Improving the quality of the cadastral map

Agenda

- Presentation 40 min
- Group discussions 40 min
- Coffee break 10 min
- Group reports in plenary 30 min

The questions you will be asked to discuss

Groups

Six discussion groups

1
Magnús Guðmundsson
Uffe Jimenez Ravn-Christensen
Marja Rantala
Turid Ellingsen
Bo Naamansen

2
Susanne Ås Sivborg
Petur Nielsen
Susanne Boiesen Petersen
Heli Ursin
Erik Perstuen

3
Pia Dahl Højgaard
Eydís Líndal Finnbogadóttir
Anders Sandin
Olav Petter Aarrestad
Ronnie Thomassen

4
Margrét Hauksdóttir
Anders Lundquist
Juha Tuomaala
Morten Nordahl Møller
Knut Arne Gjertsen

5
Arvo Kokkonen
Helge Onsrud
Stein Fossá
Jess Svendsen

6
Anne Cathrine Frøstrup
Hjörtur Grétarsson
Søren Reeberg Nielsen
Malene E. Jacobsen
Irma Lähetkangas

Each group answer its question and selects one extra question.

Groups give presentation on their discussions and key conclutions.

Six questions for discussion?

1. How acurate should the Cadaster map be?

2. How will Cadastral maps be used in 20 years? What is needed?

3. Should Cadastral maps be 100% GPS in 3D? How will be get there?

4. Should the nordic countries work together on nordic quality standards and/or best practices?

5. Should the nordic countries work together on IT projects (e.g. Augmented reality for Cadastral maps)?

6. What threats and opertunities are for our institutions with regards to the quality of our Cadastral maps?

Cadastral systems

Every country has different starting point and different Cadastral system

- Landnama bok 1160
- 480 farms in Iceland
- 100% Cadaster system

The Danish Cadastral System

Matrikelregister

Matr. nr.: **33f** Eierlavskode: **2005057**

Jorder

): Se modermatrikelnr.

blad:

styper/
ationer:

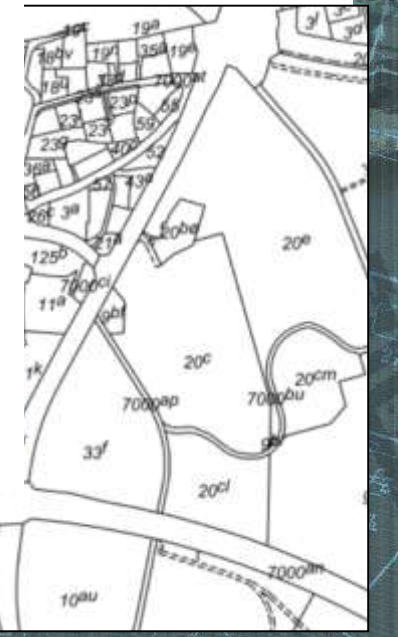
Real Property registration

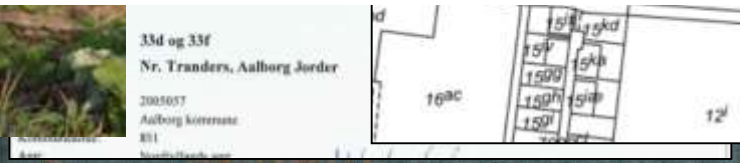
The Cadastre
- Parcel identification
- Definition of Real Property
- Parcel Register
- Cadastral Map
- Parcel survey information
- Control of subdivisions
- Legal land restriction

98 Municipalities

The Municipal Register of Real Property
- valuation (assesment)
- property tax
- Building and Dwelling Register
- addresses

The Land Register
(Land Book)
- title (ownership)
- mortgage
- easements (servitudes)





Finnish cadastral system – in numbers

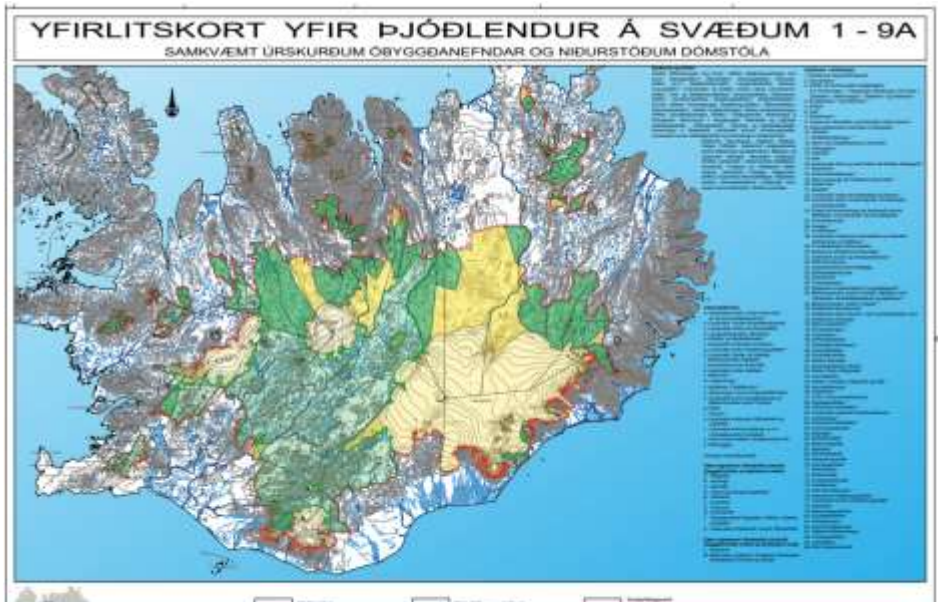
- Total area 338,000 km^2
- 2,850 000 land objects
- Cadaster covering 100% (99,99%)
- Buildings / condominium information is <u>not</u> part of cadaster
- Register units are identified by certain “register number code” (address is not cadaster information).
- Building and address –information is part of terrain information database (open data).
- Condominium register is starting stepwise at 2019

Icelandic cadastral system – in numbers

- 102.700 sqkm of land
- 107.500 land objects partially covering the whole land
- 53.500 land objects mapped in the cadaster
- 199.718 property objects whereas 56% are part of condominium
- 126.187 addresses, whereas 115.689 have associated address points, or 91,7%
- 99,9% of residential og recreational addresses mapped

Creating new Cadaster maps in Iceland.

- The Center of Iceland is being mapped out since 1995, will end 2023.
- Register Iceland is creating central digital cataster map system.
  - 2016: 13.000 land objects mapped of 106.000 in total (12,3%)
  - 2017: 37.500 land objects mapped of 106.500 or in total (35,2%)
  - 2018: 53.500 land objects mapped of 107.500 or in total (49,8%)



Norway in brief (1)

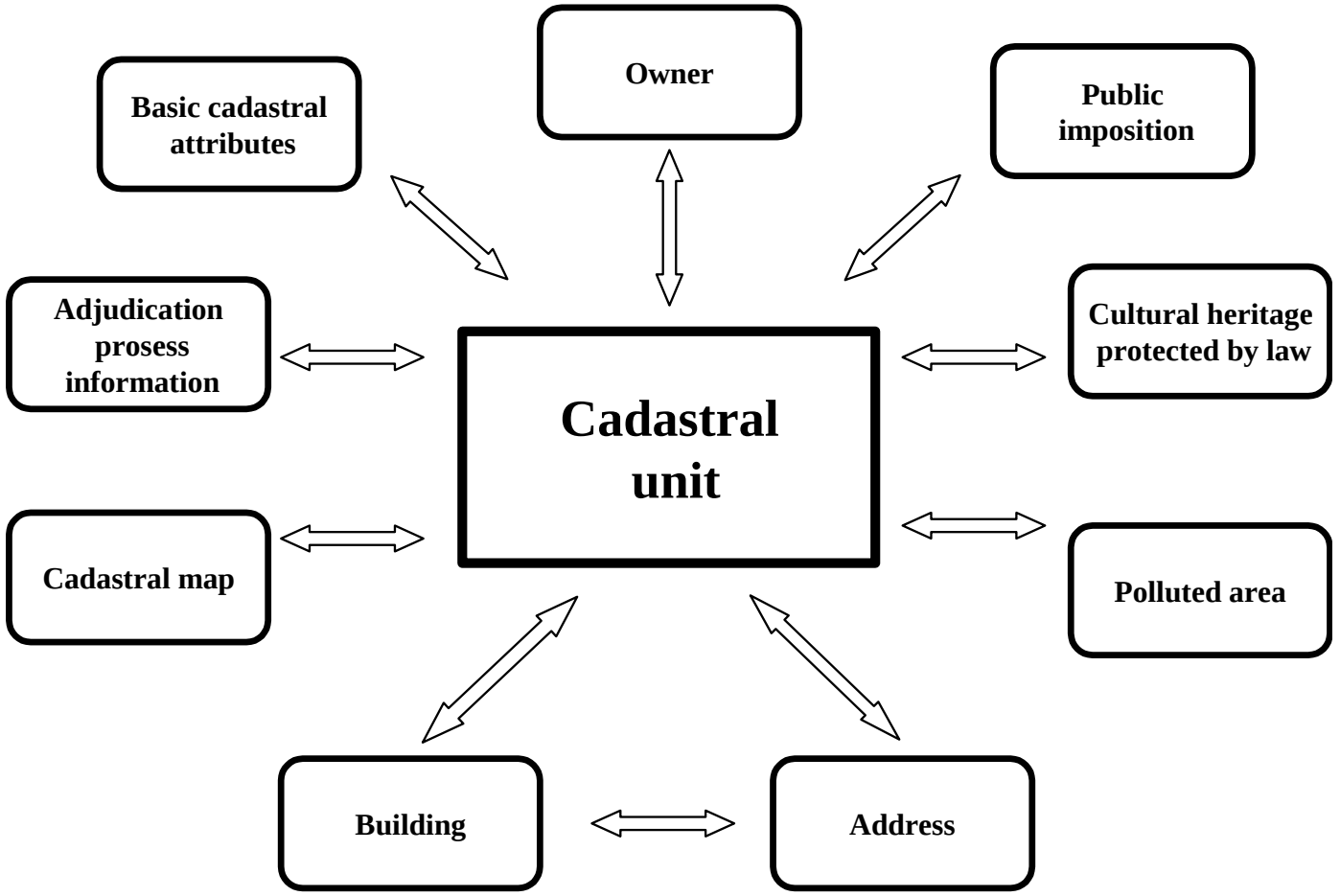
- Area: 385.186 km^2
- Population: 5.000.000
- Counties: 18 + Svalbard and Jan Mayen (arctic island groups)
- Municipalities: 422

Kartverket

Norway in Brief (2)

- Properties: 3.253.916, the most with geographic coordinates
- Buildings: 4.223.457, the most with geographic coordinates
- Addresses: 2.270.825 street adresses (about 92%), and 173.312 another addresses (the most with geographic coordinates)
- 95 % of properties are in private ownership
- 80 % of families own their house
- 99 % of farms are owned by private, single farmers – 20 hectares on average
- Only high mountains in general state ownership
- Almost all building construction are financed by mortgaging

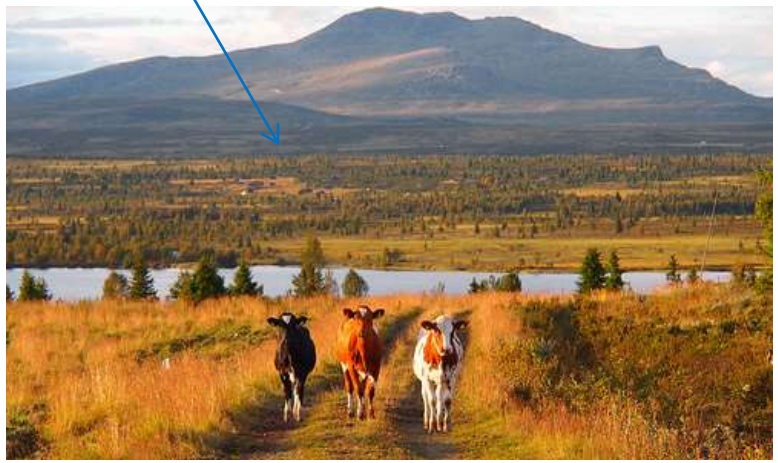
The Cadastral System (3)

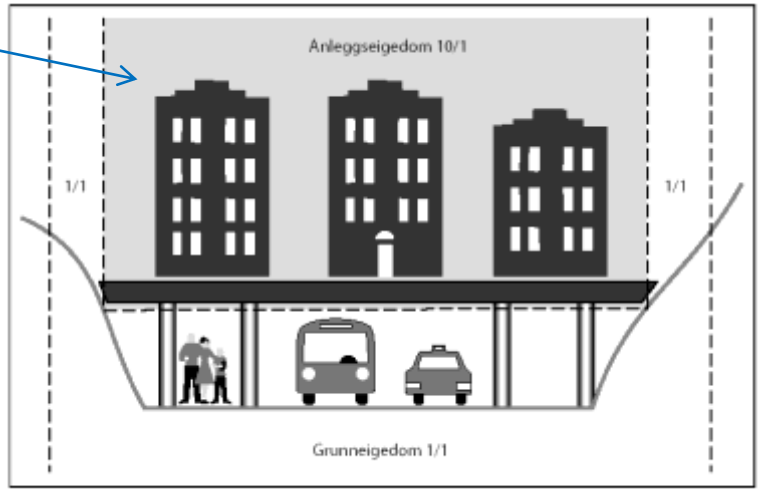


Kartverket

The Cadastral System (4)

- Five types of property units (2013)
  - Property unit (2.4 millions)
  - Condominiums (400.000)
  - Leasehold unit (165.000)
  - 3D unit (129)
  - Commons (70)





Figur 17.4 Oppretting av anleggseigedom på lokk over grunneigedom.

Kartverket

Sweden´s cadastral system - in numbers

Sweden area is 447 435 sqkm

- 3 514 472 living objects in the cadastral register 2017-12-31
  - 3 295 181 property units
  - 119 816 joint property units
  - 99 475 joint facilities

The cadastral register also contains

- 1 453 044 ”dead” proprty units
- 55 954 ”dead” joint property units
- 6 784 ”dead” joint facilities

No condominium register, there are discussions

2017-12-31

Källa: GDS-BAL

Byggnadsändamål	Antal byggnader [1]	Antal byggnader med minst en adress [2]
Bostad	3 005 344	2 959 775
Industri	81 434	78 651
Samhällsfunktion	123 006	118 365
Verksamhet	59 387	58 345
Övriga ändamål	4 752 372	123 056
Ekonomibyggnad	*34 082*	*7 493*
Komplementbyggnad	*4 590 014*	*88 009*
Övrig byggnad	*128 276*	*27 554*
Totalt	**8 021 543**	**3 338 192**

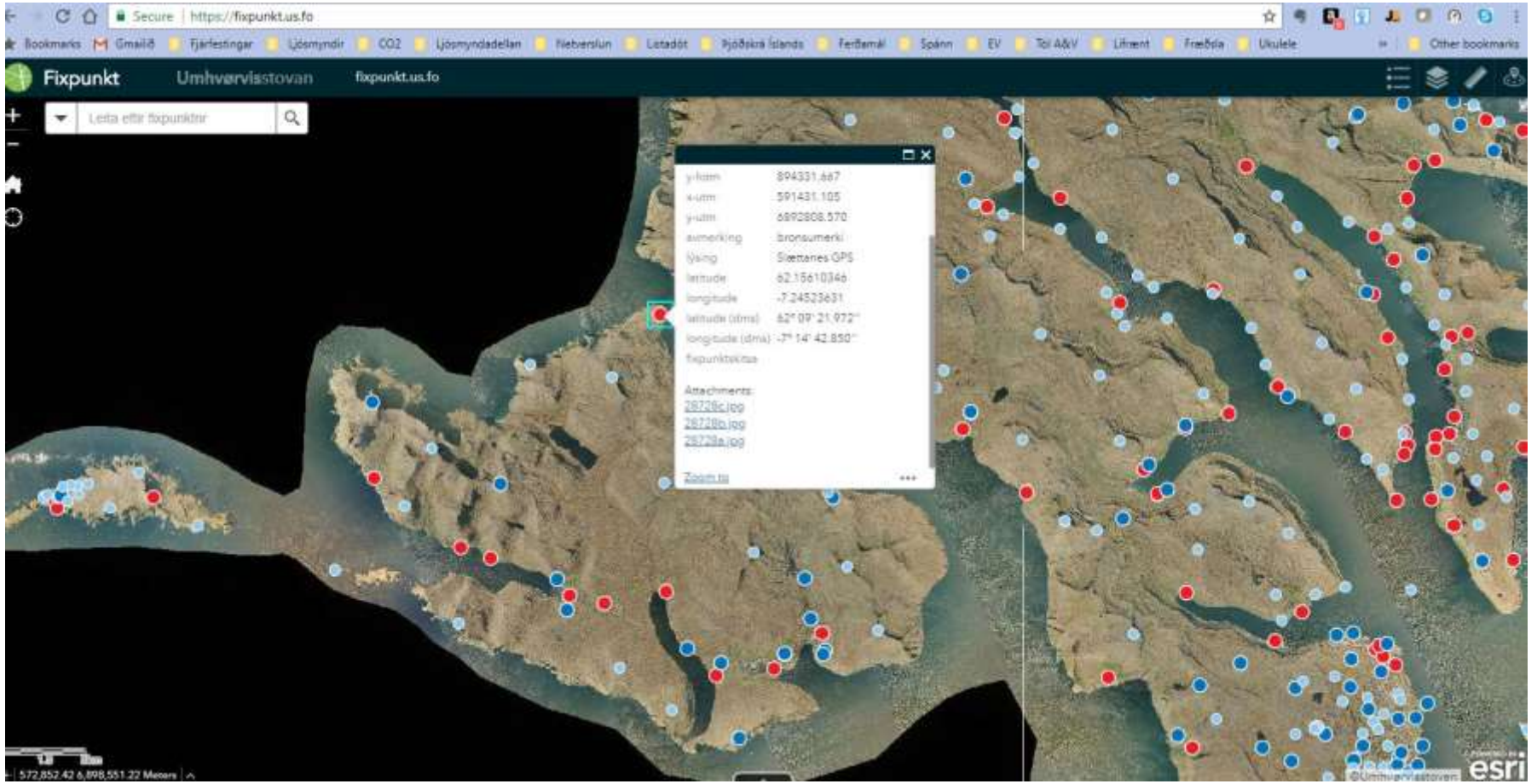
1) Byggnader med status "Gällande" och "Planerad"

2) Byggnader med status "Gällande" och "Planerad" samt byggnader med attributet "Undantagen från adressättning". Belägenhetsadresser med status "Gällande" och "Reserverad"

The Faroese cadastral system – general purpose

- The Faroese cadastral information has a legal role in the land market, as well as being used for regional planning. It has always been an object to keep the cadaster as simple as possible, and not to develop it into a multi-purpose cadaster. The reason is, that then it is simple to maintain and simple to develop new digital systems to administer and maintain.
- There is no need to develop fiscal elements into the cadaster, because property tax does not exist at The Faroes.

Faroe Island made new cadaster maps for all of the Islands, took 30 years.

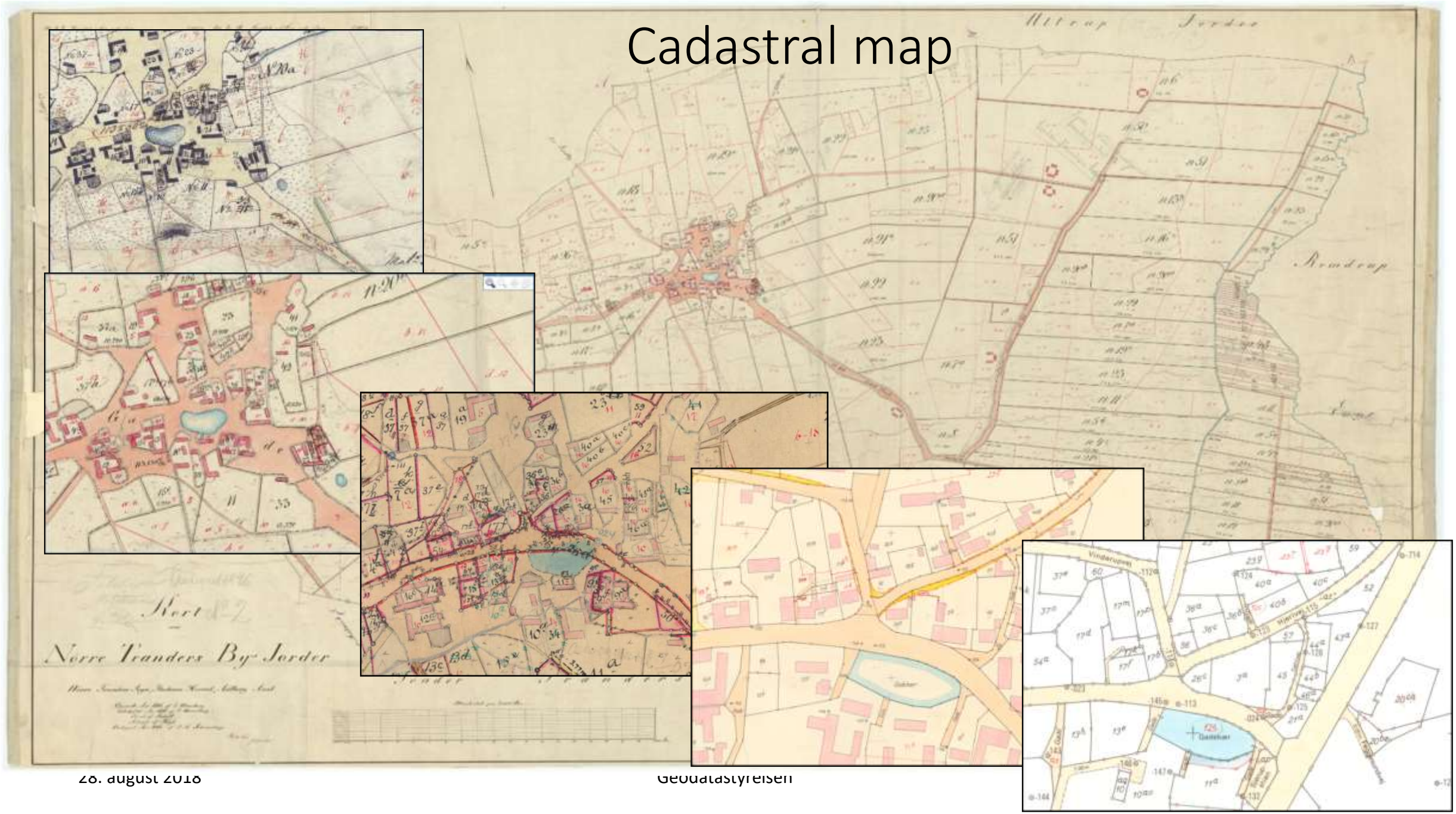


What is a Cadastral map?

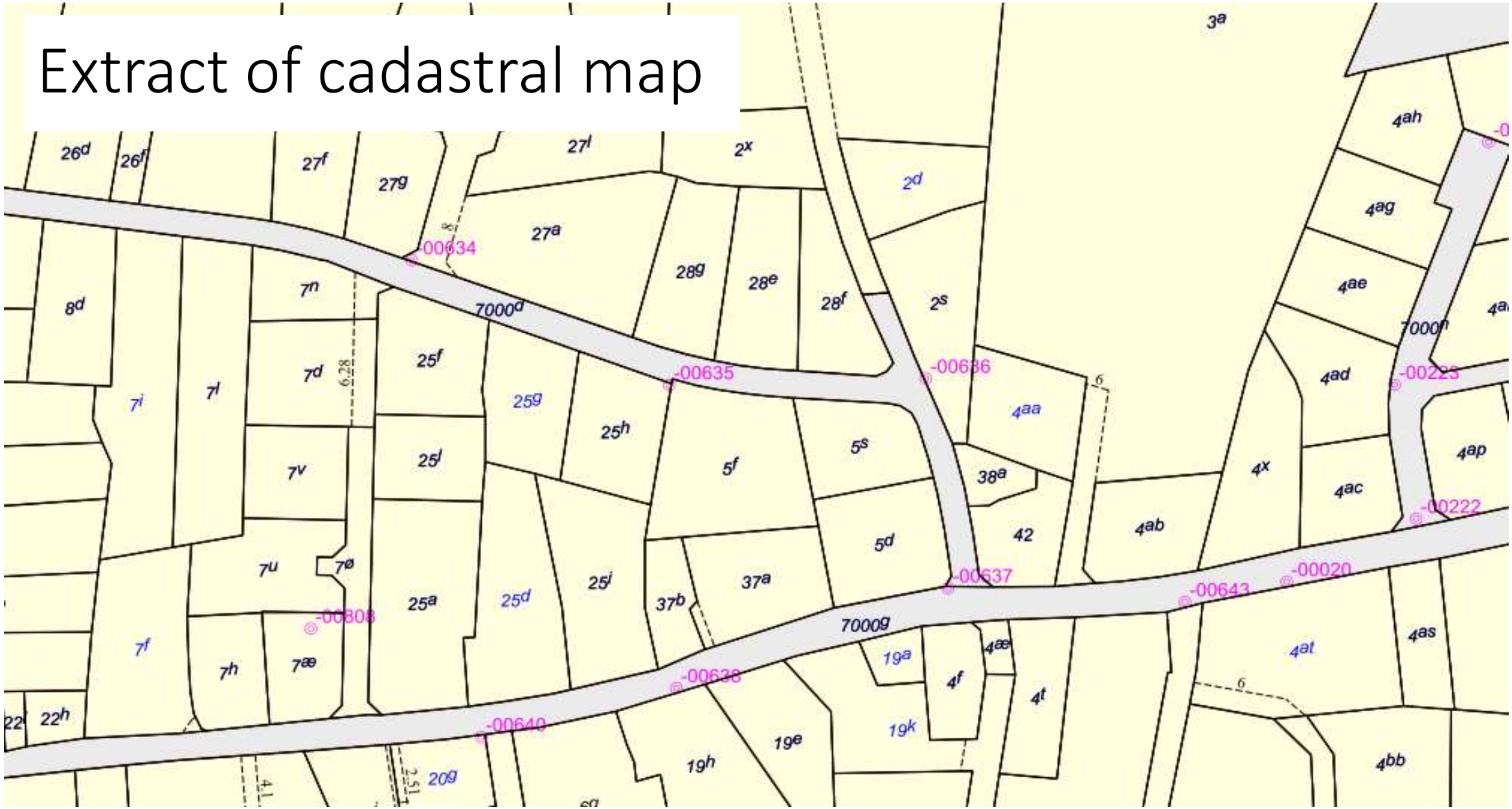
What is a cadastral map

- The cadastre is a register of property, usually made for taxation purpose
- Evolved into supplying information for title registration, land administration, environmental control etc.
- Essential for society
- The cadastral map is showing the content of the cadastre - properties (land parcels, buildings, condominiums, rights of way)
- The cadastral maps in the Nordic countries are 2 dimensional digital maps (at least almost no 3d objects)

Cadastral map



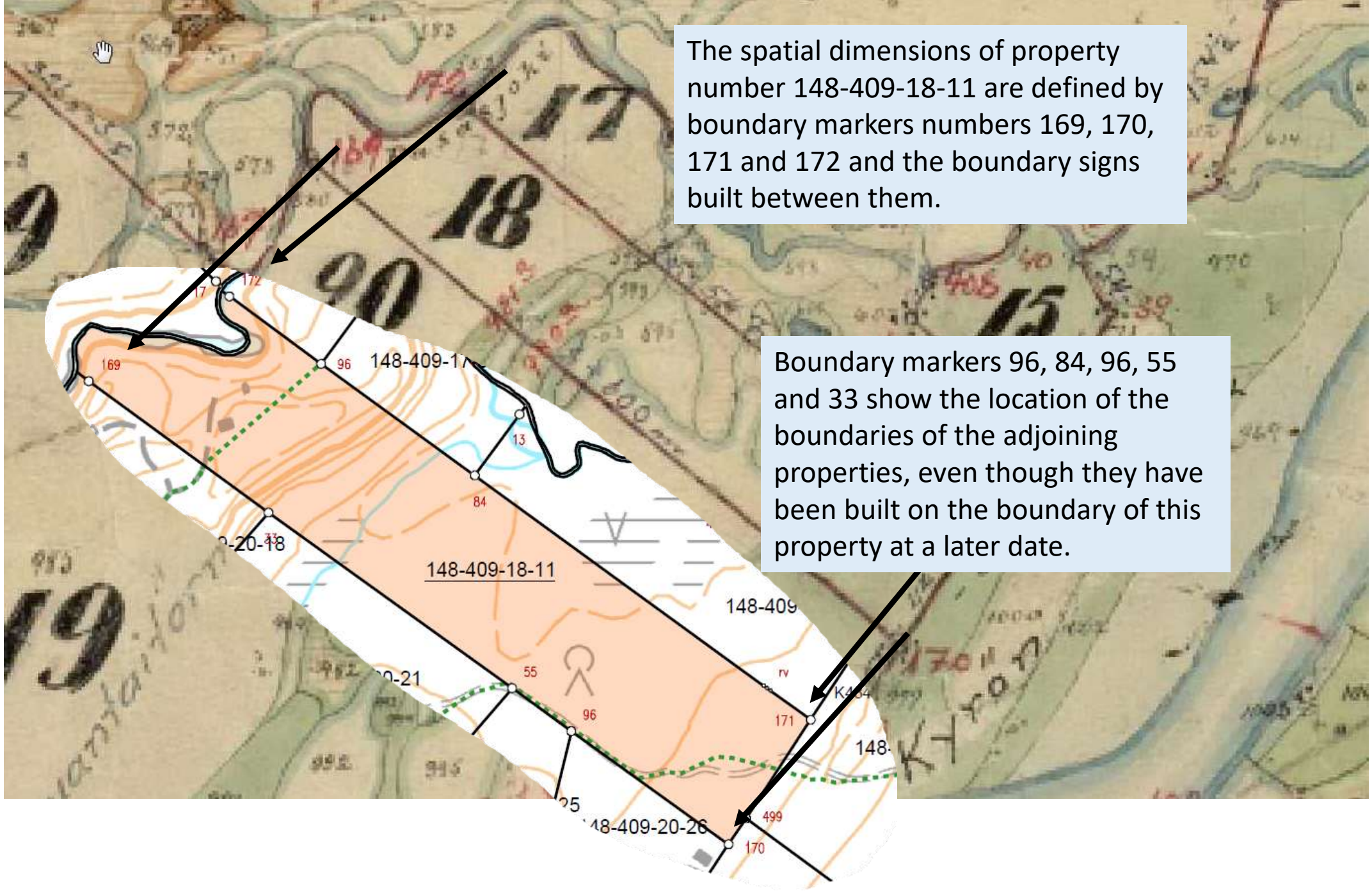
Extract of cadastral map



Why does the quality differ between areas?

- Developed over a long time period (1100 – today)

- Production method
  - Measurements
  - Areas with many changes vs. areas that have never changed
  - Digitisation

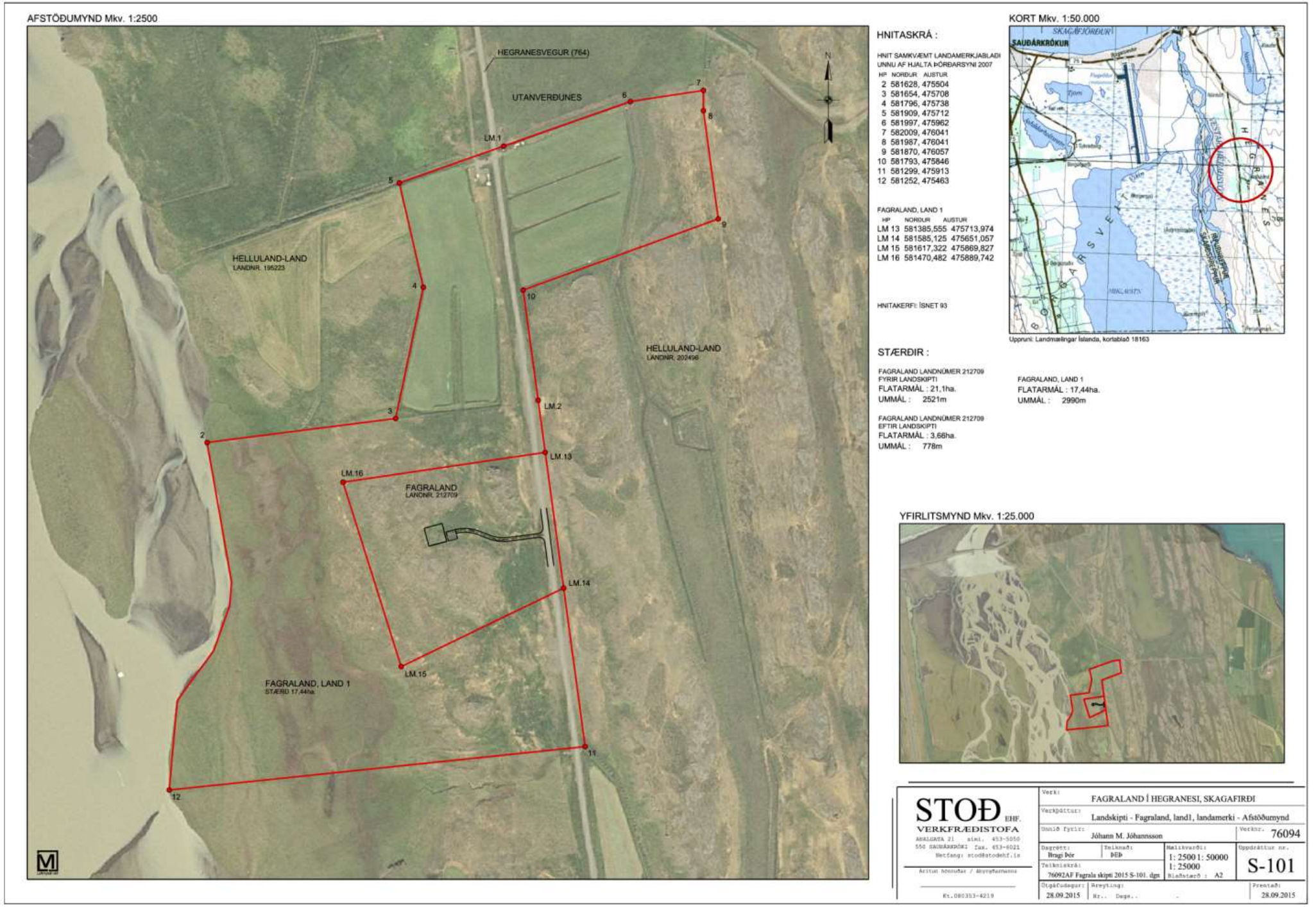

The spatial dimensions of property number 148-409-18-11 are defined by boundary markers numbers 169, 170, 171 and 172 and the boundary signs built between them.
Boundary markers 96, 84, 96, 55 and 33 show the location of the boundaries of the adjoining properties, even though they have been built on the boundary of this property at a later date.
148-409-18-11
148-409-20-26
169
172
96
84
55
171
170
499

Digitisation

- Generally very old but updated analogue maps
- Generally multiple analogue maps that have been digitised into one digital cadastral map (national or municipal)
  - Denmark has used large subdivisions and road measurements as a base for transformations
- Iceland is building a cadastre – but needs mandatory quality requirements
- Faroe Islands have measured and digitised all properties from the 1970'ies to 2000.

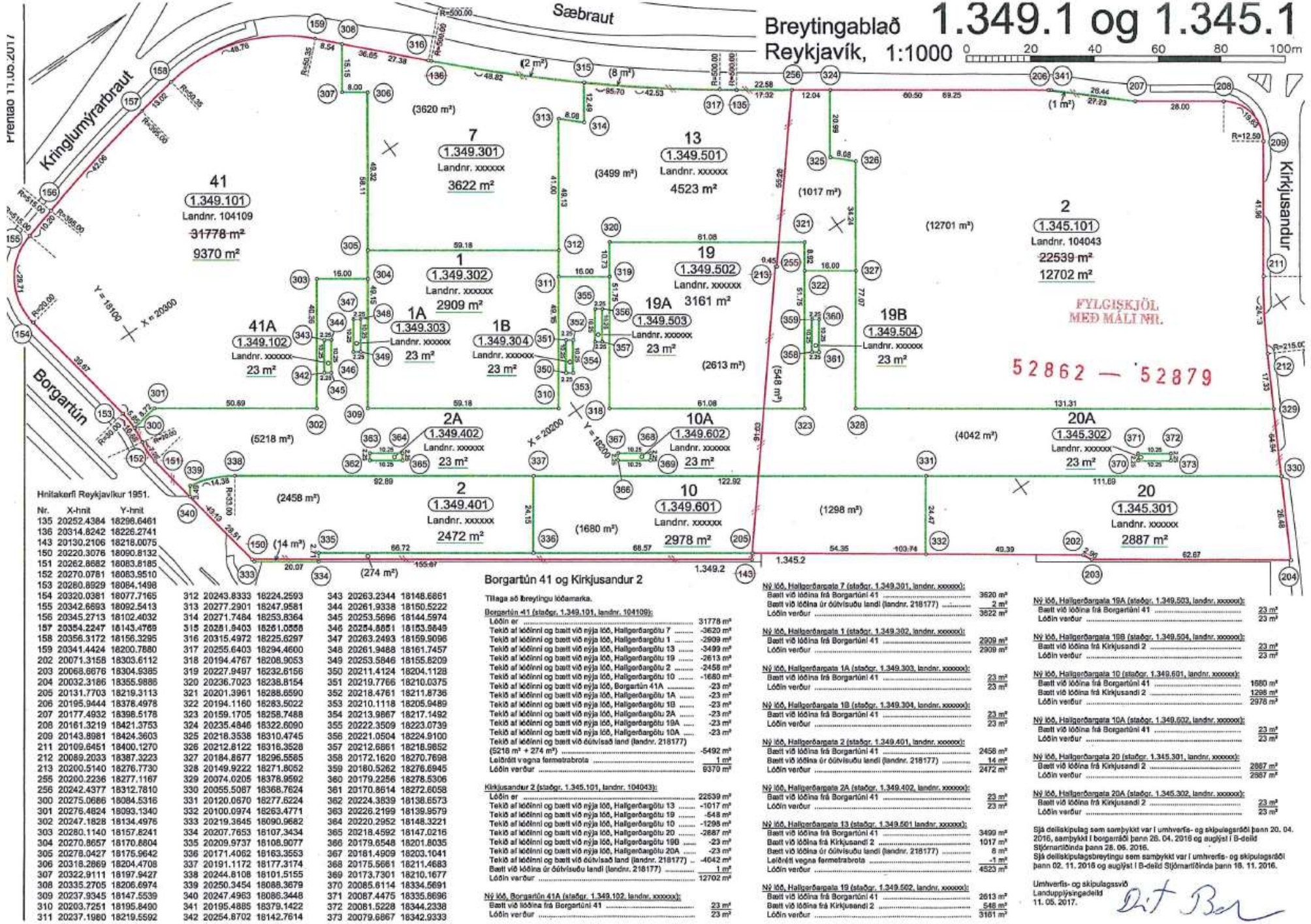
Icelandic cadastral system – example of a survey document

good

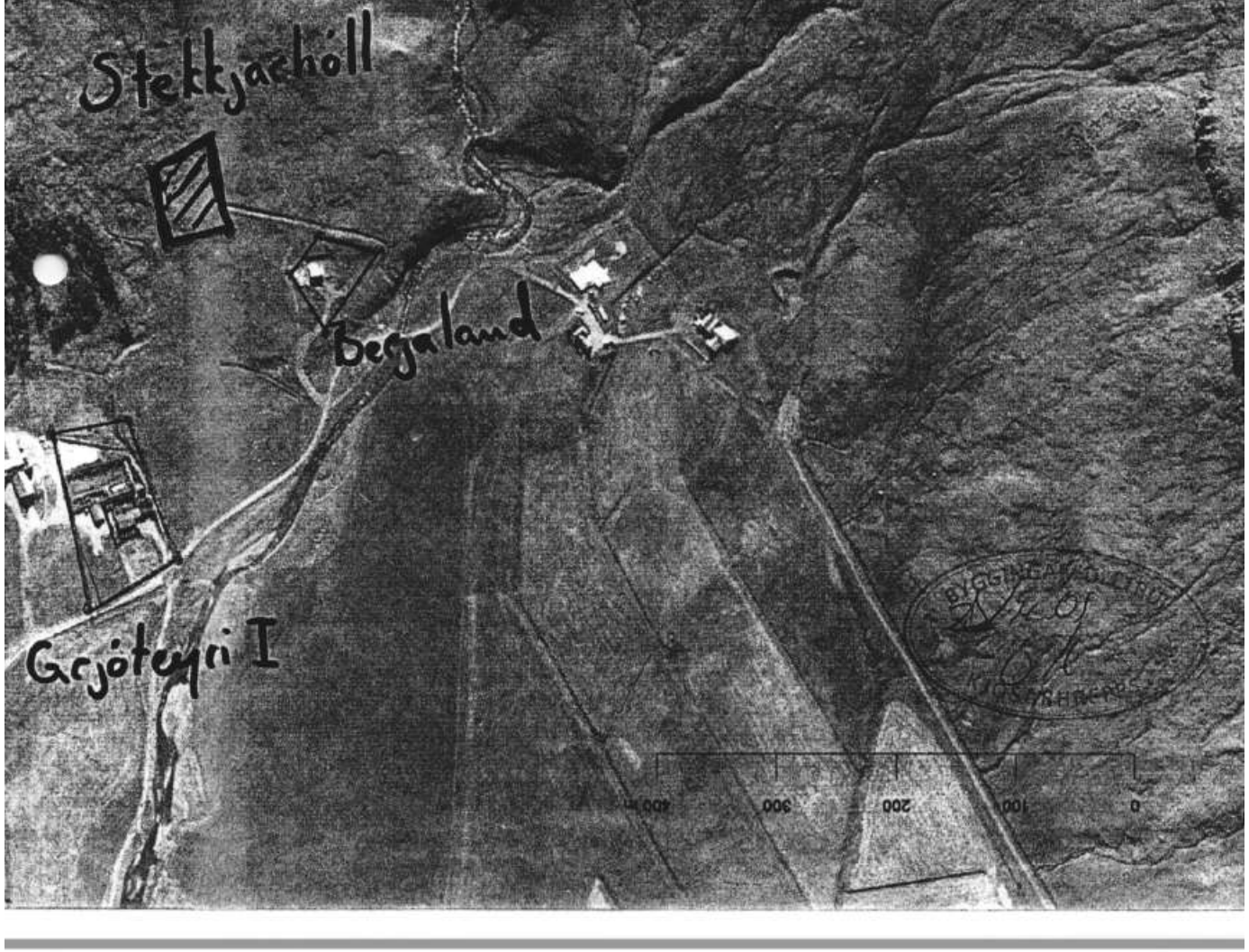


Icelandic cadastral system – example of a survey document

complex



Icelandic cadastral system – example of a survey document



bad

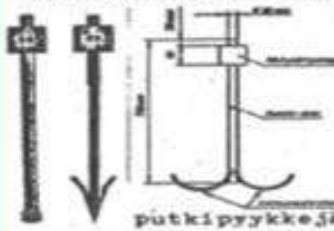
Hnitablað

Lóð	stærð m2	Hnitapunktar (ísnet 93)		
Stekkjarhóll	3558	O33	374529,614	424406,040
		O34	374548,764	424342,762
		O35	374503,965	424316,656
		O36	374482,895	424390,642

Challenges in the Nordic countries

- Example of quality issues and why
  - Denmark: The cadastral map is of high relative accuracy. Some areas – mainly rural - are of very poor absolute accuracy due to production method of the digital cadastral. Open data result in “new” use, combining with other data. Number of points of lowest accuracy class is not decreasing significantly
  - Norway: Poor accuracy in rural areas
  - Sweden: Poor accuracy in rural areas
  - Finland: Absolute accuracy is poor in rural areas. Detection of boundary marks is difficult and costly. Poor absolute accuracy causes problems especially with high tech GPS forestry
  - Iceland: Is creating a cadastral map. Urban areas are well defined. Legislation of measurement method gives problems. Land movements
  - Faroe Islands: Relatively newly measured cadastral map. Example of challenges are that municipalities does not register changes within own property

Ohessa kuvia aikanaan rakennetuista rajapyykeistä. Nykyään voimassa olevia rajamerkkejä ovat putkipyykki, yksikivinen pyykki, pulttipyykki, nelikulmainen pyykki, viisikivinen pyykki ja viisipaaluinen pyykki.



putkipyykkejä

viisikivinen pyykki

nelikulmainen pyykki

maaperäkivipyykki

kiilapultteja

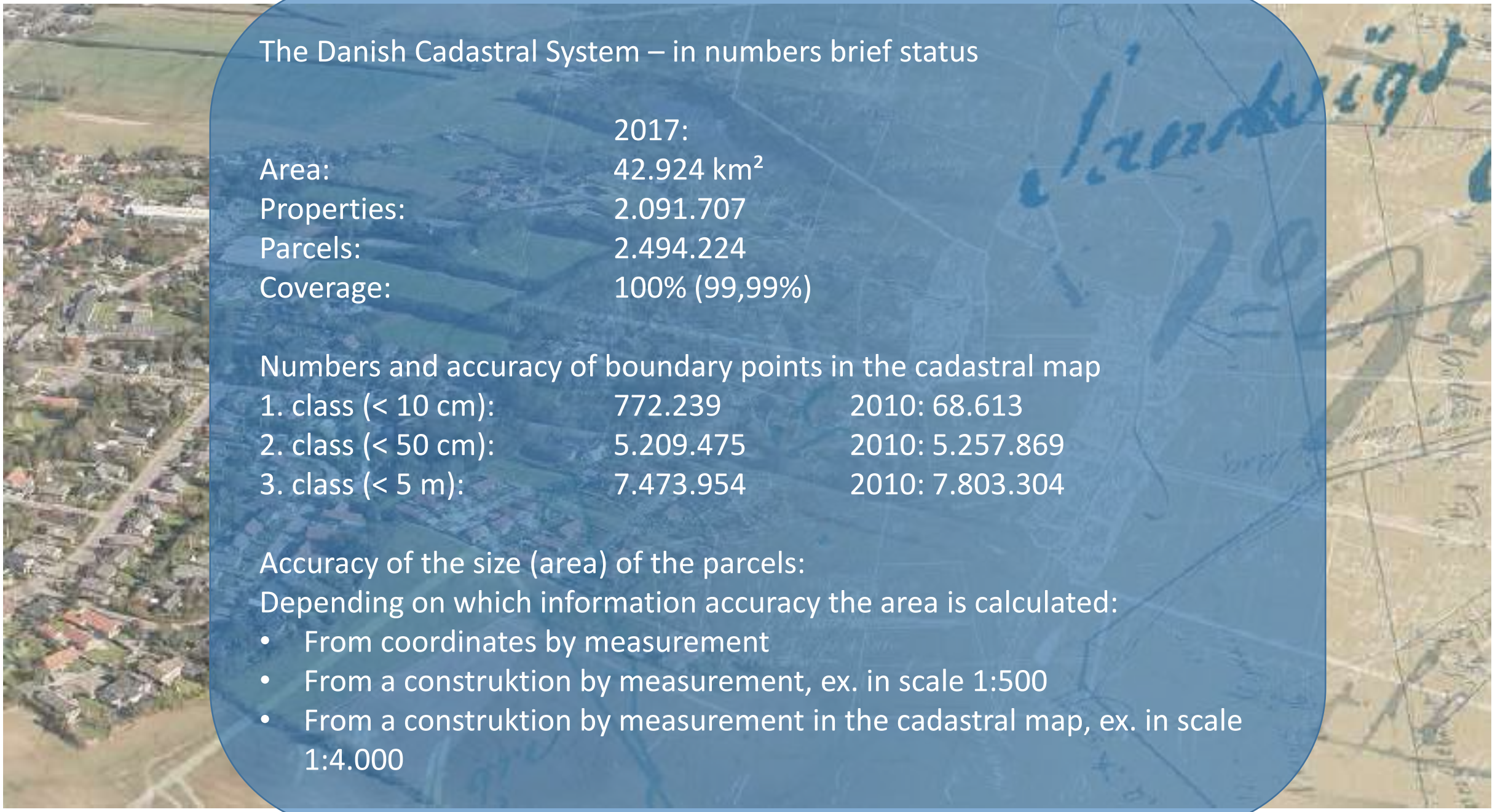
viisipaaluinen pyykki

Challenges in the Nordic countries

- In general:
  - Poor accuracy of measurements in rural areas
  - Or poor digitisation of measurements
  - Not fit for combining with other maps
- Absolute vs. relative accuracy of boundaries
- General misuse of the cadastral map
  - Combination with other maps (ortofotos)
  - Use in making decisions in public sector
  - People does not understand “relative accuracy”
- Open data makes it possible to combine data in numerous ways
  - How can it be ensured that data is not misused

Open data

How to handle challenges?



The Danish Cadastral System – in numbers brief status

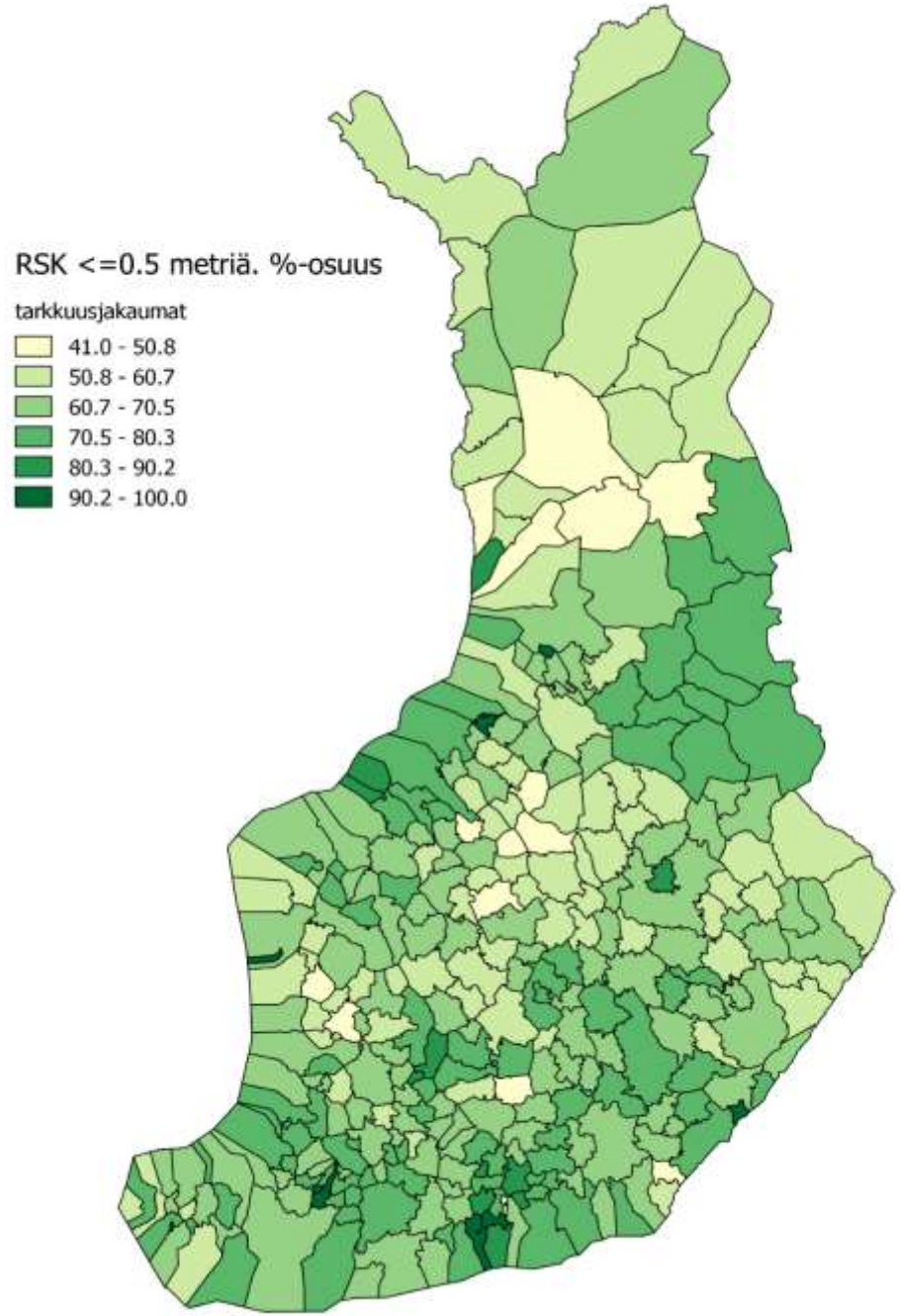
	2017:
Area:	42.924 km²
Properties:	2.091.707
Parcels:	2.494.224
Coverage:	100% (99,99%)

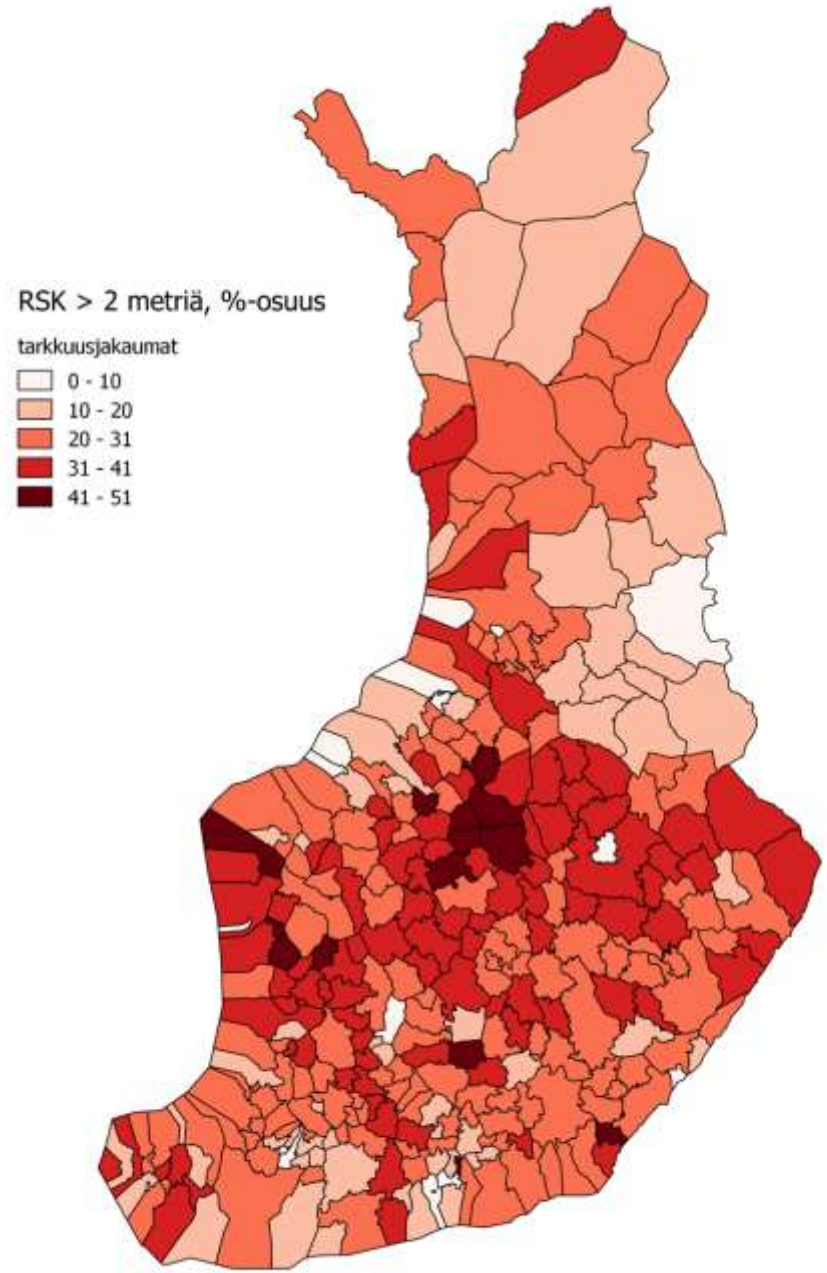
Numbers and accuracy of boundary points in the cadastral map

1. class (< 10 cm):	772.239	2010: 68.613
2. class (< 50 cm):	5.209.475	2010: 5.257.869
3. class (< 5 m):	7.473.954	2010: 7.803.304

Accuracy of the size (area) of the parcels:
Depending on which information accuracy the area is calculated:

- From coordinates by measurement
- From a construktion by measurement, ex. in scale 1:500
- From a construktion by measurement in the cadastral map, ex. in scale 1:4.000


RSK <=0.5 metriä. %-osuus
tarkkuusjakaumat
41.0 - 50.8
50.8 - 60.7
60.7 - 70.5
70.5 - 80.3
80.3 - 90.2
90.2 - 100.0


RSK > 2 metriä, %-osuus
tarkkuusjakaumat
0 - 10
10 - 20
20 - 31
31 - 41
41 - 51

Challenges

- Many kinds of boundary markers of various age
- Boundary markers are usually not visible on aerial photographs without signalling
- Current coordinates can show an error of dozens of metres
- Automatic data collection is difficult or impossible
- Topographic measurements are expensive
- Older boundary markers are often difficult to find -> clues can be found on several different graphical cadastral survey maps that must be checked individually (distances between boundary markers)
- Not even the boundary markers with the most accurate RSK number are completely reliable
- The truth is in a million stones in the terrain!

Potential results of the project

- Suggested actions to improve the situation in future (such as, more information stored concerning boundary markers)
- An example of how spatial data analyses could be utilised to manage measurements (measure those boundary markers with the greatest effect on the surface areas of properties)
- The views of stakeholders, such as the forestry sector and landowners, on the problem
- A report on the opportunities offered by targeted crowdsourcing
- Suggested changes in cadastral survey production (development of boundary demarcation procedure)
- A suggestion on how to inform users of the positional accuracy of boundaries using colours, line thickness, fuzzy lines, etc.

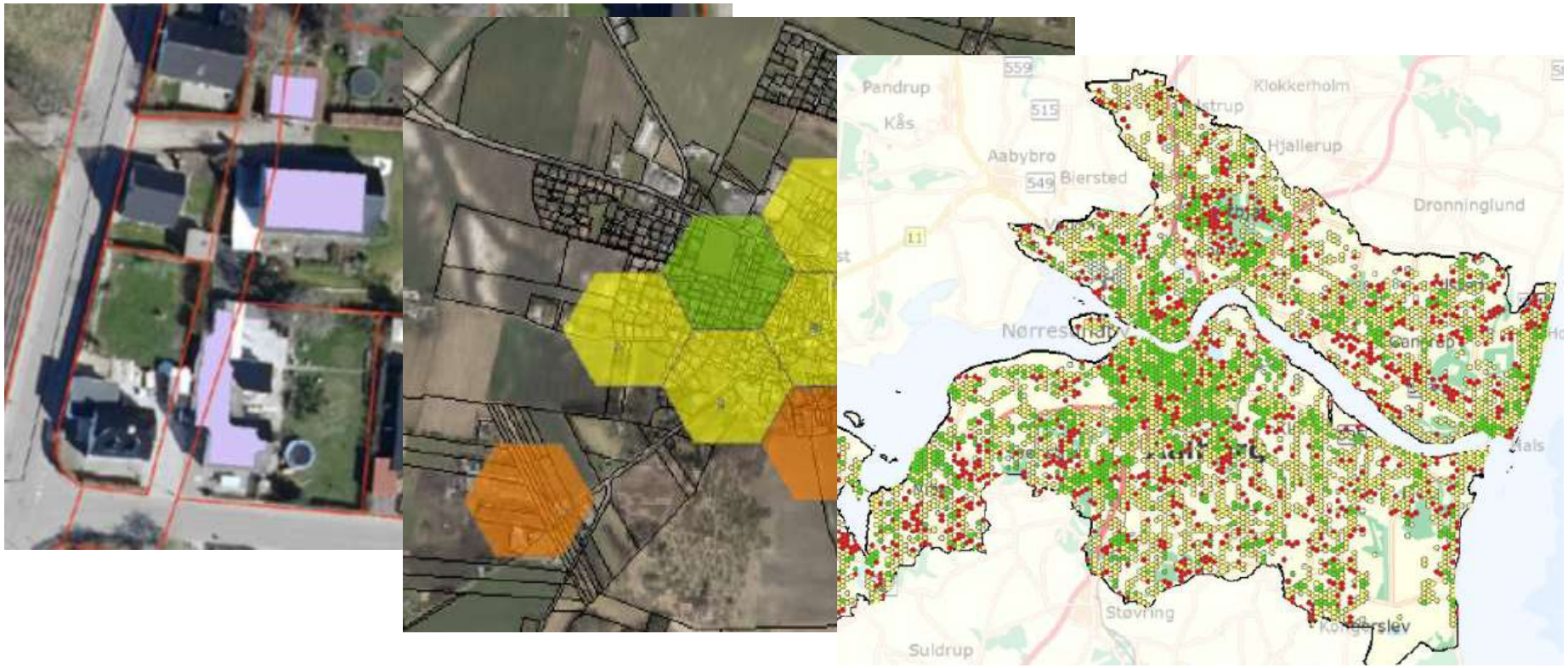
Preliminary analysis of improvements of cadastral map

- Project ordered by the Danish Tax Authority
- Project period: August-December 2017
- Main supplier: COWI
- Others:
  - Aalborg University,
  - Danish Geodata Agency
  - Interviews (50) and workshops (among users of cadastral map)
- Result: Report with recommendations

Recommendations to improve quality of cadastral map

1. Focused improvement of cadastral map based on GIS-analyzes

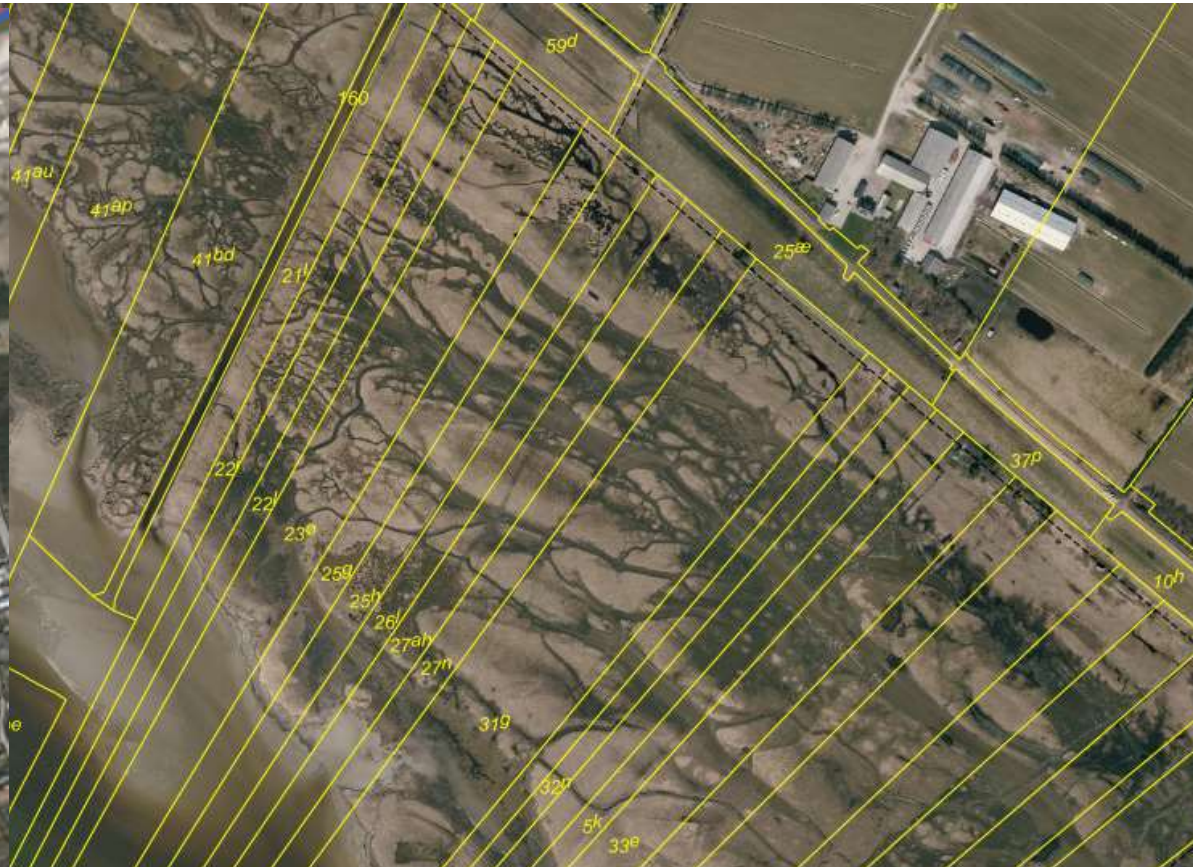
   Effort: 45 mill. Danish kr. – on standby



Recommendations to improve quality of cadastral map

2. Boundary lines towards territorial waters

   Testproject on coast line improvements



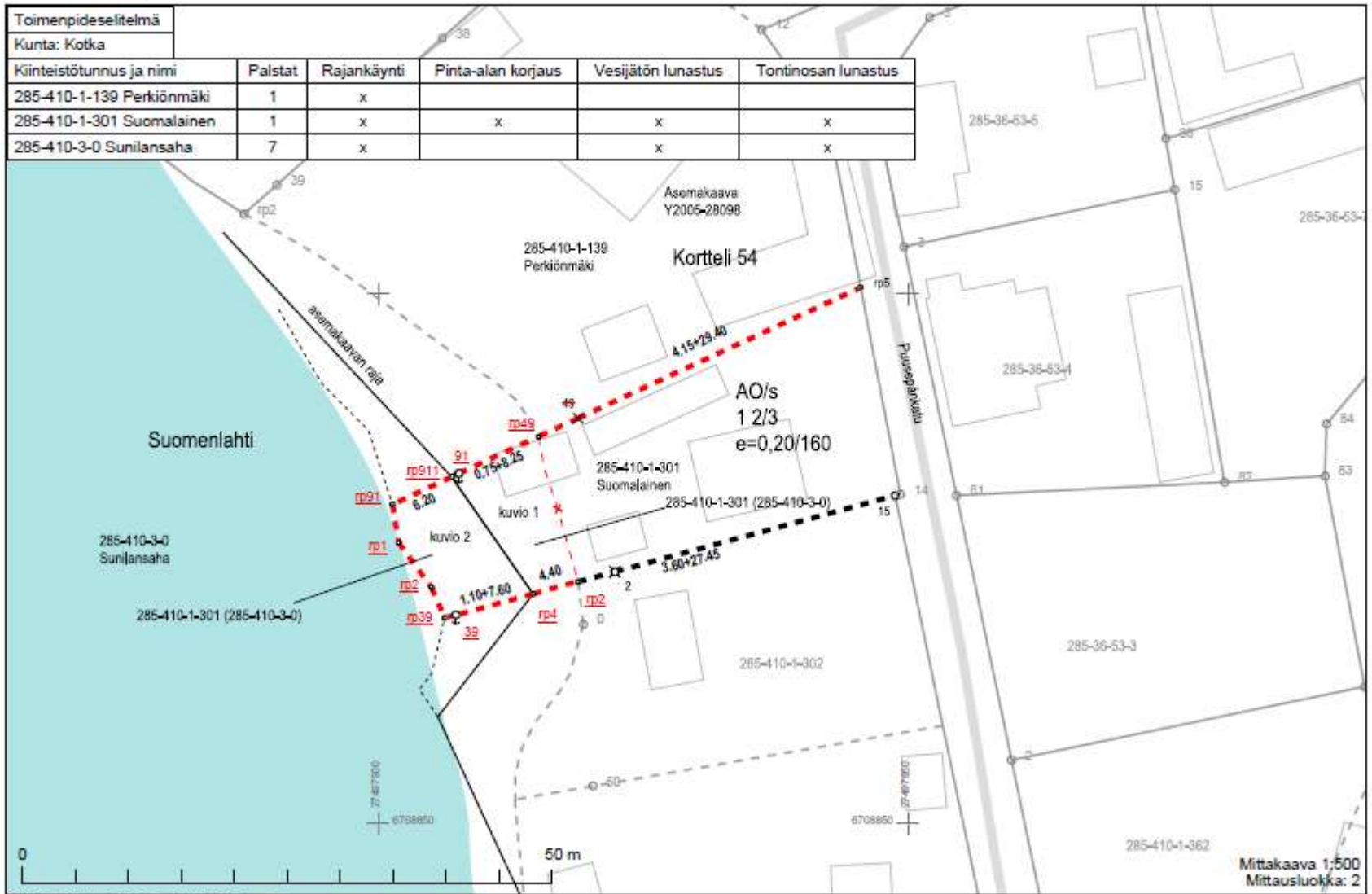
MML MAANMITTAUSLAITOS

Toimituskartta

Toimitusnumero 2016-541429

MMLm/19404/33/2016

Toimenpideselitelmä					
Kunta: Kotka					
Kiinteistötunnus ja nimi	Palstat	Rajankäynti	Pinta-alan korjaus	Vesijätön lunastus	Tontinosan lunastus
285-410-1-139 Perkiönmäki	1	x			
285-410-1-301 Suomalainen	1	x	x	x	x
285-410-3-0 Sunilansaha	7	x		x	x



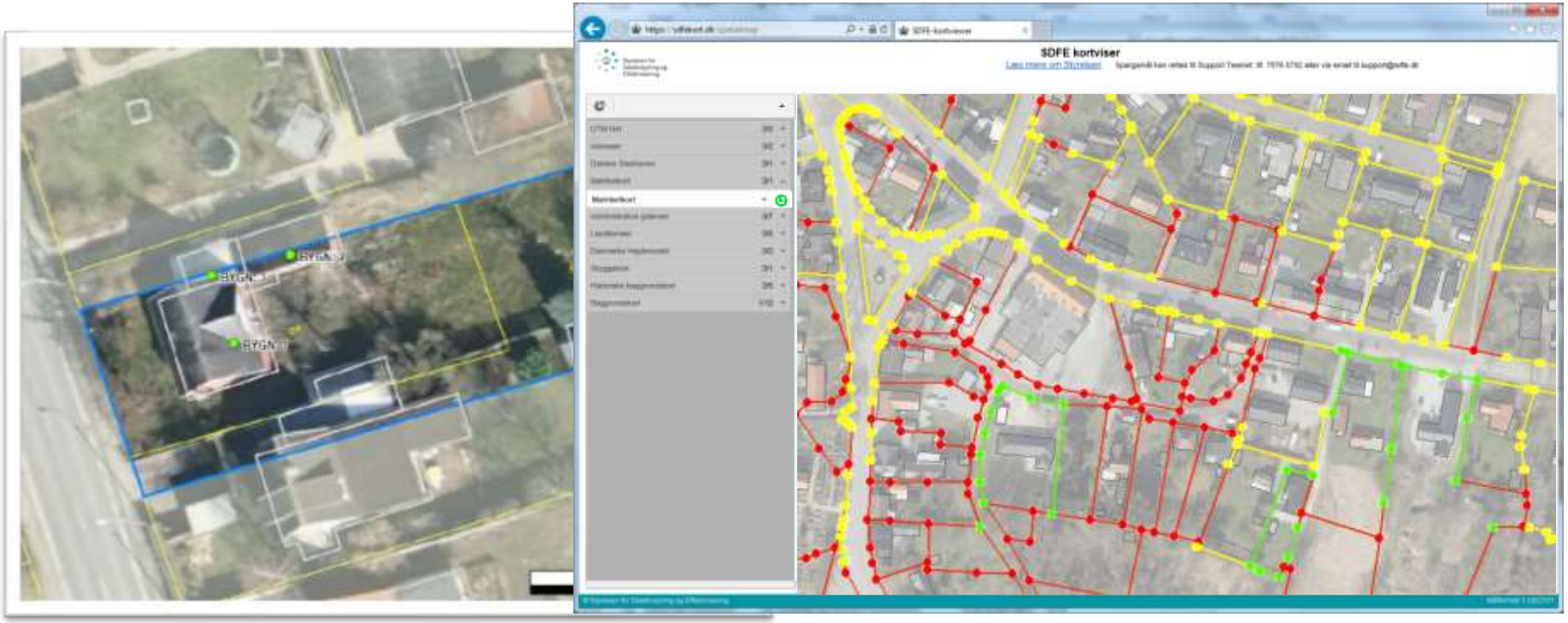
Allekirjoitettu sähköisesti, Pukki Tapani
19.6.2017 09:34:21

Koordinaattijärjestelmä: ETRS-GKn/peruskoordinaatisto

Recommendations to improve quality of cadastral map

3. Communication about cadastral map

   Effort: ”Quality-map”, metadata



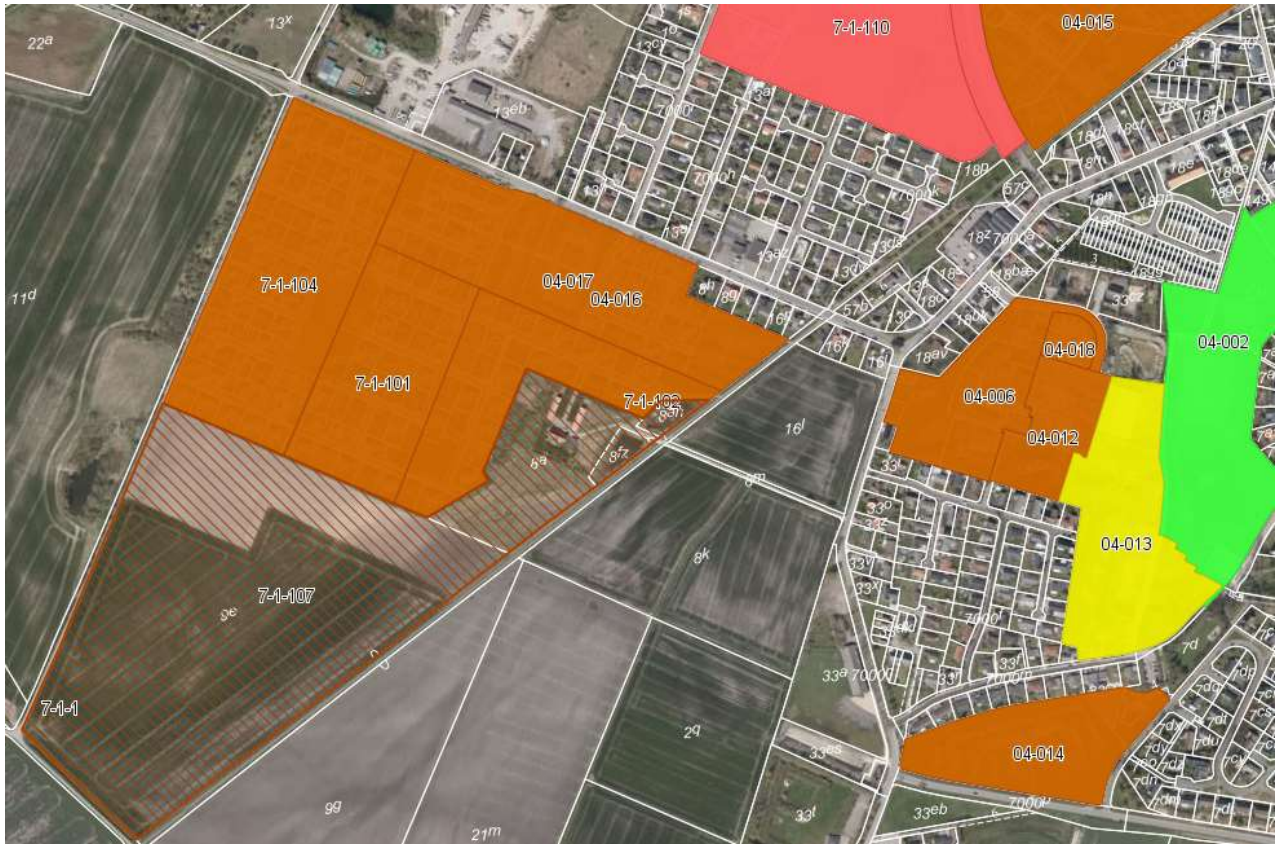
Recommendations to improve quality of cadastral map

4. Making af new map based on aerial images or orthophotos

”Fit-for-purpose”-concept (Not recommended)

Recommendations to improve quality of cadastral map

5. Cadastral map and registration of plans (on standby)



Improving the cadastral map

- New digitisation – using surveying data - very expensive/ data
- Crowd sourcing?
  - Pros and cons
  - Reliability
- Automated processes
  - Usucaption makes it difficult to use information from ortofotos
- Updating the cadastral map based on registration when selling property?

- Risk of becoming obsolete

Improving the absolute accuracy of the cadastral map

- What needs to be improved
  - A higher absolute accuracy is necessary
- What accuracy is acceptable for users of the cadastral maps?
    - Different accuracies in different areas (urban/rural)
      - New agriculture machines use GPS
- Planning and building authorities
- 3d/2+1d – Some issues occur when map is in 2d
  - Roads passing over or under parcels or buildings
  - Boundary crossing parking basements

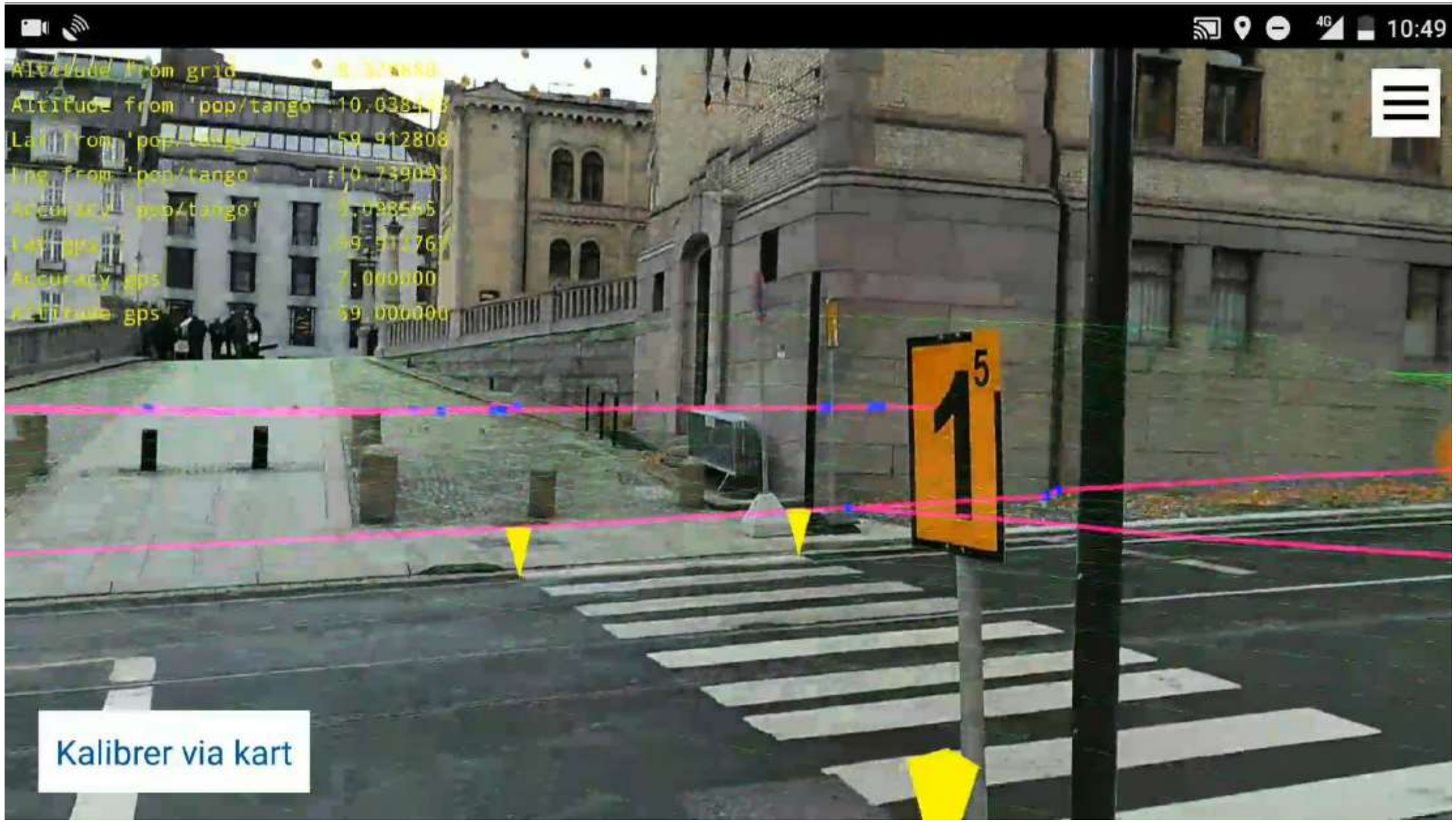
Denmark: Information material on the cadastral map

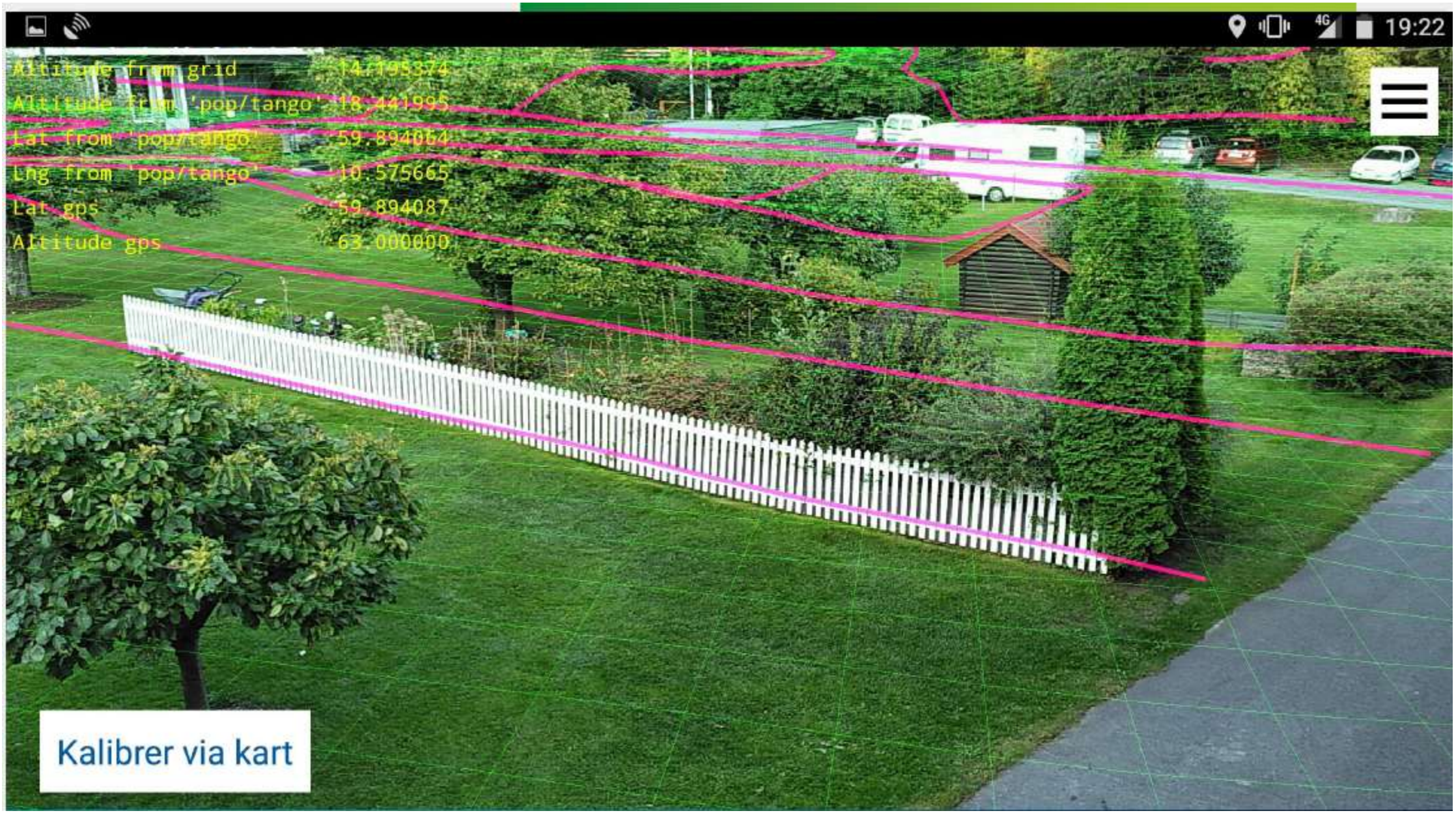
- Improving the information material for both private and professional users
- Quality map showing information about the digitisation method boundaries
  - Denmark: Showing point class for how the boundary marks are digitised
    - Does not show how well the boundary is represented in the map
- Project on improving the registered coast line
- GIS-analysis to find areas with more buildings crossing boundaries in the cadastral map

New technology

New iniciatives

- New technology permits new use of cadastral map and data
- Kartverket has developed an AR solution that shows cadastral map on mobile phones
  - Accuracy of GPS in mobile phones
  - Absolute accuracy of the cadastral map


10:49
Altitude from grid
Altitude from 'pop/tango'
Lat from 'pop/tango'
59.912808
Lng from 'pop/tango'
Accuracy 'pop/tango'
Lat gps
Accuracy gps
7.000000
Altitude gps
59.000000
Kalibrer via kart


19:22
Altitude from grid 14.1953374
Altitude from 'pop/tango' 18.441995
Lat from 'pop/tango' 59.894064
Lng from 'pop/tango' 10.575665
Lat gps 59.894087
Altitude gps 63.000000
Kalibrer via kart

Legislation

- In Sweden and Iceland it has been discussed to have legal coordinate cadastres
  - Accuracy?
  - Land movement
- Digitisation-ready legislation
  - Legally valid maps
  - Usucaption

Groups

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Irma Lähetkangas

Each group answer its question and selects one extra question.

Groups give presentation on their discussions and key conclutions.

Six questions for discussion?

1. How acurate should the Cadaster map be?

2. How will Cadastral maps be used in 20 years? What is needed?

3. Should Cadastral maps be 100% GPS in 3D? How will be get there?

4. Should the nordic countries work together on nordic quality standards and/or best practices?

5. Should the nordic countries work together on IT projects (e.g. Augmented reality for Cadastral maps)?

6. What threats and opertunities are for our institutions with regards to the quality of our Cadastral maps?