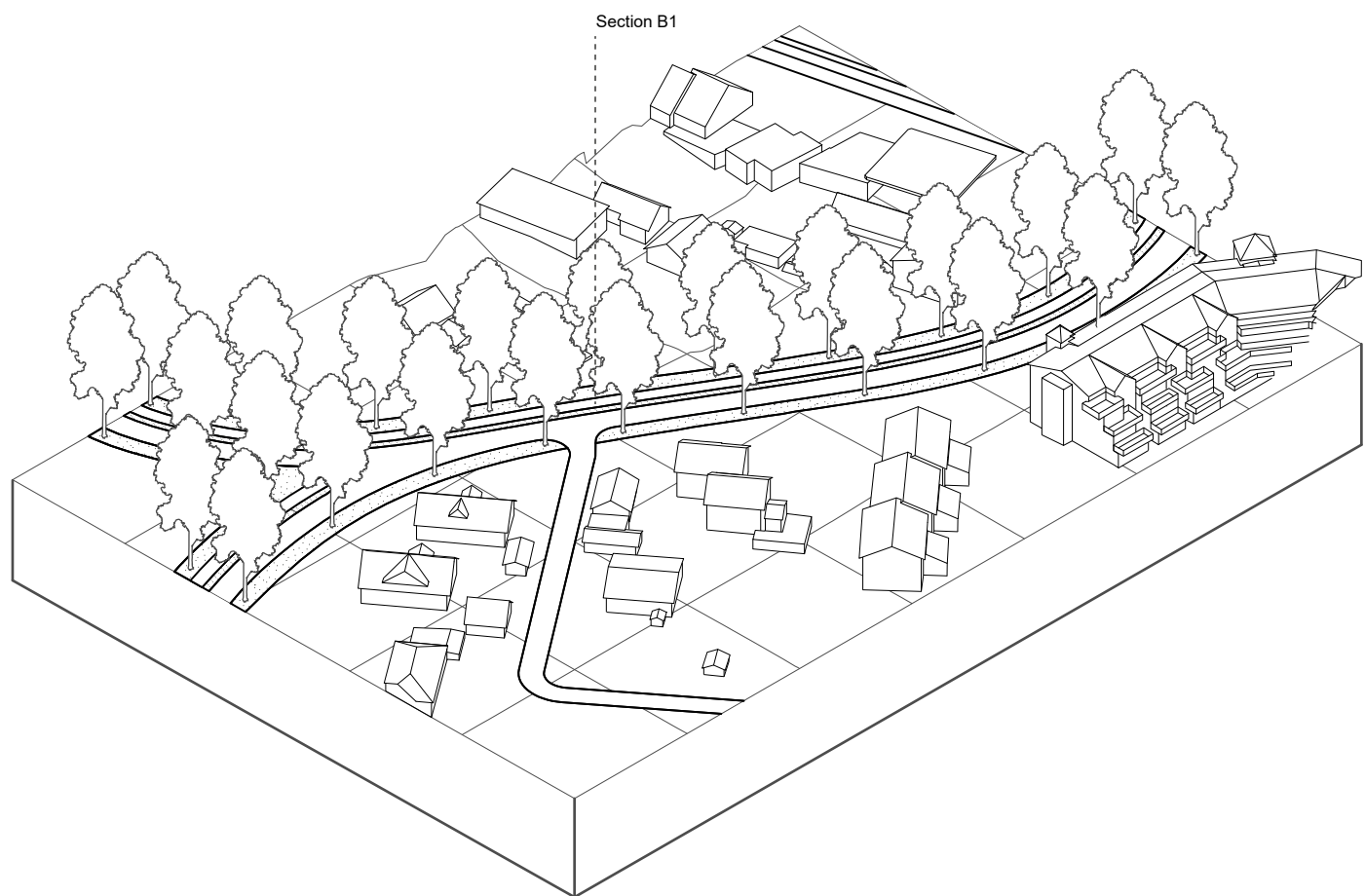


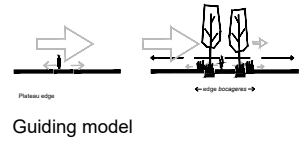


Existing situation

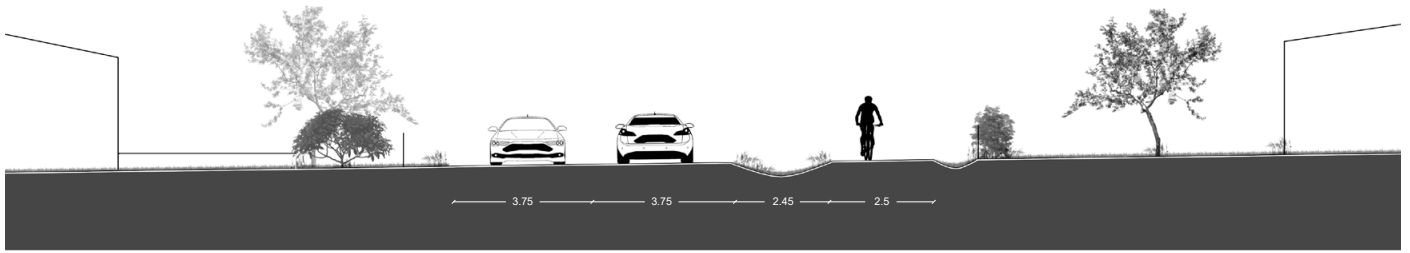


Proposed intervention





**B1**  
Existing situation



Proposed intervention





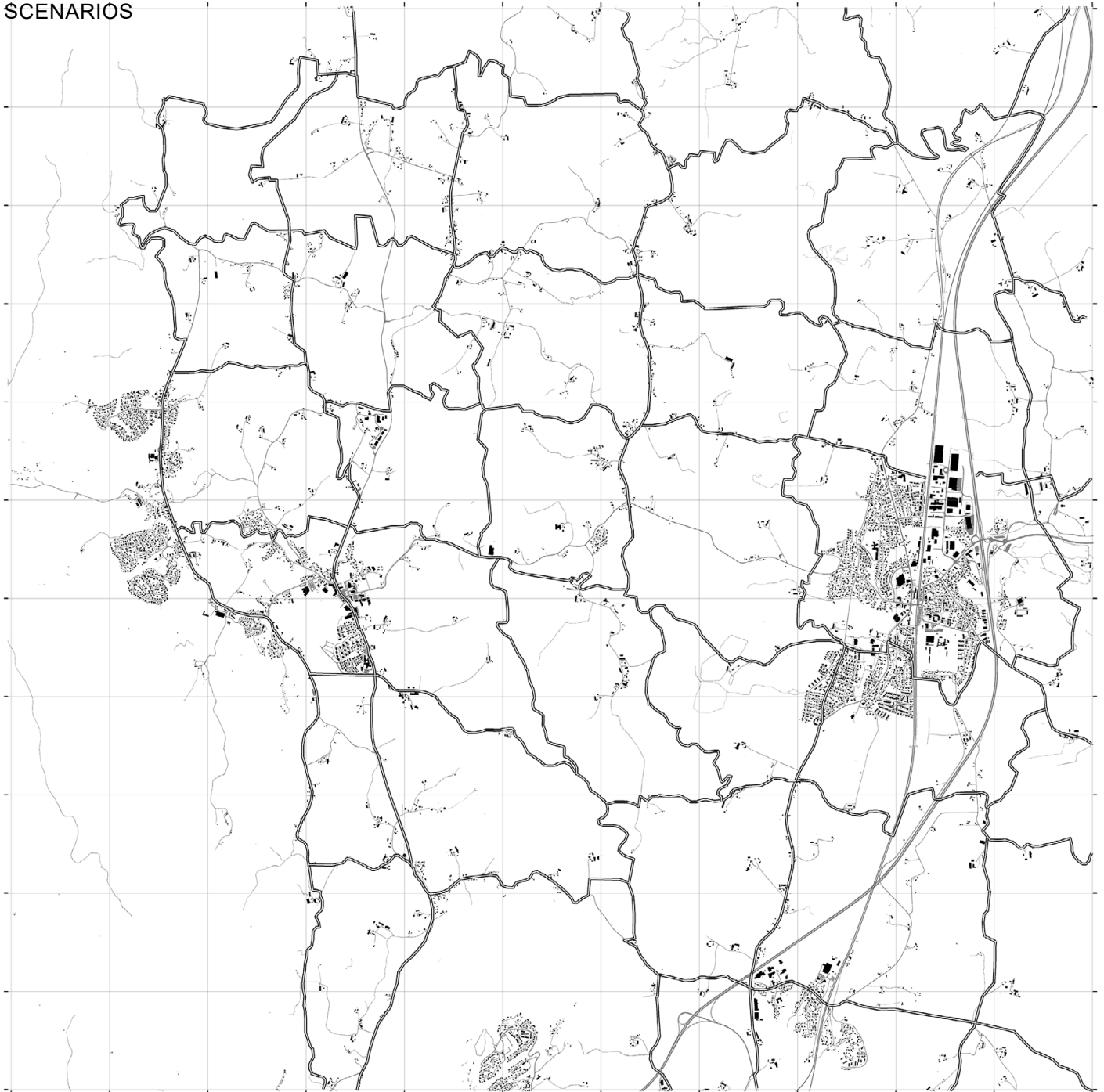
Existing field situation





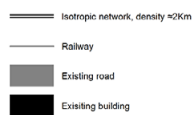
Exploration of possible interventions.

# SCENARIOS

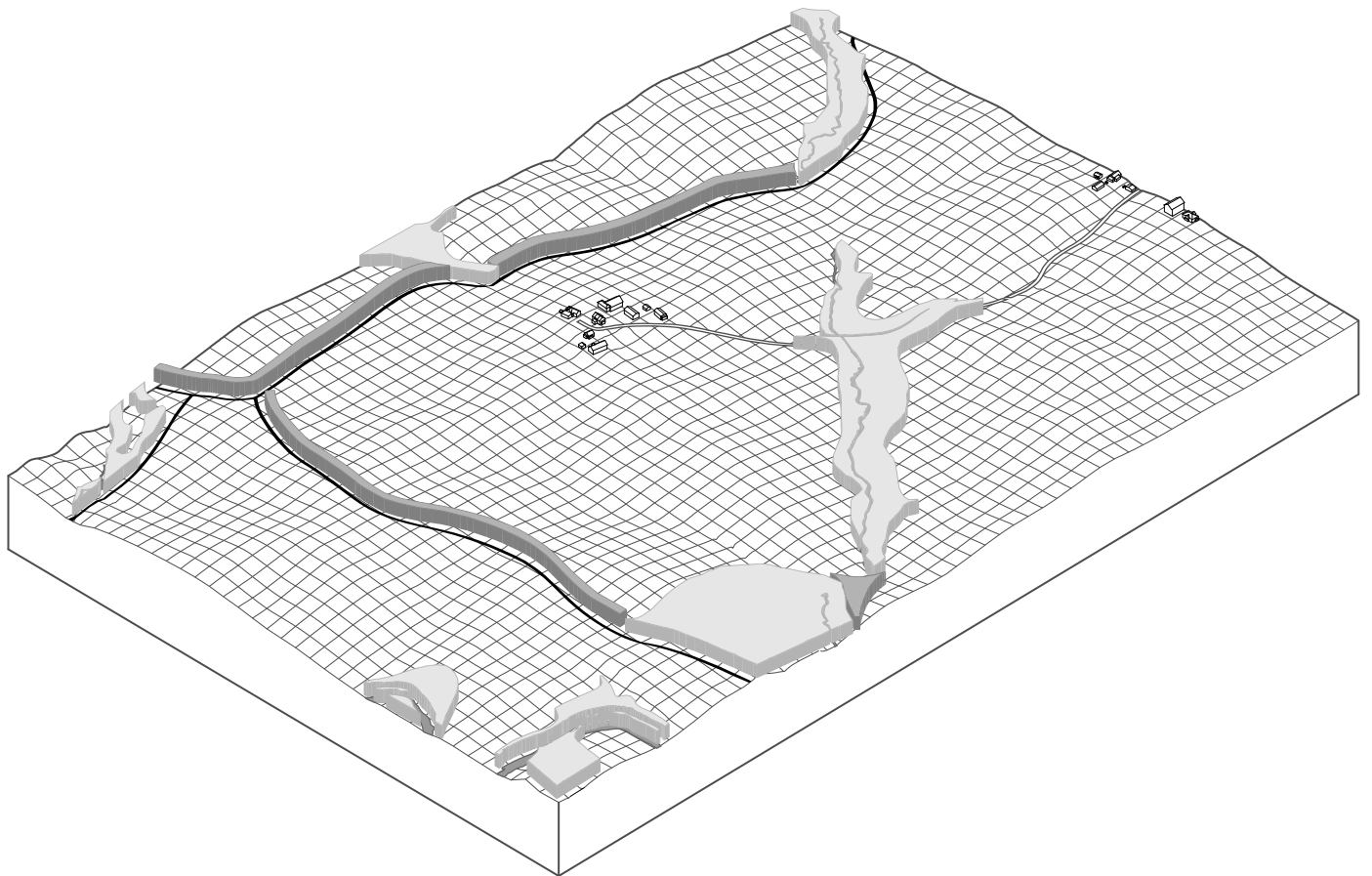
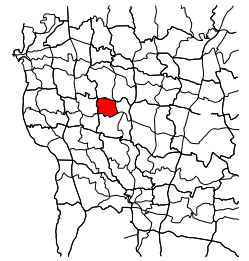


## GJERDRUM – KLØFTA, NETWORK 1, SCENARIO 1, LOW DENSITY

Source: Geonorge, own mapping








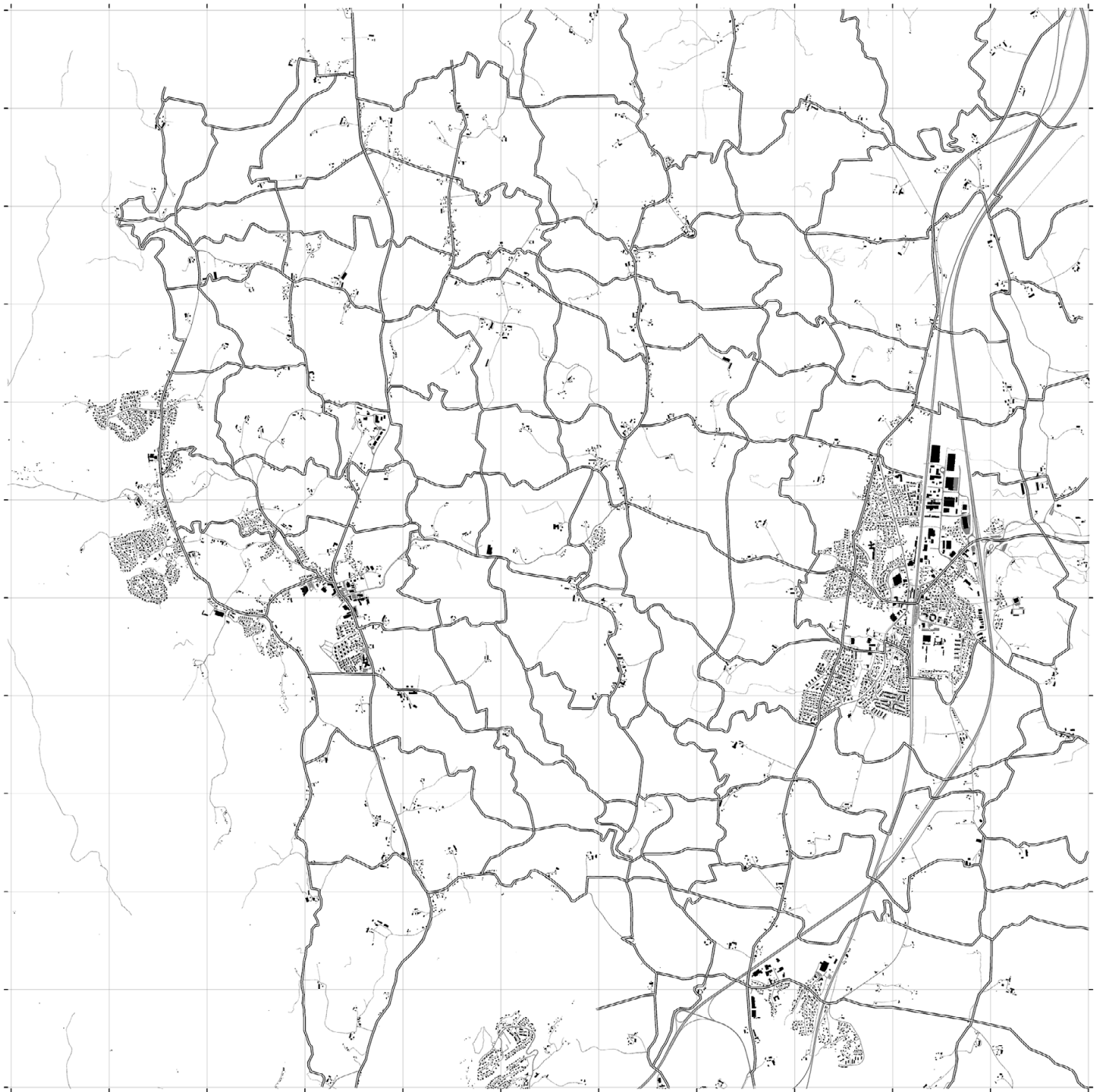
Bocager structures along existing roads, field-, forest- and water edges comprise the low density network. The network has a density of approx. 2km.



### Scenario 1 – Low density network (≈2km)

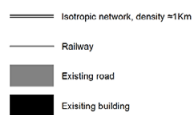
Medium political will / low economic power

-  Bocager structure
-  Proposed network link
-  Existing forest
-  Water
-  Existing road

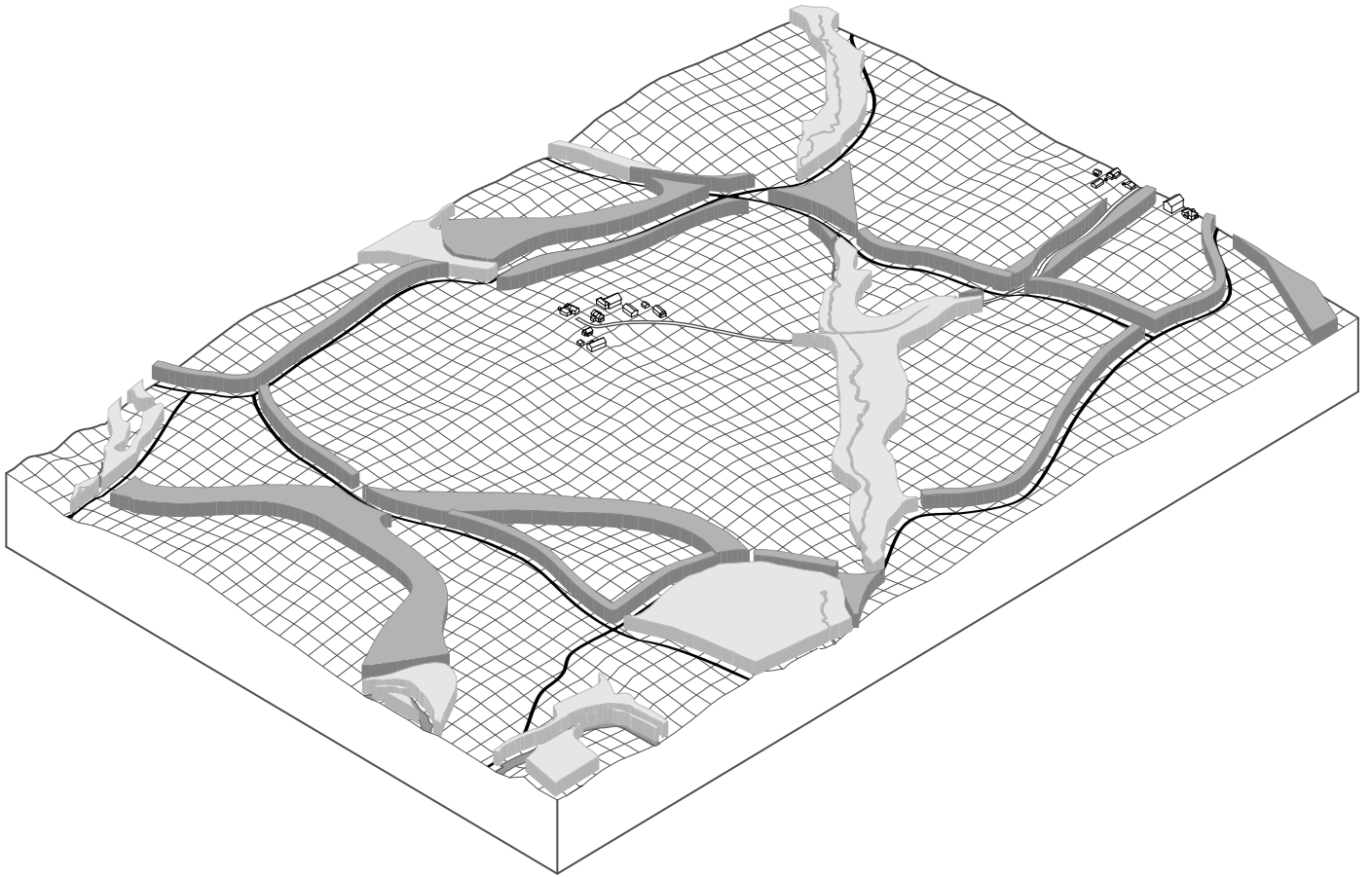
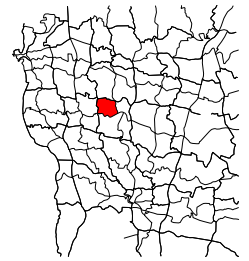


**GJERDRUM – KLØFTA, NETWORK 1, SCENARIO 2, HIGH DENSITY**

Source: Geonorge, own mapping








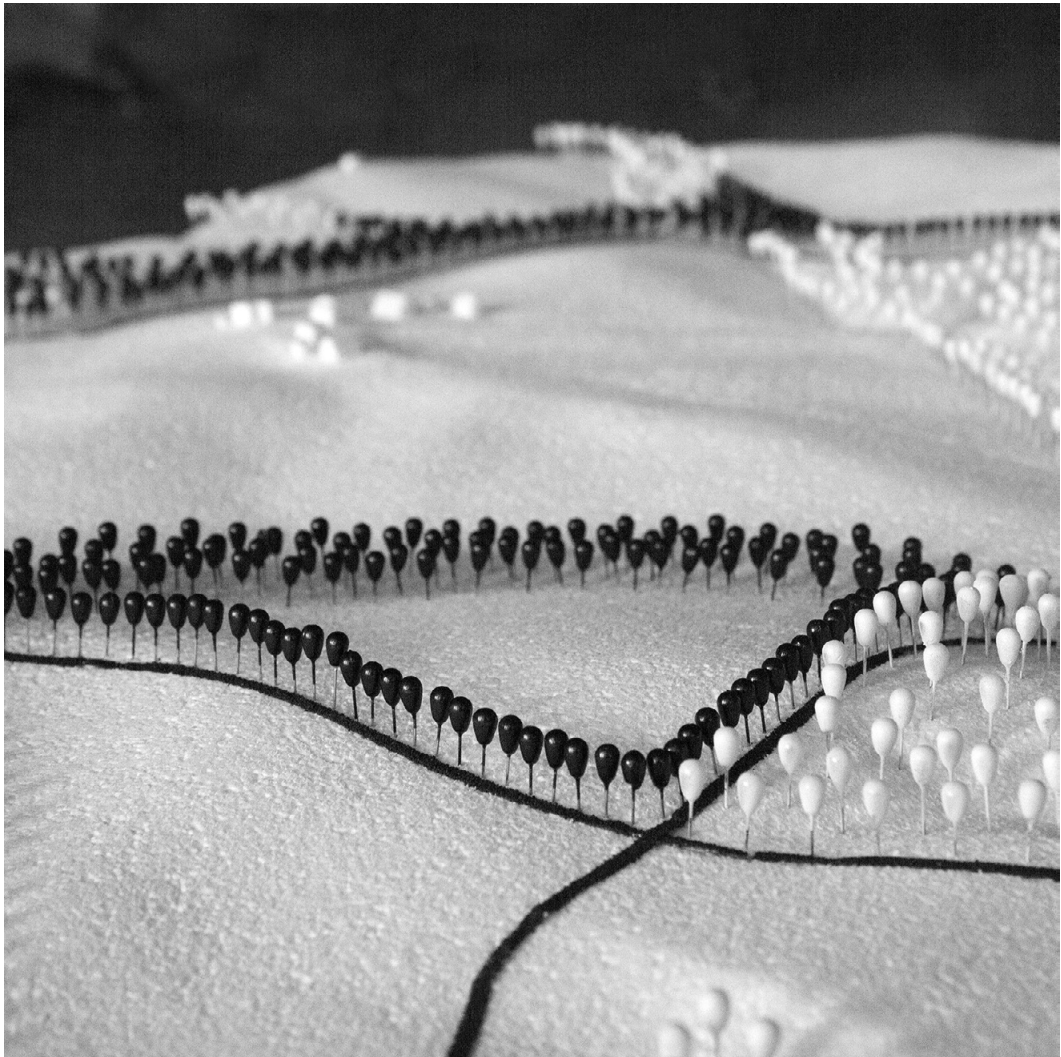
Bocager structures along existing roads, field-, forest- and water edges also comprise the high density network. The network has a density of approx. 1km.

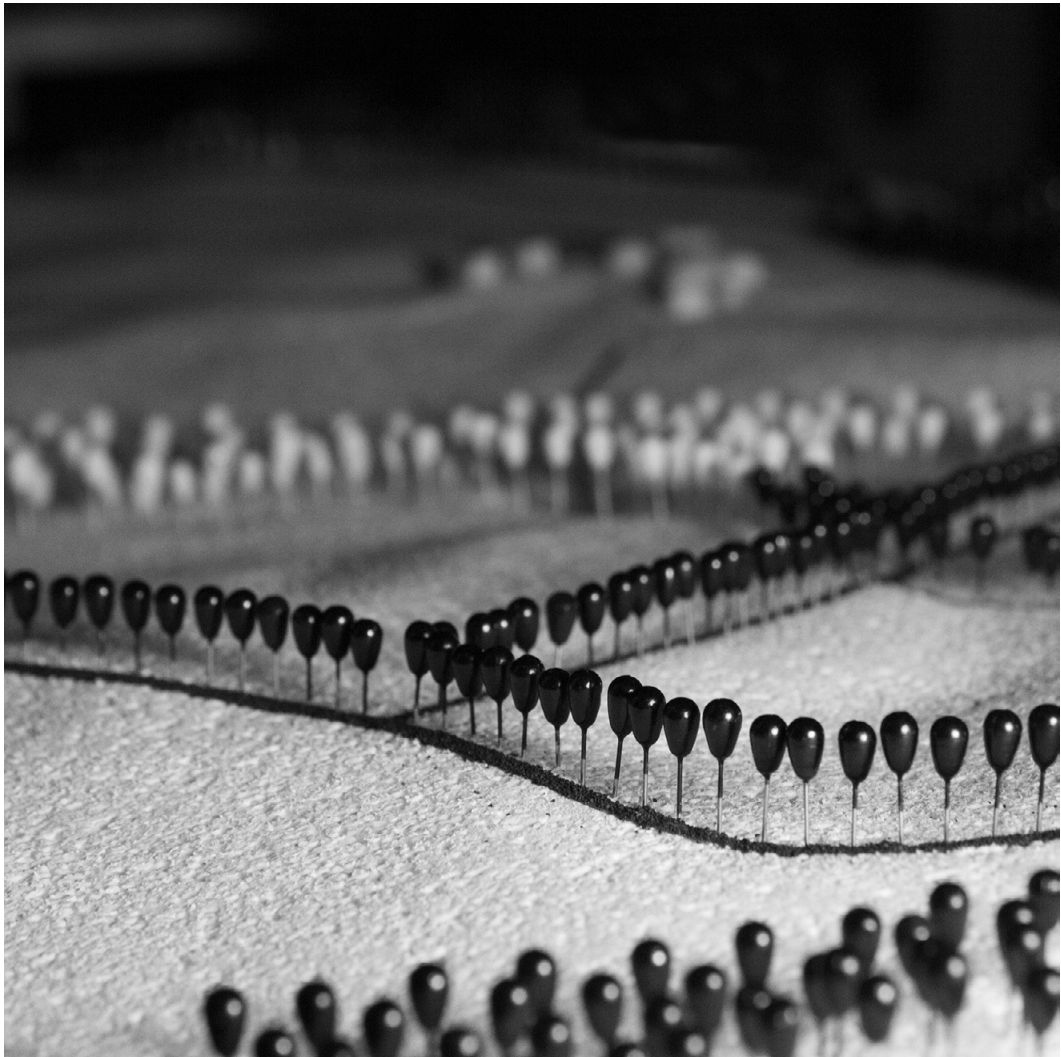


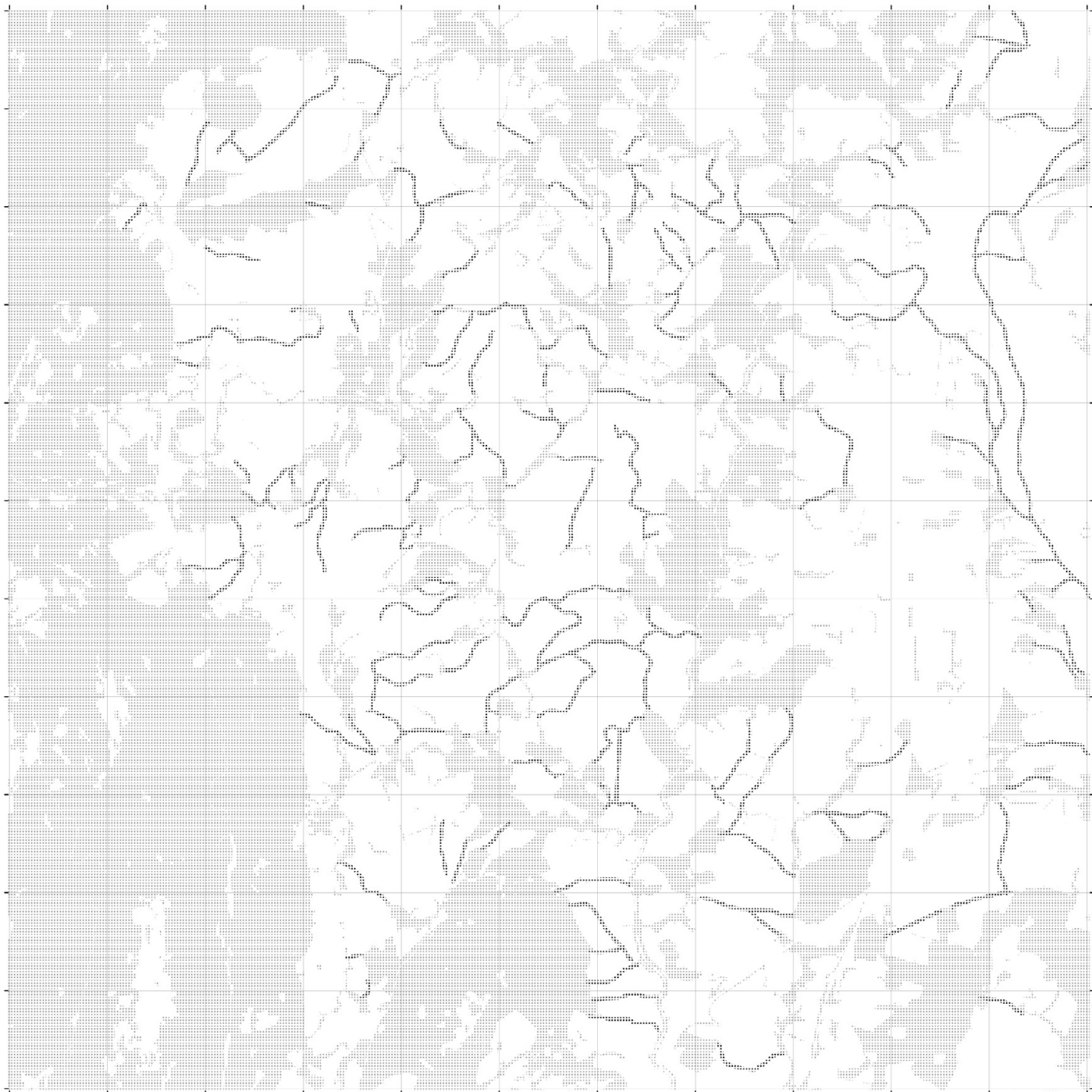
## Scenario 2 – High density network ( $\approx 1\text{km}$ )

Medium political will / medium economic power

-  Bocager structure
-  Proposed network link
-  Existing forest
-  Water
-  Existing road







0 1 Km



## GJERDRUM – KLØFTA, NETWORK 2, BOCAGER / FLOW ACCUMULATION LINES

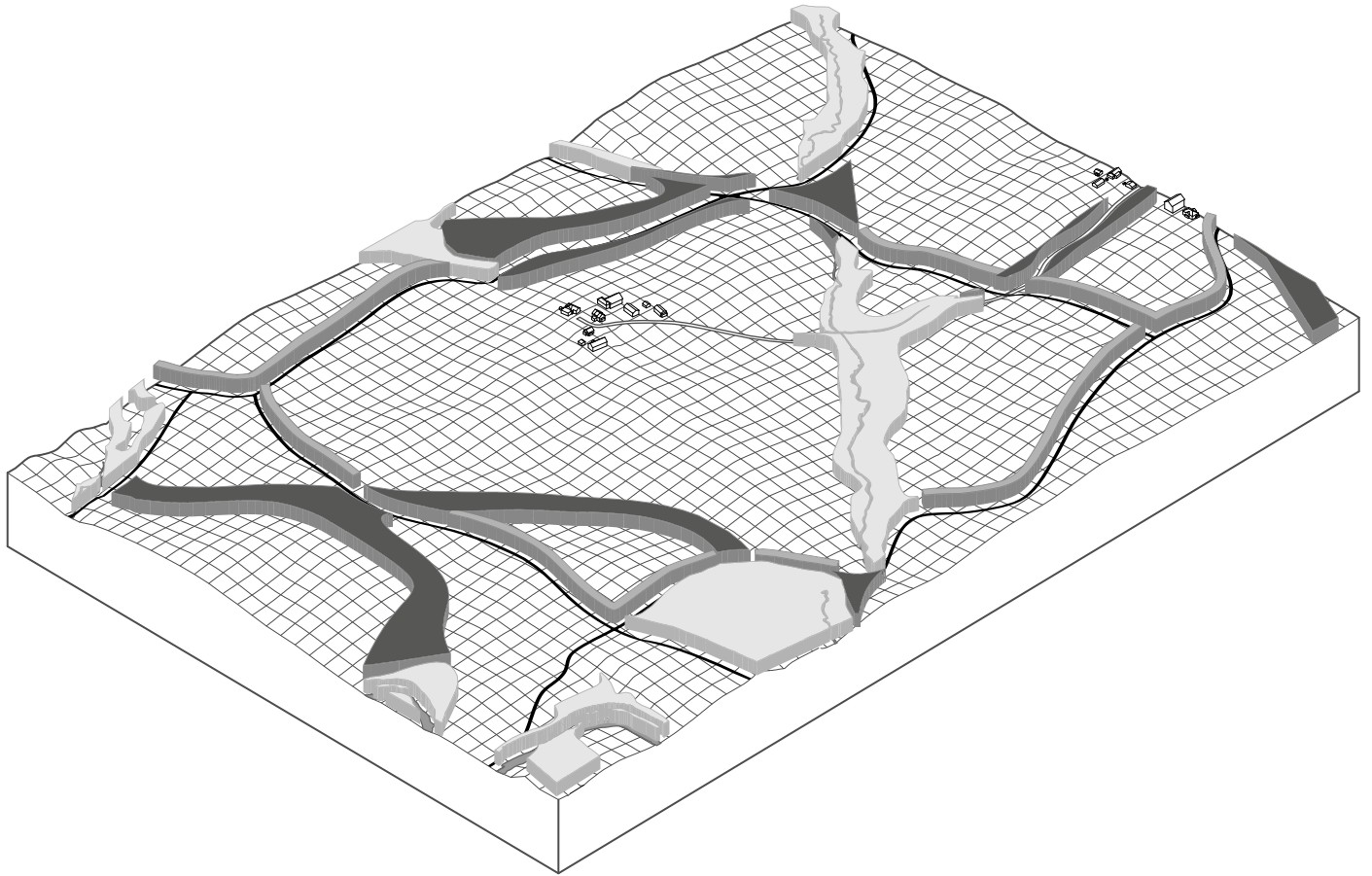
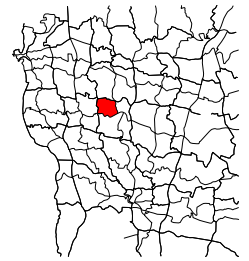
Source: Geonorge, own mapping

Restored forest corridor  
 Existing forest







A second network is based on the logic of the non permanent flow accumulation. Bocage structures are established and act as recipients and filters for agricultural runoff, so that it does not reach the permanent hydrological network untreated.

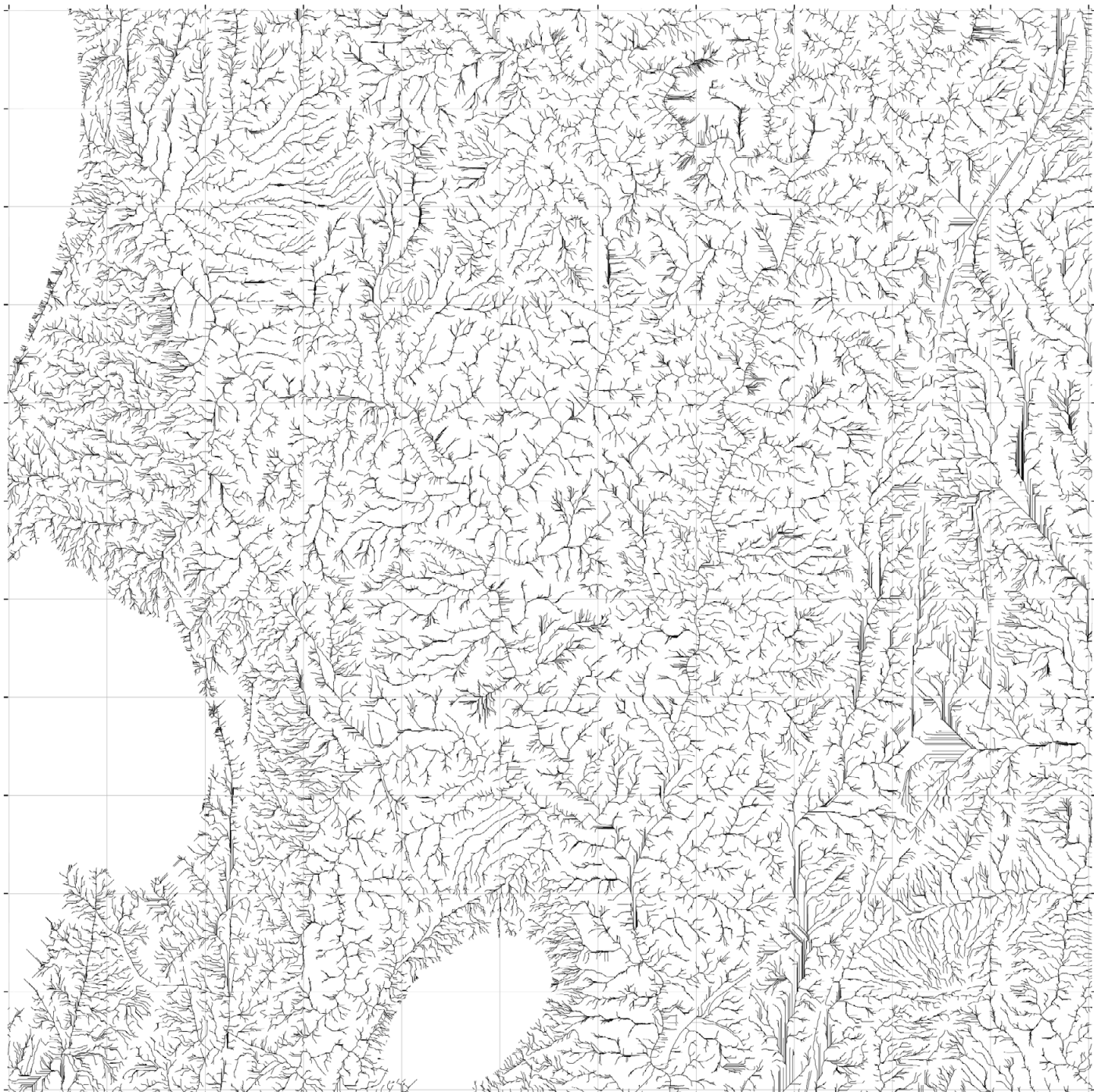
The bocage structures also aims to connect fragmented forest patches so that they form a coherent network of wildlife conduit and habitat. It also adds potential density to the mobility network, thus increasing connectivity.





### Bocager structures along flow accumulation lines

-  Bocager structure along flow accumulation lines
-  Bocager structure (windbreak)
-  Proposed network link
-  Existing forest
-  Water
-  Existing road



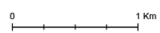
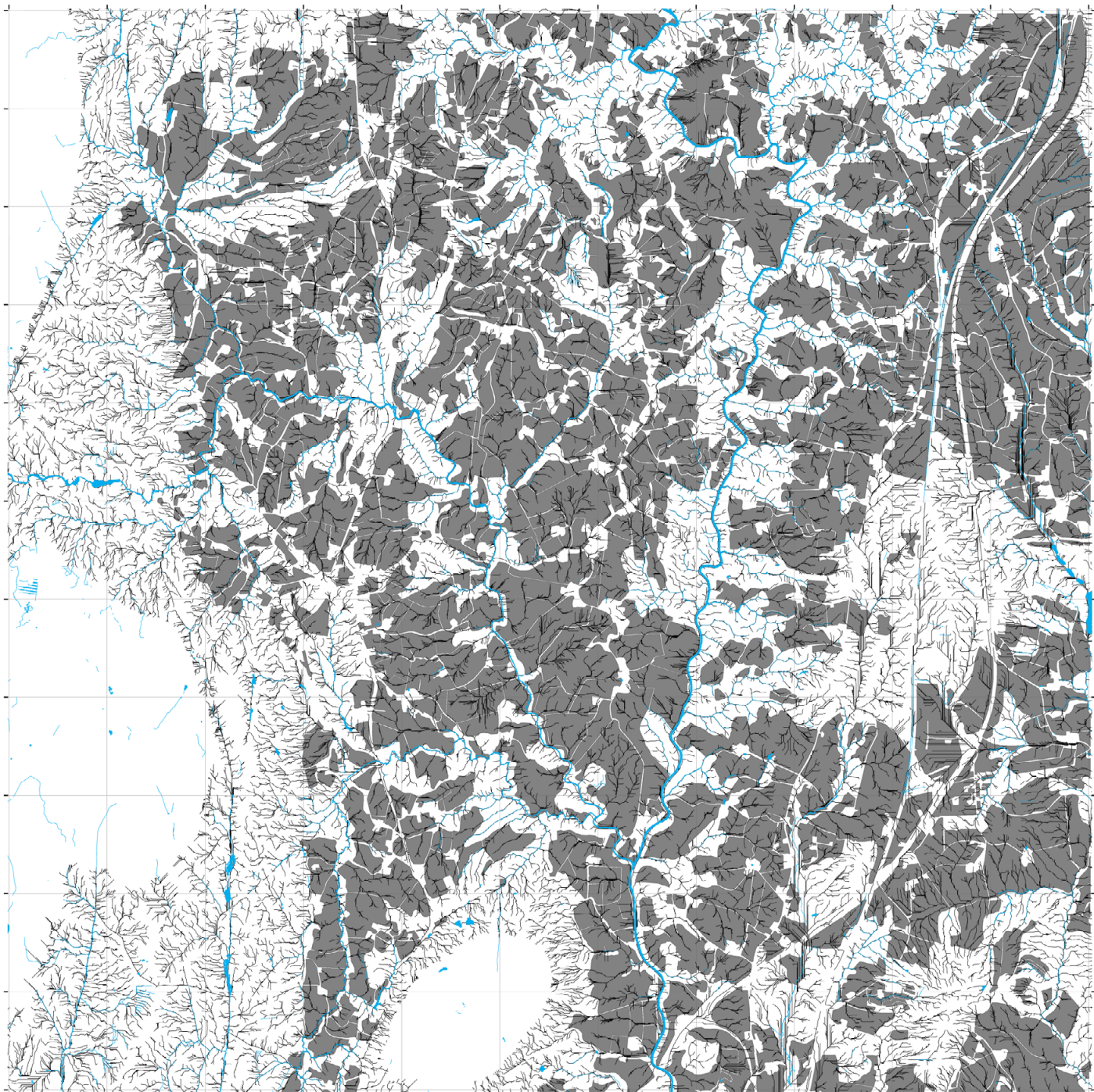
0 1 Km



### GJERDRUM - KLØFTA, TEMPORAL FLOW ACCUMULATION

Source: Own mapping

Flow accumulation analysis.

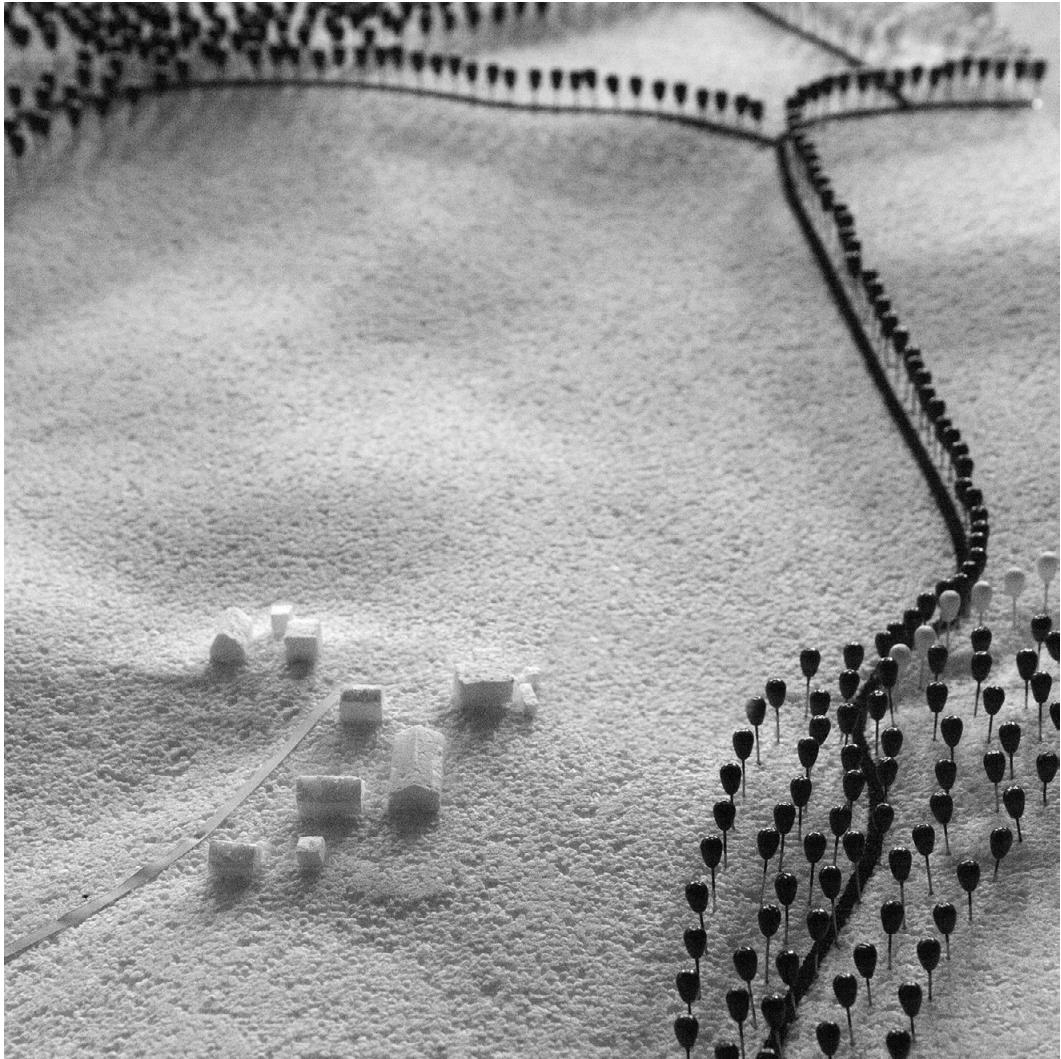


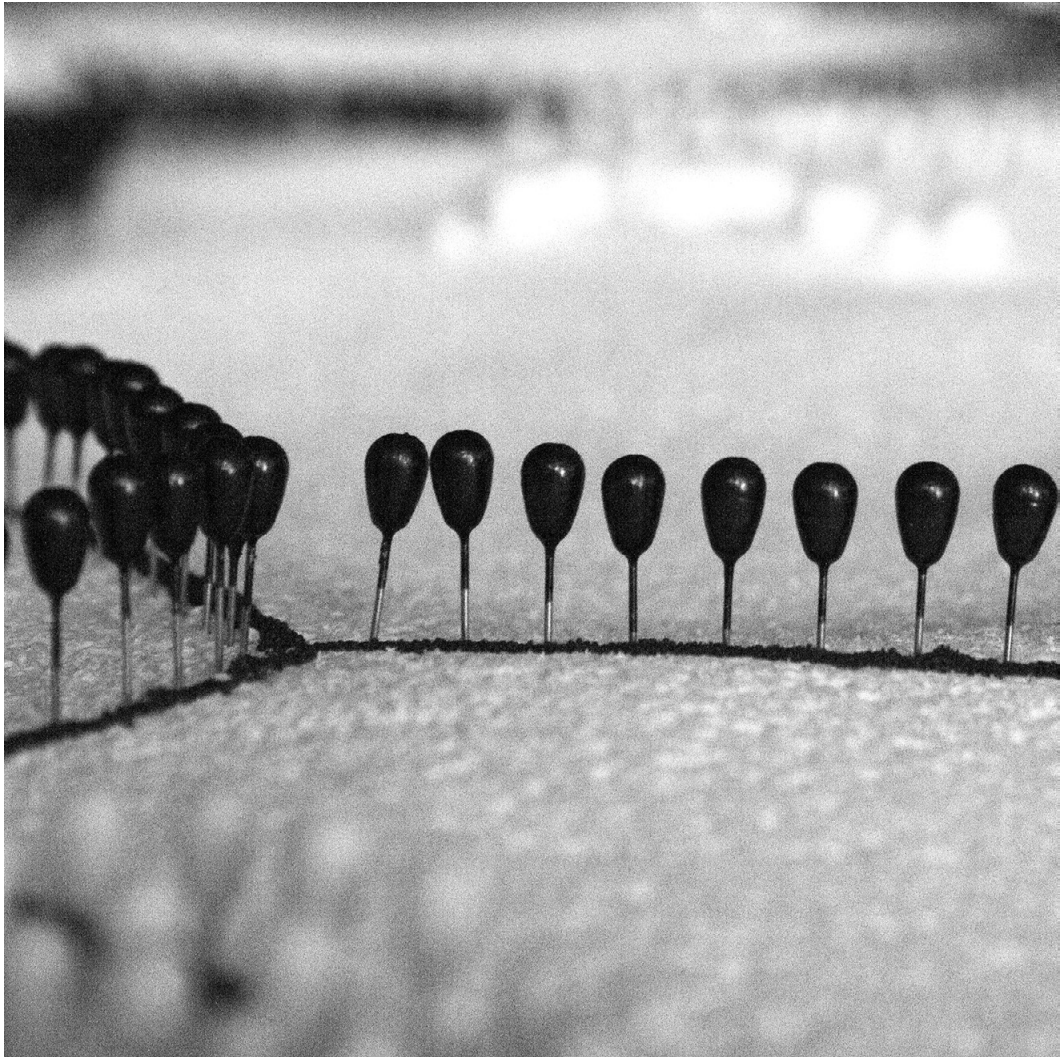
**GJERDRUM - KLØFTA, TEMPORAL FLOW ACCUMULATION II**

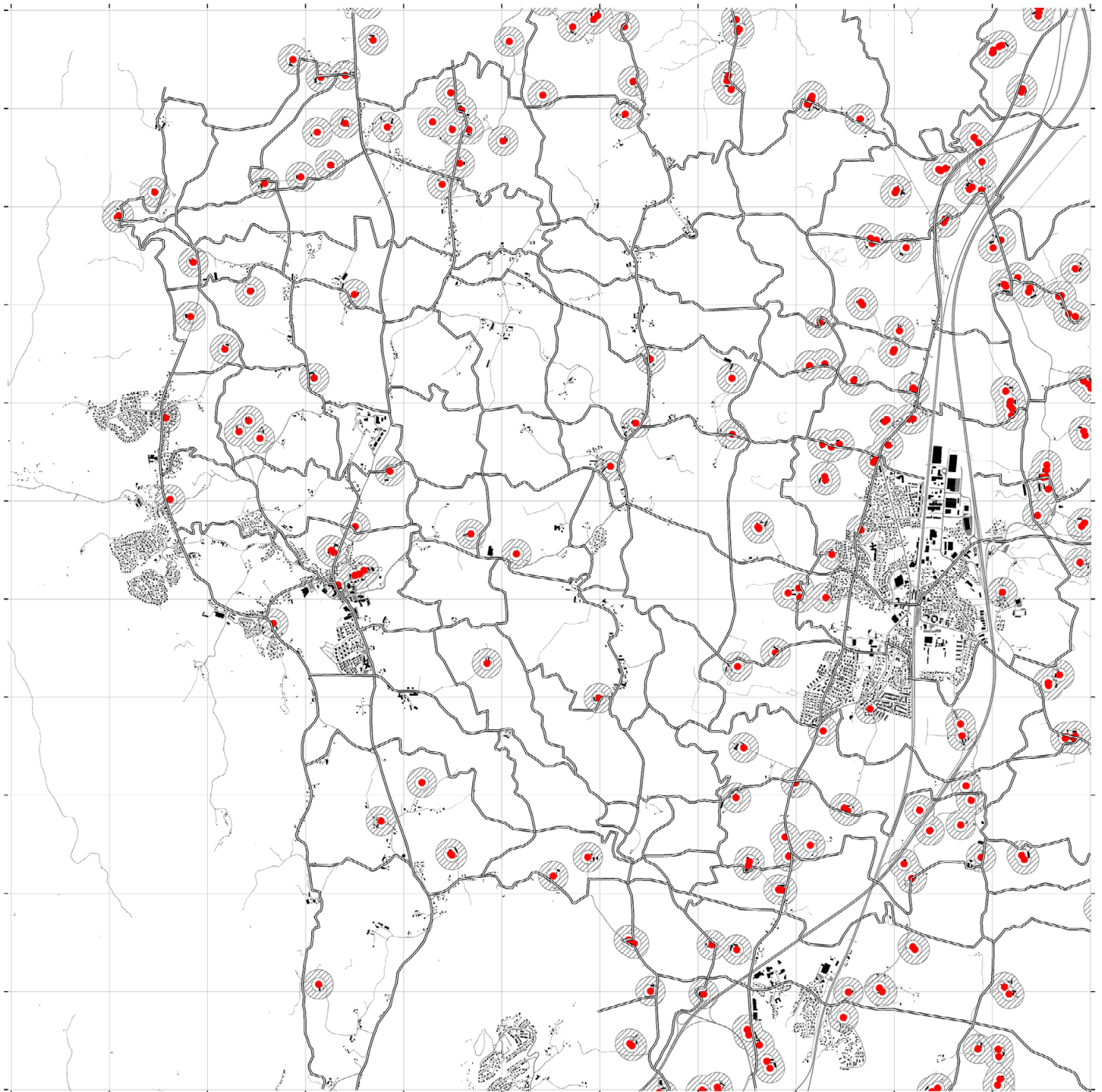
Source: Geonorge, own mapping



Flow accumulation, fields, and permanent hydrological network. The temporal flow accumulation contributes to erosion and nutrient runoff from the agricultural fields to the hydrological network. This has severe effects on water quality and marine life.







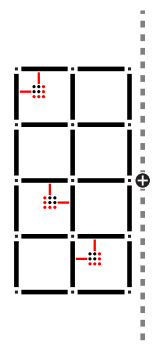
### GJERDRUM – KLØFTA, NETWORK 1, URBANIZATION SCENARIO

Source: Geonorge, own mapping

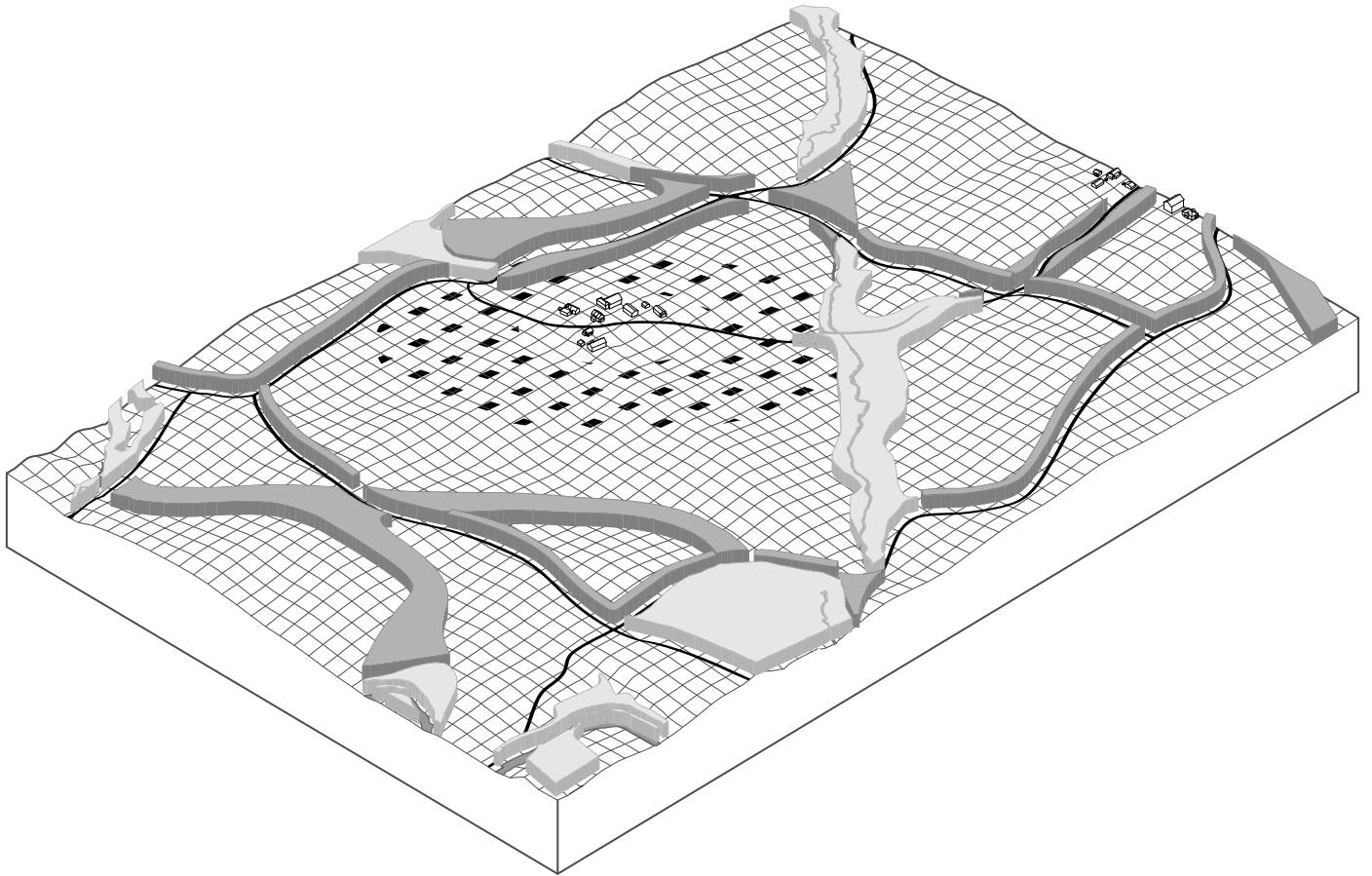
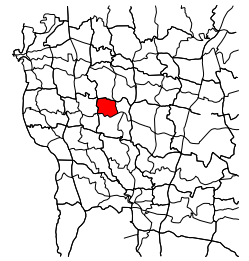
- Isotropic network, density =1Km
- Existing farms
- Railway
- ▨ Possible cluster development zones
- ▒ Existing road
- Existing building

### Residential development strategy – Farm Cluster

Up-scaling of existing farm settlements according to Open Space Residential Development principles.








- EXISTING FARM
- ▨ NEW HOUSING DEVELOPMENT
- ▨ HOUSING DEVELOPMENT CLUSTER
- ACCESS ROAD
- ⊕ RAILWAY NODE
- ▒ FAST NETWORKS (RAILWAY / FREEWAY)



### Network 1, urbanization scenario

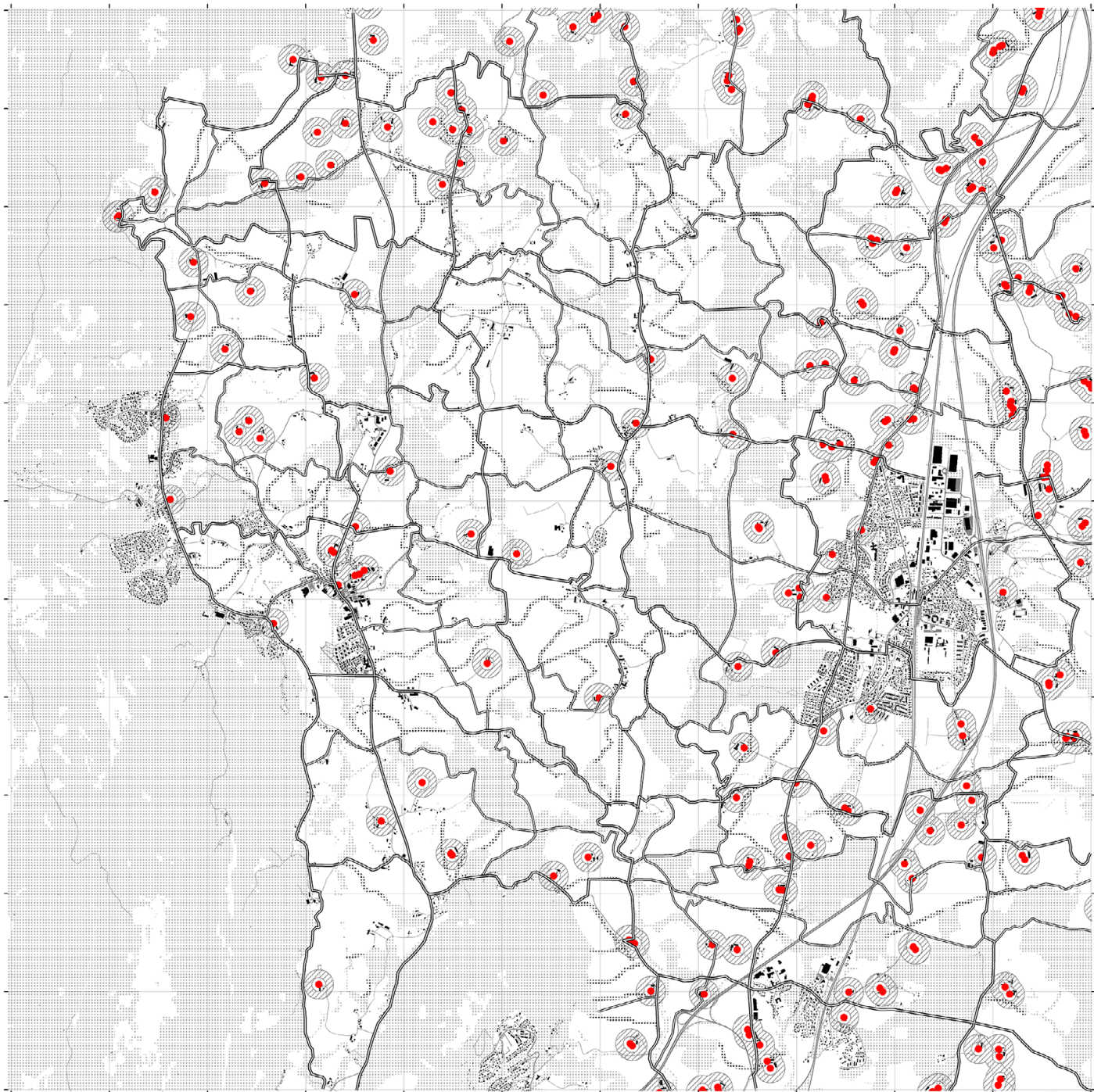
High political will / high economic power

-  Cluster housing development zone
-  Bocager structures
-  Proposed network link
-  Existing forest
-  Water









0 1 Km

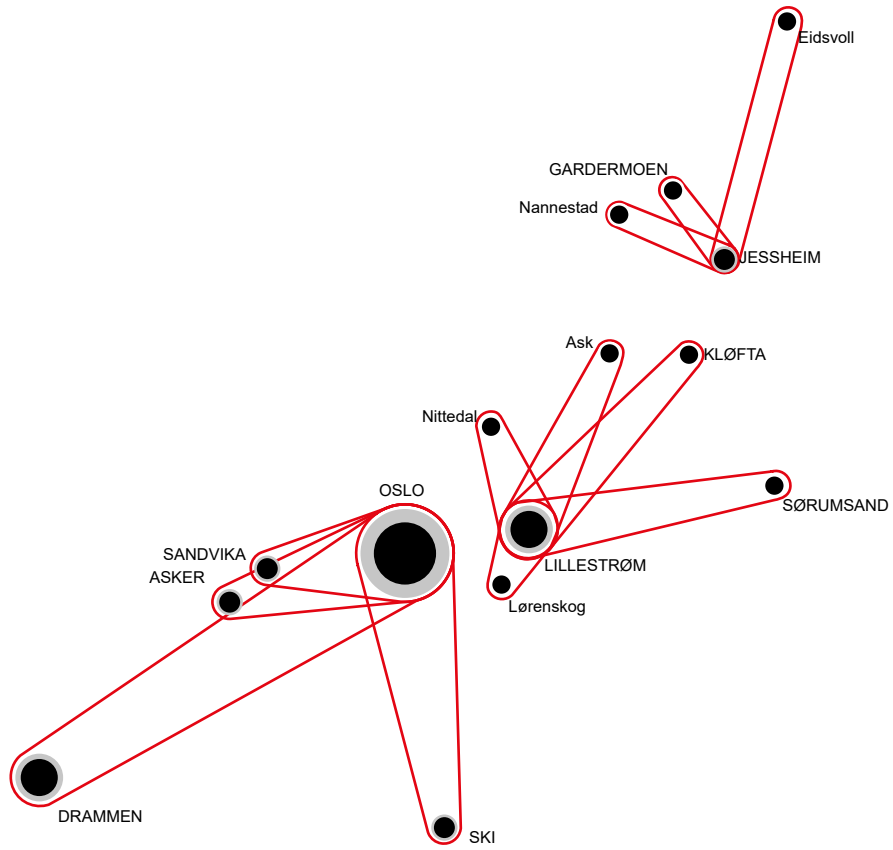


## GJERDRUM – KLØFTA, A LANDSCAPE FRAMEWORK

Source: Geonorge, own mapping

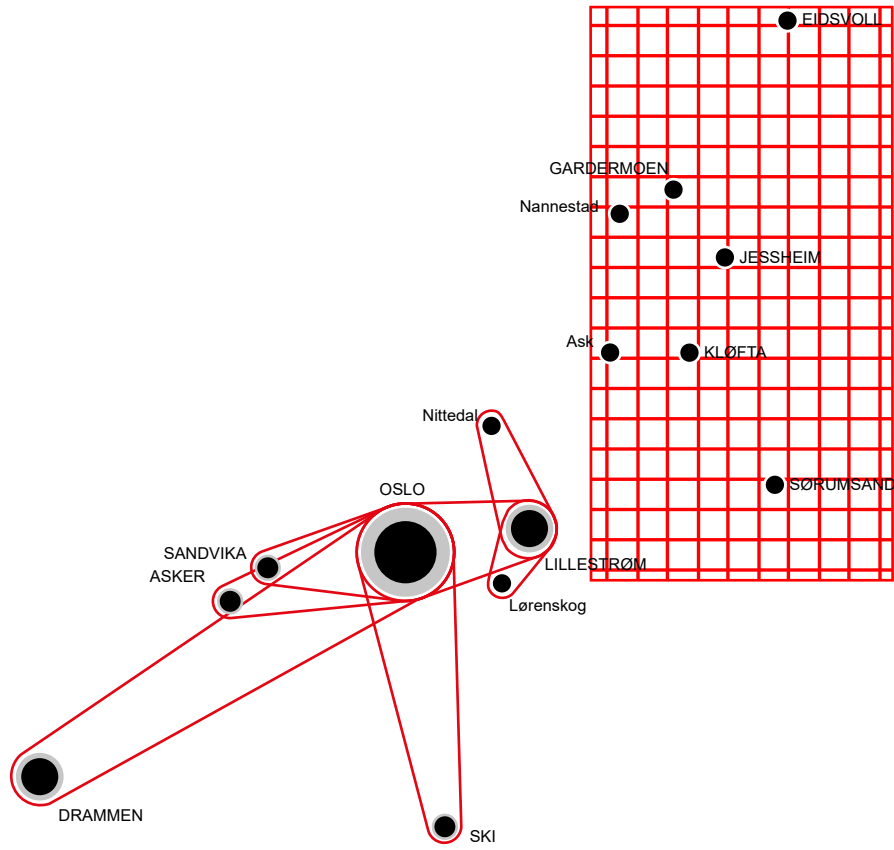
- Isotropic network, density ≈2Km
- Isotropic network, density ≈1Km
- Existing farms
- Railway
- Possible cluster development zones
- Existing road
- Existing building
- Bocage structures





## Polycentric Metropolis

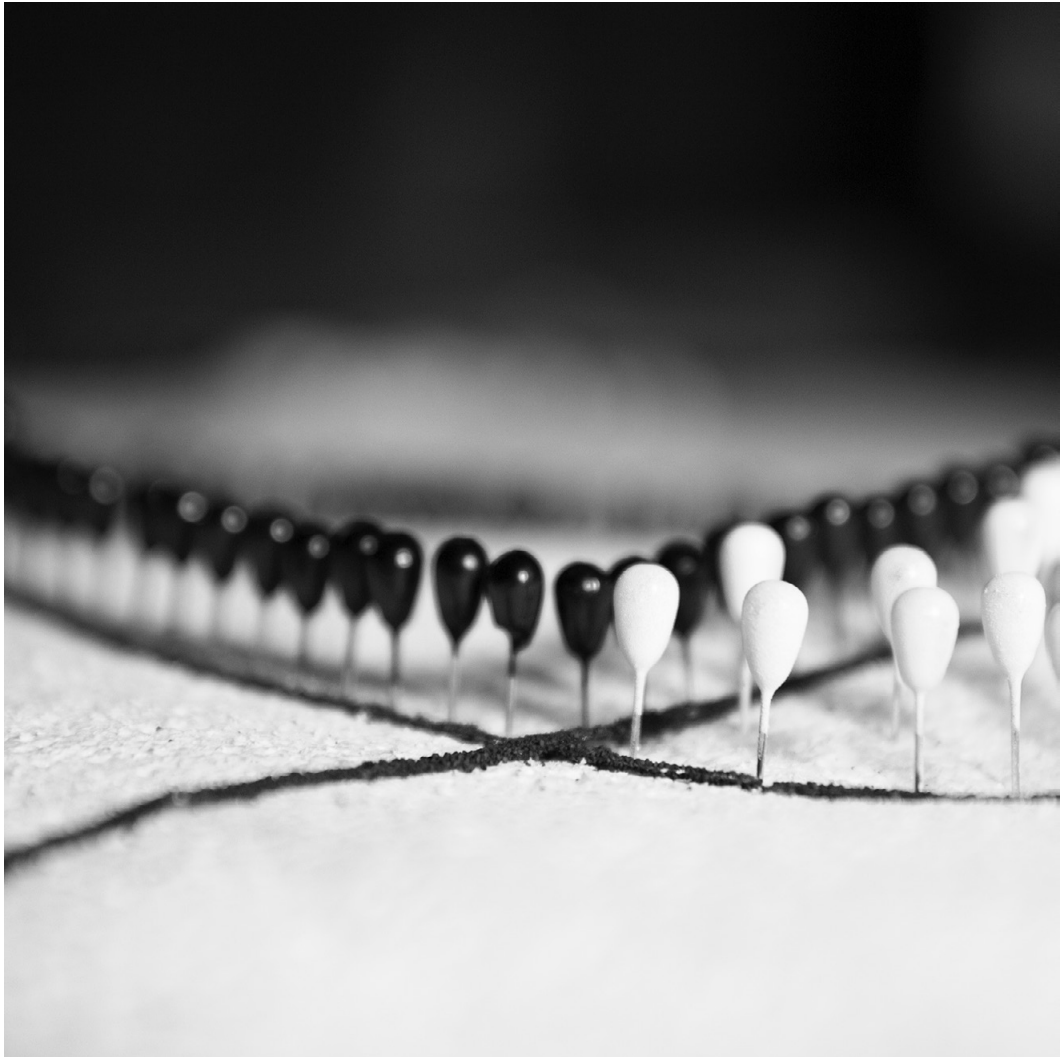
Oslo and the Romerike region as a contemporary polycentric urban system.



### Polycentric- and Field Metropolis

The central Oslo area as a polycentric urban system.  
 Romerike as a field metropolis





A LANDSCAPE FRAMEWORK  
FOR THE DISPERSED OSLO METROPOLIS

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Master thesis, AHO, spring 2017 | Roger Stemsrudhagen