Corangamite Catchment Region cont.

Soils

The sedimentary rocks of the region were deposited by the sea 560 million years ago when what is now Victoria was a deep ocean. These sedimentary rocks have since been uplifted, folded, cracked and faulted to form the hills we see today. Because of the marine origin of these sedimentary rocks, the sedimentary soils derived from these rocks are naturally higher in salts than many other soils.

The soils of the Central Highlands, the Basalt Plains and the Coastal Plains are very prone to waterlogging in winter. The wet environment together with the unstable soil conditions leads to severe tunnel erosion, gullying and land slip.

The cultivation of crops on the sandier soils makes these soils prone to wind erosion in summer. Soil fertility is very variable and fertiliser use is high across the region.

Climate

Map 5 shows the rainfall isohyets for the region. The Corangamite region in general has a temperate Mediterranean climate with dry hot summers (average mid-summer maximum temperatures of around 27 degrees C) and cool wet winters (average mid-winter minimum temperatures of around 5 degrees C). Rainfall varies from less than 500 mm per year in rain shadow areas around Lara to a State high of up to 2000 mm in the Otway Ranges (falling on more than 200 wet days).

Rainfall in the Moorabool River Basin is influenced by the rain shadow on the Werribee Plains.

Rainfall in the Barwon Basin is very high in the Otway Ranges, the headwaters of the Barwon. Its northern section receives 700 mm per year while the central parts of this catchment averages 500 - 600 mm per year.

Along the coastal section of the Otway Coast basin, rainfall averages 900 mm, decreasing to 500 mm in the far east around Torquay. The Otway Ranges also cause rain shadow effects in areas around Lara.

Interpreting water quality results

Streams within the Moorabool, Barwon and Lake Corangamite catchment basins all have similar flow characteristics. Water levels in the region are generally highest in August and lowest in March.

Because of the steepness of the catchment and good drainage, creeks in the Otway Ranges have a 'flash' flow pattern after rainfall and the area's unstable soils make these waterways very prone to erosion problems.

Present landuse

The type of landuse on the land surrounding waterways has a major influence on water quality. Map 6 shows that the major landuses at present in the Corangamite Catchment region is agriculture; mainly wool, milk, meat, crops and timber.

The Geelong urban area is an important industrial centre. Major industries include the manufacture of transport and other machinery and equipment, metallic products, textiles, food, beverages and tobacco.

The water industry is very important to the region as most of the primary and industries require water of a suitable quality and quantity. The total annual domestic and rural water used throughout the region is about 67,000 ML (megalitres).

Interpreting water quality results

Landuse upstream from your monitoring site will influence water quality at your monitoring site.

Agricultural land may contribute

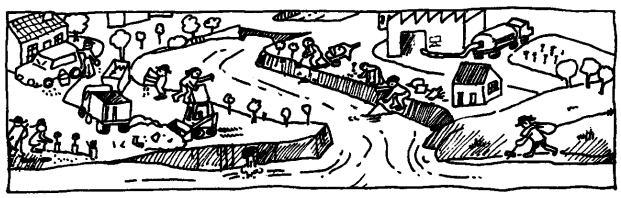
- excess fertiliser runoff
- excess sediment from eroding riverbanks or ploughed land
- chemicals from pesticides and herbicides

Industry may contribute

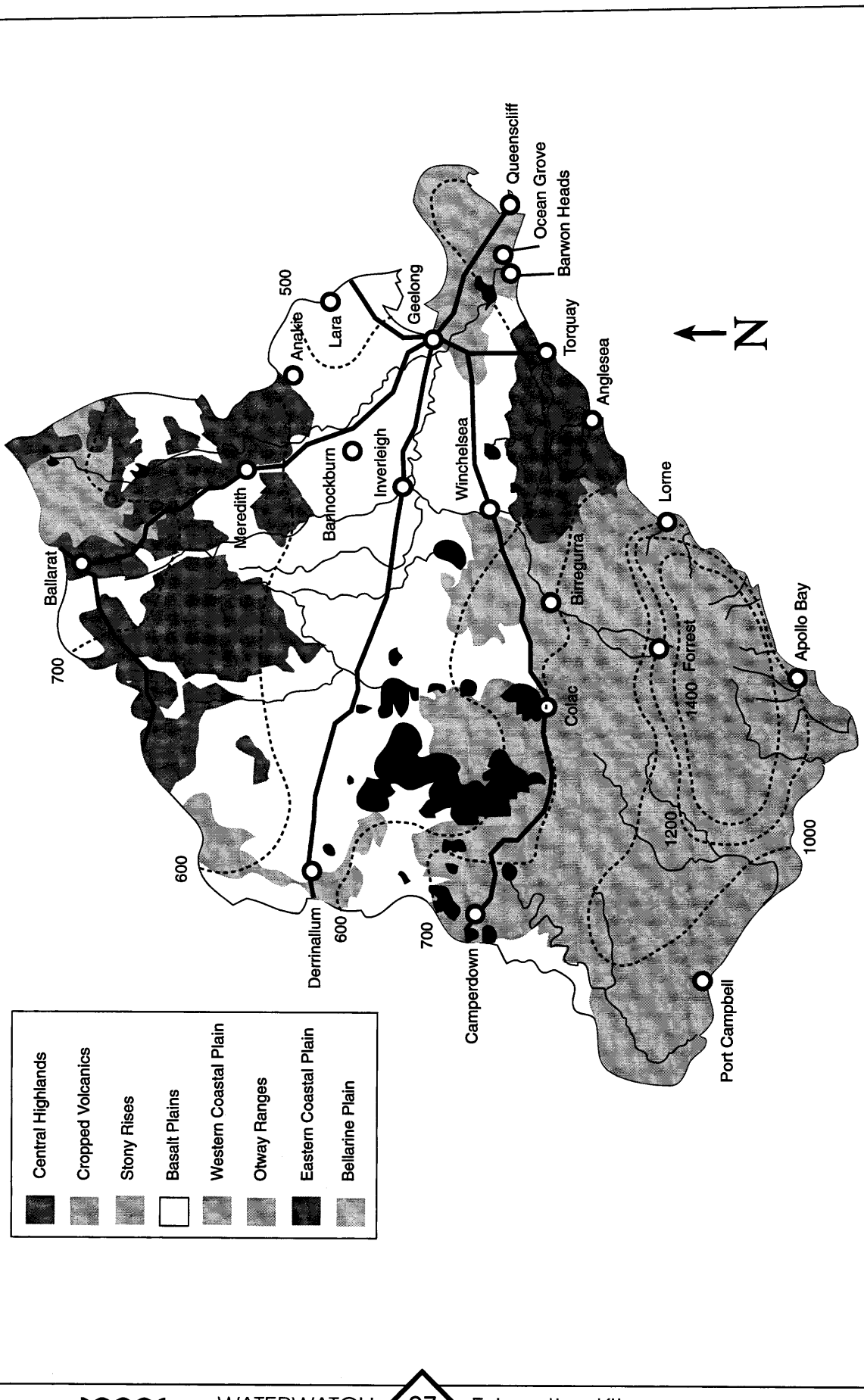
- chemicals
- heated water
- excess sediment from clearing vegetation and soil disturbance

Urban centres may contribute

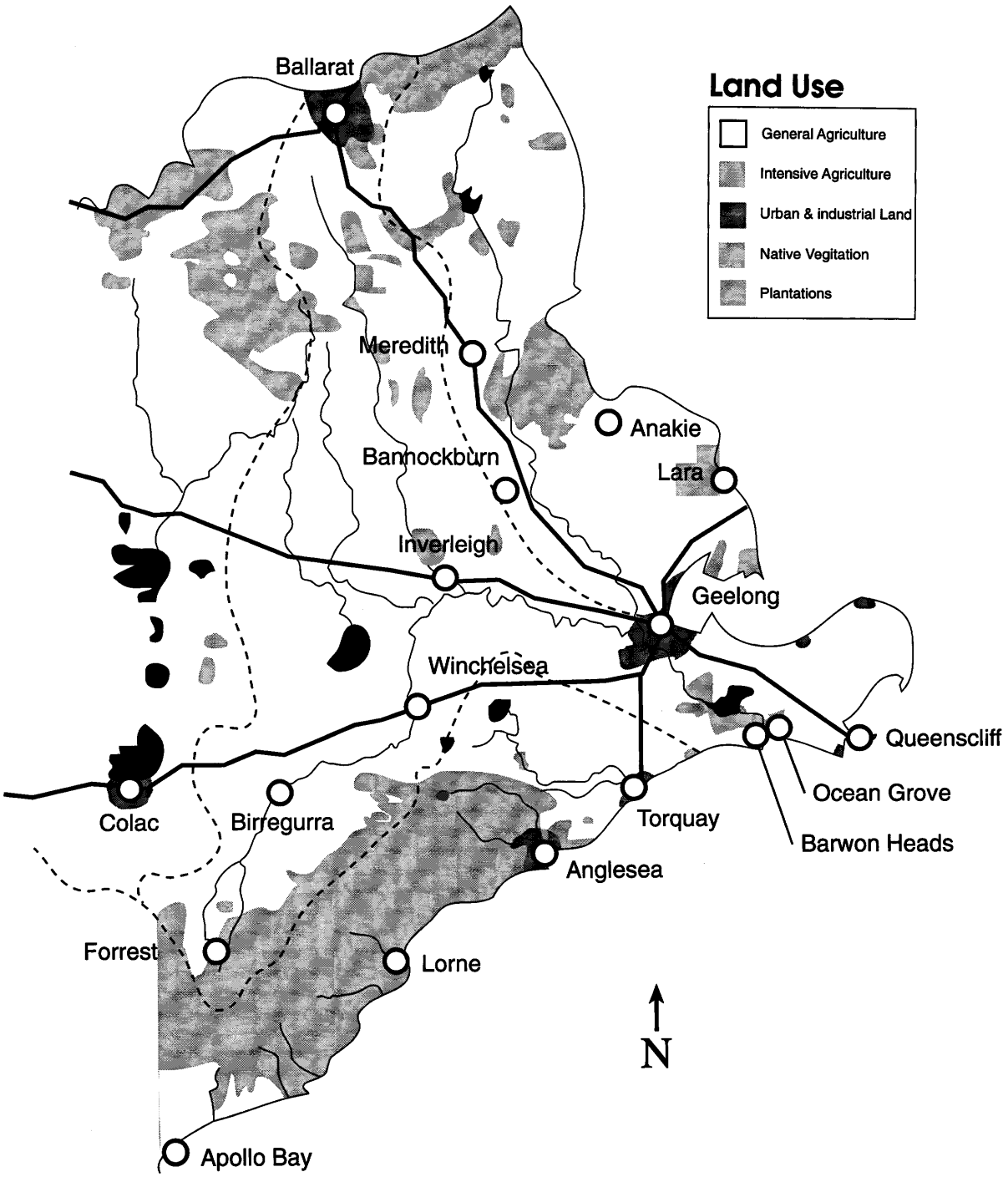
- excess nutrients and chemicals via stormwater drains
- excess sediment from development sites



Map 5 of Corangamite Region



Map 6 of Corangamite Region



c.1.eps

Corangamite Catchment Region cont.

Population

The Corangamite Region has a highly urbanised population. Most people live in the north (around the upper reaches of the Leigh/Yarrowee River which flows into the Barwon) or the east (around the lower reaches of the Barwon itself). Of a total population of about 356,000, more than 70% live in or around the major centres of Geelong, Colac and Ballarat. These centres have continued to grow in recent times as agricultural land is converted to residential and small block subdivisions.

The region's coastal attractions draw many visitors. In addition to the permanent population, 280,000 people annually visit the region.

The population concentration in the north, east and coastal areas of the region has consequences for landuse and water quality. For example, the water quality of the Leigh/Yarrowee River in its upper catchment is lower than might be expected because of high populations living near its headwaters. Ballarat City discharges treated sewerage into the Leigh/Yarrowee River in its upper catchment.

The following table shows where the greatest population growth is expected to occur in the early part of the 21st century. Water quality around and downstream of these areas may be expected to decline unless actions are taken to reduce people's impact. These increased population centres will also want the water they receive from upstream areas to be of good quality.

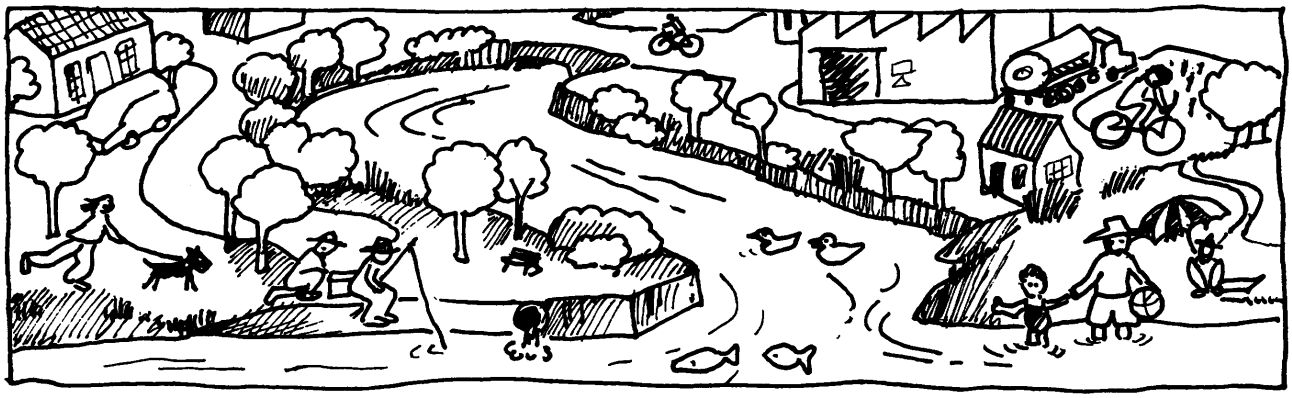
Interpreting water quality results

When interpreting water quality results along your waterway as part of your Waterwatch monitoring program, it will be helpful to take into account current population levels along the river. For example, a large town located along the river may be a cause of reduced water quality immediately downstream from the town.

Population estimates

City/Shire	Population in 1994	Estimated pop. in 2011
Ballarat City	75,870	85,000
Geelong City	182,550	217,000
Colac Otway Shire	21,400	22,900
Corangamite Shire	18,130	16,950
Golden Plains Shire	14,150	19,200
Moorabool Shire	24,630	36,000
Queenscliff Shire	3,290	3,400
Surf Coast Shire	16,340	26,500
Totals	**356,360**	**426,950**

Source: Dept of Planning and Development 1995.



Corangamite Catchment Region cont.

Conservation

The region contains waterways and wetlands of national and international significance. These include the relatively undisturbed rivers of the Otway Ranges and Basalt Plain, and coastal and estuarine wetlands. Several wetlands in the area including Lake Corangamite, Reedy Lake and Lake Murdeduke are listed as Ramsar sites (wetland sites of international significance).

Heritage Rivers are rivers of National, State or regional significance because of their outstanding nature conservation, scenic, recreation and/or cultural values. Parts of the Aire, Gellibrand and East Moorabool Rivers are classified under the *Heritage Rivers Act* 1992.

Wildlife

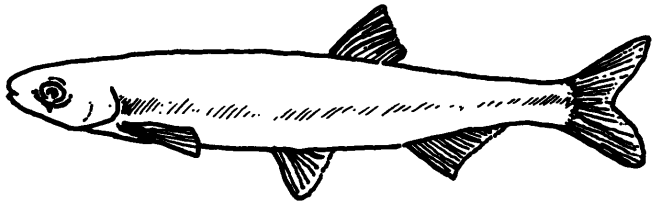
The area's rapid pastoral development has caused the extinction and declining numbers of many native species.

Animals

The now uncommon Brolga still breeds in suitable wetlands in the region.

The Platypus and Eastern Water Rat are common and are found in freshwater streams in most parts of the area. Both species have been sighted near Buckley Falls in Geelong. Platypus and Water Rats nest in the banks of watercourses and forage for crustaceans, insects, molluscs in the water.

The Australian Grayling is considered to be vulnerable and at risk of becoming endangered. The Grayling is found in the Barwon and Moorabool Rivers. Broad-finned Galaxiid (found in Painkalac Creek) and Spotted Galaxiid (found in Painkalac Creek and Barwon River) both have restricted distribution in Victoria.



Plants

The River Red Gum (*Eucalyptus camaldulensis*) is the main eucalypt found along the region's waterways and supports a large diversity of wildlife in and around rivers.

Introduced plants that increase flood risk and reduce habitat value include Poplars and Willows. Gorse (also known as Furze) and Fennel are the two most common riparian noxious weeds. Serrated Tussock, Blackberry, Sweet Briar and Boxthorn are also relatively common. To improve the heath of waterways these exotics need to be removed or controlled.

Estuaries

Estuaries are important feeding, spawning and nursery areas for many species of fish, waterbirds and invertebrates. Major estuaries in the region occur in the Barwon, Curdies, Aire Rivers and the Painkalac, Spring, Erskine and Hovells (at Limeburners Bay) Creeks.

For information on plants and wildlife, refer also to the Statewide section:

Information sheet 1: Adapted for living in water and

Information sheet 2: Victoria's wetland life,

and local references such as:

The Water Cycle

Barwon River Flora. Barwon Water booklet.

Barwon River Fauna. Barwon Water booklet.

Corangamite Catchment Region cont.

Water resources in the region

Creeks are generally spring fed in the upper catchment, and runoff fed further downstream.

Water supply for the region (including the cities of Ballarat and Geelong) is drawn mainly from the upper reaches of the Barwon and Moorabool Rivers. Groundwater resources are used when required. Some coastal towns such as Airey's Inlet and Lorne collect and store water from local streams.

The region's water and wastewater supplies are managed by Barwon Water and Central Highlands Water. In areas not serviced by water mains, people rely on collecting rain water in tanks.

The Barwon catchment

The Barwon River dominates drainage in this basin. It rises on the northern slopes of the Otway Ranges and flows in a north-easterly direction before turning south-east and flowing into Bass Strait at Barwon Heads. The Barwon flows through a large system of lakes and swamps (including Lake Connewarre) just before it flows into the ocean.

The West Barwon and Wurdee Boluc reservoirs, both important components of the Geelong water supply system, are located in the upper and middle reaches of the Barwon Basin respectively.

The Moorabool catchment

The headwaters of the Woady Yaloak and Moorabool Rivers are in the Central Highlands. Water storage supplies in the Moorabool Basin include the Bungal (Lal Lal) dam, and Stony Creek, Bostock and Koreinguboora reservoirs.

Otway Coast catchment

The Otway Coast receives freshwater from numerous small river systems. Although some of these systems are dammed for town water supplies, there are no major water storages in the Otway Coast basin.

Environmental flows

Although water is extracted from river systems for town water, industry, stock and agriculture, these extractions must be licensed. The Water Bureau must add the total of all the extractions and make sure there is enough natural river flow remaining to enable the ecosystem to function. The minimum flow is called the environmental flow.

Geelong's water supply

About 60% of Geelong's domestic and industrial water is supplied by West Barwon Dam where water is transferred by channel to Wurdee Boluc. The remaining 40% comes from the Moorabool basin via Bostock, Koreinguboora, Lal Lal and Stony Creek reservoirs. One third of the available water from the Lal Lal reservoir on the west Moorabool River is available to Geelong. This reservoir is shared with Ballarat. In times of drought, Geelong's water supply can be supplemented by 8,000 ML of water from groundwater bores at Barwon Downs.

Water storages	
Lal Lal	59,000 ML*
Moorabool	6,790 ML
Bostock	7,460 ML
Stony Creek	9,500 ML
Koreinguboora	2,090 ML
West Barwon	21,000 ML
Wurdee Boluc	19,000 ML

* One ML (megalitre) equals 1 million litres, about the volume of an Olympic size swimming pool.

Water drainage diversion schemes

Two major schemes operate to divert water from the adjacent Lake Corangamite Basin to the Barwon River. Both have been the subject of much public debate as the water they divert is more saline than natural Barwon River flows and so result in some water quality decline in the Barwon River.

The *Lough Calvert drainage scheme* diverts water from Lake Colac and the Lough Calvert system along Birregurra Creek and into the Barwon River near Rickett's Marsh, and was designed to protect agricultural land in the Lough Calvert system from flooding. The scheme operates under a series of rules that does not permit diversions to occur that would result in salinity levels in the Barwon River at Winchelsea exceeding 2,500 EC units, nor to occur between 1st October and 30th April.

The *Woady Yaloak River diversion scheme* diverts water that would otherwise have flowed into Lakes Corangamite, Gnarpurt and Martin, into Warrambine Creek and then into the Barwon River. The scheme was designed to protect agricultural land around Lake Corangamite and adjacent water bodies from flooding. This scheme also operates under a series of rules that does not permit diversions that would result in Barwon River salinity levels downstream of Inverleigh exceeding prescribed values depending on the time of year.

Corangamite Catchment Region cont.

Although the scheme has been effective in reducing Lake Corangamite's water levels, it has also resulted in the Lake's salinity levels increasing significantly to the extent that there is now concern that its value as a waterbird habitat will be reduced or lost if the scheme continues to operate. The Western District Lakes are a declared Wetland of International Importance under the Ramsar Convention. The Commonwealth and Victorian Governments are obliged to 'formulate and implement planning so as to promote the conservation of the listed Ramsar areas'.

Waste water treatment

Central Highlands Water discharges treated sewerage effluent from its Ballarat South Wastewater Treatment Plant into the Leigh/Yarrowee River, a tributary of the Barwon. Barwon Water discharges treated effluent from Colac to Lake Colac, an occasional tributary of the Barwon River via the Lough Calvert drainage scheme. The majority of sewerage effluent from the Geelong area is discharged after treatment to the ocean at Black Rock. Barwon Water also operates some regional treatment plants with disposal to irrigated woodlots at Winchelsea and Portarlington.

Most (but not all) industries in the region discharge their effluent to municipal sewage systems. Run-off from dairy farms and seepage from septic tanks in rural residential areas are some sources of nutrients which detrimentally affect the health of the region's waterways.

Rural properties and smaller country towns are not connected to the sewerage system but have septic tanks.

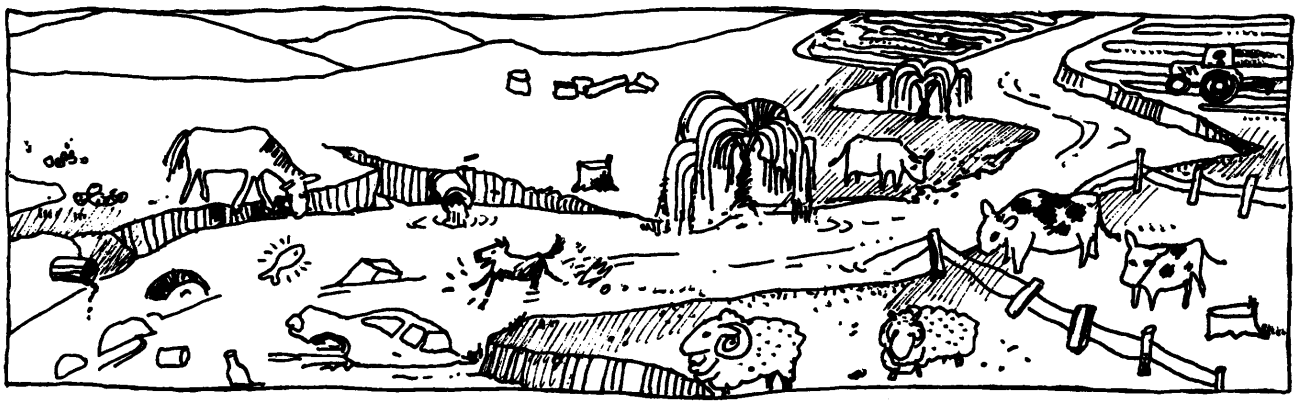
Flooding

Flooding damages low-lying agricultural areas (about 500 ha) around lakes, major streams, estuaries and some urban areas of Ballarat and Geelong. Barwon Heads, Ocean Grove, Geelong and Inverleigh are all urban areas subject to flooding from the Barwon River. A flood mitigation strategy has been developed to reduce flood impacts on urban areas. Being low-lying, rural areas along most of the Barwon valley are prone to some degree of nuisance flooding.

Land degradation

Land degradation over the whole Corangamite Landcare region costs Victorians the equivalent of many millions of dollars in economic, social and environmental losses each year. Since European settlement:

- trees have been lost from three-quarters of the region
- more than 10,000 ha of agricultural land has been degraded through salinity
- rabbits have spread throughout the region, severely degrading about 15,000 ha
- 12,000 ha have become severely eroded
- 20 species of native plants and animals have become extinct, and a further 50 are endangered



Corangamite Catchment Region cont.

The state of the waterways in the region

As much of the upper catchments of the Moorabool and Barwon Rivers have been cleared, downstream flows regimes tend to be quite 'flashy'. These flashy flows cause increased erosion resulting in high turbidity and suspended solids.

Barwon River's downstream salinity levels increase, mainly due to water diversion from the Lake Corangamite Basin drainage schemes and to natural saline inflows between Winchelsea and Inverleigh.

The northern tributaries of the Barwon, especially Native Hut and Bruce Creeks have eroded significantly in the recent past and are still being degraded. Warrambine Creek has eroded due to operation of the Woady Yaloak River diversion scheme and consequent increases in both flow volume and salinity have occurred. The most dramatic erosion in the area has occurred along streams flowing northward to the Barwon from the Otway Ranges, notably Wormbete, Retreat, Yan Yan Gurt, Deans Marsh, Matthews and Timmins Creeks. Moderate to severe erosion is occurring along many upper tributaries in the Woady Yaloak, Leigh and Barwon River systems.

About 50% of the waterways in the Barwon Basin, and 30% in the Moorabool Basin do not have good riparian vegetation cover.

Water quality in the region

Chemical pollutants, salinity and nutrient and sediment loads of the major streams are all increasing throughout the region.

Woady Yaloak River - water quality is poor in the upper reaches because of high total nitrogen levels.

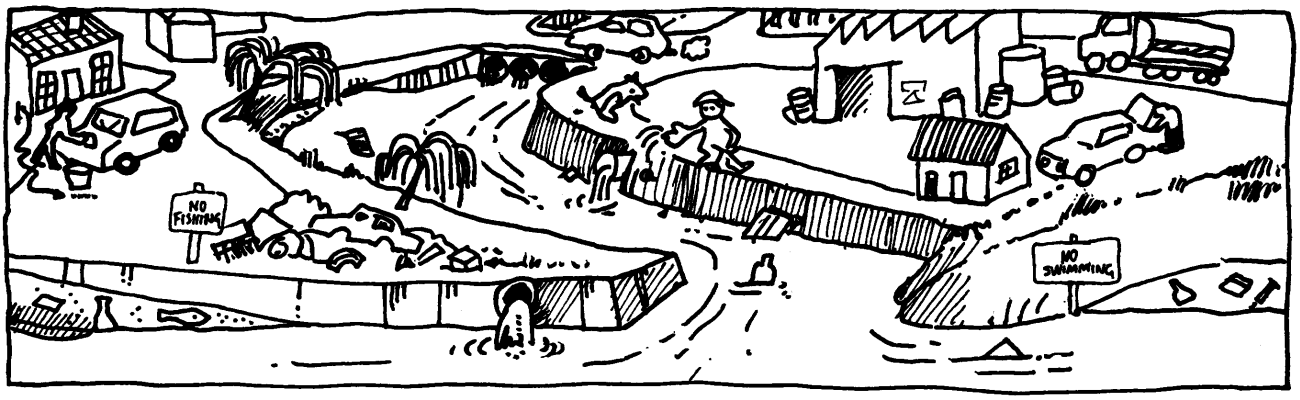
West branch Moorabool River (flows into Lal Lal Reservoir). Nutrient increases are a major concern.

Yarrowee/Leigh River has a high nutrient status; contributed by urban run-off at Ballarat, agricultural runoff, and treated effluent from Ballarat South treatment plant.

In summer, three-quarters of the flow in the Leigh/Yarrowee River is from the Ballarat South Treatment Plant. It is of interest that a number of farmers rely on this nutrient rich water for irrigation.

Toxic algal blooms are increasing across Victoria and this region is no exception. Water based recreational activities have been affected by these blooms. Outbreaks have also occurred in water storages in the upper Moorabool catchment and levels of nutrients are increasing in these storages. The increase in algal blooms in the streams and wetlands throughout the region indicates increased nutrient contamination, particularly by nitrates and phosphates. There is major concern about maintaining groundwater quantity and quality to meet current and projected demands, while increasing levels of nitrate are of particular concern.

Much of the water from the Woady Yaloak, Leigh, Moorabool, Lower Barwon, Curdies and Gellibrand Rivers therefore require treatment for safe human consumption. This has both economic and environmental costs through the increased cost of treatment, limited availability of suitable water for domestic or stock consumption and loss of habitat for wildlife and fisheries.



Corangamite Catchment Region cont.

Summary of major water quality problems in the region

Central Highlands sub-region

- Dryland salinity severely affects approx 1000 ha of agricultural land within this sub-region, limiting agricultural production, inducing soil erosion and degrading aquatic environments. Salinity problems occur on the Woady Yaloak River at the southern end of the Central Highlands, with tributaries from the Kuruc-A-Ruc Creek to the Naringhil Creek compounding the problem. The upper catchment of the Woady Yaloak is identified as a salinity hot spot.
- The sedimentary derived soils of this region are prone to erosion and as phosphorus frequently moves attached to soil particles, erosion increases the nutrient loads in the above waterways.
- Turbidity is unacceptably high for drinking quality purposes at some stages in the Moorabool River. [Barwon Water is to install a water treatment plant at considerable cost to address issues including colour and turbidity.]
- Riparian vegetation is classified as poor, is usually extensively cleared and invaded by exotic species. Sites on the Moorabool River within Lal Lal State Forest and the upper reaches of Woady Yaloak River have relatively undisturbed riparian vegetation.
- Streambank erosion ranges from moderate to severe.
- The environmental conditions of streams is very poor in cleared areas of the Central Highlands.
- Soil loss through water erosion is a large problem. The Ordovician sediments of this region have inherently low fertility and can ill afford further loss of topsoil.
- There is concern that new mining operations may affect water quality in Yarrowee/Leigh River. An example of this occurred in October 1997 when a pipe in a mining operation burst, spilling 14 tonnes of cyanide into the river. The spill had the potential to affect not only the downstream water users but all the river's plant and animal life.

Basalt Plains sub-region

- Dryland salinity affects 10800 ha of land across the north-central plains area with many hot spots identified in western section, and the lake and dune system around Winchelsea and Moriac.
- Streambank erosion is prevalent in some catchments such as the Woady Yaloak and occurs in Little Woady Yaloak Creek, Leigh/Yarrowee River. Some localised erosion occurs along the Barwon River.
- Riparian vegetation - no sites in this sub-region are in excellent condition, only one site in good condition, the rest are in moderate to very poor condition.
- Nutrients - the Leigh River at Mount Mercer was considered one of the most degraded sites in Victoria in terms of high nutrient levels (due to discharge of sewage effluent). Modifications to the treatment plants have since reduced nutrient concentrations.
- Water quality of the Barwon River as it passes through this sub-region is generally considered degraded or poor for physical and chemical factors. The highest nutrient loads have been monitored in the Barwon Water system close to Geelong. In its middle reaches the Moorabool River was classified poor for total nitrogen, while total phosphorus improved to good; near Geelong the river is classified as moderate for total phosphorus and deteriorated for total nitrogen.
- Most algal blooms in the Barwon River Basin [five between 1992 and 1996] have occurred in areas extensively used for recreation including the Barwon River at Geelong.
- Downstream portions of Barwon River tend to be very saline. The Moorabool River increases in salinity as it nears Geelong.
- Increasing salinity levels are impacting on native blackfish.
- Carp and other introduced fish are degrading waterways and lakes.
- Drainage, grazing and trampling of freshwater wetlands threatens Brolga breeding habitats.