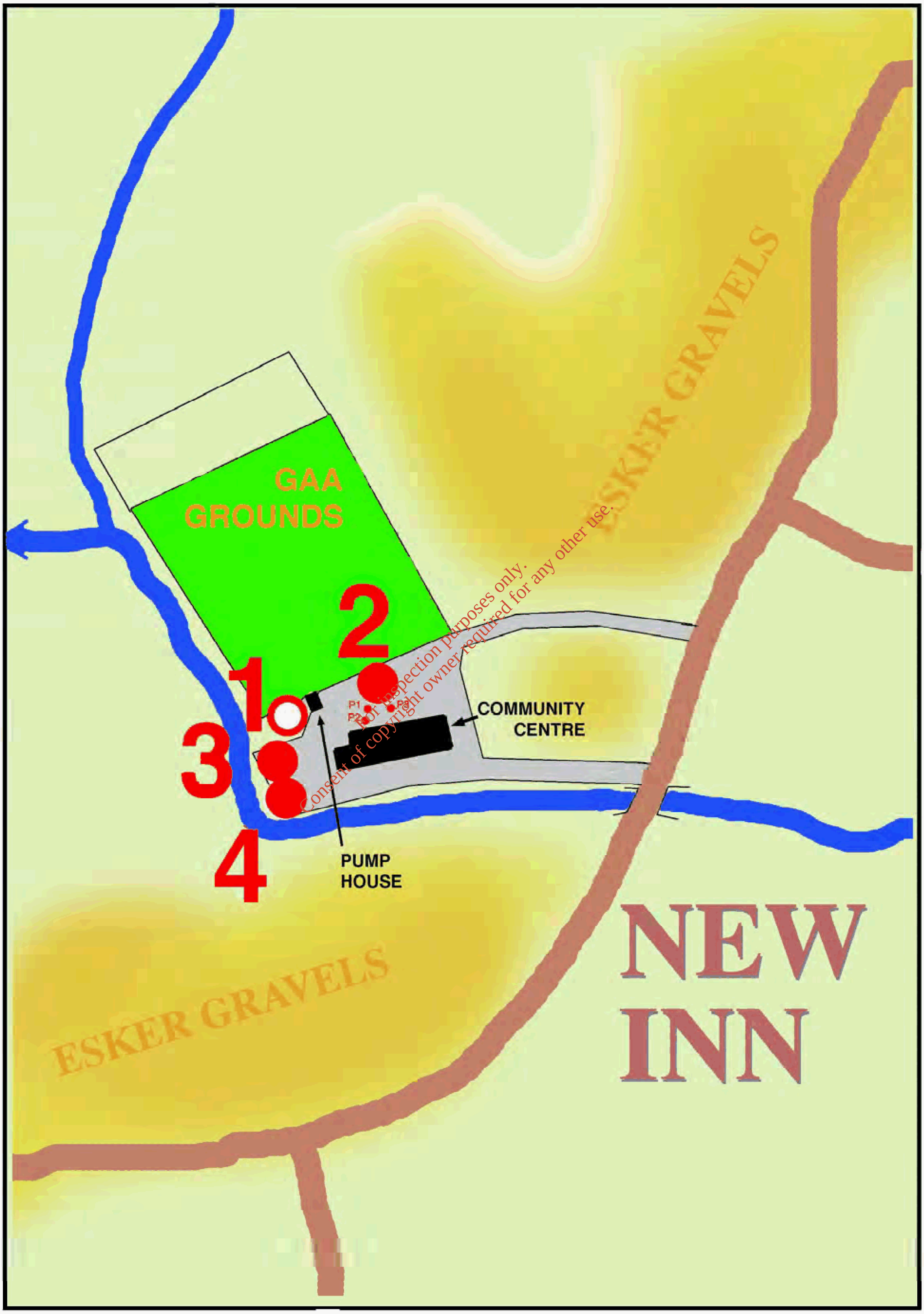
Figure 3 New Inn Group Scheme - Sketch Plan of Current Groundwater Source



The depth and basic design of all the boreholes and the piezometers is shown in Figure 4. This is a schematic cross section around the site. It shows how Borehole 1, the original source, encountered either bedrock or a large boulder at about 5 metres below the surface. This borehole was adequate for many years when the water demand was less than present but it suffered in dry periods when demand increased. When the demand increased it was usually a time when the water table was lowest. This meant that it was a time when the thickness of the zone of saturated gravel was least. Though the water was available in the aquifer, the groundwater had to struggle to move through the thin zone of saturated gravel and then through a limited open area of slotted well screen in order to pour into the hole. At these times the drawdown of the water level in the hole was very large.

Borehole 2 encountered the bedrock at a depth of about 8 metres. The borehole was designed in a different way from borehole 1. A sump was drilled and lined into the bedrock and the pump was lowered into the sump. The pump intake was therefore below the base of the aquifer. This design provided potentially a higher drawdown during pumping and a higher yield under normal water table conditions. However during dry periods this drawdown became excessive. The borehole was not supervised during the drilling, though the installation of the screen was supervised. It appears that a 2mm diameter slot screen was used. The available screen was also less than required and had been broken in transit. A pea gravel pack was installed around the screen, but even so, under high pumping rates and draw downs the screen and gravel pack fail to keep out the fine grained sands in the aquifer. These sands enter the hole and settle either in the bottom of the hole or the bottom of the reservoir. The sands also tend to lodge in the slots and impede the flow of water. This restriction of the flow through the slots can be removed by using a compressor and airlines and surging the borehole.

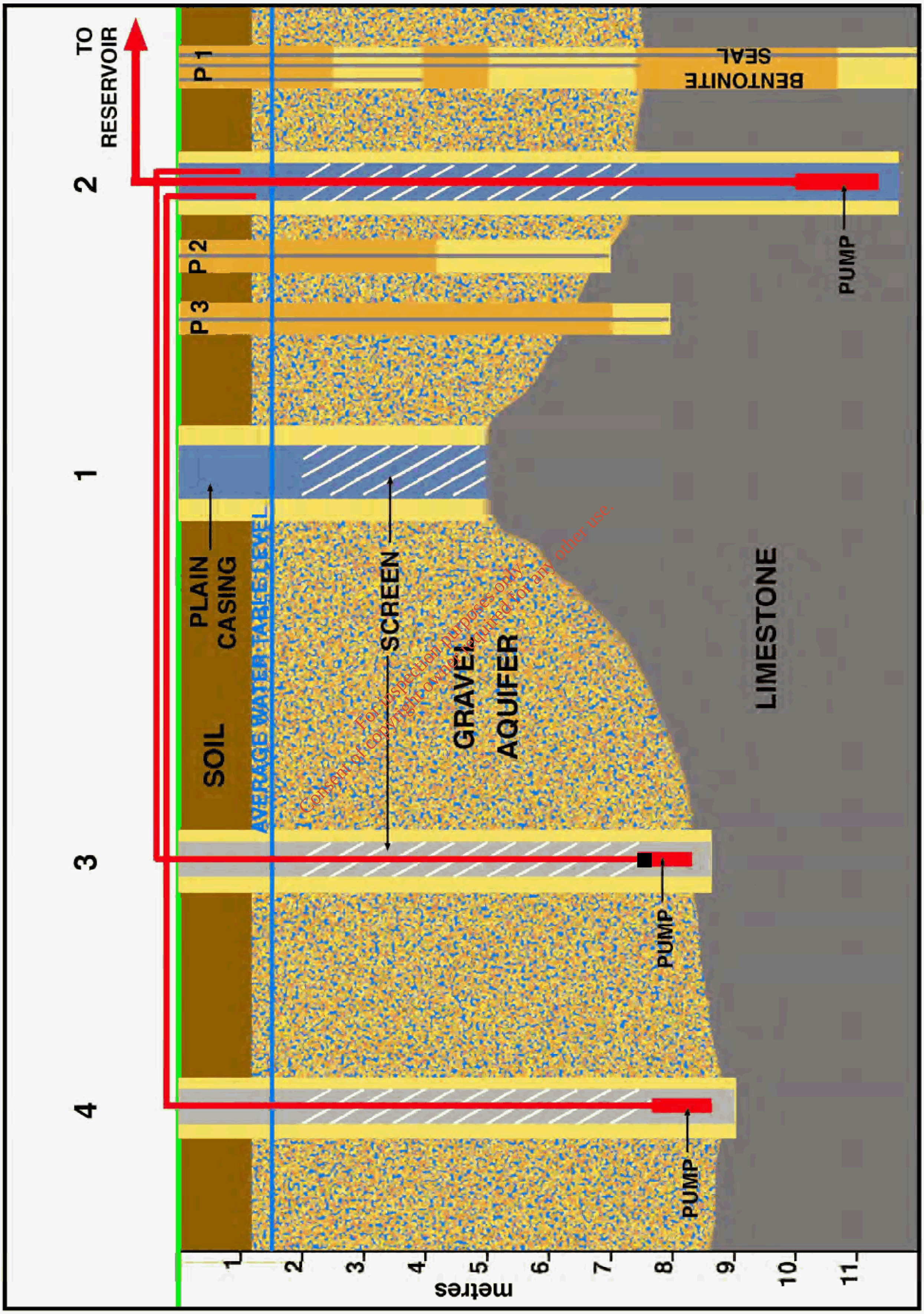
Borehole 2 is fitted with a 15 hp pump that is capable of pumping over 7,000 gallons per hour up to the reservoir. Experience has shown that it is important to not over pump borehole 2.

Boreholes 3 and 4 were drilled in 1996 as emergency additional sources to take the strain off borehole 2. These boreholes contain 8 inch screen and casing made from high grade PVC water pipe. The slots were cut at 10cm intervals on site using a circular saw. A temporary pumping arrangement was achieved, whereby low head lift pumps were installed in boreholes 3 and 4 and the water was pumped into the well chamber of borehole 2. From here the combined yield is pumped by the 15 hp pump up to the reservoir. This system works but it is not energy efficient and requires tuning. It is important to not over pump any of the boreholes, therefore all the pumps are pumping at less than their maximum discharge rate by partially closing lever valves to restrict the flow. It is not easy to fine tune the pumping rates of all three boreholes. In March 1999 the drawdown in the boreholes was 1.44 metres in borehole 2, 1.32 metres in borehole 3, and 2.48 metres in borehole 4. The pumping rates from boreholes 3 and 4 is not known because they are not metered separately.

Figure 4 shows the approximate designs for the three piezometers. It is noticeable that P1 contains three narrow diameter tubes open at three different levels separated by bentonite seals. P2 and P3 are single piezometers, one open in the bedrock, the other in the gravels.

The arrangements at the source may appear to be incongruous but they work. It is quite a sophisticated arrangement, but because water is pumped twice it is inefficient. It is evident to all concerned that the pumping arrangements need to be rationalised and the controls for managing the system need to be improved.

Figure 4 New Inn Group Scheme - Section through present Borehole Source



It is expected that the demand for water is going to increase. In my opinion the three boreholes next to the Community centre are probably withdrawing the maximum that can be obtained from such a small area. The aquifer is very permeable and when the water table is high and as a result the thickness of gravel saturated with water is also high then perhaps a combined yield of 10,000 gallons per hour could be sustained. However this will not be possible during a long dry spell in summer.

A new groundwater source is therefore required to provide additional water to meet a general increase in demand and the very high demand in dry weather.

11 trial boreholes were drilled during the 10th and 11th March 1999 using a power auger at different locations along the esker from Ballyfa to New Inn. The final and most promising holes were drilled in a piece of land prepared for forestry just to the north west of the GAA grounds. The area appears to be underlain by a thin peat and marl layer overlying sands and gravels that are similar to those found in the present well field next to the Community Centre. The holes went to 7 metres depth and bedrock was not encountered. The site is accessible, appears to be unused, and is near to the power supply and pipeline at the present well field. Therefore it is recommended that further exploratory drilling of wide diameter test boreholes is carried out at this site for a combination of hydrogeological and practical reasons. The overall programme is described below.

Recommended Water Supply Development Programme

The New Inn Group Water Scheme has been successful, but needs to be augmented and improved.

I am a hydrogeologist and therefore I am not qualified to either assess or make recommendations on pipelines or reservoirs. My comments on these items are therefore made in the context of managing the ground water source.

I recommend the following development programme:-

- Additional Source Exploration and Development.

Carry out an exploration drilling programme for an additional groundwater source. The most convenient and promising location at the moment appears to be at the northern end of the GAA grounds (see figure 5). The site is 400 metres away from the septic tanks along the western side of the road. The hydrogeological setting is similar to the position of the present boreholes. It should be possible using much finer geotextile wrapped well screens to hold out the fine sands and yet the water flow easily into the holes. I suggest that three 10" - 12" diameter boreholes are drilled at the locations shown in figure 5 using the shell and auger drilling method. Irish Drilling in Loughrea can drill at 10" diameter. A contractor from Northern Ireland or Wales may be needed to drill at 12" diameter. The advantage of the larger size is that a wider diameter 8" screen can be installed, and this will provide a larger open area for the water to flow into the hole. The hole will be more efficient. A 10" hole will only take a 6" ID screen that is nearly 8" OD. The holes should be drilled to bedrock, the screen installed, the temporary steel casing removed, the upper annulus cement grouted and then finally the holes airlift surged to develop a natural filter pack around the screen. The screen mesh will be the equivalent of a 0.25 mm pore size. A series of long pump tests should then be carried out to determine the sustainable yield and water quality. A more detailed programme will be drawn up when a contractor is located and appointed.

- Revised Groundwater Pumping System

The present pumping arrangements are energy inefficient. The water from boreholes 3 and 4 is essentially pumped twice. I recommend that pumping tests are carried out late this summer when water levels are low in order to determine the optimum drawdown and yield. In the mean time I suggest that the idea of using just one surface mounted centrifugal pump is considered. This pump should be sufficiently powerful to deliver say 6,000 gph to the reservoir but also would suck simultaneously from each borehole. Raising the water to the reservoir is not difficult. The difficulties arise from maintaining the suction head from all three holes and controlling the rate of pumping from each hole. The optimum rate will be different for each borehole. I suggest that the optimum rate will need to be the rate that does not drawdown the water level in any borehole below 3 metres below the pump level. The suction pipelines for boreholes 3 and 4 will need to be trenched below ground level. I suggest that the pump is installed in the present well house, though perhaps in a sunken chamber.

If this system of pumping works then the same arrangement could be used in the new well field at the northern end of the GAA grounds. My suggestion could lead to 6 shallow boreholes in two clusters (well fields) being pumped by just two pumps. I have located a Grundfos pump (NP 80-50-200). It is a 15 kW pump that should be able to pump 9,000 gph to a head of 55 to 60 metres. The difference in head between the well field and the reservoir is probably 35 metres therefore the critical information is the head losses in the rising main to the reservoir.

- New Pipeline, Additional Reservoir, New Water Treatment System, and Revised Metering and Controls

If the option of using just two pumps for 6 boreholes is viable, it may mean that a new rising main is required to reduce friction losses in the pipe.

The present reservoir provides only 24 hours storage in theory but because several consumers are 'above' the base of the reservoir the lower part of the reservoir is not sufficient to maintain supply to all consumers. I suggest that a second and preferably higher level reservoir is constructed. If a higher level is not achievable then consumers who experience lack of pressure must be facilitated with booster pumps.

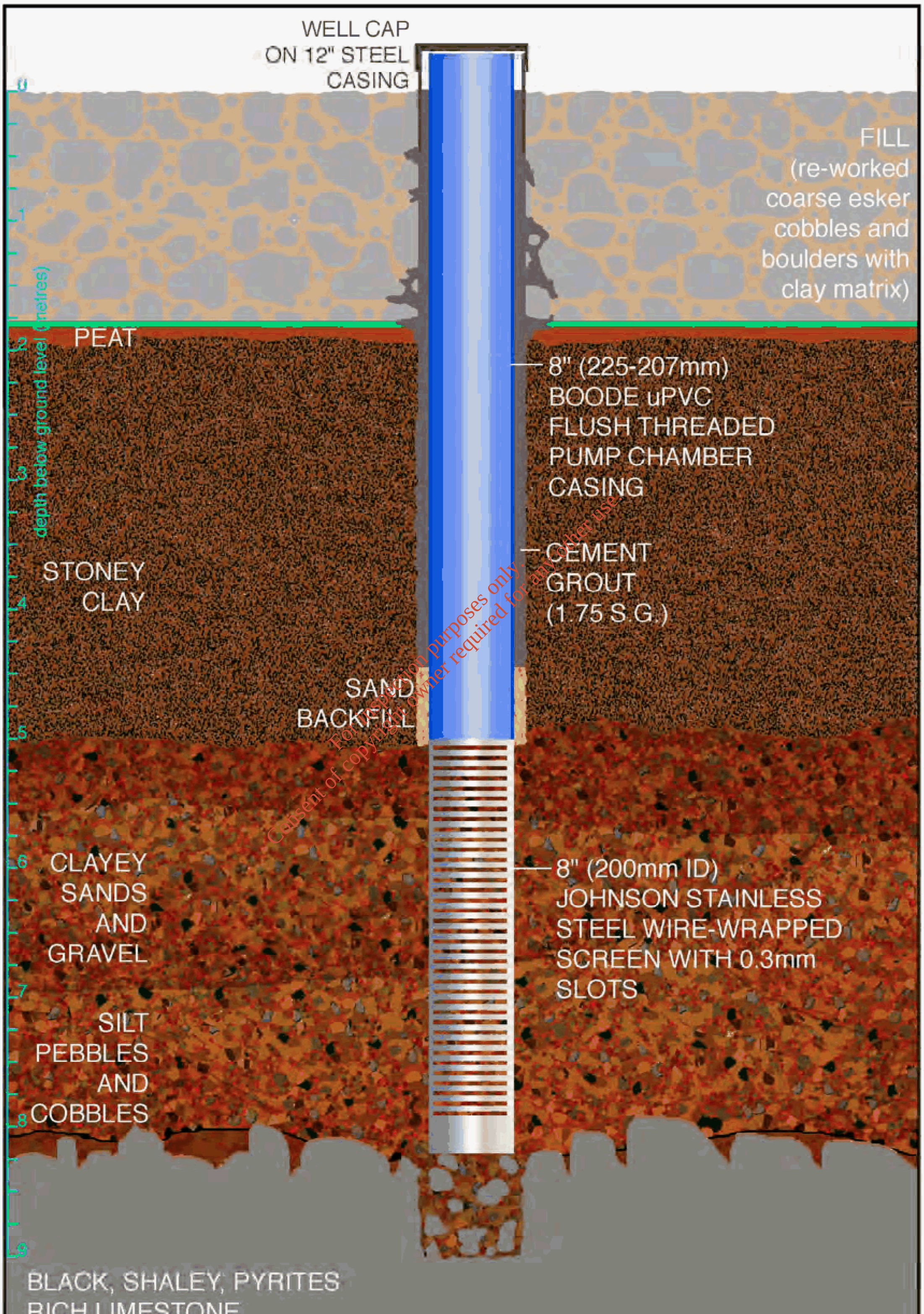
Though the water quality appears to have been very good, I suggest that water treatment by chlorine is considered. Ozone on the mains leaving the reservoir is another option but it may react adversely with the old black 'hydradare' pipelines. I suggest that the latest information on ozone treatment and plastic pipes is obtained from Forfas.

I suggest that a series of water samples are analysed for the natural level of fluoride in the water before fluoridation is considered. The natural levels may be close the recommended levels in a water supply.

The new and revised system needs to be more automated and more easily controlled. For example at the moment it is necessary for someone to drive to the reservoir, open gates, walk through mud, climb a ladder, lift off a manhole cover and dip a tape measure into the reservoir in order to see level of water in the reservoir. This system works but it is time consuming and awkward. I suggest that a consultant is employed to advice on a whole system of meters, switches and valves linked together by the latest telemetry. It should be possible to go to one location (say the well field pump house) and obtain a read out of levels pressures and flow rates in the system, the boreholes and at the reservoir(s). A cost - benefit analysis will be required.

SMG DOYLE KING Consulting Engineers and GALWAY COUNTY COUNCIL

NEW INN GROUP WATER SCHEME SUPPLEMENTARY PRODUCTION BOREHOLE DRILLING AND TESTING



SUMMARY REPORT
JANUARY 2005

David M. Ball, Hydrogeologist, 28 New Bride Street, Dublin 8

New Inn Group Water Scheme
Supplementary Production Borehole Drilling and Testing

Summary Report

January 2005

David M. Ball, Hydrogeologist

1. Introduction

The objective of this report is to provide a summary of basic information on the three, recently completed, supplementary production boreholes, in order that prospective contractors are given sufficient information before submitting tenders to design build and operate a high quality water supply scheme for the area. Copies of the Summary Report will be sent to SMG Doyle King Consulting Engineers (Athlone) and Ryan Hanley, Consulting Engineers, (Galway).

I have worked with the Trustees of the existing New Inn Group Water Scheme over about 10 years. The infrastructure that forms the basis of the water source for the scheme may seem to be a little puzzling to someone approaching the scheme for the first time in 2005. This is because the source for the scheme has evolved, from a start in a different era, as required by changing demands and periodic emergencies. The evolution of the scheme has been constrained by overall resources, hydrogeological factors, and the existing pumping, distribution and storage infrastructure. Though, at all times, I have found that the Trustees have earnestly tried to find a proper technical solution to the problems within the limits of their financial resources.

The background to the groundwater infrastructure is contained in a Summary Technical Assessment report in 1999. I do not intend to repeat the contents of that report as it explains the evolution of the source up until that time.

Since 1999 I have had two involvements. The first when a hurried intervention was necessary to boost the output of the scheme, and two boreholes were drilled in one long day in June 2000. These are boreholes labelled BH 5 and BH 6 shown in Figure 1 in this report. The second involvement has been in drilling and testing 3 supplementary production boreholes in 2003-2004.

For completion the details of the two boreholes drilled in June 2000 are as follows:

Borehole 6 (as labelled on figure 1)

0-2 m soil and marl-silts
2-6 m grey fine sands and fine gravel
6-8 m coarse gravels and cobbles
8-11.25 m black shaley limestone bedrock

The bedrock hole section was backfilled to 9 metres below ground level.

A 6 metre length of 5 inch diameter, 1mm slot size, PVC screen was installed in the aquifer below a 3 metre length of 5 inch diameter plain casing. The 5 inch screen was enclosed in a special, water well grade, 300 micron pore size, geotextile sleeve, in order to inhibit the ingress of fine sand and silt, yet permit water to efficiently enter the borehole through the 1mm slots. The borehole was crudely airlift surged, using the rig and drill rods, in order to develop a natural gravel pack around the geotextile and screen, but probably for insufficient time. The rig was only available for one day.

Borehole 5 (as labelled on figure 1)

0-4 m soil and marl/silts and clayey sand
4-6 m coarse gravels and pebbles
6-7.5 m coarse gravel, pebbles and cobbles
7.5-10 m black shaley limestone bedrock

As with BH.6 the bedrock section was backfilled to 8m below ground level and the same 6 m screen, geotextile and 2 m plain casing was installed.

The short term yield during airlift surging of both holes appeared to be about 2-3 litres per second (l/s). The scheme's operator was advised that the two new holes should be pumped gently in tandem with the earlier emergency holes Nos. 3 and 4, in order to not induce a severe drawdown (and hence high well losses), and not encourage undue aquifer recharge from the adjacent stream that could be susceptible to pollution.

The location of boreholes BH 3,4,5 and 6 were chosen because the land was accessible and available in an emergency, and the sites were as far away as possible from the septic tank for the Community Centre. Throughout all these developments it was recognised that the borehole locations were not ideal, but it appeared that the fine sand gravel aquifer material was acting, in effect, like a natural 'slow sand filter'. At the time the water supply was not being chlorinated, and Galway Co. Council water quality monitoring of the raw water from the source demonstrated the absence of pathogens.

Subsequently the water has been chlorinated.

The Summary Technical Assessment Report in 1999 recommended exploration drilling at a site to the north of the GAA pitch. Eventually permission was given for drilling to take place but without the exploration phase. Fortunately narrow diameter boring had taken place in 1999 at the site and had shown that there appeared to be fine gravels below protective peats and marls. On this basis it was considered acceptable to proceed to a production borehole drilling programme.

The site for the supplementary production boreholes was chosen in order to avoid the coarse gravels and cobbles forming an aquifer in the centre of the esker ridge to the east, and try to draw upon groundwater in a thin fine grained gravel and sand aquifer at the margins of the esker below a protective confining layer of peat and marl. In other words to stay as far away as possible from the septic tank discharges from houses along the road, into the coarse aquifer under the ridge, and find fine, well protected, aquifer material that would filter and break down pollutants before they reached the boreholes.

Two rounds of tendering were necessary before a suitable drilling contractor with appropriate equipment at reasonable prices was selected to carry out the work.

2. Drilling and Airlift Development

The scope and method of the drilling works is fully described in Section 6 of the drilling contract awarded to Tom Briody and Son Ltd. This methodology was followed during the contract. The completed boreholes were 8 inch in diameter.

Drilling was carried out between

Borehole No.1	16 – 18th December 2003
Borehole No.2	18th December 2003
Borehole No.3	18th – 19th December 2003

The completion logs for each borehole are given as accurate colour diagrams. Each hole was drilled down through fill material used to prepare the site for drilling. The sequence below the fill is shown. It consists of a peat/marl/silt horizon overlying a clay containing stones and a small proportion of gravel. This layer appears to confine or semi-confine the aquifer below. The aquifer is 2-3 metres thick and consists of ill-sorted clayey, sands, gravels, pebbles and cobbles typical of the margin of esker deposits. Below the gravel is a black shaley limestone bedrock that from previous experience at New Inn and elsewhere in east Galway often contains small quantities of iron rich, sulphurous groundwater.

The boreholes have a simple design. A 3 metre length of Johnson wire wrap continuous slot stainless steel screen is placed in the aquifer section above which is a roughly 5 metre length of plain PVC pump chamber casing. The pump chamber casing annulus was fully cement grouted in order to reinstate the protective seal above the aquifer.

The well completion diagrams show the optimum position of electric submersible borehole pumps for future operation. The position of the pump intake in Borehole No.3 is slightly lower (relative to the top of the screen) than in No.s 1 and 2. This is to provide the maximum drawdown. The position of future pumps is a critical feature of the boreholes. The pump intake must never be below the bottom of the pump chamber casing in order to ensure that the screen is not dewatered. Dewatering the screen and consequent highly turbulent inefficient flow through screen has been one of the persistent problems in the earlier production boreholes and emergency holes near the Community Centre.

The initial yield from the holes, after drilling was low (<1 l/s), because fine material was clogging the pore spaces in the gravels adjacent to the screen and inhibiting the inflow of water from the aquifer.

Airlift surging and airlift pumping to clean and develop the aquifer around the well screen was successfully carried out over three days from 11th 13th May 2004. At the end of the airlift development the water was clear of sediment and colourless. The yields during airlift pumping had increased to 2 to 3 l/s in each borehole.

3. Pumping Tests

Pumping Tests were carried out using three pumps between the 17th to the 23rd November 2004. Two small Grundfos electric submersible pumps with an output of 1,500 gph and one larger Grundfos 3,000 gph pump were used to carry out constant