environmental mapping

Ferjan Ormeling

Glossary of terms

- **Environment**: geographical circumstances that influence (preserve, ameliorate, deteriorate) the human ecological system
- **Ecology**: study of organisms, their environment and the interactions between the two
- **Ecosystem**: system of organisms and their environment, consisting of both biotic and abiotic factors
- **Environmental mapping**: collection, processing and presenting data on the environment
- **Environmental maps**: static/dynamic
  - Element maps/composite maps/synthesis maps

Glossary of terms, cont.

-**Environmental maps**: maps visualising the distribution of and the spatial relationships between the various aspects (objects, phenomena) of the environment

-Environmental maps (Leszczycki):

-maps describing the environment of an area

-maps of the degree of transformation of the environment

-maps of the degradation and pollution of the environment

-maps of the natural cataclysms of the environment

Glossary of terms, cont.

- **Environmental GIS**: GIS filled with environmental datasets
- **Environmental atlas**: conscious combination of environmental datasets made compatible and comparable to each other based on specific narrative/objective

- **Map functions**: subdivision of maps based on their objectives
- **Map types**: subdivision of maps based on their construction principles
- **Map categories**: subdivision of maps based on their contents

Glossary of terms, cont

Map functions:-descriptive/management
-evaluative
-monitoring/forecasting
-decision making
(forecast+evaluation)
-analysis/communication
-cognition/insight
-education
-propaganda

always in combination with visualisation

Map categories (contents)

-geology
-landscape
-water resources
-climate
-vegetation
-fauna
-cultural history
-pollution
-types of conservation measures

Aims of environmental mapping:

-visualise conflict situations,
-provide insight in possible impact of man-made developments,
-explain environmental situations
-compute surface areas, border lengths or ratio's
-communicate views
-monitor processes
-serve as arguments in decision support systems
-serve as analysis tool

Start of environmental mapping in the 1960s: Pollution maps and inventory maps

Pollution maps
- -aquatic
- -air
- -soil

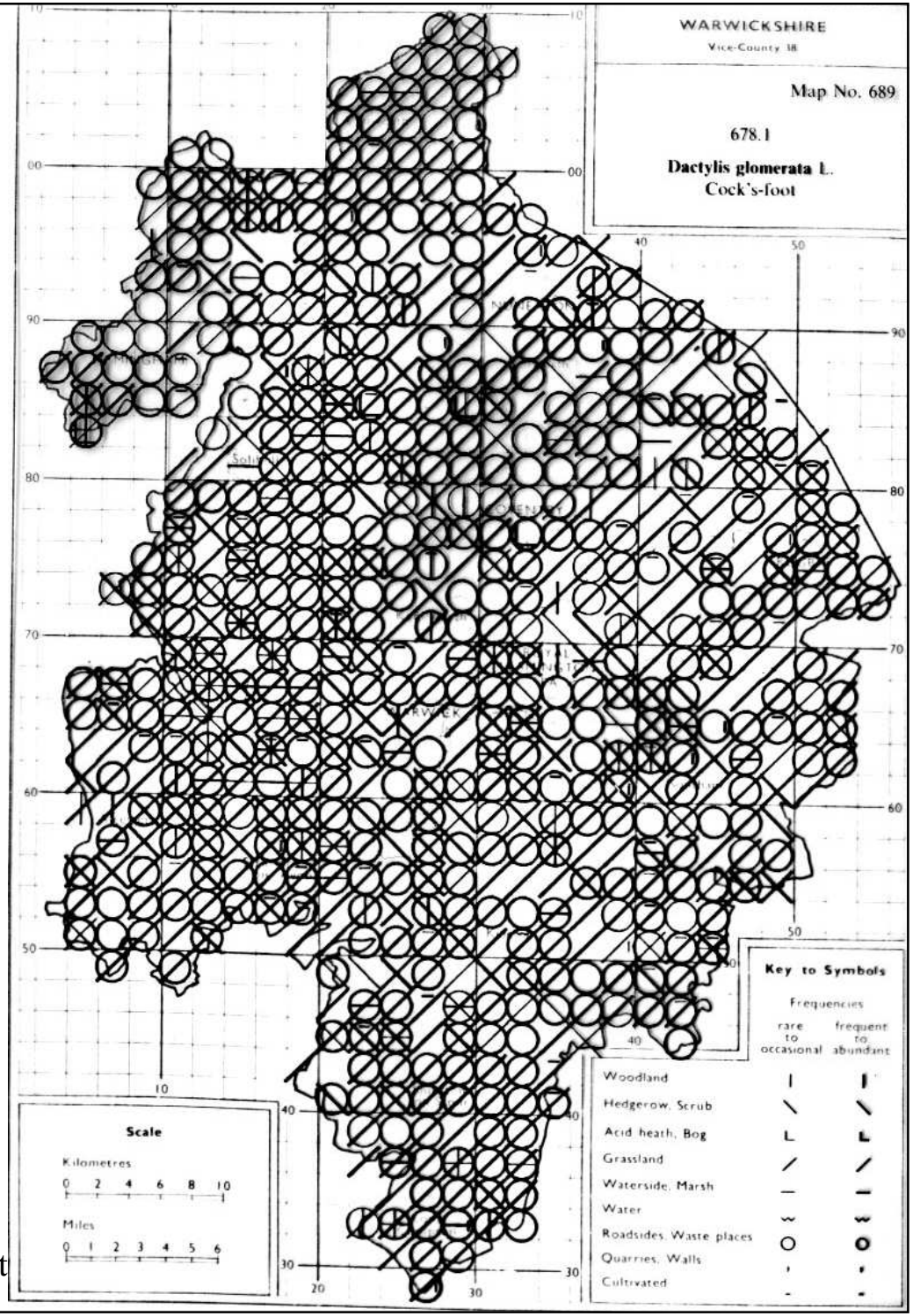
-Analytical environment maps of small areas

-Single element mapping non-compatibel

Single elements maps

- Distribution of Dactylis glomerata over Warrickshire according to habitat:

  woodland, hedgerow, scrub, bog, roadside, waste places, waterside (1960)

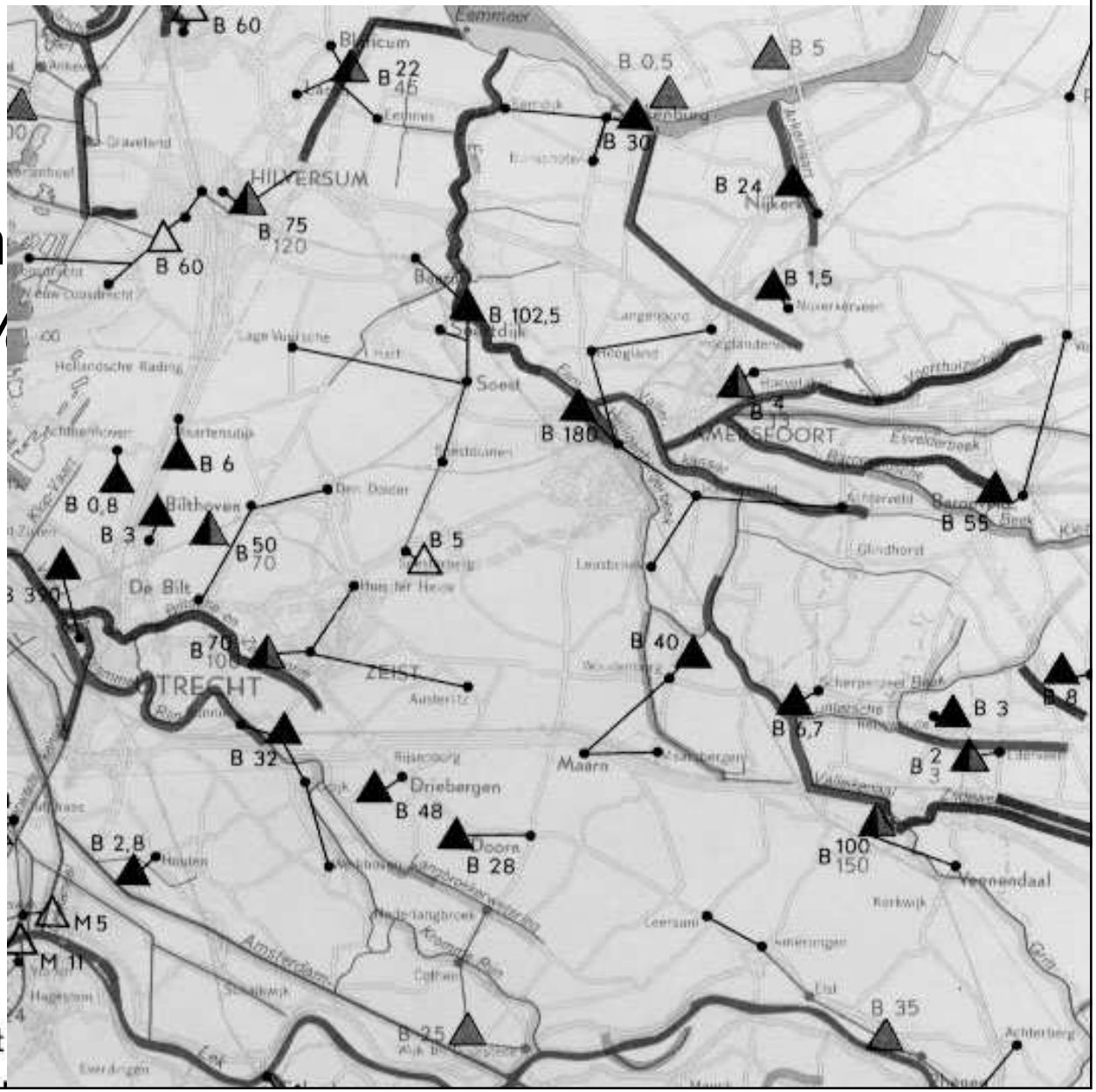


Pollution maps

Water pollution map 1973, based on

O_2 saturation, NH_3 % and biochemical O_2 use

Black triangle: sewage treatment plant

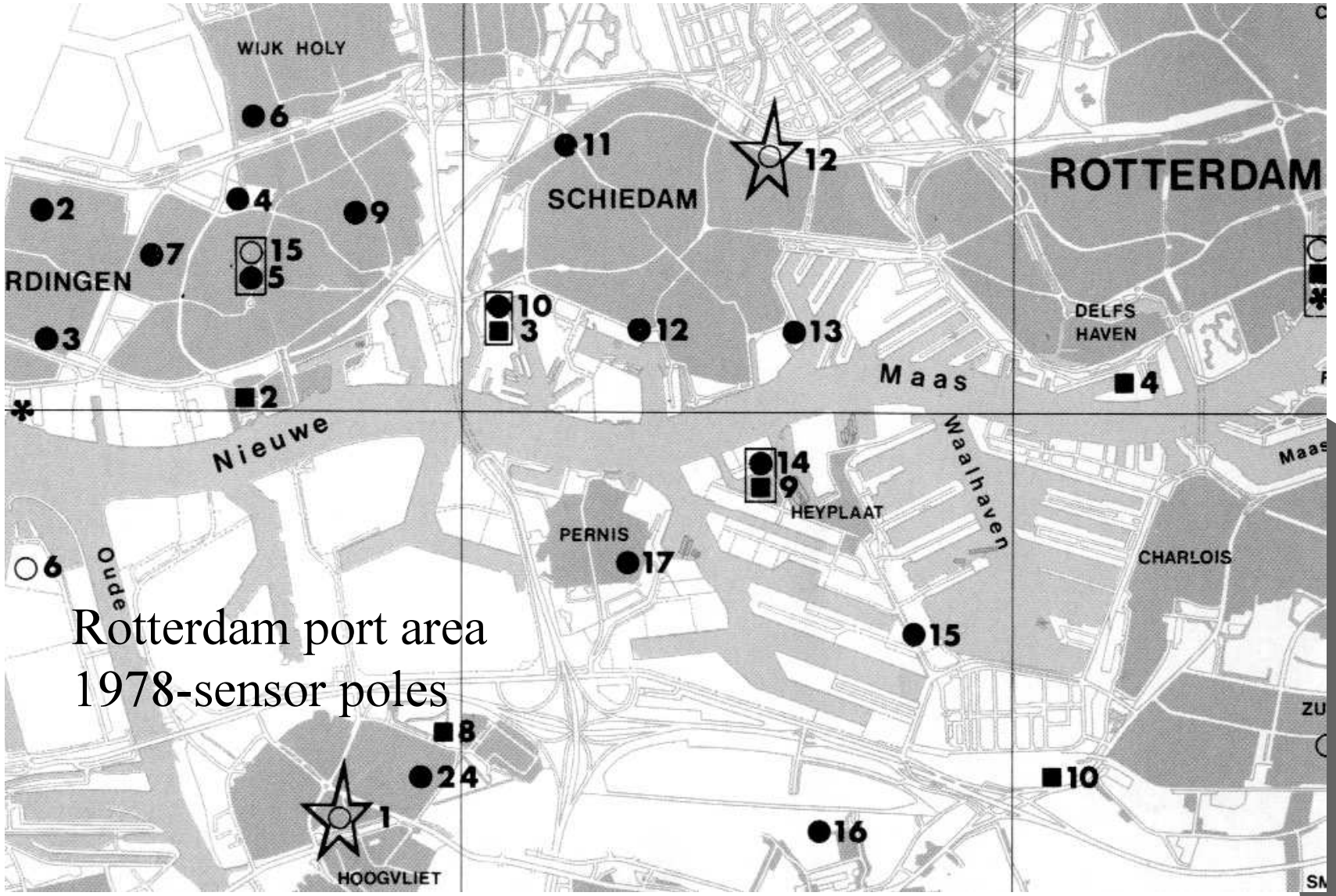


WATERKWALITEIT

goed ——————→ slecht

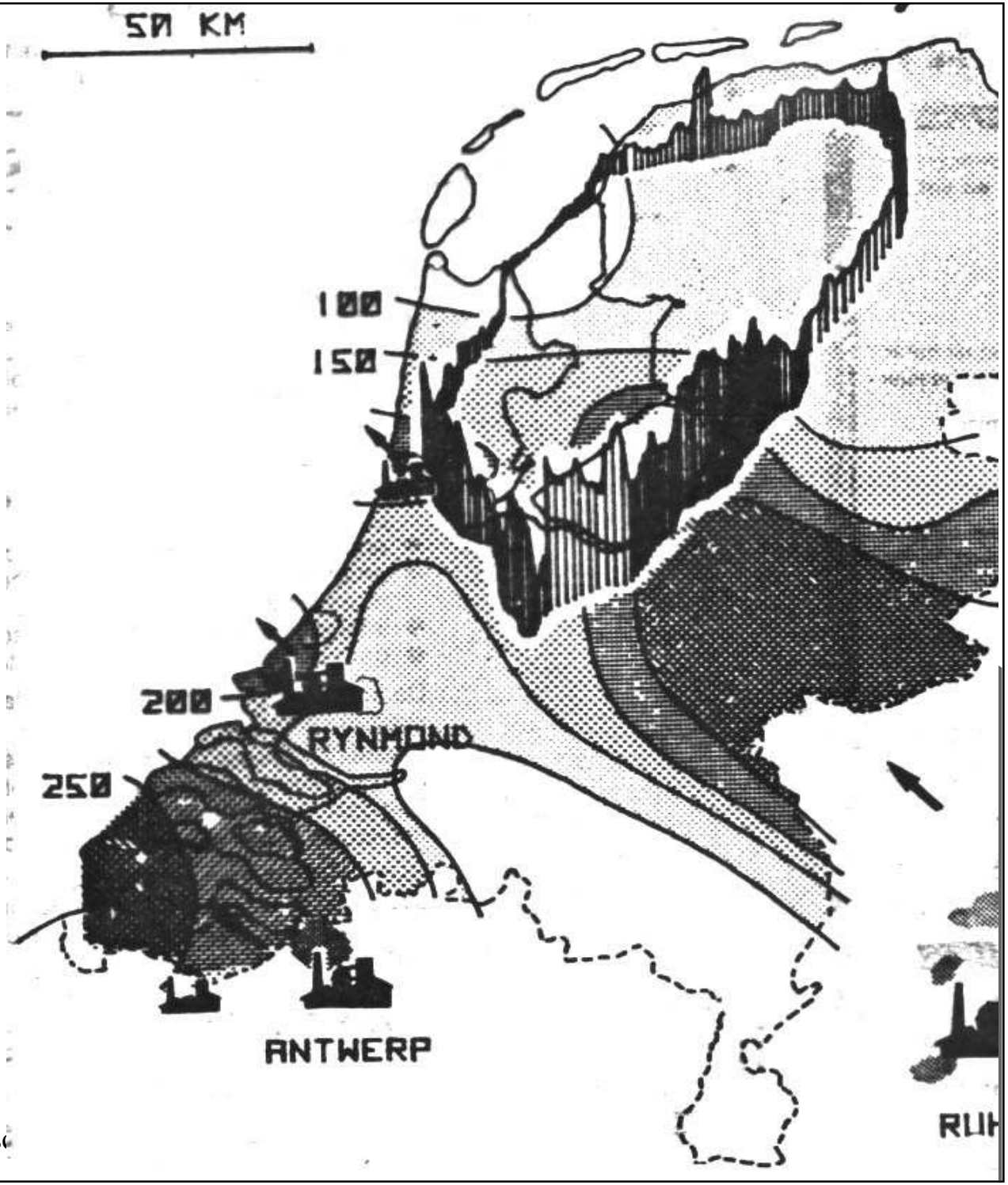
De weergave van de waterkwaliteit

Sensor networks

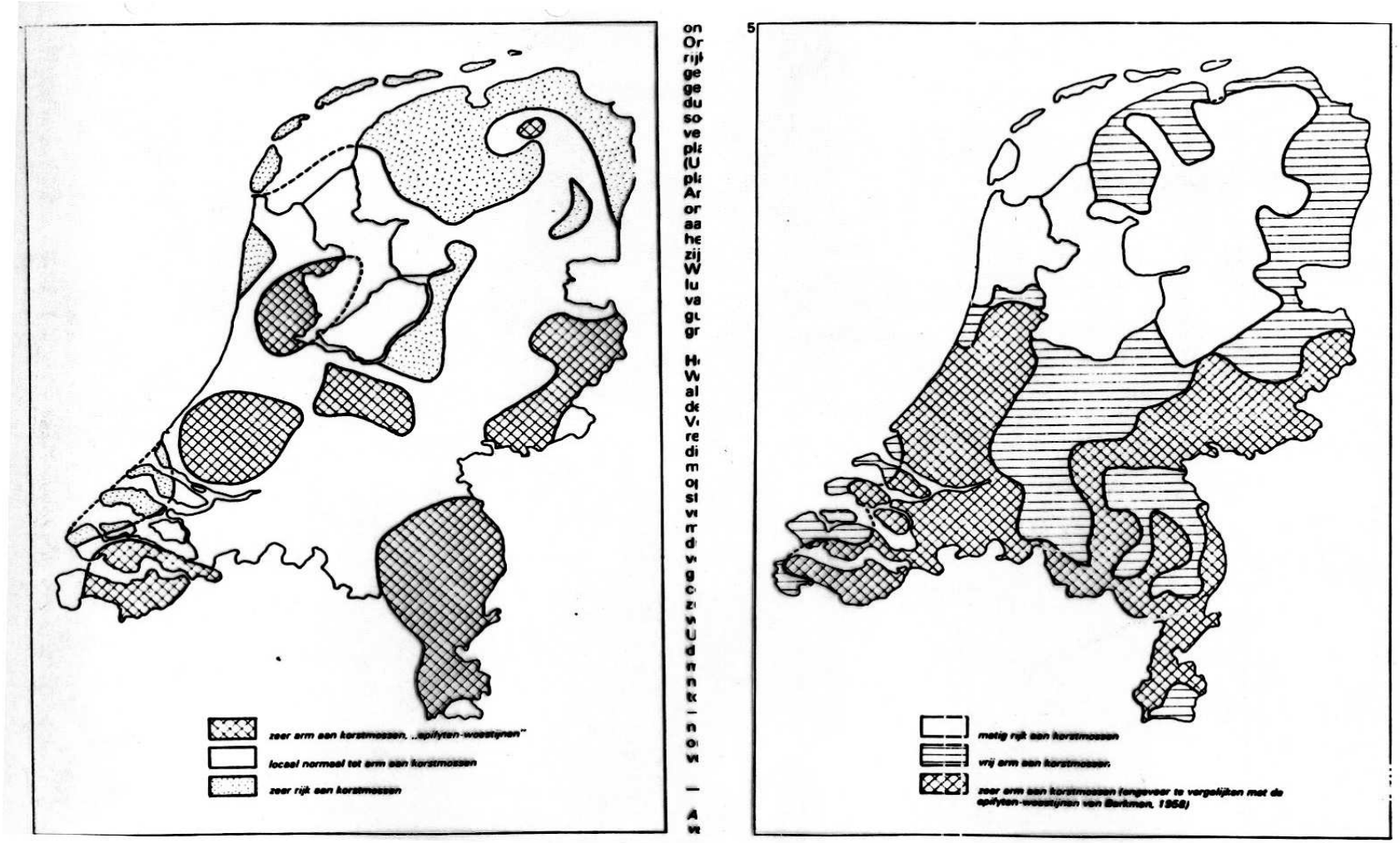


Sensor maps

- SO2 concentration on the basis of national sensor network (isoline map) and incidental sensor car route (3D)
- February 18, 1976, 15.00 GMT



Mapping change/monitoring



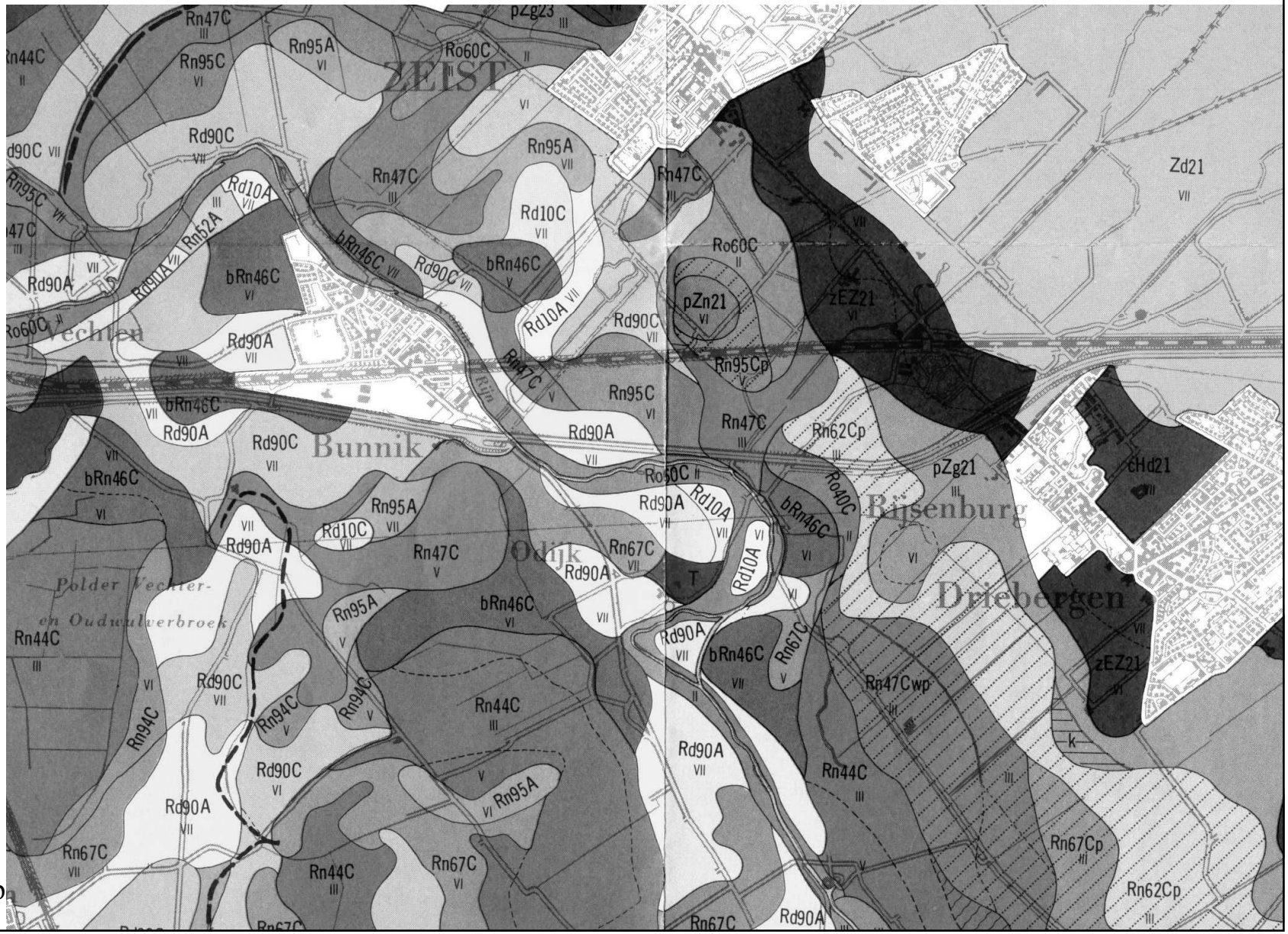
Lichen deserts 1950-74 (Flechte-Wüste 1950-1974)

Integration of environmental aspects (1970s) and evaluation

Example:
Kromme Rijn area, Southeast Utrecht prov.
Demonstration how, uniformly, data should be collected and processed for ecological evaluation, on the basis of rarity and diversity of soil and vegetation types

Soil map 1:50 000

Soil units and depth of water table



cartograp

Λ

POTENTIAL VALUES

	Soil types per km²	Simplified evaluation	Influence of gradient zone: not	Influence of gradient zone: yes
Soil type diversity	1 2 3 4	1	1	2
	5 6	2	2	3
	7 8 9 10	3	3	3

Vegetation map 1:50 000

Greens:
Grass
Red and Yellows:
Forests
Pinks:
Heaths
Browns
Arable land,tree nurseries +waste-lands

cartography

ACTUAL VEGETATION VALUES

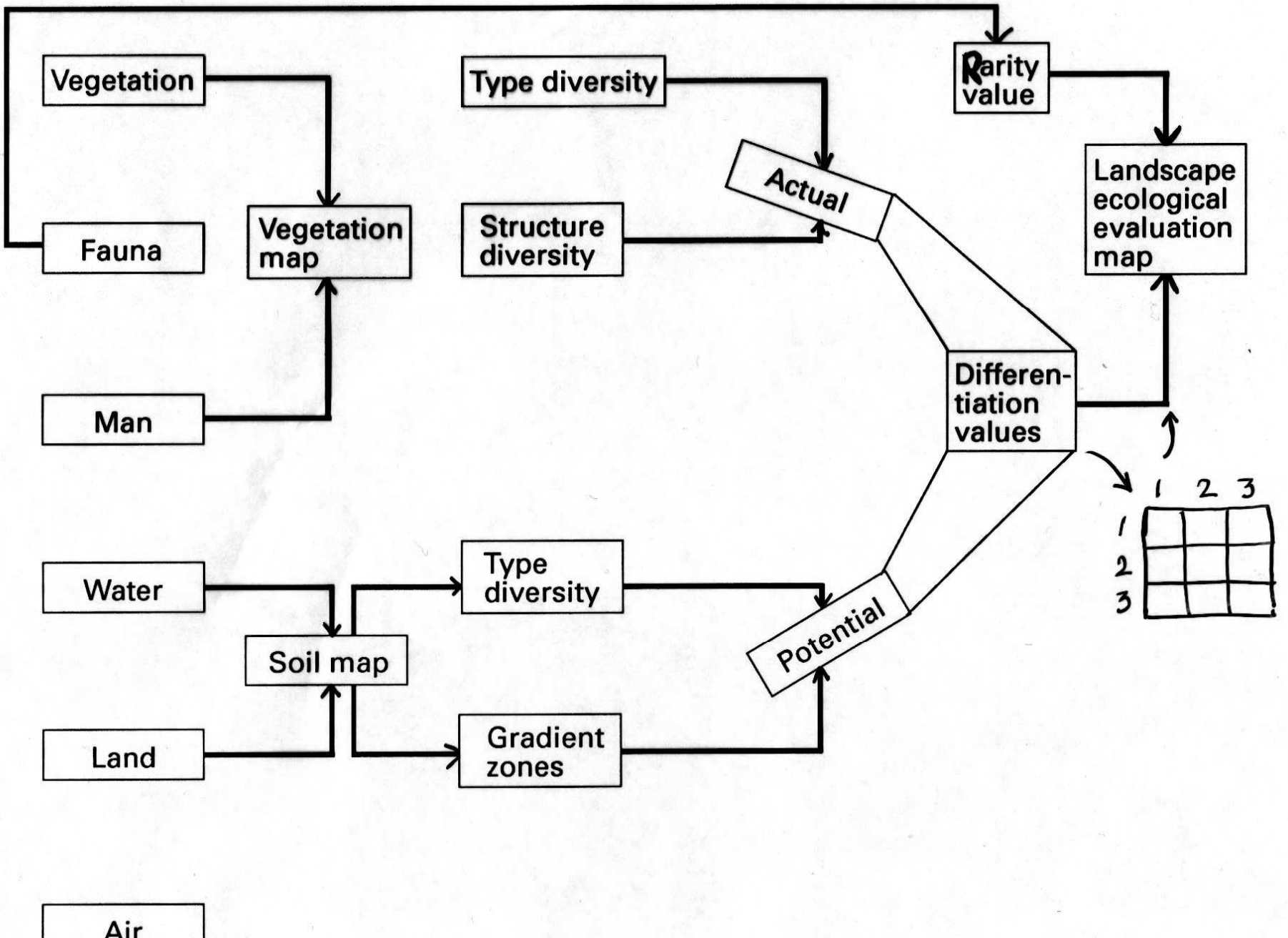
Vegetation type diversity	Vegetation types per km²	Simplified	Structure diversity II	III	IV	V
	3 4	1	3	4	5	6
	5 6	2	4	5	6	7
	7 8 9	3	5	6	7	8
	10 11 12 13 14	4	6	7	8	9

Final actual evaluation values

3,4 → 1

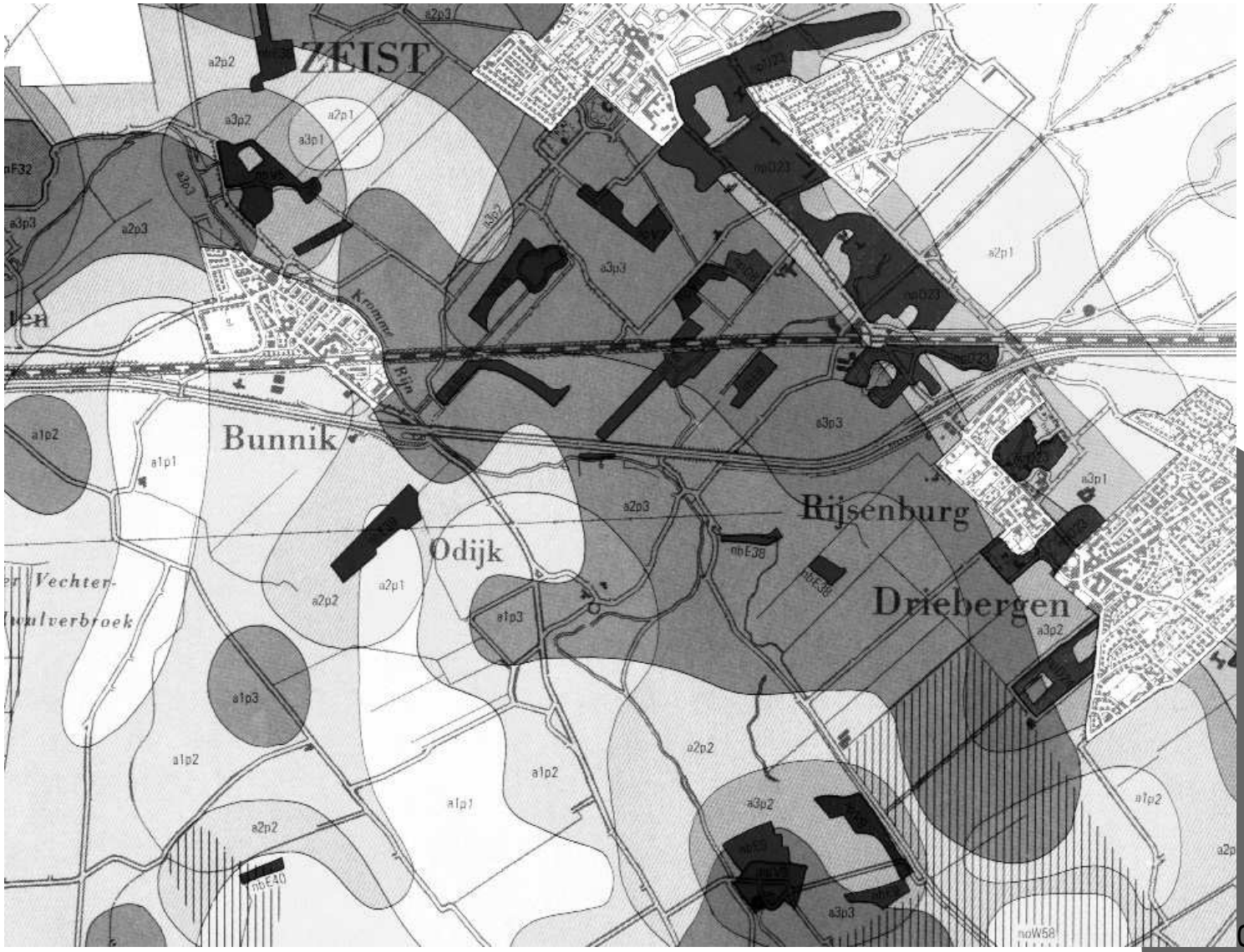
5,6,7 → 2

8,9 → 3

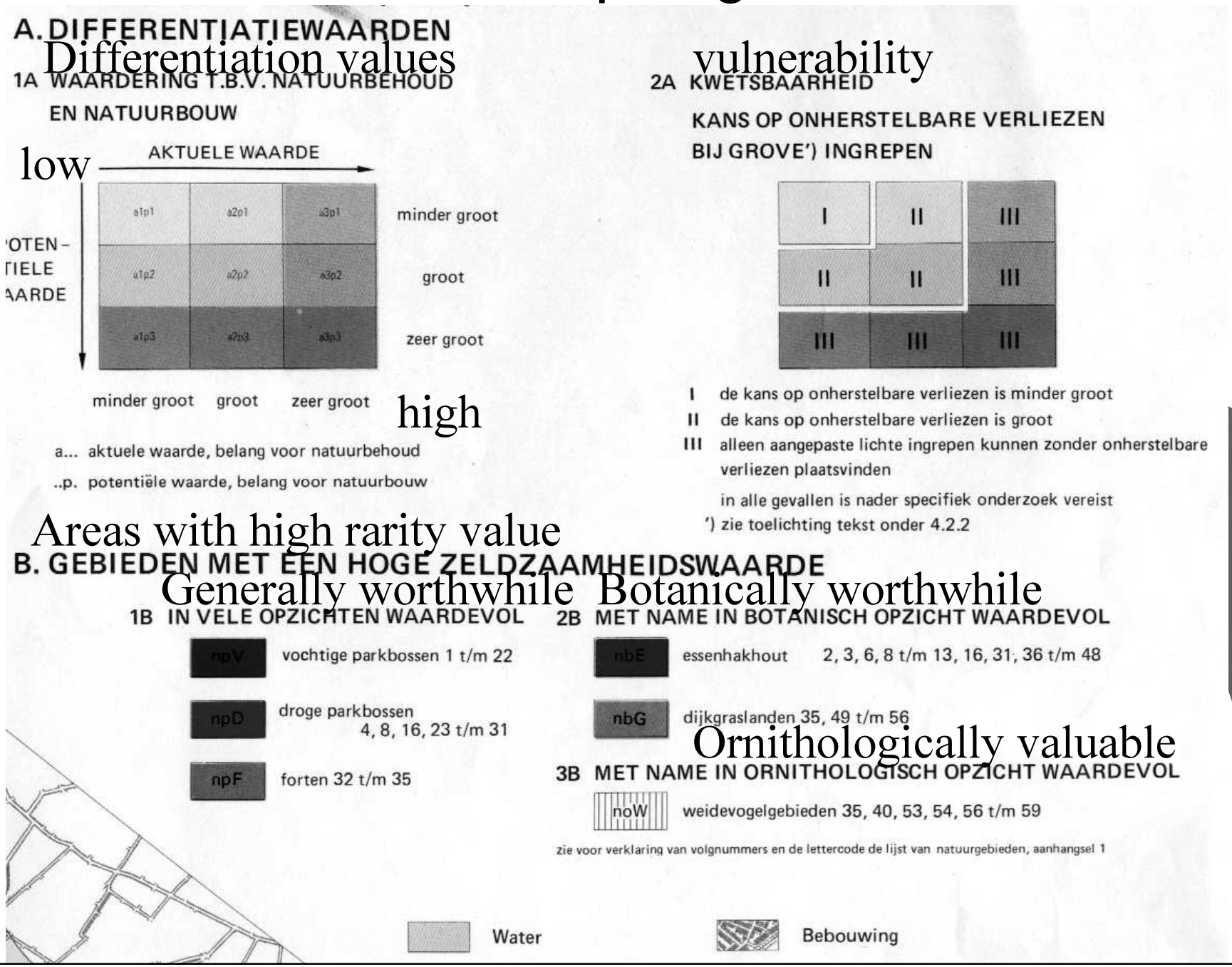

Vegetation
Fauna
Man
Vegetation map
Type diversity
Structure diversity
Actual
Rarity value
Landscape ecological evaluation map
Differen-tiation values
1 2 3
1
2
3
Water
Soil map
Land
Type diversity
Gradient zones
Potential
Air

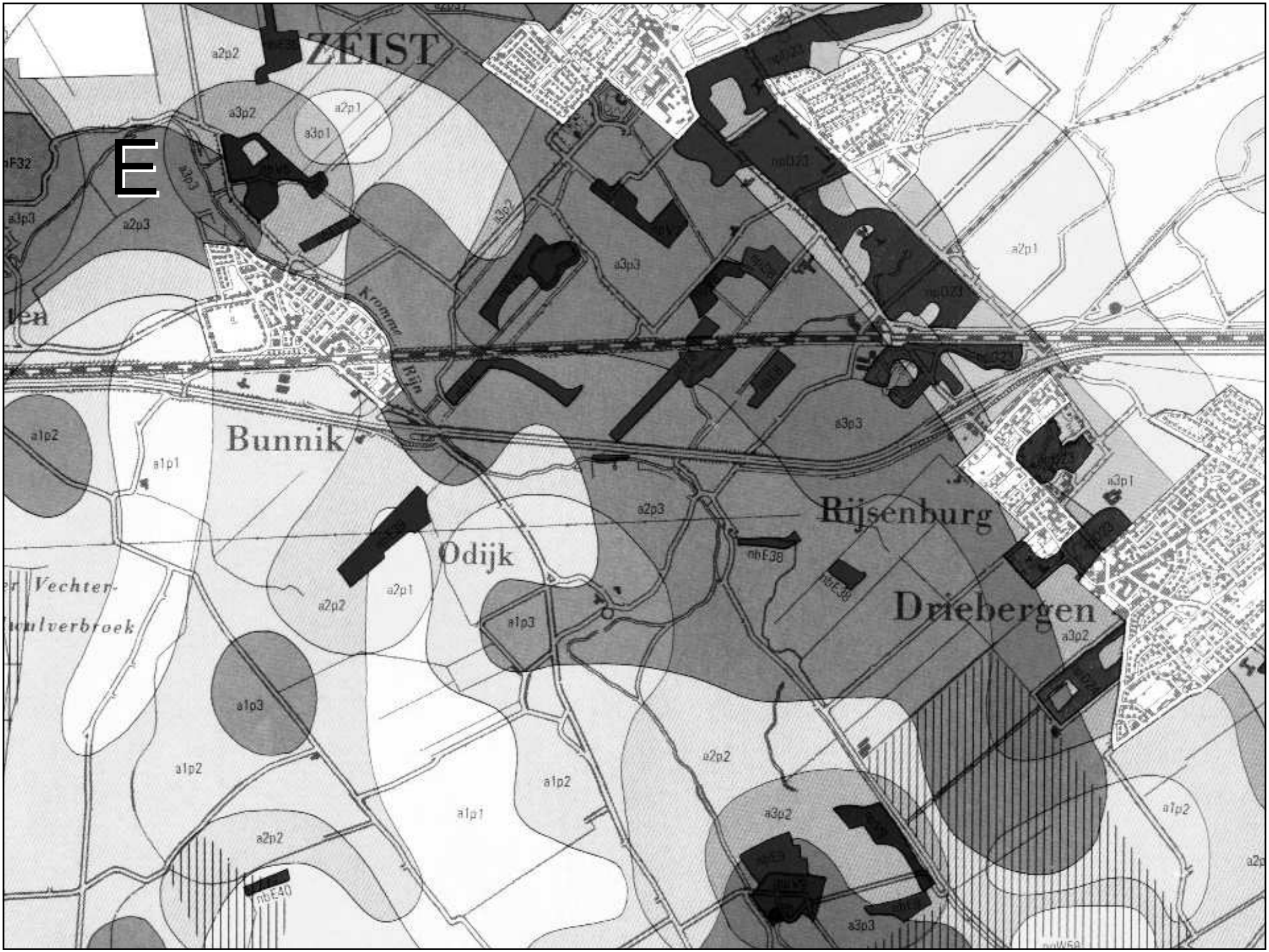
Evaluation map

For every grid cell, diversity values and rarity values are combined



Evaluation map: legend




ZEIST
E
Bunnik
Odijk
Rijsenburg
Driebergen
Vechter-
a2p2
a3p2
a2p1
a3p1
a3p3
a2p3
a1p2
a1p1
a1p3
nbE38
nbE39
nbE40

Evaluation criteria

-rarity
-type diversity
-structure diversity
-maturity
-irreplaceability
-vulnerability
-susceptibility

Criticism on environmental mapping in the 60s and 70s

- encroachment on non-highly evaluated areas
- use by the un-initiated

Result, end of 70s:

-Environmental mapping went underground
-systematic and continuous collection of all environmental data, and
-storage in environmental database, only to be used by experts.
Dangers?

Summary

- Evolution 1960-1980:
  -small to large areas
  -incidental to systematic
  -element maps to integrated maps
  -inflation in terminology
  -increased use of environmental maps
  -parochial effects

Topics of Discussion

- **Construction of environmental information systems**
  -at local level
  -at provincial level
  -at state level
- **Compatibility**
  -scale
  -geographical
  -topical
- **Clarity of overall objectives**

Environmental mapping projects on local, regional and national bases

- Aalten Municipality project (previously)
- National forestry inventory (previously)
- National landscape ecological mapping LKN
- National project “the scale of the landscape”
- Waterland
- Provincial emergency mapping projects

Local initiatives

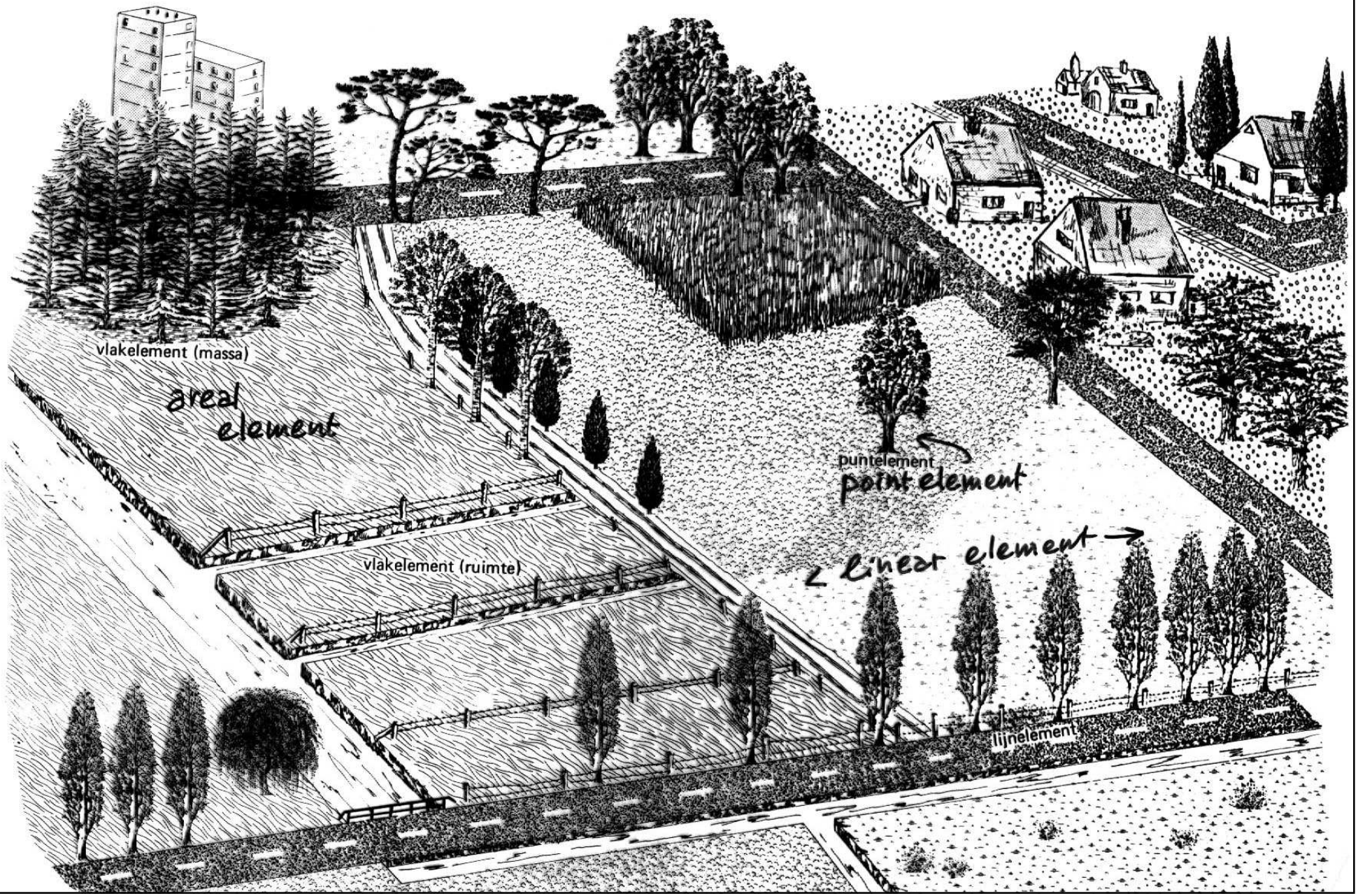
-Detailed, ad hoc

-Environmental Impact Reports/Assessment Studies

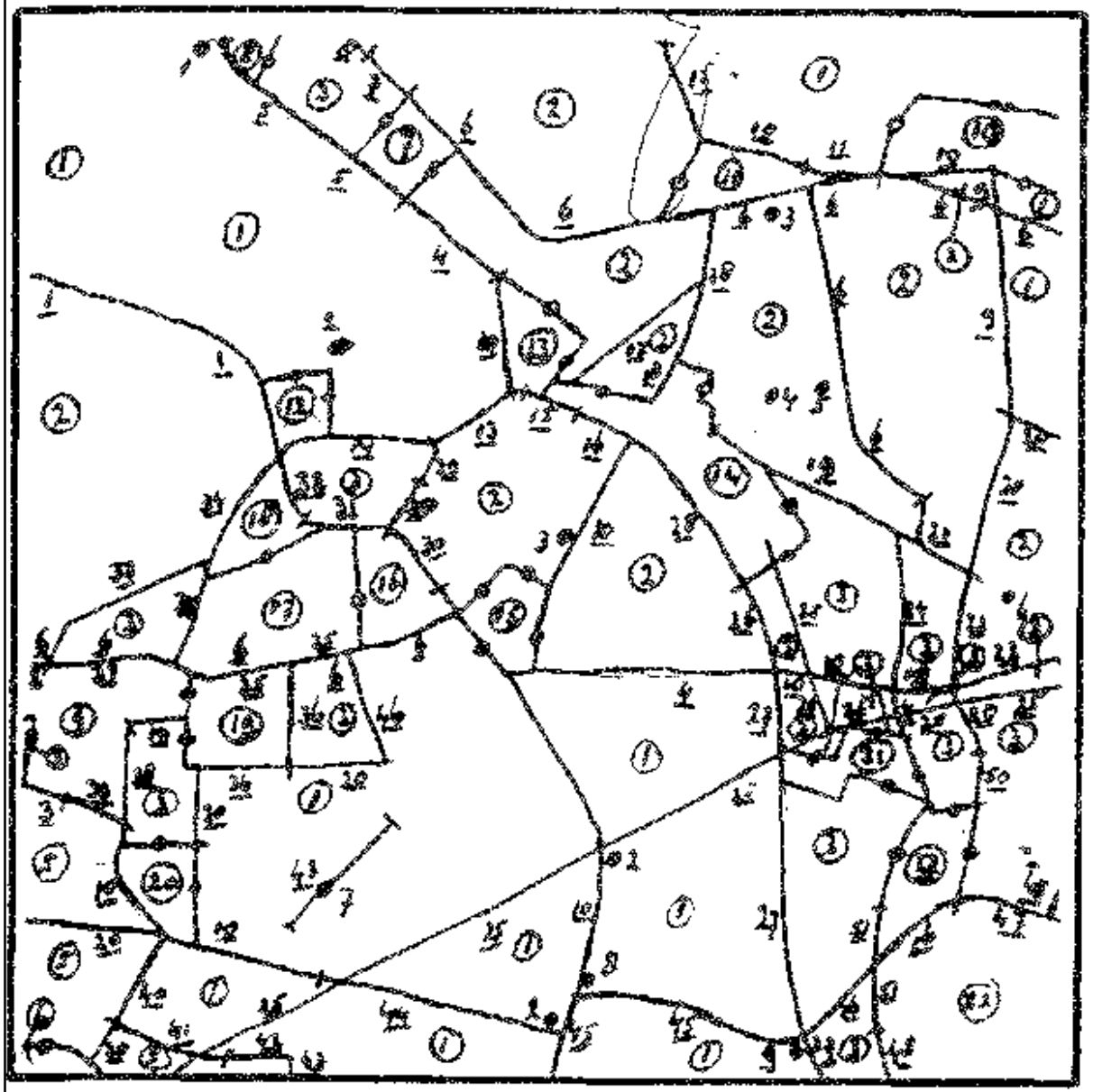
Example Aalten municipality:

- Inventory of all point, line and area elements of the vegetation
- Location, species, age, status (present/future), quality (healthy/diseased)
- Survey in 1x1 km squares

Point, line and area elements



Survey of landscape elements



OPNAME
LANDSCHAPSELEMENTEN

VELDKAART NR. 28

IDENTIFICATIE VAN SQ.KM.:

ZW HOEK 440 - 236

TOP. KAARTBLAD NR. 41 W

OPNAME DOOR: A. Buitenhuis

DATUM: 5 juli 1973

Register mit Inventar der Punkt-, Linien- und Areal-elementen

	PUNTELEMNTN					LIJNELEMENTEN						VLAKELEMENTEN							LIJNELEMENTEN						VLAKELEMENTEN						
	SOORT					SOORT						SOORT							SOORT						SOORT						
	BG	BB	O	H	BZ	BG	BB	O	H	D	BZ	BG	BB	O	STR	H	D	BZ	BG	BB	O	H	D	BZ	BG	BB	O	STR	H	D	BZ
1	40			9		40		41	12	3				32	33				37	40		41	12	12								
2	18			5		53		41	12	3	3			48	33				38	18		36	3	3								
3			24			18		36	9	5	3			48	9				39	14		36	3	9								
4	40			5				36			5	7	2	6		5			40	32	2		9	13								
5	20			5		32		36	9					32	9				41	20			2	11								
6	7			8				16				32	13	48		6			42	18			3	9								
7	21			8				16			5	13	4	6		5			43			49	2								
8	18			3		32		16	5	6		7	2	6		5			44			9									
9	10			9		10		36	3	9		32	2	6		9			45			41									
10								36				7	5	6		5			46	44			9	13								
11						13		36	5	9		32	8	6		9			47			41			5							
12						40		41	9	8		10	4	6		3			48			49	2									
13						40		41	6	2	3	16	2	6		5			49		4		5	7								
14						40		41	6	8		32	8	6		5			50	32			3	3								
15						17		41	3	4		10	4	6		3			51	32			2	13								
16								41				32	2	6		9			52													
17								35	8					8	9				53													
18						40		41	6	4		18	2	9		5			54													
19						32			6	6		18	2	9		3																
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21						63		16	3	10		39	10	6		9																
22						15		16	9	3				8	45																	
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28						16		41	5	9																						
29						18			9	3																						
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32						10			3	12																						
33						53			6	12																						
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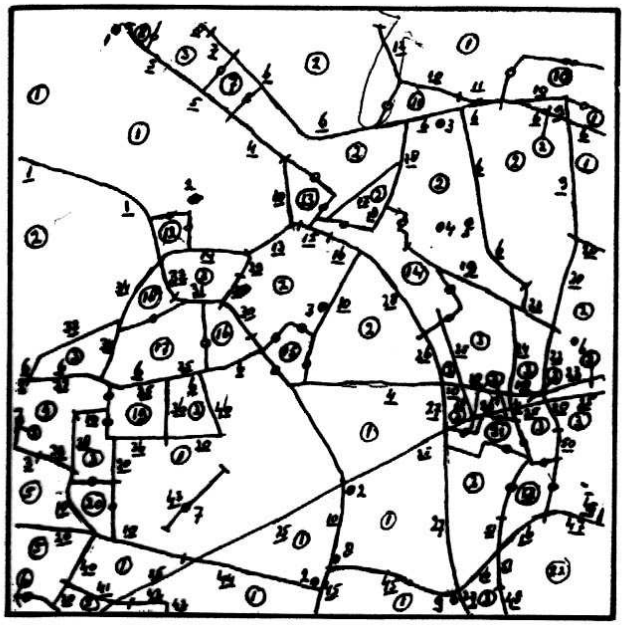
35						40		36	6	3	3																					
36						63			2	11																						



OPNAME LANDSCHAPSELEMENTEN

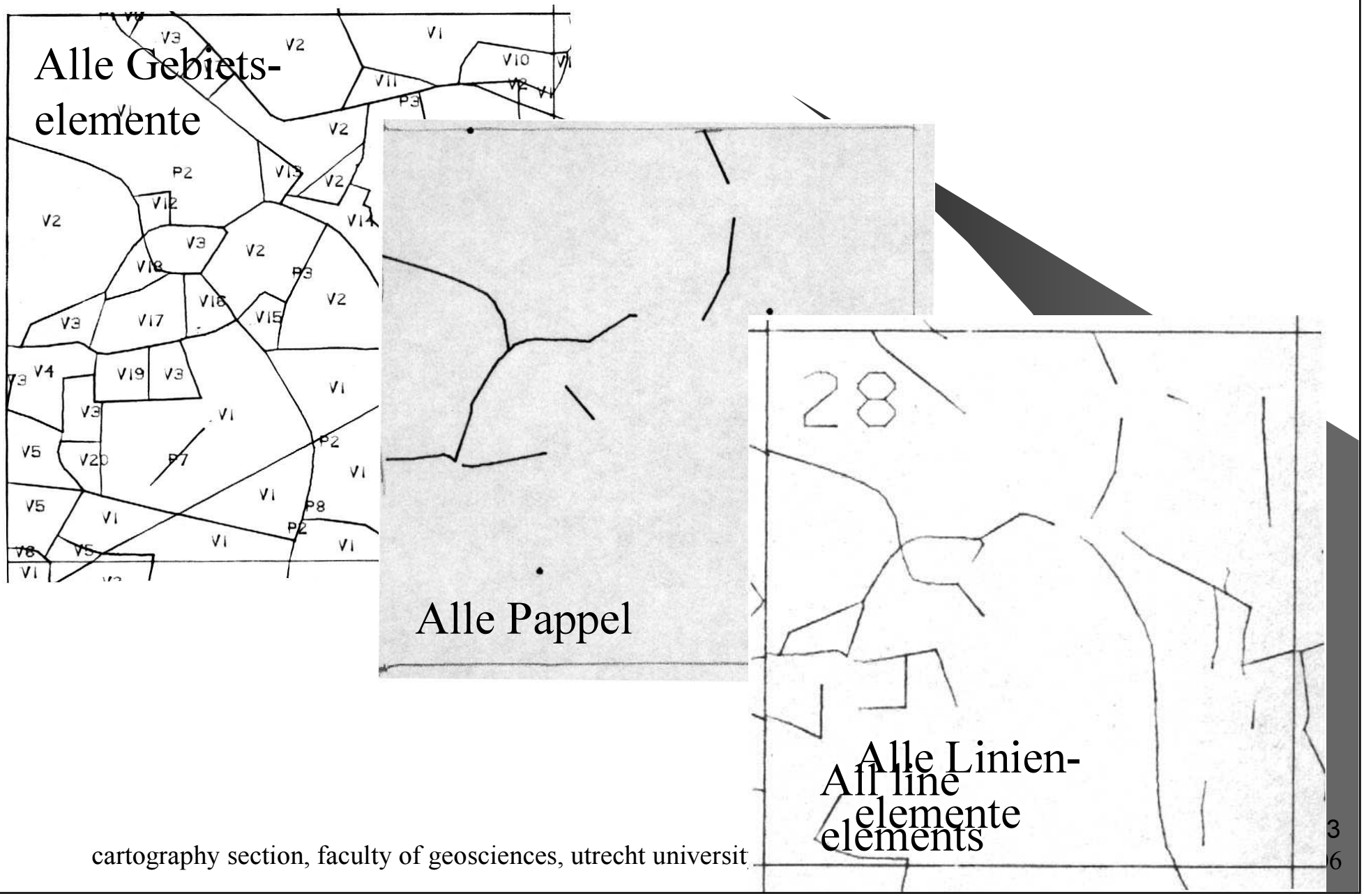
VELDKAART NR. 28

IDENTIFICATIE VAN SQ.KM.:
ZW HOEK 440-236

TOP. KAARTBLAD NR. 41 W

OPNAME DOOR: A. Bentenaar
DATUM: 5 juli 1977

Selektion von Elementen oder Kombinationen



summary

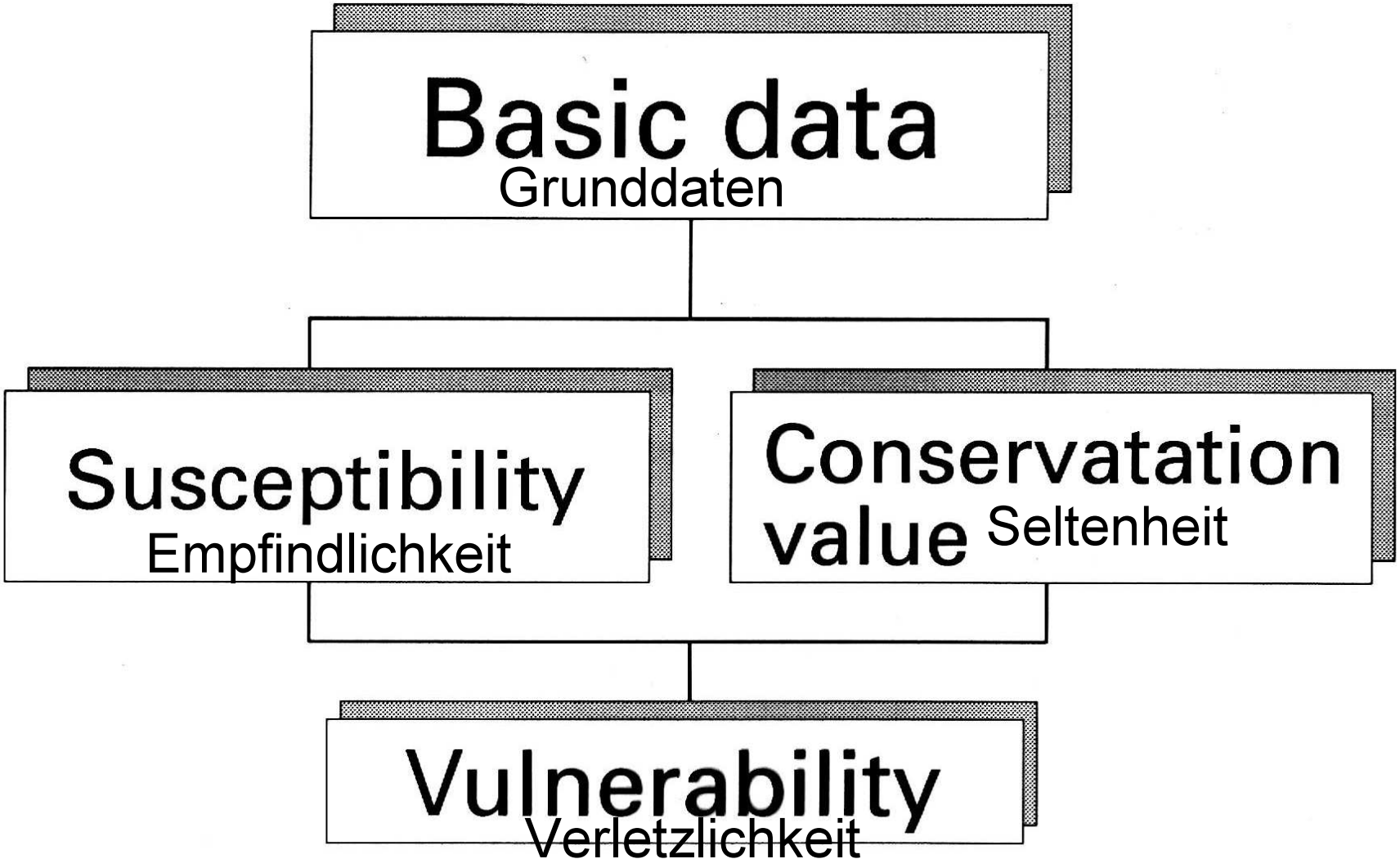
- Inventories are most time consuming: make use of existing inventories that can be modified/adapted like topographic maps
- Make sure graphical qualities are adequate for the applications envisaged.
- Make people aware of the data quality: what inaccuracies are caused by the selected processing procedures? Indicate the types of use the maps are suitable for.
- Data needs in a European framework: compatibility and comparability for agricultural subsidies etc > Corine

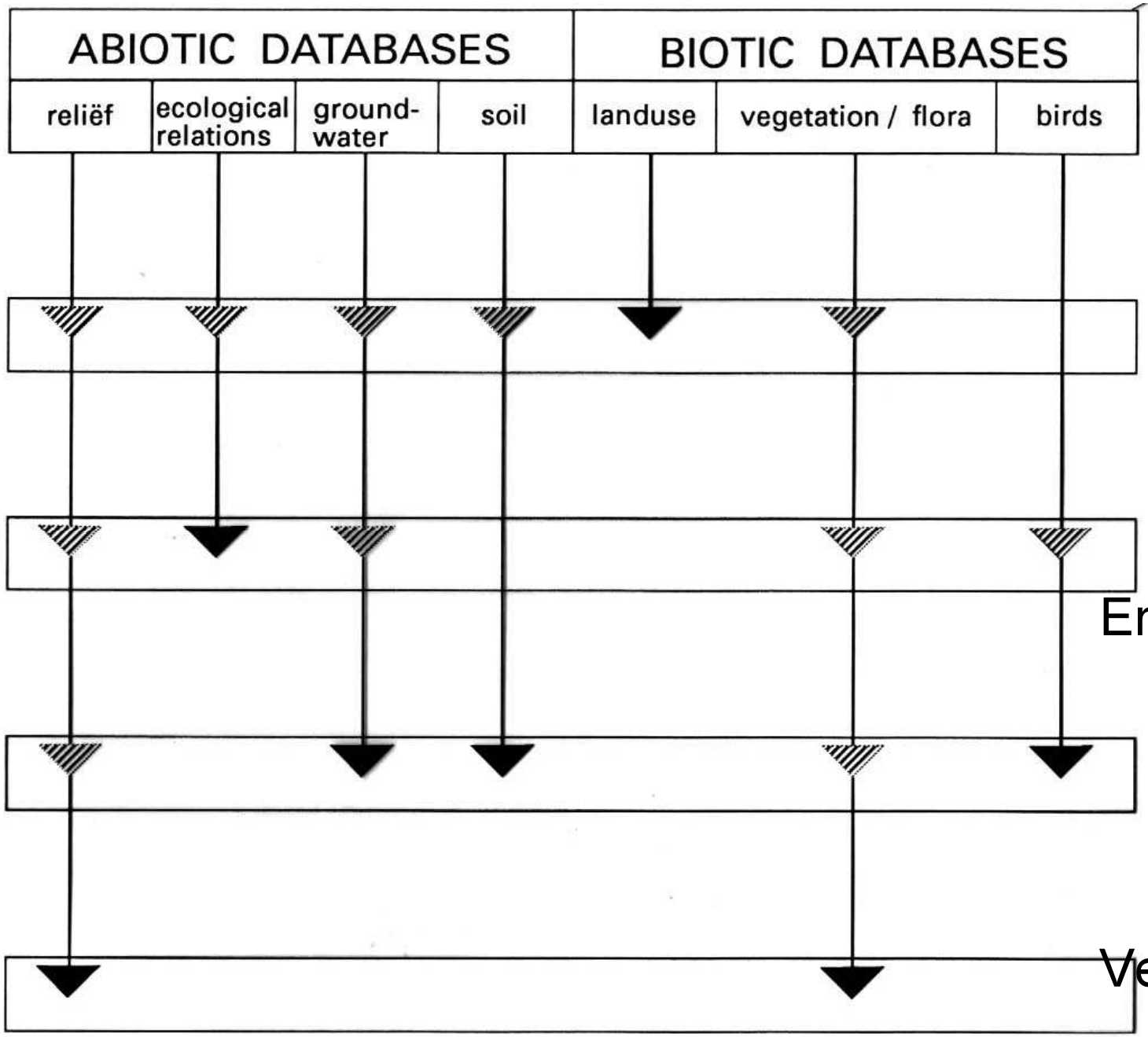
Next Steps

- Development of models (cf North Sea)
- How to collect the environmental data and geo-reference them properly
- How to store them in a GIS, taking account of the envisaged uses and resultant query types
- How to visualise them
- How to use them

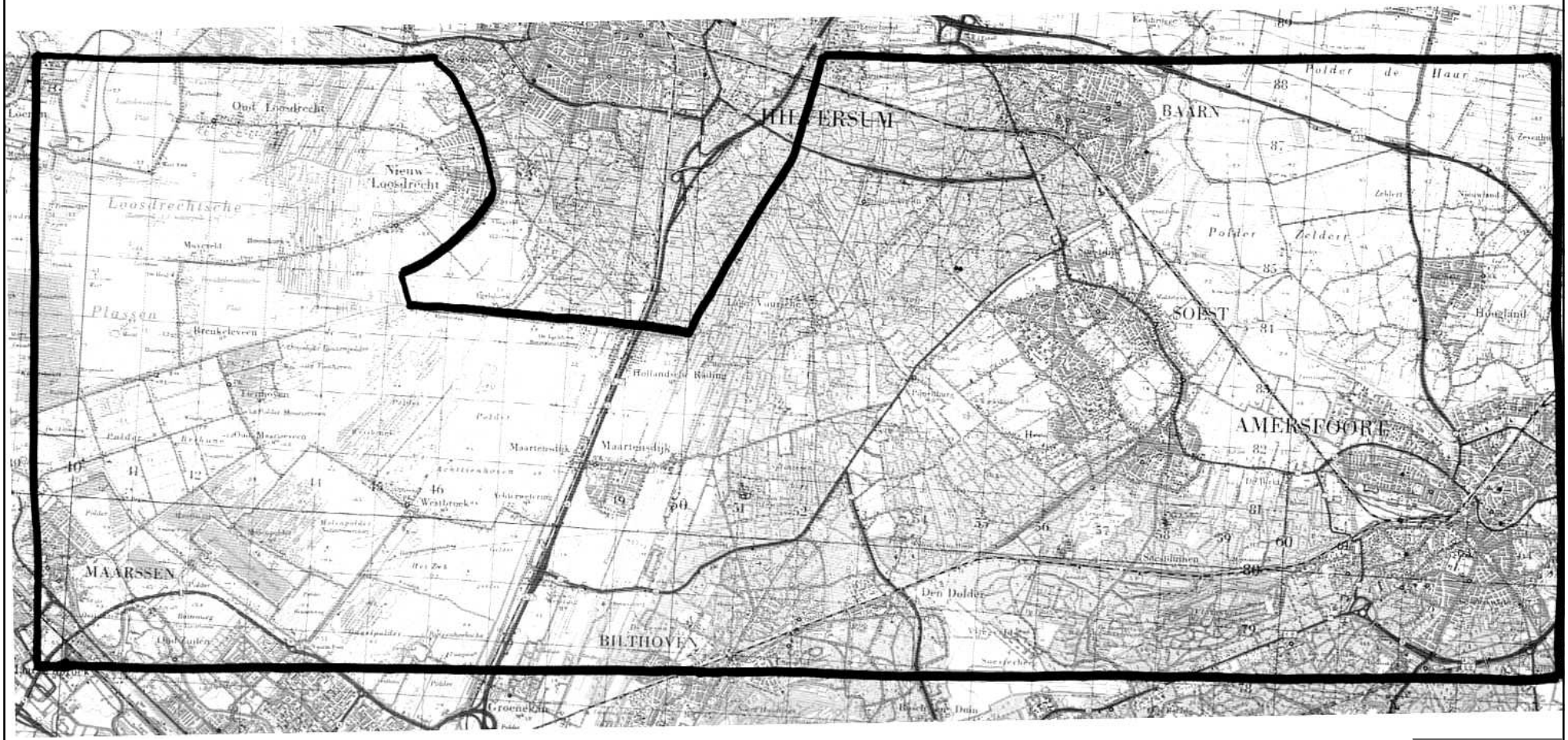
Landscape ecological mapping in the Netherlands

If phenomena are both susceptible and rare (and therefore have a high conservation value), they are vulnerable and in need of protection




ABIOTIC DATABASES
BIOTIC DATABASES
reliëf
ecological relations
ground-water
soil
landuse
vegetation / flora
birds
CULTURAL ARTEFACTS
V
Description of BASIC DATA
Grunddaten
Susceptibility
Empfindlichkeit
+
Conservation value
Seltenheit
Verletzlichkeit
Vulnerability

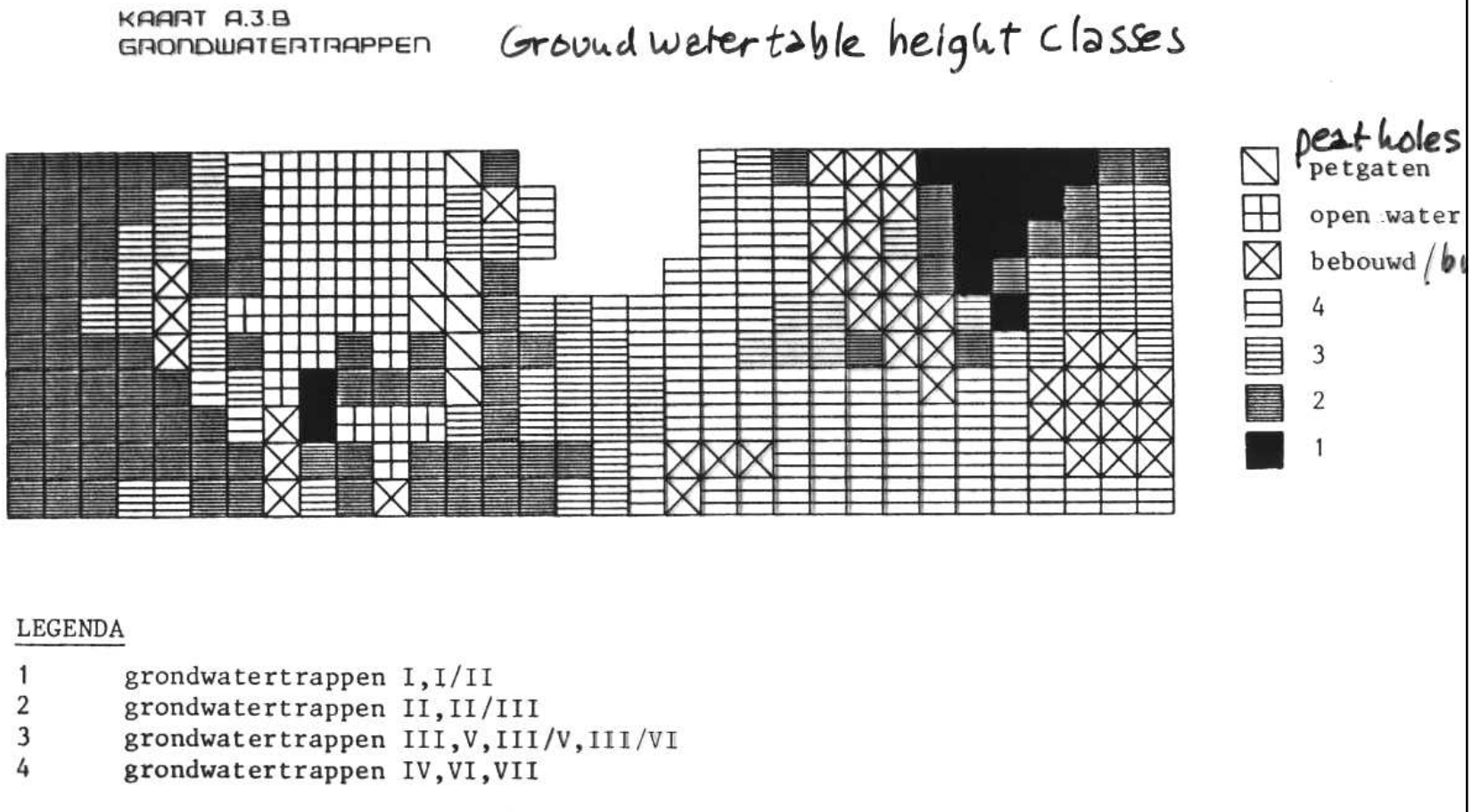
test area: north part Utrecht province

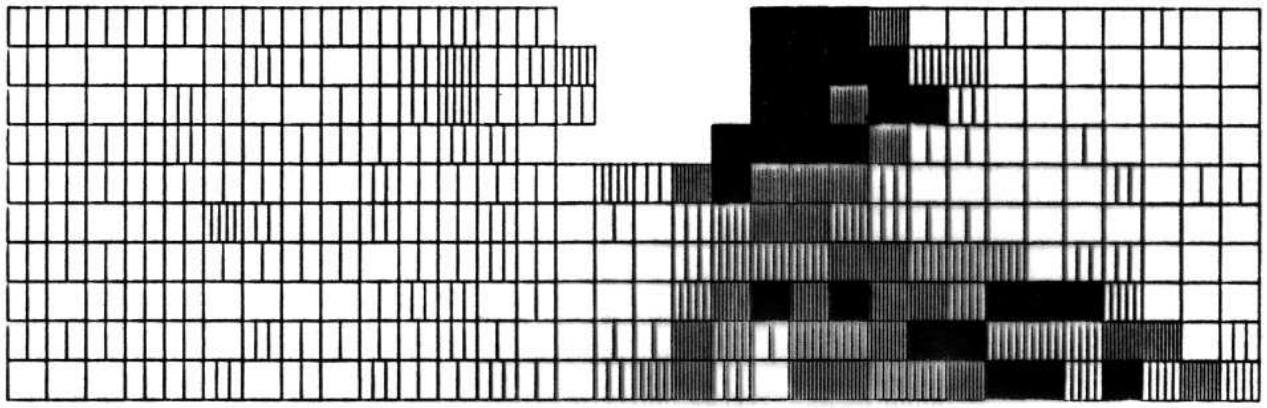


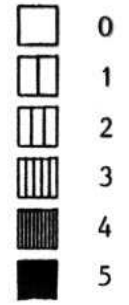
Inventory map examples

- Groundwater table
- % forest
- Soils, etc

per 2x2km grid cell which allows for rapid estimation



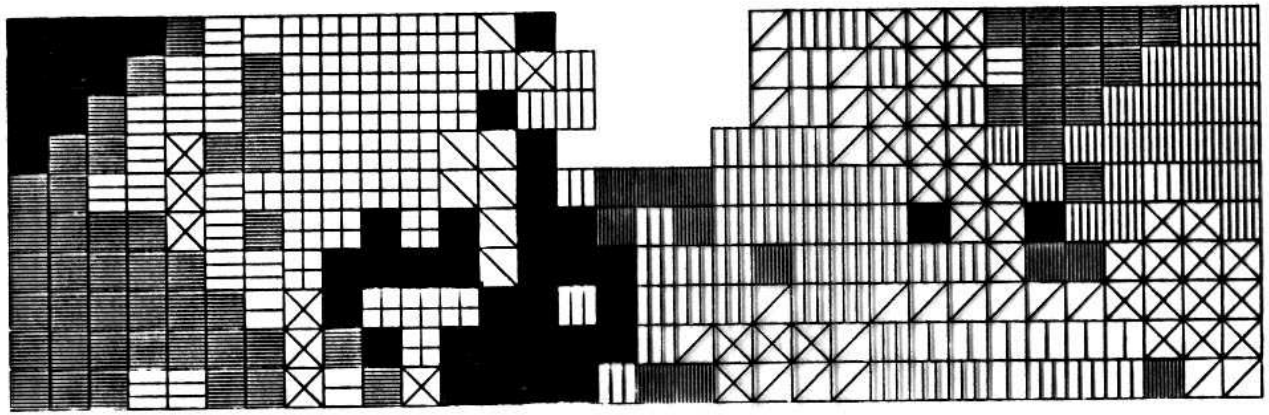


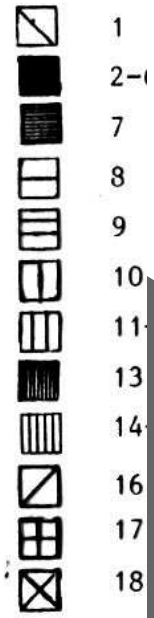


Forest %

LEGENDA

0	geen bos aanwezig	
1	1-10	ha. bos
2	10-25	ha. bos
3	25-50	ha. bos
4	50-75	ha. bos
5	> 75	ha. bos





soils

LEGENDA

1	petgaten
2-6	veen- en moerige gronden — peat
7	kleigronden op veen — clay on peat
8	kalkarme-kalkhoudende kleigronden — etc
9	kalkloze kleigronden
10	moderpodzolgronden
11-12	humuspodzolgronden
13	eerdgronden met een dikke eerdlaag
14-15	eerdgronden met een dunne eerdlaag
16	vaaggronden
17	open water — open water
18	bebouwd — built-up

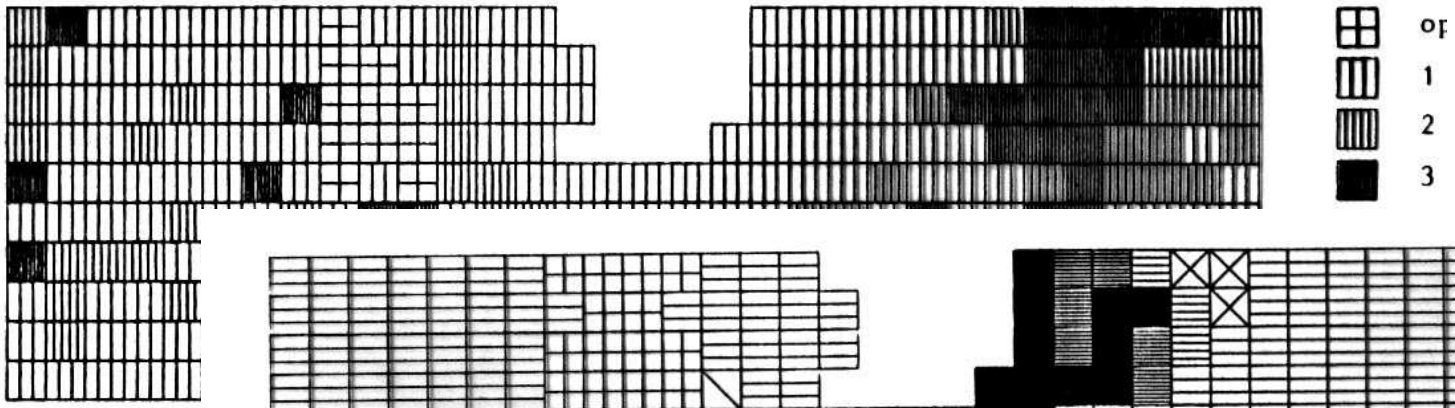
(Voor details zie codeka

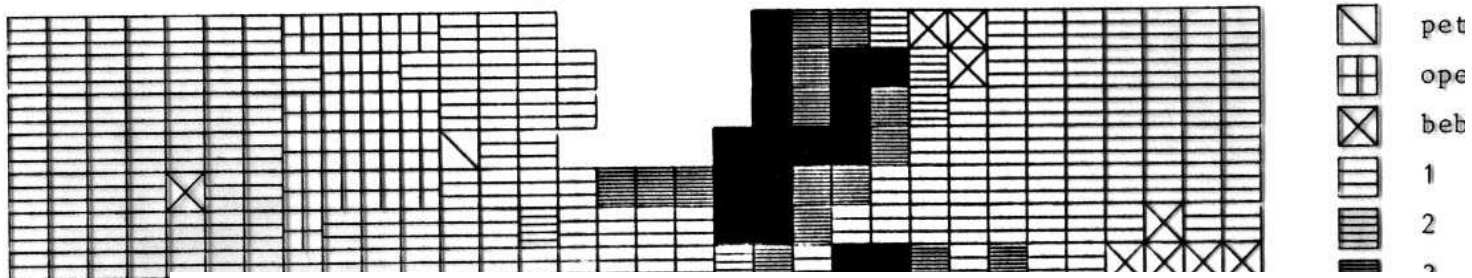
Susceptibility maps

- Susceptibility of soils to fertilizer
- Susceptibility of flora to groundwater lowering
- Susceptibility of soils to exhaustion
- Susceptibility of fauna to habitat fragmentation
- etc

Examples of susceptibility maps

Vegetation to groundwater lowering





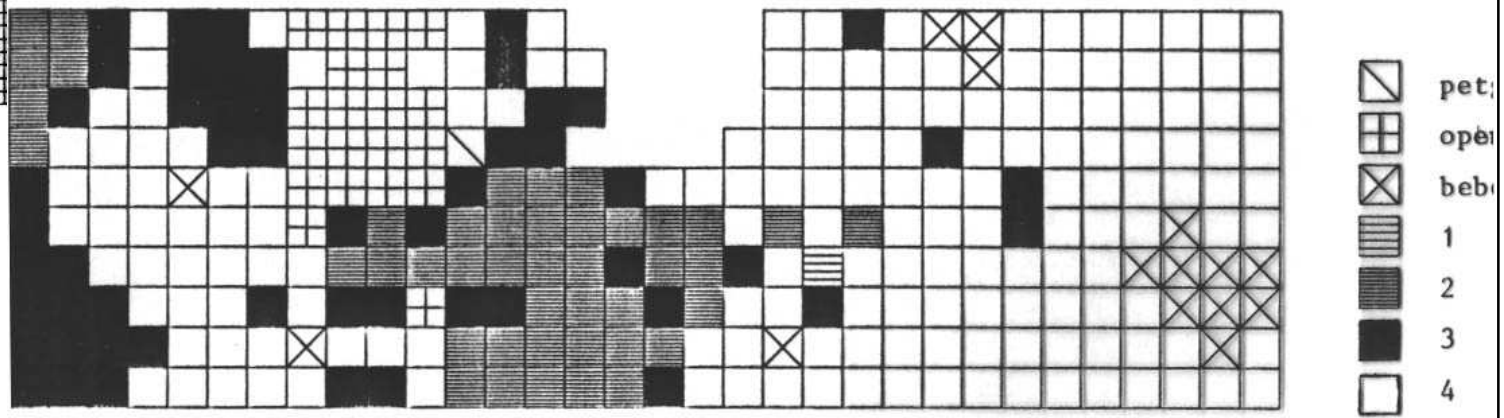
LEGENDA

Klasse

4

3

2



LEGENDA

Klasse

4

3

Soils to fertilizer or exhaustion >

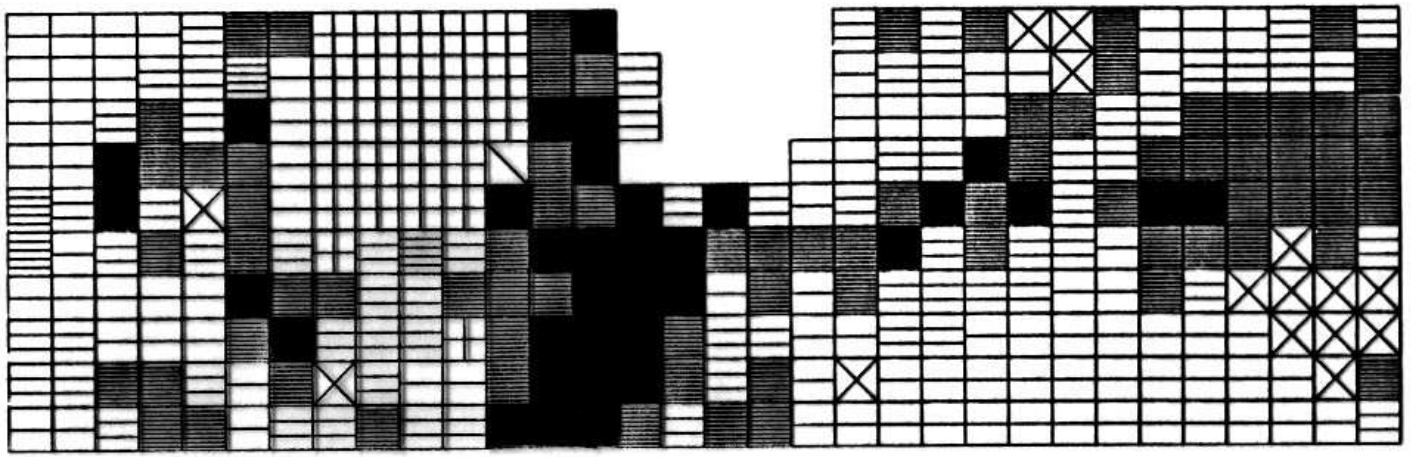
LEGENDA

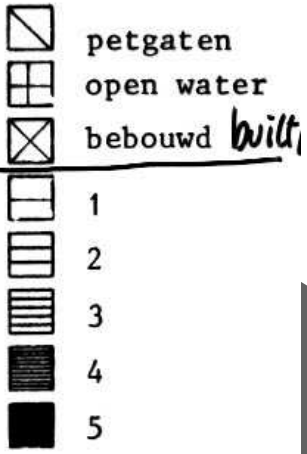
Klasse	Mogelijkheid	Oppervlakteverdeling
1	klein	>50 ha. aH en pO
2	matig groot	>10-50 ha. aH en pO of >50 ha. aE en pO

a = actue
p = potent
H = Hyper
E = Eutro
M = Mesot
O = Oligo

Diversity or rarity maps

Number of map units per grid cell compared to number of legend units per grid cell





LEGENDA

number of legend units

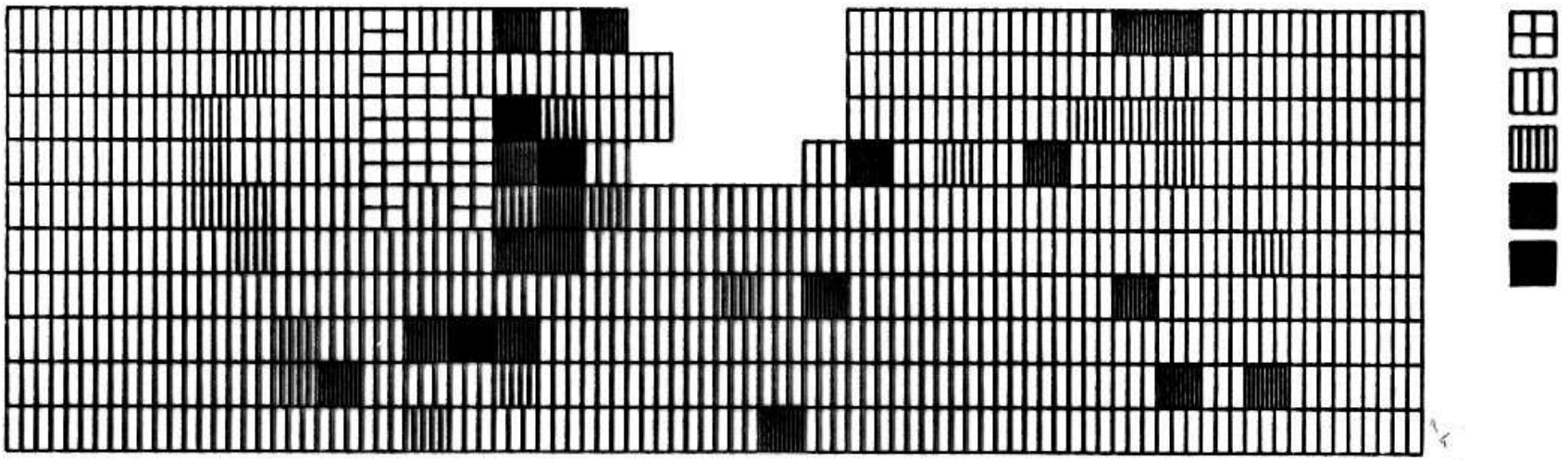
Aantal kaart-vlakken (afwisseling)	Aantal kaarteenheden (variatie) 1	2	3-4	≥5
1	1	–	–	–
2-4	–	2	4	–
≥5	–	3	5	6

number of map units

Vulnerability maps

Areas that are both susceptible and rare are vulnerable!!

This map: Vulnerability of flora to groundwater lowering



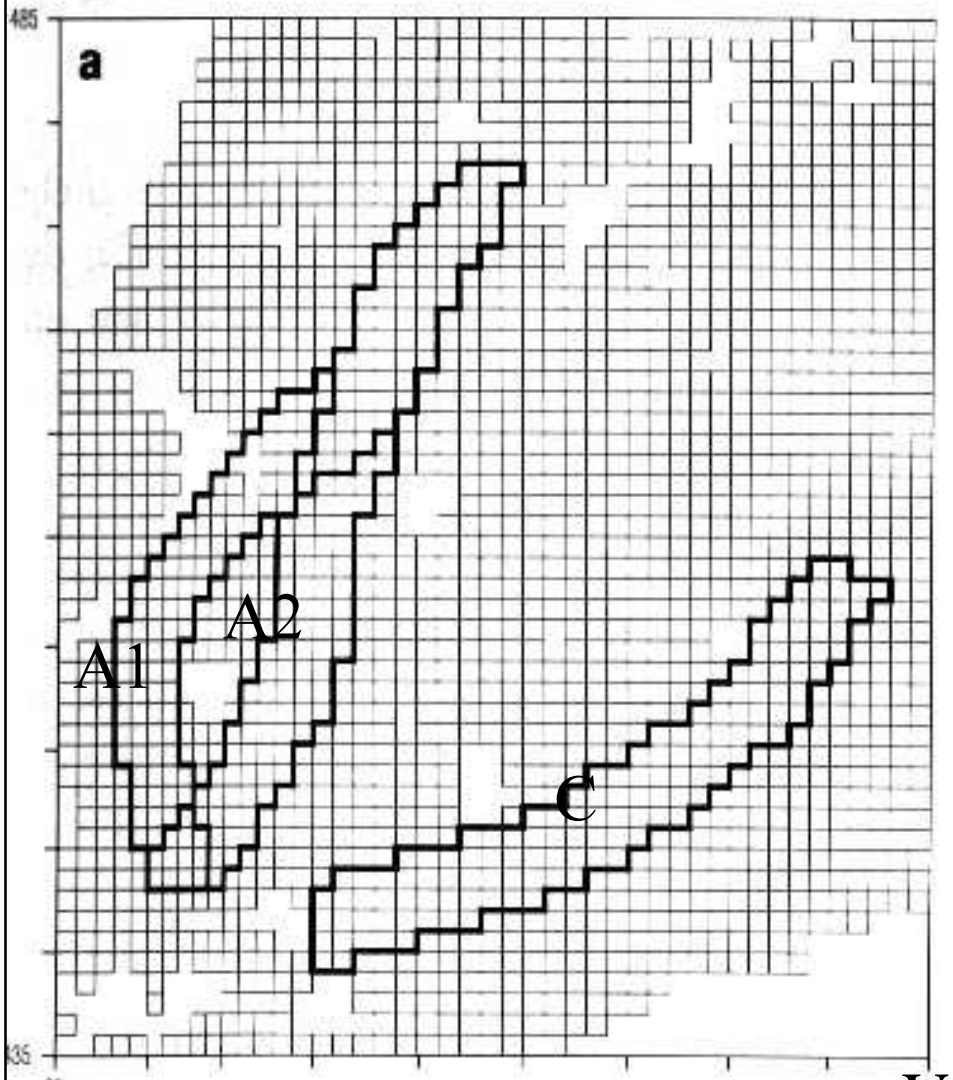
Size of area with vulnerability

LEGENDA

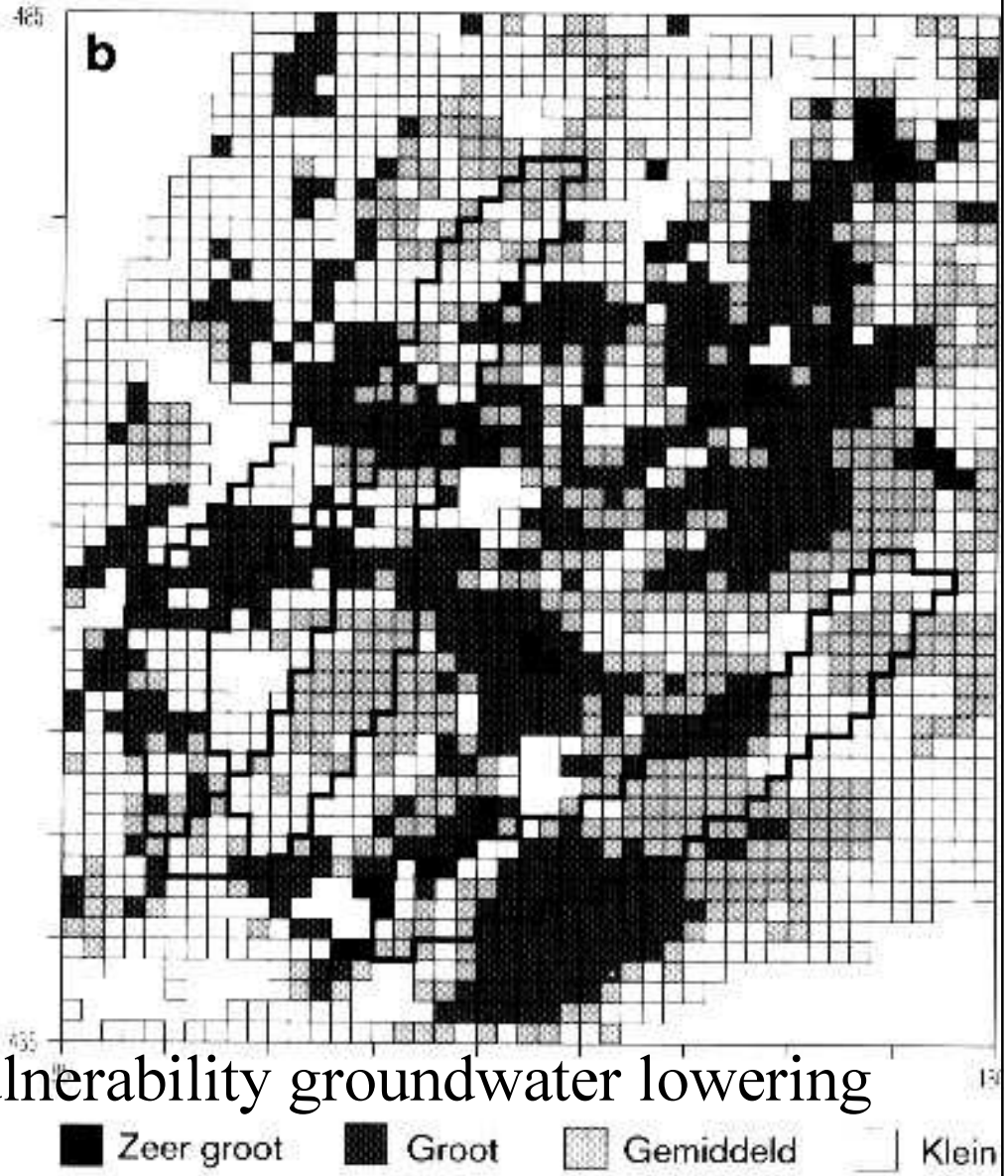
Klasse	Kwetsbaarheid	Oppervlakteverdeling
4	zeer groot	>10 ha. zeer kwetsbaar
3	groot	>1-10 ha. zeer kwetsbaar of >10 ha. matig kwetsbaar
2	matig groot	0-1 ha. zeer kwetsbaar of >1-10 ha. matig kwetsbaar of >10 ha. weinig kwetsbaar
1	klein of afwezig	overig

Application of landscape ecological mapping system

- Determination of route of high velocity rail system (TGV)



Optional routes

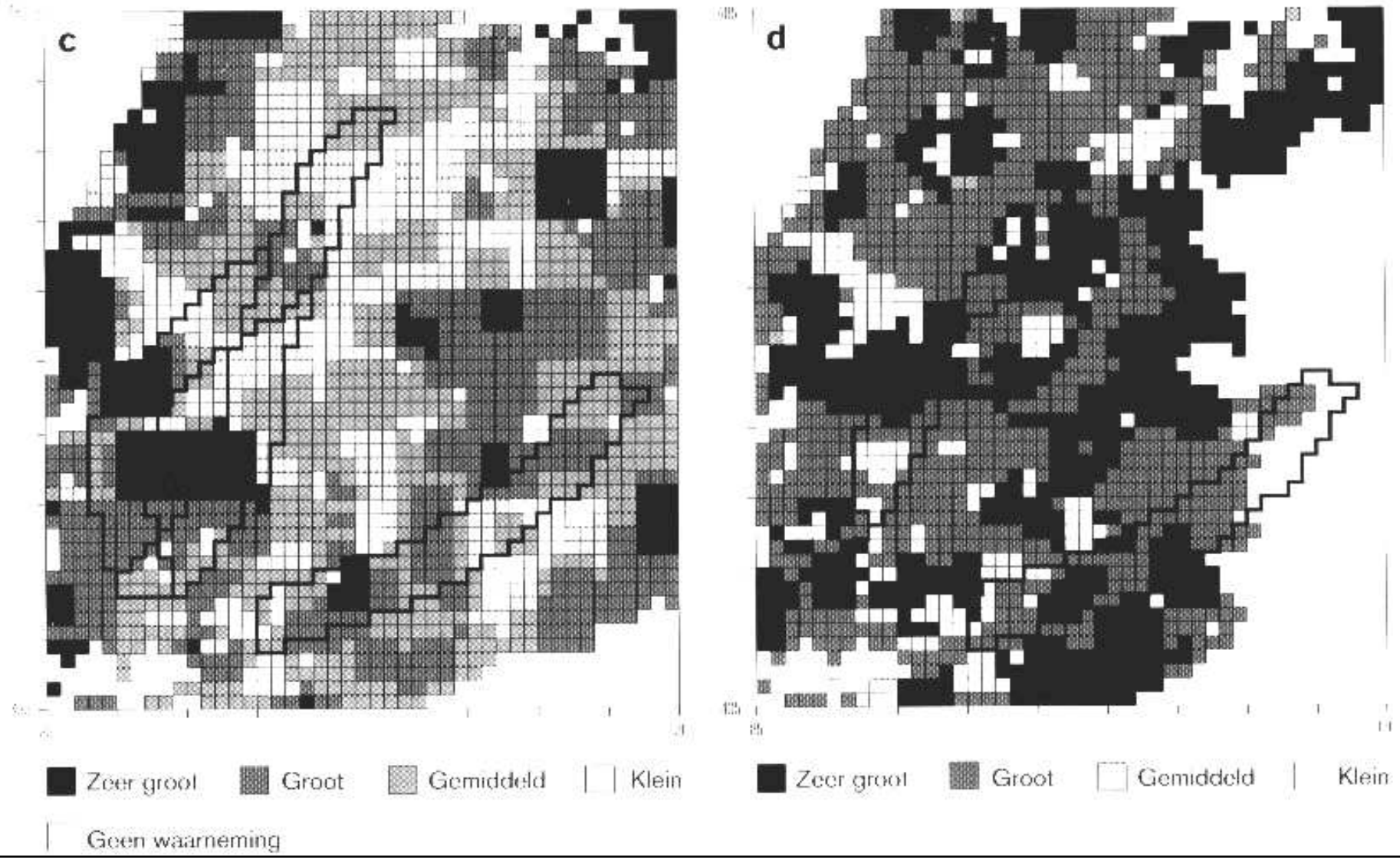


Vulnerability groundwater lowering

Application of landscape ecological mapping system

Determination of route of high velocity rail system (TGV)

Vulnerability to fragmentation of mammal habitat (l) and birds to traffic



Number of cells affected for the three proposed routes

Proposed route	A1	A2	C
Destruction of earth scientific monuments	30	13	0
Influence of water table lowering on soils	59	35	32
Influence of traffic increase on birds	149	141	95
Influence of fragmen-tation on mammals	69	50	62
total	…	…	…

Conclusion: A1 most unfavourable; A2 and C less unfavourable
Fragmentation unfavourable in all 3 scenario's

Applications

The system enables quick, systematic, country-wide and flexible use of landscape-ecological data for decision support, evaluation and scientific research. It enables to match a-biotic and biotic data and deduce consequences of specific interventions. The data can be applied for:

-various forms of land evaluation (susceptibility-, vulnerability- and suitability maps);

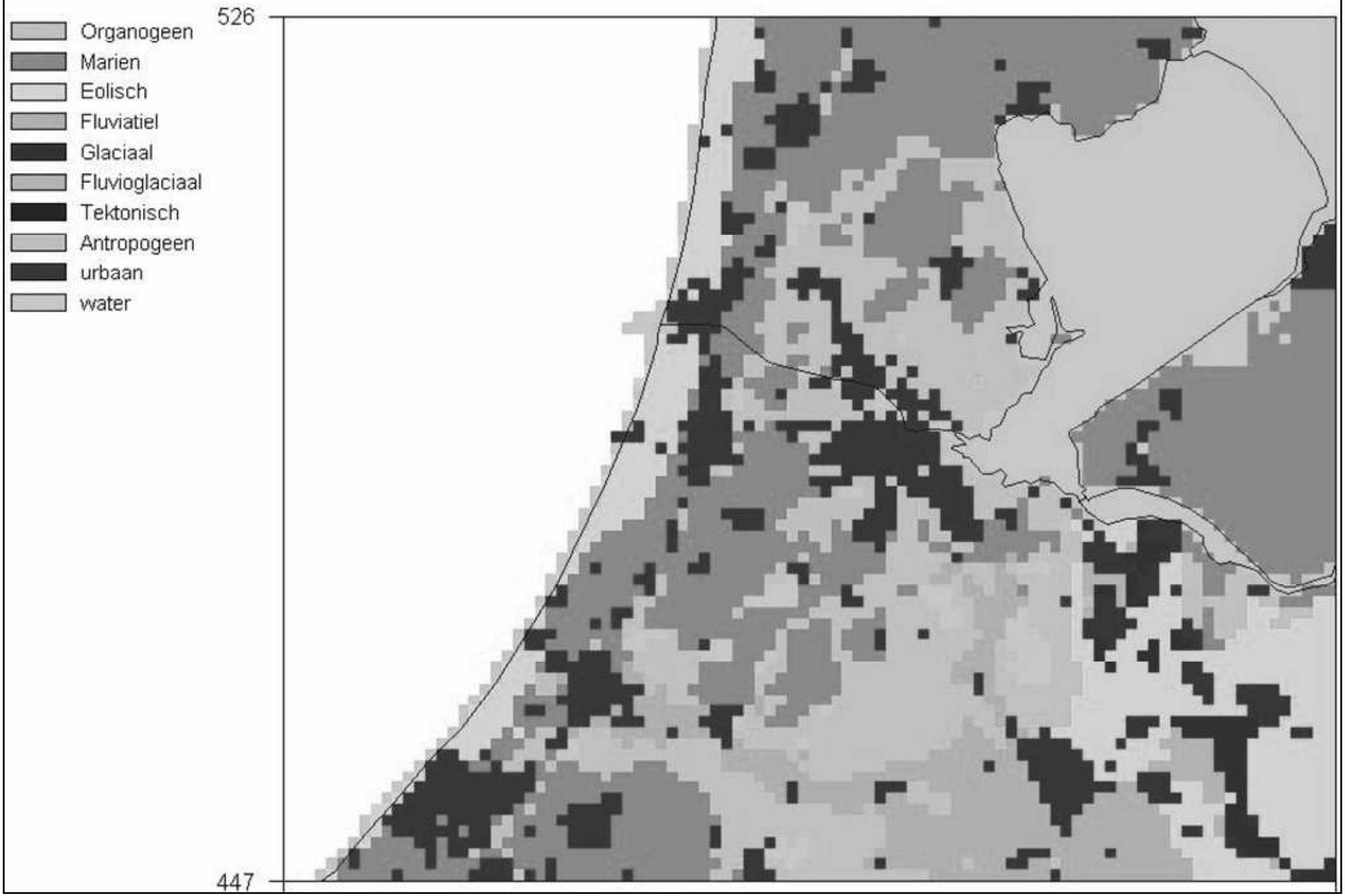
-generating areal subdivisions;

-interpretation and generalisation of monitoring-data;

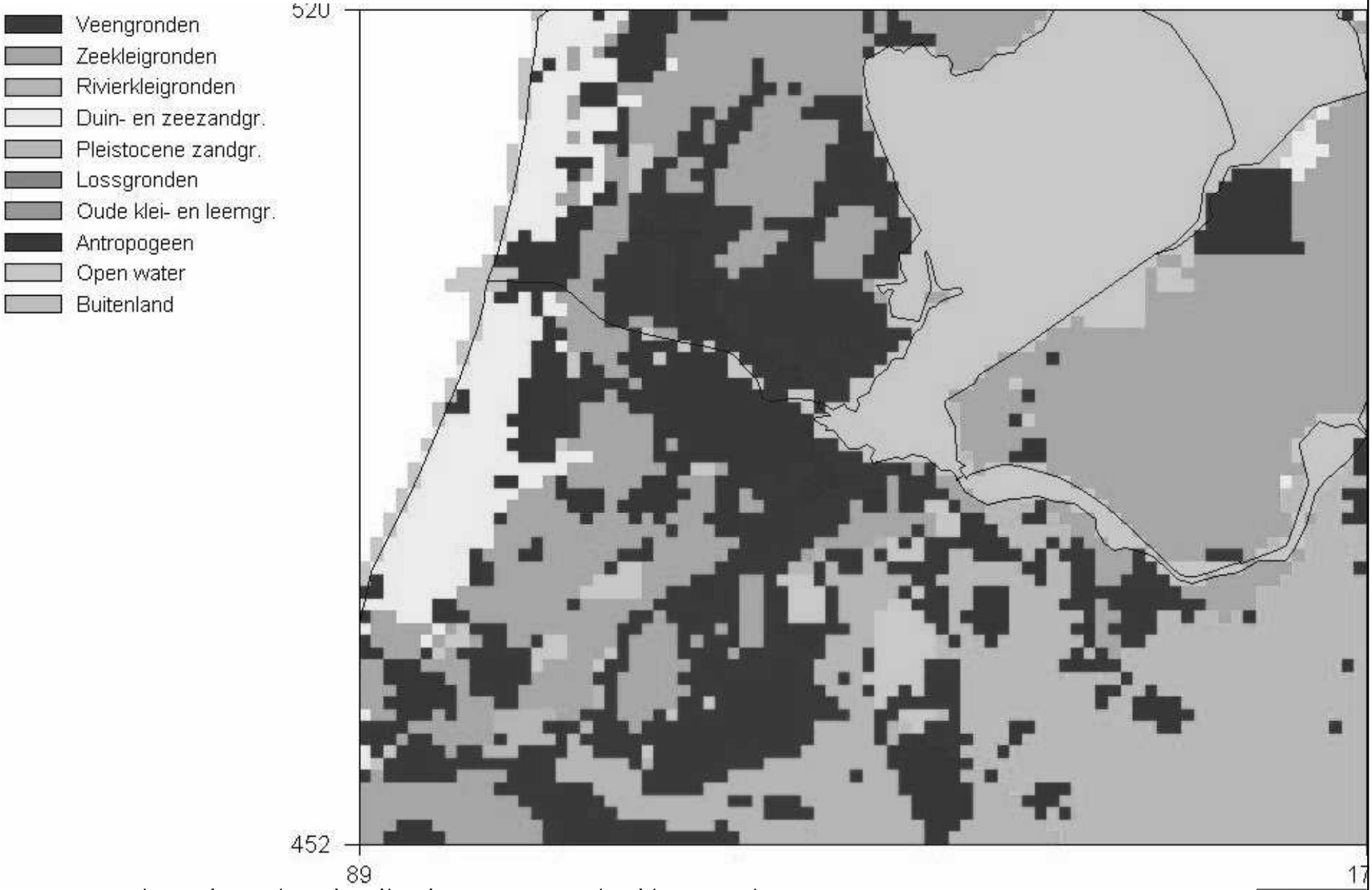
-prediction models for scenario analyses;

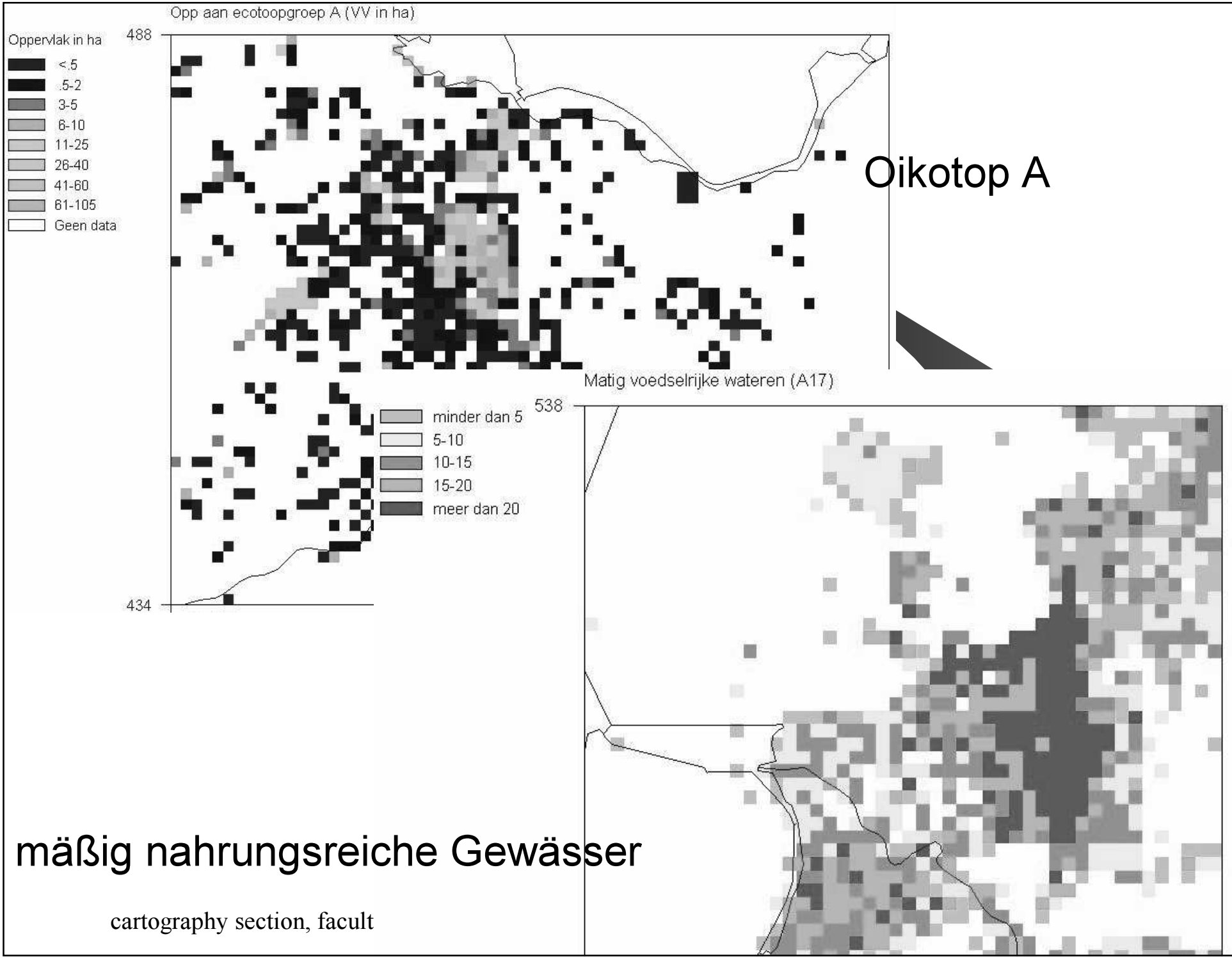
-evaluation models and large environmental impact reports

Dominant geomorphological influences



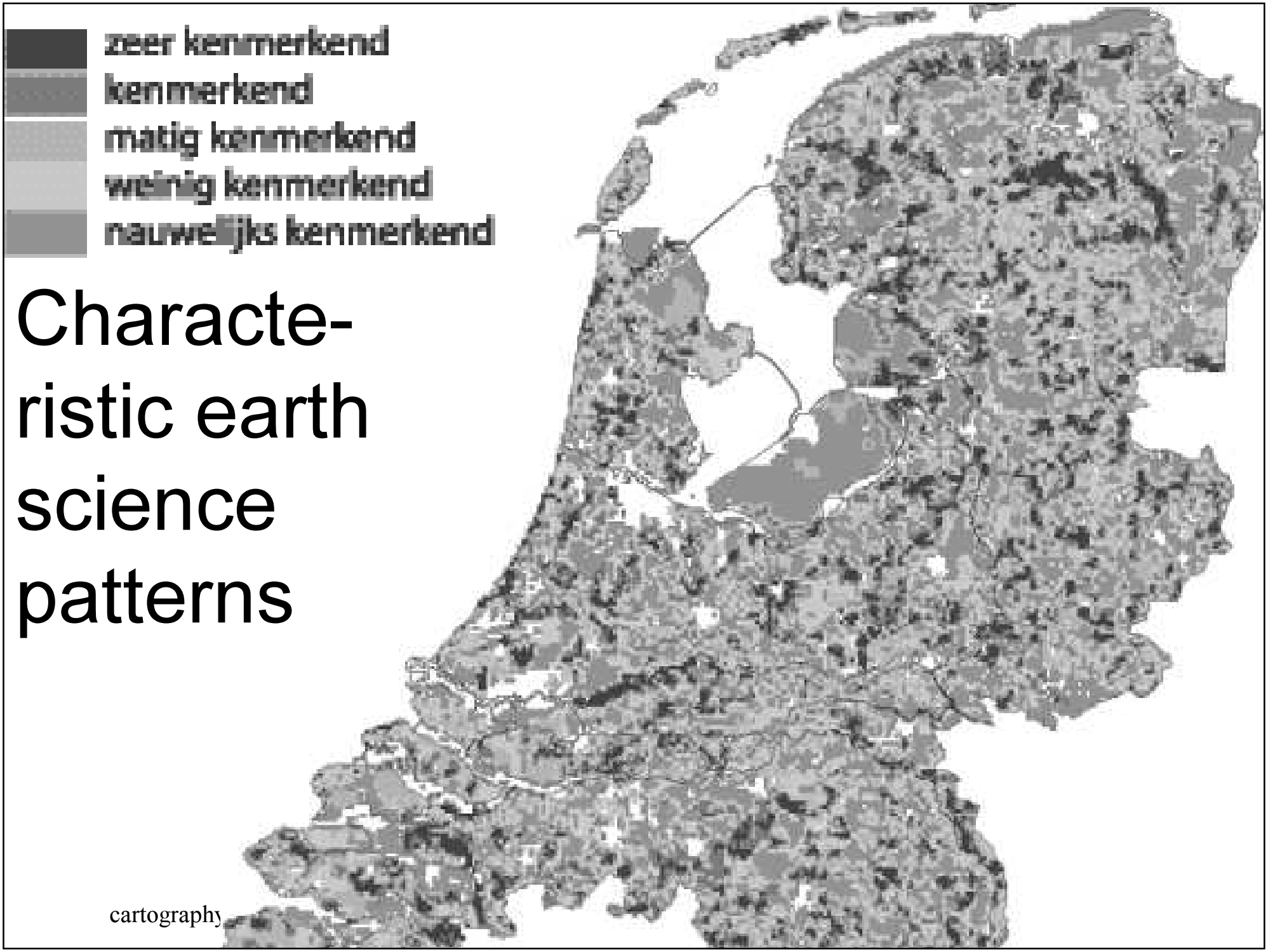
Dominant soil units





mäßig nahrungsreiche Gewässer

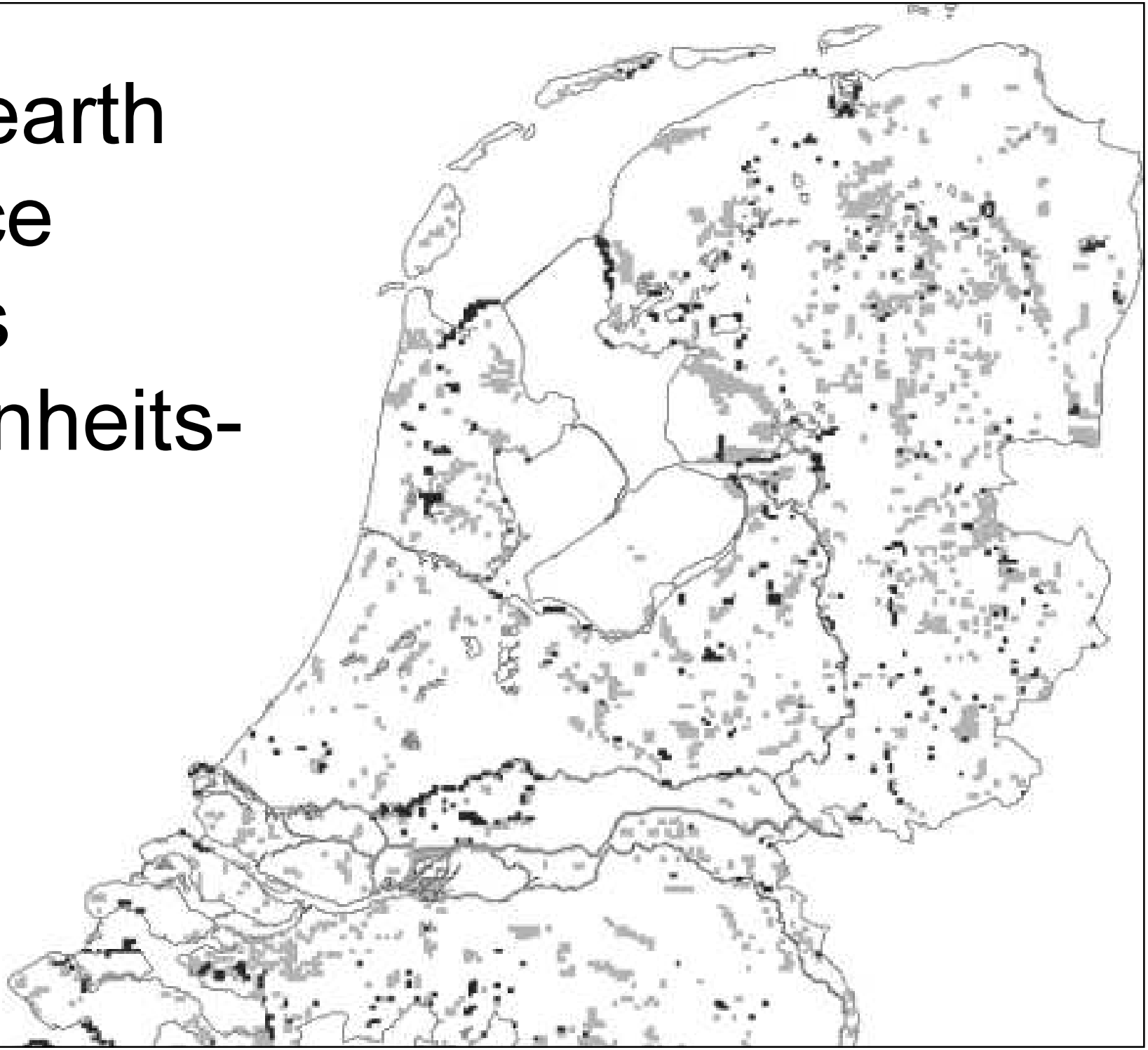
cartography section, facult



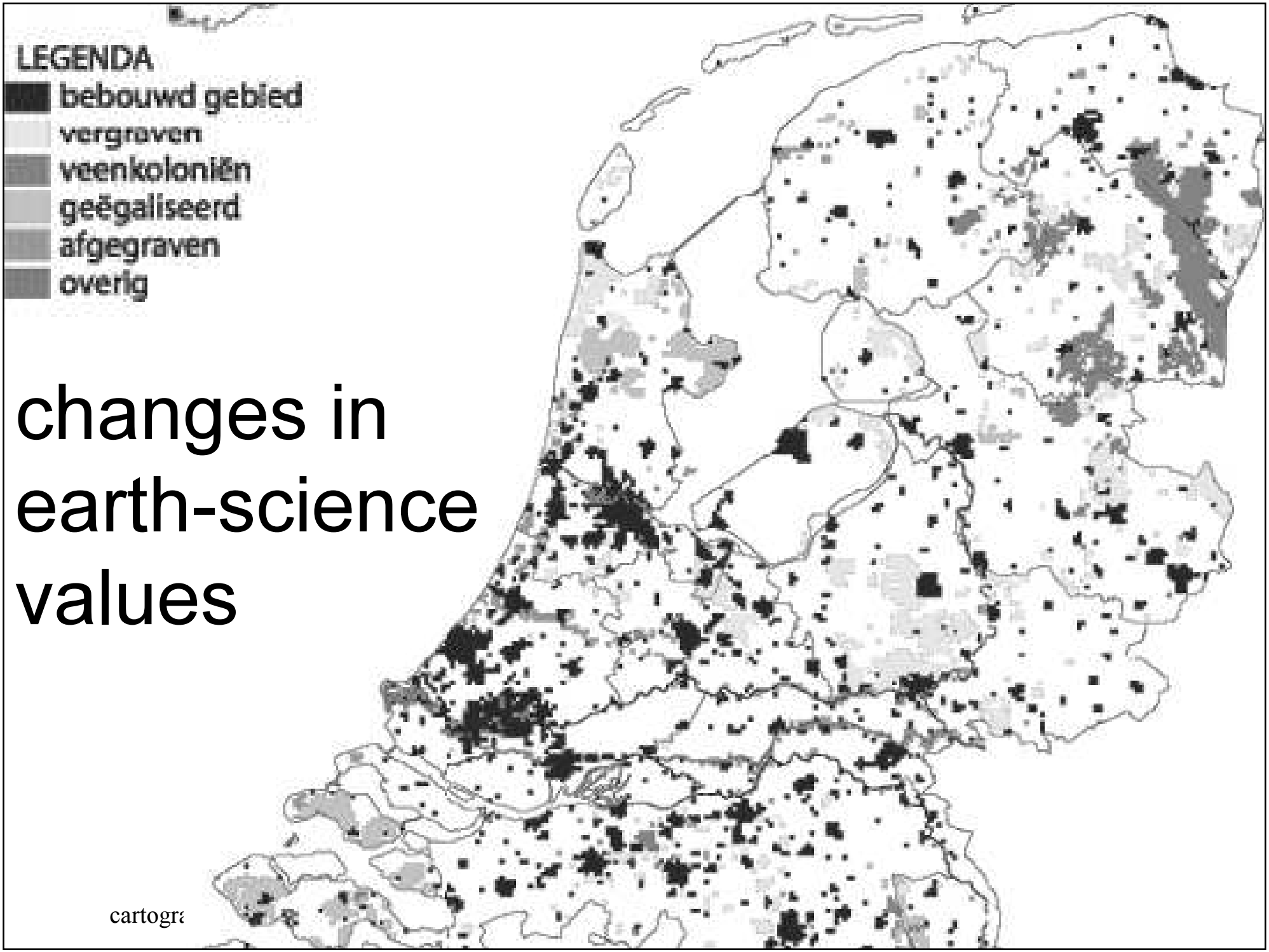
Characte-ristic earth science patterns

cartography

Rare earth science values (Seltenheits-karte)



cartograph



changes in earth-science values

cartogra

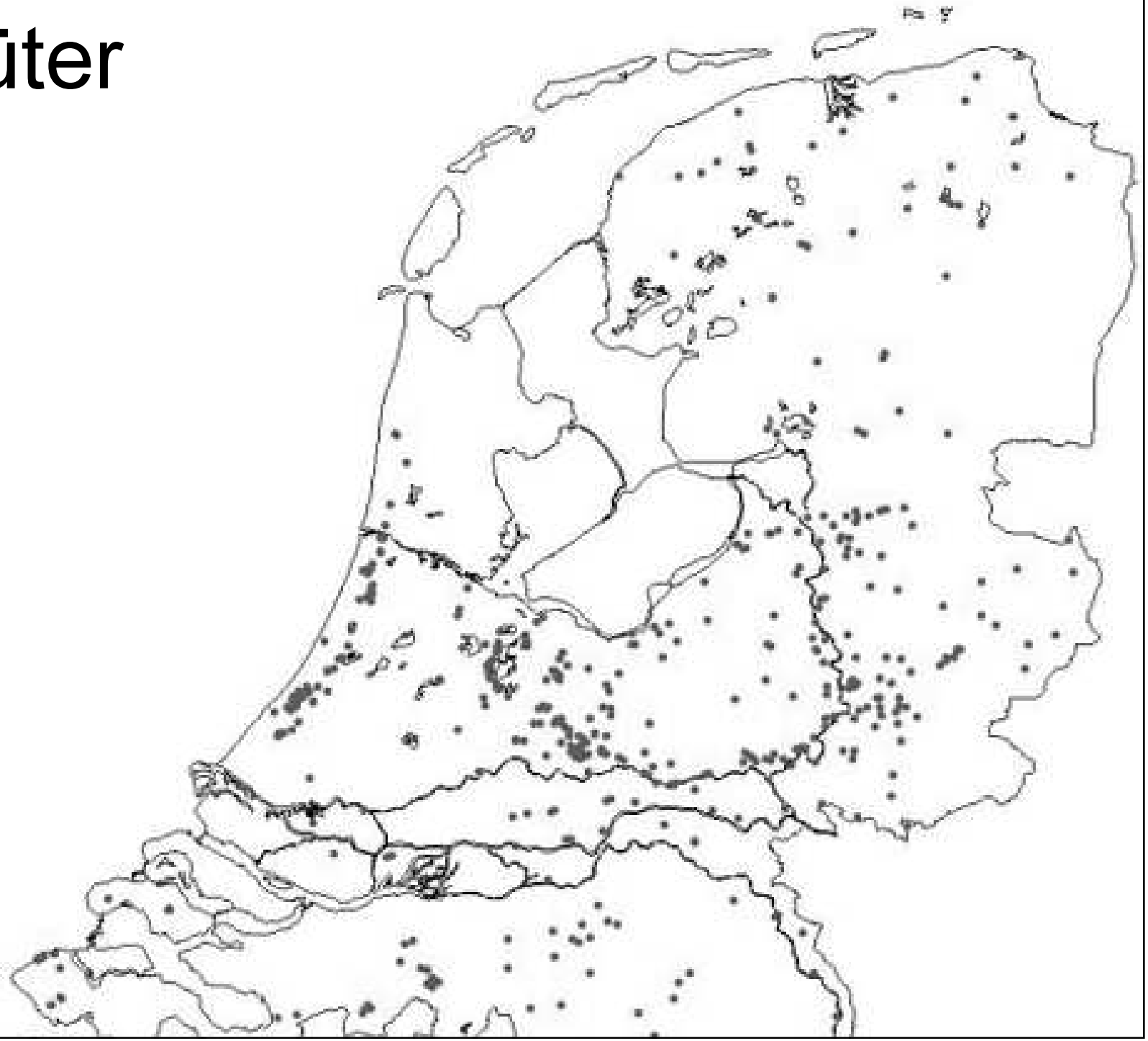
Ecological evaluation

- On the basis of the soil map the potential vegetation can be determined (climax vegetation)
- On the basis of the vegetation map the actual vegetation can be determined
- By comparing the actual to the potential vegetation ecological values can be assigned (the lower the value the further away from climax vegetation)
- Bonus points can be added for occurrences of rare species
- But, if we want to protect our typical landscapes there is more than only natural aspects:

Evaluation of cultural artefacts

- Archeological monuments
- Farm types, important from a construction point of view
- Castles, historical fortifications
- Mills
- Special landscapes - parcellation type
  - relation of farm building to parcels
  - types of boundary structures

Landgüter



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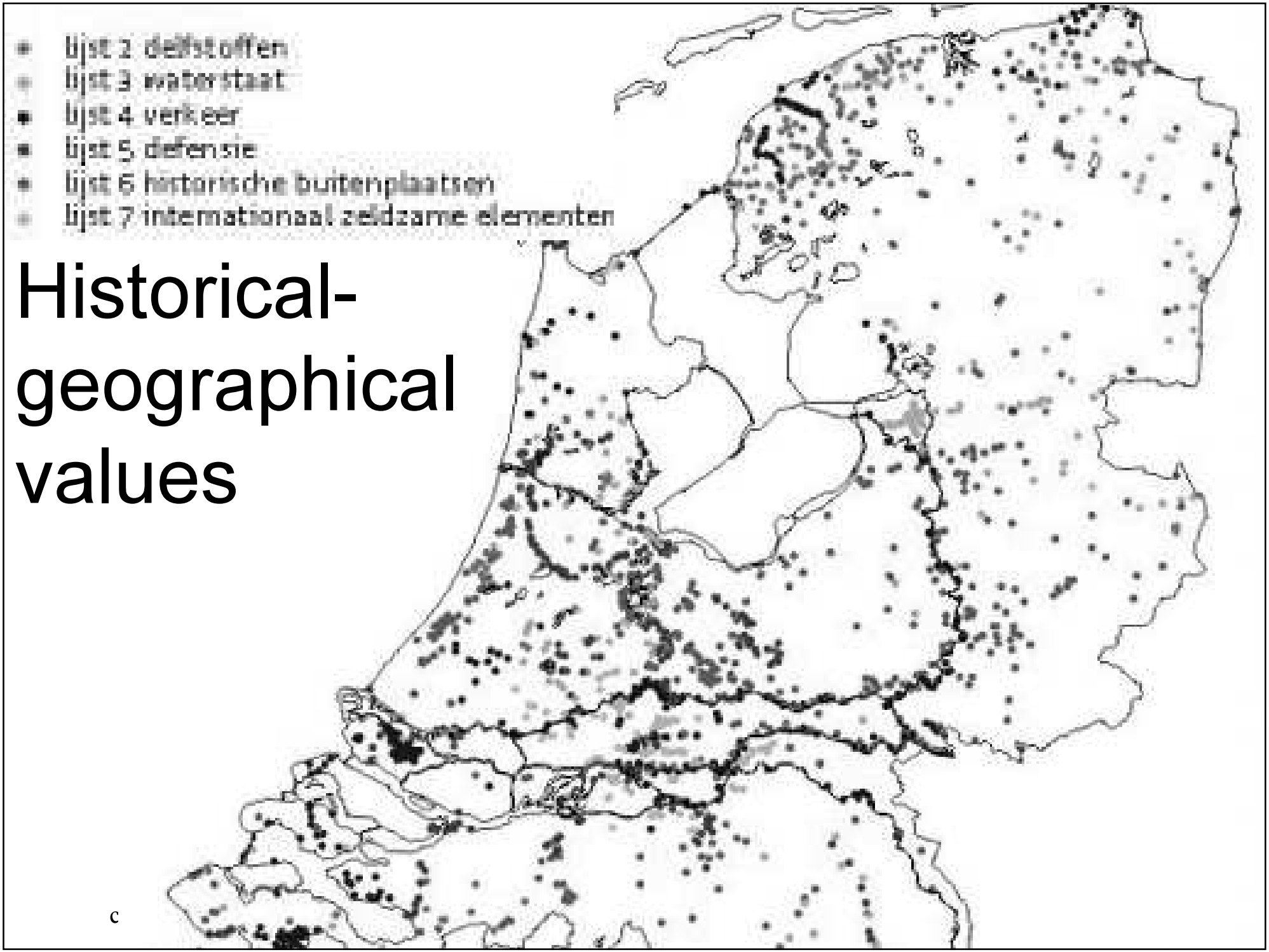


Historical-geographical values

c

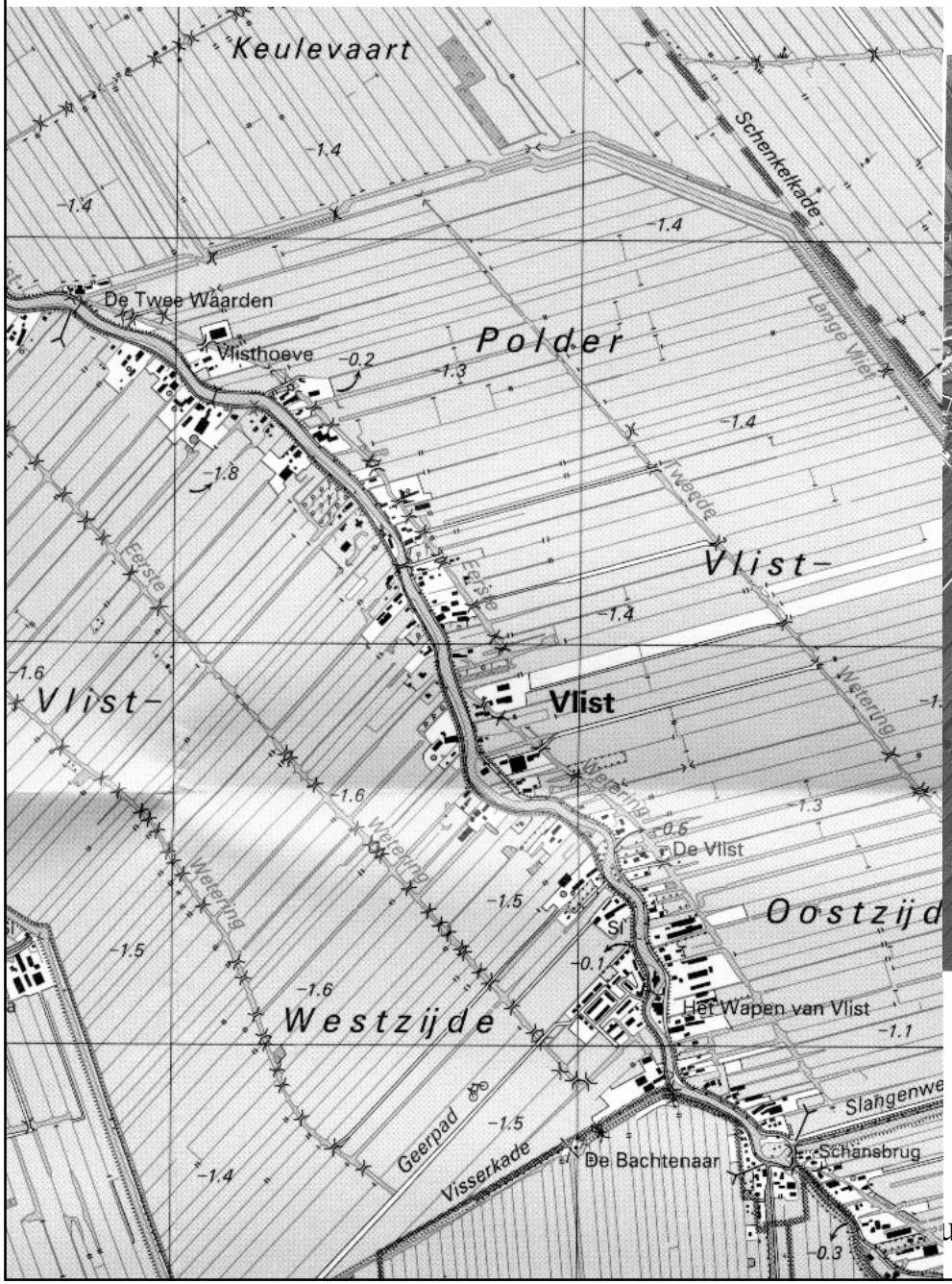
Another project: The scale of the landscape: GIS with scale characteristics of the Dutch landscape

- How to measure spatial characteristics of landscape?
- Assess relationships between the patterns of visual vertical and horizontal boundaries
- Data: vegetation, buildings, cadastral boundaries, infrastructure and its locations
- Sources: topographic maps, aerial photographs (vertical and oblique), horizontal photographs

-‘small scale’ area: one cannot see far

-‘large scale’ landscape: one can see over large distances (1000 ha) (typical for Dutch landscape, but only 18% of territory)

The scale of the landscape: sources

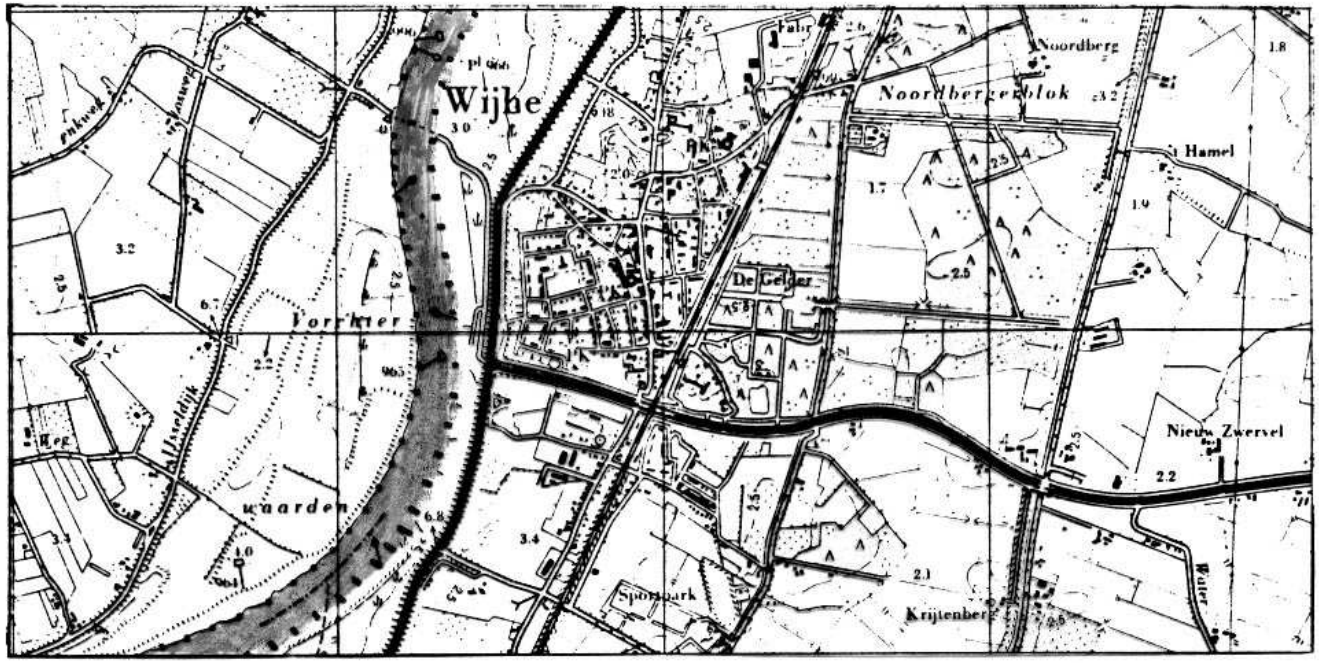


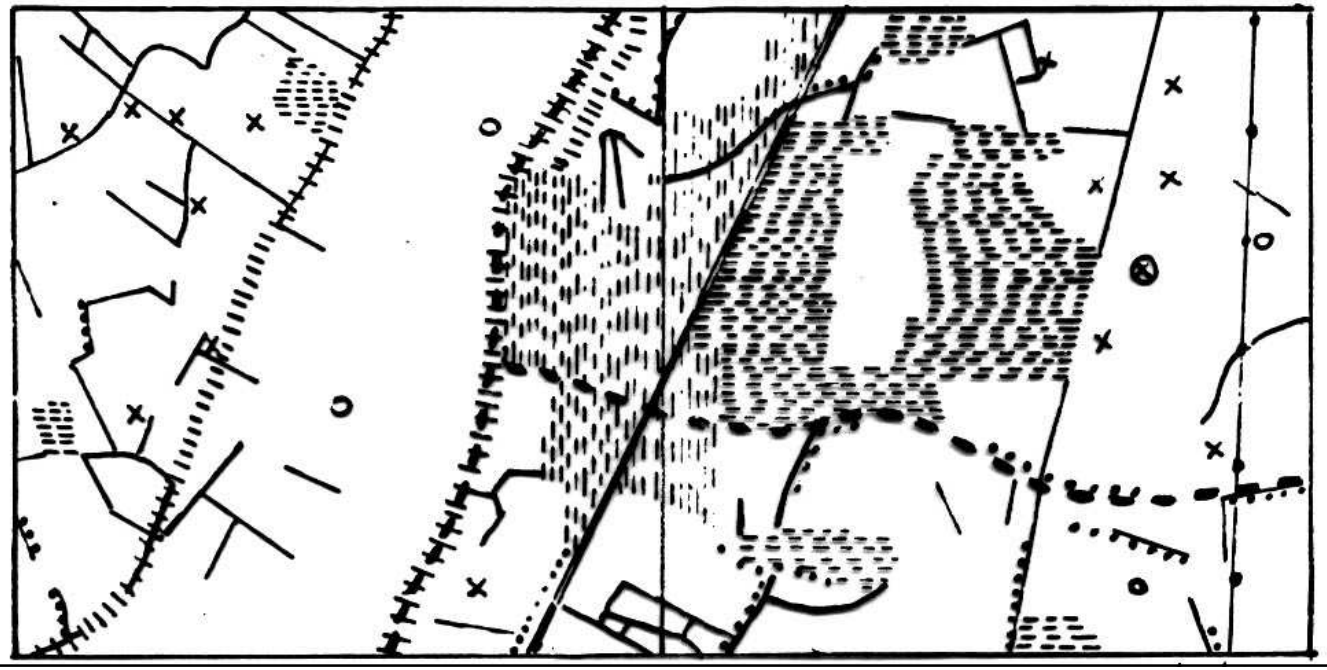
The scale of the landscape: sources 2

The scale of the landscape:
sources

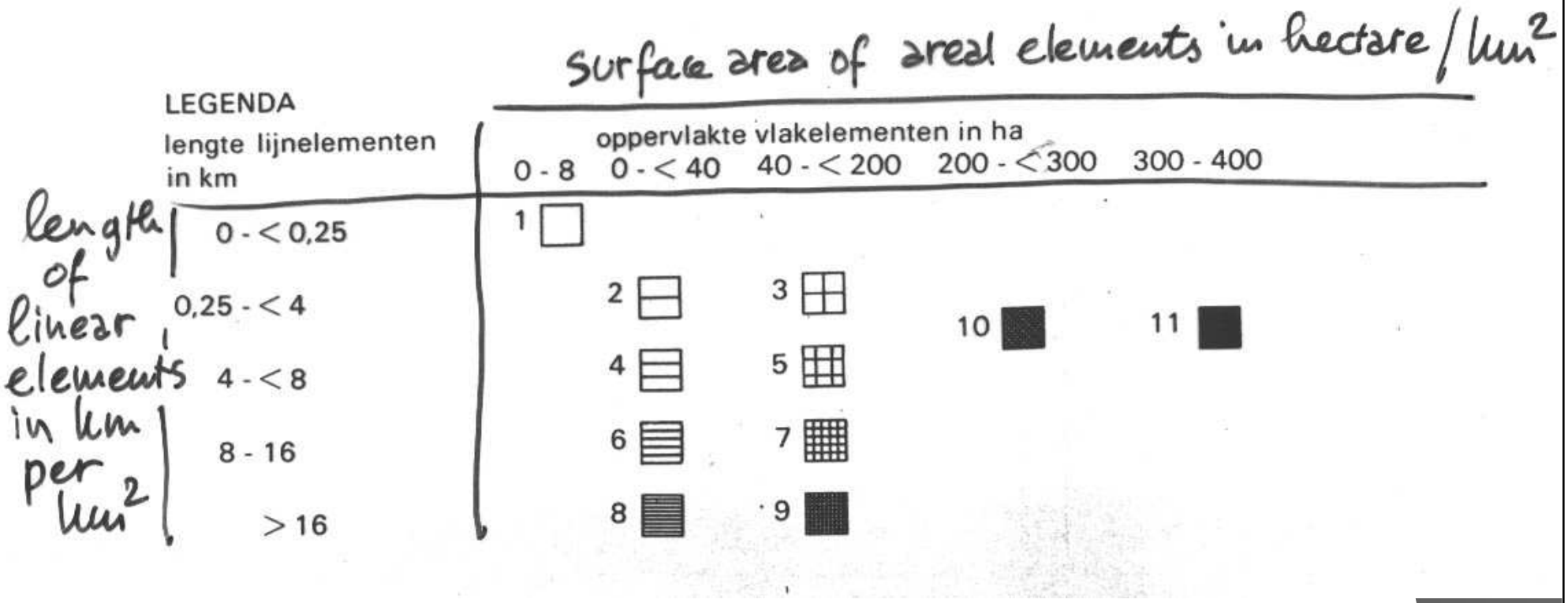
processing of topographic maps by high-lighting the relevant elements and measuring them per grid cell

Similar procedures also followed for geomorphologi-cal information system

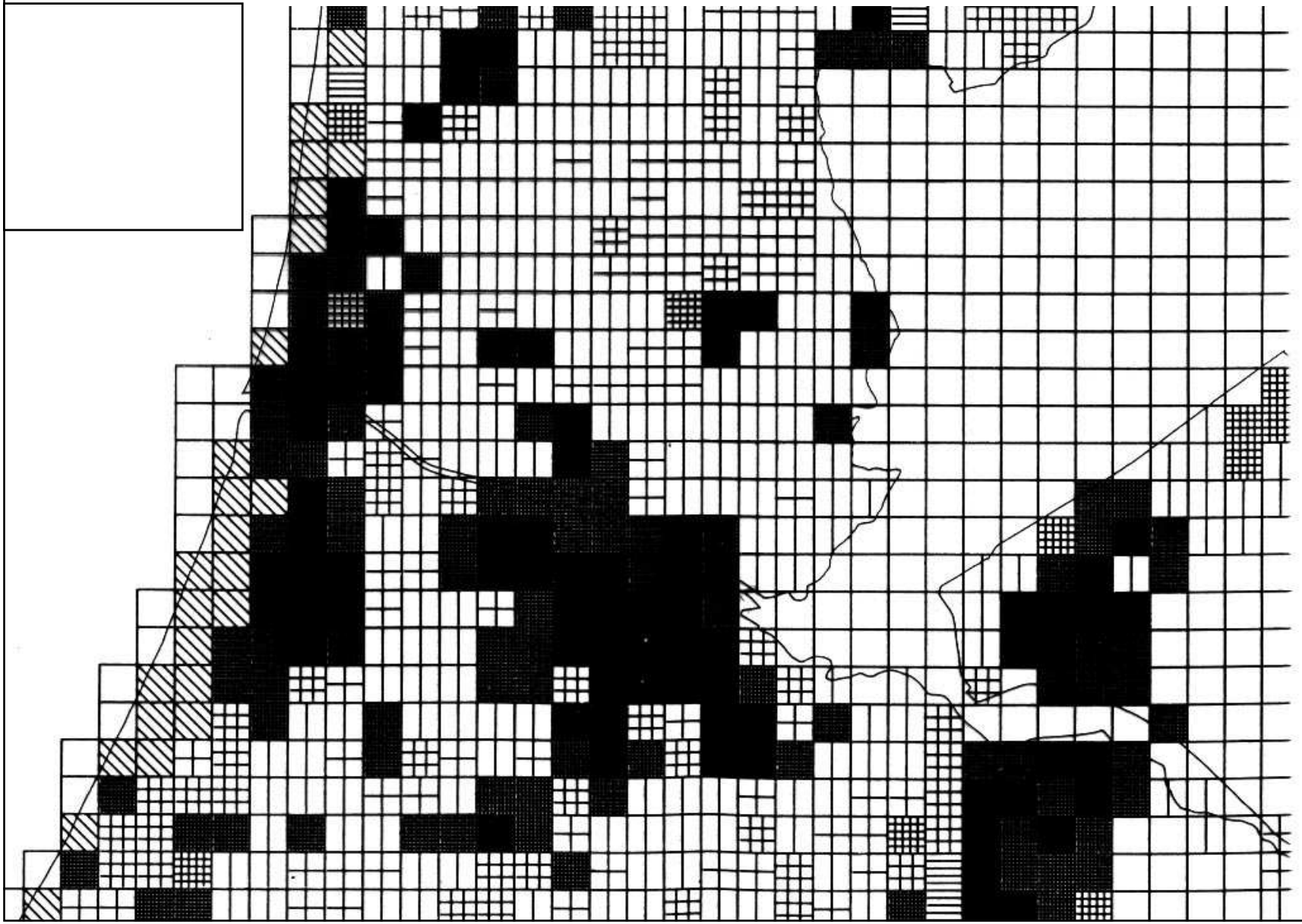




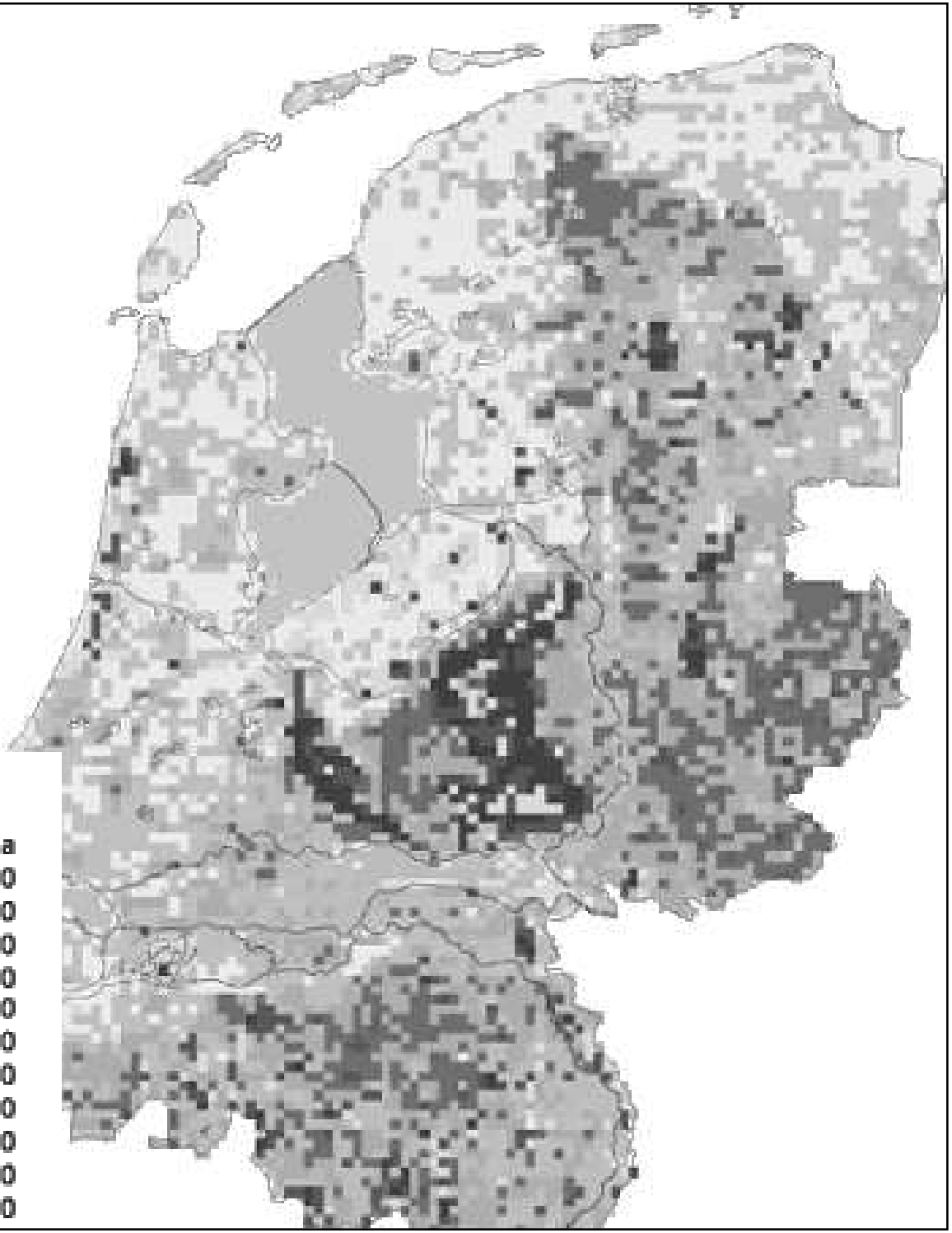
The scale of the landscape: output



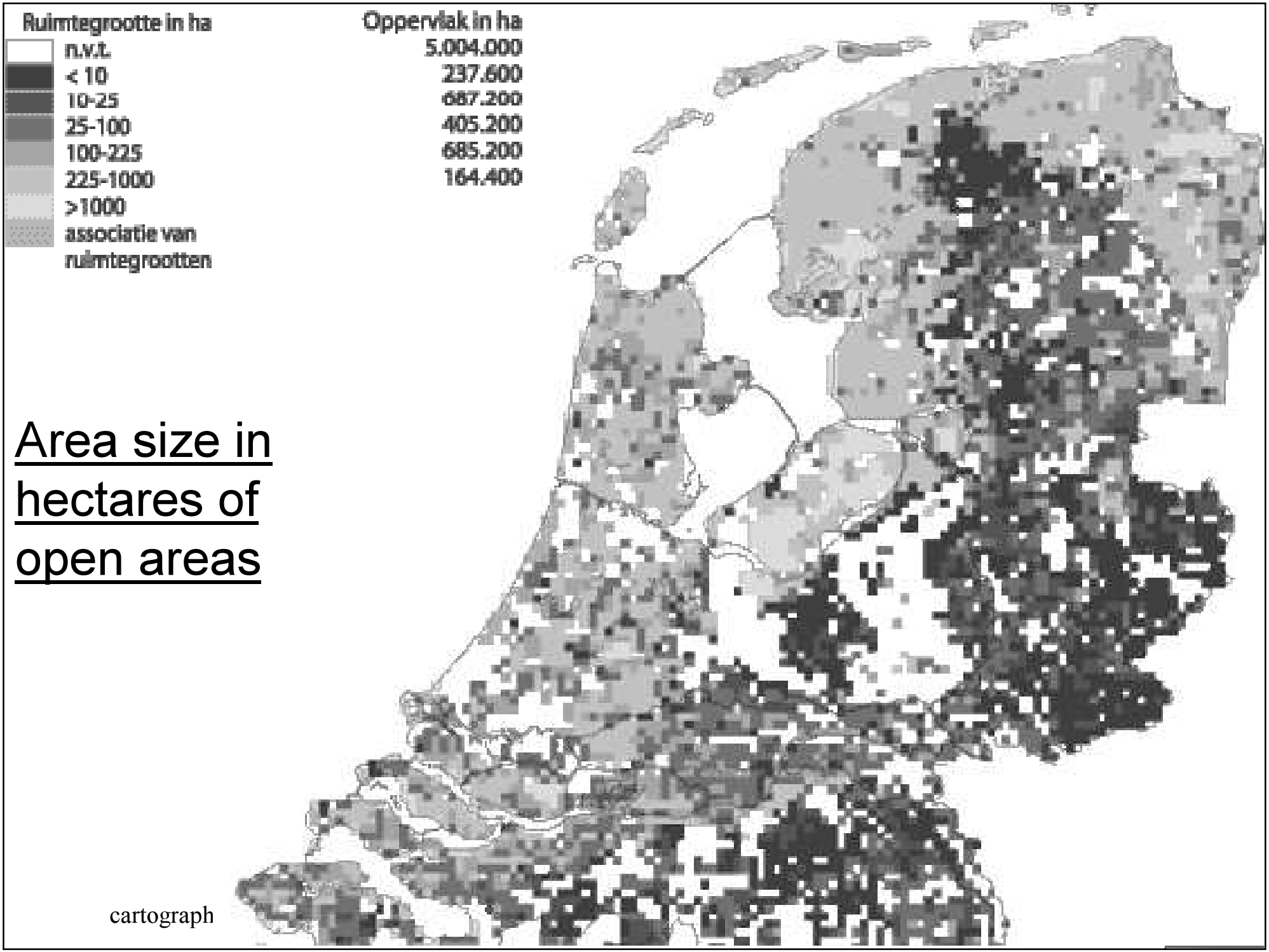
The scale of the landscape: output



Length of linear elements in km or surface of areal elements in ha



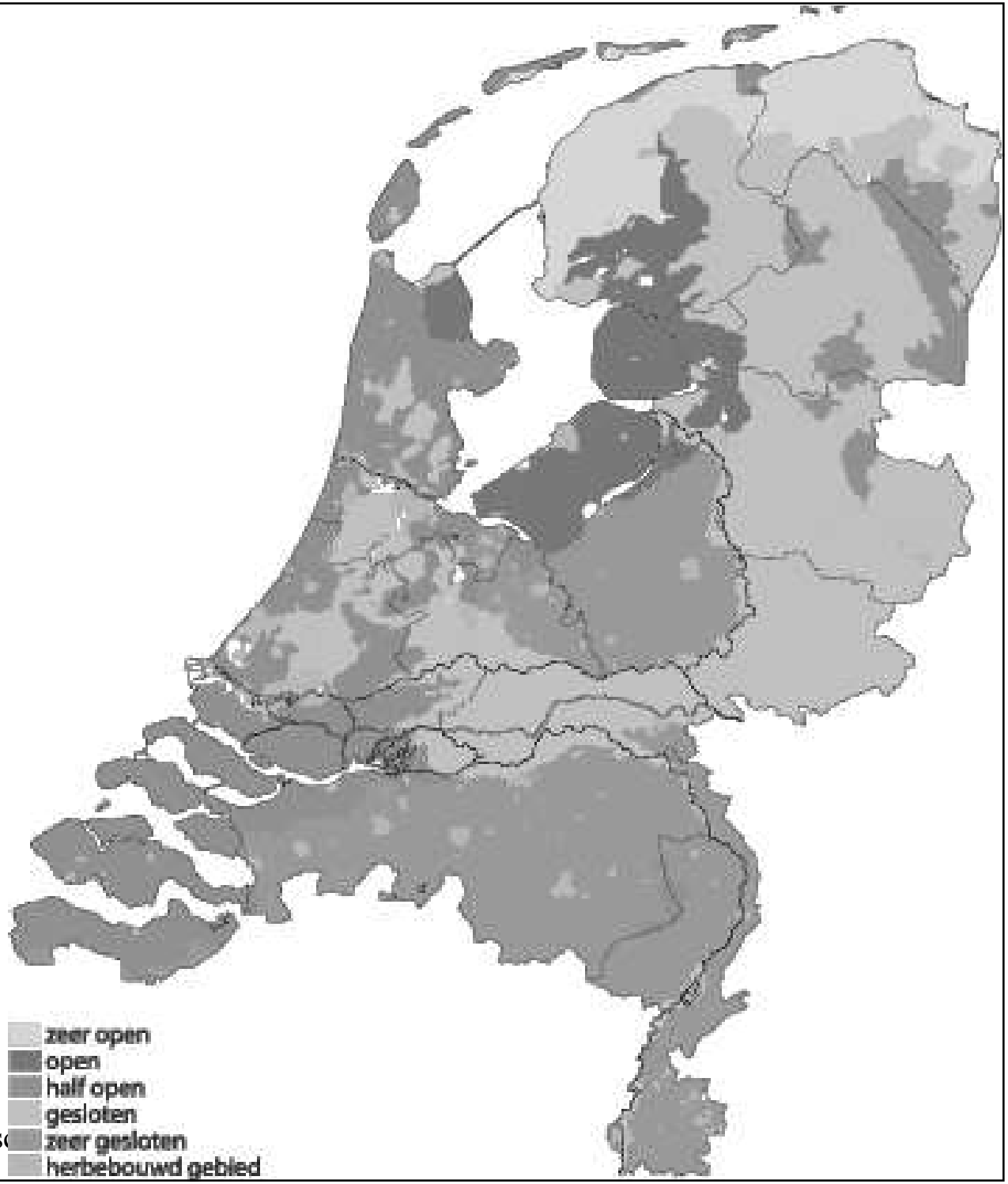
Opgaande begroeiing lengte lijnelementen in km resp. opp. vlakelementen in ha	Oppervlak in ha
0-0.25, 0-8	236.400
0-0.25, 8-40	801.600
0.25-4, 40-200	175.200
4-8, 0-40	893.200
4-8, 40-200	405.200
8-16, 0-40	636.800
8-16, 40-200	238.000
>16, 0-40	134.800
>16, 40-200	18.400
<8, 200-300	141.200
<4, 300-400	88.800



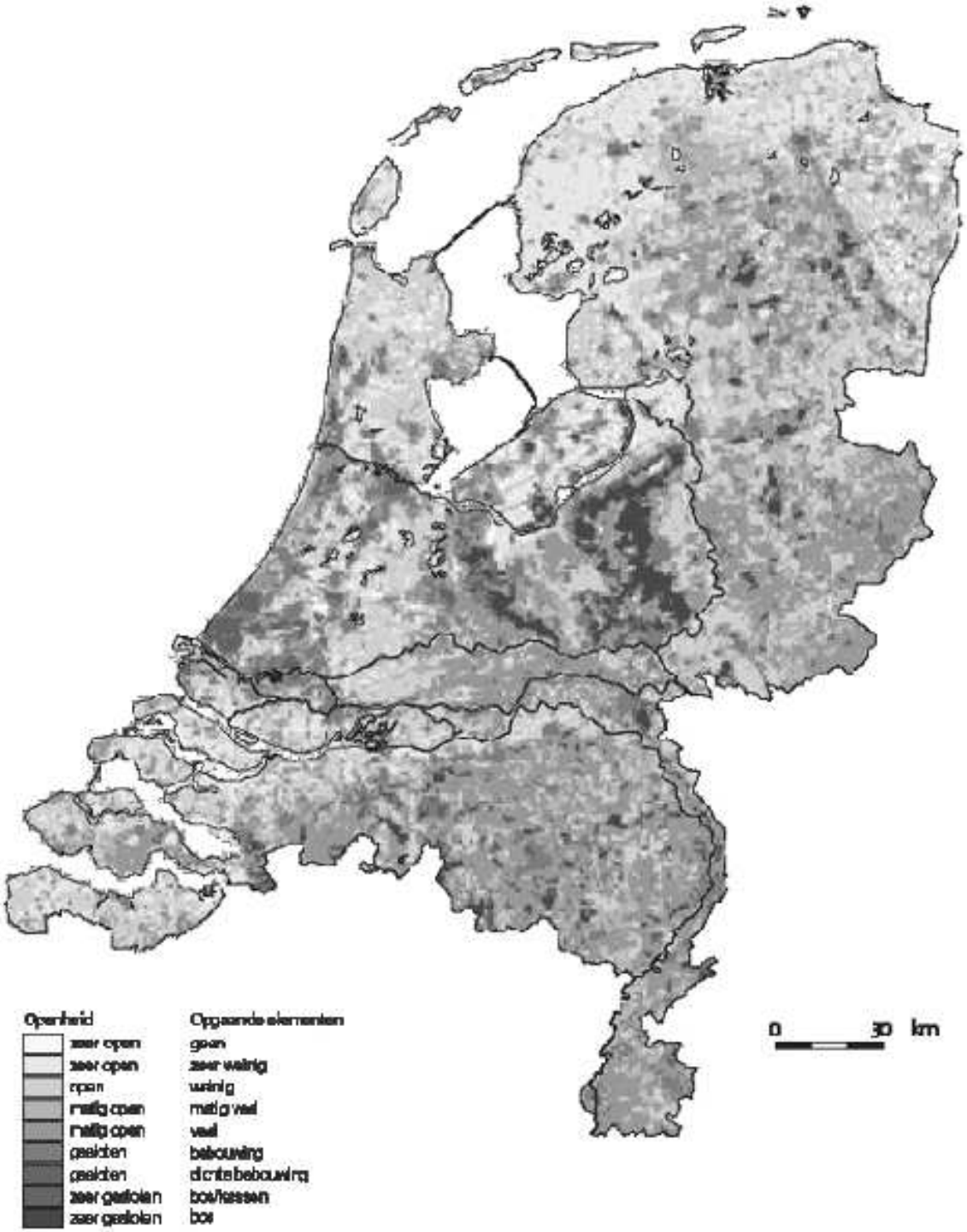
Area size in hectares of open areas

cartograph

Relative open-ness of landscapes



Open-ness of areal elements, (with few to many vertical elements)



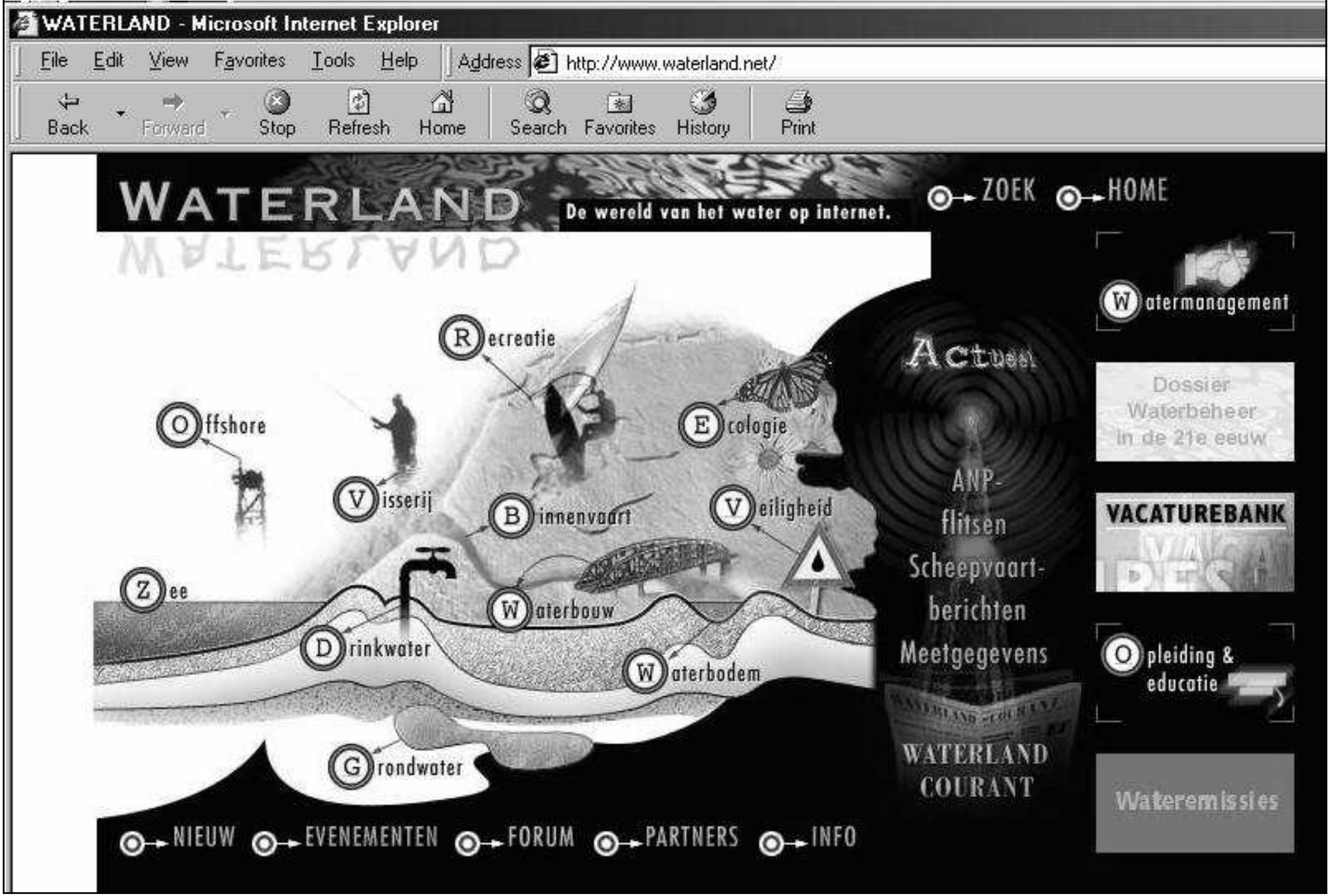
cartography section, faculty of geosciences,

AHN – hypsometric file: 1 measurement per 16m^2

Other projects/databases

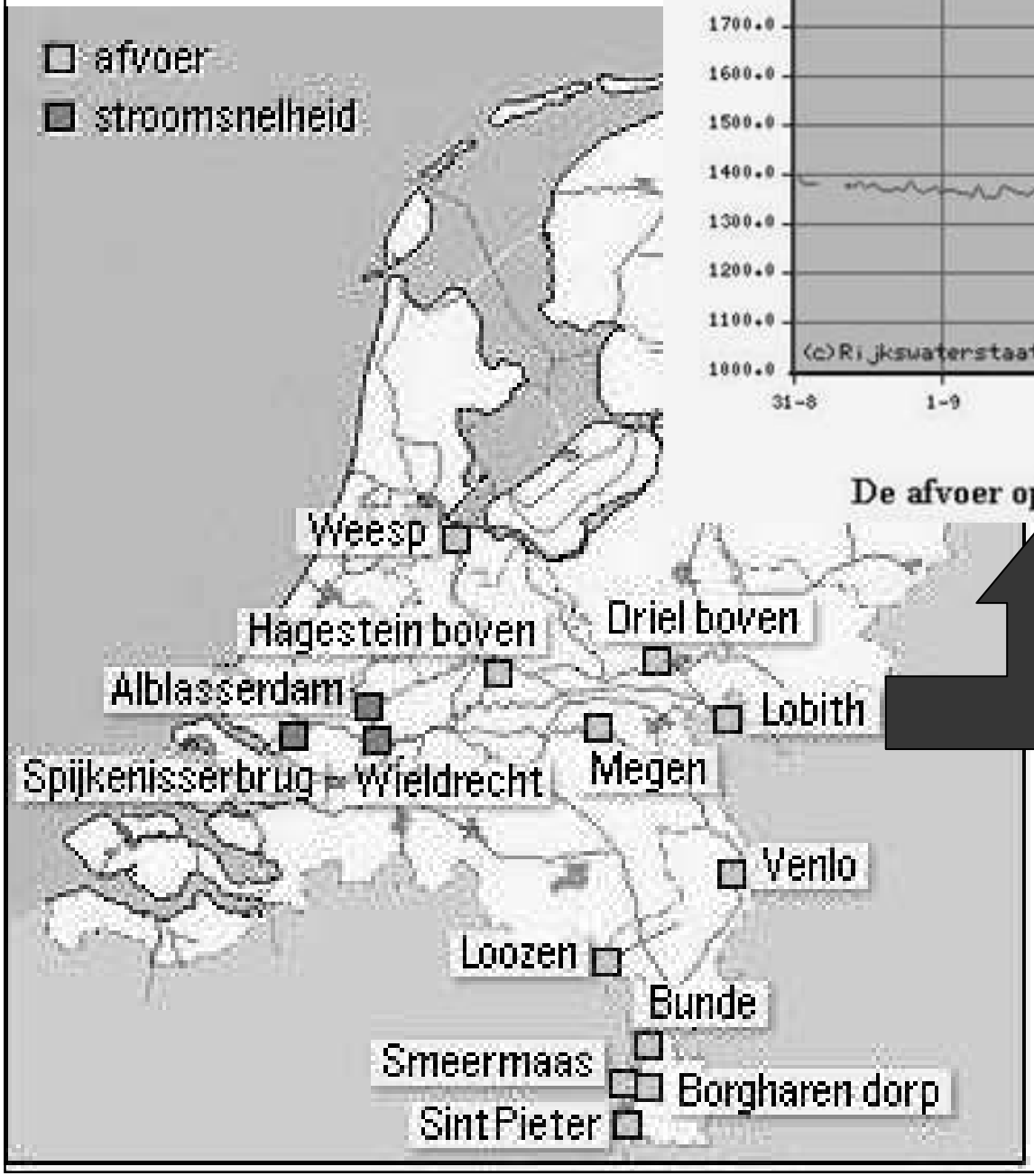
- Waterland
- Cultural historic GIS
- Risk maps
- Meetnet/measuring network

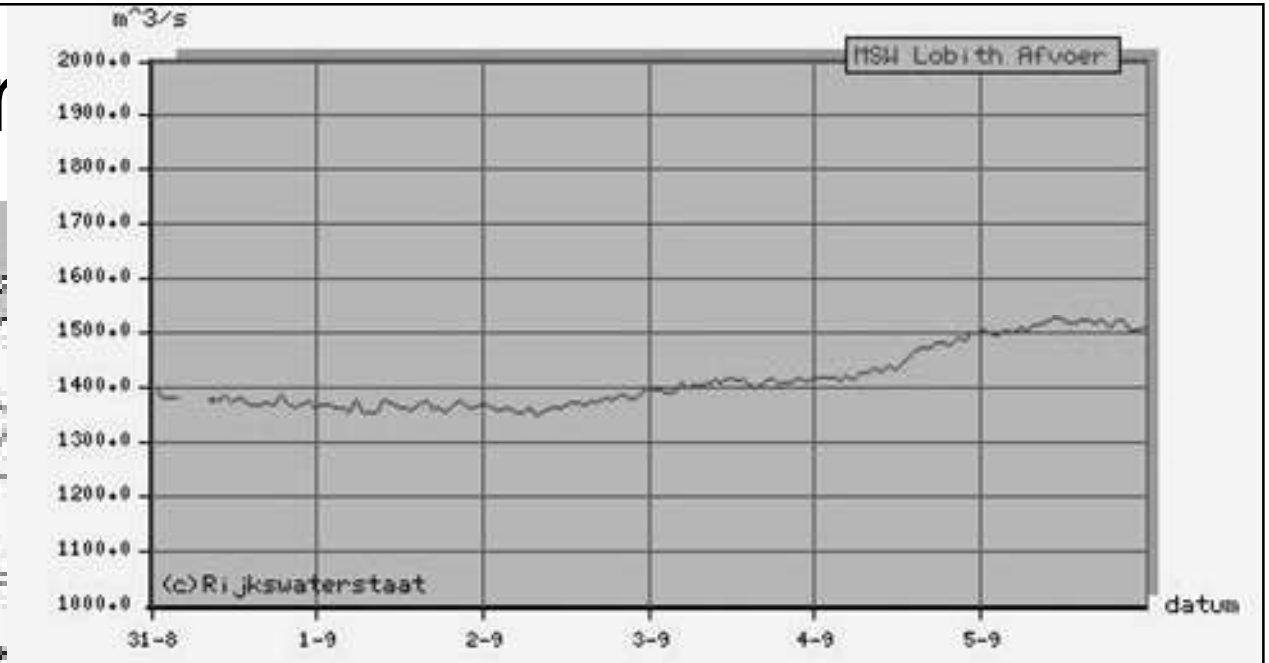
Waterland: http://www.waterland.net



Waterland : water capacity and velocity

Waterland water

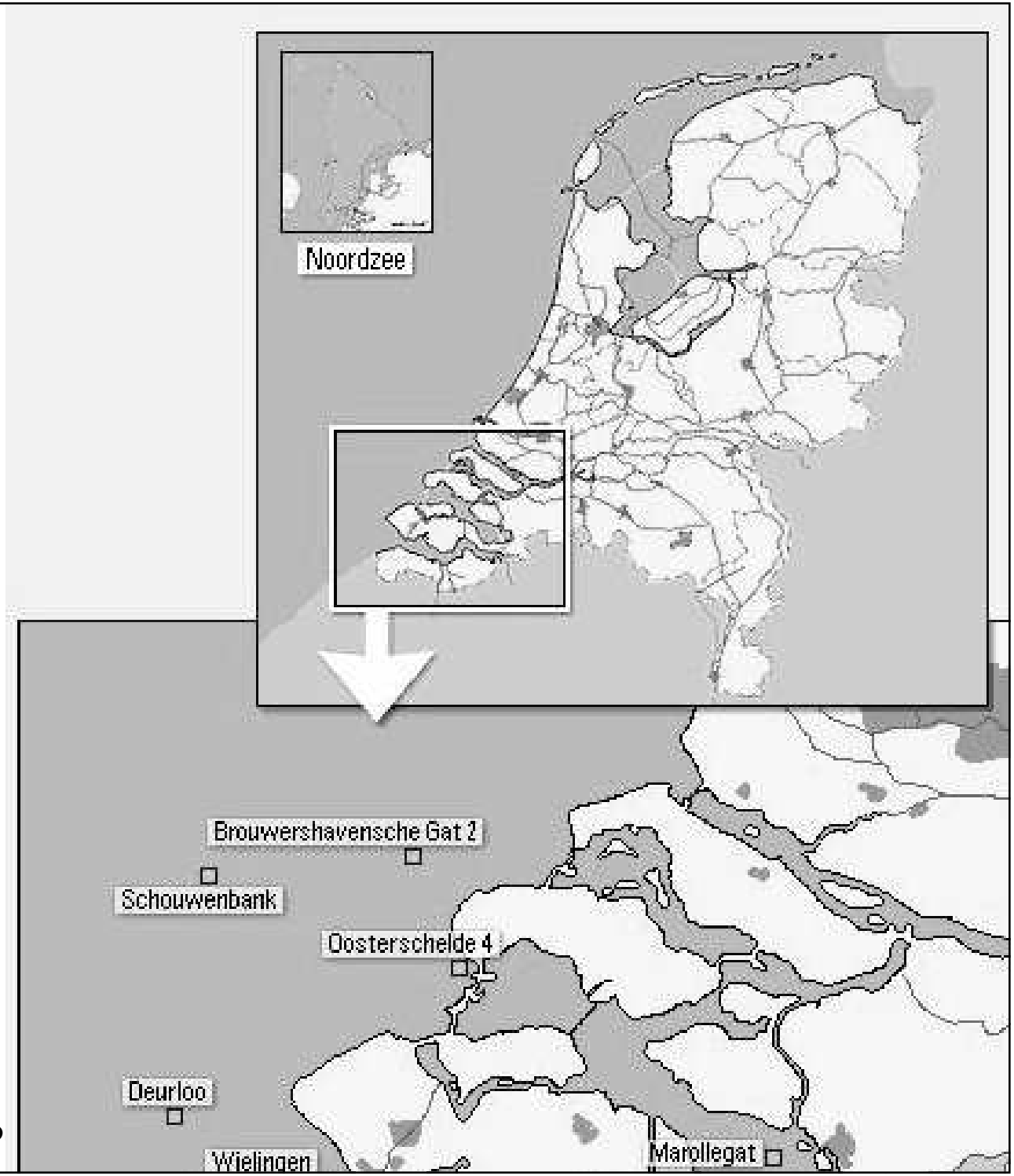


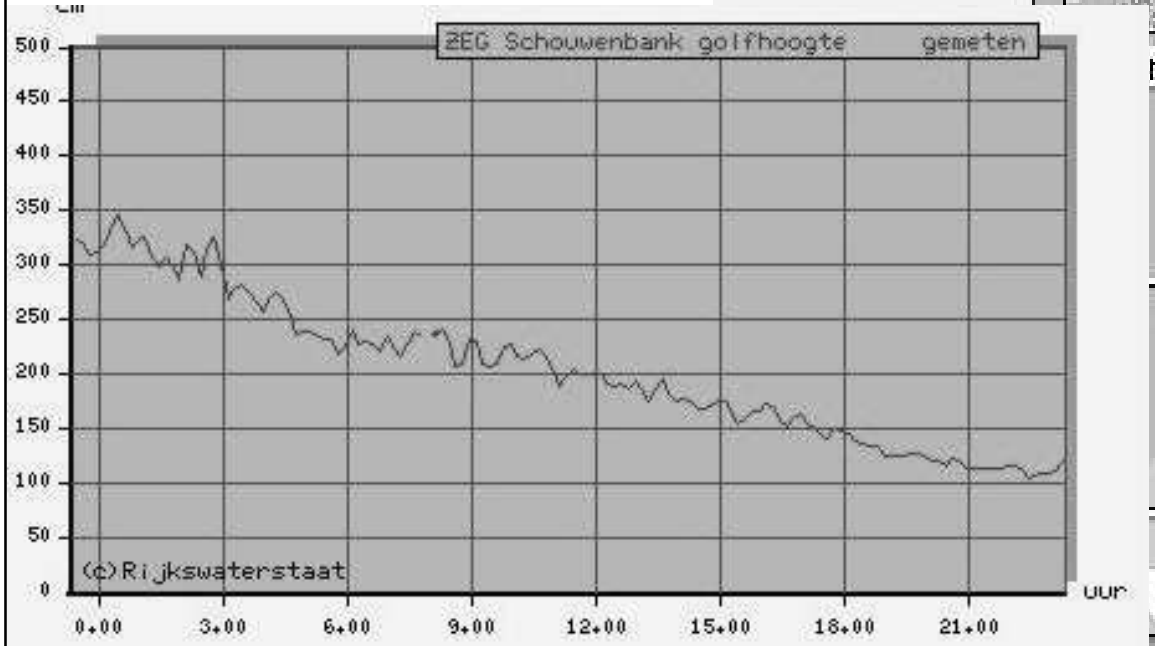


De afvoer op 05 september, 23:20 uur is 1512.9 m^3/s

On-line link to water-gauge

Waterland

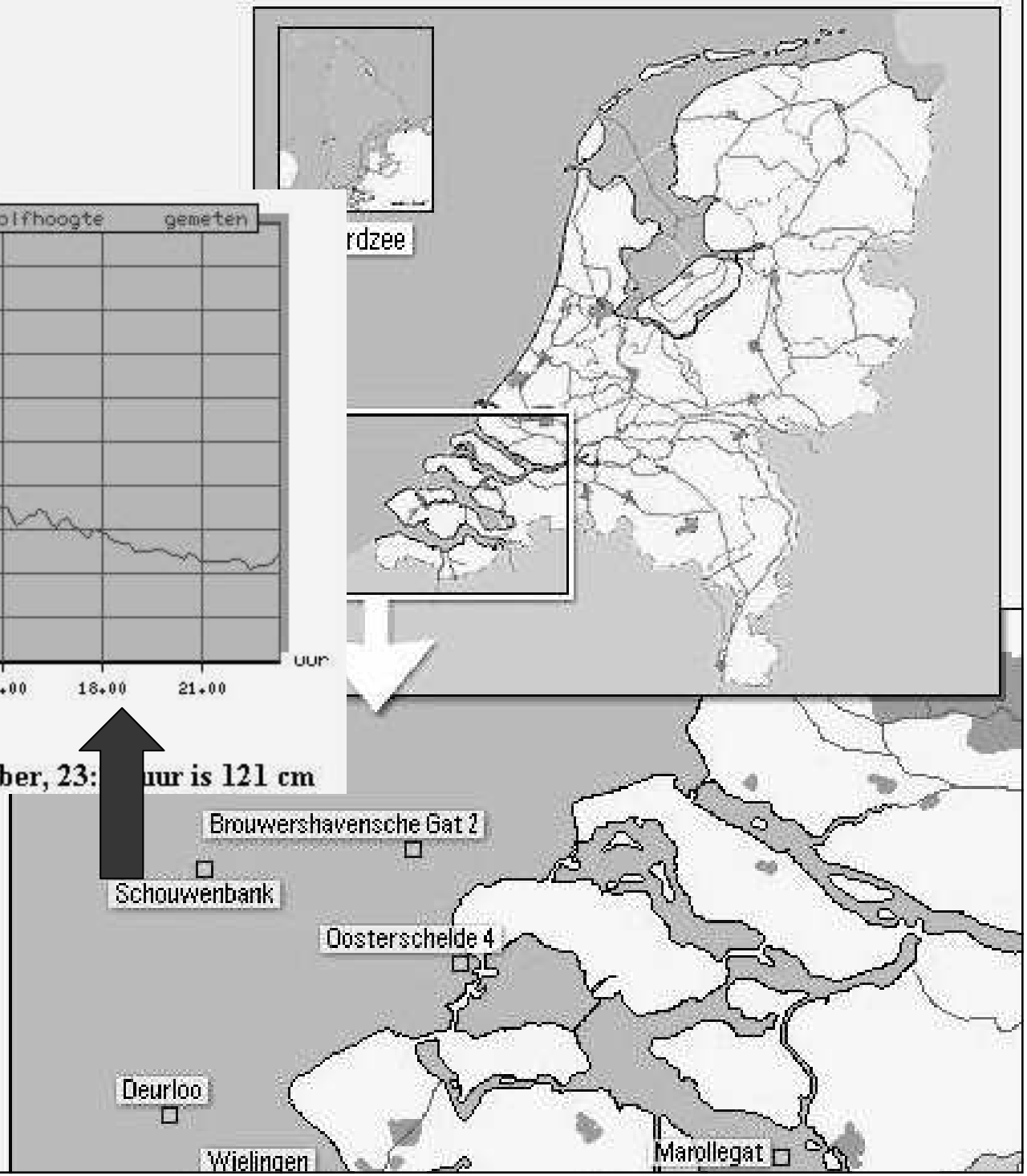

Noordzee
Brouwershavensche Gat 2
Schouwenbank
Oosterschelde 4
Deurloo
Wielingen
Marollegat

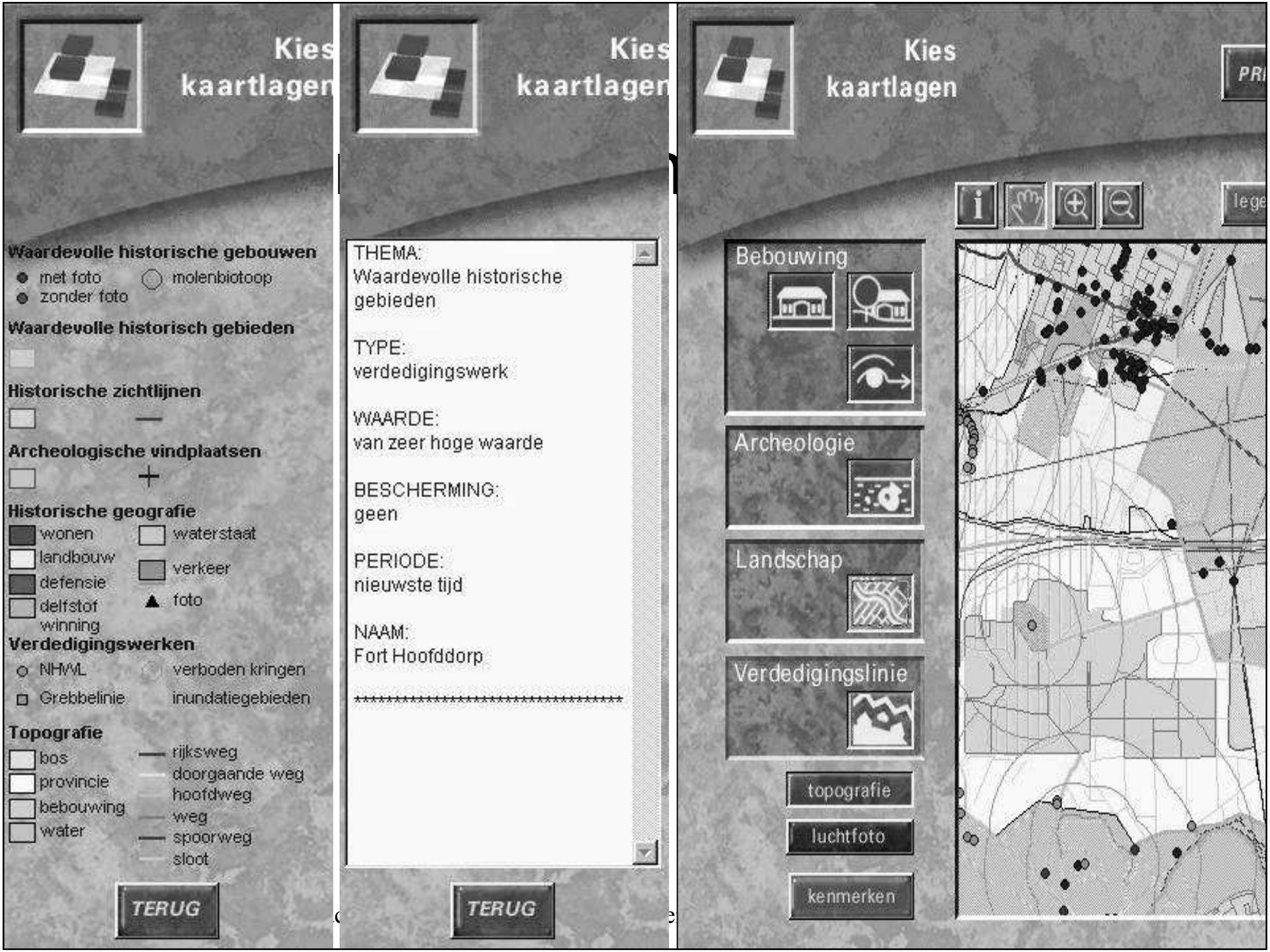


De significante golfhoogte op 05 september, 23: uur is 121 cm

On-line link with wave height gauging station

cartography section, faculty of geo




Kies kaartlagen
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zonder foto
molenbiotoop
Waardevolle historisch gebieden
Historische zichtlijnen
Archeologische vindplaatsen
Historische geografie
wonen
landbouw
defensie
delfstof winning
waterstaat
verkeer
foto
Verdedigingswerken
NHVL
Grebbelinie
verboden kringen
inundatiegebieden
Topografie
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provincie
bebouwing
water
rijksweg
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Waardevolle historische gebieden
TYPE:
verdedigingswerk
WAARDE:
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BESCHERMING:
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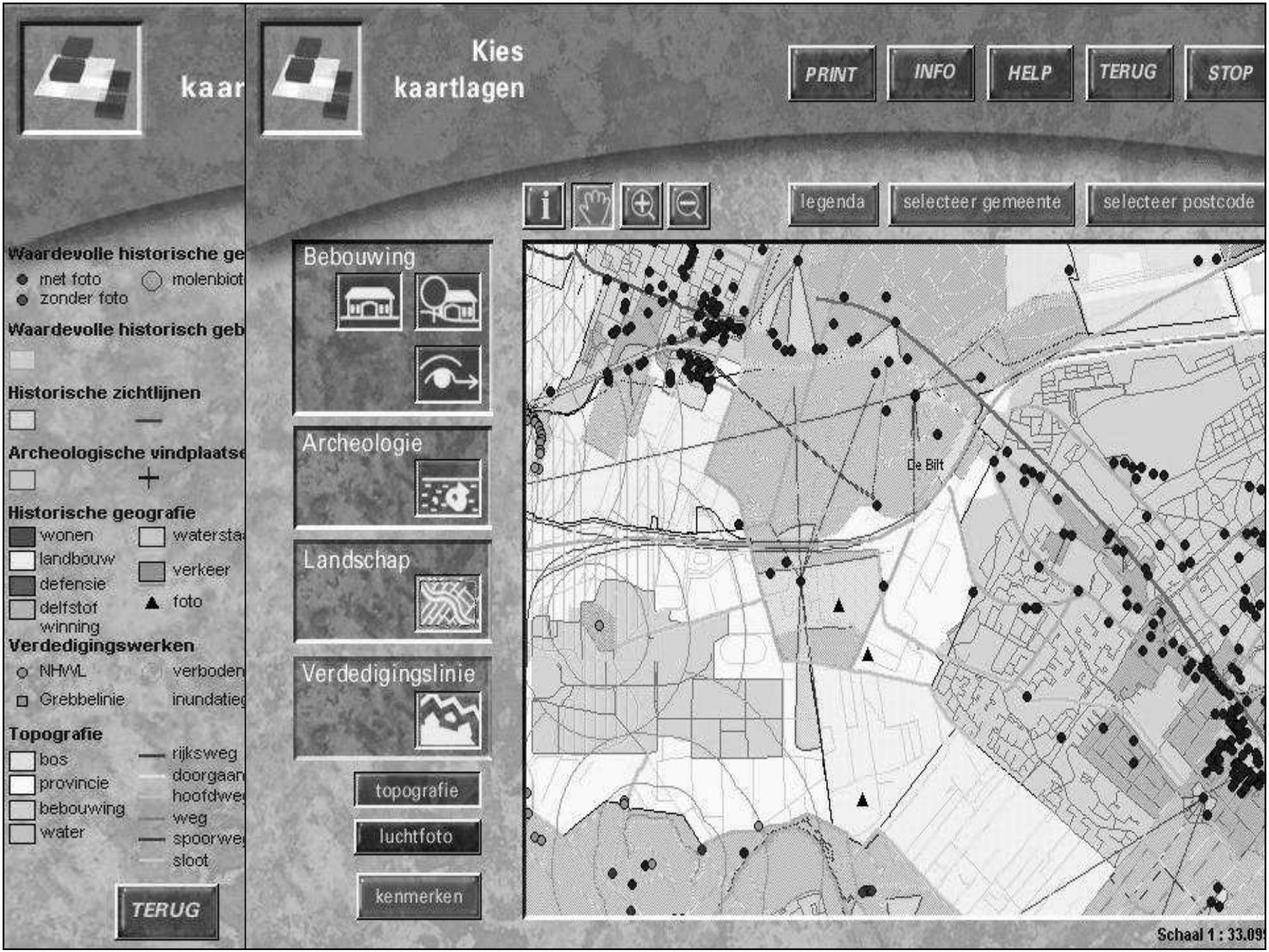
Bebouwing
Archeologie
Landschap
Verdedigingslinie
topografie
luchtfoto
kenmerken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Verdedigingswerken
NHVL
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verboden
inundatieg
Topografie
bos
provincie
bebouwing
water
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doorgaan
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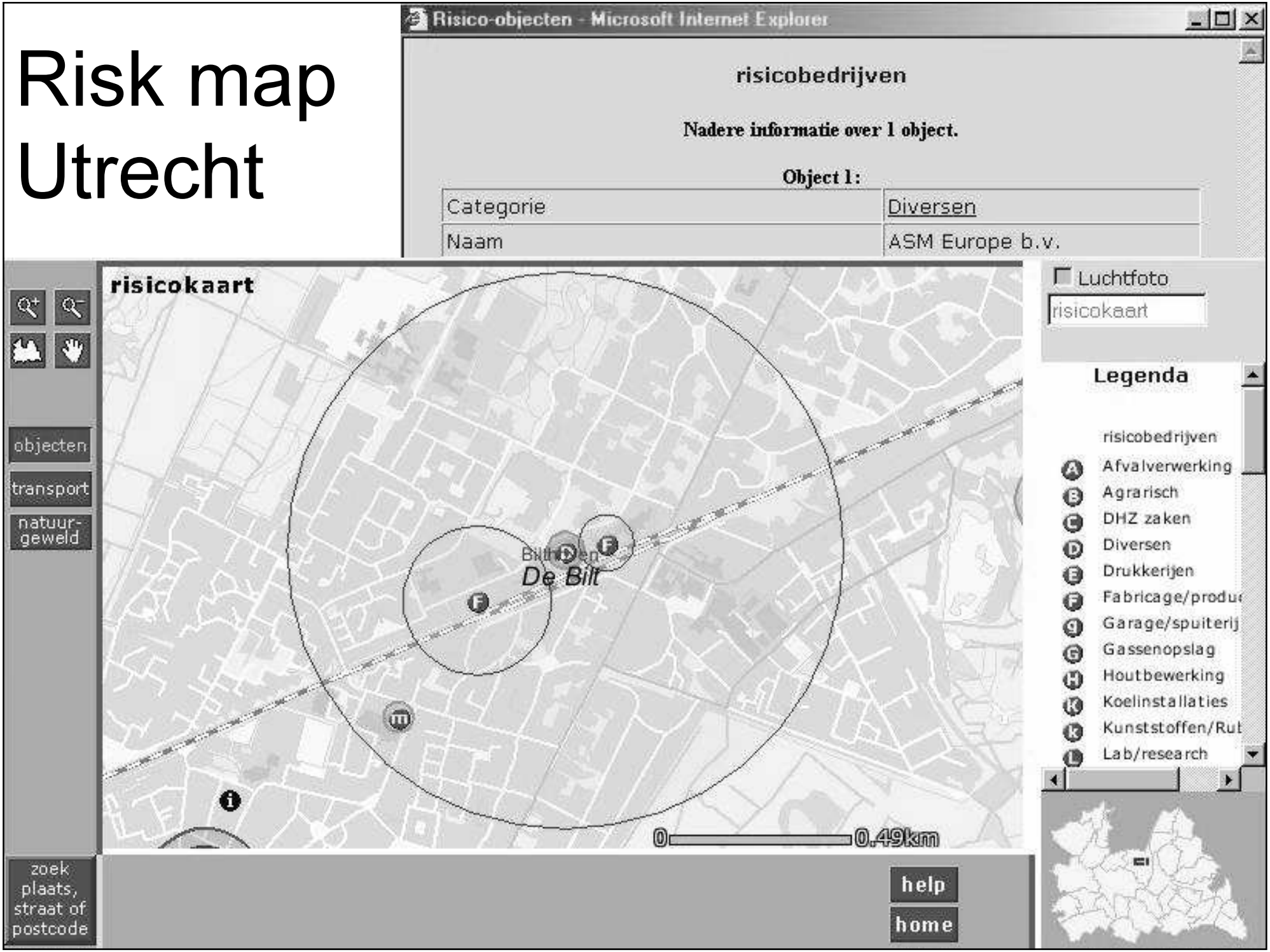
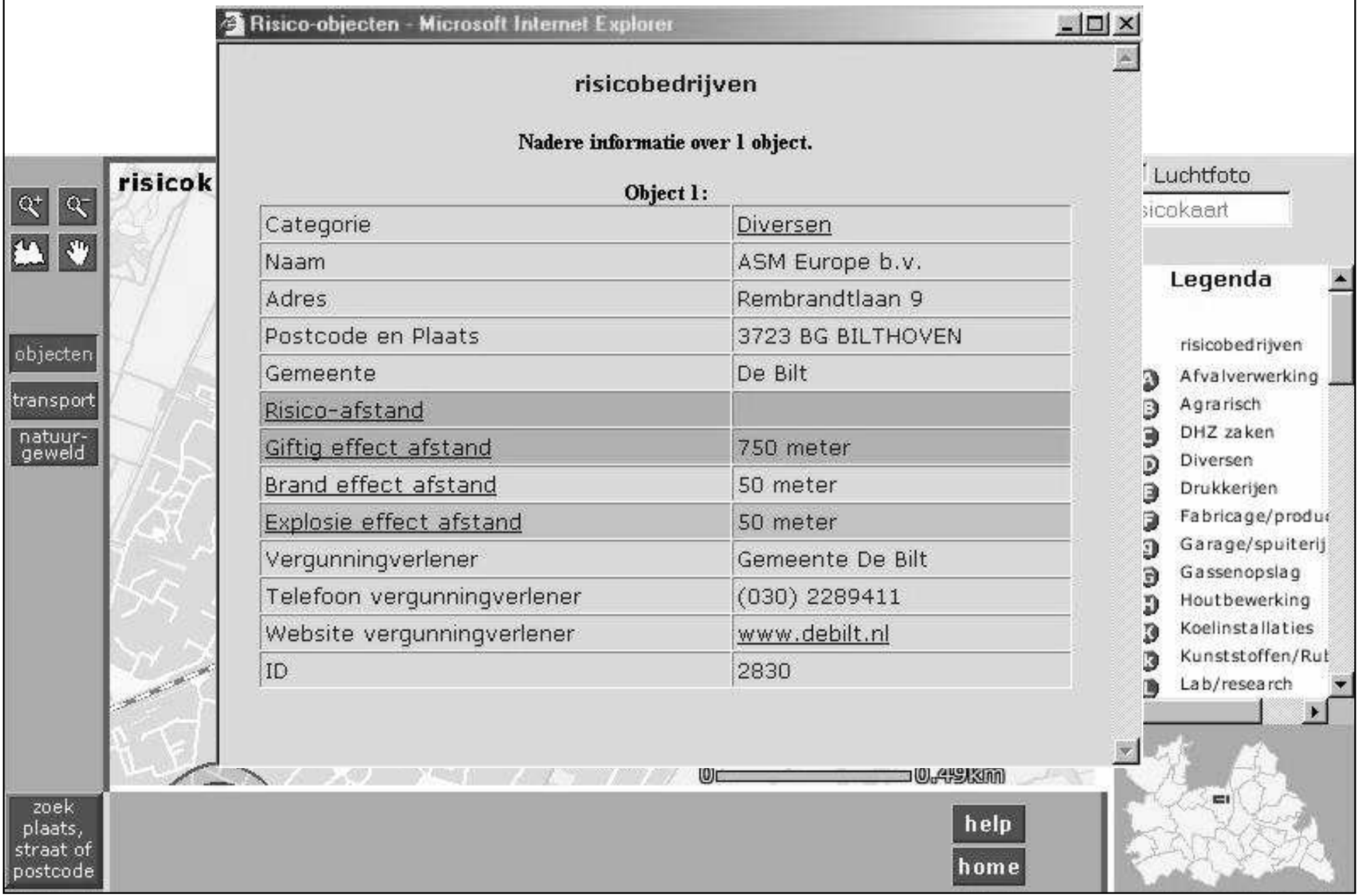
kenmerken
De Bilt
Schaal 1 : 33.09

Risk map Utrecht



Risk map Utrecht



Meetnet landschap / LandscapeMonitoring system

- Measurement of people's landscape perception
- Monitoring changes in characteristic cultural historic elements
- Local checking (schouw)
- Monitoring changes in characteristic earth science patterns

Meetnet landschap / LandscapeMonitoring system (cont.)

- Defining identifying scale characteristics
- Monitoring characteristic ecological patterns
- Monitoring changes in land use

Meetnet landschap / LandscapeMonitoring system (cont.)

- Measurement systems for biodiversity
- Measurement system for the quality of the ecological main structure
- Cultgis: cultural-historical GIS + TDN
- AKIS Earth Science information system (+AHN)
- VIRIS (visual spatial information system (classification of landscape on the basis of vertical elements per 1km grid cells)
- Ecological landscape index (+LGN)

Phases of Environmental mapping

- Local individual initiatives for single elements
- Building of monitoring systems
- Integration on a regional level, evaluation
- Going underground because of misuse

- Development of models (cf North Sea)
- Integrating measurement systems
- Development of automated checking systems (AHN,TDN,LGN)
- From national to Europe-wide level

Scale aspects

Different environmental problems exist at different scale levels