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SGAB, Uppsala

June 1991

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ABSTRACT

Fallout studies in the Gideå study site after the Chernobyl fallout in 1986, has come to the point that a more exact surface mapping of the studied catchment basin is needed. This surface mapping is mainly made for area calculations of different soil types within the study site. The mapping focus on the surface, as the study concerns fallout redistribution and it is extended to also include materials down to a depth of 0.5 meter. Volume calculations are made for the various soil materials within the top 0.5 m. These volume and area calculations will then be used in the modelling of the migration and redistribution of the fallout radionuclides within the studied catchment basin.

CONTENTS Page

1. INTRODUCTION

Within the project: Fallout studies in the Finnsjö and Gideå areas after the Chernobyl accident 1986, one of the main tasks is to calculate the redistribution of radionuclides within the Orrmyrberget catchment basin at Gideå (Figure 1). Before the modelling of the redistribution can start it is quite obvious that detailed local knowledge about the geology, vegetation and hydrology is a necessary condition for a successful result.

During June 1989 the field work was performed for the soil map. For further project information see Gustafsson et al 1987 and Ittner 1991.

2. AIM OF SOIL MAPPING

The aim of mapping the soil is to get detailed knowledge about the ground surface with respect to material, vegetation cover degree, hydrological conditions etc. and to describe the various materials and their distribution down to a depth of 0.5 m so that the area and the volume of the materials can be estimated. Within the top 10 cm every cm is documented, thereafter every 10 cm. This is made for budget calculations and modelling of the migration of the radionuclides in the soil.

In 1986, SGAB constructed a soil map with aerial photography as basis (Gustafsson et al 1987). This map was made with customary methodology for soil mapping. This methodology is mapping the soil, under the of ground weathering or cropping changed soil horizon, at usually 0.5 m depth. (SGU 1978) This customary methodology gives an incorrect information of the prevailing conditions because the highest concentration of the fallout radionuclides are to be found in the uppermost soil layers. However, a customary soil map was constructed in field for the study site and it is presented in Figure 21.

3. SITE DESCRIPTION

The Gideå study site is situated in the county of Ångermanland, about 20 km from the coast and 30 km north of the city of Örnsköldsvik. The terrain is relatively flat, forested and with many small mires. The highest coastline in this part of the country is parallel to and about 50 km from the present coast. This makes the Gideå study site, with its highest altitudes at 125 m.a.s.l., situated far below the highest coast line with its 280 m.a.s.l..

The catchment of Orrmyrberget is about 500 m wide and about 1500 m long (0.74 km^2) and it is a trough shaped catchment basin (Figures 2, 9, and 11–15). The highest altitudes are strongly wave–washed and distinct shingle lines can clearly bee seen, especially in the eastern part of the area. Down–

wards the wave washed altitudes, on the side of the basin, till is found. The till surface is wave-washed. In the bottom of the catchment basin out-washed silt and sand deposits are found. These are partly covered with peat.

4. MAPPING METHOD

The original thought was to make a wery detailed mapping and the study site was divided into squares with 20 m side in a fixed local coordinate system. This resulted in about 2500 squares. The work input would have been too extensive. The mapping effort was reduced by mapping only each sixth (or third) E–W line. This gives one mapping point every 20 m in E–W direction and one mapping point each 120 m (in some cases 60 m) in N–S direction. In total this makes about 320 survey points (Figure 4) with mapping clas-sifications at 14 depths intervals with eleven material specifications at each depth. The main points in data collecting for the surface survey were: soil type (material), thickness of organic layer, groundwater level depth (within 50 cm if possible), vegetation and hydrology.

The short distances between survey points in E–W direction, compared to N–S, are due to that the changes in soil material are more frequent in E–W direction. This becomes of the geological history during holocene shore displacement, and so consequently the generalizations that are made can be done with better accuracy in N–S direction than to E–W.

The map is relatively precise in large parts of the mapped study site. Only the central–west part is more imprecise compared to the rest due to its geological structure (the terrain consists of bedrock with almost no soil cover except for the peat, moss and lichen cover) and here rock and peat are generalized. This part consists of outcrop and large blocks with hollows filled with peat (Figure 7). The large blocks sometimes changes into large–block till. The peat hollows or pools can in some cases be very wet and most probably the water from these are slowly infiltrated in the bedrock.

The coordinates were fixed in field mainly by a N–S base line. Out from this N–S base line, the E–W lines were mapped with compass and goniometer.

The mapping were made with a prick–probe and the information was registered in an specially made form (Table 4). One form was used fore every mapping point. This was to simplify both for the field work the fourth–coming transfer of all the collected field data to a computer.

The generalizations for the soils are made in agreement with the field practice established by the Swedish Geological Survey.

For better coordination of the coming detailed measurements within the study site, a combined mapping and sampling (for surface activity measurements) were performed. The samples for measuring the activity distribution within the study site were taken every 60 m in E–W and every 120 m in N–S, every third mapping point, in all 120 samples (Figure 5).

5. CLASSIFICATION OF MATERIALS

The mapping of the materials within the study site are classified in the following way:
- Geology
- Vegetation
- Hydrology

5.1 GEOLOGY

Geology are sub–divided into different types of material:

Rock surfaces is divided into three types namely; non–fractured rock, fractured or large block surfaces.

Till is not sub–divided within the study site. The till is covered with a thin (usually 5 – 10 cm) organic layer. Till within the study site is uniform, usually sandy stony till with wave washed surface. Large blocks on the surface are frequent in the northern part.

Shingle is found on the high altitudes in the eastern part of the catchment basin. The thickness of the shingle lines varies from 5 cm, in the south, to 0.5 – 1 m in the eastern part. Shingle is a residuum of wave washed till material on a shore line.

Sand within the study site is an out–wash material produced by the regress-ing sea during Litorina time (7000 BP). The sand is sub–layering the peat to a relatively large extent. When the sand is near–surface it is mostly covered by thin vegetation (usually 0 – 5 cm).

Silt is occurring between sand and peat in the central and southern part of the study site. In two thin N–S passages in the central part, silt is near-surface. Silt is, like the sand, an out–wash product and it has probably sedimented on the sand in the southern more sheltered part of the bay in the litorinian see.

Gravel is found east of the well (central part) probably has the organic top soil cover been scraped off in connection with the construction of the well or the road.

Backfill is usually gravel. Mapped as road material.

Clay has not been found near–surface. One observation was yet made during the field sampling in 1987. Clay was found in the creek, near to drillhole HGI24, at about 10–20 cm under the creek bottom (about one meter below ground level).

Peat covers large areas within the catchment basin. Peat is sub–divided due to different degrees of wetting into; Fen, open and wet, Fen with coniferous forest and dry peat (drained by the creek).

Humus The thin vegetation cover on sand and till, includes the litter and rawhumus layers.

5.2 VEGETATION

Vegetation has been divided into two main groups, namely, over–vegetation like trees and under–vegetation like shrubs. Over–vegetation is sub–divided into high or low as well as dens, open or spars (forest). Under–vegetation is sub–divided into shrubs, dwarf shrubs, grass or/and ground–vegetation and also as dens, open or spars. Information about moss and lichen vegetation cover degree is supplementary (Table 3).

The vegetation cover on the rock surfaces is divided into bare rock, **moss** covered or **lichen** covered. The vegetation cover is sub–divided into "high" or "low" types (Low mosses e.g. racomitrium, high mosses e.g. pleurozium. Low lichens e.g. rhizocarpon, high lichens e.g. cladina). The degree of lichen/moss cover on rock surfaces is given in percent (c.f. Table 3).

5.3 HYDROLOGY

Hydrology is sub–divided into recharge and discharge areas (Figure 7). In the western part of the study site small recharge hollows are found in an otherwise clearly discharging area. These hollows are peat filled depressions in surroundings dominated by outcrop.

The groundwater level is determined with a prick–probe in low–level areas where this is possible. The groundwater level follows the ground level very closely, independent of altitude, and varies mostly between 10 – 20 cm below the surface (Figure 8).

Data about precipitation, groundwater level and discharge of/from the study site is given in Ittner et al 1989.

6. INTERPRETATION OF GEOLOGY AND GROUNDWATER FLOW

The geology within the study site consists of crystalline precambrian bedrock and of quaternary soils. The totally dominating rock type is migmatite. The migmatite is an old sediment (2000 Ma), transformed by the svecocarelian orogeny (1800 Ma) to a medium grained massive rock, grey in color. Some dolerite dikes are also cutting trough the bedrock within the study site. The geology and tectonics (Figure 3) for the Gideå area is presented in Ahlbom et al 1983, Albino et al 1982 and in Gustafsson et al 1987.

The soils within the study site are all late quaternary. Till were deposited by the regressing ice directly on the bedrock during the finiglacial era (9000 BP). The isostatic uplift of the land is wery noticeable in this part of sweden. When the inland ice disappears from the Gideå area, the sea level were at the current 280 m level. The isostatic uplift was fast and when the see level reaches the top of the Orrmyrberget, at 125 m.a.s.l., it will rework the soil on top of the mountain. The impressing shingle lines is a result of this rework. It should be noticed that the highest altitudes are much more reworked than lower. On the highest levels the soil is completely missing. This is probably a result of the large fetch area (The Baltic sea). Materials displaced from these high altitudes by baltic waves were deposited as e.g. sand and silt in the low altitudes between 110 - 100 m.a.s.l. Orrmyrberget catchment basin was a small and shallow bay during Litorina time (7000 BP). The shallow bay with its relative sheltered position, gave the opportunity for materials like sand and silt to sediment. (Ittner 1981).

The infiltrating precipitation will produce groundwater. This groundwater and the precipitation will to a large extent penetrate in the creek that drains the basin. The response of precipitation on groundwater level and discharge is documented (Ittner et al 1989). To some minor extent precipitation and shallow groundwater will produce deep groundwater. Discharge from the packed-off sections in the artesian borehole KGI02 shows the contact with the surface (Ittner et al 1990).

7. CALCULATION OF AREAS AND VOLUMES

The study site, Orrmyrberget catchment basin, has an area of 0.74 km^2. The surface mapping includes 14 E – W lines with varying number of survey points, in all about 320 (Figure 4). Every mapping point has 14 level specifications namely; 0–1, 1–2, 2–3, 3–4, 4–5, 5–6, 6–7, 7–8, 8–9, 9–10, 10–20, 20–30, 30–40 and 40–50 cm below ground surface (Figures 16 – 20 and 25 – 35). The materials are chosen out of 11 types. Each mapping point represents 20 x 20 m and generalized to mostly cover an area of 20 x 120 m, in some cases 20 x 60 depending on how close the survey points are mapped (Figures 22, 23 and 24). This 20 x 120 m square will then be the base for the volume and area calculations of the various materials within the ground surface uppermost 50 cm. The maps shown in Figures 22, 23 and 24, made out of the basis maps in Figures 25 – 35, are examples of how the digitalized calculations of areas and volumes are generalized.

The 0 cm level, ground surface, for each mapping point was subjectively determined to the level were the vegetation cover "starts". Blades of grass were in this case defined to be above the ground surface.

To create iso–level lines and three dimensional "fish net" plots in a coordinate system, the computer program SURFER was used. Interpolation was made with KRIGIN program. SURFER creates HPGL–format files. HP plotter 7475A was used for plotting (Figure 6, 8, 9 and 10).

The results of the area and volume calculations are presented in Figures 36, 37 and in Tables 1, 2.

8. REFERENCES

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Ittner T. 1991: Long term sampling and measuring program. Joint report for 1987, 1988 and 1989. Within the project: Fallout studies in the Gideå and Finnsjö areas after the Chernobyl accident in 1986. SKB Technical Report 91-09.

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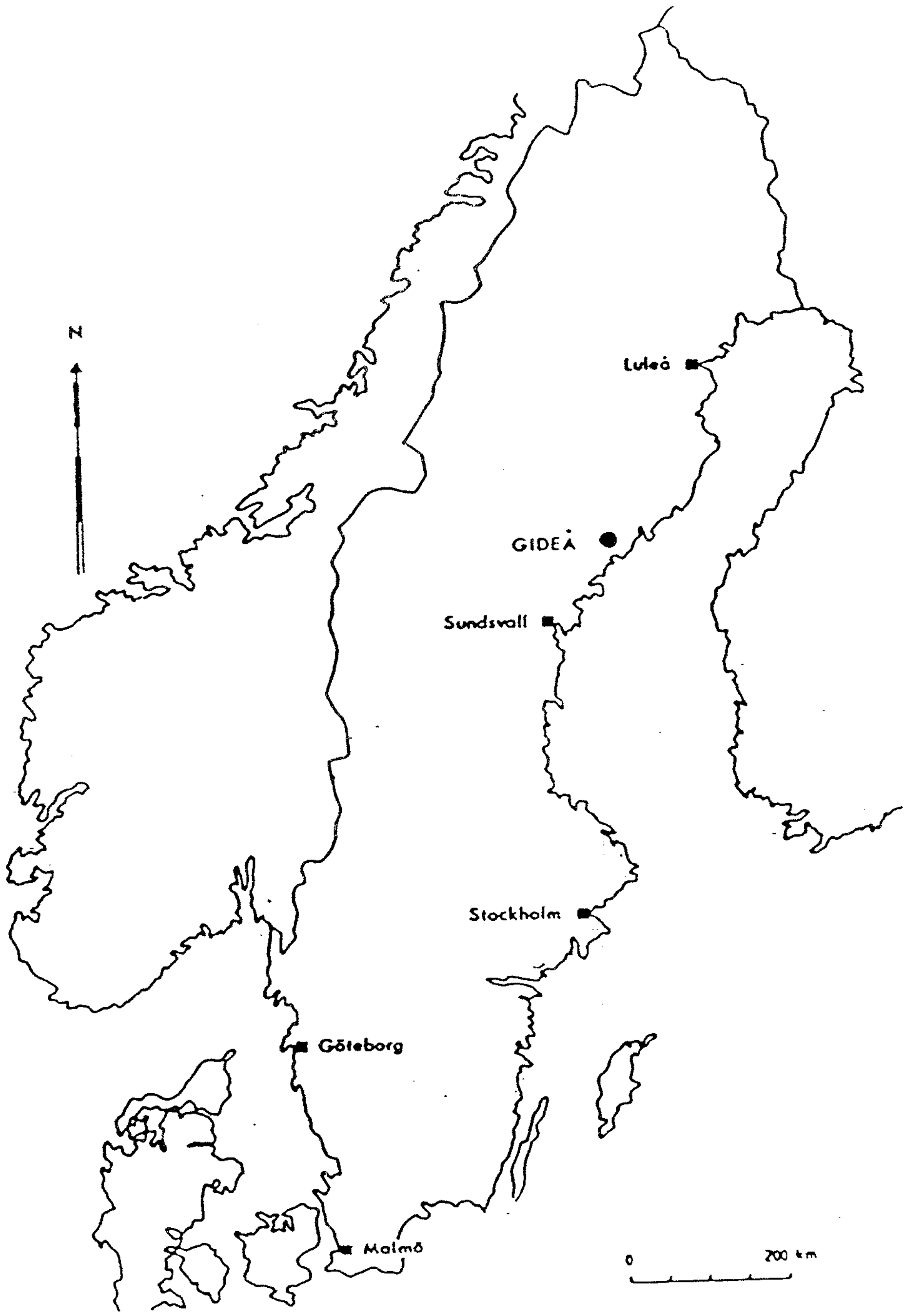

Figure 1 Location of the Gideå study site.

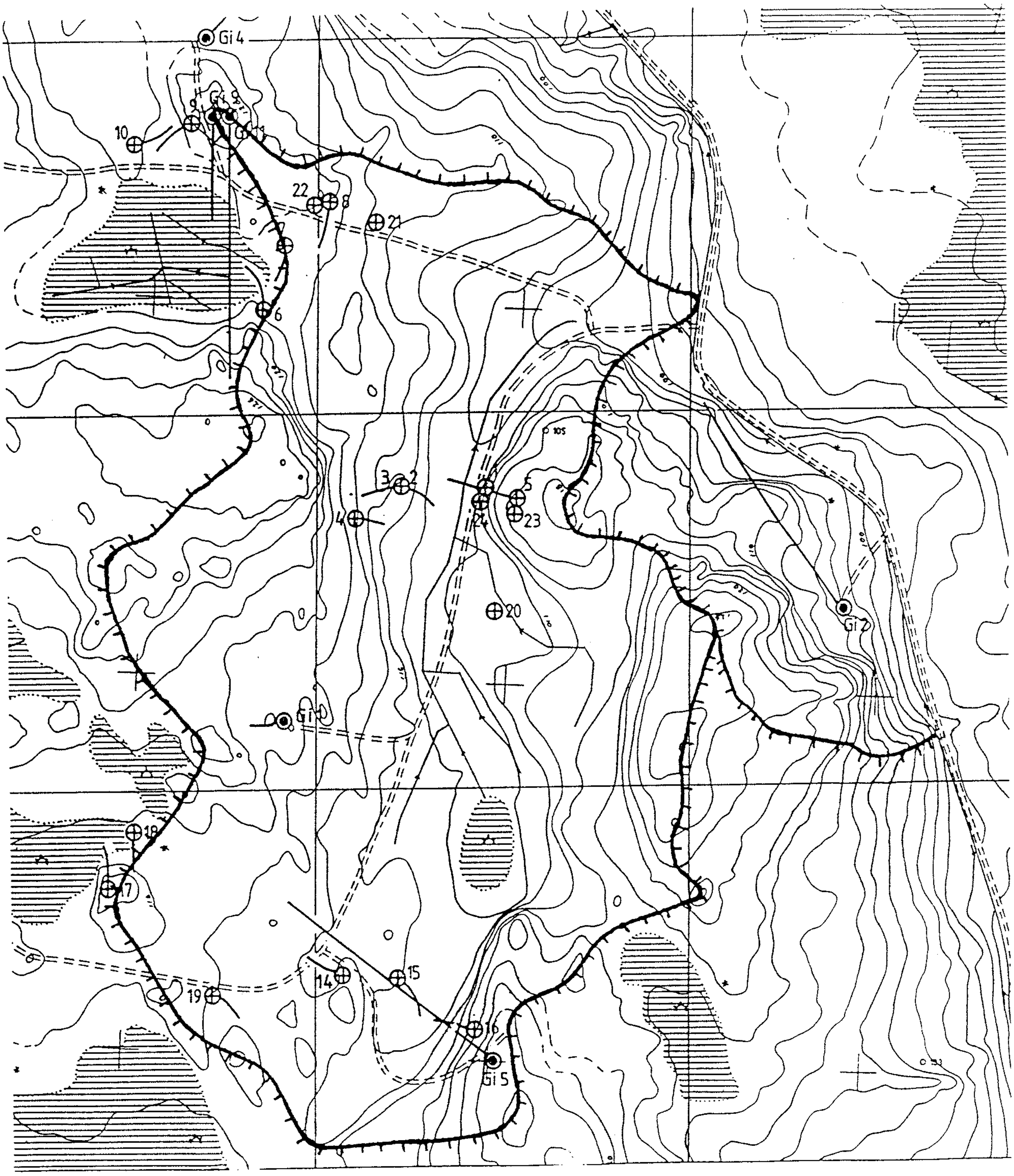

Figure 2 Orrmyrberget catchment basin at Gideå. Borehole location map. Lines pointing out from boreholes indicates their projection at ground surface.

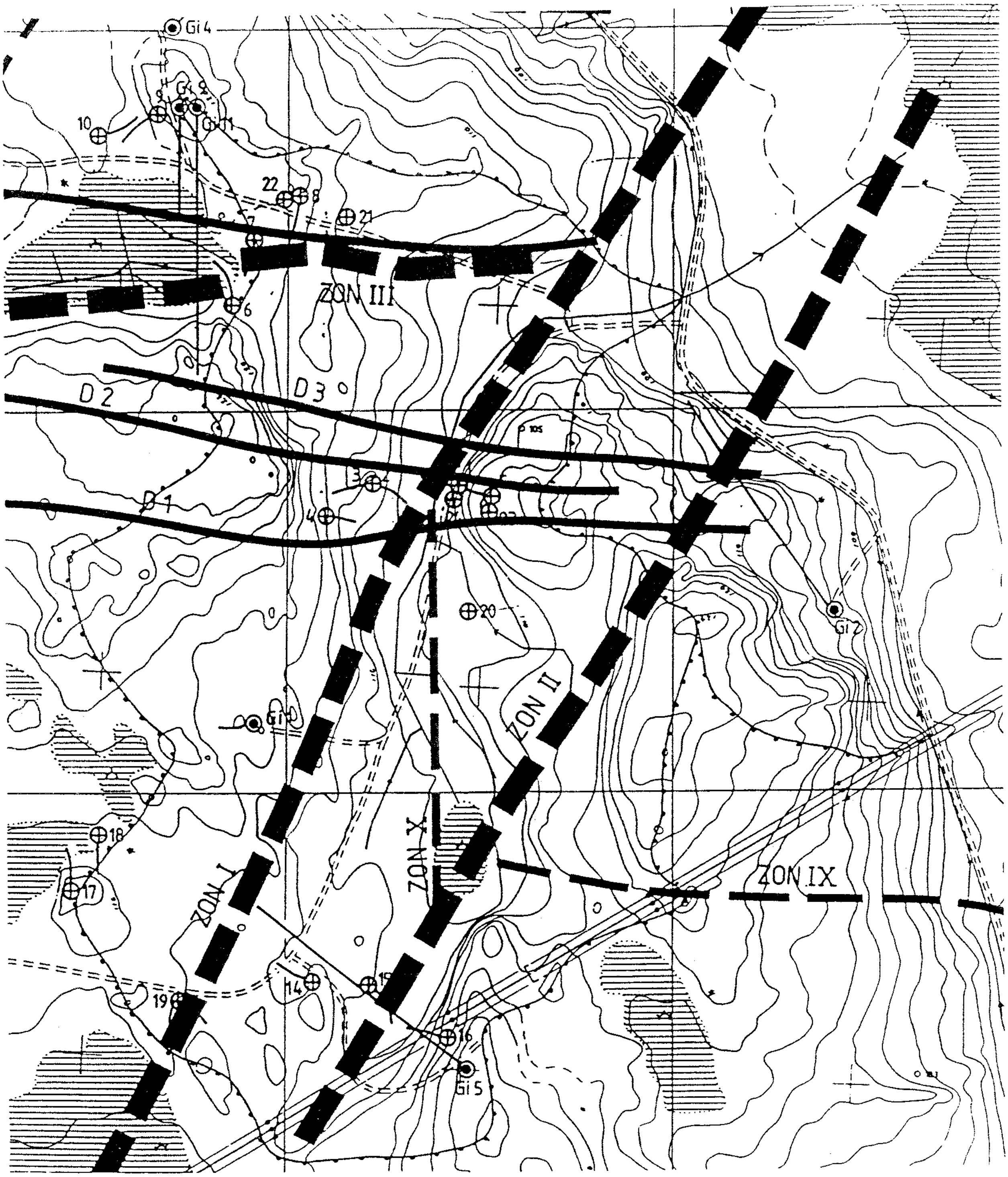

Figure 3 Major lineaments within Orrmyrbergets catchment basin.

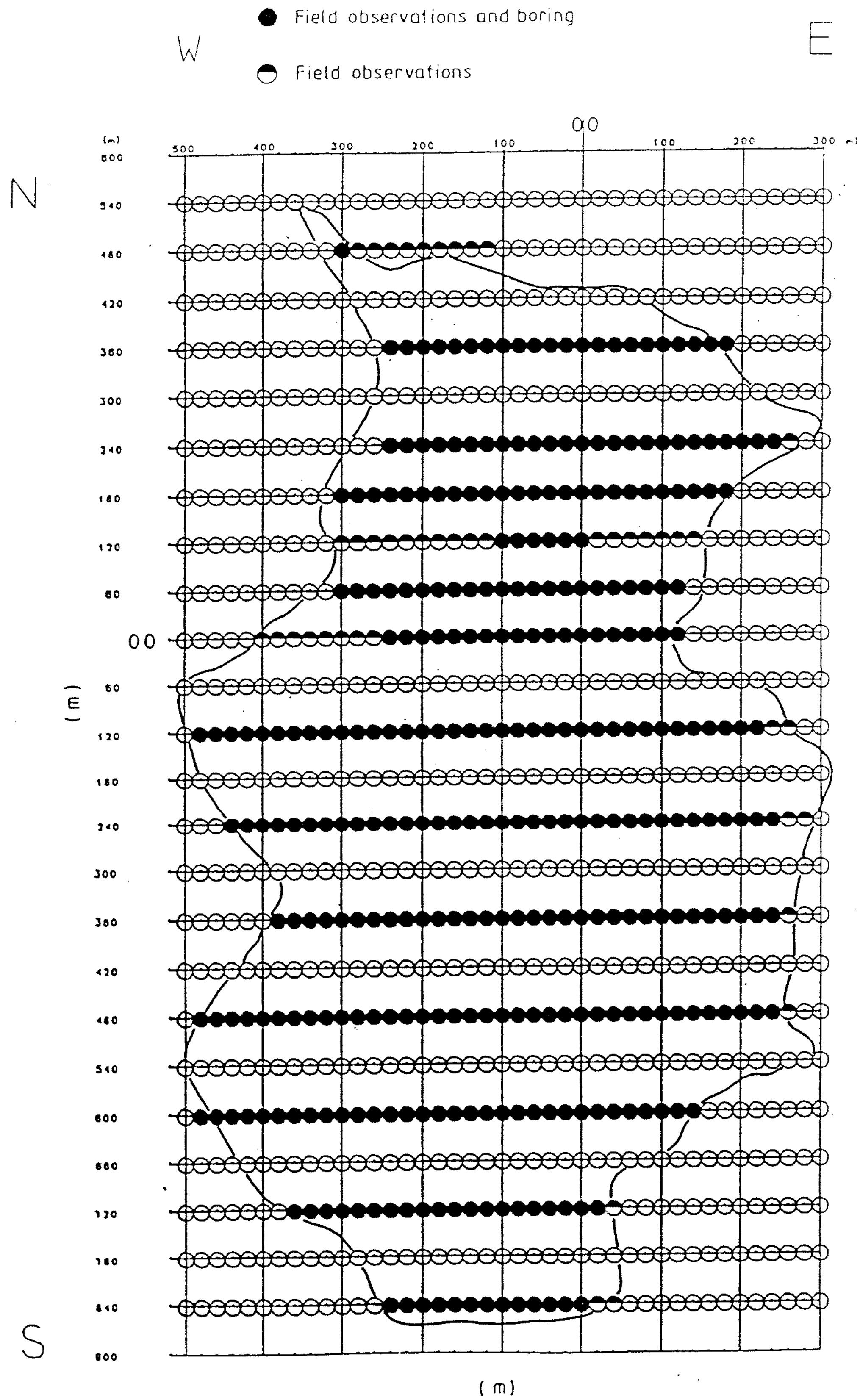

Figure 4 The geographical distribution of the survey points within Orrmyrberget catchment basin.

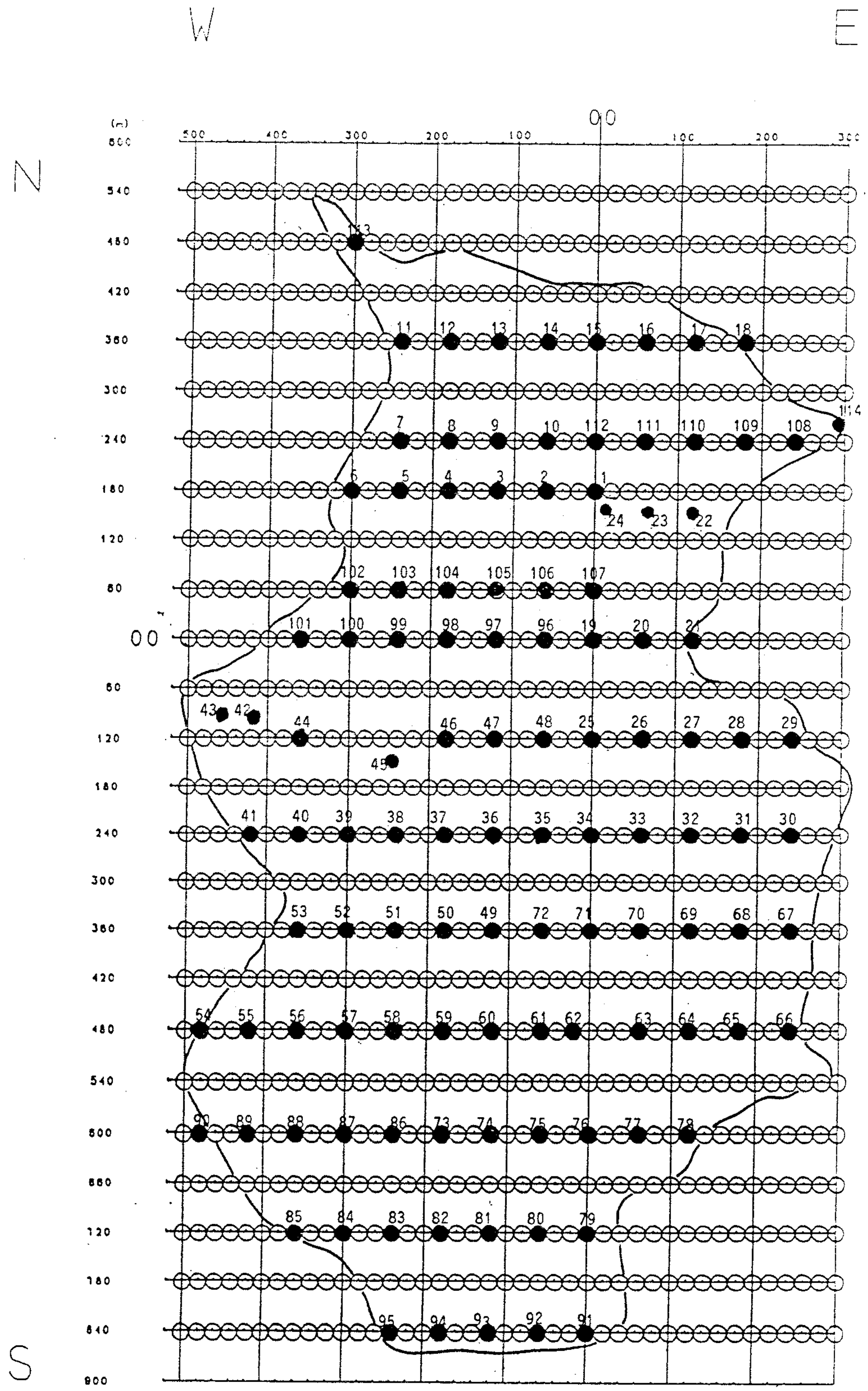

Figure 5 The distribution of the surface activity samples.

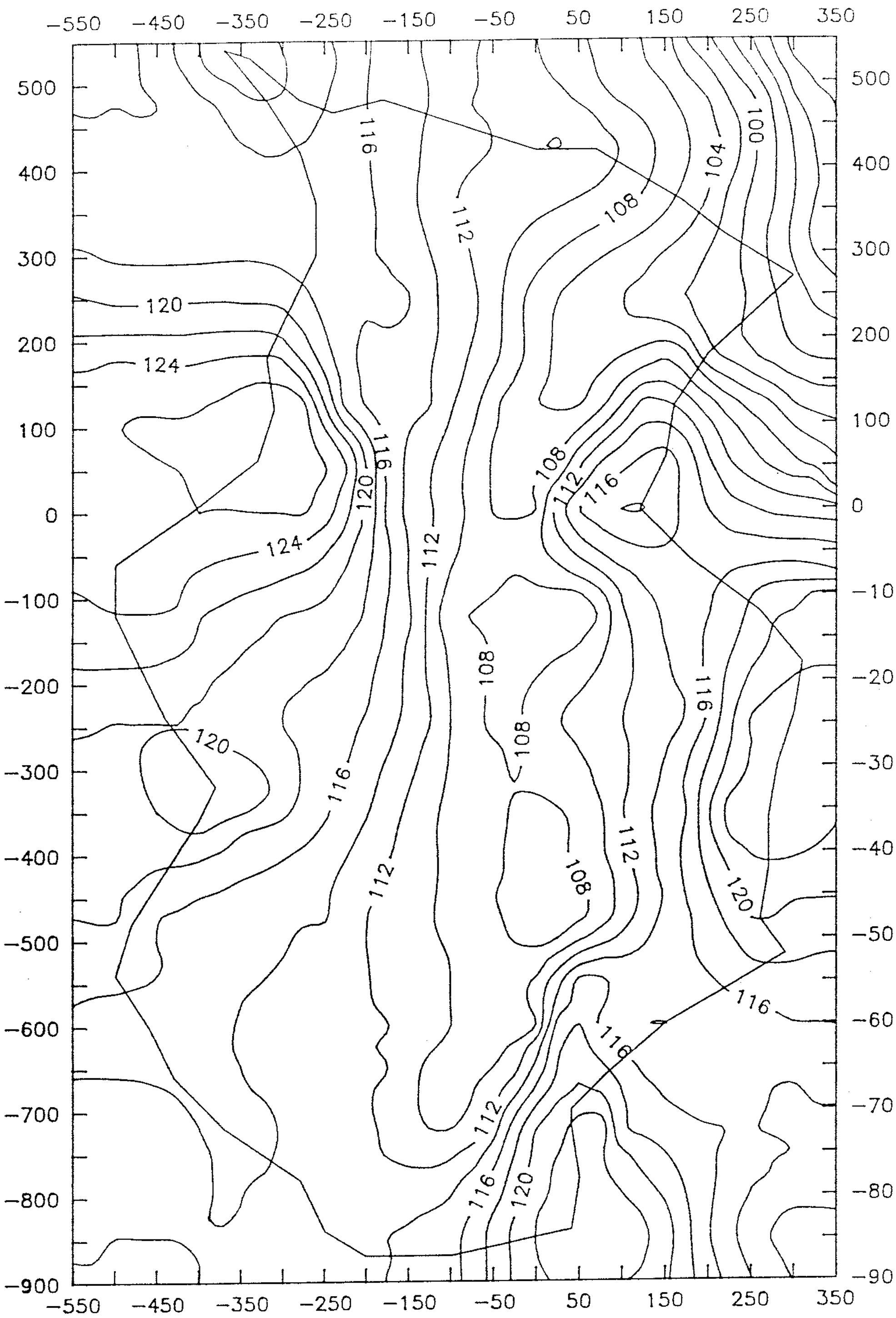

Figure 6 Topographical map for Orrmyrberget catchment basin used in calculations. Isolevels every second m.a.s.l.

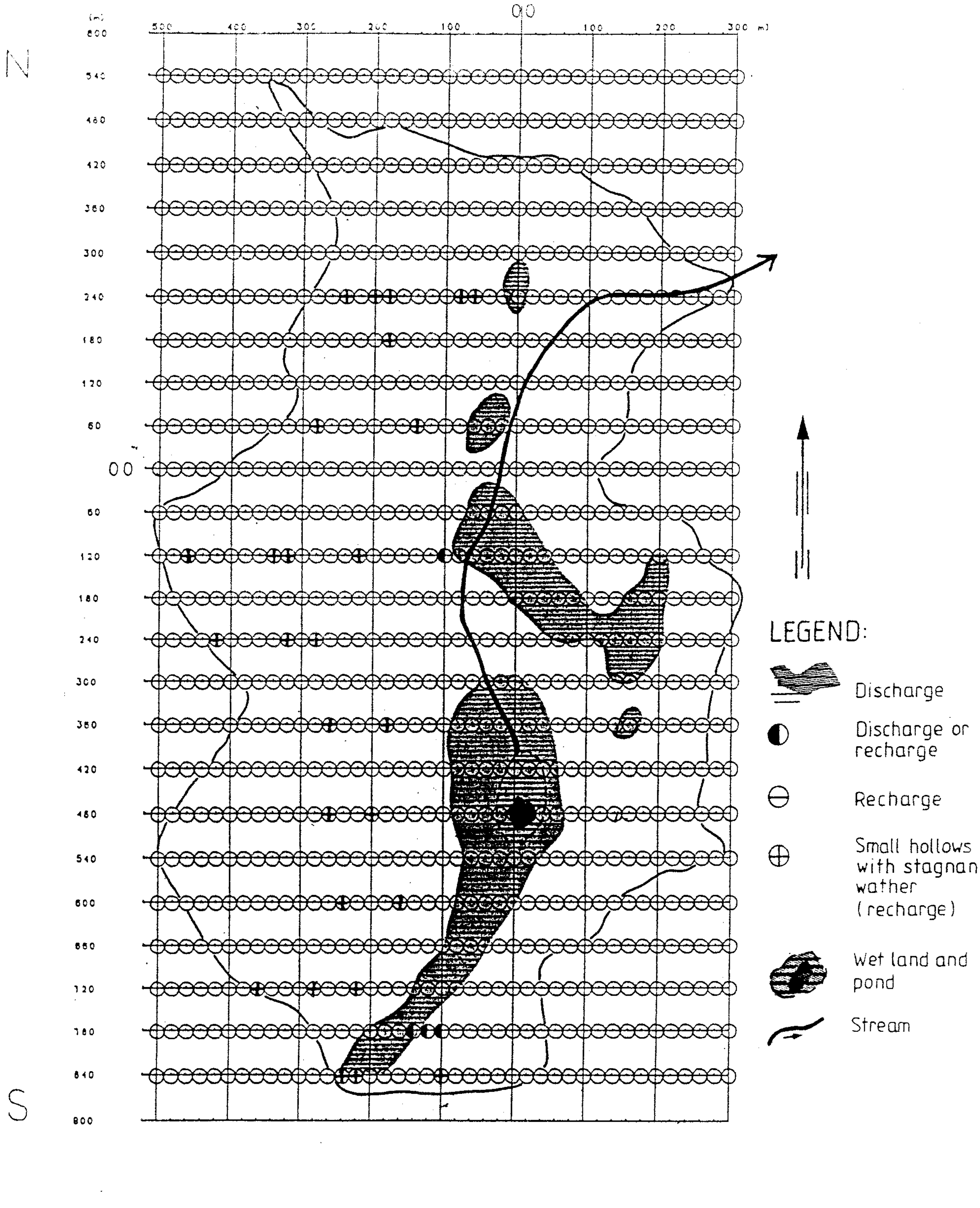

Figure 7 Map showing the distribution of the discharge and recharge areas.

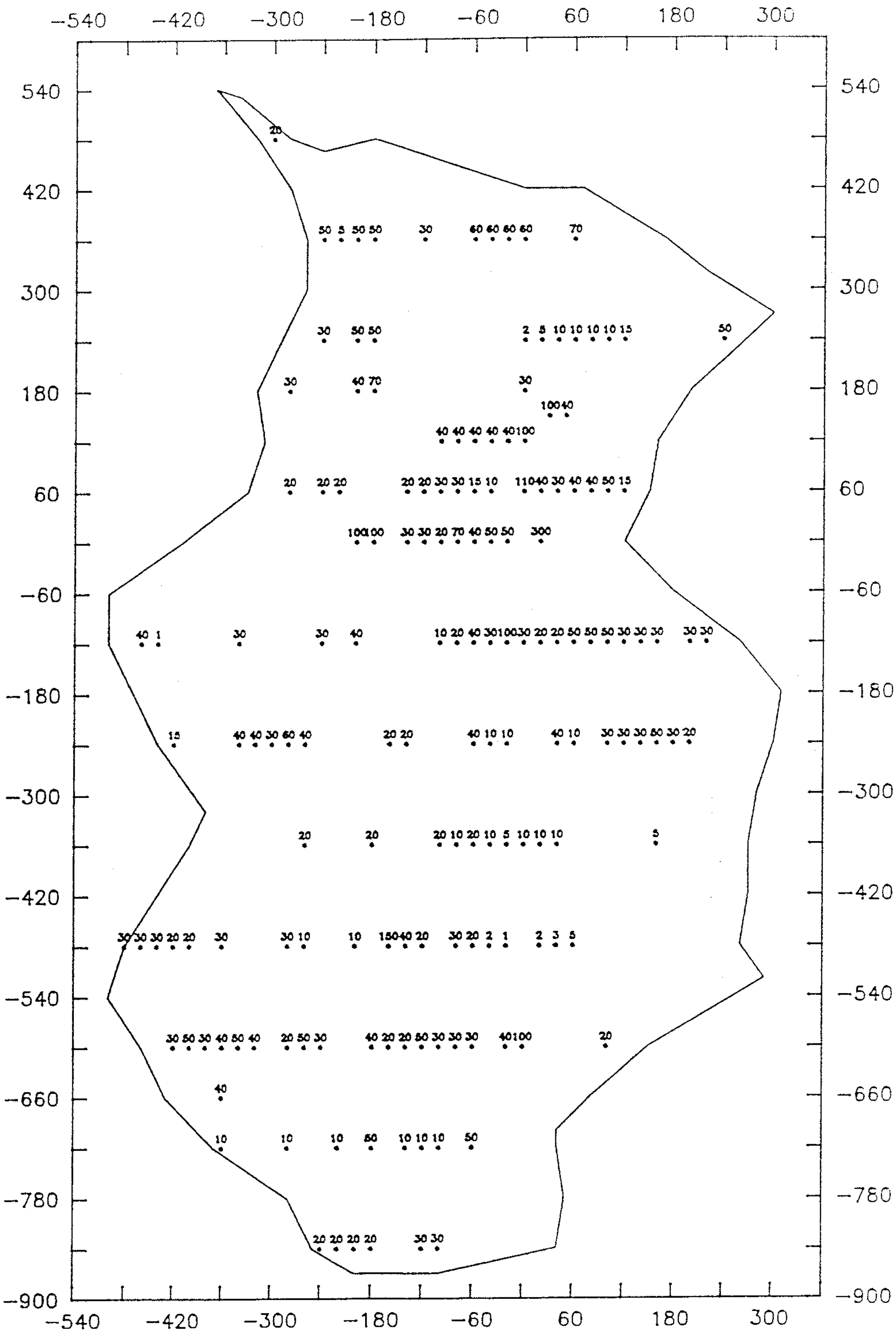

Figure 8 Map showing the depth to the groundwater table. (cm below ground surface)

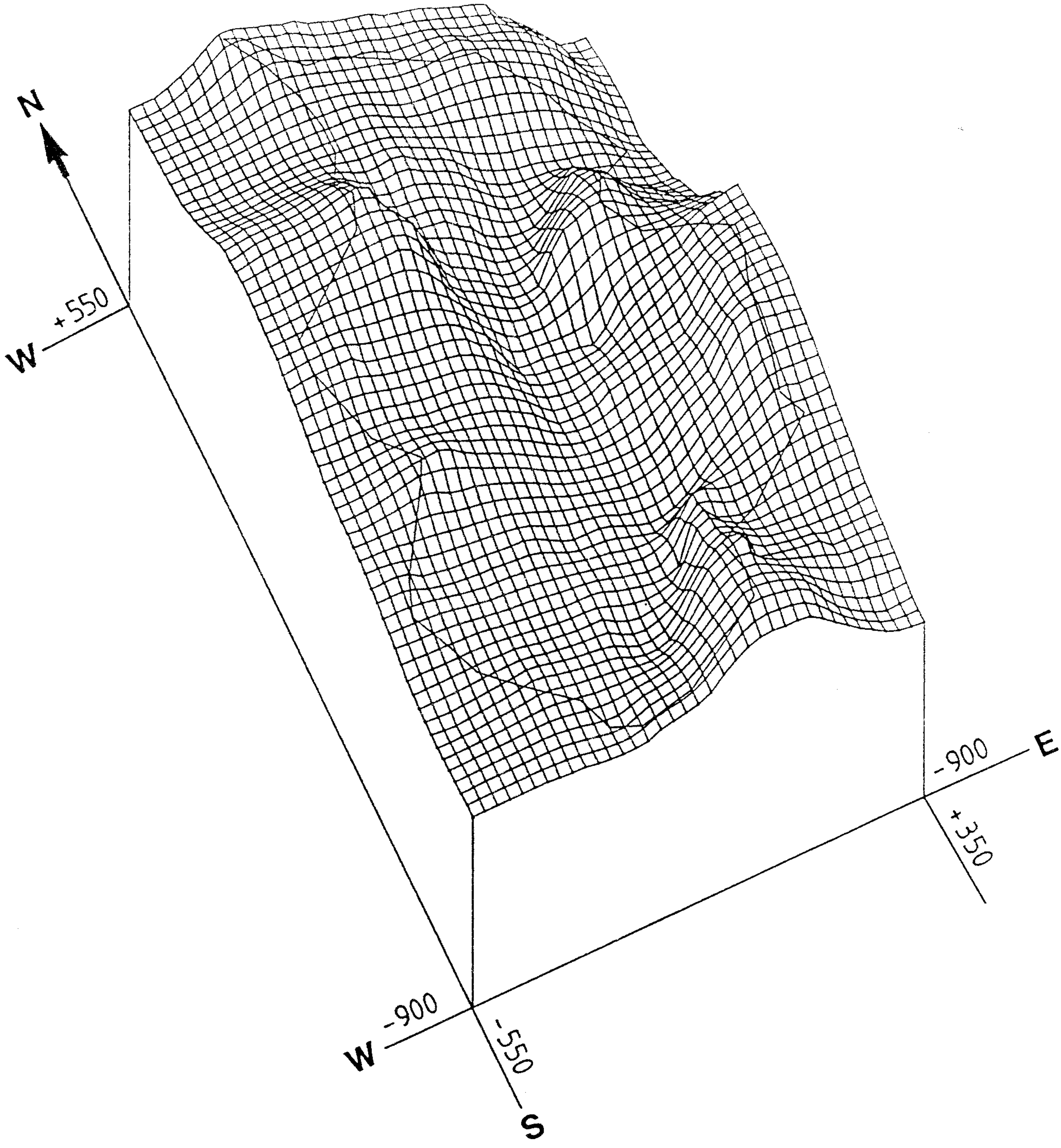

Figure 9 Three dimensional image over–looking Orrmyrberget catchment basin.

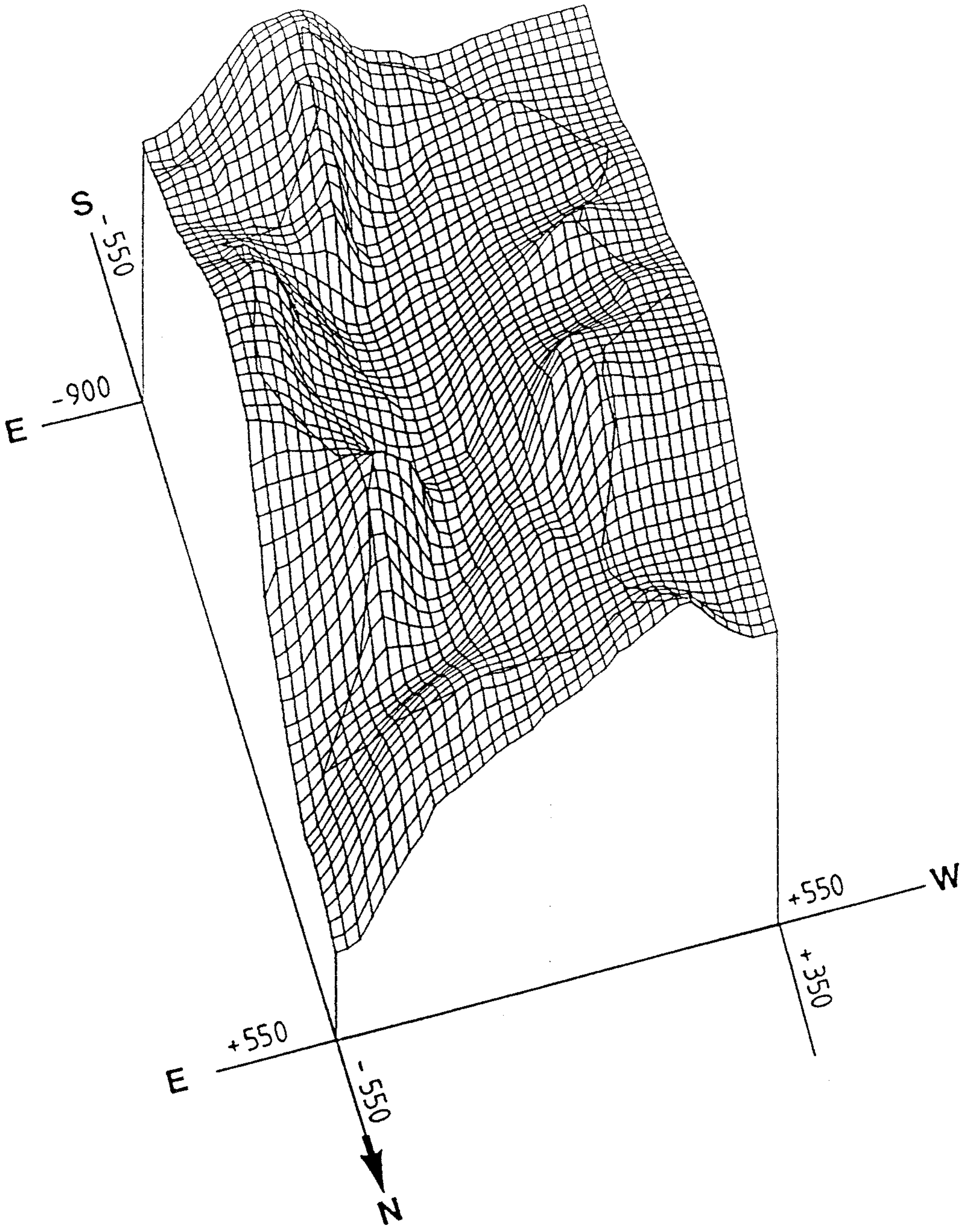

Figure 10 Three dimensional image over–looking Orrmyrberget catchment basin towards the south.

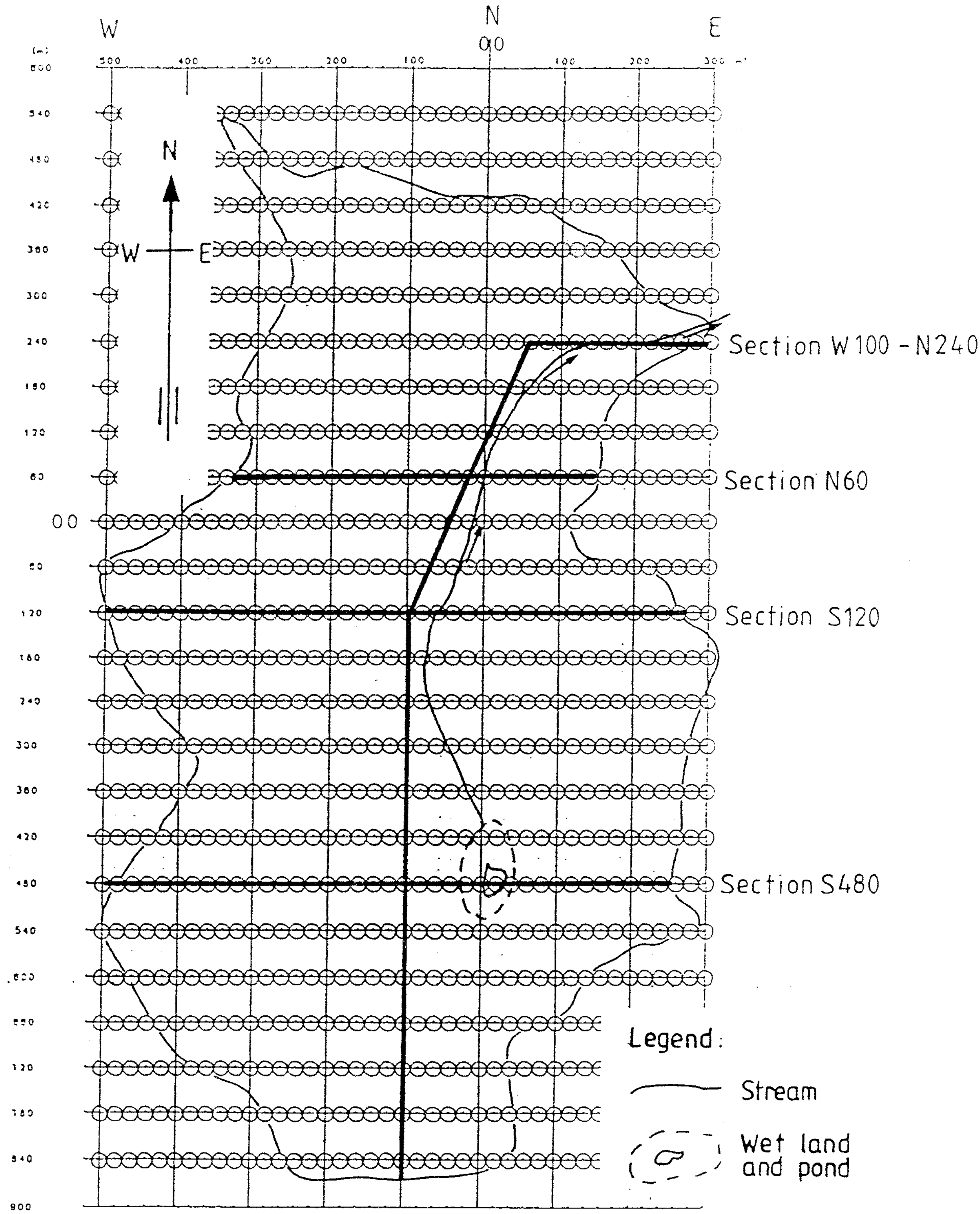

Figure 11 Map showing the position of the topographical sections shown in Figures 12 - 15.

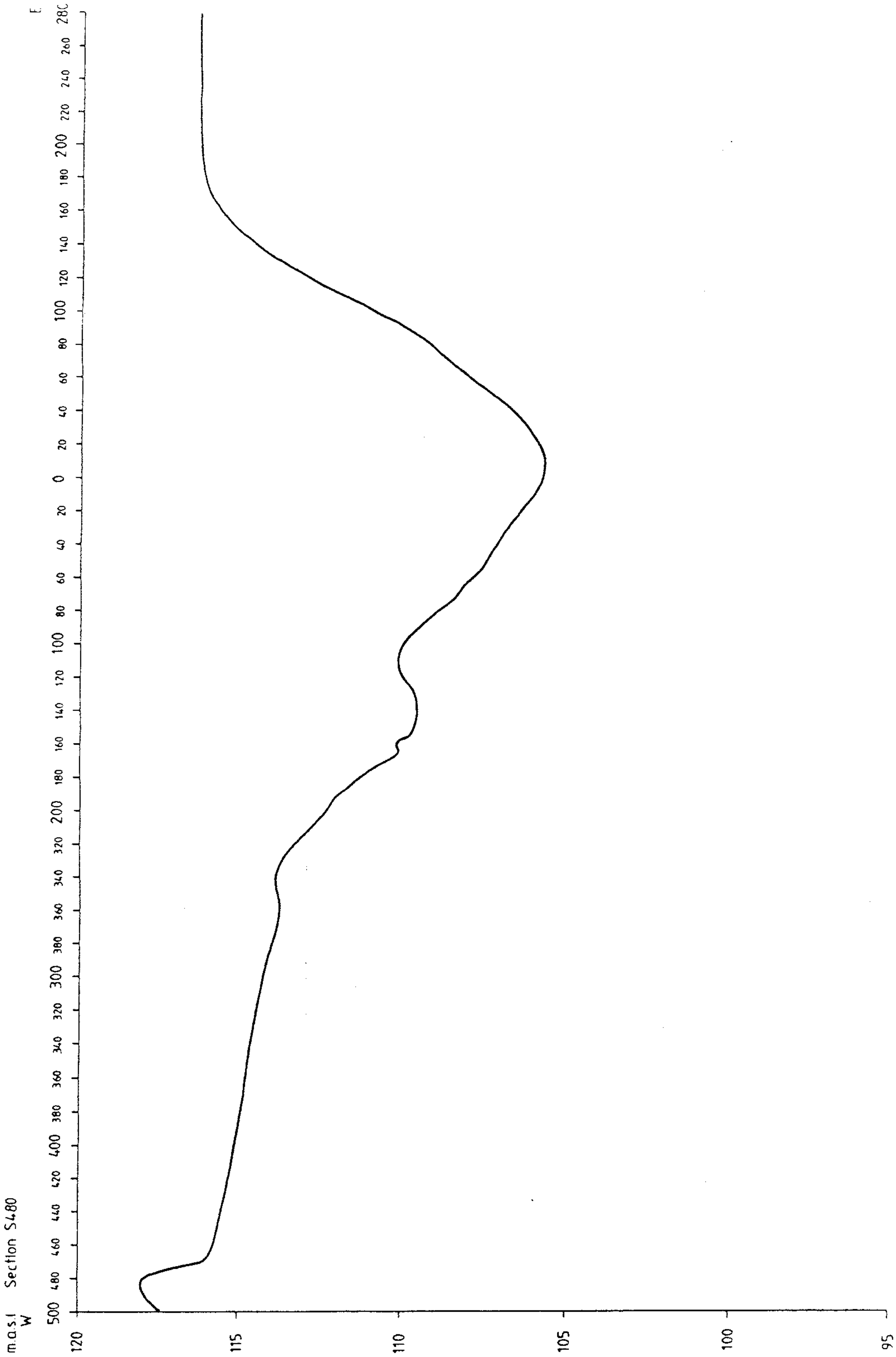

Figure 12 Topographical E–W section S480. cf. Figure 19.

Figure 13 Topographical E–W section S120. cf. Figure 18.

Figure 14 Topographical E–W section N60. cf. Figure 17.

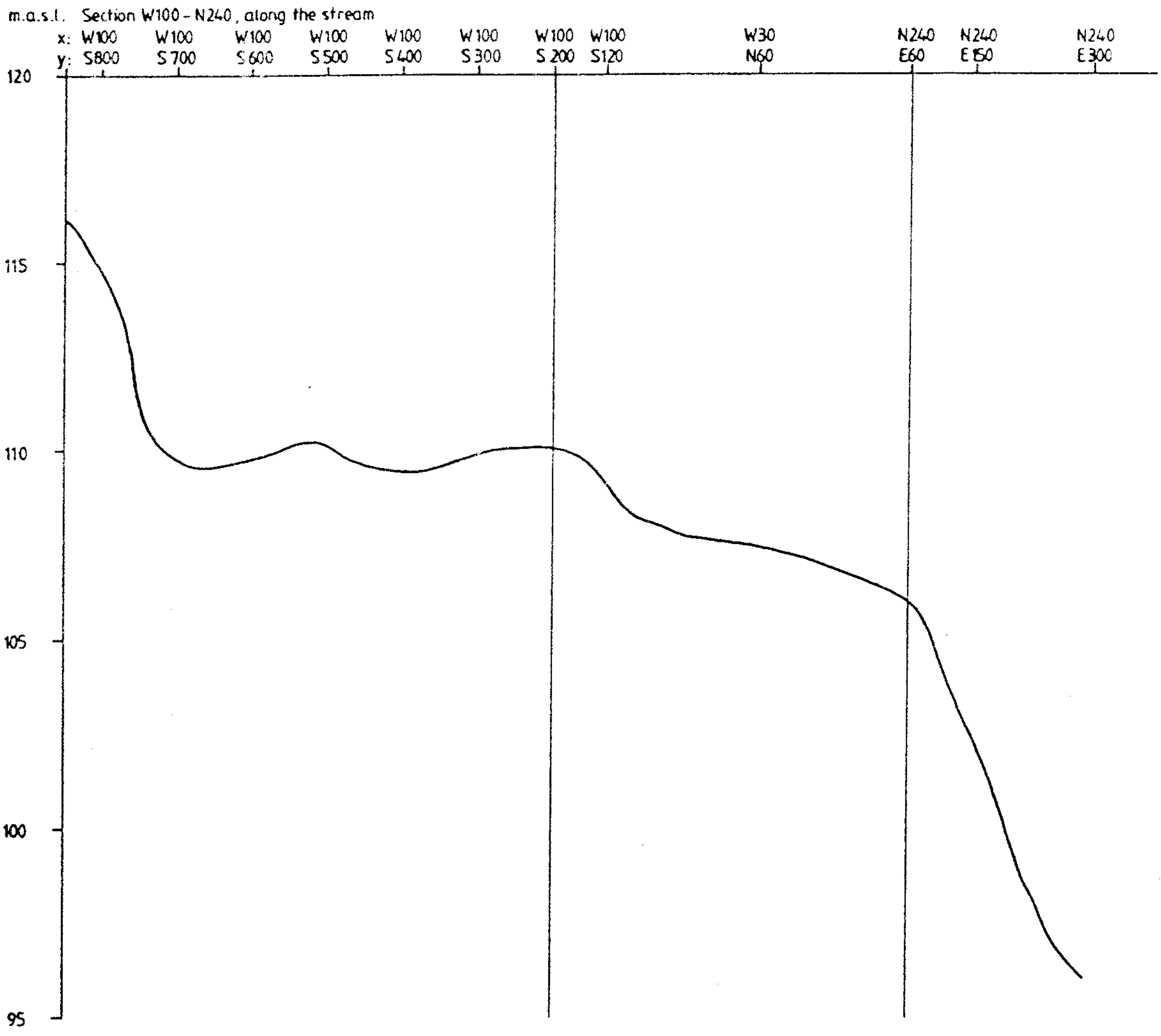

Figure 15 Topographical N–S section W100–N240, that partly is picturing the creek. cf. Figure 11.

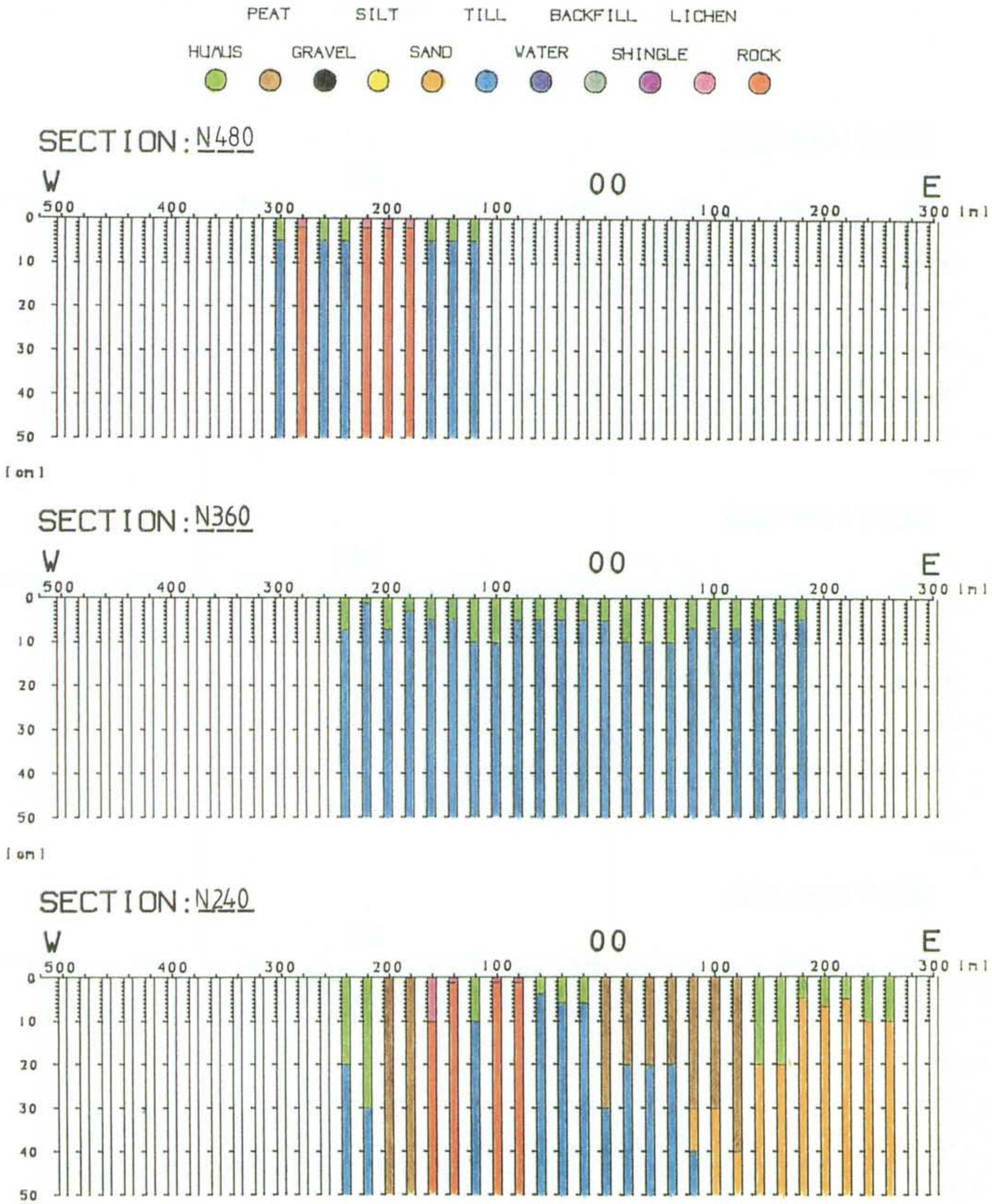

Figure 16 Material description from ground surface down to 0.5m for sections N480, N360 and N240.

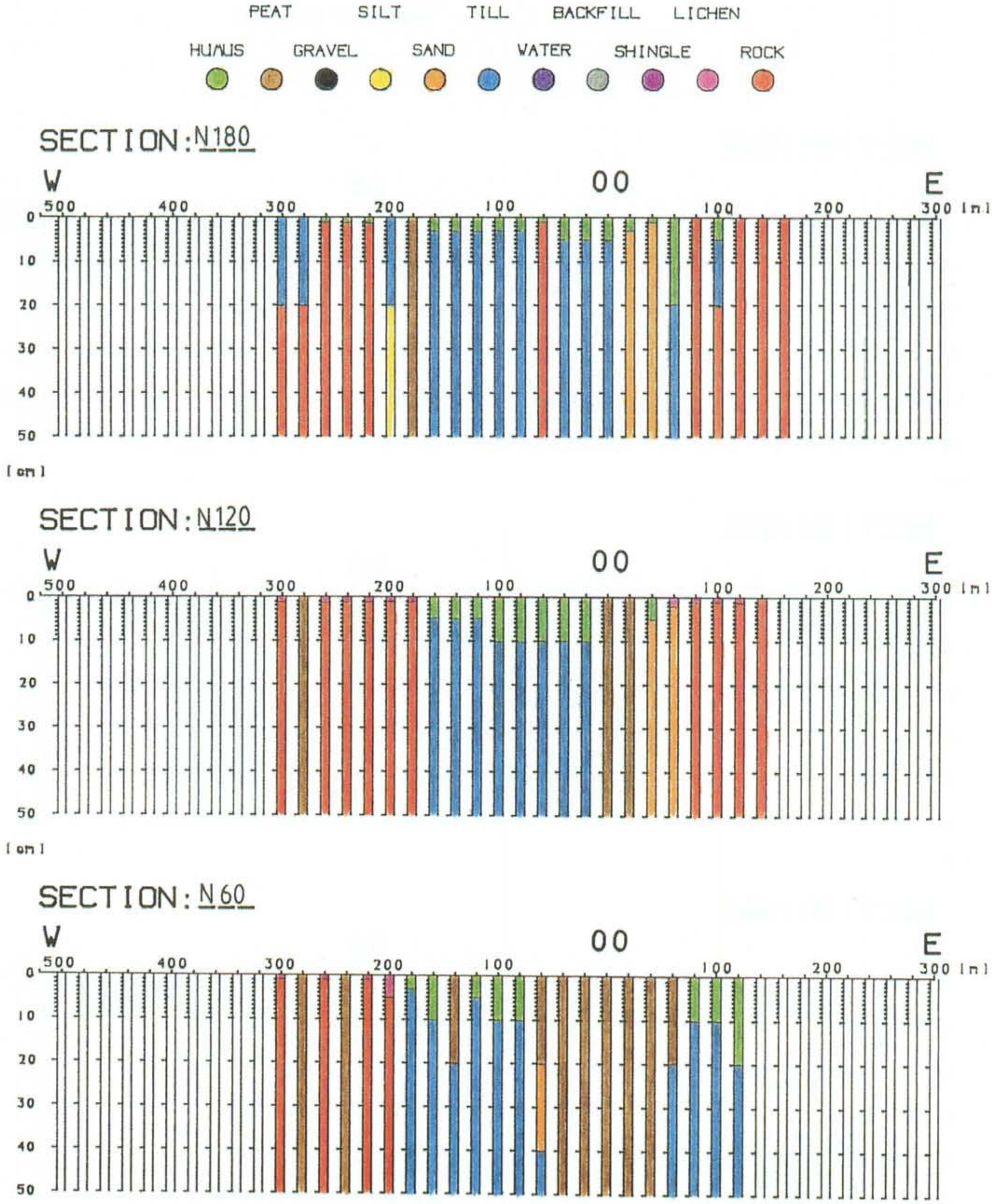

Figure 17 Material description from ground surface down to 0.5m for sections N180, N120 and N60.

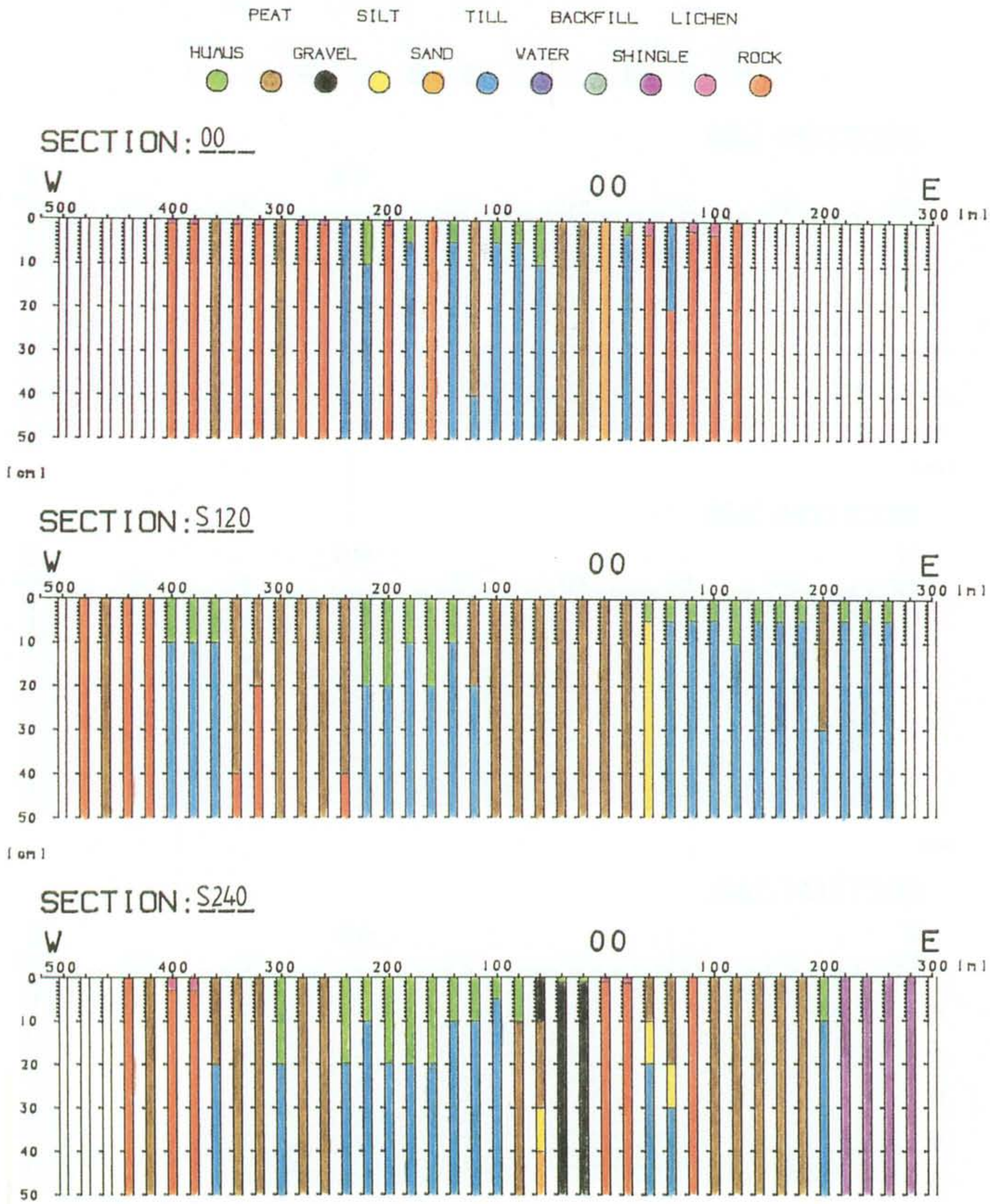

Figure 18 Material description from ground surface down to 0.5m for sections 00, S120 and S240 .

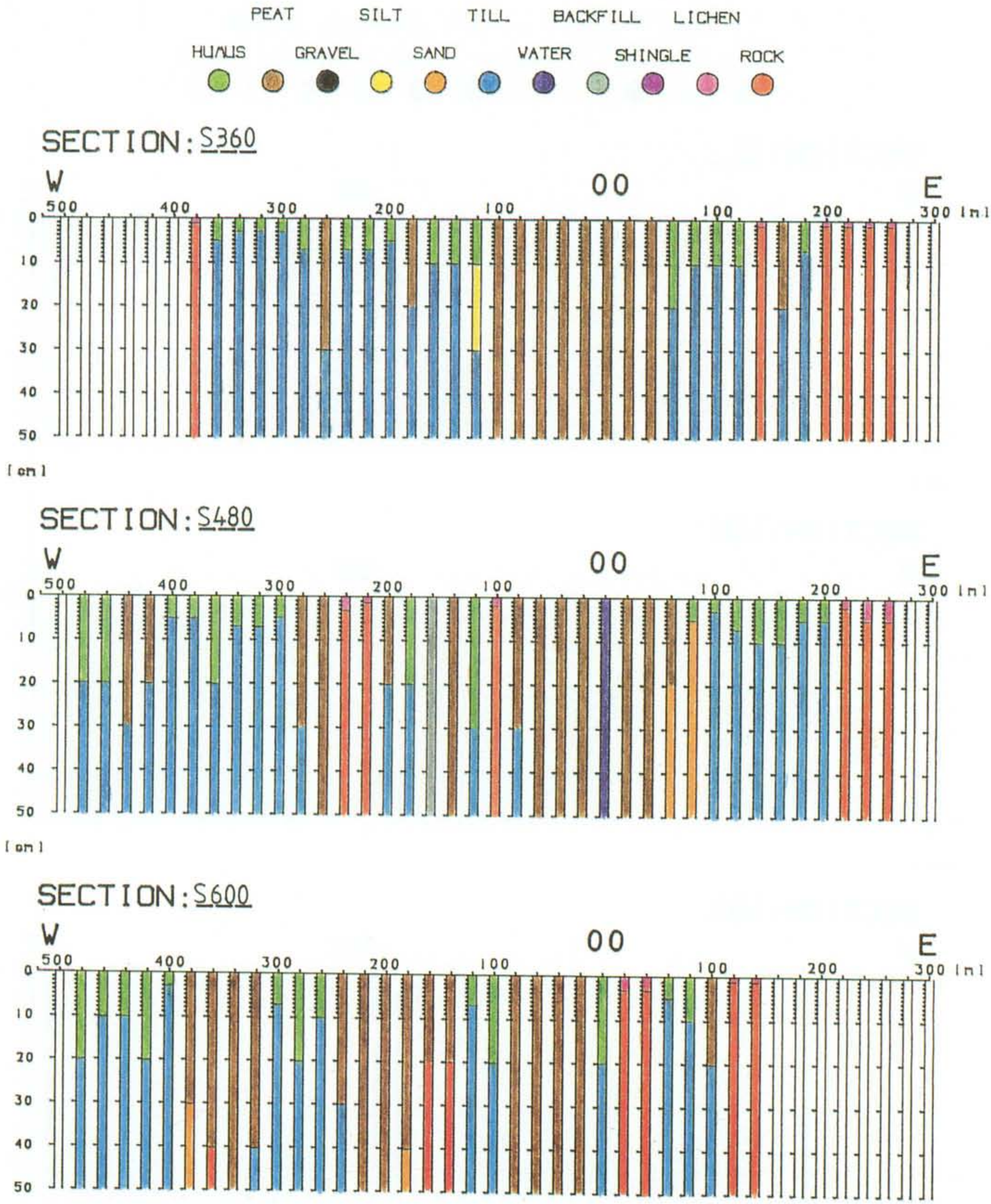

Figure 19 Material description from ground surface down to 0.5m for sections S360, S480 and S600.

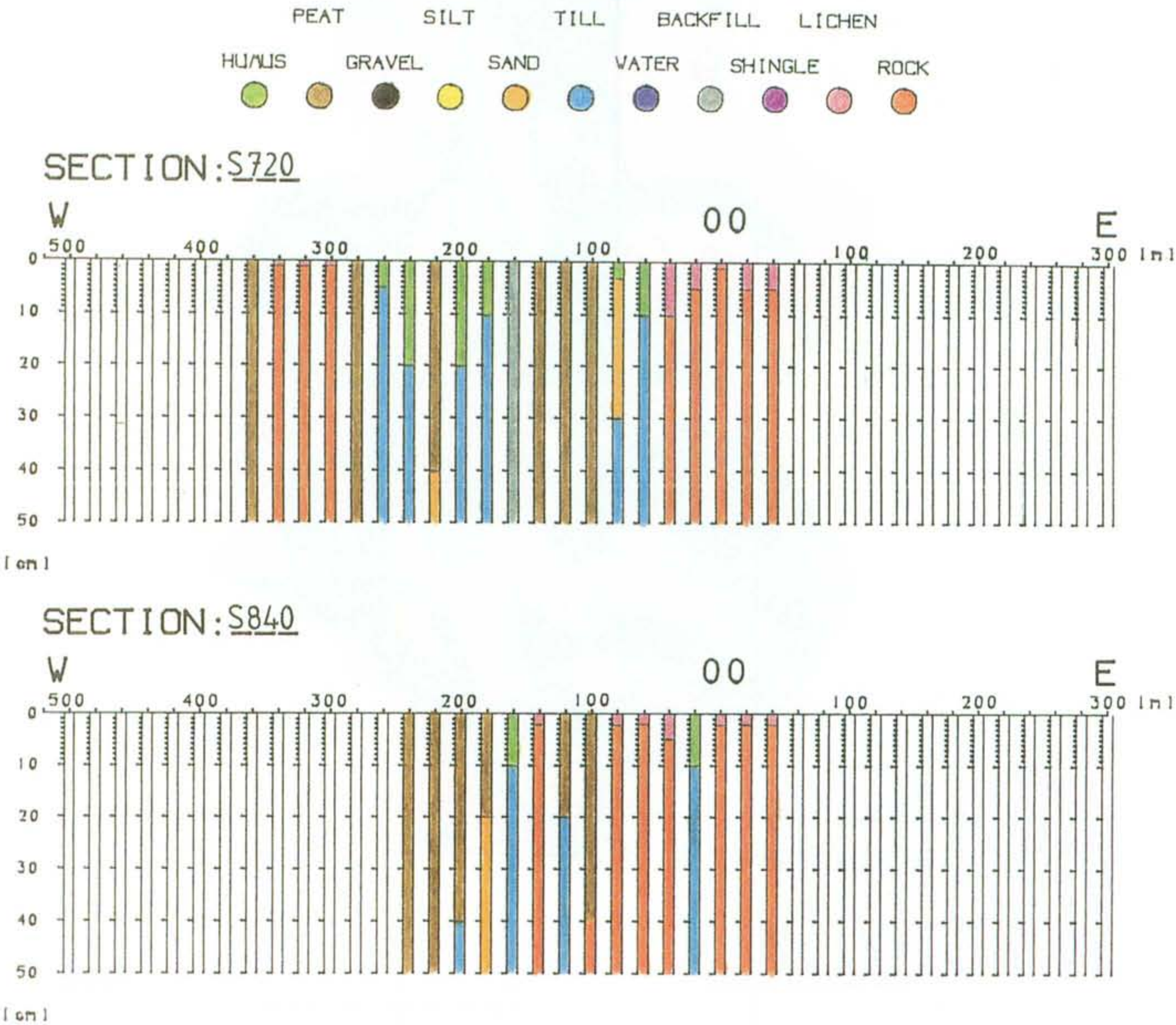

Figure 20 Material description from ground surface down to 0.5m for sections S720 and S840.

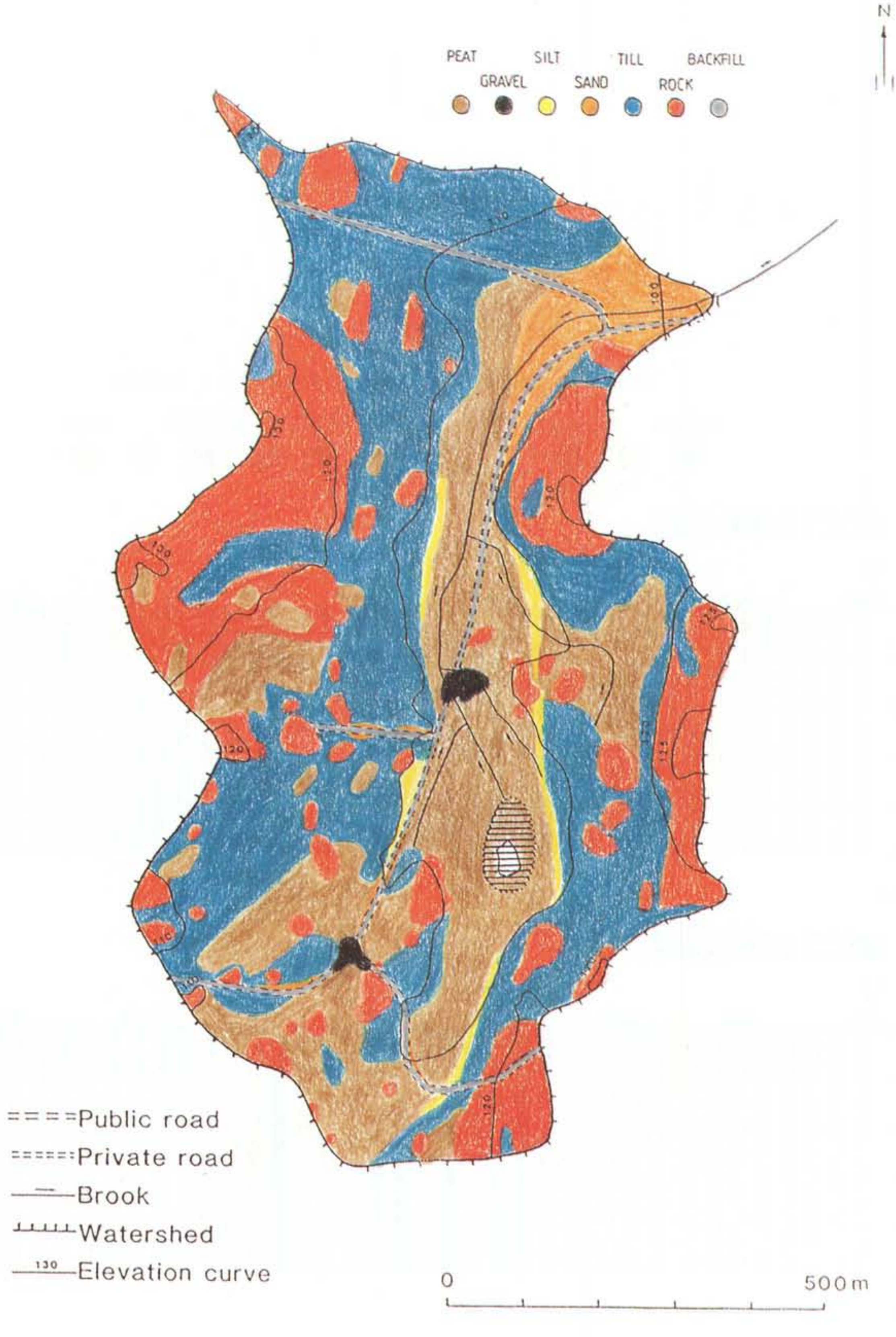

Figure 21 Interpretation of surface materials, "Classical soil map".

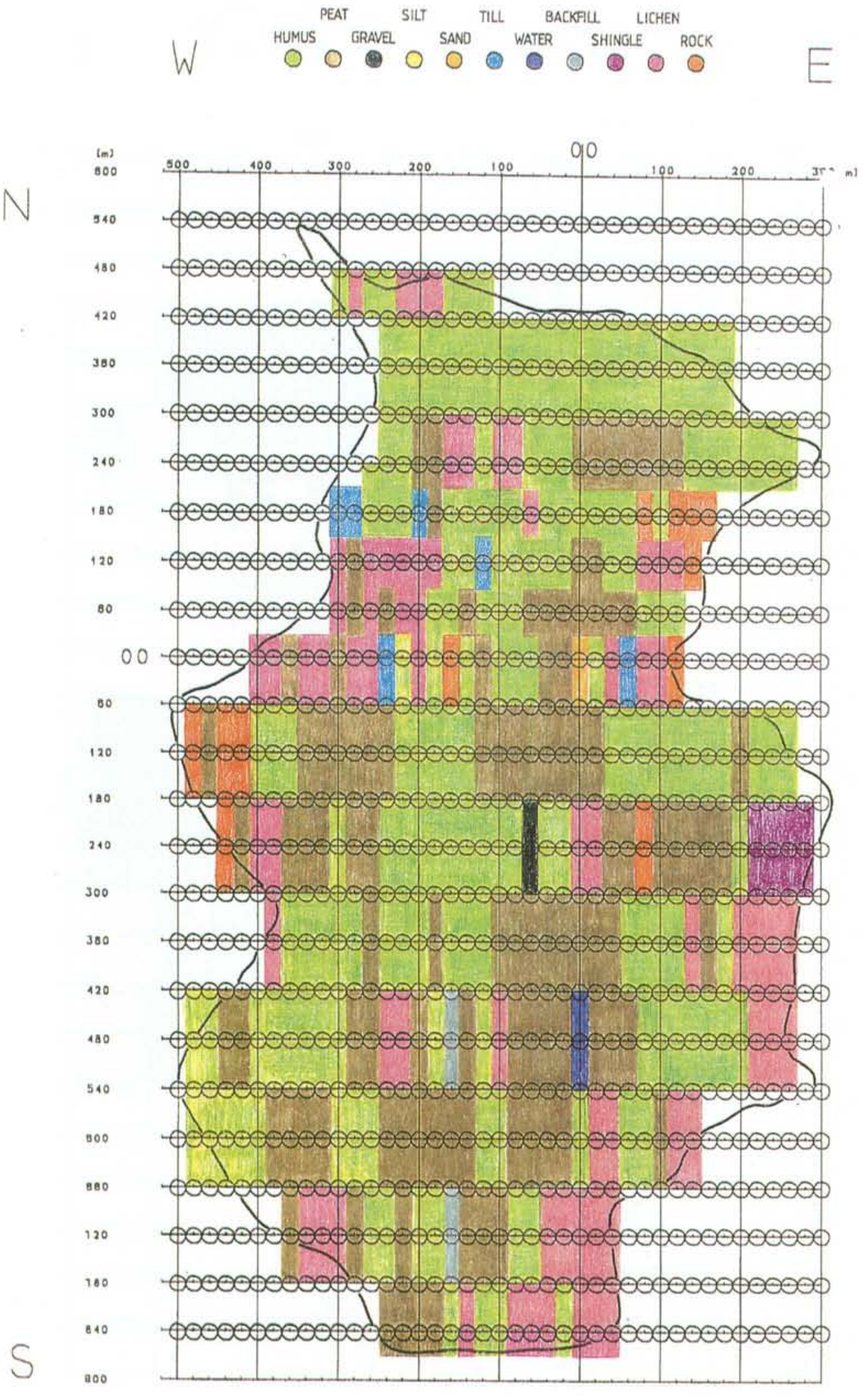

Figure 22 Material distribution at surface, 0 – 1 cm. Illustration of digitalized area used in volume and area calculations of the materials within the catchment.

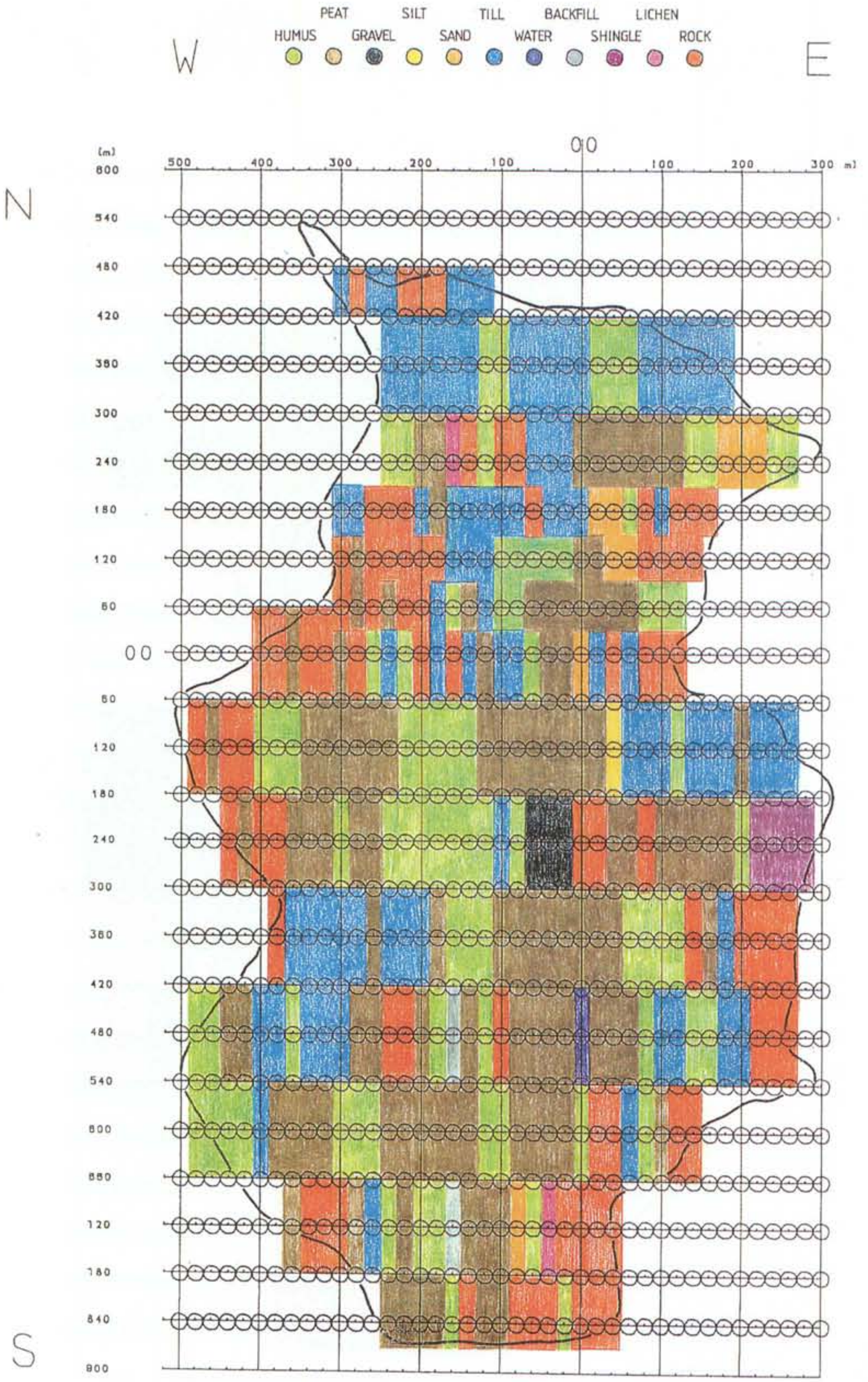

Figure 23 Material distribution at 7 – 10 cm depth. Illustration of digitalized area used in volume and area calculations of the materials within the catchment.

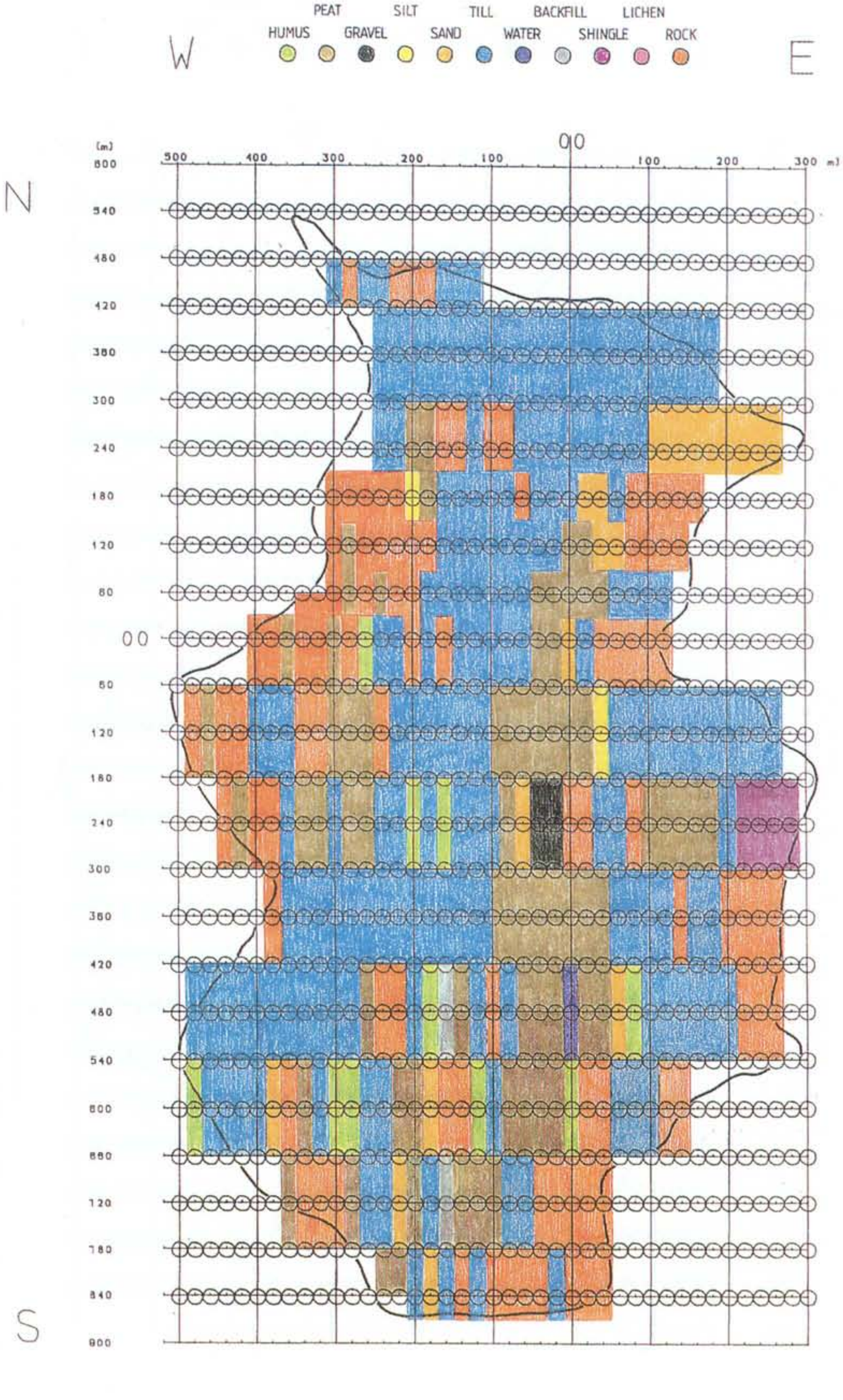

Figure 24 Material distribution at 40 – 50 cm depth. Illustration of digitalized area used in volume and area calculations of the materials within the catchment.

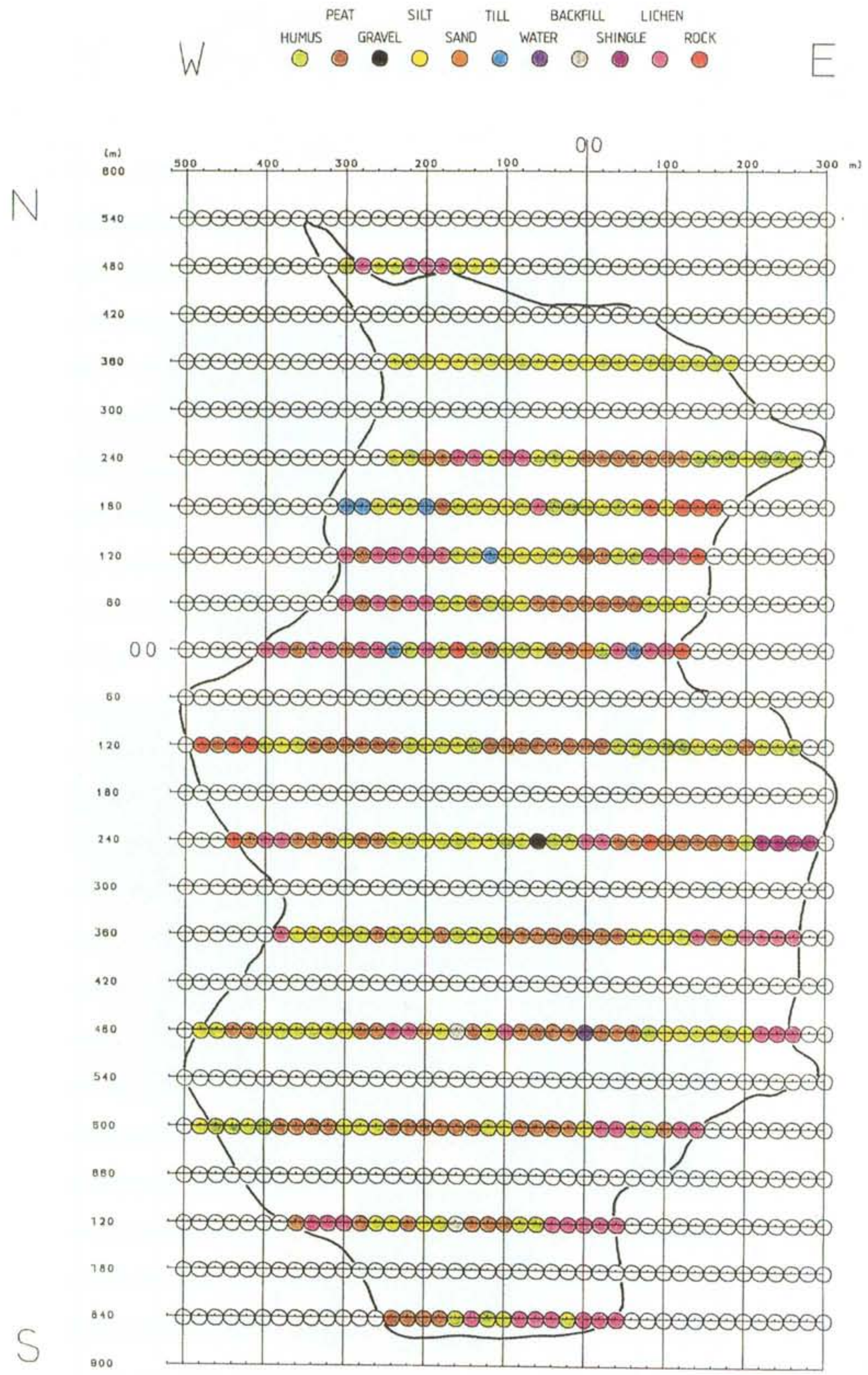

Figure 25 Material distribution at surface, 0 – 1 cm.

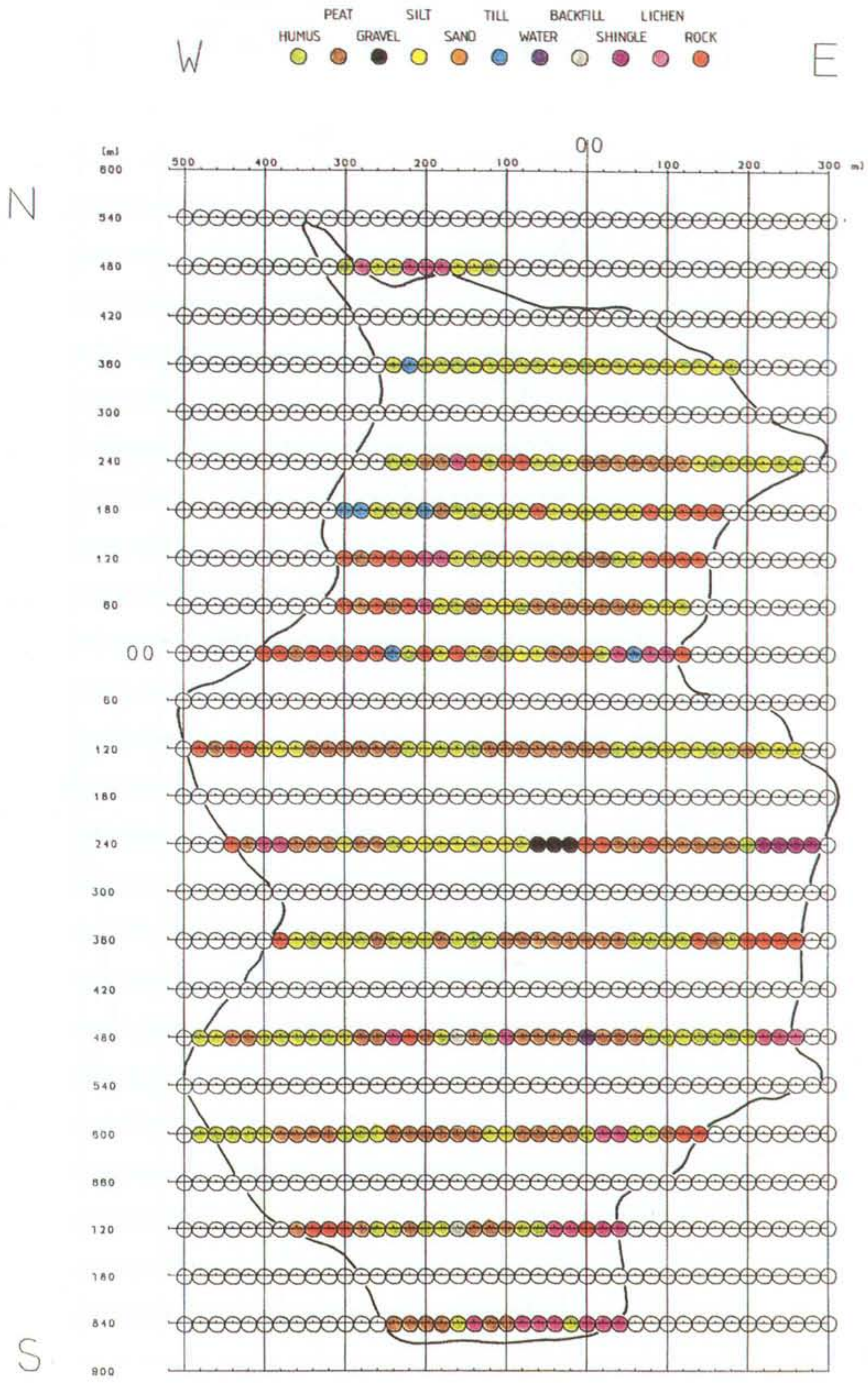

Figure 26 Material distribution at 1 – 2 cm depth

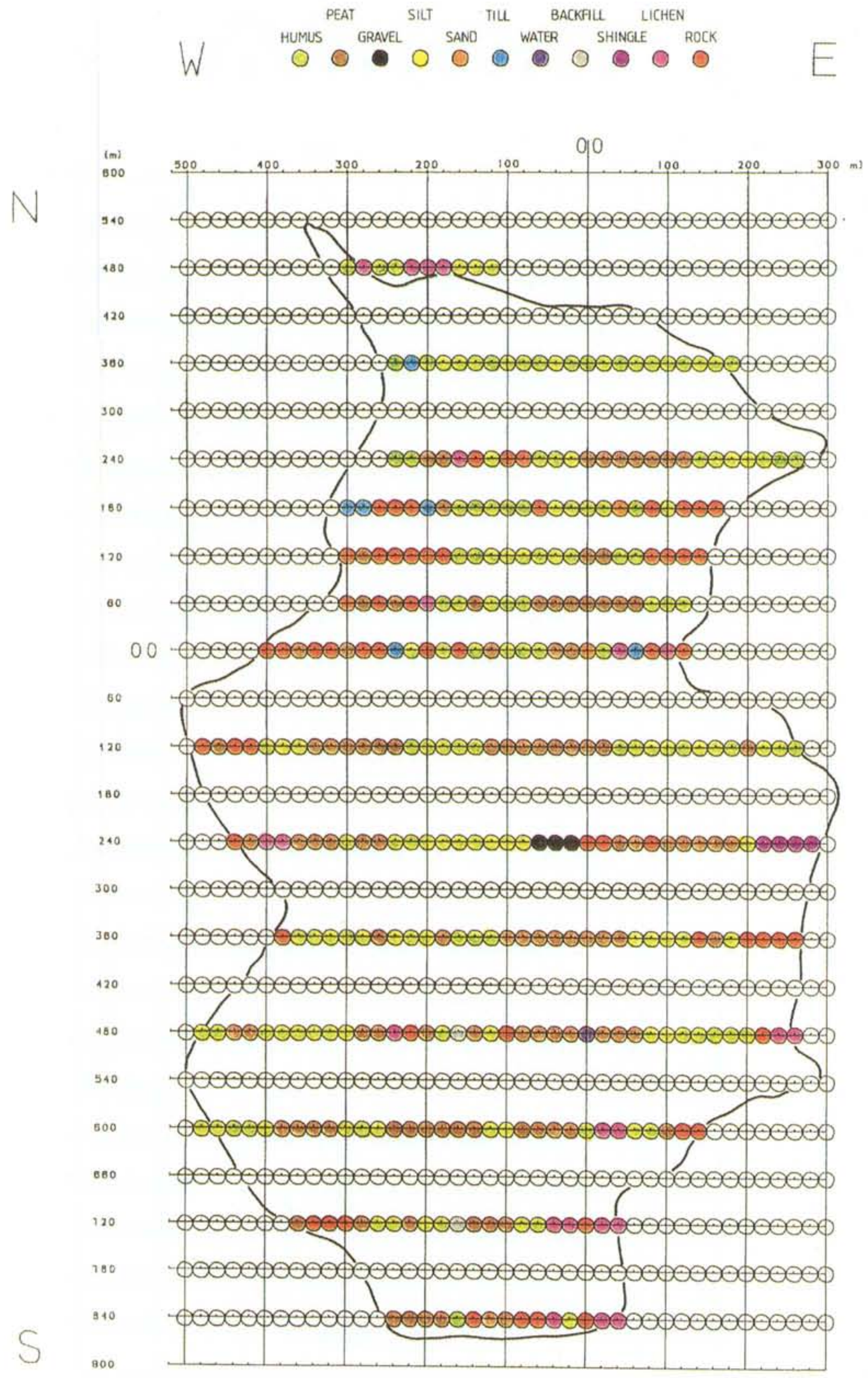

Figure 27 Material distribution at 2 – 3 cm depth

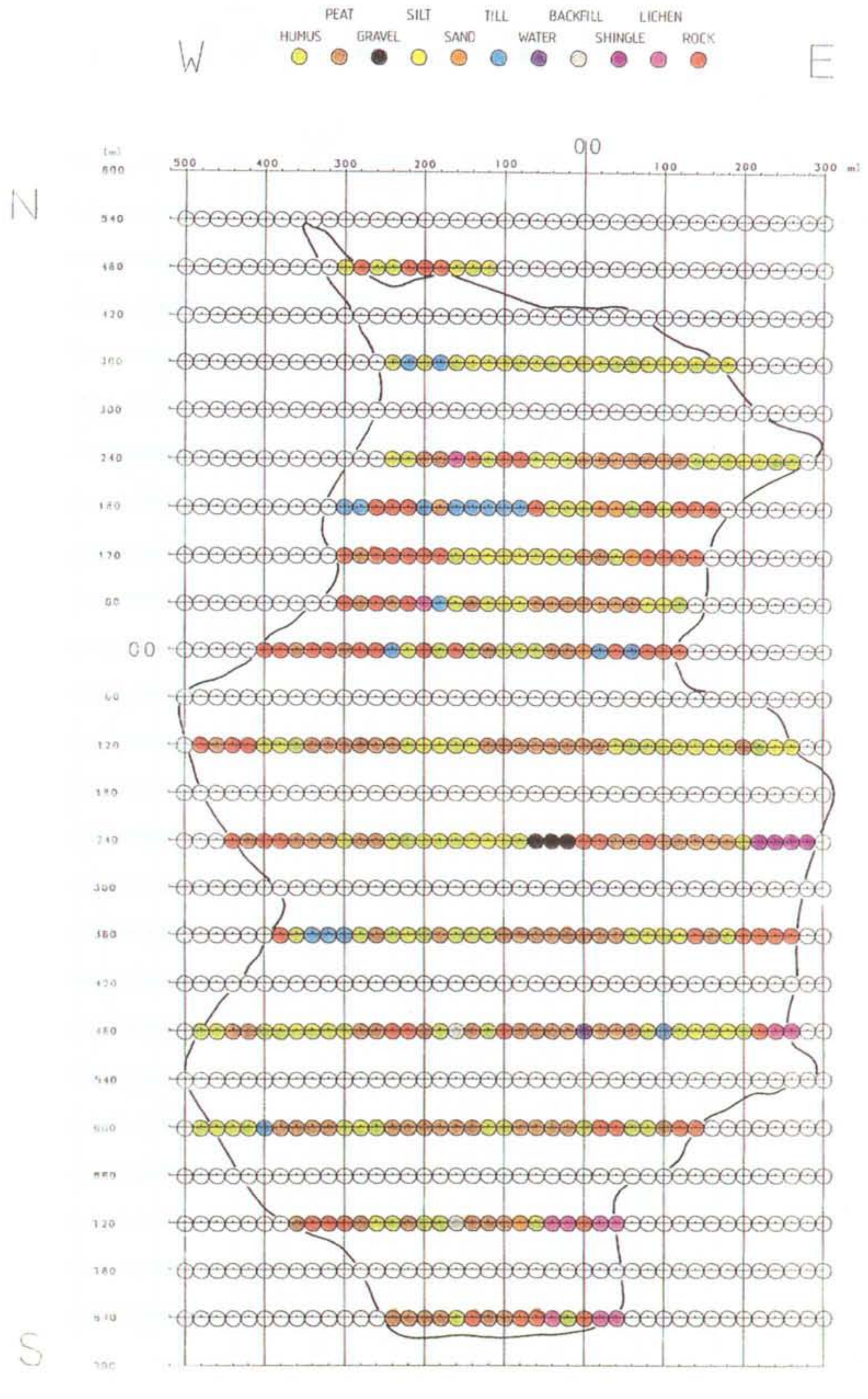

Figure 28 Material distribution at 3 – 4 cm depth

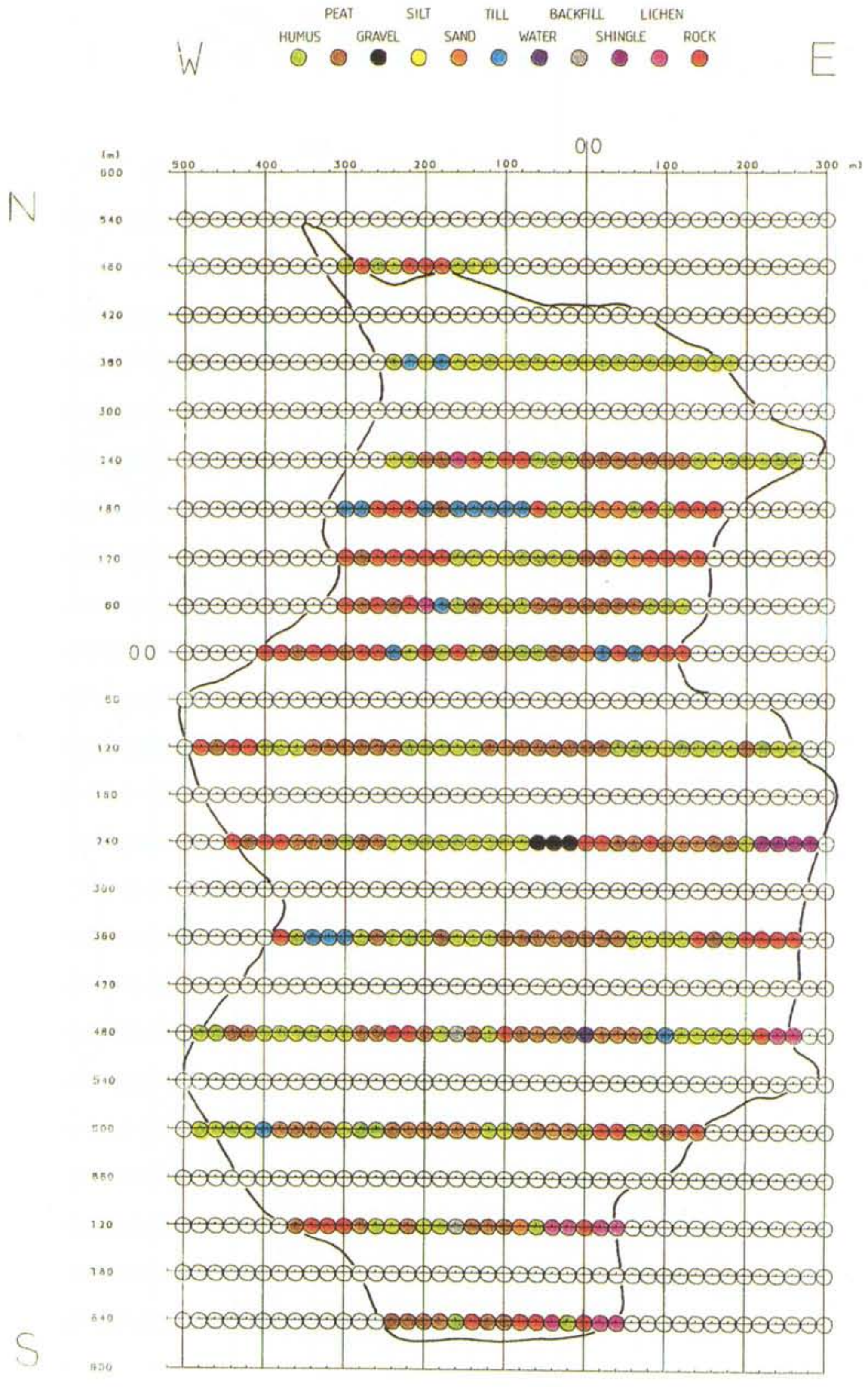

Figure 29 Material distribution at 4 – 5 cm depth

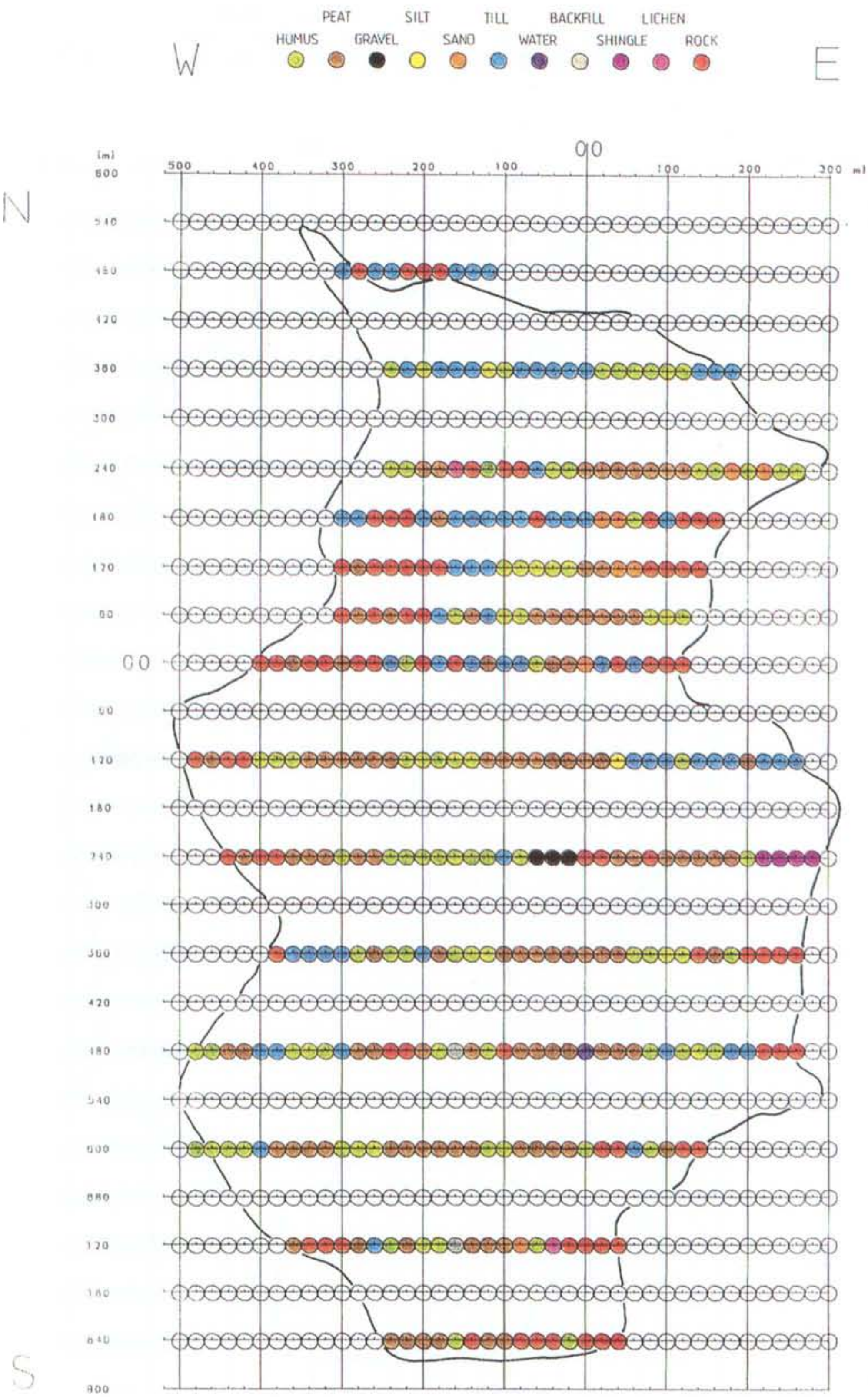

Figure 30 Material distribution at 5 – 6 and 6 – 7 cm depth.

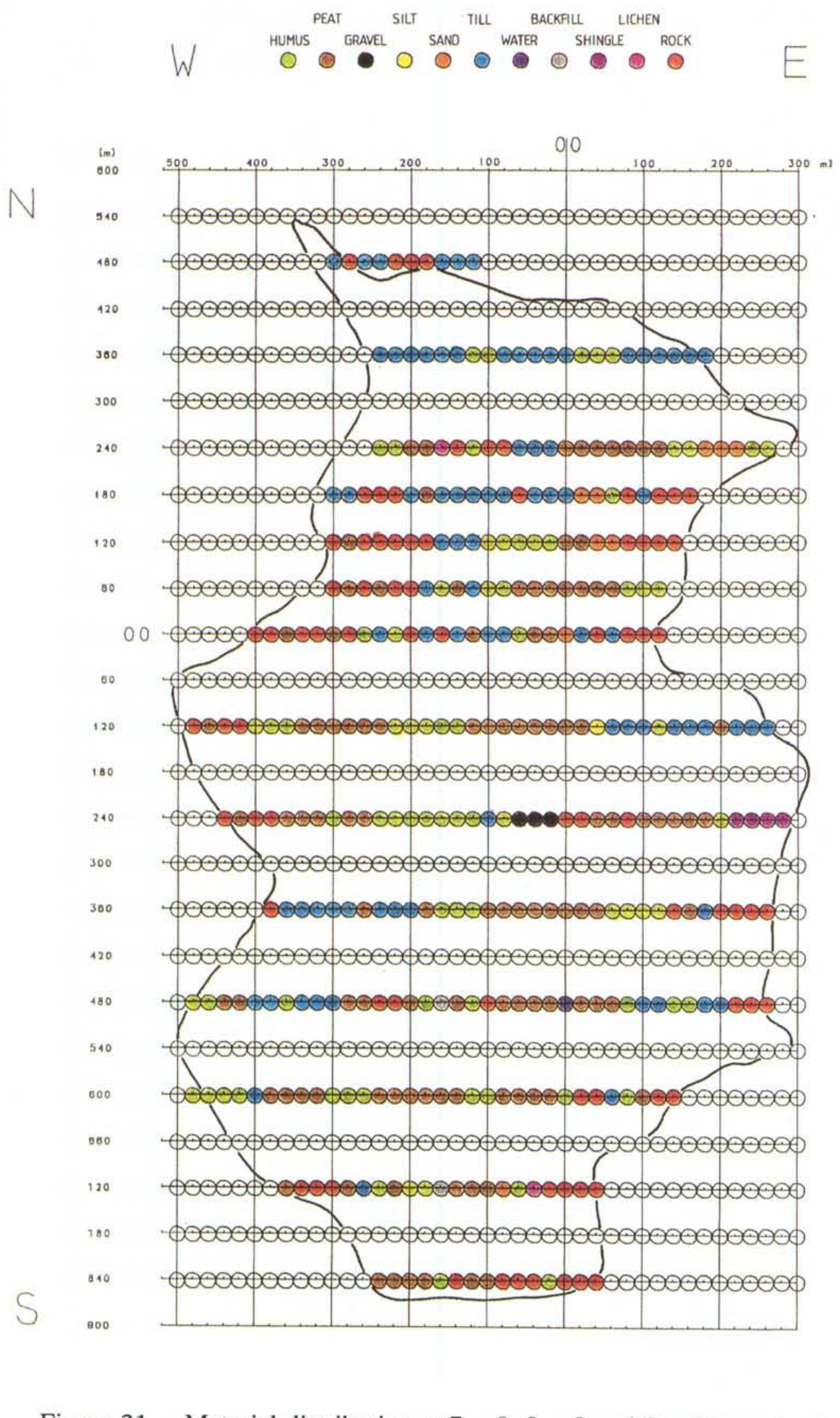

Figure 31 Material distribution at 7 – 8, 8 – 9 and 9 – 10 cm depth.

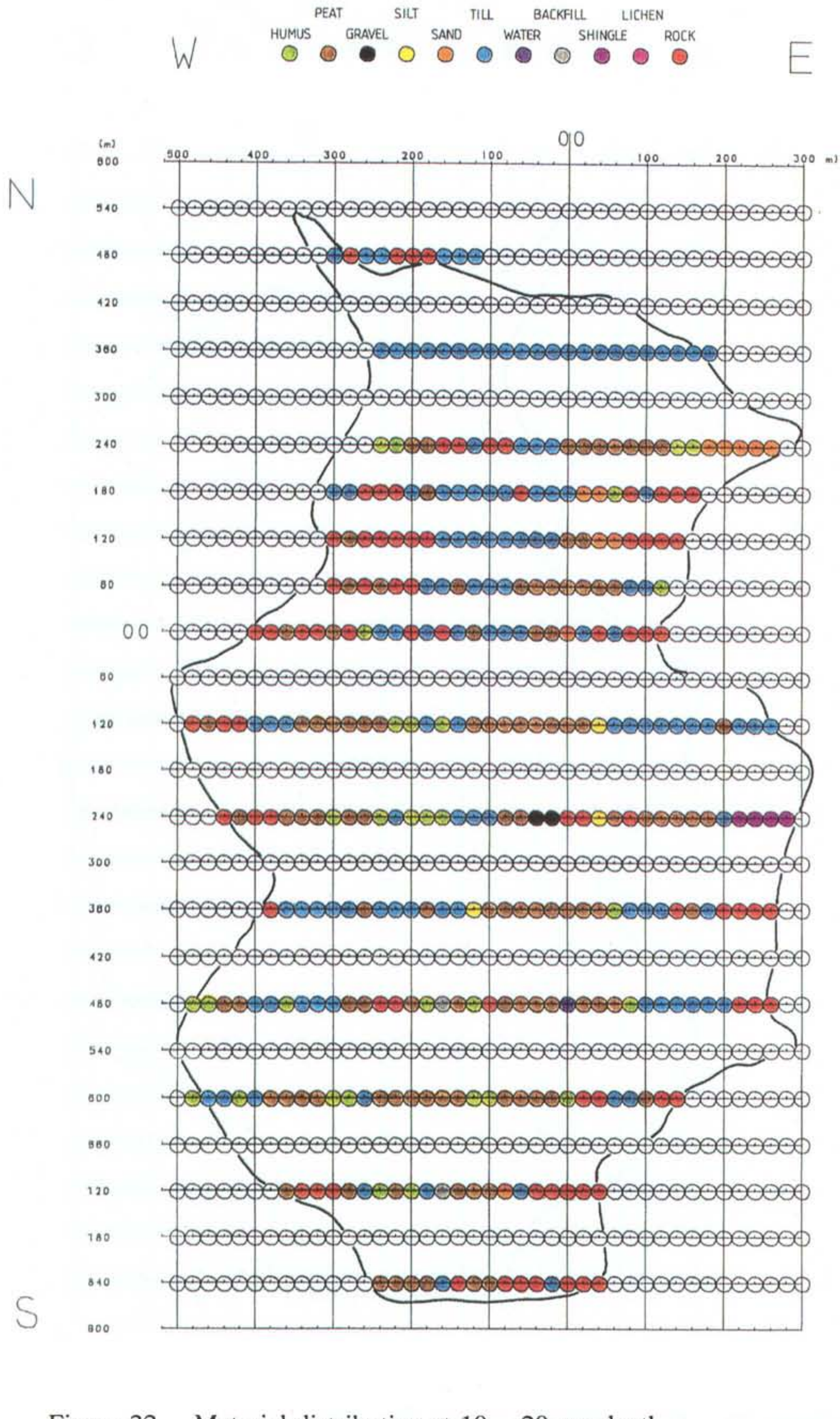

Figure 32 Material distribution at 10 – 20 cm depth.

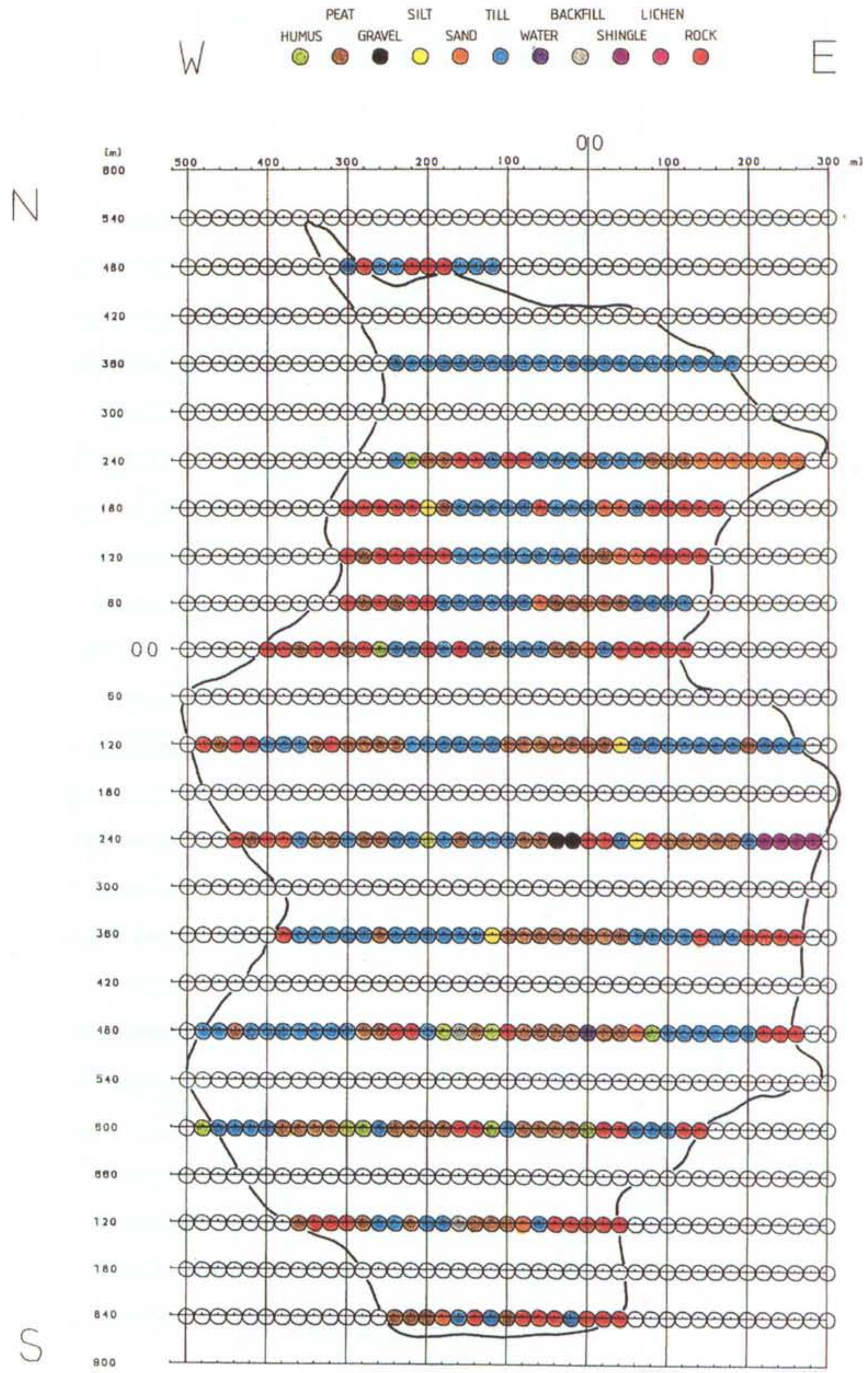

Figure 33 Material distribution at 20 – 30 cm depth.

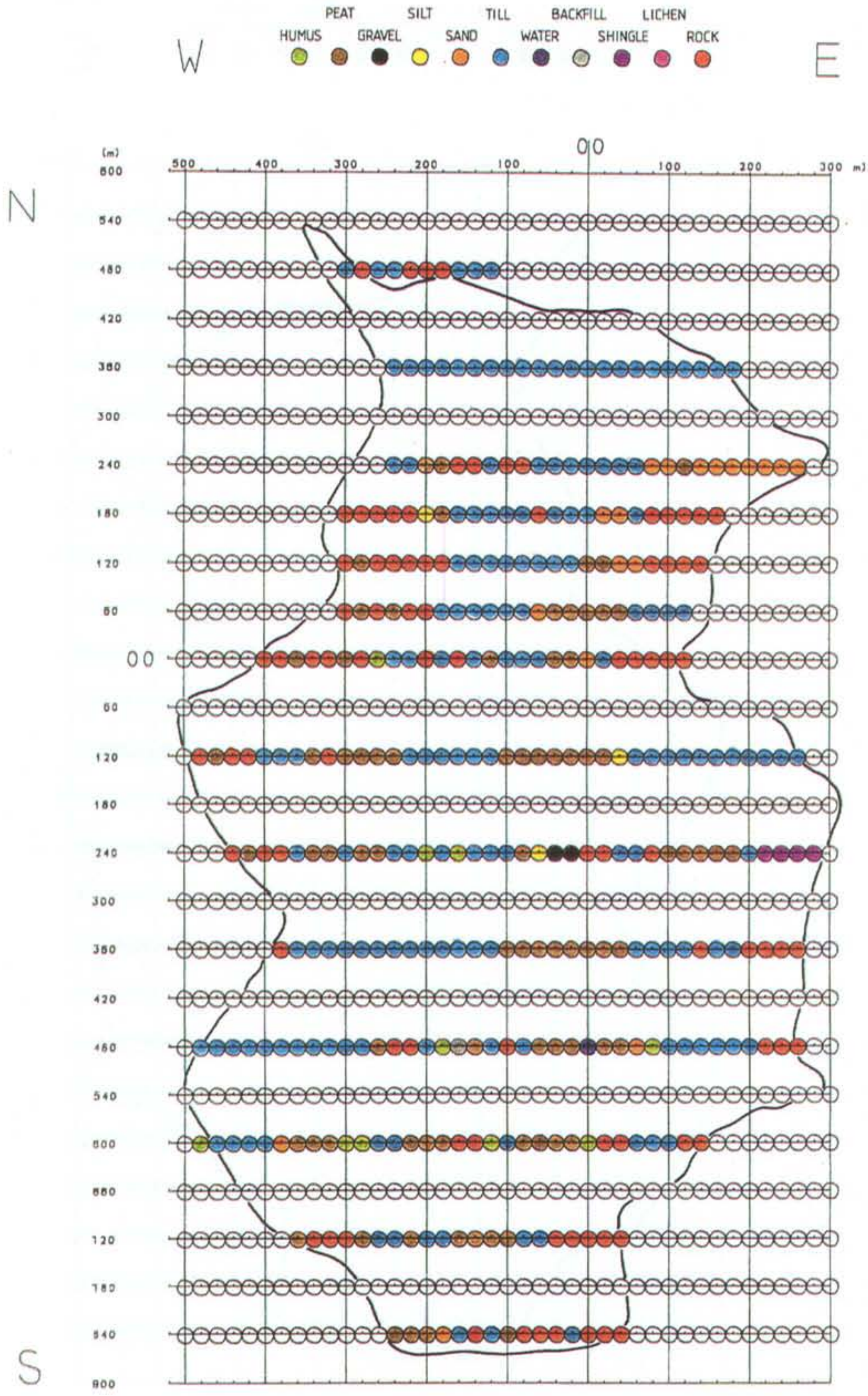

Figure 34 Material distribution at 30 – 40 cm depth.

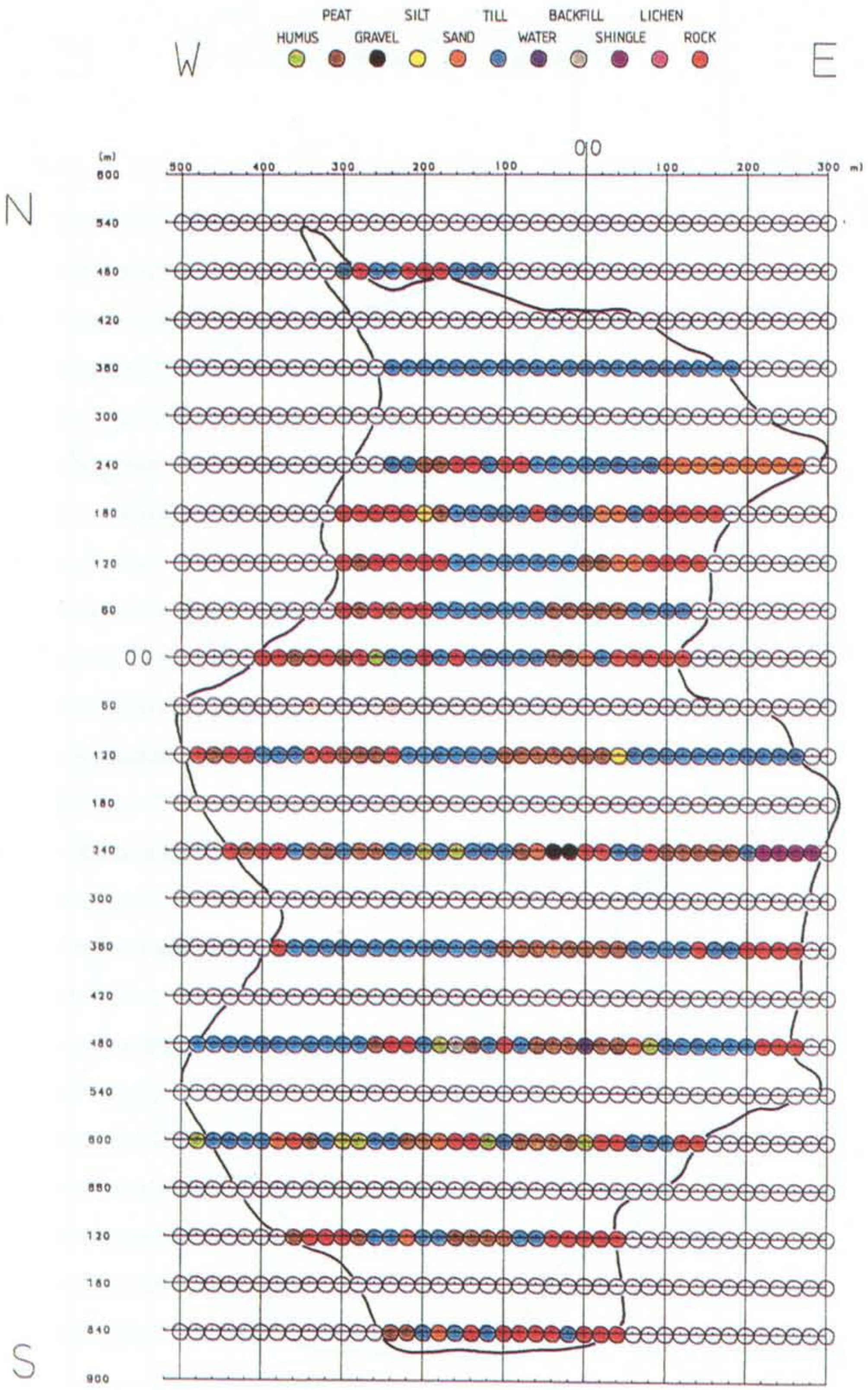

Figure 35   Material distribution at 40 – 50 cm depth.

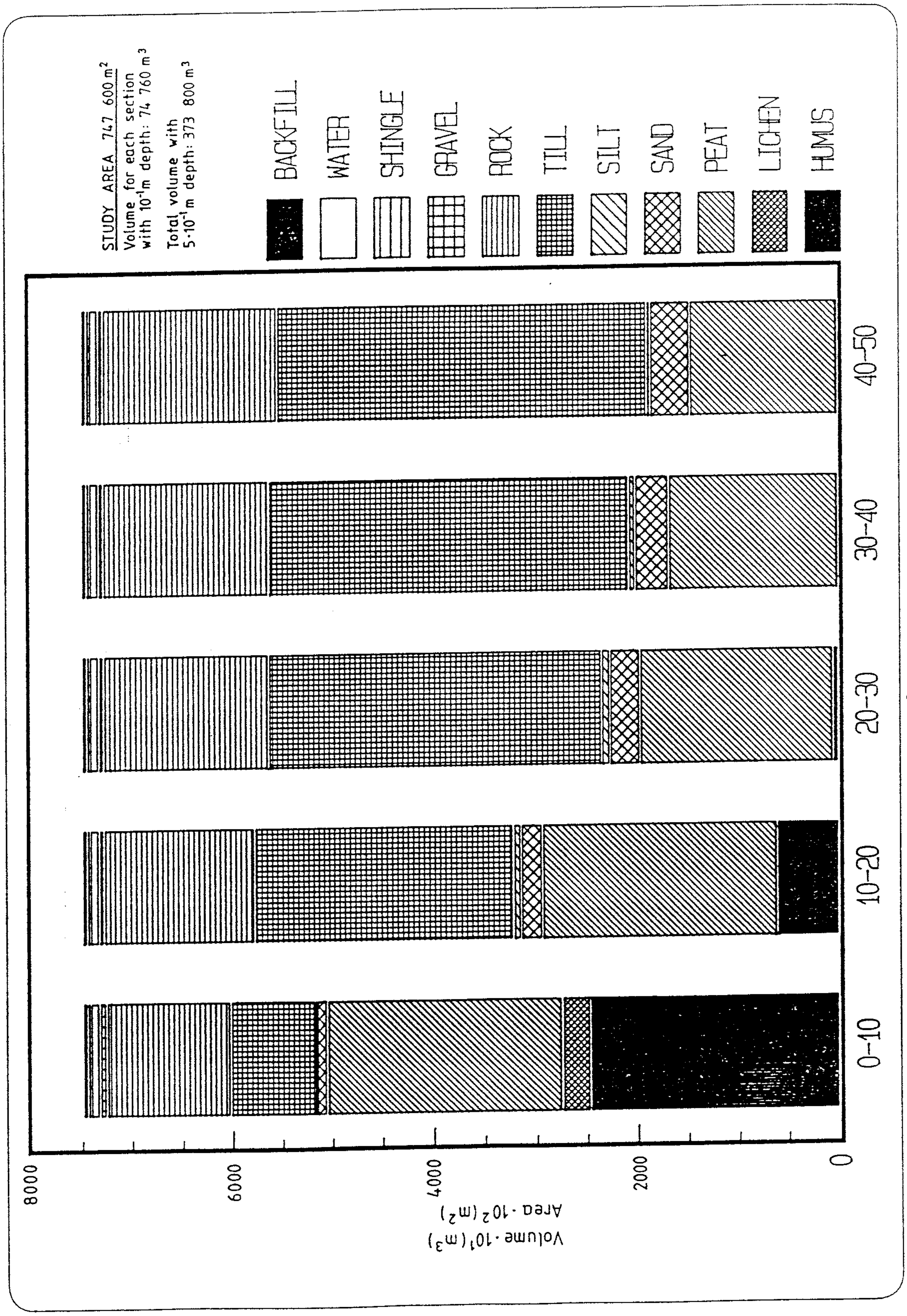

Figure 36 Illustration of materials volume/area distribution at every 10 cm depth, below ground surface.

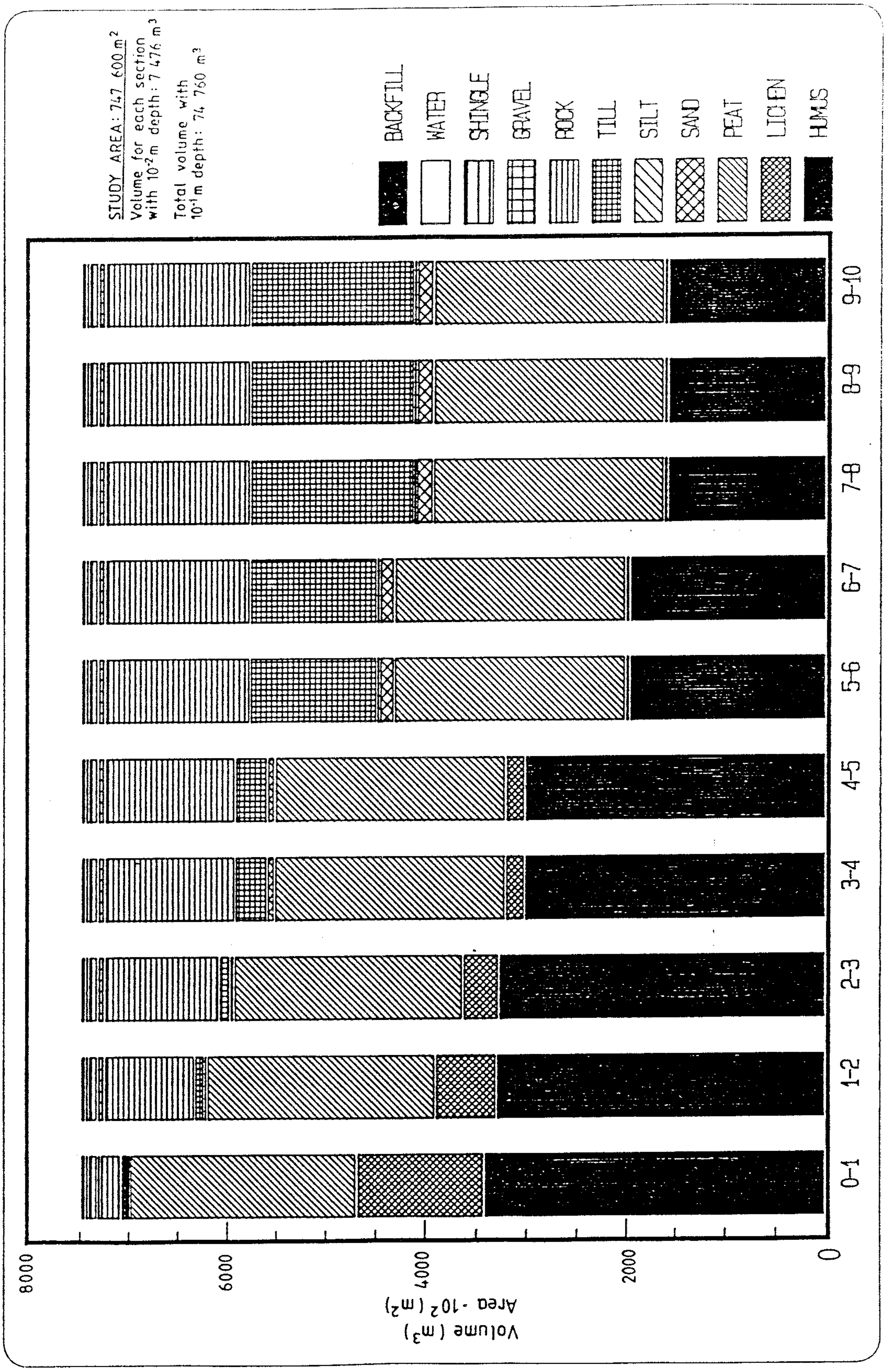

Figure 37 Detailed illustration of materials volume/area distribution within the top 10 cm of the surface layer.

Table 1 Area calculations of materials at various depths. (cf. Figures 22, 23 and 24)

AREA CALCULATIONS PER SECTION

DEPTH (0.1m)	HUMUS (m 2)	LICHEN (m 2)	PEAT (m 2)	SAND (m 2)	SILT (m 2)	TILL (m 2)	ROCK (m 2)	GRAVEL (m 2)	SHINGLE (m 2)	WATER (m 2)	BACKFILL (m 2)	TOTAL (m 2)
0-1	340800	126600	230400	1800	0	7200	21600	2400	9600	2400	4800	747600
1-2	328800	59400	230400	3000	0	9600	92400	7200	9600	2400	4800	747600
2-3	326400	34800	230400	4200	0	10800	117000	7200	9600	2400	4800	747600
3-4	300600	19200	230400	7800	0	33000	132600	7200	9600	2400	4800	747600
4-5	300600	19200	230400	7800	0	33000	132600	7200	9600	2400	4800	747600
5-6	195600	4200	230400	15000	2400	128400	147600	7200	9600	2400	4800	747600
6-7	195600	4200	230400	15000	2400	128400	147600	7200	9600	2400	4800	747600
7-8	156600	4200	230400	16800	2400	165600	147600	7200	9600	2400	4800	747600
8-9	156600	4200	230400	16800	2400	165600	147600	7200	9600	2400	4800	747600
9-10	156600	4200	230400	16800	2400	165600	147600	7200	9600	2400	4800	747600
0-10	245820	28020	230400	10500	1200	84720	123420	6720	9600	2400	4800	747600
10-20	60000	0	232800	20400	7200	253800	151800	4800	9600	2400	4800	747600
20-30	4200	0	191400	29400	8400	328200	164400	4800	9600	2400	4800	747600
30-40	0	0	166800	33000	6000	355800	164400	4800	9600	2400	4800	747600
40-50	0	0	145200	39000	3600	364800	173400	4800	9600	2400	4800	747600

AREA IN % PER SECTION

DEPTH (0.1m)	HUMUS (%)	LICHEN (%)	PEAT (%)	SAND (%)	SILT (%)	TILL (%)	ROCK (%)	GRAVEL (%)	SHINGLE (%)	WATER (%)	BACKFILL (%)	TOTAL (%)
0-1	45,59%	16,93%	30,82%	0,24%	0,00%	0,96%	2,89%	0,32%	1,28%	0,32%	0,64%	100,00%
1-2	43,98%	7,95%	30,82%	0,40%	0,00%	1,28%	12,36%	0,96%	1,28%	0,32%	0,64%	100,00%
2-3	43,66%	4,65%	30,82%	0,56%	0,00%	1,44%	15,65%	0,96%	1,28%	0,32%	0,64%	100,00%
3-4	40,21%	2,57%	30,82%	1,04%	0,00%	4,41%	17,74%	0,96%	1,28%	0,32%	0,64%	100,00%
4-5	40,21%	2,57%	30,82%	1,04%	0,00%	4,41%	17,74%	0,96%	1,28%	0,32%	0,64%	100,00%
5-6	26,16%	0,56%	30,82%	2,01%	0,32%	17,17%	19,74%	0,96%	1,28%	0,32%	0,64%	100,00%
6-7	26,16%	0,56%	30,82%	2,01%	0,32%	17,17%	19,74%	0,96%	1,28%	0,32%	0,64%	100,00%
7-8	20,95%	0,56%	30,82%	2,25%	0,32%	22,15%	19,74%	0,96%	1,28%	0,32%	0,64%	100,00%
8-9	20,95%	0,56%	30,82%	2,25%	0,32%	22,15%	19,74%	0,96%	1,28%	0,32%	0,64%	100,00%
9-10	20,95%	0,56%	30,82%	2,25%	0,32%	22,15%	19,74%	0,96%	1,28%	0,32%	0,64%	100,00%

Table 2 Volume calculation of materials at various depths. (cf. Figures 22, 23 and 24)

VOLUME CALCULATIONS PER SECTION

DEPTH (0.01m)	HUMUS (m 3)	LICHEN (m 3)	PEAT (m 3)	SAND (m 3)	SILT (m 3)	TILL (m 3)	ROCK (m 3)	GRAVEL (m 3)	SHINGLE (m 3)	WATER (m 3)	BACKFILL (m 3)	TOTAL (m 3)
0-1	3408	1266	2304	18	0	72	216	24	96	24	48	7476
1-2	3288	594	2304	30	0	96	924	72	96	24	48	7476
2-3	3264	348	2304	42	0	108	1170	72	96	24	48	7476
3-4	3006	192	2304	78	0	330	1326	72	96	24	48	7476
4-5	3006	192	2304	78	0	330	1326	72	96	24	48	7476
5-6	1956	42	2304	150	24	1284	1476	72	96	24	48	7476
6-7	1956	42	2304	150	24	1284	1476	72	96	24	48	7476
7-8	1566	42	2304	168	24	1656	1476	72	96	24	48	7476
8-9	1566	42	2304	168	24	1656	1476	72	96	24	48	7476
9-10	1566	42	2304	168	24	1656	1476	72	96	24	48	7476
0-10	24582	2802	23040	1050	120	8472	12342	672	960	240	480	74760
10-20	6000	0	23280	2040	720	25380	15180	480	960	240	480	74760
20-30	420	0	19140	2940	840	32820	16440	480	960	240	480	74760
30-40	0	0	16680	3300	600	35580	16440	480	960	240	480	74760
40-50	0	0	14520	3900	360	36480	17340	480	960	240	480	74760

VOLUME IN % PER SECTION

DEPTH (0.01m)	HUMUS (%)	LICHEN (%)	PEAT (%)	SAND (%)	SILT (%)	TILL (%)	ROCK (%)	GRAVEL (%)	SHINGLE (%)	WATER (%)	BACKFILL (%)	TOTAL (%)
0-1	45,6%	16,9%	30,8%	0,2%	0,0%	1,0%	2,9%	0,3%	1,3%	0,3%	0,6%	100,0%
1-2	44,0%	7,9%	30,8%	0,4%	0,0%	1,3%	12,4%	1,0%	1,3%	0,3%	0,6%	100,0%
2-3	43,7%	4,7%	30,8%	0,6%	0,0%	1,4%	15,7%	1,0%	1,3%	0,3%	0,6%	100,0%
3-4	40,2%	2,6%	30,8%	1,0%	0,0%	4,4%	17,7%	1,0%	1,3%	0,3%	0,6%	100,0%
4-5	40,2%	2,6%	30,8%	1,0%	0,0%	4,4%	17,7%	1,0%	1,3%	0,3%	0,6%	100,0%
5-6	26,2%	0,6%	30,8%	2,0%	0,3%	17,2%	19,7%	1,0%	1,3%	0,3%	0,6%	100,0%
6-7	26,2%	0,6%	30,8%	2,0%	0,3%	17,2%	19,7%	1,0%	1,3%	0,3%	0,6%	100,0%
7-8	20,9%	0,6%	30,8%	2,2%	0,3%	22,2%	19,7%	1,0%	1,3%	0,3%	0,6%	100,0%
8-9	20,9%	0,6%	30,8%	2,2%	0,3%	22,2%	19,7%	1,0%	1,3%	0,3%	0,6%	100,0%
9-10	20,9%	0,6%	30,8%	2,2%	0,3%	22,2%	19,7%	1,0%	1,3%	0,3%	0,6%	100,0%

Table 3 Vegetation cover within Orrmyrberget catchment basin.

xcoord ysection = orientation, cf. Figure 4.
grwsurf= groundwater, depth in cm
coverspec= **Peat**; TT=Drained, KF=Fen with coniferous forest, KV=Fen, carpet-like vegetation and open with flarks.
Outcrop; S=Large outcrop, H= "Non" fractured rock, U=fractured rock - with veg.cover; Lichen high/low= LH/LL, Moss high/low= MH/ML, bare outcrop=K
Other materials; se maps for information.
rockov= % of outcrop covered by moss or lichen
overveg=Overvegetation. First letter: H=high(trees), L=low. second letter: T=dens, G=intermidient, S=spars.
underveg= Under vegetation. First letter: B=shrubs, R=dwarf shrubs, G=grass, M=moss. Second letter: c.f. overveg.

XCOORDYSECTION	GRWSURF	COVERSPEC	ROCKCOV	OVERVEG	UNDERVEG			
0 0				-	G-S	-	-	-
20W0	50	TT		-	G-S	M-T	-	-
40W0	50	TT		LT	B-G	R-G	G-T	-
60W0	40			LG	B-S	G-T	M-G	-
80W0	70			LT	B-S	R-T	G-G	M-T
100W0	20			LT	B-S	R-S	G-G	M-T
120W0	30	KF		LG	B-G	R-G	G-G	M-T
140W0	30			LG	B-S	R-S	G-T	M-T
160W0		S-LH	60	-	B-S	M-G	-	-
180W0	100			LS	B-S	R-G	M-G	-
200W0	>100	S-LH	90	HS	-	-	-	-
220W0	40			HG	R-T	M-T	-	-
240W0				HS	R-T	M-T	-	-
20E0	300			LS	B-S	R-G	G-G	M-G
40E0		S-LH	90	LS	R-T	M-T	-	-
60E0				LS	B-S	R-T	M-T	-
80E0		H-LH	95	LS	R-T	M-G	-	-
100E0		H-LH	95	LS	R-T	M-G	-	-
120E0		H-LH		LS	R-G	-	-	-
300W60N		H-LH	50	LS	G-G	-	-	-
280W60N	20	KF		LS	R-T	M-T	-	-
260W60N		H-LH	90	LS	R-G	-	-	-
240W60N	20	KF		LS	R-T	M-T	-	-
220W60N		H-LH	90	LS	R-G	-	-	-
200W60N		S-LH	50	-	R-G	-	-	-
180W60N				LG	B-G	R-G	M-G	-
160W60N				LT	R-T	G-G	M-G	-
140W60N	20	KF		LT	R-G	G-T	M-G	-
120W60N	20			LT	R-T	G-T	M-T	-
100W60N	30			LT	R-T	G-G	M-T	-
80W60N	30			LT	R-T	G-G	M-T	-
60W60N	15			LT	R-G	G-T	M-T	-
40W60N	10	TT		LT	B-T	R-T	G-T	M-T
20W60N		TT		LT	B-T	R-T	G-T	M-T
0 60N	110	TT		LS	G-T	B-G	-	-
20E60N	40	TT		LG	B-T	G-T	-	-
40E60N	30	TT		LS	B-T	G-T	-	-
60E60N	40	TT		LS	B-G	R-S	G-T	-
80E60N	40			LG	B-G	R-G	G-G	M-T
100E60N	50			LG	B-G	R-G	M-T	-
120E60N	15			LG	B-G	R-G	G-T	M-G
0 120N	100	TT		LS	G-T	-	-	-
20W120N	40			LS	B-G	G-T	-	-
40W120N	40			LS	B-G	G-T	-	-
60W120N	40			LS	B-G	G-T	-	-
80W120N	40			LS	B-G	G-T	-	-

Table 3 Cont.

100W120N	40			LS	B-G	G-T	-	-
150E150N		H-LH	95	LS	B-G	-	-	-
130E150N		H-LH	95	LS	B-G	-	-	-
110E150N				LT	R-T	M-T	-	-
90E150N		H-LH	90	LS	R-G	-	-	-
70E150N				LS	G-T	-	-	-
50E150N	40			LS	G-T	-	-	-
30E150N	100			LS	G-T	-	-	-
0 180N	>30			LS	G-T	-	-	-
20W180N				-	G-G	M-G	-	-
40W180N				LS	R-G	M-G	-	-
60W180N		S	95	LS	B-G	R-G	M-T	-
80W180N				LS	B-S	R-T	-	-
100W180N				LS	B-S	R-T	-	-
120W180N				LS	B-S	R-T	-	-
140W180N				LS	B-S	R-T	-	-
160W180N				LS	B-S	R-T	-	-
180W180N	70	KF		HS	B-T	R-T	M-T	-
200W180N	40			HG	B-G	R-T	M-T	-
220W180N		S-LH		HG	-	-	-	-
240W180N		U-LH	95	HS	R-G	-	-	-
260W180N		U-LH	95	HS	R-G	-	-	-
280W180N	30			HT	R-T	M-T	-	-
300W180N	30			HT	R-T	M-T	-	-
240W240N	30			HT	R-T	M-T	-	-
220W240N	30			HT	R-T	-	-	-
200W240N	50	KF		-	R-G	M-T	-	-
180W240N	50	KF		LS	R-T	M-T	-	-
160W240N		S		LS	R-T	M-T	-	-
140W240N		S-LH	90	-	-	-	-	-
120W240N				LS	R-T	M-T	-	-
100W240N		S-LH	90	LS	B-G	R-G	M-T	-
80W240N		S-LH	90	LS	B-G	R-G	M-T	-
60W240N				LG	B-G	M-T	-	-
40W240N				LG	G-T	M-G	-	-
240E240N	50			LT	G-T	M-T	-	-
220E240N				LT	G-T	M-T	-	-
200E240N				LG	G-T	-	-	-
180E240N				LG	B-G	G-T	-	-
160E240N				LS	G-T	-	-	-
140E240N				LS	G-T	-	-	-
120E240N	15	TT		-	B-T	G-T	M-T	R-G
100E240N	10	KF		-	B-T	G-T	M-T	-
80E240N	10	KF		LS	B-T	G-T	M-T	-
60E240N	10	KF		LS	B-T	G-T	M-T	-
40E240N	10			LS	G-T	-	-	-
20E240N	5	KF		LS	B-G	G-T	M-T	-
0 240N	2	KF		LS	B-T	G-T	M-T	-
240W360N	50			HG	R-G	M-T	-	-
220W360N	5			HG	B-T	G-T	M-T	-
200W360N	50			HG	B-T	G-T	M-T	-
180W360N	50			HG	R-G	G-T	M-T	-
160W360N				LT	B-S	G-G	M-T	-
140W360N				LT	B-S	G-G	M-T	-
120W360N	30			LT	B-G	G-T	M-T	-
100W360N				LG	B-G	R-G	G-T	M-T
80W360N				LG	B-G	R-G	G-T	M-T
60W360N	60			LG	R-G	G-T	M-T	-
40W360N	60			LG	R-G	G-T	M-T	-
20W360N	60			LG	R-G	G-T	M-T	-
0 360N	60			LG	R-G	G-T	M-T	-
20E360N				LG	G-T	M-T	-	-
40E360N				LG	G-T	M-T	-	-
60E360N	70			LG	G-T	-	-	-
80E360N				LG	G-T	-	-	-
100E360N				LG	G-T	-	-	-
120E360N				LG	R-G	G-G	M-G	-
140E360N				LG	R-G	G-G	M-G	-
160E360N				LG	R-G	G-G	M-G	-
180E360N				LG	R-G	G-G	M-G	-

Table 3 Cont.

0 120S	30	KF		LS	R-T	M-T	-	-
20E120S	20	KF		LS	B-G	R-G	G-T	M-T
40E120S	20			LT	R-G	G-T	M-G	-
60E120S	>50			LG	R-G	G-T	-	-
80E120S	>50			LG	R-G	G-T	-	-
100E120S	>50			LG	R-G	G-T	--	-
120E120S	30			LG	R-G	G-T	M-G	-
140E120S	30			LG	R-G	G-T	M-G	-
160E120S	30			LG	R-G	G-T	M-G	-
180E120S				LG	R-G	G-T	M-G	-
200E120S	>30	KF		LG	G-T	M-T	-	-
220E120S				LG	G-T			-
240E120S				LG	R-G	G-G	M-G	-
240E180S				LG	R-T	M-T	-	-
420W120S		H	80	HS	R-G	-	-	-
440W120S	1	H-LL	50	HS	R-G	-	-	-
460W120S	40	KF		HS	R-T	M-T	-	-
480W120S		H-LH-LL	40-30	HS	R-G	-	-	-
400W120S				HG	R-T	-	-	-
380W120S				HG	R-T	-	-	-
360W120S		LH		HS	R-T	M-T	-	-
340W120S	30	KF		HG	R-T	M-T	-	-
320W120S		KF		HG	R-T	M-T	-	-
240W120S	30	KF		HS	R-T	M-T	-	-
220W120S				HS	R-T	-	-	-
200W120S	40			-	R-T	-	-	-
180W120S				LT	R-T	-	-	-
160W120S				LT	G-T	M-G	-	-
140W120S				-	G-T	M-G	-	-
120W120S				LG	G-T	M-T	-	-
100W120S	10	KF		LG	G-T	M-G	-	-
80W120S	20	KF		LG	B-G	R-G	G-T	M-G
60W120S	40	TT		LG	B-G	G-T	-	-
40W120S	30	TT		LG	B-G	G-T	M-T	-
20W120S	100	TT		LS	B-G	R-G	G-T	M-T
240E240S				LS	R-G	G-T	-	-
260E240S		U-LH-LL		-	-	-	-	-
220E240S		U-LH-LL		LS	-	-	-	-
200E240S	20			LG	R-G	G-T	M-T	-
180E240S	30			LG	R-T	M-T	-	-
160E240S	50(CREEK)			LG	R-T	M-T	-	-
140E240S	30			LG	R-T	M-T	-	-
120E240S	30			LG	R-T	M-T	-	-
100E240S	30			LG	R-T	M-T	-	-
80E240S		S-LH	90	-	-	-	-	-
60E240S	10	KF		LG	G-G	M-T	-	-
40E240S	40			LG	G-T	M-T	-	-
20E240S		S-LH	95	LG	B-G	R-G	M-G	-
0 240S		S-LH	95	LG	B-G	R-G	M-G	-
20W240S	10			-	G-G	-	-	-
40W240S	10			-	G-G	-	-	-
60W240S	40			-	G-T	-	-	-
80W240S				LG	G-T	-	-	-
100W240S				LG	B-S	G-T	-	-
120W240S				LG	B-S	G-T	-	-
140W240S	20			LG	G-T	M-G	-	-
160W240S	20			LT	B-G	R-G	G-G	M-G
180W240S				LT	B-G	R-G	M-T	-
200W240S				LS	R-T	M-G	-	-
220W240S				-	-	-	-	-
240W240S				LG	B-T	R-G	G-G	M-G
260W240S	40	TT		LG	B-T	M-G	-	-
280W240S	60	TT		HG	R-T	-	-	-
300W240S	30			HG	R-T	M-G	-	-
320W240S	40	KF		HG	R-T	M-T	-	-
340W240S	40	KF		HG	R-T	M-T	-	-
360W240S		KF		HG	R-T	M-T	-	-
380W240S		S-LH		HG	R-T	M-T	-	-
400W240S		S-LH		HG	R-T	M-T	-	-
420W240S	15	KF		HG	R-T	M-T	-	-

Table 3 Cont.

420W180S		S-LH-LL		HS	B-S	R-G	-	-
120W360S				LG	G-T	M-G	-	-
140W360S				LG	G-T	M-T	-	-
160W360S				LG	R-T	M-T	-	-
180W360S	20	KF		LG	G-T	M-T	-	-
200W360S				LG	R-G	G-T	M-T	-
220W360S				LG	R-G	G-T	M-T	-
240W360S				LG	R-G	G-T	M-T	-
260W360S	20			LG	B-G	R-G	M-T	-
280W360S				HG	R-T	M-G	-	-
300W360S				HG	R-T	M-G	-	-
320W360S				HG	R-T	M-G	-	-
340W360S		LH		HG	R-T	M-G	-	-
360W360S				HG	R-T	M-G	-	-
380W360S		S-LH		HG	R-T	-	-	-
240E360S		H-LH-MH	30-20	LS	R-G	M-S	-	-
220E360S		H-LH-MH	30-20	LS	R-G	M-S	-	-
200E360S		H-LH-MH	30-20	LS	R-G	-	-	-
180E360S				LT	B-G	R-G	G-T	M-T
160E360S	5	KF		LG	R-G	G-G	M-T	-
140E360S		S-LH	90	-	B-S	-	-	-
120E360S				LT	R-G	G-S	M-T	-
100E360S				LT	R-G	G-T	M-T	-
80E360S				LT	R-G	G-T	M-T	-
60E360S				LG	G-T	M-T	-	-
40E360S	10	KF		LG	R-G	G-T	M-T	-
20E360S	10	KF		LG	R-G	G-T	M-T	-
0 360S	10	KV		LS	R-T	M-T	-	-
20W360S	5	KV		LS	R-G	M-T	-	-
40W360S	10	KV		LS	R-T	M-T	-	-
60W360S	20	KF		LG	R-T	M-T	-	-
80W360S	10	KF		LT	B-T	R-T	G-T	M-G
100W360S	20	KF		LG	B-G	R-T	G-T	M-T
240E420S		H-LH	70	LS	M-G	-	-	-
480W480S	30			HT	R-T	-	-	-
460W480S	30			HT	R-T	-	-	-
440W480S	30	KF		HT	R-T	M-T	-	-
420W480S	20	KF		HT	R-T	M-T	-	-
400W480S	20			HT	R-T	M-T	-	-
380W480S		LH		HT	R-T	M-T	-	-
360W480S	30			HT	R-T	M-T	-	-
340W480S		LH		HG	R-G	M-T	-	-
320W480S		LH		HG	R-G	M-T	-	-
300W480S				LG	B-G	R-G	M-T	-
280W480S	30	KF		LG	G-T	M-T	-	-
260W480S	10	KF		LG	G-T	M-T	-	-
240W480S		S-LH	50	LG	G-G	-	-	-
220W480S		S-LH		LG	B-G	R-G	-	-
200W480S	10			LG	B-G	R-G	M-G	-
180W480S				LG	B-G	R-G	G-G	M-G
160W480S	150(ROAD)			-	-	-	-	-
140W480S	40	TT		LS	G-T	-	-	-
120W480S	20	LH		LS	B-G	R-G	M-G	-
100W480S		S-LH	80	LG	M-G	-	-	-
80W480S	30	KF		LG	B-G	R-G	G-G	M-G
60W480S	20	KF		LG	B-G	R-G	G-G	M-G
40W480S	2	KF		LG	R-T	M-T	-	-
20W480S	1	KV		-	M-T	-	-	-
0 480S	(WATER)	KV		-	-	-	-	-
20E480S	2	KV		-	M-T	-	-	-
40E480S	3	KF		LT	B-G	G-G	M-T	-
60E480S	5	KF		LG	B-G	G-T	M-G	-
80E480S				LG	G-T	-	-	-
100E480S				LT	B-G	G-T	M-S	-
120E480S				LG	B-G	R-S	G-T	M-S
140E480S				LG	B-G	R-S	G-T	M-S
160E480S				LG	B-G	R-S	G-T	M-S
180E480S				LT	B-G	R-G	G-G	M-G
200E480S				LG	R-G	G-T	M-T	-
220E480S		S-MH		-	-	-	-	-

Table 3 Cont.

240E480S		H-LH	80	LG	R-G	M-G	-	-
180W600S	40	TT		LG	G-T	M-G	-	-
160W600S	20			LS	R-G	M-T	-	-
140W600S	20			LT	B-T	M-G	R-T	-
120W600S	>50			LT	R-T	M-T	-	-
100W600S	30			LG	G-T	M-T	-	-
80W600S	30	TT		LG	B-G	G-T	M-T	-
60W600S	30	KF		LS	R-T	M-T	-	-
40W600S		KF		LS	R-T	M-T	-	-
20W600S	40	KF		LT	R-T	M-T	-	-
0 600S	100			-	R-G	G-G	M-T	-
20E600S		H-LH-MH	70-20	LS	R-G	M-G	-	-
40E600S		H-LH-MH	70-20	LS	R-G	M-G	-	-
60E600S				LS	R-T	M-G	-	-
80E600S		LH	20	LS	R-T	-	-	-
100E600S	20			LS	B-T	R-T	M-T	-
120E600S		H-LH-MH	70-20	-	M-G	-	-	-
140E600S		H-LH-ML	60-20	-	-	-	-	-
240W600S	30	KF		LG	R-G	G-G	M-T	-
260W600S	50			LS	B-G	R-T	M-G	-
280W600S	20			LS	R-T	M-G	-	-
300W600S				LG	R-T	M-G	-	-
320W600S	40	KF		LS	R-T	M-G	-	-
340W600S	50	TT		LG	B-G	R-T	M-G	-
360W600S	40	KF		LG	B-G	R-G	G-G	M-G
380W600S	30	KF		LG	B-G	R-T	G-G	M-T
400W600S	50			-	R-T	-	-	-
420W600S	30			HG	R-T	M-G	-	-
440W600S				HG	R-T	M-G	-	-
460W600S				HG	R-T	M-G	-	-
480W600S				HG	R-T	M-G	-	-
360W660S	40			LG	G-T	-	-	-
0 720S		U-LH-MH	50-10	LS	R-G	-	-	-
20E720S		U-LH-MH	50-20	LG	R-T	M-T	-	-
20W720S		LH	50	HG	R-T	M-T	-	-
40W720S		U-LH	50	HG	R-G	M-G	-	-
60W720S	50			LT	R-G	G-G	M-G	-
80W720S				-	G-T	-	-	-
100W720S	10	KF		LG	R-T	M-T	-	-
120W720S	10	KF		LG	R-T	M-T	-	-
140W720S	10	KF		LT	G-T	M-T	-	-
160W720S	(ROAD)			-	-	-	-	-
180W720S	50			LT	R-G	G-G	M-T	-
200W720S				LT	R-G	G-T	M-T	-
220W720S	10	KF		LG	R-G	G-T	M-T	-
240W720S				LG	B-G	R-G	G-G	M-G
260W720S				LG	R-T	G-G	M-G	-
280W720S	10	KF		LS	R-G	M-T	-	-
300W720S		S		LS	R-T	M-G	-	-
320W720S		S		-	R-T	M-G	-	-
340W720S		S-LH	90	-	-	-	-	-
360W720S	10	KF		LG	M-T	-	-	-
0 840S		H-LH		LG	R-G	M-G	-	-
20W840S				HG	R-T	M-T	-	-
40W840S				HG	R-T	M-T	-	-
60W840S		H-LH-MH	70-20	HS	M-G	-	-	-
80W840S		H-LH-MH	70-20	HS	M-G	-	-	-
100W840S	30	KF		HG	M-T	-	-	-
120W840S	30			HG	M-T	-	-	-
140W840S		S-LH	100	HT	R-G	-	-	-
160W840S				HT	R-T	M-T	-	-
180W840S	20			HT	R-T	M-T	-	-
200W840S	20	KF		HG	R-T	M-T	-	-
220W840S	20	KF		HG	M-T	-	-	-
240W840S	20	KF		HG	R-T	M-T	-	-
300W480N	20			HT	R-T	G-T	M-T	-

Table 4 Example of form used in field for registration of the various data needed in the construction for the maps and calculations presented in this report.

SVERIGES GEOLOGISKA AB

DATUM	KLOCKSLAG	SIGNATUR	PROV
890615	1158	IA	K33 30

OBJEKTNAMN	
Gideå Orrmyrberget	116

UNDERSÖKNINGSPUNKT

	X		Y	ÖVER VEG.	UNDER VEG.	HYDRO LOGI
0	60	S	240	LG		V
				L S H G T	B S R G G T M	I U

	Humuslagrets djup i cm	Överytans jordart	Grundvattenytans djup i cm	Överyta specifikation BE TO	Täcknings grad på berg %
1	15	TO	10	KFU	
2	30	SI			
3		MO			
4					
5					
6					
7					
8					
9					

Överytans jordart: BE, MO, SA, SI, LE, TO

BE — UPPSPRUCKET UPS; HELT HEL

BE — KALT KAL; LAV HÖG LAH; LAV LÅG LAL; MOSSA HÖG MOH; MOSSA LÅG MOL

TO — KÄRR VAT ÖPPET KVÖ; KÄRR FAST UNDERGR KFU; TORV TORRT TOT

List of SKB reports

Annual Reports

1977-78
TR 121
KBS Technical Reports 1 – 120
Summaries
Stockholm, May 1979

1979
TR 79-28
The KBS Annual Report 1979
KBS Technical Reports 79-01 – 79-27
Summaries
Stockholm, March 1980

1980
TR 80-26
The KBS Annual Report 1980
KBS Technical Reports 80-01 – 80-25
Summaries
Stockholm, March 1981

1981
TR 81-17
The KBS Annual Report 1981
KBS Technical Reports 81-01 – 81-16
Summaries
Stockholm, April 1982

1982
TR 82-28
The KBS Annual Report 1982
KBS Technical Reports 82-01 – 82-27
Summaries
Stockholm, July 1983

1983
TR 83-77
The KBS Annual Report 1983
KBS Technical Reports 83-01 – 83-76
Summaries
Stockholm, June 1984

1984
TR 85-01
Annual Research and Development Report 1984
Including Summaries of Technical Reports Issued during 1984. (Technical Reports 84-01 – 84-19)
Stockholm, June 1985

1985
TR 85-20
Annual Research and Development Report 1985
Including Summaries of Technical Reports Issued during 1985. (Technical Reports 85-01 – 85-19)
Stockholm, May 1986

1986
TR 86-31
SKB Annual Report 1986
Including Summaries of Technical Reports Issued during 1986
Stockholm, May 1987

1987
TR 87-33
SKB Annual Report 1987
Including Summaries of Technical Reports Issued during 1987
Stockholm, May 1988

1988
TR 88-32
SKB Annual Report 1988
Including Summaries of Technical Reports Issued during 1988
Stockholm, May 1989

1989
TR 89-40
SKB Annual Report 1989
Including Summaries of Technical Reports Issued during 1989
Stockholm, May 1990

Technical Reports

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TR 91-01
Description of geological data in SKB's database GEOTAB
Version 2
Stefan Sehlstedt, Tomas Stark
SGAB, Luleå
January 1991

TR 91-02
Description of geophysical data in SKB database GEOTAB
Version 2
Stefan Sehlstedt
SGAB, Luleå
January 1991

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1. The application of PIE techniques to the study of the corrosion of spent oxide fuel in deep-rock ground waters
2. Spent fuel degradation
R S Forsyth
Studsvik Nuclear
January 1991

TR 91-04
Plutonium solubilities
I Puigdomènech[1], J Bruno[2]
[1]Enviromental Services, Studsvik Nuclear, Nyköping, Sweden
[2]MBT Tecnologia Ambiental, CENT, Cerdanyola, Spain
February 1991

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SGAB, Luleå
April, 1991

TR 91-06
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Version 2
Ebbe Eriksson, Stefan Sehlstedt
SGAB, Luleå
March 1991

TR 91-07
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Version 2
Margareta Gerlach[1], Bengt Gentzschein[2]
[1]SGAB, Luleå
[2]SGAB, Uppsala
April 1991

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Overview of geologic and geohydrologic conditions at the Finnsjön site and its surroundings
Kaj Ahlbom[1], Sven Tirén[2]
[1]Conterra AB
[2]Sveriges Geologiska AB
January 1991

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Thomas Ittner
SGAB, Uppsala
December 1990

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Eva Hakami[1], Anders Ekstav[2], Ulf Qvarfort[2]
[1]Vattenfall HydroPower AB
[2]Golder Geosystem AB
January 1991

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Akke Bengtsson[1], Bertil Grundfelt[1], Anders Markström[1], Anders Rasmuson[2]
[1]KEMAKTA Konsult AB
[2]Chalmers Institute of Technology
January 1991

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Björn Lindbom, Anders Boghammar, Hans Lindberg, Jan Bjelkås
KEMAKTA Consultants Co, Stockholm
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Phase 1 feasibility study
J E Geier, C-L Axelsson
Golder Geosystem AB, Uppsala
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Kai Palmqvist, Marianne Lindström
BERGAB-Berggeologiska Undersökningar AB
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Robert Finch, Rodney Ewing
Department of Geology, University of New Mexico
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Robert Lagerbäck
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Rogaland University, Stavanger, Norway
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Sven Norman[1], Nils Kjellbert[2]
[1]Starprog AB
[2]SKB AB
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K-E Almén, O Zellman
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[1]KEMAKTA Consultants Co
[2]Chalmers Institute of Technology

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Starprog AB
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