Environmental Protection Agency

Establishment of Groundwater Source Protection Zones

Mitchelstown PWS (South) Water Supply Scheme

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PROJECT DESCRIPTION

Since the 1980's, the Geological Survey of Ireland (GSI) has undertaken a considerable amount of work developing Groundwater Protection Schemes throughout the country. Groundwater Source Protection Zones are the surface and subsurface areas surrounding a groundwater source, i.e. a well, wellfield or spring, in which water and contaminants may enter groundwater and move towards the source. Knowledge of where the water is coming from is critical when trying to interpret water quality data at the groundwater source. The Source Protection Zone also provides an area in which to focus further investigation and is an area where protective measures can be introduced to maintain or improve the quality of groundwater.

The project "Establishment of Groundwater Source Protection Zones", led by the Environmental Protection Agency (EPA), represents a continuation of the GSI's work. A CDM/TOBIN/OCM project team has been retained by the EPA to establish Groundwater Source Protection Zones at monitoring points in the EPA's National Groundwater Quality Network.

A suite of maps and digital GIS layers accompany this report and the reports and maps are hosted on the EPA and GSI websites (www.epa.ie; www.gsi.ie).

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1 Introduction

Groundwater Source Protection Zones (SPZ) have been delineated for the Mitchelstown PWS (South) source according to the principles and methodologies set out in 'Groundwater Protection Schemes' (DELG/EPA/GSI, 1999) and in the GSI/EPA/IGI Training course on Groundwater SPZ Delineation.

The Mitchelstown PWS (South) Water Supply is provided by two boreholes, BH-1 (IE_SW_G_047_04_022) and BH-2 (Standby, no code assigned) in the townland of Kiltrislane. BH-1 and BH-2 were installed in 1981 and 1982 respectively. They replaced a spring supply, located 1.7 km to east-southeast of the boreholes, which was decommissioned because of frequent contamination issues.

The objectives of the study were:

- To outline the principal hydrogeological characteristics of the Mitchelstown area.
- To delineate source protection zones for both boreholes.
- To assist the Environmental Protection Agency and Cork County Council in protecting the water supply from contamination.

The protection zones are intended to provide a guide in the planning and regulation of development and human activities to ensure groundwater quality is protected. More details on protection zones are presented in 'Groundwater Protection Schemes' (DELG/EPA/GSI, 1999).

2 Methodology

The methodology applied to delineate the SPZs consisted of data collection, desk studies, site visits and field mapping, and subsequent data analysis and interpretation.

The site visit and interview with the caretaker took place on 15/06/2010. Field mapping of the study area (including measuring the electrical conductivity and temperature of the source and streams in the area) took place on 14/07/2010 and 09/09/10.

While specific fieldwork was carried out in the development of this report, the maps produced are based largely on the readily available information and mapping techniques using on inferences and judgment from experience at other sites. As such, the maps may not be definitively accurate across the whole area covered, and should not be used as the sole basis for site-specific decisions, which will usually require the collection of additional site-specific data.

3 Location, Site Description and Well Head Protection

The wells are located approximately 2.5 km south of Mitchelstown, as shown in Figure 1. They are in a narrow compound, which is aligned north-northeast to south-southwest, roughly parallel to the N8 National Primary Route. The compound is on a former access road from the N8 to farmlands. Access to the compound is via a gate off the N8. BH-2 is 150 m from the entrance and BH-1 is a further 60 m away. The wells are approximately 5 m below the level of the N8. The recently constructed M8 motorway is approximately 200 m to the east of the N8.

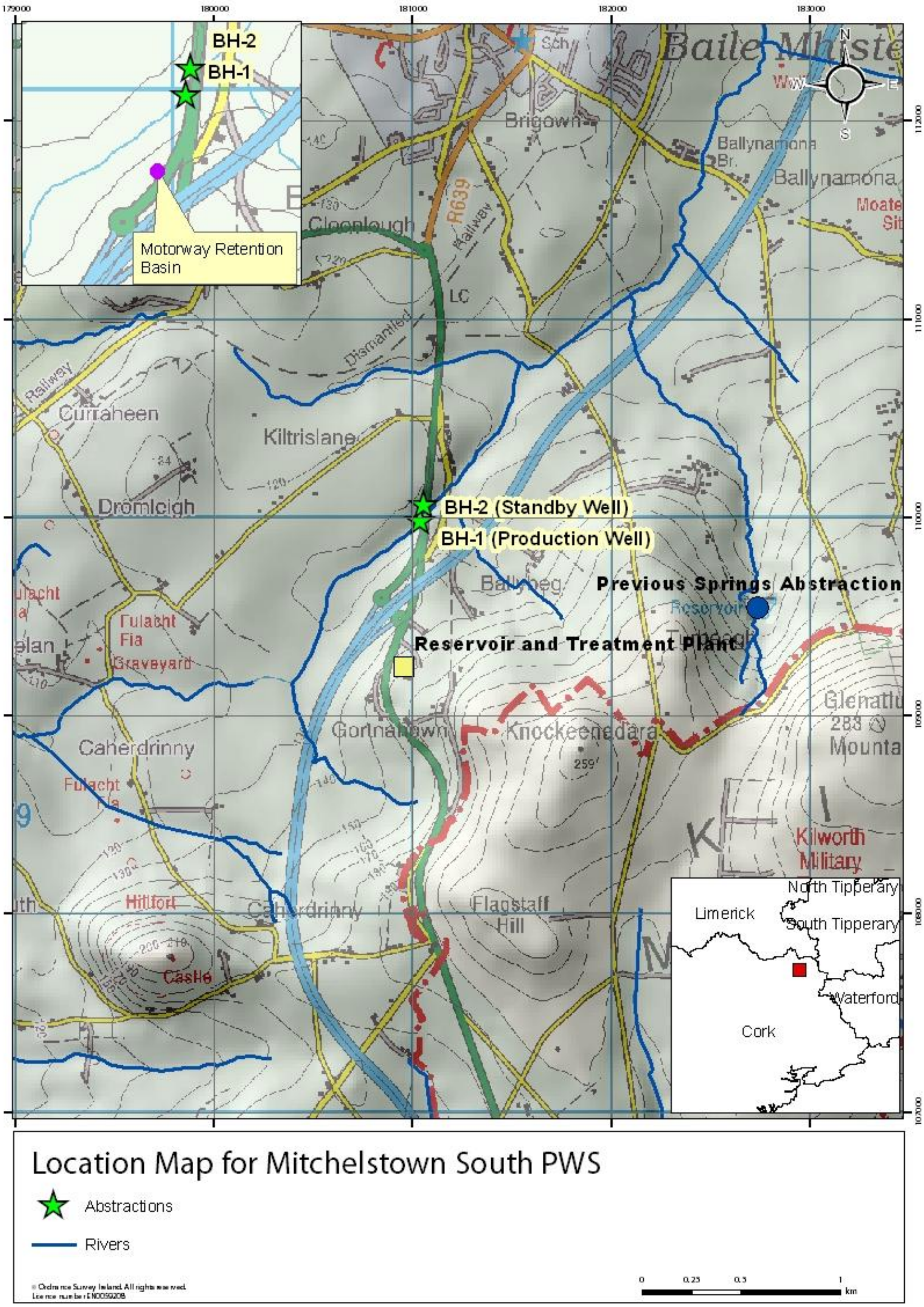

Figure 1: Location Map

There is an unnamed stream (Photo 1) running along the western side of the access road, at a level approximately 3 m below the road. The stream flows between the 2 wells in a culverted section beneath the compound and the N8. There is a surface water retention basin located close to the southern end of the compound, which receives runoff from the recently constructed M8 Motorway (photo 2). The retention basin discharges into the stream.

The groundwater is pumped to a treatment plant located 850 m to the south. The treatment plant comprises an aeration chamber, chlorination (sodium hypochlorite) and fluoridation system. There is no cryptosporidium filter.

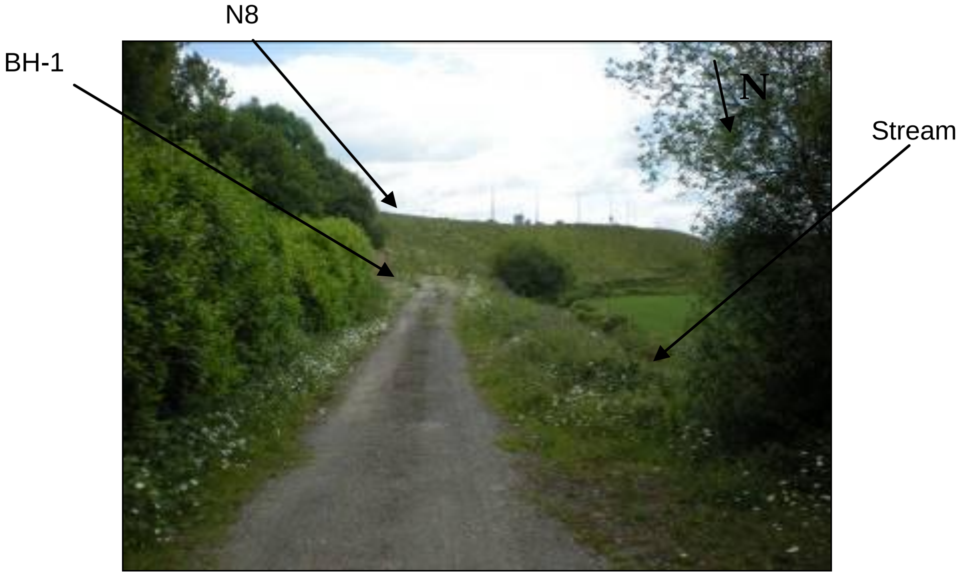

Photo 1: Hardcore track to access the boreholes

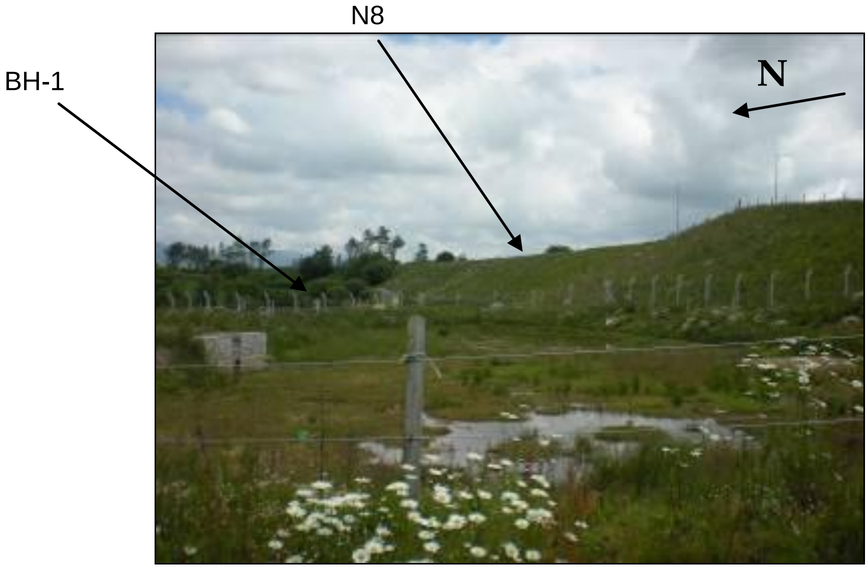

Photo 2: M8 Motorway Retention Basin

The two boreholes (BH-1 and BH-2) are located in concrete inspection chambers (c. 2 m by 1 m) covered by a large, hinged, lockable, steel lid (Photos 3 and 4). The top of the chambers are set approximately 0.25 m above ground level, with the base approximately 1 m below ground level (bgl) for BH-1 and 2 m bgl for BH-2 (Photos 5 and 6). Well caps are not fitted on the steel well casings but there are concrete seals at the bottom of the chambers that provide protection against surface water inflow. Based on the site inspection it appears that the steel casing has been driven to the top of bedrock, but there is no information on well construction to establish whether or not the boreholes are grouted above the bedrock.

Photo 3: BH-1 Inspection Chamber Cover

Photo 4: BH-2 Inspection Chamber Cover

Photo 5: BH-1 Chamber and Well Head

Photo 6: BH-2 Chamber and Well Head

4 Summary of Well Details

The well details are derived from two reports and the GSI Well Database;

- "North East Regional Water Supply Scheme" (Cork County Council, 1984).
- "Pump test on wells 1 and 2" and "Tables of results of well pump test at Kiltristlane, Mitchelstown" (GEOX Limited, 1982).

The reports are included in Appendix 1. The well construction and geological logs of BH-1 and BH-2 are included as Appendix 6 and 7 of the 1984 North East Regional Water Supply Scheme Council Report and are summarised in Table 4.1.

BH-1 was drilled in 1981 and BH-2 was installed in 1982. The drilling was supervised by Cork County Council. BH-1 (Well No 1 in the 1984 report) was drilled to a depth of 62.50 m. The boring comprised a 340 mm outer steel liner from ground level to 4 m (bgl), then a reduced diameter 300 mm steel liner from 4 m to 10.70 m bgl, a 200 mm steel liner from 10.70 m to 17.40 m bgl and a final 150 mm diameter open borehole to the base.

BH-2 (Well No 2 in the 1984 report) was drilled to a depth of 30.50 m. The borehole was installed with a 375 mm steel liner from ground level to 17.07 m bgl, then a reduced diameter 300 mm steel liner from 17.07 to 20.70 m bgl, and a 300 mm open hole from 20.70 m to 30.50 m. The borehole was completed with a 250 mm slotted plastic casing from ground level to the base of the borehole.

Water is pumped exclusively from BH-1 at 96 m^3/h, operating 19 hours per day to a 2025 m^3 capacity reservoir located at the treatment plant which is on a hill 1 km to the southeast of the boreholes. The abstraction rate is controlled by the demand, which results in fluctuations in the rate. BH-2 is only used as a back up or when BH-1 is undergoing maintenance. The maximum abstraction rate from BH-2 is 60 m^3/h.

The average abstraction for the well is recorded by the Council as 1800 m^3/d. The caretaker stated that the yield is very reliable and that the boreholes have never suffered from a shortage of water.

A pumping test was undertaken in 1982, which ran from October 6th to 20th. Pumping was carried out initially in BH-2 for 8 days with drawdown monitored in BH-1 and BH-2 and no recovery allowed after the first step. Pumping then subsequently commenced in both BH-1 and BH2 simultaneously. The second phase of testing ran for 4 days, starting on 14th of October, with recovery measured from October 18th to 20th. Because of some interruptions to the pumping cycles in both tests, the recovery data is more reliable for the assessment of relevant aquifer characteristics and was used in this assessment to provide an indication of the aquifer transmissivity. The data are included in Appendix 1.

As part of investigations for the Mitchelstown Water Supply Scheme in 1981/2, four boreholes were installed in the vicinity of the site. Two boreholes were installed approximately 60 m to the south of the compound and two boreholes were installed approximately 200 m to the northeast. While the boreholes are still in situ the top of the boreholes have been covered with large concrete slabs. They have never been used for public supply. These boreholes are however included on the GSI Well Database which was used to establish the depth of the wells and depth to bedrock. Boreholes details are shown in Table 4.2 below and on Figure 4.

Table 4-1 provides a summary of the well details as currently known.

Table 4-1: Boreholes Details

	BH-1	BH-2 (Standby)
EU Reporting Code	IE_SW_G_047_04_022	No Code
Grid ref. (GPS)	181039 109989	181053 110071
Townland	Kiltrislane	Kiltrislane
Source type	Borehole	Borehole
Drilled	1981	1982
Owner	Cork Co Co	Cork Co Co
Elevation (Ground Level)	~ 120 m OD	~ 120 m OD
Depth	62.50 m	30.50 m
Depth of casing	17.38 m	30.50 m
Diameter	150 mm open hole	250 mm slotted plastic liner
Depth to rock	20.6 m	19.6 m
Static water level	1.98 m bgl (14/10/1982)	Reported as artesian in commissioning report
Pumping water level	22 m bgl at 96 m^3/h on the 15/06/2010 16 m bgl at 45 m^3/h on the 14/10/1982 10.66 m bgl at 50 m^3/h in Nov. 1980	11.25 m bgl (15/06/2010) When BH-1 pumping 25 m bgl at 30 m^3/h on the 14/10/1982
Consumption (Co. Co. records)	96 m^3/h or 1800 m^3/d	60 m^3/h or 1440 m^3/d (when in use)
Pumping test summary: (i) abstraction rate m^3/d	1080 m^3/d	720 m^3/d
(ii) specific capacity	In 1982, 67.5 m^3/d/m In 1980, 112 m^3/d/m	In 1982, 28.8 m^3/d/m
(iii) transmissivity	Not Tested	Range: 30 m^2/d to 75 m^2/d

Table 4-2: Sealed Borehole Details

	1709NWW025	1709NWW022	1711SWW168	1711SWW167
Location	Side/Downgradient 65 m to the SW	Side/Downgradient 70 m to the S	Side/Downgradient 180 m to the NE	Side/Downgradient 220 m to the NE
Grid Ref	181040 109960	181030 109980	181190 110100	181200 110150
Grid Accuracy	to 20 m	to 20 m	to 20 m	to 50 m
Townland	Kiltrislane	Kiltrislane	Ballybeg	Ballybeg
Type	Bore	Bore	Bore	Bore
Drilled	10/01/1984	10/01/1984	15/12/1985	15/08/1985
Owner	Cork Co. Co.	Cork Co. Co.	Cork Co. Co.	Cork Co. Co.
Depth	61	61	62.8	68
Depth of Casing	19.8	18.3	5.5	8.2
Diameter	381	356	-	450

5 Topography, Surface Hydrology, Landuse

The source is located in the footslopes of the Kilworth Mountains, at approximately 120 mOD. The land slopes to the north and northwest from the upland areas toward the valley in the townland of Kiltrislane. The catchment boundary is defined to the south and east by the peaks and ridges running between Caherdrinny, Flagstaff hill and Knockeenadara. The boundary between the Blackwater to the west and the Suir to the southeast, is defined by the high ridges between Flagstaff hill and Knockeenadara. The highest point in the local catchment is 259 mOD, approximately 1.4 km southeast of the source. The topographical gradient on the upper slopes of the flanking ridges is approximately 0.1 and decreases to 0.05 in the vicinity of the boreholes.

Drainage density is low in the catchment, with much of the land comprising free draining agricultural grass land. The stream that flows along the western side of the access road rises in the high ground to the south of the site, in the townland of Gortnahown. The stream flows from south to north and then swings to the east in the compound between the two boreholes where it is culverted under the well compound and the N8 Road. The stream is a tributary of the Gradoge River, which it joins approximately 3 km to the north of the boreholes.

The landuse within the catchment and immediately surrounding the boreholes is dominated by agriculture, primarily grassland dairy farming. The nearest farm yard is c. 600 m east-southeast of the boreholes. There is a flood retention basin 300 m to the southwest of the boreholes, which was constructed to take rainfall runoff from the M8 motorway. The N8 primary route and M8 motorway run from north to south, approximately 20 and 200 m to the east, respectively.

6 Hydrometeorology

Establishing groundwater source protection zones requires an understanding of general meteorological patterns across the area of interest. Meteorological information was obtained from Met Eireann.

Annual rainfall: 1100 mm. The contoured data map of rainfall in Ireland (Met Éireann website, data averaged from 1961–1990) shows that the source is located between two 1200 mm average annual rainfall isohyets.

Annual evapotranspiration losses: 458 mm. Average potential evapotranspiration (P.E.) is estimated to be 482 mm/yr based on the contoured data map of potential evapotranspiration in Ireland (Met Éireann website, data averaged from 1971–2000) which shows that the source is located between the 480 mm and 490 mm average annual evapotranspiration isohyets. Actual evapotranspiration (A.E.) is estimated as 95% of P.E., to allow for seasonal soil moisture deficits.

Annual Effective Rainfall: *642* mm. The annual average effective rainfall is calculated by subtracting actual evapotranspiration from rainfall. Potential recharge is therefore equivalent to this, or 642 mm/year.

7 Geology

7.1 Introduction

This section briefly describes the relevant characteristics of the geological materials that underlie the site. It provides a framework for the assessment of groundwater flow and source protection zones that will follow in later sections.

Geological information was taken from a desk-based survey of available data, which comprised the following:

- Geology of East Cork-Waterford. Bedrock Geology 1 : 100,000 Map series, sheet 22, Geological Survey of Ireland (A.G. Sleeman and B. McConnell, 1995).
- Forest Inventory and planning system – Integrated Forestry Information System (FIPS-IFS) Soils Parent Material Map, Teagasc (Meehan, 2002).
- Groundwater Vulnerability Map for County Cork. Digital Map prepared for this project using existing available depth to bedrock and permeability data (Meehan, R.T., 2010).
- Report "North East Regional Water Supply Scheme" (Cork County Council Report, 1984).

7.2 Bedrock Geology

The bedrock geology is illustrated in Figure 2. The area is mapped as being underlain by the Knockmealdown Sandstone Formation (Medium grained pink-purple sandstone) from the Devonian period. The description in the logs for BH-1 (Appendix 1) is consistent with the mapped geological formation. The Kiltorcan Formation (yellow and red sandstone and green Mudstone) is mapped 350 m to the north, 850 m to the south and 1.25 km to the west of the site. The log for BH-2 indicates that this borehole may actually be close to the boundary between the two formations as the upper 7–8 m of the bedrock is described as a red sandstone, with purple sandstone and traces of red shale at depth.

The geological map (GSI Sheet No. 22) indicates that the rocks have been folded into anticlines and synclines, with approximately east-west axes, by the Variscan mountain building event. The wells are located near the axis of a 'minor' anticline. The rock unit beds are in a sub vertical position, with the bedding dip direction to the north. As is the case across much of this section of Munster, the rocks are broken by a series of faults trending NNW–SSE at approximately right angles to the fold axes. These faults are mapped to the north (1.5 km) in the Carboniferous Rocks and to the south (5 km) in the Kiltorcan Formation. There is a major fault mapped running roughly east to west 1 km north of the boreholes along the mapped northern boundary of the Kiltorcan Formation.

The geological map (Figure 2) does not show major faults in Knockmealdown formation in the area of the boreholes. However, it is likely that extensive fracturing and faulting has accompanied the folding of the Knockmealdown Sandstone Formation, which has most likely given rise to zones of enhanced permeability. This is discussed further in Section 9.4.

7.3 Soil and Subsoil Geology

The soil and subsoil are illustrated in Figures 3 and 4, respectively. The EPA and GSI Web Mapping classify the soils over the high ground to the south and east where rock is close to the surface as Acid Mineral Soil with a shallow peaty surface layer (AminSRPT) with a very small area of Acid Mineral Deep Poorly Drained (AminPD) along the margins of the rock outcrop. At lower elevations within the catchment (c. 190mOD) the soil is classified as Acid Mineral Deep Well Drained (AminDW)

Over much of the eastern part of the catchment, on the slopes of the Kilworth Mountains, the bedrock either outcrops or is close to the surface. In the western part, in the valley close to the source, the bedrock is overlain by a relatively thick succession of Devonian Sandstone Tills (TDSs) derived from the underlying Devonian bedrock. The subsoil at the boreholes is c. 20 m thick.

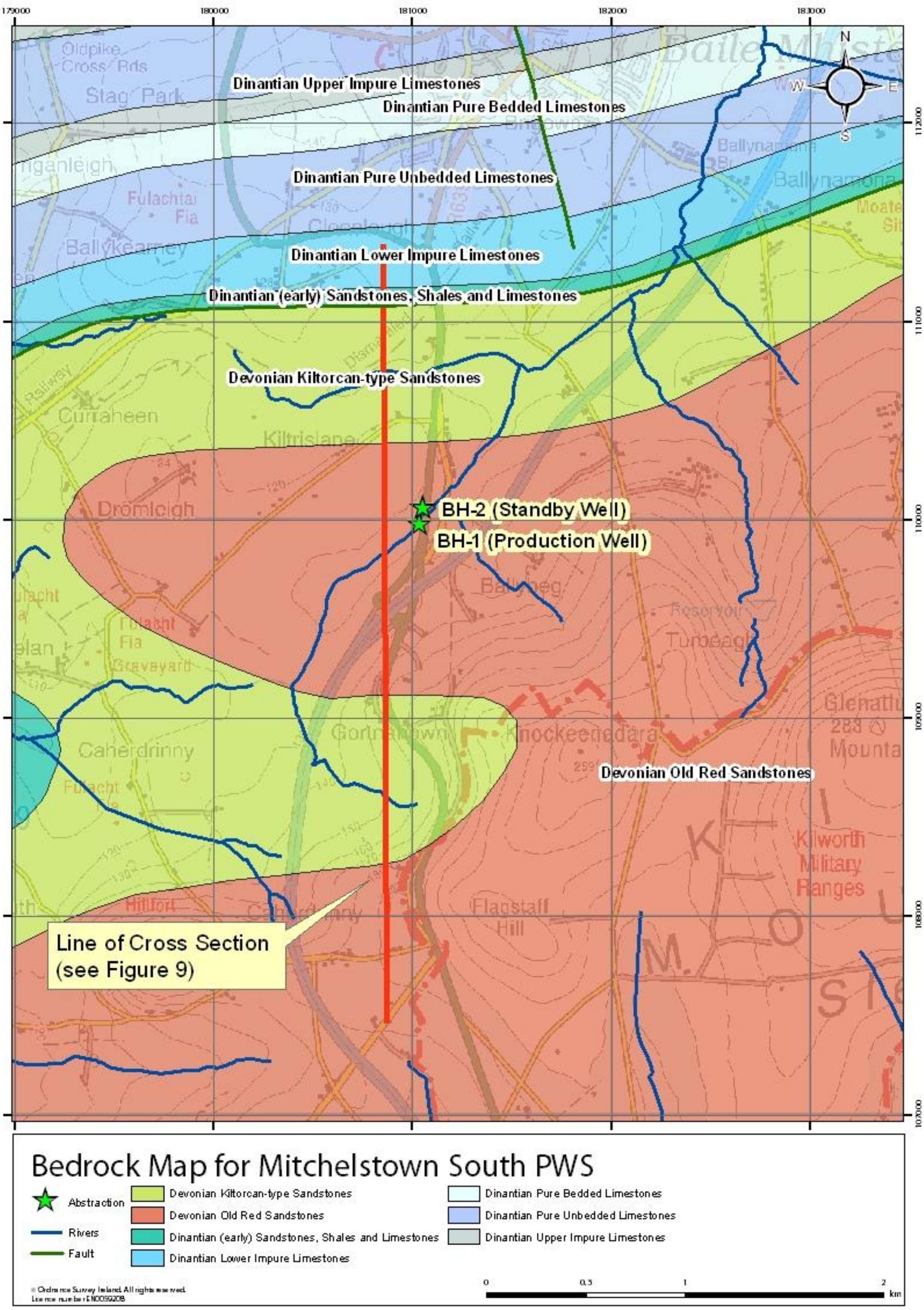

Figure 2: Bedrock/Rock Unit Map

The subsoil permeability is provisionally characterised as moderate by the GSI. This is generally consistent with the field mapping evidence based on BS5930 assessment of subsoil samples, hand augured subsoil samples and the presence of well drained lands to the north, west and south of the boreholes. It was noted however, in subsoil cores close to the well compound, that the subsoils appeared to be mottled at depths of less than 0.5 m bgl, possibly indicating poorer drainage and therefore less permeable subsoils here. The borehole logs indicate that the subsoils at BH-1 comprise gravels and interbedded silts and sands to approximately 20.6 m bgl, whereas at BH-2 the subsoil comprises boulder clay of approximately the same thickness.

7.4 Depth to Bedrock

The RBD interim vulnerability mapping for the area indicates that from 140/150 m OD to the top of the Kilworth Mountains, the bedrock either outcrops or is close to the surface (less than 3 m). The subsoil increases in thickness moving below 140/150 m OD to 110 m OD, where the source is located. The depth to bedrock in the borehole logs for BH-1 and BH-2 is 20.6 and 19.6 m bgl respectively. The logs of 4 other groundwater investigation boreholes installed by Cork County Council in the vicinity of the source boreholes (GSI Groundwater database, detailed in Table 4.2 and illustrated in Figure 4), indicate that the depth to bedrock is between 5.5 and 16.7 m.

8 Groundwater Vulnerability

Groundwater vulnerability is dictated by the nature and thickness of the material overlying the uppermost groundwater 'target'. This means that in this area the vulnerability relates to the permeability and thickness of the subsoil. A detailed description of the vulnerability categories can be found in the Groundwater Protection Schemes document (DELG/EPA/GSI, 1999) and in the draft GSI Guidelines for Assessment and Mapping of Groundwater Vulnerability to Contamination (Fitzsimons et al, 2003).

Currently only Interim vulnerability mapping for the North Cork area has been carried out with rock close to the surface, extreme and 'high to low' zones provisionally defined. Over the main portion of the study area, a detailed vulnerability map was developed during the course of this project by Dr. Robert Meehan who was also part of the SPZ field mapping team. A full vulnerability map for the north Cork area is due for completion in 2011/2012.

The vulnerability map is shown in Figure 5 and in terms of subsoil coverage within the catchment of wells, the area can be divided into two zones:

Over the high ground to the south and east, situated between approximately 140/150 m OD and 260 m OD and which represents the largest portion of the source catchment (around 70%), the subsoil is very thin or absent. Here the vulnerability is classed as Extreme or Extreme with Rock near the surface.

From the source to the foot slopes of the Kilworth Mountains, which is between approximately 110 m OD and 140/150 m OD , the subsoil ranges from 5 m and 20 m and the vulnerability is considered to be Moderate to High.

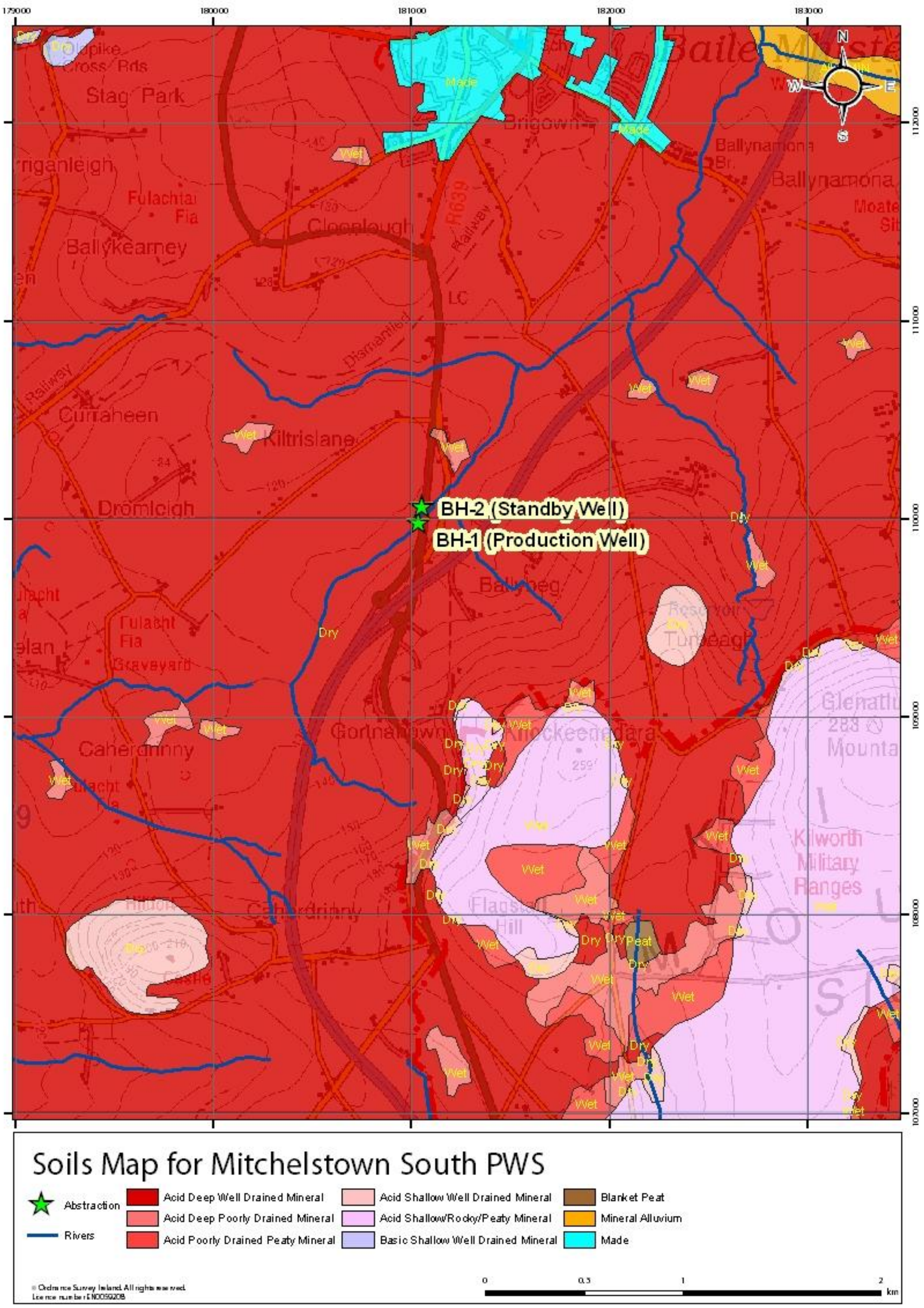

Figure 3: Soils Map

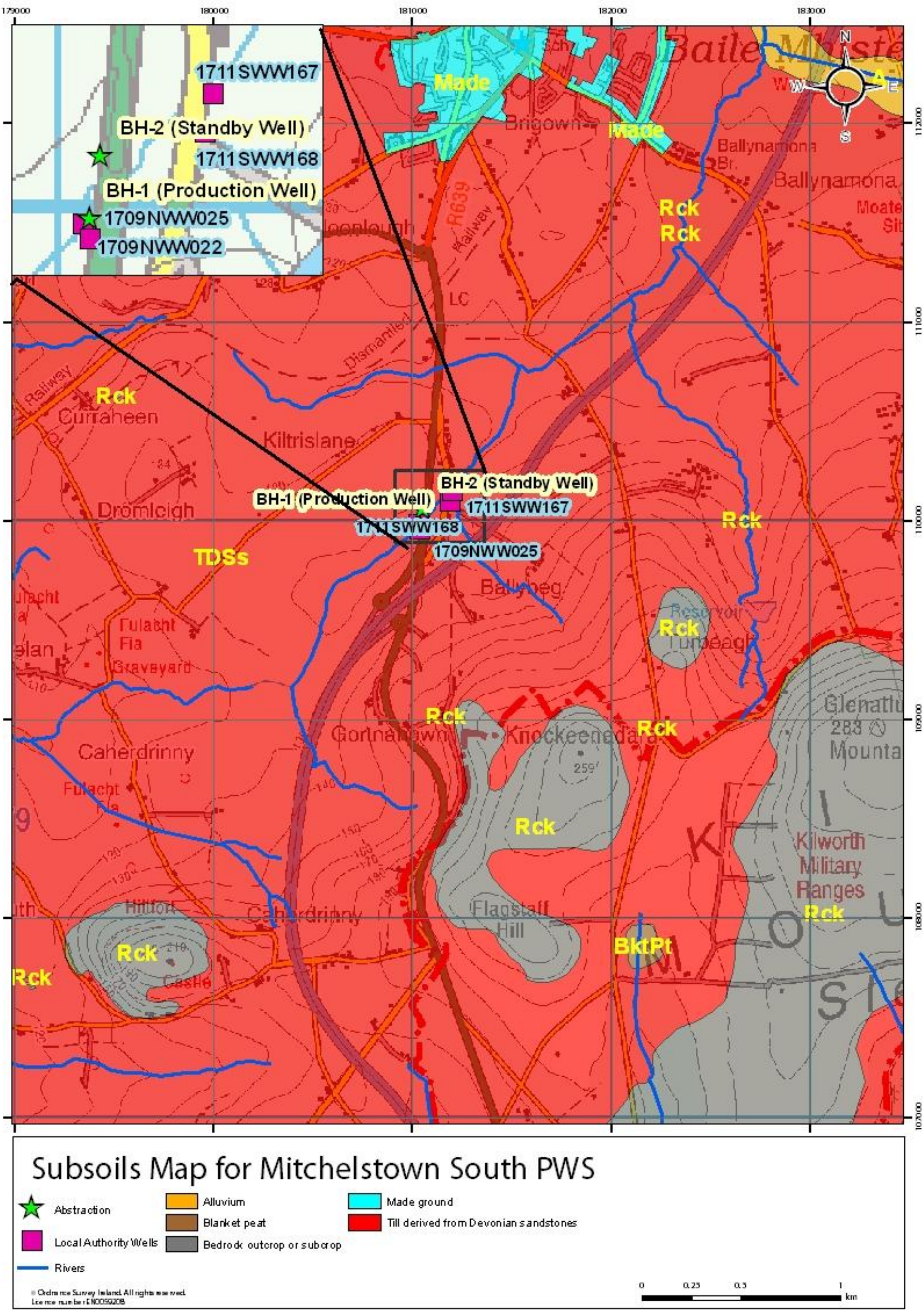

Figure 4: Subsoils Map

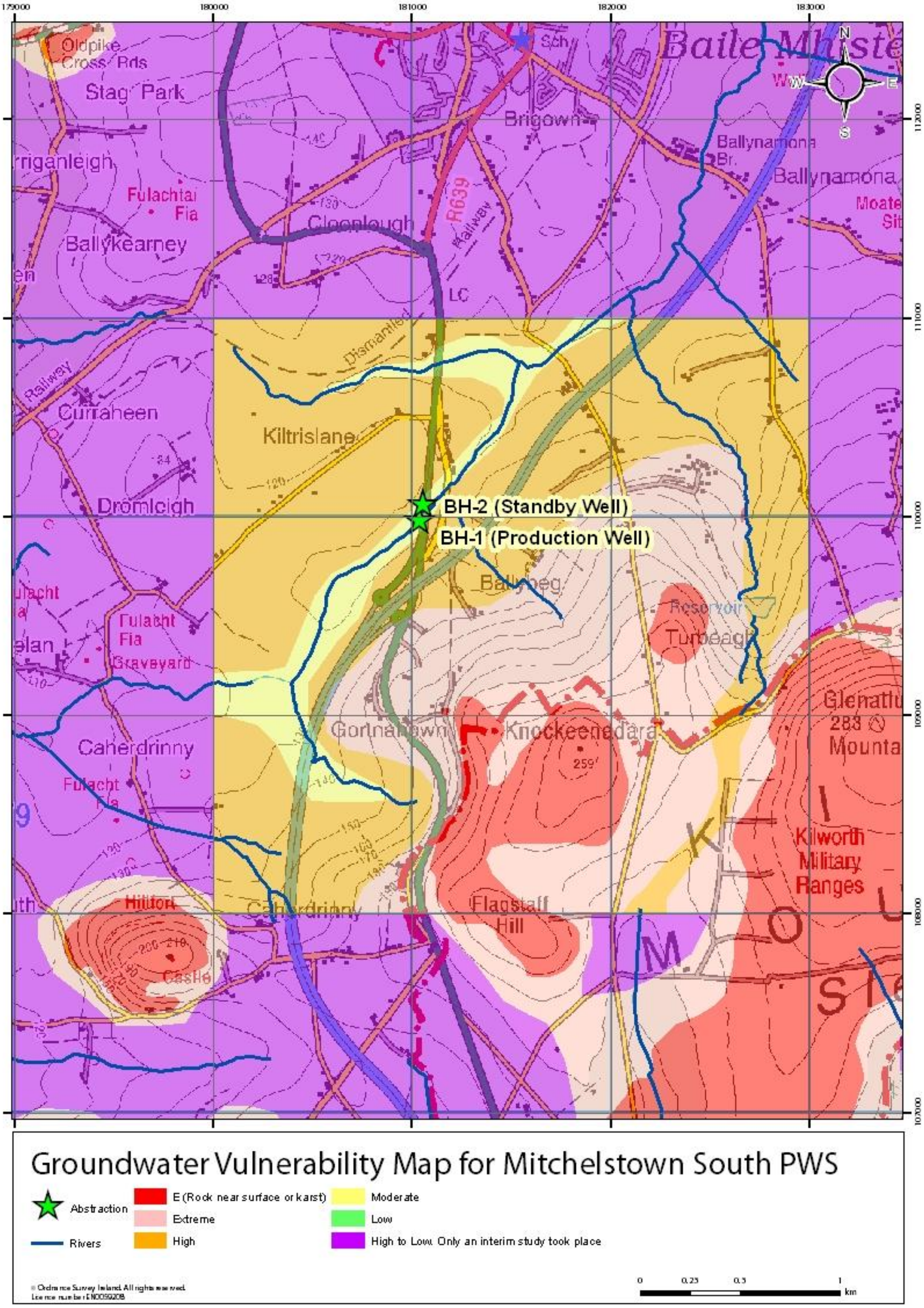

Figure 5: Vulnerability Map

9 Hydrogeology

This section describes the current understanding of the hydrogeology in the vicinity of the source. Hydrogeological and hydrochemical information was obtained from the following sources:

- GSI Website and Database
- County Council Staff
- EPA website and Groundwater Monitoring database
- Local Authority Drinking Water returns
- Reports "Pump test on wells 1 and 2" and "Tables of results of well pump test at Kristislane, Mitchelstown" (GEOX Limited, 1982) and Report "North East Regional Water Supply Scheme (Cork County Council, 1984),

9.1 Groundwater Body and Status

The source boreholes are situated in the Knockmealdown Groundwater Body (IE_SW_G_047) which has been classified as being of Good Status. The groundwater body descriptions are available from the GSI website: www.gsi.ie and the 'status' is obtained from the Water Framework Directive website: www.wfdireland.ie/maps.html.

9.2 Groundwater Levels, Flow Directions and Gradients

Based on the groundwater levels recorded during the 1982 pumping test, the water level in the Borehole BH-1 at the start of the test was 1.98 mbgl, while BH-2 was artesian. It was not possible to monitor the water levels in the four other wells in the vicinity of BH-1 and BH-2 (Table 7.1) as the well caps have been sealed and could not be accessed during the 2010 field mapping.

It appears that locally (e.g. around BH-2), the subsoil has a lower permeability because of the presence of clay, which confined the bedrock in these areas resulting in artesian conditions.

Based on the local topography and surface water drainage pattern, groundwater infiltrates directly to the bedrock in the high ground to the east and the south of the boreholes, where the subsoils are thin or absent, and flows to the north-northwest, towards the stream. In the rest of the catchment, infiltration occurs through the moderately permeable subsoil and flows primarily north and west, discharging into the stream.

Given that the Knockmealdown Formation is not typically very permeable, it is anticipated that the groundwater gradient is likely to reflect the valley topography, which is approximately 0.05 in the vicinity of the boreholes but 0.1 over much of the remaining portions of the catchment. An average value of 0.07 has been estimated for the entire catchment.

9.3 Hydrochemistry and Water Quality

BH-1 has been included in the EPA operational chemical monitoring network since 1995. The raw water sample point is a tap located in the treatment plant. The laboratory results have been compared to the EU Drinking Water Council Directive 98/83/EC Maximum Admissible Concentrations (MAC) and where applicable mean values are compared to the European Communities Environmental Objectives (Groundwater) Regulations 2010 recently adopted in Ireland under (S.I. No. 9/2010) as part of the implementation of the Water Framework Directive 2000 in Ireland. The EPA data are graphed in Figures 6 to 8 below and are summarised below.

- The water has a moderately hard calcium bicarbonate hydrochemical signature (average 124 mg/l $CaCO_3$). The average conductivity is 312 µS/cm and the range is from 141 µS/cm to 385 µS/cm. The average pH is around 6.8 while it ranges between 5.5 and 7.8. These values are indicative of siliceous bedrock material.

- There are no reported incidents of faecal coliforms in the analysis. No ammonium values were recorded greater than the Threshold Value of 0.175 mg/l.

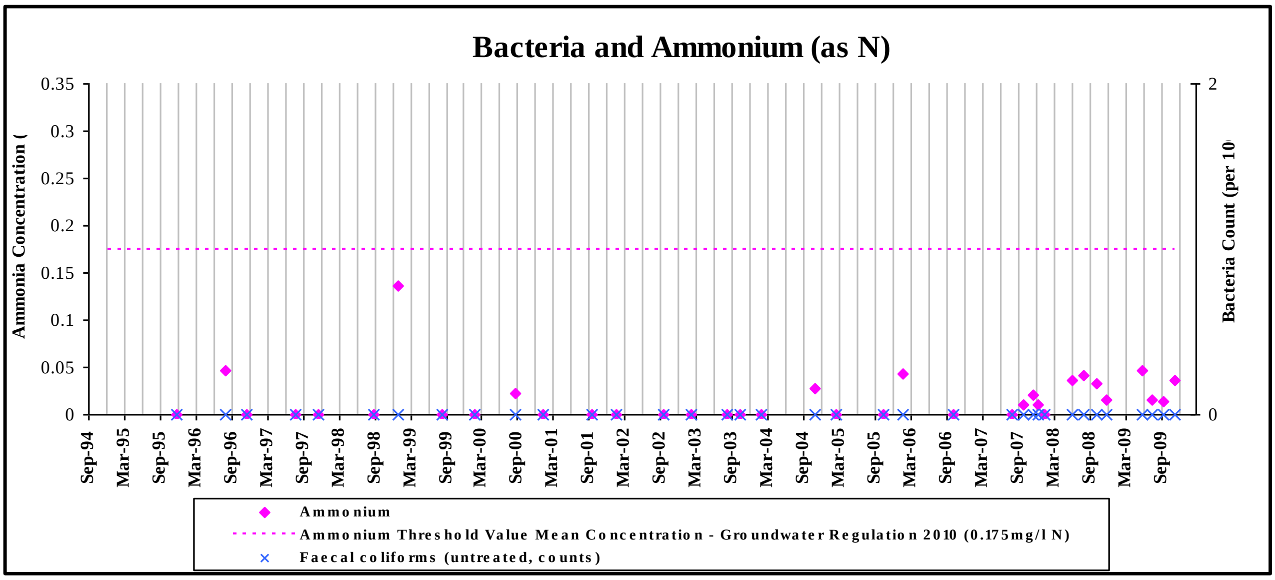

Figure 6: Key Indicators of Agricultural and Domestic Contamination: Bacteria and Ammonium

- The concentration of nitrate ranges from 14.9 mg/l to 29.1 mg/l with a mean of 22.7 mg/l (as NO3). These values do not exceed the EU Drinking Water Directive maximum admissible concentration (MAC) of 50 mg/l or the Threshold Value of 37.5 mg/l.

- Chloride is a constituent of organic wastes, sewage discharge and artificial fertilisers, and mean concentrations higher than 24 mg/l (Groundwater Threshold Value, Groundwater Regulations S.I. No. 9 of 2010) may indicate contamination, with levels higher than 30 mg/l usually indicating significant contamination (Daly, 1996). Chloride concentrations range from 16 mg/l to 24 mg/l with a mean of 20.4 mg/l which is below the Threshold Value.

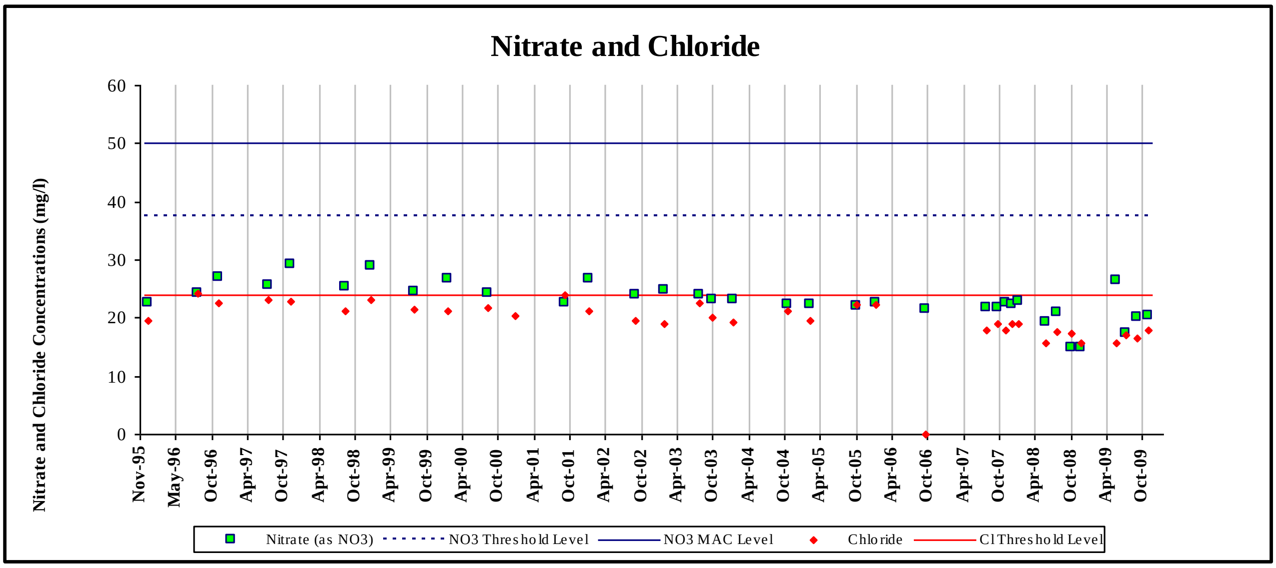

Figure 7: Key Indicators of Agricultural and Domestic Contamination: Nitrate and Chloride Graph

- The turbidity was above the drinking water limit of 1 NTU on the 11/06/08 and the 06/08/08. This is likely due to the presence of very fine clay particles. The turbidity may indicate inflow at a faster rate than expected in this type of bedrock, e.g. along the faults or fissures.
- The sulphate, potassium, sodium, magnesium and calcium levels are within normal ranges. The potassium/sodium ratio was marginally above the threshold of 0.35, on 4 occasions.

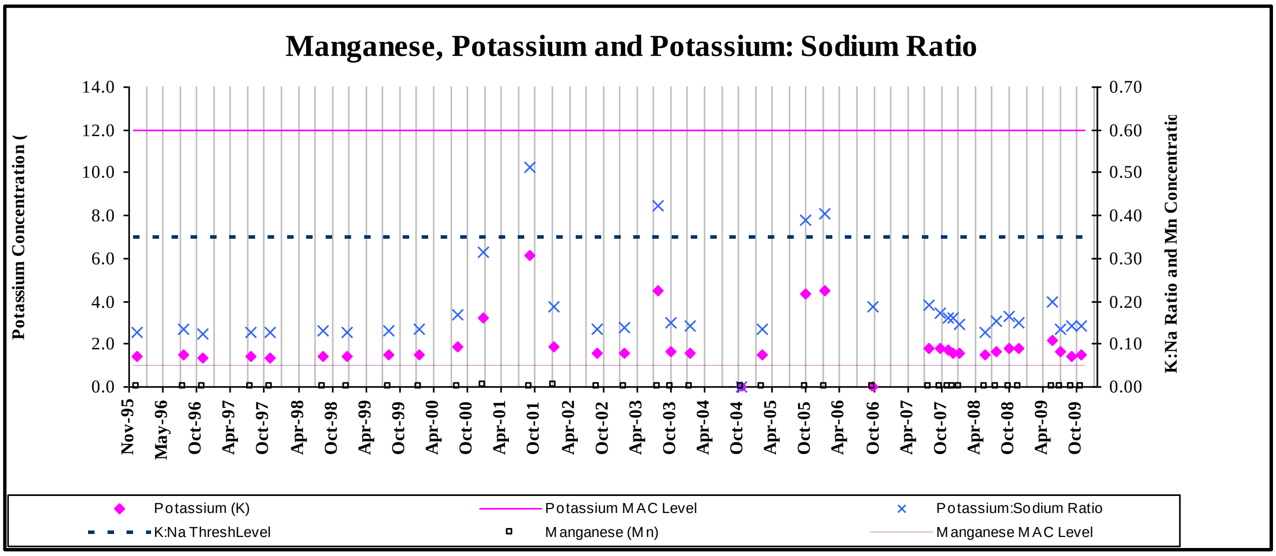

Figure 8: Key Indicators of Agricultural and Domestic Contamination: Manganese, Potassium and K/Na ratio Graph

- The concentration of iron and manganese is also within normal ranges.
- Trace metals were within either within the normal range for good quality drinking water or were not detected. Similarly organic compounds and herbicides have not been detected.

In summary, the data suggest that agricultural practices in this rural catchment have had a moderate impact on the groundwater quality. An improvement in water quality has been observed since 2008, with a significant decrease in nitrate and chloride levels. This improvement may be due in part to improved agricultural practices as a result of implementation of the Good Agricultural Practices Regulations. Period or may be attributable to the dilution effect of higher than normal rainfall levels in 2008 and 2009.

The EPA monitoring at the borehole and the field monitoring at the streams (Table 9-1 and Figure 9) indicate similar characteristics, with relatively low ranges for pH and electrical conductivity. However the groundwater pH average is generally slightly higher than the surface water pH but electrical conductivity values are in the same range. Given the artesian conditions and thickness of subsoil, any hydraulic connection between the stream and the groundwater is likely to be very limited. The similar pH and electrical conductivity are more likely to be related to the nature of the subsoil overlying the aquifer and through which the stream flows. The results are outlined in Table 9-1:

Table 9-1: Groundwater and Surface Water Quality

	BH1	BH2	Stream 1	Stream 2	Stream 3
	From EPA Analyses		From monitoring Field		
Location	On site		1.5 km to the SW	200 m to the E	1.3 km to the S
pH	Ave 6.8 Range: 5.5-7.8		7.05	7.30	7.21
Conductivity (µS/cm)	Ave 312 Range: 141-385		312	371	354

9.4 Aquifer Characteristics

The boreholes abstract water from the Devonian, Knockmealdown Sandstone Formation (Medium grained pink-purple sandstone). The aquifer is classified as a *Locally Important aquifer which is moderately productive only in Local Zones (Ll),* as indicated in Figure 9. The aquifer comprises 99% of the Knockmealdown Groundwater Body which has been delineated by the GSI.

The local artesian conditions at BH-2 are either likely due to up to 20 m of glacial till and boulder clay overlying the aquifer south of the stream or possibly the presence of some shale beds in the formation confining more water bearing units at depth. However, no such shale beds are recorded in the borehole logs for either BH-1 or BH-2. The presence of primarily gravels and interbedded silts and sands at BH-1, which is c.60m from BH-2, indicate that the aquifer may be less confined at this location.

Groundwater flows along bedding planes and through fractures and faults in the sandstone. The bedrock permeability for an Ll aquifer generally decreases with depth, with most of the groundwater flow through the upper weathered 10–15 m and decreasing dramatically with depth. However, the Mitchelstown source provides an average yield of 1800 m^3/d. This yield is very reliable and the boreholes are reported to have never suffered from a shortage of water. In the GWB delineation report, the GSI indicate that a yield >400 m^3/d in this formation is usually associated with boreholes being located on fault zones. It is likely therefore that the high yield is due to the boreholes intersecting fault zones or fractures connected to such fault zones emanating from the east to west anticline formed in the vicinity of the boreholes during the variscan mountain building event. It should be noted that no faults are currently mapped in the catchment.

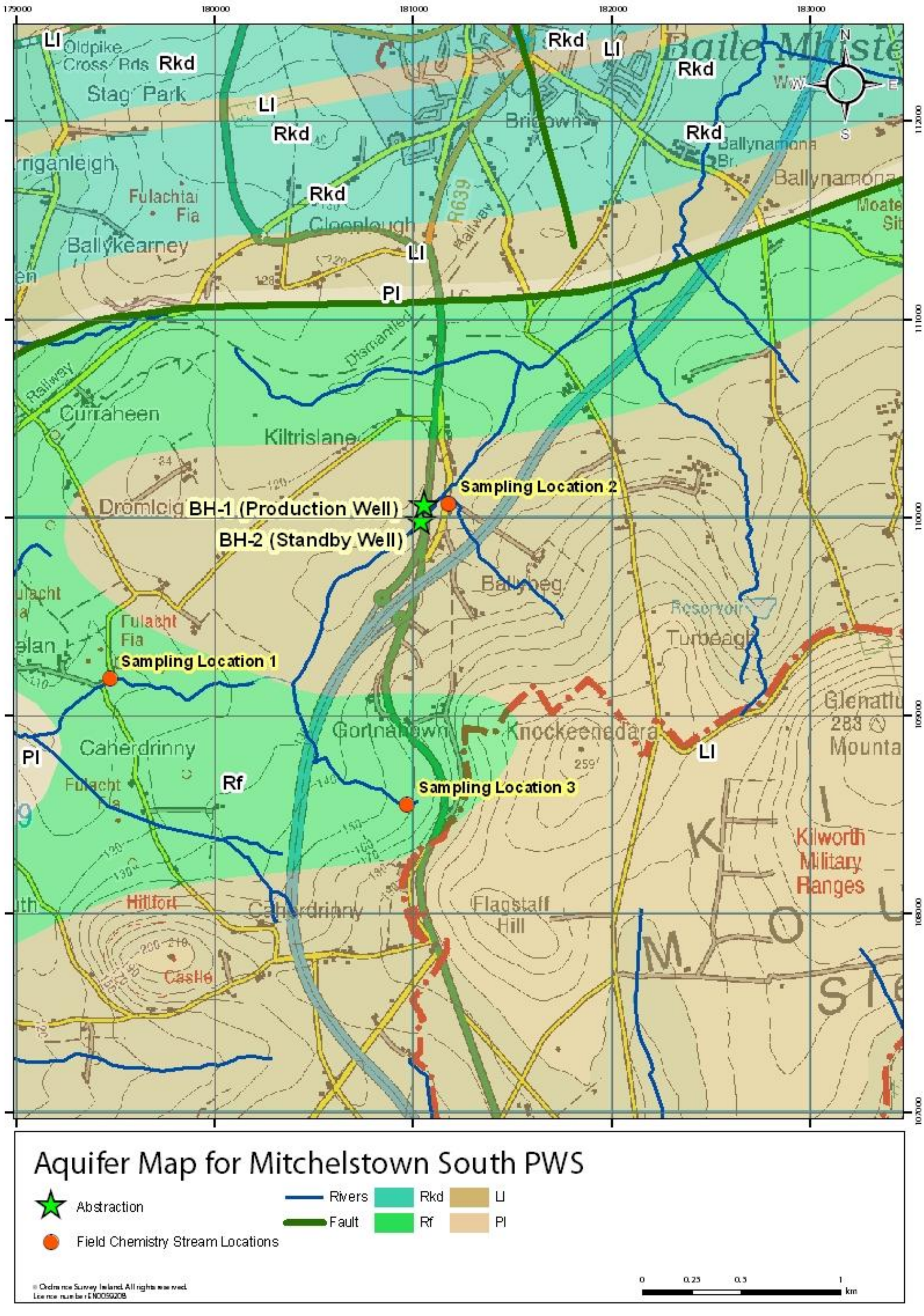

Figure 9 Aquifer Map

The GSI indicate that the expected transmissivity (T) range for LI aquifers in this groundwater body is 2–20 m^2/d, with median values occurring towards the lower end of the range. However, the yields at this source are higher than would be expected and thus T is calculated as c. 60 m^2/d using the CE Jacob formula on the 1982 pumping test recovery data (refer Section 4).

$$\text{Transmissivity (T)} = 0.183Q / \Delta s$$

Where: Q= pumped discharge rate (m^3/d or m^3/s) and Δs= change in drawdown per log cycle of t. (m)

The pumping test data indicate interference hydraulic connection between the two wells, which are located 60 m apart (around 2 m drawdown in BH-1 when borehole BH-2 abstracts 30 m^3/h).

The permeability of the aquifer in the vicinity of the wells is calculated by dividing the transmissivity by the saturated thickness of the aquifer. The saturated thickness of the aquifer is assumed to be c. 40 m. (the full depth of BH-1 minus the depth of overlying subsoil thickness of 20 m). Therefore the bulk permeability (K) is estimated as follows:

Table 9-2: Permeability Range for BH1 and BH2

	Local Assumption
Transmissivity (m^2/d)	60
Permeability (m/d)	1.5

The aquifer permeability is 1.5 m/d.

The velocity of water moving through this aquifer to the borehole has been estimated using Darcy's Law:

$$\text{Velocity (V)} = (\text{K x Groundwater Gradient(i)}) / \text{porosity}$$

The natural gradient is estimated at 0.07 (described in section 9.2). The effective fracture porosity in the Old Red Sandstone is estimated by the GSI, based on regional experience, at 0.02.

Table 9-3: Estimated velocity for BH1 and BH2

	Velocity (m/d)
Local K Assumption (1.5 m/d) Local effective porosity (2%)	5.25

The velocity of the groundwater moving through the aquifer is estimated at 7 m/d. The aquifer parameters are summarized in Table 9-4 below.

Table 9-4: Indicative Parameters for the Knockmealdown Sandstone Formation Aquifer in Mitchelstown (South)

Parameters	**Source of Data**	**BH1/BH2**
Transmissivity (m^2/d)	Assumed (based on recovery phase of pumping test data)	60
Permeability (m/d)	Estimated from T value assuming saturated thickness is the full depth of the boreholes	1.5
Effective Porosity	Estimated from Carrignadoura and Carraignabhfear SPZ Reports, 2010	2%
Groundwater gradient	Assumed based on topography	0.07
Velocity (m/d)	Assumed (calculated based on above)	5.25

10 Zone of Contribution

The Zone of Contribution (ZOC) is the complete hydrologic catchment area to the source, or the area required to support an abstraction from long-term recharge. The size and shape of the ZOC is controlled primarily by (a) the total discharge, (b) the groundwater flow direction and gradient, (c) the subsoil and rock permeability and (d) the recharge in the area. This section describes the conceptual model of how groundwater flows to the source, including uncertainties and limitations in the boundaries, and the recharge and water balance calculations which support the hydrogeological mapping techniques used to delineate the ZOC.

10.1 Conceptual model

Groundwater flows through the Knockmealdown Sandstones from the high ground to the south and east in the Kilworth Mountains towards the source and the river valley to the north. Rainfall recharge occurs readily through the thin subsoil and exposed rock area of the catchment above 140/150mOD, where infiltrating water travels relatively quickly through the upper weathered portions of the bedrock to the streams in the river valley.

Below the 140 mOD contours, the subsoil increases in thickness from 5 m in the footslope of the Kilworth Mountains to approximately 20 m close to the boreholes. Where the subsoils are thick, toward the bottom of the valley and close to the wells, recharge is likely to be lower and run-off to the streams higher. The protection offered by the thick subsoil cover is reflected in the relatively good water quality in the boreholes.

The borehole production is an average of 1800 m^3/d. This is more than expected for this type of aquifer and indicates the presence of significant fractures in the bedrock, though no major faults are mapped in the local catchment.

Artesian conditions were observed when the borehole BH-2 was drilled and probably reflect the thicker and more poorly draining subsoil in the immediate vicinity of this borehole relative to the surrounding lands in the catchment. A schematic of the conceptual model is shown in Figure 9.

10.2 Boundaries of the ZOC

The boundaries of the area contributing to the source are considered to be as follows (Figure 10).

The Southern, Eastern and Western boundaries are primarily based on the topography, conceptualized groundwater flow-lines, which flow to the north-northwest towards the stream, and the size of the estimated ZOC using the recharge and water balance equations in section 10.3.

The Northern boundary – the Downgradient boundary is the maximum downgradient distance that the borehole can pump water from is based on the uniform flow equation (Todd, 1980).

$$x_L = Q / (2 * \pi * T * i)$$

where: Q is the daily pumping rate +/- X%; T is Transmissivity (taken from aquifer characteristics); i is gradient.

With a pumping rate in B-1 is 1800 m^3/d for the borehole, the transmissivity is 60 m^2/d and the hydraulic gradient is 0.07, the approximate downgradient distance from the borehole is 70 m. The boundary has been extended approximately 300 m north to incorporate the topographic catchment in this area.

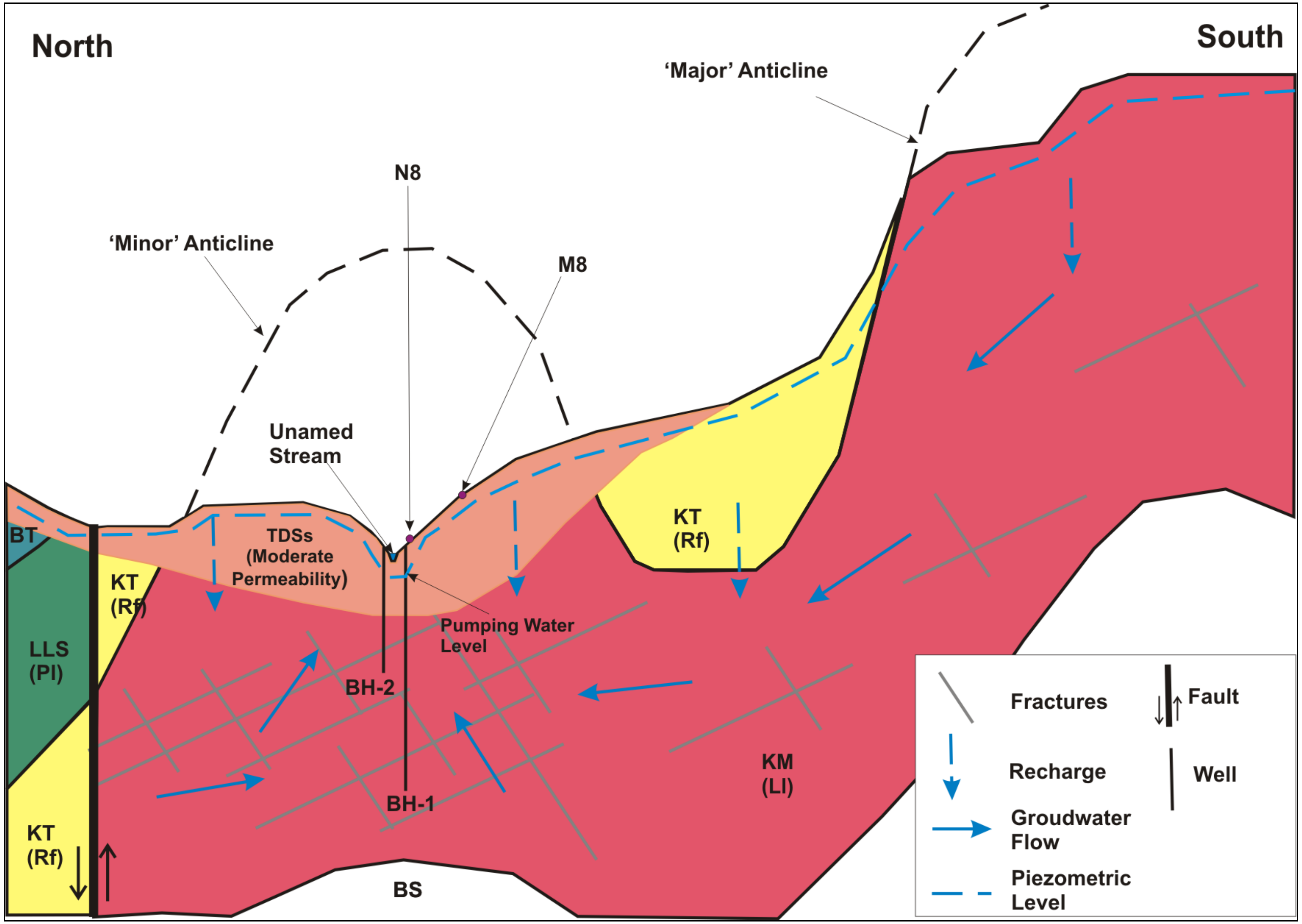

Figure 9: Conceptual Model

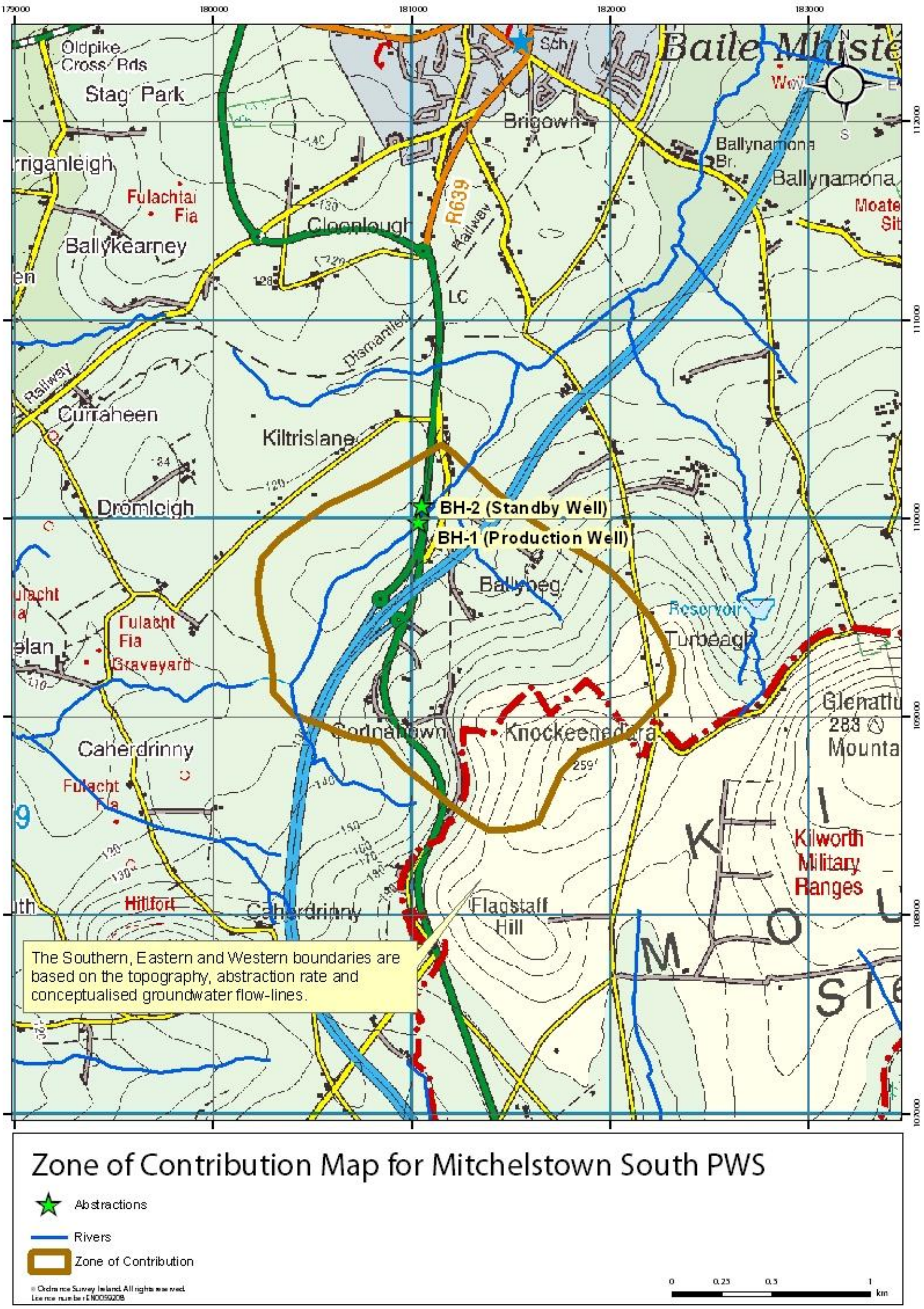

Figure 10: Zone of Contribution

10.3 Recharge and Water Balance

The term 'recharge' refers to the amount of water replenishing the groundwater flow system. The recharge rate is generally estimated on an annual basis, and assumed to consist of input (i.e. annual rainfall) less water loss prior to entry into the groundwater system (i.e. annual evapotranspiration and runoff). The estimation of a realistic recharge rate is critical in source protection delineation, as it will dictate the size of the zone of contribution to the source (i.e. the outer Source Protection Area).

Given the high permeability of this aquifer locally and the overlying sands and gravels subsoil which may add some storage, the recharge aquifer cap of 200 mm normally applied to an LI aquifer has not been applied here. At Mitchelstown therefore, the main parameters involved in recharge rate estimation are: annual rainfall; annual evapotranspiration and a recharge coefficient. The recharge is estimated as follows.

Potential recharge is equivalent to 642 mm/yr i.e. (Annual Effective Rainfall as outlined in Section 6).

Actual recharge has been estimated to be 292 mm/yr; this value is based on the following observations:

The majority of the area up to the source (60% of the ZOC to the source), is mapped either as Extreme Vulnerability, where the bedrock outcrops (10%) which is turn is overlain Acid Mineral Soil with shallow peaty surface layer (AminSRPT) or bedrock overlain by less than 3 m of Till (50%) which is turn is overlain by well drained soil. Guidance document GW5 recommends respectively a recharge coefficient in the range of 0.60 to 1 with an inner range of 0.80-0.90 and a recharge coefficient in the range of 0.45 to 0.8 with an inner range of 0.50-0.70 (IWWG, 2005). The shallow peaty surface layer on the outcrop rocks, the moderate drainage density and the steep slopes up hydraulic gradient of the wells indicate a relatively high runoff. Therefore the recharge coefficients applied are respectively of 0.60 and 0.50.

In the reminder of the catchment, mapped as high (30%) and moderate (10%) vulnerability, near the well, the bedrock is overlain by till subsoil, which is turn is overlain by deeply well drained soils. It was noted in subsoil cores close to the well compound, that the subsoils appeared to be mottled at depths of less than 0.5 m bgl, possibly indicating poorer drainage and therefore less permeable subsoils here. The guidance document GW5 recommends respectively for the high vulnerability a recharge coefficient in the range of 0.35 to 0.80, with an inner range of 0.50-0.70 and for the moderate vulnerability area a recharge coefficient in the range of 0.25 to 0.60, with an inner range of 0.30-0.40 (IWWG, 2005). Given the subsoil may be less permeable at depth in this area, it considered that the minimum coefficient can be applied in this case which is for the high and moderate Vulnerability respectively 0.35 and 0.25.

Runoff losses are assumed to be 55% of the potential recharge (effective rainfall). This value is based on an assumption of c.49% runoff for 70% of the area (extreme vulnerability – rock close to surface) and 68% runoff for 30% of the area (high to moderate vulnerability). The **bulk recharge** coefficient for the area is therefore estimated to be 45%.

These calculations are summarised as follows:

Average annual rainfall (R)	1100 mm
Estimated P.E.	458 mm
Estimated A.E. (95% of P.E.)	435 mm
Effective rainfall	642 mm
Potential recharge	642 mm
Runoff losses	55%
Bulk recharge coefficient	45%
Assumed Recharge	289 mm

The water balance calculation states that the recharge over the area contributing to the source, should equal the discharge at the source. At a recharge of 289 mm/yr, the discharge of 1800 m^3/day would require a recharge area of 2.30 km^2.

The ZOC described above is 2.5 km^2 and is based on topography and the current understanding of the hydrogeology and the direction of groundwater flow. The larger ZOC area delineated is primarily based on the topography, conceptualised groundwater flow-lines while also considering the recharge and water balance equations. It is likely that there is some discharge of groundwater to the streams running through the ZOC. To allow for daily variations in abstraction, a possible increase in demand, and for the expansion of the ZOC during dry weather periods, the GSI recommends increasing the abstraction rate by 50% for the purposes of delineating the ZOC. The ZOC delineated is slightly greater than that required to support the abstraction and increasing the size of the ZOC in this case would be unrealistic in terms of the hydrogeological limitations of the boreholes and the topography of the catchment.

The boundaries of ZOC are shown in Figure 10.

11 Source Protection Zones

The Source Protection Zones are a landuse planning tool which enables an objective, geoscientific assessment of the risk to groundwater to be made. The zones are based on an amalgamation of the source protection areas and the aquifer vulnerability. The source protection areas represent the horizontal groundwater pathway to the source, while the vulnerability reflects the vertical pathway. Two source protection areas have been delineated, the Inner Protection Area and the Outer Protection Area.

The Inner Protection Area (SI) is designed to protect the source from microbial and viral contamination and it is based on the 100-day time of travel to the supply (DELG/EPA/GSI 1999). Based on the indicative aquifer parameters presented in section 9.4, the groundwater velocity is 5.25 m/d, and hence the 100-day time of travel distance is 525 m. The Inner Protection Area is illustrated in Figure 11.

The Outer Protection Area (SO) encompasses the entire zone of contribution to the source. The GSI recommends increasing the abstraction rate by 50% for the purposes of delineating the ZOC. However in this case the ZOC area delineated is slightly greater than that required to support the abstraction and increasing the size of the ZOC in this case would be unrealistic in terms of the hydrogeological limitations of the boreholes and the topography of the catchment.

The groundwater Source Protection Zones are based on an overlay of the source protection areas on the groundwater vulnerability. They are listed in Table 11-1 and are shown in Figure 12. Therefore the groundwater protection zones are SI/E, SI/H and SI/M. The majority of the area is designated SO/E.

Table 11-1 Source Protection Zones (%area, km^2)

Source Protection Zone		**% of total area (km^2)**
SI/E	Inner Source Protection area / <3 m subsoil	0.8 % (0.02 km2)
SI/H	Inner Source Protection area / High vulnerability	21.60 % (0.54 km2)
SI/M	Inner Source Protection area / Moderate vulnerability	4 % (0.10 km2)
SO/X	Outer Source Protection area / ≤1 m subsoil	11.6 % (0.29 km2)
SO/E	Outer Source Protection area / <3 m subsoil	45.2 % (1.13 km2)
SO/H	Outer Source Protection area / High vulnerability	11.60 % (0.29 km2)
SO/M	Outer Source Protection area / Moderate vulnerability	5.20 % (0.23 km2)

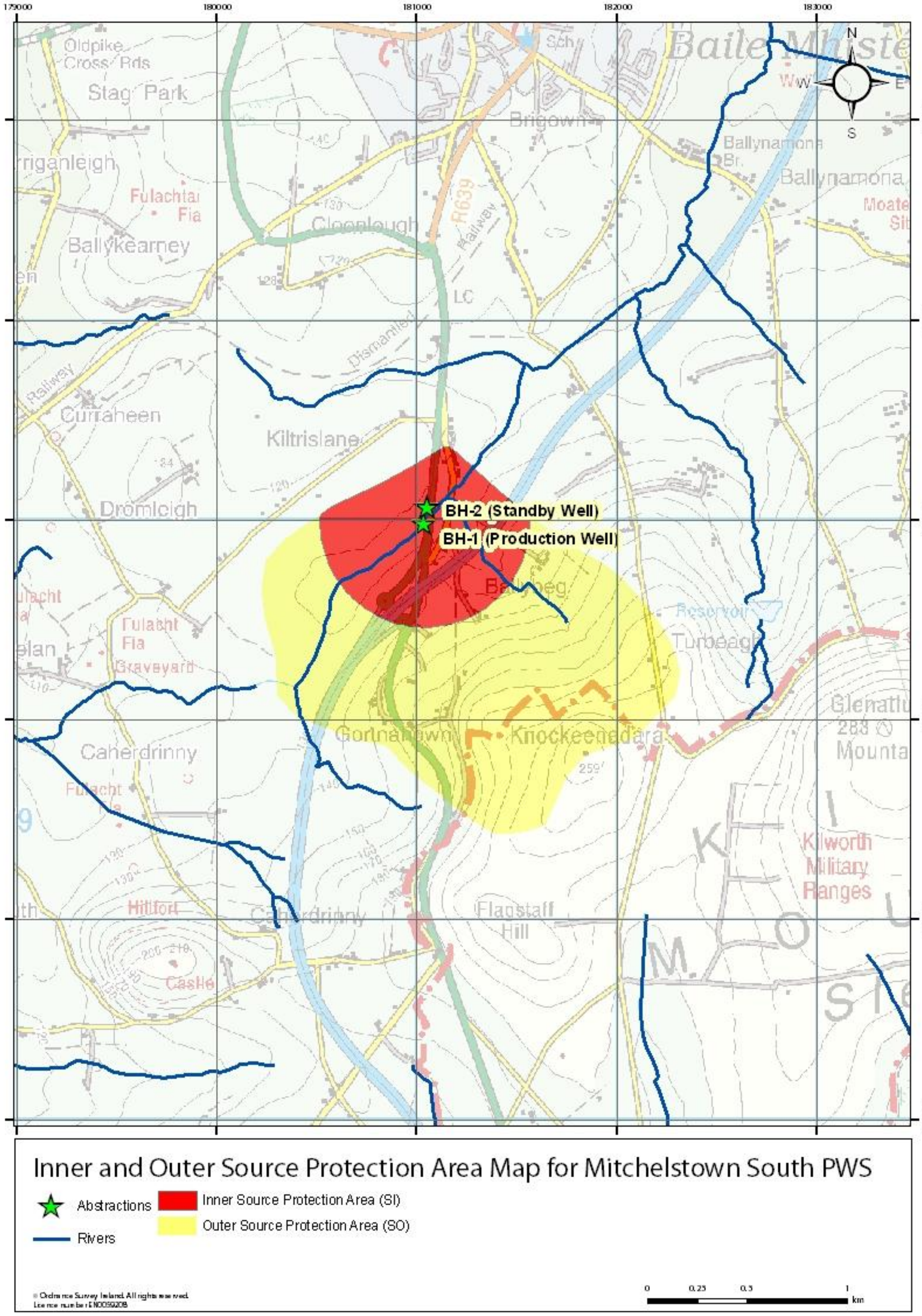

Figure 11: Inner and Outer Source Protection Areas

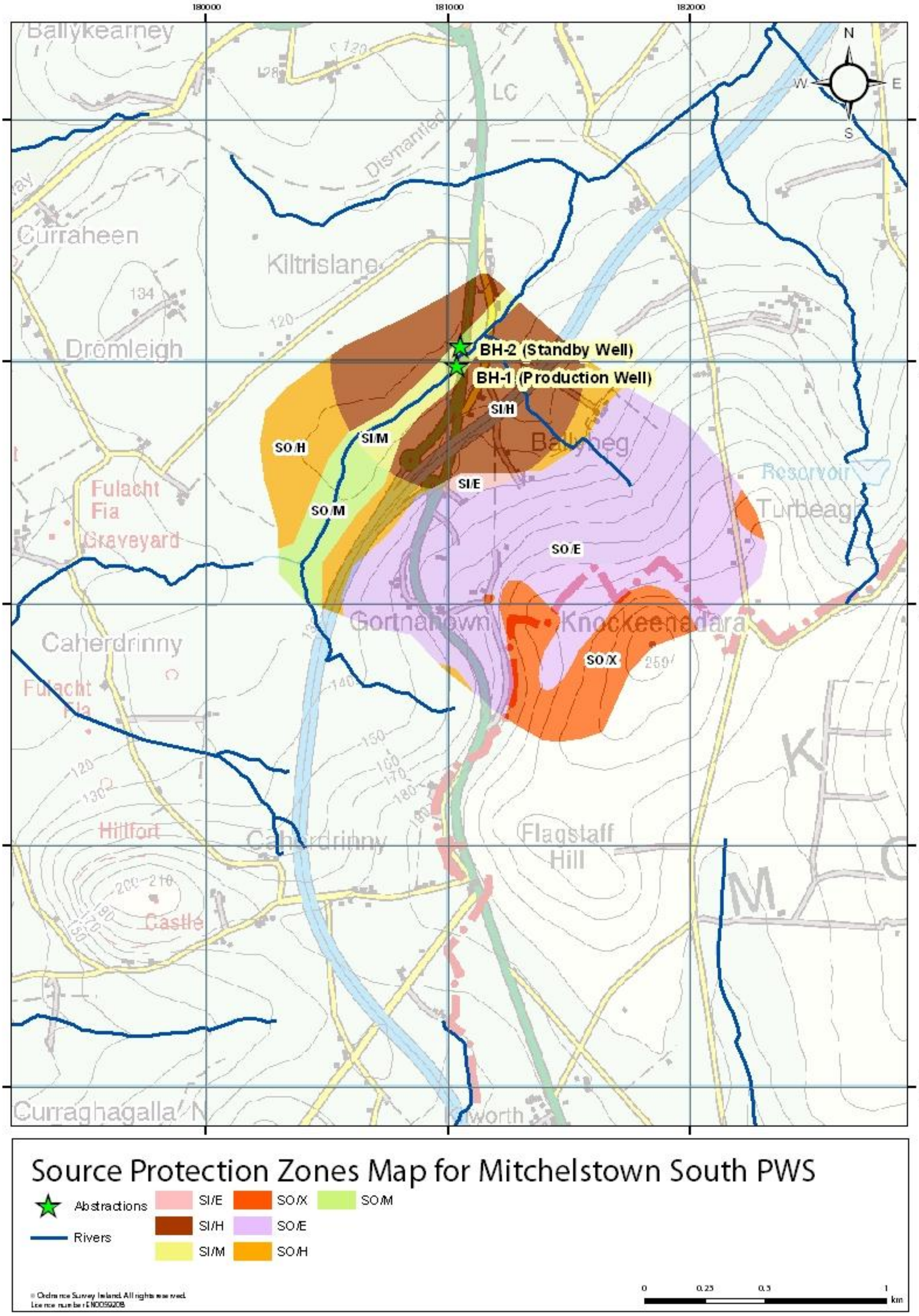

Figure 12: Source Protection Zones

12 Potential Pollution Sources

BH-1 and BH-2 are located in below ground chambers (c 2 m by 1 m) covered by a large, hinged, lockable, steel lid. The top of the chambers are approximately 0.25 m above the ground level. Based on the site inspection it appears that neither borehole is grout sealed but a steel casing has been driven to the top of bedrock. Given the protection of the boreholes and their location, the potential risk for contamination as a result of surface spills in the vicinity of the well head is moderate.

The landuse within the Inner Source Protection is primarily pastureland for grazing animals. The main potential pollution sources are considered to be the presence of cattle grazing in the field surrounding the compound. Impacts associated with these sources are typically elevated levels of ammonia, nitrates, phosphate, chloride, potassium, pesticides, faecal bacteria, viruses and cryptosporidium. Faecal coliforms have not been detected in the untreated water. Given the moderate to high vulnerability of the aquifer, and the presence of c. 20 m of subsoil above the bedrock at the source, the potential contamination risk is considered to be moderate.

The source is located on an embankment footslope off the N8, approximately 5 meters below the level of road. Rainfall run off to soakaways from the road is likely to contain hydrocarbons and metals. The run-off is collected locally in an attenuation pond with over flow to a stream which flows close to the wells. Because of the likely moderate to low permeability and depth of the subsoil in the vicinity of the wells the stream does not appear to have a significant connection to the aquifer in the vicinity of the wells. The risk from road run-off to the source is therefore considered to be low.

The majority of land within the Outer Source Protection Area is agricultural grassland and the dominant farm activity is dairy farming. The closest farm yard is c. 600 m east southeast of the boreholes. The main potential pollution sources associated with farming activities are animal slurry storage areas, farmyard washings, grazing animals and landspreading of agricultural waste. The possible impacts to the water quality of the public supply associated with these activities within its Outer Source Protection Area are elevated levels of ammonia, nitrate, phosphate, chloride, potassium, BOD, COD, TOC and pesticides. With the exception of the nitrate levels average 24.2 mg/l, these parameters are not elevated in the untreated water supply.

In summary, given the nature of the activities within the outer zone and the generally good water quality, the potential risk of contamination is moderate.

13 Conclusions

The public water supply at Mitchelstown South comprises two boreholes (BH-1 and BH-2) situated c. 60 m apart which were drilled in 1981 and 1982 respectively. The water supply is located approximately 1.8 km south of Mitchelstown.

The boreholes abstract water from the Devonian, Knockmealdown Sandstone Formation (Medium grained pink-purple sandstone). The aquifer is classified as a *Locally Important aquifer which is moderately productive only in Local Zones (Ll)*. The Mitchelstown wells provide an average of 1800 m^3/d. The yield is very reliable and the boreholes have never suffered from a shortage of water.

The water table in the aquifer at the borehole locations appears to be close to the surface in BH-1 while BH-2 is artesian. Artesian conditions may be due to the presence of up to 20 m of glacial till and boulder clay overlying the aquifer south of the stream at the site. The presence of primarily gravels and interbedded silts and sands overlying the bedrock in BH-1 located c. 60 m from BH-2 indicates that the aquifer may be less confined by the overlying subsoil at that location.

Groundwater flows along bedding planes and through fractures and faults in the sandstone bedrock. Typically bedrock permeability for an Ll aquifer generally decreases with depth with most of the water flow through the upper weathered 10–15 m and decreasing dramatically with depth. The better than expected well yields and aquifer transmissivities at the Mitchelstown source suggest that fracturing emanating from the east to west anticline formed in the vicinity of the boreholes during the variscan mountain building event has played a role in increasing productivity.

The groundwater vulnerability with the ZOC ranges from Extreme or Extreme with Rock near the surface over approximately 60% of the area. In the remaining 40%, closer to the water supply wells, the vulnerability is considered to be Moderate to High. Water quality is generally good although nitrate and chloride are slightly above background levels which suggest there are pollution pressures within the ZOC, probably within the extreme vulnerability areas closer to the source.

The ZOC encompasses an area of 2.5 km^2 which incorporates a 9 % increase in the current pumping rate. The Source Protection Zones are based on the current understanding of the groundwater conditions and the available data. Additional data obtained in the future may require amendments to the protection zone boundaries.

14 Recommendations

Given that the potential risk of contamination is moderate it is recommended that a cryptosporidium filter be fitted at the treatment plant.

Because BH-2 is used occasionally, water quality in this well should occasionally be monitored to confirm suitability for drinking water supply.

15 References

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APPENDIX 1

Report "North East Regional Water Supply Scheme
(Cork County Council, 1984)
and
Reports "Pump test on wells 1 and 2" and "Tables of results of well pump test at Kristislane, Mitchelstown" (GEOX Limited, 1982)

CORK COUNTY COUNCIL - NORTH

NORTH EAST REGIONAL WATER SUPPLY
STAGE 1.

MITCHELSTOWN WATER SUPPLY AUGMENTATION

PRELIMINARY REPORT

July 1984

C.B. DEVLIN, B.E.,
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Cork County Council,
Annabella

NORTH EAST REGIONAL WATER SUPPLY SCHEME

STAGE 1

MITCHELSTOWN WATER SUPPLY AUGMENTATION

CONTENTS

INTRODUCTION:

The region which is the subject of this report is bounded on the east by County Tipperary and County Waterford, on the south by the Fermoy, Killavullen and Mallow Water Supplies and by the river Blackwater, on the west by Mountnorth and Charleville Water Supplies and on the north by County Limerick and the Ballyhoura Mountains.

The region is served at present by the following separate Water Supply Schemes: (1) Mitchelstown; (2) Glanworth; (3) Ballyenihan/Derryvillane; (4) Kilworth, Grange and Johnstown; (5) Castletownroche; (6) Buttevant/Doneraile; (7) Kildorrery.

These schemes have been extended over the years and are now at the hydraulic limit of their network. In order to determine the most economic way of developing the water resources in this region to meet the demands being made on them, the actual demand in each scheme was compared with the yield of the individual sources, the type of source and the existing storage capacity. This is shown in Table 1. It can be seen that there is substantial spare capacity in some sources but that storage is inadequate on all schemes. The sources of the Castletownroche W.S.; Buttevant/Doneraile W.S. and Kildorrery W.S. are adequate for the likely future development of these schemes.

The Ballykenley source supplying the Glanworth W.S. and the Ballyenihan/Derryvillane W.S. is nearing capacity and a new future source will be required for this area. The Grange and Johnstown source in the forestry with no treatment, other than chlorination, together with a small spring supply to Kilworth Village, are no longer regarded as suitable sources because of forestry operations, pine needles, colour problems and customer complaints, culminating in refusal to pay water rents. A new source is required for this area.

MITCHELSTOWN AREA - PRESENT SUPPLY:

Mitchelstown Water Supply is supplied from two sources - the Behenagh river and an impounding reservoir at Glenatlucky. The original water supply for Mitchelstown was constructed about one hundred years ago. It consisted of an impounding reservoir at Glenatlucky with a surface area of 3 acres and a capacity of 36,360 cubic metres, approximately. There are two take off points for water on 1.67 metres below T.W.L. of the reservoir and the other 4.17 below T.W.L. The water was originally carried through a 150 mm. cast iron delivery main to Mitchelstown and distributed

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through a cast iron network. This 150 mm. was replaced with a 175 mm. main about forty years ago. See Map 2. This main has a capacity of 1,090 cubic metres per day (240,000 gallons per day).

In the late fifties this scheme became inadequate leading to a four-hour on, four-hour off situation in Summer time.

A new scheme was designed by the Co. Council (See Map 2). This consisted of an abstraction of 1,591 m^3 (350,000 gallons) from the river Behenagh (low flow greater than 4,545 m^3 per day) (one million gallons) at 221.04 m (725 ft. O.D.). The water was delivered through 1,830 metres of 150 mm. P.V.C. Class B watermain to Slow Sand filters at 194.97 metres O.D. (639.5 ft. O.D.). There are eight Slow Sand filters each with a capacity to treat 227 m^3 per day (50,000 gallons). From here it flows into a service reservoir with a capacity of 364 m^3 (80,000 gallons) and a T.W.L. of 196.60 m. O.D. (635 ft. O.D.). After fluoridation and chlorination, the water is delivered through 5,135 metres of 175 mm. (7 inch) Class B P.V.C. and 175 mm. Class B AC main to a 1,136 m^3 (250,000 gallon) Tower at Garryleigh with a T.W.L. of 152.44m. O.D. or (500 ft. O.D.). The estimated capacity of this main is between 2,273 m^3 and 2,455 m^3 per day (500,000 gallons to 540,000 gallons).

From the Tower the water gravitates through 200 mm. Class B P.V.C. and A.C. main to the traffic lights at the Clonmel/ Dublin road junction. The length of this main is 4,110 metres. Some service mains were also laid in the town replacing existing mains. This scheme was completed in 1964 at a cost of £109,000. - an augmentation scheme to the Glenatlucky supply which remained in use. The estimated cost of duplicating the Galtee Scheme in 1984 is £1,031,000.

The increasing water demands in the 1970's led to the need for an increased use of the Glenatlucky supply. The variable quality from the Glenatlucky supply led to consumer complaints. As the Glenatlucky water quality could not be improved at a reasonable cost, and as the supply from the springs was inadequate and polluted (See Appendix 1), the Council considered it advisable to investigate for alternative water sources for future development. This was done under Small Capital Schemes in 1981 and 1982 by ground water investigation. Meanwhile, as Mitchelstown is served by two sources with distinctly different quality, deterioration at Glenatlucky meant that the supplies in either side of the town were diverging in quality. Complaints built up over a period of five years to a peak in April, 1984. The complaints were about sediment, taste, colour, smell, pollution and larvae in the water. These complaints, together with the water quality examinations, led the Council to the search for alternative sources commencing in 1981.

The Council were obliged in April, 1984 to supply drinking water by tanker to approximately 275 houses from 18.4.84 to 30.4.84, following deputations to the Co. Council on the matter. The total number of houses in Mitchelstown is 800. A copy of a report in the "Cork Examiner" is included in this report. The Council's investigation into the cause of the problems showed that the fishy tastes and fishy smells were caused by an algal growth in the impounding reservoir. This is a seasonal occurrence but was particularly severe on this occasion (See Appendix 2). Chlorination also aggravated the taste and smell. As this is an open source, and as the springs are now showing high orthophosphate levels, it is now necessary to abandon Glenatlucky as a source for a modern water supply at the earliest possible date.

SUPPLY TO SUB-REGIONS:

Following a report of a Hydrgeological Consultant in 1981 - two wells were drilled at Kiltrislane in 1981 and 1982 and at Curraghoo Beg in 1983. The drilling confirmed two things -

(i) that substantial quantities of water of moderate hardness could be obtained from the Kiltoran beds of the old red sandstones. The proven yield at Kiltrislane is 75 m^3/hr. (16,600 g.p.h.) and a 12-hour pump test at Curraghoo Beg yielded 50 m^3/hr. (11,000 g.p.h.)

(ii) that the configuration of the Kiltoran beds (See Map 3) confirmed the idea that Mitchelstown, Glanworth and Kilworth should each be treated as sub-regions on their own and that water resources development should take place in each area separately. The sites of the three main reservoirs can now be fixed so as to give the shortest possible rising mains and the most economic pumping costs.

Mitchelstown reservoir will be located at Gortnahown T.W.L. 163 m. O.D. (534' O.D.). Glanworth reservoir will be located at Dunmahon with a T.W.L. of 131 m. O.D. (430' O.D.). Kilworth reservoir will be located at Ballinrush with a T.W.L. of 111 m. O.D. (365' O.D.).

TESTING AT KILTRISLANE:

The well drilled in 1981 was a test well. The well drilled in 1982 was intended as a test production well. Details of well construction and Geological Logs of the wells are shown in Appendix 6 and Appendix 7 Both wells were tested continuously and simultaneously from 6th October 1982 to 18th October, 1982. With both wells pumping well No. 1 yielded 45 m^3/hr. (10,000 g.p.h.) with a drawdown of 16 metres and

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well No. 2 produced 30 m^3/hr. (6,600 gallons per hour) with a drawdown of 25 metres. The total reliable yield from both wells is 75 m^3/hr. (16,600 g.p.h.) or 1510 m^3/day (332,000 gallons per day of 20 hours pumping). Both wells are artesian. From further drilling which we carried out at Curraghoo Beg, Glanworth, in the old red sandstones, we have obtained a supply of approximately 50 m^3/hr. (11,000 gallons per hour.).

Therefore, following detailed examinations of the geological structure around Mitchelstown and from the flows obtained from the drilling by the Cork County Council, the old redstones are a proven water supply source and that Mitchelstown town and district will be best and most economically augmented from this underground source. Two further sites have been selected for drilling in the sandstones and these are shown on Map 5 at points A and B. Reports on these will be forwarded as soon as the'drilling has been completed.

DESIGN OF MITCHELSTOWN AUGMENTATION SCHEME:

The existing Galtees Scheme has a design capacity of 1,591 m^3/day (350,000 gallons per day). An additional 545 m^3/day (120,000 gallons/day) is supplied from Glenatlucky Reservoir giving a total usage of 2,136 m^3/day (470,000 g.p.d.). It is proposed to meet the Glenatlucky demand from Kiltrislane bored wells and to provide for future development as well on a phased basis by further well drilling. Pumping the existing wells for twenty hours a day will provide a spare capacity of 964 m^3/day (212,000 g.p.d.) for future domestic and industrial development. This alone justifie the development at Kiltrislane apart from any further drilling for water in the area (See Map 5).

The reservoir site at Gortnahown 163 m. O.D. (534' O.D.) is selected there to give adequate hydraulic residual head in Mitchelstown town. It means that the rising main and trunk main can be laid in the margins of the National Primary without any wayleaves being required. It also means that future bored wells can be pumped also to this site because of the configuration of the old red sandstones in this area. Again there will be only 1,136 m^3 (250,000 gallons) storage at the Tower in Garryleigh when Glenatlucky Reservoir is taken out of commission. This represents just over a half a day's storage. By constructing a 2,000 m^3 reservoir at Gortnahown this will give a combined reservoir storage of 1.47 days at present. Future requirements will require an additional 2,000 m^3 reservoir. Accordingly, it is recommended that one 2,000 m^3 reservoir be constructed at present with land acquisition to accommodate a second reservoir here.

The rising main is designed to take the safe yield of the wells. Future wells will have additional rising mains to the reservoir. From an examination of the bacteriological and chemical tests it is intended to make provision for aeration, PH correction, chlorination and fluoridation at the reservoir site - thus having all the treatment processes at the site for any future water pumped to the reservoir site. Arrangements can be made at the reservoir site for gravity treatment of the water, and avoid the necessity of duplicating the treatment if this were carried out at each of the pumphouses.

The trunk main from the reservoir to the Market Square in Mitchelstown is designed to meet the requirements of the Chief Fire Officer, i.e. 75 litres/second (1,000 gallons per minute) at the Market Square with a residual of 1.36 Bars (20 P.S.I.) at Mandeville Park - the highest housing estate in the town (floor levels 134.15 m. O.D. - 440' O.D.). This is equivalent to a peak demand of 1.82 m^3/minute (400 gallons per minute) or a total usage of 2,618 m^3/day (576,000 gallons per day). This means that the trunk main will have spare capacity for any future well development in the area (See Map 5.).

PIPE DESIGN:

Rising Main.
Q = 1,509 m^3 (332,000 g.p.d.).
Pumping time 20 hours/day (ult.).
Pumping Rate 20.93 litres/sec.
Length 950 metres.

Head loss.
150 mm. Ø Class 15 AC; 7.6 metres.
200 mm. Ø Class 15 AC; 1.9 metres.
250 mm. Ø Class 15 AC; .67 metres.

Use
200 mm. Class 15 AC main.

DISTRIBUTION MAIN:

Constraints:
75.67 litres/sec. (1,000 g.p.m. with a residual of 20 P.S.I. at Mandeville Park.
Reservoir T.W.L. 534'.
Q = 75.67 litres/sec. (1,000 g.p.m.).
Hydraulic level at Mandeville Park 148 m. O.D. (486' O.D.)
Length 4,150 metres.
Assume 300 mm. AC main.
1,000 g.p.m.. through 300 mm. main gives a loss of 3.3. ft./1,000 or 3.3. metres/1,000 metr

Total Head Loss
45 ft. or 13.70 metres.

Use
300 mm. Class 15 AC main.

......................over/

PHASING AND COSTS:

It is proposed to ring Mitchelstown Town with a 200 mm. AC watermain (See Map 4). This is dependent on further well development, including pumphouses and rising mains and on the necessary funds becoming available. The second 2,000 m^3 reservoir will be dependent of future well development and rising mains also. Replacement of defective services would also be carried out in the future.

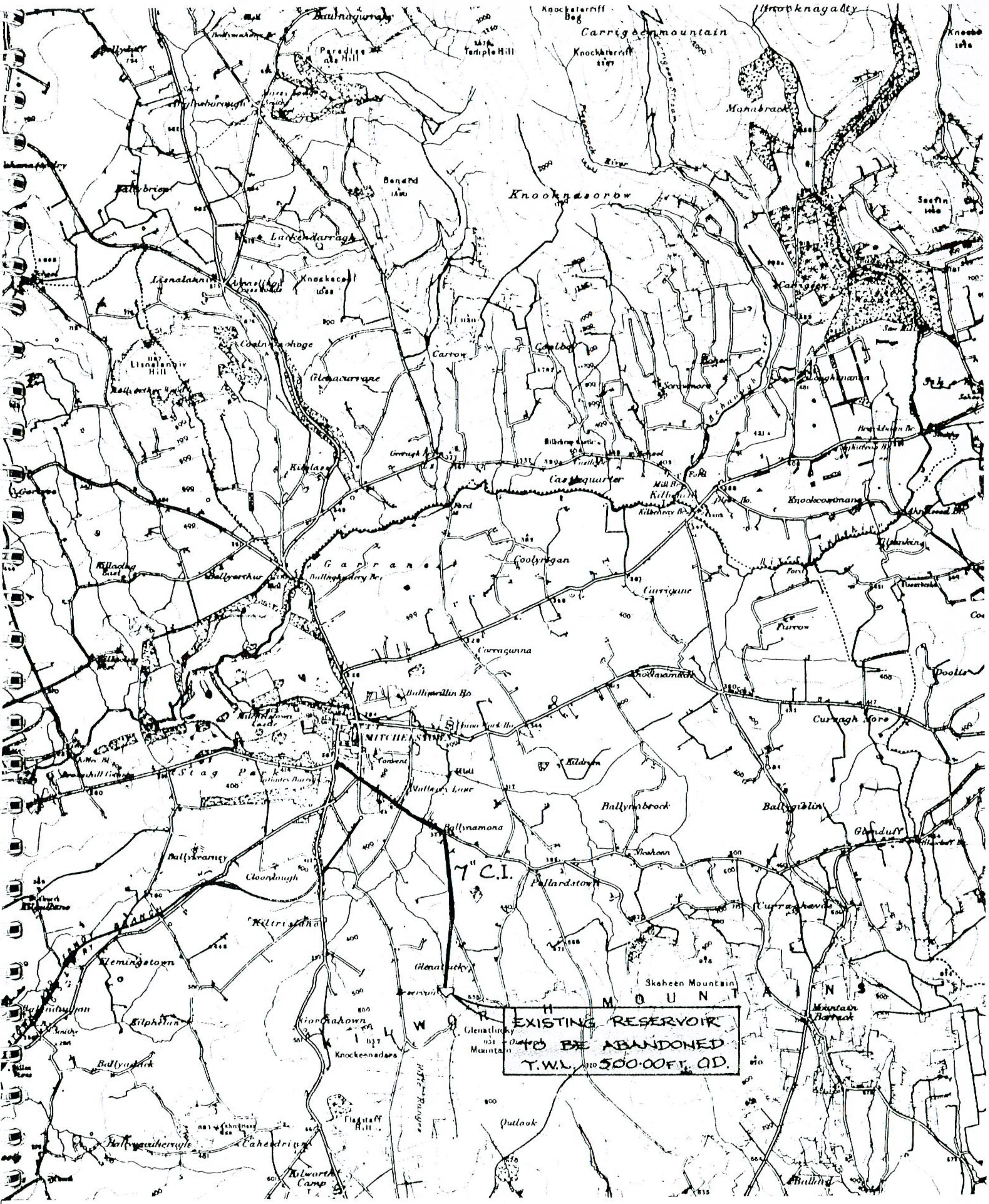
PRESENT DEVELOPMENT COSTS:

(1)	Provide E.S.B. 3 Phase Supply to Kiltrislane ...	£ 10,000.
(2)	Complete development on both wells to a depth of 60 metres	£ 15,000.
(3)	Submersible Pumps control house and access road	£ 15,000.
(4)	1,050 metres of 200 mm. AC Class 15 Rising Main, including road restoration @ £50. metre...	£ 52,500.
(5)	4,050 metres of 300 mm. AC Class 15 Trunk Main, including road restoration @ £65. metre	£263,250.
(6)	Reservoir Site - access road and fencing	£ 25,000.
(7)	2,000 m^3 Reservoir and Treatment Works	£275,000.
		£655,750.

COST OF FUTURE DEVELOPMENT:

(1)	2,000 m^3 Reinforced Concrete. Reservoir and ancillary works	£220,000.
(2)	Drill two wells, list and install pumps and control house	£ 30,000.
(3)	Provide 3 Phase E.S.B. to 2 sites	£ 15,000.
(4)	900 m - 6" AC main (two legs) @ £30. metre..	£ 27,000.
	1,150 m - 8" Ac main @ £40. metre	£46, 000.
(5)	1,600 lin. metres of 200 mm. AC Main in Mitchelstown Town, including road restoration @ £50. per metre	£ 80,000.
(6)	Replacement of defective services	£ 50,000.
		£468,000.

T O T A L ....£1,123,750.



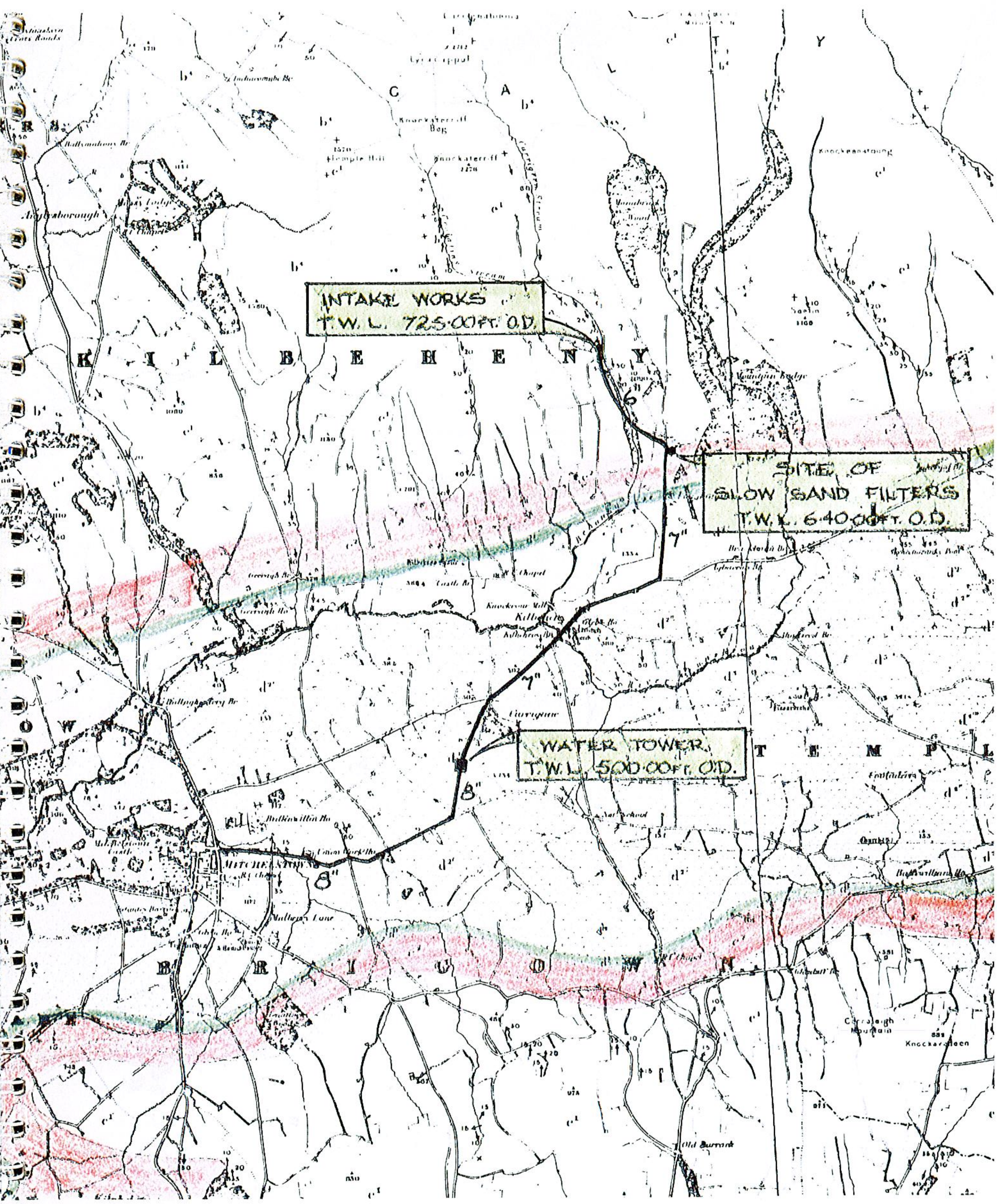
CORK COUNTY COUNCIL NORTH

NORTH ~ EAST REGIONAL W.S.S.

STAGE 1 ~ MITCHELSTOWN W.S. AUGMENTATION

C. B. DEVLIN, B.E.,
Deputy Co. Engineer

MAP 1 MAP 1



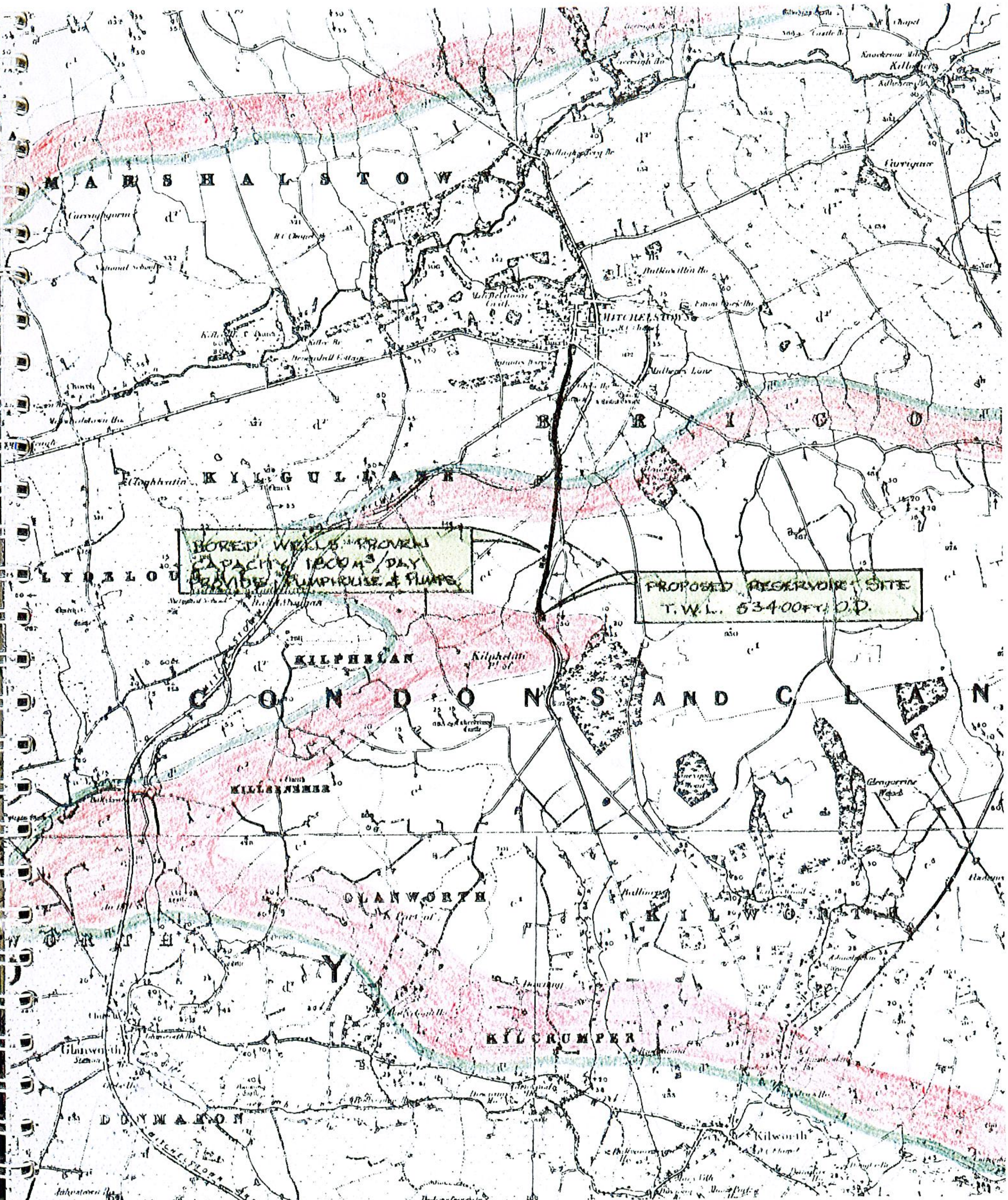
CORK COUNTY COUNCIL NORTH

NORTH ~ EAST REGIONAL W. S. S.

STAGE 1 ~ MITCHELSTOWN W. S. AUGMENTATION

C. B. DEVLIN, B.E.,
Deputy Co. Engineer,
Annabella, Mallow.

MAP 2.



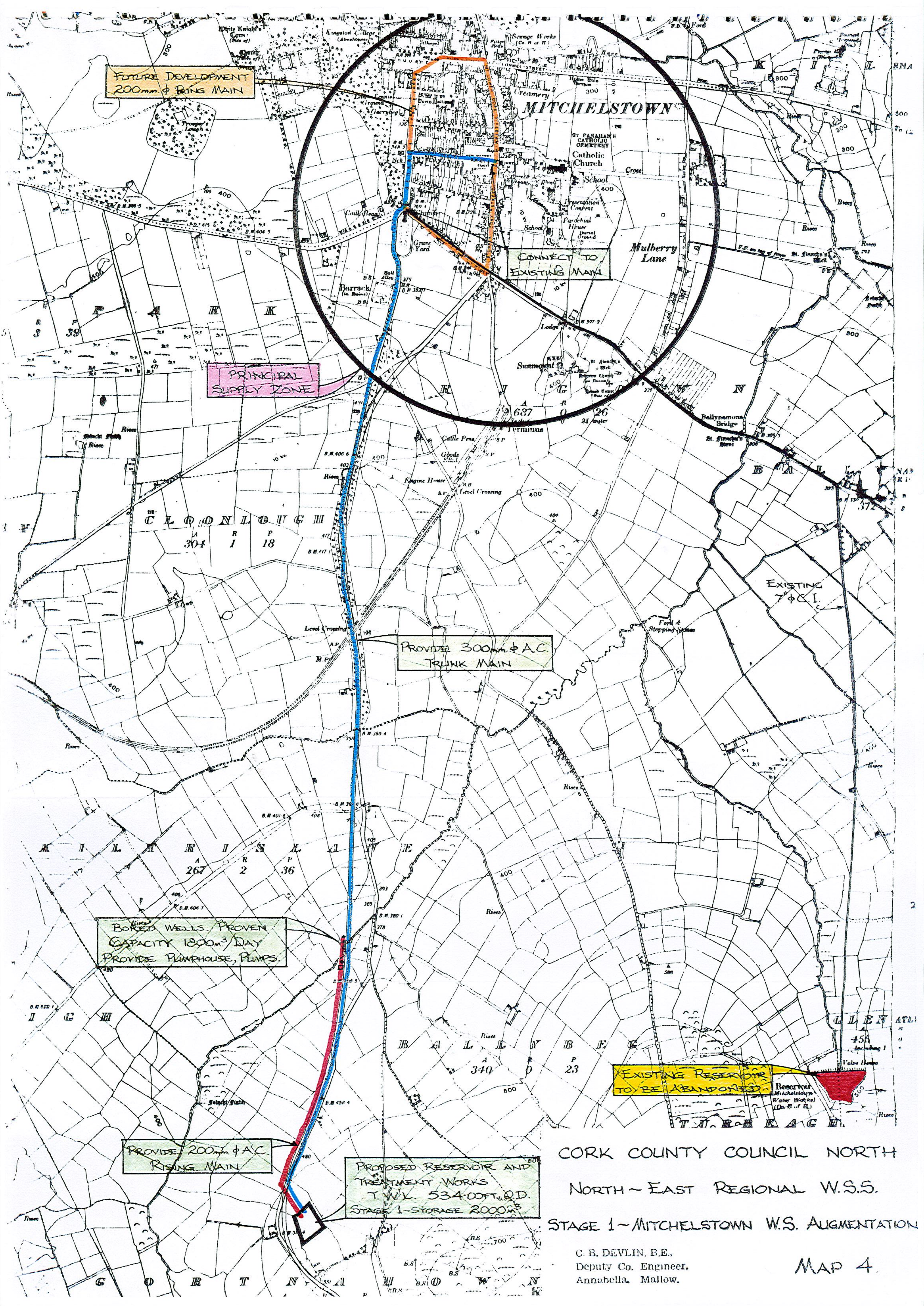
CORK COUNTY COUNCIL – NORTH

NORTH – EAST REGIONAL W.S.S.

STAGE 1 – MITCHELSTOWN W.S. AUGMENTATION.

C. B. DEVLIN, B.E.,
Deputy Co. Engineer,

MAP. 3.



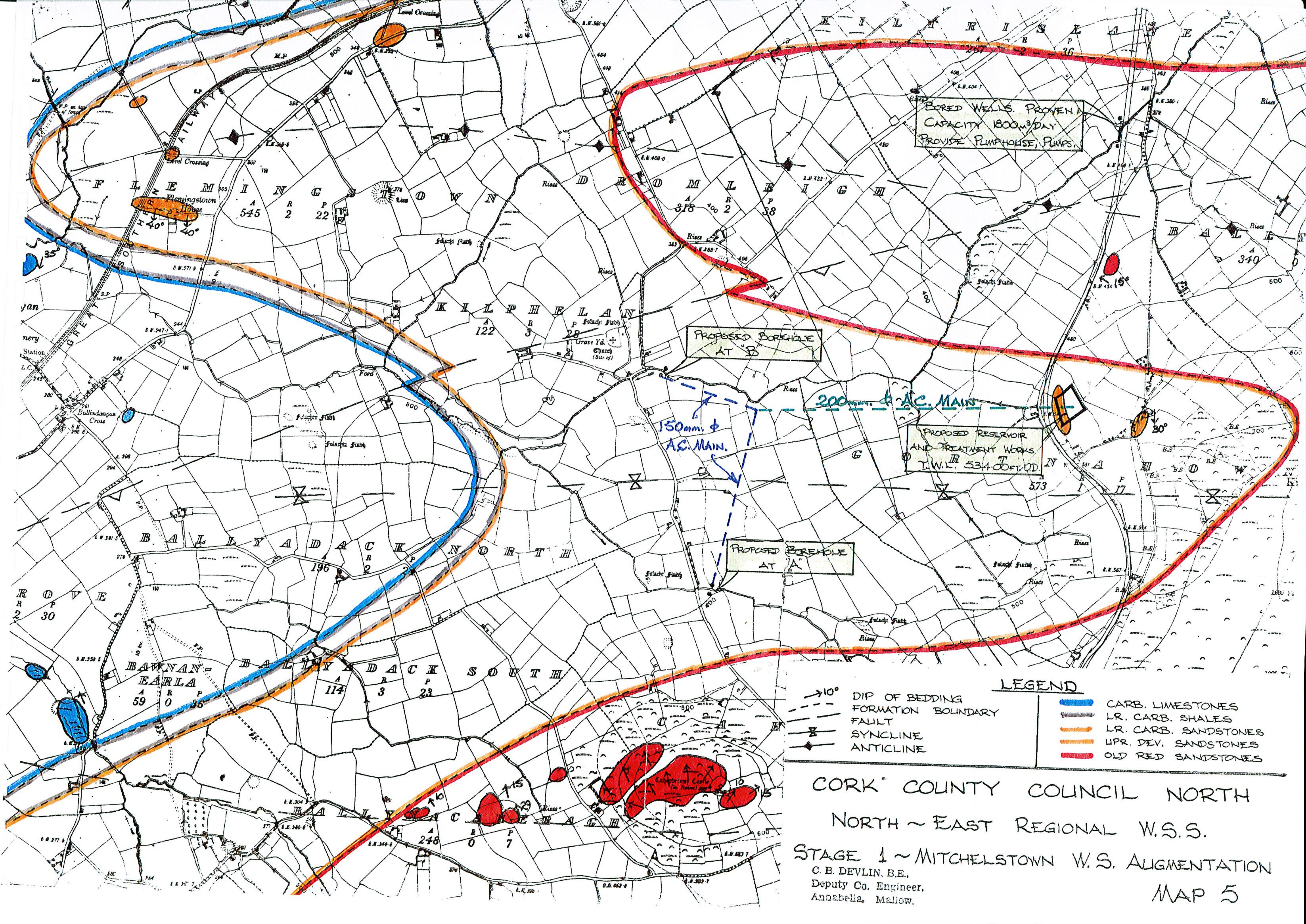
CORK COUNTY COUNCIL NORTH

NORTH ~ EAST REGIONAL W.S.S.

STAGE 1 ~ MITCHELSTOWN W.S. AUGMENTATION

C. B. DEVLIN, B.E.,
Deputy Co. Engineer,
Annabella, Mallow.

MAP 4.


BORED WELLS. PROVEN CAPACITY 1800m³/DAY PROVIDE PUMPHOUSE, PUMPS.
PROPOSED BOREHOLE AT "B"
200mm. ɸ A.C. MAIN
150mm. ɸ A.C. MAIN.
PROPOSED RESERVOIR AND TREATMENT WORKS T.W.L. 534.00ft O.D.
PROPOSED BOREHOLE AT "A"
FLEMINGSTOWN
Flemingstown House
DROMLEIGH
KILPHELAN
Grave Yd.
Church (Site of)
BALLYADACK NORTH
BALLYADACK SOUTH
BAWNAN-EARLA
GREAT SOUTHERN RAILWAY
Level Crossing
Ballindangan Cross
LEGEND
DIP OF BEDDING
FORMATION BOUNDARY
FAULT
SYNCLINE
ANTICLINE
CARB. LIMESTONES
LR. CARB. SHALES
LR. CARB. SANDSTONES
UPR. DEV. SANDSTONES
OLD RED SANDSTONES
CORK COUNTY COUNCIL NORTH
NORTH ~ EAST REGIONAL W.S.S.
STAGE 1 ~ MITCHELSTOWN W.S. AUGMENTATION
C. B. DEVLIN, B.E.,
Deputy Co. Engineer,
Annabella, Mallow.
MAP 5

A P P E N D I X 1

SPRINGS AT GLENATLUCKY

PARAMETER	SPRING 1	2	3	4
Appearance	Clear	Clear	Some S.S.	Clear
Temperature °C	10	10	10	10
Colour (Hazen)	/ 5	/ 5	/ 10	/ 5
PH	5.52	5.62	5.97	5.93
PHs	7.78	7.72	7.98	7.80
Langlier Index	- 2.26	- 2.10	- 2.01	- 1.87
Hardness	24	24	34	34
Temporary	12	16	30	22
Permanent	12	8	4	12
Alkalinity	12	16	30	22
Suspendid Solids	2	7	4	4
Orthophosphate	0.195	0.155	0.65	0.185
Ammonia	0.035	0.14	0.09	0.055
Nitrates	1.5	1.6	0.95	1.55
Nitrites	N.D.	0.003	N.D.	0.0025
Iron	N.D.	N.D.	N.D.	N.D.
Copper	N.D.	N.D.	N.D.	N.D.
Zinc	N.D.	0.01	N.D.	0.01
Total Count @ 37 °C	High	High	High	High
" " @ 22 °C	"	"	"	"
Total Coliforms	5	350	7	50
E Coli	5	250	7	50
Clostridium	+	-	+	+

Examination of the four springs leading to the reservoir show that the water from Glenatlucky is corrosive; soft; has high coliform counts, including the presence of E Coli. The orthophosphate levels are high leading to algal growth in the reservoir. As the reliable yield of this reservoir is only 650 m^3/day, it is evident that this supply is not suitable for the development of a modern waterworks.

CONSULT-US LTD.

..d Analysis
..ater and Effluent Testing
..iterature Searches

ANALYSTS AND TECHNICAL CONSULTANTS

BRIDGE HOUSE, GLANMIRE,
CO. CORK

Phone (021) 822288

General Consulting
Specialised Reagents

REPORT ON ANALYSIS OF WATER SAMPLE LABELLED ....Glenatlucky Reservoir....

Received on ....8/10/80.... Sampled on ....8/10/80.... Submitted by ....-....

Received from ....Cork County Council, Anabella, Mallow, Co. Cork.

Lab. Ref. No. 623 C

CHEMICAL RESULTS EXPRESSED IN MILLIGRAMS/LITRE (p.p.m.)

CONDUCTIVITY 102 μ siemens/cm

General Appearance	Satisfactory	Total Hardness (as $CaCO_3$)	32 mg/l
Colour	14 Hazen units	Temporary (Carbonate)	28 mg/L
pH	6.45	Permanent (Non-carbonate)	4 mg/l
Suspended Solids	negligable	Calcium	8.8 mg/l
Total dissolved solids	56 mg/l	Magnesium	
Albuminoid-N	0.02 mg/l	Copper	0.009 mg/l
Ammonia-N	0.02 mg/l	Iron (Dissolved)	0.107 mg/l
Nitrite-N	0.011 mg/l	Zinc	0.019 mg/l
Nitrate-N	1.2 mg/l	Manganese	0.014 mg/l
Chloride (as Cl)	12.0 mg/l	Lead	less than 0.01 mg/l
Sulphate (as SO_4)	5.0 mg/l	FREE CO_2	17.0 mg/l
Phosphate (as P)	15 μg/l	pHs	9.21
Total Alkalinity (as $CaCO_3$)	28 mg/l	LANGLIER INDEX	-2.76

BACTERIOLOGICAL

Standard Plate Count @ 21°C	1120/ml	Faecal Coliform	present/50 mls
Standard Plate Count @ 37°C	450/ml	Faecal Streptococci	
Total Coliform @ 37°C	present/50 mls	Salmonella	

REMARKS :

APPENDIX 3

Form No. 74

PHYSICAL AND CHEMICAL ANALYSIS OF WATER

J. J. BEHAN,
Public Analyst
Telephone: Cork (021) 966555 Ext. 246

Southern Health Board,
Public Analyst's Laboratory,
St. Finbarrs Hospital,
Cork.

18th April 1984

REPORT ON ANALYSIS OF A SAMPLE OF WATER MARKED Mitchelstown

Tap over sink

Received on 12/4/1984 Date of Sampling 12/4/1984

Submitted by Paula Bolster H.I.

Dr. P.B. O'Meara C.M.O.
Room 702
County Hall
CORK

Lab. Ref. No.
571/84

RESULTS IN MILLIGRAMS PER LITRE

Appearance: Clear

Turbidity (Formazin Units)	1.4	Colour (Hazen Units)	<5
Conductivity at 20° C	93 /uS/cm	Odour	
Ammoniacal Nitrogen (as N)	0.004	pH	6.62
Albuminoid Nitrogen (as N)	0.056	Langelier Index at 15° C	-2.4
Nitrite Nitrogen (as N)	<0.001	Langelier Index at 80° C	-1.4
Nitrate Nitrogen (as N)	3.0	Free Chlorine	None
Chlorides (as Cl^-)	16	Total Chlorine	None
Sulphates (as SO_4^{2-})	1.0	Free Carbon Dioxide (CO_2)	
Total Hardness (as $CaCO_3$)	40	Iron (Fe^{2+})	0.04
Total Alkalinity (as $CaCO_3$)	24	Zinc (Zn^{2+})	<0.02
Fluoride (F^-)	0.7	Copper (Cu^{2+})	0.03
Oxygen absorbed from permanganate solution in 4 hours at 27°C	1.2	Lead (Pb^{2+})	<0.02
		Manganese ~~Cadmium (Cd^{2+})~~	<0.02

REMARKS:- The Albuminoid Nitrogen level is high and indicates the presence of dissolved vegetable material. This results in high chlorine dosing to achieve a reasonable level of residual chlorine. In turn this usually results in off tastes and is the most likely cause of the complaint. Cleaning of the sand filters if such are used, could improve matters. Alga growth and breakdown is a possible cause of the problem. Treatment is difficult unless the reservoir can be cleaned. Filtration of the water through activated charcoal would solve the problem but this is an expensive procedure.

J.J. Behan

J.J. BEHAN
(Public Analyst)

APPENDIX 4

'Fishy' water sickens town

A DEPUTATION from Mitchelstown was received at County Hall yesterday by Mr. J. O'Regan, acting county engineer, prior to a meeting of the county council.

In a statement after the meeting, Mr. Michael Hayes, a deputation member, said he had impressed on Mr O'Regan the concern of the people in the southern half of the town at the quality of the water from the Glenatluckey reservoir.

The matter had been mentioned by him to the northern committee of the county council in Mallow last Monday, but the water still tasted foul, and it was sickening children and adults.

"Mitchelstown people are not," he said, "prepared to accept the statement that the water was up to E.E.C. standards and not injurious to health.

"The deputation had recommended that the Glanatluckey reservoir be closed down immediately, cleaned out and fenced in properly."

Mr. Hayes said that Mr O'Regan had agreed to a small deputation at the council offices in Mitchelstown on Thursday.

Cllr. Jerry Sheedy said that both he and Cllr. Dick Fitzgerald had been demanding that the problem be solved.

He said he had a motion before the northern committee on Monday last when the engineer had stated that the water was suitable for drinking and tests had shown it was not a health hazard.

But the people were not prepared to accept this with sickness now affecting the area.

The "fish taste" from the water made it undrinkable.

Cllr. Sheedy argued that private tests at four different laboratories indicated that in view of the high level of contamination, the water was unsuitable even when boiled.

The Mitchelstown deputation also included Dr. Jack Griffin, who said it was his opinion that the water was unsafe to drink and this was shown by the high level of sickness among adults and children after using it.

Cllr. Sheedy added that 500 signatures were handed to the county engineer and he had demanded that the supply be cut off.

The Glenatluckey reservoir should he said be cleaned out and a water supply sought from Mitchelstown Creameries until the problem is solved.

"The fact that the Mitchelstown branch of the Red Cross are now delivering water door to door from a truck supplied by Mitchelstown Creameries makes a laugh of the county council," added Cllr. Sheedy.

"As a water and sanctary authority it will not be tolerated."

Cllr. Dick Fitzgerald said there was serious concern at the taste and smell of the supply from the Glenatluckey reservoir.

He said it has been ongoing for several weeks now, and it was clearly unfit for domestic purposes. The public were worried that the matter had not been rectified, and indications were that the position could obtain for a long time to come.

Augmentation from the Mitchelstown Creamery supply would appear to be the only feasible course since, despite investigations and tests, no hope was offered of an early solution.

(CORK EXAMINER)

AP 5

CHEMICAL ANALYSIS

APPENDIX 5

APPENDIX 5

Well No.	1	1	1	1	1
Date Sampled	4/11/80	5/11/80	6/11/80	14/10/82	16/10/82
Appearance	O.K.	O.K.	O.K.	CLEAR	CLEAR
Colour	7H.U.	7H.U.	-	-	-
Conductivity	-	-	-	-	-
S.Solids	NONE	NONE	NONE	NONE	NONE
Total Dissolved Solids	200	200	179	-	-
pH	7.2	7.15	7.26	7.31	7.17
pHs	8.05	-	7.86	7.93	7.82
Alkalinity	124	120	120	139	137
Total Hardness	140	140	140	-	-
Non Carbonate Hardness	16	20	20	-	-
Ammonia	.11	.05	.03	ND	ND
Nitrates	1.2	.7	1.0	4.8	5.1
Nitrites	.005	.005	.003	ND	ND
Chlorides	15	16	15	-	-
Sulphates	5.5	5.0	4	-	-
$O-Po_4$	.02	.02	.02	0.025	0.035
Fluoride	-	-	-	-	-
Aluminium	-	-	-	-	-
Iron (Dissolved)	.42	.40	.33	-	-
Manganese	.03	.015	.012	-	-
Lead	.02	.02	.01	-	-
Copper	.01	.01	.01	-	-
Zinc	.09	.09	.09	-	-

APPENDIX 5

Well No	1	1	1	1	1
Bacteriological	4/11/80	5/11/80	6/11/80	14/10/82	16/10/82
Std.Plate Count					
@ 20°C	70	14	48	60	-
Coliform	0	0	0	0	-
E.Coli	0	0	0	0	-
E.Strep	0	0	0	0	-

APPENDIX 5

Well No	2	2	2	2
Date Sampled	7/10/82	9/10/82	14/10/82	16/10/82
Appearance	CLEAR	CLEAR	CLEAR	CLEAR
Colour				
Conductivity	36			
S. Solids	Nil		1	0
Total Dissolved Solids				
pH	6.66	6.87	7.53	6.70
phs	7.42	7.77	7.82	7.90
Alkalinity	96	93	95	90
Total Hardness	119	116	118	117
Non Carbonate Hardness	23	23	23	27
Ammonia	ND	ND	ND	ND
Nitrates	5.6	4.0	6.2	6.2
Nitrites	ND	ND	ND	ND
Chlorides	20.5			
Sulphates				
$O\text{-}Po_4$	0.03	0.026	0.03	0.025
Fluoride				
Aluminium				
Iron (Dissolved)	ND	0.05		
Manganese	ND	ND		
Lead	ND	ND		
Copper	ND	ND		
Zinc	ND	ND		

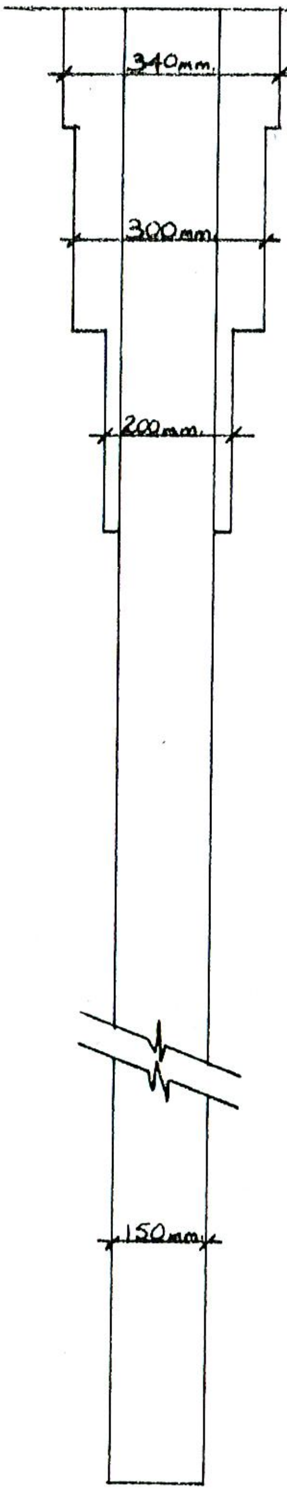
APPENDIX 5

Well No.	2	2	2	2
Bacteriological	7/10/82	9/10/82	14/10/82	16/10/82
Std. Plate Count @ 28°C & 37°C			32 & 3	N/A
Coliform	0		0	
E. Coli	0		0	
E. Strep	0		0	

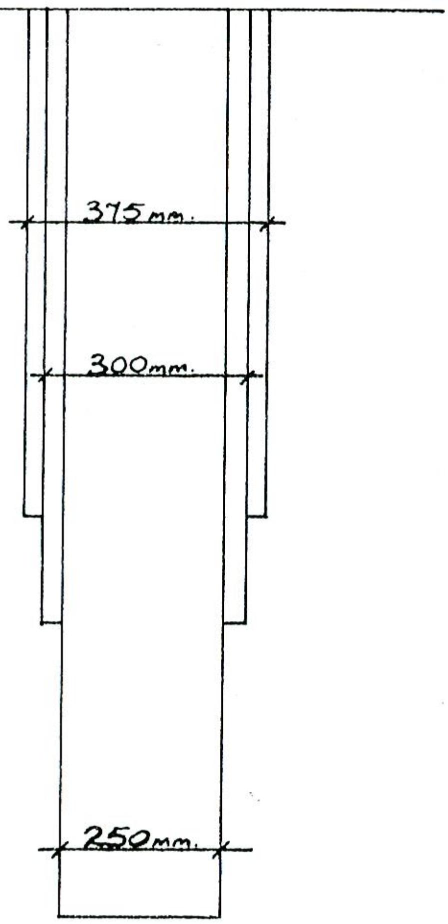
APPENDIX 6

DETAILS OF WELL CONSTRUCTION

BORE No. 1.



BORE No. 2.



BORE No. 1.

340mm.	I.D. BLANK STEEL CASING	TO 3·96M.	B.G.L.
300mm.	I.D. BLANK STEEL CASING	TO 10·67M.	B.G.L.
200mm.	I.D. BLANK STEEL CASING	TO 17·38M.	B.G.L.
150mm.	OPEN HOLE	TO 62·50M.	B.G.L.

BORE No. 2.

375mm.	I.D. BLANK STEEL CASING	TO 17·07M.	B.G.L.
300mm.	I.D. BLANK STEEL CASING	TO 20·73M.	B.G.L.
300mm.	OPEN HOLE	TO 30·49M.	B.G.L.
250mm.	I.D. SLOTTED PLASTIC LINER	TO 30·49M.	B.G.L.

Geological Log of Test Well 1

Footage From	To	Description.
0'	10'	Made up ground - gravel and rock fill.
10'	18'	Hard packed gravel.
18'	28'	Fine sands.
28'	68'	1" down gravels interbedded with fine silty sand. The rock fragments are mainly sandstone with minor limestones.
68'	80'	Pale pink coarse grained recrystallised sandstone with minor layers of fine grained purple sandstone.
80'	95'	Pale pink coarse grained recrystallised sandstone interbedded with fine grained purple sandstone.
95'	110'	Pale pink coarse grained recrystallised sandstone with traces of limonite staining on surfaces. Few fragments of green sandstone.
110'	120'	Pale pink coarse grained recrystallised sandstone interbedded with purple fine grained sandstone.
120'	140'	Purple fine grained recrystallised sandstone.
140'	145'	Pale pink coarse grained recrystallised sandstone interbedded with purple fine grained sandstone.
145'	155'	Pale pink coarse grained recrystallised sandstone with minor purple fine grained sandstone.

Footage		Description
From	To	
155'	165'	Purple fine grained recrystallised sandstone with minor green sandstone fragments.
165'	175'	Pale pink coarse grained recrystallised sandstone interbedded with purple fine grained sandstone.
175'	185'	Purple fine grained recrystallised sandstone.
185'	205'	Pale pink coarse grained recrystallised sandstone interbedded with purple fine grained sandstone.
	205'	End of Hole.

....

APPENDIX 7

GEOLOGICAL LOG OF TEST WELL NO. 2.

Footage		Description
From	To	
0	50	boulder clay - fragments of sandstone and limestone in a red clay matrix.
50	55	sandy boulder clay - mainly red sandstone rock fragments in the boulder clay.
55	65	broken clayey red sandstone - rock head.
65	80	very fine grained recrystallised purple sandstone - the sandstone is well cemented.
80	85	Medium grained, recrystallised, purple sandstone with traces of red shale.
85	100	medium to coarse grained sandstone.
	100	end of hole.

TABLE 1

SCHEME	Estimated Demand	Type of Source	Reliable Yield of Source	Storage Capacity Available
	m^3/day		m^3/day	m^3
CASTLETOWNROCHE	1,395	Spring	3,068	1,318
BUTTEVANT/ DONERAILE	1,818	Spring	5,279	1,046
KILDORRERY	263	Bored Well	455	100
BALLYENIHAN/ DERRYVILLANE	739	Spring	1,370**	518
MITCHELSTOWN	2,160	Stream Impound. Res.	2,160	1,182
GLANWORTH	493	Spring	1,370**	182
GRANGE/ JOHNSTOWN	536	Stream	536	Nil

** Spring Source at Ballykenly.

....

MITCHELSTOWN WATER SUPPLY

EVALUATION OF GROUND-WATER RESOURCES

REPORT ON PUMP TEST ON

WELLS NO 1 AND 2

FOR

CORK COUNTY COUNCIL

GEOEX LIMITED

GROUND-WATER CONSULTANCY DIVISION

....

October 1982

1. Introduction.

Following the Drilling and Testing of Well No. 1 and the drilling of Well No. 2 a difference of elevation of the standing water level in each well was noted (2.6M). Well 1 and Well 2 are situated 58.3M apart and are seperated by a small stream. This suggested that the Hydraulic Continunity between the two wells was very slight.

It was therefore decided to test both wells, first by testing Well No. 2 and observing the effect on Well No. 1 and then by testing both well together. The results of this testing and recommendation on further work is described in the following report.

The testing confirmed our projections that both wells could be pumped independently without significant interference with each other. The joint yields of the wells is in the order of 16,600 gph and if these wells were pumped continuously for 24 hours they would produce 80% of the projected additional water requirement for Mitchelstown.

....

. . . .

MITCHELSTOWN WATER SUPPLY

EVALUATION OF GROUND-WATER

RESOURCES

REPORT ON PUMP TEST ON

WELLS NO 1 AND 2

FOR

CORK COUNTY COUNCIL

GEOEX LIMITED

GROUND-WATER CONSULTANCY DIVISION

. . . .

October 1982

CONTENTS

....

2. Well Construction and Previous Testing

The construction of the two wells is as follows:-

WELL NO. I.

15" I.D. Blank Steel Casing to 13ft. B.G.L.

12" I.D. Blank Steel Casing to 35ft. B.G.L.

8" I.D. Blank Steel Casing to 57ft. B.G.L.

6" I.D. Blank Steel Casing to 68.5ft. B.G.L.

Open Hole at 6" diameter to 205ft.

The standing water level was 1.98M below the top of the casing and the cut saturated section of sandstone in this well is 136.5ft.

WELL NO. 2.

15" I.D. Blank Steel Casing to 56ft. B.G.L.

12" I.D. Blank Steel Casing to 68ft. B.G.L.

10" I.D. slotted plastic liner to 100ft. B.G.L.

This well was artesian (i.e. water flowed over the top of the casing) and the cut saturated section in this well was 32ft.

A pump test was carried out on Well No.1 in November 1980 and a yield of 11,000 gph was established with a draw-down of 35ft. The basic difference between Well No. 1 and Well No. 2 is that Well No. 1 has an additional 101.5ft of saturated cut section. Saturated cut section is the length of well through which ground-water can enter the well.

3. Pump Tests on Wells No. 1 and No. 2.

The programme of testing that was carried out is as follows:-

1. 6/10/82 to 14/10/82 Well No.2 Pumping Well No. 1 Observing.

2, 14/10/82 to 18/10/82 Well No. 2 and Well No. 1 Pumping.

3. 18/10/82 to 20/10/82 Recovery Measurements.

The pump in Well No 1 was an electrically driven mono pump the top of the pump being set at 25.60M (below top of casing) and pump intake is at 27.43 metres. The pump in Well No. 2 was at 20 h.p. submersible pump wun by an electric generator. The top of the pump was set at 25.6M (below top of casing) and the pump intake was at 26.82M.

The water levels in the wells were measured with an electric water level indicator and the pump discharge was measured using in-line flow metres and checked occasionally into measured containers. The draw-down measured and pump discharge was measured by the contractor and checked by the Councils own staff. The data was presented as depth of water from the top of the liner and the readings on the accumulater flow meter at varying times. These had to be calculated to actual draw-down levels and the pump discharge to gallons per minute. This interpreted data is shown in Appendix 1 as actual draw-down in metres and pump discharge is gallons per minute.

When the data is examined in its new format a number of comments should be made. The first phase of the pumping involves the pumping of No. 2 well and observing Well No.1. The draw-down levels were not recorded very systematically for the first 80 minutes in Well No.1. After the first hour a more systamatic approach was taken. In the records of the pumping well, Well No. 2 the pump discharge was not recorded for the first 80 minutes. This unfortunately left us with no usable data for the first important part of the pump test. The rate of flow as calculated from the accumulater meter showed considerable variation over short periods of time which should have effected the draw-down but did not. This would suggest that there was problems with the meter readings and while this was checked at irregular intervals by a measured container, with results that correspond to within measuring error (5%) the end result appears to show considerable variation in pump discharge. We must assume that there was some error i.e. the meter was not actually read at the stated time or (b) a faulty meter.

To compensate in as far as possible for errors in discharge readings it was decided to average the recordings over as long a time of continuous pumping at reported constant pump rates as possible. This basically is broken down to two periods as follows:-

WELL NO. 2 - 1st.PHASE PUMPING

Elapsed Time 90 - 6825mins Q = 123gpm

(meter checked by Council at 121gpm)

Elapsed Time 7035 - 11235mins Q = 126gpm

On examining Table 2 of Elapsed Time - Drawdown curve it can be seen that stabilisation was not achieved for the required 72 hours although after 1000 minutes of elapsed time there are strong indications that stabilisation is about to occur. It would be best to assume a pump discharge of around 110 - 120gpm (6600 - 7200gph) with a draw-down of almost 24 metres. It is interesting at this time to compare the results with the projected yield for this well. In the previous report on this well we had suggested a specific capacity of 74.88gph/ft.D.D. while in fact the actual specific capacity from the well was 91.4gph/ft.D.D. As we are dealing with a 12" diameter well (well screen will not effect the diameter in this case) the yield is 10% higher than would be expected from a 6" diameter well and hence the permeability in Well No. 2 is approximately 10% higher than in Well No. 1.

While Well No. 2 was being pumped, the draw-down was being observed in Well No. 1 and this has been plotted on semi log graph paper (Table 1). The 24M draw-down in Well No. 2 produced a draw-down of 2.1M in Well No. 1.

For the second stage of the pump test a pump was installed in the No. 1 Well and both No. 1 and No 2 Wells were pumped together. This data on draw-down and pump discharge was recorded in the same way as for the first phase and the results were then converted to draw-down (actual) and pumping rate in gpm. This data is shown in Appendix 1 (Table 3 & 4)

In Well No. 1 it can be seen that the pump discharge varies - due at times to actual variations caused by closing the valve and at other times by meter reading variations. The variation in pump discharge readings is calculated over longer periods in an attempt to obtain a better average reading. The average readings are as follows:

WELL NO. 1 - PHASE 2 PUMPING

Elapsed Time (Mins)	PUMP DISCHARGE RATE
11 - 160	180gpm
48	200gpm (meter checked)
103	171gpm (meter checked)
111	173gpm (meter checked)
220 - 2525	173gpm
268	197gpm (meter checked)
1429	191gpm (meter checked)
1740	197gpm (meter checked)
2835 - 3556	171gpm
2835	187gpm (barrel checked

The readings above at specific elapsed times are spot checks carried out by the Council at the time stated.

It can be seen from the graph of draw-down and elapsed time (Table 4) that while the well did not stabilise, it showed definite stages of approaching stabilisation. There are breaks in the draw-down curve which reflect not only changes in the pump discharge in the well but also variation in pump discharge in Well No. 2.

The actual discharge of the pump is not clear, the average readings tend to be lower than spot readings. The only option is to be conservative and use a pumping rate of 170gpm i.e. 10,200gpm with a draw-down of about 16M. The first pump test, which was carried out just after the well was drilled, gave a yield of 11280gph with a draw-down of 10.6M. The variation between the original pump test on this well is that the 1980 test gave a specific capacity of 322gph/ft.D.D. while with Well No. 2 pumping it is 196gph/ft. D.D. There is still room for further draw-down in Well No.1 of about 2.5M which should allow for the pump discharge to be increased somewhat.

The second phase of the pump test was carried out on Well No. 2. The pump was not stopped from the first phase. The problem with the variation on the meter readings of pump discharge still occur and as previously we have had to average them.

Well NO. 2. | Phase 2 Pumping

Elapsed Time	Pump Discharge gpm
0 - 22mins	122gpm
22 - 40mins	127gpm
22mins	101gpm est.
26mins	130gpm est.
32mins	120gpm est.
40 - 480mins	110gpm
56mins	119gpm (meter checked)
173mins	117gpm (meter checked)
273mins	112gpm (Barrel) 115gpm (meter checked)
480 - 2760mins	117gpm
1435	119gpm (meter checked)
1439	116gpm (Barrel)
2757	114gpm (meter checked)
2786 - 5592mins	110gpm
4452	115gpm (meter checked)

The readings above at specific elapsed times are spot checks carried out by the Council at the time stated.
It can be seen from the graph of draw-down v elapsed time Table 3 that the well did not properly stabilise. It was not far from stabilisation but it would appear that apart fr the problem of what the pump discharge should be, there is not a proper relationship between the pump discharge and

draw-down towards the end of the test. This cannot be related to variations in pump discharge in Well No.1 either. When the average pump discharge increases from 110 to 117gpm the draw-down decreases by 3 metres, with an increase in pump discharge the draw-down should increase. We therefore have doubts about draw-down and pump discharge reading in this part of the test. The average pump readings are sometimes higher, sometimes lower, by a few gph than the spot checks. We would use an average pump discharge of 110gpm with a draw-down of 25M. It would appear that the main effect that the pumping of Well No. 1 had on Well No. 2 was to increase the draw-down by about 1M for a discharge of 6,600gpm. This would suggest that the % of recharge that Well No. 1 is obtaining from the direction of Well No. 2 is greater then the % of recharge that Well No. 2 is receiving from the direction of Well No. 1. The recovery data was recorded for Well No. 1 (Table 5). However as the dipper was stuck it was not possible to obtain more than a few readings. It is doubtful if any reliance can be put on these figures except to say that it did recover at a somewhat faster rate than did Well No. 2. The recovery curve of Well No. 2 (Table 6) is typical of what would be expected in the sandstone aquifer.

Water samples for chemical and bacteriological analysis were also collected. These analysis are shown on Tables 8 and 9 as well as the analysis of samples collected from Well No. 1 in November 1980. The water quality is good on both wells and there is only minor differences between the two wells. The water quality over the two year period in Well No. 1 shows an increase in nitrate and alkalinity but it must be kept in mind that two different laboratories were involved, one in 1980 and the Councils own laboratory in 1982 and the analyitical methods may not correspond.

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Conclusions and Recommendations

The standard of recording of the observations by the contractor was poor during this pump test. It was not up to the standard that would allow us to make precise statements regarding well yields but it allows us to make reasonable estimates. There is little point in placing a pump in a well and running it without making accurate observations of pump discharge and draw-down.

The results of the pump test correspond to previous predictions as to what should have occured. The interference between the two wells was minimal and they can be both pumped together without one taking the water from the other well.

With both wells pumping Well No.1 yielded 10,000gph with a draw-down of 16M and Well No. 2 produced 6,600gph with a draw-down of 25M. The total yield of the site is 16,600gph, almost 400,000gpd which is 80% of the required additional water from Mitchelstown i.e. 500,000gpd.

The next phase of the development is to obtain the additional 100,000gpd. The most attractive option is to obtain the water from the existing site i.e. by deepening Well No. 2 by 100ft. It is possible that it could be done without removing the 10" plastic liner, by drilling through it with an 8" or 9" bit.

Well No. 1 should not be interfered with as if the

6" liner is removed then it is very likely that the well will collapse. If both the wells could be pumped into a sump on site then it should be possible to use Well No. 1 as it is presently constructed - alternatively a well could be drilled beside Well No. 1. The construction of a small sump on site with a pump in it would do away with the necessity of two rising mains to the reservoir.

It would also be advisable to develop one of the other sites as recommended in our Phase 2 report on Mitchelstown Water Supply. One well should be drilled on one of these sites astoproduce the 500,000gpd from the existing site would require that the pumps be working for 24hours per day. This additional site would also further evaluate the aquifer and would also be a reserve supply should there be an requirement for new industry or indeed for the existing industry if they had problems with their own water supplies.

The existing industries in Mitchelstown depend on their own well for their water supply. They are extracting large quantities of water from the limestone aquifer and if the aquifer was to be polluted they would be in serious trouble. At this time the Council have almost their projected requirement proved and they could make provision for stand by facilities for the local industry if the local industry required it and were willing to fund it.

The budget costing of the various works recommended above are as follows:-

1.	Deepening Well No. 2 by 100ft.	=	£600.00
2.	Drilling of new well beside Well No. 1.	=	£4,000 - £4,500
3.	Drilling of Well on new site plus land purchase	=	£4,000 - £4,500
4.	Testing of New Well at original Site.	=	£4,000 - £4,500

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APPENDIX I

TEST DATA

PUMPING TEST RECORD SHEET

SEARCH AREA LOCATION & No: MITCHELSTOWN 6" BORE OBSERVATION NO. I.

HOLE DIA. & DEPTH: 6" 62.48 DEPTH OF PERMANENT LINER: 20.8M

HOLE DATUM: - LEVEL:

RATE OF FLOW, COMMENCEMENT OF PHASE: - FINISH OF PHASE: -

COMMENCING DATE: 6 - 10 - 1982 FINISHING DATE: 13 - 10 - 1982

NOTES: NO. I. BORE - OBSERVING NO. 2 BORE PUMPING
X DRAWDOWN NOT RECORDED AS PUMP BEING INSTALLED
XX PUMP DISCHARGE REDUCED
XXX PUMP STOPPED.

READINGS FOR *OBSERVATION/[illegible] HOLE

*DRAWDOWN/[illegible]

Date	Lapsed time (mins)	G.M.T.	DRAW DOWN Water Level M	Rate of Flow	Date	Lapsed time (mins)	G.M.T.	DRAW DOWN Water Level M	Rate of Flow
Standing Water Level: 1.98				GPM					GPM
Starting time: 15.15									
6/10	0.5	-	-	-	6/10	26	-	-	-
6/10	1.0	-	-	-	6/10	28	-	-	-
6/10	1.5	-	-	-	6/10	30	-	-	-
6/10	2.0	-	-	-	6/10	32	-	-	-
6/10	2.5	-	-	-	6/10	36	-	-	-
6/10	3.0	-	-	-	6/10	40	15.55	0.91	-
6/10	3.5	-	-	-	6/10	44	-	-	-
6/10	4.0	-	-	-	6/10	48	16.03	0.97	-
6/10	4.5	-	-	-	6/10	52	16.07	1.00	-
6/10	5	15.20	0.10	-	6/10	56	-	-	-
6/10	6	-	-	-	6/10	60	16.15	1.07	-
6/10	7	-	-	-	6/10	65	-	-	-
6/10	8	-	-	-	6/10	70	-	-	-
6/10	9	-	-	-	6/10	75	-	-	-
6/10	10	15.25	0.35	-	6/10	80	16.35	1.11	-
6/10	11	-	-	-	6/10	90	16.45	1.19	-
6/10	12	-	-	-	6/10	100	16.55	1.21	-
6/10	14	-	-	-	6/10	110	17.05	1.23	-
6/10	16	-	-	-	6/10	120	17.15	1.25	-
6/10	18	-	-	-	6/10	140	17.35	1.28	-
6/10	20	-	-	-	6/10	160	17.55	1.32	-
6/10	22	-	-	-	6/10	180	18.15	1.36	-
6/10	24	-	-	-	6/10	200	18.35	1.39	-

*Delete as appropriate

SEARCH AREA LOCATION & No: MITCHELSTOWN 6" BORE NO. I. OBSERVATION.

READINGS FOR *OBSERVATION/~~PRODUCTION~~ HOLE
*DRAWDOWN/~~RECOVERY~~

Date	Lapsed time (mins)	G.M.T.	Water Level	Rate of Flow	Date	Lapsed time (mins)	G.M.T.	Water Level	Rate of Flow	
6/10	230	19.05	1.41	-	8/10	2990	17.05	1.86	-	
6/10	270	19.45	1.44	-	8/10	3240	9.15	1.88	-	
6/10	310	20.25	1.46	-	9/10	3490	1.25	1.90	-	
6/10	350	21.05	1.48	-	9/10	3740	5.35	1.91	-	
6/10	390	21.45	1.50	-	9/10	3990	9.45	1.91	-	
6/10	430	22.25	1.51	-	9/10	4315	15.10	-	-	
6/10	470	23.05	1.54	-	9/10	4495	18.10	1.92	-	
7/10	530	0.05	1.56	-	10/10	5370	8.45	1.97	-	
7/10	590	1.05	1.58	-	10/10	5875	17.10	1.97	-	
7/10	650	2.05	1.60	-	11/10	6795	8.30	1.97	-	
7/10	710	3.05	1.62	-	11/10	6825	9.00	1.97	-	
7/10	770	4.05	1.63	-	11/10	6960	11.15	0.94	-	XXX
7/10	830	5.05	1.63	-	11/10	6967	11.22	-	-	
7/10	890	6.05	1.64	-	11/10	6977	11.32	0.91	-	
7/10	950	7.05	1.65	-	11/10	7005	12.00	0.85	-	
7/10	1010	8.05	1.66	-	11/10	7020	12.15	0.82	-	
7/10	1050	8.45	1.66	-	11/10	7035	12.30	-	-	
7/10	1080	9.15	1.67	-	11/10	7065	13.00	-	-	
7/10	1110	9.45	1.68	-	11/10	7095	13.30	1.73	-	
7/10	1130	10.05	1.68	-	11/10	7125	14.00	1.81	-	
7/10	1170	10.45	1.69	-	11/10	7155	14.30	1.89	-	
7/10	1230	11.45	1.70	-	11/10	7215	15.30	1.94	-	
7/10	1250	12.05	1.70	-	11/10	7275	16.30	1.97	-	
7/10	1290	12.45	1.70	-	11/10	7370	18.05	2.02	-	
7/10	1350	13.45	1.70	-	12/10	7725	00.00	2.07	-	
7/10	1390	14.25	1.72	-	12/10	8165	07.20	2.08	-	
7/10	1410	14.45	1.72	-	12/10	8235	08.30	2.08	-	
7/10	1470	15.45	1.72	-	12/10	8295	09.30	2.08	-	
7/10	1490	16.05	1.73	-	12/10	8355	10.30	2.08	-	
7/10	1530	16.45	1.72	-	12/10	8415	11.30	2.08	-	
7/10	1610	18.05	1.75	-	12/10	8475	12.30	2.08	-	
7/10	1730	20.05	1.76	-	12/10	8535	13.30	2.08	-	
7/10	1850	22.05	1.77	-	12/10	8595	14.30	2.08	-	
8/10	1970	00.05	1.77	-	12/10	8655	15.30	2.08	-	
8/10	2090	02.05	1.77	-	12/10	8715	16.30	2.08	-	
8/10	2290	05.25	1.80	-	12/10	8895	19.30	2.08	-	
8/10	2475	08.30	1.82	-	13/10	9165	00.00	2.08	-	
8/10	2490	08.45	1.82	-	13/10	9645	08.00	2.08	-	
8/10	2535	09.30	1.82	-	13/10	9675	08.30	2.08	-	
8/10	2595	10.30	1.84	-	13/10	9735	09.30	2.08	-	
8/10	2655	11.30	1.84	-	13/10	9795	10.30	2.08	-	
8/10	2715	12.30	1.84	-	13/10	9855	11.30	2.08	-	
8/10	2740	12.55	1.85	-	13/10	9915	12.30	2.08	-	
8/10	2775	13.30	1.84	-	13/10	9975	13.30	-	-	X
8/10	2835	14.30	1.85	-	13/10	10035	14.30	-	-	
8/10	2895	15.30	1.85	-	13/10	10095	15.30	-	-	
8/10	2955	16.30	1.86	-	13/10	10155	16.30	-	-	
8/10	2985	17.00	-	-						

P U M P I N G   T E S T   R E C O R D   S H E E T

SEARCH AREA LOCATION & No: MITCHELSTOWN 10" BORE NO 2 PUMPING

HOLE DIA. & DEPTH: 10" BORE (NO.2) 30.4M DEPTH OF PERMANENT LINER: 20.72M

HOLE DATUM: LEVEL:

RATE OF FLOW, COMMENCEMENT OF PHASE: FINISH OF PHASE:

COMMENCING DATE: 6 - 10 - 1982 FINISHING DATE: 14 - 10 - 1982

NOTES: NO 2 BORE PUMPING
X READING IN DOUBT - PROBE NEAR TOP OF PUMP
XX PUMP DISCHARGE REDUCED
XXX METER INSTALLED
XXXX BARREL READING (Co.Co.) 112.3gpm (METER 102gpm)
XXXXX PUMP STOPPED 9.38 - STARTED 12.15 - METER STARTED 12.30.

READINGS FOR *~~OBSERVATION~~/PRODUCTION HOLE

*DRAWDOWN/~~RECOVERY~~

	Date	Lapsed time (mins)	G.M.T.	DRAW DOWN ~~Water Level~~ M	Rate of Flow	Date	Lapsed time (mins)	G.M.T.	Water Level	Rate of Flow	
	Standing Water Level: 0.00				GPM					GPM	
	Starting time: 15.15										
	6/10	0.5	15.155	6.20	?	6/10	26	15.41	23.10	?	
	6/10	1.0	15.160	11.20	?	6/10	28	15.43	22.68	?	
	6/10	1.5	15.165	13.95	?	6/10	30	15.45	22.20	?	
	6/10	2.0	15.170	16.20	?	6/10	32	15.47	21.88	?	
	6/10	2.5	15.175	17.80	?	6/10	36	15.51	21.61	?	
	6/10	3.0	15.180	19.72	?	6/10	40	15.55	21.52	?	
	6/10	3.5	15.185	20.98	?	6/10	44	15.59	21.51	?	
	6/10	4.0	15.190	21.55	?	6/10	48	16.03	21.52	?	
	6/10	4.5	15.195	22.85	?	6/10	52	16.07	21.57	?	
	6/10	5	15.20	23.88	?	6/10	56	16.11	21.65	?	
X	6/10	6	15.21	25.42	?	6/10	60	16.15	21.75	?	
X	6/10	7	15.22	25.42	?	6/10	65	16.20	21.76	?	
X	6/10	8	15.23	25.42	?	6/10	70	16.25	21.76	?	
X	6/10	9	15.24	25.42	?	6/10	75	16.30	21.33	?	
X	6/10	10	15.25	25.42	?	6/10	80	16.35	21.09	?	
	6/10	11	15.26	25.42	?	6/10	90	16.45	21.12	127	XXX
	6/10	12	15.27	25.42	?	6/10	100	16.55	21.30	127	
	6/10	14	15.29	25.42	?	6/10	110	17.05	21.50	127	
X	6/10	16	15.31	25.30	?	6/10	120	17.15	21.58	127	
	6/10	18	15.33	24.92	?	6/10	140	17.35	21.82	127	
	6/10	20	15.35	24.65	?	6/10	160	17.55	21.83	127	
	6/10	22	15.37	24.31	?	6/10	180	18.15	21.97	127	
	6/10	24	15.39	24.00	?	6/10	200	18.35	22.60	127	

*Delete as appropriate

PUMPING TEST RECORD SHEET CONTINUED

SEARCH AREA LOCATION & No: MITCHELSTOWN 10" BORE (NO 2) PUMPING

READINGS FOR *~~OBSERVATION~~/PRODUCTION HOLE

*DRAWDOWN/~~RECOVERY~~

Date	Lapsed time (mins)	G.M.T.	DRAW DOWN Water Level M	Rate of Flow GPM	Date	Lapsed time (mins)	G.M.T.	DRAW DOWN Water Level M	Rate of Flow GPM	
6/10	230	19.05	22.56	127	8/10	2990	17.05	23.65	102	
6/10	270	19.45	22.59	127	8/10	3240	9.15	23.74	118	
6/10	310	20.25	22.67	127	9/10	3490	1.25	23.78	126	
6/10	350	21.05	22.72	127	9/10	3740	5.35	23.76	119	
6/10	390	21.45	22.91	127	9/10	3990	9.45	23.62	126	
6/10	430	22.25	22.91	127	9/10	4315	15.10	-	124	(121)
6/10	470	23.05	23.12	201	9/10	4495	18.10	23.51	121	
7/10	530	0.05	23.22	80	10/10	5370	8.45	24.06	122	
7/10	590	1.05	23.30	123	10/10	5875	17.10	23.28	121	
7/10	650	2.05	23.28	138	11/10	6795	8.30	23.71	122	
7/10	710	3.05	23.24	121	11/10	6825	9.00	24.06	123	XXXXX
7/10	770	4.05	23.15	121	11/10	6966	11.15	1.00	?	
7/10	830	5.05	23.02	115	11/10	6967	11.22	0.96	?	
7/10	890	6.05	22.98	145	11/10	6977	11.32	-	?	
7/10	950	7.05	22.95	98	11/10	7005	12.00	0.89	?	
7/10	1010	8.05	23.02	131	11/10	7020	12.15	?	?	
7/10	1050	8.45	NR	122	11/10	7035	12.30	?	?	
7/10	1080	9.15	NR	123	11/10	7065	13.00	22.15	136	
7/10	1110	9.45	NR	120	11/10	7095	13.30	21.91	136	
7/10	1130	10.05	23.14	105	11/10	7125	14.00	22.40	116	
7/10	1170	10.45	23.37	137	11/10	7155	14.30	22.32	136	
7/10	1230	11.45	23.37	123	11/10	7215	15.30	27.76	120	
7/10	1250	12.05	23.34	100	11/10	7275	16.30	22.43	131	
7/10	1290	12.45	23.36	135	11/10	7370	18.05	23.11	125	
7/10	1350	13.45	23.35	125	12/10	7725	00.00	23.62	127	
7/10	1390	14.25	23.35	125	12/10	8165	7.20	24.02	130	
7/10	1410	14.45	23.39	125	12/10	8225	8.30	24.10	130	
7/10	1470	15.45	23.38	123	12/10	8295	9.30	24.80	100	
7/10	1490	16.05	23.35	100	12/10	8355	10.30	24.50	130	
7/10	1530	16.45	23.24	140	12/10	8415	11.30	23.85	120	
7/10	1610	18.05	23.35	105	12/10	8475	12.30	23.69	130	
7/10	1730	20.05	23.35	127	12/10	8535	13.30	23.90	140	
7/10	1850	22.05	23.35	120	12/10	8595	14.30	23.77	113	
8/10	1970	00.05	23.29	127	12/10	8655	15.30	23.89	126	
8/10	2090	2.05	23.27	127	12/10	8715	16.30	23.88	125	
8/10	2290	5.25	23.13	122	12/10	8895	19.30	23.98	127	
8/10	2475	8.30	24.24	124	13/10	9165	00.00	23.87	125	
8/10	2490	8.45	22.68	93	13/10	9645	8.00	23.25	126	
8/10	2535	9.30	23.57	131	13/10	9675	8.30	23.93	160	
8/10	2595	10.30	23.65	123	13/10	9735	9.30	23.96	100	
8/10	2655	11.30	23.59	125	13/10	9795	10.30	23.94	123	
8/10	2713	12.30	23.57	121	13/10	9855	11.30	23.87	136	
8/10	2740	12.55	23.47	124	13/10	9915	12.30	23.79	120	
8/10	2775	13.30	23.64	125	13/10	9975	13.30	23.76	126	
8/10	2835	14.30	23.64	121	13/10	10035	14.30	23.84	126	
8/10	2895	15.30	23.63	121	13/10	10095	15.30	23.69	125	(120B)
8/10	2955	16.30	23.73	125	13/10	10155	16.30	23.72	126	
XXX 8/10	2985	17.00	-	123						

(110B)

SEARCH AREA LOCATION & No: MITCHELSTOWN 10" BORE (NO.2) PUMPING

READINGS FOR *~~OBSERVATION~~/PRODUCTION HOLE

*DRAWDOWN/~~RECOVERY~~

Date	Lapsed time (mins)	G.M.T.	Water Level	Rate of Flow	Date	Lapsed time (mins)	G.M.T.	Water Level	Rate of Flow
14/10	11115	8.30	23.88	126					
14/10	11175	9.30	23.85	105					
14/10	11235	10.30	24.08	120					

P U M P I N G   T E S T   R E C O R D   S H E E T

SEARCH AREA LOCATION & No: MITCHELSTOWN NO 2 (10") PUMPING (PHASE 2)

HOLE DIA. & DEPTH: 10" 30.4M   DEPTH OF PERMANENT LINER: 20.72M

HOLE DATUM: LEVEL:

RATE OF FLOW, COMMENCEMENT OF PHASE: FINISH OF PHASE:

COMMENCING DATE: 14 - 10 - 1982   FINISHING DATE: 18 - 10 - 1982

NOTES: PHASE 2 PUMPING - CONTINUATION OF PHASE 1 - PUMP NOT STOPPED
X PUMPING RATE REDUCED
XX PUMPING RATE INCREASED
XXX PUMPING RATE REDUCED
XXXX METER CHECKED ON SITE 118gpm
XXXXX PUMP CUT BACK TO 117gpm

READINGS FOR *~~OBSERVATION~~/PRODUCTION HOLE

*DRAWDOWN/~~RECOVERY~~

	Date	Lapsed time (mins)	G.M.T.	DRAW DOWN Water Level (M)	Rate of Flow	Date	Lapsed time (mins)	G.M.T.	DRAW DOWN Water Level (M)	Rate of Flow	
	Standing Water Level:(D.D.)24.14										
	Starting time: 11.15				GPM					GPM	
	14/10	0.5	11.155	.24.14	135	14/10	26	11.41	-	127	XX
	14/10	1.0	11.160	24.13	135	14/10	28	11.43	21.80	127	
	14/10	1.5	11.165	24.14	135	14/10	30	11.45	23.30	127	
	14/10	2.0	11.170	24.15	135	14/10	32	11.47	23.30	127	XXX
	14/10	2.5	11.175	24.16	135	14/10	36	11.51	24.31	127	
	14/10	3.0	11.180	24.17	135	14/10	40	11.55	24.33	127	
	14/10	3.5	11.185	24.19	135	14/10	44	11.59	24.29	118	
	14/10	4.0	11.190	24.23	135	14/10	48	12.03	24.27	118	
	14/10	4.5	11.195	24.26	135	14/10	52	12.07	24.31	118	
	14/10	5	11.200	24.31	122	14/10	56	12.11	24.35	118	XXXX
	14/10	6	11.210	24.38	122	14/10	60	12.15	24.45	135	
	14/10	7	11.220	24.38	122	14/10	65	12.20	24.55	135	
	14/10	8	11.230	24.58	122	14/10	70	12.25	24.62	135	
	14/10	9	11.240	24.65	122	14/10	75	12.30	24.60	116	XXXXX
	14/10	10	11.250	24.75	122	14/10	80	12.35	24.54	116	119(M)
	14/10	11	11.260	24.83	122	14/10	90	12.45	24.61	116	
	14/10	12	11.270	24.90	122	14/10	100	12.55	24.70	116	
	14/10	14	11.290	25.00	122	14/10	110	13.05	24.76	116.	
	14/10	16	11.310	25.17	100	14/10	120	13.15	24.20	116	
	14/10	18	11.330	25.30	100	14/10	140	13.35	23.87	145	
	14/10	20	11.350	25.50	100	14/10	160	13.55	24.15	145	
X	14/10	22	11.370	25.85	100	14/10	180	14.15	24.02	105	
	14/10	24	11.390	-	127	14/10	200	14.35	24.01	105	

*Delete as appropriate

SEARCH AREA LOCATION & No: MITCHELSTOWN NO 2 (10") PUMPING PHASE 2

X BARREL READY 112gpm XXX MEASURED IN BARREL 116.7gpm
XX PUMPED STOPPED XXXX PUMP STOPPED

READINGS FOR *~~OBSERVATION~~/PRODUCTION HOLE

*DRAWDOWN/~~RECOVERY~~

	Date	Lapsed time (mins)	G.M.T.	Water Level (M)	Rate of Flow	Date	Lapsed time (mins)	G.M.T.	Water Level (M)	Rate of Flow	
	14/10	240	15.15	24.14	118	16/10	2778	9.33	-	-	
	14/10	253	15.28	24.19	118	16/10	2780	9.35	5.95	-	
	14/10	269	15.44	24.30	118	16/10	2785	9.40	5.9	-	XXXXX
X	14/10	280	15.55	24.41	115*	16/10	2835	10.30	21.65	108	
	14/10	320	16.35	24.80	115	16/10	3030	13.45	22.22	122	
	14/10	360	17.15	24.86	110	16/10	3255	17.30	23.37	115	
	14/10	400	17.55	24.85	115	16/10	3558	22.33	22.60	116	XXXXXX
	14/10	440	18.35	24.88	-	17/10	4452	13.27	22.70	114	(115M)
XX	14/10	540	20.15	19.64	-	18/10	5592	8.30	5.6	-	
	14/10	600	21.15	20.00	-	18/10	5607	8.45	5.55	-	
	14/10	660	22.15	-	-	18/10	5622	9.00	5.49	-	
	15/10	780	00.15	20.96	168	18/10	5637	9.15	5.47	-	
	15/10	840	1.15	21.55	68	18/10	5652	9.30	5.46	-	
	15/10	900	2.15	21.91	121	18/10	5712	10.30	5.33	-	
	15/10	960	3.15	21.85	121	18/10	5757	11.15	-	? P	STARTED
	15/10	1020	4.15	21.63	118	18/10	5801	11.59	PUMP STOPPED		
	15/10	1140	6.15	21.22	118						
	15/10	1260	8.15	21.30	130						
	15/10	1275	8.30	21.31	80						
	15/10	1335	9.30	21.40	186						
	15/10	1380	10.15	21.46	6						
	15/10	1393	10.28	-	-						
	15/10	1395	10.30	21.51	153						
XXX	15/10	1445	11.20	21.47	118(116B)						
	15/10	1500	12.15	21.52	108						
	15/10	1515	12.30	21.54	20						
	15/10	1575	13.30	21.56	115						
	15/10	1620	14.15	21.65	120						
	15/10	1635	14.30	21.66	126						
	15/10	1695	15.30	21.59	113						
	15/10	1740	16.15	21.70	110						
	15/10	1755	16.30	21.76	110						
	15/10	1860	18.15	21.70	118						
	15/10	1980	20.15	21.70	136						
	16/10	2225	00.20	21.72	105						
	16/10	2545	5.40	21.75	431?						
	16/10	2758	9.13	-	-						
XXXX	16/10	2760	9.15	21.80	100						
	16/10	2761	9.16	16.6	-						
	16/10	2761.5	9.165	13.2	-						
	16/10	2762	9.17	12.35	-						
	16/10	2762.5	9.175	10.6	-						
	16/10	2765	9.20	6.9	-						
	16/10	2767	9.22	6.5	-						
	16/10	2771	9.27	-	-						
	16/10	2775	9.30	6.05	-						
	16/10	2777	9.32	6.02							

* (1103)

XXXXX PUMP STARTED

XXXXXX PUMP STARTED

P U M P I N G   T E S T   R E C O R D   S H E E T

SEARCH AREA LOCATION & No: MITCHELSTOWN NO I (6") PUMPING PHASE 2

HOLE DIA. & DEPTH: 6" 62.48 DEPTH OF PERMANENT LINER: 20.8M

HOLE DATUM: LEVEL:

RATE OF FLOW, COMMENCEMENT OF PHASE: FINISH OF PHASE:

COMMENCING DATE: 14 - 10 - 1982 FINISHING DATE: 17 - 10 - 1982

NOTES:
X DOUBTS OF RELIABILITY OF DIPPER READING
XXX DISCHARGE CHECKED - 200gpm (COUNCIL)
XXXX METER READING 175gpm (COUNCIL)
XXXXX COUNCIL READING 171gpm
XXXXXX METER STOPPED

READINGS FOR *~~OBSERVATION~~/PRODUCTION HOLE

*DRAWDOWN/~~RECOVERY~~

	Date	Lapsed time (mins)	G.M.T.	Water Level	Rate of Flow	Date	Lapsed time (mins)	G.M.T.	Water Level	Rate of Flow	
	Standing Water Level: 2.23(D.D.)										
	Starting time:		11.15								
	14/10	0.5	11.155	-	?	14/10	26	11.41	12.36	233	X
	14/10	1.0	11.160	-	?	14/10	28	11.43	12.58	233	
	14/10	1.5	11.165	5.36	?	14/10	30	11.45	12.76	233	
	14/10	2.0	11.170	-	?	14/10	32	11.47	12.96	200	
	14/10	2.5	11.175	6.26	?	14/10	36	11.51	13.10	200	
	14/10	3.0	11.180	6.81	?	14/10	40	11.55	13.31	200	
	14/10	3.5	11.185	-	?	14/10	44	11.59	13.20	200	
	14/10	4.0	11.190	6.97	?	14/10	48	12.03	13.41	181	XXX
	14/10	4.5	11.195	7.37	?	14/10	52	12.07	13.55	181	
	14/10	5	11.200	-	?	14/10	56	12.11	13.69	181	(200M)
	14/10	6	11.210	7.61	?	14/10	60	12.15	13.85	181	
	14/10	7	11.220	8.21	?	14/10	65	12.20	14.02	215	
	14/10	8	11.230	8.51	?	14/10	70	12.25	14.14	215	
	14/10	9	11.240	8.88	?	14/10	75	12.30	14.28	215	
	14/10	10	11.250	-	?	14/10	80	12.35	14.41	215	(173M)
	14/10	11	11.260	9.59	240	14/10	90	12.45	14.59	192	XXXX
	14/10	12	11.270	9.86	240	14/10	100	12.55	14.67	150	
	14/10	14	11.290	10.13	240	14/10	110	13.05	14.86	150.	XXXXX
X	14/10	16	11.310	10.43	240	14/10	120	13.15	14.96	200	XXXXXX
X	14/10	18	11.330	11.23	240	14/10	140	13.35	15.14	?	
X	14/10	20	11.350	11.71	240	14/10	160	13.55	15.29	?	
	14/10	22	11.370	11.94	240	14/10	180	14.15	15.44	?	
	14/10	24	11.390	12.16	240	14/10	200	14.35	15.59	?	

*Delete as appropriate

SEARCH AREA LOCATION & No: MITCHELSTOWN NO I (6") PUMPING PHASE 2

X 10" PUMP STOPPED — XXX METER STOPPED

XX 197gpm barrell — XXXX DIPPER STUCK @

READINGS FOR *~~OBSERVATION~~/PRODUCTION HOLE

*DRAWDOWN/~~RECOVERY~~

	Date	Lapsed time (mins)	G.M.T.	DRAW DOWN Water Level M	Rate of Flow GPM	Date	Lapsed time (mins)	G.M.T.	Water Level	Rate of Flow
	14/10	240	15.15	15.69	254					
	14/10	258	15.33	15.76	193	(197M)				
	14/10	280	15.55	15.76	228					
	14/10	297	16.12	15.78	192					
	14/10	319	16.34	15.80	192					
	14/10	320	16.35	15.80	192					
	14/10	360	17.15	15.80	167					
	14/10	400	17.55	15.81	205					
	14/10	440	18.35	15.82	200					
X	14/10	480	19.15	15.61	240					
	14/10	540	20.15	15.67	176					
	14/10	600	21.15	15.72	185					
	14/10	660	22.15	15.76	173					
	15/10	780	00.15	-	214					
	15/10	840	01.15	-	214					
	15/10	900	02.15	-	214					
	15/10	960	03.15	-	214					
	15/10	1020	04.15	-	214					
	15/10	1140	06.15	-	214					
	15/10	1260	08.15	-	214					
	15/10	1275	08.30	16.00	214					
	15/10	1335	09.30	16.03	150					
	15/10	1380	10.15	-	216					
	15/10	1395	10.30	16.07	216					
	15/10	1445	11.20	16.15	175	(191M)				
	15/10	2455	11.30	16.17	175					
	15/10	1500	12.15	16.22	175					
	15/10	1515	12.30	16.19	246					
	15/10	1575	13.30	16.17	198					
	15/10	1620	14.15	16.22	175					
	15/10	1635	14.30	16.20	173					
	15/10	1695	15.30	16.20	185					
XX	15/10	1740	16.15	16.23	195	(186M)				
	15/10	1755	16.30	16.22	153					
	15/10	1860	18.15	16.26	186					
	15/10	1980	20.15	16.71	177					
	15/10	2100	22.15	16.34	125					
XXX	16/10	2225	00.20	16.35	125					
	16/10	2525	05.20	16.36	-					
	16/10	2545	05.40	-	-					
	16/10	2772	09.27	16.16	-					
	16/10	2778	09.33	16.06	-					
	16/10	2805	10.00	-	187	(B)				
	16/10	2835	10.30	16.05	-					
XXX	16/10	3030	13.45	-	173					
	16/10	3255	17.30	-	150					
	16/10	3556	22.31	-	171					
	17/10	4441	13.16	-	184					

P U M P I N G   T E S T   R E C O R D   S H E E T

SEARCH AREA LOCATION & No: MITCHELSTOWN NO I 6" BOREHOLE

HOLE DIA. & DEPTH: 6" 62.48 DEPTH OF PERMANENT LINER: 20.8M

HOLE DATUM: LEVEL:

RATE OF FLOW, COMMENCEMENT OF PHASE: FINISH OF PHASE:

COMMENCING DATE: 18 - 10 - 1982 FINISHING DATE: 20 - 10 - 1982

NOTES:

PUMP STOPPED @ 8.30hrs ON 18/10/'82 - DIPPER STUCK @ 6.79M.

READINGS FOR ~~*OBSERVATION~~/PRODUCTION HOLE

~~*DRAWDOWN~~/RECOVERY

Date	Lapsed time (mins)	G.M.T.	Water Level (M)	Rate of Flow	Date	Lapsed time (mins)	G.M.T.	Water Level (M)	Rate of Flow
Standing Water Level: 1.39(NEW)									
Starting time: 8.30									
18/10	0.5		-		18/10	26		-	
18/10	1.0		-		18/10	28		-	
18/10	1.5		-		18/10	30		-	
18/10	2.0		-		18/10	32		-	
18/10	2.5		-		18/10	36		-	
18/10	3.0		-		18/10	40		-	
18/10	3.5		-		18/10	44		-	
18/10	4.0		-		18/10	48		-	
18/10	4.5		-		18/10	52		-	
18/10	5		-		18/10	56		-	
18/10	6		-		18/10	60		-	
18/10	7		-		18/10	65		-	
18/10	8		-		18/10	70		-	
18/10	9		-		18/10	75		-	
18/10	10		-		18/10	80		-	
18/10	11		-		18/10	90		-	
18/10	12		-		18/10	100		-	
18/10	14		-		18/10	110		-	
18/10	16		-		18/10	120	13.39	-	
18/10	18		-		18/10	140	13.59	-	
18/10	20		-		18/10	160	14.29	4.33	
18/10	22		-		18/10	167	14.36	4.16	
18/10	24		-		18/10	170	14.39	4.11	

*Delete as appropriate

SEARCH AREA LOCATION & No: MITCHELSTOWN NO I 6" BOREHOLE

READINGS FOR *~~OBSERVATION~~/PRODUCTION HOLE

*~~DRAWDOWN~~/RECOVERY

Date	Lapsed time (mins)	G.M.T.	Water Level (M)	Rate of Flow	Date	Lapsed time (mins)	G.M.T.	Water Level	Rate of Flow
18/10	172	14.41	4.06	-					
18/10	176	14.45	3.98	-					
18/10	179	14.48	3.92	-					
18/10	180	14.49	-	-					
18/10	185	14.54	3.79	-					
18/10	193	15.02	3.65	-					
18/10	207	15.26	3.41	-					
18/10	211	15.30	3.35	-					
18/10	225	15.44	3.14	-					
18/10	227	15.46	-	-					
18/10	241	16.00	2.96	-					
18/10	256	16.15	2.78	-					
18/10	267	16.26	-	-					
18/10	271	16.30	2.64	-					
18/10	631	22.30	1.10	-					
19/10	1231	8.30	0.36	-					
19/10	1351	10.30	0.26	-					
19/10	1831	18.00	0.01	-					
20/10	2711	10.40	+0.30	-					

P U M P I N G   T E S T   R E C O R D   S H E E T

SEARCH AREA LOCATION & No: MITCHELSTOWN NO.2 BOREHOLE (10")

HOLE DIA. & DEPTH: 10" 30.40M   DEPTH OF PERMANENT LINER: 20.72M

HOLE DATUM: LEVEL:

RATE OF FLOW, COMMENCEMENT OF PHASE: -   FINISH OF PHASE: -

COMMENCING DATE: 18 - 10 - 1982   FINISHING DATE: 20 - 10 - 1982

NOTES:

READINGS FOR *~~OBSERVATION~~/PRODUCTION HOLE

*~~DRAWDOWN~~/RECOVERY

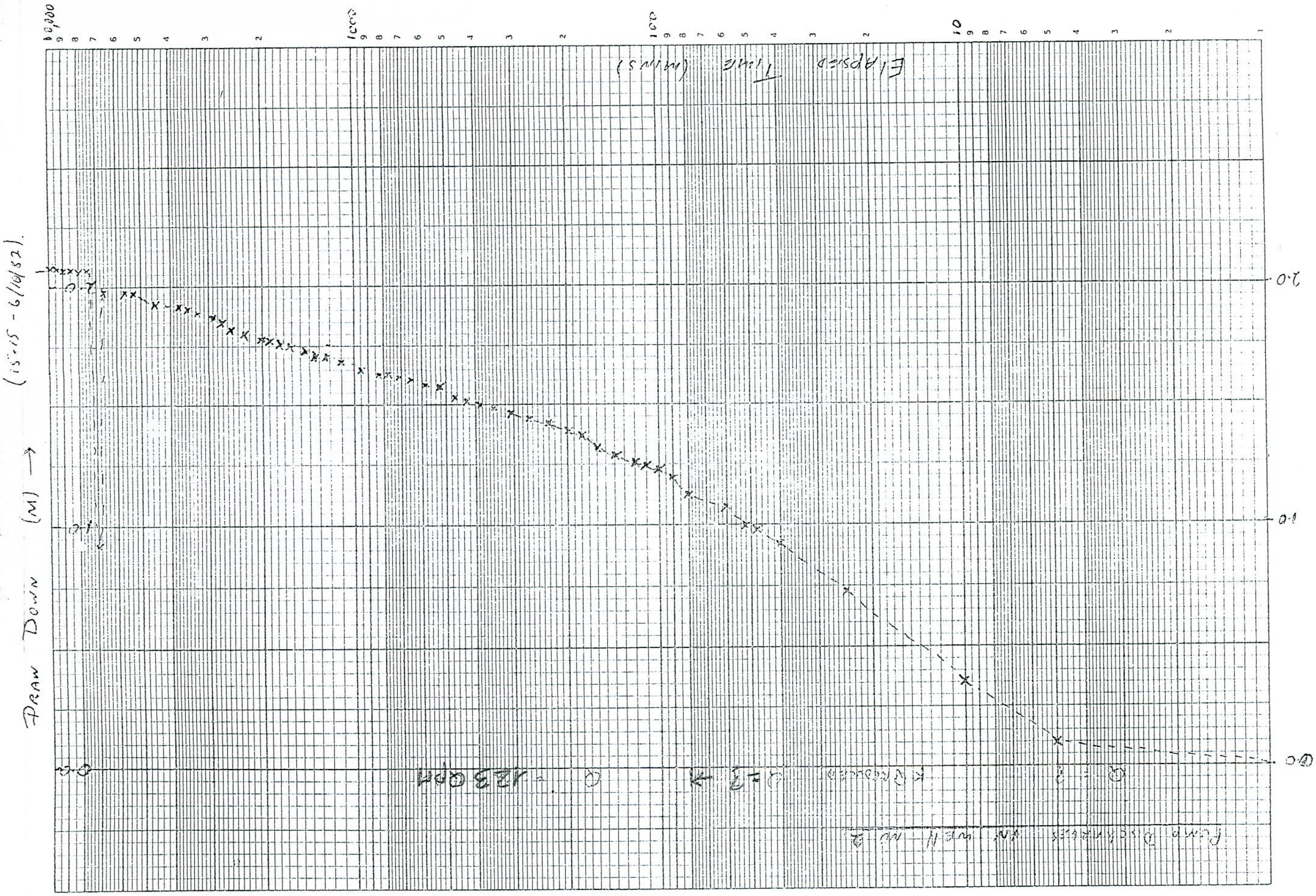
Date	Lapsed time (mins)	G.M.T.	Water Level M	Rate of Flow	Date	Lapsed time (mins)	G.M.T.	Water Level M	Rate of Flow
Standing Water Level:			22.65						
Starting time:		11.59							
18/10	0.5	11.595	20.00	-	18/10	26	12.25	5.05	-
18/10	1.0	12.000	16.45	-	18/10	28	12.27	5.00	-
18/10	1.5	12.005	13.80	-	18/10	30	12.29	4.96	-
18/10	2.0	12.010	11.50	-	18/10	32	12.31	4.93	-
18/10	2.5	12.015	9.90	-	18/10	36	12.35	4.84	-
18/10	3.0	12.020	8.20	-	18/10	40	12.39	4.77	-
18/10	3.5	12.025	7.94	-	18/10	44	12.43	4.70	-
18/10	4.0	12.030	7.40	-	18/10	48	12.47	4.64	-
18/10	4.5	12.035	7.00	-	18/10	52	12.51	4.57	-
18/10	5	12.040	6.70	-	18/10	56	12.55	4.51	-
18/10	6	12.050	6.35	-	18/10	60	12.59	4.44	-
18/10	7	12.060	6.00	-	18/10	65	13.04	4.36	-
18/10	8	12.070	5.88	-	18/10	70	13.09	-	-
18/10	9	12.080	5.75	-	18/10	75	13.14	4.24	-
18/10	10	12.090	5.68	-	18/10	80	13.19	4.17	-
18/10	11	12.100	-	-	18/10	90	13.29	4.07	-
18/10	12	12.110	-	-	18/10	100	13.39	3.95	-
18/10	14	12.130	5.42	-	18/10	110	13.49	3.83	-
18/10	16	12.150	5.34	-	18/10	120	13.59	3.63	-
18/10	18	12.170	5.27	-	18/10	140	14.19	3.52	-
18/10	20	12.190	5.21	-	18/10	160	14.39	3.38	-
18/10	22	12.210	-	-	18/10	180	14.59	3.25	-
18/10	24	12.230	-	-	18/10	200	15.19	3.06	-

*Delete as appropriate

SEARCH AREA LOCATION & No: MITCHELSTOWN NO 2 BOREHOLE 10"

READINGS FOR ~~*OBSERVATION~~/PRODUCTION HOLE
~~*DRAWDOWN~~/RECOVERY

Date	Lapsed time (mins)	G.M.T.	Water Level	Rate of Flow	Date	Lapsed time (mins)	G.M.T.	Water Level	Rate of Flow
18/10	227	15.46	2.88	-					
18/10	267	16.26	2.66	-					
18/10	631	22.30	1.41	-					
19/10	1231	8.30	0.65	-					
19/10	1351	10.30	0.53	-					
19/10	1831	18.00	0.19	-					
20/10	2711	10.40	0.00	-					


ELAPSED TIME (MINS)
DRAW DOWN (M) →
10,000
1000
100
10
2.0
1.0
0.0

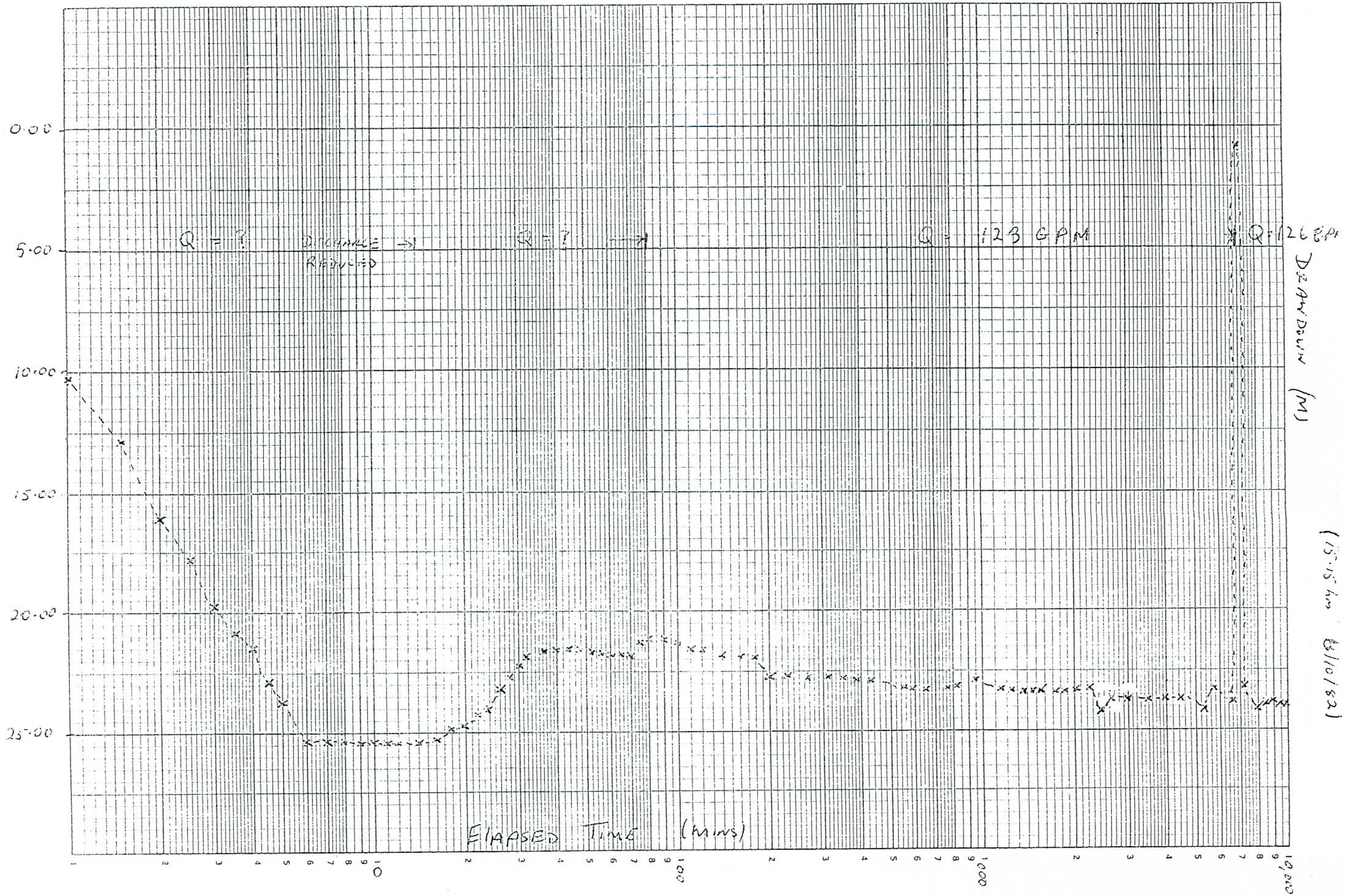

Q = ?
DISCHARGE →
REDUCED
Q = ?
Q = 123 GPM
Q = 126 GPM
DRAWDOWN (M)
(15.15 hrs 8/10/82)
0.00
5.00
10.00
15.00
20.00
25.00
ELAPSED TIME (MINS)
1
10
100
1000
10,000

TABLE 3

(11.15 14/10/82)
(PHASE 2)

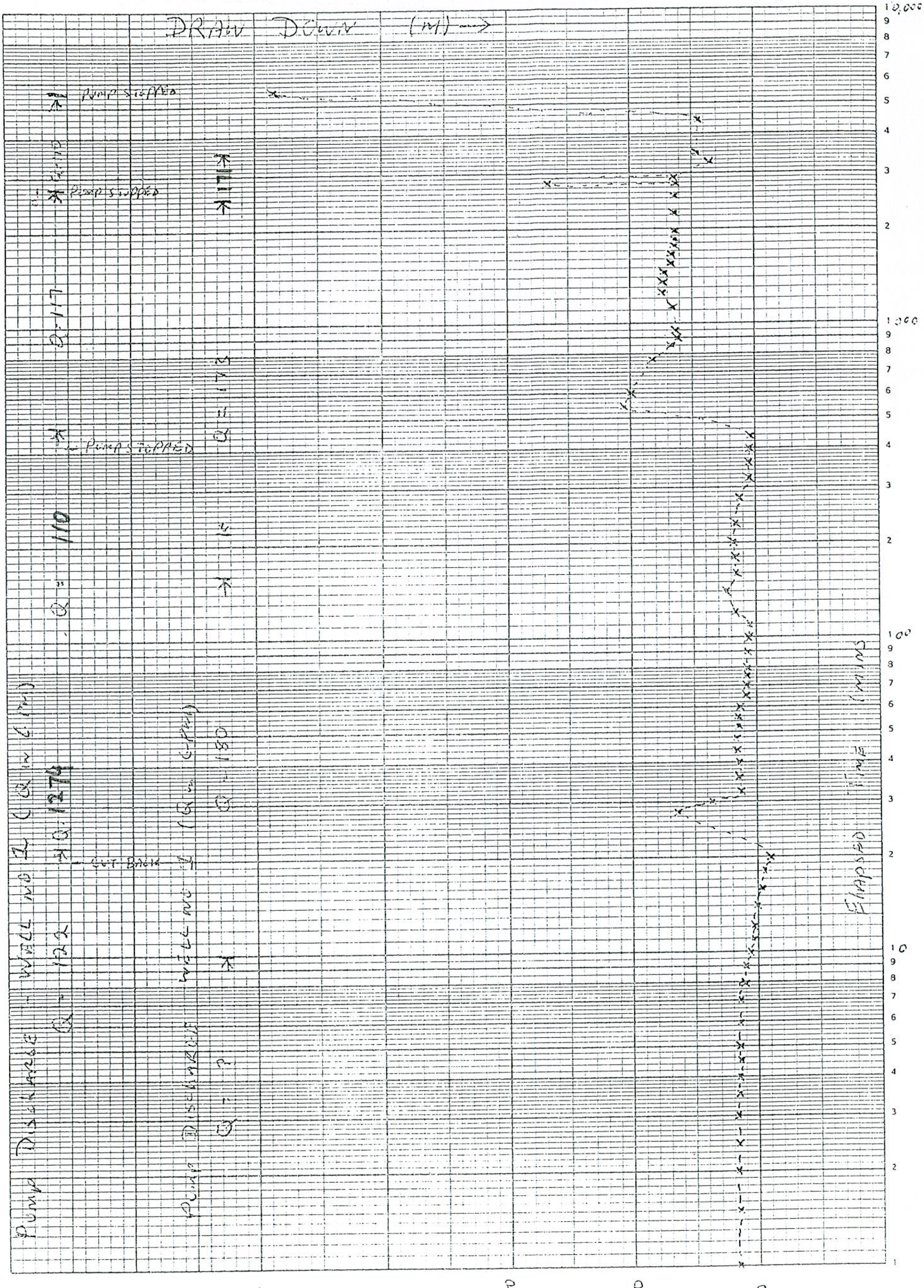


TABLE No 4

14/10/82 - 11.15 GMT

PHASE 2

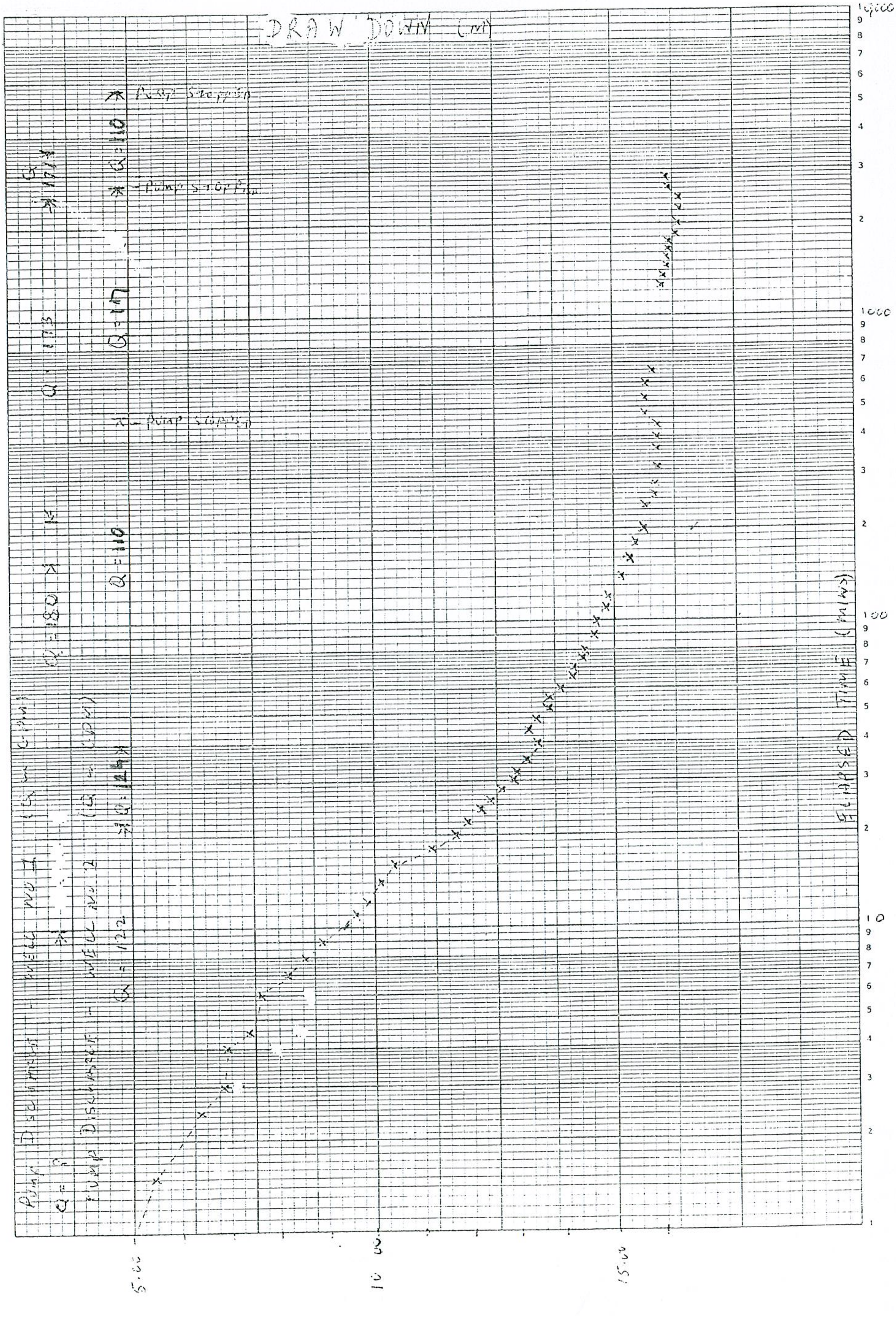
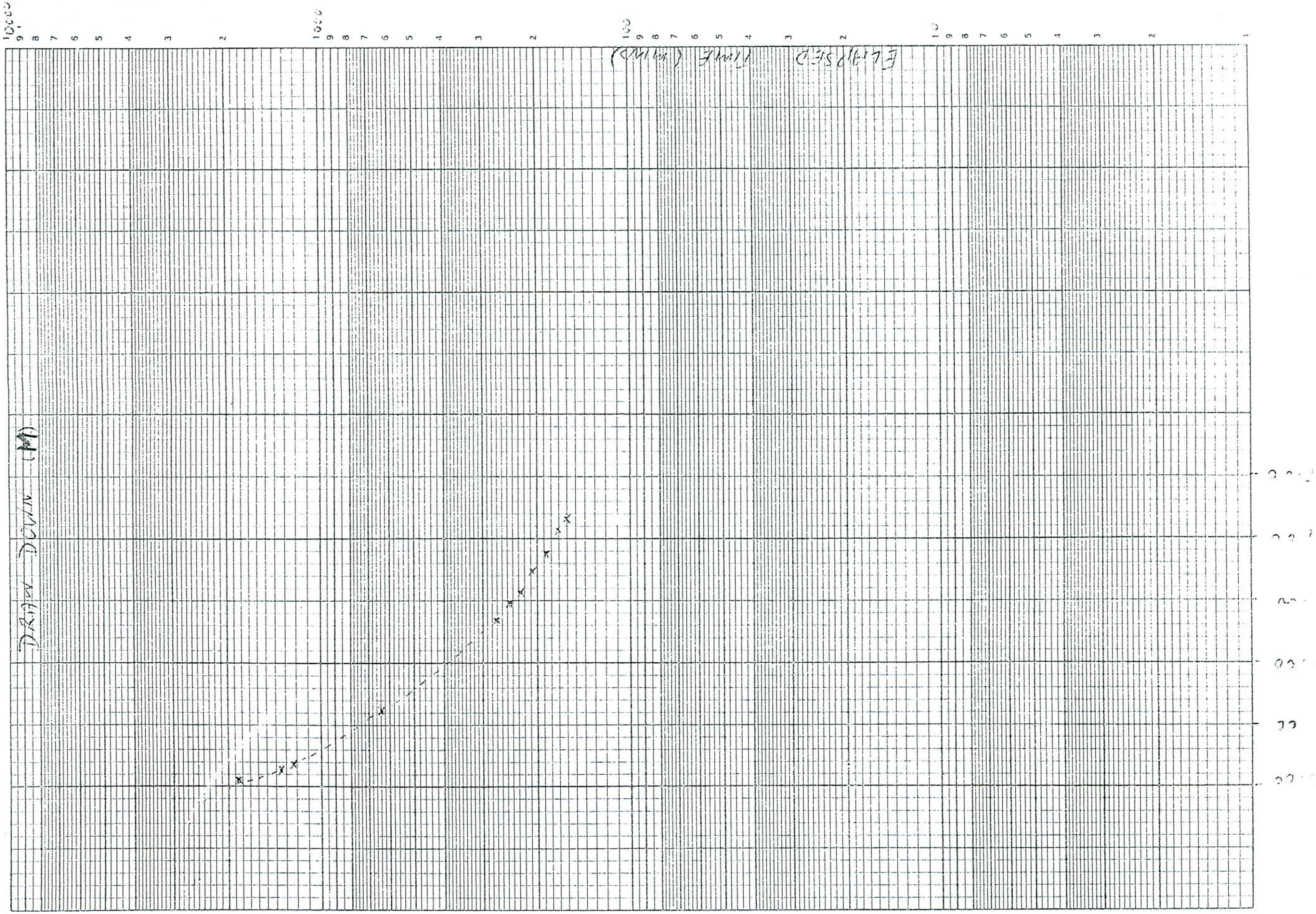


TABLE 2

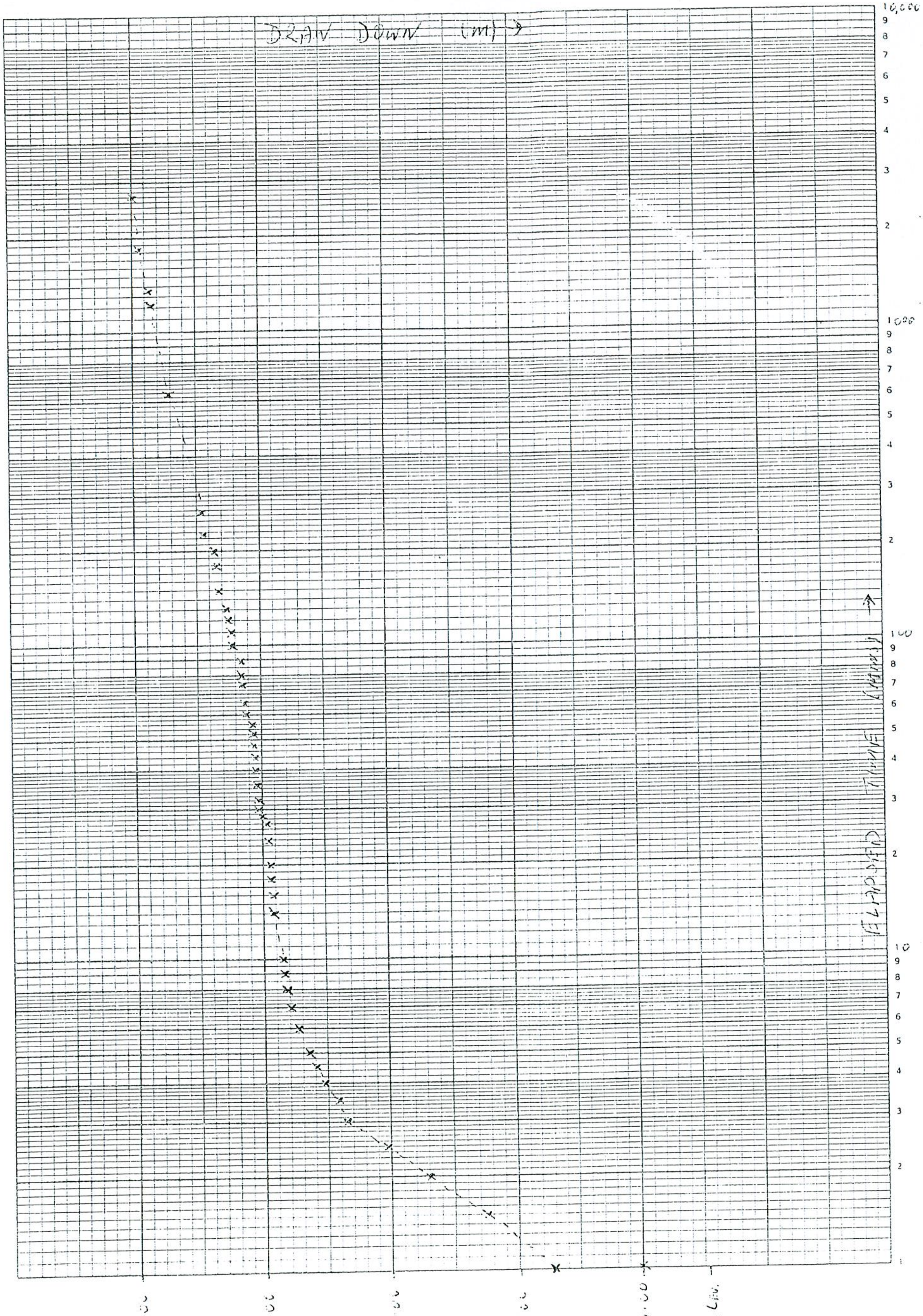
RECOVERY



Reverse the original ?

TABLE 6

RECOVERY



WELL Graph Data Ref. 5543

Log 4 Cycles x 10th, 2 and 1 inch

TABLE 8

Well No.	1	1	1	1	1
Date Sampled	4/11/80	5/11/80	6/11/80	14/10/82	16/10/82
Appearance	O.K.	O.K.	O.K.	CLEAR	CLEAR
Colour	7H.U.	7H.U.	-	-	-
Conductivity	-	-	-	-	-
S.Solids	NONE	NONE	NONE	NONE	NONE
Total Dissolved Solids	200	200	179	-	-
pH	7.2	7.15	7.26	7.31	7.17
pHs	8.05	-	7.86	7.93	7.82
Alkalinity	124	120	120	139	137
Total Hardness	140	140	140	-	-
Non Carbonate Hardness	16	20	20	-	-
Ammonia	.11	.05	.03	ND	ND
Nitrates	1.2	.7	1.0	4.8	5.1
Nitrites	.005	.005	.003	ND	ND
Chlorides	15	16	15	-	-
Sulphates	5.5	5.0	4	-	-
O-Po_4	.02	.02	.02	0.025	0.035
Fluoride	-	-	-	-	-
Aluminium	-	-	-	-	-
Iron (Dissolved)	.42	.40	.33	-	-
Manganese	.03	.015	.012	-	-
Lead	.02	.02	.01	-	-
Copper	.01	.01	.01	-	-
Zinc	.09	.09	.09	-	-

Well No	1	1	1	1	1
Bacteriological	4/11/80	5/11/80	6/11/80	14/10/82	16/10/82
Std.Plate Count @ 20°C	70	14	48	60	-
Coliform	0	0	0	0	-
E.Coli	0	0	0	0	-
E.Strep	0	0	0	0	-

TABLE 9

Well No	2	2	2	2
Date Sampled	7/10/82	9/10/82	14/10/82	16/10/82
Appearance	CLEAR	CLEAR	CLEAR	CLEAR
Colour				
Conductivity	86			
S.Solids	Nil		1	0
Total Dissolved Solids				
pH	6.66	6.87	7.53	6.70
pHs	7.42	7.77	7.82	7.90
Alkalinity	96	93	95	90
Total Hardness	119	116	118	117
Non Carbonate Hardness	23	23	23	27
Ammonia	ND	ND	ND	ND
Nitrates	5.6	4.0	6.2	6.2
Nitrites	ND	ND	ND	ND
Chlorides	20.5			
Sulphates				
$O-Po_4$	0.03	0.026	0.03	0.025
Fluoride				
Aluminium				
Iron(Dissolved)	ND	0.05		
Manganese	ND	ND		
Lead	ND	ND		
Copper	ND	ND		
Zinc	ND	ND		

Well No.	2	2	2	2
Bacteriological	7/10/82	9/10/82	14/10/82	16/10/82
Std.Plate Count. @ 28°C & 37°C			32 & 3	N/A
Coliform	0		0	
E.Coli	0		0	
E.Strep	0		0	

CONTENTS

....

200ft

100ft

30f

25m.

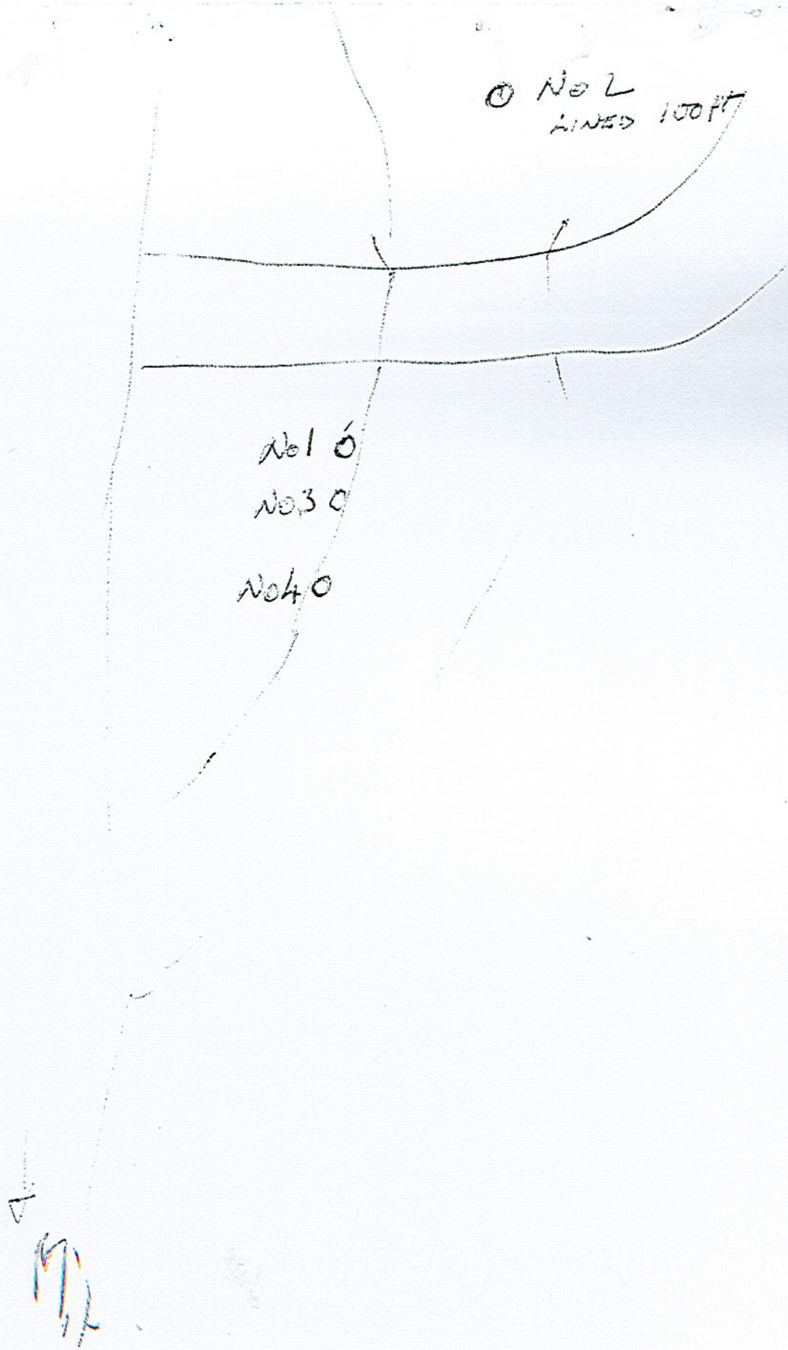
CORK COUNTY COUNCIL

(NORTH)

TABLE OF RESULTS OF WELL PUMP TEST

@ Kiltrislane, Mitchelstown

October 6th - October 18th, 1982



CONTENTS

INTRODUCTION

The pump tests were carried out in 2 stages.

Stage 1 consisted of pumping No. 2 well using a 20 hp submersible pump. Drawdown in No. 1 and No. 2 wells was observed. This stage was from 6th October, 1982 (3.15 p.m.) to 14th October, 1982 (11.15 a.m.)

Stage 2 consisted of pumping both No. 1 and No. 2 wells. (A mono pump was installed in No. 1 well). Drawdown in both wells was again observed. This stage was from 14th October, 1982 (11.15 a.m.) to 18th October, 1982 (11.59 a.m.)

The recovery rate was then measured from 11.59 a.m. on 18th October, 1982 until full recovery.

Note: All the drawdown (water levels) given in the following tables were measured from top of the linings (i.e., the 6" lining in bore No. 1 and the 10" lining in bore No. 2). The readings given are the actual readings taken. Therefore, in the case of No. 1 bore allowance should be made when analysing results that 0.59m was cut off the 6" lining on 13th October, 1982. Details of levels of bores relative to each other are given in the Well & Pump Data Section.

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98m				
me T	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
23p.m.	8.0	25.42										)Water Level readings) (10" bore) in doubt as) drawdown near top of)pump.
24	9.0	25.42										
25	10.0	25.42						2.83				
26	11.0	25.42										
27	12.0	25.42										
29	14.0	25.42										
31	16.0	25.30										← Cut back pump.
33	18.0	24.92										
35	20.0	24.65										
37	22.0	24.31										
39	24.0	24.00				2	$2\frac{3}{4}$	2.71				
1	26.0	23.10										
3	28.0	22.68										
5	30.0	22.20										
7	32.0	21.88										
1	36.0	21.61										
5	40.0	21.52						2.89				
9	44.0	21.51										

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.0m				Weir (4 ft.)		BORE 1 Static Level = 1.98m				
Time GMT	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
4.03 p.m.	48.0	21.52						2.95				
4.07	52.0	21.57						2.98				
4.11	56.0	21.65										
4.15	60.0	21.75				2	$2\frac{3}{4}$	3.05				
4.20	65.0	21.76										
4.25	70.0	21.76										
4.30	75.0	21.33										
4.35	80.0	21.09				2	$2\frac{3}{4}$	3.09				
4.45	90.0	21.12	8250					3.17				Meter installed.
4.55	100.0	21.30						3.19				
5.05	110.0	21.50						3.21				Water clear.
5.15	120.0	21.58						3.23				
5.35	140.0	21.82						3.26				
5.55	160.0	21.83						3.30				
6.15	180.0	21.97						3.34				
6.25	190.0	22.60						3.37				
7.05	230.0	22.56						3.39				
7.45 pm	270.0	22.59						3.42				

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98m				
e	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. hr.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
5m	310	22.67						3.44				
5	350	22.72						3.46				
5	390	22.91						3.48				
5 pm	430	22.91	51,500		)			3.49				
5 pm	470	23.12	59,550		)			3.52				
5 am	530	23.22	64,400		)			3.54				The Meter readings
5	590	23.30	71,800		)			3.56				between 10.25 p.m.
5	650	23.28	80,100		) 7,510			3.58				and 8.05 a.m. (7/10/1982)
5	710	23.24	87,400		)			3.60				were taken by
5	770	23.15	94,700		)			3.61				Dunnes. It would
5	830	23.02	101,600		)			3.61				give us a better estimate
5	890	22.98	110,300		)			3.62				of output overnight by
5	950	22.95	116,200		)			3.63				averaging the total readings,
5 am	1010	23.02	124,100		)			3.64				i.e., 124,100 - 51,500 gal
												= 7,510 gal/hr .

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98m				
Time GMT	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. hr	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
8.45 am	1050	Not	129,000		7,350	$1\frac{3}{4}$	$2\frac{1}{4}$	3.64				Council reading
9.15	1080	read	132,700		7,400	$1\frac{5}{8}$	$2\frac{1}{4}$	3.65				Council reading
9.45	1110		136,300		7,200	$1\frac{5}{8}$	$2\frac{1}{4}$	3.66				Council reading
10.05	1130	23.14	138,400					3.66				
10.45	1170	23.37	143,900		7,600	$1\frac{5}{8}$	$2\frac{1}{4}$	3.67				Council Reading
11.45 am	1230	23.37	151,300		7,400	$1\frac{5}{8}$	$2\frac{1}{4}$	3.68				Council
12.05 pm	1250											Readings omitted
12.45	1290	23.36	158,700		7,400	$1\frac{5}{8}$	$2\frac{1}{4}$	3.68				Council
1.45	1350	23.35	166,200		7,500	$1\frac{5}{8}$	$2\frac{1}{4}$	3.68				Council
2.05	1390	23.35										Readings omitted
2.45	1410	23.39	173,700		7,500	$1\frac{1}{2}$	$2\frac{1}{4}$	3.70				Council
3.45	1470	23.38	181,100		7,400	$1\frac{1}{2}$	$2\frac{1}{4}$	3.70				Council
4.05	1940											Readings omitted.
4.45	1530	23.24	188,700		7,600	$1\frac{1}{2}$	$2\frac{1}{4}$	3.70				
6.05	1610	23.35	197,100		6,300			3.73				
8.05	1730	23.35	212,400		7,650			3.74				P.T.O
10.05 pm	1850	23.35	226,900		7,250			3.76				

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98m				
[illegible]e	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
05 am	1970	23.29	242,200		7,650			3.76				Av. Between 4.45 p.m.
05	2090	23.27	257,500		7,650			3.76				+ 8.30 a.m., 8/10/1982
25	2290	23.13	281,900		7,320			3.78				= 7,378/hr.
30	2475	23.24	304,900		7,460	$1\frac{1}{2}$	$2\frac{1}{8}$	3.80				Council reading
45	2490											Readings omitted.
30	2535	23.57	312,200		7,300	$1\frac{1}{2}$	$2\frac{1}{8}$	3.80				Council
30	2595	23.65	319,600		7,400	$1\frac{1}{2}$	$1\frac{1}{2}$	3.82				Council.
30 am	2655	23.59	327,100		7,500	$1\frac{3}{8}$	$2\frac{1}{8}$	3.82				Council.
0 pm	2715	23.57	334,400		7,300	$1\frac{3}{8}$	$2\frac{1}{8}$	3.82				Council.
5	2740											Readings omitted.
0	2775	23.64	341,900		7,500	$1\frac{3}{8}$	$2\frac{1}{8}$					Council.
0	2835	23.64	349,200		7,300	$1\frac{3}{8}$	$2\frac{1}{8}$					Council.
0	2895	23.63	356,500		7,300	$1\frac{3}{8}$	$2\frac{1}{8}$					Council.
0	2955	23.73	364,000		7,500	$1\frac{3}{8}$	$2\frac{1}{8}$					Council.
0	2985			123 (Meter)								Council 123gpm = 7,380/hr.

TEST PUMPING DATA SHEET

Time EMT	Lapsed Time (mins)	BORE 2 Static Level = 0.00 Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr	Weir (4 ft.) Weir A ins.	Weir B ins.	BORE 1 Static Level = 1.98 Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
5.05 pm	2990	23.65	367,600					3.84				Average between 4.30 pm
9.15 pm	3240	23.74	397,100		7,080)			3.86				and 9.45 am (9/10/1982)
					)							= 490,400 - 364,000
1.25 am	3490	23.78	428,800		7,608)			3.88				= 7,327 gph .
5.35 am	3740	23.76	458,700		7,176)			3.89				
9.45 am	3990	23.62	490,400		7,608)			3.89				
3.10 pm	4315		530,800	121 Meter	7,454							Council .
6.10 pm	4495	23.51	552,700		7,300			3.90				
8.45 am	5370	24.06	659,600		7,330			3.95				
5.10 pm	5875	23.28	721,000		7,295			3.95				
8.30 am	6795	23.71	833,800		7,356	$1\frac{1}{8}$	$1\frac{7}{8}$	3.95				Council.
9.00 am	6825											Readings omitted ,

Note: Pump stopped at 842,000 gals., i.e., 9.37 (estimated using 7,356 as Av. reading)

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98m					
…me …T	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks	
.15 am	6960	1.00				$1\frac{1}{8}$	$1\frac{7}{8}$	2.92				Council.	Pump stopped
.22	6967	0.96				$1\frac{1}{8}$	$1\frac{7}{8}$					Council.	recovery reading
.32	6977					$1\frac{1}{8}$	$1\frac{7}{8}$	2.89				Council.	Pump restart
.00	7005	0.89				$1\frac{1}{8}$	$1\frac{7}{8}$	2.83				Council.	at 12.15 approx.
.15 pm	7020					$1\frac{1}{8}$	$1\frac{7}{8}$	2.80				Council.	
00	7065	22.15											
30	7095	21.91	850,200			$1\frac{1}{8}$	$1\frac{7}{8}$	3.71				Council.	
00	7.25	22.40						3.79					
30	7155	22.32	857,800		7,600	$1\frac{3}{8}$	$2\frac{1}{8}$	3.87				Council.	
30	7215	22.76	865,000		7,200	$1\frac{3}{8}$	$2\frac{1}{8}$	3.92				Council.	
30	7275	22.93	872,900		7,900	$1\frac{3}{8}$	$2\frac{1}{8}$	3.95				Council.	
05 pm	7370	23.11	884,800		7,517			4.00					
.00 am	7725	23.62	930,000		7,639								
20 am	8165	24.02						4.06					
0	8235	24.10	996,700		7,847	$1\frac{1}{8}$	2	4.06				Council. Note Av. between 4.30 + 8.30 am (12/10/1982) = 7,737	

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98m				
ime MT	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
9.30 am	8295	24.80	1,002,700		6,000	$1\frac{1}{8}$	2	4.06 *				* Dunne's Reading = 4.06 .
0.30	8355	24.50	1,010,500		7,800	$1\frac{1}{8}$	2	4.06 *				Council .
1.30	8415	23.85	1,017,700		7,200	$1\frac{1}{8}$	2	4.06 *				Council . reading = 4.6m .
2.30	8475	23.69	1,025,500		7,800	$1\frac{1}{2}$	$2\frac{1}{4}$	4.06 *				Accept 4.06
1.30	8535	23.90	1,033,900		8,400	$1\frac{5}{8}$	$2\frac{1}{2}$	4.06 *				Readings (estimated)
2.30	8595	23.77	1,040,700		6,800	$1\frac{3}{4}$	$2\frac{5}{8}$	4.06 *				Appear to be fluctuate .
3.30	8655	23.89	1,048,300		7,600	$1\frac{3}{4}$	$2\frac{5}{8}$	4.06 *				Council .
4.30	8715	23.88	1,055,800		7,500	$1\frac{3}{4}$	$2\frac{5}{8}$	4.06 *				
7.30 pm	8895	23.98	1,078,700		7,633			4.06 *				Dunne's reading .
2.00 am	9165	23.87	1,112,700		7,555							
8.00 am	9645	23.75										
8.30 am	9675	23.93	1,178,300		7,717	$1\frac{5}{8}$	$2\frac{1}{4}$	4.06 *				Council Meter reading
9.30	9735	23.96	1,184,300		6,000	$1\frac{5}{8}$	$2\frac{1}{4}$	4.06 *				Council . again appear to
0.30	9795	23.94	1,191,700		7,400	$1\frac{5}{8}$	$2\frac{1}{4}$	4.06 *				Council . fluctuate .
1.30 am	9855	23.87	1,199,900		8,200	$1\frac{5}{8}$	$2\frac{1}{4}$	4.06 *				Council.

TEST [PUMPING] DATA SHEET

		BORE 2 Static Level = 0.0m				Weir (4 ft.)		BORE 1 Static Level = 1.98m				
[Tim]e	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
.30 pm	9915	23.79	1,207,100		7,200	$1\frac{5}{8}$	$2\frac{1}{2}$	4.06				Council
30	9975	23.76	1,214,700		7,600	2	$2\frac{3}{4}$		Water levels			Council
30	10035	23.84	1,222,300		7,600	2	$2\frac{3}{4}$		not recorded as			Council
30	10095	23.69	1,229,800	122	7,500	$2\frac{1}{8}$	3		pump being			Council, 125 gpm - meter 120 gpm - barrel
30	10155	23.72	1,237,400		7,600	$2\frac{1}{8}$	3		installed			Council
30 am	11115	23.88	1,358,800	116	7,696	$1\frac{1}{2}$	$2\frac{1}{4}$					Council
30	11175	23.85	1,365,100		6,300	$1\frac{1}{2}$	$2\frac{1}{4}$		ditto			Council
30 am	112.35	24.08	1,372,300		7,200	$1\frac{3}{8}$	$2\frac{1}{8}$					Council

[Not]e: (1) Test on both wells began at 11.15 a.m. - 14/10/1982

(2) From this point onwards 10.59 metres should be added to actual readings on water level in Bore 1 (6")

Actual readings are given.

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.0m				Weir (4 ft.)		Revised BORE 1 Static Level = 1.98 - 0.59m				
Time GMT	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
11.15 am	0.0	24.14	1,378,200					3.62				2 pumps operating.
11.15½	0.5	24.13										
11.16	1.0	24.14										
11.16½	1.5	24.14						6.75				
11.17	2.0	24.15										
11.17½	2.5	24.16						7.65				
11.18	3.0	24.17						8.20				
11.18½	3.5	24.19										
11.19	4.0	24.23						8.36				
11.19½	4.5	24.26						8.76				
11.20	5.0	24.31	1,379,000		9,600							
11.21	6.0	24.38						9.00				
11.22	7.0	24.38						9.60				
11.23	8.0	24.58						9.90				
11.24	9.00	24.65						10.27				
11.25	10.0	24.75										

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
e	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
26 am	11.0	24.83						10.61	7,734,100			
27	12.0	24.90						10.88				
29	14.0	25.00	1,380,100		7,333			11.15				
31	16.0	25.17						11.45	7,735,400		15,600	Bore 2 water level
33	18.0	25.30						12.25				result in doubt as
35	20.0	25.50						12.72				tape was near pump.
37	22.0	25.85	1,380,900		6,000			12.95				→ trottle back Pump 2.
39	24.0							13.18	7,737,200		13,500	to 101 gpm (est.).
41	26.0							13.38				→ Trottle up Pump 2
43	28.0	21.80						13.60				to 130 gpm (est.).
45	30.0	23.30						13.78	7,738,600		14,000	
47	32.0	24.40						13.98				→ Trottle back Pump 2
51	36.0	24.37						14.12				to 120 gpm (est.).
55	40.0	24.33	1,383,200		7,666			14.33				
59 am	44.0	24.29						14.59				
03 pm	48.0	24.27						14.80				Note ~~Bore 1~~ BORE I = 200 gpm (meter).

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00 m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
Time GMT	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
12.07 pm	52	24.31						14.95				
12.11	56	24.35	1,385,100		7,125			15.09				Note Bore 2 = 119 gpm (meter)
12.15	60	24.45						15.25	7,744,300		11,400	
12.15	60	24.45				$1\frac{3}{8}$	3					Council reading.
12.20	65	24.55						15.41				
12.25	70	24.62	1,387,000		8,142			15.53				
12.30	75	24.60						15.67				
12.35	80	24.54						15.80	7,748,600		12,900	
12.45	90	24.61						15.98				
12.49	94							15.98	7,751,300	(Council).	11,572	Bore 1 = 175 gpm (meter).
12.55	100	24.70						16.06				
12.58	103							16.15		(Council).		Bore 1 = 171 gpm (meter).
1.03	108							16.24				(Council).
1.05	110	24.76						16.24	7,753,700		9,000	
1.06	111									(Council).		Bore 1 = 173 gpm (meter).
1.09	114								7,754,700		15,000	(Council).

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
e	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
15 pm	120	24.20	1,392,800		6,966	1¼	2⅞	16.35	7,755,700		10,000	Council
35	140	23.83						16.53				
55	160	24.15	1,398,600		8,700			16.68	7,761,000			
00	165							16.68				Council, Bore 1 meter stopped at 7,761,000.
08	173											
5	180	24.02	1,400,600		6,000			16.83				
35	200	24.01	1,402,800		6,600			16.98				
5	220								7,762,600			
5	240	24.14	1,406,500		5,550	1¼	2⅞	17.08	7,766,200		10,800	Council — Note Bore 1 appeared
8	253	24.19										Council. — to increase output at 3.00 pm
3	258							17.15				Council. — approx (visual).
3	268											Council. — (meter) Bore 1 = 197 gpm
4	269	24.30										Council.
8 pm	273			112								Council. — Bore 2 = 115 gpm (meter).

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
ime MT	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
3.52 pm	277		1,410,900		7,135							Council.
3.55	280								7,774,600		11,586	Council.
3.55	280	24.41	1,411,100			$1\frac{1}{8}$	$2\frac{3}{4}$	17.15				
4.07	292									198.5		Council. 10-11 sec to fill 36.4 gallon container,
4.09	294								7,777,500		12,428	Council.
4.12	297							17.17				Council.
4.20	305								7,779,650		11,727	Council.
4.34	319							17.19	7,782,230		11,057	Council.
4.35	320	24.80	1,415,700		6,900			17.19				
4.35	320					$1\frac{1}{8}$	$2\frac{3}{4}$					Council.
5.13	358	24.86	1,420,100		6,947				7,790,100		12,108	Council.
5.15	360	24.86						17.19				
5.55	400	24.85	1,424,700		6,571			17.20	7,797,400		10,428	
6.35	440	24.88						17.21	7,805,400		12,000	
7.15	480		1,431,600					17.00	7,815,000		14,400	No 2 pump stop at 7.00 pm (?) (approx).
8.15 pm	540	19.64	1,439,200					17.26	7,825,600		10,600	

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
me T	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
9.15 pm	600	20.00	1,446,000					17.31	7,836,700		11,100	
0.15 pm	660							17.35	7,847,100		10,400	
1.15 pm	720											
2.15 am	780	20.96	1,467,300		7,100			17.41	7,870,800		11,850	
1.15	840	21.55	1,477,400		10,100			17.41	7,882,600		11,800	Av. = 7,100 gpm
2.15	900	21.71	1,481,500		4,100			17.41	7,894,400		11,800	i.e., 10,100 + 4,100 ÷ 2
3.15	960	21.85	1,488,800		7,300			17.41	7,905,600			
4.15	1020	21.63	1,496,100		7,300			17.40	7,916,800			
6.15	1140	21.22	1,510,300		7,100			17.40	7,939,600			
8.15	1260	21.30	1,525,900		7,800			17.37	7,964,200			
8.30	1275	21.31	1,527,100			1	$2\frac{5}{8}$	17.39	7,966,300	9,000		Council.
9.30	1335	21.40	1,538,300		11,200	1	$2\frac{5}{8}$	17.42	7,975,300	13,000		Council.
0.15	1380	21.46	1,538,600					17.47				
0.28	1393							17.46				Council.
0.30	1395	21.51	1,540,900			1	$2\frac{5}{8}$	17.46	7,988,300			Council.
1.04	1429									(Council)		Bore 1 = 191 gpm (meter).

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
ime MT	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
11.10 am	1435											Council Bore 2 = 119 gpm (meter
11.14	1439			116.7								Council Barrel: 24 sec.
11.20	1445							17.54				Council
11.30 am	1455	21.47	1,548,000		7,100	1	$2\frac{5}{8}$	17.56	7,999,800		11,500	Council
12.15 pm	1500	21.52						17.61				Readings omitted.
12.30 pm	1515	21.54	1,555,200		7,200	1	$2\frac{5}{8}$	17.58	8,011,400		11,600	Council
1.30	1575	21.56	1,562,100		6,900				8,023,300		11,900	
2.15	1620	21.65						17.61				Readings omitted.
2.30	1635	21.66	1,569,400		7,300	1	$2\frac{5}{8}$	17.59	8,033,800		10,500	
3.30	1695	21.59	1,576,200		6,800	1	$2\frac{1}{2}$	17.59	8,044,900		11,100	
4.15	1740									197		Council 181 gal in 55 secs.
4.15	1740	21.70						17.62				Readings omitted.
4.17	1742								8,054,300			Council
4.20	1745									(Council)		Bore 1 186 gpm meter
4.30	1755	21.76	1,582,800		6,600	1	$2\frac{1}{2}$		8,056,300		11,400	Council 3.30 - 4.30 pm
6.15 pm	1860	21.70	1,595,200		7,085			17.65	8,075,900		11,200	

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
e	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
8.15 pm	1980	21.70	1,609,500		7,150			17.70	8,097,200		10,650	
0.15 pm	2100							17.73	8,171,700	Overnight	12,250	
2.20 am	2225	21.72	1,634,400		6,095			17.75	8,137,400	Readings	7,850	Time + readings doubtful
5.20 am	2525							17.76	8,161,500	in doubt.		meter stopped at 8161500.
5.40 am	2545	21.75	1,772,600									→ Should this be 1672600 (?).
			Note: Overnight readings (morning 15/10/1982) are in doubt									
			However they may be of use as the rate of increase									
			of drawdown in Bore 1 may be needed (these are the final measurements									
			of drawdown in Bore 1).									
9.12am	2757								8,161,500			114 gpm Bore 2 (meter).
9.13 am	2758		1,699,400									
9.15	2760	21.80	1,699,600									→ Pump No. 2 stopped
9.16	2761	16.6								Council		after taking 9.15 readings.
9.16½	2761½	13.2										
9.17	2762	12.35										

TEST PUMPING DATA SHEET

Time GMT	Lapsed Time (mins)	BORE 2 Static Level = 0.00m: Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr	Weir (4 ft.): Weir A ins.	Weir B ins.	BORE 1 Static Level = 1.98 - 0.59m: Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
9.17½ am	2762½	10.6										
9.20	2765	6.9										
9.22	2767	6.5										
9.26	2771	6.3										
9.27	2772							17.55				Note: 17.55 = water level in Bore 1 with pump
9.30	2775	6.05								Council		No. 2 stopped 12 minutes.
9.32	2777	6.02								Readings.		
9.33	2778							17.47				
9.35	2780	5.95										
9.40	2785	5.90										
9.41	2786		1,699,600									Restart No. 2 pump, 26min stop.
9.45 am	2790		1,700,100									Heavy Rain: Council.
			Note: from 4.30 p.m. (15th) to 9.13 (16th)									
			Av. Bore 2 = 6961 gph									

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
...e ...	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
.00 am	2805									187		181 gallon container.
.30 am	2835	21.65	1,705,000					17.44	8,174,700			Council Readings
.45 pm	3030	22.22	1,728,900		7,353				8,208,600		1,430	Tape trapped Bore 1.
.30 pm	3255	23.37	1,754,900		6,933				8,247,100		10,266	
.31 pm	3556								8,298,600		10,198	
.33	3558	22.60	1,790,200		6,990							
.16 pm	4441								8,451,000	184	10,332	Council.
.21	4446		1,893,000		6,945							Council.
.26	4451											Council.
.27	4452	22.70										Council.
.39 pm	4464									(Council)		→ Bore 1 173 gpm (meter = 10,380 gph

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
ime MT	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est. /hr.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
3.30 am	5595	5.6	2,010,800*						8,489,600*			*No. 2 pump stopped
3.45	5610	5.55										* No. 1 meter stopped
9.00	5625	5.49										
9.15	5640	5.47						Tape				
9.30	5655	5.46						Trapped				
0.30	5715	5.33										
1.15	5760											Restart Pump 2
1.59 am	5804	22.65	Shut down the 2 pumps and start measuring recovery rates.									

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
9 am	0.0	22.65										Tape can only record
	0.5	20.00						>6.2				to 6.2m in Bore 1 .
0 pm	1.0	16.45										Note (>) = Greater than .
	1.5	13.80										
1	2.0	11.50										
	2.5	9.90										
2	3.0	8.70										
	3.5	7.94										
3	4.0	7.40										
	4.5	7.00										
4	5.0	6.70										
5	6.0	6.35										
6	7.0	6.00										
7	8.0	5.88										
8	9.0	5.75										
9	10.0	5.68										

TEST PUMPING DATA SHEET

RY		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
e	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
.10 pm	11.0											
.11	12.0											
.13	14.0	5.42						>6.20				
.15	16.0	5.34										
.17	18.0	5.27										
.19	20.0	5.21										
.21	22.0											
.23	24.0	5.10										
.25	26.0	5.05										
.27	28.0	5.00										
.29	20.0	4.96										
.31	32.0	4.93						>6.20				
.35	36.0	4.84										
.39	40.0	4.77										
.43	44.0	4.70										
.47	48.0	4.64										

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
pm	52.0	4.57										
	56.0	4.51										
	60.0	4.44										
	65.0	4.36										
	70.0	4.31						>6.20				
	75.0	4.24										
	80.0	4.17										
	90.0	4.07										
	100	3.95										
	110	3.83										
	130	3.63										
	140	3.52						>6.20				
	160							5.72				
	164	3.38										
	167							5.55				
	170							5.50				

TEST PUMPING DATA SHEET

ERY		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
e	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
.51 pm	172							5.45				
.55	176							5.73				
.58	179							5.31				
.59	180	3.25										
.04	185							5.18				
.12	193							5.04				
.19	200	3.06										
.26	207							4.80				
.30	211							4.74				
.44	225							4.53				
.46	227	2.88										
.00	241							4.35				
.15	256							4.17				
.26	267	2.66										
.30	271							4.03				
.30	631	1.41						2.49				

TEST PUMPING DATA SHEET

		BORE 2 Static Level = 0.00m				Weir (4 ft.)		BORE 1 Static Level = 1.98 - 0.59m				
	Lapsed Time (mins)	Water Level (mts)	Meter Reading (gals)	Barrel Test (gpm)	Q Est.	Weir A ins.	Weir B ins.	Water Level (mts)	Meter Reading (gals)	Container Test (gpm)	Q Est. /hr.	Remarks
am	1231	0.65						1.75				
am	1351	0.53						1.65				Note: 1 day recovery at 11.59 am
pm	1801	0.19						1.40				
am	280.	0.00						1.09*				* This appears to recover
												beyond original static level.

B + Chemical Analysis Report

BORE 1

Location: Mitchelstown Bore

Parameter	14/10/1982	16/10/1982		Limits
Appearance	Clear	Clear		(E.E.C. 1980) Guide Max
Colour (Hazen)				1 20
Conductivity				400
S. Solids	0	0		None
Total Dissolved Solids				1500
pH	7.31	7.17		6.5-8.5 9.2
pHs	7.93	7.86		
Alkalinity ($CoCo_3$)	139	137		
Total Hardness				
Non-Carbonate Hardness				
Ammonia	Not detected	Not detected		0.05 0.5
Nitrates	4.8	5.1		25 50
Nitrites	Not detedted	Not detected		0.1
Chlorides				25
Sulphates				25 250
O-Po4	0.025	0.035		
Fluoride				0.7 1.5
Aluminium				0.05 0.2
Iron				0.05 0.3
Manganese				0.02 Who .5 0.05
Lead				0.05 0.1
Copper				0.1 3.0
Zinc				0.1 5.0
Bacteriological				
Std. Plate Count @ 22°C & 37°C	60 & 1	Not Analysed		
Coliform	0			

B + Chemical Analysis Report

BORE 2 | Location: Mitchelstown Bore

Parameter	7/10/1982	9/10/1982	14/10/1982	Limits	
Appearance	Clear	Clear	Clear	(E.E.C. 1980) Guide	Max
Colour (Hazen)				1	20
Conductivity	86			400	
S. Solids	Nil		1	None	
Total Dissolved Solids					1500
pH	6.66)) -.8	6.87)) -.9	7.53	6.5-8.5	9.2
pHs	7.42)	7.77)	7.82		
Alkalinity ($CoCo_3$)	96	93	95		
Total Hardness	119	116	118		
Non-Carbonate Hardness	23	23	23		
Ammonia	Not detected	Not detected	Not detected	0.05	0.5
Nitrates	5.6	4.0	6.2	25	50
Nitrites	Not detected	Not detected	Not detected		0.1
Chlorides	20.5			25	
Sulphates				25	250
O-Po4	0.03	0.026	0.03		
Fluoride				0.7	1.5
Aluminium				0.05	0.2
Iron	Not detected	0.05		0.05	0.3 Who .5
Manganese	Not detected	Not detected		0.02	0.05
Lead	Not detected	Not detected		0.05	0.1
Copper	Not detected	Not detected		0.1	3.0
Zinc	Not detected	Not detected		0.1	5.0
Bacteriological					
Std. Plate Count @ 22°C & 37°C			32 & 3		
Coliform	0		0		

B + Chemical Analysis Report

BORE 2 Location: Mitchelstown Bore

Parameter	16/10/1982			Limits (E.E.C. 1980) Guide	Max
Appearance	Clear				
Colour (Hazen)				1	20
Conductivity				400	
S. Solids	0			None	
Total Dissolved Solids					1500
pH	6.70			6.5-8.5	9.2
pHs	7.90				
Alkalinity ($CoCo_3$)	90				
Total Hardness	117				
Non-Carbonate Hardness	27				
Ammonia	Not detected			0.05	0.5
Nitrates	6.2			25	50
Nitrites	Not detected				0.1
Chlorides				25	
Sulphates				25	250
O-Po4	0.025				
Fluoride				0.7	1.5
Aluminium				0.05	0.2
Iron				0.05	0.3
Manganese				0.02	Who .5 0.05
Lead				0.05	0.[illegible]
Copper				0.1	3.0
Zinc				0.1	5.0
Bacteriological					
Std. Plate Count @ 22°C & 37°C	N.A.				
Coliform					

Well & Pump Data

Well No 1 (mono pump) electric motor driven. (See sketch)

Total depth = 205 feet = 62.48m

Depth of 6" line = 68 feet = 20.72 m

Depth to top of pump = 84 feet = 25.60m

Depth of pump intake = 90 feet

Original Static Level = 1.98 metres

Drawdown at end of Stage 1 = 4.06 metres

Drawdown (Stage 2) as measured on 16/10/1982 (5.40 am) = 17.76m
+ 0.59m = 18.35m (corrected measurement)

Recovery as measured 20/10/1982 (10.40 am) = 1.09m + 0.59m = 1.68m (corrected measurement)

Note: On 13/10/1982, 0.59 metres was cut off 6" liner to facilitate pump installation.

Well No. 2 submersible pump (20 h.p.)

Total depth of well = 100 feet = 30.48m

Depth of (10") liner = 100 feet = 30.48m

Depth to top of pump = 84 feet = 25.60m

Depth to pump intake = 88 feet = 26.82m

Original Static Level = 0.00 m (overflow

Drawdown at end of Stage 1 = 22.69 m

Drawdown Stage 2 = 22.70 m (fluctuating)

Recovery measured 20/10/1982 (10.40 am) = 0,00m (overflow)

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Well No. 1 and Well No. 2 (relative heights)

Difference between top of 6" line (Well No. 1) and 10" liner (Well No. 2) = 0.55 metres - Well No. 1 being higher

Difference between top of Well No. 1 + Well No. 2 (after 0.59m was cut off Well No. 1 Liner) = 0.04m - Well No. 2 being higher

Well No. 1 and Well No. 2 - Distance between bores = 58.3 metres p Data

(mono pump) electric motor driven. (See sketch)
h = 205 feet = 62.48m
" line = 68 feet = 20.72 m
op of pump = 84 feet = 25.60m
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(corrected measurement)

Well No. 2 submersible pump (20 h.p.)
Total depth of well = 100 feet = 30.48m
Depth of (10") liner = 100 feet = 30.48m
Depth to top of pump = 84 feet = 25.60m
Depth to pump intake = 88 feet = 26.82m
Original Static Level = 0.00 m (overflow
Drawdown at end of Stage 1 = 22.69 m
Drawdown Stage 2 = 22.70 m (fluctuating)
Recovery measured 20/10/1982 (10.40 am) = 0,00m (overflow)

3/10/1982, 0.59 metres was cut off 6" liner to facilitate
installation.

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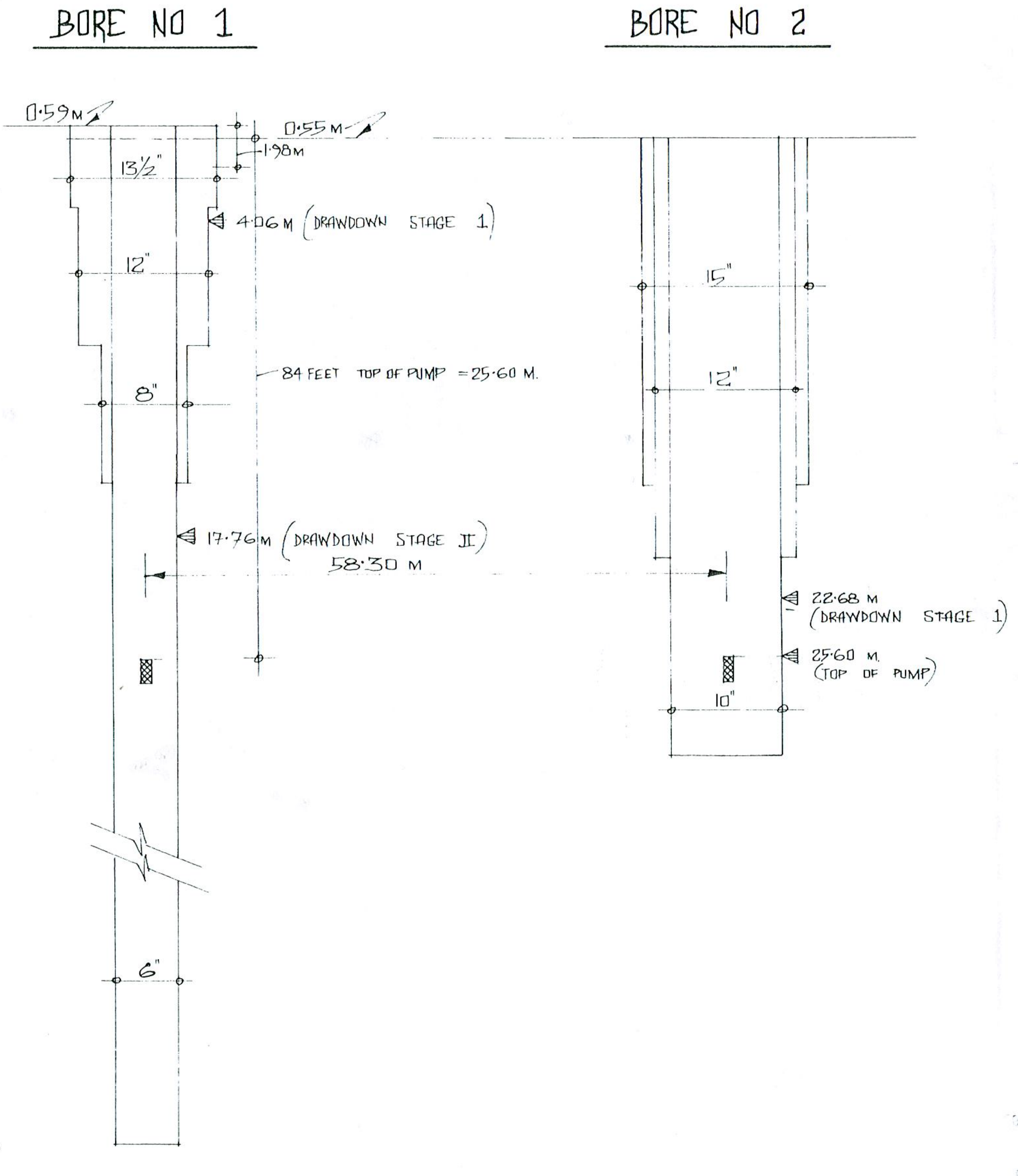
and Well No. 2 (relative heights)
between top of 6" line (Well No. 1) and 10" liner (Well No. 2) = 0.55 metres - Well No. 1 being higher
between top of Well No. 1 + Well No. 2 (after 0.59m was cut off Well No. 1 Liner) = 0.04m - Well No. 2 being higher

and Well No. 2 - Distance between bores = 58.3 metres

0·55 M. = ORIGINAL DIFFERENCE BETWEEN BORE 2 AND BORE 1 (BORE 1 BEING HIGHER)

0·59 M. CUT FROM BORE 1 BRINGS THE DIFFERENCE TO 0·04 M (BORE 2 BEING HIGHER)



OBSERVATIONS:

Stage 1 (Pumping No. 2 well)
It would appear that Well No. 2 had an output of approx. 7,300 g.p.h. However this pump fluctuated quite a lot during the test. This was in part due to problems with the generator and partly due to fact that drawdown at times was very near to top of pump and this necessitated trottling down pump.
Drawdown in Well No. 1 appeared to be steady at 4.06 metres.

Stage 2 (Pumping both No. 1 and No. 2 Wells)
It would appear that Well No. 2 had an output of approximately 6,950 g.p.h. during this stage with a drawdown of approx. 22.60 m (fluctuating). It would appear that Well No. 1 had an output of approx 11,044 g.p.h. with a drawdown in the region of 17.76 m (16/10/1982 at 5.40 am). Pump No. 1 ran reasonably well during Stage 2.
The meter on Pump No. 2 was reasonably accurate. It was checked against barrel of capacity 46.7 gals.
The meter on Pump No. 1 gave a lot of problems. In fact it stopped on a number of occasions. In estimating the output of Pump No. 1 it would therefore be safer to use the container test. Towards end of Stage 2 container test was fairly consistant, filling 181 gals. container in 58 - 59 secs.

Recovery
Recovery measurements were all taken by Council Officials. As measuring tape was stuck in bore 1 we were unable to measure any recoveries greater than 6.2 meters. It would appear that the initial recovery was quicker in bore 2 than bore 1. However we must take into account that bore 2 was recovering from a "false" reading. Pump was stopped from early morning. It was restarted at 11.15 a.m. and ran until 11.59 am (18/10/1982).
An indication of how bore no. 2 really recovers may be got from results on 16/10/1982 (Saturday) when no. 2 pump stopped and recovery rate was recorded.
Note: Well No. 1 recovered to 1.09 + 0.59 = 1.68m. The original static being 1.98 meters.