

**CAPPAMORE FAILEEN/BILBOA  
PUBLIC SUPPLY**

**GROUNDWATER SOURCE PROTECTION ZONES**

(DRAFT)

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# CAPPAMORE FAILEEN/BILBOA PUBLIC SUPPLY

## 1. SUMMARY OF WELL DETAILS

GSI no.	: 1715SWW034
Grid ref.	: 18172, 15677
Owner	: Limerick Co. Co.
Well type	: Spring
Elevation	: ~260 m OD (Poolbeg)
Depth	: 3 m
Depth-to-rock	: $\geq 3$ m
Static water level	: ~1 m b.g.l.
Abstraction rate	: 336 m <sup>3</sup> /d (~74,000 gal/d)
Average overflow	: 205 m <sup>3</sup> /d (~45,000 gal/d)
Total average spring output	: ~540 m <sup>3</sup> /d

## 2. METHODOLOGY

There were three stages involved in assessing the area, a detailed desk study, site visits and fieldwork, and analysis of the data. The desk study was conducted in the Geological Survey where the subsoil and bedrock geologies were compiled from the original 6" field sheets. Basic public supply well details were recorded by County Council personnel in the form of a questionnaire which included a precise location and any relevant spring flow, water chemistry and construction data available.

The second stage comprised site visits and fieldwork in the surrounding area. Walk-over surveys of the surface water catchment area were carried out which enabled an assessment of the bedrock geology, subsoils, hydrogeology and vulnerability to contamination. Three raw water samples were taken for full suites of chemical and bacterial analyses, in September 1993, April 1994 and March 1995.

Stage three, the analytical stage, utilised water balance equations and hydrogeological mapping to delineate the catchment area and hence identify the groundwater protection zones.

## 3. WELL LOCATION AND SITE DESCRIPTION

The Faileen Spring lies on the easterly bank of the Glashacloonaraveela River, in its upper valley region (Fig. 1). It is enclosed in a rectangular concrete collecting chamber which is surrounded by a barbed wire fence. The spring overflow discharges directly into the river. Access to the site is via private property to the south, approximately 25 minutes walk along the river bank. At present the Faileen source is a backup supply to the Glasha River source which supplies the village of Cappamore and it is only used in the summer months.

## 4. TOPOGRAPHY, SURFACE HYDROLOGY AND LAND USE

The spring is located on the southerly flank of the Slieve Phelim Mountains, at an elevation of approximately 260 m OD (850 ft). The mountains rise to a height of 410 m to the west and 464 m to the east (Cullaun), and fall off in a series of terraces to the deeply incised river valley (with cliffs up to 27 m depth in places). The valley slopes away in a southerly direction (Fig. 1).

The Glashacloonaraveela River starts about 1 km north-west of the source at two rises, which merge to the north of the site to form the southerly flowing river. Surface drainage is often poor in the lower terraced area, although it is enhanced in places with the construction of drainage channels. Up-slope of the spring to the northeast of the site, the ground is fairly dry and there are no surface streams apart from a small stream, which enters the river upstream of the source, from a deeply incised valley.

The land is primarily used for forestry and much of the area is owned by Coillte. There are also one or two farms at higher elevations, which are serviced by a minor access road from the east.

## **5. GEOLOGY**

### **5.1 Bedrock geology**

The bedrock in the area is Silurian in age and includes sandstones, slates and shales. Outcrop to the north of the site in the stream beds comprise grey and greenish grits. These rocks are fractured and broken, and have also undergone a certain degree of folding; beds vary in dip from 20–60° in northerly, southerly and easterly directions.

### **5.2 Subsoils (Quaternary) geology**

The subsoils in the area comprise sands and gravels, various tills, slope deposits and till-with-gravel, with some thin overlying peat in places (Fig. 1). The deposits in the southerly end of the valley are dominated by Old Red Sandstone lithologies which generally have a sandy texture while the Silurian dominated deposits further up the valley are often silty. A section opposite the source on the western side of the valley, exposes a loose sandy deposit with substantial gravel. The spring source has been dug out from the sands and gravels.

The majority of the sediments can be interpreted as part of an ice marginal environment but two main types of deposits can be identified. Basal till sections are found high up in the stream valley and these were observed as compacted, matrix supported deposits with some clay. These deposits would have been laid down with the advancement of the ice which would have lapped around the hills. The overlying dead ice deposits are generally loose, clast supported sands and gravels, with little clay in their makeup, and these would have been deposited at the ice margin. This interpretation is supported by the terraced morphology of the area which highlights the changes in deposits up the valley.

Iron pans, formed by the downward leaching of heavy minerals, are very common and they are present at depths of less than 1 m below surface in distinctive layers, up to 3 cm thick in places. They have been broken up in places, however, by the forestry trenching.

### **5.3 Soils**

The soils of the area to the west of the river are classified as blanket peat. To the east of the river, brown earths from the Ballylanders Series are common. These are derived from shale and sandstone dominated solifluction deposits which are underlain by mixed glacial deposits. The soils are shown on the published soils map of Co. Limerick (Finch and Ryan, 1966) and so are not reproduced here.

### **5.4 Depth-to-rock**

Outcrop in the upper stream sections indicates that rock is close to surface in the upland areas on the hill slopes (Fig. 1). Depth-to-bedrock in the immediate vicinity of the spring is not known, although it is estimated at greater than 3 m below ground level, based on the depth of the collection chamber. The river valley is deeply incised and the bluffs on either side reach up to approximately 30 m in places. As there is no bedrock outcropping in the river in these areas, it may be assumed that there is a substantial thickness of subsoils in the valley. These thicknesses are typical in ice marginal areas where extensive deposition takes place. There are no borehole data for the general area and precise depths are therefore unknown.

## 6. HYDROGEOLOGY

### 6.1 Data availability

There are few hydrogeological data for the area around the Cappamore Faileen Source and first principles of groundwater flow are therefore used. The spring discharge values are estimated using an average daily abstraction figure extrapolated over the period of one year, and an average overflow figure measured in March 1995 which is also extrapolated as daily figures were not available.

### 6.2 Groundwater levels

The static water level in the public supply spring in February 1995 was approximately 1 m below ground level (approx. 259 m OD). It is reasonable to assume that the river is in hydraulic continuity with groundwater and the water level is therefore taken as that of groundwater. As the spring is at a relatively low elevation, it is likely that the unsaturated zone is quite thick in the lower regions of the valley although this is likely to decrease in thickness in the higher regions where there is thin subsoil cover. There may be perched water tables in places due to the presence of the iron pans.

### 6.3 Groundwater flow directions

Groundwater flow direction is likely to follow topography, flowing down slope on all sides of the valley into the river channel. Flow direction will be perpendicular to the topographical contours and there will be a groundwater divide along the ridge at the top of the hills.

### 6.4 Meteorology and recharge

Rainfall data for the area are estimated using a contoured Meteorological Service map based on the long-term monthly data for the years 1941–1980, and the monthly 1993–1994 data for the nearby rainfall station at Murroe. Mean annual rainfall at the site is estimated to be in the region of 1275 mm/a. Rainfall at Murroe however was 20% higher than the average during the period November 1993 – November 1994. Assuming that the same percentage increase applies at the site, the annual rainfall for this period is estimated as approximately 1530 mm. (This rainfall period was selected as it can be related to the discharge.) Potential evapotranspiration (P.E.) is estimated from a regional Meteorological Service contoured map, and a ranking scheme with all the other sources, as 520 mm per annum. Actual evapotranspiration (A.E.) is then calculated by taking 93% of the potential figure, to allow for soil moisture deficits during part of the year. Using these figures, the average annual effective rainfall (E.R.) is taken to be approximately 1045 mm for 1994.

The subsoil deposits are highly permeable and despite the presence of the iron pans, there is only one surface stream on the eastern side of the valley, up-slope of the source. A high proportion of the effective rainfall must therefore be infiltrating to the water table. Estimating runoff to be of the order of 25%, recharge to the aquifer is taken to be *approximately* 785 mm in 1994, although the average annual recharge is approximately 595 mm/a. It is emphasised that the results are based largely on estimated values; the uncertainties are however, incorporated in the catchment area delineation.

These calculations are summarised below:

	<b>1994 values</b>	<b>Mean annual values (1941–1980)</b>
Annual rainfall	1530 mm	1275 mm
Estimated P.E.	520 mm	520 mm
Estimated A.E. (93% P.E.)	485 mm	485 mm
Effective rainfall	1045 mm	790 mm
Recharge (75% E.R.)	approx. 785 mm	approx. 595 mm

The presence of the forestry in the area is an additional factor which must be taken into consideration, as many studies have shown that forestry plantations can reduce the infiltration to groundwater by 20–30% (summarised in *Flooding in the Gort-Ardrahan Area*, Daly, D., 1992, GSI publication). Only trees which are 10 years old or greater however, will have an influence. It is estimated from Coillte data, that in this catchment area, approximately 10% of the land surface falls into this category, at the present time. Recharge in these areas will therefore be slightly less (~715 mm in 1994) and this must be accounted for in the Recharge Equation (refer to Section 8).

## 6.5 Hydrochemistry and water quality

The hydrochemical analyses of groundwater at the Faileen source are indicative of a **moderately soft to moderately hard** water (64–183 mg/l (CaCO<sub>3</sub>)), with low alkalinity (52–66 mg/l (CaCO<sub>3</sub>)). Conductivities are also relatively low at 17–167 µS/cm.

The routine analyses carried out by the Council for the purposes of the EC regulations are of limited use in assessing the water quality of the Faileen Spring, as the samples are taken from private residences in Cappamore and this supply also includes water taken from the Glasha Spring. From the three analyses taken as part of the study however, it appears that the water quality is generally excellent, with all indicator parameters at background levels.

## 6.6 Conceptual model

The aquifer supplying the Faileen source is the unconsolidated high permeability gravelly subsoil deposits. The soils were not found to be as free draining as expected and it is probable that the iron pans are causing localised perched water tables, although the absence of surface water drainage would suggest that they are not consistent over the area. The forestry trenching has also broken the iron pans up in places, and there appear to be sufficient discontinuities to enable recharge to the aquifer to occur. The discharge at the spring remains fairly constant, even during the summer months, and this would suggest that the aquifer has a reasonable storage capacity. As the level of the spring is higher than the level of the river, it is probable that groundwater flowing down the western side of the valley will discharge into the river and not at the spring. The small spring to the north of the source is likely to be perched, although groundwater may be contributing to the associated stream as it approaches the lower regions of the river valley.

## 6.7 Aquifer categories

The gravelly subsoils at the Cappamore Faileen source are considered to be a **locally important sand and gravel aquifer**. Till-with-gravel deposits are not usually classed as locally important aquifers, as generally the extent and hydraulic connection between the gravelly units is not known. In this case however, there are extensive thicknesses of a very loose sandy deposit and with the high recharge, the source can provide a supply which is adequate for the local community.

The underlying Silurian bedrock is classed as a **poor aquifer** which is **generally unproductive except for local zones**.

## 7. VULNERABILITY

Using the GSI vulnerability mapping guidelines, the area in the immediate vicinity of the Faileen source is considered to have a **probably high** vulnerability to contamination (Fig. 2), as the unsaturated zone in the gravels is >3 m thick. On the higher slopes of the valley where subsoils are likely to be quite thin, the groundwater is mapped as having a **probably extreme** vulnerability.

## 8. DELINEATION OF SOURCE PROTECTION AREAS

### 8.1 Outer Protection Area

The Outer Protection Area (SO) includes the complete catchment area to the spring and it is delineated as the area required to support an abstraction from long-term groundwater recharge.

The catchment area (Fig. 3) is controlled primarily by the river and the groundwater divide at the top of the hill, beyond which groundwater will flow in the opposite direction. The northwest and southeast boundaries are more tentative and are based on the likely groundwater flow lines.

The Recharge Equation estimates that the area required to collect enough recharge to sustain the source on an annual basis, is in the region of 0.25 km<sup>2</sup>. The area described above is significantly larger than this and will therefore incorporate an additional safety margin.

## 8.2 Inner Protection Area

The Inner Protection Area (SI) is the area defined by a 100-day time of travel from any point below the water table to the source and it is delineated to protect against the effects of potentially contaminating activities which may have an immediate influence on water quality at the source, in particular from microbial pollution.

The Time of Travel Equation was used to estimate the 100-day time of travel distance to the source. In view of the lack of definitive hydrogeological information however, conservative estimates were used for each of the relevant aquifer coefficients. Taking the permeability as 50 m/d and the hydraulic gradient as 0.004, and assigning a porosity value of 0.07, the 100-day time of travel radius is calculated as approximately 285 m (Fig. 2). The radius will only be valid within the spring catchment and so the shape of the area is amended accordingly.

## 8.3 Source Site

In addition to the Inner and Outer Areas there is a third protection area, the Source Site (SS), which is delineated as the area in the immediate vicinity of the source (minimum 10 m radius), and it is designed to maintain good wellhead sanitary protection. The Source Site will encompass an area of radius 10 m around the collecting chamber; the fenced off enclosure at present is too small.

## 9. POTENTIAL POLLUTION SOURCES

The current primary threat to the public supply at Faileen is a farm on the access road to the northeast of the site. The farmyard effluent is poorly managed and is allowed to flow onto the road and into a ditch where it ponds before slowly infiltrating into the subsoils. Fertilisers and pesticides on the forestry development may also be a problem if they are being applied; there are no analyses currently carried out for pesticides and the possible extent of any problem is not known.

## 10. GROUNDWATER PROTECTION SCHEME

Combining the Source Protection Areas, as described above, with the vulnerability ratings, delineates a total of three groundwater source protection zones for the Cappamore Faileen source. These are listed here and are shown in Figure 5 (with the exception of the Source Site):

- Source Site / High (SS – H)
- Inner Protection Area / High (SI – H)
- Outer Protection Area / High (SO – E)

It is not within the scope of this report to delineate the protection zones in the surrounding area and this is dealt with at the regional resource protection scale. The accompanying code of practice imposing restrictions on developments will follow when discussions as to the degree of restriction necessary in each protection zone have been carried out between the Council and the EPA, with assistance from the GSI.

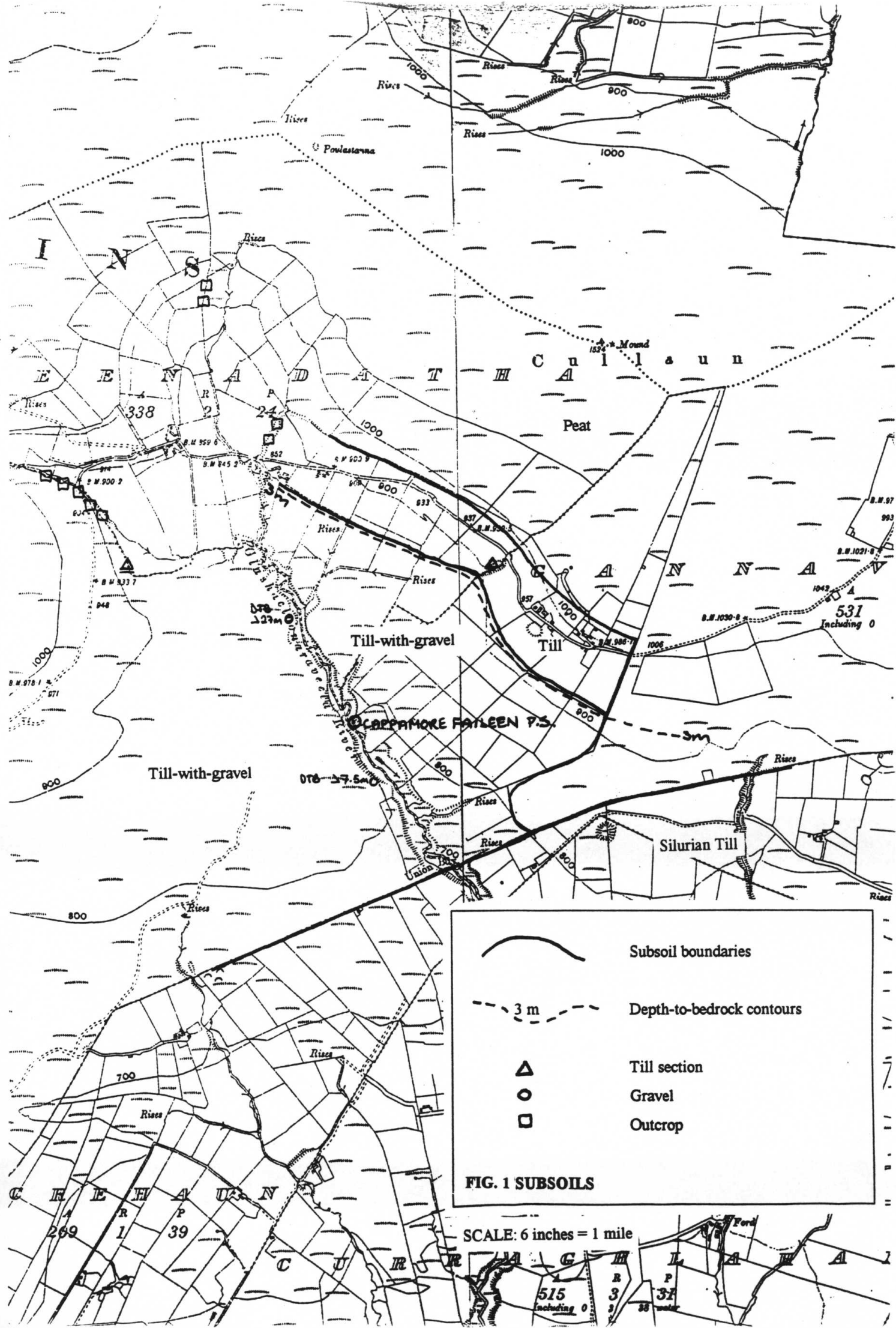
## 11. CONCLUSIONS AND RECOMMENDATIONS

Overall the source at Faileen is a good high yielding spring which is derived from a gravelly subsoil aquifer. It is highly vulnerable to pollution although at present there appear to be no problems with water quality. This may be due to the fact that there is a thick unsaturated zone which will facilitate attenuation of any possible contaminants, but is probably mainly a consequence of the relatively low levels of pollution loading in the valley.

The County Council should consider using the Faileen spring as the main source of water for the village of Cappamore and maintain the Glasha river supply as the backup. The groundwater supply will generally be more reliable in terms of water quality than the river.

It is recommended that the Council control and monitor potentially contaminating activities being carried out near the river banks and in the river valley to the northeast of the source. The farm management practices at the small farm should be addressed, and the source site, although fairly remote, should be properly fenced off.

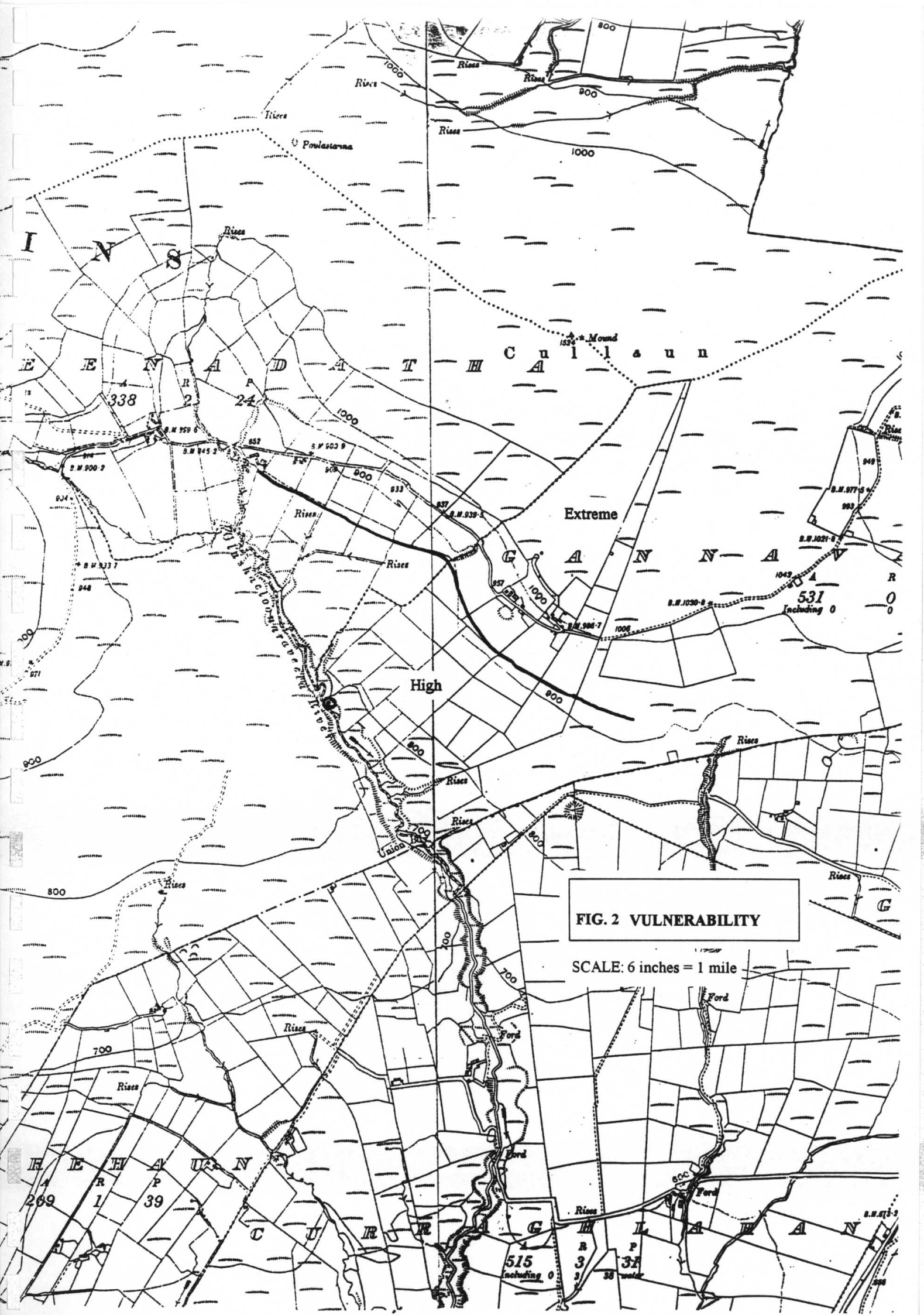
The majority of the forestry plantation was planted in 1988 and by 1998 the trees will be big enough to reduce the spring discharge by almost 20%. This should not be a problem if the demand does not increase as the overflow is quite substantial. This should be considered in terms of total water supply to Cappamore for the future. It would also be advisable to analyse for pesticides in the supply (if they are being used by Coillte) as these can persist in groundwaters for quite some time and are not easily remediated.



**FIG. 1 SUBSOILS**

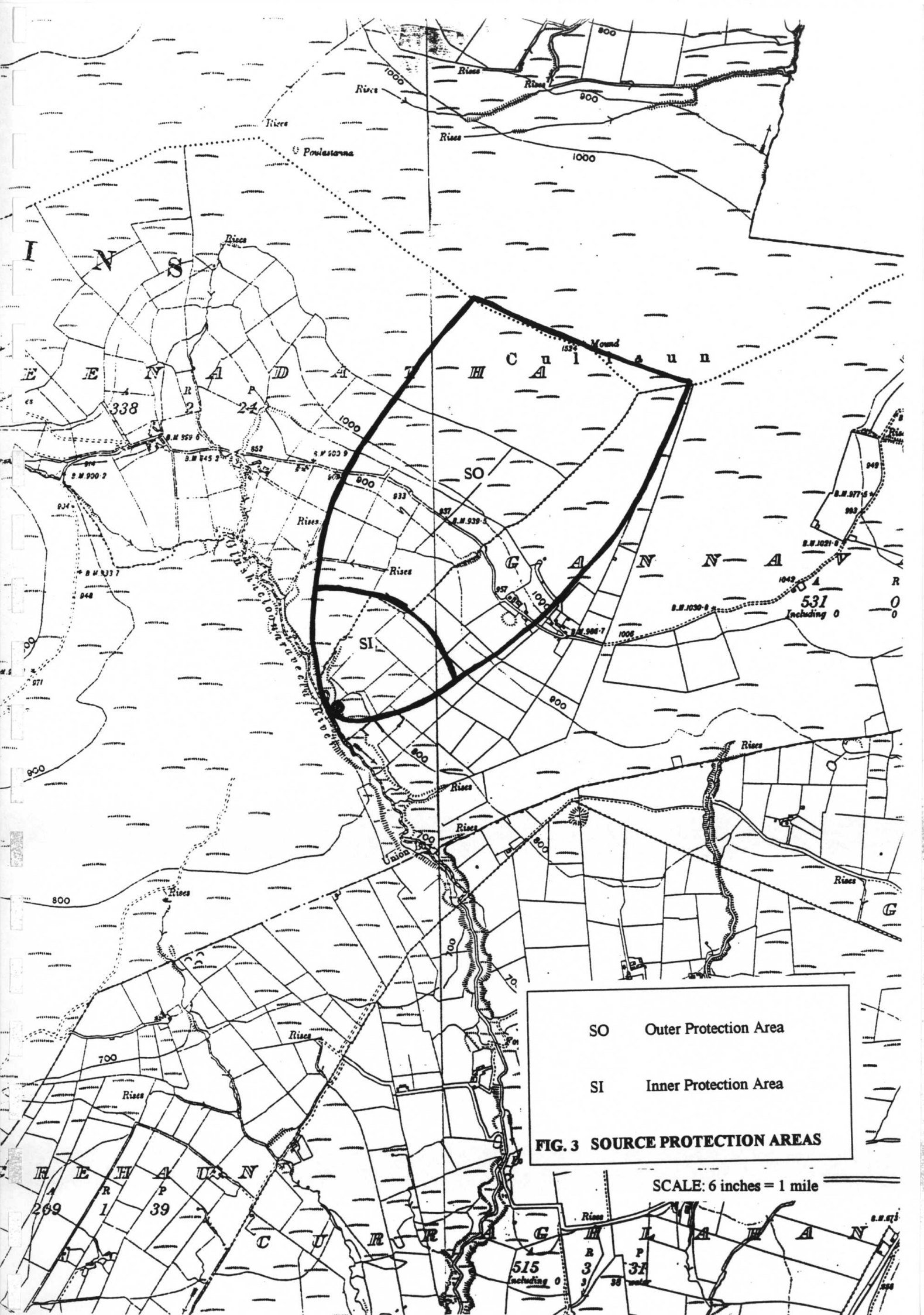
SCALE: 6 inches = 1 mile





**FIG. 2 VULNERABILITY**

SCALE: 6 inches = 1 mile



SO Outer Protection Area  
 SI Inner Protection Area

**FIG. 3 SOURCE PROTECTION AREAS**

SCALE: 6 inches = 1 mile

