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Title: Mapping of special sand for Rescon Mapei AS in Nord-Odal			
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<p>Summary:</p> <p>Following a request from Rescon Mapei AS, Nord-Odal, to assess the properties of local sand deposits for use in the company's products, NGU carried out investigations on five deposits. The deposits at 7 Slettholen, 10 Snekkermoen, 12 Moajordet, 15 Knapper and 16 Prærien in Nord-Odal have been examined and sampled. Grain distribution analyses have been carried out on material from all five deposits, as well as alkali reactivity analyses from three of the occurrences.</p> <p>Based on grain distribution analyses and field observations, four of the surveyed deposits are estimated to contain sand masses suitable for Rescon's purposes. The most favourable deposits are those at 7 Slettholen, 10 Snekkermoen and 12 Moajordet.</p>			
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1. INTRODUCTION

Following a request from Rescon Mapei AS, agreement was reached to establish a cooperative project where Rescon asked for an assessment of local sand deposits for use in their special mortar. After examining NGU's 'Grus og Pukk database' (Gravel and aggregate database), Rescon considered the deposits at 7 Slettholen, 10 Snekkermoen, 12 Moajordet, 15 Knapper and 16 Prærien to be the most important for further investigation.

The fieldwork was carried out by Leif and Oddvar Furuhaug during a 5-day period in October 2004.

Trondheim 19.01.2005

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2. CONCLUSION

With the aim of finding sandy superficial deposits suitable for Rescon Mapei's special mortar, NGU carried out a study of five deposits at 7 Slettholen, 10 Snekkermoen, 12 Moajordet, 15 Knapper and 16 Prærien in Nord-Odal commune.

Based on field observations and grain distribution analyses, the deposit at 7 Slettholen is considered to be the one most suitable for Rescon's purposes. Large parts of the other deposits contain material that is too coarse grained, but some areas do have sandy sediments which might be of future interest. In particular, this concerns the deposits at 10 Snekkermoen and 12 Moajordet.

Deposit 7 Slettholen seems to consist mainly of sand and silt, and the actual areas for potential extraction are forest covered. Possible areal conflicts would therefore seem to be minimal. At deposit 10 Snekkermoen there is a suitable area at sandpit 1; this area is also forested. At deposit 12 Moajordet, sandpit 1 and the surrounding area is the most promising. At deposit 16 Prærien, a forest-covered area at the sample localities 16-2 and 16-3 might prove to be a suitable place for sand extraction.

It should be mentioned, however, that the analyses carried out on the sands from the deposits at 10 Snekkermoen, 12 Moajordet and 16 Prærien contain alkali-reactive rock material (see page 12).

In order to determine how large the areas and estimated volumes from the different occurrences actually are, further investigations will be required. These should include digging with an excavating machine for direct observation of the sand deposits, and additional sampling and analysis. Georadar measurements might usefully be employed to assess the thickness of the sediments above the groundwater table, as well as the presence of other soils or solid bedrock.

3. INVESTIGATED DEPOSITS

Surveyed and sampled deposits:

At the request of Rescon, the deposits 10 Snekkermoen, 12 Moajordet, 15 Knapper og 16 Prærien in Nord-Odal were examined and sampled. In addition, one sample was collected from no. 7 Slettholen. (All numbers and names refer to NGU's Grus og Pukkdatabase).



Figure 1. Cut in the northern part of sandpit 7-1.

Deposit 7 Slettholen is located 6-7 km northwest of Sand. The deposit consists of glaciofluvial and fluvial material, consisting mainly of sand, but some gravel and large blocks are also present. One relatively large sandpit is registered in this deposit. The sandpit is disused; but it is currently in use as a car-rally race track. A sample was taken (no. 7-1-1) from the northern end of the pit in a c. 3 m-high cut where the sediments consist only of fine sand and silt. See Figures 1, 2, and 3.



Figure 2. Sandpit 7-1.

Deposit 10 Snekkermoen is a relatively large glaciofluvial and fluvial deposit located c. 1 km east of Slettholen. The thickness of the deposit varies considerably, partly because of the uneven, terrain surface. There are also large variations in the grain distribution analyses. Most of the area is covered by arable land or by farms and houses.

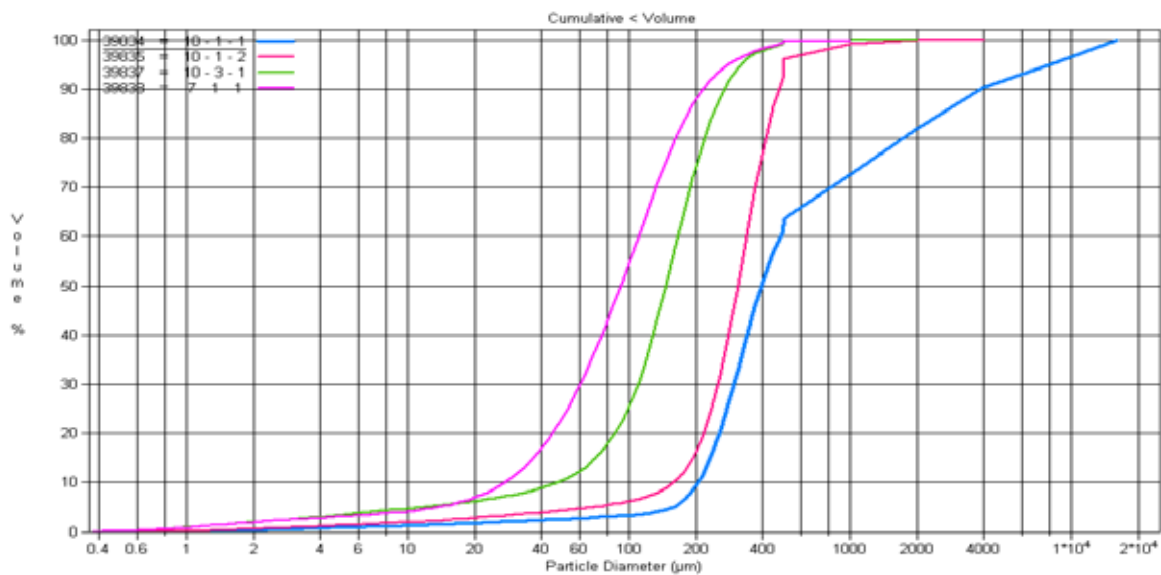


Figure 3. Grain distribution analyses. Deposits 7 og 10.



Figure 4. Sandpit 10-1.

Three sandpits are registered within the deposit (see figure 6). Sandpit 1 is a small, disused pit in sandy sediments. At the top of a c. 5 m-high cut there is a thin layer of gravel some few cm thick, beneath which the sediments mostly consist of a uniform, layered sand. Sample 10-1-1 is taken from 0.5-1 m above the exposed base of sandpit 1, whereas sample 10-1-2 comes from the base of the section.

Sandpit 2 is situated in the northeasternmost part of the deposit, towards its very base. Today, this sandpit is disused and overgrown, and there are no open cuts, but from earlier registrations we know that the sediments consist of coarse gravel and sand with some scattered pebbles.



Figure 5. Sandpit 10-3.

Sandpit 3 is quite small. Some sediments have been excavated from a site close to the edge of a terrace on a low river plain at Sandbekken. A 1 m -high cut exposes fine sand, except for a 10-20 cm-thick gravel layer just beneath the surface. Sample 10-3-1 is taken from here.

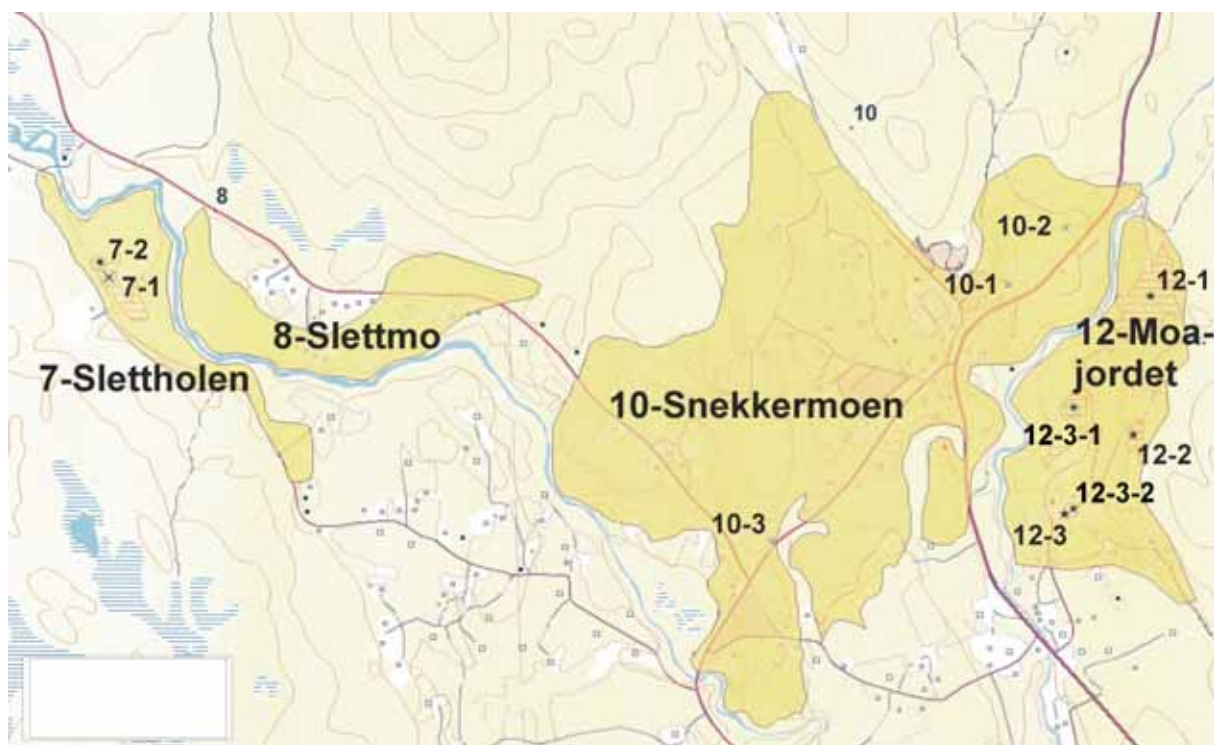


Figure 6. Map showing the deposits 7 Slettholen, 8 Slettmo, 10 Snekkermoen og 12 Moajordet. Scale c. 1: 16,000.

Deposit 12 Moajordet is situated on the other side of the river from Snekkermoen, but belongs to the same geological deposit. Here, the terrain surface is also rough and uneven, resulting in a varying thickness of the deposit. Several outcrops of bedrock are registered within the area. Three sandpits are registered within the Moajordet deposit.



Figure 7. Sandpit 12-1

Sandpit 1 is situated in the northern-most part of the deposit. This is a big sandpit, at least 200 m long and 50 m wide. Within this area there are large variations in grain distribution. Cuts 3-4 m in height show sections with much gravel and some stone clasts, whereas other sections consist mainly of sand. Sample (12-1-1) is taken from a cut mainly comprising sand.



Figure 8. Sandpit 12-2.

Sandpit 2 is situated c. 200 m south of sandpit 1, and is excavated down to the approximate level of a horizontal delta surface. The maximum thickness is 10-15 m, and the sediments consist of sand and gravel with some stone clasts. In the bottom of the pit the sediments are a little more fine grained, but they still consist mostly of sand and gravel. Sample 12-2-1 is taken from the bottom of the sandpit section.



Figure 9. Sandpit 12-3.

Sandpit 3 is situated in the southern part of the deposit, and covers a large area. A relatively thin layer of sediment has been removed from much of this sandpit area. From the sampling site of sample 12-3-1, the excavation activity today is quite irregular and restricted to the extraction of sand and gravel. At the top of the pit there is a 3-4 m-high cut with coarse-grained sediments, comprising well-graded sand and gravel. Beneath this layer, and where the sample was taken, there are fine-grained deposits of fine sand and silt.

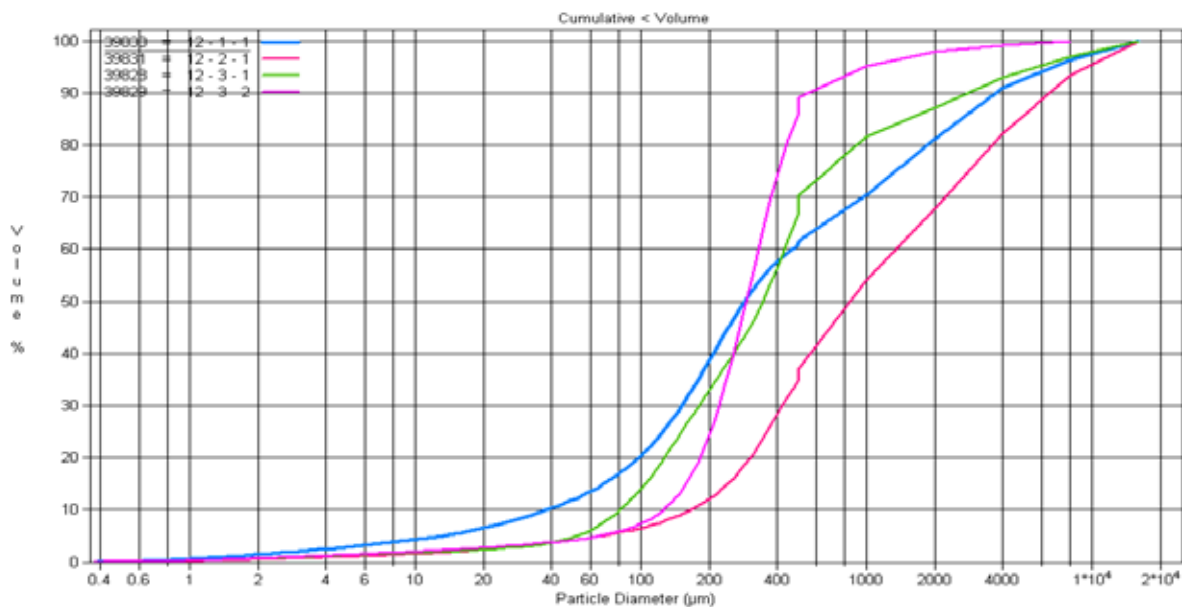


Figure 10. Grain distribution analyses. Deposit 12.

Deposit 15 Knapper is situated at the western side of the river Juråa, and stretches c. 2.5 km to the north of the small town Knapper. The deposit is of glaciofluvial origin and consists essentially of coarse-grained sediments.



Figure 11. Sandpit 15-1.

Sandpit 1 is situated in the northern part of the deposit. This is a large, disused sandpit. A 3-4 m-high cut shows a well-graded sediment with c. 5 % stone clasts, 65 % gravel and 30 % sand. Today, the pit is used for storage purposes, and there are several hillocks of crushed sediment.

Earlier, a smaller sandpit (no. 2) was situated about 500 m southwest of sandpit 1. This particular pit has now been levelled out. The sediments in this small sandpit were relatively coarse grained, and consisted of sand, gravel and some stone clasts.

It is possible that there are more fine-grained sediments in the southernmost part of the deposit, but since most of the deposit is now either arable land or covered by buildings, and as no particular area seems to be especially suitable for sand extraction, no investigations were carried out.

Deposit 16 Prærien belongs to the same superficial deposit as 15 Knapper, but this one is situated on the opposite side of the river. No sandpit has been registered within this deposit earlier, but sample 16-1-1 was taken from a little pit in the northeastern part of the deposit (see figure 13) where the sediments consist of c. 50 % gravel and 50 % sand. Within an area to the south and southwest of the sandpit, 2 holes were drilled with a shovel-drill, 16-2 and 16-3. From 16-2, one sample was taken (16-2-1), and from 16-3 two samples were collected, marked 16-3a and 16-3b.

Sample 16-2-1 was taken at 1.5 m depth. Except for a c. 2 cm-thick silt layer at 1.2 m, the whole cut consists of sand with some gravel-size grains.

Sample 16-3a was taken at a depth of 1 m in fine sand, and 16-3b at 2.5 m also in fine sand.

Attempts to drill a third hole were made c. 40 m east and 70 m south of 16-3-1, but in these places penetration was impossible because of the presence of coarse material at the surface.

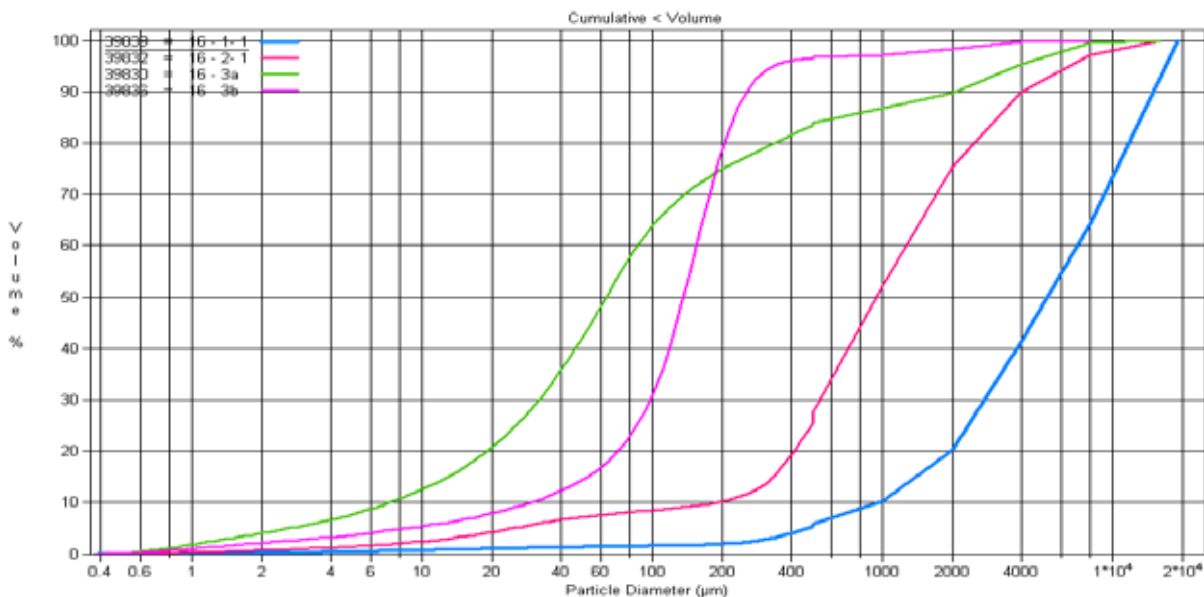


Figure 12. Grain distribution analyses. Deposit 16.

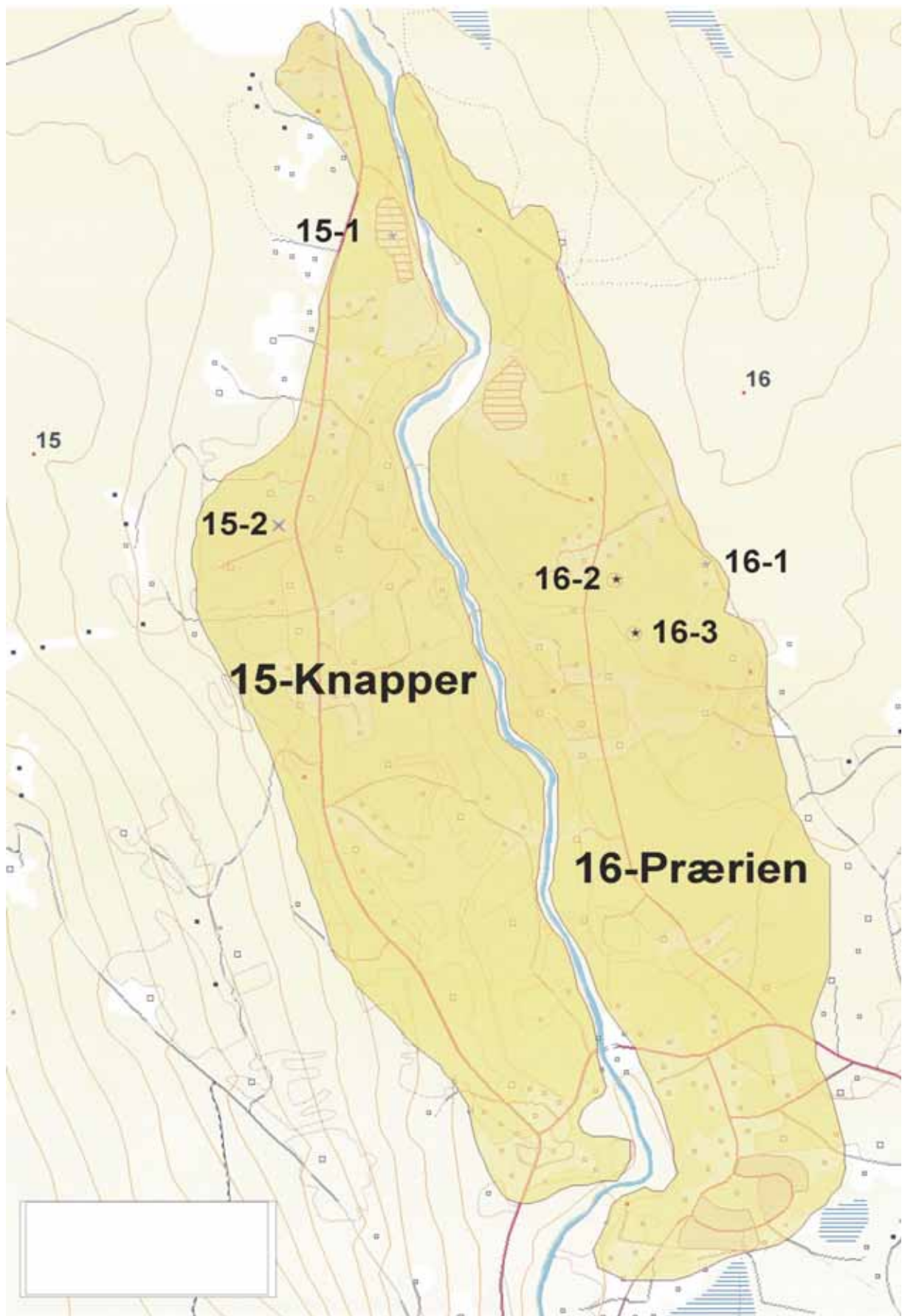


Figure 13. Map showing the deposits 15 Knapper and 16 Prærien. Scale c. 1: 7,000.

4. ANALYSES

Grain distribution analyses were carried out on the samples collected from all the various deposits, and alkali reaction analyses were completed on 3 of the deposits. Material from deposit 7 Slettholen was also included, but this sample was too fine grained for this method of analysis. However, it is most likely that this deposit has a comparable composition of alkali reactive material, which seems to be the case throughout this area.

Alkali reactions – Petrographic analyses

Deposit	% Summary reactive grains
10 Snekkermoen	26
12 Moajordet	21
16 Prærien	29

The analyses show that the deposits have a higher content of alkali-reactive rock components than is acceptable. The limiting value is set at 15% of reactive grains. To be absolutely certain, it is recommended that additional analyses be carried out in the form of expansion tests, in order to detect whether or not the deposits will give alkali reactions.

It should be pointed out that alkali reactions appear when different conditions are fulfilled simultaneously, among these being the presence of water. By using an alkali-free cement, one can prevent alkali reactions.

It must be noted here that NGU has not yet received accreditation for performing the petrographic analyses pertaining to alkali reactivity. However, NGU is participating in an annual analysis control, where the results achieved so far are comparable to those of approved laboratories. The analyses presented in this project report should therefore be regarded as advisory.

5. FAVOURABLE LOCALITIES FOR SAND EXTRACTION

The starting point and reason for these investigations was to try to find deposits where the material consists mainly of sand with a grain size of <2 mm.

Based on field observations, an assessment of the conditions of deposition, and the actual grain distribution analyses, it has been possible to assess and determine which areas are most favourable for finding suitable sandy sediment for Rescon Mapei's requirements.

Deposit 7 Slettholen might have a sufficiently large volume of such sandy sediments. An area north and east of the sandpit would seem to be the most favourable. In this area, the deposit is covered by forest, and any potential areal conflict would therefore appear to be minimal. The sediment thickness north of the sandpit is <3 m. The groundwater table will probably mark the limit at depth. The true thickness of the deposit is difficult to estimate, but it is likely to be comparatively modest.

Sandpit 1 within *deposit 10 Snekkermoen* contains sediments that consist mainly of sand. The area to the north is a forested terrace. Most likely this terrace contains mainly sandy sediments, but a coarser layer with sand and gravel towards the top is likely to increase in thickness to the north. In this area, the thickness of the sediments is uncertain, but in addition to the 5 m in the main sandpit there might be considerable amounts of sediment at depth. About 150 m north of the sandpit there is a mud lagoon which might conceivably have contaminated the superficial deposits in its vicinity.

Sandpit 3 in the same deposit also contains mainly sand. The sandpit is situated at the edge of a terrace where a 50-100 m-thick belt of forest occurs just behind. Farther north there are large areas of arable land. Such areas might be suitable for sand extraction, providing that they are returned to farmland after sand extraction activities have ceased. In such cases, one should ensure that there is a sufficient sediment thickness above the groundwater table.

In the bottom of sandpit 3 in *deposit 12 Moajordet*, there are sandy sediments. A relatively thin layer of sand and gravel seems to have been removed from over a large area, and the excavation has stopped just above fine-grained sediments at the base. It might be possible to continue extraction below the floor of the sandpit, but the distance to the groundwater table might possibly be short. A consequence of this will be that the extractable thickness of sediment will be too little.

A part of *deposit 16 Prærien*, at the sample localities 16-2 and 16-3, between some houses to the south and north, might constitute an area suitable for sand production. The thickness of the fine-grained sediments in this area might be quite considerable. Farther to the north, large parts of the deposit are too coarse grained, while farther south the conflict with agricultural activities and built-up areas would seem to cause insurmountable problems.

6. FURTHER INVESTIGATIONS

It is suggested that further investigations should be carried out at some future date. These might include:-

- Digging with an excavator for direct observation of the sand deposits, followed by further sampling and analysis.
- Employing georadar measuring techniques to help determine sediment thickness above the groundwater table, and to detect the possible presence of soils or solid bedrock.

If none of the investigated deposits is regarded as sufficiently interesting or promising, then it might be worth considering extending the area available for prospecting.