



NIKU Oppdragsrapport 36/2010

**The Bryggen Monitoring Project,
Part 10: report on the archaeo-
logical investigation of three
dipwell boreholes, Bugården/-
Bredsgården, Bryggen, 2009**

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1. Introduction

In September and October 2009, three dipwells – designated MB15, MB32 and MB33 – were installed on the “Bryggen side” of the sheet piling that surrounds the SAS-hotel site. The work was undertaken in connection with the general monitoring project in the Bryggen area, and with particular regard to the mapping/modelling of the hydrogeology and geochemical make-up of the area bordering the sheet piling that surrounds the SAS-hotel site. This area is considered to be very active hydrogeologically; among other things, the groundwater-level has been lowered by up to 3 metres in places, so that the uppermost archaeological deposits have become unsaturated and their organic content therefore rendered more susceptible to accelerated decomposition.

MB15 was installed on September 9th in the former eavesdrop area between the Bredsgården and Bugården tenements. MB32 was installed on October 8th about 1.5 metres to the northwest of the western corner of the stonecellar known as Arent Meyers Kjeller, which marks the landward end of the otherwise removed northern Bugården tenement (the actual spot of the borehole may well have been situated within the property of the former Englgården tenement). MB33 was installed on September 11th about 3 metres to the southwest of the middle of the southwestern side of the little wooden building that marks the landward end of the otherwise now mostly removed southern Bugården tenement. In all cases the fieldwork involved A. R. Dunlop (an archaeologist from the Bergen office of the Norwegian Institute for Cultural Heritage Research) along with Frank Dyrkolbotn and Odd Martin Slaatten (geotechnical/drilling specialists from the firm of Multiconsult AS).

The investigation’s NIKU project number is 156132921. The work was funded in its entirety by *Riksantikvaren* (the Norwegian Directorate for Cultural Heritage).

2. Methods

The drillings were carried out using rotary drilling and in accordance with established procedures. Only one archaeological find was recovered, but numerous soil samples were taken for geochemical analysis at the Eurofins laboratory in Denmark (with interpretation of the results carried out by H. Matthiesen at the Conservation Department at Denmark’s National Museum). These samples, along with two ¹⁴C-dating samples, have been registered under *Middelaldersamlingen*’s reference numbers “BRM 910”, “BRM 911” and “BRM 912” for MB15, MB32 and MB33 respectively.

The various strata distinguished in the drillings have been numbered in the following way. First comes “MBxx” (MB stands for *miljøbrønn*, the Norwegian for “dipwell”), followed by sequential numbering of the individual stratum (from top to bottom). Thus “MB15-01” denotes the uppermost stratum in MB15.

Detailed information on samples and photos are to be found in separate tables in an MS-Access database (filename *156132921dba.mdb*).

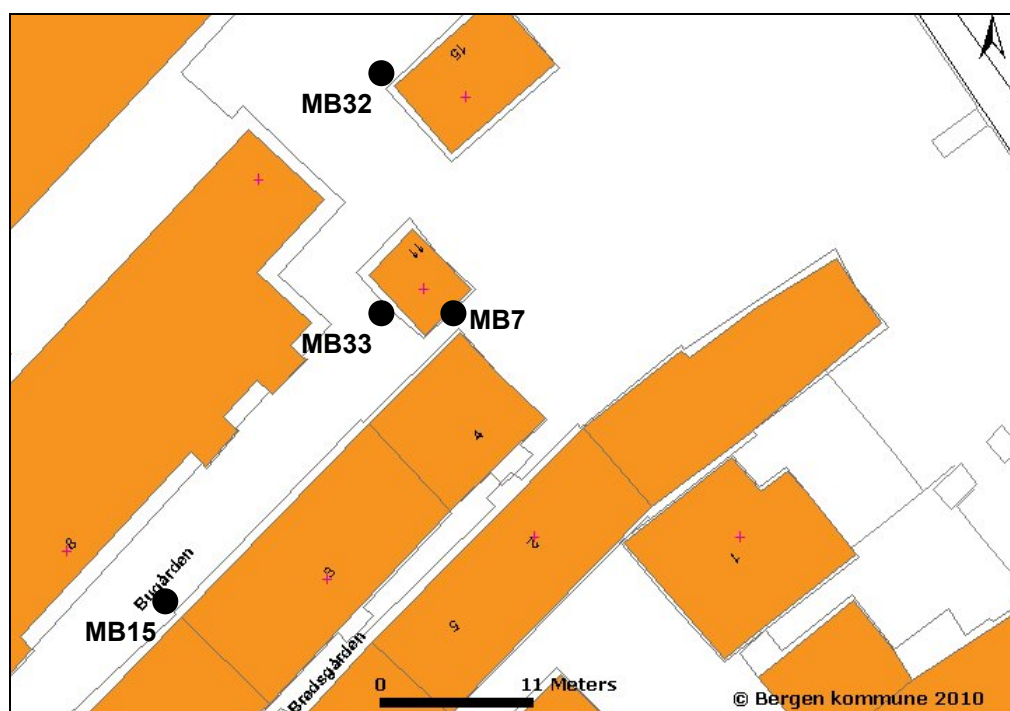


Fig. 1. Map showing the approximate positions of MB15, MB32 and MB33, along with MB7 (installed in 2003). Another dipwell referred to in the text – MB13 (installed in 2005) – lies just over one metre to the northwest of MB15.

3. Fieldwork results

3.1 General remarks

In this report, the stratigraphic sequence in each drilling is presented in tabular form. One of the columns is headed PC, which stands for Preservation Category, and the values in this column are in accordance with the State of Preservation Scale.

The abbreviation “masl” stands for “metres above sea-level”. Depths below sea-level are therefore prefixed with a minus sign.

3.2 Dipwell MB15: sediment sequence (visual inspection)

This hole was in the former eavesdrop area between the Bredsgården tenement and the Bugården tenement. It is situated only 1.2 metres to the southwest of MB13 (Dunlop 2008a), and lies roughly halfway between the existing dipwell pairs MB4/MB5 and MB7/MB8 (Dunlop 2008b). Multiconsult determined the borehole’s coordinates as X6701355.22/Y297476.61 (UTM EUREF89 32N), and the modern surface was at an elevation of ca. 1.90 masl (datum NN1954). The filter was placed at ca. -5.0 to -6.0 masl, and the grey shading in the following table indicates those strata coinciding (more or less) with the dipwell’s filter. The heading “PC” in the column second from right stands for Preservation Category.

It is worth noting that the borehole is very close to the sheet piling around the SAS-hotel site. Weather conditions during the investigation were not good, with some rain and poor light.

Masl		Stratum number	Same as stratum no.	Samples/ ¹⁴ C-dating/ finds	Accession number	Period	PC	Description
From	To							
1.90	-0.20	MB15-01				Mod	E0	Cobblestones in mortar down to 1.50 masl, over modern fill containing stones/ large pebbles with pieces of brick (fill in ditch for sheet piling) Preservation indefinable Groundwater at ca. 0.1 masl (measured 11.11.2009)
-0.20	-0.45	MB15-02		Sample: C-prøve 1 from -0.30 to -0.40 masl	910/3	Med (?)	C2	Relatively compact brown humus with a good quantity of rotted woodchips (inclined at all angles) and a few hazelnut shells, a lot of fine sand and some pebbles Medium-strong H ₂ S odour Slow darkening
-0.45	-0.90	MB15-03	MB13-04			Med	-	Fairly loose, grey fine to coarse sand, gravel and pebbles with a few medium-well-preserved woodchips Eavesdrop deposit Preservation indefinable
-0.90	-1.20	MB15-04		Sample: C-prøve 2	910/4	Med	C2	Relatively compact brown humus with a good quantity of rotted woodchips (inclined at all angles) and a few hazelnut shells, a lot of fine sand and some pebbles Medium-strong H ₂ S odour Slow darkening
								The section from -1.10 to -2.10 was quite badly affected by a stone being trapped between the drill and the borehole's side, and by water washing soil off the drill – so that little material was left on the drill
-1.20	-1.60	MB15-05				Med (?)	-	Thin strips of brown humus and woodchips alternating with thin strips of sand and gravel Probable eavesdrop deposit Preservation indefinable
-1.60	-1.90	MB15-06	MB13-07 (?)	Sample: B-prøve 1	910/5	Med	C3	Probable timber (went to pieces under drilling) Medium preservation
-1.90	-2.20	MB15-07				Med	C0	Fairly loose, grey fine to coarse sand, gravel and pebbles Probable eavesdrop deposit

Masl		Stratum number	Same as stratum no.	Samples/ ¹⁴ C-dating/ finds	Accession number	Period	PC	Description
From	To							
-2.20	-2.35	MB15-08		Sample: B-prøve 2 (bone) from -2.30 masl	910/6	Med	C3	Compact, grey/brown humus with a good quantity of half-rotted woodchips, a small amount of moss, charcoal and hazelnut shells, one walnut, and a few pieces of animal bone Faint H ₂ S odour Slow darkening
-2.35	-2.45	MB15-09				Med	C0	Fairly loose, grey fine to coarse sand and gravel Probable eavesdrop deposit
-2.45	-2.60	MB15-10	MB13-09 (?)	Sample: C-prøve 3	910/7	Med	C4	Very organic, but almost no humus; compact, brown/yellow, somewhat laminated plant/vegetable remains with a few medium-well-preserved woodchips and twigs, a small amount of moss, and probably also small chips from sawing Medium-strong H ₂ S odour Medium-fast darkening
-2.60	-2.95	MB15-11	MB13-10 (?)	Sample: B-prøve 3 (bone) from -2.80 masl	910/8	Med	C4	Mixture of fine, organic matter and some larger woodchips with a copious amount of fine sand, a few small fragments of sea shell, and a few animal bones
-2.95	-3.20	MB15-12				Med	C4	Loose, black-looking, well-preserved, finely ground bark with coarse sand and gravel
-3.20	-3.30	MB15-13				Med	C4	Mixture of fine, organic matter and some larger woodchips with a copious amount of fine sand, a few small fragments of sea shell, and a few animal bones
-3.30	-3.45	MB15-14				Med	C0	Light-grey fine sand with some coarse sand, gravel, pebbles, and a few small fragments of sea shell
-3.45	-3.85	MB15-15		Samples: C-prøve 4 from -3.50 to -3.60 masl B-prøve 4 from -3.75 masl	910/9 910/10	Med	C4	Very organic, but almost no humus; mostly finely ground, somewhat laminated, organic matter with some larger woodchips and twigs, and a small amount of fine sand Medium-strong H ₂ S odour Slow darkening
-3.85	-3.95	MB15-16	MB13-14			Med	C0	Light-grey fine sand with some coarse sand, gravel, pebbles, and a few small fragments of sea shell

Masl		Stratum number	Same as stratum no.	Samples/ ¹⁴ C-dating/ finds	Accession number	Period	PC	Description
From	To							
-3.95	-4.50	MB15-17	MB13-15 MB16-03	Sample: B-prøve 5 (bone) from -4.30 masl	910/11	Med	C4	Mixture of fine, organic matter and some larger woodchips with a copious amount of fine sand, a few small fragments of sea shell, and a few animal bones Good preservation in general, but some of the woodchips snapped quite easily
-4.50	-6.00	MB15-18	MB13-18 MB16-05	¹⁴ C-dating sample: moss from -5.70 masl AD1060-1160 Samples: B-prøve 6 (bone) from -4.95 masl C-prøve 5 from -4.50 to -4.60 masl C-prøve 6 from -5.50 to -5.60 masl	910/2 910/13 910/12 910/14	Med (early)	C4	Very organic, but almost no humus; very compact, laminated moss and some other plant remains, a substantial quantity of well-preserved woodchips (mostly inclined parallel with the plane of deposition) and numerous hazelnut shells, along with a small amount of excrement and a few small animal bones Piece of wood-fibre rope at -4.70 masl Strong – but somewhat "sour" – H ₂ S odour Almost no darkening Good preservation, but not excellent: the moss had a duller colour compared with what one has seen previously in this area, and some of the woodchips snapped easily
-6.00	?	MB15-19		Wall-sherd of Paffrath from ca. -6.02 masl	910/1	Med (early)	C3	Probably grey/brown gyttja with a few medium-well-preserved woodchips Not much material on drill to inspect
								Rotary drilling abandoned at ca. -6.10 masl (in order not to "puncture" the bottom-most culture-layer)

In all, nine digital photos were taken: one of the length from -0.10 to -1.10 masl; one of the length from -1.10 to -2.10 masl; one of the length from -2.10 to -3.10 masl; one of the length from -3.10 to -4.10 masl; one close-up of the length from -3.60 to -4.10 masl; one of the length from -4.10 to -5.10 masl; one close-up of the length from -4.60 to -5.10 masl; one of the length from -5.10 to -6.10 masl; and one close-up of the length from -5.40 to -5.80 masl.

The groundwater-level is at ca. 0.10 masl, which means – happily – that all the culture-layers lie in the waterlogged zone.

The archaeological deposits are about 6 metres thick, which is less than one might expect in this area – but is, of course, a result of truncation in connection with the excavation of the ditch for the sheet piling. Medieval deposits probably reached about 5 metres in thickness. No clear firelayers were visible in the sequence.

3.3 Dipwell MB32: sediment sequence (visual inspection)

This hole was about 1.5 metres to the northwest of the western corner of the stonecellar known as Arent Meyers Kjeller, which marks the landward end of the otherwise removed northern Bugården tenement. Multiconsult determined the borehole's coordinates as X6701396.00/Y297493.80 (UTM EUREF89 32N), and the modern red-brick surface was at an elevation of ca. 4.55 masl (datum NN1954). The filter was placed at ca. 1.30 to ca. 0.30 masl, and the grey shading in the following table indicates those strata coinciding (more or less) with the dipwell's filter. The heading "PC" in the column second from right stands for Preservation Category.

Weather conditions during the investigation were not good, with some rain and poor light.

Masl		Stratum number	Same as stratum no.	Samples/ ¹⁴ C-dating/ finds	Accession number	Period	PC	Description
From	To							
4.55	2.65	MB32-01				Mod	-	Red bricks in sand down to ca. 4.20 masl, over modern fill containing stones/large pebbles with pieces of brick (probably fill in ditch for sheet piling) Very strong stench of diesel
2.65	2.50	MB32-02				Med	-	Firelayer, in situ (red ash/sand over charcoal) Preservation indefinable
2.50	1.90	MB32-03				Med	A0	Light-grey/green/brown clay, very pure; a couple of pebbles and few small, half-rotted woodchips (perhaps "contamination") Strong stench of diesel
1.90	1.75	MB32-04		Sample: C-prøve 1	911/2	Med	A4	Red/brown, finely ground wood/bark, laminated for the most part Strong stench of diesel Slow darkening
1.75	1.70	MB32-05		Sample: B-prøve 1	911/3	Med	A3	Horizontal, half-rotted wood, perhaps a plank bottom for a large wooden "bath" as used in connection with tanning Strong stench of diesel on first exposure, gradually replaced by medium-strong odour of "sour" wood
1.70	1.30	MB32-06				Med	A0 / B0	Light-grey/green/brown clay, very pure; a couple of pebbles and some larger, "horizontal" woodchips (perhaps "contamination") Strong stench of diesel Groundwater at 1.57 masl (as measured 11.11.2009)

Masl		Stratum number	Same as stratum no.	Samples/ ¹⁴ C-dating/ finds	Accession number	Period	PC	Description
From	To							
1.30	1.05	MB32-07		Sample: C-prøve 2	911/4	Med	C4	Red/brown, finely ground wood/bark, laminated for the most part, with some larger, "horizontal" woodchips, a few larger pieces of bark/birch-bark, and some hazelnut shells Strong stench of diesel
1.05	0.75	MB32-08		Sample: C-prøve 3 B-prøve 2 (bone) from 0.85 masl	911/5 911/6	Med	C3	Dark-grey/brown humus, numerous medium-well-preserved woodchips, hazelnut shells, some pieces of birch-bark, and a few animal bones Components inclined at all angles Faint H ₂ S odour Unable to ascertain darkening (due to poor light)
0.75	0.65	MB32-09		Samples: C-prøve 4 from 0.70 masl B-prøve 4 (bone) from 0.70 masl	911/7 911/9	Med	C4	Compact, relatively laminated moss and some other plant remains, some well-preserved woodchips (mostly inclined parallel with the plane of deposition), hazelnut shells, some pieces of birch-bark, and a few animal bones Faint H ₂ S odour Unable to ascertain darkening (due to poor light)
0.65	0.55	MB32-10		Sample: B-prøve 3 from 0.65 masl	911/8	Med	C4	Horizontal timber, well preserved
0.55	0.30	MB32-11		¹⁴ C-dating sample: moss from 0.45 masl AD1180-1245 Sample: C-prøve 5 from 0.40 masl	911/1 911/10	Med	C4	Compact, relatively laminated moss and some other plant remains, some well-preserved woodchips (mostly inclined parallel with the plane of deposition), hazelnut shells, some pieces of birch-bark, and a few animal bones Faint H ₂ S odour Unable to ascertain darkening (due to poor light)
0.30	-0.20	MB32-12						Probable fluvial deposit, coarse sand, gravel, stones Top of natural Strong stench of diesel (and an oily film ran out of a sample placed in a puddle)

Masl		Stratum number	Same as stratum no.	Samples/ ¹⁴ C-dating/ finds	Accession number	Period	PC	Description
From	To							
-0.20	↓	MB32-13						Light-green/yellow/grey, fine sand and silt Fluvioglacial deposit from close to ice-sheet edge Strong stench of diesel
								Rotary (auger) drilling abandoned at ca. -0.45 masl

Seven digital photos were taken in all: two of the length from 2.55 to 1.55 masl; two of the length from 1.55 to 0.55 masl; two of the length from 0.55 to -0.45 masl; and one close-up of a mossy stratum from 0.55 to 0.30 masl.

The groundwater-level is at ca. 1.60 masl. This may be somewhat lower than it should be, something that would be due to the draining effect of the sheet-piling surrounding the SAS-hotel site. It means that about a metre's thickness of culture-layers lies in the unsaturated zone (i.e. above the groundwater-level) – which is, of course, detrimental to the continued preservation of the deposits' organic content.

Total deposit thickness was a little less than 2.5 metres, which is less than might be expected in this area – but is a minimum value, being a result of truncation in connection with the excavation of the ditch for the sheet piling. Medieval deposits may originally have reached a thickness of about 3 metres in all. There were traces of only one definite firelayer.

The sequence in the upper part of MB32 (from stratum MB32-03 down to and including MB32-07) was extremely unusual – not to say unique! The combination of thick clay strata alternating with red/brown, laminated, finely ground wood/bark had not been encountered previously by the attending archaeologist. There are two-three possible scenarios (which will not be elaborated on here) to account for the observed situation, but only further excavation will provide any satisfactory answers.

3.4 Dipwell MB33: sediment sequence (visual inspection)

This hole was about 3 metres to the southwest of the middle of the southwestern side of the little wooden building that marks the landward end of the otherwise now mostly removed southern Bugården tenement. Multiconsult determined the borehole's coordinates as X6701377.10/Y297492.90 (UTM EUREF89 32N), and the modern red-brick surface was at an elevation of ca. 3.35 masl (datum NN1954). The filter was placed at ca. -1.60 to -2.60 masl, and the grey shading in the following table indicates strata coinciding (more or less) with the dipwell's filter. The heading "PC" in the column second from right stands for Preservation Category.

Weather conditions during the investigation were not good, with some rain and poor light.

Masl		Stratum number	Same as stratum no.	Samples/ ¹⁴ C-dating/ finds	Accession number	Period	PC	Description
From	To							
3.35	1.50	MB33-01				Mod	E0	Red bricks in sand down to ca. 3.00 masl, over modern fill containing stones/large pebbles with pieces of brick (fill in ditch for sheet piling) Preservation indefinable
1.50	1.25	MB33-02				Med	-	Firelayer, perhaps in situ Preservation indefinable

Masl		Stratum number	Same as stratum no.	Samples/ ¹⁴ C-dating/ finds	Accession number	Period	PC	Description
From	To							
1.25	1.10	MB33-03		Sample: C-prøve 1	912/2	Med	A2	Grey/brown humus with a good quantity of half-rotted woodchips and some hazelnut shells; some fine sand and gravel Weak earthy odour No darkening
1.10	1.05	MB33-04				Med	-	Charcoal with some ash and sand : probable firelayer Preservation indefinable
1.05	0.95	MB33-05				Med	A2	Grey/brown humus with a good quantity of half-rotted woodchips and some hazelnut shells; some fine sand and gravel Weak earthy odour No darkening
0.95	0.65	MB33-06		Sample: B-prøve 1	912/3	Med	A2 A3	Probable timber (went to pieces under drilling) Poor/medium preservation
0.65	0.50	MB33-07		Sample: C-prøve 2	912/4	Med	A3	Dark-grey, silty, sticky humus with some woodchips (mostly inclined parallel to plane of deposition) Faint H ₂ S odour No darkening
0.50	?	MB33-08				Med	A2 A3	Medium-grey (with hint of brown), silty, sticky humus with some woodchips (mostly inclined at all angles) Faint H ₂ S odour No darkening
0.35	0.20							Soil washed off and replaced by contaminated material from higher levels Groundwater at 0.27 masl (as measured 11.11.2009)
0.20	0.15	MB33-09				Med	C3	Red/brown "sawdust" or finely ground bark, some larger woodchips and some hazelnut shells No odour Medium-fast darkening
0.15	-0.25	MB33-10		Sample: B-prøve 2	912/5	Med	C3 C4	Timber Strong odour of freshly cut pine
-0.25	-0.35	MB33-11				Med	C3	Dark-grey, silty, sticky humus with some medium-well-preserved woodchips (mostly inclined parallel to plane of deposition) Faint H ₂ S odour No darkening

Masl		Stratum number	Same as stratum no.	Samples/ ¹⁴ C-dating/ finds	Accession number	Period	PC	Description
From	To							
-0.35	-0.55	MB33-12		Sample: C-prøve 3	912/6	Med	C4	Compact, laminated moss and some other plant remains, some medium-well to well-preserved woodchips (mostly inclined parallel with the plane of deposition) and some hazelnut shells Moss was somewhat dull in colour, and it was relatively easy to pull strands apart Faint H ₂ S odour Slow darkening
								The length from -0.65 to -1.65 masl lacked some material due to its being washed off the drill on retraction
-0.55	-0.90	MB33-13		Samples: B-prøve 3 (bone) from -0.60 masl C-prøve 4 from -0.70 to -0.90 masl	912/7 912/8	Med	C4	Soft, "loose" grey/brown humus with numerous hazelnut shells, some well-preserved woodchips and animal bones, with a minor amount of moss, straw and pieces of birch-bark Medium-strong H ₂ S odour Medium-fast darkening
-0.90	-1.35	MB33-14				Med	C3	Loose, grey coarse sand with gravel and pebbles, and a few small woodchips Thin pocket of moss at -1.10 masl
-1.35	-2.20	MB33-15		Samples: C-prøve 5 from -1.35 to -1.55 masl C-prøve 6 from -1.95 to -2.15 masl	912/9 912/10	Med	C3	50/50 mixture of fine sand, and grey/brown humus with some small woodchips and hazelnut shells, a few fish-bones and a minor amount of moss Most of the woodchips were badly preserved Moss was medium-well preserved Strong H ₂ S odour Medium-fast darkening

Masl		Stratum number	Same as stratum no.	Samples/ ¹⁴ C-dating/ finds	Accession number	Period	PC	Description
From	To							
-2.20	> -2.65	MB33-16		Samples: C-prøve 7 from -2.35 to -2.55 masl B-prøve 4 (wood) from -2.25 masl B-prøve 5 (bone) from -2.55 masl	912/11 912/12 912/13	Med	C4	Very organic, but almost no humus; compact, laminated moss and some other plant remains, some medium-well to well-preserved woodchips (mostly inclined parallel with the plane of deposition), some hazelnut shells, and a few animal bones at the bottom of the stratum Weak H ₂ S odour Slow darkening Good preservation overall, but not excellent: the moss had a duller colour compared with what one has seen previously in this area, and some woodchips could be snapped quite easily (despite having fresh colour)
								Rotary drilling abandoned at ca. -2.65 masl (in order not to "puncture" the bottom-most culture-layer)

Eight digital photos were taken in all: one of the length from 1.35 to 0.35 masl; one close-up of the length from 0.95 to 0.35 masl; one of the length from 0.35 to -0.65 masl; one close-up of the length from 0.15 to -0.40 masl; one of the length from -0.65 to -1.65 masl; one close-up of the length from -1.05 to -1.65 masl; one of the length from -1.65 to -2.65 masl; and one close-up of the length from -2.05 to -2.65 masl.

The groundwater-level is at ca. 0.30 masl (cf. a level of about 0.70 masl in the neighbouring MB7). This artificially low level is definitely due to the draining effect of the sheet-piling surrounding the SAS-hotel site. It means that more than a metre's thickness of culture-layers lies in the unsaturated zone (i.e. above the groundwater-level). Obviously, this is detrimental to the continued preservation of the deposits' organic content.

Total deposit thickness was a little more than 4 metres, but this is of course a minimum value that is partly a result of truncation in connection with the excavation of the ditch for the sheet piling, and partly a result of the fact that drilling was not carried out all the way down to the natural. Medieval deposits reached a thickness in excess of 4 metres. There were traces of only one definite firelayer, along with one other stratum that may have been a firelayer.

4. Finds & Dating

4.1 General remarks

Two radiocarbon datings, one from MB15 and one from MB32, were carried out by the National Laboratory for Radiometric Dating at NTNU, Trondheim.

4.2 MB15

4.2.1 Archaeological material

A wallsherd of (early) medieval Paffrath ware (accession no. 910/1) was recovered from stratum MB15-19 at ca. -6.02 masl.

4.2.2 Radiometric dating

¹⁴C-dating of a sample of moss (finds accession no. 910/2) from stratum MB15-18 yielded a result of 930±25 BP, calibrated to AD 1060-1160.

4.3 MB32

4.3.1 Archaeological material

No archaeological artefacts were recovered from MB32.

4.3.2 Radiometric dating

¹⁴C-dating of a sample of moss (finds accession no. 911/1) from stratum MB32-11 yielded a result of 845±35 BP, calibrated to AD 1180-1245.

4.4 MB33

4.4.1 Archaeological material

No archaeological artefacts were recovered from MB33.

4.5 Dating: conclusions

In all three drillings, it seems likely that modern disturbance has removed all the post-medieval deposits, so that the intact archaeological sequence consists of strata of medieval date right from the top. The lowest 2-3 strata in MB15 are quite certainly from the early medieval period, and so too may be the lowest 1-2 strata in MB33 (this based mainly on comparison with the nearby MB7). In MB32, on the other hand, it is possible that the earliest deposits are no older than ca. 1200.

5. State of preservation assessment

It was stipulated that the report should contain archaeological assessments of the state of preservation of the deposits, and table 1 below attempts to provide an easy-to-grasp picture of the situations in the three boreholes (with MB13 – installed in 2005 at a spot close to MB15 – included for comparison with MB15, and MB7 – installed in 2003 at a spot not far from MB33 – included for comparison with MB33).

Table 1. Schematic comparative presentation of the state of preservation (archaeological assessment) of the deposits in MB15, MB32 and MB33. MB13 has been included for purposes of comparison with MB15, while MB7 has been included for purposes of comparison with MB33. Each individual symbol represents a length of about 20 centimetres, and depth from the surface increases from left to right. Grey shading indicates the approximate position of the filters in the dipwells.

MB32 (2009)	MB33 (2009)	MB7 (2003)	MB15 (2009)	MB13 (2005)	Masl	Symbols
\$\$\$?			5.0 – 4.0	\$ - INORGANIC
\$\$\$\$\$	\$\$	XXXXX			4.0 – 3.0	X - VERY POOR
\$\$\$\$\$	\$\$\$\$\$	\$X?XX			3.0 – 2.0	X - POOR
X\$\$\$X	\$\$\$\$X	XXXXX	?????	?????	2.0 – 1.0	X - MEDIUM
XXXXN	XXX?X	X\$XXX	?????	??XXX	1.0 – 0.0	X - GOOD
	XXXXX	X\$??\$?X???	XXXXX	0.0 – -1.0	X - VERY GOOD
	XXXXX	XXXN	X??XX	XXXXX	-1.0 – -2.0	? - INDEFINABLE
	XXXA(N)		\$XXXX	XXXXX	-2.0 – -3.0	0 - NO SOIL RECOVERED
			X\$XX\$	XXXXX	-3.0 – -4.0	N - NATURAL
			XXXXX	XXXXX	-4.0 – -5.0	A - DRILLING STOPPED
			XXXXX	XXXXX	-5.0 – -6.0	
			XA(N)	N	-6.0 – -7.0	

The state of preservation situations are more or less what one might expect, with the best-preserved strata generally located in the lower part of the deposit sequence. Other than that, it is difficult to draw any detailed conclusions – the main problem, as virtually always applies in the case of drilling, lies in not knowing whether layers exhibiting poorer preservation were exposed to decomposition prior to, or around the time of, or long after deposition.

What gives most grounds for concern is the situation in MB15 compared with that in the neighbouring MB13, investigated just four years earlier. Deep strata that in 2005 had been assessed as displaying an excellent state of preservation now displayed only a good state of preservation.

MB33 is a lot closer to the sheet piling than MB7, so it is perhaps a bit unreasonable to compare the respective state of preservation situations. Having said that, there is some similarity to the situation of MB15 vis-à-vis MB13.

MB15: comparison of state of preservation (archaeological assessment) with LOI and water-content results (analysed by Multiconsult)

Stratum no./nos.	PC	LOI (%)	H ₂ O (%)	Notes
MB15-02	C2	11,5	72	Mostly organic
MB15-04	C2	16,2	95	Mostly organic
MB15-05	-	30,2	50	Preservation indefinable
MB15-06	C3	13,8	112	Probable timber (came up in pieces)
MB15-08	C3	24,9	123	Mostly organic
MB15-12	C4	26,8	187	Ground-up bark with sand
MB15-13, -14, -15	C4, C0	13,2	96	Only one stratum was highly organic
MB15-15, -16, -17	C4, C0	24,4	178	Only one stratum was highly organic
MB15-17	C4	43,2	215	Mixture of organic and mineral

Stratum no./nos.	PC	LOI (%)	H ₂ O (%)	Notes
MB15-18	C4	34,8	174	Highly organic
MB15-18	C4	67,1	311	Highly organic

MB32: comparison of state of preservation (archaeological assessment) with LOI and water-content results (analysed by Multiconsult)

Stratum no./nos.	PC	LOI (%)	H ₂ O (%)	Notes
MB32-04, -05, -06	A4, A3, A0	11,9	62,8	Two strata were highly organic
MB32-06, -07, -08, -09, -10	A0, C4, C3, C4, C4	42,8	230,5	Four strata were highly organic
MB32-11	C4	30,0	69,4	Highly organic

MB33: comparison of state of preservation (archaeological assessment) with LOI and water-content results (analysed by Multiconsult)

Stratum no./nos.	PC	LOI (%)	H ₂ O (%)	Notes
MB33-02	-	29,0	40,3	Firelayer
MB33-03	A2	19,6	115	Mostly organic
MB33-06	A2/A3	25,4	181	Probable timber
MB33-07, -08	A2, A3	18,9	136	Mostly organic strata
MB33-12, -13	C4	24,7	146	Both strata were highly organic
MB33-13, -14	C4, C3	13,7	68	Only one stratum was highly organic
MB33-15	C3	9,2	65	Mixture of organic and mineral
MB33-15	C3	19,2	109	Mixture of organic and mineral
MB33-16	C4	42,9	241	Highly organic

6. Concluding remarks

In MB15 we have seen, **for the very first time at Bryggen**, concrete indications of a change for the worse in the state of preservation of organic deposits compared with a situation recorded only four years previously (in MB13). Furthermore, **this worsening has occurred in strata at a very deep level**, something that nobody would really have expected.

The first thing to ask is whether there are any potential sources of error. The answer to this is that there are no obvious ones. The two archaeological assessments involved were carried out by the same person (Dunlop) and under roughly similar conditions. The methods employed (including the drilling work itself) in 2009 were the same as in the previous investigation.

This development is extremely alarming. It would seem to indicate an ongoing – and serious – deterioration of deep-level preservation conditions. Confirming this deterioration and determining the possible causal factors is a task for geochemist Matthiesen and hydrogeologist de Beer, but to this archaeologist at least the fact that this is occurring right next to the sheet piling encircling the hotel site strongly suggests that more than coincidence is involved.

7. References

- Dunlop, A. R., 2008a. The Bryggen Monitoring Project, Part 4: report on the archaeological investigation of five dipwell boreholes, 2005. – NIKU Arkeologi avdeling, arkivrapport 28/2008. Bergen.
- Dunlop, A. R., 2008b. The Bryggen Monitoring Project, Part 2: Archaeological investigations in connection with monitoring project, Bredsgården tenement, Bryggen, Bergen, 2002-3. – NIKU Arkeologi avdeling, arkivrapport 66/2008. Bergen.

Matthiesen, H. 2010. Preservation conditions in the area bordering the sheet piling at Bryggen, Bergen: Results from new dipwells MB15, 30, 31, 32 and 33 installed in 2009. – Report no. 11031041. Copenhagen, National Museum of Denmark, Department of Conservation.

8. Documentation (NIKU)

- Report on PC (filename 156132921#1.doc)
- Soil sequences noted down in *Boreprøvebok* (drilling logbook) 6
- 24 digital photographs (9 for MB15, 7 for MB32, 8 for MB33)
- Finds/samples information entered into *Gjenstandsbasen, Bergen Museum*

NIKU prosjektnumre	156132921 (2009)
Berørt område	Bugården, Bredsgården
Gnr/Bnr	167/1632, 167/1639, 167/1645
Oppdragets art	Arkeologisk undersøkelse av grunnboringer
Saksnummer	08/00262
Oppdragsgiver	Riksantikvaren Distriktskontor Vest
Tiltakshaver	Riksantikvaren
Oppdraget utført av	NIKU distriktskontor Bergen v/ Rory Dunlop
Oppdraget utført dato	Sept. og okt. 2009
Koordinator	Se i teksten
Overflate, dagens	Varierer fra brønn til brønn
Tilstedeværelse av automatisk fredete kulturminner	Ja

Photo list

Bildenummer	Undersøkelsestype	Motiv
niku_ark_100528	MOV brønnboring (naver)	MB15 borelengde 2,0 til 3,0 m dyp
niku_ark_100529	MOV brønnboring (naver)	MB15 borelengde 3,0 til 4,0 m dyp
niku_ark_100530	MOV brønnboring (naver)	MB15 borelengde 4,0 til 5,0 m dyp
niku_ark_100531	MOV brønnboring (naver)	MB15 borelengde 5,0 til 6,0 m dyp
niku_ark_100532	MOV brønnboring (naver)	MB15 borelengde 5,5 til 6,0 m dyp
niku_ark_100533	MOV brønnboring (naver)	MB15 borelengde 6,0 til 7,0 m dyp
niku_ark_100534	MOV brønnboring (naver)	MB15 borelengde 6,5 til 7,0 m dyp
niku_ark_100535	MOV brønnboring (naver)	MB15 borelengde 7,0 til 8,0 m dyp
niku_ark_100536	MOV brønnboring (naver)	MB15 borelengde 7,3 til 7,7 m dyp
niku_ark_100664	MOV brønnboring (naver)	MB32 borelengde 2,0 til 3,0 m dyp
niku_ark_100665	MOV brønnboring (naver)	MB32 borelengde 2,0 til 3,0 m dyp (m/ blitz)
niku_ark_100666	MOV brønnboring (naver)	MB32 borelengde 3,0 til 4,0 m dyp
niku_ark_100667	MOV brønnboring (naver)	MB32 borelengde 3,0 til 4,0 m dyp (m/ blitz)
niku_ark_100668	MOV brønnboring (naver)	MB32 borelengde 4,0 til 5,0 m dyp
niku_ark_100669	MOV brønnboring (naver)	MB32 borelengde 4,0 til 5,0 m dyp (m/ blitz)
niku_ark_100670	MOV brønnboring (naver)	MB32 detaljbilde av mose 4,0 til 4,25 m dyp
niku_ark_100537	MOV brønnboring (naver)	MB33 borelengde 2,0 til 3,0 m dyp
niku_ark_100538	MOV brønnboring (naver)	MB33 borelengde 2,4 til 3,0 m dyp
niku_ark_100539	MOV brønnboring (naver)	MB33 borelengde 3,0 til 4,0 m dyp
niku_ark_100540	MOV brønnboring (naver)	MB33 borelengde 3,2 til 3,75 m dyp
niku_ark_100541	MOV brønnboring (naver)	MB33 borelengde 4,0 til 5,0 m dyp
niku_ark_100542	MOV brønnboring (naver)	MB33 borelengde 4,4 til 5,0 m dyp
niku_ark_100543	MOV brønnboring (naver)	MB33 borelengde 5,0 til 6,0 m dyp
niku_ark_100544	MOV brønnboring (naver)	MB33 borelengde 5,4 til 6,0 m dyp