IRISH - DUTCH RAISED BOG STUDY
GEOHYDROLOGY AND ECOLOGY

- National Parks and Wildlife Service of the Office of Public Works, Dublin
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HYDROLOGY OF CLARA AND RAHEENMORE BOG

Permeability of Raheenmore Bog
Subsidence study of Clara Bog West

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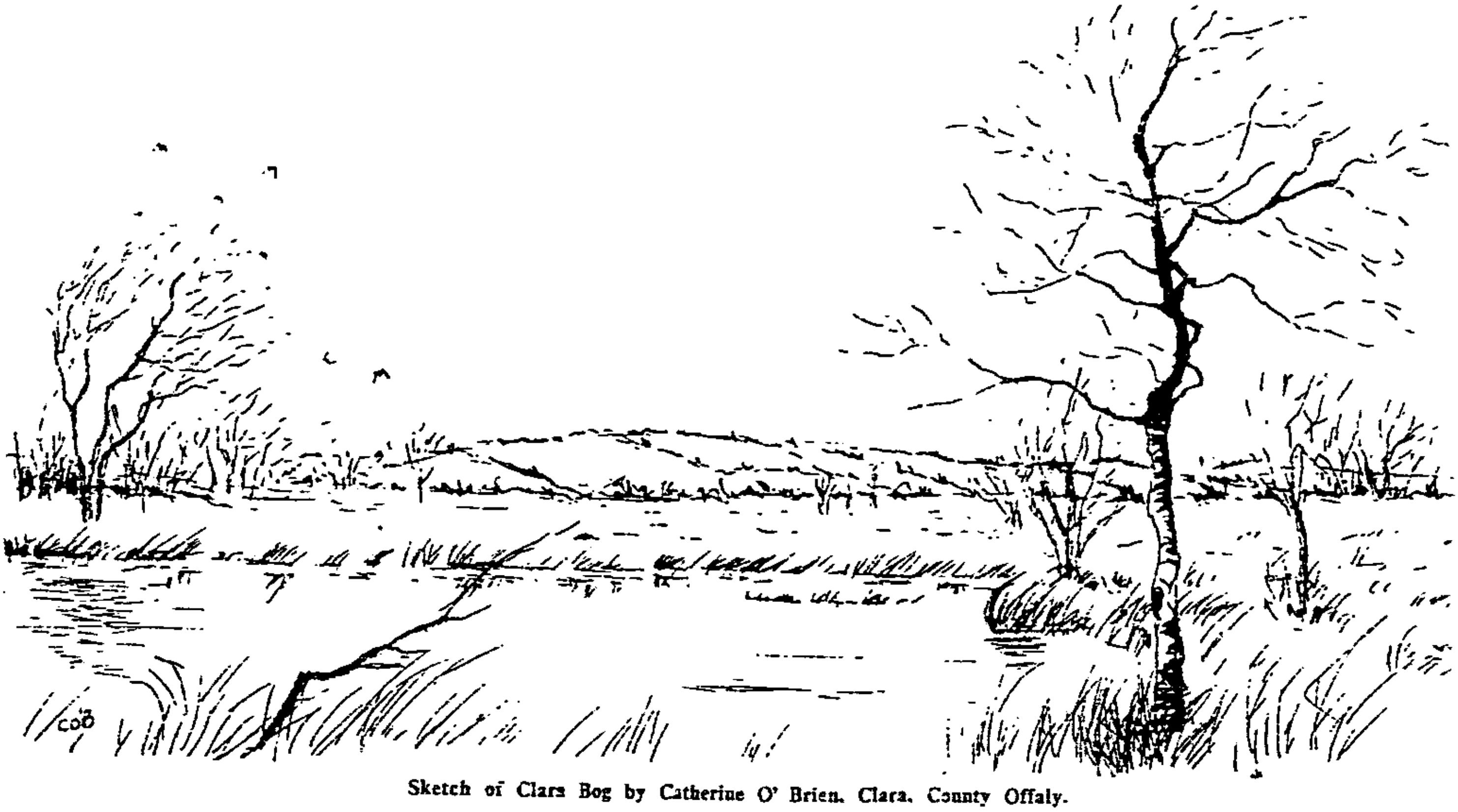

Sketch of Clara Bog by Catherine O' Brien, Clara, County Offaly.

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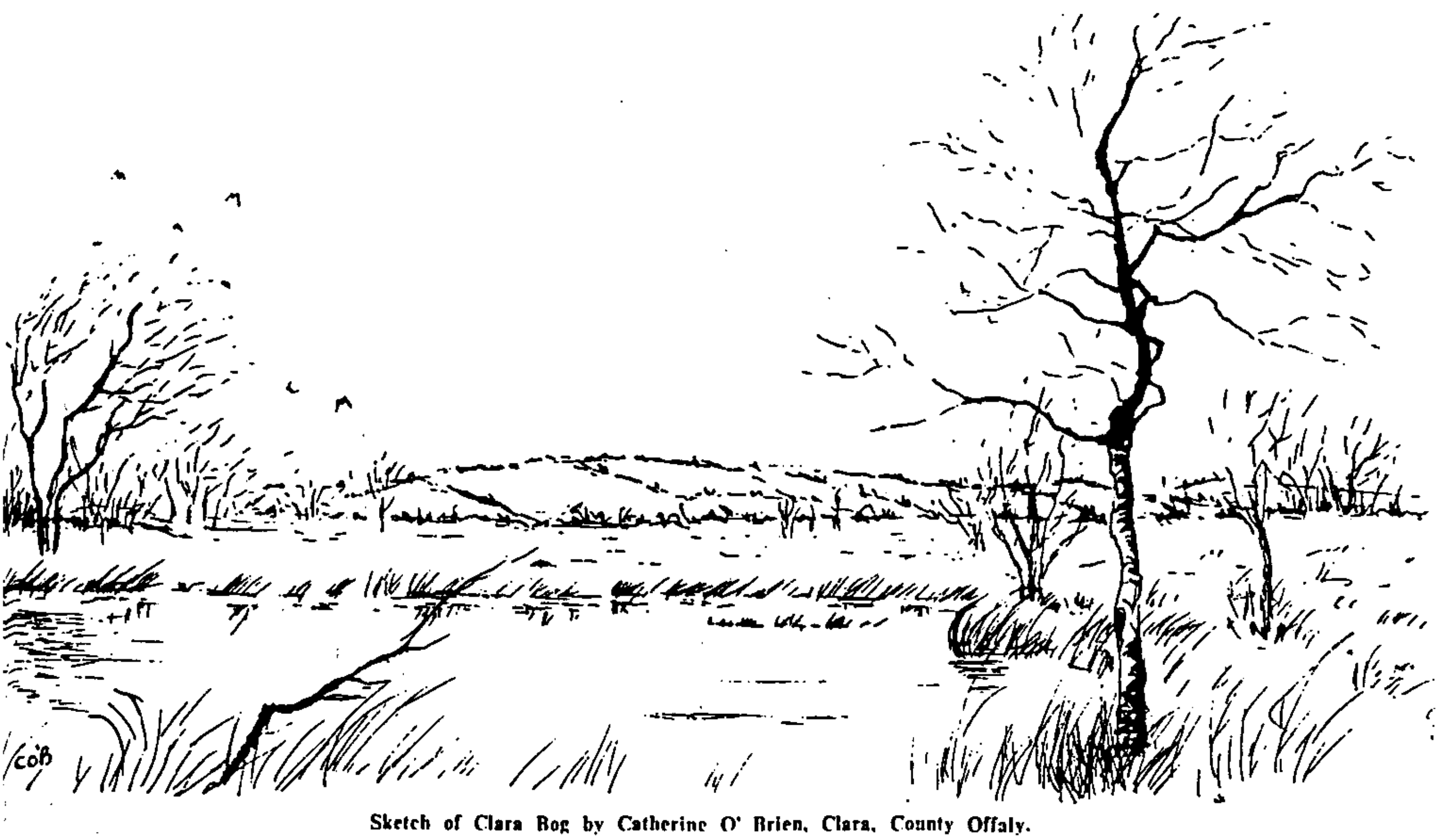

Sketch of Clara Bog by Catherine O' Brien, Clara, County Offaly.

CONTENTS

VOORWOORD

Het voor u liggende rapport is uitgevoerd in het kader van een afstudeervak/stage bij de Vakgroep Waterhuishouding, Landbouw Universiteit Wageningen in de periode april-oktober 1992. Het voornaamste onderdeel daarvan was een verblijf van vijf maanden in Clara, Ierland.

Gedurende deze periode hebben wij samengewerkt met een aantal mensen, die we via deze weg willen bedanken; Mary Smyth voor haar geologische uiteenzettingen en Ray Flynn voor de vruchtbare discussies. Verder willen we noemen: Iain Blackwell, Manon van den Boogaard, Vincent Hussy, Lara Kelly, Helen Samuels en Marco Scheffers. Jim Ryan (thanks for the Renault !) en Jan Streefkerk ondersteunden het onderzoek, elk op hun eigen wijze.

De begeleiding was in handen van Sake van der Schaaf.

PREFACE

This thesis was written as a graduate study at the Department of Water Resources of the Agricultural University Wageningen. A major part was a stay of five months in Clara, Ireland.

During this period we have collaborated with several people. We would like to thank Mary Smyth for her geological rationalizations and Ray Flynn for the ingenious discussions. Furthermore we would like to name the following people: Iain Blackwell, Manon van den Boogaard, Vincent Hussy, Lara Kelly, Helen Samuels and Marco Scheffers. Jim Ryan (thanks for the Renault !) and Jan Streefkerk supported this study, each in his own manner.

And last but not least we thank our supervisor Sake van der Schaaf.

SAMENVATTING

In het kader van dit rapport voor het Iers-Nederlandse Hoogveen Projekt, komen twee hydrologische onderwerpen aan de orde. Het eerste onderwerp is het bepalen van de doorlatendheid van de catotelm van Raheenmore bog, het tweede onderwerp is een zettingstudie op Clara west.

Na het afwegen van de falling, rising en constant head methode, bleek de constant head methode theoretisch het beste te zijn, echter uit praktisch oogpunt was de falling head methode te prefereren, en werd daarom ook toegepast om de doorlatendheid te meten. De metingen zijn langs een transekt gedaan op verschillende diepten (0.5m, 1m, 2m, 3m, 4m, 7m, 10m, 13m). Geen relatie tussen doorlatendheid en diepte is vastgesteld. Echter, een relatie werd aangetroffen; van het centrum van het veen naar de rand neemt de doorlatendheid af.

Een methode om de variantie van individuele metingen van de doorlatendheid in een profiel te verkleinen is toegepast. De methode voldeed niet, wellicht als gevolg van twee oorzaken. Ten eerste kunnen de berekende doorlatendheden onnauwkeurig zijn, ten tweede, kan de aanname van wegzijging ongeacht plaats en diepte niet op gaan ten gevolge van seizoensfluktuaties.

Om het oorspronkelijk veenoppervlak van Clara west te reconstrueren, is een zettingstudie uitgevoerd. Langs vier transekten zijn veenmonsters genomen op elk veelvoud van een halve meter diepte. Vegetatietype, humificatiegraad en kleur zijn opgenomen in een boorstaat. Bovendien is de volumetrische koncentratie van organische stof bepalen, die werd gebruikt om de zetting te berekenen.

De keuze van het referentiepunt bleek grote invloed te hebben op de berekende zetting. Dit referentie punt dient aan twee voorwaarden te voldoen:
1. Geen zetting is opgetreden op het referentie punt.
2. De gemiddelde volumetrische koncentratie van organische stof C_0 voor konsolidatie van beide kolommen zijn bij benadering gelijk.

Drie referenties zijn gebruikt voor verschillende hydrologische omstandigheden in het veen. De plek waar het veen het dikst is, of de plek waar de laagste C_0 werd gemeten, bleken niet betrouwbaar genoeg om als referentie te gelden. Derhalve werd het referentie punt genomen op een ander veen, Carrowbehy bog in Mayo, dat niet door zetting lijkt aangetast. De referentie voor veenranden werd genomen op Clara West, aan de noordelijke rand, bij de Esker. Dit is zeer waarschijnlijk een natuurlijke veenrand.

De referentie voor ongestoord veen bedraagt 0.04018 m^3/m^3, de intermediaire referentie bedraagt 0.04272 m^3/m^3 , deze zijn beide genomen op Carrowbehy bog, Mayo. De randreferentie, genomen bij de Esker op Clara West bedraagt 0.051262 m^3/m^3. Enige voorzichtigheid met, en verder onderzoek naar deze getallen is gewenst.

Het westen van Clara West is vrijwel onaangetast door zetting, ~~de oorspronkelijke dome-vorm is nog aanwezig.~~
Naar de weg toe daalt het huidige veenoppervlak. Alhoewel verwacht was dat het oorspronkelijke, berekende, veenoppppervlak horizontaal zou lopen, tonen de berekeningen een lichte daling aan naar de weg toe. Echter, wanneer veenafgraving en oxidatie mee in overweging worden genomen, voldoet het beeld wel aan de verwachtingen.
Bij de Soak werd relatief weinig zetting aangetroffen.
Bemonstering boven de grondwaterspiegel leidt tot *over*schatting van de zetting, omdat het monster dan niet verzadigd is.
De berekeningen tonen aan dat in het verleden de Mound niet of minder afgetekend aanwezig was. In tegenstelling tot de rest van het veen, kon het veen ter plaatse van de Mound niet zakken vanwege de opwelling van de ondergrond, zodat de Mound nu boven het veen uitsteekt. Het westen van Clara West fungeer(t/de) wellicht als een autonoom veen, gescheiden van de rest van Clara bog door de Mound.
Naar de zuidelijke rand neemt de zetting toe, dat een bevestiging is voor het vermoeden dat de centrale delen van het veen vroeger meer naar het zuiden lagen.

Het bleek geen probleem om Sytsma werk te integreren in deze studie. Het gebruik van gegevens van Samuels om de zetting te berekenen leverde teleurstellende resultaten.

SUMMARY

Within the framework of this thesis for the Irish-Dutch Raised Bog Study mainly two hydrologic aspects are being dealt with. The first aspect is the determination of the permeability of the catotelm of Raheenmore bog, the second is a subsidence survey of Clara west.

After weighing the falling, rising and constant head method, the constant head method appeared to be theoretically the best, though from practical point of view the falling head method was more suitable and was therefore implemented to measure the permeability of the catotelm. The measurements were done along a transect at several depths (0.5m, 1m, 2m, 3m, 4m, 7m, 10m, 13m) across Raheenmore bog. No connection between permeability and depth was found. However, another relationship was established: from the centre of the bog to the edge the permeability decreases.

A method to diminish variance on individual measurements in the permeability profiles was applied. The method failed, possibly because of two reasons. Firstly, the permeabilities calculated with the falling head method can be wrong. Secondly, the assumption of downward flow irrespective of place and depth, can be disrupted due to seasonal influences.

To reconstruct the original bog surface of Clara west a subsidence survey was executed. Along four transects, peat was sampled at every half meter. A detailed log of the whole core was taken noting vegetation type, humification degree, colour. Furthermore the volumetric concentration of organic matter was calculated which was used to estimate the subsidence.

The choice of the reference site appeared to have an major influence on the calculated subsidence. The reference site must comply with two requirements:
1. No subsidence has occurred at the reference site.
2. The average volumetric concentration of organic matter (C_0) before consolidation of both columns were approximately the same.

Three reference sites were used for different hydrological environments in the peat. The site where peat is thickest on the bog and the site with the volumetric concentration of organic matter C_0 is least, did not produce reliable reference sites. Consequently, the reference site was taken on another bog, Carrowbehy bog in Mayo, which did not seem to be affected by subsidence. The edge reference was taken on Clara West, near the Esker, because this is most probably a natural bogedge.

The reference for undisturbed bog is 0.04018 m^3/m^3, the intermediair reference is 0.04272 m^3/m^3 , both were taken on Carrowbehy bog, Mayo. De edgereference, taken near the Esker on Clara West is 0.051262 m^3/m^3. Some prudence with, and further research at these figures is desirable.

On the west of Clara West did not suffer from much subsidence, the original (calculated) bog surface has a dome shape alike the present day situation.
Near the road, the original (calculated) level of the bog drops, where it is expected to remain the same or even increase. However when peat cutting and oxidation are taken into consideration, the result fulfills the expectation.
The Soak is not a spot of strong local subsidence, on the contrary, subsidence has been little at the Soak.
Sampling above the groundwatertable leads to overestimation of the subsidence, because the sample is not fully saturated.
The presence of the Mound was at least less pronounced in the past. However when subsidence struck the bog, the Mound could not subside because of the rising of the underlying substratum, and hence became elevated. Possibly the west of Clara West act(s/ed) as an autonomous bog, seperated from the rest of the bog by the Mound.
To the southern bog edge the subsidence increases, which can be interpreted as confirmation of an original bog centre situated southern of the present bog.

Sytsma's work was easily integrated in this study, Samuels work not, because of an essentially different approach to calculate the subsidence. The use of Samuels data to calculate the subsidence led to disappointing results.

1 INTRODUCTION

Raised bog is a landform typical of those parts of the world experiencing high precipitation, high relative humidity and low temperatures all year around. In this context the climate of North-West Europe in general and Ireland in particular is ideally suited for their development and indeed at one stage a large part of Ireland was covered by bog. Nowadays most raised bogs have disappeared as a result of turf cutting for fuel and electricity generation. As a consequence the intact raised bog has become a rare phenomenon both in Ireland and in North-West Europe. In the Netherlands there are only a few bog remnants left, while in the Irish Midlands raised bog still occur. In order to preserve some relatively intact examples, Clara bog and Raheenmore bog, as well as others, have been acquired by the Irish Wildlife service. Raheenmore bog is a classic example of a raised bog in a deep basin, with a well developed dome. Its size is about 213 ha (Lensen 1991). Clara bog is a raised bog with soak systems and is with its size of about 660 ha one of the largest relatively intact raised bogs remaining in Ireland. Both Raheenmore and Clara bog form the research area of the Clara bog project.

In september 1989 an Irish - Dutch research project (Clara bog project) was initiated. One of the aims of this project is to develop appropriate programs concerning the conservation and management of raised bogs. To achieve that, specific knowledge of the hydrology of the raised bogs is indispensable.

The acquired knowledge could lead to an improved insight into the safeguarding of and the taking of specific management measures in and around these areas. Moreover, this knowledge can be implemented in the regeneration programs of Dutch raised bogs such as Bargerveen.

This thesis is divided into two parts. Part one is the determination of the permeability of the catotelm of Raheenmore Bog, part two is a subsidence study of Clara Bog West. H.J. ten Dam and J.F.M. Spieksma are responsible for part one, J.F.M. Spieksma for part two.

In chapter 2 the development of raised bogs is discussed, and the study sites are described. Chapter 3 deals with the permeability measurements and determination of the permeability of the catotelm of Raheenmore bog. Finally chapter 4 contains a subsidence study of Clara west.

2 RAISED BOGS

2.1 The origin of raised bogs

Peat consists mainly of water, about 95% of peat is water. The rest of the peat consists of the dead remains of plants that have accumulated over thousands of years in areas where the rate of plant production exceeds the rate of plant decomposition. In fact there are different kind of peatlands, but in this particular case we are dealing with raised bogs.

Raised bogs occur in areas with a high precipitation excess (high average rainfall and/or low evapotranspiration values). They are termed raised bogs because of their domed shape. Current bog formation started at the end of the last glaciation, some 10.000 years ago, when the glaciers had retreated northwards. At this time much of central Ireland was covered by shallow lakes left behind by melting ice. Bog formation started in these lakes or waterlogged depressions. Five stages can be distinguished in the development from an open lake to a raised bog. The stages are given in Figure 1. In stage 1, peat forms on *lake* beds or in waterlogged depressions where the water is nutrient rich. In stage 2 beds of reeds develop and their dead remnants accumulate. The lake gradually fills under anaerobic conditions that prevents the decay of the dead vegetation. In stage

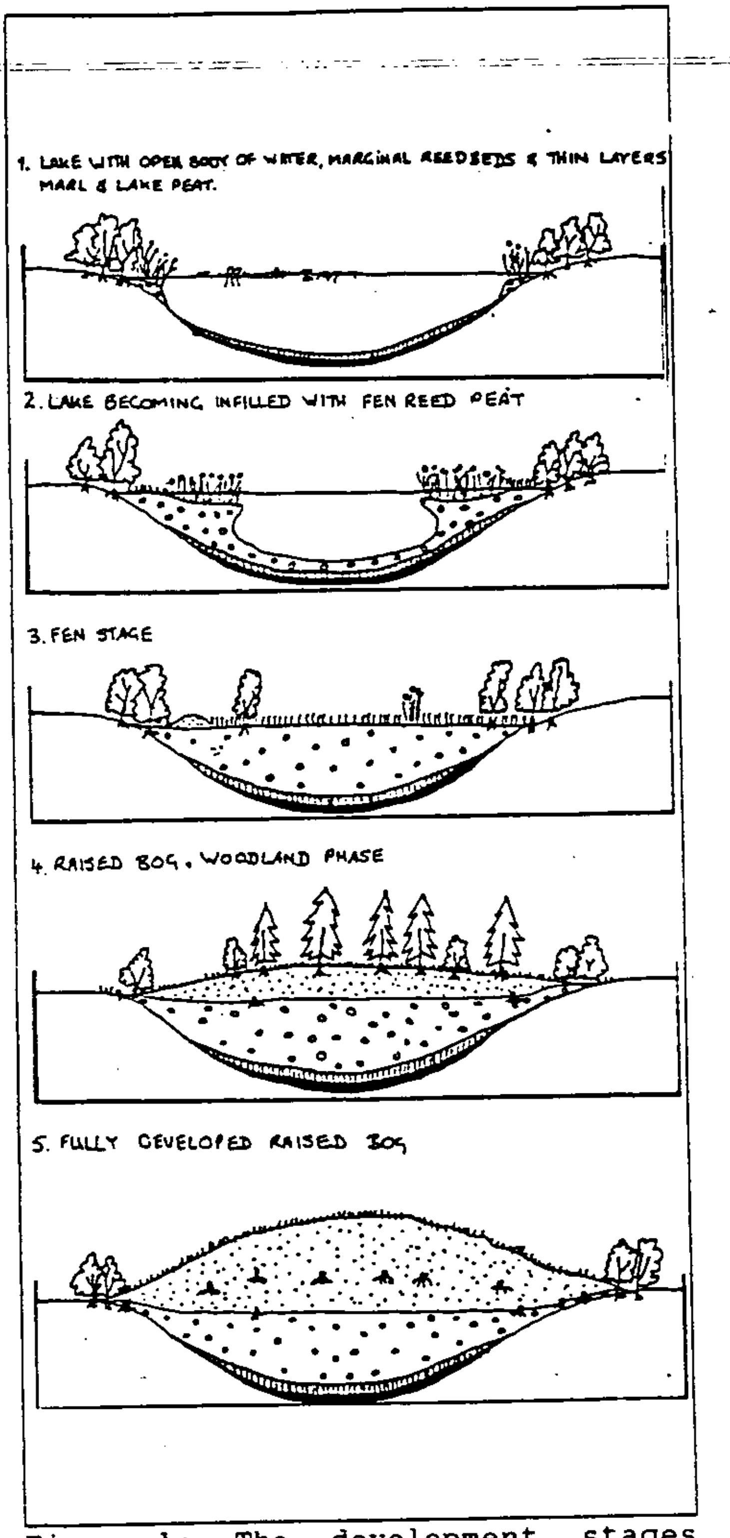

Figure 1; The development stages from a lake to a raised bog (Samuels 1992).

3, called *fen,* reeds are replaced by rushes, sedges, grasses and sometimes trees and shrubs. Fen peat is rather fibrous. At this time Sphagnum, able to survive on rainwater, which is nutrient poor, colonize the fen. In stage 4 accumulation of Sphagnum forms light coloured spongy peat situated above the influence of the ground water. By now, accumulation of peat is more rapid at the centre of the fen than at the margins, where decomposition takes place at faster rate. As a result of this differential rate of accumulation, the peat surface gradually becomes raised. Fen plants are replaced by species that can survive in much poorer, acid conditions and stage 5, *raised bog,* is reached. A well developed raised bog is fed only by rainfall. Some water is held by the spongy surface of the bog, though the greater part of the water runs of through the bog's surface (acrotelm).

More detailed information about the geology of the area and the causes of bog formation can be found in several other theses on the Clara bog project.

2.2 Clara bog

Clara is situated in the Midlands of Ireland in county Offaly. Clara bog is recognised internationally as an important nature reserve as it is one of the largest raised bogs remaining in Western Europe, with an area of 660 ha, and the only one left with a well developed soak system. A soak is richer in nutrients than the other parts of the bog, as a result of which plants characteristic of fens occur. Such areas often have an open lake. Both Clara west and Clara east have soak systems.

Although the bog is relatively intact, it's not at all free from human influence. The edge of the south-west area is still under private ownership and is actively being cut! The eastern part of Clara bog has a drainage system cut by Bord na Mona, the former owner of Clara bog, in order to prepare the bog for 'harvesting'. The drains now have been blocked by dams. Clara bog also is intersected by a road, dividing the bog into a western and an eastern part. This bog road and its drains have caused more than 5 meters of subsidence and have in effect caused two domes (Clara west and Clara east). Originally the bog had one raised dome. (Bell 1991)

2.3 Raheenmore bog

Raheenmore bog is much smaller than Clara bog, about 213 ha. It is a particular example of a raised bog with a well developed dome, positioned in a deep basin. On the edges some cutting has been done. This bog suffers from deep ditches around the bog, made to drain the agricultural lands around the bog. These drains were made about ten years ago. Just as on Clara east, a drainage system has been dug by Bord na Mona on the eastern side of Raheenmore. These drains are older and therefore, they already have been filled up with sphagnum. Transport of water, however, still occurs (van 't Hullenaar and ten Kate, 1991). Until now hydrological research has been focused mainly on Raheenmore.

PART 1

Permeability of Raheenmore Bog

H.J. ten Dam
J.F.M. Spieksma

3 PERMEABILITY OF THE CATOTELM

3.1 Diplotelmic bog

In a raised bog two layers can be distinguished (Ingram and Bragg 1984)

1) the *acrotelm*, being the uppermost layer where peat is formed, usually a few tens of centimetres.

2) the *catotelm* where the peat is deposited, usually much thicker.

A bog with both an acrotelm and a catotelm is said to be diplotelmic. Their different characteristics are summarised by Ivanov 1981:

The acrotelm

1 An extensive exchange of moisture with the atmosphere and the surrounding area.
2 Frequent fluctuations in the level of the water table and a changing content of moisture.
3 High permeability and water yield and a rapid decline of these with depth.
4 Periodic access of air to its pores
5 A large quantity of aerobic bacteria and micro-organisms facilitating the rapid decomposition and transformation into peat of each years dying vegetation.
6 The presence of living plant cover, which constitutes the top layer of the acrotelm.

The catotelm

1 A constant or little changing water content.
2 A very slow exchange of water with the subjacent mineral strata and the area surrounding it.
3 Very low permeability in comparison with the acrotelm.
4 No access of atmospheric oxygen to the pores of the soil.
5 No aerobic micro-organisms and a reduced quantity of other kinds in comparison with the acrotelm.

An acrotelm study of Raheenmore has been executed by Lensen 1991 and van 't Hullenaar & ten Kate 1991, an acrotelm study of Clara bog will be carried out in autumn 1992.

The acrotelm can be described as the system of living peat moss. This is in practice the top layer of the living raised bog. The acrotelm has a high storage coefficient and a high permeability (rapid lateral discharge of water when the watertable starts to rise), which causes the watertable to fluctuate very little. This means that the water table usually does not fall beneath the top of the catotelm. A more comprehensive description of the acrotelm is given by Lensen 1991.

The catotelm is defined as the hydrological system between the acrotelm and the mineral subsoil. Waterlogged conditions prevail in the catotelm (and the lower acrotelm). In these anaerobic conditions O_2 is lacking, so that decomposition of the peat takes place at a very low rate. The catotelm has a high degree of humification and the permeability is low. Streefkerk & Casparie (1989) mention k-values of 10^{-3} - 10^{-6} m/d. The results of this study are presented in paragraph 3.3.

3.2 Permeability

3.2.1 Introduction

In order to calculate the flow of water in the peat the permeability of the catotelm must be known at reasonable accuracy. For this reason, permeability profiles have been measured. Eleven such measuring sites have been installed on Raheenmore bog.

The basic relationship describing soil water flow is Darcy's law:

$$v = -k * i$$

v =	flow velocity	(m/d)
k =	permeability	(m/d)
i =	dh/dx = hydraulic gradient	(-)

Further theory concerning the method is described in 3.2.2 and an improvement and check of it is described in 3.2.3.

The piezometers used to measure the permeability of the catotelm, were all made by hand. Therefore, every piezometer is slightly different, referring to perforation and filterlength. According to Sytsma & Veldhuizen (1992) the perforation density has no influence on the derived permeability. Because of the generally low permeability of the catotelm the inflow of water will never become limited by the filter. The filter length however, does have influence on the derived permeability and is settled in the geometry factor (moving head methods) or shape factor (constant head method).

The bottom of all piezometers were sealed with corks in stead of ferrules, as recommended by Van 't Hullenaar & Ten Kate (1991) and Sytsma & Veldhuizen (1992).

3.2.2 Methodology

The methodology of measuring the permeability of the catotelm has been a disputed subject. During the Clara bog project different people have used different methods. Before the measurements were started, a decision had to be made which method should be used. Three methods were considered. All three are piezometer methods, as recommended by van Gerven (1990):

-constant head method
-falling head method
-rising head method

Constant head method

The constant head method involves measuring the inflow of water in a piezometer by using a small imposed constant head. It includes the use of a Mariotte vessel in which the outflow can be measured. This vessel produces a fixed imposed head irrespective of flow from the piezometer. The permeability can be derived with the formula:

$$k = \frac{Q_{infin}}{(S * Y_0)} \qquad (1)$$

k	= permeability	(m/s)
Q_{infin}	= steady flow rate	(m^3/s)
Y_0	= constant imposed head	(m)
S	= shapefactor	(m)

A more comprehensive description is given by Flynn (1990), Bell (1991) and Van 't Hullenaar & Ten Kate (1991)

Rising and Falling head

The rising head piezometer method was developed by Luthin and Kirkham, 1949. It involves measuring the rate of flow into the piezometer, after removing an amount of water from the tube.

The formulas for the calculation of the permeability obtained with the rising and the falling head method are the same. The methods are supposed to be each others contrary. The principles of both of them are the same. The only difference is that water is added with the falling head method and water is removed with the rising head method. The calculated permeability with both methods applied in the same tube should be equal.

According to Luthin and Kirkham

$$k = \frac{\pi r^2}{A} * \frac{\ln(y_1/y_2)}{(t_2 - t_1)} \qquad (2)$$

k	= permeability	(m/s)
t_1, t_2	= time at time 1, 2	(s)
Y_1, Y_2	= difference of groundwaterlevel and waterlevel in piezometer at time 1, 2	(m)
r	= radius of the tube	(m)
A	= geometrical constant	(m)

The geometrical constant is dependent on the dimensions of the filter. It can be obtained from the graph in appendix 3.

A number of assumptions are attached to this method. In this context, the most relevant are (Flynn 1990):

- the tested medium is rigid;
- flow in the tube is in steady state.

Discussion

Sytsma & Veldhuizen (1992) carried out a statistical analysis of the three methods, applied in peat. All three methods give a significantly different permeability. The resulting values for the permeability k of the constant head method were a factor 2.3 larger than those obtained from the falling head method (straight part of the $\log(y_0/y_t)$ versus time graph). The results of the falling head method were about 1.5 times as high as those from the rising head test. The falling head produced k-values with the smallest variance (van der Schaaf, 1992).

Previous studies, Flynn (1990) and Sytsma & Veldhuizen (1992), also showed that the permeability varies with the imposed head. A large imposed head led to large permeabilities, whereas smaller heads led to smaller permeabilities. This can be explained as a result of variation of the permeability of the medium, a constant value according to Darcy's law. Hence, non Darcian flow can be deduced. Variation in the imposed head produces either dilation or contraction of the pore geometry of peat, depending on whether the operational head is increased or reduced. This phenomenon in turn causes an increase or decrease in permeability and thus explains so-called non-Darcian behaviour of the catotelm.

So firstly, the peat through which the water is flowing is not a rigid medium, secondly the flow regime is in a non-steady state with moving head methodes. The behaviour of peat in view of the above features therefore implies that variable head methods are inappropriate for the determination of peat permeability, as Flynn (1990) puts it. Considering this, Flynn (1990) concludes that implementing the constant head method, with low imposed heads, leads to the most accurate undisturbed permeabilities.

Hemond and Goldman (1985), however, argue that groundwaterflow through peat does obey Darcy's law. This means that the k is constant. Removal from water results in greater total stress application to the matrix of the surrounding medium. This results in a compression of the medium, and during initial stages of the test additional water is released otherwise held by retentive forces. Reductions of the permeability can therefore be explained as the restoration of previous undisturbed conditions. Field measurement methods which provide steady-state conditions and minimal alteration of effective stress are likely to produce the most accurate permeabilities.

Sytsma & Veldhuizen (1992), argues that the falling head, given a small head applied, seems to meet best with these requirements. The constant head, if it is applied with a relative large head, causes too much stress on the peat and it therefore refers to peat in which the water content has been raised from its natural state. A constant head method, with low imposed heads, could solve this problem.

Although theoretically the constant head method, applied with a low imposed head, probably is the best method (van der Schaaf, 1992) it has some practical disadvantages. During this project a lot of people have been struggling while implementing this method. The comments in their theses speak for themselves. To name a few:

- -The method is difficult to operate, Van 't Hullenaar & Ten Kate (1991).
- -Apparatus is bulky and cumbersome, while the apparatus for the variable head is portable, Flynn (1990).
- -Failures in measurements are hard to see, Van 't Hullenaar & Ten Kate (1991).
- -It is hard to be sure if a constant waterlevel is achieved, Bell (1991).
- -Constant head method is time consuming, while the variable head takes less time, Flynn (1990).

Other disadvantages experienced by the authors are leaking of air into the vessel and deformation of the vessel. When the Marriotte Vessel was used upside down air leaked into the vessel through the tap and through the lid, even though vaseline was used. When we finally made it air tight, the pressure on the vessel became so large that the vessel began to indent. This resulted in a head which became larger in time rather than being constant.

So from a practical point of view the variable head methods seem to be the better ones. But as stated before, the permeability varies with the imposed head. For that reason we use the data that is obtained in the latter part of the test, when the imposed head is low. When the imposed head is low, the pore geometry of the peat is not much affected any more, and the derived permeability should be accurate.

Also, the fact that the line of log y_0/y versus time becomes more or less a straight line, indicates that the moving head in the end approaches the behaviour of a constant low-head method.

Furthermore, Sytsma & Veldhuizen (1992) argue that the influence of the initial head on the permeability at the end of the test is negligible.

Because the falling head method produces k-values with the smallest variance (Sytsma & Veldhuizen 1992) and is relatively economic in time, this method was selected for further use.

Conclusion

Scientifically and theoretically the constant head, with a low imposed head, is the best method. However, from a practical point of view it has many disadvantages. Besides, proper equipment to implement it, was not available. Therefore variable head methods are used. Statistical analysis by Sytsma & Veldhuizen (1992) shows that the falling head method is preferable above the rising head method. Finally, when the data is obtained, the latter part of the data (or graph, derived from it) is used to calculate the permeability.

3.2.3 An improvement and check of the falling head method

Method derived from Van der Schaaf, 1992.

An improvement and a check of the falling head method may be obtained by installing a number of piezometer at the test sites and comparing the differences in hydraulic head with the k-values found. The filters screens of the piezometers should be installed at depth interval of 1 meter, halfway between the depths, the k-tests are done (Figure 2).

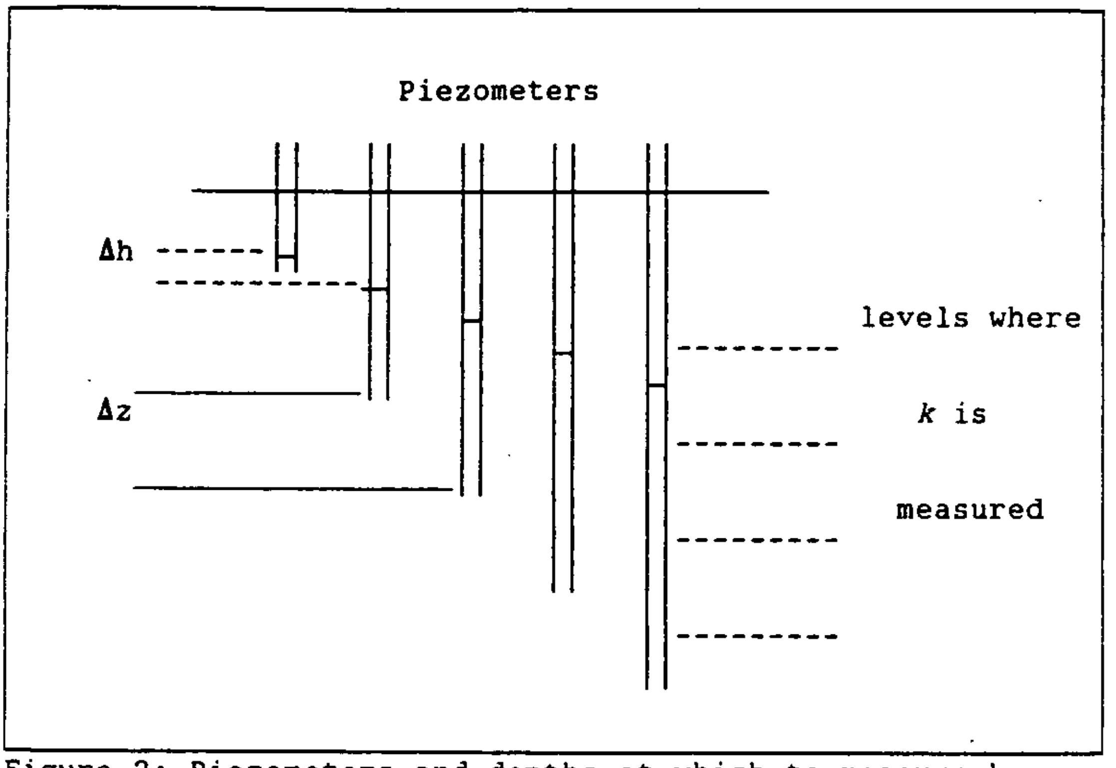

Figure 2; Piezometers and depths at which to measure k

Because distinct differences are found between piezometers installed at the same site but at different depths over the whole of Raheenmore Bog, there is a vertical (downward) flux everywhere in the catotelm body. If the vertical flux component is assumed independent of depth at a particular spot (which implies there is no such thing as a no-flow boundary at the bottom of the peat as assumed in some early models of the bog), the differences in head between successive piezometers are directly proportional to the vertical hydraulic resistance of the layer of peat between them.

The piezometer method mainly measures permeability in the horizontal direction. Vertical hydraulic resistance relates to conductivity in the vertical direction.

An assumption of a linear relationship between horizontal seems not unreasonable. This would mean that there should also be a linear relationship between k^{-1} for a layer of peat and the difference in head Δh across such a layer.

The relationship can be derived as follows :

Divide the peat body into layers, numbered 1..n. A layer i ($1 \le i \le n$) has a thickness Δz_i (m) and the difference in head in the vertical direction is Δh_i (m).

The relationship with the vertical flux v (m/day) is :

$$v = \frac{\Delta h_i}{C_i} \tag{3}$$

C_i : vertical hydraulic resistance of layer i (days)

C_i can be expressed in terms of vertical hydraulic conductivity and thickness

$$C_i = \frac{\Delta z_i}{k_{vi}} \tag{4}$$

k_{vi} : vertical hydraulic conductivity in layer i (m/day)

Combining (1) and (2) yields

$$v = \frac{\Delta h_i}{\Delta z_i} k_{vi} \tag{5}$$

If horizontal flow components in the peat body can be neglected, compared to vertical components (which may not be justified close to the bog margins), v may be assumed to be equal in each layer i. This means that

$$\frac{\Delta h_1}{\Delta z_1} k_{v1} = \frac{\Delta h_2}{\Delta z_2} k_{v2} = \ldots\ldots\ldots = \frac{\Delta h_n}{\Delta z_n} \tag{6}$$

which is the same as

$$\frac{1}{k_{v1}} : \frac{1}{k_{v2}} : \ldots\ldots : \frac{1}{k_{vn}} = \frac{\Delta h_1}{\Delta z_1} : \frac{\Delta h_2}{\Delta z_2} : \ldots\ldots : \frac{\Delta h_n}{\Delta z_n} \tag{7}$$

If the vertical hydraulic conductivity k_v may be assumed proportional to horizontal conductivity k_h, k_v in (7) may be replaced by k_h

$$\frac{1}{k_{h1}} : \frac{1}{k_{h2}} : \ldots . : \frac{1}{k_{hn}} = \frac{\Delta h_1}{\Delta z_1} : \frac{\Delta h_2}{\Delta z_2} : \ldots . : \frac{\Delta h_n}{\Delta z_n} \qquad (8)$$

Because k_h is measured with the piezometer method , (8) can be used as a means to reduce the variance of individual measurement results. This is done by plotting k_h versus $\Delta z/\Delta h$ and fitting a straight line through the points by linear regression (Figure 3).

Because Δh is the result of the situation in a much larger volume of peat than the measured k_h, the k_h found from the fitted line and $\Delta z/\Delta h$ may be expected to be a better estimation of the mean horizontal conductivity over a layer with thickness Δz than the result of the measurement itself. Hence it may be expected that this method will reduce the variance of the individual measurements of the horizontal hydraulic conductivity in a k-profile. A 1:1 relationship between k_h and k_v (in the catotelm) is used, which is suggested by Streefkerk and Casparie (1992). Then the k_v simply equals the k_h found from the fitted line.

If the fit looks good in most partly completed profiles, some measurements of k may be skipped, which can save time. The values of k can then be derived from $\Delta z/\Delta h$.

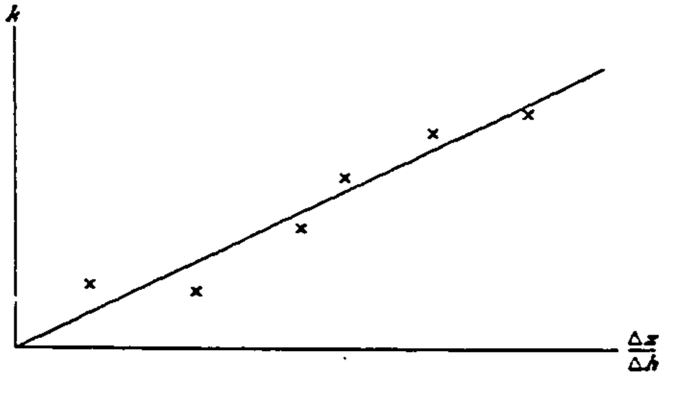

Figure 3; Plot of k versus $\Delta z/\Delta h$.

(van der Schaaf 1992)

3.3 Results

<u>Measured permeabilities</u>[1]
The calculated permeability of all the permeability tests (falling head) are in Table 1. The measurements and the calculations are in appendix 1.

nr	201	206	209	210	211	330	327	324	321	317	313
0.5 m	0.0406	0.0265	0.0363	0.0827	0.0081	0.1023	0.1350	0.0218	0.0497	0.0999	0.3022
1 m	0.0187	0.0078	0.1435	0.4208	0.1977	0.0284	0.3143	0.1278	0.1422	0.0632	
2 m	0.0018	0.0146	0.0266	0.0086	0.0207	0.1684	0.0704	0.2236	0.0936	0.0112	
3 m		0.0019	0.0011	0.1425	0.0499	0.0632	0.1735	0.0869	0.0658	0.0095	
4 m		0.0002	0.0047	0.0786	0.0010	0.1997	0.4474	0.1725		0.0008	
7 m			0.0145	0.0991	0.1285	0.4248	0.4103	0.0201	0.0070		
10 m			imprbl	0.0770	0.0215	0.0756	0.0109	imprbl			
13 m						0.0841					

Table 1; The permeability of the catotelm (m day^{-1})

It is very difficult to distinguish trends in the results. The measured permeabilities are an order of magnitude larger compared with values mentioned in previous studies (Sytsma & Veldhuizen 1992, Bell 1991). The small permeabilities account for the fact that lateral discharge of water through the catotelm is negligible. The flow system of a raised bog must therefore be dominated by either surface flow or interflow. (van der Molen et. al. 1992)

The most striking feature of the results, is a sharp decrease of the permeability at the deepest measurement of almost each location.

Only piezometer 201 and 317 comply with the theory that the permeability decreases with depth. Others like 324, 327, 317 show first an increase and then decrease of the permeability with depth. However, the majority of piezometers do not seem to show a trend (209, 210, 211, 330).

Therefore one is inclined to draw the conclusion that there is no relation between the horizontal permeability and the depth, apart from the sharp decrease at the basis of the peat mentioned

[1] Permeability tests at 0.5 and 1.0 m were not performed by the authors.

above. Variation of the permeability could be caused by local layering of the peat. More so, drilling in the peat shows rapid alternation of poorly and strongly humified peat and sometimes even fen peat. This could support the theory that the permeability is more dependent on local layering then on depth.

The measurements at shallow depths could have been influenced by treading down the peat surface around the piezometer, which might change the k-values substantially. Another influence on the measurements at shallow depths could be an increased humification and shrinkage of the top layer as a result of drainage.

Furthermore, measuring the permeability of peat is still a difficult matter, as is explained in 3.2.2. Therefore the results should be interpreted carefully.

In horizontal direction it is possible to distinguish a slight trend, although not very clear. From the edges of the bog (201 and 317) to the middle of the bog (211 and 330), generally, the permeability increases for every depth (Table 1). Low k values at piezometer 201, 206 and 209 are probably due to an old drainage system. To illustrate these trends, the weighted arithmetical and geometrical mean permeability for each location is presented in Table 2. A geometrical mean is probably more appropiate, because measured values of the permeability usually show a log normal distribution.

Generally, the gradient of an undisturbed bog becomes larger to the edges, causing larger fluctuations of the ground watertable and therefore to more subsidence at the edge. It is likely that subsidence causes a smaller permeability which explains the trend of Table 2.

201	206	209	210	211	330	327	324	321	317
0.0185	0.0078	0.0254	0.1056	0.0588	0.1813	0.2382	0.0974	0.0499	0.0263
0.0111	0.0041	0.0148	0.0823	0.0240	0.1066	0.1396	0.0757	0.0497	0.0140

Table 2; The weighted arithmetical (second row) and geometrical (third row) mean permeability per location.

Interpolation of permeability values

In order to obtain the permeability values at depths which are not determined with the falling head method, the interpolation method described in 3.2.3 is used. For that reason graphs of k versus $\Delta z/\Delta h$ are constructed for every location. The locations were measured at three different occasions. A linear relationship was expected, with which the missing k values could be derived.

Two representative examples of k versus $\Delta z/\Delta h$ are presented in

Figure 4 and Figure 5. One can easily see that no such relationship can be found at all.

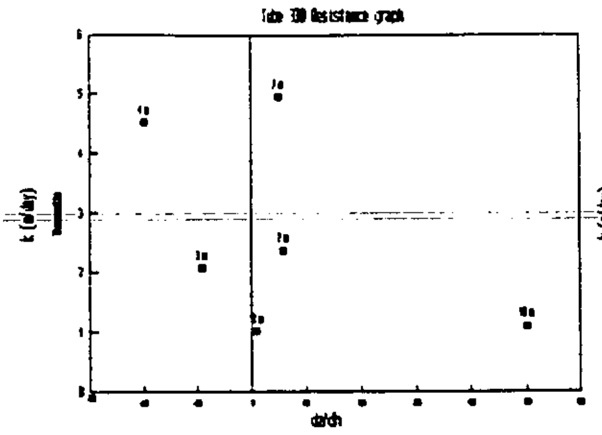

Figure 4; Plot of k versus $\Delta z/\Delta h$ of tube 330

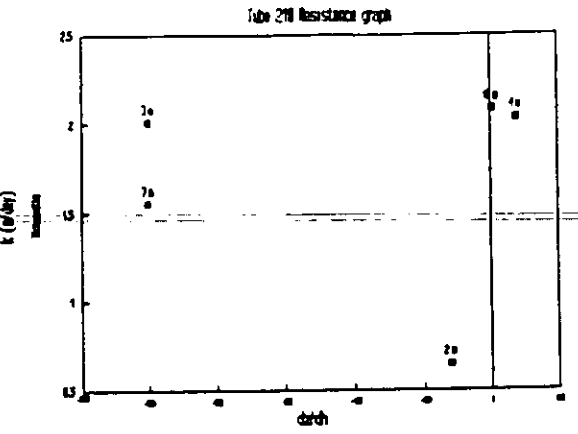

Figure 5; Plot of k versus $\Delta z/\Delta h$ of tube 210

There are three possible reasons for the failure of the interpolation method:

1 The k values measured are wrong.
2 The $\Delta z/\Delta h$ measured are wrong.
3 The horizontal and vertical permeability differ considerably

ad 1 As is mentioned before, the falling head method, because of the small imposed head, accounts for the permeability in a relatively small volume. Therefore the falling head method can be disturbed by local irregularities in the peat, so the calculated permeabilities do not necessarily have to be valid for the whole layer considered in the interpolation method.

ad 2 The $\Delta z/\Delta h$ in the interpolation method, however, reflects a relatively large volume, so k found from the fitted line is a better estimation of the mean conductivity over a layer with thickness Δz.

The season in which is measured can have its effects on the interpolation method. Obviously in the summer there is less rainfall than in the winter. This could result in periods in which the evapotranspiration exceeds infiltration in summer, meaning an upward flow of water in the catotelm body. If so, the assumption of downward flow irrespective of place and depth, used in 3.2.3, is not valid any more. This means that the interpolation method cannot be used under these conditions. One can meet this problem by averaging $\Delta z/\Delta h$ over a year, probably leading to an average downward flow. Due to limitations in time this was not undertaken.

ad 3 When the horizontal and vertical permeability differ considerably the k_v in (7) cannot be substituted by k_h without knowing a relationship between the two.

In order to find the expected linear relationship between k and $\Delta z/\Delta h$, it is recommended to average $\Delta z/\Delta h$ over a year. If still no relationship can be found, it is likely that the measured permeabilities are questionable.

<u>Difficulties encountered in the field</u>
A number of difficulties have been encountered doing the permeability measurements. First of all the recovery of the hydraulic head took a lot of time. In some occasions it took a few days. Or on other occasions the important latter part of the recovery of the hydraulic head took place during nighttime. And, as it was difficult to predict how long the measurement would last, it was not always possible to measure the latter part of the hydraulic head accurately.

Secondly, because the measurements took so much time, weather conditions had an influence on the recovery of the hydraulic head. The groundwatertable can rise or fall within a couple of days, so we were not always sure if the hydraulic head had recovered or if it had not reached equilibrium yet.

Thirdly, some of the measured hydraulic levels in the piezometers used for interpolation, looked suspicious. On one occasion, clearly, the piezometer was leaking at a connector (the deepest pzm at 330), so that one is left out. It is not totally impossible that other piezometers could be leaking as well.

PART 2

A subsidence study of Clara Bog West

J.F.M. Spieksma

4 SUBSIDENCE STUDY OF CLARA WEST

4.1 Introduction

It is agreed upon that subsidence has occurred along the bog road of Clara bog. Moreover, there is evidence that Clara bog has subsided as a whole. This theory is connected with the Mound on Clara West, an area that elevates significantly above the bog. The peat on the Mound is hard, dried out and no acrotelm is present. At this particular spot the underlying substratum rises. The hypothesis is that Clara bog used to have the same elevation (or even higher) as the Mound, but then subsidence occurred, for whatever reason. At the Mound however, the bog could not subside because of the rising of the underlying substratum, so this area remained higher than its surroundings. This theory also accounts for the relative flatness of Clara bog.

The theory that the Mound is a local occurrence of blanket bog is neither feasible nor relevant, because the meteorological conditions are totally unsuitable for the development of blanket bog.

A second hypothesis on the origin of the soak on Clara West is, that it arose due to extra local subsidence of the bog at that particular spot, possibly as a result of peat cutting at the edge. Because that area became lower than its surroundings, the flow pattern of the water changed from divergent (to the edges of the bog) to convergent. The water would flow to that lower place, forming a soak with a single outlet to the south east.

4.2 General description of the layers in peat

(Wood) Fenpeat
(Wood) fen peat is the name for a compilation of peat types with an abundance of plants, shrubs and trees. Fluctuation of the water table gave rise to a series of alternative supersessions of trees by reed and vice versa. Thus the resulting stratified peat layers have a complex nature and therefore an overall layer was introduced: (Wood) fen peat.

Strongly humified peat
As the name says, this peat is strongly humified which indicates a lower groundwatertable then at present. It consist of Sphagna and many roots and twigs from plants like heather.

Poorly humified peat
This peat mainly consist of Sphagna, with few roots and twigs. The peat is not or poorly humified, which indicates a rise in the groundwater table. (Bloetjes 1992)

4.3 Drilling

A special hand auger (Eijkelkamp) with a 50 cm long semi-cylindral chamber (=sampling body) at the end was used. While pushing the auger into the peat the sampling body was kept empty by the auger head and a cover fin. At the desired sample depth the sampling body was filled and closed at the same time by turning the auger half a circle. The cover fin kept the body at the same place. Once back at the surface the sampling body was turned back again, which allowed an almost undisturbed sample to be obtained. Drilling was stopped once the clay was reached or sometimes earlier if an impenetrable layer was encountered. (Bell 1991, Sytsma 1992)

A detailed log was made noting the humification degree of the peat, color and vegetation types present.

The degree of humification was assessed using the criteria outlined in "Von Post's Humification Index" (Appendix 2). This is a scale of humification from 1 (hardly humified plants remains) to 10 (totally humified plant remains) based on the structure of the peat, the degree to which it can be squeezed between the fingers and the color of the water. By its nature it is a very subjective method, but it can give useful insights into the processes of peat formation.

The color of the bulk of each sample was determined with "Munsell's standard soil color charts". Like the assessment of the Humification degree, it is a subjective method. Nevertheless, this scale can give a reasonable indication of the color of each sample.

Although hindered by little knowledge, the vegetation types found in each sample were determined. Using these vegetation types we establish peat layers as described in 4.2. These are required for the subsidence calculations.

The description of all the augerings can be found in Ten Dam & Spieksma (1993). Bloetjes 1992 already made a thorough drilling survey of Clara bog.

A 5 cm long peat sample was taken from every fifty centimetre long core. These were used to calculate the volumetric concentration of organic matter by means of the wet and dry weight of the sample. The samples were dried in an oven for 24 to 36 hours at 105 •C until a constant weight was achieved. This gives the weight (W_0) of the organic matter of the sample.

4.4 Calculation of subsidence

Peat consist of water (circa 95%) and organic matter (circa 5%). Consequently, subsidence may occur through

1- loss of water (par 4.4.1)
2- loss of organic matter (par 4.4.3).

The first process, subsidence because of water loss, will be referred to as shrinkage. The second process usually is a result of oxidation[2]. Besides disappearance of organic matter, oxidation has a second, much larger, influence on the subsidence: the amount of water, attached to the organic matter, will also disappear. Although this process is a combination of oxidation and shrinkage, it will be referred to as oxidation (Schothorst & Broekhuizen 1985).

4.4.1 Subsidence through shrinkage

Data collected from undisturbed peat samples show distribution of the organic matter along a vertical profile. Comparing the distribution of the organic matter along a consolidated profile with the distribution along an unconsolidated profile can give an estimation of the subsidence of the bog surface. The underlying idea is that the change in total amount of organic matter in the profile is negligible.

The volumetric concentration of organic matter C_0 (m^3/m^3), assuming saturation of the sample ($V = V_0 + V_w$), is

$$C_0 = \frac{V_0}{V_0 + V_w} \qquad (9)$$

C_0 = volumetric concentration of organic matter (m^3/m^3)
V = total volume of the sample (m^3)
V_0 = volume of organic matter in the sample (m^3)
V_w = volume of water in the sample (m^3)

Because volumetric sampling cannot be done very accurately, the volumetric concentration of the organic matter is calculated using equations (10) and (11). The weight of the organic matter of the sample is measured after drying. The density of the organic matter then has to be known with reasonable accuracy. According to Galvin (1976) Sphagnum peat, reed-fen peat and woody fen peat have a density of respectively 1.36, 1.38 and 1.36-1.38 kg/dm^3.

[2] Loss of organic matter could also be caused by reduction of organic matter, with methane (CH_4) as product.

Because

$$V = \frac{W}{\rho} \tag{10}$$

W = mass (kg)
ρ = density (kg/m^3)

the C_0 of a sample using equation (9) and (10) can be calculated as

$$C_0 = \frac{\rho_w W_0}{\rho_w W_0 + \rho_0 W_w} \tag{11}$$

$\rho_{0,w}$ = density of organic matter respectively water (kg/m^3)
$W_{0,w}$ = mass of organic matter respectively water (kg)

The average volumetric concentration of organic matter in a profile is described by

$$\overline{C_0} = \frac{1}{L}\int_0^L C_0(z)\,dz \tag{12}$$

z = vertical distance (m)
L = length of the peat column (m)

After sampling at n different depths equation (12) is approximated by

$$\overline{C_0} \approx \frac{1}{L}\sum_{i=1}^{n} C_{0i}(\Delta L)_i \tag{13}$$

ΔL = length of column represented by a sample (m)

Equation (13) is valid for the consolidated as well as the unconsolidated column.

The consolidation ratio S is defined by the total length of the consolidated column divided by the length of the unconsolidated column

$$S = \frac{L_c}{L_u} \tag{14}$$

L_u = length of the unconsolidated column (m)
L_c = length of the consolidated column (m)
S = consolidation ratio (-)

Combining (13) and (14) yields:

$$S \approx \frac{L_c}{L_u} \approx \frac{\overline{C_{ou}}\sum_{j=1}^{m} C_{ocj}(\Delta L)_j}{\overline{C_{oc}}\sum_{i=1}^{n} C_{oui}(\Delta L)_i} \approx \frac{\overline{C_{ou}}\frac{V_{oc}}{A}}{\overline{C_{oc}}\frac{V_{ou}}{A}} \approx \frac{\overline{C_{ou}}V_{oc}}{\overline{C_{oc}}V_{ou}} \tag{15}$$

C_{oc} = volumetric concentration of organic matter of the consolidated column (m^3/m^3)
C_{ou} = volumetric concentration of organic matter of the unconsolidated column (m^3/m^3)
V_{oc} = volume of organic matter before consolidation (m^3)
V_{ou} = volume of organic matter after consolidation (m^3)
A = cross section of peat column m^2

If consolidation occurs in a column, the volume of organic matter in it may be assumed to remain approximately constant[3]

$$V_{ou} = V_{oc} \tag{16}$$

Using equation (16) the consolidation ratio simplifies to the average volumetric concentration of organic matter in the unconsolidated column divided by the average volumetric concentration of organic matter in the consolidated column:

$$S \approx \frac{L_c}{L_u} \approx \frac{\overline{C_{ou}}}{\overline{C_{oc}}} \tag{17}$$

The average volumetric concentration of organic matter of the consolidated column is measured. For the determination of the volumetric concentration of organic matter in an unconsolidated column, a reference site is used. The selection of the reference site is discussed in par 4.4.2. This reference site has to comply with two assumptions:

1. No subsidence has occurred at the reference site.
2. The average volumetric concentration of organic matter before consolidation of both columns has been approximately the same.

This means that the average volumetric concentration of organic matter measured at this reference site, can be considered as the volumetric concentration of organic matter of an unconsolidated column peat, in general. So now, one can calculate the consolidation ratio. After measuring the present length of the consolidated column, the length of the unconsolidated column can be derived using equation (17).

Eventually, the objective is reached : the determination of the length of the unconsolidated column. The present day length of the consolidated column is also known by drilling. Assuming that the underlying substratum did not move, the original height of the bog can be determined. Doing this for a number of transects

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[3] Oxidation of organic matter consumes oxygen. Oxygen, however, is not very soluble in water. Thus, one can assume no loss of organic matter in places where waterlogged conditions prevail, even more so, because soil water is stagnant, or at best slow moving, so no oxygen will be stirred in. However at the edges of the bog waterlogged conditions do not prevail (the groundwatertable fluctuates). This means that oxygen is available to oxidate the organic matter. Therefore the assumption of no loss of organic matter wouldbe less likely at the edges of the bog.

over the bog, the original surface of the bog can be reconstructed.

A short, point by point, practical description of the procedure is given in appendix 4. (Van der Schaaf 1991)

4.4.2 Reference site

The results of the subsidence survey on Clara bog depend to a great extent on the reference site. Applying various references leads to large differences in subsidence of each single location. However, the effect of changing the reference site is the same for each location, which means that the *difference in subsidence between two locations* generally remains the same. Changing the reference site does not have a strong influence on the trend of subsidence in a transect !

Even an undisturbed natural bog has not one uniform volumetric concentration of organic matter (C_0). Because a bog has a steep gradient to the edges and generally the storage is less, the groundwatertable will fluctuate here. As more fluctuations in the groundwatertable lead to a large C_0, the C_0's of the edges will be larger than those of the center by nature.

In the early stages of bog development the growth of the bog starts on the edge, infilling the lake towards the middle (Figure 1, stage 2). This process also suggests that the C_0's of the edge will be larger than those of the center of the bog.

In this subsidence survey of Clara West we chose to use three reference sites:

-The main reference site, for the areas that used to be the middle (and wet) parts of the bog.

-The intermediate reference site, for slightly less wet areas, more to the edge of the bog.

-The edge reference site, for the natural edges of the bog.

4.4.2.1 Theory

How can one justify the selection of a reference site? In this paragraph we try to answer this question.

Three possibilities to establish the main reference site are discussed:

1. The site where peat is thickest on the bog is used for reference.
2. The site of least subsidence (i.d. the site where C_0 is lowest), along the profiles surveyed on the bog, is used for reference.
3. A site on another bog is used for reference.

Every reference site must comply with the two requirements mentioned in paragraph 4.4.1:

1. No subsidence has occurred at the reference site.
2. The average volumetric concentration of organic matter (C_0) before consolidation of both columns have been approximately the same.

ad 1 ---- With the augering data of Bloetjes 1992 it is easy to determine the site where peat is thickest on Clara bog. The two assumptions, mentioned above, imply that the reference site should have the lowest C_0 of all. However, some other sites showed lower C_0's than the site where peat is thickest. This would mean that the bog surfaces has risen at these sites, which is most unlikely. It is more likely that the reference site has subsided, but that is in contradiction with the assumptions.

So, the site where peat is thickest on Clara Bog does not necessarily have to be the site of least subsidence.

ad 2 ---- The main reference site can also be established after the drilling is completed. Now, the site where subsidence is lowest (i.d. the site where C_0 is lowest) is used for reference. In this manner the reference site does correspond with both assumptions. However there are some problems:

It is very likely that even the site where C_0 is lowest on Clara Bog has subsided, and therefore should not be used as a reference.

Possibly, the site where C_0 is lowest is situated at a soak. Using such a place as reference may lead to substantial errors, because a soak is not representative for the rest of the bog.

ad 3 ---- Choosing a reference site on another bog also could involve some problems. First of all you have to assume that the reference bog, or in any case the reference site on the reference bog, did not subside. Secondly, one cannot be sure that the initial C_0 (before consolidation) of the surveyed bog is equal to the present C_0 of the reference bog. This bog may have had other environmental conditions (size, climate, geo(morpho)logy etcetera) which caused a different C_0.

4.4.2.2 Selecting the reference sites

Considering the previous paragraph, it seems that a bog which has not subsided and where the environmental conditions are comparable to Clara bog, would give the best reference site. Such bogs however, are not easily found. Raheenmore for instance, is not suitable as a reference bog, because firstly, Raheenmore has subsided, secondly, Raheenmore is positioned in a deep basin and thirdly, Raheenmore is much smaller the Clara Bog.

Carrowbehy bog

Carrowbehy bog seemed a feasible option for the reference site. This bog is situated in Mayo, the north-western part of Ireland, in the transition zone from blanket bog to raised bog. Although the climate in Mayo is wetter than in Offaly and the size of Carrowbehy bog is smaller than Clara bog (respectively 276ha and 660ha), it has an important feature; it is remarkebly intact and virtually not affected by subsidence. Additionally, Carrowbehy bog has a thickness of 7-8m and is underlain by sandy deposits, whereas Clara bog is 9-10m thick and is underlain by finer lacustrien deposits. In spite of these differences, we considered the fact that Carrowbehy bog did not suffer from subsidence, more important than the differences between the two bogs. Two augerings were made on Carrowbehy bog, one for the main reference (C_0 of 0.04018 m^3/m^3) and one for the intermediate reference (C_0 of 0.04272 m^3/m^3). The main reference was taken in the center of Carrowbehy bog, at the most elevated part (generally between the two drumlins bordering the bog). The intemediant reference was taken halfway the center and the edge of the bog. Carrowbehy bog does not have natural edges, so the third, edge reference could not be taken here.

Since Carrowbehy bog does not have a natural edge, we had to look for a natural edge on Clara bog itself. The edge to the north of the bog, bordering the Esker, offers a good opportunity for a reference. The Esker is most plausibly the natural edge of the bog. Peg N4 is positioned close to it and therefore used as edge reference site. The augering at peg N4 resulted in a C_0 of 0.051262 m^3/m^3.

The C_0's (Volumetric concentration of organic matter) of the reference sites are presented in Table 3.

Main reference:	0.04018	m^3/m^3
Intermediant reference:	0.04272	m^3/m^3
Edge reference:	0.051262	m^3/m^3

Table 3; The volumetric concentrations of organic matter (C_0) of the reference sites.

It was a difficult job to establish these reference sites. The values of the C_0's may be considered as arbitrary, and could be exposed to criticism. Since the reference sites have a large impact on the calculated subsidence, further research on it would not be luxurious. But, as asserted before, changing the reference site does not have a large impact on the difference in subsidence between the various locations. In other words: if the main reference is changed from its current value to 0.06, each location would show a lot less subsidence, still the differences in subsidence between the locations would almost be the same.

4.4.2.3 Rejected reference sites

Other attempts to select a reference were made on Raheenmore bog and Clara bog. The locations were the peat is thickest on Clara East (peg H4' and Log Roe) or highest on Clara (north) West (peg O9) were tested as reference site, but failed, because other locations appeared to have lower C_0's, which involves a rising of the bog surface, which is most unlikely; other sites on Clara West (besides peg N10, which is situated at the little birchwood or soak) clearly had lower C_0's. The data of the augerings on Raheenmore were rejected because of reasons stated earlier in this paragraph.

The locations with the lowest C_0's also were tested on their ability to act as a reference site. Peg N10 has an extremely low C_0 of 0.033, but is positioned at a little birchwood or soak, which is not representative. Other locations with low C_0's, such as peg L9 and N8, were considered too much out of line with most measured C_0's to be reliable enough to be used as reference.

The results of all the reference augerings are in appendix 7.

4.4.3 Oxidation

Oxidation is a bio-chemical process that decomposes organic matter in CO_2 and H_2O. Oxidation of organic matter consumes oxygen. Oxygen, however, is not very soluble in water. Thus, one can assume no loss of organic matter in soil profiles where waterlogged conditions prevail. This will be the case for most areas on the bog. However in places of the bog waterlogged conditions do not predominate (the groundwatertable fluctuates), oxygen is able to enter the peat. Now oxygen is available to oxidate the organic matter.

As alleged before, the contribution of oxidation to the subsidence of the bog is twofold: Firstly, the loss of organic matter causes the surface to subside. The second contribution, however, is more important: loss of water attached to the disappeared organic matter, will also cause the bog surface to subside. (Schothorst & Broekhuizen 1985)

Obviously it is difficult to determine how much peat has oxidated. Schothorst (1971) attempts to measure the subsidence due to oxidation. He argues that oxidation produces, besides CO_2 and H_2O some nitrogen. Through determining the protein yield of a crop, grown on peat soils, without fertilizing, he is able to estimate the subsidence due to oxidation. Schothorst (1971) finds for the bog Zegvelderbroek a subsidence due to oxidation of 2 mm per year. It should be taken into account that this value is valid for consolidated peat.

4.5 *Results*

In Figure 7 the transects of the subsidence survey on Clara West are shown. The locations refer to pegs (for example N6) or piezometer tubes (for example 87). Tube 55 and 56 are situated in the soak near Shanly's Lough, Peg N10 is situated in a soak (birch wood) more to the west side of the bog. The area east of the bog road is Clara East. The two transects that cross the bog road onto Clara East are made by Samuels 1992. These will be discussed in paragraph 4.7. The remaining five transects displayed in Figure 7 will be discussed subsequently.

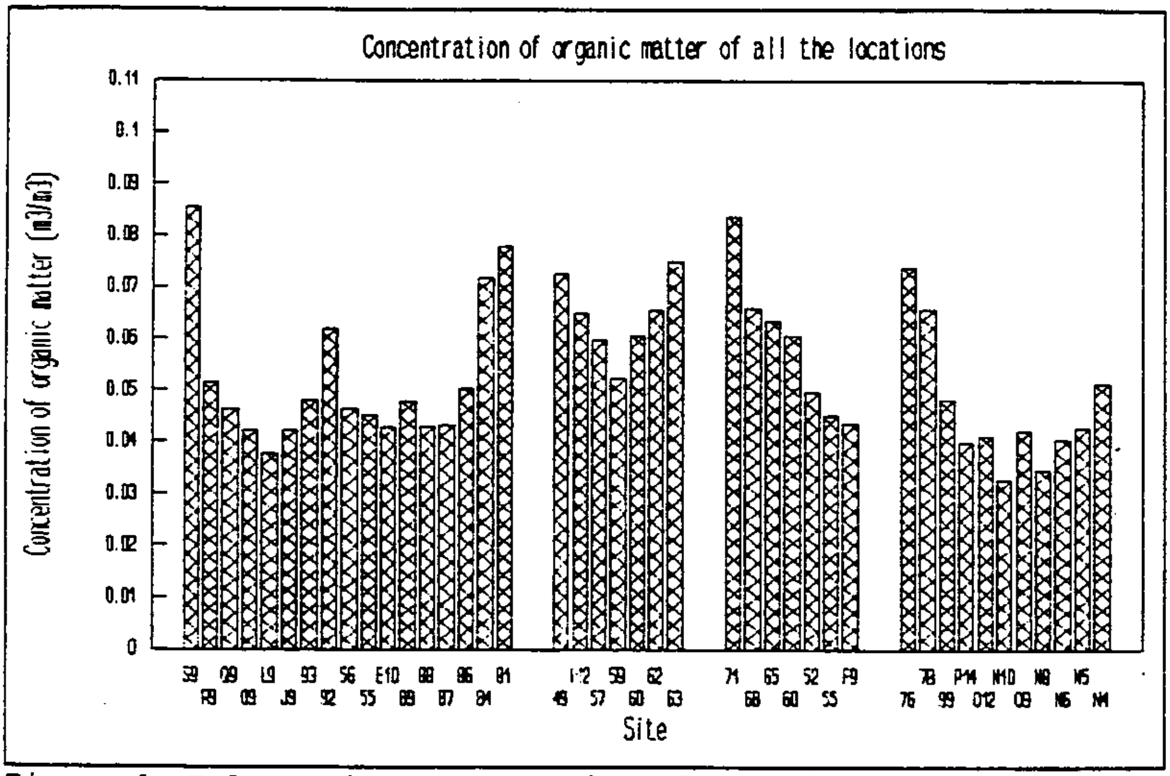

Figure 6: Volumetric concentration of organic matter of all locations.

Figure 6 displays the volumetric concentration of organic matter C_0 of all the auger locations on Clara West. The calculated subsidence at these locations is presented both in tables and bar graphs in appendix 5 and 6.

<u>Remark</u>
The main reference is used to calculate the subsidence of all locations, except for 49, N4, S9, R9, 92 (edge reference) and N5, Q9, I12, 93 (intermediate reference).

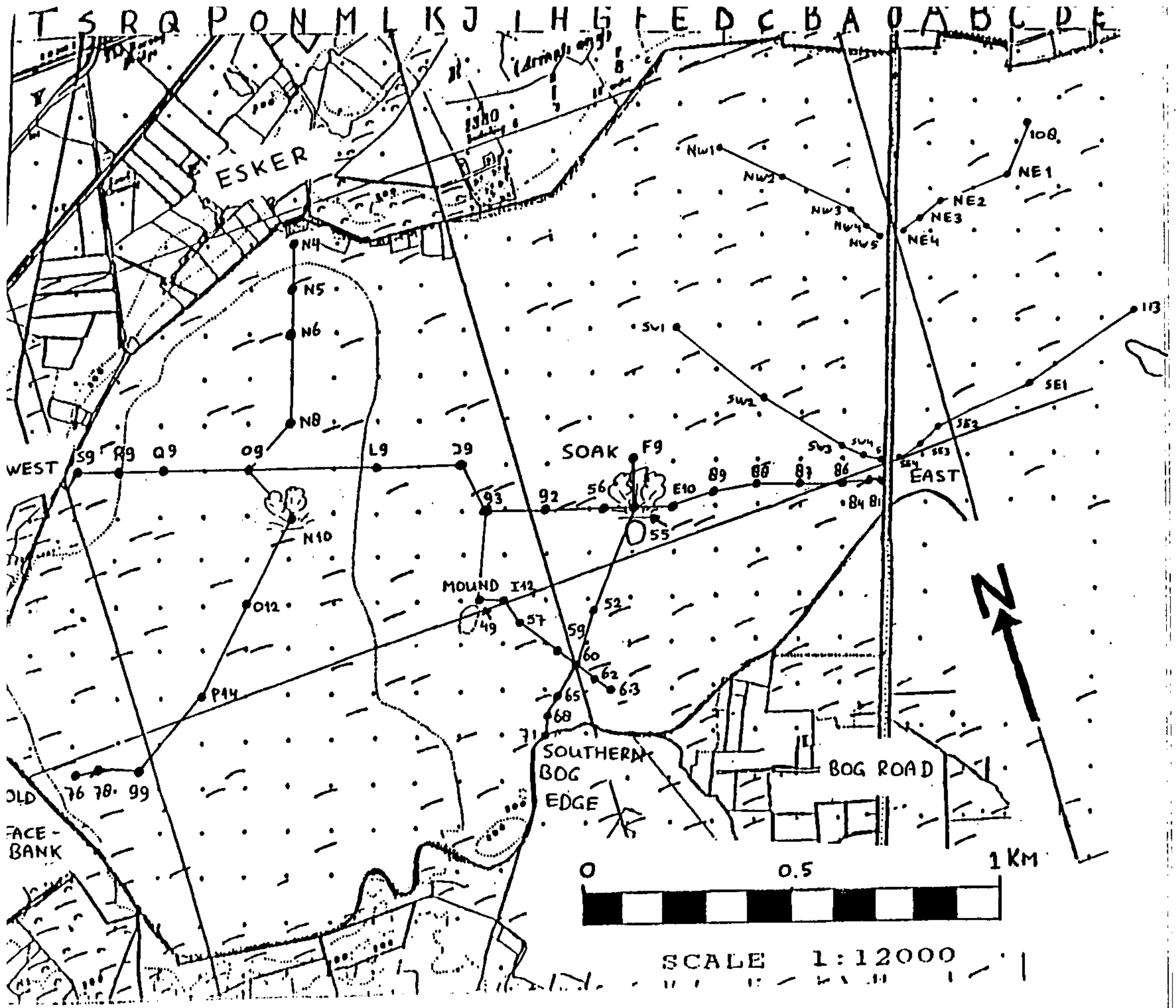

Figure 6: Transects of Subsidence survey on Clara west.

Four transect are displayed:

West - East transect
Old Facebank - Esker transect
Mound - Edge transect
Soak transect

The locations at which has been augered are indicated with dots.

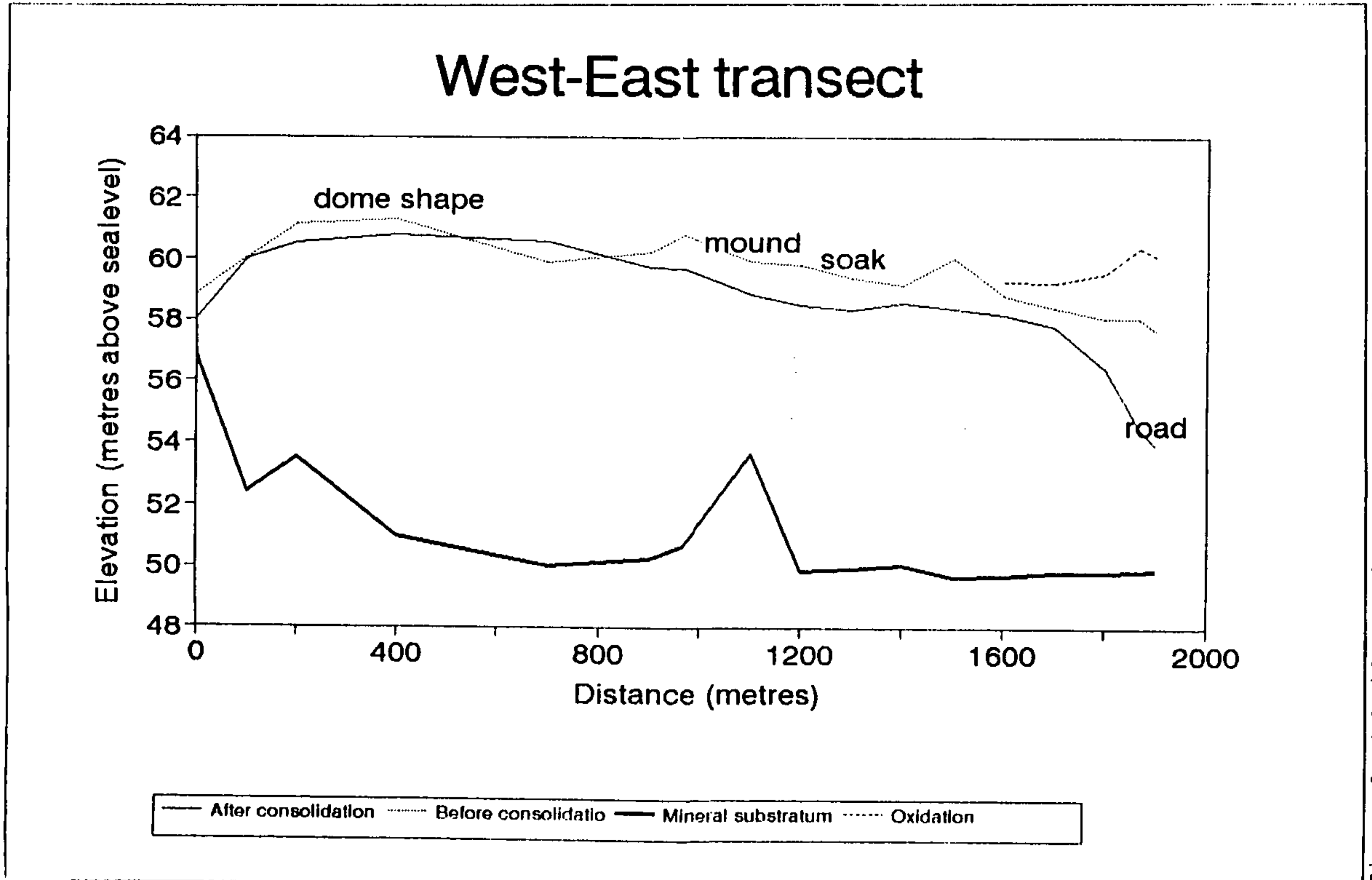

Figure 8; Subsidence along West - East transect

4.5.1 West - East transect

The present day bog surface has a dome shape on the west side of the transect, a practically flat surface in the middle, with a slight dip at the soak, and a strong downward gradient to the bog road on the east side of the transect.

A vertical cross section of the East-West transect is displayed in Figure 8 and will be discussed from east to west in separate parts:
-dome shaped area (S9, R9, Q9, O9, L9, J9)
-the Mound (93, 92)
-the Soak (56, 55, E10)
-underestimation of subsidence near the road (89, 88, 87, 86, 84, 81).

Dome shaped area
The original (calculated) bog surface on the west side has a dome shape alike the present day situation. Apparently the western part of the Clara West did not suffer from much subsidence. The northern part of the Old Facebank-Esker transect confirms this.

Looking closer to this part of the bog, it is logical that subsidence has been limited, here. Human influence probably has been small on this part of the bog. The edge to the north and northwest is natural (Esker), the bog road in the east and peat cutting in the south/south-west are distant enough to have a negligible impact. Possibly, the rising of the substratum at the Mound hindered discharge to the east, so that the west of Clara West could be regarded as a separate, autonomous bog. This hypothesis will be clarified in paragraph 4.5.3.

The Mound
Although the elevated position of the mineral substratum at the Mound is clearly visible in Figure 8, the elevated position of the present day bogsurface of the Mound is not obvious, because this transect crosses the northern flank. Figure 11 and Figure 14, that display the Mound-Edge transect, respectively the Mound-Soak transect, offer a better view of the present elevation of the Mound. Paragraph 4.5.3 contains a more thorough description of the subsidence at the Mound.

The Soak
Although some subsidence seems to have occurred at the soak, no decisive verdict can be given as yet. With the Edge-Soak and Mound-Soak transect a more distinctive pattern of subsidence around the soak can be distinguished.

Underestimation of subsidence near the road
Near the road, the original level of the bog drops, where it is expected to remain the same or even increase. Tube 81, 84 and 86, situated close to the road, are well short of the average unconsolidated levels of about 60m - 61m a.s.l. of the rest of the West-East transect (respectively 57.66m, 58.08m and 58.09m). This underestimation of the subsidence can be explained by firstly:

-oxidation of the peat column and hence loss of organic matter, and secondly:
-peat cutting near the road.

In this context, the road acts as a big drain, so that the peat near the road is not waterlogged. This in contrary to the rest of the bog where waterlogged conditions prevail. This means that in the vicinity of the road oxygen is able to enter the peat, and oxidate the organic matter. So, the nearer to the road, the more oxidation of organic matter has taken place, the shorter the unconsolidated peat column.

If the bog road is 250 years old, and an average subsidence due to oxidation of 2 mm per year is assumed[4] (Schothorst 1971), the subsidence due to oxidation near the road would amount 250 year * 2 mm/year = 0.5 m. However, this is not enough to compensate the underestimation of the unconsolidated peat column.

Hence, it should be taken into account that some peat cutting has taken place in plots along the road. The augerings at tube 81 and 84 are most certainly affected by this, because an old facebank is visible between tube 84 and 86. Similar to the oxidated peat, it is difficult to determine the thickness of the cutaway peat.

But if this is known, the surplus subsidence can easily be calculated according to:

$$S = \frac{L_c}{L_u} \quad \rightarrow \quad \rightarrow \quad \rightarrow \quad \Delta L_u = \frac{\Delta L_c}{S} \tag{18}$$

S = Consolidation ratio
ΔL_c = Thickness of cutaway peat
ΔL_u = Surplus length of unconsolidated peat column

Under the condition that the peat has been removed recently.

For example; assume a peat layer with a thickness of 1 meter (ΔL_c = 1m) has recently been cut away at tube 81. With a consolidation ratio S of 0.5165 the surplus length of the unconsolidated column will total ΔL_u= 1 / 0.5165 = 1.94 meter. Now, the unconsolidated column is stretched from 7.74m to 9.68m (original bog surface from 57.66m to 59.60m).
When the estimation of subsidence due to oxidation and the effects of peat cutting are added; 59.60 + 0.50 = 60.10m, which is a feasible reconstruction of the original bogsurface at tube 81.

[4] As stated in paragraph 4.4.3 an oxidation rate of 2 mm/year is valid for consolidated peat. This reasoning assumes that the oxidation rate for unconsolidated peat is the same.

The same can be done for the following tubes :

84[5]:	58.08	+ (1.0/0.5589)	+ 0.50	=	60.37m
86[6]:	58.09	+ (0.75/0.7980)	+ 0.50	=	59.53m
87[7]:	58.43	+ (0.25/0.9280)	+ 0.50	=	59.20m
88[8]:	58.77		+ 0.50	=	59.27m

At tube 89 clearly, no peat cutting took place, and extra subsidence due to oxidation is probably negligible. The original bogsurface, considering both peat cutting and oxidation near the road, is represented in Figure 8.

Therefore, the subsidence is underestimated near the road, not only by oxidation but also by peat cutting.

4.5.2 Old Facebank - Esker transect

This transect traverses the extreme west of Clara West north-south (Figure 9). It starts at an old facebank at the southern end of the bog, crosses a birchwood or little soak at peg N10 and ends at the Esker. It confirms that there has been little subsidence on the west side of Clara West. Furthermore, two things are noticeable;

--At the birchwood or soak (peg N10) and at peg N8 a rising of the bogsurface (or: negative subsidence) was calculated.

N10 is located in a birchwood or soak. Possibly this birchwood has had wet conditions (wetter than the rest of the bog, for whatever reason) from the start, leading to a natural very low C_0. This would indicate that the main reference should not be applied here. Properly, a new reference, specially for wet soaks, should be used in this case. Unfortunately such a reference is not available, so the main reference is used. This explains the negative subsidence (rising) at the birchwood or soak. Furthermore, the fact that a very low C_0 was measured at the birchwood (peg N10) and conventional C_0's were measured at

---

5 Tube 84: Assuming thickness cutaway peat = 1m
Consolidation ratio S = 0.5589
Calculated level original bogsurface = 58.08m
Loss due to Oxidation = 0.5m (2mm per year)

6 Tube 86: Assuming thickness cutaway peat = 0.75m
Consolidation ratio S = 0.7980
Calculated level original bogsurface = 58.09m
Loss due to Oxidation = 0.5m (2mm per year)

7 Tube 87: Assuming thickness cutaway peat = 0.25m
Consolidation ratio S = 0.9280
Calculated level original bogsurface = 58.43m
Loss due to Oxidation = 0.5m (2mm per year)

8 Tube 88: Assuming thickness cutaway peat = 0m
Calculated level original bogsurface = 58.77m
Loss due to Oxidation = 0.5m (2mm per year)

the large soak (tube 55) suggests that the birchwood or soak at peg N10 could have a different origin than the large soak at tube 55 (Table 4). Why the C_0's of the two soaks are different remains unknown.

location	Co	Remark
Peg N10	*0.032787*	*birchwood*
Tube 55	*0.046267*	*large soak*
Tube 56	*0.04513*	*large soak*
C'behy	*0.04018*	*reference*

Table 4; Comparison of volumetric concentrations of organic matter (C_0) of both soaks.

More to the north in the transect, at peg N8, again a negative subsidence has been measured. The reason for this is unknown.

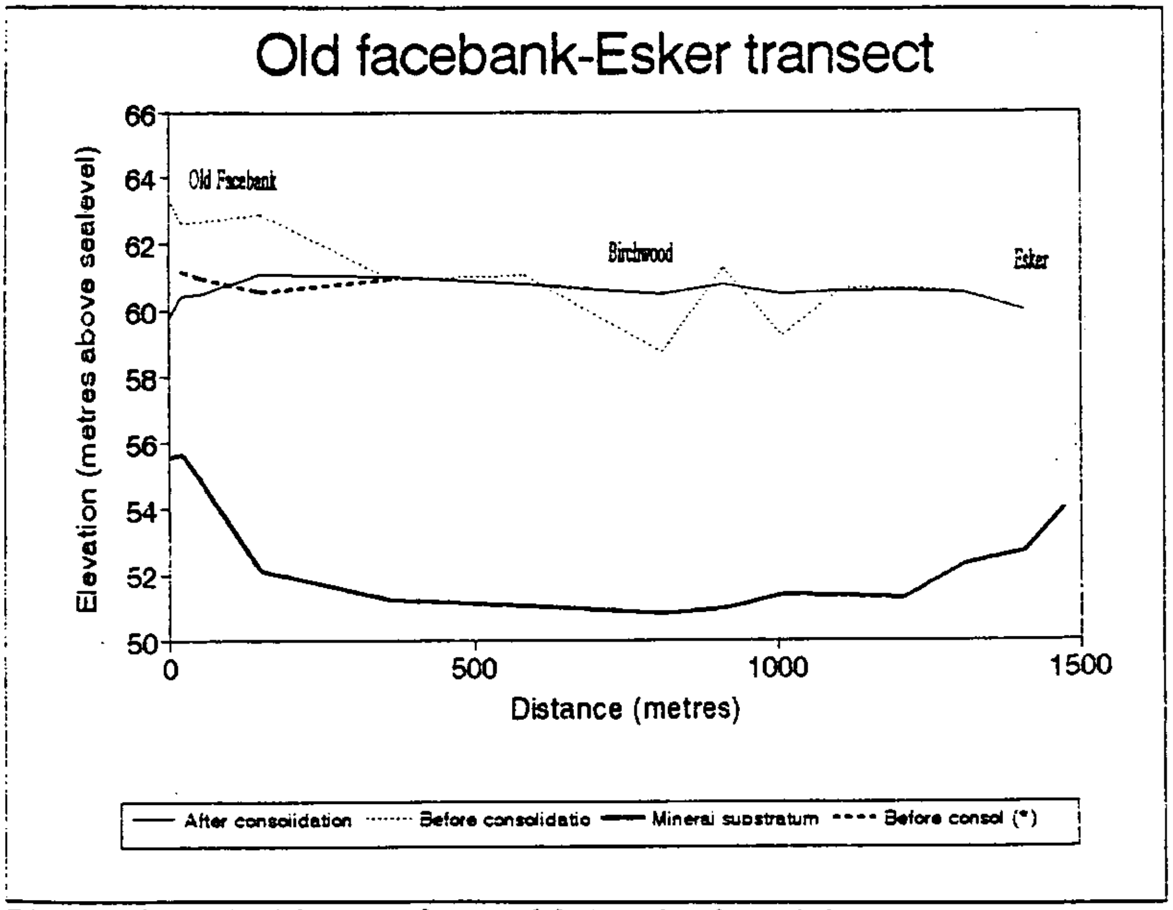

Figure 9; Subsidence along Old Facebank - Esker transect (* represents consolidation calculated with edge reference instead of main reference)

--Locations 76, 77, 78, and 99 at the old facebank show substantial subsidence. As these locations are near the edge of the bog, the samples taken were rather dry. Moreover, the samples were taken in summer, which makes them even drier. Therefore, the samples did not meet the requirement of saturation of the sample (par 4.4.1). This resulted in an overestimation of the C_0 and thus an overestimation of the subsidence.

Therefore augering at locations 77 and 78 were (re)done in November[9]. On this occasion, the samples taken above the groundwater table were wetted, so the requirement of saturation of the sample was satisfied.

loc.	Subsdnc.	Month	Wetted
Tub 76	3.56	Sept	No
Tub 77	2.23	Nov	Yes
Tub 78	3.52	Sept	No
Tub 78	2.19	Nov	Yes

Table 5; Subsidence at the old facebank, with and without wetting.

In Table 5 can be seen that the subsidence in November, with a wetted sample, is considerably less than in September, without wetting. But still, the subsidence remains significant at the old facebank. Three possible explanations are possible:

1--- The bog used to extend more to the south (west), so the center used to be situated south of the present day bog as well. This involves rising of the original bogsurface to the south (dashed line, Figure 9).

2--- The bog did not extend more to the south, so the old facebank is close to the original natural edge of the bog. This involves using the edge reference at locations 76, 77, 78, and 99. If this is done, subsidence of the original bogsurface, virtually disappears (heavily dashed line, Figure 9).

3--- The method of wetting the samples taken above the groundwatertable failed. Possibly because of crumbling of these samples, which made proper wetting difficult.

9 At location 76 and 99, was augered only in September.
At location 77, was augered only in November.
At location 78, was augered in September and re-augered in November.

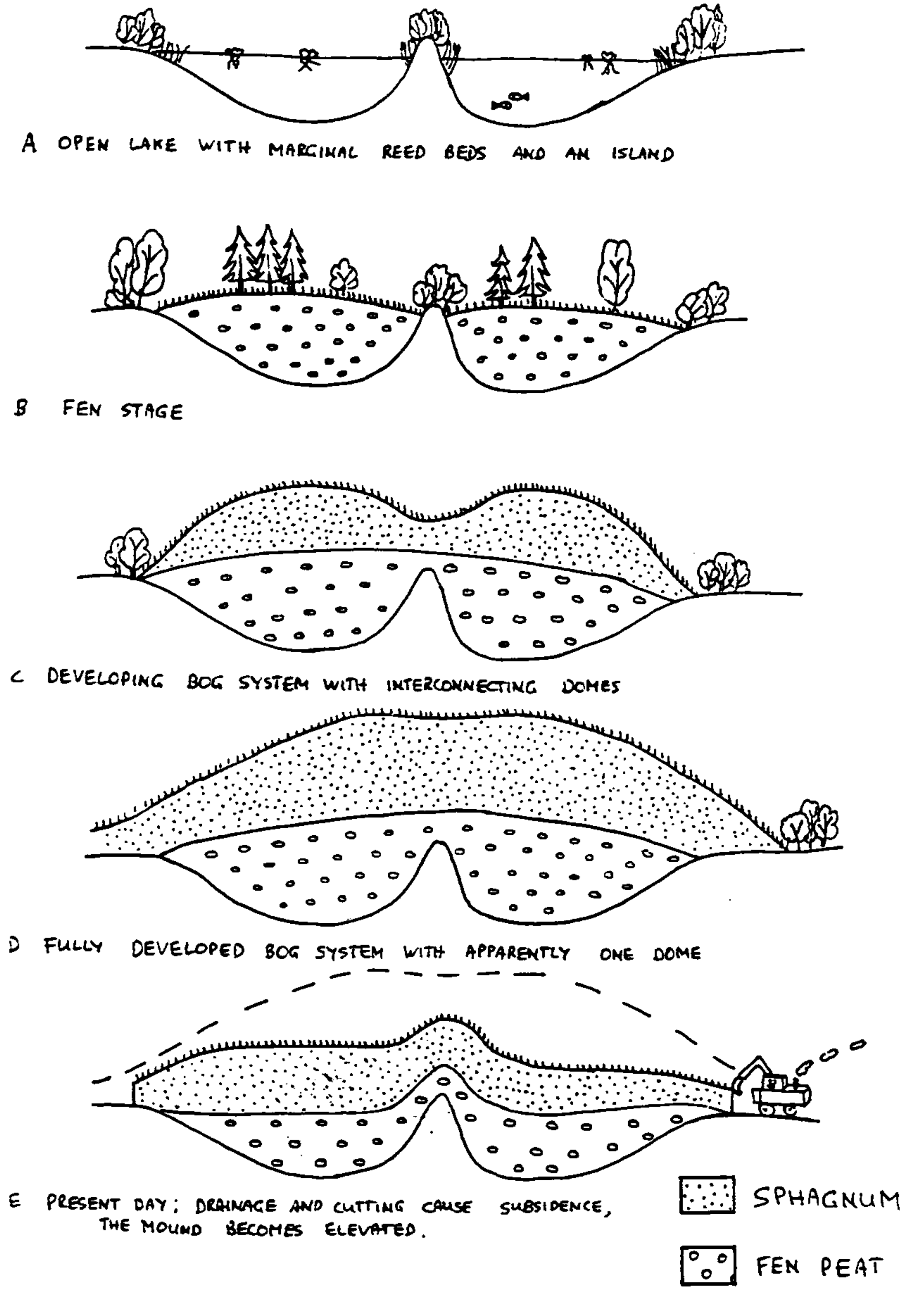

Figure 10; Possible stages of development of Clara Bog and the Mound.

4.5.3 Mound - Edge transect

The present day bog surface descends from the elevated Mound to the southern edge of Clara West. Because of the elevated position of the mineral substratum at the Mound, the peat is very shallow here. For reasons pointed out below, the edge reference is used on the Mound (tube 49, 92), and the intermediate reference at peg I12 and tube 93, on the flank of the Mound. Using these references, generally, the subsidence increases from Mound to the edge, suggesting a less pronounced presence of the Mound in the undisturbed situation. Also in the West-East transect and the Mound-Soak transect the original bog surface shows no real sign of a rise at the Mound. This supports the theory that the Mound used to have the same elevation as the rest of the bog. However when subsidence struck the bog, the Mound could not subside because of the rising of the underlying substratum, and hence became elevated.

The bog extended more to the south, so the southern edge, where this transect ends, is no natural edge. Hence, an edge reference is not appropriate at location 62 or 63, on the southern end of this transect. The main reference is used here, because the southern edge is not a natural edge.

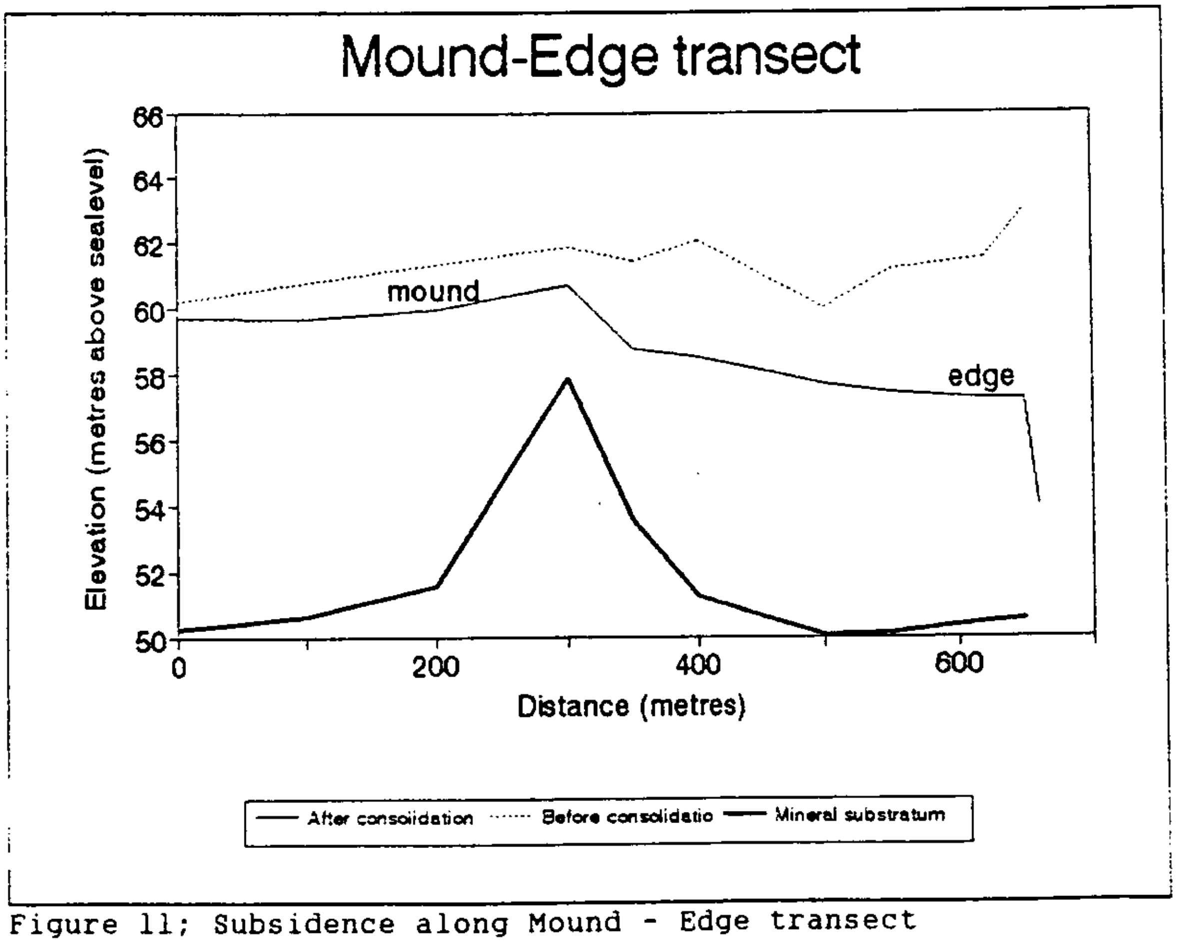

Figure 11; Subsidence along Mound - Edge transect

Edge reference on the Mound
Because of the high concentrations of organic matter, measured on the Mound, subsidence on the Mound seems to be more severe than on other parts of the bog. The conclusion that the Mound was the highest part of the bog, even before the subsidence, could be drawn. However, it is also likely that the hydrology on the Mound because of its shallowness, has been different from the surroundings, from the start, resulting in higher concentrations of organic matter. This means that the Mound, in terms of concentrations of organic matter, is not representative for the rest of the bog. Hence, for the locations on the Mound the edge reference (49, 92) or the intermediate reference (93, I12) is used to calculate the subsidence.

Theory; Clara West separated?
It is likely that in the early stages of the development of Clara bog, the rising in the mineral substratum, referred to as Mound, was an island, surrounded by fen (Figure 10). On both sides of the rising of the substratum, a raised bog developed. The two bogs were possibly interconnected with each other. Later, as the bog became fully developed, the elevated position of the substratum was no longer visible. When drainage and peat cutting caused the bog to subside, the Mound became elevated. This theory indicates that originally, the extreme west of Clara bog was separated from the rest of the bog. The extreme west acted as an autonomous bog, and possibly still does. To verify this theory, the exact extent of the elevation of the substratum at the Mound should be examined.

4.5.4 Edge - Soak transect

This transect traverses the soak north-south. It reveals two obvious trends. Firstly, the present day bog surface descends from the soak to the edge. Secondly, the original bog surface ascends from the soak to the edge.

The reason for the first trend is evident; peat cutting resulting in a facebank causes waterloss and therefore subsidence.
The second trend could be explained by the fact that in former days the center of the bog was located more to the south.

The Soak
With the West-East transect no decisive verdict about the subsidence at the soak could be given. Studying this Edge-Soak transect and the subsequent Mound-Soak transect the pattern of subsidence around the soak becomes clearer. In Figure 12 and Figure 14 can be seen that the subsidence at the soak is relatively small, and increases to the edge. In other words, the Edge-Soak transect suggests terrain-height-inversion. Perhaps, the direction of drainage was initially not from north to south but the other way round. Extensive peat cutting at the southern edge perhaps is to blame for this reversal. The West- East transect indicates that the soak is situated in a slight dip. In this manner the Soak could be acting as a place where the water collects, before it drains to the southern edge. This hypothesis can be proven or denied by examining the waterlevels and the drainage around the Soak.

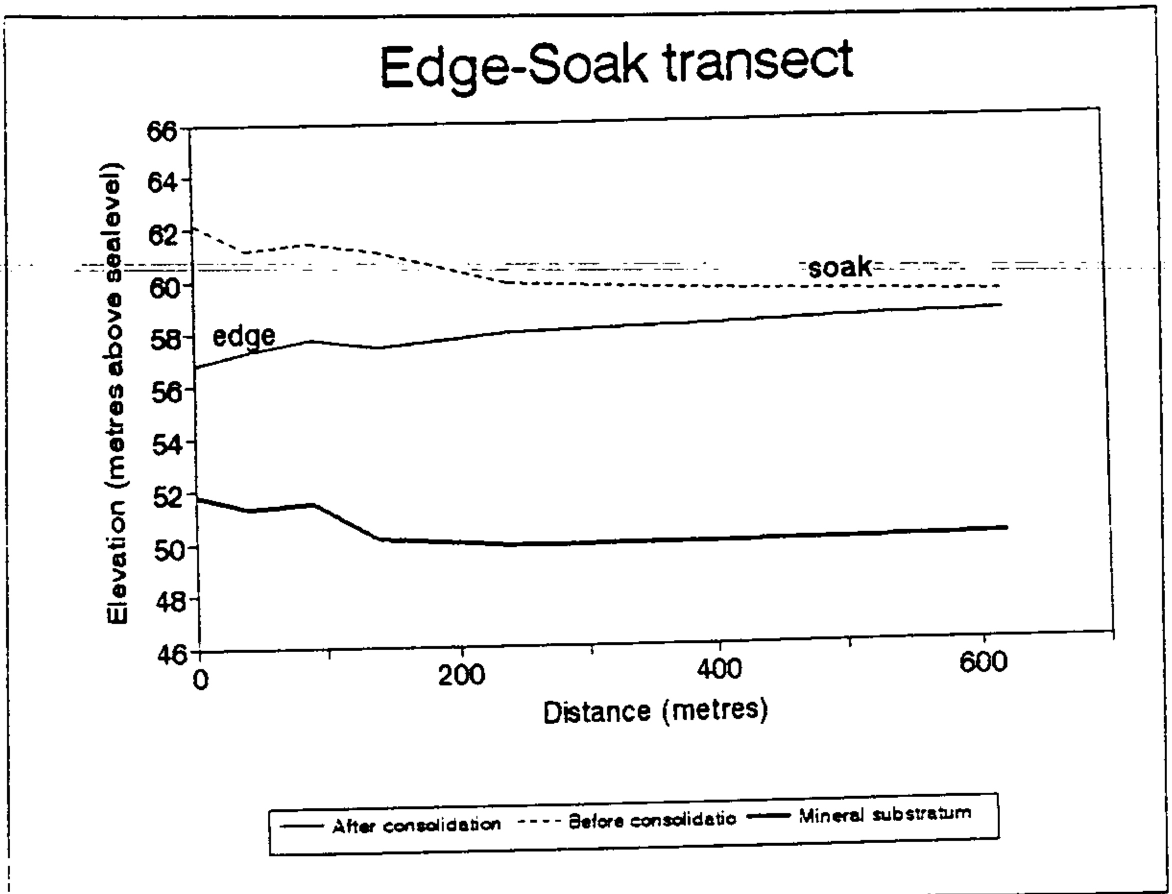

Figure 12; Subsidence along Edge - Soak transect

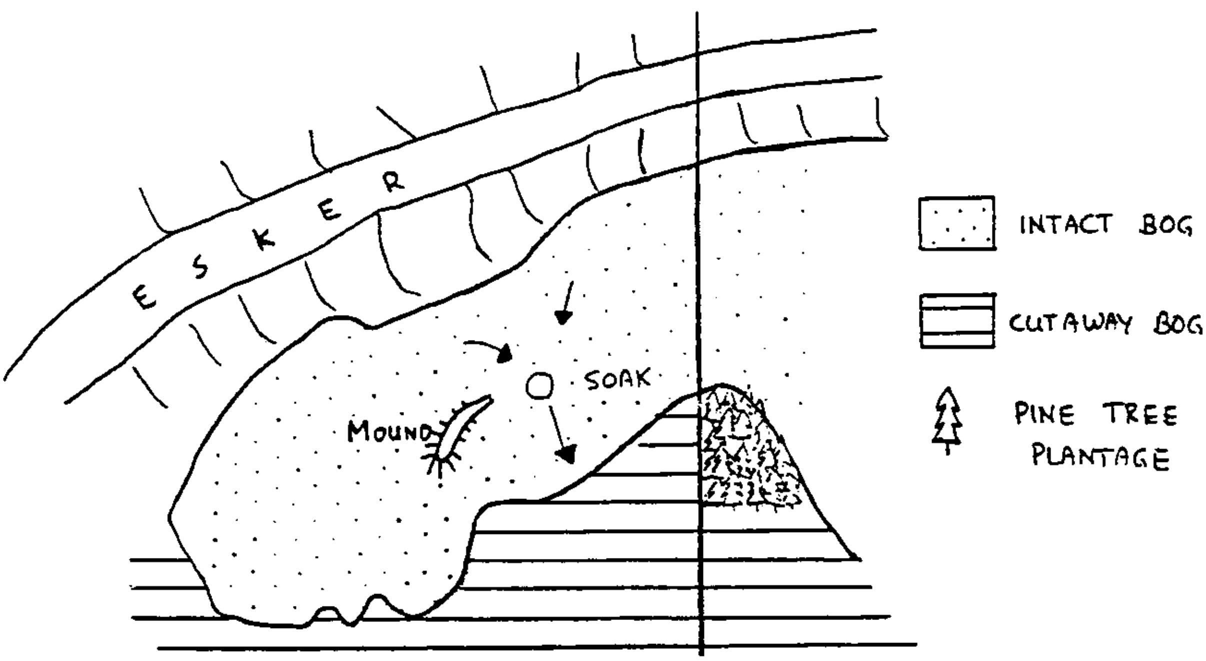

Figure 13; Clara West; Possibly water collects at the soak, before it drains to the south.

So, the soak is not a spot of strong local subsidence, on the contrary, subsidence has been little at the soak, but it could be regarded as a place where the water collects before it drains to the south. Further research, however, is indispensable to confirm this theory. Still, a lot of questions about the origin of the Soak remain unanswered. The previous remarks do not intend to solve the matter, but hopefully it contributes to the unraveling of origin of the Soak.

4.5.5 Mound - Soak transect

This last transect is short, and is only to confirm and enhance the previous; relatively little subsidence at the Soak and a less pronounced presence of the Mound in the past.

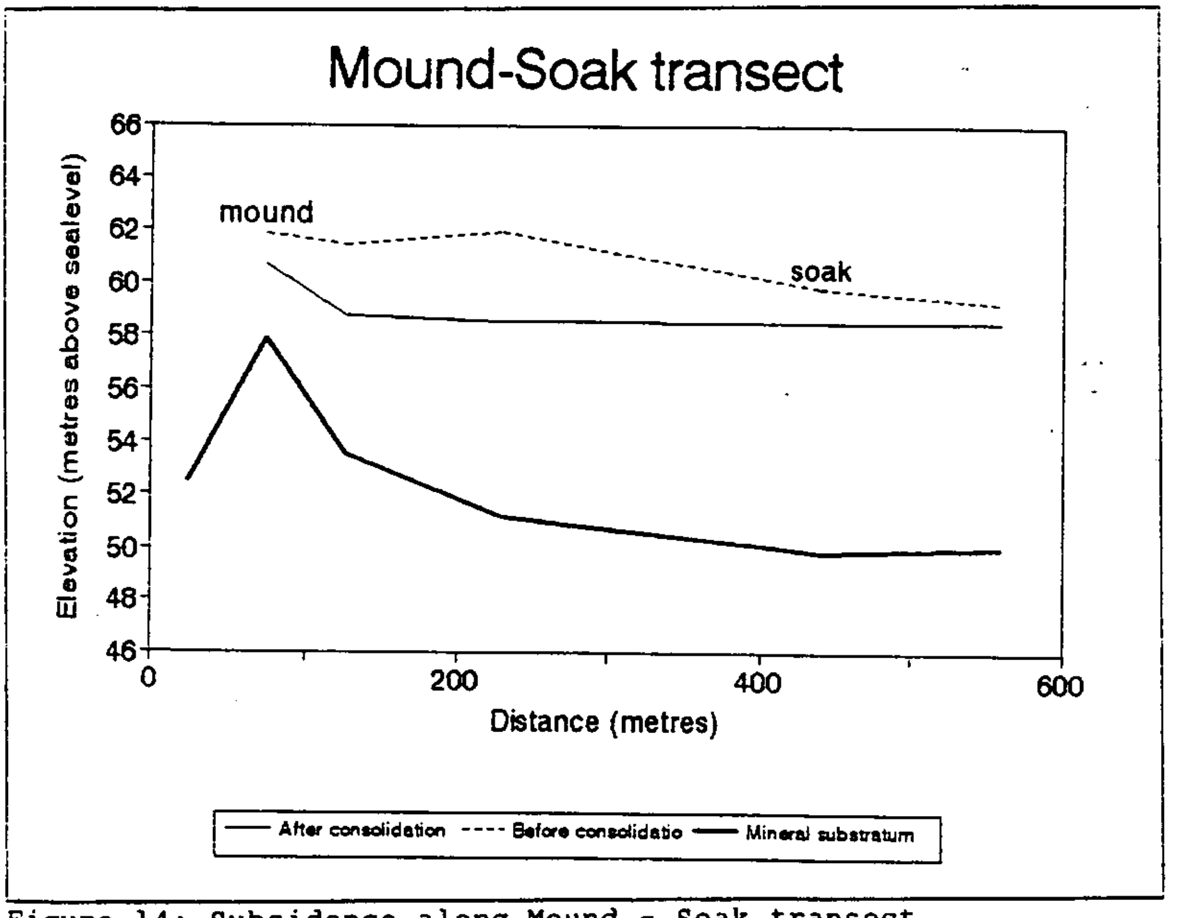

Figure 14; Subsidence along Mound - Soak transect

4.6 Sytsma's work

Sytsma 1992 already performed a subsidence study on Raheenmore bog and did a few augerings on Clara West. These augerings on Clara West were at locations I12, 49, 50, 56, 57, 65, and 68. They have been integrated in this study, after recalculation of the measurements. This was needed because, although Sytsma used the same method, there was a slight difference:

Sytsma 1992 calculated the average volumetric concentration of organic matter (C_0) seperately for each of the three layers (young sphagnum, old sphagnum, fen peat) in the peat column. Each layer has its own, characteristic reference and therefore its own amount of subsidence. (Method 1)
In this study, however, the subsidence is calculated using one reference for the whole column. (Method 2)

To compare the two methods, the subsidence is calculated for each location with both methods. The results are presented in appendix 8. Although differences between the two methods appeared to be significant (generally, method 1 showed less subsidence than method 2), it is not clear which method is preferable. Further research on this subject is recommended.

Method 2 was implemented because of two reasons:

-Three reference sites were used. These were assumed to be representative not only in C_0, but also in lithology. If the lithology at an augering location and at the reference site generally is the same, then there is no need to calculate the subsidence of each layer seperately.

-Method 2 shows a more feasible unconsolidated bogsurface. For example, at locations 56 and E10 method 1 produces very little or no subsidence, which is in contradiction with the expected outcome. Furthermore, method 1 applied to locations R9 and 88 resulted in a negative subsidence, where method 2 did not.

4.7 Samuels' work

In the summer of 1992 an english student researched the subsidence of the bog road (Samuels 1992). The subsidence along two transects perpendicular to the road was calculated. She, however, used a totally different approach to determine the subsidence.

Samuels 1992 claims that the specific gravity of solids Sg_s

$$Sg_s = \frac{\rho_s}{\rho_w} = \textit{specific gravity of solids} \qquad (19)$$

ρ_s =density of solid matter kg/m^{-3}
ρ_w =density of water = 1000 kg/m^{-3}

in peat varies due to:
- the varying degree of humification
- the range of plant material which might be contributing to the soil, and
- the chemical adsorption of water

and therefor she tries to measure the Sg_s. Furthermore, Samuels decided to use the ratio of mass of water to mass of solids (Mw/Ms) to calculate the subsidence, as this would combine the subsidence due to waterloss, with the volume loss through biological oxidation. The location with the largest value of the Mw/Ms ratio simply was used as a reference, no subsidence was assumed here. Samuels considered the subsidence of the Fen peat and the Sphagnum peat separately.

In this study the Mw/Ms ratios were converted into volumetric concentrations so that the C_0 value of each location could be derived. These C_0 values appeared to be very much different from the C_0 values measured by the author on other locations. This is logical because the Mw/Ms ratios were converted using $\rho_s = \rho_0 =$ 1,37 kg/m^{-3}, while Samuels tried to measure ρ_s[10]. This problem, however, was solved by using the same reference as Samuels used in her study.

The amounts of subsidence calculated by Samuels along her two transects and the subsidence of the same transects calculated by the method in paragraph 4.4.1 (after converting the Mw/Ms ratios) are displayed in appendix 9. Generally the method used in this thesis yields about 10 percent more subsidence then the method used by Samuels 1992. This is remarkably little and regular, considering the essentially different approach of the two methods.

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[10] Samuels found values of ρ_s in the range from 0.19 to 0.83 kg/m^{-3}, according to Galvin 1976 ρ_s should be about 1.37 kg/m^{-3}.

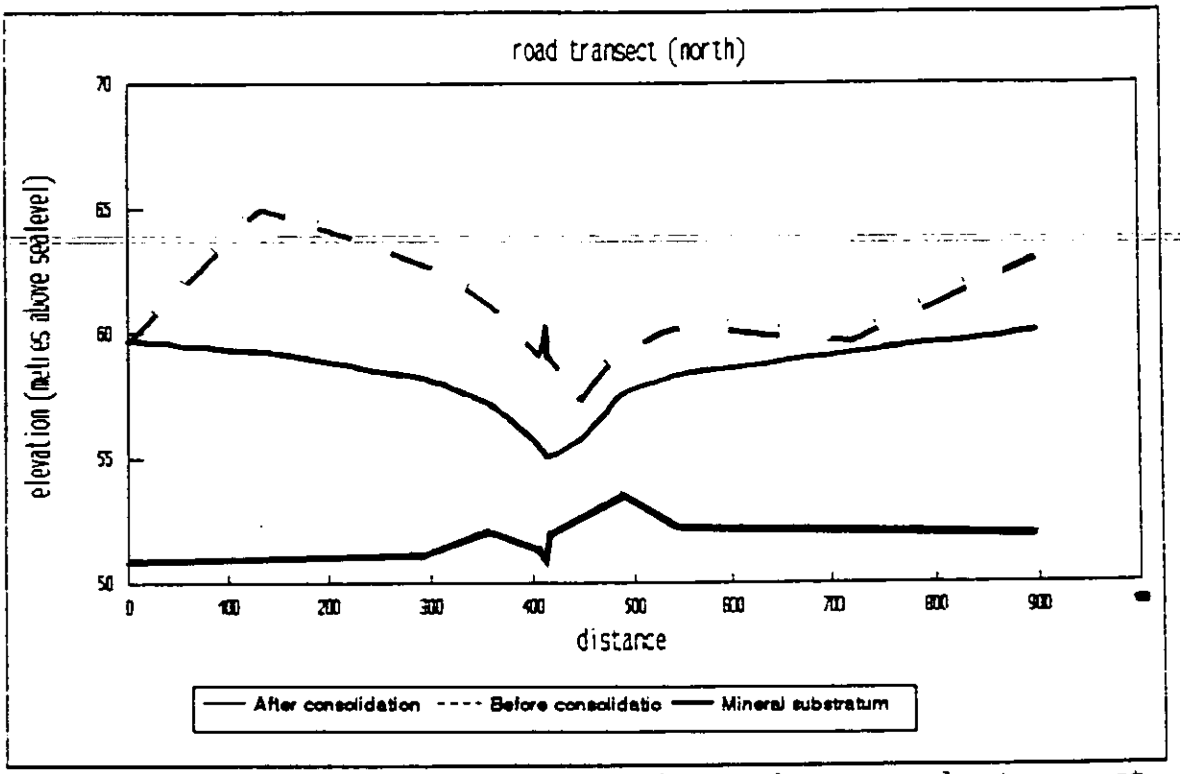

Figure 15; Subsidence along nothern bog road transect. Measurements derived from Samuels 1992, original bogsurface calculated according to method described in paragraph 4.4.1.

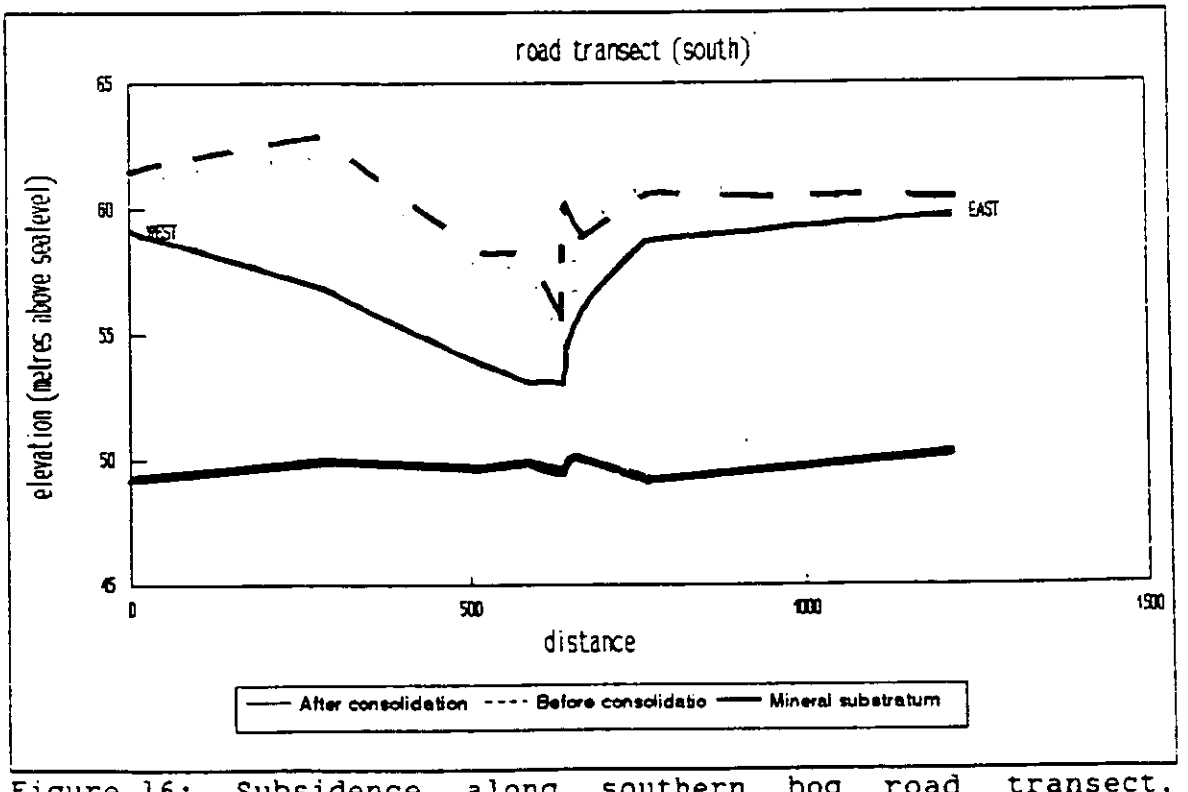

Figure 16; Subsidence along southern bog road transect. Measurements derived from Samuels 1992, original bogsurface calculated according to method described in paragraph 4.4.1.

Both transects are displayed in Figure 15 and Figure 16. The incision of the road in the bog is clearly visible in both transects. At the southern transect the incision has progressed deeper and wider, probably because of the direction of drainage to the south and the extensive peat cutting at this end of the bog. These effects are particularly obvious on the west side of the southern transect. Extensive peat cutting in this area is to blaim.

Unfortunately, the results of the original bogsurface are disappointing. No pattern can be distinguished, the calculated points of the original bogsurface seem to be random. Samuels 1992 simply draws -with the same results- a line from the highest level on Clara West to the highest level on Clara East, and claims to have reconstructed the original bogsurface. Thereby, Samuels seems to ignore the measured points. The author, however, is the opinion that on basis of these results no conclusions can be drawn, leave alone that an original bogsurface can be reconstructed.

Because both the method of Samuels and the method used in this thesis to calculate the subsidence (on basis of Mw/Ms ratios) yielded almost the same results, the reason for the unsatisfactory bog reconstruction is perhaps due to the measurements performed by Samuels. Volumetric sampling that was needed to determine Sg_s is difficult, as stated in paragraph 4.4.1, and can easily lead to inaccuracies.

4.8 Conclusions

-The reference site has a major infuence on the calculated subsidence.

-Every reference site must comply with two requirements:

1. No subsidence has occurred at the reference site.
2. The average volumetric concentration of organic matter (C_0) before consolidation of both columns have been approximately the same.

-The site where peat is thickest on the bog or the site with the volumetric concentration of organic matter C_0 is least do not necessarily produce reliable reference sites.

-A bog which has not subsided and where the environmental conditions are comparable to Clara bog, would yield the best reference site.

-Applying various references leads to large differences in subsidence of each single location. However, the effect of changing the reference site is the same for each location, which means that the *difference in subsidence between two locations* generally remains the same. Changing the reference site does not have a strong influence on the trend of subsidence in a transect.

-The contribution of oxidation to the subsidence of the bog is twofold: Firstly, the loss of organic matter causes the surface to subside. The second contribution, however, is more important: loss of water attached to the disappeared organic matter, will also cause the bog surface to subside.

-The birchwood at peg N10 and the Soak show different volumetric concentrations of organic matter.

-Locations 76, 78, and 99 show substantial subsidence. The locations, near the edge of the bog, where the samples were taken were rather dry. Therefore, the samples do not meet the requirement of saturation of the sample. This results in an overestimation of the C_0 and thus an overestimation of the subsidence.

-When locations 77 and 78 were re-augered and wetted in November 1992, the calculated subsidence was less, but still considerable.

-On the west of Clara West the original (calculated) bog surface has a dome shape alike the present day situation. Apparently the west part of the Clara West did not suffer from much subsidence; human influence has been relatively little, here.

-Maybe, on both sides of the rising of the substratum, a raised bog developed, possibly interconnected with eachother. This indicates that possibly the west of Clara West act(s)(ed) as an autonomous bog, separated from the rest of the bog by a rising in the mineral substratum, referred to as Mound.

-The presence of the Mound was at least less pronounced in the past. Possibly the Mound used to have the same elevation as the rest of the bog. However when subsidence struck the bog, the Mound could not subside because of the rising of the underlying substratum, and hence became elevated.

-Peat cutting and oxidation cause underestimation of subsidence near the road.

-To the southern bog edge the subsidence increases, which can be interpreted as confirmation of an original bog center situated southern of the present bog.

-The Soak is not a spot of strong local subsidence, on the contrary, subsidence has been little at the Soak. However, it could be regarded as a place where the water collects before it drains to the south. Further research is indispensable to confirm this theory.

-Sytsma 1992 calculated the average volumetric concentration of organic matter (C_0) separately for each of the three layers (young sphagnum, old sphagnum, fen peat) in the peat column. Each layer has its own, characteristic reference and therefore its own amount of subsidence. In this study, however, the subsidence is calculated using one reference for the whole column. Differences between the two methods appeared to be not negligible. It is not clear which method is preferable, further research is recommended.

-With the work of Samuels no conclusion concerning reconstruction of the original bogsurface can be drawn.

-The method of Samuels to calculate the subsidence (on basis of Mw/Ms ratios) yielded about ten percent less subsidence than with the method used in this thesis.

-The reason for the unsatisfactory bog reconstruction of both her transects is perhaps due to the measurements performed by Samuels, because volumetric sampling, that was needed to determine Sg_s, is difficult and can easily lead to inaccuracies.

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APPENDICES

APPENDIX 1: PERMEABILITY OF THE CATOTELM

According to Luthin and Kirkham

$$k = \frac{\pi r^2}{A} * \frac{\ln(y_1/y_2)}{(t_2 - t_1)} \qquad (20)$$

k	= permeability (m/s)
t_1, t_2	= time at time 1, 2 (s)
Y_1, Y_2	= difference in groundwaterlevel and waterlevel in piezometer at time 1, 2 (m)
R	= radius of the tube (m)
A	= geometrical constant (m)

The geometrical constant is dependent on the dimensions of the filter part. It can be obtained from the nomogram in appendix 3.

To determine t_1, t_2, Y_1, Y_2 the straight, latter part of the t versus $\ln(Y_0/Y(t))$ graph is established. With the aid of this line the values of t_1 en t_2 are chosen, leading to the values of Y(t=1) and Y(t=2).

Measurements and calculations of the permeability k.

Depth : 2 mtr
number : 201
startlvl 84.6

Time (s)	level	ln(level)
0		
15	66.7	0.0000
30	66.7	0.0000
45	66.9	0.0112
30	66.9	0.0112
75	66.9	0.0112
90	66.9	0.0112
105	66.9	0.0112
120	66.9	0.0112
150	67.1	0.0226
180	67.1	0.0226
210	67.1	0.0226
240	67.1	0.0226
300	67.1	0.0226
360	67.1	0.0226
480	67.1	0.0226
1350	67.1	0.0226
3800	68.4	0.0998
6644	69.5	0.1701
12301	71.1	0.2821
84705	81.7	1.8201

t1 = 3800
t2 = 84705

k=0.0018 m/day

Depth : 2 mtr
number : 206
startlvl 60.1 4.09601

Time (s)	level	ln(level)
0		
15	41.6	0.0000
30	41.7	0.0054
45	42.1	0.0274
60	42.2	0.0330
75	42.4	0.0442
90	42.5	0.0499
105	42.5	0.0499
120	42.7	0.0613
150	42.9	0.0729
180	43.2	0.0905
210	43.5	0.1084
240	43.6	0.1144
270	43.8	0.1266
330	44.2	0.1515
390	44.6	0.1769
450	44.9	0.1965
780	46.8	0.3300
1670	48.8	0.4930
2907	52.1	0.8383
6064	55.3	1.3492
8493	56.9	1.7546
11420	58.2	2.2759

t1 = 3000
t2 = 11000

k = 0.00146 m/day

Depth 3 mtr
number : 206
startlvl 119.5

Time (s)	level	ln(level)
0		
14	92.3	0.0000
21	92.7	0.0148
36	92.8	0.0186
46	93.1	0.0299
52	93.2	0.0336
75	93.2	0.0336
90	93.4	0.0413
120	93.5	0.0451
180	93.7	0.0528
300	94.2	0.0724
420	94.7	0.0924
1496	95.9	0.1420
4485	98.8	0.2731
62220	113.5	1.5115

t1 = 4485
t2 = 62220

k = 0.0019 m/day

Depth 4 mtr
number : 206
startlvl 132.7

Time (s)	level	ln(level)
0		
35	106.8	0.0000
60	106.5	-0.0115
90	106.5	-0.0115
120	106.4	-0.0153
4650	108	0.0474
9250	109.1	0.0930
11350	109.4	0.1058
193260	118.7	0.6152
198000	118.8	0.6224

t1 = 2500
t2 = 7000

k = 0.0002 m/day

Depth 2 mtr
number : 209
startlvl 57.8

Time (s)	level	ln(level)
0		
40	46.3	0.0000
60	47.3	0.0910
75	47.9	0.1498
90	48.8	0.2451
105	49.2	0.2906
120	49.6	0.3382
135	50	0.3882
150	50.3	0.4274
165	50.6	0.4683
180	50.9	0.5108
195	51.1	0.5402
210	51.3	0.5705
240	51.6	0.6178
270	52	0.6845
300	52.5	0.7746
330	52.8	0.8329
360	53	0.8737
420	53.3	0.9383
830	55	1.4127
1675	56.1	1.9117

Depth 3 mtr
number : 209
startlvl 110.5

Time (s)	level	ln(level)
0		
42	83.5	0.0000
20	83.6	0.0037
50	83.9	0.0149
68	84	0.0187
95	84.3	0.0301
110	84.3	0.0301
140	84.5	0.0377
200	84.7	0.0455
320	85	0.0572
440	85.2	0.0650
830	86.1	0.1013
3410	89.1	0.2324
61760	102.7	1.2417
255000	109.9	3.8067

t1 = 61760
t2 = 255000

Depth 4 mtr
number : 209
startlvl 113.3

Time (s)	level	ln(level)
0		
10	95	0.0000
30	94.6	-0.0216
60	94.8	-0.0109
90	94.9	-0.0054
120	95	0.0000
180	95.2	0.0110
2550	99.1	0.2537
3450	100	0.3191
6690	102	0.4821

t1 = 2500
t2 = 7000

k = 0.0047 m/day

5150	57.2	2.9532	k	=	0.0011 m/day	
5840	57.3	3.1355				
7240	57.4	3.3586				
7820	57.4	3.3586				
10205	57.7	4.7449				

t1 = 4000
t2 = 10000

k = 0.0266 m/day

Depth 7 mtr

number :	209	
startlvl	116.9	
Time (s)	level	ln(level)
0		
20	99.9	0.0000
60	100.7	0.0482
120	101.8	0.1185
180	102.7	0.1800
300	104	0.2760
360	104.7	0.3318
480	105.5	0.3996
1740	110.7	1.0087
2640	112.7	1.3981
3390	113.6	1.6393
17040	116.5	3.7495

t1 = 3000
t2 = 15000

k = 0.0145 m/day

Depth 2 mtr			Depth 3 mtr			Depth 4 mtr		
number :	210		number :	210		number :	210	
startlvl	54.4		startlvl	102.1		startlvl	104.1	
Time (s)	level	ln(level)	Time (s)	level	ln(level)	Time (s)	level	ln(level)
0			0			0		
20	42.6	0.0000	16	86	0.0000	15	89.2	0.0000
28	44.4	0.1655	19	87.3	0.0842	30	90.5	0.0913
35	45	0.2274	25	89	0.2062	45	91.4	0.1593
40	45.5	0.2820	33	90.5	0.3278	60	92.4	0.2413
46	46	0.3399	39	91.4	0.4086	90	93.5	0.3405
54	46.3	0.3762	45	92.5	0.5171	120	94.4	0.4292
60	46.6	0.4140	60	93.7	0.6506	180	95.7	0.5731
66	46.8	0.4400	75	94.7	0.7773	240	96.5	0.6732
70	47	0.4666	90	95.7	0.9225	300	97.2	0.7698
74	47.2	0.4940	105	96.5	1.0561	360	97.9	0.8768
80	47.4	0.5222	120	96.7	1.0924	420	98.2	0.9264
89	47.6	0.5512	135	97.1	1.1694	490	98.7	1.0150
95	47.8	0.5810	165	97.8	1.3202	540	99	1.0721
110	48	0.6118	195	98.2	1.4178	600	99.6	1.1973
125	48.3	0.6598	225	98.6	1.5261	825	100.3	1.3664
140	48.5	0.6931	255	99	1.6474	870	100.5	1.4204
155	48.7	0.7276	315	99.7	1.9034	915	100.8	1.5074
170	48.8	0.7453	375	100.2	2.1370	1020	100.9	1.5382

200	48.9	0.7634
230	49.1	0.8004
260	49.3	0.8389
290	49.3	0.8389
350	49.4	0.8587
410	49.5	0.8789
3870	51	1.2443
4545	51.1	1.2742
5560	50.7	1.1598
6530	50.8	1.1872
8630	51	1.2443

t1 = 1000
t2 = 5000

k = 0.0086 m/day

435	100.4	2.2482
1448	101.6	3.4720

t1 = 500
t2 = 1000

k = 0.1425 m/day

1080	101	1.5700
1200	101.2	1.6367
1320	101.6	1.7851
1440	101.8	1.8685
1560	102.2	2.0595
1620	102.3	2.1136
1680	102.4	2.1707
3120	103.1	2.7014
5880	103.8	3.9053

t1 = 1000
t2 = 1500

k = 0.0786 m/day

Depth 7 mtr
number : 210
startlvl 110.1

Time (s)	level	ln(level)
0		
60	100	0.0000
120	102.8	0.3247
180	104.3	0.5547
240	105.1	0.7031
300	105.8	0.8539
360	106.3	0.9775
420	106.7	1.0888
540	107.6	1.3962
660	107.9	1.5241
1260	109	2.2172

t1 = 600
t2 = 1200

k = 0.0991 m/day

Depth 10 mtr
number : 210
startlvl 110.2

Time (s)	level	ln(level)
0		
30	100.6	0.0000
60	101.6	0.1100
120	102.6	0.2336
180	103.7	0.3900
240	104.3	0.4868
300	104.7	0.5570
360	105.1	0.6325
420	105.5	0.7142
540	106.2	0.8755
660	106.6	0.9808
780	106.9	1.0678
900	107.2	1.1632
1020	107.5	1.2685
1140	107.8	1.3863
1260	108.1	1.5198
1380	108.3	1.6199

t1 = 500
t2 = 1400

k = 0.0770 m/day

Depth 2 mtr
number : 211
startlvl 97.4

Time (s)	level	ln(level)
0		
20	72.5	0.0000
51	72.5	0.0000
68	72.8	0.0121
90	73	0.0203
105	73.3	0.0327
135	73.5	0.0410
165	73.8	0.0536
195	74.3	0.0750
225	74.8	0.0969
255	75.1	0.1103
315	75.6	0.1330
375	76.2	0.1609
435	76.6	0.1799
870	79.6	0.3357
3292	87.1	0.8827

t1 = 1000
t2 = 3500

k = 0.0207 m/day

Depth 3 mtr
number : 211
startlvl 104.5

Time (s)	level	ln(level)
0		
10	80.5	0.0000
18	81.3	0.0339
20	82.1	0.0690
23	82.4	0.0825
27	82.9	0.1054
30	83.5	0.1335
34	84	0.1576
40	84.5	0.1823
44	85	0.2076
57	86.1	0.2657
64	86.5	0.2877
70	87	0.3159
81	87.6	0.3507
92	88.2	0.3869
110	89	0.4372
130	90.3	0.5248
160	91.1	0.5828
190	91.9	0.6444
220	92.6	0.7015
250	93.7	0.7985
280	94	0.8267
310	94.4	0.8655
340	94.9	0.9163
370	95.5	0.9808
430	95.8	1.0147
490	96.3	1.0739
550	96.9	1.1499
730	98.1	1.3218
2500	102.1	2.3026

t1 = 1000
t2 = 2500

k = 0.0499 m/day

Depth 4 mtr
number : 211
startlvl 108.5

Time (s)	level	ln(level)
0		
15	80.5	0.0000
75	80.9	0.0144
135	81.5	0.0364
255	82.5	0.0741
10425	93.7	0.6376
10665	93.8	0.6444
10785	94	0.6581
190725	106.5	2.6391

t1 = 8000
t2 = 10000

k = 0.0010 m/day

Depth 7 mtr
number : 211
startlvl 114.6

Time (s)	level	ln(level)
0		
15	103.7	0.0000
35	104.5	0.0762
60	105.9	0.2254
90	106.8	0.3346
135	107.5	0.4287
180	108.2	0.5325
240	108.9	0.6483
360	109.9	0.8412
480	110.5	0.9778
600	111.3	1.1948
720	111.6	1.2902
780	111.9	1.3955

Depth 10 mtr
number : 211
startlvl 118.1

Time (s)	level	ln(level)
0		
20	95.9	0.0000
60	97.3	0.0651
120	98.4	0.1195
180	99.6	0.1823
240	100.2	0.2153
300	100.9	0.2552
360	101.5	0.2907
720	104.6	0.4974
840	105.3	0.5506
1020	106.3	0.6320
1320	107.6	0.7487
1740	109.1	0.9029

840	112.3	1.5559	2220	110.3	1.0460
960	112.6	1.6956	2460	111	1.1400
			4740	114	1.6891
t1 =	500		4920	114.1	1.7138
t2 =	1000		5160	114.4	1.7918
			5340	114.6	1.8473
			t1 =	2500	
k =	0.1285 m/day		t2 =	6000	
			k =	0.0215 m/day	

Depth 2 mtr			Depth 3 mtr			Depth 4 mtr		
number :	317		number :	317		number :	317	
startlvl	82		startlvl	145.2		startlvl	147.9	
Time (s)	level	ln(level)	Time (s)	level	ln(level)	Time (s)	level	ln(level)
0			0			0		
15	63.7	0.0000	14	120.5	0.0000	20	129	0.0000
24	64.1	0.0221	20	120.6	0.0041	60	129	0.0000
32	64.3	0.0333	29	120.7	0.0081	90	129	0.0000
41	64.5	0.0447	79	121	0.0205	390	129	0.0000
51	64.9	0.0678	140	121.5	0.0413	690	129.2	0.0106
68	65.2	0.0855	200	122.5	0.0844	69150	138.3	0.6774
84	65.4	0.0975	260	123.8	0.1434	171390	144.1	1.6042
99	65.5	0.1035	1250	126.1	0.2571	241590	146.2	2.4085
120	65.8	0.1219	1940	127.4	0.3276			
150	66	0.1343				t1 =	100000	
180	66.4	0.1596	t1 =	500		t2 =	250000	
210	66.5	0.1661	t2 =	1500				
240	66.7	0.1790						
300	67.2	0.2123						
360	67.5	0.2328				k =	0.0008 m/day	
1795	71.5	0.5555	k =	0.0095 m/day				
3287	73.2	0.7321						
4480	74.6	0.9054						
t1 =	1000							
t2 =	4000							
k =	0.0112 m/day							

Depth 2 mtr
number : 321
60.4

Time (s)	level	ln(level)
0		
10	49.2	0.0000
15	50.2	0.0935
21	51.2	0.1967
28	52	0.2877
36	52.6	0.3618
45	53.1	0.4280
56	53.7	0.5138
65	54	0.5596
74	54.4	0.6242
87	54.9	0.7112
102	55.1	0.7482
121	55.6	0.8473
150	56	0.9343
180	56.4	1.0296
210	56.8	1.1350
240	57.2	1.2528
270	57.4	1.3173
300	57.6	1.3863
360	58	1.5404
420	58.1	1.5830
1180	59.7	2.7726
2673	60.2	4.0254
3870	60.4	

t1 = 400
t2 = 1200

k = 0.0936 m/day

Depth 3 mtr
number : 321
114.7

Time (s)	level	ln(level)
0		
17	87.5	0.0000
25	90	0.0964
31	90.5	0.1169
39	91.2	0.1462
56	92.5	0.2031
71	95.2	0.3328
140	96.5	0.4018
170	98.6	0.5244
200	100	0.6154
270	101	0.6858
330	102.8	0.8267
390	103.8	0.9145
800	107	1.2620
1410	109.7	1.6938

t1 = 500
t2 = 2000

k = 0.0658 m/day

Depth 7 mtr
number : 321
startlvl 195.2

Time (s)	level	ln(level)
0		
60	183.5	0.0000
120	183.5	0.0000
180	183.5	0.0000
4860	187.4	0.4055
6480	188.3	0.5281
7680	189	0.6350

t1 = 4000
t2 = 8000

k = 0.0070 m/day

Depth 2 mtr
number : 324
59.8

Time (s)	level	ln(level)
0		
17	54.1	0.0000
25	55.4	0.2589
36	56.2	0.4595
46	56.7	0.6091
55	57.1	0.7472
66	57.4	0.8650
78	57.6	0.9520
92	57.1	0.7472
120	58.1	1.2098
150	58.2	1.2705
210	58.6	1.5581
270	58.6	1.5581
1815	58.6	1.5581
2570	58.7	1.6452
2970	58.7	1.6452

t1 = 100

Depth 3 mtr
number : 324
113.6

Time (s)	level	ln(level)
0		
17	95	0.0000
21	96	0.0553
26	97	0.1138
37	98	0.1759
45	98.8	0.2285
78	101.1	0.3974
91	101.7	0.4466
108	102.4	0.5072
120	102.8	0.5436
135	103.3	0.5910
165	104	0.6614
200	104.8	0.7484
225	105.3	0.8069
255	105.8	0.8690
315	106.7	0.9916
435	108	1.2004
875	110	1.6422
4035	112.7	3.0285

Depth 4 mtr
number : 324
startlvl 120.1

Time (s)	level	ln(level)
0		
21	105.2	0.0000
170	108.7	0.2677
240	110.3	0.4190
380	112.8	0.7135
560	113.9	0.8768
720	115.2	1.1121
840	116.4	1.3930
960	117	1.5700
1110	117.9	1.9129
1320	118.6	2.2959
1560	119.2	2.8067

t1 = 1000
t2 = 1500

k = 0.1725 m/day

t2 = 300

k = 0.2236

t1 = 435
t2 = 875

k = 0.0869 m/day

Depth 7 mtr
number : 324
startlvl 150.9

Time (s)	level	ln(level)
0		
20	132.8	0.0000
60	133.7	0.0510
120	134.7	0.1109
180	135.5	0.1615
240	136.2	0.2081
300	136.9	0.2569
360	137.6	0.3081
420	138	0.3387
480	138.3	0.3622
540	138.6	0.3863
600	139	0.4194
660	139.3	0.4449
780	139.9	0.4980
930	140.3	0.5351
1920	143.1	0.8418
4700	146.5	1.4143

t1 = 1000
t2 = 4000

k = 0.0201 m/day

Depth 2 mtr
number : 327
54.5

Time (s)	level	ln(level)
0		
18	44.1	0.0000
23	44.6	0.0493
27	45.1	0.1011
30	45.6	0.1558
35	45.8	0.1785
44	46.4	0.2499
51	46.6	0.2749
60	47	0.3269
67	47.1	0.3403
74	47.4	0.3817
88	47.8	0.4397
103	48.1	0.4855
114	48.3	0.5173
150	49.1	0.6554
190	49.4	0.7126
210	49.7	0.7732
240	49.9	0.8157
270	50.1	0.8602
340	50.5	0.9555
390	50.6	0.9808

Depth 3 mtr
number : 327
103.6

Time (s)	level	ln(level)
0		
22	93.5	0.0000
29	94.5	0.1043
33	95	0.1608
43	96	0.2844
50	96.5	0.3524
59	97	0.4255
68	97.5	0.5042
81	98	0.5898
105	98.6	0.7031
120	98.8	0.7439
135	99.1	0.8085
150	99.3	0.8539
180	99.7	0.9516
210	100	1.0316
240	100.3	1.1186
270	100.5	1.1811
330	100.7	1.2478
390	101.1	1.3962

t1 = 150

Depth 4 mtr
number : 327
startlvl 106.1

Time (s)	level	ln(level)
0		
20	98.5	0.0000
40	101.5	0.5021
50	102.1	0.6419
55	102.5	0.7472
60	102.8	0.8342
65	103.2	0.9634
70	103.5	1.0726
80	103.7	1.1527
90	103.8	1.1952
100	104.2	1.3863
120	104.6	1.6227
150	104.8	1.7658
180	105	1.9328
210	105.3	2.2513
240	105.6	2.7213

t1 = 100
t2 = 200

k = 0.4474 m/day

1570	53	1.9363	t2 =	400	
t1 =	500				
t2 =	1500				
			k =	0.1735 m/day	
k =	0.0704 m/day				

Depth 7 mtr			Depth 10 mtr		
number :	327		number :	327	
startlvl	110.3		startlvl	123.1	
Time (s)	level	ln(level)	Time (s)	level	ln(level)
0			0		
20	99.1	0.0000	30	113.2	0.0000
30	102	0.2997	60	114.2	0.1065
60	104.6	0.6754	120	114.3	0.1178
75	105.4	0.8267	190	114.6	0.1525
90	106	0.9573	540	115.5	0.2644
105	106.5	1.0809	840	116.6	0.4207
120	107	1.2220	1260	117.1	0.5008
150	107.6	1.4227	1500	117.3	0.5347
180	108.1	1.6275	1800	118.1	0.6831
210	108.3	1.7228	2160	118.3	0.7239
240	108.7	1.9459	2460	118.5	0.7665
300	109.2	2.3206	2700	118.6	0.7885
360	109.3	2.4159	2880	118.7	0.8109
420	109.6	2.7726	3000	118.8	0.8339
			3780	119.2	0.9316
t1 =	200				
t2 =	400		t1 =	2000	
			t2 =	4000	
k =	0.4103 m/day				
			k =	0.0109 m/day	

Depth 2 mtr
number : 330
48

Time (s)	level	ln(level)
0		
16	43.5	0.0000
23	44.5	0.2513
26	45.5	0.5878
32	45.7	0.6712
44	46	0.8109
52	46.2	0.9163
68	46.4	1.0341
80	46.5	1.0986
97	46.7	1.2417
115	46.8	1.3218
138	46.9	1.4088
149	47	1.5041
170	47.1	1.6094
190	47.1	1.6094
220	47.2	1.7272
250	47.2	1.7272
280	47.2	1.7272
340	47.3	1.8608
400	47.4	2.0149
460	47.5	2.1972
640	47.5	2.1972

t1 = 200
t2 = 500

k = 0.1684 m/day

Depth 3 mtr
number : 330
97.8

Time (s)	level	ln(level)
0		
20	81	0.0000
24	82	0.0614
30	83	0.1268
36	84	0.1967
48	86	0.3533
65	87	0.4418
80	87.5	0.4892
98	88.2	0.5596
105	88.6	0.6022
118	88.8	0.6242
126	89.1	0.6581
140	89.6	0.7172
155	90	0.7673
185	90.5	0.8335
215	91	0.9045
260	91.5	0.9808
320	92.4	1.1350
380	93	1.2528
440	93.3	1.3173
1565	95.8	2.1282

t1 = 500
t2 = 1500

k = 0.0632 m/day

Depth 4 mtr
number : 330
startlvl 102.9

Time (s)	level	ln(level)
0		
30	93	0.0000
45	95.4	0.2776
60	95.8	0.3324
75	96.7	0.4680
90	97.2	0.5521
120	98.2	0.7450
150	98.9	0.9062
180	99.9	1.1939
210	100.1	1.2629
240	100.2	1.2993
300	100.8	1.5506
360	101	1.6507
420	101.1	1.7047

t1 = 200
t2 = 400

k = 0.1997 m/day

Depth 7 mtr
number : 330
startlvl 110

Time (s)	level	ln(level)
0		
25	103	0.0000
35	104.3	0.2054
45	105.2	0.3773
60	105.9	0.5349
70	106.4	0.6650
80	106.7	0.7520
100	107.4	0.9904
120	107.8	1.1575
150	108.2	1.3581
180	108.4	1.4759
210	108.7	1.6835
255	109	1.9459
300	109.1	2.0513

t1 = 150
t2 = 300

k = 0.4248 m/day

Depth 10 mtr
number : 330
startlvl 112.4

Time (s)	level	ln(level)
0		
30	103.4	0.0000
60	105.5	0.2657
120	106.9	0.4925
180	107.6	0.6286
240	108.2	0.7621
300	108.6	0.8622
360	108.8	0.9163
420	109.1	1.0033
480	109.2	1.0341
600	109.5	1.1325
660	109.7	1.2040
720	109.9	1.2809
900	110.2	1.4088
1020	110.6	1.6094
1140	110.6	1.6094
1260	110.7	1.6666
1380	111	1.8608
1440	111.1	1.9349

t1 = 1000
t2 = 1500
k = 0.0756m/day

Depth 13 mtr
number : 330
startlvl 114.7

Time (s)	level	ln(level)
0		
20	104.8	0.0000
60	106.5	0.1884
120	107.8	0.3610
240	109.1	0.5698
300	109.7	0.6831
420	110.6	0.8815
540	111.1	1.0116
720	111.7	1.1939
900	112.1	1.3370
1080	112.6	1.5506
1140	112.8	1.6507
1200	112.9	1.7047
1320	113.1	1.8225
1620	113.5	2.1102
1800	113.7	2.2925

t1 = 1200
t2 = 1800

k = 0.0841 m/day

APPENDIX 2: THE VON POST HUMIFICATION SCALE

H 1 Completely unhumified plant remains, from which by only almost colorless water can be squeezed.

H 2 Almost unhumified plant remains; the squeeze water is light brown and almost clear.

H 3 Very poorly humified plant remains; the squeeze water is cloudy and brown.

H 4 Poorly humified plant remains; peaty substance does not escape from between the fingers by squeezing.

H 5 Moderately humified plant remains; the structure is however still clearly visible; the squeeze water is dark brown and very cloudy, while some peat escapes through the fingers.

H 6 Fairly highly humified plant remains; the structure is unclear; about a third part of the peat escapes through the fingers. The part remaining in the hand has a more clear plant structure than the part that was squeezed out.

H 7 Highly humified plant remains; about half of the material escapes when squeezed. The water, which may escape is dark brown in color.

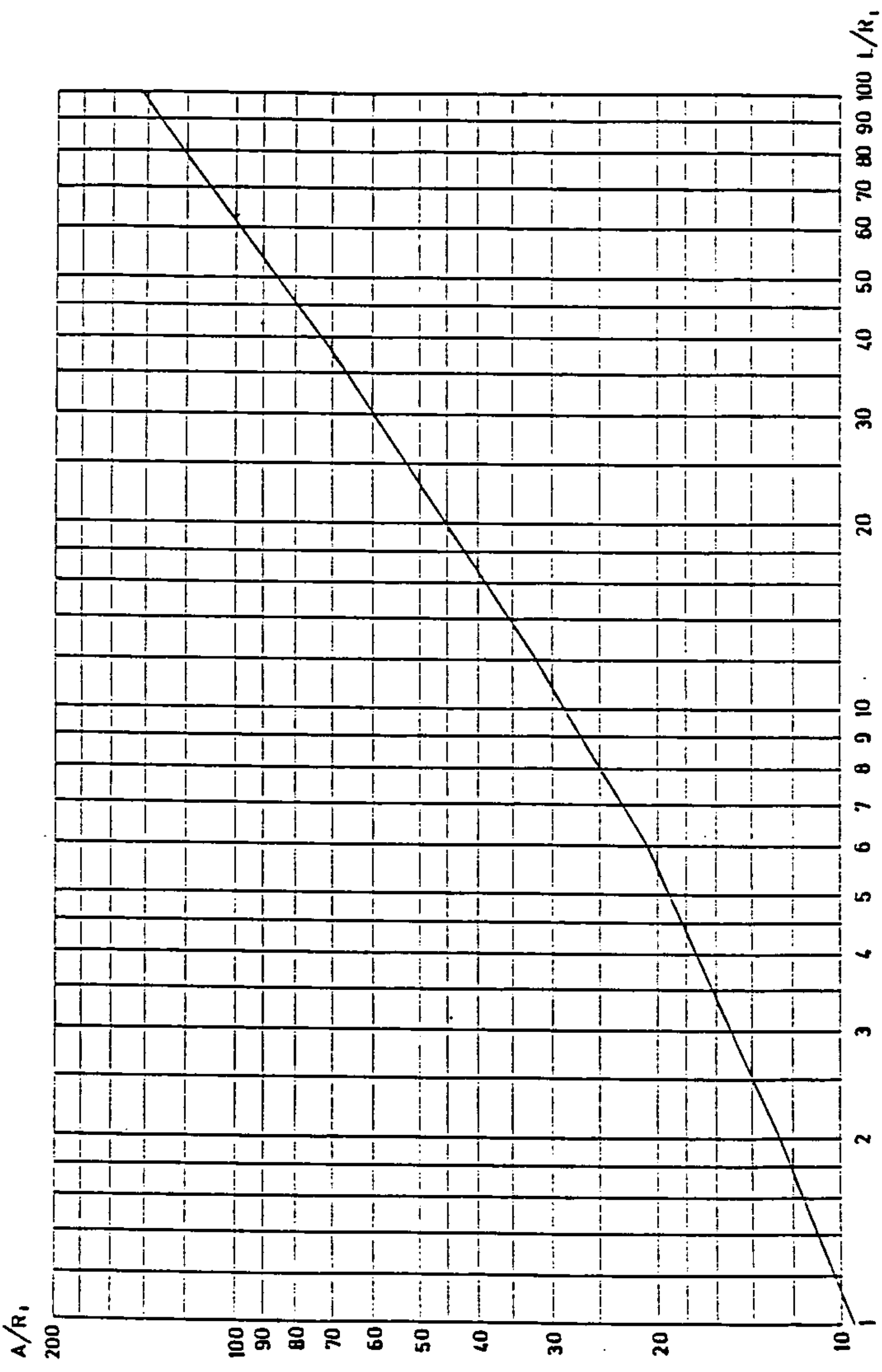
H 8 Very highly humified plant remains; two third escapes through the fingers. The remainder consists mainly of resistant bits of roots, wood.

H 9 Almost completely humified plant remains; almost all the peat escapes through the fingers. Structure is almost absent.

H 10 Totally humified plant remains; amorphous peat: all the peat escapes through the fingers without any water being squeezed out.

APPENDIX 3: NOMOGRAM

Nomogram for the determination of the geometrical factor A



APPENDIX 4: PRACTICAL PROCEDURE TO CALCULATE SUBSIDENCE

1. Weigh the saturated sample.

2. Dry the sample at 105 °C until the weight is constant (24-36 hours).

3. Weigh the dried sample. This gives the weight of organic matter in the sample. Calculate the weight of the water by substraction from the weight before drying.

4. Calculate the volumetric concentration of organic matter.

5. Calculate the average volumetric concentration of organic matter in the profile.

6. Calculate the subsidence by comparing with the volumetric concentration of a reference profile.

APPENDIX 5: SUBSIDENCE SURVEY OF CLARA WEST ; TABLES [11]

5.1 West - East transect

Location	Co	S	Lc	Lu	Lu-Lc	level consol	level uncons	Substratum
PEG S9	0.085439	0.6000	1.20	2.00	0.80	58.02	58.82	56.82
PEG R9	0.05156	0.9924	7.60	7.64	0.04	59.98	60.02	52.38
PEG Q9	0.046414	0.9204	7.00	7.61	0.61	60.52	61.13	53.52
PEG O9	0.042206	0.9520	9.80	10.29	0.49	60.78	61.27	50.98
PEG L9	0.037666	1.0667	10.50	9.84	-0.66	60.54	59.88	50.04
PEG J9	0.042267	0.9506	9.45	9.94	0.49	59.72	60.21	50.27
TUB 93	0.047936	0.8912	9.00	10.10	1.10	59.66	60.76	50.66
TUB 92	0.061949	0.8275	5.20	6.28	1.08	58.82	59.91	53.62
TUB 56	0.046267	0.8684	8.65	9.96	1.31	58.49	59.80	49.84
TUB 55	0.04513	0.8903	8.40	9.43	1.03	58.35	59.38	49.95
PEG E10	0.042699	0.9410	8.50	9.03	0.53	58.57	59.10	50.07
TUB 89	0.047838	0.8399	8.70	10.36	1.66	58.38	60.04	49.68
TUB 88	0.042937	0.9358	8.50	9.08	0.58	58.19	58.77	49.69
TUB 87	0.043296	0.9280	8.00	8.62	0.62	57.81	58.43	49.81
TUB 86	0.05035	0.7980	6.60	8.27	1.67	56.42	58.09	49.82
TUB 84	0.071892	0.5589	4.60	8.23	3.63	54.45	58.08	49.85
TUB 81	0.077787	0.5165	4.00	7.74	3.74	53.92	57.66	49.92

Table 6; Subsidence along West-East transect, Clara West

Co = volumetric concentration of organic matter (m^3/m^3)
S = Consolidation ratio = Lc/Lu = Cou/Coc (-)
Lc = length profile after consolidation (m)
Lu = length profile before consolidation (m)
Lu - Lc = nett subsidence
level consol = level above sea of consolidated peat column (m)
level uncons = level above sea of unconsolidated peat column (m)
Substratum = level above sea of underlying mineral substratum

[11] All the augerings were performed with the attendance of the author, except the augerings at tube 49, 49-57 (peg i12), 50, 56, 57, 65, and 68. Those augerings were derived from Sytsma 1992. Augerings at tube 77 and 78n were done with the attendance of S. van der Schaaf.

5.2 Old Facebank - Esker transect

location	Co	S	Lc	Lu	Lu-Lc	level consol	level uncons	Substratum
TUB 76	0.073805	0.5444	4.25	7.81	3.56	59.79	63.34	55.54
TUB 77 n	0.059009	0.6809	4.75	6.98	2.23	60.42	62.25	55.67
TUB 78	0.065884	0.6099	5.50	9.02	3.52	60.49	64.00	54.97
TUb 78 n	0.055893	0.7298	5.60	7.79	2.19	60.49	62.28	54.89
TUB 99	0.048178	0.8340	9.00	10.79	1.79	61.10	62.89	52.10
PEG P14	0.039854	1.0082	9.80	9.72	-0.08	61.02	60.94	51.22
PEG 012	0.041263	0.9737	9.70	9.96	0.26	60.77	61.03	51.07
PEG N10	0.032787	1.2255	9.70	7.92	-1.78	60.49	58.71	50.79
PEG O9	0.042206	0.9520	9.80	10.29	0.49	60.78	61.27	50.98
PEG N8	0.034503	1.1645	9.10	7.81	-1.29	60.49	59.20	51.39
PEG N6	0.040465	0.9929	9.30	9.37	0.07	60.58	60.65	51.28
PEG N5	0.042802	0.9981	8.20	8.22	0.02	60.52	60.54	52.32
PEG N4	0.051262	1.0000	7.30	7.30	0.00	60.00	60.00	52.70

Table 7; Subsidence along Old Facebank - Esker transect

n = Augering was (re)done in November 1992.

Co = volumetric concentration of organic matter (m^3/m^3)
S = Consolidation ratio = Lc/Lu = Cou/Coc (-)
Lc = length profile after consolidation (m)
Lu = length profile before consolidation (m)
Lu - Lc = nett subsidence
level consol = level above sea of consolidated peat column (m)
level uncons = level above sea of unconsolidated peat column (m)
Substratum = level above sea of underlying mineral substratum

5.3 Mound - Edge transect

location	Co	S	Lc	Lu	Lu-Lc	level consol	level uncons	Substratum
PEG J9	0.042267	0.9506	9.45	9.94	0.49	59.72	60.21	50.27
TUB 93	0.047936	0.8912	9.00	10.10	1.10	59.66	60.76	50.66
TUB 49	0.072635	0.7057	2.85	4.04	1.19	60.71	61.90	57.86
PEG I12	0.064898	0.6583	5.20	7.90	2.70	58.75	61.45	53.55
TUB 57	0.059879	0.6710	7.30	10.88	3.58	58.50	62.08	51.20
TUB 59	0.052355	0.7674	7.65	9.97	2.32	57.69	60.01	50.04
TUB 60	0.060704	0.6619	7.30	11.03	3.73	57.41	61.14	50.11
TUB 62	0.06556	0.6129	6.80	11.10	4.30	57.23	61.52	50.43
TUB 63	0.074857	0.5368	6.70	12.48	5.78	57.25	63.04	50.55

Table 8; Subsidence along Mound - Edge transect, Clara west.

5.4 Edge - Soak transect

location	Co	S	Lc	Lu	Lu-Lc	level consol	level uncons	Substratum
TUB 71	0.083653	0.4803	5.00	10.41	5.41	56.77	62.18	51.77
TUB 68	0.066043	0.6084	6.00	9.86	3.86	57.30	61.16	51.30
TUB 65	0.063472	0.6330	6.25	9.87	3.62	57.80	61.42	51.55
TUB 60	0.060704	0.6619	7.30	11.03	3.73	57.41	61.14	50.11
TUB 52	0.049625	0.8097	8.10	10.00	1.90	57.95	59.85	49.85
TUB 54			8.20			57.87	59.50	49.67
TUB 55	0.04513	0.8903	8.40	9.43	1.03	58.35	59.38	49.95
PEG F9	0.04361	0.9213	8.50	9.23	0.73	58.51	59.24	50.01

Table 9; Subsidence along Edge - Soak transect, Clara west.

5.5 Mound - Soak transect

location	Co	S	Lc	Lu	Lu-Lc	level consol	level uncons	Substratum
PEG F9	0.04361	0.9213	8.50	9.23	0.73	58.51	59.24	50.01
TUB 56	0.046267	0.8684	8.65	9.96	1.31	58.49	59.80	49.84
TUB 50	0.058514	0.6867	7.40	10.78	3.38	58.53	61.91	51.13
PEG I12	0.064898	0.6583	5.20	7.90	2.70	58.75	61.45	53.55
TUB 49	0.072635	0.7057	2.85	4.04	1.19	60.71	61.90	57.86

Table 10; Subsidence along Mound - Soak transect, Clara West

Co = volumetric concentration of organic matter (m^3/m^3)
S = Consolidation ratio = Lc/Lu = Cou/Coc (-)
Lc = length profile after consolidation (m)
Lu = length profile before consolidation (m)
Lu - Lc = nett subsidence
level consol = level above sea of consolidated peat column (m)
level uncons = level above sea of unconsolidated peat column (m)
Substratum = level above sea of underlying mineral substratum

APPENDIX 6: SUBSIDENCE SURVEY OF CLARA WEST ; BAR GRAPHS

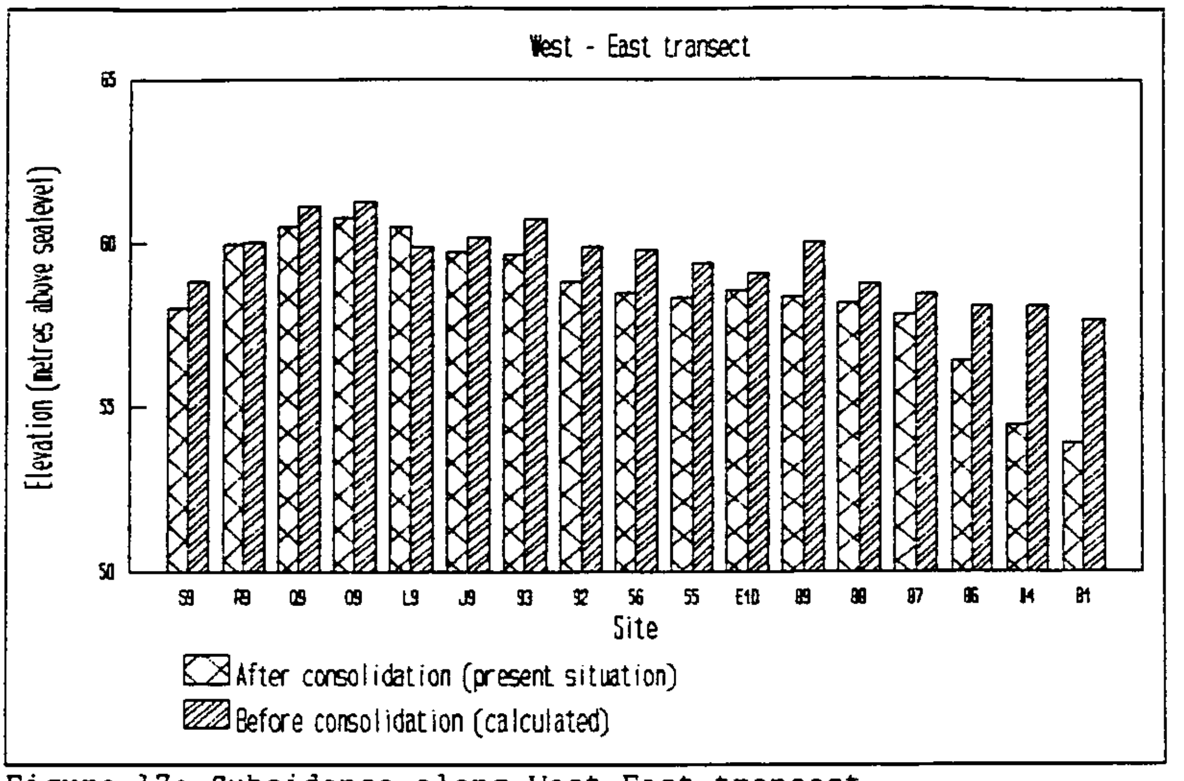


Figure 17: Subsidence along West-East transect.

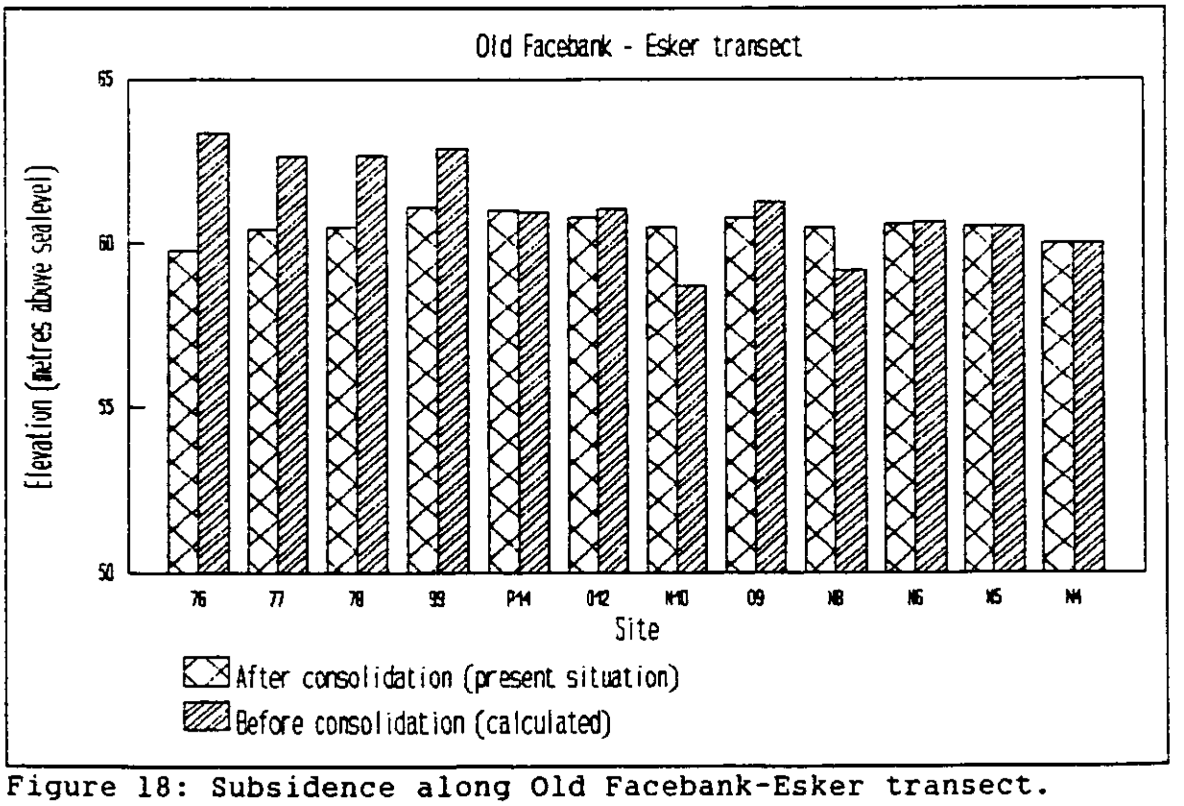


Figure 18: Subsidence along Old Facebank-Esker transect.

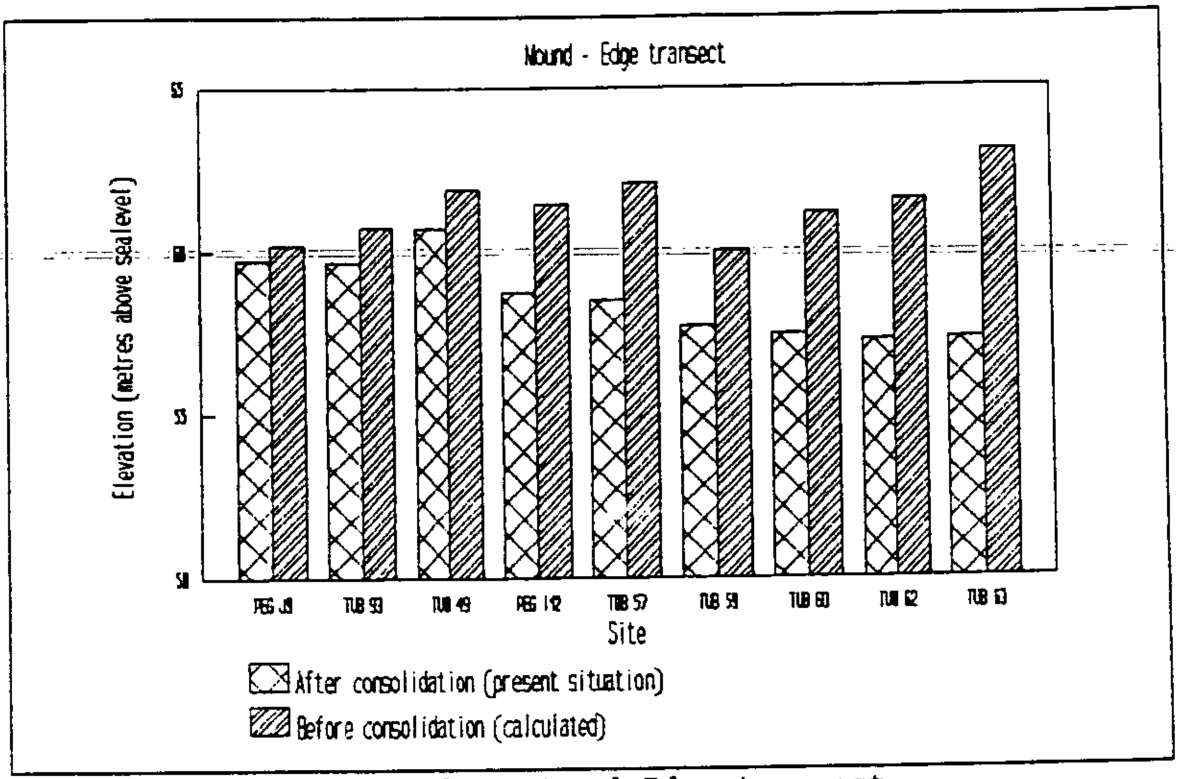


Figure 19: Subsidence along Mound-Edge transect.

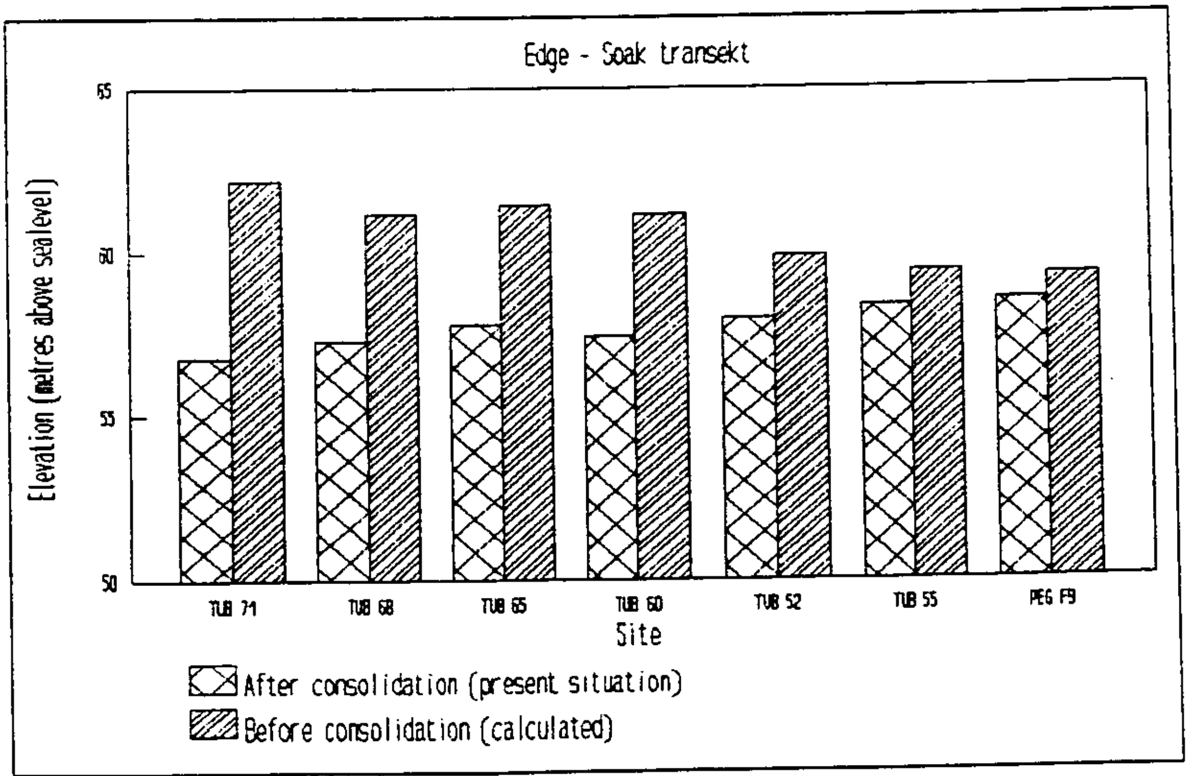


Figure 20: Subsidence along Edge - Soak transect.

APPENDIX 7: REFERENCE AUGERINGS

location	Co	Length of Column	Reference
Carrow behy	0.04018	7.70	The main reference
Carrow behy	0.04272	7.80	The intermediate reference
Clara, Esker	0.051262	7.30	The edge reference

Table 11; The reference sites

location	Co	Length of Column	comments
PEG H4'	0.043434	9.75	Location where peat is thickest on Clara East
Log Roe	0.044456	9.85	
PEG L9	0.037666	10.50	Very low Co
PEG O9	0.042206	9.80	Top of domed shape area on north-western Clara
PEG N8	0.034503	9.10	Extremely low Co
PEG N10	0.032787	9.70	Located at birchwood on Clara West

Table 12; Possible reference sites that were dropped.

APPENDIX 8: COMPARISON OF TWO METHODS TO CALCULATE SUBSIDENCE

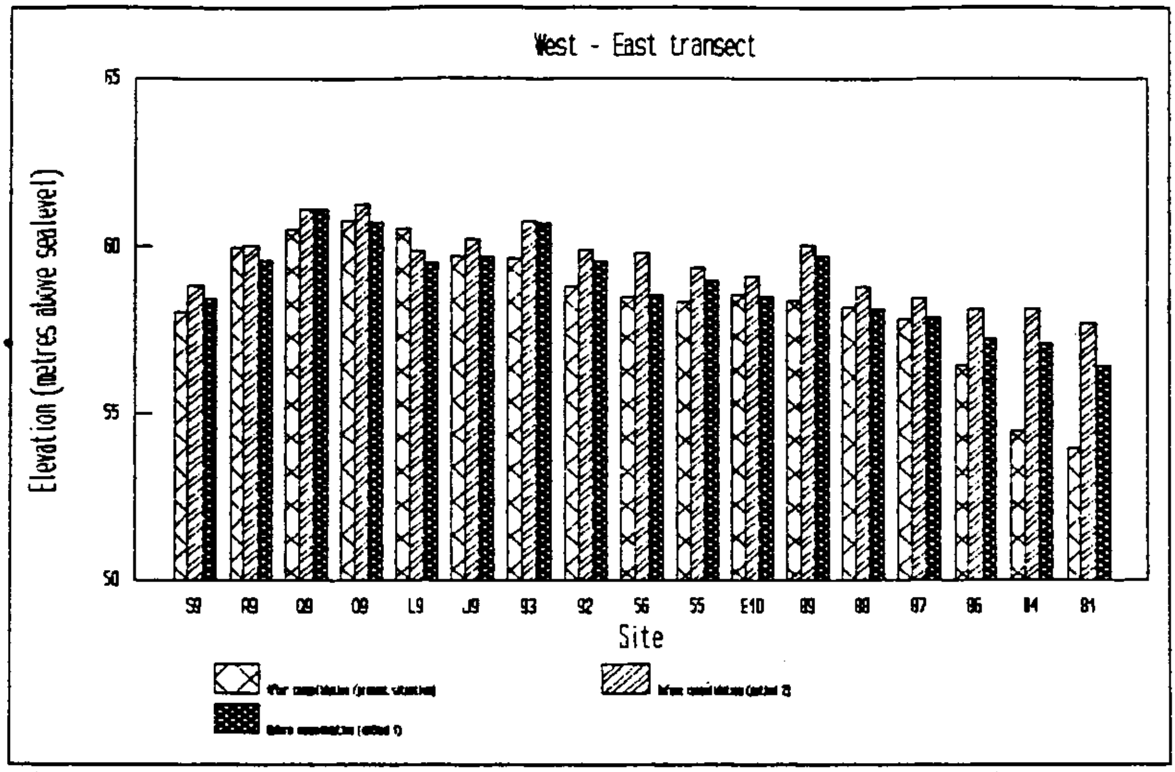


Figure 21; Subsidence along West-East transect, comparing method 1 and method 2.

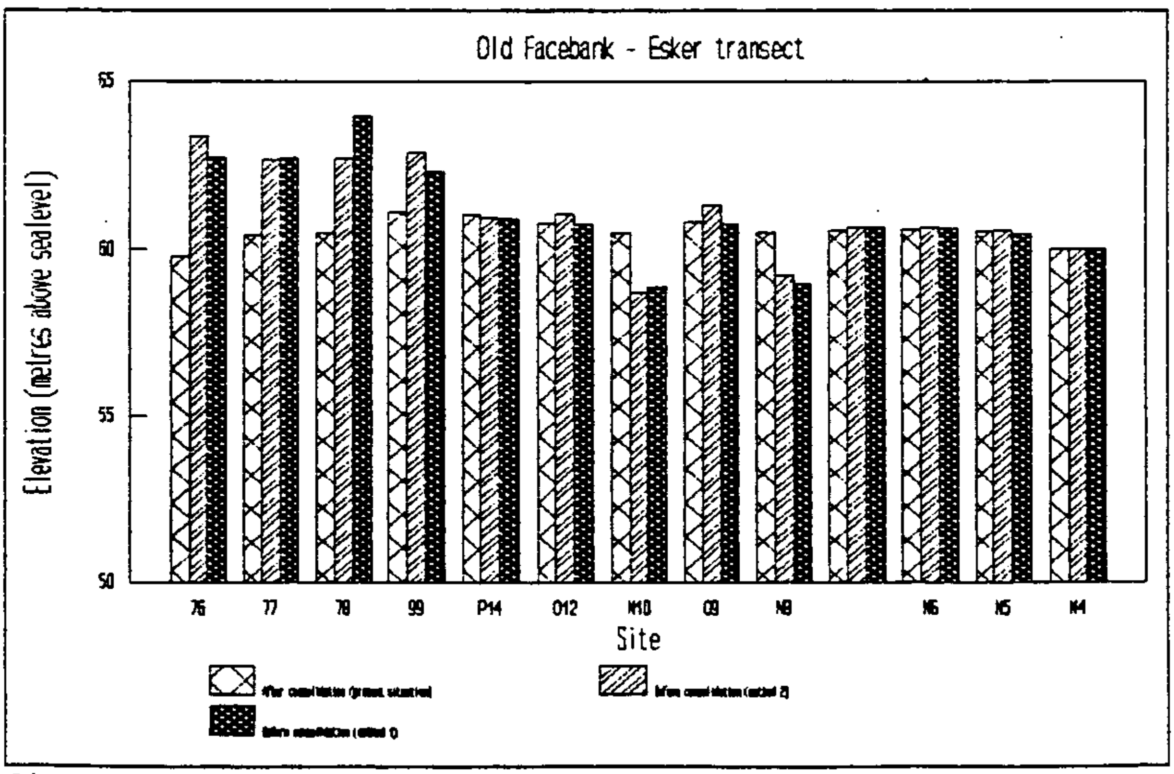


Figure 22; Subsidence along Old Facebank-Esker transect, comparing method 1 and method 2.

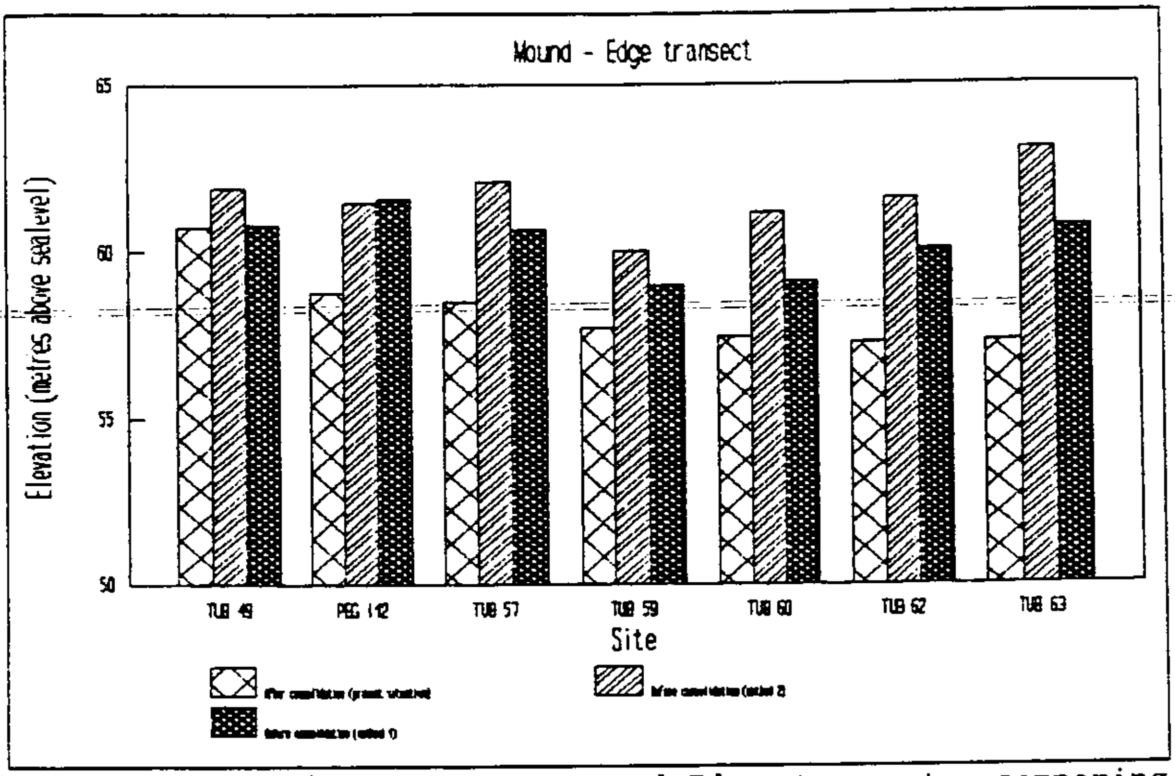


Figure 23; Subsidence along Mound-Edge transect, comparing method 1 and method 2.

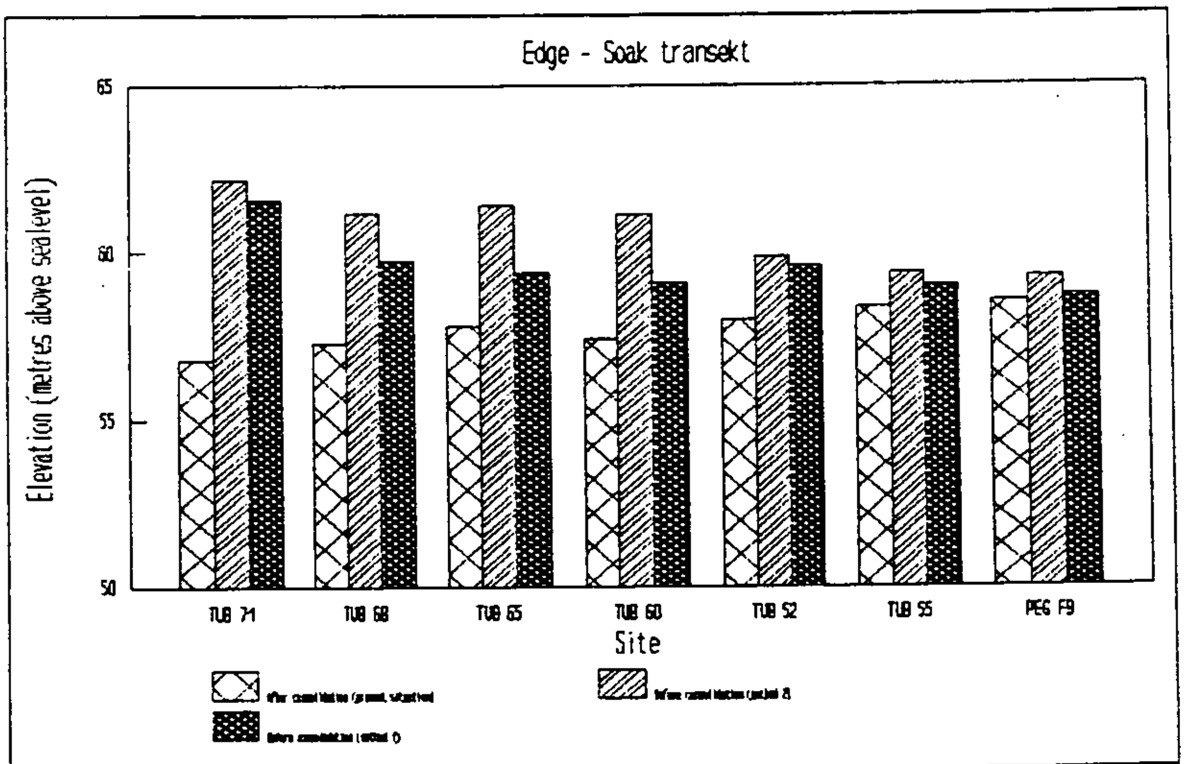


Figure 24; Subsidence along Soak transect, comparing method 1 and method 2.

APPENDIX 9: COMPARING SAMUELS' METHOD TO CALCULATE SUBSIDENCE

9.1 Road transect north

Location	Subsidence (Spieksma)	Subsidence (Samuels)	Difference
108 *	0	0	0 %
NE 1	5.77	5.33	7.6 %
NE 2	4.58	4.21	8.1 %
NE 3	4.02	3.70	8.0 %
NE 4	3.67	3.33	9.3 %
NE 5	5.34	4.73	11.4 %
NE 6	4.07	3.61	11.5 %
NW 5	1.63	1.51	7.4 %
NW 4	1.66	1.55	6.6 %
NW 3	1.92	1.81	5.7 %
NW 2	0.45	0.43	4.4 %
NW 1	2.86	2.5	12.6 %

Table 13; Difference in subsidence at the road transect north between method used by Spieksma and Samuels. Based on measurements done by Samuels.

* Used as a reference site

9.2 Road transect south

Location	Subsidence (Spieksma)	Subsidence (Samuels)	Difference
113	0.70	0.66	5.7 %
SE 1	1.86	1.76	5.4 %
SE 2	2.84	2.65	6.7 %
SE 3	5.62	5.07	9.8 %
SE 4	2.43	2.20	9.5 %
SE 5	5.20	4.49	13.6 %
SW 5	4.44	2.57 ???	42.1 %
SW 3	6.11	5.61	8.2 %
SW 1	2.49	2.34	6.0 %

Table 14; Difference in subsidence at the road transect south between method used by Spieksma and Samuels. Based on measurements done by Samuels.

APPENDIX 10: DESCRIPTION OF THE AUGERINGS

*Location: Clara west, **peg E10** (between tube 55 and 89)*
Date: 12 aug 1992
Method: Drilling with an Eijkelkamp auger
Surfacelevel (M.O.D.): 58.57
Starring: Jan & Harald

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.00-1.00	Fresh Sphagnum, Roots	7	5YR 4/5
1.00-1.50	Fresh Sphagnum, Roots	9	5YR 4/4
1.50-2.00	Fresh Sphagnum, Calluna	9	5YR 3/3
2.00-2.50	Calluna, Twigs	10	5YR 3/5
2.50-3.00	Fresh Sphagnum	9	5YR 3/3
3.00-3.50	Fresh Sphagnum, Calluna	8	5YR 4/5
3.50-4.00	Fresh Sphagnum	8	5YR 4/5
4.00-4.50	Fresh Sphagnum, Calluna	7	5YR 4/5
4.50-5.00	Sphagnum, Calluna	7	5YR 3/4
5.00-5.50	Sphagnum, Calluna	7	5YR 3/3
5.50-6.00	Wood, Reed	8	5YR 3/2
6.00-6.50	Wood, Reed	8	5YR 3/2
6.50-7.00	Wood, Reed	8	5YR 3/2
7.00-7.50	Wood, Reed	5	5YR 3/1
7.50-8.00	Wood, Reed	4	5YR 3/1
8.00-8.50	Wood, Reed	6	5YR 3/1

Peat layers:

0.00-4.50	Young Sphagnum
4.50-5.50	Old Sphagnum
5.50-8.50	Fen Peat

Location: Clara west, peg F9
Date: 30 aug 1992
Method: Drilling with an Eijkelkamp auger
Surfacelevel (M.O.D.): 58.51
Starring: Jan

Depth (m)	Vegetation type	Humification degree	Color
0.00–1.00	Fresh Sphagnum, Roots	3	5YR 4/5
1.00–1.50	Fresh Sphagnum	9	5YR 4/4
1.50–2.00	Fresh Sphagnum, Calluna	9	5YR 3/3
2.00–2.50	Fresh Sphagnum, Calluna	8	5YR 3/5
2.50–3.00	Fresh Sphagnum	8	5YR 3/2
3.00–3.50	Fresh Sphagnum, Calluna	8	5YR 4/5
3.50–4.00	Fresh Sphagnum	8	5YR 4/5
4.00–4.50	Fresh Sphagnum, Calluna	5	5YR 4/5
4.50–5.00	Bog Cotton, Sphagnum, Calluna	7	5YR 3/4
5.00–5.50	Sphagnum, Calluna	7	5YR 3/3
5.50–6.00	Wood, Reed	6	5YR 3/2
6.00–6.50	Wood, Reed	6	5YR 3/2
6.50–7.00	Wood, Reed	7	5YR 3/2
7.00–7.50	Wood, Reed	5	5YR 3/2
7.50–8.00	Reed	4	5YR 3/1
8.00–8.50	Wood, Reed	6	5YR 3/1

Peat layers:

0.00–4.50	Young Sphagnum
4.50–5.50	Old Sphagnum
5.50–8.50	Fen Peat

Location: Clara east, peg H'4
Date: 8 july 1992
Method: Drilling with an Eijkelkamp auger
Starring: Harald & Jan
Surfacelevel (M.O.D.): 60.61

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.50-1.00	Fresh Sphagnum	2	5YR 3/3
1.00-1.50	Fresh Sphagnum	2	5YR 3/4
1.50-2.00	Fresh Sphagnum	2	5YR 3/4
2.00-2.50	Fresh Sphagnum	2	5YR 3/5
2.50-3.00	Old Sphagnum	5	5YR 3/3
3.00-3.50	Fresh Sphagnum	2	5YR 3/3
3.50-4.00	Old Sphagnum	6	5YR 3/3
4.00-4.50	Sphagnum	4	5YR 3/3
4.50-5.00	Fresh Sphagnum	2	5YR 3/5
5.00-5.50	Old Sphagnum	6	5YR 3/3
5.50-6.00	Old Sphagnum	6	5YR 3/2
6.00-6.50	Betula, Fen	3	5YR 3/3
6.50-7.00	Fen	4	5YR 3/4
7.00-7.50	Fen	8	5YR 3/2
7.50-8.00	Fen	7	5YR 3/1
8.00-8.50	Wood, Fen	7	5YR 3/1
8.50-9.00	Wood, Fen	6	5YR 3/1
9.00-9.50	Wood	6	5YR 3/1

Peat layers

0.00-3.50	Young Sphagnum
3.50-6.00	Old Sphagnum
6.00-9.50	Fen Peat

Location:Clara west, ***peg I12*** *(Between tube 49 and 57)*
Date: 4 sept 1991
Method: Drilling with Eijkelkamp auger
Surfacelevel (M.O.D.): 58.75

Depth (m)	*Vegetation Type*	*Humification degree*	*Color*
0.00-0.20	*Sphagnum, Small Fibre*	*3*	*4/5 5YR*
0.20-0.30	*Bog Cotton, Heather, Sphagnum*	*3*	*2/2 5YR*
0.30-0.50	*Bog Cotton, Heather, Sphagnum*	*4*	*2/2 5YR*
0.50-0.75	*Bog Cotton, Sphagnum, Heather, Small Fibre*	*5*	*3/2 5YR*
0.75-1.00	*Bog Cotton, Sphagnum, Heather, Small Fibre, Alder*	*7*	*3/3 5YR*
1.00-1.30	*Sphagnum, Birch, Small Fibre*	*7*	*3/2 5YR*
1.30-1.50	*Bog Cotton, Sphagnum, Heather*	*6*	*2/3 5YR*
1.50-1.60	*Sphagnum, Bog Cotton, Heather*	*8*	*2/2 5YR*
1.60-2.00	*Bog Cotton, Sphagnum*	*8*	*2/1 5YR*
2.00-2.15	*Sphagnum*	*7*	*2/2 5YR*
2.15-2.50	*Sphagnum, Bog Cotton, Heather*	*5*	*3/3 5YR*
2.50-2.75	*Heather, Sphagnum, Birch*	*6*	*2/1 5YR*
2.75-2.85	*Birch*		
2.85-3.00	*Alder, Reed*	*6*	*2/2 5YR*
3.00-3.20	*Alder, Birch, Reed*	*5*	*3/1 5YR*
3.20-3.50	*Birch, Reed*	*5*	*3/2 5YR*
3.50-4.00	*Reed, Birch, Alder*	*5*	*2/3 10YR*
4.00-4.10	*Reed, Small Fibre*	*5*	*2/2 5YR*
4.10-4.20	*Birch, Alder*		
4.20-4.50	*Birch, Reed, Small Fibre*	*4*	*3/3 7.5YR*
4.50-5.00	*Birch, Reed, Small Fibre*	*5*	*2/2 10YR*
5.00-5.20	*Birch, Reed, Small Fibre*	*9*	*2/1 5YR*
5.20	*Clay with Pebbles*		*6/1 5Y*

Peat layers:

0.00-0.75	*Young Sphagnum*
0.75-2.50	*Old Sphagnum*
2.50-5.20	*Fen Peat*

Location: Clara west, peg J9
Date: 31 july 1992
Method: drilling with an Eijkelkamp auger
Starring: Harald & Jan
Surfacelevel (M.O.D.): 59.72

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.50-1.00	*Fresh Sphagnum, Roots*	*4*	*5YR 3/1*
1.00-1.50	*Fresh Sphagnum, Roots*	*2*	*5YR 4/2*
1.50-2.00	*Bog Cotton*	*3*	*5YR 4/2*
2.00-2.50	*Calluna*	*8*	*5YR 3/1*
2.50-3.00	*Calluna, Fibres*	*6*	*5YR 3/1*
3.00-3.50	*Sphagnum*	*8*	*5YR 3/4*
3.50-4.00	*Calluna, Fibres*	*7*	*5YR 3/2*
4.00-4.50	*Fresh Sphagnum*	*3*	*5YR 3/4*
4.50-5.00	*Fresh sphagnum*	*2*	*5YR 3/1*
5.00-5.50	*Bog Cotton, Calluna, Fibres*	*6*	*5YR 3/2*
5.50-6.00	*Calluna, Bog Cotton*	*8*	*5YR 3/3*
6.00-6.50	*Sphagnum*	*9*	*5YR 3/1*
6.50-7.00	*Reed*	*9*	*5YR 3/1*
7.00-7.50	*Wood, Reed*	*8*	*5YR 3/1*
7.50-8.00	*Wood, Reed*	*8*	*5YR 3/1*
8.00-8.50	*Wood, Reed*	*8*	*5YR 3/1*
8.50-9.00	*Wood, Reed*	*8*	*5YR 3/1*
9.00-9.50	*Wood, Reed*	*8*	*5YR 3/1*

Peat layers:

0.00-5.00	*Young Sphagnum*
5.00-6.50	*Old Sphagnum*
6.50-9.50	*Fen Peat*

Location: Clara west, ***peg L9***
Date: 29 July 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 60.54

Depth (m)	Vegetation type	Humification degree	Color
0.50-1.00	Fresh Sphagnum, Roots	1	5YR 4/5
1.00-1.50	Fresh Sphagnum, Roots	1	5YR 4/5
1.50-2.00	Fresh Sphagnum, Roots	4	5YR 3/2
2.00-2.50	Fresh Sphagnum, fibres	4	5YR 3/2
2.50-3.00	Fresh Sphagnum, fibres	4	5YR 3/3
3.00-3.50	Fresh Sphagnum, fibres	7	5YR 3/3
3.50-4.00	Fresh Sphagnum	2	5YR 3/4
4.00-4.50	Bog Cotton, Fresh Sphagnum	6	5YR 3/3
4.50-5.00	Bog Cotton, Fresh Sphagnum	6	5YR 3/3
5.00-5.50	Fresh Sphagnum	3	5YR 3/5
5.50-6.00	Calluna twigs, Sphagnum	6	5YR 3/2
6.00-6.50	Fresh Sphagnum	2	5YR 3/4
6.50-7.00	Bog Cotton	5	5YR 3/2
7.00-7.50	Bog Cotton	4	5YR 3/2
7.50-8.00	Old Sphagnum, Calluna twigs	8	5YR 3/2
8.00-8.50	Wood, fine fibres, Old Sphagnum	7	5YR 3/2
8.50-9.00	Wood, Reed	8	5YR 3/1
9.00-9.50	Wood, Reed	8	5YR 3/1
9.50-10.00	Wood, Reed	7	5YR 3/1
10.00-10.50	Reed, few clay	8	5YR 3/1
10.50-11.00	Clay		N4

Peat layers:

0.00-6.00	Young Sphagnum
6.00-8.00	Old Sphagnum
8.00-10.50	Fen Peat

Location: Clara west,   peg N4
Date: 22 Sept 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Arjen
Surfacelevel (M.O.D.): 60.00

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.50-1.00	Fresh Sphagnum, Calluna	1	5YR 4/5
1.00-1.50	Fresh Sphagnum, Calluna	6	5YR 3/4
1.50-2.00	Fresh Sphagnum, Calluna	6	5YR 3/4
2.00-2.50	Sphagnum, Bog Cotton	6	5YR 3/3
2.50-3.00	Fresh Sphagnum, Bog Cotton, Calluna	6	5YR 3/3
3.00-3.50	Fresh Sphagnum, Bog Cotton, Calluna	2	5YR 3/3
3.50-4.00	Bog Cotton, Sphagnum, Calluna	2	5YR 3/3
4.00-4.50	Bog Cotton, Calluna	7	5YR 3/3
4.50-5.00	Bog Cotton, Sphagnum, Calluna	6	5YR 3/2
5.00-5.50	Bog Cotton, Calluna	3	5YR 3/2
5.50-6.00	Bog Cotton, Wood	8	5YR 3/2
6.00-6.50	Wood, Reed	3	5YR 3/2
6.50-7.00	Reed, Wood	3	5YR 3/2
7.00-7.30	Wood, Reed	3	5YR 3/3
7.30-7.50	Silty Clay		N4

Peat layers:

0.00-3.50	Young Sphagnum
3.50-6.50	Old Sphagnum
6.50-7.30	Fen Peat

*Location: Clara west, **peg N5***
Date: 14 sept 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan Spieksma & Ray Flynn
Surfacelevel (M.O.D.): 60.52

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.50-1.00	*Fresh Sphagnum, Bog Cotton*	*2*	*5YR 3/4*
1.00-1.50	*Fresh Sphagnum*	*2*	*5YR 3/4*
1.50-2.00	*Fresh Sphagnum, Calluna*	*4*	*5YR 3/3*
2.00-2.50	*Fresh Sphagnum*	*7*	*5YR 3/3*
2.50-3.00	*Fresh Sphagnum*	*8*	*5YR 3/3*
3.00-3.50	*Amorphous*	*9*	*5YR 3/3*
3.50-4.00	*Sphagnum, Calluna*	*8*	*5YR 3/2*
4.00-4.50	*Fresh Sphagnum, Bog Cotton*	*8*	*5YR 3/1*
4.50-5.00	*Sphagnum, Bog Cotton, Calluna*	*8*	*5YR 3/2*
5.00-5.50	*Sphagnum*	*7*	*5YR 3/3*
5.50-6.00	*Bog Cotton, Sphagnum*	*8*	*5YR 3/2*
6.00-6.50	*Sphagnum, Calluna*	*8*	*5YR 3/2*
6.50-7.00	*Bog Cotton, Calluna*	*9*	*5YR 2/1*
7.00-7.50	*Reed, Wood*	*5*	*5YR 3/1*
7.50-8.00	*Wood, Reed*	*4*	*5YR 3/1*
8.00-8.50	*Silt*		*N5*

Peat layers:

0.00-4.50	*Young Sphagnum*
4.50-7.00	*Old Sphagnum*
7.00-8.00	*Fen Peat*

Location: Clara west, ***peg N6***
Date: 15 Sept 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Arjen
Surfacelevel (M.O.D.): 60.58

Depth (m)	Vegetation type	Humification degree	Color
0.50-1.00	Fresh Sphagnum	2	5YR 4/4
1.00-1.50	Fresh Sphagnum, Roots	2	5YR 4/4
1.50-2.00	Fresh Sphagnum	2	5YR 3/4
2.00-2.50	Fresh Sphagnum	9	5YR 3/3
2.50-3.00	Fresh Sphagnum, Calluna	9	5YR 3/3
3.00-3.50	Fresh Sphagnum	7	5YR 3/3
3.50-4.00	Fresh Sphagnum	9	5YR 3/3
4.00-4.50	Fresh Sphagnum	7	5YR 3/3
4.50-5.00	Fresh Sphagnum, Calluna	6	5YR 3/3
5.00-5.50	Fresh Sphagnum, Calluna	7	5YR 3/3
5.50-6.00	Sphagnum, Bog Cotton	9	5YR 3/3
6.00-6.50	Bog Cotton	8	7.5YR 3/4
6.50-7.00	Sphagnum, Bog Cotton	9	5YR 3/3
7.00-7.50	Bog Cotton	8	5YR 3/3
7.50-8.00	Reed, Wood	9	5YR 3/2
8.00-8.50	Wood, Reed	9	5YR 3/1
8.50-9.30	Reed, Wood	6	5YR 3/1
9.30-9.50	Silty Clay		N4

Peat layers:

0.00-6.00	Young Sphagnum
6.00-7.50	Old Sphagnum
7.50-9.30	Fen Peat

Location: Clara west, ***peg N8***
Date: 15 Sept 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Arjen
Surfacelevel (M.O.D.): 60.49

Depth (m)	Vegetation type	Humification degree	Color
0.50-1.00	Fresh Sphagnum, Roots	7	7.5YR 4/4
1.00-1.50	Fresh Sphagnum	3	7.5YR 4/4
1.50-2.00	Fresh Sphagnum, Calluna, Bog Cotton	2	5YR 3/3
2.00-2.50	Fresh Sphagnum, Bog Cotton	8	5YR 3/2
2.50-3.00	Fresh Sphagnum	6	5YR 3/3
3.00-3.50	Fresh Sphagnum	6	5YR 3/3
3.50-4.00	Fresh Sphagnum, Bog Cotton	9	5YR 3/3
4.00-4.50	Fresh Sphagnum, Calluna, Bog Cotton	6	5YR 3/2
4.50-5.00	Fresh Sphagnum	2	5YR 3/2
5.00-5.50	Fresh Sphagnum, Calluna	3	5YR 3/2
5.50-6.00	Bog Cotton	6	5YR 3/4
6.00-6.50	Bog Cotton	7	5YR 3/2
6.50-7.00	Bog Cotton, Sphagnum, Calluna	9	5YR 3/2
7.00-7.50	Sphagnum, Calluna, Bog Cotton	8	5YR 3/3
7.50-8.00	Wood, Sphagnum, Reed	7	5YR 3/1
8.00-8.50	Sphagnum, Reed, Wood	7	5YR 3/1
8.50-9.10	Wood, Fibres, Reed	3	5YR 3/1
9.10-9.50	Silt		N5

Peat layers

0.00-5.50	Young Sphagnum
5.50-7.00	Old Sphagnum
7.00-9.10	Fen Peat

Location: Clara west, ***peg N10*** *(tube 96)*
Date: 24 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 60.49

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.50–1.00	Fresh Sphagnum	2	5YR 3/3
1.00–1.50	Fresh Sphagnum	2	5YR 3/4
1.50–2.00	Calluna, Bog Cotton	8	5YR 3/3
2.00–2.50	Fresh Sphagnum, Wood, Bog Cotton	7	5YR 3/3
2.50–3.00	Fresh Sphagnum	2	5YR 3/3
3.00–3.50	Fresh Sphagnum, Calluna	5	5YR 3/3
3.50–4.00	amorphous	9	5YR 3/4
4.00–4.50	Fresh Sphagnum, Calluna	6	5YR 3/4
4.50–5.00	Fresh Sphagnum, Calluna	6	5YR 3/4
5.00–5.50	Fresh Sphagnum, Calluna	7	5YR 3/5
5.50–6.00	Fresh Sphagnum, Calluna	9	5YR 3/3
6.00–6.50	Bog Cotton	8	5YR 3/3
6.50–7.00	Calluna	9	5YR 3/3
7.00–7.50	Calluna, Bog Cotton	9	5YR 3/3
7.50–8.00	Wood, Reed	7	5YR 3/3
8.00–8.50	Reed, Wood	7	5YR 3/3
8.50–9.00	Wood, Reed	8	5YR 3/4
9.00–9.50	Wood, Sphagnum	6	5YR 3/3
9.50–9.70	Wood, Fibres	6	5YR 3/3

Peat layers:

0.00–6.00	Young Sphagnum
6.00–7.50	Old Sphagnum
7.50–9.70	Fen Peat

Location: Clara west, peg O9
Date: 27 July 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 60.78

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.00-1.00	Fresh Spagnum	1	5YR 3/4
1.00-1.50	Fine Fibres	2	5YR 3/2
1.50-2.00	Fresh Sphagnum	2	5YR 3/2
2.00-2.50	Fresh Sphagnum	2	5YR 3/3
2.50-3.00	Fresh Sphagnum	2	5YR 3/4
3.00-3.50	Fresh Sphagnum	2	5YR 3/3
3.50-4.00	Calluna, Sphagnum	8	5YR 3/3
4.00-4.50	Bog Cotton	8	5YR 3/3
4.50-5.00	Sphagnum	9	5YR 2/4
5.00-5.50	Old Sphagnum	9	5YR 2/3
5.50-6.00	Sphagnum, Fine Fibres	6	5YR 3/3
6.00-6.50	Old Sphagnum	8	5YR 3/4
6.50-7.00	Old Sphagnum	8	5YR 3/2
7.00-7.50	Reed	3	5YR 3/2
7.50-8.00	Reed	8	5YR 3/2
8.00-8.50	Wood	7	5YR 2/3
8.50-9.00	Wood, Reed	8	5YR 2/2
9.00-9.50	Wood	4	5YR 3/3
9.50-9.80	Wood	4	5YR 3/2
9.80-10.00	Clay		N4

Peat layers:

0.00-5.50	Young Sphagnum
5.50-7.00	Old Sphagnum
7.00-9.80	Fen Peat

Location: Clara west, peg O12 (tube 97)
Date: 25 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 60.77

Depth (m)	Vegetation type	Humification degree	Color
0.50–1.00	Fresh Sphagnum, Calluna	6	5YR 3/3
1.00–1.50	Fresh Sphagnum	2	5YR 3/3
1.50–2.00	Fresh Sphagnum, Calluna	6	5YR 3/3
2.00–2.50	Fresh Sphagnum, Calluna	3	5YR 3/3
2.50–3.00	Fresh Sphagnum, Calluna	8	5YR 3/2
3.00–3.50	Fresh Sphagnum, Calluna	6	5YR 3/2
3.50–4.00	Fresh Sphagnum, Calluna	4	5YR 3/2
4.00–4.50	Fresh Sphagnum, Calluna	8	5YR 3/3
4.50–5.00	Bog Cotton	9	7.5YR 3/4
5.00–5.50	Bog Cotton	9	7.5YR 3/4
5.50–6.00	Calluna, Bog Cotton	6	5YR 3/2
6.00–6.50	Calluna, Bog Cotton	6	5YR 3/3
6.50–7.00	Calluna, Sphagnum, Reed	6	5YR 3/2
7.00–7.50	Bog Cotton	7	5YR 3/2
7.50–8.00	Wood	9	5YR 3/1
8.00–8.50	Reed, Wood	8	5YR 3/1

Peat layers:

0.00–4.50	Young Sphagnum
4.50–7.50	Old Sphagnum
7.50–8.50	Fen Peat

Location: Clara west, peg P14 (tube 98)
Date: 25 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 61.02

Depth (m)	Vegetation type	Humification degree	Color
0.50-1.00	Fresh Sphagnum	2	5YR 3/4
1.00-1.50	Reed, Fresh Sphagnum	5	5YR 3/3
1.50-2.00	Fresh Sphagnum	2	5YR 3/4
2.00-2.50	Fresh Sphagnum, Calluna	7	5YR 3/3
2.50-3.00	Fresh Sphagnum, Calluna	7	5YR 3/3
3.00-3.50	Fresh Sphagnum, Calluna	5	5YR 3/2
3.50-4.00	Fresh Sphagnum	4	5YR 3/3
4.00-4.50	Sphagnum, Bog Cotton	9	7.5YR 3/3
4.50-5.00	Bog Cotton	9	7.5YR 3/3
5.00-5.50	Bog Cotton	9	7.5YR 3/2
5.50-6.00	Bog Cotton	7	7.5YR 3/2
6.00-6.50	Sphagnum, Bog Cotton	6	5YR 3/3
6.50-7.00	Bog Cotton	9	5YR 3/3
7.00-7.50	Reed, Wood	9	5YR 3/2
7.50-8.00	Reed, Wood	7	5YR 3/3
8.00-8.50	Reed, Wood	9	5YR 3/2
8.50-9.00	Reed, Wood	8	5YR 3/2
9.00-9.50	Wood, Sphagnum	5	5YR 3/1

Peat layers:

0.00-4.00	Young Sphagnum
4.00-7.00	Old Sphagnum
7.00-9.50	Fen peat

Location: Clara west, ***peg Q9***
Date: 27 July 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 60.52

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.00–1.00	Fresh Sphagnum	1	5YR 3/4
1.00–2.00	Fresh Sphagnum, Fine fibres	5	5YR 3/4
2.00–2.50	Fresh Sphagnum	2	5YR 3/4
2.50–3.00	Sphagnum	4	5YR 3/4
3.00–3.50	Sphagnum	6	5YR 3/3
3.50–4.00	Sphagnum	6	5YR 3/4
4.00–4.50	Old Sphagnum	7	5YR 3/3
4.50–5.00	Old Sphagnum	8	5YR 3/2
5.00–5.50	Old Sphagnum	7	5YR 2/3
5.50–6.00	Old Sphagnum	8	5YR 2/3
6.00–6.50	Wood, Reed	9	5YR 3/4
6.50–7.00	Wood	6	5YR 3/2

Peat layers:

0.00–4.00	Young Sphagnum
4.00–6.00	Old Sphagnum
6.00–7.00	Fen Peat

Location: Clara west, ***peg R9***
Date: 22 July 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 59.98

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.00-1.00	*Fresh Sphagnum*	*2*	*2.5Y R3/3*
1.00-1.50	*Fresh Sphagnum*	*2*	*5YR 3/3*
1.50-2.00	*Fresh Sphagnum*	*5*	*5YR 3/3*
2.00-2.50	*Fresh Sphagnum*	*2*	*5YR 3/5*
2.50-3.00	*Old Sphagnum*	*8*	*5YR 3/3*
3.00-3.50	*Old Sphagnum*	*8*	*5YR 3/3*
3.50-4.00	*Old Sphagnum*	*8*	*5YR 3/2*
4.00-4.50	*Old Sphagnum*	*9*	*5YR 3/3*
4.50-5.00	*Old Sphagnum*	*9*	*5YR 3/3*
5.50-6.00	*Old Sphagnum*	*5*	*5YR 3/3*
6.00-6.50	*Old Sphagnum*	*9*	*5YR 3/1*
6.50-7.00	*Wood, Reed*	*6*	*5YR 3/2*
7.00-7.50	*Wood, Reed*	*7*	*5YR 3/2*
7.50-7.60	*Wood*	*7*	*5YR 3/2*

Peat layers:

0.00-2.50	*Young Sphagnum*
2.50-6.50	*Old Sphagnum*
6.50-7.60	*Fen Peat*

Location: Clara west, peg S9
Date: 22 July 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 58.02

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.00–1.00	*Old Sphagnum, Fine fibres*	*3*	*5YR 2/4*
1.00–1.20	*Old Sphagnum, Fine fibres*	*3*	*5YR 2/3*

Peat layers:

0.00–1.20	*Old Sphagnum*

Location: Clara west, tube 49
Date: 24 aug 1991
Method: Drilling with Eijkelkamp auger
Surfacelevel (M.O.D.): 60.71

Depth (m)	Vegetation type	Humification degree	Color
0.00–0.05	Heather	-	
0.05–0.15	Heather, Bog Cotton	-	2/3 2.5YR
0.15–0.25	Heather, Bog Cotton	-	2/3 2.5YR
0.25–0.50	Reed, Alder, Small Fibre	3	2/1 5YR
0.50–0.75	Reed, Small Fibre	3	2/2 5YR
0.75–1.00	Reed, Alder, Small Fibre	3	2/2 7.5YR
1.00–1.20	Reed, Small Fibre	5	3/3 5YR
1.20–1.50	Reed, Small Fibre	5	2/3 5YR
1.50–1.75	Reed, Small Fibre	8	2/2 5YR
1.75–1.80	Reed	7	2/2 5YR
1.80–1.85	Reed, Small Fibre	5	3/4 7.5YR
1.85–2.00	Reed, Small Fibre	4	3/3 5YR
2.00–2.10	Sphagnum	7	
2.10–2.30	Reed	7	
2.30–2.50	Reed	7	
2.50–2.70	Reed, Birch	8	2/2 5YR
2.70–2.85	Alder, Reed	-	
2.85	Clay, Pebble stones, Tree roots		4/2 2.5Y

Peat layers:

0.00–0.25	Old Sphagnum
0.25–2.85	Fen peat

Location: Clara west, tube 50
Date: 3 sept 1991
Method: Drilling with Eijkelkamp auger
Surfacelevel (M.O.D.): 58.53

Depth (m)	Vegetation Type	Humification degree	Color
0.00–0.50	Sphagnum, Bog Cotton, Small Fibre	7	2/2 5YR
0.50–1.00	Bog Cotton, Heather, Small Fibre	7	2/3 5YR
1.00–1.30	Bog Cotton, Sphagnum, Heather	7	2/4 5YR
1.30–1.40	Bog Cotton, Heather, Sphagnum	6	2/3 5YR
1.40–1.50	Heather, Sphagnum, Bog Cotton	6	2/4 5YR
1.50–2.00	Sphagnum, Bog Cotton, Heather, Small Fibre	7	2/3 5YR
2.00–2.65	Sphagnum, Bog Cotton, Small Fibre	3	3/4 5YR
2.65–2.75	Sphagnum, Bog Cotton	7	2/2 5YR
2.75–2.90	Sphagnum, Bog Cotton	3	2/3 5YR
2.90–2.95	Sphagnum, Bog Cotton	7	2/4 5YR
2.95–3.00	Sphagnum, Bog Cotton	8	2/4 5YR
3.00–3.25	Sphagnum, Bog Cotton	8	2/2 5YR
3.25–3.50	Sphagnum, Bog Cotton	7	3/4 5YR
3.50–3.70	Bog Cotton	9	3/3 7.5YR
3.70–4.00	Sphagnum, Heather, Bog Cotton	3	3/6 5YR
4.00–4.40	Bog Cotton, Sphagnum, Heather	5	2/2 5YR
4.40–4.80	Bog Cotton, Sphagnum, Heather	5	3/3 5YR
4.80–5.00	Bog Cotton, Sphagnum, Heather	4	2/1 5YR
5.00–5.20	Bog Cotton, Heather	7	2/2 5YR
5.20–5.40	Reed, Alder, Heather	7	2/1 7.5YR
5.40–5.50	Reed	5	3/4 7.5YR
5.50–5.85	Reed, Alder	5	2/1 5YR
5.85–6.00	Birch, Reed	5	2/1 5YR
6.00–6.50	Alder, Reed, Small Fibre	7	2/1 5YR
6.50–7.00	Reed, Birch, Small Fibre	8	2/2 5YR
7.00–7.40	Reed, Birch, Small Fibre	5	2/1 5YR
7.40	Clay (laminated)		N5

Peat layers:

0.00–2.90	Young Sphagnum
2.90–5.20	Old Sphagnum
5.20–7.40	Fen Peat

Location: Clara west, Soak, tube 52
Date: 22 Sept 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Arjen
Surfacelevel (M.O.D.): 57.95

Depth (m)	Vegetation type	Humification degree	Color
0.50-1.00	Fresh Sphagnum, Roots	6	5YR 3/4
1.00-1.50	Fresh Sphagnum, Bog Cotton	3	5YR 3/3
1.50-2.00	Fresh Sphagnum	7	5YR 3/3
2.00-2.50	Fresh Sphagnum	7	5YR 3/3
2.50-3.00	Fresh Sphagnum, Bog Cotton, Calluna	3	5YR 3/3
3.00-3.50	Fresh Sphagnum, Calluna	8	5YR 3/3
3.50-4.00	Fresh Sphagnum	3	5YR 3/4
4.00-4.50	Bog Cotton	6	5YR 3/3
4.50-5.00	Bog Cotton	7	5YR 3/3
5.00-5.50	Bog Cotton, Calluna	7	5YR 3/2
5.50-6.00	Bog Cotton, Reed	8	5YR 3/2
6.00-6.50	Wood, Reed	6	5YR 3/3
6.50-7.00	Reed, Wood	6	5YR 3/1
7.00-7.50	Reed, Wood	3	5YR 3/1
7.50-8.00	Reed	6	7.5YR 3/2
8.00-8.10	Reed	6	7.5YR 3/2
8.10-8.50			N4

Peat layers:

0.00-4.00	Young Sphagnum
4.00-6.00	Old Sphagnum
6.00-8.10	Fen Peat

Location: Clara west, Soak, tube 55
Date: 12 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 58.35

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.00-1.00	*Fresh Sphagnum, Roots*	*5*	*5YR 4/5*
1.00-1.50	*Fresh Sphagnum*	*7*	*5YR 3/3*
1.50-2.00	*Fresh Sphagnum*	*1*	*5YR 3/3*
2.00-2.50	*Fresh Sphagnum*	*1*	*5YR 3/3*
2.50-3.00	*Fresh Sphagnum*	*1*	*5YR 3/3*
3.00-3.50	*Fresh Sphagnum*	*1*	*5YR 3/4*
3.50-4.00	*Fresh Sphagnum*	*9*	*5YR 3/3*
4.00-4.50	*Fresh Sphagnum*	*7*	*5YR 3/3*
4.50-5.00	*Fresh Sphagnum, Calluna*	*7*	*5YR 3/3*
5.00-5.50	*Bog Cotton, Fresh Sphagnum, Calluna*	*7*	*5YR 3/3*
5.50-6.00	*Bog Cotton, Fresh Sphagnum, Calluna*	*8*	*5YR 3/2*
6.00-6.50	*Wood, Reed*	*7*	*5YR 3/2*
6.50-7.00	*Wood, Reed*	*9*	*5YR 3/2*
7.00-7.50	*Wood, Sphagnum, Reed*	*6*	*5YR 3/2*
7.50-8.00	*Wood, Sphagnum*	*6*	*5YR 3/1*
8.00-8.50	*Reed, Sphagnum*	*5*	*5YR 3/2*

Peat layers:

0.00-5.00	*Young Sphagnum*
5.00-6.00	*Old Sphagnum*
6.00-8.50	*Fen Peat*

Location: Clara west, Soak, tube 56
Date: 4 Sept 1991
Method: Drilling with an Eijkelkamp auger
Surfacelevel (M.O.D.): 58.49

Depth (m)	Vegetation type	Humification degree	Color
0.00-1.00	Sphagnum, Roots	-	
1.00-1.50	Bog Cotton, Small Fibre, Heather, Sphagnum	9	2/2 5YR
1.50-1.75	Sphagnum, Bog Cotton, Small Fibre	4	2/2 5YR
1.75-2.00	Sphagnum, Bog Cotton, Small Fibre	3	2/3 5YR
2.00-2.25	Sphagnum, Bog Cotton, Small Fibre	7	2/2 5YR
2.25-2.50	Sphagnum, Bog Cotton, Small Fibre, Heather	6	2/3 5YR
2.50-3.00	Sphagnum, Bog Cotton, Heather	2	2/4 5YR
3.00-3.50	Sphagnum	2	3/3 2.5YR
3.50-4.10	Sphagnum, Heather	2	2/4 2.5YR
4.10-4.30	Bog Cotton, Small Fibre	8	3/4 5YR
4.30-4.45	Sphagnum, Bog Cotton, Heather	2	3/6 5YR
4.45-4.50	Bog Cotton, Small Fibre, Sphagnum	9	2/4 5YR
4.50-4.70	Sphagnum	2	3/3 2.5YR
4.70-5.00	Bog Cotton,Heather	8	3/4 7.5YR
5.00-5.25	Sphagnum, Bog Cotton	9	3/4 7.5YR
5.25-5.50	Sphagnum	4	3/3 5YR
5.50-6.00	Bog Cotton, Sphagnum	9	3/4 5YR
6.00-6.15	Reed, Alder	5	2/3 7.5YR
6.15-6.30	Reed, Small Fibre	5	2/3 7.5YR
6.30-6.50	Birch, Reed, Small Fibre	7	3/4 7.5YR
6.50-6.90	Birch, Alder, Reed	5	3/1 7.5YR
6.90-7.00	Birch, Alder, Reed	7	2/2 7.5YR
7.00-7.25	Alder, Reed, Birch	7	2/2 7.5YR
7.25-7.50	Reed, Alder	5	2/3 7.5YR
7.50-8.00	Reed, Small Fibre, Birch, Alder	6	2/2 7.5YR
8.00-8.25	Reed	9	2/2 10YR
8.25-8.50	Reed	5	2/2 10YR
8.50-8.65	Reed	5	2/2 5YR
8.65-8.75	Clay with Reed		5/2 5Y
8.75	Clay (stiff)		4/1 10Y

Peat layers:

0.00-4.10	Young Sphagnum
4.10-6.00	Old Sphagnum
6.00-8.65	Fen Peat

Location: Clara west, tube 57
Date: 26 Aug 1991
Method: Drilling with an Eijkelkamp auger
Surfacelevel (M.O.D.): 58.50

Depth (m)	Vegetation type	Humification degree	Color
0.00–0.25	Sphagnum, Heather	5	2/3 5YR
0.25–0.35	Sphagnum, Bog Cotton	3	4/6 7.5YR
0.35–0.50	Sphagnum, Heather, Bog Cotton	3	3/4 5YR
0.50–0.75	Sphagnum, Heather, Bog Cotton	5	3/3 5YR
0.75–1.00	Sphagnum, Bog Cotton, Small Fibre	7	2/3 5YR
1.00–1.10	Sphagnum, Bog Cotton, Small Fibre	7	2/3 5YR
1.10–1.20	Sphagnum, Small Fibre	3	3/3 5YR
1.20–1.40	Sphagnum, Heather, Bog Cotton, Small Fibre	7	2/3 5YR
1.40–1.50	Sphagnum, Heather, Small Fibre	8	3/3 2.5YR
1.50–1.75	Small Fibre, Sphagnum, Heather, Bog Cotton	8	2/3 5YR
1.75–2.00	Sphagnum, Heather, Small Fibre	8/9	3/3 5YR
2.00–2.10	Bog Cotton	9	2/2 5YR
2.10–2.40	Bog Cotton, Heather, Sphagnum	4	3/3 7.5YR
2.40–2.60	Sphagnum, Bog Cotton, Heather	5	2/4 5YR
2.60–2.80	Sphagnum, Bog Cotton	3	3/6 5YR
2.80–3.00	Bog Cotton	4	3/3 5YR
3.00–3.35	Sphagnum, Heather	5	3/2 7.5YR
3.35–3.50	Bog Cotton, Heather	5	3/2 5YR
3.50–3.80	Sphagnum, Bog Cotton, Heather	4	3/2 5YR
3.80–4.00	Heather, Birch	4	2/1 5YR
4.00–4.50	Heather, Birch	5	3/2 5YR
4.50–4.90	Alder, Reed, Heather	6	3/2 5YR
4.90–5.00	Reed, Birch, Heather	5	2/1 5YR
5.00–5.25	Reed	6	2/1 5YR
5.25–5.50	Reed, Birch	7	2/2 5YR
5.50–5.60	Reed, Birch	8/9	2/2 5YR
5.60–5.65	Birch, Alder		
5.65–6.00	Reed, Birch	7	3/2 7.5YR
6.00–6.50	Reed, Birch	6	2/1 5YR
6.50–6.90	Reed, Birch	5	2/2 5YR
6.90–7.00	Birch	5	2/2 5YR
7.00–7.30	Reed, Birch	7	2/1 5YR
7.30 Clay			N 5/0

Peat layers:

0.00–2.00	Young Sphagnum
2.00–3.80	Old Sphagnum
3.80–7.30	Fen Peat

Location: Clara west, tube 59
Date: 17 June 1991
Method: Drilling with an Eijkelkamp auger
Surfacelevel (M.O.D.): 57.69

Depth (m)	Vegetation type	Humification degree	Color
0.00–0.15		3	3/4 10YR
0.15–0.35		7	2/3 7.5YR
0.35–0.60		5	2/3 5YR
0.60–0.85		6	2/3 2.5YR
0.85–1.10		7	2/2 2.5YR
1.10–1.70	"Heather peat"	6	2/4 5YR
1.70–1.80		8	3/4 7.5YR
1.80–2.00		6	2/2 2.5YR
2.00–2.20		6	
2.20–2.35		8	2/3 5YR
2.35–2.50		7	2/3 5YR
2.50–3.00		8	2/3 2.5YR
3.00–3.50	Sphagnum	5	3/3 5YR
3.50–3.65	Sphagnum	7	2/3 5YR
3.65–3.80	Wood	4	3/2 5YR
3.80–3.90	Sphagnum	7	2/3 5YR
3.90–4.00	Sphagnum	6	2/2 2.5YR
4.00–4.25	Sphagnum	5	2/3 2.5YR
4.25–4.50	Sphagnum, Heather	6	2/1 2.5Y
4.50–4.75	Sphagnum, Heather	7	2/1 5YR
4.75–5.00	Sphagnum, Heather	6	3/1 5YR
5.00–5.50	Birch, Heather	7	2/2 7.5YR
5.50–5.90		7	2/2 7.5YR
5.90–6.00	Alder, Birch	8	2/2 7.5YR
6.00–6.50	Alder, Birch, Small Fibre	7	2/1 5YR
6.50–7.00	Alder, Birch	7	2/1 5YR
7.00–7.65			
7.65	Clay with pebbles		

Peat layers:

0.00-5.00	Young / Old Sphagnum
5.00-7.65	Fen Peat

Location: Clara west, ***tube 60***
Date: 4 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Arjen
Surfacelevel (M.O.D.): 57.41

Depth (m)	Vegetation type	Humification degree	Color
0.50-1.00	Fresh Sphagnum, Roots	1	5YR 4/5
1.00-1.50	Calluna, Roots	7	5YR 3/4
1.50-2.00	Fresh Sphagnum, Fibres	3	5YR 3/4
2.00-2.50	Fresh Sphagnum	5	5YR 3/4
2.50-3.00	Bog Cotton	8	5YR 3/1
3.00-3.50	Sphagnum, Wood	3	5YR 3/2
3.50-4.00	Sphagnum, Wood	3	5YR 3/2
4.00-4.50	Sphagnum	5	5YR 3/2
4.50-5.00	Sphagnum, Wood	5	5YR 3/2
5.00-5.50	Wood	6	5YR 3/2
5.50-6.00	Twigs, Wood, Fibres	6	5YR 3/1
6.00-6.50	Wood, Reed, Fibres	6	5YR 3/1
6.50-7.00	Reed, Fibres	6	5YR 3/2
7.00-7.50		6	5YR 3/2

Peat layers

0.00-2.00	Young Sphagnum
2.00-3.00	Old Sphagnum
3.00-7.50	Fen Peat

Location: Clara west, ***tube 62***
Date: 11 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 57.23

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.00-1.00	*Fresh Sphagnum, Roots*	*2*	*5YR 3/3*
1.00-1.50	*Fresh Sphagnum, Fibres, Twigs*	*2*	*5YR 3/3*
1.50-2.00	*Twigs, Roots*	*7*	*5YR 3/2*
2.00-2.50	*Calluna, Fibres*	*7*	*5YR 3/3*
2.50-3.00	*Fresh Sphagnum, Bog Cotton*	*6*	*5YR 3/4*
3.00-3.50	*Calluna, Fibres*	*5*	*5YR 3/2*
3.50-4.00	*Wood, Calluna, Fibres*	*6*	*5YR 3/2*
4.00-4.50	*Wood, Twigs*	*4*	*5YR 3/1*
4.50-5.00	*Fibres, Reed*	*4*	*5YR 3/1*
5.00-5.50	*Wood, Reed*	*5*	*5YR 3/3*
5.50-6.00	*Reed, Wood*	*7*	*5YR 3/2*
6.00-6:50	*Reed, Old Sphagnum*	*6*	*5YR 3/2*
6.50-6.80	*Reed, Old Sphagnum*	*5*	*5YR 3/1*
6.80			*N4*

Peat layers:

0.00-2.50	*Young Sphagnum*
2.50-3.50	*Old Sphagnum*
3.50-6.80	*Fen Peat*

Location: Clara west,   tube 63
Date: 11 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 57.25

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.00–1.50	*Fresh Sphagnum, Wood, Reed*	*6*	*5YR 3/4*
1.50–2.00	*Fresh Sphagnum, Wood, Reed*	*7*	*5YR 3/3*
2.00–2.50	*Reed, Wood, Twigs*	*8*	*5YR 3/2*
2.50–3.00	*Reed*	*8*	*5YR 3/3*
3.00–3.50	*Reed, Wood, Sphagnum*	*8*	*5YR 3/2*
3.50–4.00	*Sphagnum, Twigs, Wood*	*8*	*5YR 3/2*
4.00–4.50	*Reed, Wood*	*5*	*5YR 3/3*
4.50–5.00	*Reed, Wood*	*9*	*5YR 3/3*
5.00–5.50	*Reed, Wood*	*7*	*5YR 3/2*
5.50–6.00	*Reed, Wood*	*8*	*5YR 3/2*
6.00–6.50	*Reed, Wood*	*7*	*5YR 3/2*

Peat layers:

0.00–2.00	*Young Sphagnum*
2.00–6.50	*Fen Peat*

Location: Clara west, tube 71
Date: 4 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 56.77

Depth (m)	Vegetation type	Humification degree	Color
0.50–1.00	Roots, Twigs	7	5YR 3/3
1.00–1.50	Roots	5	5YR 3/3
1.50–2.00	Fresh Sphagnum, Twigs	5	5YR 3/2
2.00–2.50	Fresh Sphagnum	1	5YR 3/4
2.50–3.00	Sphagnum, Reed	2	5YR 4/5
3.00–3.50	Fresh Sphagnum, Reed	3	5YR 3/2
3.50–4.00	Sphagnum, Reed, Wood, Fibres	5	5YR 3/2
4.00–4.50	Reed	5	5YR 3/1
4.50–5.00	Reed, Wood	4	5YR 3/1

Peat layers:

0.00–3.00	Young Sphagnum
3.00–5.00	Fen Peat

Location: Clara west, tube 76
Date: 8 Sept 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Arjen
Surfacelevel (M.O.D.): 59.79

Depth (m)	Vegetation type	Humification degree	Color
0.50-1.00	Fresh Sphagnum	2	5YR 3/2
1.00-1.50	Fresh Sphagnum, Calluna	2	5YR 3/2
1.50-2.00	Fresh Sphagnum, Calluna	2	5YR 3/4
2.00-2.50	Fresh Sphagnum, Bog Cotton, Calluna	2	5YR 3/3
2.50-3.00	Sphagnum, Calluna, Bog Cotton	2	5YR 3/2
3.00-3.50	Reed	5	5YR 3/2
3.50-4.00	Wood, Reed	6	5YR 3/4

Peat layers:

0.00-2.50	Young Sphagnum
2.50-3.00	Old Sphagnum
3.00-4.00	Fen Peat

Location: Clara west, tube 78
Date: 8 Sept 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Arjen
Surfacelevel (M.O.D.): 60.49

Depth (m)	Vegetation type	Humification degree	Color
0.50-1.00	Fresh Sphagnum, Fibres, Bog Cotton	2	5YR 4/5
1.00-1.50	Fresh Sphagnum, Fibres, Bog Cotton	6	5YR 2/4
1.50-2.00	Fresh Sphagnum, Bog Cotton	3	5YR 3/3
2.00-2.50	Fresh Sphagnum, Calluna	5	5YR 3/3
2.50-3.00	Fresh Sphagnum, Calluna	5	5YR 3/4
3.00-3.50	Sphagnum, Calluna, Bog Cotton	8	5YR 3/2
3.50-4.00	Bog Cotton, Sphagnum, Calluna	7	5YR 2/2
4.00-4.50	Bog Cotton, Sphagnum, Calluna	4	5YR 2/4
4.50-5.00	Reed, Wood	4	5YR 3/3
5.00-5.50	Wood, Reed	5	5YR 3/3

Peat layers:

0.00-3.50	Young Sphagnum
3.50-4.50	Old Sphagnum
4.50-5.50	Fen Peat

Location: Clara west, tube 81
Date: 20 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 53.92

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.50–1.00	*Sphagnum, Twigs*	*2*	*5YR 3/1*
1.00–1.50	*Sphagnum, Calluna, Reed*	*2*	*5YR 3/3*
1.50–2.00	*Wood, Reed*	*6*	*5YR 3/2*
2.00–2.50	*Wood, Reed*	*6*	*5YR 3/1*
2.50–3.00	*Wood, Reed*	*5*	*5YR 3/1*
3.00–3.50	*Wood, Reed*	*5*	*5YR 3/1*
3.50–4.00	*Wood, Reed*	*5*	*5YR 3/1*

Peat layers:

0.00–1.50	*Old Sphagnum*
1.50–4.00	*Fen Peat*

Location: Clara west, tube 84
Date: 18 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 54.45

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.00-0.75	Calluna	5	5YR 3/1
0.75-1.00	Fresh Sphagnum	5	5YR 3/2
1.00-1.50	Fresh Sphagnum, Bog Cotton	5	5YR 3/4
1.50-2.00	Bog Cotton, Calluna	5	5YR 3/3
2.00-2.50	Bog Cotton, Calluna	6	5YR 3/3
2.50-3.00	Fibres, Wood	7	5YR 3/2
3.00-3.50	Reed, Wood	8	5YR 3/1
3.50-4.00	Reed, Fibres	6	5YR 3/1
4.00-4.50	Reed, Wood	6	5YR 3/1

Peat layers:

0.00-2.50	Old Sphagnum
2.50-4.50	Fen Peat

Location: Clara west, tube 86
Date: 18 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 56.42

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.50-1.00	Fresh Sphagnum	6	5YR 3/3
1.00-1.50	Fresh Sphagnum	6	5YR 3/3
1.50-2.00	Calluna	9	5YR 2/2
2.00-2.50	Calluna, Sphagnum	8	5YR 3/2
2.50-3.00	Sphagnum, Calluna	2	5YR 3/4
3.00-3.50	Sphagnum, Calluna	2	5YR 3/4
3.50-4.00	Bog Cotton, Calluna	6	5YR 3/2
4.00-4.50	Reed, Calluna, Wood	8	5YR 3/2
4.50-5.00	Wood, Reed	8	5YR 3/2
5.00-5.50	Wood, Reed	8	5YR 3/2
5.50-6.00	Wood, Reed	6	5YR 3/1
6.00-6.50	Reed	6	5YR 2/2

Peat layers:

0.00-1.50	Young Sphagnum
1.50-4.00	Old Sphagnum
4.00-6.50	Fen Peat

Location: Clara west, tube 87
Date: 18 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 57.81

Depth (m)	Vegetation type	Humification degree	Color
0.00-1.00	Fresh Sphagnum	1	5YR 4/5
1.00-1.50	Fresh Sphagnum	1	5YR 3/4
1.50-2.00	Fresh Sphagnum	2	5YR 4/5
2.00-2.50	Fresh Sphagnum	2	5YR 4/5
2.50-3.00	Calluna, Bog Cotton	7	5YR 3/2
3.00-3.50	Calluna, Sphagnum	8	5YR 3/2
3.50-4.00	Fibres	8	5YR 3/2
4.00-4.50	Calluna, Sphagnum	9	5YR 3/2
4.50-5.00	Fresh Sphagnum, Bog Cotton	6	5YR 3/4
5.00-5.50	Amorphous	9	5YR 3/2
5.50-6.00	Wood	9	5YR 3/2
6.00-6.50	Wood, Reed	7	5YR 3/1
6.50-7.00	Wood, Reed, Fibres	9	5YR 3/2
7.00-7.50	Wood, Reed, Fibres	8	5YR 3/1
7.50-8.00	Reed, Wood	3	7.5YR 3/3

Peat layers:

0.00-2.50	Young Sphagnum
2.50-5.50	Old Sphagnum
5.50-8.00	Fen Peat

Location: Clara west, ***tube 88***
Date: 13 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 58.19

Depth (m)	Vegetation type	Humification degree	Color
0.50–1.00	Fresh Sphagnum, Roots	1	5YR 3/4
1.00–1.50	Fresh Sphagnum, Roots	5	5YR 3/3
1.50–2.00	Fresh Sphagnum, Roots	5	5YR 3/3
2.00–2.50	Fresh Sphagnum, Calluna	5	5YR 3/3
2.50–3.00	Bog Cotton	6	5YR 3/2
3.00–3.50	Bog Cotton	9	5YR 3/3
3.50–4.00	Sphagnum, Calluna	7	5YR 3/3
4.00–4.50	Sphagnum, Calluna	7	5YR 3/3
4.50–5.00	Fresh Sphagnum, Calluna, Bog Cotton	7	5YR 3/4
5.00–5.50	Bog Cotton	8	5YR 3/3
5.50–6.00	Wood, Reed	9	5YR 3/2
6.00–6.50	Wood, Reed	8	5YR 3/2
6.50–7.00	Wood, Sphagnum, Reed	7	5YR 3/1
7.00–7.50	Wood, Sphagnum, Reed	5	5YR 3/1
7.50–8.00	Wood, Sphagnum, Reed	5	5YR 3/1
8.00–8.50	Reed	5	5YR 3/1

Peat layers:

0.00–3.50	Young Sphagnum
3.50–5.50	Old Sphagnum
5.50–8.50	Fen Peat

Location: Clara west, tube 89
Date: 12 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 58.38

Depth (m)	Vegetation type	Humification degree	Color
0.50-1.00	Fresh Sphagnum	2	5YR 3/3
1.00-1.50	Fresh Sphagnum, Calluna, Bog Cotton	5	5YR 3/3
1.50-2.00	Fresh Sphagnum, Calluna	5	5YR 3/2
2.00-2.50	Fresh Sphagnum, Calluna, Fibres	5	5YR 3/2
2.50-3.00	Calluna, Bog Cotton	9	5YR 3/3
3.00-3.50	Fresh Sphagnum, Wood, Bog Cotton	5	5YR 3/1
3.50-4.00	Sphagnum	9	5YR 3/2
4.00-4.50	Fresh Sphagnum, Calluna, Bog Cotton	5	5YR 3/3
4.50-5.00	Sphagnum, Calluna, Bog Cotton	6	5YR 3/3
5.00-5.50	Sphagnum, Calluna, Bog Cotton	7	5YR 3/3
5.50-6.00	Sphagnum, Calluna	9	5YR 3/2
6.00-6.50	Sphagnum, Wood	8	5YR 3/2
6.50-7.00	Wood	9	5YR 3/1
7.00-7.50	Wood, Reed	5	5YR 3/2
7.50-8.00	Sphagnum, Wood, Reed	6	5YR 3/1
8.00-8.50	Sphagnum, Wood, Reed	4	5YR 3/1

Peat layers:

0.00-4.00	Young Sphagnum
4.00-6.00	Old sphagnum
6.00-8.50	Fen Peat

Location: Clara west, tube 92
Date: 31 July 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 58.82

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.50-1.00	*Fresh Sphagnum*	*2*	*5YR 3/3*
1.00-1.50	*Roots*	*6*	*5YR 3/1*
1.50-2.00	*Fresh Sphagnum*	*2*	*5YR 3/3*
2.00-2.50	*Roots*	*8*	*5YR 3/2*
2.50-3.00	*Fibres, Calluna*	*8*	*5YR 3/2*
3.00-3.50	*Reed*	*4*	*5YR 3/2*
3.50-4.00	*Wood, Reed*	*4*	*5YR 3/3*
4.00-4.50	*Wood*	*6*	*5YR 3/2*
4.50-5.00	*Wood (birch)*	*6*	*5YR 3/1*
5.00-5.20	*Reed*	*3*	*5YR 3/2*
5.20	*Clay (marl?)*		*N7*

Peat layers:

0.00-2.00	*Young Sphagnum*
2.00-3.00	*Old Sphagnum*
3.00-5.20	*Fen Peat*

Location: Clara west, ***tube 93***
Date: 3 Aug 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 59.66

Depth (m)	*Vegetation type*	*Humification degree*	*Color*
0.50-1.00	Fresh Sphagnum, Roots	2	5YR 3/4
1.00-1.50	Fresh Sphagnum, Roots	2	5YR 3/4
1.50-2.00	Sphagnum, Roots, Bog Cotton	7	5YR 3/4
2.00-2.50	Fresh Sphagnum, Roots	3	5YR 3/4
2.50-3.00	Fresh Sphagnum, Calluna, Wood	4	5YR 3/3
3.00-3.50	Calluna, Roots, Fibres	9	5YR 3/2
3.50-4.00	Sphagnum, Fibres	8	5YR 3/3
4.00-4.50	Sphagnum, Calluna	9	5YR 3/2
4.50-5.00	Fresh Sphagnum	2	5YR 3/5
5.00-5.50	Sphagnum, Calluna, Wood	5	5YR 3/4
5.50-6.00	Bog Cotton, Calluna, Wood	8	5YR 3/2
6.00-6.50	Calluna, Bog Cotton	7	5YR 3/2
6.50-7.00	Bog Cotton	6	5YR 3/3
7.00-7.50	Wood, Fibres, Twigs	8	5YR 3/2
7.50-8.00	Wood, Reed, Fibres	7	5YR 3/2
8.00-8.50	Wood, Reed, Fibres	7	5YR 3/2
8.50-9.00	Wood, Reed, Fibres	6	5YR 3/2

Peat layers:

0.00-3.50	Young Sphagnum
3.50-7.00	Old Sphagnum
7.00-9.00	Fen Peat

Location: Clara west, tube 99
Date: 7 Sept 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Harald
Surfacelevel (M.O.D.): 61.10

Depth (m)	Vegetation type	Humification degree	Color
0.00-1.00	Fresh Sphagnum	2	5YR 5/6
1.00-1.50	Fresh Sphagnum, Bog Cotton	5	5YR 3/4
1.50-2.00	Sphagnum, Calluna	8	5YR 3/3
2.00-2.50	Sphagnum, Calluna, Fibres	9	5YR 3/3
2.50-3.00	Fresh Sphagnum, Calluna, Fibres	7	5YR 3/3
3.00-3.50	Sphagnum, Fibres	9	5YR 3/3
3.50-4.00	Fresh Sphagnum, Bog Cotton	2	5YR 3/3
4.00-4.50	Fresh Sphagnum, Calluna, Fibres	7	5YR 3/4
4.50-5.00	Sphagnum, Calluna, Bog Cotton, Fibres	8	5YR 3/4
5.00-5.50	Bog Cotton, Calluna	7	5YR 3/3
5.50-6.00	Bog Cotton, Calluna, Sphagnum	7	5YR 3/3
6.00-6.50	Bog Cotton, Calluna	7	5YR 3/3
6.50-7.00	Reed	8	5YR 3/2
7.00-7.50	Bog Cotton	7	7.5YR 3/3
7.50-8.00	Fibres	7	5YR 3/2
8.00-8.50	Wood, Fibres	6	7.5YR 3/2
8.50-9.00	Fibres	6	7.5YR 2/3

Peat layers:

0.00-4.50	Young Sphagnum
4.50-7.00	Old Sphagnum
7.00-9.00	Fen Peat

Reference augering
Intermediate reference; Moderately wet

Location: Carrowbehy bog, Mayo
In the central parts, between the drumlins,
near the area with pools.

Date: 16 Sept 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Arjen

Depth (m)	Vegetation type	Humification degree	Color
0.5-1.0	Fresh Sphagnum, Calluna, Roots	3	5YR3/3
1.0-1.5	Fresh Sphagnum, Calluna, Bog Cotton	6	5YR3/3
1.5-2.0	Fresh Sphagnum	9	5YR3/3
2.0-2.5	Fresh Sphagnum, Calluna	3	5YR3/3
2.5-3.0	Fresh Sphagnum, Calluna	6	5YR3/3
3.0-3.5	Fresh Sphagnum, Calluna	9	5YR3/3
3.5-4.0	Sphagnum, Calluna	9	5YR3/2
4.0-4.5	Sphagnum, Bog Cotton	9	5YR3/2
4.5-5.0	Bog Cotton	9	5YR3/2
5.0-5.5	Bog Cotton, Sphagnum	8	5YR3/2
5.5-6.0	Bog Cotton, Sphagnum, Wood	8	5YR3/2
6.0-6.5	Bog Cotton, Calluna, Sphagnum	7	5YR3/1
6.5-7.0	Amorphous	10	5YR3/1
7.0-7.5	Wood	6	5YR3/2
7.5-7.8	Reed	6	5YR3/2
7.8-8.0	Sand with pebbles		7.5YR4/1

Peat layers:

0.00-4.50	Young Sphagnum
4.50-7.00	Old Sphagnum
7.00-7.80	Fen Peat

Reference augering
Main reference; Wet

Location: Carrowbehy bog, Mayo
In the central parts, between the drumlins,
near the area with pools.

Date: 16 Sept 1992
Method: Drilling with an Eijkelkamp auger
Starring: Jan & Arjen

Depth (m)	Vegetation type	Humification degree	Color
0.5-1.0	Fresh Sphagnum, Roots	2	5YR3/4
1.0-1.5	Fresh Sphagnum, Bog Cotton	2	5YR3/4
1.5-2.0	Fresh Sphagnum, Bog Cotton	2	5YR3/4
2.0-2.5	Fresh Sphagnum, Calluna	2	5YR3/3
2.5-3.0	Sphagnum, Bog Cotton, Calluna	9	5YR3/2
3.0-3.5	Fresh Sphagnum, Bog Cotton	6	5YR3/3
3.5-4.0	Fresh Sphagnum, Bog Cotton, Calluna	6	5YR3/2
4.0-4.5	Bog Cotton, Sphagnum	9	5YR3/2
4.5-5.0	Bog Cotton	9	7.5YR3/3
5.0-5.5	Fresh Sphagnum, Bog Cotton	7	5YR3/3
5.5-6.0	Sphagnum, Reed, Bog Cotton	6	5YR3/1
6.0-6.5	Bog Cotton	9	5YR3/1
6.5-7.0	Wood	8	5YR3/1
7.0-7.5	Wood, Reed	8	5YR3/1
7.5-7.7	Reed, Wood, Sphagnum	6	5YR3/2
7.7-7.8	Well sorted medium Sand		
7.8-8.0	Silty Sand with a lot of pebbles		
8.0-8.1	Fine Sandy Silt		

Peat layers:

0.00-4.00	Young sphagnum
4.00-6.50	Old Sphagnum
6.50-7.70	Fen Peat

0