NRA

National Rivers Authority
Anglian Region

NATIONAL RIVERS AUTHORITY
ANGLIAN REGION

BEDFORD OOLITE AQUIFER WELLS
HISTORY TO SEPTEMBER 1989

1.) Two licences of right currently exist in this part of north Bedford (see figure 1). The first exists near to the River Great Ouse at the Clapham Pumping Station operated by Anglian Water (AW)(Licence no 6/33/11/22). This consists of two wells with headings and collecting galleries in the Oolitic Limestone, constructed between 1867 and 1928. The second is situated 950 m east of the first at Park Road North and is operated by Charles Wells Ltd.,(CWL)(Licence no. 6/33/11/14), a brewery and major employer in the town. This dates from around 1903 and is 24 metres (m) deep.

2.) The Clapham well (No 1) was sunk at TL 03575124 to 32m in 1867 by Charles Wells, and donated to the towns people of Bedford. In 1870 an open cutting 47m long was made up the approach road in an ESE direction and arched over. A yield of between 0.19 and 0.26 million gallons per day (mgpd) (863.7 to 1182 cubic metres - m^3), was achieved. In 1874 the cutting was extended 61m further, increasing the yield to between 0.26 and 0.36 mgpd (1182 to 1637 m^3). This was again extended, so that by 1903 it was 247m long. In 1897 a further heading was constructed 141m long which branched off from the first one at a point 66m from the starting point of the latter, taking a SSE course [ref 4.]. This increased yield to approximately 1 mgpd (4546 m^3), and 5 to 7 mg (22730 to 31822 m^3) per week. A new well (No 2.) at TL 03655104, 18.5m deep and with a 96m long heading in a NW direction, was constructed between 1903 and 1905 with a "...considerable increase in the supply of water..."[ref 1]. A heading linking No. 1 and No. 2 Pumping Stations was made in 1928, extending the branch adit from 141m to 204m long [ref. 4]. Details of the adits existing in 1903 can be seen in figures 2, and 3. Details of the adit system in 1965 are shown in figure 4.

3.) In 1903 Major Tulloch, Chief Engineering Inspector, Local Government Board, wrote on Bedford's Water Supply. From his records a maximum of over 1.4 mgpd (6364 m^3) was abstracted in a period of a week, the average for the full 21 weeks between June and November 1906 was 1.092 mgpd (4964 m^3). His full report, which comments in detail on local geology and sources of water, makes interesting reading. [ref 2.].

4.) Up to about 1915 all water for Bedford was produced from these underground sources but thereafter, river water was also drawn into the collecting galleries by way of river intakes as a wartime necessity. This river water was only coarsely screened.

This abstraction was regularised by the Bedford Corporation Act 1927. The powers to abstract from the river intakes was repealed on 29th June 1960, under the Bedford Water Order 1951, and incorporated in the North Bedfordshire Water Order 1960. The provision relating to underground supplies was still retained. With the completion in 1960 of a new river abstraction scheme pumping from the well and headings ceased because the two sources (i.e new river intake and Oolite well) were not connected.

5.) The steam plant originally installed in the No. 1 Pumping Station was replaced in 1933 by a vertical spindle borehole type pump designed to abstract up to 1.5.mgpd (6819 m^3) from the well and headings. This pump was dismantled when the building at the No.1 site was demolished in 1965. A new 12 inch diameter main and new submersible pump was then installed to connect the No. 2 well with a new river abstraction site and treatment plant, just upstream (TL 036515). Water from the No. 2 site was regarded as much cleaner.

6.) 'Dams' in the adits (see fig 4.) appear to have been constructed to separate "Rock Water" from the No.2 well from the "River Water" of the No. 1 source. The Rock Water was then pumped straight into the service reservoir at Manton Lane, by-passing the filters, as it was regarded as sufficiently pure. This direct connection to the reservoir ceased in the mid 1950's. Water from the No. 1 source required screening.

7.) In June 1965, North Bedfordshire Water Board applied for a Licence Of Right under the terms of the 1963 Water Resources Act. Section 34(3) of this act required details of quantities taken during the period of five years ending 1/4/65. The Oolite wells had not been used during that period, but Section 34(4) directed the River Authority to take into account the extent to which works etc., were reasonably provided by the applicant in anticipation of future requirements. As the Board had already incurred expenditure on a connecting pipeline and overhaul of the pump, this was deemed sufficient to establish the entitlement of a licence of 366 million gallons per annum (mgpa) (1663836 m^3). The Licence was granted on 6/12/67 for 70,000 gallons per hour (gph) (318 m^3), 1.5 million gallons per day (mgpd)(6819 m^3), and 366 mgpa (1663836 m^3).

8.) Little is known of the operation of the Charles Wells source, other than it too was granted Licence of Right status in June 1967, having justified abstractions for the five years prior to 1965 of 4,000 gph (18 m^3), 60,000 gpd (273 m^3) and 13.14 mgpa (59734 m^3).

9.) In October 1965 a licence application was made by Texas Instruments Ltd (TIL) for a site situated 540 m north of the CWL well. The application was to provide water for a "super purity water production plant" for later use in cleaning semi - conduc-

tors. Local surface water from AW's predecessors North Beds. Water Board had unacceptable quantities of organics which ruined the purity of deionized water. They therefore had to rely on Mid Beds. Water Board supplies brought in by road tankers from Birchmoor every night. This source had no guarantee of continuance.

10.) TIL's original licence application was for 10,000 gph, (45.5 m^3), 240,000 gpd (1091 m^3) and 87.5 mgpa (397775 m^3). No objections were received although the two close wells mentioned above were within a radius of one mile. (N.B. all water would be returned to the R. Ouse via Beds. Corps. Sewage Works.).

11.) The application was referred to the Water Resources Board (WRB) for comment. They replied that 10,000 gph (45.5 m^3) seemed rather high compared with other yields experienced locally. As a result of the uncertainties regarding the yield the request was to be deferred until after the completion of pump tests and only a trial bore could be constructed. (December 1965).

12.) On 5/4/1966 CWL contacted the Great Ouse River Authority (GORA) to lodge an objection. It seems the TIL plans came to light with the request to monitor their well during pumping tests. Test pumping of TIL's 0.53m diameter, 73.1m deep borehole at TL 046 515 started on 10/9/1966. According to the WRB, in a letter dated 27/10/1966 the data obtained indicated that near equilibrium conditions were obtained in the vicinity after 13 days pumping; the maximum drawdown being a little over one metre for approximately 10,000 gph (45.5 m^3). They thought it "....probable that the aquifer (Great Oolite Limestone and Upper Estuarine Sands) is recharged by streambed infiltration from the Ouse. Though the partial recovery levels recorded at the observation wells after intermittent pumping show a sympathetic decline it is pointed out that the drawdown at Clapham is almost exactly the same as that at the CWL well. (i.e 0.91m at CWL and 1.0m at Clapham). It is unlikely that the Clapham well was affected at all as the TIL tested hole showed very little response to the two periods of pumping at this observation well. No long term adverse effects appear likely except the interference noted above but the test must be regarded as unsatisfactory from a quantitative stand point."

13.) As a result TIL, after consultation, applied for a temporary licence (6/33/12/101) of 6,000 gph (27.3 m^3), 60,000 gpd (273 m^3), and 10 mgpa (45460 m^3), for the 12 month period starting 30/4/1967. Despite further objections from CWL and Great Ouse Water Authority (GOWA) - who dropped the objection when they discovered that the water would end up back in the river via the STW - TIL requested and obtained a further licence for another year. In March 1969 TIL requested that the licence be made permanent. However since they had not abstracted any water under the two

previous temporary licence periods, the effect on the CWL borehole of continued pumping could not be assessed. Therefore a further 12 month temporary licence was agreed.

14.) In January 1970 TIL informed the GORA that they had not used water from the borehole due to the high level of dissolved solids which they could not remove. They therefore decided not to extend the licence but wished to hold the option open until treatment technology improved. They were informed that this could not be done and that unless they kept hold of the licence it may be re - allocated. They still however let the licence expire.

15.) In 1973 CWL requested permission to investigate a borehole at the new brewery, a site previously used as a gas works and tip, at TL 040 493. If this proved successful they would revoke two licences of right at the old Horne Lane brewery site. These were 6/33/11/13, a two borehole and two well source with a licence of 5.19 mgpa (23594 m^3), and 6/33/11/12/39, a surface water source from the River Ouse for 5.4 mgpa (24548 m^3). Drilling started early in 1974 but the borehole was abandoned as gas oil and creosote were found entering the well from Hard Grey rock approximately 18.3m below the surface. The well was plugged.

16.) The plan to revoke the licences at Horne Lane was postponed but no further water was in fact abstracted. The site at the old brewery was sold to the Bedford local authority and therefore the licences were revoked in 1976. This left CWL dependent on their Park Lane source.

17.) In 1978 CWL began questioning the reliability of the Park Lane source (Licence 6/33/11/14) as a result of pumping from Clapham. They also asked for an increase in quantity abstracted from 13.14 mgpa (59734 m^3) to 26 mgpa (118196 m^3) due to them no longer having the resources at Horne Lane. In fact they had already pumped 17 mgpa (77282 m^3) during 1977. Their request was denied. CWL then put forward a proposal for a new 0.25m borehole to be drilled to a depth of 36m at the Park Lane site to augment present abstraction from the well a few metres away. After pumping tests in 1979 CWL applied for a variation to the existing licence to include this second source. Quantities of 6,000 gph (27.3 m^3), 105,000 gpd (477 m^3) and 32 mgpa (145472 m^3) were required.

18.) This varied licence was agreed as only slight drawdown had resulted at the Clapham well, but as two other sources were thought to be at risk it was made subject to an arrangement being made between North Bedford Borough Council (NBBC),(Bedford Park Lane), APE - Allens Ltd (APE),(a two pond source), and CWL which was acceptable to AW. to safeguard any derogation. As a result of talks a test took place between 25/5 and 15/6 1980 with abstraction from both Clapham and CWL - Park Lane. As a result it was found that variations in water level at the APE ponds were caused

by abstraction by the company itself and abstractions at Clapham and CWL Park Lane did not result in an inability to abstract the licensed quantity. Geological details from numerous well constructions in the area suggested that the ponds may be penetrating the Cornbrash and not the Oolite as previously postulated. Subsequently NBBC confirmed that they had no objection to the licence being granted, as the pump and float levels in the Bedford Park Well had been removed and installed at a depth sufficient to ensure no derogation.

19.) It is of note that the maximum quantity which could be maintained at Clapham over the 21 day test period was 0.72 mgpd (3273 m^3) despite the licensed quantity of 1.5 mgpd (6819 m^3). (Clapham Licence : 70,000 gph (318 m^3), 1.5 mgpd (6819 m^3), 366 mgpa (1663836 m^3) subject to an aggregate not exceeding 12 mgpd (54552 m^3) for this source and the river abstraction at TL 036 515 - This quantity was assessed on abstraction in 1926 when the two wells and headings were in operation). Also of note is that prior to 1974 the well at Clapham was used as a stand-by source only. Quantities abstracted increased after this time due to the need to dilute high nitrate water abstracted from the River Ouse. Even by 1977 however, when CWL were experiencing difficulties at Park Lane, Clapham was only using 25% of its licensed quantity.

19.) In January 1983 TIL approached Great Ouse River Division ORD) to open talks on the possibility of obtaining a licence. It appears that the problem of dissolved solids could now be overcome with a new Reverse Osmosis Plant they had installed, (initially to treat mains water). A meeting was held in March 1983 involving representatives from TIL, CWL., Dr.C. Wilson (consultant to CWL) and two GORD officers. At this TIL expressed a requirement for a licence of 6000 gph (27.3 m^3), 144,000 gpd (654.6 m^3) and 52 mgpa (236392 m^3). They had refurbished their pump and borehole in January and had abstracted during 8 - 24 February at a rate of 3,600 gph (16.4 m^3) to 5,600 gph (25.5 m^3) as an emergency measure during the water workers strike with the consent of Bedford Water Division.

21.) CWL stated their objection to the TIL application. Dr Wilson pointed out that in January 1983 CWL had experienced difficulty in obtaining their water due to a lowering of their rest water level when the Clapham source was pumped. He suggested that the Oolite in the neighbourhood was very close to full development and that the only effective way forward would be for A.W. to investigate the possibility of reducing the abstraction at Clapham, which could in any case only extract half its licensed daily rate of 1.5 million gpd (6819 m^3). It was finally agreed that GORD would contact TIL to make arrangements for pumping tests of their borehole whilst Clapham and CWL Park Lane, sources were operated in a controlled manner.

22.) This test was carried out on 9/10 April 1983 at a constant rate for 30 hours. Water levels at CWL Park Lane, and Clapham were monitored and showed a slight drawdown in the groundwater levels. (analysis indicated a lowering of 0.5m in the rest water level at CWL Park Lane.). Such a drawdown is small compared with that created by the operation of the Clapham source which can range from 1m after four days pumping to 2.5m after sixty days pumping.

23.) After internal A.W. discussions during June 1983 it was concluded that the application should be refused on the grounds that CWL were already experiencing difficulties in obtaining adequate supplies and that the TIL source would further exacerbate the existing problem. However, if in the future there was a reduction in the licensed quantities e.g CWL moved their source to the south of Bedford, then a future application would be more favourable. It was also thought that conditional licences (i.e. with control rules) should be avoided due to difficulty in operation.(NB this approach had previously been agreed as the basis for settling the 1980 licence increase at CWL, Park Lane, involving APE,NBBC and CWL although in the end it was not required.) With respect to the Clapham source imposing greater drawdown than TIL - as it was already a licence of right this was not considered relevant.

24.) As a result TIL were told in August 1984 that a licence application would not be favourably received as "...Provisional calculations based on existing data for the Oolite Aquifer in the Bedford area indicate that the proposed abstraction by Texas Instruments (288,000 gpd/100mgpa) could result in an unacceptable drawdown, during prolonged periods without recharge, at the Division's Clapham Source. This also applies, as I am sure you are aware, to the Charles Wells Park Road source. They were advised to wait until CWL had looked at their new site with the hope that success here would reduce the amount they required from Park Lane. A further meeting between all parties was held in November 1984. CWL indicated that in the long term they wished to abandon their existing licence of right at Park Lane and develop a new borehole at their brewery. A twenty year overlap of operation was however deemed necessary, for CWL to ensure continuity of the particular quality of the Oolite Water, which is vital to their product.

25.) In March 1985 TIL again applied for a licence, this time for an increased quantity of 8,500 gph (38.6 m^3), 204,000 gpd (927.3 m^3), and 74,460,000 gpa (338495 m^3). TIL were informed that until this well had been test pumped no decision could be made (this was the existing borehole test pumped previously in April 1983 and September 1966) and the request was deferred to July 1986. Test pumping was undertaken in January and February 1986, but the report was not delivered to Anglian Water until September 1988. The determination of the application was therefore deferred to

July 1987, then to July 1988, and again to July 1989. TIL did not pursue the issue as they were awaiting the decision of CWL on the viability of the New Brewery site source.

26.) In May 1985 CWL applied for a two part licence for the new Brewery site to replace the existing Park Lane site. This comprised of a large diameter borehole in the Great Oolite for brewing purposes, set at 7,000 gph (31.8 m^3), 122,500 gpd (556.9 m^3) and 37 mgpa (168202 m^3), and a further series of small shallow boreholes in the river gravels for industrial and cooling purposes requested at 6,750 gph (30.7 m^3), 135,000 gpd (613.7 m^3) and 45 mgpa (204570 m^3). This request was deferred for 12 months awaiting test pumping initially, and has subsequently been deferred each year up to July 1989 as the test pumping results were not forthcoming. Pumping tests were carried out in 1985 but the results raised doubts as to whether a single large diameter well could meet the brewery requirements and so a further four "production" 2m bores were drilled in 1986. It was also found that the river gravel sources were unproductive when the water table was drawn down and so plans to licence these were abandoned.

27.) Quality problems were encountered with the Oolite Boreholes and during further pumping tests in 1987 all bar bore number 2 were found to be unsuitable due to high iron levels. The brewery therefore decided to revise the licence application for this site downwards to 2,000 gph (9.1 m^3), 48,000 gpd (218.2 m^3) and 17.5 mgpa (79555 m^3), and to limit the proposed abstraction to the Great Oolite aquifer. This volume is insufficient for the brewery requirement and so they request that this source be licensed as an emergency reserve supply which under normal circumstances will not be used.

28.) In November 1987 CWL applied to sink and test a third borehole at the Park Lane site to a depth of 28m (cased to 20m) and diameter of 1m. As a result they requested to vary the licence (6/33/11/14) in June 1988 from 6,000 gph (27.3 m^3), 105,000 gpd (477.3 m^3), and 32 mgpa (145472 m^3) taken from their old well and borehole at TL04605098 to 12,000 gph (54.6 m^3), 288,000 gpd (1309.2 m^3), and 80 mgpa (363680 m^3) from both the old sources and a new well at TL04625099. A.W. queried this application due to the effect on its Licence of Right at Clapham. TIL did not object despite awaiting a decision on their prior application, as they were now co - operating with CWL in pursuance of a similar goal. A letter deferring this application was sent in October 1988 to provide time to look at test pumping undertaken at the Brewery and Park Lane boreholes.

29.) In July 1988 CWL and TIL signed an agreement - that in the event of both licences being granted TIL would limit the right to operate (i.e cease abstracting) within one hour, in the event of CWL not being able to extract water from its Park Lane sources at

a rate equivalent to the new variation licence quantities. This was agreed in the light of the new third borehole at Park Lane which CWL claimed was far more efficient than the existing wells.

30.) In February 1989 a formal meeting was arranged between representatives of CWL, TIL and the NRA Unit of Anglian Water. The meeting concluded that : -

a.) A pump test should be carried out, starting early March, for two months, with TIL pumping at 8,500 gph (38.6 m^3) and CWL pumping at 12000 gph (54.6 m^3) (the licence application quantities) and AW Clapham operating "normally". Results to be assessed directly.

b.) If the first test was successful, AW to undertake a Sourceworks Reliable Output (SRO) test analysis at Clapham, with just CWL abstracting its licence of right quantity - 6,000 gph (27.3 m^3).

c.) If the first and second tests were successful, proceed with all sources pumping at licensed, or required licensed quantities.

31.) During the discussions TIL representatives informed the NRA staff that they had been abstracting at Manton Lane for some time, and for the preceding six months had abstracted at over 4000 gph (18.2 m^3). They have subsequently ceased abstractions, except for the authorised test pumping.

Summary of Results of Test Pumping, March to July 1989.

Programme of Tests :

32.) The TIL borehole was pumped at a constant rate of 948 m^3/d from 10:30 on 2nd March to 11:00 on 8th May. The borehole was pumped intermittently for supply purposes (mean rate 393 m^3/d) for several months before the test, and continued at a mean rate of 355 m^3/d for 18 days after the test, and was then shut down.

33.) CWL's new borehole was pumped at a constant rate of 1351 m^3/d from 14:00 on the 9th March, to 11:00 on the 12th May. Before and after this period the borehole was pumped intermittently for supply at the present licensed rate of 477 m^3/d.

34.) During the test and recovery period, Clapham Source (Number 2 Well) operated normally, pumping on demand. After recovery of water levels following completion of the TIL and CWL test, two brief test pumping exercises were conducted on the Clapham source, between the 13th of June and 29th June. Discharge rates were between 2680 m^3/d and 4040 m^3/d; the higher rates being sustainable for only a few hours.

35.) In the test period, water levels and pumped discharges were recorded at all three sites. During this phase it was realised that the measurement of drawdown at Clapham was inaccurate. Telemetry data from the Number 2 well showed greater drawdown than actually occurred. These data were adjusted using the Ott recorder charts, also on at Well Number 2. This failure explained partially why operation of the well had become increasingly difficult, with the pumps cutting out due to wrongly perceived low water levels. Resulting plots of the data for the test period are shown in figure 5.

36.) The third option to pump all three sites could not take place due to the July deadline for licence investigation.

Results.

37.) During the test period (March to July) all three sources experienced no difficulties in maintaining their required operational abstractions.

38.) The maximum drawdown at Clapham due to the test pumping at CWL and TIL was approximately 1.5 metres; the value is approximate due to the effect of Clapham source pumping during the start of the test, and possible aquifer recharge occurring in response to rainfall in early April, obscuring the record.

39.) The pumping tests at Clapham, to assess Sourceworks Reliable Output (SRO), demonstrated that the sustainable output of the source is very sensitive to changes in Rest Water Level (RWL), due to the operational regime which regularly dewaters the adits during pumping. Since any reduction in RWL would decrease the yield of the source to some degree, derogation is likely to occur whenever the RWL at Clapham is below +29.4 metres above datum (the highest soffit level of the adit system). The SRO test investigations did, however, suggest that much of the adit system was now blocked off, with a valve restricting flow at shaft 3 and a dam at shaft 5. Much of the adit bottom was also silted up. Both problems were being further investigated to improve yield and storage. It was thought that storage could be sufficiently increased in the adits to allow the existing daily licensed amount to be achieved for a short period. [ref 3.]

40.) However, due to the nature of the Clapham source, and its existing large Annual licensed quantity, the only way to prevent derogation being caused is to set a cessation level of 29.4 + 1.5 = 30.9 metres above ordnance datum at Clapham. Such a high cessation level would mean that, on the evidence of water levels recorded at Clapham between October 1988 and July 1989, CWL and TIL would only be permitted to abstract at their requested rates for 20% or less of the time; this is considered not viable.

41.) On this basis, there appears no alternative but to refuse the application on derogation grounds.

Ref: 1 = The Water Supply Of Bedfordshire & Northamptonshire From Underground Sources H.M.S.O. 1909.

Ref: 2 = Report On The Water Supply Of The Town Of Bedford - Major H. Tulloch. C.B., (Retd.) R.E. 1903.

Ref: 3 = Clapham Sourceworks Investigations, Interim Report On Testing Of Well NR 2. Charles Jones - Groundwater Development Consultants Ltd (On Behalf Of Anglian Water Authority) 1989.

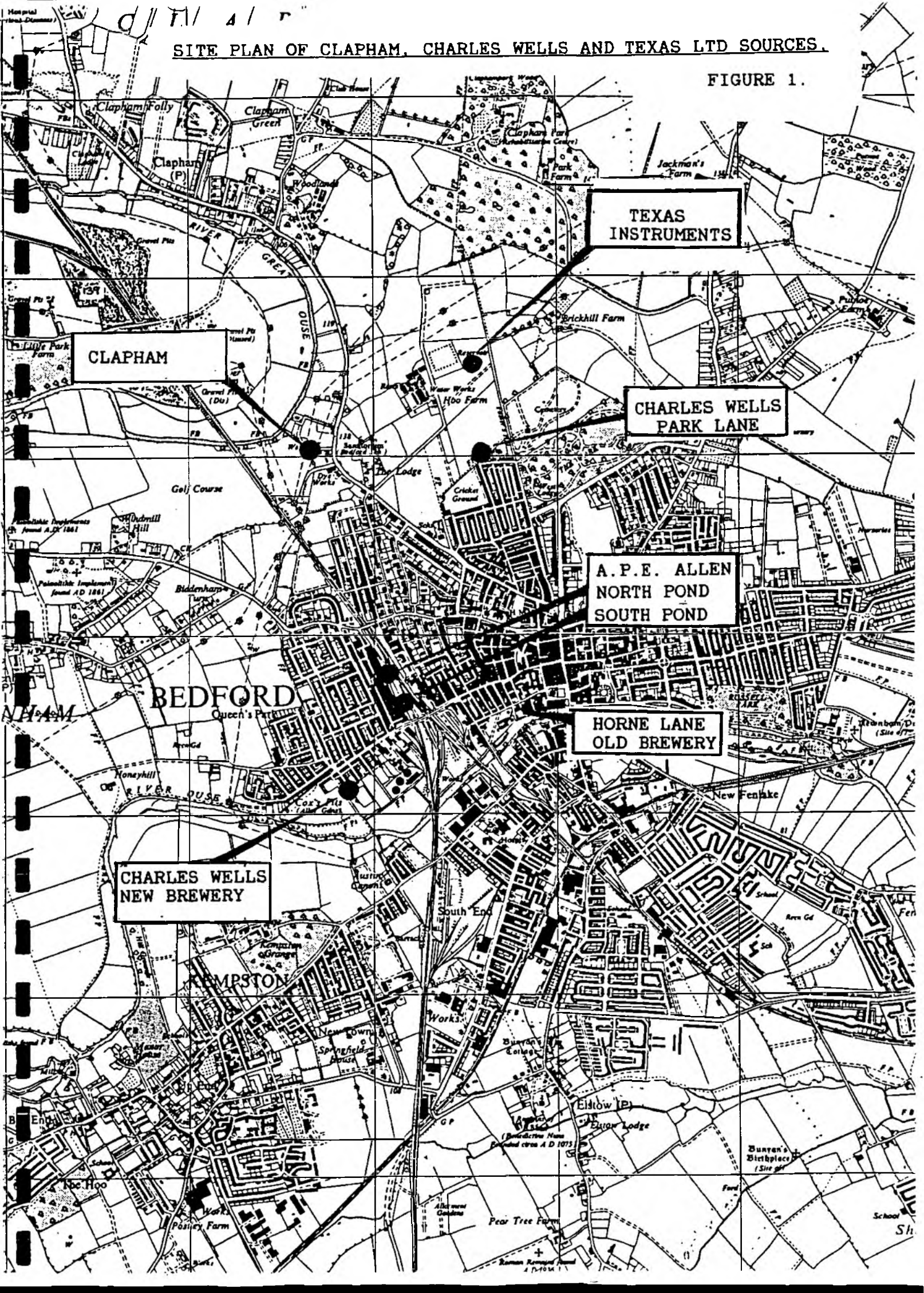
Ref: 4 = Annual Report 1949 - History of Works pp 16.

R. VAUGHAN 1:3:90

Thanks to D.C. Clarke - NRA for Pump Test Result summary,
Mr Brian Lodge, - Ex Bedford Water works 1953 to 1987.

SITE PLAN OF CLAPHAM, CHARLES WELLS AND TEXAS LTD SOURCES.

FIGURE 1.

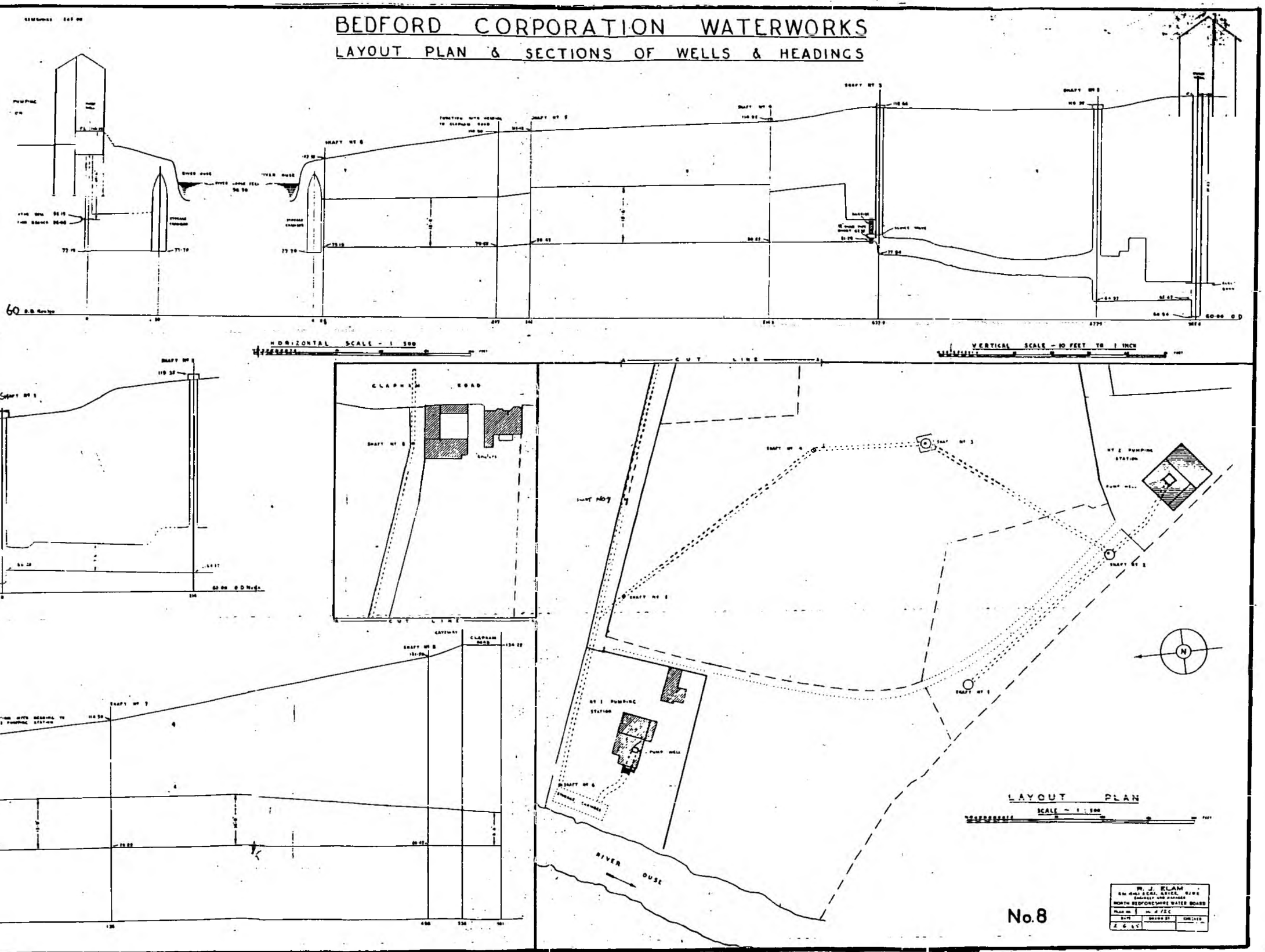


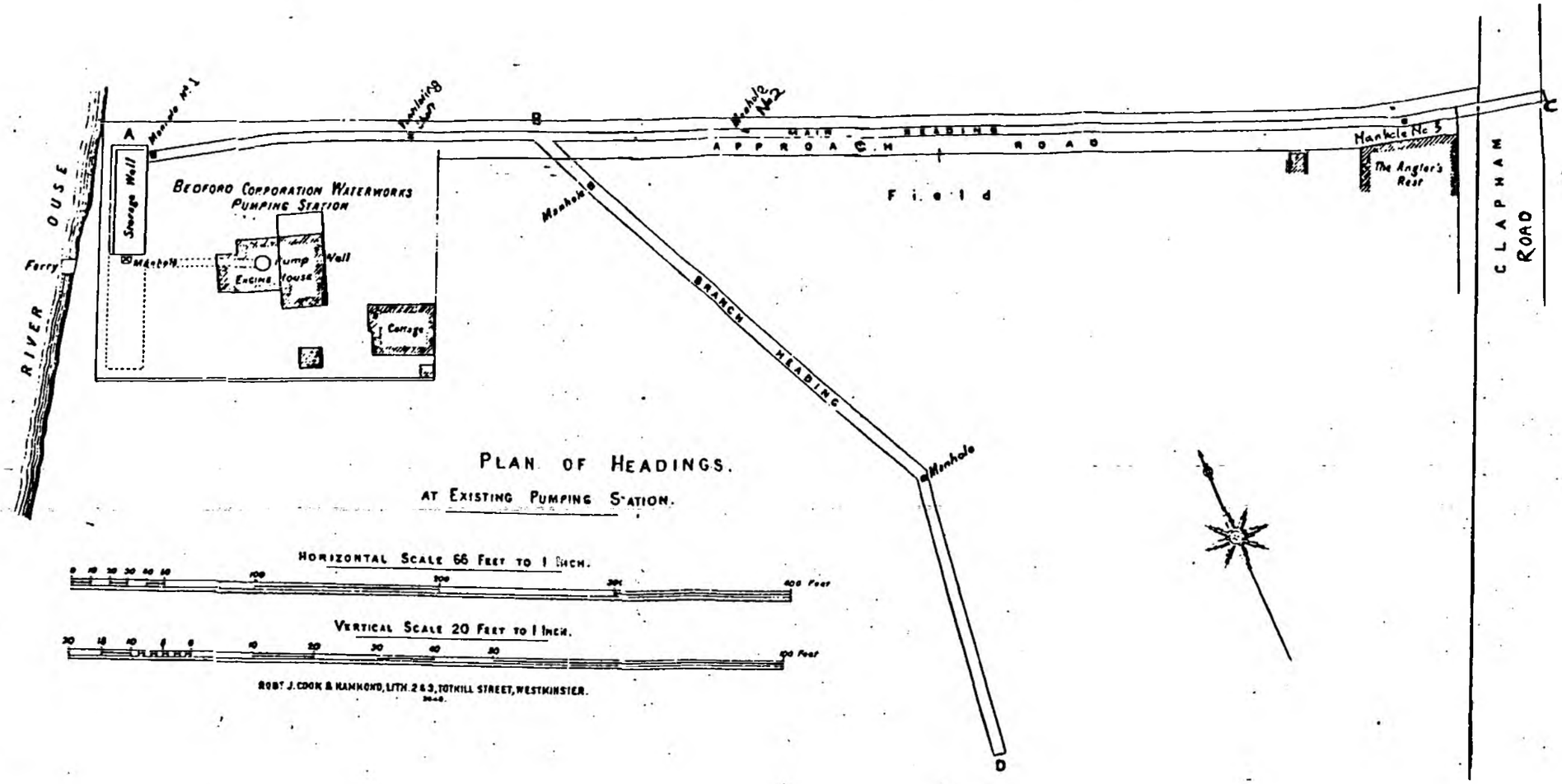
CLAPHAM WELLS No 1. & No 2. AND ADITS - 1965.

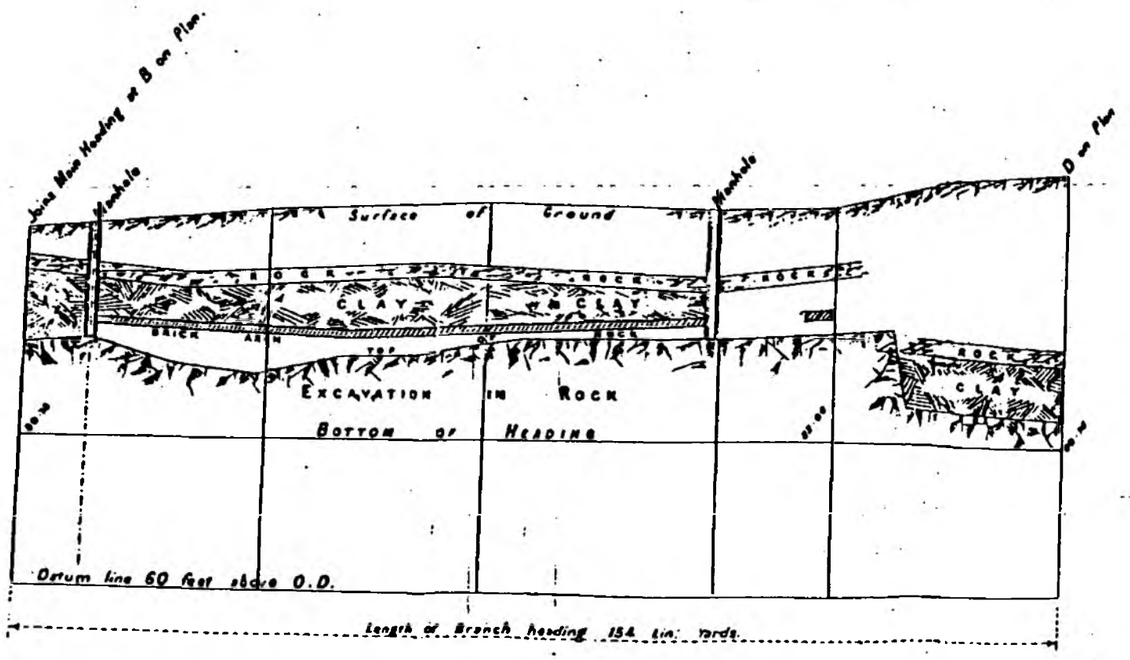
FIGURE 2.

BEDFORD CORPORATION WATERWORKS

LAYOUT PLAN & SECTIONS OF WELLS & HEADINGS







SECTION OF BRANCH HEADING B.D. ON PLAN ABOVE

NOTE.

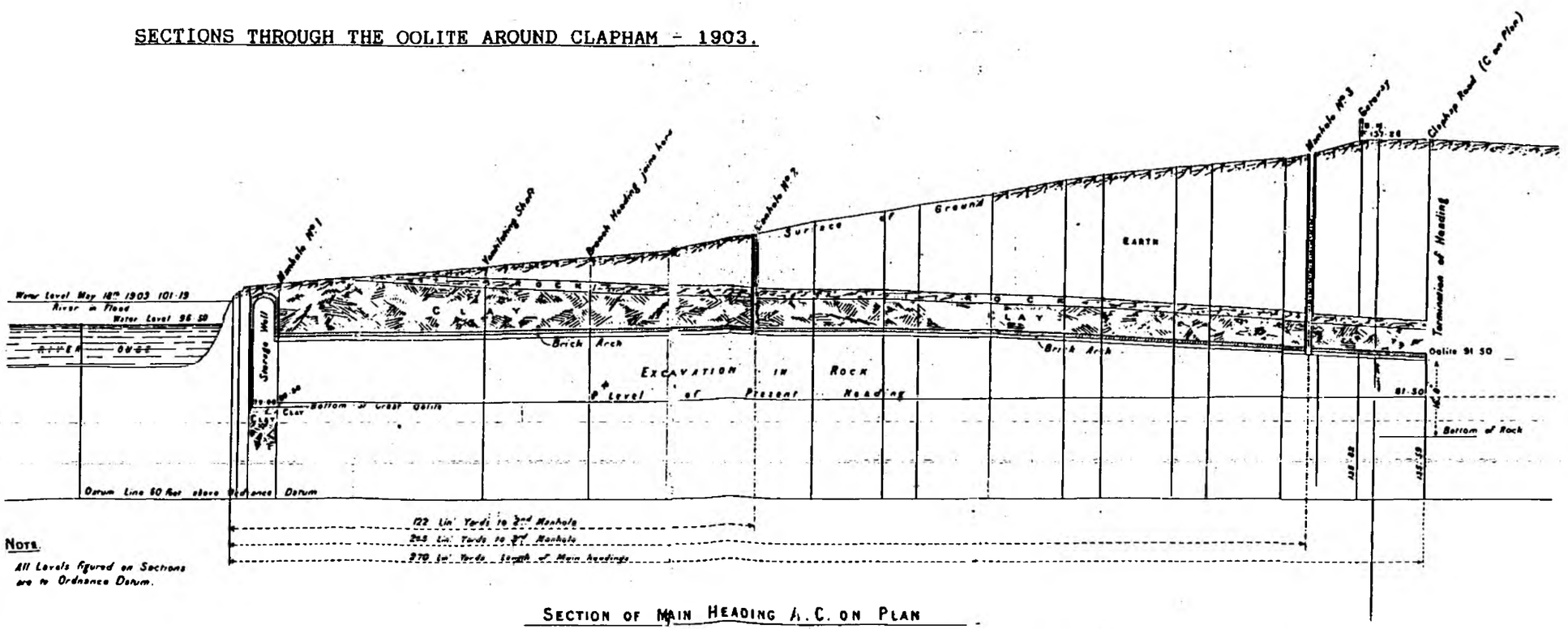
The headings vary in width generally from 3 to 4 feet but much wider in Parts, the Rock having been left as blasted out.

CLAPHAM WELL No 1. AND ADITS - 1903.

FIGURE 3.

F. Bullock MAJOR, C.B. (Retd) R.E.

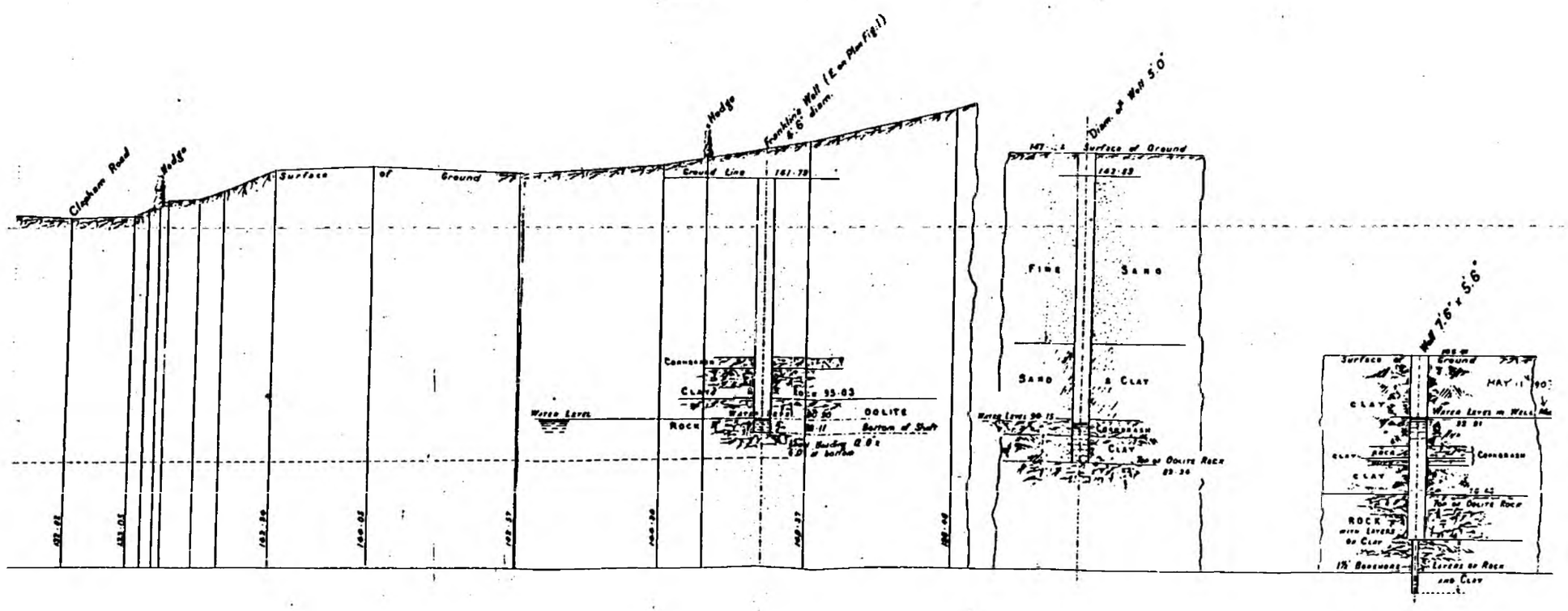
SECTIONS THROUGH THE OOLITE AROUND CLAPHAM - 1903.



NOTE.

All Levels figured on Sections are to Ordnance Datum.

SECTION OF MAIN HEADING A.C. ON PLAN



SECTION Continued to Mr Franklins Well (at E on Plan.)

SECTION OF WELL SITUATE AT NORTH PARK ROAD BEDFORD. Belonging to Mr Chas Wells.

SECTION OF WELL SITUATE AT BEDFORD PARK

FIGURE 4.