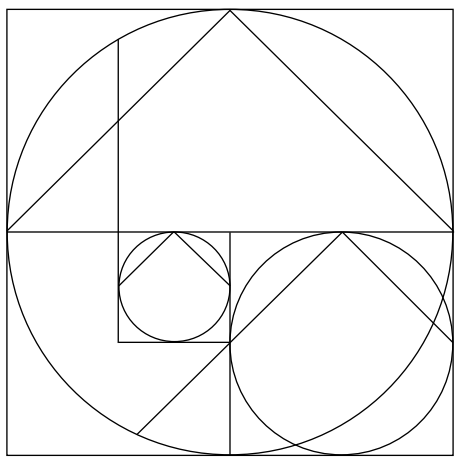


Z O N E

A MASTER THESIS IN ARCHITECTURE
at the DEPARTEMENT OF ARCHITECTURE, ETH ZURICH
in the WINTER OF 2021/22

by JOËL BERGER (14-701-601)

conducted at

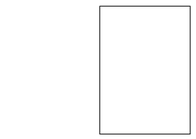
THE CHAIR OF ARCHITECTURE AND CONSTRUCTION
of PROF. TOM EMERSON

together with AMY PERKINS and BORIS GUSIC

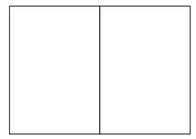
&

THE CHAIR OF THE HISTORY OF ART AND ARCHITECTURE
of PROF. DR. PHILIP URSPRUNG

together with DR. ADAM JASPER and TIM KLAUSER

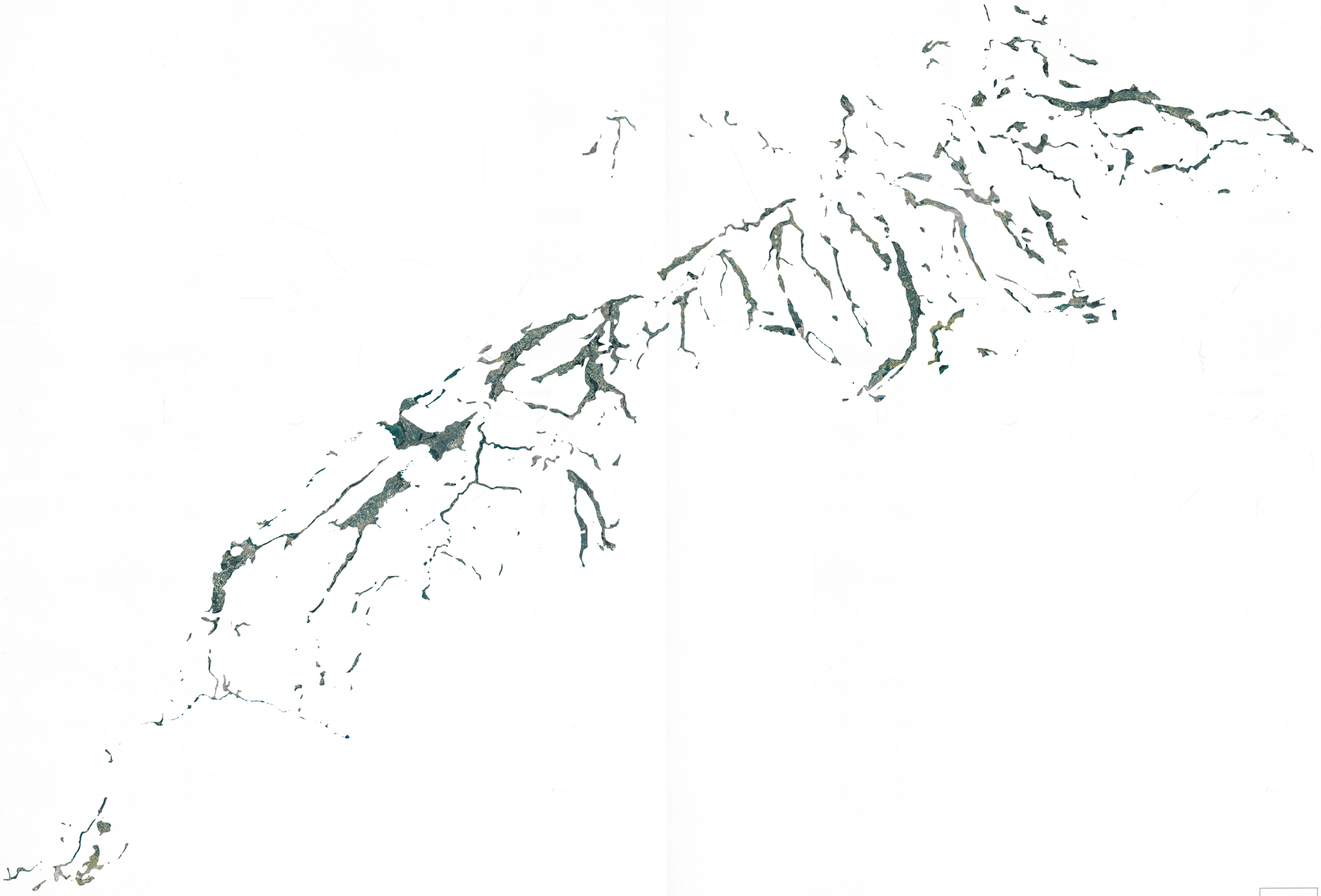


format single page: DIN A3 portrait



format print sheet: DIN A2 landscape

01 A2 map Mittelland topographic lines 1 : 500'000



02 A2 map Mittelland areas of potential flood 1 : 500'000

Mittelland

The Mittelland is Switzerland‘s economic and social conurbation. Two thirds of the population live here, not only in the country‘s largest cities, but also in a myriad of small towns and villages. The Mittelland has the highest density of roads and, in addition to the largest number of settlements, most of Switzerland‘s industries and agricultural areas are located in it.

Floods

Many lakes lie and many rivers flow through the Mittelland. Nuclear power plants depend on powerful watercourses to cool their reactors. It is therefore not surprising that the four remaining Swiss nuclear power plants are not only all found in the Mittelland, but are located immediately next to its rivers. Nuclear power and floods are related – by their obvious technical connection, but also by their similarly long temporalities. Half-life on the one hand, probability on the other. A million years of decay of an isotope, or a thousand, ten thousand years of probability of occurrence of a flood.
Because of their large catchment areas from the Alps or the Jura mountains, the waters of the Mittelland have always been at risk of overflowing their banks. Since the middle of the 19th century, rivers have been canalised and weirs built to better regulate the water level and to generate electricity from its flow. Nevertheless, floods did occur, and between 1999 and 2007, Switzerland experienced four different floods whose intensities were expected only to happen once every hundred years. Despite the obvious risk of flood, the river edges the Mittelland are highly developed. Since the mid-19th century, the Swiss population has almost quadrupled[1] and between 1990 and 2020 the number of buildings with residential use increased by 30%.[2] Of course most of the increased building mass is located in the Mittelland. In the event of flooding, more built-up area leads to greater damage and, in turn, to higher costs. Currently, the average annual property damage from flooding hovers in the neighborhood of CHF 300,000,000, whilst the last few years turned out higher than the average. Due to the high density of people and goods, floods in urban centres such as the Mittelland are therefore particularly devastating. Switzerland‘s flood policy seems now to be slowly changing: From technical regulation attempts through dams and canalisation of watercourses towards the acceptance, that the probabilities of a flood‘s recurrence and intensity cannot be calculated conclusively and thus its occurrence and consequences will remain surprising. But why exactly do floods seem to increase in intensity and unpredictability over the years?

Dense grounds

In Switzerland, 4.8% of the total soil is already permanently sealed because of building activities.[3] These soils can no longer absorb rainwater, bind CO2 or produce biomass. In the medium term, due to their excessive compaction, the soil would not recover even if it were unsealed. Swiss soils were recently analysed nationwide for their ability to absorb water.[4] It is striking that, as expected, sealed surfaces do not absorb any, but also some unsealed surfaces do so very poorly – such as intensively used farmland, certain meadows, pits and gardens. Compaction is therefore not the same as sealing, and unsealed land can also be compacted or naturally be dense. Compacted and sealed soils drain water during heavy rainfall instead of absorbing it, which greatly increases the intensity of flood events downhill. Looking to the future, it is assumed that due to climate change periods of increasing rainfall and prolonged dry periods will alternate.[5] Simply this means extreme storms and then long droughts. In view of this prognosis, it would make sense to focus on the interplay between water and soil.

Proposal

The project proposes on two levels how to deal with the sword of Damocles of flood risk in Switzerland. On the one hand, it would only make sense to stop further building in endangered areas and to declare a supra-regional flood risk zone, within which, as a second level, the handling of the unsealed but nevertheless compacted, water-repellent soils will shape the landscape.
These soils are to be loosened and what they have lacked is to be restored. In a scalable process, deep holes are to be dug and dead tree trunks are to be buried in them as degradable biomass before the excavated material above them is backfilled as a loose cone.
Untreated trunk wood has the property of absorbing water well and being able to conduct it from the surface into the groundwater. As the upper layers of wood slowly decays in the soil, organisms such as insects are attracted and bacteria and fungi are activated, which together begin to loosen the soil around for longer periods of time. Piling a mound on top of the buried wood both brings deeper layers of soil to the reactive surface and cuts off the oxygen supply to the wood buried below, resulting in slow, anaerobic decay, as is the case in a marsh (or in the very slow decay of certain radioactive isotopes). The heaped cones become markers of the zone, generating a new landscape and possibly evoking new modes of dealing with the now undulating ground.

The act of burying an organic material such as wood for the benefit of the ground can be directly and somehow ironically related to the contemporary search for solutions to store nuclear waste in a sealed and impermeable repository for a seemingly infinite time.[6]

1 bfs.admin.ch 1850; 2.4 million / 2020; 8.8 million citizens
2 bfs.admin.ch 1990; 1.2 million / 2020; 1.8 million residential buildings
3 bfs.admin.ch 1979/85; 3.8% / 1992/97; 4.1% / 2004/09; 4.8% of surface sealed
4 bafu.admin.ch Surface runoff risk map
5 nccs.admin.ch; National Centre for Climate Services, Climate Scenarios for Switzerland
6 nagra.ch; Where is the best site for a deep geological repository?

Federal law on the supraregional zone of flood protection

(Flood protection act)

dated January 13, 2022 (as of January 13, 2022)

The Federal Assembly of the Swiss Confederation,
based on Article 24 paragraphs 3 and 4 of the Federal Constitution1,
having considered a dispatch of the Federal Council dated September 12, 1979
decides:

Art. 1 Essence and purpose

[1] The zone is a supra-regional, scalable area dedicated to the awareness of flood events. In the zone, further constructions are generally prohibited, unless the interventions directly serve the preservation of the zone.

[2] The zone is freely accessible to the general public. It shall be the subject of permanent scientific research.

Art. 2 Responsible body

[1] The zone shall be borne jointly by the communes located within it, the cantons and the Confederation.

Art. 3 Funding

[1] The Confederation and the cantons shall make an annual contribution to the costs of administration, supervision and maintenance.

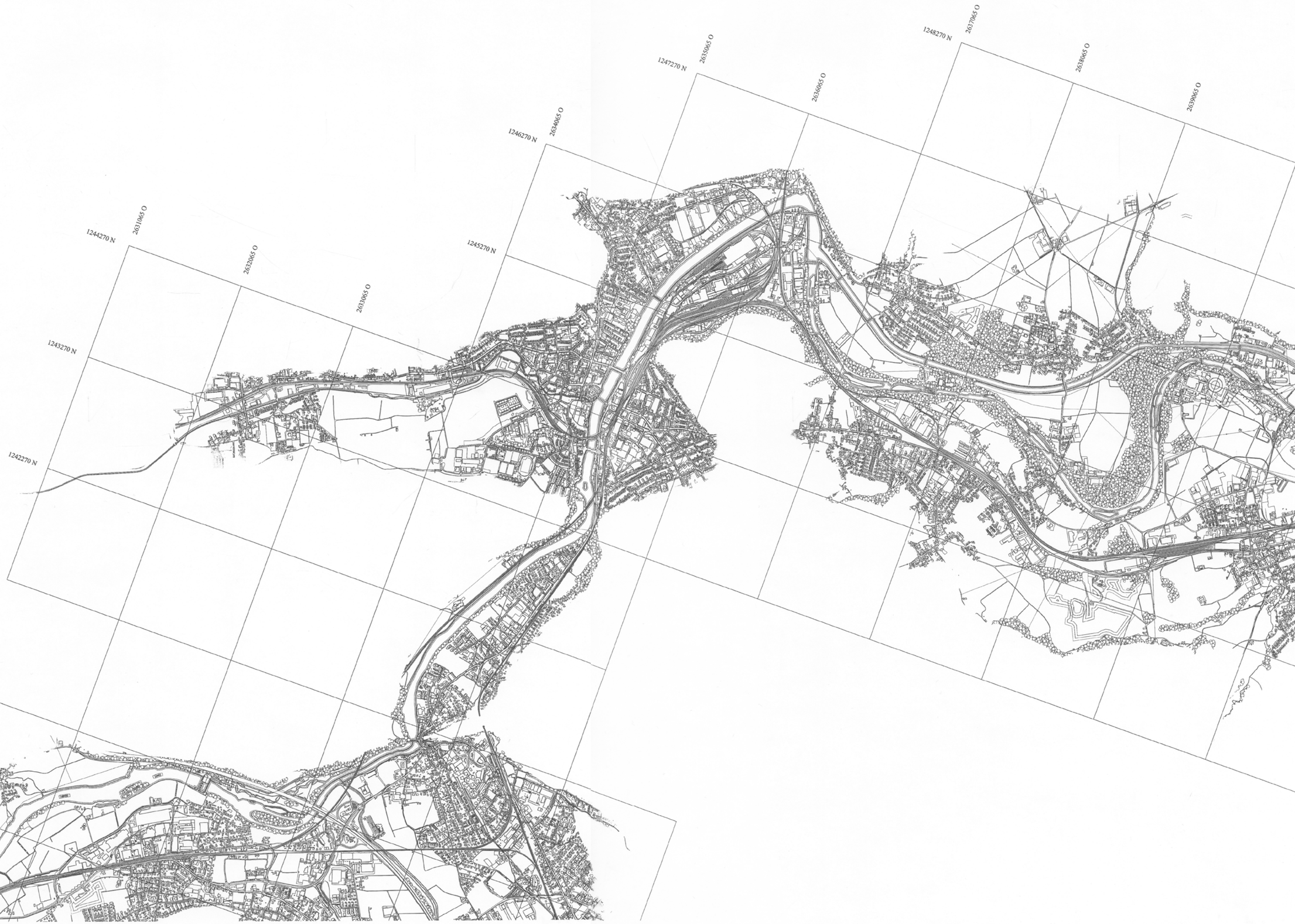
AS 1981 236

1 [AS 1962 749]. Today, the aforementioned provisions correspond to Art. 78 para. 3 and 4 of the Federal Constitution of 18 April 1999 (SR 101).
2 BBl 1979 III 705

03 A2 map Zone, Olten-Aarau inked 1 : 50'000

04 A2 map Zone; Olten-Aarau endangered buildings 1 : 50'000

0 1'000 2'000 3'000 4'000 5'000



05	2*A2	plan	Zone; Situation	1 : 20'000


1250270 N
1251270 N
1252270 N
1249270 N
2640065 O
2641065 O
2649065 O
2650065 O
2642065 O
2643065 O
2644065 O
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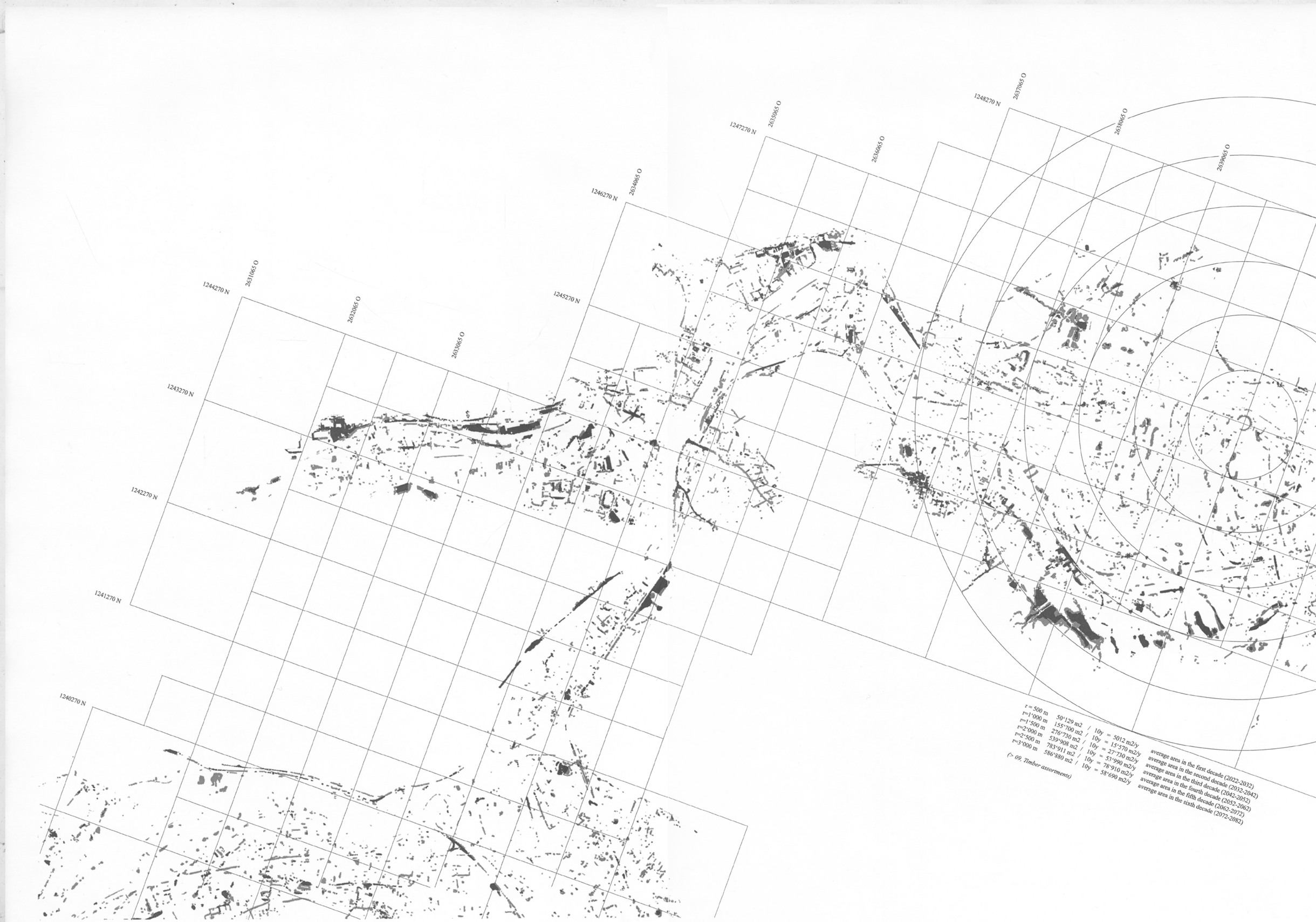
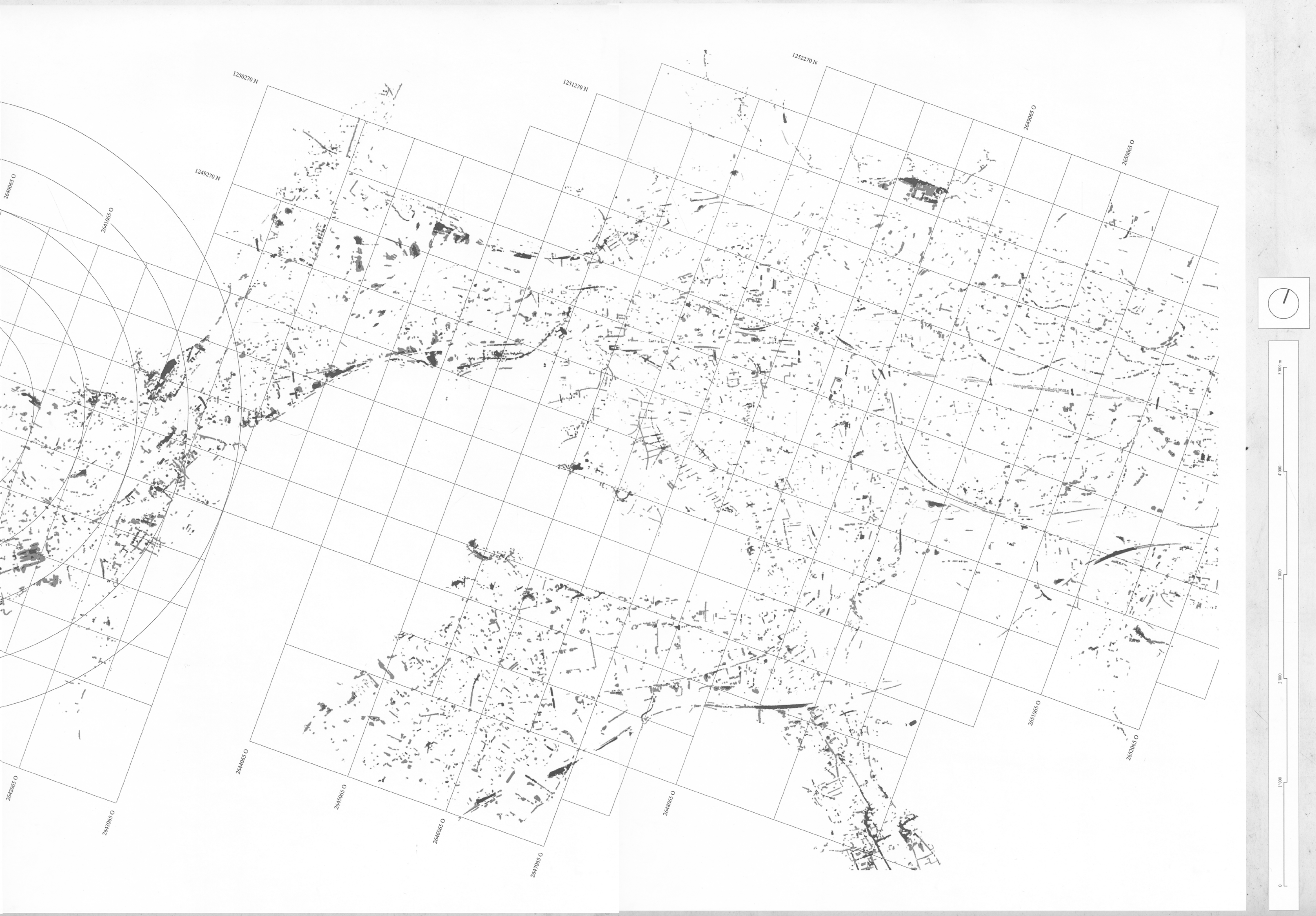


r = 500 m	50'129 m2	/ 10y	= 5012 m2/y	average area in the first decade (2022-2032)
r=1'000 m	155'700 m2	/ 10y	= 15'570 m2/y	average area in the second decade (2032-2042)
r=1'500 m	276'730 m2	/ 10y	= 27'730 m2/y	average area in the third decade (2042-2052)
r=2'000 m	539'908 m2	/ 10y	= 53'990 m2/y	average area in the fourth decade (2052-2062)
r=2'500 m	783'911 m2	/ 10y	= 78'910 m2/y	average area in the fifth decade (2062-2072)
r=3'000 m	586'880 m2	/ 10y	= 58'690 m2/y	average area in the sixth decade (2072-2082)

(> 00. Timber assortments)

06	2*A2	plan	Zone; areas of poor surface-runoff	1 : 20'000


1250270 N
1251270 N
1252270 N
1249270 N
2640065 O
2641065 O
2642065 O
2643065 O
2644065 O
2645065 O
2646065 O
2647065 O
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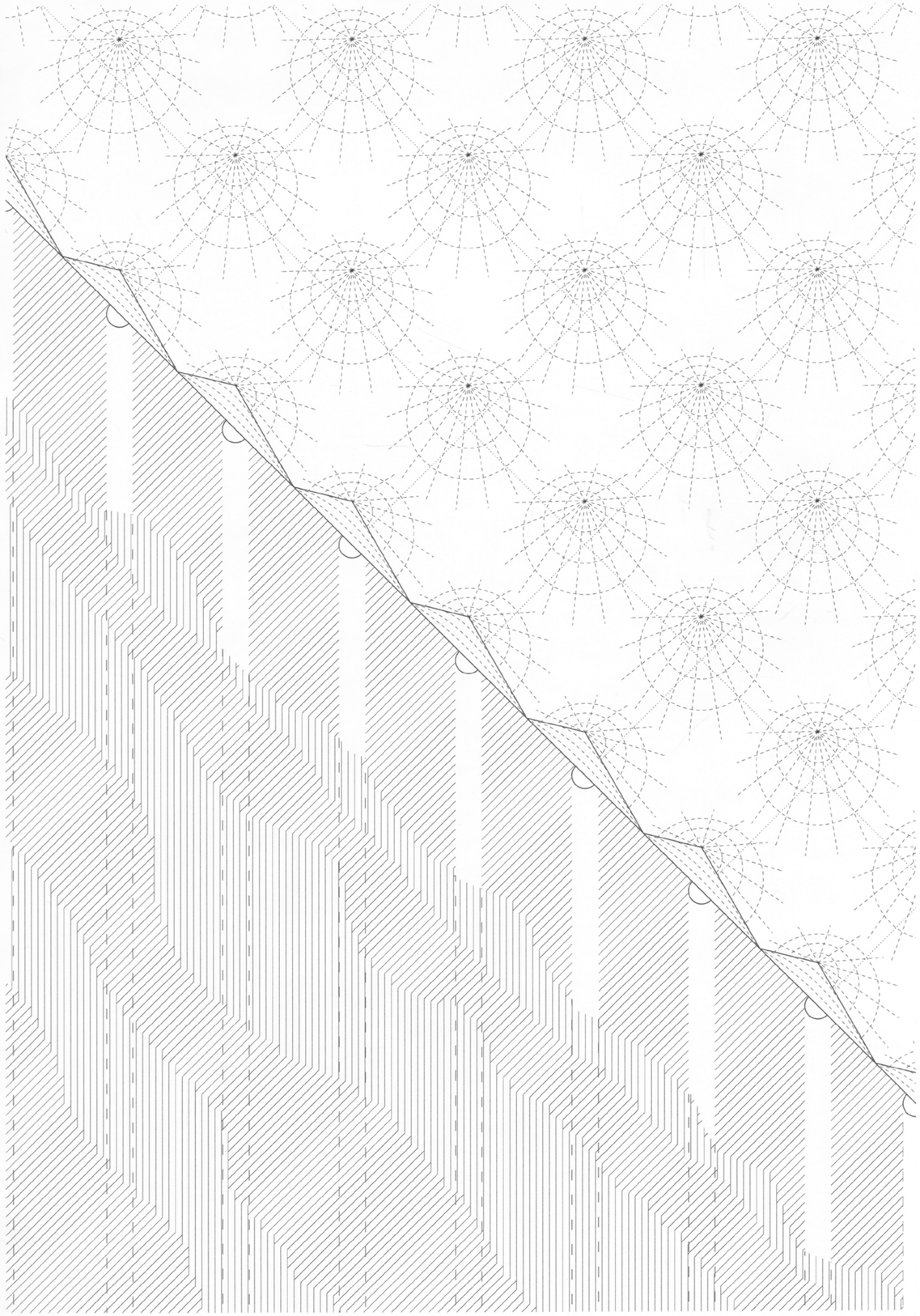
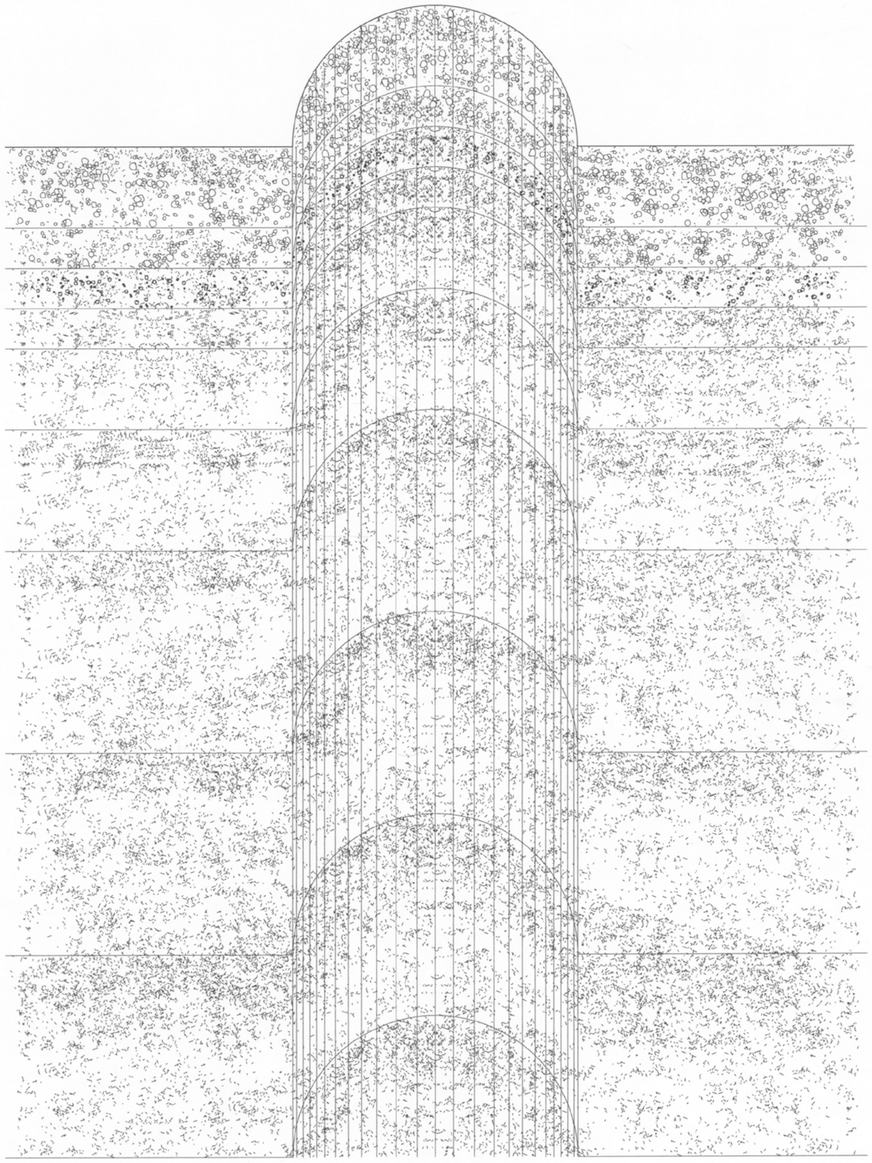
2650065 O
2651065 O
2652065 O
0
1'000
2'000
3'000
4'000
5'000 m

Groundwater is considered the most important and largest water reservoir in Switzerland. Water only infiltrates from the surface into the groundwater if the surface layer can guarantee this exchange. Soil that is too compacted is incapable of absorbing water and so the water runs off in those places instead of seeping into the groundwater.

Climate change affects the various groundwater reservoirs in Switzerland in different ways. Glacier and snow melt and solid rock strata, as they affect the higher altitudes, are considered to play a lesser role in the changing climate of the Mittelland. In the flat lands, rainfall is the most decisive contributor to groundwater. In the future, rainfall will be more intense than previously known and longer dry periods will occur between the events of rainfall. It is important to ensure that the soils can absorb the water from the rainfall as well as possible and drain it into the groundwater below, so in the time of drought, the groundwater reservoirs remain equipped.



07	A3	drawing	The below and the above	1 : 100



groundwater level;
ca. -5.50m

1	Br4 (Bröckel) diam. 10-20mm Organic matter % 2	Clay; 16%	Silt; 30%	Sand; 54%	> Clay soil	Clay soils differ from silt and sand in that excessive crusting can occur here. The soil crust is often so hard that it has to be broken up. Due to low proportions of clay and organic matter, aggregate formation is often deficient.
2	Br4 (Bröckel) diam. 10-20mm Organic matter % 2	Clay; 16%	Silt; 40%	Sand; 44%	> Clay soil	
3	Po3 (polyhedron) diam. 5-10mm Organic substance % 1.5	Clay; 16%	Silt; 30%	Sand; 54%	> Clay soil	
4	Po2 (polyhedron) diam. 2-5mm Organic substance % 0.0	Clay; 12%	Silt; 30%	Sand; 58%	> Silt soil	Silt soil have a higher tendency to crusting, and can often be very hard. Excessive tillage can lead to compaction and thus reduced water absorption.
5	Ek (single grain) Organic substance % 0.0	Clay; 2%	Silt; 10%	Sand; 88%	> Sand soil	Sandy soils are usually dry and nutrient-poor. Their ability to transport water upward from the lower layers by capillary transport is very low to nonexistent. The ability to retain nutrients and water can be improved in sandy soils by incorporating organic matter.

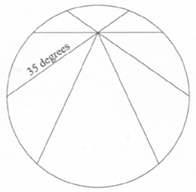
08	A3	drawing	Soil section and composition	1 : 10

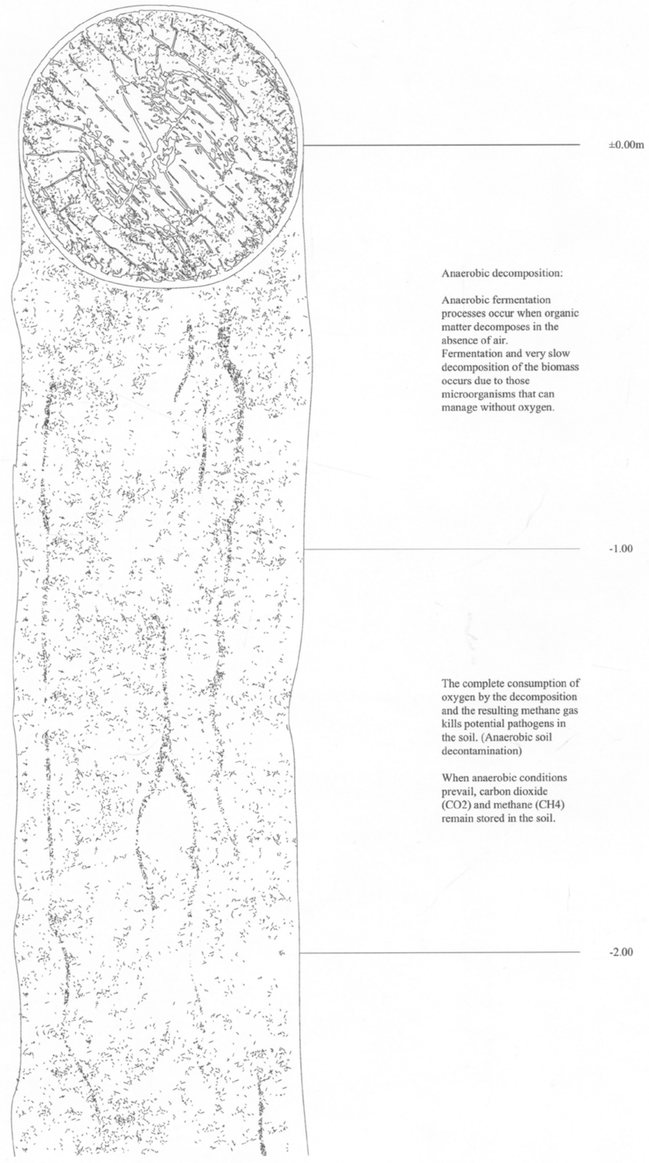
Total; 4'802'000 m³

coniferous wood; 3'368'000 m³

hard wood; 1'434'000 m³

1;	coniferous wood logs	43.8%
2;	coniferous wood for industry	7.6%
3;	coniferous wood for energy	18.7%
4;	hard wood logs	4.3%
5;	hard wood for industry	3.8%
6;	hard wood for energy	21.7%
7;	remaining assortment	0.1 %





Anaerobic decomposition:

Anaerobic fermentation processes occur when organic matter decomposes in the absence of air.
Fermentation and very slow decomposition of the biomass occurs due to those microorganisms that can manage without oxygen.

The complete consumption of oxygen by the decomposition and the resulting methane gas kills potential pathogens in the soil. (Anaerobic soil decontamination)

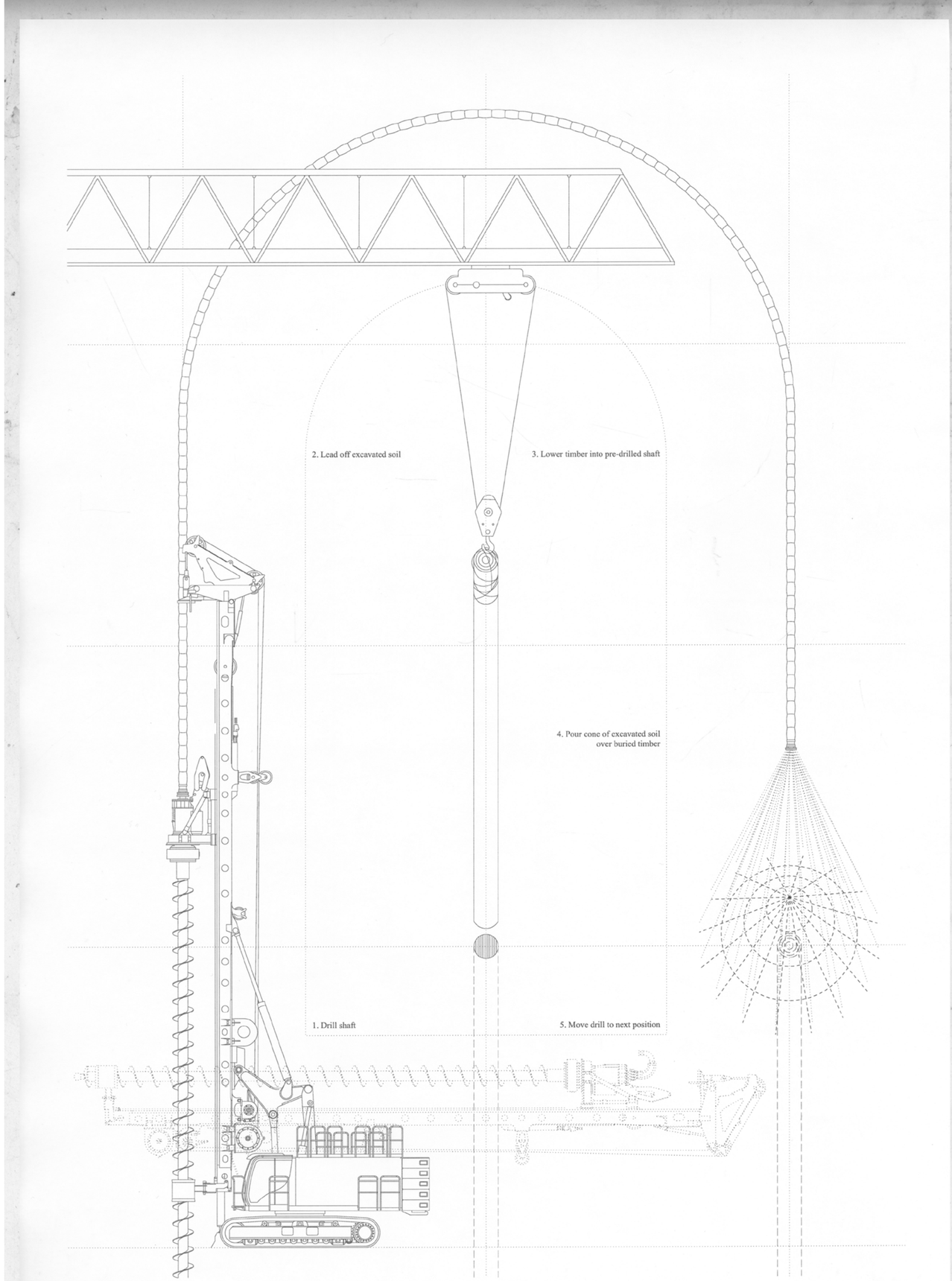
When anaerobic conditions prevail, carbon dioxide (CO_2) and methane (CH_4) remain stored in the soil.

estimated depth;
ca. -30.00m

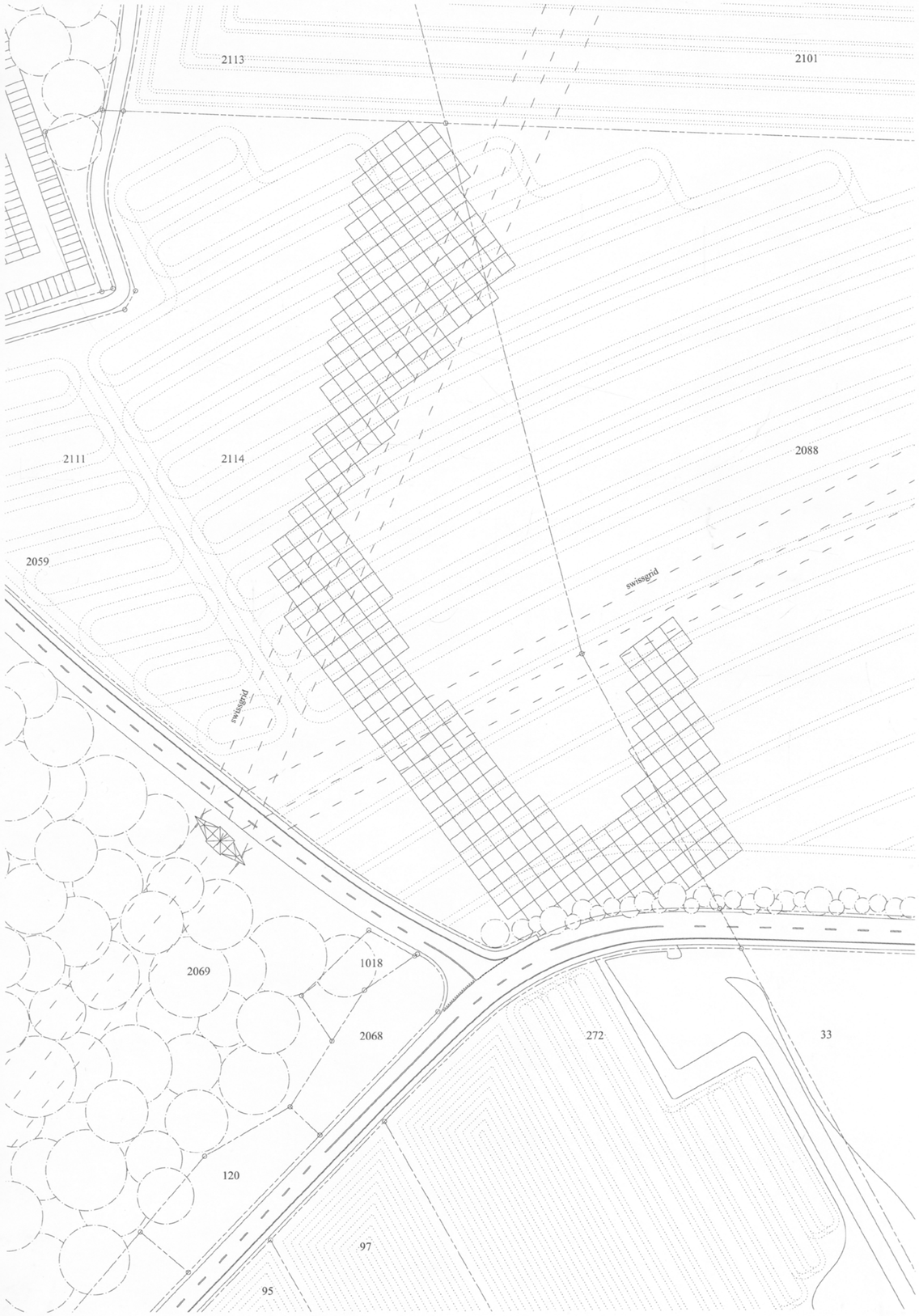
Burial of both coniferous and hard wood logs with an average count of one log per 25 m² and an annual average of 5'012 m² of burial sites	(5'012 m² / 25 m²) * 1.15 safetly index = 231 logs per year	231 logs, with an estimated 5012 m² in volume, which results in 0.01 % of the yearly Swiss wood assortment (2020) in the first decade or 3'629 logs, with an estimated 78'910 m2 in volume, which results in 1.16 % of the yearly Swiss wood assortment (2020) in the fifth decade ***(> 06, Zone, areas of poor surface-runoff)***
Burial of 30 m long pine logs with an average diameter of 0.7 m	30 m * 0.4 m² [area of log at 0.7m diameter] = 12 m³	Results both in 12m³ of organic matter and soil excavated per pine log
Possible cones shaped by 12 m³ of excavated soil	h = (3*V) / pi * r² = 36 / pi * 2.5² = 36 / 19.65 = 1.85 m	Results 1.85 m high cones of excavated soil at a diameter of 5 m and with a slope of 35 degrees

09	A3	drawing	Timber assortments	1 : 10

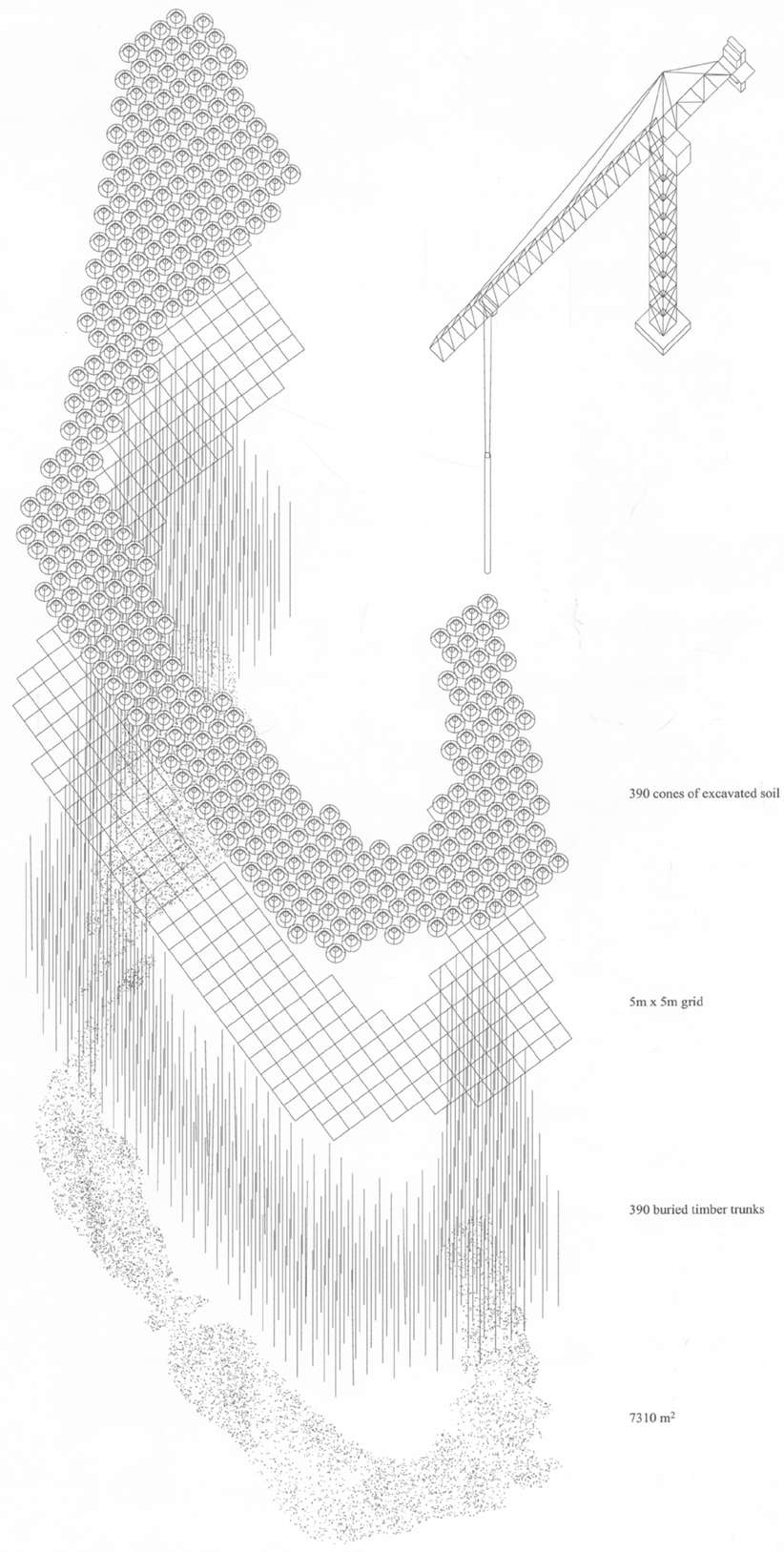
Some companies specialise in bored piles. This type of foundation is used in loose, unstable building soils. Because in this case the soil is not to be additionally compacted, but on the contrary loosened, the method of driving logs into the ground without a previous borehole is not feasible. For the boreholes for the later burial of the timber logs, a rotary drilling method with an endless auger is proposed, which allows the excavated material to be sucked off at the surface during the drilling process and transported few meters further where a log of timber already has been buried, awaiting the mound of soil. Because of the large drilling depth, the drill rig „BG 33 BT 85“ of the V-equipment line by BAUER would match the task.



10	A3	drawing	Construction circuit	1 : 100



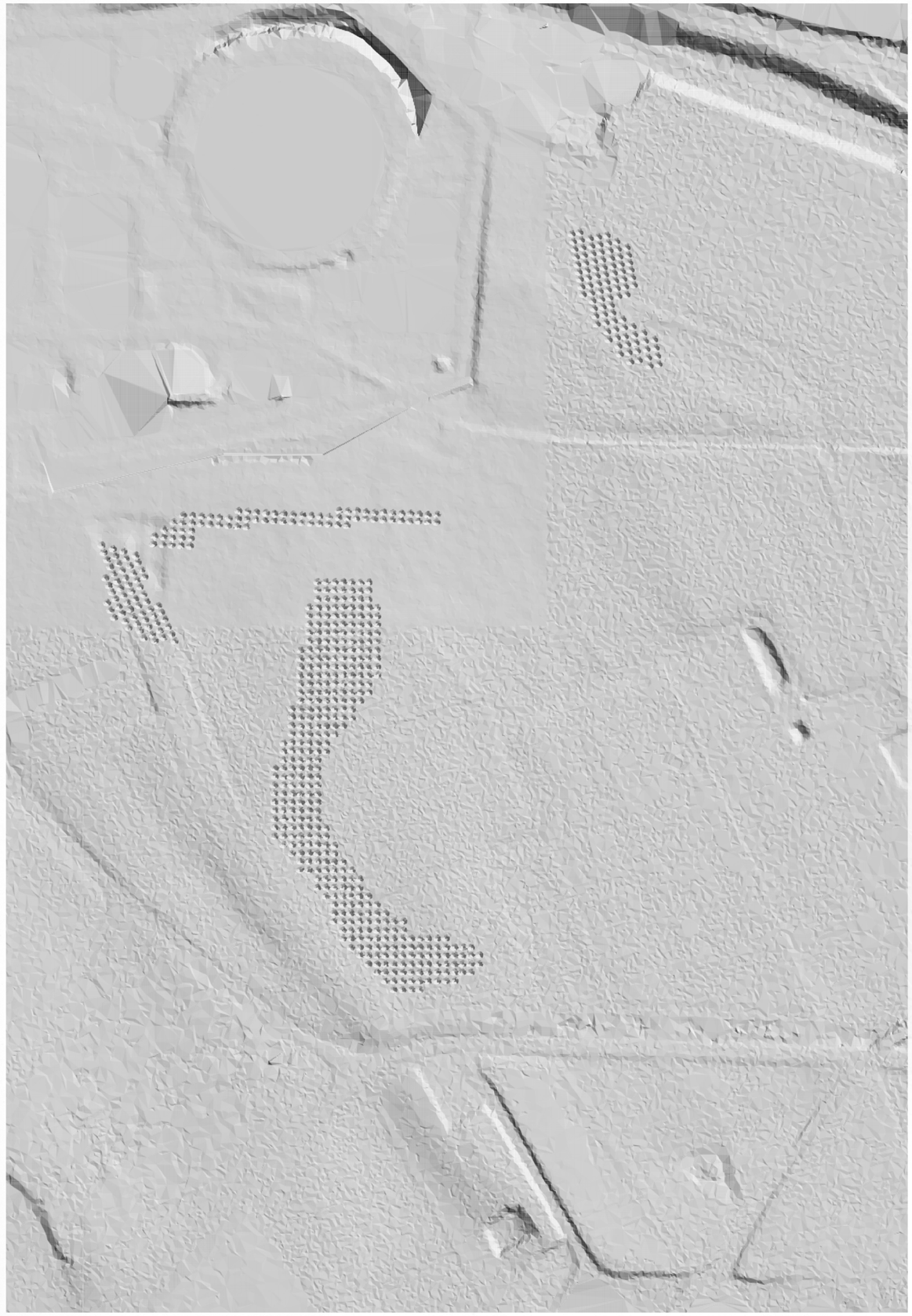
11 A3 drawing Site Zero; in the shadow of the cooling tower 1 : 1'000



12 A3 drawing Site Zero; construction diagram and numbers 1 : 1'000

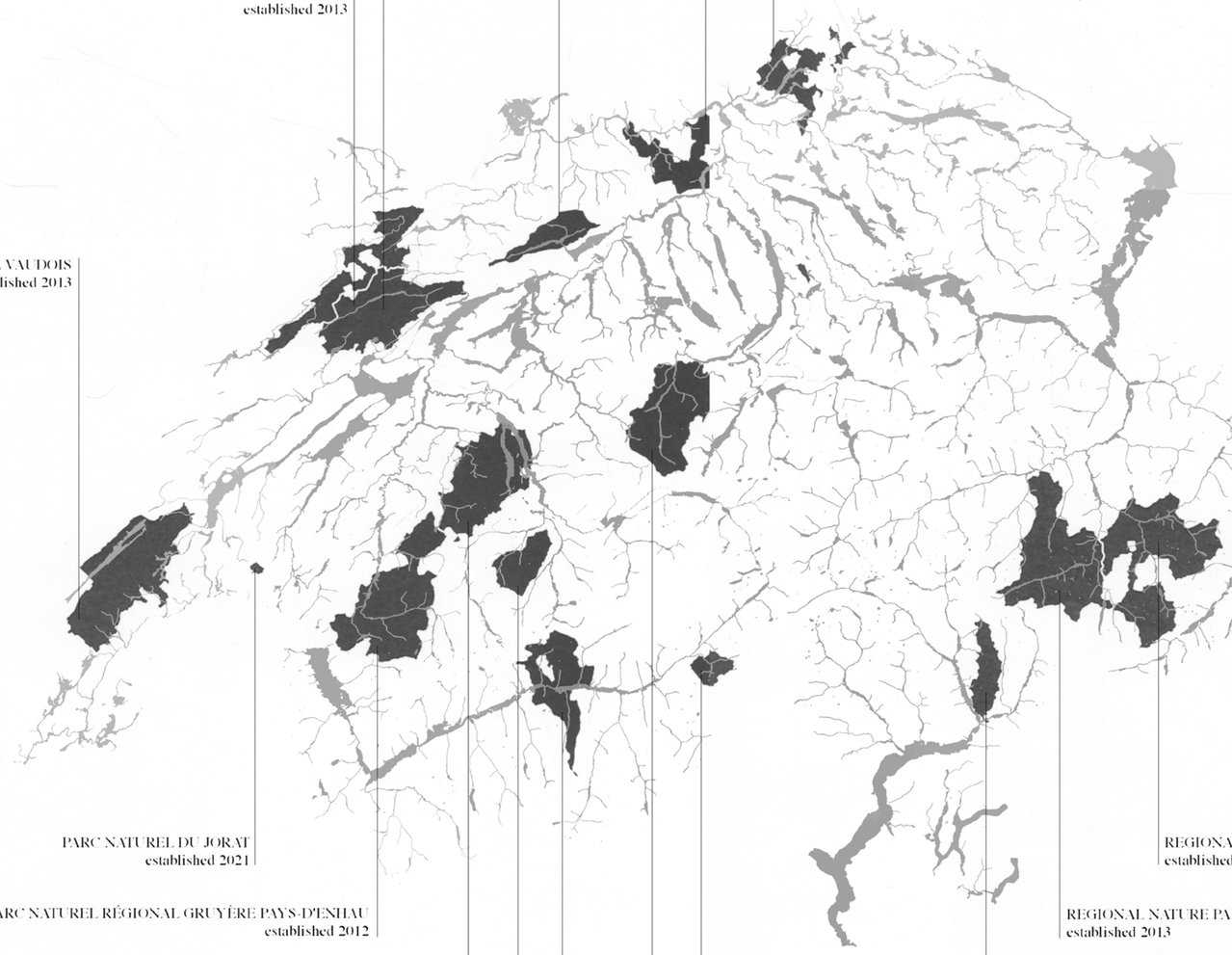
13	A2	drawing	Site Zero; perspective on site	n/a

The construction of the cones had begun at the Gösgen nuclear power plant. Like buildings, roads or dams, they are now a topographical part of the Zone‘s landscape. Their repetitive patterns are shown on the LiDAR satellite images that are increasingly used for planning and archaeological purposes. They persist without much maintenance and beside everything else they are the scars of the graves, traces for civilisations to come, the markers of the Zone.



14 A3 image Site Zero; far future light detection and ranging 1 : 2‘000

black existing Swiss national parks
grey Zone nationwide



REGIONAL NATURE PARK THAL
established 2010

REGIONAL NATURE PARK JURA
established 2012

REGIONAL NATUER PARK SCHAFFHAUSEN
established 2018

PARC RÉGIONAL CHASSERAL
established 2012

PARC RÉGIONAL DU DOUBS
established 2013

PARC RÉGIONAL JURA VAUDOIS
established 2013

SWISS NATIONAL PARK
established 1914

REGIONAL NATURE PARK VAL MÜSTAIR
established 2011

REGIONAL NATURE PARK ELA
established 2012

REGIONAL NATURE PARK BEVERIN
established 2013

REGIONAL NATURE PARK PARCO VAL CALANCA
candidate since 2020

PARC NATUREL DU JORAT
established 2021

PARC NATUREL RÉGIONAL GRUYÈRE PAYS-D'ENHAU
established 2012

REGIONAL NATURE PARK GANTRISCH
established 2012

REGIONAL NATURE PARK DIEMTIGTAL
established 2012

REGIONAL NATURE PARK PFYN-FINGES
established 2013

REGIONAL NATURE PARK BINNTAL
established 2012

REGIONAL NATURE PARK & UNESCO BIOSPHERE ENTLEBUCH
established 2008

300'000 m
200'000
100'000
0

15 A2 map Swiss National Parks and Zone 1 : 1'000'000

Many of the soils treated by the project within the Zone had been intensively used agricultural land before their conversion. Although the land ownership had not changed due to the intervention, the use as conventionally operated agricultural land was no longer possible because of the mounds that had been created.
The cooperative „Gemüse Erzeuger Seeland“ (GES) had tried to promote Swiss vegetable cultivation in greenhouses and launched the project „Vision Energiebündel Seeland“ (EBS) in 2017. The project proposed to build an enormously large greenhouse structure, but eventually lost against political pressure and general disapproval and thus never was realised.

The agriculture within greenhouses no heavy harvesters or tractors are used and so it would not matter whether the ground was not flat. In addition, the hilly ground increases the total ground surface by 25%7, so not only would an alternative, more extensive agricultural use work on the mentioned loosened grounds, but there would be more area available for it.

16 A4 image Built greenhouses inside of Zone 1 : 5'000

7 cone with r = 2.5m and h = 1.85m; footprint = 19.6 qm; results in shell surface = 24.4 qm

In the last ten years, prices for single-family homes in Switzerland have risen by 40%. Low and negative interest rates on many investments are increasingly motivating people to invest in real estate. In view of the coming interest rate increases after the Covid–19 pandemic, the Swiss real estate market seems to be tending towards optimism, but non-urban properties in particular could nevertheless experience a reduction in price. Declaring a larger area in the most populated part of the country as a Zone where no further building is allowed will equally reaffirm the property value of the buildings located in the Zone and embed them in a new situation together with the properties outside the Zone. The Swiss population is forecast to grow between 10 and 20% by 2050 and to double in about one hundred years from now. Due to the positive internal migration to the suburbs, it can be assumed that the lion‘s share of these people will settle in smaller towns in the Mittelland. In such a scenario, naturally the smaller towns will develop to large cities and so the settlers destroy the thing they are looking for through finding it. The Zone could develop into a park, a loosely populated open space in an otherwise increasingly blighted Swiss Mittelland.

17 A4 image Developed edge of Zone 1 : 10'000