# MALAKOFF CREEK (LANDSBOROUGH) WATER SUPPLY CATCHMENT

## REPORT OF THE INVESTIGATION FOR A PROPOSED LAND USE DETERMINATION


BY

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# PART 1

# BACKGROUND INFORMATION

# 1. INTRODUCTION

The Malakoff Creek catchment provides the domestic water supply for the townships of Landsborough and Navarre within the Shire of Avoca. The supply system is administered by the Shire.

The catchment is within the Wimmera River Water Supply Catchment which was proclaimed on 2 September 1959.

The Malakoff Creek catchment has been investigated for a Land Use Determination (LUD) firstly because of difficulties in obtaining sufficient water yield from the catchment to the Landsborough Reservoir and secondly because of concern over the possibility of increased residential development of the many small blocks of land in the catchment

During the course of the investigation it was resolved that a land use determination for this catchment would be most effective if it were complemented by planning controls, thereby giving integrated control over land use and development. Accordingly, as part of this investigation, a detailed Interim Development Order (IDO) and an associated Development Policy were prepared for the catchment, in conjunction with the Department of Planning and Environment. The Order and Policy were subsequently adopted by the Shire of Avoca.

# 2. WATER SUPPLY

## *2.1 Water supply system*

The Shire of Avoca system supplies approximately 30 Megalitres (ML) annually to Landsborough and Navarre. The 136 ML, Landsborough Reservoir can provide about two years supply from full capacity. However, the 73 hectares (ha) natural catchment of the reservoir is insufficient to fill it in an average year.

Dry years emphasize this: from 1925 - 32 annual rainfall averaged 102 millimetres (mm) less than the long term mean. The repetition of a similar dry period would virtually empty the storage in three years (Murphy C.C. 1978).

The Shire therefore needs to augment supply and this is presently achieved by pumping from offtakes on the Malakoff Creek and Franks Gully, which have a combined catchment of 2940 hectares.

The Shire would prefer to reduce the need for pumping by diverting additional water to the reservoir via a water race, thus enlarging the effective catchment'. Some possible alignments for this race have been surveyed and a preliminary report has been submitted to the Rural Water Commission (RWC).

In the 1982-83 drought, the Shire developed a supplementary underground water supply. The bore, located north of Landsborough, can supply 11,000 litres per hour (L/hr) to the Landsborough Reservoir. With the provision of a storage tank at the existing pumps, 18 000 L/hr could be supplied to the reservoir, which could then be considered a satisfactory supply during drought periods.

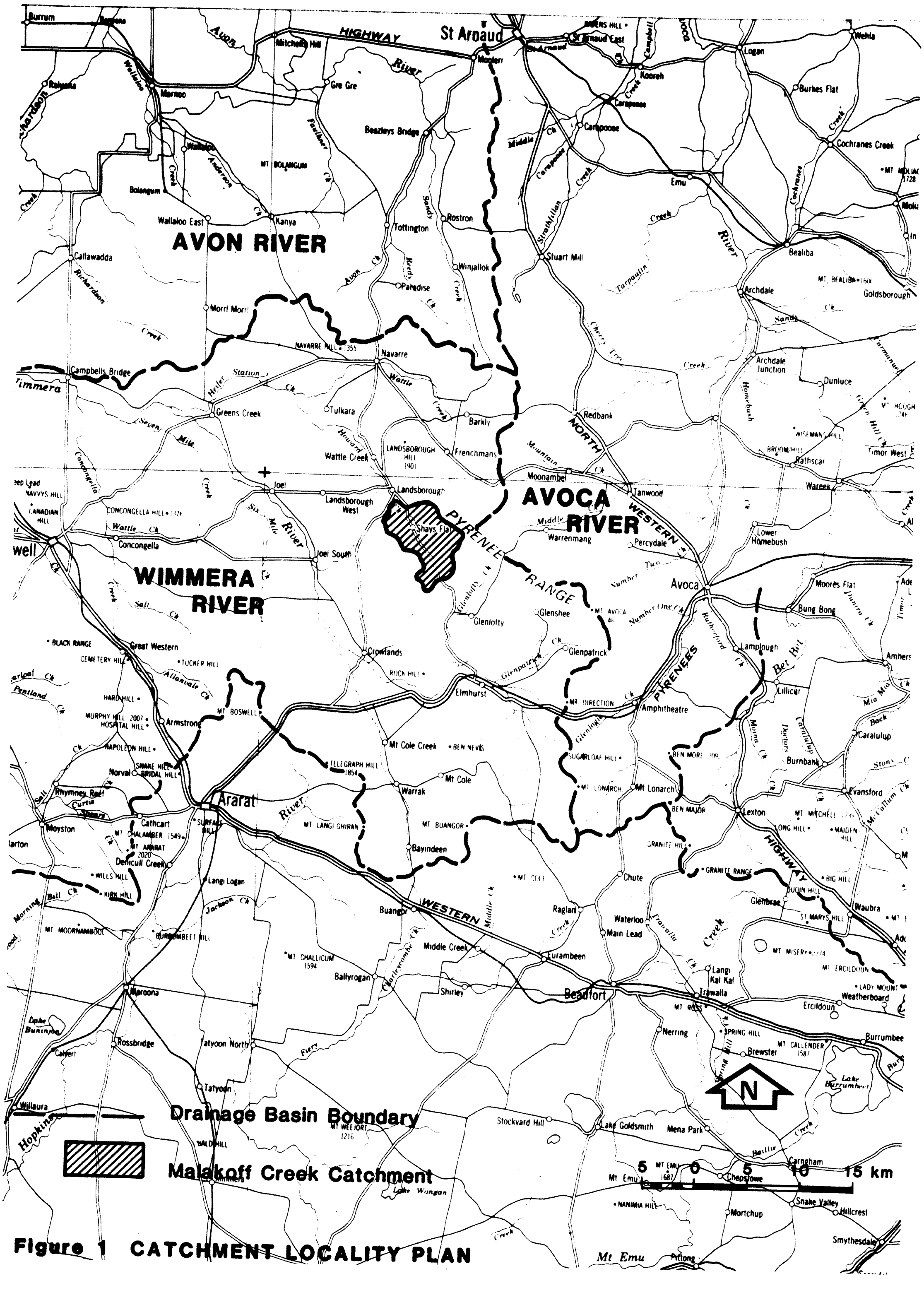
## *2.2 Water Quality*

Regular water quality sampling and analysis for bacteriological or chemical indicators are not carried out. Occasional samples have indicated moderate to high level of dissolved salts, colour, turbidity and iron in the Landsborough Reservoir and the reticulation system. Water from the bore has a moderate level of hardness. There are numerous salty seeps in the catchment, both on flat land and in the well-defined drainage lines in hilly areas. Some of the seeps have a high iron content and a water sample taken from the reservoir in June 1977 had an iron level of 4.1 milligrams per litre (mg/L), compared with the recommended standard level of 1.0 mg/L for domestic supply. High salt levels in parts of the catchment are indicated by the example of the Dredge Dam. The dissolved salt level in this dam when tested in June 1977 was 2900 mg/L. Also, some of the drainage lines above the Dam have borders of crystalline salt.

Both the use of the offtake pumps to supplement supply and the proposed water race would reduce the risk of the reservoir developing an unsatisfactory level of salt. Iron levels would be reduced by detention.

Detention would also allow settlement of suspended sediment, and aggregation of the less dispersive clays.

# FIGURE 1 - CATCHMENT LOCALITY PLAN



# 3. CATCHMENT DESCRIPTION

## *3.1 Physiography*

The Malakoff Creek catchment is located on the west side of the Pyrenees Range. The creek drains northwest into Howard Creek, a tributary of Heifer Station Creek, which drains directly to the Wimmera River, (see Figure 1). The catchment elevation falls from its highest point of approximately 760 metres (m) to approximately 250 m at the pump off take.

The catchment is strongly defined by two southeast/northwest trending ridges, Blue Mountain Range along the east side, which is high, steep and timbered; and a parallel ridge of cleared, lower hills to the west,

The Malakoff Creek runs centrally between these ridges, with a basically parallel pattern of drainage lines feeding the creek.

In the upper reaches, an apparent example of stream capture provided a good site for the Dredge Dam, which was constructed for mining use.

The present catchment area to this dam would previously have drained into Shay Creek. Following the ridge breach and stream capture, drainage lines above this point have undergone a period of accelerated down-cutting, as the course of the Malakoff Creek was at a lower elevation.

The present Pyrenees Range has been derived from an early Tertiary period peneplain which was approximately 150 m higher than at present.

By the Late Tertiary, the course of the Malakoff Creek, dissecting the western edge of the peneplain, had been established as originating at the Malakoff Gap as at present. There have since been periods of further substantial erosion and deposition.

Dunn (1912) recognised the remnants of three distinct systems of prior depositional terraces, laid down by the Malakoff Creek and located on the western flank of the catchment. The oldest of these is approximately 45 m above the present creek level.

## *3.2 Geology*

The Pyrenees Range comprises marine sediments whose age cannot be precisely determined owing to their lack of fossils; however they are assigned Cambrian-Ordovician age. The rocks are thinly bedded, tightly folded, yellow and grey sandstones, shales and soft yellow micaceous slates. The formation of slate from the bedded shale probably resulted from low-grade metamorphism accompanying the folding which was most active during the Early Silurian.

In the Malakoff Creek catchment such rock occurs as both outcrop and derived colluvium in the Blue Mountain Range along the eastern and southern sides. On the west side of the catchment the Cambrian-Ordovician sediments have been partly contact metamorphosed to schist, knotted schist and spotted hornfels.

The high level terrace remnants previously mentioned, occur along the west side of the catchment and the oldest of these comprises Pliocene gravels and sands, which include partly-rounded quartz grains. Much of this material is cemented in a reddish brown iron-rich matrix.

The lower hills on both sides of the creek are dissected alluvial terraces, probably of Pleistocene age. The deposits consist of clay, silt, sand and gravel.

The present valley floor comprises recent alluvium of clay and sand, with brown gravel in the recent leads.

### *3.3 Soils and vegetation*

Eleven soil types have been recognised in this area (Land Systems of Victoria, SCA, 1975) and three of these occupy almost 70 per cent of the catchment. The dominant soils are described below, together with the two most common of the remaining eight soil types. The main *Eucalyptus* species occurring on each soil type are also listed.

Shallow stony gradational soils (26 per cent). These soils occur on the long steep slopes of the Blue Mountain Range, on colluvium from the Cambrian-Ordovician parent rock, and on the hard rocky crests and upper slopes of the metamorphosed rock.

Surface texture is commonly gravel or stony loam, and the soil profile has a moderate to high permeability, owing to the large proportion of gravel. Soil depth is from 0.5 to 1 metre.

Native vegetation is a stringybark box open forest, the main species found being red stringybark *(E. macrorhyncha)*, red box *(E. polyanthemos),* long-leaf box *(E. goniocalyx),* yellow box *(E. melliodora),* and red ironbark *(E. sideroxylon).*

Yellow sodic duplex soils, coarse structure (22 per cent). These soils are found on the gentle lower slopes on Cambrian-Ordovician rock on the eastern side of the catchment, and on the lower slopes of the Tertiary gravel material on the western side.

These soils also have gravelly-loam surface textures, but the influence of the clay subsoil on internal drainage means the profile permeability is generally very low.

On the older rock the native vegetation is an open forest with grey box *(E. microcarpa),* and yellow gum *(E. leucoxylon).* On the Tertiary parent material, the same species occur as an open woodland with a heath understorey.

Red sodic duplex soils, coarse structure (21 per cent). These soils occur on the crests and gentle upper slopes on Cambrian-Ordovician rock on the eastern flank of the catchment.

These red duplex soils are similar to the yellow duplex described above in a having gravelly loam surface texture. The permeability is moderate to low.

These soils also carry an open forest of grey box and yellow box.

Stony gradational soils (7 per cent). These soils occur on deeply-weathered Cambrian-Ordovician rock on the crests and steep upper slopes in the Blue Mountain Range, an area receiving higher rainfall. These soils also occur on the lower slopes, on colluvial fans below metamorphosed parent material, on the western edge of the catchment.

Surface texture is a gravelly loam, and profile permeability is moderate to high. Soil depth is from 1 to 2 metres.

On the Blue Mountain Range the main tree species found on this soil are St. John's blue gum *(E. St. Johnii),* candlebark *(E. rubida)* and messmate *(E. obliqua)* in an open forest. On the metamorphic rocks the vegetation is a stringybark box open forest, similar to that found on the shallow stony gradational soils.

Mottled duplex soils with ironstone (6 per cent). These soils are found on the gentle upper slopes of lateritised terraces on the western side of the catchment. Surface texture is again a gravelly loam and permeability is moderate to low.

Native vegetation comprises open woodland of long-leaf box, red stringybark, and red box. The remaining soils are mainly alluvial soils, located in the drainage lines.

### *3.4 Climate*

**Rainfall.** The annual average rainfall at Landsborough is 505 mm, which compares with St. Arnaud (north of Landsborough) 499 mm, Stawell (west) 533 mm and Avoca (east) 573 mm.

The Pyrenees Range has a local effect on the amount of rainfall in the region, creating a rain-shadow in the valleys. The Malakoff Creek catchment would benefit from the higher rainfall along the Blue Mountain Range. The monthly rainfall distribution has a major peak occurring in July, winter being the wettest season with 166 mm.

A low peak in February resulting from a few wet days indicates the occurrence of heavy summer storms.

**Temperature.** Landsborough has no temperature recording station, so statistics from other stations in the region have been used to indicate the temperature regime. February is the warmest month of the year, having an average daily maximum temperature of about $28^{0}$C (degrees celsius). July is the coldest month, with a daily maximum of about $12^{0}$C and a minimum of about $2^{0}$C. Very high temperatures (over $35^{0}$C) occur on a few days between November and March.

**Frost.** Frequency of frost occurrence depends on humidity, wind and the characteristics of the site (landform, slope, cover, etc.), as well as temperature. The average frost free period at Landsborough is 5-6 months, and this may limit the suitability of the area for growing frost sensitive crops.

**Growing Season** The growing season depends on both the rainfall and temperature. Sufficient rainfall to initiate and maintain plant growth can be expected in the period April to October. The chance of receiving effective rainfall in the period November to March is less than 50 percent. The amount of moisture actually available to plants however will depend also on a number of soil and site factors.

Mean daily temperatures less than $10^{0}$C in June, July and August would lead to reduced plant growth rates, and on days with mean temperatures below $7.2^{0}$C no significant growth would occur.

## 4. LAND TENURE AND LAND USE

### *4.1 Public Land*

About 32 percent of the catchment is public land, located mainly on the upper eastern slopes of the catchment.

**Historic uses.** The Cambrian-Ordovician parent rock in the Malakoff Creek Catchment contains gold-bearing quartz reefs and there has been a long history of mining for reef and alluvial gold, following its discovery near the head of Malakoff Creek in October 1862.

Extraction took three forms:

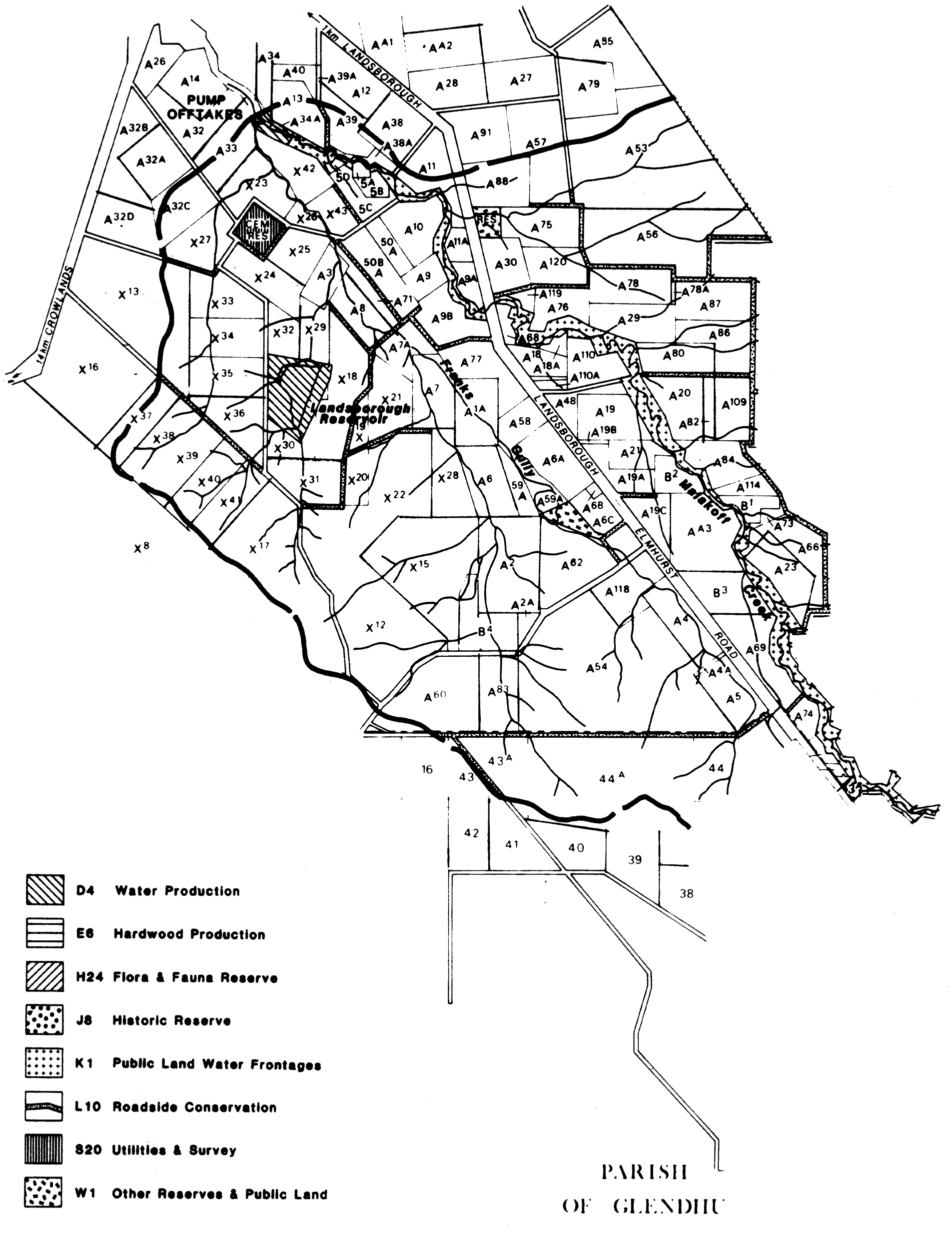
(a) shafts dug to exploit reefs;

(b) shafts, dredging and sluicing to retrieve gold deposited along the present creek course and Recent Leads, particularly the Landsborough and Malakoff Leads; and

(c) shafts to mine older leads under the prior creek terraces on the west side of the catchment, up to 45 m above the present creek level.

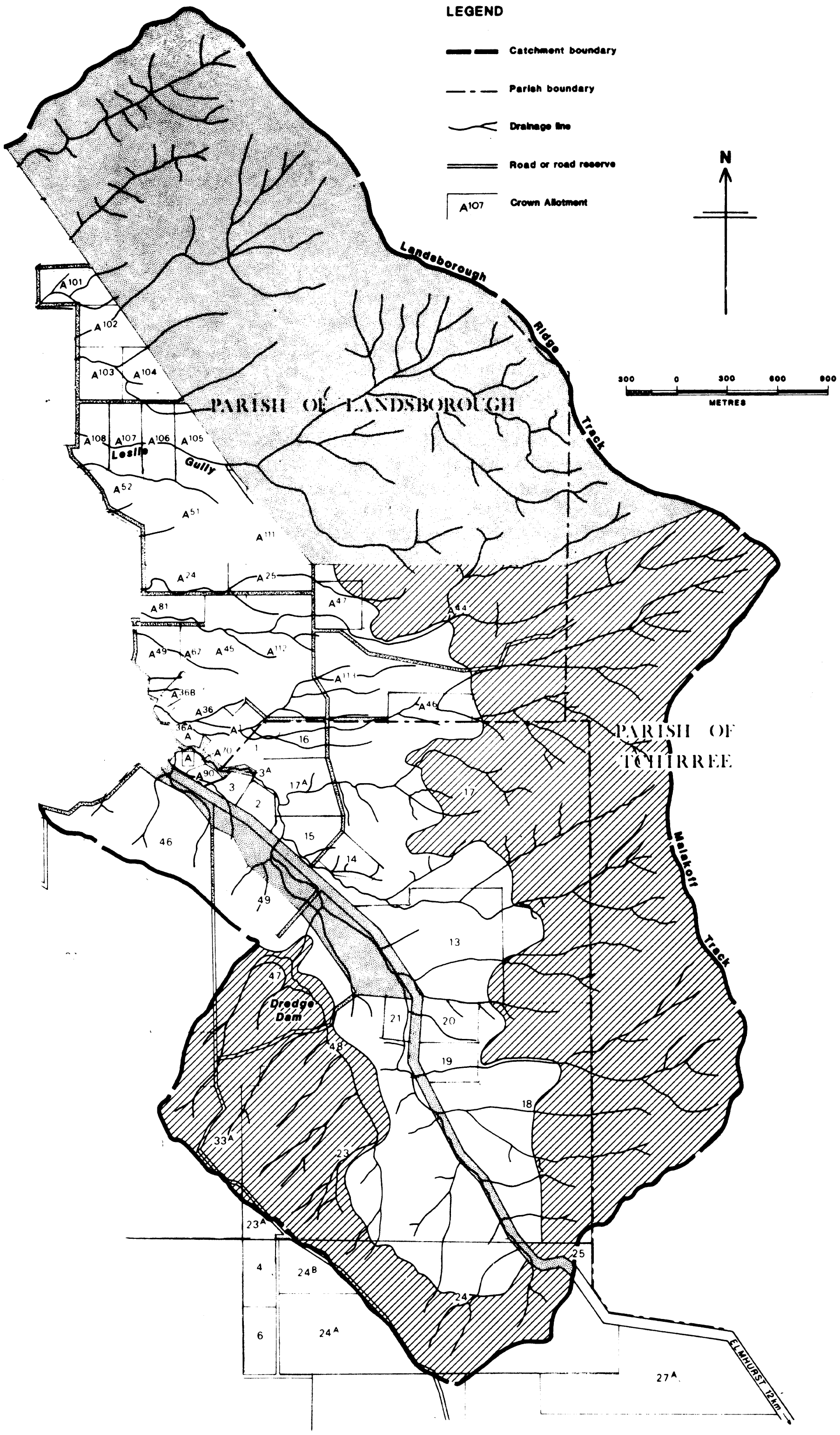
In some areas vertical shafts were dug at a density of about 70 per hectare. Most of these areas have now been filled and levelled, leaving gravel and subsoil material at the surface. Subsidence and variations in soil colour and vegetative growth identify their location.

## FIGURE 2 - LCC RECOMMENDATIONS




LANDSBOROUGH (MALAKOFF CREEK)
WATER SUPPLY CATCHMENT

**PLAN No. S-969 B**



LEGEND
Catchment boundary
Parish boundary
Drainage line
Road or road reserve
Crown Allotment
N
METRES
PARISH OF LANDSBOROUGH
PARISH OF TCHIRREE
Landsborough Ridge Track
Malakoff Track
Leslie Gully
Dredge Dam
ELMHURST 12km

Sluicing was carried out on a large scale at the Malakoff lead using water from Osman's Dam (breached) and the Dredge Dam.

During the mining period all timbered areas were heavily cut-over for mine timbers and fuel.

A charcoal burner remains near the Elmhurst Road south of the Malakoff lead and presumably local timber was also cut for charcoal production.

**Present uses.** Low intensity forestry has been the main use of this land for many years and the area is an important source of timber for firewood, poles and posts for use on surrounding farms.

Preferred species are the high-density, durable types such as grey box, red box, yellow gum and red ironbark.

The bulk of the public land has steep slopes. Access to the Landsborough Ridge (Blue Mountain Range) is via steep rough tracks and it is unlikely that these areas will be greatly used for recreation.

There is no mining at present in the catchment. However an application has been made to rework the Malakoff Lead.

Land Conservation Council (LCC) Recommendations. See Figure 2 and Appendix 1 for details of Council's Final Recommendations for the North Central Area, as they apply to the catchment. All relevant recommendations have been approved. Three recommendations cover the bulk of the public land area. These are the lands forming part of the Landsborough Flora and Fauna Reserve, H24, and part of the Pyrenees Range Forest, E6, on the eastern boundary and the Landsborough Historic Reserve, J8, which is situated on the Malakoff Lead.

### *4.2 Freehold land*

Freehold land in the catchment is located on the flats adjoining the Malakoff Creek, on the lower slopes and foothills of the ridges, and on the steep rocky hills along the west side of the catchment. It occupies 68 per cent of the catchment

**Alienation.** Freehold land in the catchment was alienated in four phases. The first phase extended from 1875 to 1885, when many rectangular 20 acre allotments were surveyed, mostly along the creeks, and probably associated with dugover and worked-out mining claims. These were probably converted residence areas, occupied by ex-miners.

The second phase, which overlapped the first, involved land selection.

Tucker (1884) describes the alienation trend after 1880;

> "instead of selectors taking up agricultural land they began to take up grazing land of the 2nd, 3rd, 4th or 5th quality of soil and not adapted to agriculture at all. They also began to take up small patches of land here and there following the course of the valleys.

This trend continued beyond 1884.

During the third phase between the early 1890's and 1920, there was a further gradual process of alienation. This alienation took two forms: firstly small blocks, often of irregular shape, were surveyed adjacent to existing blocks and alienated in the same name; and secondly, large blocks of 100 to 120 ha were alienated in the steep hills along the west and south sides of the catchment.

In the last alienation phase, between 1922 to 1932, there was a further release of 20 acre blocks. However, unlike earlier blocks of this type, these were located in the remaining poor hill country.

Cumulatively these phases produced a total of 158 allotments either wholly or partly within the Malakoff Creek Catchment. Excluding 16 large allotments, the remainder averaged 7.3 ha in area.

A gradual decrease in the number of holdings over the years had, by the mid 1970's resulted in the many allotments being held in only fourteen separate holdings.

**Present uses.** Most of the freehold land has been cleared of its native trees for agriculture. An exception is the slopes in the southwest, where about 25 percent tree cover still remains.

The freehold land is used mainly for sheep grazing, with occasional cropping of wheat and oats. Crops generally are planted in association with the establishment of improved pasture.

Farmlet and residential uses have arisen in the catchment in recent years. This was facilitated by the presence of many small allotments and the absence of specific planning control to regulate the minimum size of holdings which attracted speculative purchase of several larger holdings during the mid to late 1970's for resale as farmlet and residential sized areas. This led to the development controls, discussed in Section 6, being introduced in 1980 following SCA concern that such changes could adversely affect water supply interests.

# 5. HAZARDS TO THE WATER SUPPLY

Overcutting of timbered land for mine timbers, firewood and charcoal, and the clearing of native forest from most of the freehold land, have initiated substantial erosion. Land management problems subsequent to clearing have resulted in continued gully, tunnel and sheet erosion in the more susceptible areas.

As a result of these problems, run-off reaching the Landsborough Reservoir is frequently turbid. There is however, substantial detention time in storage which allows clarification to occur. The shire is considering undertaking erosion control measures close to the storage to reduce turbidity. Each of the major hazards is discussed in more detail below.

## *5.1 Gully and tunnel erosion*

In a study of gully erosion on Victoria's Northern Slopes region, Milton (1972) found that the following factors were associated with a high density of gully erosion

(a) poor land management, the worst situation being unimproved pasture, with rotting tree stumps and sealed soils;

(b) landform patterns which concentrate runoff, particularly onto very erodible soils;

(c) local zones of thunderstorm activity; and

(d) in the case of scour gullies, long steep slopes.

The general area around Landsborough was identified as having the highest density of gullies in the region, with 2.8 kilometres per square kilometre ($km/km^2$). The Malakoff Creek catchment has an estimated gully density of 1.2 $km/km^2$. These figures compare with the average gully density in the region of 0.5 $km/km^2$.

Around Landsborough, Milton noticed that factors (a) and (b) prevailed as extreme cases. In the Malakoff Creek Catchment the unimproved pastures on the cleared hills represent the type of poor land management characterised by Milton as factor (a).

With respect to landform pattern (b), Milton characterised the area around Landsborough as having:

'Widely spaced, steep, rocky ridges flanked by extensive bodies of impermeable, cemented gravel. Most of the valleys cut in the gravels are quite widely spaced, but narrow, so the high runoff from the ridges and gravels Is strongly concentrated in the valleys. The valleys contain two main deposits of alluvium, both of which are very erodible. One deposit is a thick, highly dispersible loam or clay, which occurs as a terrace, and has solodic soils. This material is prone to tunnelling, which is a major mechanism of headward erosion, as well as A horizon sapping. The other alluvium is earthy, and cracks into columns. It is found in the bottoms of the valleys. This material is prone to scouring, and also to tunnel-sapping between the columns.

One of its most important characteristics is the ease with which it is undercut, so gullies in it are often wide and irregular in plan.

Another indicator of the degree of gullying is Milton's Severity Index. For a given area this index is equal to the length of gullies in alluvial valleys divided by the total length of alluvial valleys, expressed as a percentage. In some areas near Landsborough, the severity index is as high as 65 per cent. This means that almost two thirds of the total possible gullies in alluvial valleys have formed. While the Malakoff Creek catchment would have a lower severity index, the land types and land uses are similar. Clearly a potential exists for further extension of the gully systems within the catchment. Management will need to acknowledge the limitations imposed on activities because of differing soil/slope factors and make appropriate adjustments to land use practices if further deterioration is not to occur.

Tunnel erosion also occurs on hillslopes and can be readily identified by dispersed clay outwash.

### *5.2 Sheet erosion*

The sealed surfaces described in Miltons' factor (a) above are actually exposed lower soil horizons, the topsoil having been lost by sheet erosion. Sheet erosion is evident on the steep slopes and foothill slopes in the freehold land and also on the lower slopes of the forested ridge on the east side of the catchment.

The most severe sheet erosion has occurred on the steep rocky hillslopes on the west side of the catchment and on other areas with unimproved pastures.

The Tertiary terraces support sparse pastures. Gross overgrazing by stock and rabbits and low-fertility soils with gravelly surfaces and clay subsoil, have resulted in pastures dominated by less-palatable prickly heaths and bare ground. However despite the generally poor surface conditions of the terrace areas, their low slope angle restricts the potential for sheet erosion by comparison with the adjoining slopes.

### *5.3 Salting*

Dryland salting occurs as a minor problem in the catchment, as scalded areas beside drainage lines or as saline seeps.

Salting in the Dredge Dam sub-catchment has been described previously in the water quality section. Lower in the catchment, evidence of salt where a dam was constructed on Crown Allotment A30, was found to be fed by a salty spring.

### *5.4 Small lot development*

There are a number of problems associated with the development and management of small lots which can create hazards to water supply catchment values. The general concern is that pollution of the creeks in the catchment will result from earthworks, domestic effluent disposal and an increase in the number of people living in the area.

A particular concern is the generation of turbid run-off, which can result from development works for house siting, access track construction and provision of services. The risk associated with these activities is greatest where they occur on the coarse-structured yellow sodic duplex soils which have dispersible subsoils.

A further limitation associated with many soil types in the catchment is that of low to very low profile permeability. Such behaviour could result in failure of septic tank effluent disposal systems unless appropriate design, siting and installation standards and practices for the particular soil type are used. Failure of these systems may result in pollution of drainage waters resulting in nutrient enrichment and bacteriological contamination.

## 6. LAND DEVELOPMENT CONTROLS

The alienation phases described in Section 4.2 left a legacy of many small crown allotments each with separate title. In recent years, farms containing many allotments of this type have been purchased, and offered for resale in separate parcels. This situation created the potential for a large increase in the number of houses in the catchment and was the major reason for developing the planning controls administered by the Shire of the Avoca.

Prior to controls being introduced there was potential for a house to be built on each of the 158 separate crown allotments within the catchment area. Planning control now limits the maximum number of houses which can be built in the catchment to fourteen, in addition to the eight existing residences.

The methodology used in developing a solution for the problems arising from residential/rural use within the catchment is outlined in Appendix II.

Development policy for the area has been approved by the Shire and is detailed in Appendix III. Implementation of the policy is administered by the Shire with statutory planning controls through the Malakoff Creek Catchment Interim Development Order (IDO), an edited version of which is given in Appendix IV.

A feature of the IDO with specific relevance to water supply matters is the Special Control Area. This covers the catchment to the Landsborough Reservoir and the proposed water race. Within this area the construction of large farm dams is prohibited. This ensures that run-off, which is particularly limited during dry periods, will reach the reservoir rather than being retained in on-farm storages.

Continuing advice supplied by advisory services of the Department of Conservation Forests and Lands (CFL) on particular proposals assists the Shire in the application of its planning control and this Land Use Determination complements the planning process in this area.

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