DUNBOYNE WATER SUPPLY

GROUNDWATER SOURCE PROTECTION ZONES

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DUNBOYNE WATER SUPPLY

1. WELL LOCATION AND SITE DESCRIPTION

These boreholes are the main public water supply for Dunboyne, Clonee and their surrounds. The wells are located northeast of Dunboyne, on the Navan Road. PW No.1, PW No.2 and PW No.4 are located 1 km northeast of the village on the southern bank of a tributary of the River Tolka and PW No.3 is located 500 metres northeast of the village, beside Dunboyne Industrial Estate. The original Production Wells, PW No.1 and PW No.2 are approximately 40 m and 120 metres respectively from the river bank and are completed above ground level (1.1metres) inside raised manholes. The boreholes are completed below the natural ground level inside the manholes which are two metres deep. The new pumping borehole PW No.4 is temporarily finished above ground level and the wellhead is not yet completed and has no protection at present (1996). The wells are located in a small field behind the old pump house (see sketches, pages 13-14).

There is also an Infiltration Gallery, constructed in 1960, which consists of a 450mm (18") main top perforated pipe with several feeder pipes on each side. Two of the feeders pipes are directly from a tributary of the River Tolka. The Gallery is approximately 6 metres deep and has a yield of around 380 m^3/d (3,500 gal/hour). The wells, old pump house and gallery are fenced off from cattle, although the entrance to the field at the road has no gate.

There is no backup supply for any production well at Dunboyne. During periods of high demand, water may be pumped from the old Gallery, located between PW No.1 and PW No.2, to supplement the water supply from the wells, except during very dry periods when the Gallery goes dry. The most recent pumping well, PW No.4, is located in the same field some 12 metres from PW No.2 and 85 metres from PW No.1.

At present all the pumping wells are in use. The pump in PW No.1 continuously cuts out on the low water probe in the well. PW No.3 is presently pumping continuously for approximately 18 hours at 18.8 m^3/hr; this rate is higher than was maintained for the pumping test, and it is likely that the meter is clogged and not measuring the discharge accurately.

The groundwater in Dunboyne is presently treated. It is hoped all the groundwater will be pumped to a new storage reservoir prior to being chlorinated, fluoridated and filtered in the new pump house and then pumped to the storage tower which has a capacity of 27,000 gallons. The pumps operate according to the water level in the tower and low water probes in the wells. The total pumpage from the wells at Dunboyne is not sufficient to meet the demands for the area and the water supply will be supplemented by water from County Dublin.

There are numerous private shallow dug wells in the vicinity of this source, particularly north of Dunboyne which is not served by the public water supply. The village itself is almost entirely served by the public water scheme and with the construction of new housing estates the demand for water is increasing.

2. WELL DETAILS

PRODUCTION WELL NO.1

GSI no.:	2923NW388
Grid ref.:	30172 24304
Owner:	Meath County Council
Well type:	Borehole
Elevation (top of manhole):	71.06 m OD (Poolbeg). Ground level is 70 m OD.
Depth:	estimated 60 m
Depth of casing:	unknown

Diameter:	150 mm (6")
Depth-to-rock:	estimated 6m
Static water level:	2.45m below top of manhole (t.o.m.) 67.55 m OD (b.g.l) (21-6-95)
Pumping water level:	10.78 m t.o.m. 59.22 m b.g.l. (after 12 hrs continuous pumping)
Drawdown:	8.33 m (after 12 hrs continuous pumping)
Pumping rate:	115 m^3/d (1,050 gal/hr)
Normal consumption:	34 m^3/d (7,500 gal/d on average, over 24 hrs)

Pumping test summary:

(i) abstraction rate: 115 m^3/d
(ii) specific capacity: 11 m^3/d/m (12 hours)
(iii) transmissivity: 10 – 50 m^2/d

PRODUCTION WELL NO.2

GSI no.:	2923NW289
Grid ref.:	30162 24306
Owner:	Meath County Council
Well type:	Borehole
Elevation (top of manhole):	72.13 m OD (Poolbeg). Ground level is 71 m OD.
Depth:	estimated 60 m
Depth of casing:	unknown
Diameter:	200 mm (8")
Depth-to-rock:	estimated 6 m
Static water level:	3.97 m t.o.m. 67.03m OD b.g.l. (21-6-95)
Pumping water level:	30.72 m t.o.m. 40.28m b.g.l. (after 11 hrs continuous pumping)
Drawdown:	26.75 m (after 11 hrs continuous pumping)
Pumping rate:	175 m^3/d (1,600 gal/hr)
Normal consumption:	estimated 145 m^3/d (32,000 gal/d on average, over 24 hrs)

Pumping test summary:

(i) abstraction rate: 175 m^3/d
(ii) specific capacity: 7m^3/d/m (11 hours)
(iii) transmissivity: 10 - 50m^2/d

PRODUCTION WELL NO.3

GSI no.:	2923NW390
Grid ref.:	30162 24306
Owner:	Meath County Council
Well type:	Borehole
Elevation (top of timber):	73.73 m OD (Poolbeg). Ground level is 73.70 m OD.
Depth:	61 m
Depth of casing:	12.8 m of 300 mm, 61m of 200 mm slotted from 23 m to 58 m
Diameter:	200 mm (8")
Depth-to-rock:	12.8 m
Static water level:	8.45 m b.g.l. 65.25m b.g.l. OD (21-6-95)
Pumping water level:	12.50 m b.g.l. 61.20 m OD (after 3 days continuous pumping)
Drawdown:	4.05 m (after 3 days continuous pumping)
Pumping rate:	335 m^3/d (3,100 gal/hr)
Normal consumption:	estimated 340 m^3/d (75,000 gal/d on average, over 18 hrs)

Pumping test summary:

(i) abstraction rate: 335 m^3/d
(ii) specific capacity: 80 m^3/d/m (3 days)
(iii) transmissivity: 60 – 150 m^2/d

PRODUCTION WELL NO.4

GSI no.:	2923NW403
Grid ref.:	30161 24304
Owner:	Meath County Council
Well type:	Borehole
Elevation (top of casing):	71.10 m OD (Poolbeg). Ground level is 70.90 m OD.
Depth:	122 m (-51.1m OD)
Depth of casing:	7.15 m of 300 mm
Diameter:	200 mm (8")
Depth-to-rock:	4.6 m
Static water level:	2 m b.g.l. 68.90 m b.g.l. OD (25-7-95)
Pumping water level:	29 m b.g.l. (41.90 m OD) (after 72 hrs continuous pumping)
Drawdown:	27 m (after 72 hrs continuous pumping)
Pumping rate:	535 m^3/d (5,000 gal/hr)
Normal consumption:	estimated 535 m^3/d (120,000 gal/d on average, over 24 hrs)

Pumping test summary:

(i) abstraction rate:	535 m^3/d
(ii) specific capacity:	35 m^3/d/m (12 hours)
(iii) transmissivity:	30 – 100 m^2/d

Total abstraction rate	:	900 m^3/d (8,000 gal/hr)
Apparent transmissivity	:	50 - 150 m^2/d

3. METHODOLOGY

There were three stages involved in assessing the area: (a) detailed desk study, (b) site visits and fieldwork, and (c) analysis of the data. The desk study the compiled geology from all available data sources. Basic public supply well details were obtained from Council personnel, including precise locations and any relevant borehole, chemistry and pumping test data available.

The second stage comprised site visits and fieldwork in the surrounding area. A pumping test and recovery tests were carried out to examine the aquifer characteristics on PW No.1 & PW No.2, a 56 hour pumping test with two recovery tests on PW No.3 in June 1995, and a 72 hour pumping test with a recovery test on PW No.4 in July 1995. Subsequently, the area around the wells was surveyed with regard to geology, hydrogeology, vulnerability to pollution and current pollution loading. Raw water samples were taken in March, June, September 1995 and January 1996 for full suites of chemical and bacterial analyses. Conductivity measurements were taken at regular intervals from early 1995 to mid-1996.

The assessment stage used analytical equations and hydrogeological mapping to delineate protection zones.

4. TOPOGRAPHY, DRAINAGE AND LAND USE

The Dunboyne sources are located beside the River Tolka. The ground topography of the area is characteristically flat to gently undulating ranging from to 70 m OD (230 ft) to 80 m OD (260 ft).

The River Tolka flows in a south-southeasterly direction, with numerous small streams draining the area. Drainage in the area is very good.

Agriculture is the principal activity to the north and northeast of the area, with most of the land around the public supply being used primarily for pasture. To the south the main land use is residential with numerous new housing estates.

5. GEOLOGY

5.1 Bedrock geology

The Dunboyne area is underlain by Lower Carboniferous Calp Limestones. Borehole logs (61metres) from drilling (1989, 1991 and 1994) at the new pump house indicated 48.2 m of black fine grained limestone. The upper 24 metres of bedrock were reported to be highly broken and unstable, which required casing to support the wells. The bedrock geology is shown in Figure 1.

5.2 Quaternary (subsoils) geology

Three types of Quaternary deposits are present in the vicinity of the Dunboyne source (Figure 2).

Along the River Tolka, to the north of the wells, is a narrow strip of alluvium varying in width from 100 m to 200 m across. The alluvium is generally sandy in texture and is usually less than 3 metres deep, generally thinning away from the river. Some gravel lenses are present within the alluvium.

The area around the wells is underlain by fluvioglacial gravels. The depths of these gravels are unknown, and they may overlie limestone till or the limestone bedrock. The gravels are well sorted but poorly bedded. The gravels are pebble to cobble grade, with a sand matrix. Most of the gravel clasts are of Carboniferous limestone. At the new pump house 8 metres of pebbly silty clay overlie 4.8 metres of sandy gravels.

Flanking the gravel and the alluvial deposits is an extensive area of limestone dominated till which is generally clayey in texture. The till is interpreted as a lodgement till deposited during the last glacial period. In places the till has a gravelly texture but clay dominates the matrix in all cases investigated. At Bracetown the limestone till has been excavated to obtain sand & gravel.

5.3 Soils

The soils information is taken from the published soil map of County Meath (Finch *et al*, 1983).

Soils in the area are derived from a parent material consisting primarily of limestone and shale till. The Great Soil Group is the Grey Brown Podzolic Group and the Soil Series is Dunboyne. These soils are well to moderately drained and have a wide range of uses but are best suited to grassland. To the north of the sources a gravelly phase of the Dunboyne Series occurs and the parent material is composed chiefly of gravelly drift mixed with limestones and shales. Because of the gravelly parent material the soil is well to excessively drained with a wide range of uses, but is mainly grassland.

Associated with the Dunboyne Series is the Ashbourne Soil Series (Gley Group) which is found adjacent to Dunboyne village. Gleys develop under poor drainage conditions with permanent or intermittent water logging usually due to a high water table. The soil parent material is very fine grained with an abundance of clay, which gives rise to low permeability and poor drainage even on slopes.

5.4 Depth to rock

Depth to rock at the old Gallery is around 5.5-6 metres and on the same site the new supply borehole PW No.4 indicated a depth of 4.6 metres. Drilling at the new pump house indicated a depth to rock of 12.8 metres. No bedrock outcrops occur in the immediate vicinity of the wells.

In general the subsoils are on average much thicker (greater than 10 metres) further away from the River Tolka. The depth-to-rock contours are based on limited data points, particularly in some areas and may need refining as further depth to bedrock records become available (see Figure 3).

6. HYDROGEOLOGY

6.1 Data availability

Hydrogeological data for the Dunboyne area is very good, although lacking for the older wells (PW No.1 and PW No.2). Two trial wells were drilled and tested in January 1989 at the now, new pump house, following a geophysical survey which indicated three areas with possible groundwater potential. Trial well No.2 was located 1.2 metres from Trial well No.1 and was completed in the gravels to investigate their groundwater potential. A short report on the drilling and testing of the trial wells was prepared by K.T. Cullen & Co. Ltd.

In June 1991 a production well (PW No.3) was drilled and tested, adjacent to the trial wells and a second report was prepared by K.T. Cullen & Co. Ltd.

Pumping tests with recovery tests were carried out in June 1995 on PW No.1, PW No.2 and PW No.3 (which continued for 56 hours) and a survey of pollution sources and wells was conducted around the sources (Figure 4). As part of this survey water levels in private wells were measured and a water table map constructed to determine the groundwater flow direction. Some of these water level readings were used with caution as the well heads were not all accurately levelled in and the survey includes dug wells which may only be tapping a perched water table within the till. The majority of wells in the vicinity of the production well are shallow dug wells.

In July 1995 PW No.4 was drilled adjacent to PW No.2 and was tested for 72 hours, with a 1.5 hour recovery test.

There was no original information available for the first pumping wells (PW No.1 & PW No.2). Information from private wells in the area is of varying quality and a well survey was conducted by GSI in the region during the summer of 1975.

6.2 Groundwater levels

Groundwater is generally close to the surface, being less than 5 metres below surface at the gallery which is close to the river and less than 10 metres below surface at the new pump house. The static water levels taken in the public supply wells following recovery, are shown below. All measurements are approximate as full recovery may not have been obtained. The unsaturated zone therefore is generally thin ranging from 0 - 10 m thick.

The water level data collected indicate that the pumping wells, in particular PW No.3, had not reached full recovery when the pumping tests were conducted; the original static water level for this well was around 2-2.5 metres below ground level 71.5 to 71 metres OD. This indicates that groundwater would flow from PW No.3 towards the river.

Date	Well Number	Height above ground	OD (ground level)	Static Water Level m (b.g.l)	Metres OD	Pumping Water Level m (b.g.l)	Metres OD
21-6-95	PW No.1	1.1	70.00	1.35	68.65	9.70	60.30
21-6-95	PW No.2	1.1	71.00	2.90	68.10	29.60	41.40
21-6-95	PW No.3	0	73.70	8.45	65.25	12.50	61.20
21-6-95	OW No.1	*0.5	69.90	1.40	68.50	2.45	67.45
21-6-95	OW No.2	0.5	73.60	8.35	65.25	8.60	65.00
25-7-95	PW No.4	0.2	70.90	2.90	68.00	29.35	41.55
25-7-95	PW No.1			pumping			
25-7-95	PW No.2			4.40	66.60		
25-7-95	OW No.1			2.35	67.55		

*Height below ground level.

6.3 Groundwater flow directions and gradients

Regional groundwater flow is generally towards the southeast, but locally it depends on topography and moves in all directions to the River Tolka. It is inferred that the river is in hydraulic continuity with the water table, at least in the vicinity of the wells, as the static water levels in the wells are equivalent to the river level. The exact flow direction is difficult to assess due to the relatively flat lying ground near the well.

Groundwater gradients in the general area may range from approximately 0.01 to 0.02.

6.4 Rainfall and Recharge

Rainfall data for the area are taken from the nearest rainfall station in Dunboyne, (which is at a similar altitude) 1.5 km southwest. Mean annual rainfall as recorded by Met Eireann for 1951-80 was 814 mm. Potential evapotranspiration (P.E.) is estimated from a Met Eireann contoured map as 550 mm/yr. Actual evapotranspiration (A.E.) has been estimated at 522 mm by calculating a percentage (95%) of the extrapolated P.E., to allow for seasonal soil moisture deficits.

Using the above figures the effective rainfall (E.R.) is taken to be approximately 292 mm/yr. As there are some drainage ditches or streams in the immediate area of the supply and the Quaternary deposits are semi-free draining and with varying depths, a moderate proportion of the effective rainfall infiltrates to the water table. Estimating run off to be of the order of 30%, the actual annual recharge to the aquifer is estimated to be 204 mm/yr.

These calculations are summarised below:

Average annual rainfall	814 mm
Estimated P.E.	550 mm
Estimated A.E. (95% P.E.)	522 mm
Effective rainfall	292 mm
Recharge (70% E.R.)	204 mm

6.5 Hydrochemistry and Water Quality

The chemical analyses of groundwater from the Dunboyne sources indicate a very hard water (360-485 mg/l $CaCO_3$), with a high alkalinity (300-335 mg/l $CaCO_3$). Conductivities are also high, ranging 540-910 μS/cm. The groundwater can be classed as a calcium bicarbonate water. The groundwater analyses are included in the Appendices.

The water quality at Dunboyne is excellent with no bacterial contamination (E. *coli*) and all the major cations, anions and trace elements are within the Irish Drinking Water Standards and the EU limits except for iron and manganese which are naturally high. Calcium and sulphate levels are above the guide values.

The levels of nitrates are very low and range up to 6 mg/l which is within the background levels for County Meath. PW No.3, PW No.4 and the Gallery have higher values than PW No.1 and PW No.2. The chloride value for PW No.4 (30mg/l) is also slightly higher than for the other wells (range 20-25 mg/l). Regular sampling of the raw water from Dunboyne should be continued to monitor the water quality and in particular PW No.4 for indicators of contamination.

The limestone aquifer is generally overlain by sands and gravels or very gravelly till which are moderately to highly vulnerable to pollution. This is confirmed by the occasional small numbers of background Coliforms, the higher levels of nitrates and chloride in PW No.3 and PW No.4, together with the fluctuations in the conductivities in all the pumping wells (see Table 1). *(Some of the conductivity readings were taken using a different conductivity meter)*

Table 1. Conductivity readings from the Dunboyne Sources

	PW No. 1		PW No. 2		PW No. 3		PW No. 4	
Date	**E.C.**	**Temp.**	**E.C.**	**Temp.**	**E.C.**	**Temp.**	**E.C.**	**Temp.**
	(µS/cm)	**(^{O}C)**	**(µS/cm)**	**(^{O}C)**	**(µS/cm**	**(^{O}C)**	**(µS/cm)**	**(^{O}C)**
*8-3-95			588	10.6	597	7.6		
+20-3-95	-	-	561	10.5	574	9.7		
13-4-95			617	13.2	565	10.8		
19-5-95			572	11.3	548	10.9		
2-6-95					554	10.9		
+12-6-95	549	10.6	577	11.3	544	10.6		
*21-6-95	700-740	10.4-13	740-800	11.2-13.8	550-580	11.1-13		
18-7-95					572	13.1	well being drilled	
7-7-95					520	15.9	-	-
4-8-95			561	13.7	564	11.9		
15-9-95			584	11.8	545	11.2		
+25-9-95	540	11.6	570	11.3	540	10.6		
17-10-95					540	11.1		
11-11-95					530	9.7		
8-12-95	not in commission		not in commission		753	9.9	748	9.7
2-1-96					761	10.3	790	9.8
+8-1-96					793	10.1	800	9.5
25-1-96					776	10	797	8.8
20-2-96					793	9.6	785	9.3
20-3-96					780	10.1	763	8.8
7-5-96					763	11.1	734	10.8

* Reading taken using a different conductivity meter
+ Full analyses

6.6 Short Pumping Tests, June 1995

The three pumping wells at Dunboyne were tested from June 20th to 21st 1995. PW No.3 at the filter house was treated as a separate location, while PW No.1 and PW No.2 were tested together. The testing consisted of a recovery test from 21:00 on June 20th to 6:00 on June 21st for PW No.3 and from 22:00 to 6:00 for PW No.1 and PW No2. The drawdown test was conducted from 6:00 on June 21st to 14:00 on June 23rd for PW No.3, on PW No.1 from 6:30 and PW No.2 from 7:30 to 18:00 on June 21st. A 1½ hour recovery test was repeated on PW No.3. During the testing, water levels were monitored in all pumping wells and observation wells, conductivity and temperature readings were taken regularly from each pumping well. A datalogger was installed on the bulk meter to record the changes in the discharge during the pumping from the wells.

The results from both the pumping tests were satisfactory. In addition to the data collected during the tests, information was obtained at Dunboyne on the maximum pumping rate for PW No.3 ($14m^3/d$). PW No.1 and PW No.2 pump into a 4" mains and when PW No.2 is pumping it restricts the discharge from PW No.1.

6.7 72 hour Pump Test, PW No. 4, July 1995

Dunnes Water Services of Dundalk were commissioned by Meath County Council to undertake a 72 hour pumping test on the new pumping well PW No.4 at Dunboyne. This test commenced on July 25th 1995 and continued to July 28th. The test was delayed until 15:30 to allow PW No.2 to recover for 3 hours. It was not possible to turn off PW No.1, as the chlorination pump required either PW No.1 or PW No.2 to be in operation. Observation data was collected from PW No.2. On Day 2 of the test the electrician changed the chlorination pump to work independently, thus PW No.1 was turned off and allowed to recover. No useful data were obtained from PW No.1 or the adjacent OW No.1.

The test well was initially pumped at 432 m^3/d for 43 hours, when the pumping rate was increased to 562 m^3/d for the remainder of the test. The static water level in the test well was 3.08 metres and the final pumping level was 29.70 metres below the measuring point. Thus the drawdown for the 72 hours was 26.62 metres. The pumping of the test well affected PW No.2 by approximately 5.70 metres during the 72 hours. It also affected PW No.1 slightly. As PW No.1 did not stop pumping until Day 2 of the test, the exact amount of effect cannot be calculated. A 1.5 hour recovery test was carried out at the end of the 72 hours from 15:30 to 17:00 on July 28th.

During the tests, water levels were monitored in all the wells. Conductivity and temperature readings were taken throughout the 72 hour test. The discharge from the well was checked throughout the test using the bulk meter and also by filling a 50 gallon tank.

The discharge from the test well was directed into the gallery sump, where it was pumped into distribution after filtering and chlorination. At the beginning of the test the water was coloured brown by sediment and was allowed to run to waste into the ditch adjacent to the pump house. The water cleared very quickly. When the pumping rate was increased the water again became dirty and was allowed to run to waste until it cleared, although by the end of the test the water was still slightly cloudy with minor traces of sediment and a slight odour. At 11:00am on July 28th a sample was collected by the Council for chemical and bacterial analysis. The analysis indicated that the water contained no bacteria but the iron and manganese concentrations are above the maximum limits.

The results from this pumping test were satisfactory in terms of yield. A large diameter (10" or 8") production well with a well screen adjacent to this test well would give the County Council a high yielding well of the order of 700 m^3/d.

All the pumping tests were complicated, either by interference between pumping wells (e.g. PW No.1 & PW No.2) or by restrictions on pumping conditions. The pumping test data are in the Appendices.

6.8 Aquifer coefficients

The pumping test analyses provided apparent transmissivities of around 50 to 150 m^2/d from the pumping tests. The specific capacities ranged between 10 and 80 m^3/d/m. The specific yield, from the observation well data, ranged from 0.001 to 0.04, indicating that the underlying aquifer is unconfined.

Analyses of the original pumping test data for PW No.3 with a pumping rate of 655m^3/d and a drawdown of 7.35 metres indicated transmissivities of around 150 m^2/d from the 72 hour test. The calculated specific capacity was 90 m^3/d/m. The 12 hour test gave a pumping rate of 335m^3/d and a drawdown of 4 metres, with indicated transmissivities of up to 115 m^2/d; an increase in the pumping rate was unsustainable. The overall results indicates that a higher permeability zone exists close to the surface, possibly along the interface of the broken limestone bedrock and the overlying sands and gravels. The transmissivity and yield of the well are now lower than indicated by the original pumping test and this may be due to clogging of the well by iron and manganese precipitates. An increase in the well yield may be obtained by regular acidification of the well.

The pumping test results for PW No.1 and PW No.2 are complicated due to interference. The drawdown after 72 hours was 26.62 metres and steady state conditions had not been achieved. This suggests that the well may not sustain a further increase in yield. However, more comprehensive pumping tests would be needed to confirm the sustainable maximum yield of the well, especially if a properly designed large diameter pumping well was installed.

6.9 Conceptual Model

The aquifer feeding the Dunboyne sources is the Calp Limestone. This is overlain by between 5 and 12 metres of sands and gravels, alluvium and till, that have high to moderate permeability, and the aquifer is considered to be unconfined. The thin unsaturated zone (<5m in winter) in this unconfined aquifer (in the vicinity of the well) suggests that the aquifer is moderately permeable and this is supported by the well yields. Permeabilities within the bedrock are increased by joints and fractures. During the drilling of Production Well No.3, a major inflow of groundwater was recorded in the

broken limestone between 30-36 metres below ground level (43.7-37.7 m O.D) and at 45 metres below ground level (28.7 m O.D). While drilling PW No.4, water was encountered at 10 metres and the amount gradually increased with the depth of the well.

Groundwater flow is influenced by topography. The groundwater divide between the Tolka Catchment and the Broadmeadow Catchment occurs to the northeast of Dunboyne. The regional groundwater flow to the public sources is from the northwest.

The groundwater protection zones are delineated for PW No.3 at the new filter house and for PW No.4 located at the old gallery.

Production Well No.3

In this well, the top 8 m of till and the underlying 4.8 metres of sands and gravels were lined with 300 mm steel casing (depth 12.8 m). The well was drilled at 300 mm diameter to a depth of 61 metres (12.7 m O.D.) and lined with 200 mm steel casing throughout the entire depth of the well as a broken layer of rock was encountered between 30-36 metres. The casing is slotted over 35 metres between 23 and 58 metres. The main inflow into the well was between 30-36 metres and at 45 metres. Inflows from the sand and gravels are prevented by the presence of the steel casing.

Raw water samples from PW No.3 were analysed in 1991(data in Appendices). The results indicated that the groundwater from the well was of excellent quality except for the high iron and manganese concentrations. There has been no significant change in the hydrochemistry, although the sodium and the sulphate values are now slightly higher (9 mg/l to 12-14 mg/l of Na) and 58 mg/l to 80-140 mg/l SO_4).

Production Well No.4

In this production well, the top 4.6 metres of clay, sands and gravels overlay a layer of broken limestone to a depth of 7 metres which was lined with 200 mm steel casing and grouted. The well is open hole at 200 mm to a depth of 122 metres (-51.1m O.D.). There is no concentrated inflow into this well, and groundwater from the subsoil is prevented from entering by the steel casing.

6.10 Aquifer category

The aquifer supplying the Dunboyne source is the Calp Limestone, supplemented by the overlying sand and gravel deposits. The aquifer classification of the Calp in this area has been changed since 1998, in the light of additional data and a study of the influence of geological structure on aquifer characteristics. It is now classed as a **locally important aquifer, moderately productive only in local zones (Ll).**

7. GROUNDWATER VULNERABILITY

The catchment for the source at Dunboyne filter house, PW No.3, is predominantly moderately vulnerable to pollution. The subsoils are generally poorly permeable.

The catchment for the source at the gallery, PW No.4, is moderately to highly vulnerable to pollution. The subsoils here are generally highly permeable, although again detailed investigation would be required to confirm this. Since it is probable that a small proportion of flow to the well may be from the river, particularly during the winter (river is dry during very dry weather) the vulnerability of the source to pollution is increased depending on the river water quality.

Under the GSI vulnerability mapping guidelines, areas where rock is less than 3 m below surface are mapped as having a ‘probably extreme vulnerability’, and areas to the south fall into this category. Much of the area around the river is classified as ‘moderately vulnerable’. Away from the river, the subsoils are thicker than 10 metres and are classified as ‘low vulnerability’. The vulnerability zones are shown on Figure 5.

8. GROUNDWATER SOURCE PROTECTION AREAS

Source protection areas are delineated for the output (355 m^3/d for PW No.3 and 535 m^3/d for PW No.4) which is approximately that currently abstracted, and allow for expansion of the zone of contribution during dry weather. If it is proposed to pump all the wells to their maximum capacity to meet the local demands for water, the delineated protection zones may have to be increased.

8.1 Inner Protection Area (SI)

The Inner Protection Area is the area defined by a 100 day time of travel to the source and is delineated to protect against the effects of potentially contaminating activities which may have an immediate influence on water quality at the source, in particular from microbial contamination.

Using the following aquifer coefficients (average) : permeability (k) = 20 m/d, porosity = 0.05, and the hydraulic gradient (i) = 0.02, the 100 day time of travel distance to the well is estimated to be approximately 800 metres (Figure 6).

8.2 Outer Protection Area (SO)

The Outer Protection Area includes the remainder of the catchment area to the source, i.e. the zone of contribution (ZOC), and it is defined as the area required to support an abstraction from long-term recharge. The ZOC at Dunboyne is derived from hydrogeological mapping techniques and is controlled primarily by the groundwater flow direction. The ZOC is shown in Figure 6, and its size is based largely on the Recharge Equation. Taking the average annual recharge to be 204 mm, the combined area required to supply the pumping rates of 335 and 535 m^3/d is calculated to be 1.6 km^2 (0.6 km^2 and 1 km^2 respectively for PW No.3 and PW No.4). The null point or down-gradient boundary of the ZOC (the distance down-gradient after which water is not contributing to the well) is estimated to be 200 metres. The ZOC area shown in Figure 6 includes a buffer (safety margin).

9. GROUNDWATER SOURCE PROTECTION ZONES

Combining the Source Protection Areas, as described above, with the vulnerability ratings produces four groundwater protection zones for the source at Dunboyne. These are listed here in order of decreasing degree of protection required and are shown in Figure 7:

- Inner Protection Area / High (SI/H)
- Inner Protection Area / Moderate (SI/M)
- Inner Protection Area / Low (SI/L)
- Outer Protection Area / Low (SO/L)

10. POTENTIAL POLLUTION SOURCES

The primary threat to the public supplies at Dunboyne are farmyards, septic tanks and the quality of the water in the river upstream of the source, which may be affected in particular by runoff from the land. This may account for the slightly elevated background levels of nitrates.

A number of houses with septic tanks and farmyards are present in the general area of the wells. The nearest farmyards are located approximately 600 metres up-gradient of PW No.4. The storage of silage and cattle feeding yards may pose a significant risk to the wells if the present farmyard management is not maintained.

11. CONCLUSIONS AND RECOMMENDATIONS

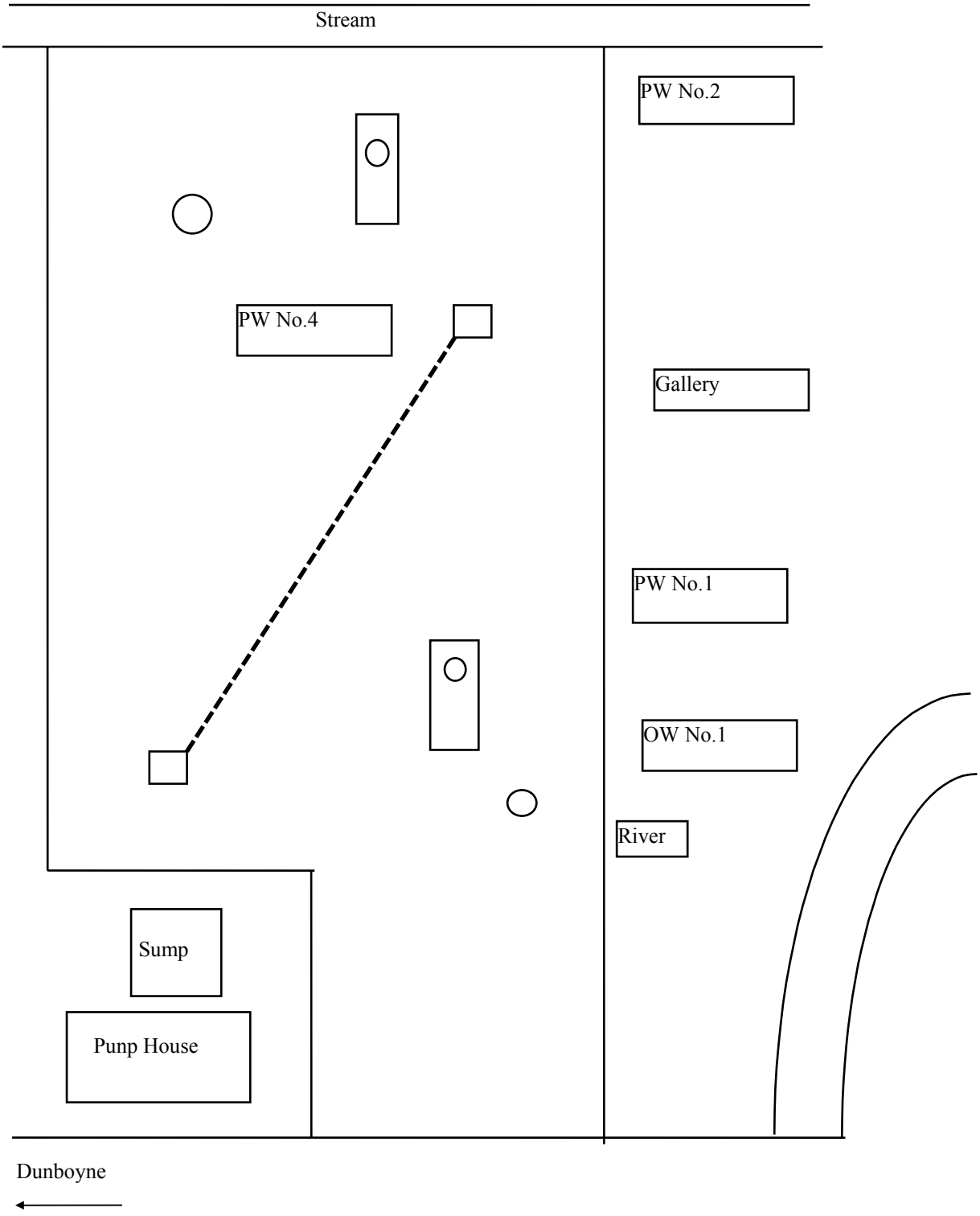
Overall the sources at Dunboyne are reasonably high yielding but are unlikely to be able to support an increased yield. The water analyses indicate no major water quality problems at these sources, except

the naturally high iron and manganese, but the groundwater catchments for the sources are moderately to highly vulnerable to pollution due to the shallow thickness and permeability of the subsoils in their immediate vicinity.

It is recommended that the Council continue to monitor the quality of the raw water from the Dunboyne sources and to examine the effects of the potentially polluting activities nearby. In addition it is recommended that the Council control and monitor potentially polluting activities being carried out within the delineated groundwater source protection zones. In particular, the Council should monitor the farmyards uphill from the wells and all industrial developments in the area.

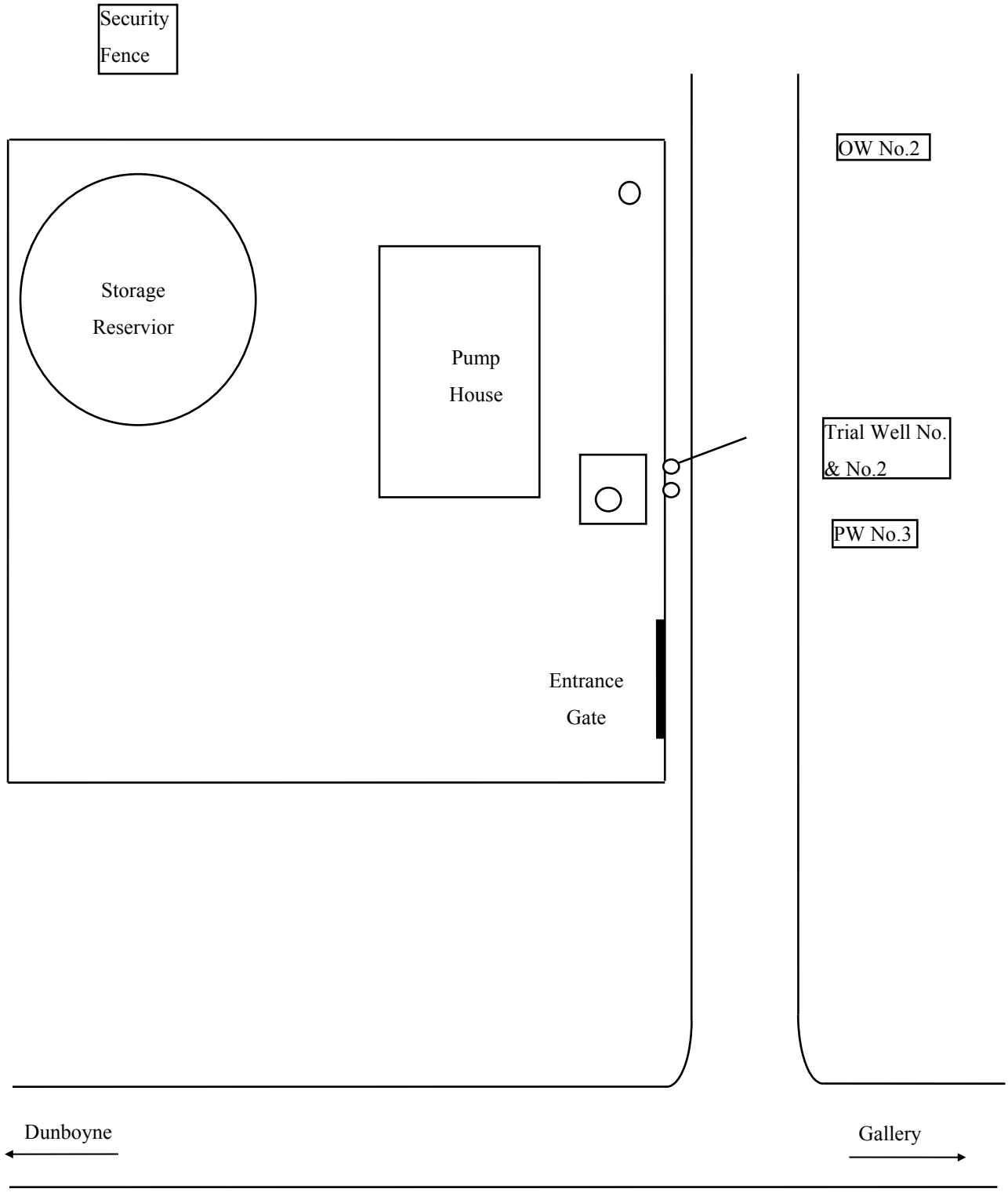
PW No.4 should be completed as soon as possible and the monitoring well at the gallery (OW No.1) should also be properly covered. In addition, to protect the source sites, these should be fenced around, thus the entrance to the well field at the gallery should be secured. PW No.3 should also be completed with a manhole cover.

Further investigation work should be conducted to establish the amount of recharge from the river and refine the protection zones as necessary.



Sketch of Dunboyne Water Supply

PW No. 1, PW No. 2 & PW No. 4 (Not to Scale)



Sketch of Dunboyne Water Supply

PW No. 3 (Not to Scale)

Appendix 1
Pump Test Data

PUMPING TEST DATA SHEET

Location : DUNBOYNE **Borehole name: TW No.1 (Limestone)** **Date: ??-01-89**

Test: Drawdown Data from Trial Well No.1 Weather :
Duration : 102hrs Well depth : 61metres

Date	Time	Time since pumping began (min.)	Water level below datum (m)	Drawdown (metres)	Discharge m3/d	Conductivity uS/cm
??-01-89		0	1.98	0	243	
		0.5	3.65	1.67		
		1	3.86	1.88		
		1.5	3.99	2.01		
		2	4.05	2.07		
		2.5	4.11	2.13		
		3	4.15	2.17		
		3.5	4.17	2.19		
		4	4.18	2.2		
		5	4.22	2.24		
		6	4.24	2.26		
		8	4.29	2.31		
		9	4.3	2.32		
		10	4.34	2.36		
		12	4.36	2.38	246	
		14	4.39	2.41		
		16	5.03	3.05		
		18	5.08	3.1		
		20	5.14	3.16		
		22	5.19	3.21		
		24	5.27	3.29		
		26	5.34	3.36		
		28	5.34	3.36		
		30	5.39	3.41		
		35	5.45	3.47		
		40	5.5	3.52		
		45	5.52	3.54		
		50	5.55	3.57		
		60 (1hr)	5.59	3.61		
		75	5.62	3.64		
		90	5.65	3.67		
		105	5.77	3.79		
		120 (2hrs)	5.79	3.81		
		150	5.82	3.84		
		180	5.78	3.8	243	
		210	5.79	3.81	Stopped for 15 minutes	
		240 (4hrs)	5.6	3.62	243	
		300 (5hrs)	5.85	3.87		
		360 (6hrs)	5.91	3.93		
		420 (7hrs)	5.94	3.96		
		480 (8hrs)	5.97	3.99	249	
		540 (9hrs)	5.98	4		
		600 (10hrs)	6	4.02		
		720 (12hrs)	6	4.02		
		840 (14hrs)	6.01	4.03		
		960 (16hrs)	6.01	4.03		
		1080 (18hrs)	6.02	4.04		
		1200 (20hrs)	6.04	4.06		
		1440 (24hrs)	6.07	4.09		
		1560 (26hrs)	6.07	4.09		
		1680 (28hrs)	6.1	4.12		
		1800 (30hrs)	6.12	4.14		
		1920 (32hrs)	6.15	4.17		
		2160 (36hrs)	6.16	4.18		
		2880 (48hrs)	6.18	4.2		
		3240 (54hrs)	6.2	4.22		
		3600 (60hrs)	6.17	4.19		
		3960 (66hrs)	6.14	4.16		
		4320 (72hrs)	6.11	4.13		
		4680 (78hrs)	6.1	4.12		
		5040 (84hrs)	6.07	4.09		
		5400 (90hrs)	6.12	4.14		
		5760 (96hrs)	6.12	4.14		
		6120 (102hrs)	6.09	4.11	249	

PUMPING TEST DATA SHEET

Location : Dunboyne **Borehole name : TW No.1** **Date : ??01-89**

Test : Recovery Data from Trial Well No.1

Duration :1 hr Weather :

Distance from Pumping Well: Well depth : 61 m.

Height of datum point above ground level : Datum Point :

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
		1	2.8	0.82			
		1.5	2.6	0.62			
		2	2.58	0.6			
		2.5	2.57	0.59			
		3	2.56	0.58			
		3.5	2.55	0.57			
		4	2.54	0.56			
		4.5	2.53	0.55			
		5	2.51	0.53			
		6	2.48	0.5			
		7	2.46	0.48			
		8	2.43	0.45			
		9	2.41	0.43			
		10	2.4	0.42			
		12	2.36	0.38			
		14	2.33	0.35			
		16	2.27	0.29			
		18	2.26	0.28			
		20	2.24	0.26			
		22	2.22	0.24			
		24	2.2	0.22			
		26	2.18	0.2			
		28	2.16	0.18			
		30	2.14	0.16			
		35	2.12	0.14			
		40	2.1	0.12			
		45	2.08	0.1			
		50	2.06	0.08			
		55	2.05	0.07			
		60 (1hr)	2.04	0.06			

PUMPING TEST DATA SHEET

Location : Dunboyne **Borehole name : TW No.2** **Date : ??-01-89**

Test :Drawdown Data from Trial Well No. 2 while Trial Well No. 1 is Pumping

Duration :96 hrs Weather :

Distance from Pumping Well : < 2 m. Well depth : 10.4 m

Height of datum point above ground level : Datum Point :

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
??-01-89		0	1.84	0			
		3.5	2.1	0.26			
		5	2.16	0.32			
		10	2.26	0.42			
		20	2.36	0.52			
		24	2.42	0.58			
		30	2.46	0.62			
		35	2.49	0.65			
		40	2.51	0.67			
		45	2.53	0.69			
		50	2.55	0.71			
		55	2.57	0.73			
		60	2.58	0.74			
		75	2.61	0.77			
		90	2.63	0.79			
		105	2.65	0.81			
		120 (2hrs)	2.66	0.82			
		150	2.66	0.82			
		180 (3hrs)	2.68	0.84			
		210	2.68	0.84			
		240 (4hrs)	2.53	0.69			
		300 (5hrs)	2.68	0.84			
		360 (6hrs)	2.69	0.85			
		420 (7hrs)	2.69	0.85			
		480 (8hrs)	2.69	0.85			
		540 (9hrs)	2.69	0.85			
		600 (10hrs)	2.7	0.86			
		720 (12hrs)	2.7	0.86			
		840 (14hrs)	2.7	0.86			
		960 (16hrs)	2.7	0.86			
		1080 (18hrs)	2.7	0.86			
		1200 (20hrs)	2.7	0.86			
		1440 (24hrs)	2.7	0.86			
		1560 (26hrs)	2.7	0.86			
		1680 (28hrs)	2.7	0.86			
		1800 (30hrs)	2.7	0.86			
		1920 (32hrs)	2.7	0.86			
		2040 (34hrs)	2.7	0.86			
		2160 (36hrs)	2.7	0.86			
		2880 (48hrs)	2.7	0.86			
		3240 (54hrs)	2.7	0.86			
		3600 (60hrs)	2.64	0.8			
		3960 (66hrs)	2.6	0.76			
		4320 (72hrs)	2.6	0.76			
		4680 (78hrs)	2.6	0.76			
		5040 (84hrs)	2.62	0.78			
		5400 (90hrs)	2.62	0.78			
		5760 (96hrs)	2.62	0.78			

PUMPING TEST DATA SHEET

Location :Dunboyne **Borehole name : TW No.1** **Date : ??-01-89**

Test :Drawdown Data from Trial Well No.1 while Trial Well No. 2 is pumping

Duration :72 hrs Weather :

Distance from Pumping Well : < 2m. Well depth : 61 m.

Height of datum point above ground level : Datum Point :

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature degrees C	Conductivity uS/cm
		0	1.98	0			
		4	2.24	0.26			
		7	2.3	0.32			
		22	2.51	0.53			
		35	2.62	0.64			
		60 (1hr)	2.7	0.72			
		75	2.73	0.75			
		90	2.75	0.77			
		105	2.77	0.79			
		120 (2hrs)	2.78	0.8			
		150	2.8	0.82			
		180 (3hrs)	2.81	0.83			
		210	2.82	0.84			
		240 (4hrs)	2.83	0.85			
		300 (5hrs)	2.84	0.86			
		360 (6hrs)	2.84	0.86			
		420 (7hrs)	2.83	0.85			
		480 (8hrs)	2.83	0.85			
		540 (9hrs)	2.82	0.84			
		600 (10hrs)	2.82	0.84			
		720 (12hrs)	2.82	0.84			
		840 (14hrs)	2.82	0.84			
		960 (16hrs)	2.82	0.84			
		1080 (18hrs)	2.46	0.48			
		1200 (20hrs)	2.79	0.81			
		1440 (24hrs)	2.8	0.82			
		1560 (26hrs)	2.8	0.82			
		1680 (28hrs)	2.81	0.83			
		1800 (30hrs)	2.82	0.84			
		1920 (32hrs)	2.85	0.87			
		2040 (34hrs)	2.86	0.88			
		2160 (36hrs)	2.87	0.89			
		2520 (42hrs)	2.91	0.93			
		2880 (48hrs)	2.95	0.97			
		3240 (54hrs)	2.96	0.98			
		3600 (60hrs)	3	1.02			
		3960 (66hrs)	3.02	1.04			
		4320 (72hrs)	3.04	1.06			

PUMPING TEST DATA SHEET

Location : Dunboyne **Borehole name : TW No. 2** **Date : ??-01-89**

Test : Drawdown Data from Trial Well No. 2

Duration : 72 hrs Weather :

Distance from Pumping Well : Well depth : 10.4 m

Height of datum point above ground level : Datum Point :

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
		1	2.1	0.29			
		1.5	2.11	0.3			
		2	2.14	0.33			
		2.5	2.17	0.36			
		3	2.19	0.38			
		4	2.23	0.42			
		5	2.25	0.44			
		6	2.27	0.46			
		7	2.31	0.5			
		8	2.35	0.54			
		9	2.35	0.54			
		12	2.4	0.59			
		14	2.43	0.62			
		16	2.45	..64			
		18	2.48	0.67			
		20.5	2.51	0.7			
		22	2.51	0.7			
		24	2.54	0.73			
		26	2.56	0.75			
		28	2.58	0.77			
		30	2.58	0.77			
		35	2.61	0.8			
		45	2.65	0.84			
		50	2.68	0.87			
		55	2.69	0.88			
		60 (1hr)	2.7	0.89			
		75	2.73	0.92			
		90	2.75	0.94			
		105	2.76	0.95			
		120 (2hrs)	2.77	0.96			
		150	2.79	0.98			
		180 (3hrs)	2.8	0.99			
		210	2.81	1			
		240 (4hrs)	2.82	1.01			
		300 (5hrs)	2.82	1.01			
		360 (6hrs)	2.82	1.01			
		420 (7hrs)	2.82	1.01			
		480 (8hrs)	2.82	1.01			
		540 (9hrs)	2.81	1			
		600 (10hrs)	2.81	1			
		720 (12hrs)	2.81	1			
		840 (14hrs)	2.81	1			
		960 (16hrs)	2.81	1	Pump off for 1 hour		
		1080 (18hrs)	2.44	0.63	258		
		1200 (20hrs)	2.77	0.96			
		1440 (24hrs)	2.8	0.99			
		1560 (26hrs)	2.8	0.99			
		1680 (28hrs)	2.8	0.99			
		1800 (30hrs)	2.8	0.99			
		1920 (32hrs)	2.85	1.04			
		2040 (34hrs)	2.86	1.05			
		2160 (36hrs)	2.87	1.06			
		2520 (42hrs)	2.9	1.09			
		2880 (48hrs)	2.92	1.11			
		3240 (54hrs)	2.95	1.14			
		3600 (60hrs)	2.98	1.17			
		3960 (66hrs)	3	1.19			
		4320 (72hrs)	3.02	1.21	253		

PUMPING TEST DATA SHEET

Location : DUNBOYNE **Borehole name : PW No.1** **Date : 09-08-91**

Test : Drawdown Data from PW No.1

Duration : 72hrs Well depth : 60m (est.)

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
09-08-91		0	2.54	0			
		0.5	4.85	2.31			
		1	5.5	2.96			
		1.5	5.9	3.36			
		2	6.13	3.59			
		2.5	6.26	3.72			
		3	6.38	3.84			
		3.5	6.46	3.92			
		4	6.53	3.99			
		4.5	6.58	4.04			
		5	6.66	4.12			
		6	6.76	4.22			
		7	6.8	4.26			
		8	6.88	4.34			
		9	6.98	4.44			
		10	6.98	4.44	655		
		12	7.09	4.55			
		14	7.17	4.63			
		16	7.2	4.66			
		18	7.3	4.76			
		20	7.36	4.82	640		
		22	7.38	4.84			
		24	7.41	4.87			
		26	7.47	4.93			
		28	7.52	4.98			
		30	7.56	5.02	640		
		35	7.63	5.09			
		40	7.66	5.12			
		45	7.71	5.17			
		50	7.75	5.21			
		55	7.79	5.25			
		60 (1hr)	7.83	5.29	640		
		75	7.91	5.37			
		90	7.98	5.44			
		105	8.05	5.51			
		120 (2hrs)	8.06	5.52	640		
		150	8.13	5.59			
		180 (3hrs)	8.13	5.59	640		
		210	8.16	5.62	640		
		240 (4hrs)	8.59	6.05	*opened gate valve*		
		300 (5hrs)	8.67	11.18	655		
		360 (6hrs)	8.76	11.27	655		
		420 (7hrs)	8.81	11.38	655		
		480 (8hrs)	8.81	6.27	655		
		540 (9hrs)	8.81	6.27	655		
		600 (10hrs)	8.83	6.29	655		
		720 (12hrs)	8.93	6.39	655		
		840 (14hrs)	8.97	6.43	655		
		960 (16hrs)	9.05	6.51	655		
		1080 (18hrs)	9.14	6.6	655		
		1200 (20hrs)	9.14	6.6	655		
		1440 (24hrs)	9.18	6.64	655		
		1560 (26hrs)	9.18	6.64	655		
		1680 (28hrs)	9.19	6.65	655		
		1800 (30hrs)	9.25	6.71	655		
		1920 (32hrs)	9.36	6.82	655		
		2040 (34hrs)	9.4	6.86	655		
		2160 (36hrs)	9.41	6.87	655		
		2520 (42hrs)	9.54	7	655		
		2880 (48hrs)	9.56	7.02	655		
		3240 (54hrs)	9.68	7.14	655		
		3600 (60hrs)	9.66	7.12	655		
		4320 (72hrs)	9.89	7.35	655		

PUMPING TEST DATA SHEET

Location : DUNBOYNE **Borehole name : PW No.1** **Date : 12-08-91**

Test : Recovery Data from PW No.1

Duration : 1hr Well depth : 60m (est.)

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
12-08-91		0	9.89	7.35			
		0.5	6.65	4.11			
		1	5.3	2.76			
		1.5	5.15	2.61			
		2	5.09	2.55			
		2.5	5.04	2.5			
		3	5.03	2.49			
		3.5	4.99	2.45			
		4	4.92	2.38			
		4.5	4.93	2.39			
		5	4.91	2.37			
		6	4.85	2.31			
		7	4.8	2.26			
		8	4.74	2.2			
		9	4.69	2.15			
		10	4.66	2.12			
		12	4.57	2.03			
		14	4.5	1.96			
		16	4.44	1.9			
		18	4.39	1.85			
		20	4.33	1.79			
		22	4.29	1.75			
		24	4.25	1.71			
		26	4.21	1.67			
		28	4.18	1.64			
		30	4.15	1.61			
		35	4.08	1.54			
		40	4.02	1.48			
		45	3.98	1.44			
		50	3.94	1.4			
		55	3.89	1.35			
		60	3.86	1.32			

PUMPING TEST DATA SHEET

Location : DUNBOYNE **Borehole name : TW No.1** **Date : 09-08-91**

Test : Drawdown Data from TW No.1 while PW No.1 is pumping

Duration : 72hrs Well depth : 61m

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
09-08-91		0	2.43	0			
		0.5	2.67	0.24			
		1.5	2.87	0.44			
		2.5	3	0.57			
		3.5	3.11	0.68			
		4.5	3.19	0.76			
		6.5	3.34	0.91			
		7.5	3.39	0.96			
		9	3.46	1.03			
		11	3.57	1.14			
		13	3.63	1.2			
		15	3.71	1.28			
		17	3.76	1.33			
		19	3.82	1.39			
		21	3.87	1.44			
		23	3.9	1.47			
		25	3.95	1.52			
		27	3.99	1.56			
		29	4.02	1.59			
		35	4.1	1.67			
		40	4.16	1.73			
		45	4.2	1.77			
		50	4.24	1.81			
		55	4.27	1.84			
		60 (1hr)	4.3	1.87			
		75	4.37	1.94			
		90	4.42	1.99			
		105	4.45	2.02			
		120 (2hrs)	4.48	2.05			
		150	4.51	2.08			
		180 (3hrs)	4.54	2.11			
		210	4.56	2.13			
		240 (4hrs)	4.66	2.23			
		300 (5hrs)	4.7	11.18			
		360 (6hrs)	4.72	11.27			
		420 (7hrs)	4.74	11.38			
		480 (8hrs)	4.76	2.33			
		540 (9hrs)	4.77	2.34			
		600 (10hrs)	4.76	2.33			
		720 (12hrs)	4.83	2.4			
		840 (14hrs)	4.86	2.43			
		960 (16hrs)	4.88	2.45			
		1080 (18hrs)	4.88	2.45			
		1200 (20hrs)	4.93	2.5			
		1440 (24hrs)	4.98	2.55			
		1560 (26hrs)	4.99	2.56			
		1680 (28hrs)	5.01	2.58			
		1800 (30hrs)	5.03	2.6			
		1920 (32hrs)	5.08	2.65			
		2040 (34hrs)	5.11	2.68			
		2160 (36hrs)	5.13	2.7			
		2520 (42hrs)	5.15	2.72			
		2880 (48hrs)	5.27	2.84			
		3240 (54hrs)	5.38	2.95			
		3600 (60hrs)	5.43	3			
		4320 (72hrs)	5.62	3.19			

PUMPING TEST DATA SHEET

Location : DUNBOYNE **Borehole name : TW No.1** **Date : 12-08-91**

Test : Recovery Data from TW No.1

Duration : 1hr Well depth : 61m

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
12-08-91		0	5.62	3.19			
		1.5	5.18	2.75			
		2	5.08	2.65			
		6	4.77	2.34			
		8	4.68	2.25			
		9	4.61	2.18			
		10	4.57	2.14			
		12	4.49	2.06			
		14	4.43	2			
		16	4.37	1.94			
		18	4.32	1.89			
		20	4.27	1.84			
		22	4.22	1.79			
		24	4.18	1.75			
		26	4.14	1.71			
		28	4.11	1.68			
		30	4.08	1.65			
		35	4.01	1.58			
		40	3.95	1.52			
		45	3.91	1.48			
		50	3.87	1.44			
		55	3.83	1.4			
		60	3.8	1.37			

PUMPING TEST DATA SHEET

Location : DUNBOYNE **Borehole name : TW No.2** **Date : 09-08-91**

Test : Drawdown Data from TW No.2 while PW No.1 is pumping

Duration : 72hrs Well depth : 10.4m

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
09-08-91		0	2.5	0			
		1	2.55	0.05			
		2	2.58	0.08			
		3	2.65	0.15			
		4	2.7	0.2			
		5	2.8	0.3			
		6	2.94	0.44			
		7	3.04	0.54			
		8	3.14	0.64			
		10	3.28	0.78			
		12	3.4	0.9			
		14	3.49	0.99			
		16	3.59	1.09			
		18	3.67	1.17			
		20	3.72	1.22			
		22	3.78	1.28			
		24	3.83	1.33			
		26	3.88	1.38			
		28	3.92	1.42			
		30	3.96	1.46			
		35	4.05	1.55			
		40	4.1	1.6			
		45	4.1	1.6			
		50	4.1	1.6			
		60 (1hr)	4.1	1.6			
		90	4.1	1.6			
		120 (2hrs)	4.1	1.6			
		150	4.1	1.6			
		180 (3hrs)	4.1	1.6			
		240 (4hrs)	4.1	1.6			
		300 (5hrs)	4.1	1.6			
		360 (6hrs)	4.1	1.6			
		480 (8hrs)	4.1	1.6			
		600 (10hrs)	4.1	1.6			
		720 (12hrs)	4.1	1.6			
		1080 (18hrs)	4.1	1.6			
		1440 (24hrs)	4.1	1.6			
		1800 (30hrs)	4.1	1.6			
		2160 (36hrs)	4.1	1.6			
		2520 (42hrs)	4.1	1.6			
		2880 (48hrs)	4.11	1.61			
		3240 (54hrs)	4.12	1.62			
		3600 (60hrs)	4.11	1.61			
		4320 (72hrs)	4.12	1.62			

Location : DUNBOYNE **Borehole name : TW No.2** **Date : 12-08-91**

Test : Recovery Data from TW No.2

Duration : 1hr Well depth : 10.4m

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
12-08-91		0	4.12	1.62			
		2	4.12	1.62			
		10	4.12	1.62			
		20	4.12	1.62			
		30	4.12	1.62			
		35	4.12	1.62			
		40	4.06	1.56			
		45	4.01	1.51			
		50	3.97	1.47			
		55	3.94	1.44			
		60	3.91	1.41			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : PW No.4** **Date : 25-07-95**

Test : Drawdown Data from PW No.4.

Duration : 72hrs Weather : Fine

Distance from Pumping Well : Well depth : 122m.

Height of datum point above ground level : 0.66m. Datum Point : Top of dipping pipe.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
25-07-95	15:30	0	3.08	0			
		0.5	5.92	2.84			
		1	6.97	3.89			
		1.5	7.46	4.38			
		2	7.77	4.69			
		2.5	7.95	4.87			
		3	8.02	4.94			
		3.5	8.18	5.1			
		4	8.3	5.22			
		4.5	8.48	5.4			
		5	8.65	5.57			
		6	8.94	5.86			
		7	9.21	6.13			
		8	9.45	6.37			
		9	9.7	6.62			
		10	9.92	6.84			
		12	10.31	7.23			
		14	10.66	7.58			
		16	10.8	7.72			
		18	10.98	7.9			
		20	11.18	8.1			
		22	11.35	8.27			
		24	11.51	8.43			
		26	11.63	8.55			
		28	11.72	8.64			
		30	11.84	8.76			
		35	12.08	9			
		40	12.3	9.22			
		45	12.5	9.42			
		50	12.64	9.56			
		55	12.77	9.69			
	16:30	60 (1hr)	12.87	9.79	430		
		75	13.15	10.07			
		90	13.39	10.31		12	773
		105	13.59	10.51			
	17:30	120 (2hrs)	13.66	10.58		11.5	776
		150	13.85	10.77		12.4	764
	18:30	180 (3hrs)	13.85	10.77	415	11.2	774
		210	13.88	10.8			
	19:30	240 (4hrs)	14.16	11.08		10.8	780
	20:30	300 (5hrs)	14.26	11.18		10.7	784
	21:30	360 (6hrs)	14.35	11.27		11.1	775
	22:30	420 (7hrs)	14.46	11.38	415	10.08	789
	23:30	480 (8hrs)	14.44	11.36		10.07	785
26-07-95	00:30	540 (9hrs)	14.52	11.44		10.05	792
	01:30	600 (10hrs)	14.58	11.5		10.08	795
	03:30	720 (12hrs)	14.75	11.67		10.04	807
	05:30	840 (14hrs)	14.9	11.82	410	10.05	812
	07:30	960 (16hrs)	15.08	12	405	10.7	805
	09:30	1080 (18hrs)	15.24	12.16		11	802
	10:30	1200 (20hrs)	15.42	12.34	400		
	15:30	1440 (24hrs)	15.55	12.47	400	11.2	786
	17:30	1560 (26hrs)	15.67	12.59	400	11.3	789
	19:30	1680 (28hrs)	15.62	12.54	400	10.7	789
	21:30	1800 (30hrs)	15.79	12.71	400	11.1	792
	23:30	1920 (32hrs)	15.85	12.77	400	10.9	794
27-07-95	01:30	2040 (34hrs)	15.92	12.84		11	789
	03:30	2160 (36hrs)	15.97	12.89	400	10.7	794
	09:30	2520 (42hrs)	16.12	13.04		11.1	795

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : PW No.4** **Date : 25-07-95**

Test : Drawdown Data from PW No.4.

Duration : 72hrs Weather : Fine

Distance from Pumping Well : Well depth : 122m.

Height of datum point above ground level : 0.66m. Datum Point : Top of dipping pipe.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
	Step 2						
	10:30	2580 (43hrs)	16.13	13.05	545	10.9	805
		2580.5	18.66	15.58			
		2581	20.35	17.27			
		2581.5	21.58	18.5			
		2582	22.67	19.59			
		2582.5	23.53	20.45			
		2583	24.23	21.15			
		2583.5	24.74	21.66			
		2584	25.06	21.98			
		2584.5	25.31	22.23			
		2585	25.44	22.36			
		2586	25.58	22.5			
		2587	25.65	22.57			
		2588	25.72	22.64			
		2589	25.78	22.7			
		2590	25.83	22.75			
		2592	25.95	22.87			
		2594	26.1	23.02			
		2596	26.23	23.15		10.9	785
		2598	26.39	23.31	560		
		2600	26.7	23.62			
		2602	26.89	23.81			
		2604	27.03	23.95			
		2606	27.08	24			
		2608	27.11	24.03			
		2610	27.12	24.04		11	784
		2615	27.21	24.13			
		2620	27.23	24.15			
		2625	27.31	24.23			
		2630	27.31	24.23			
		2635	27.34	24.26			
	11:30	2640 (44hrs)	27.41	24.33			
		2655	27.55	24.47		11.5	770
		2670	27.73	24.65		11.3	780
		2685	27.79	24.71			
	12:30	2700 (45hrs)	27.9	24.82	545	11.1	784
		2730	28.3	25.22		11	774
	13:30	2760 (46hrs)	28.33	25.25	545	11.3	776
	14:30	2820 (47hrs)	28.58	25.5	545	12.5	756
	15:30	2880 (48hrs)	28.79	25.71		11.4	758
	16:30	2940 (49hrs)	28.83	25.75	540	11.6	760
	17:30	3000 (50hrs)	28.98	25.9	535	11.4	775
	18:30	3060 (51hrs)	29.04	25.96		11.3	764
	19:30	3120 (52hrs)	29.06	25.98	535	10.7	780
	20:30	3180 (53hrs)	29.12	26.04		11.2	760
	21:30	3240 (54hrs)	29.21	26.13		10.5	780
	23:30	3360 (56hrs)	29.33	26.25	535	10.7	775
28/07/95	03:30	3600 (60hrs)	29.45	26.37		11.3	777
	09:30	3960 (66hrs)	29.55	26.47		11	778
	15:30	4320 (72hrs)	29.7	26.62		12.5	768

PUMPING TEST DATA SHEET

Location : DUNBOYNE **Borehole name : PW No.4** **Date : 28-07-95**

Test : Recovery Data from PW No.4.

Duration Time : 1.5hrs Weather : Fine

Distance from Pumping Well : Well depth : 122m.

Height of datum point above ground level : 0.66m. Datum Point : Dipping Pipe

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
28-07-95	15:30	0	29.7	26.62			
		0.5	26.3	23.22			
		1	22.9	19.82			
		1.5	18.6	15.52			
		2	14.4	11.32			
		2.5	11.9	8.82			
		3	9.8	6.72			
		3.5	8.15	5.07			
		4	7.04	3.96			
		4.5	6.9	3.82			
		5	6.5	3.42			
		6	6.23	3.15			
		7	6.16	3.08			
		8	6.11	3.03			
		9	6.05	2.97			
		10	6.02	2.94			
		12	5.96	2.88			
		14	5.9	2.82			
		16	5.86	2.78			
		18	5.82	2.74			
		20	5.78	2.7			
		22	5.78	2.7			
		24	5.76	2.68			
		26	5.73	2.65			
		28	5.7	2.62			
		30	5.67	2.59			
		35	5.62	2.54			
		40	5.56	2.48			
		45	5.49	2.41			
		50	5.45	2.37			
		55	5.4	2.32			
	16:30	60 (1hr)	5.37	2.29			
		75	5.25	2.17			
	17:00	90	5.1	2.02			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Filter Hse.) **Borehole name : PW No.3** **Date : 21-06-95**

Test : Drawdown Data from PW No.3.

Duration : 56hrs Weather : Fine

Distance from Pumping Well : Well depth : 61m

Height of datum point above ground level : 0 m. Datum Point : Wooden Plank

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
21-06-95	06:00	0	8.45	0	420		
		0.5	10.3	1.85			
		1	11.55	3.1			
		1.5	12.45	4			
		2	13.1	4.65			
		2.5	13.85	5.4			
		3	14.5	6.05			
		3.5	15.3	6.85			
		4	15.95	7.5			
		4.5	16.55	8.1			
		5	17.2	8.75			
		6	18.5	10.05			
		7	19.65	11.2			
		8	20.7	12.25			
		9	21.8	13.35			
		10	22.78	14.33	420		
		12	24.9	16.45			
		14	26.5	18.05			
		16	27.95	19.5			
		18	27.5	19.05	410		

Cut back the discharge as dipper was approaching the end of the dipping pipe.

		20	27.15	18.7	330		
		22	26.5	18.05	330		
		24	26.05	17.6			
		26	25.6	17.15			
		28	25.2	16.75	340		
		30	24.8	16.35		13.2	565
		35	23.9	15.45	340		
		40	23.15	14.7			
		45	22.5	14.05			
		50	21.9	13.45			
		55	21.41	12.96	345		
	07:00	60 (1hr)	20.98	12.53	345	12.8	573
		75	19.72	11.27	345		
		90	19.07	10.62	345	13	575
		105	18.25	9.8			
	08:00	120 (2hrs)	17.52	9.07		13.4	587
		135	16.78	8.33	345		
		150	16.26	7.81		13.5	586
		165	15.61	7.16			
	09:00	180 (3hrs)	14.99	6.54		11.1	552
		200	14.5	6.05			
		220	13.95	5.5	345	11.5	562
	10:00	240 (4hrs)	13.7	5.25		11.3	553
		260	13.35	4.9			
		280	13.1	4.65		11.4	554
	11:00	300 (5hrs)	12.9	4.45		11.8	554
		330	12.67	4.22			
	12:00	360 (6hrs)	12.71	4.26		11.8	562
		380	12.68	4.23			
		400	12.67	4.22	340	11.8	554
	13:00	420 (7hrs)	12.64	4.19		11.5	560
		440	12.62	4.17			
		460	12.65	4.2		11.3	559
	14:00	480 (8hrs)	12.7	4.25		11.5	564
		510	12.52	4.07	340	11.2	554
	15:00	540 (9hrs)	12.54	4.09	330	11.9	565
		570	12.59	4.14		11.5	560
	16:00	600 (10hrs)	12.57	4.12		11.7	562

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Filter Hse.) **Borehole name : PW No.3** **Date : 21-06-95**

Test : Drawdown Data from PW No.3.

Duration : 56hrs

Weather : Fine

Distance from Pumping Well :

Well depth : 61m

Height of datum point above ground level : 0 m.

Datum Point : Wooden Plank

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
		630	12.55	4.1	330	11.1	556
	17:00	660 (11hrs)	12.5	4.05		11.4	555
		690	12.5	4.05		11.9	560
		795	12.51	4.06		11.6	563
	21:00	900 (15hrs)	12.49	4.04			
	23:00	1020 (17hrs)	12.49	4.04			
22-06-95	08:00	1560 (26hrs)	12.45	4			
	11:00	1740 (29hrs)	12.48	4.03			
	14:00	1920 (32hrs)	12.51	4.06			
	17:00	2100 (35hrs)	12.47	4.02			
	20:00	2280 (38hrs)	12.49	4.04			
	23:00	2460 (41hrs)	12.51	4.06			
23-06-95	08:00	3000 (50hrs)	12.49	4.04		12.1	563
	11:00	3180 (53hrs)	12.51	4.06		11.3	545
	14:00	3360 (56hrs)	12.52	4.07	340	10.8	540

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Filter Hse.) **Borehole name : PW No.3** **Date : 20-06-95**

Test : Recovery Data from PW No.3

Duration : 9hrs Weather : Fair

Distance from Pumping Well : Well depth : 61m

Height of datum point above ground level : 0 m. Datum Point : Wooden Plank.

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
20-06-95	21:00	0	21.58	13.13			
		0.5	19.6	11.15			
		1	17.35	8.9			
		1.5	15.2	6.75			
		2	13.1	4.65			
		2.5	11.3	2.85			
		3	10.1	1.65			
		3.5	9.3	0.85			
		4	8.9	0.45			
		4.5	8.7	0.25			
		5	8.67	0.22			
		6	8.66	0.21			
		7	8.65	0.2			
		8	8.65	0.2			
		9	8.64	0.19			
		10	8.64	0.19			
		12	8.63	0.18			
		14	8.62	0.17			
		16	8.61	0.16			
		18	8.6	0.15			
		20	8.6	0.15			
		22	8.6	0.15			
		24	8.6	0.15			
		26	8.59	0.14			
		28	8.59	0.14			
		30	8.59	0.14			
		35	8.58	0.13			
		40	8.57	0.12			
		45	8.57	0.12			
		50	8.57	0.12			
		55	8.56	0.11			
	22:00	60 (1hr)	8.56	0.11			
		75	8.55	0.1			
		90	8.54	0.09			
		105	8.54	0.09			
	23:00	120 (2hrs)	8.54	0.09			
		135	8.54	0.09			
		150	8.53	0.08			
		165	8.53	0.08			
	24:00	180 (3hrs)	8.51	0.06			
21-06-95		200	8.51	0.06			
		220	8.51	0.06			
	01:00	240 (4hrs)	8.5	0.05			
	02:00	300 (5hrs)	8.51	0.06			
	03:00	360 (6hrs)	8.48	0.03			
	04:00	420 (7hrs)	8.5	0.05			
	05:00	480 (8hrs)	8.45	0			
	06:00	540 (9hrs)	8.45	0			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : PW No.2** **Date : 21-06-95**

Test : Drawdown Data from PW No. 2 while PW No.1 and PW No.2 are pumping.

Duration : 11.5hrs. Weather : Fine

Distance from Pumping Well : 86.7m to PW No.1. Well depth : 60m (est.)

Height of datum point above ground level : 1.1m Datum Point : Edge of manhole cover.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
Test commences with only PW No.1 pumping.							
21-06-95	06:30	0	4.16	0			
		0.5	4.16	0			
		1	4.16	0			
		1.5	4.15	-0.01			
		2	4.13	-0.03			
		2.5	4.13	-0.03			
		3	4.12	-0.04			
		3.5	4.12	-0.04			
		4	4.12	-0.04			
		4.5	4.12	-0.04			
		5	4.12	-0.04			
		6	4.12	-0.04			
		7	4.12	-0.04			
		8	4.12	-0.04			
		9	4.11	-0.05			
		10	4.11	-0.05			
		12	4.11	-0.05			
		14	4.1	-0.06			
		16	4.1	-0.06			
		18	4.08	-0.08			
		20	4.08	-0.08			
		22	4.08	-0.08			
		24	4.08	-0.08			
		26	4.07	-0.09			
		28	4.07	-0.09			
		30	4.06	-0.1			
		35	4.03	-0.13			
		40	4.04	-0.12			
		45	4.02	-0.14			
		50	4.01	-0.15			
		55	4	-0.16			
	07:30	60 (1hr)	3.99	-0.17			
PW No.1 and PW No.2 pump for the remainder of the test.							
		60.5	8.31	4.15	175	11.2	800
		61	9.45	5.29			
		61.5	10.78	6.62			
		62	12.4	8.24			
		62.5	13.67	9.51			
		63	14.65	10.49			
		63.5	15.8	11.64			
		64	16.84	12.68			
		64.5	17.48	13.32	175		
		65	18.37	14.21	175		
		66	19.73	15.57			
		67	21	16.84			
		68	21.89	17.73			
		69	22.41	18.25			
		70	23.37	19.21			
		72	24.52	20.36			
		74	25.38	21.22			
		76	25.95	21.79			
		80	26.74	22.58			
		82	27	22.84			
		84	27.2	23.04			
		86	27.41	23.25			
		88	27.53	23.37			
		90	27.65	23.49		11.2	782
		95	27.95	23.79			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : PW No.2** **Date : 21-06-95**

Test : Drawdown Data from PW No. 2 while PW No.1 and PW No.2 are pumping.

Duration : 11.5hrs. Weather : Fine

Distance from Pumping Well : 86.7m to PW No.1. Well depth : 60m (est.)

Height of datum point above ground level : 1.1m Datum Point : Edge of manhole cover.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
		100	28.1	23.94			
		105	28.23	24.07			
		110	28.41	24.25			
		115	28.54	24.38			
	08:30	120 (2hrs)	28.66	24.5		11.8	772
		135	28.85	24.69			
		150	29.16	25		11.9	763
		165	29.32	25.16			
	09:30	180 (3hrs)	29.46	25.3		11.8	761
		195	29.68	25.52			
		210	29.77	25.61		12.2	764
		225	29.89	25.73			
	10:30	240 (4hrs)	29.96	25.8		11.6	768
		260	30.1	25.94			
		280	30.26	26.1		12.5	757
	11:30	300 (5hrs)	30.32	26.16		11.4	761
		320	30.42	26.26			
		340	30.48	26.32		11.9	765
	12:30	360 (6hrs)	30.55	26.39		11.8	758
		390	30.5	26.34		11.8	768
	13:30	420 (7hrs)	30.45	26.29		12.8	755
		440	30.38	26.22			
		460	30.35	26.19		11.8	769
	14:30	480 (8hrs)	30.5	26.34		11.8	757
	15:30	540 (9hrs)	30.52	26.36		11.8	766
		570	30.58	26.42		12	755
	16:30	600 (10hrs)	30.59	26.43		11.5	761
		630	30.62	26.46		11.7	753
	17:30	660 (11hrs)	30.69	26.53		11.6	766
	18:00	690	30.74	26.58	175	11.3	771

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery)	Borehole name : PW No.2	Date : 20-06-95
Test : Recovery Data from PW No.2		
Duration : 8hrs	Weather : Fair	
Distance from Pumping Well : 86.7m to PW No.1.	Well depth : 60m (est.)	
Height of datum point above ground level : 1.1m	Datum Point : Edge of manhole cover.	

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
20-06-95	22:00	0	32.35	27.75			
		0.5	30.1	25.5			
		1	27.8	23.2			
		1.5	26	21.4			
		2	24.23	19.63			
		2.5	22.55	17.95			
		3	20.97	16.37			
		3.5	19.6	15			
		4	18.37	13.77			
		4.5	17.35	12.75			
		5	16.45	11.85			
		6	14.9	10.3			
		7	13.28	8.68			
		8	12.5	7.9			
		9	11.85	7.25			
		10	11.2	6.6			
		12	10.55	5.95			
		14	10.24	5.64			
		16	9.97	5.37			
		18	9.79	5.19			
		20	9.66	5.06			
		22	9.45	4.85			
		24	9.4	4.8			
		26	9.3	4.7			
		28	9.19	4.59			
		30	9.09	4.49			
		35	8.91	4.31			
		40	8.68	4.08			
		45	8.52	3.92			
		50	8.39	3.79			
		55	8.22	3.62			
	23:00	60 (1hr)	8.09	3.49			
		75	7.82	3.22			
		90	7.41	2.81			
		105	7.13	2.53			
	24:00	120 (2hrs)	6.89	2.29			
		135	6.65	2.05			
		150	6.5	1.9			
		165	6.23	1.63			
	01:00	180 (3hrs)	5.91	1.31			
	02:00	240 (4hrs)	5.6	1			
	06:00	450 (8hrs)	4.6	0			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : PW No.1** **Date : 21-06-95**

Test : Drawdown Data from PW No.1 while PW No.1 and PW No.2 are pumping.

Duration : 11.5hrs. Weather : Fine

Distance from Pumping Well : 86.7m to PW No.2. Well depth : 60m (est.)

Height of datum point above ground level : 1.1m Datum Point : Edge of manhole cover.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
Test commences with only PW No.1 pumping.							
21-06-95	06:30	0	2.45	0	115		
		0.5	3.85	1.4			
		1	4.65	2.2			
		1.5	5.3	2.85			
		2	5.7	3.25			
		2.5	6	3.55			
		3	6.3	3.85			
		3.5	6.45	4			
		4	6.6	4.15			
		4.5	6.68	4.23			
		5	6.72	4.27			
		6	6.95	4.5			
		7	7.25	4.8			
		8	8	5.55			
		9	9	6.55			
		10	9.8	7.35			
		12	11.25	8.8			
		14	12.13	9.68			
		16	12.9	10.45			
		18	13.23	10.78			
		20	13.67	11.22			
		22	14.05	11.6			
		24	14.35	11.9			
		26	14.35	11.9			
		28	14.46	12.01			
		30	14.47	12.02		10.4	743
		35	15	12.55			
		40	14.89	12.44			
		45	14.9	12.45			
		50	15.1	12.65			
		55	15.95	13.5			
	07:30	60 (1hr)	16.2	13.75		11.5	732
PW No.1 and PW No.2 pump for the remainder of the test.							
		60.5	15.9	13.45			
		61	15.85	13.4			
		61.5	15.71	13.26			
		62	15.65	13.2			
		62.5	15.56	13.11			
		63	15.48	13.03			
		63.5	15.4	12.95			
		64	15.32	12.87			
		64.5	15.26	12.81	115		
		65	15.21	12.76	115		
		66	15.07	12.62			
		67	15	12.55			
		68	14.83	12.38			
		69	14.71	12.26			
		70	14.65	12.2			
		72	14.52	12.07			
		74	14.42	11.97			
		76	14.32	11.87			
		78	14.18	11.73			
		80	14.17	11.72			
		82	13.95	11.5			
		84	13.85	11.4			
		86	13.76	11.31			
		88	13.7	11.25			
		90	13.65	11.2		10.6	740

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : PW No.1** **Date : 21-06-95**

Test : Drawdown Data from PW No.1 while PW No.1 and PW No.2 are pumping.

Duration : 11.5hrs. Weather : Fine

Distance from Pumping Well : 86.7m to PW No.2. Well depth : 60m (est.)

Height of datum point above ground level : 1.1m Datum Point : Edge of manhole cover.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
		95	14.45	12			
		100	14	11.55			
		105	13.7	11.25			
		110	13.63	11.18			
		115	13.64	11.19			
	08:30	120 (2hrs)	15.21	12.76		11	735
		135	13.42	10.97			
		150	13.37	10.92		11	729
		165	13.57	11.12			
	09:30	180 (3hrs)	14.18	11.73		12	726
		195	13.22	10.77			
		210	14.15	11.7		12.2	720
		225	13.3	10.85			
	10:30	240 (4hrs)	13	10.55		11.5	738
		260	13.2	10.75			
		280	14.09	11.64		13	700
	11:30	300 (5hrs)	12.46	10.01		11.3	731
		320	12.18	9.73			
		340	11.95	9.5		11	739
	12:30	360 (6hrs)	11.8	9.35		11.8	726
		390	12.48	10.03		11.3	730
	13:30	420 (7hrs)	10.94	8.49		11	729
		440	10.62	8.17			
		460	10.4	7.95		10.9	733
	14:30	480 (8hrs)	10.61	8.16		10.9	738
	15:30	540 (9hrs)	10.37	7.92		11.5	736
		570	10.32	7.87		10.9	734
	16:30	600 (10hrs)	10.32	7.87		10.9	734
		630	10.19	7.74		10.9	732
	17:30	660 (11hrs)	10.5	8.05		11.2	731
	18:00	690	10.78	8.33	115	12.2	720

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : PW No.1** **Date : 20-06-95**

Test : Recovery Data from PW No.1.

Duration : 8hrs Weather : Fair

Distance from Pumping Well : 86.7m to PW No.2. Well depth : 60m (est.)

Height of datum point above ground level : 1.1m Datum Point : Edge of manhole cover.

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
20-06-95	22:00	0	13.05	10.6			
		0.5	7.2	4.75			
		1	6.3	3.85			
		1.5	5.9	3.45			
		2	4.4	1.95			
		2.5	3.8	1.35			
		3	3.4	0.95			
		3.5	3.15	0.7			
		4	2.95	0.5			
		4.5	2.85	0.4			
		5	2.8	0.35			
		6	2.73	0.28			
		7	2.69	0.24			
		8	2.66	0.21			
		9	2.66	0.21			
		10	2.65	0.2			
		12	2.65	0.2			
		14	2.63	0.18			
		16	2.62	0.17			
		18	2.61	0.16			
		20	2.6	0.15			
		22	2.6	0.15			
		24	2.6	0.15			
		26	2.6	0.15			
		28	2.59	0.14			
		30	2.59	0.14			
		35	2.59	0.14			
		40	2.57	0.12			
		45	2.57	0.12			
		55	2.55	0.1			
	23:00	60 (1hr)	2.55	0.1			
		75	2.56	0.11			
		90	2.53	0.08			
		105	2.51	0.06			
	24:00	120 (2hrs)	2.5	0.05			
21/06/95		135	2.5	0.05			
		150	2.47	0.02			
	01:00	180 (3hrs)	2.47	0.02			
		195	2.47	0.02			
	02:00	240 (4hrs)	2.47	0.02			
	06:00	480 (8hrs)	2.45	0			

PUMPING TEST DATA SHEET

Location :Dunboyne **Borehole name : PW No.3** **Date : 23-06-1995**

Test : Recovery Data from Pumping Well No. 3

Duration :1 hr Weather : Fine

Distance from Pumping Well : Well depth : 61 m.

Height of datum point above ground level : 0 m. Datum Point : Wooden Plank

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
23-06-95		0	12.5	4.05			
		0.5	10.9	2.45			
		1	9.8	1.35			
		1.5	9.1	0.65			
		2	8.8	0.35			
		2.5	8.76	0.31			
		3	8.64	0.19			
		3.5	8.64	0.19			
		4	8.64	0.19			
		4.5	8.63	0.18			
		5	8.63	0.18			
		6	8.63	0.18			
		7	8.63	0.18			
		8	8.62	0.17			
		9	8.62	0.17			
		10	8.62	0.17			
		12	8.62	0.17			
		14	8.61	0.16			
		16	8.61	0.16			
		18	8.6	0.15			
		20	8.6	0.15			
		22	8.6	0.15			
		24	8.6	0.15			
		26	8.59	0.14			
		28	8.59	0.14			
		30	8.58	0.13			
		35	8.58	0.13			
		40	8.57	0.12			
		45	8.57	0.12			
		50	8.56	0.11			
		55	8.56	0.11			
		60 (1hr)	8.55	0.1			

PUMPING TEST DATA SHEET

Location : Dunboyne **Borehole name : OW No.2** **Date : 23-06-1995**

Test : Recovery Data from Observation Well No.2

Duration :1 hr Weather : Fine

Distance from Pumping Well : 17.5 m. Well depth : 60 m.

Height of datum point above ground level : 0.5 m. Datum Point : Top of Casing

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
23-06-95		0	9.09	0.22			
		0.5	9.09	0.22			
		1	9.09	0.22			
		1.5	9.09	0.22			
		2	9.09	0.22			
		2.5	9.09	0.22			
		3	9.09	0.22			
		3.5	9.08	0.21			
		4	9.08	0.21			
		4.5	9.08	0.21			
		5	9.07	0.2			
		6	9.07	0.2			
		7	9.06	0.19			
		8	9.06	0.19			
		9	9.05	0.18			
		10	9.05	0.18			
		12	9.04	0.17			
		14	9.04	0.17			
		16	9.03	0.16			
		18	9.03	0.16			
		20	9.02	0.15			
		22	9.02	0.15			
		24	9.01	0.14			
		26	9.01	0.14			
		28	9.01	0.14			
		30	9	0.13			
		35	9	0.13			
		40	8.99	0.12			
		45	8.98	0.11			
		50	8.98	0.11			
		55	8.98	0.11			
		60 (1hr)	8.97	0.1			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Filter Hse.) **Borehole name : OW No.2** **Date : 20-06-95**

Test : Recovery Data from OW No.2.

Duration : 9hrs Weather : Fair

Distance from Pumping Well : 17.5m. Well depth : 60 m.

Height of datum point above ground level : 0.5m Datum Point : Top of Casing

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
20-06-95	21:00	0	9.12	0.25			
		0.5	9.12	0.25			
		1	9.12	0.25			
		1.5	9.12	0.25			
		2	9.12	0.25			
		2.5	9.12	0.25			
		3	9.11	0.24			
		3.5	9.11	0.24			
		4	9.11	0.24			
		4.5	9.11	0.24			
		5	9.11	0.24			
		6	9.1	0.23			
		7	9.1	0.23			
		8	9.09	0.22			
		9	9.08	0.21			
		10	9.08	0.21			
		12	9.07	0.2			
		14	9.06	0.19			
		16	9.05	0.18			
		18	9.04	0.17			
		20	9.04	0.17			
		22	9.03	0.16			
		24	9.03	0.16			
		26	9.03	0.16			
		28	9.02	0.15			
		30	9.02	0.15			
		35	9.01	0.14			
		40	9	0.13			
		45	8.99	0.12			
		50	8.99	0.12			
		55	8.99	0.12			
	22:00	60 (1hr)	8.98	0.11			
		75	8.98	0.11			
		90	8.97	0.1			
		105	8.96	0.09			
	23:00	120 (2hrs)	8.95	0.08			
		135	8.94	0.07			
		150	8.94	0.07			
		165	8.94	0.07			
	24:00	180 (3hrs)	8.94	0.07			
21/06/95		200	8.93	0.06			
		220	8.92	0.05			
	01:00	240 (4hrs)	8.92	0.05			
	02:00	300 (5hrs)	8.92	0.05			
	03:00	360 (6hrs)	8.89	0.02			
	04:00	420 (7hrs)	8.88	0.01			
	05:00	480 (8hrs)	8.88	0.01			
	06:00	540 (9hrs)	8.87	0			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Filter Hse.) **Borehole name : OW No.2** **Date : 21-06-95**

Test : Drawdown Data from OW No.2 while PW No.3 is pumping.

Duration : 56hrs Weather : Fine

Distance from Pumping Well : 17.5m. Well depth : 60 m.

Height of datum point above ground level : 0.5m Datum Point : Top of Casing

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
21-06-95	06:00	0	8.87	0			
		1	8.87	0			
		2	8.87	0			
		2.5	8.88	0.01			
		3	8.88	0.01			
		3.5	8.88	0.01			
		4	8.89	0.02			
		5	8.89	0.02			
		6	8.9	0.03			
		7	8.9	0.03			
		8	8.91	0.04			
		9	8.91	0.04			
		10	8.92	0.05			
		12	8.92	0.05			
		14	8.93	0.06			
		16	8.94	0.07			
		18	8.95	0.08			
		20	8.95	0.08			
		22	8.96	0.09			
		24	8.96	0.09			
		26	8.97	0.1			
		28	8.97	0.1			
		30	8.97	0.1			
		35	8.98	0.11			
		40	8.98	0.11			
		45	8.99	0.12			
		50	8.99	0.12			
	07:00	60 (1hr)	8.99	0.12			
		75	9	0.13			
	07:30	90	9.01	0.14			
	08:00	120 (2hrs)	9.01	0.14			
		135	9.01	0.14			
		150	9.02	0.15			
	09:00	180 (3hrs)	9.02	0.15			
	10:00	240 (4hrs)	9.02	0.15			
	11:00	300 (5hrs)	9.02	0.15			
	12:00	360 (6hrs)	9.02	0.15			
	13:00	420 (7hrs)	9.03	0.16			
	14:00	480 (8hrs)	9.03	0.16			
	15:00	540 (9hrs)	9.03	0.16			
	16:00	600 (10hrs)	9.03	0.16			
		630	9.04	0.17			
	17:00	660 (11hrs)	9.04	0.17			
	17:30	690	9.03	0.16			
	19:15	795	9.03	0.16			
	21:00	900 (15hrs)	9.04	0.17			
	23:00	1020 (17hrs)	9.05	0.18			
22-06-95	08:00	1560 (26hrs)	9.05	0.18			
	11:00	1740 (29hrs)	9.06	0.19			
	14:00	1920 (32hrs)	9.05	0.18			
	17:00	2100 (35hrs)	9.06	0.19			
	20:00	2280 (38hrs)	9.07	0.2			
	23:00	2460 (41hrs)	9.08	0.21			
23-06-95	08:00	3000 (50hrs)	9.08	0.21			
	11:00	3180 (53hrs)	9.08	0.21			
	14:00	3360 (56hrs)	9.08	0.21			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : OW No.1** **Date : 20-06-95**

Test : Recovery Data from OW No.1.

Duration : 8hrs Weather : Fair

Distance from Pumping Well : 12.4m to PW No.1. Well depth : 60m (est.)

Height of datum point above ground level : -0.5m Datum Point : Top of casing.

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
20-06-95	22:00	0	1.96	1.05			
		0.5	1.96	1.05			
		1	1.96	1.05			
		1.5	1.96	1.05			
		2	1.96	1.05			
		2.5	1.96	1.05			
		3	1.96	1.05			
		3.5	1.95	1.04			
		4	1.95	1.04			
		4.5	1.94	1.03			
		5	1.93	1.02			
		6	1.92	1.01			
		7	1.91	1			
		8	1.9	0.99			
		9	1.89	0.98			
		10	1.88	0.97			
		12	1.86	0.95			
		14	1.84	0.93			
		16	1.81	0.9			
		18	1.79	0.88			
		20	1.76	0.85			
		22	1.74	0.83			
		24	1.74	0.83			
		26	1.7	0.79			
		28	1.68	0.77			
		30	1.66	0.75			
		35	1.62	0.71			
		40	1.6	0.69			
		45	1.55	0.64			
		50	1.51	0.6			
		55	1.49	0.58			
	23:00	60 (1hr)	1.46	0.55			
		75	1.4	0.49			
		90	1.34	0.43			
		105	1.3	0.39			
	24:00	120 (2hrs)	1.26	0.35			
21-06-95		135	1.21	0.3			
		150	1.19	0.28			
		165	1.16	0.25			
	01:15	195	1.11	0.2			
	02:00	240 (3hrs)	1.1	0.19			
	05:30	450	0.94	0.03			
	06:00	480 (8hrs)	0.91	0			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : OW No.1** **Date : 21-06-95**

Test : Drawdown Data from OW No.1 while PW No.1 and PW No.2 are pumping.

Duration : 11.5hrs. Weather : Fine

Distance from Pumping Well : 12.4m to PW No.1. Well depth : 60m (est.)

Height of datum point above ground level : -0.5m Datum Point : Top of casing.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
Test commences with only PW No.1 pumping.							
21-06-95	06:30	0	0.91	0			
		1	0.91	0			
		1.5	0.92	0.01			
		2	0.93	0.02			
		2.5	0.93	0.02			
		3	0.94	0.03			
		3.5	0.95	0.04			
		4	0.95	0.04			
		4.5	0.96	0.05			
		5	0.96	0.05			
		6	0.98	0.07			
		7	1	0.09			
		8	1.01	0.1			
		9	1.02	0.11			
		10	1.03	0.12			
		12	1.05	0.14			
		14	1.09	0.18			
		16	1.13	0.22			
		18	1.13	0.22			
		20	1.14	0.23			
		22	1.16	0.25			
		24	1.18	0.27			
		26	1.2	0.29			
		28	1.21	0.3			
		30	1.23	0.32			
		35	1.29	0.38			
		40	1.3	0.39			
		45	1.33	0.42			
		50	1.35	0.44			
		55	1.37	0.46			
	07:30	60 (1hr)	1.4	0.49			
PW No.1 and PW No.2 pump for the remainder of the test.							
		61	1.4	0.49			
		62	1.4	0.49			
		62.5	1.4	0.49			
		63	1.4	0.49			
		64	1.41	0.5			
		64.5	1.41	0.5			
		65	1.41	0.5			
		66	1.41	0.5			
		67	1.42	0.51			
		68	1.42	0.51			
		69	1.42	0.51			
		70	1.42	0.51			
		72	1.44	0.53			
		74	1.44	0.53			
		76	1.45	0.54			
		78	1.45	0.54			
		80	1.46	0.55			
		82	1.46	0.55			
		84	1.47	0.56			
		86	1.47	0.56			
		88	1.48	0.57			
		90	1.49	0.58			
		95	1.5	0.59			
		100	1.52	0.61			
		105	1.52	0.61			
		110	1.51	0.6			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : OW No.1** **Date : 21-06-95**

Test : Drawdown Data from OW No.1 while PW No.1 and PW No.2 are pumping.

Duration : 11.5hrs. Weather : Fine

Distance from Pumping Well : 12.4m to PW No.1. Well depth : 60m (est.)

Height of datum point above ground level : -0.5m Datum Point : Top of casing.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
		115	1.52	0.61			
	08:30	120 (2hrs)	1.58	0.67			
		135	1.62	0.71			
		150	1.65	0.74			
		165	1.67	0.76			
	09:30	180 (3hrs)	1.7	0.79			
		195	1.73	0.82			
		210	1.75	0.84			
		225	1.77	0.86			
	10:30	240 (4hrs)	1.79	0.88			
		260	1.81	0.9			
		280	1.82	0.91			
	11:30	300 (5hrs)	1.84	0.93			
		320	1.85	0.94			
		340	1.86	0.95			
	12:30	360 (6hrs)	1.86	0.95			
		390	1.88	0.97			
	13:30	420 (7hrs)	1.88	0.97			
	15:30	540 (9hrs)	1.9	0.99			
		570	1.9	0.99			
	16:30	600 (10hrs)	1.9	0.99			
		630	1.92	1.01			
	17:30	660 (11hrs)	1.93	1.02			
	18:00	690	1.93	1.02			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : PW No. 2.** **Date : 28-07-95**

Test : Recovery Data from PW No.2

Duration : 1.5hrs

Weather : Fine

Distance from Pumping Well : 12m.

Well depth : 60m (est.)

Height of datum point above ground level : 1.1m

Datum Point : Edge of manhole cover.

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
28-07-95	15:30	0	11.28	5.73			
		0.5	11.27	5.72			
		1	11.27	5.72			
		1.5	11.26	5.71			
		2	11.25	5.7			
		2.5	11.23	5.68			
		3	11.21	5.66			
		3.5	11.17	5.62			
		4	11.13	5.58			
		4.5	11.08	5.53			
		5	11.03	5.48			
		6	10.92	5.37			
		7	10.83	5.28			
		8	10.73	5.18			
		9	10.65	5.1			
		10	10.57	5.02			
		12	10.43	4.88			
		14	10.3	4.75			
		16	10.18	4.63			
		18	10.09	4.54			
		20	9.99	4.44			
		22	9.89	4.34			
		24	9.8	4.25			
		26	9.73	4.18			
		28	9.64	4.09			
		30	9.58	4.03			
		35	9.44	3.89			
		40	9.28	3.73			
		45	9.12	3.57			
		50	8.97	3.42			
		55	8.84	3.29			
	16:30	60 (1hr)	8.72	3.17			
		75	8.36	2.81			
	17:00	90	8.03	2.48			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : PW No.2.** **Date : 25-07-95**

Test : Drawdown Data from PW No.2 while PW No.4 is pumping.

Duration : 72hrs Weather : Fine

Distance from Pumping Well : 12m. Well depth : 60m.(est.)

Height of datum point above ground level : 1.1m Datum Point : Edge of manhole cover.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
25-07-95	15:30	0	5.55	0			
		0.5	5.55	0			
		1	5.55	0			
		1.5	5.55	0			
		2	5.55	0			
		3	5.55	0			
		4	5.55	0			
		4.5	5.56	0.01			
		5	5.56	0.01			
		6	5.57	0.02			
		7	5.57	0.02			
		8	5.58	0.03			
		9	5.59	0.04			
		10	5.6	0.05			
		12	5.62	0.07			
		14	5.65	0.1			
		16	5.67	0.12			
		18	5.68	0.13			
		20	5.68	0.13			
		22	5.69	0.14			
		24	5.71	0.16			
		26	5.72	0.17			
		28	5.73	0.18			
		30	5.75	0.2			
		40	5.81	0.26			
		45	5.83	0.28			
		50	5.86	0.31			
		55	5.88	0.33			
	16:30	60 (1hr)	5.9	0.35			
		75	5.96	0.41			
		90	6.02	0.47			
		105	6.07	0.52			
	17:30	120 (2hrs)	6.14	0.59			
		150	6.21	0.66			
	18:30	180 (3hrs)	6.28	0.73			
	19:30	240 (4hrs)	6.36	0.81			
	20:30	300 (5hrs)	6.42	0.87			
	21:30	360 (6hrs)	6.49	0.94			
	22:30	420 (7hrs)	6.56	1.01			
	23:30	480 (8hrs)	6.59	1.04			
26-07-95	00:30	540 (9hrs)	6.64	1.09			
	01:30	600 (10hrs)	6.67	1.12			
	03:30	720 (12hrs)	6.7	1.15			
	05:30	840 (14hrs)	6.74	1.19			
	07:30	960 (16hrs)	6.79	1.24			
	09:30	1080 (18hrs)	6.82	1.27			
	11:30	1200 (20hrs)	6.85	1.3			
	15:30	1440 (24hrs)	6.9	1.35			
	17:30	1560 (26hrs)	6.92	1.37			
	19:30	1680 (28hrs)	6.93	1.38			
	21:30	1800 (30hrs)	6.96	1.41			
	23:30	1920 (32hrs)	6.99	1.44			
27-07-95	01:30	2040 (34hrs)	7.01	1.46			
	03:30	2160 (36hrs)	7.04	1.49			
	09:30	2520 (42hrs)	7.09	1.54			
	10:30	2580 (43hrs)	7.11	1.56			Step 2
		2580.5	7.11	1.56			
		2581	7.11	1.56			
		2581.5	7.11	1.56			

PUMPING TEST DATA SHEET

Location : DUNBOYNE (at Gallery) **Borehole name : PW No.2.** **Date : 25-07-95**

Test : Drawdown Data from PW No.2 while PW No.4 is pumping.

Duration : 72hrs Weather : Fine

Distance from Pumping Well : 12m. Well depth : 60m.(est.)

Height of datum point above ground level : 1.1m Datum Point : Edge of manhole cover.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C °	Conductivity uS/cm @20 C
		2582	7.11	1.56			
		2582.5	7.12	1.57			
		2583	7.14	1.59			
		2583.5	7.15	1.6			
		2584	7.16	1.61			
		2584.5	7.18	1.63			
		2585	7.2	1.65			
		2586	7.23	1.68			
		2587	7.26	1.71			
		2588	7.3	1.75			
		2589	7.33	1.78			
		2590	7.35	1.8			
		2592	7.4	1.85			
		2594	7.46	1.91			
		2596	7.5	1.95			
		2598	7.55	2			
		2600	7.58	2.03			
		2602	7.62	2.07			
		2604	7.66	2.11			
		2606	7.7	2.15			
		2608	7.73	2.18			
		2610	7.76	2.21			
		2615	7.86	2.31			
		2620	7.92	2.37			
		2625	7.99	2.44			
		2630	8.06	2.51			
		2635	8.13	2.58			
	11:30	2640 (44hrs)	8.19	2.64			
		2655	8.37	2.82			
		2670	8.52	2.97			
		2685	8.66	3.11			
	12:30	2700 (45hrs)	8.78	3.23			
		2730	9.01	2.09			
	13:30	2760 (46hrs)	9.21	2.29			
	14:30	2820 (47hrs)	9.54	2.62			
	15:30	2880 (48hrs)	9.81	2.89			
	16:30	2940 (49hrs)	10.02	3.1			
	17:30	3000 (50hrs)	10.18	3.26			
	18:30	3060 (51hrs)	10.32	3.4			
	19:30	3120 (52hrs)	10.44	3.52			
	20:30	3180 (53hrs)	10.54	3.62			
	21:30	3240 (54hrs)	10.62	3.7			
	23:30	3360 (56hrs)	10.81	3.89			
28-07-95	03:30	3600 (60hrs)	11	4.08			
	09:30	3960 (66hrs)	11.15	4.23			
	15:30	4320 (72hrs)	11.28	4.36			

Groundwater Quality Analyses

Groundwater Source :		Dunboyne				
Sample Location :		TW No.1	TW No.2	Pw1/Pw2	PW No.3	PW No.1
Date :		??/01/89	??/01/89	??/01/89	??/06/91	12/06/95
Parameters	**Units**					
Alkalinity	mg/l	294	272	282	298	334
Aluminium	mg/l					<0.02
Ammonium	mg/l	0.12	0.06	0.09	0.06	
Ammonium as Nitrogen	mg/l					0.03
Arsenic	mg/l					
Barium	mg/l					0.14
Bicarbonate	mg/l	358	332	344	363	
Boron	mg/l					0.041
Cadmium	mg/l					<0.025
Calcium	mg/l	140	132	102	140	129
Calcium Hardness	mg/l					322
Total Hardness	mg/l	390	360	350	376	360
Chloride	mg/l	23	22	25	22	23.4
Chromium	mg/l					<0.025
Copper	mg/l	<0.07	<0.07	<0.07		<0.01
Cyanide	mg/l					<0.01
Electrical Conductivity	mS/cm	0.433	0.363	0.376	0.645	0.737
Fluoride	mg/l					<0.25
Iron (total)	mg/l	<0.1	<0.1	0.46	0.18	0.152
Lead	mg/l					<0.25
Magnesium	mg/l	10	9	23	9	9.1
Magnesium Hardness	mg/l					37
Manganese	mg/l	0.31	0.3	0.05	0.5	0.297
Mercury	mg/l					
Nickel	mg/l					<0.05
Nitrate	mg/l	0.9	0.9	<0.1	4	<0.1
Nitrite	mg/l	0.08	0.06	<0.005	<0.05	<0.1
pH		7.5	7.5	7.4	7.3	7.2
Phosphate	mg/l					<0.5
Phosphorus	mg/l					<0.25
Potassium	mg/l	1.3	1.5	3.6	0.9	1.8
Selenium	mg/l					
Silver	mg/l					<0.01
Sodium	mg/l	10	9	21	8.8	12
Strontium	mg/l					0.503
Sulphate	mg/l	73	64	70	58	66.8
Temperature	C					10.6
Total dissolved solids	mg/l					577
Zinc	mg/l					0.02
Total Coliforms	/100 ml	0	0		0	0
E. coli	/100 ml	0	0		0	0

TW No.1 is a sample taken from the limestone trial well adjacent to Pw No. 3.
TW No.2 is a sample taken from the gravel trial well adjacent to PW No. 3.
PW1/PW2 indicates that the sample is a joint sample of both PW No.1 & PW No.2.

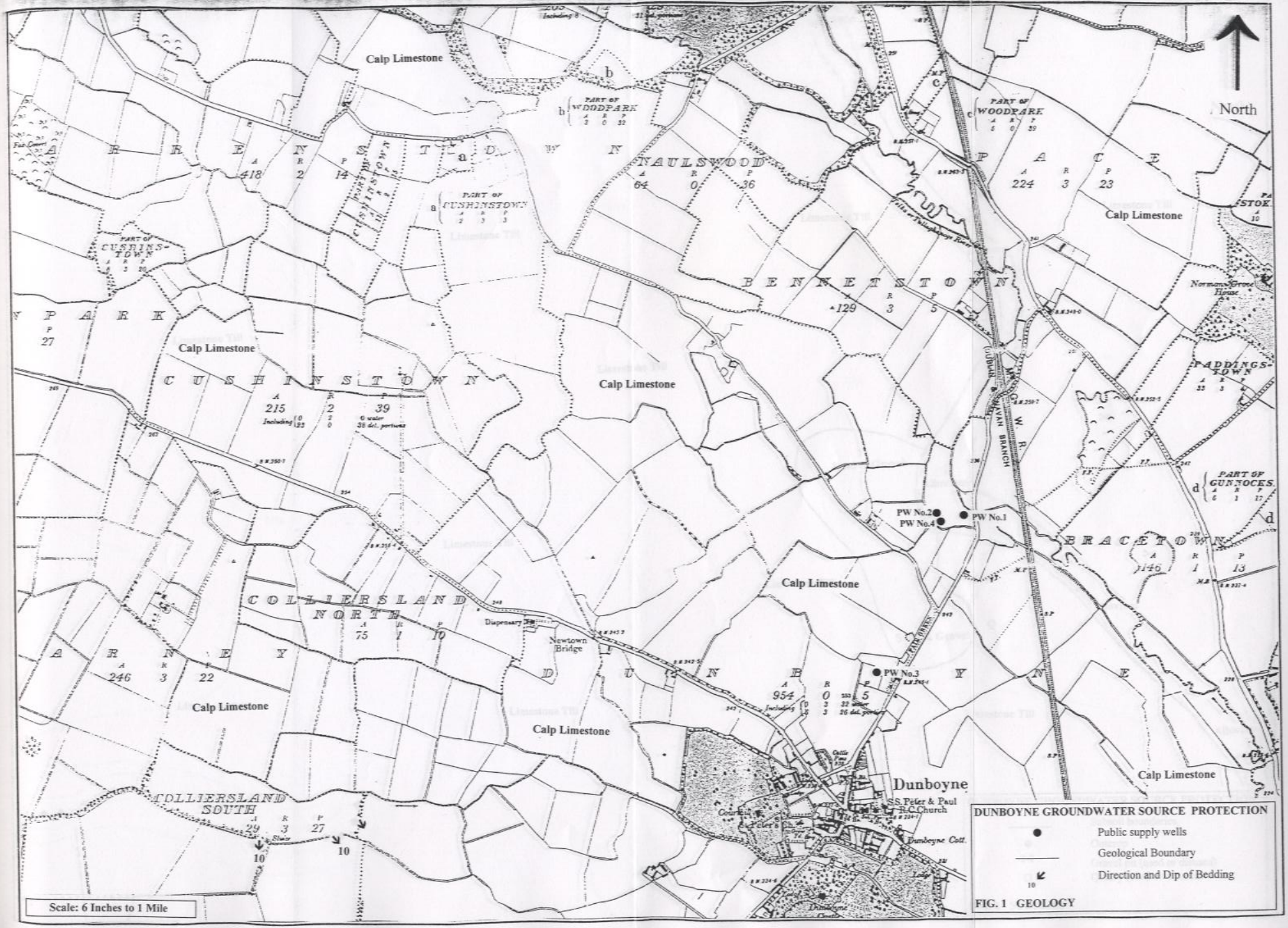
Groundwater Quality Analyses

Groundwater Source :		Dunboyne				
Sample Location :		PW No.1	PW No.2	PW No.2	PW No.2	PW No.3
Date :		25/09/95	20/03/95	12/06/95	25/09/95	20/03/95
Parameters	**Units**					
Alkalinity	mg/l	318	320	318	320	306
Aluminium	mg/l	<0.02	<0.02		<0.02	<0.02
Ammonium	mg/l					
Ammonium as Nitrogen	mg/l	0.05	0.029	0.05	0.06	<0.01
Arsenic	mg/l	<0.05	<0.25		<0.05	<0.25
Barium	mg/l	0.15	0.047		0.087	0.12
Bicarbonate	mg/l					
Boron	mg/l	0.046	0.053		0.055	0.029
Cadmium	mg/l	<0.005	<0.025		<0.005	<0.025
Calcium	mg/l	131	123	120	118	169
Calcium Hardness	mg/l	327	307	300	295	422
Hardness	mg/l	369	415	375	389	470
Chloride	mg/l	25	25.3	25.2	23.7	19.9
Chromium	mg/l	<0.005	<0.025		<0.005	<0.025
Copper	mg/l	<0.005	<0.01		<0.005	0.013
Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
Electrical Conductivity	mS/cm	0.754	0.779	0.772	0.804	0.812
Fluoride	mg/l	<0.25	<0.25	<0.25	<0.25	<0.25
Iron (total)	mg/l	0.07	0.098	0.254	0.26	0.014
Lead	mg/l	<0.02	<0.25		<0.02	<0.25
Magnesium	mg/l	10.3	26.3	18.3	22.7	12
Magnesium Hardness	mg/l	42	108	75	93	49
Manganese	mg/l	0.25	0.129	0.2	0.16	0.509
Mercury	mg/l					
Nickel	mg/l	<0.01	<0.05		<0.01	<0.05
Nitrate	mg/l	<0.1	<0.1	<0.1	<0.1	5.81
Nitrite	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1
pH		7.1	7.1	7.2	6.9	7.4
Phosphate	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5
Phosphorus	mg/l	<0.25			<0.25	
Potassium	mg/l	1.6	2.2	2.1	1.8	1.1
Selenium	mg/l					
Silver	mg/l	<0.005	<0.01		<0.005	<0.01
Sodium	mg/l	15.2	19.8	18.8	20.9	12.4
Strontium	mg/l	0.54	1.5		1.385	0.633
Sulphate	mg/l	54.7	97	91	84.5	130
Temperature	C	11.6	10.5	11.3	11.3	10.2
Total dissolved solids	mg/l	556	614	594	592	651
Zinc	mg/l	0.02	<0.01		0.026	0.028
Total Coliforms	/100 ml	0	0	0	0	0
E. coli	/100 ml	0	0	0	0	0

Groundwater Quality Analyses

Groundwater Source :		Dunboyne					
Sample Location :		PW No.3	PW No.3	PW No.3	PW No.4	PW No.4	Gallery
Date :		12/06/95	25/09/95	10/01/96	28/07/95	08/01/96	12/06/95
Parameters	**Units**						
Alkalinity	mg/l	308	300	304		302	378
Aluminium	mg/l	<0.02	<0.02	<0.02		<0.02	0.023
Ammonium	mg/l				0.186		
Ammonium as Nitrogen	mg/l	<0.015	0.023	<0.015		0.027	<0.015
Arsenic	mg/l		<0.05	<0.05		<0.05	
Barium	mg/l	0.131	0.157	0.145		0.164	0.034
Bicarbonate	mg/l						
Boron	mg/l	0.038	0.057	0.041		<0.05	0.051
Cadmium	mg/l	<0.025	<0.005	<0.005		<0.005	<0.025
Calcium	mg/l	135	131.2	162		170	141
Calcium Hardness	mg/l	337	327	405		424	352
Total Hardness	mg/l	378	371	452		484	380
Chloride	mg/l	21.1	20.5	19.2		29.7	20.5
Chromium	mg/l	<0.025	<0.005	<0.005		<0.005	<0.025
Copper	mg/l	<0.01	<0.005	<0.005	0.11	<0.005	0.016
Cyanide	mg/l	<0.01	<0.01	<0.01		<0.01	<0.01
Electrical Conductivity	mS/cm	0.751	0.754	0.867	0.8	0.91	0.755
Fluoride	mg/l	<0.25	<0.25	<0.25		<0.25	<0.25
Iron (total)	mg/l	0.041	0.065	0.028	0.46	0.28	0.038
Lead	mg/l	<0.25	<0.02	<0.02		<0.02	<0.25
Magnesium	mg/l	9.8	10.5	11.5		14.4	6.9
Magnesium Hardness	mg/l	40	43	47		59	28
Manganese	mg/l	<0.005	0.631	0.558	0.35	0.484	0.226
Mercury	mg/l			<0.02		<0.02	
Nickel	mg/l	<0.05	<0.01	<0.01		<0.01	<0.05
Nitrate	mg/l	0.16	0.16	0.63	0.17	1.36	4.7
Nitrite	mg/l	<0.1	<0.1	<0.1	0.013	<0.01	<0.1
pH		7.6	7	6.8	7.2	6.8	7.7
Phosphate	mg/l	<0.5	<0.5	<0.5		<0.05	<0.05
Phosphorus	mg/l	<0.25	<0.25	<0.25		<0.005	0.372
Potassium	mg/l	1.1	0.9	1.1		1.835	2.2
Selenium	mg/l			<0.05		<0.05	
Silver	mg/l	<0.01	0.005	<0.005		<0.005	<0.01
Sodium	mg/l	11.3	14.2	13.9		14.3	9.8
Strontium	mg/l	0.54	0.546	0.612		0.934	0.508
Sulphate	mg/l	91.5	80	140.3		151.2	30.7
Temperature	C	10.6	11.5	10.4	11	9.4	11.6
Total dissolved solids	mg/l	578	558	653		684	590
Zinc	mg/l	0.026	<0.02	0.058		0.029	0.011
Total Coliforms	/100 ml	0	3	0	34	1	1,000
E. coli	/100 ml	0	0	0	0	0	230

Appendix 2
Maps


North
Calp Limestone
Calp Limestone
Calp Limestone
Calp Limestone
Calp Limestone
Calp Limestone
Calp Limestone
Calp Limestone
ARREN STAD
418 2 14
PART OF WOODPARK
3 0 32
PART OF CUSHINSTOWN
2 3 3
NAULSWOOD
64 0 36
PART OF WOODPARK
5 0 39
PACE
224 3 23
PART OF CUSHINS-TOWN
3 3 20
PARK
27
CUSHINSTOWN
215 2 39
Including 0 25
0 water
38 del. portions
BENNETSTOWN
129 3 5
Norman Grove House
PADDINGS-TOWN
33 3
PART OF GUNNOCES
6 1 17
PW No.2
PW No.4
PW No.1
BRACETOWN
146 1 13
COLLIERSLAND NORTH
75 1 10
Dispensary
Newtown Bridge
ARNEY
246 3 22
DUNBOYNE
954 0 5
Including 3 22 water
3 26 del. portions
PW No.3
COLLIERSLAND SOUTH
29 3 27
Slwtr
10
10
Dunboyne
SS. Peter & Paul R.C.Church
Dunboyne Cott.
Scale: 6 Inches to 1 Mile
DUNBOYNE GROUNDWATER SOURCE PROTECTION
Public supply wells
Geological Boundary
Direction and Dip of Bedding
10
FIG. 1 GEOLOGY

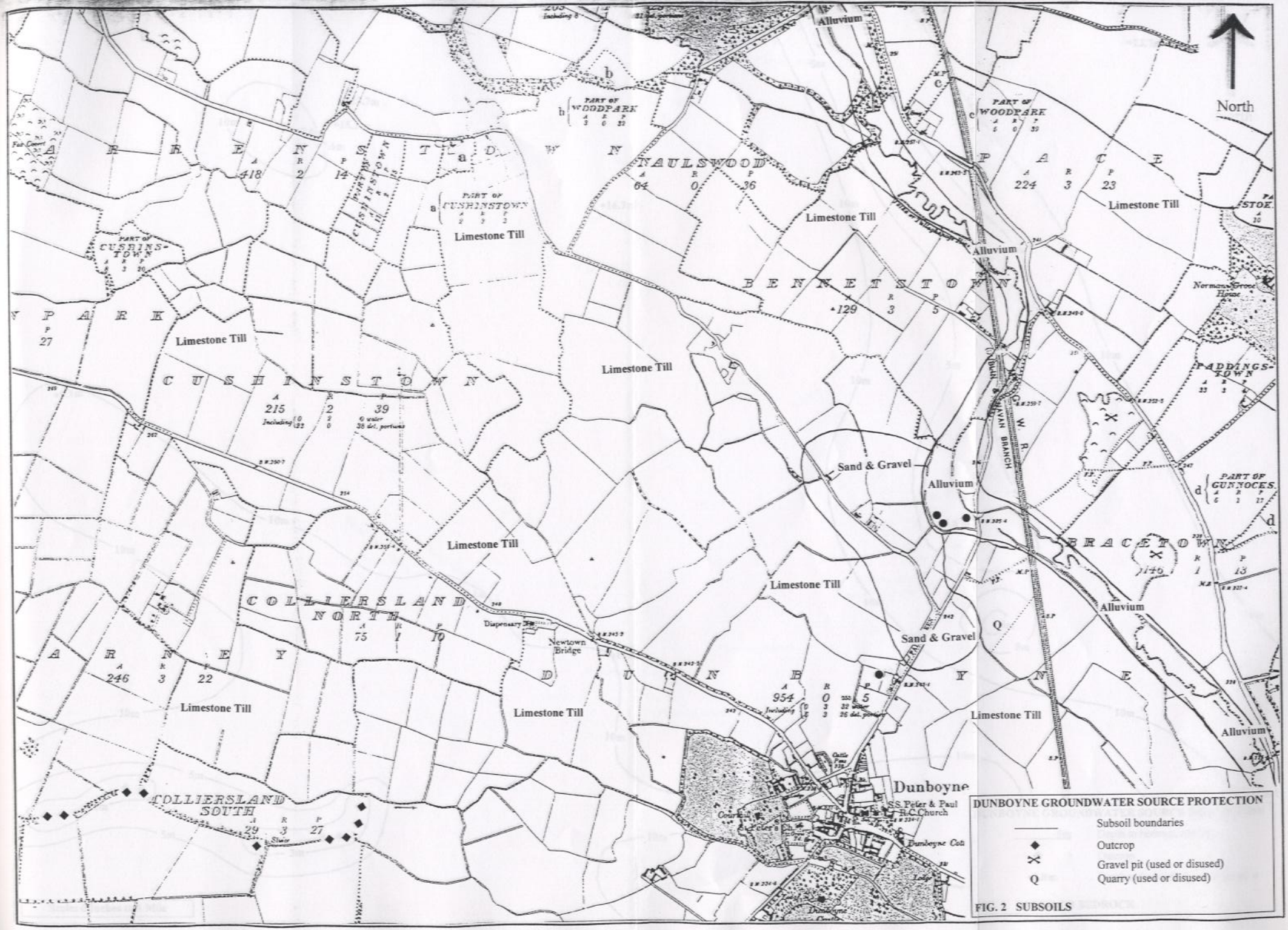


FIG. 2 SUBSOILS

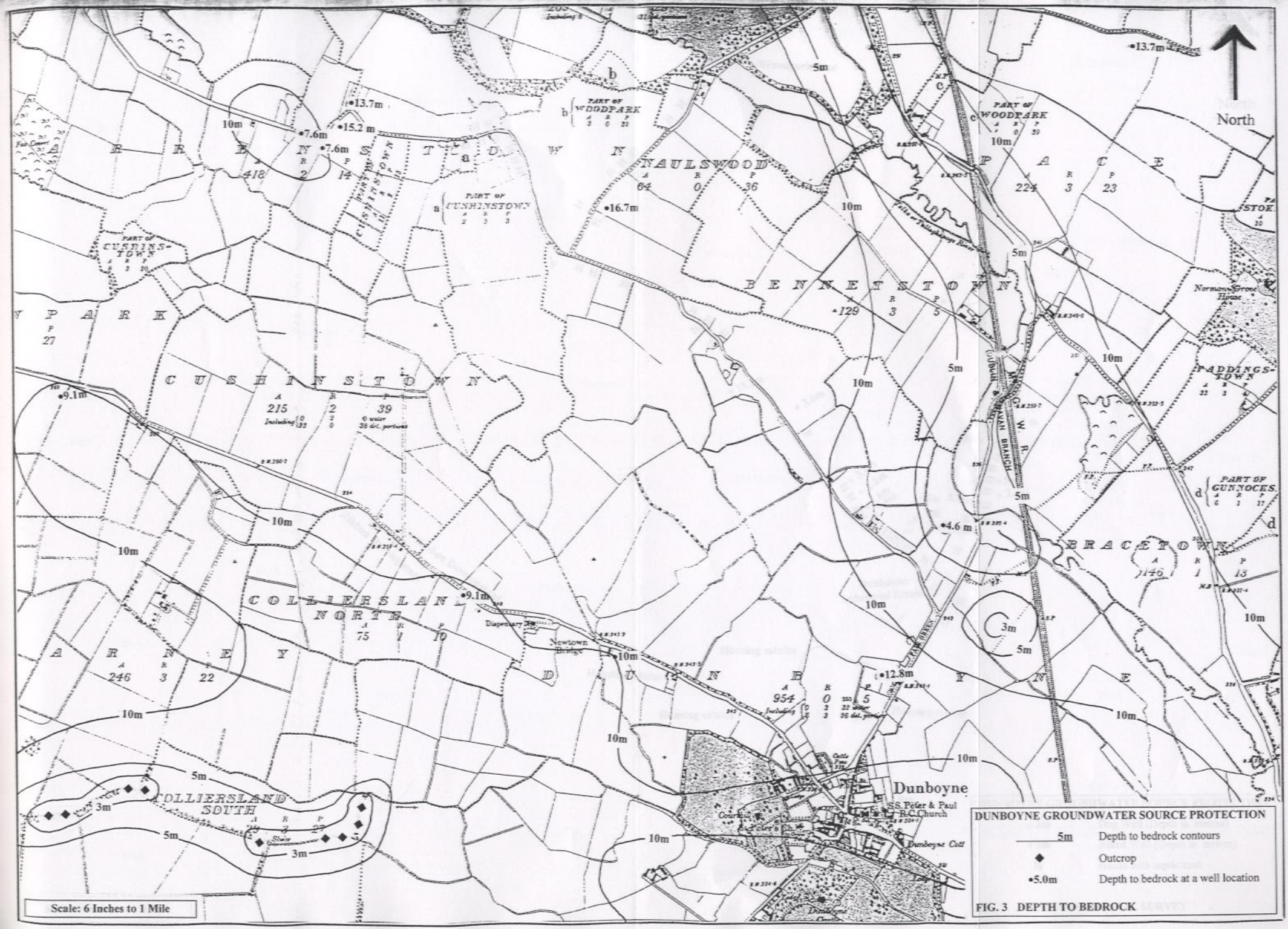
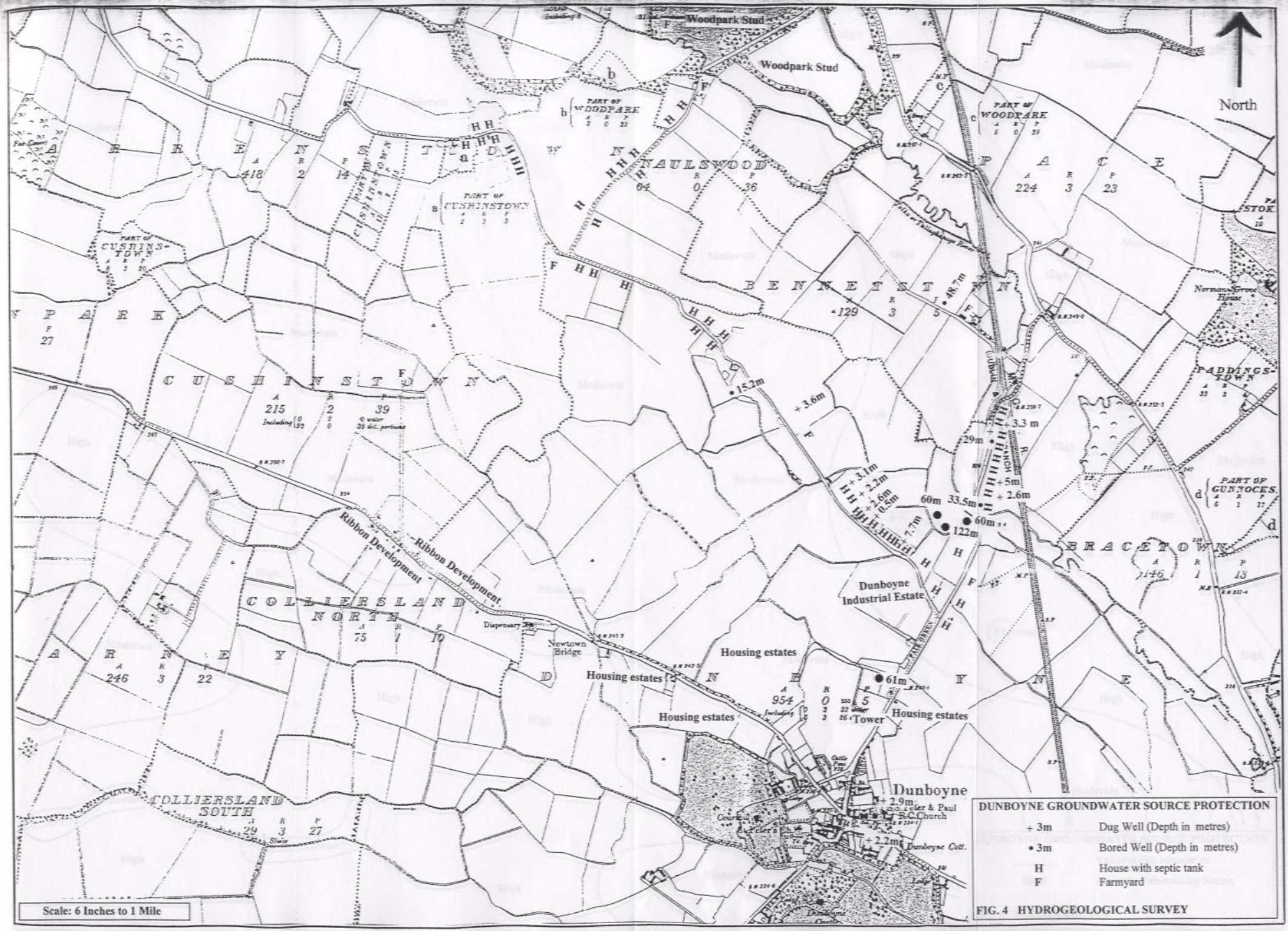


FIG. 3 DEPTH TO BEDROCK



DUNBOYNE GROUNDWATER SOURCE PROTECTION

+ 3m	Dug Well (Depth in metres)
• 3m	Bored Well (Depth in metres)
H	House with septic tank
F	Farmyard

FIG. 4 HYDROGEOLOGICAL SURVEY

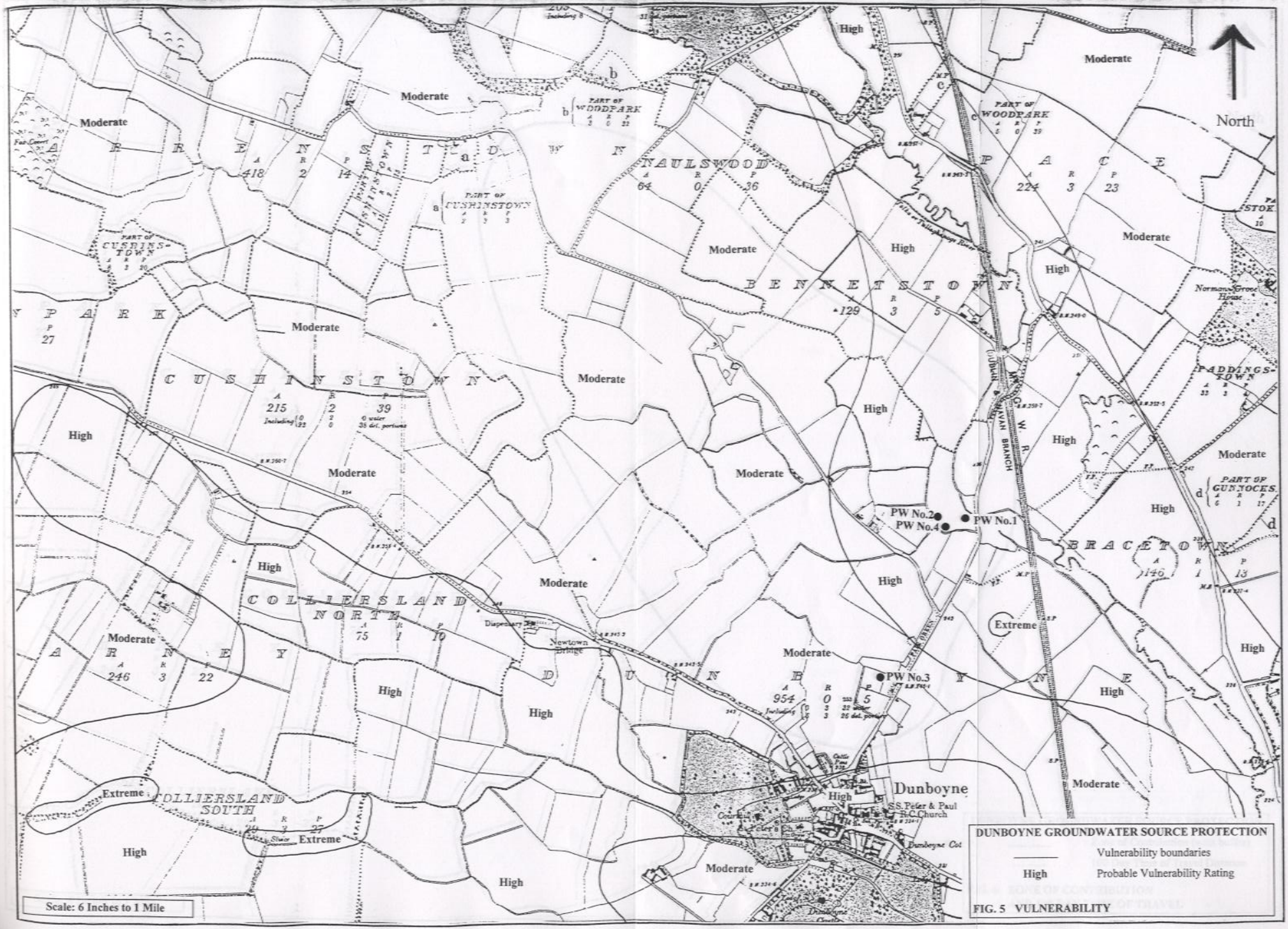


FIG. 5 VULNERABILITY

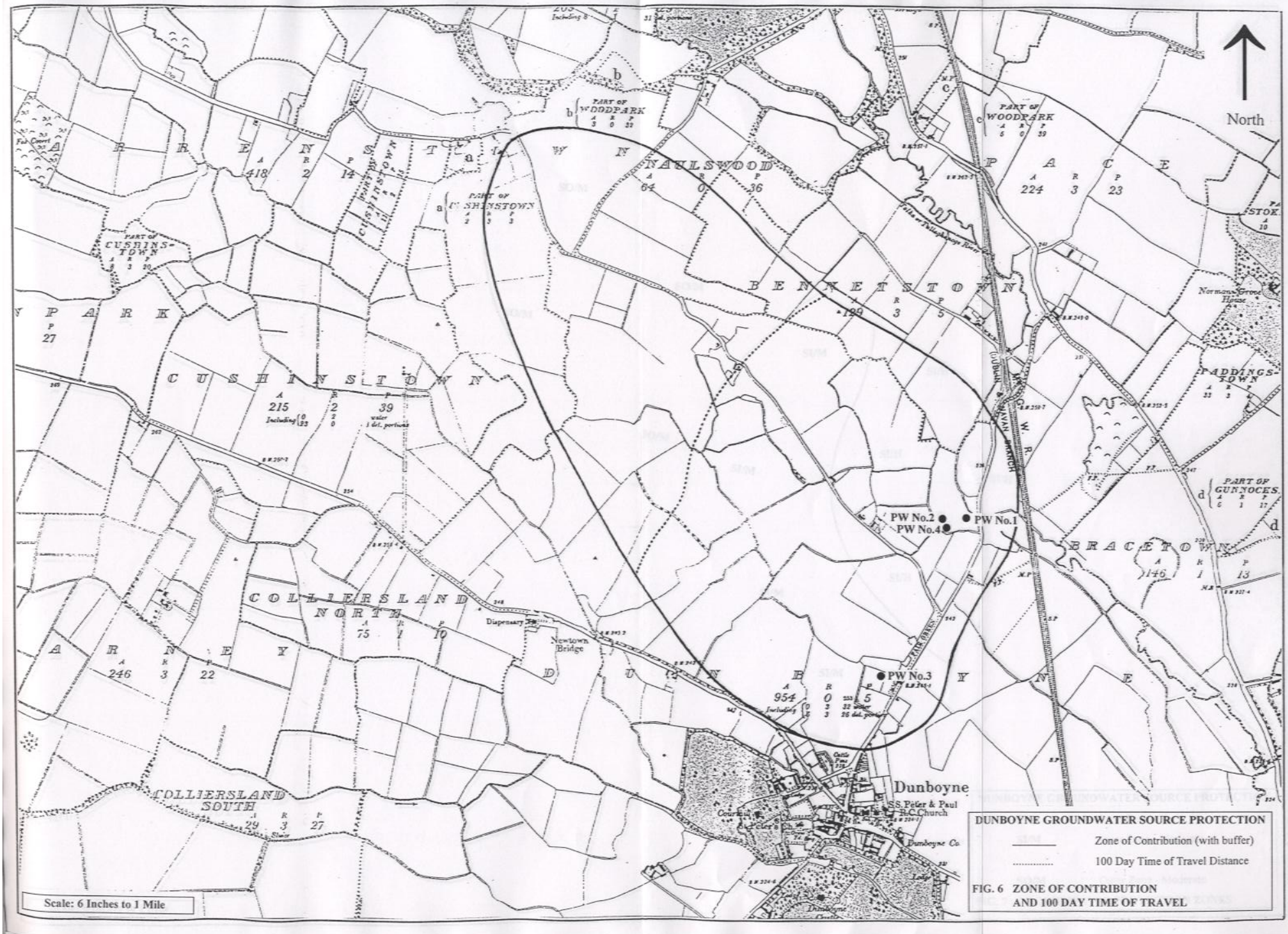


FIG. 6 ZONE OF CONTRIBUTION AND 100 DAY TIME OF TRAVEL

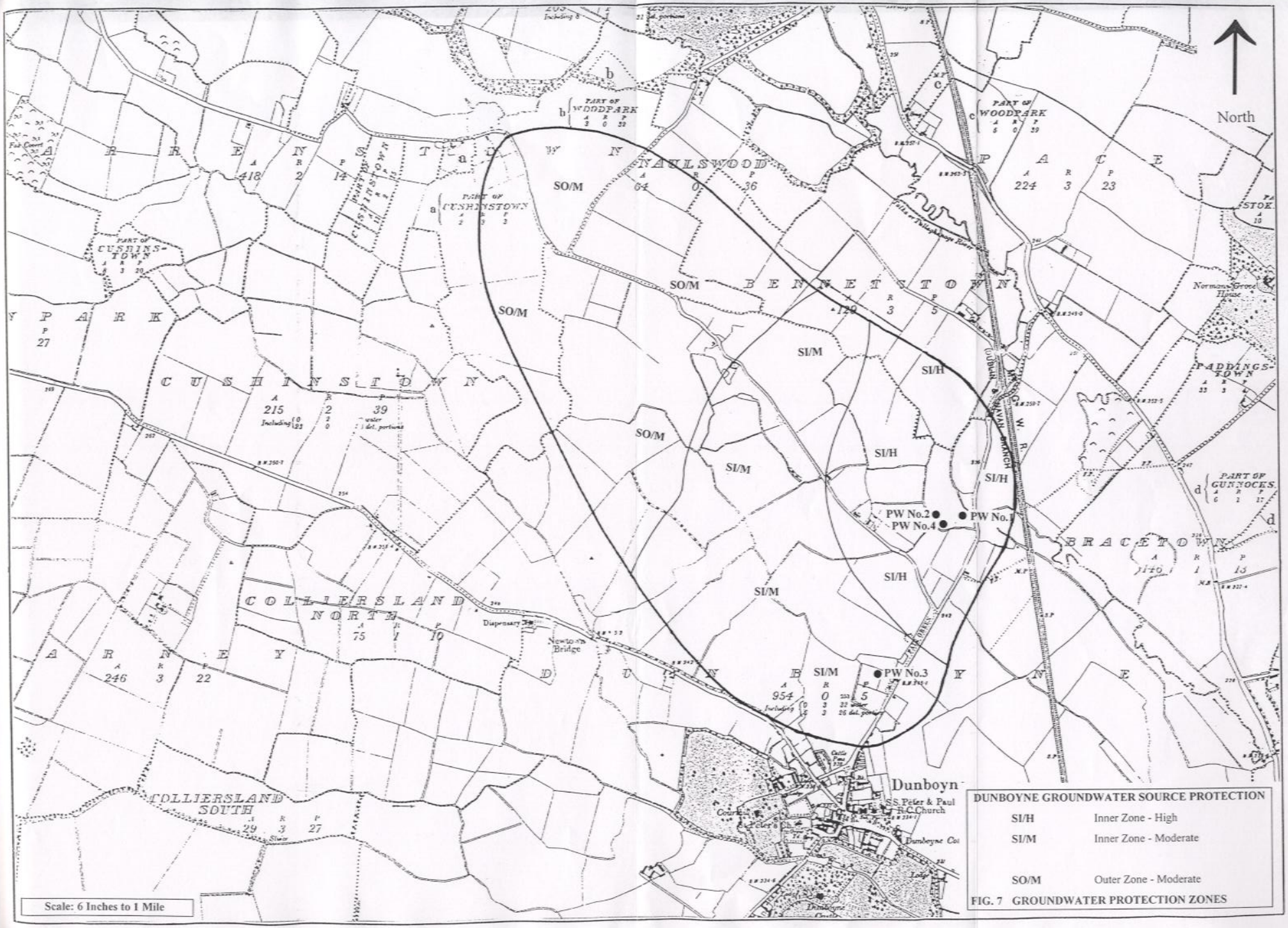


FIG. 7 GROUNDWATER PROTECTION ZONES

COUNTY MEATH
GROUNDWATER PROTECTION SCHEME
SOURCE PROTECTION ZONES

Vulnerability Rating	Source Protection Zones	
	Inner (SI)	Outer (SO)
Extreme (E)	SI/E	SO/E
High (H)	SI/H	SO/H
Moderate (M)	SI/M	SO/M
Low (L)	SI/L	SO/L

Zone of Contribution of Wells (SO)

Inner protection area (SI)

County Boundary

Public Supply Well

Project Hydrogeologist: Coran Kelly
Project Manager: Geoff Wright
Digital Map Production: Silvia Caloca

This Source Protection Zone map is designed for general information and strategic planning usage. The boundaries are based on the available evidence and local details have been generalised to fit the map scale. Evaluation of specific sites and circumstances will normally require further and more detailed assessments and will frequently require site investigations to determine the risk to groundwater.

The map is intended for use in conjunction with groundwater protection responses for potentially polluting activities, which lists the degree of acceptability of these activities in each zone and describes the control measures necessary to prevent pollution

GEOLOGICAL SURVEY OF IRELAND
Suirbhéireacht Gheolaíochta Éireann
Beggars Bush, Haddington Rd, Dublin 4

Dunboyne

1:25,000

Kilometres

0 0.5 1 2