

Site investigation for the proposed Lower Forth Treatment Plant.

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Abstract

Subsurface investigations for the proposed Lower Forth Treatment Plant have shown the area to be underlain by unconsolidated valley fill deposits. These materials are expected to provide a suitable foundation for proposed structures. One area, the site of the proposed clarifier basin, may be subject to minor settlement.

The North West Regional Water Authority commissioned Gutteridge, Haskins and Davey, consulting engineers, to carry out the design for the proposed Lower Forth Water Treatment Plant. The complex is to be situated approximately 1.5 km south of the township of Forth, in the vicinity of the existing weir and pumping station on the River Forth [DQ364383].

Information was required as to the nature of the near surface materials, the extent of rock which may be encountered at the proposed excavation depths and consideration given to possible settlement of proposed structures.

GEOLOGY

The proposed water treatment plant is to be constructed on the well developed meander terraces of the River Forth. The geomorphological features of these river terraces have been used to advantage in the planning and positioning of proposed structures.

The nature of the underlying materials was determined by a series of test pits; the siting of these pits (fig. 1) was governed largely by the consulting engineers. The logs of the materials encountered during excavation are given in Appendix 1.

Valley fill deposits, ranging from coarse boulder beds down to silt, were found to be present. All test pits (with the exception of test pit 8) exposed a thin soil horizon overlying a variable thickness (up to 3 m) of essentially dry ferruginous unconsolidated grit, sand, clayey sand and silt. The origin for at least part of this material is undoubtedly colluvial, as evidenced by similarities with the residual soils developed over the Precambrian quartzite and garnet schist sequence cropping out on the valley sides above the terraces. Alluvial processes were also possibly active in the formation of these materials.

Below this layer, boulder beds were encountered in all test pits with the exception of pits 7 and 8. The boulders range from 30-300 mm in size, are sub-angular to sub-rounded and have been derived from several sources further upstream. A variety of rock types were noted; granite, quartzite, garnet schist, serpentinite, mudstone and chert being the most common. These boulder bed deposits are largely a Pleistocene alluvial feature and may have a fluvio-glacial origin.

Test pit 7 failed to expose the boulder bed horizon at 3.0 m, the limit of excavation. However, the profiles from test pits 1 and 2 indicated a thickening of the ferruginous grit and sand towards test pit 7. Thus it is anticipated that this local base level of coarse boulder beds should be present within about one metre of the bottom of the excavation; i.e. at approximately 4.0 m depth.

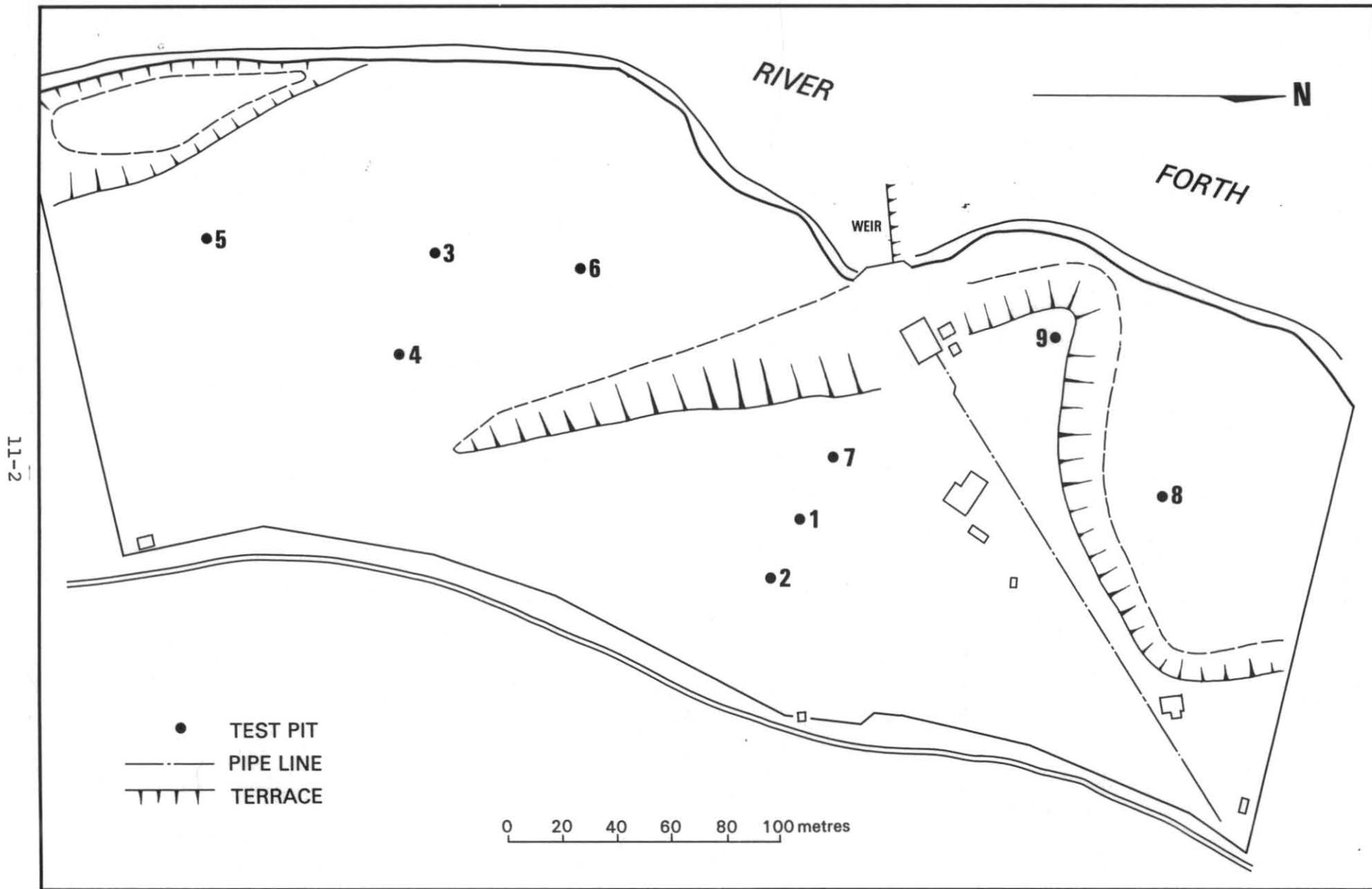


Figure 1. Location of test pits.

5 cm

Test pit 9 was excavated to determine whether the ground forming the natural projection of the high ground to the north of the existing pumping station was fill associated with construction or part of the natural river terrace system; the latter situation proved to be the case.

Neither the ferruginous grit and sand, nor the boulder beds were encountered during excavation of test pit 8. In contrast, a moist mottled grey/brown clayey sand was exposed, overlying a moist soft grey clay with associated mica (muscovite) and fine sand. Water was noted seeping into the pit from between the two horizons (2.2 m depth).

DISCUSSION

Subsurface investigations have indicated that with the possible exception of the proposed clarifier basin site (test pit 8), a satisfactory foundation is considered to exist for the estimated loadings of the various intended structures. Solid rock foundations should not be encountered within the limits of excavation, reported to be not more than 3.0 m deep. The boulder beds which occur within 2-3 m of the surface are conceivably several metres thick but are easily excavated with suitable machinery.

The one site which warrants consideration with respect to potential settlement is that of the proposed clarifier basin. This would be one of the more major structures of the project, with an estimated water depth of some 5.0 m. Test pit 8 indicates that this site is underlain in part by soft moist clay, the total thickness of which was not determined. As these sediments represent alluvial deposits, it is conceivable that lenses of unconsolidated sandy material are intercalated with the clay, with the result that settlement could eventuate.

Although the intended loadings are not high (say 50-60 kPa), it may prove advantageous to pre-load the area as a precaution against any potential settlement problem.

CONCLUSIONS

The proposed water treatment plant complex is to be sited entirely on unconsolidated valley fill deposits. With the exception of the construction of the clarifier basin, excavations for the remaining proposed structures should encounter between 2-3 m of unconsolidated sand and grit, below which a boulder bed horizon may be expected. These materials will provide an adequate foundation for the estimated loadings of the various proposed structures.

The potential for minor settlement of the proposed clarifier basin cannot be completely ruled out. Further investigations could be undertaken, or alternatively, any potential settlement problem could be effectively eliminated by pre-loading the area with the fill required for the clarifier basin.

[10 April 1978]

APPENDIX 1

Logs of test pits

<i>Test Pit No.</i>	<i>Depth (m)</i>	<i>Thickness (m)</i>	<i>Description</i>
1	0-0.25	0.25	Grey sandy top soil.
	0.25-2.1	1.85	Dry, unconsolidated, ferruginous sand and grit.
	2.1 -3.5	1.4(+)	Boulder beds - size range from 30 mm-300 mm, sub-angular to sub-rounded. Rock types noted: granite, quartzite, garnet schist, mudstone, chert, serpentinite.
2	0-0.15	0.15	Grey sandy top soil.
	0.15-1.4	1.25	Dry, ferruginous granular soil, sand and grit.
	1.4 -3.0	1.6(+)	Boulder beds.
3	0-0.4	0.4	Grey sandy top soil.
	0.4-2.6	2.2	Dry, ferruginous sand, grit and minor clayey sand.
	2.6-3.1	0.5(+)	Boulder beds.
4	0-0.35	0.35	Grey sandy top soil.
	0.35-1.4	1.05	Dry ferruginous sand, grit and minor sandy clay.
	1.4-1.8	0.4(+)	Boulder beds.
5	0-0.4	0.4	Grey sandy top soil.
	0.4-2.2	1.8	Essentially ferruginous sand and grit, with associated boulders and rock fragments up to 50 mm.
6	0-0.5	0.5	Grey sandy top soil.
	0.5-1.3	0.8	Dry ferruginous sand and clayey sand.
	1.3-1.5	0.2(+)	Boulder beds.
7	0-0.4	0.4	Grey sandy top soil.
	0.4-3.0	2.6(+)	Dry ferruginous sand and grit.
8	0-0.8	0.8	Grey sandy top soil.
	0.8-2.2	1.4	Moist mottled grey-brown clayey sand.
	2.2-3.4	1.2(+)	Soft moist grey sandy clay, containing mica (muscovite). Water noted seeping into pit between bottom two horizons.
9	0-0.4	0.4	Grey sandy top soil.
	0.4-2.5	2.1	Dry ferruginous sand, grit and minor clay. 2.5 m: Backhoe stopped by large quartzite boulders.