13

WATER RESOURCES AND SEWERAGE

WATER RESOURCES AND THEIR CONTROL

Ministry of Water Resources and Water Supply

During the summer of 1973, the Melbourne metropolitan area was faced with a serious water shortage becaue of a prolonged dry spell of weather. To advise the Victorian Government on steps to overcome the emergency at that time and to plan future water conservation works, a Standing Committee consisting of representatives of Victoria's two major water authorities—the State Rivers and Water Supply Commission and the Melbourne and Metropolitan Board of Works—and a representative of the Victorian Treasury, was appointed. The work of the Committee emphasised the desirability of having a co-ordinating body for Victoria's water resources.

The *Water Resources Act* 1975 established the Ministry of Water Resources and Water Supply for the purpose of ensuring the most efficient utilisation of the water resources of Victoria. This Act vested in the Minister of Water Supply the administration of the Water Act, the Melbourne and Metropolitan Board of Works Act (in respect of the water, sewerage, and drainage functions), Geelong Waterworks and Sewerage Act, Latrobe Valley Act, Mildura Irrigation and Water Trusts Act, Sewerage Districts Act, Dandenong Valley Authority Act, River Improvement Act, West Moorabool Water Board Act, Groundwater Act Part V, and Drainage of Land Act.

As part of the Ministry, there is a Water Resources Council, consisting of eleven members appointed by the Governor in Council comprising the three commissioners of the State Rivers and Water Supply Commission, the chairman, deputy chairman, and engineer-in-chief of the Melbourne and Metropolitan Board of Works, a representative or nominee from each of the Waterworks Trusts Association of Victoria, the Victorian Irrigators Central Council, and the Ministry for Conservation, the co-ordinator of works from the Victorian Treasury, with the Director of Water Resources as chairman. The functions of the Council are to investigate and advise the Minister generally on matters pertaining to the water resources of Victoria or to water supply, drainage, or sewerage throughout Victoria referred to it by the Minister.

The Ministry performs a co-ordinating function in assessing and developing Victoria's water resources, including the extension and development of sewerage and drainage services, and has responsibilities for long-range planning of future requirements, for achieving a balance between rural, urban, and industrial development, and for advice on priorities for construction.

The legislation does not change in any way the functions of either the State Rivers and Water Supply Commission or the Melbourne and Metropolitan Board of Works, but implements the Victorian Government's policy of bringing both bodies under a single Ministry for the co-ordination of their activities.

Groundwater Act

The Groundwater Act, which was proclaimed in September 1970, enabled the Mines Department and State Rivers and Water Supply Commission to establish the administrative procedures necessary for the investigation, conservation, and utilisation of

the groundwater resources of Victoria. The Act gives the Mines Department authority to investigate Victoria's groundwater resources so that total water resources and their proper use can be considered by the Victorian Government in the future.

At August 1978, 4,407 licences to extract groundwater for purposes other than domestic and stock use had been issued by the Commission, and more than 12,350 bores had been registered for domestic and stock use.

A Groundwater Conservation Area has been declared in the Koo-Wee-Rup–Dalmore District. More than 200 bores are operated in the district for the irrigation of a total area of about 4,000 hectares of pastures and miscellaneous cash crops. Investigations are in progress to determine the safe volume which may be extracted annually.

Further reference: ***Victorian Year Book*** **1977, pp. 373–4**

MELBOURNE AND METROPOLITAN BOARD OF WORKS

Introduction

The Melbourne and Metropolitan Board of Works is the authority for providing water supply, sewerage, and main drainage services to the Melbourne metropolitan area. It is also Melbourne's metropolitan planning authority. The formation of a body such as the Board was urged by an 1889 Royal Commission into Melbourne's sanitary conditions after continuous agitation by local municipalities for a sewerage system in the City. The Board was constituted by an Act of the Victorian Parliament in 1890 and began operations in July 1891. Its initial functions were to provide a sewerage system for Melbourne and the metropolitan area, and to assume responsibility for the City's water supply, previously administered by the Public Works Department.

In the years since its inception, the Board, in addition to assuming responsibility for main drainage, has also been made responsible for maintenance and improvement of metropolitan rivers and watercourses, town planning, and metropolitan parks. With the exception of town planning, the Board's responsibilities are laid down in the *Melbourne and Metropolitan Board of Works Act* 1958 (as amended). Until 1 August 1978, the Board comprised of 54 unpaid commissioners, a full-time elected chairman, and from 1975, a deputy chairman. Commissioners who were required to be members of a municipal council, could not hold their seats for more than three years without reappointment, while the maximum term for the chairman was four years before his appointment was reviewed. The deputy chairman's term was also for four years. Following recommendations by a Board of Inquiry, the composition of the Board was changed on 1 August 1978. It now comprises a full-time appointed chairman and six part-time members, four elected by Area Commissions comprising of groupings of municipalities and two appointed by the Government. Their appointments are for four-year terms.

Acts of the Victorian Parliament empower the Board to levy four rates annually: the water rate, metropolitan general rate (for sewerage services), metropolitan drainage and river improvement rate, and the metropolitan improvement or planning rate, all of which are based on net annual valuations of rateable properties with certain minimum amounts payable for the three former rates. The incoming revenue is used to operate and maintain the water, sewerage, and main drainage systems, to pay interest and redemption charges on loans raised for capital works, and to meet administrative expenses.

The proceeds of the metropolitan improvement rate meet annual expenditure for town planning, payments of compensation for lands reserved under the Metropolitan Planning Scheme, and for metropolitan parks. The capital works of the Board are financed mainly from moneys which the Board is given approval to borrow after the annual meeting of the Australian Loan Council has considered the projected loan programmes of semi-governmental authorities throughout Australia.

Melbourne's water storages

Water to Melbourne and the metropolitan area is supplied from seven storage reservoirs drawing on the water resources of mountain catchment areas. Pipelines carry the water from on-stream storages distant from the city to off-stream storages located around the perimeter of the metropolitan area. Water is then conveyed to service reservoirs and elevated tanks throughout the suburbs for distribution to consumers.

When the Upper Yarra Dam was completed in 1957, the capacity of the storage reservoirs serving the supply system was increased to 296,000 megalitres, comprising Yan Yean Reservoir (30,000 megalitres), Maroondah (22,000), O'Shannassy (4,000), Silvan (40,000), and Upper Yarra (200,000). In the 22 years since Upper Yarra was commissioned, this storage capacity has more than doubled to 610,000 megalitres and work is under way on two new major reservoirs to add about another 1.2 million megalitres of water storage and give Melbourne, by the early 1980s, a supply system with a storage capacity equivalent to three times the expected annual demand.

The years since the completion of the Upper Yarra Dam have been the most significant in the history of Melbourne's water supply system. Major works undertaken since 1957—and particularly following the severe drought of 1967–68—include duplication of the transfer main between the Upper Yarra and Silvan Reservoirs; diversion of several Yarra tributaries into the supply system; construction of Greenvale and Cardinia Reservoirs; construction of the Yarra Valley Conduit to further increase transfer capacity between Upper Yarra and Silvan; construction of a transfer main between Silvan and Cardinia Reservoirs, as well as transfer mains from Cardinia to Dandenong, and from Dandenong to Notting Hill; and the Thomson Diversion Tunnel and Easton Diversion Works to transfer water from the Thomson River to Upper Yarra Reservoir. Major works currently in progress include the Sugarloaf Dam, with associated pumping station and water treatment works, and construction of the Thomson Dam.

The completion of the Greenvale (1971) and Cardinia Reservoirs (1973) added another 314,000 megalitres to the storage capacity of the metropolitan water supply system, bringing this capacity to its current level. Greenvale and Cardinia are off-stream storages in the sense that they are located on watercourses with little catchment of their own and hence are filled from external sources, i.e., the on-stream storages.

Greenvale Reservoir is on Yuroke Creek, a branch of the Moonee Ponds Creek to the north of the city, and serves Melbourne's north-western and western suburbs to Werribee. With a capacity of 27,000 megalitres, Greenvale is supplied by pipeline from the Silvan Reservoir near Monbulk in the Dandenong Ranges, east of Melbourne. Silvan stores water from the O'Shannassy, Upper Yarra, and Thomson systems.

Cardinia is by far the biggest of the Board's storages, with a capacity of 287,000 megalitres. It supplies Melbourne's south-eastern suburbs as far south as the boundary of Frankston and is fed from the Upper Yarra System via a pipeline from the southern end of Silvan Reservoir. Supply to Silvan is supplemented by the new Yarra Valley Conduit from the Upper Yarra Reservoir, which enables surplus water from the O'Shannassy and Upper Yarra catchments to be stored, and provides a marked degree of regulation of water from the diversion of the Thomson River, pending construction of the Thomson Dam.

Cardinia, with its large storage, provides a substantial reserve supply for use during extremely dry or drought periods and supplies water to both the Dandenong and Notting Hill service reservoirs. The main dam embankment, with a base width of 303 metres, is generally rockfill with an impervious earth core. It has a maximum height of 86 metres, a crest length of 1,542 metres and contains about 3.7 million cubic metres of earth and rock. Cardinia started filling in 1973 and filled for the first time late in October 1977. The reservoir, which was designed by the Snowy Mountains Engineering Corporation, has a shoreline of about 56 kilometres and a surface area of more than 1,295 hectares.

In mid-1973, the Victorian Government announced a dam-building programme aimed at further increasing the storage capacity of Melbourne's water supply system. Included in this programme is the Thomson Reservoir as the main component of the third stage of the Board of Works' largest water supply project to date—the diversion of water from the Thomson River, about 170 kilometres east of Melbourne, into the Upper Yarra System. Construction work on the Thomson project started in 1969 and the first stage—allowing diversion of water from the Thomson through a 19.6 kilometre tunnel to Fehrings Creek, a tributary of the Yarra—was commissioned in September 1974. Water from the Thomson was channelled into the diversion tunnel, then into the Yarra River via Fehrings Creek. From the Yarra, the flow entered the Upper Yarra Reservoir. Stage two of the project involved extending this tunnel at both its western and eastern ends. The western extension

carried the diversion tunnel to the Yarra River near the Reservoir, thereby superseding the outlet into Fehrings Creek. The eastern tunnel extension allows diversion of flow from the Thomson at a point known as Swingler, just below the confluence of the Thomson and Jordan Rivers, thus making use of a larger catchment area. Incorporating a concrete diversion dam at Swingler, stage two was completed early in the second half of 1977. The major component of the third stage of the Thomson Diversion Scheme is a large storage on the Thomson River, north of Erica, to be formed by the Thomson Dam. When completed, this dam will be about 160 metres high and the earth and rockfill structure will form a reservoir inundating about 2,200 hectares. The dam will impound about 1.1 million megalitres and the proposed reservoir will extend for some 20 kilometres north of the wall.

A final decision to proceed with the Thomson Dam and its associated works was made by the Victorian Government early in 1976 after a study of the environmental implications during both the construction and operation of the dam. During the study, members of the public were able to make written submissions, either as individuals or collectively, on any aspect of the investigation, and these submissions were taken into account during preparation of the final report and recommendations. Apart from the Thomson Dam, the works involved in the third and final stage of the Thomson scheme entail an extension of the Thomson–Yarra diversion tunnel in a south-easterly direction for about 5.5 kilometres from Swingler to emerge within the proposed Thomson Reservoir, and allowing water to be transferred to the Upper Yarra System as required, as well as outlet works in the Thomson Dam for the release of water for other uses downstream. The Thomson Reservoir will store water during the wetter years when inflows are high and thus ensure an adequate water supply for Melbourne during the drier years. This will enable the Board to operate its available storages much more efficiently than would be possible without a large back-up storage such as the Thomson. In addition, the dam will provide regulation of the stored water to supplement the variable flows in the Thomson River for the irrigators and water users in the Thomson Valley.

The augmentation programme announced in 1973 also included the Sugarloaf Reservoir (95,000 megalitres live capacity), which will store water pumped from the Yarra River at Yering Gorge and from the nearby Maroondah aqueduct. Basically, the Sugarloaf scheme comprises an intake and pumping station on the Yarra in Yering Gorge; a "pressure tunnel" from the pumping station to the reservoir; a draw-off structure and tunnel from the reservoir to carry water to a pumping station below the main dam wall; a pipeline rising from this pumping station to a water treatment plant; a covered "clearwater" storage basin adjacent to the treatment plant; and a pipeline from the storage basin through which treated water will be introduced to the supply system. Comprehensive treatment of Sugarloaf water will be necessary because it will contain agricultural and urban run-off. The treatment plant will be located close to the southern end of the main dam and will use conventional water treatment methods. Chemicals will be added to the water to encourage the settling of particles which cause turbidity and then the water will be filtered and chlorinated to kill any bacteria. The plant will produce a high quality potable water. Water from the Sugarloaf Reservoir will be introduced to the supply system via the Sugarloaf–Preston Pipeline which will run from the clearwater basin to a tunnel of the Maroondah aqueduct. Downstream of this point, the aqueduct is being converted to a 2.1 metre diameter pressure pipeline. As with the rest of Melbourne's water supply, water from Sugarloaf will be fluoridated in line with the requirements of the *Health (Fluoridation) Act* 1973. The reservoir, being an off-stream storage, is formed by a dam across the Sugarloaf Creek near Christmas Hills. The main dam will be 85 metres above stream bed level and will have a crest length of 1,000 metres. There will be two small saddle dams on the southern side of the reservoir. Sugarloaf will supply the northern and western suburbs, as well as Greenvale and Yan Yean storages, and thus reduce this component of demand on Silvan Reservoir.

Water reaches houses and industry in the Melbourne metropolitan area from the various service reservoirs situated in the highest convenient places so that a maximum pressure can be maintained, and peak demands can be met. There are 72 service reservoirs and tanks with a combined capacity of 2,017 megalitres. Underground mains and pipes convey the water from the service reservoirs to its point of use. As part of its water supply catchment management programme, the Board is carrying out extensive forest hydrology research at

Coranderrk and North Maroondah, two eucalypt forest areas south and north of Healesville. The experiments are designed to determine a scientifically based, efficient catchment management policy related to water yield and quality. At Coranderrk, the effects of two timber harvesting operations applied to mature eucalypt forests are being monitored, while at North Maroondah studies are being made to assess the effects of a regenerated eucalypt forest on water yield.

While public access to the Board of Works' forested catchment areas is not allowed, there are picnic and passive recreational facilities at all the Board's storages, except the O'Shannassy Reservoir. Public access is also available to four smaller reserves—Donnellys Weir, Coranderrk Weir, Fernshaw, and the top of Black Spur. All the reserves are easily reached by car.

Total water consumption for the year 1976–77 was 381,500 megalitres, a 7 per cent decrease over the previous year's consumption of 384,000 megalitres. Rainfall was about 10 per cent above average for this period, but stream flow about 5 per cent below. Notwithstanding the present decline in the rate of population growth, the planning of future water requirements for Melbourne has allowed for a continuous increase in water consumption due mainly to the continuing growth in households.

At 30 June 1977, there were 850,834 properties or an estimated 2,467,000 people in Melbourne supplied with reticulated water. Average consumption for the 1976–77 year was 448,000 litres per property.

Lower Yarra Development Scheme

For the first time in its history, the Board of Works is to draw water from the lower reaches of the Yarra River for supply to the Melbourne metropolitan area. A new water storage — the Sugarloaf Reservoir — is being built about 35 kilometres north-east of Melbourne. Water for the reservoir will be taken from the Yarra River and pumped through a tunnel to the reservoir itself. There will be provision to pump water from Maroondah Aqueduct into the reservoir. The water will be fully treated and fluoridated before being introduced to the general supply via the Preston Service Reservoir. The Lower Yarra Development Scheme (Stage One of which is the Sugarloaf Reservoir Project) is based on a 1967 recommendation by the Parliamentary Public Works Committee that the Board develop the Thomson River and Lower Yarra catchments as sources of water for the Melbourne metropolitan area. Work on the Thomson scheme began in 1969, but the entire project is not scheduled for completion until at least 1982. Although the Cardinia Reservoir — the Board's largest water storage so far — is in service, Melbourne cannot be sure of a desirable level of protection against drought (and water restrictions) until the Thomson development is completed. For this reason, the Victorian Government, in 1973, decided that work should proceed immediately on Stage One of the Lower Yarra Scheme as it was the best one available to meet possible short-term supply shortages.

The Sugarloaf Reservoir will be formed by a dam across the Sugarloaf Creek near Christmas Hills. The main dam will be 85 metres high and will have a crest length of 1,000 metres. It is being built of rock and random fill, with concrete facing on the upstream side. There will be two small saddle dams on the southern side of the reservoir. Sugarloaf will be an "off-river" storage in the sense that, although it will store water from the Yarra River, the dam will not be on the Yarra River itself, but on a tributary creek which has only a small catchment area. This catchment area is being acquired by the Board.

At full supply level, Sugarloaf will have a usable capacity of 95,000 megalitres, and pending completion of the big Thomson Reservoir (1m megalitres), will be the third largest of the Board's water storages after Cardinia and Upper Yarra. A pumping station on the northern bank of the Yarra River, at Yering Gorge, will pump water to the Sugarloaf Reservoir from both the Yarra River and, when required, the Maroondah Aqueduct through a pressure tunnel 1,200 metres long and 2.4 to 2.6 metres in diameter. From Sugarloaf, water will gravitate down a drain-off tunnel to another pumping station at the left abutment of the main dam where it will be lifted into a rising main and carried to a treatment plant. The treatment plant is necessary because the Sugarloaf scheme is the first in which the Board has harvested water from an inhabited catchment area. The plant will

be located close to the southern end of the main dam and will use conventional water treatment methods. Chemicals will be added to the water to encourage the settling of particles which cause turbidity, and then the water will be filtered and chlorinated to kill any disease-producing bacteria which might remain. The plant will produce a very high quality potable water, and water passing through the plant will also be fluoridated in line with Victorian Government requirements. After treatment, the water will be stored in a covered "clear water" storage adjacent to the treatment plant before being conveyed to the supply system by a pipeline. Water from Sugarloaf is expected to be available by the summer of 1980–81 and the reservoir is scheduled to be fully integrated into the system in 1981.

VICTORIA—MELBOURNE AND METROPOLITAN BOARD OF WORKS: WATER SUPPLY SYSTEMS: STREAMFLOW YIELDS
(megalitres)

Year	Yan Yean	Maroondah	O'Shannassy	Upper Yarra	Thomson	Total water yield
1972–73	15,000	63,200	102,800	128,800	17,200	327,000
1973–74	27,400	93,800	136,200	206,500	26,500	490,400
1974–75	31,900	108,500	170,300	351,000	25,300	687,000
1975–76	23,000	91,400	152,400	230,900	47,200	544,900
1976–77	21,600	104,400	120,400	219,500	80,000	545,900

Cost of water supply system

The cost of capital works in respect of the water supply system under the control of the Board is shown in the following table for each of the years 1972–73 to 1976–77:

VICTORIA—MELBOURNE AND METROPOLITAN BOARD OF WORKS: CAPITAL OUTLAY ON WATERWORKS
($'000)

Particulars	1972–73	1973–74	1974–75	1975–76	1976–77
Yan Yean System (including Greenvale)	813	246	320	82	45
Maroondah System	47	136	802	8,574	21,286
O'Shannassy, Upper Yarra, and Thomson System (including Silvan and Cardinia)	19,923	26,350	36,678	23,041	28,473
Service reservoirs	441	1,286	1,627	4,523	3,686
Large mains and pumping stations	9,827	6,134	3,690	14,086	18,488
Reticulation	4,667	4,533	5,963	8,766	9,590
Afforestation	5	2	22	6	21
Investigations, future works	796	1,994	1,917	*Cr.* 91	1
Total outlay	36,519	40,681	51,019	58,987	81,589

Consumption of water

During the year ended 30 June 1977, the maximum consumption of water in Melbourne and suburbs on any one day was 2,273 megalitres on 23 December 1976, and the minimum consumption was 638 megalitres on 11 April 1977.

The following table shows, for each of the years 1972–73 to 1976–77, the number of properties supplied with water and sewers, the quantity of water consumed, the daily average consumption, the daily average consumption per head of population served, etc.:

VICTORIA—MELBOURNE AND METROPOLITAN BOARD OF WORKS: WATER CONSUMPTION AND SEWERAGE CONNECTIONS

Year	Improved properties supplied with water at 30 June	Total annual consumption of water	Consumption of water on any one day		Daily average of annual consumption of water	Daily consumption of water per head of population served	Improved properties for which sewers were provided at 30 June
			Maximum	Minimum			
	number	megalitres	megalitres	megalitres	megalitres	litres	number
1972–73	748,990	315,208	1,637	534	864	357.60	591,673
1973–74	787,052	361,858	2,202	590	991	405.48	621,161
1974–75	809,372	355,625	2,274	620	974	393.66	640,165
1975–76	829,941	384,058	2,290	658	1,049	418.56	662,912
1976–77	850,834	381,489	2,273	638	1,045	423.59	689,336

Sewerage system

Cost of the sewerage system

The cost of sewerage works during each of the years 1972–73 to 1976–77, is shown in the following table:

VICTORIA—MELBOURNE AND METROPOLITAN BOARD OF WORKS: CAPITAL OUTLAY ON SEWERAGE SYSTEM
($'000)

Particulars	1972–73	1973–74	1974–75	1975–76	1976–77
Farm purchase and preparation	707	496	560	898	742
Treatment works	21,091	21,265	11,425	10,409	7,458
Outfall sewer and rising mains	16,675	2,975	1,430	393	354
Pumping stations, buildings, and plant	4,770	4,935	2,772	1,969	921
Main and branch sewers	12,879	24,201	43,301	45,249	33,575
Reticulation sewers	7,001	12,096	20,067	26,554	30,667
Sanitary depots	—	*Cr.* 48	*(a)*	—	3
Investigations	149	1,057	1,437	*Cr.* 121	11
Total outlay	63,273	66,978	80,992	85,351	73,731

(a) Less than $500.

Disposal of nightsoil from unsewered premises

The responsibility for the collection, removal, and disposal of nightsoil from unsewered premises within the Melbourne metropolitan area was transferred from the individual municipal councils to the Melbourne and Metropolitan Board of Works by legislation in 1922. By agreement, each council pays to the Board a prescribed amount per annum to offset the cost of the service, etc. For the year 1976–77, working expenses were $276,885, and interest $42,922 making a total of $319,807. Revenue was $479,383, giving a surplus of $159,576.

Drainage

Retarding basins

The Board of Works, acting as the drainage authority in the metropolitan area, is responsible for providing flood protection works to serve in the most effective and economical manner. This has often been done by the construction of retarding basins. A retarding basin is a reservoir, normally empty, having an outlet always open, which is smaller than the inlet, so that during heavy storms part of the flow is held back and released gradually as the storm abates.

The first retarding basin constructed by the Board of Works is still in operation in Hawthorn, after 50 years' service. Twenty-one others have been constructed since, and there are plans to construct new basins and extend two existing basins in Moorabbin. It is probable that more basins will accompany the continuing growth of Melbourne.

The Board's network of retarding basins can be divided into five systems, each system feeding one of the following watercourses: Moonee Ponds Creek, Merlynston Creek,

Hawthorn East Drain, Gardiners Creek, and Mordialloc Creek. Although each basin had unique legal and economic problems associated with its development, all have similar hydrological reasons for their inception.

As the older catchments developed, no effective legislation was available to exclude development from the flood-prone areas adjacent to the creeks. This type of growth in some cases constricted the passage of larger flows and, during heavy storms, showed the retarding basin as the most effective and economical method of reducing peak flows to a flow which can be transmitted safely along the downstream drainage system. The alternative would have been the duplication or enlargement of the existing drainage systems.

In other areas, retarding basins are included in the original design of the drainage system. In these cases the basin not only retains peak flows but also reduces the size, and therefore the cost, of drainage works further downstream.

Some regions of Melbourne were originally swamp land and unfit for development. In such areas it is desirable to reduce flows and confine them to a narrower, controlled drainage system. This, in turn, drains the marshy areas and effectively opens up new lands for development. All this can and has been achieved most economically by the careful location of retarding basins.

A retarding basin may be formed in one of two ways. It can be excavated from a relatively flat area, or it can be formed by an embankment traversing a natural valley. The embankment may be specially constructed for the retarding basin or it can be used for a dual purpose by carrying a road across the valley.

The nature of a retarding basin lends itself easily to other uses. As many of the basins are empty and dry for the greater part of the time, some, with the co-operation of local councils, have been used for reserves and playing fields. Others have been designed to blend naturally with the surrounding flora to form parks, which to the untrained eye would not be recognised as flood protection structures.

The Lake Road Retarding Basin in the City of Nunawading is an example where a permanent lake has been incorporated in the design. The area surrounding the lake is preserved as a wildlife sanctuary by the Council. In addition, Cherry's Swamp and Truganina Swamp in Altona have been developed to act as retarding basins, but the original character of the swamps has been maintained so that these areas still provide a habitat for bird life, including several migratory species from the northern hemisphere.

Finance

Assessed value of property

The net annual value of property in 1975–76 and 1976–77 for the purpose of the Board's rating is shown in the following table:

VICTORIA—MELBOURNE AND METROPOLITAN BOARD OF WORKS: ASSESSED VALUE OF PROPERTY RATED
($m)

Rate	Net annual value of property	
	1975–76	1976–77
Water rate	791.3	804.7
Metropolitan general rate (for sewerage services)	644.7	663.3
Metropolitan drainage and river improvement rate	680.6	690.6
Metropolitan improvement rate	822.1	838.4

Finance for capital works

Capital works are financed mainly from moneys which the Board is given approval to borrow after the annual meeting of the Australian Loan Council has considered the projected loan programmes of semi-governmental authorities throughout Australia.

Board's borrowing powers and loan liability

The Board is empowered under section 187 of its Act to borrow up to $1,300m, exclusive of loans of $4.8m originally raised by the Victorian Government for the

construction of waterworks for the supply of Melbourne and suburbs. In addition, the Board may, under section 200 of its Act, receive advances by way of loan from the Treasurer of Victoria, and the value of these loans is not included in the limit of $1,300m quoted in section 187. At 30 June 1977, the Board's total loan liability amounted to $1,130.5m, of which $915.5m had been incurred under section 187. All moneys borrowed are charged and secured upon the Board's revenues.

Revenue, expenditure, etc.

The following table shows the revenue, expenditure, surplus or deficit, and capital outlay of the Board in respect of its water supply, sewerage, and drainage functions during each of the years 1972–73 to 1976–77. The Board keeps a separate account of its financial activities as the Metropolitan Planning Authority.

VICTORIA—MELBOURNE AND METROPOLITAN BOARD OF WORKS: REVENUE, EXPENDITURE, ETC.
($'000)

Particulars	1972–73	1973–74	1974–75	1975–76	1976–77
REVENUE					
Water supply—					
Water rates and charges (including revenue from water supplied by measure)	30,960	34,926	44,960	57,140	67,189
Sewerage—					
Sewerage rates	32,083	41,294	57,688	73,237	84,228
Trade waste charges	3,168	3,490	3,471	5,033	6,681
Sanitary charges	1,225	1,329	1,280	1,456	2,423
Metropolitan farm—					
Grazing fees, rents, pastures, etc.	4	3	3	4	3
Balance, livestock account	589	756	*Dr.* 263	*Dr.* 4	229
Metropolitan drainage and rivers—					
Drainage and river improvement rate	6,299	8,068	8,366	10,353	11,870
River water charges	13	12	16	11	12
Total	74,340	89,878	115,521	147,231	172,635
EXPENDITURE					
Water supply—					
Management	4,655	6,068	6,394	7,690	8,694
Maintenance	6,916	8,226	11,531	14,158	16,488
Water supply works	1,400	1,400	1,400	1,652	1,652
Sewerage—					
Management	4,365	5,811	9,232	9,617	10,755
Maintenance	5,098	6,616	11,364	15,320	19,599
Sewerage works	2,600	2,600	2,600	3,068	3,068
Metropolitan farm—					
Management	329	399	465	658	813
Maintenance	1,441	1,645	2,118	2,548	2,992
Metropolitan drainage and rivers—					
Management	979	1,298	1,053	1,588	1,735
Maintenance	1,626	2,097	2,734	3,421	4,162
Drainage works	1,000	1,000	1,000	1,180	1,180
Pensions and allowances	283	376	404	513	844
Loan flotation expenses	273	384	628	720	1,128
Interest (including exchange)	36,978	42,027	51,708	64,161	74,246
Contributions to—					
Sinking fund	1,883	2,023	2,210	2,408	2,727
Loans redeemed reserve	3,616	4,125	4,955	5,610	6,436
Renewals fund	988	1,109	1,151	1,466	1,796
Depreciation	341	264	320	1,015	1,019
Superannuation account	871	1,640	3,123	4,505	4,965
Municipalities for valuations, etc.	199	265	273	279	265
Rates equalisation reserve	*Cr.* 1,513	505	858	3,674	4,371
Appropriations for contingencies, etc.	—	—	—	1,880	3,200
Other	13	—	—	100	500
Total	74,340	89,878	115,521	147,231	172,635

VICTORIA—MELBOURNE AND METROPOLITAN BOARD OF WORKS: REVENUE, EXPENDITURE, ETC.—*continued*
($'000)

Particulars	1972–73	1973–74	1974–75	1975–76	1976–77
Capital outlay at 30 June—					
Water supply	283,657	324,338	375,356	434,343	515,931
Sewerage	393,716	460,694	541,686	627,037	700,769
Drainage and river improvement works	45,215	49,285	57,104	66,139	74,098

Town planning, metropolitan freeways, etc.

As a result of the passing of the *Metropolitan Bridges, Highways, and Foreshores Act* 1974 by the Victorian Parliament, the Board's road-making powers, road assets, etc., and certain officers and other employees were transferred to the Country Roads Board, as from 1 July 1974.

Also, under the same Act, the Board's responsibility for foreshores reverted to the Public Works Department.

In respect of its town planning functions, the Board now operates under the authority of the Minister for Local Government and Planning.

The following table summarises the revenue, expenditure, and capital outlay of the Board in connection with its functions as the Metropolitan Planning Authority during the period 1972–73 to 1976–77:

VICTORIA—MELBOURNE AND METROPOLITAN BOARD OF WORKS: METROPOLITAN IMPROVEMENT FUND: REVENUE ACCOUNT AND CAPITAL OUTLAY
($'000)

Particulars	1972–73	1973–74	1974–75	1975–76	1976–77
Revenue—					
Metropolitan improvement rate and sundry income	9,022	11,760	12,438	14,972	16,344
Recoup from Country Roads Board	—	—	1,026	—	—
Sales of land	—	—	2,042	5,225	1,644
Other	—	—	993	665	19
Total revenue	9,022	11,760	16,499	20,863	18,007
Expenditure—					
Management	1,644	2,144	2,936	4,249	4,576
Maintenance	1,216	1,110	42	38	305
Interest	65	70	73	77	120
Contributions to sinking fund	24	24	24	*Cr.* 24	—
Reserved land and acquisitions	4,441	6,056	8,615	4,759	5,557
Metropolitan parks land acquisitions	—	—	3,170	3,812	6,080
Special Road Projects acquisitions, etc.	—	—	553	553	—
Construction works	—	—	81	308	894
Road and foreshore works	1,452	114	—	—	—
Contribution to Melbourne Underground Rail Loop Authority	174	306	721	1,261	1,372
Transfer to rates equalisation fund	*Cr.* 163	1,778	61	5,469	1,289
Other	170	158	222	361	392
Total expenditure	9,022	11,760	16,499	20,863	20,585
Capital outlay at 30 June *(a)*	121,580	145,472	*(b)* 41,213	44,825	55,591

(a) Includes expenditure of the following amounts paid from the Roads (Special Projects) Fund: 1972–73, $5,712,000; and 1973–74, $8,864,000. Also includes expenditure of the following amounts paid from the Commonwealth Aid Roads Fund: 1972–73, $9,301,000; and 1973–74, $10,458,000.

(b) Henceforth excludes highways and bridge works, and foreshore works, responsibility for which has been transferred to other authorities.

Further references: Thomson-Yarra development scheme, *Victorian Year Book* 1974, p.253; Cardinia Reservoir, 1975, pp.188–9

STATE RIVERS AND WATER SUPPLY COMMISSION

Operations

The State Rivers and Water Supply Commission was constituted under the Water Act passed by the Victorian Parliament in 1905 and was made responsible for the conservation and distribution of rural water resources and the control of the use of water from rivers and streams and other natural sources, with the exception of the area controlled by the water supply authority for the Melbourne metropolitan area.

The establishment of the Commission followed earlier attempts to set up a body to manage Victoria's water resources. The Irrigation Act of 1886 provided a solid foundation for the development of water supply and irrigation that followed its effective nationalisation of all surface waters of Victoria, whereby the right to the use and control of waters in every river, creek, stream, billabong, lake, lagoon, swamp, and marsh was vested in the Crown. The Act also provided for the establishment of irrigation trusts with financial advances from the Victorian Government to meet the cost of irrigation works and for certain headworks to be constructed by the Victorian Government. The earliest of these headworks were the Goulburn Weir near Murchison and the Laanecoorie Weir on the Loddon River. The irrigation trusts proliferated and within a few years spread throughout Victoria, but they failed to provide a reserve water supply in dry seasons because of the lack of large storages and the unreadiness of landholders to make appropriate use of water when it was available.

Three commissioners, appointed by the Governor of Victoria, are responsible for the activities of the State Rivers and Water Supply Commission. The Commission employs a permanent work force of some 1,840 persons throughout Victoria and up to 1,300 casual staff, according to the demand for labour on Commission works. Of the total permanent staff employed (1,840) about 500 are engaged on engineering, surveying, drafting, and other professional occupations, about 650 on water distribution, district operations, and maintenance, and about 500 on accounting and administrative duties. Of the casual labour force of 1,300 persons, 350 are engaged on construction projects and 950 on district maintenance.

More than 60 large storages, 264 subsidiary reservoirs, and 30,000 kilometres of channels and pipelines are operated by the Commission to supply water for irrigation, stock, and domestic purposes, and for reticulated town supplies. In addition, the Commission provides water supply for domestic, stock, and industrial purposes in an area of rural and urban lands totalling about 5,000,000 hectares. It also administers flood protection, drainage, and river improvement works throughout Victoria. Delivery of irrigation water totalled 2,896,382 megalitres for 1977-78.

The Commission's engineering functions are divided into the following four main branches, each under the control of a chief engineer: major works—investigation, survey, design, and construction of major projects; rural water supplies—operation and maintenance of irrigation, drainage, and flood protection districts; town water supplies—construction, operation, and maintenance of urban water supplies, as well as engineering and financial supervision of local authorities for water supply, sewerage, and river improvement; and mechanical—design, construction, operation, and maintenance of the Commission's mechanical and electrical engineering works. All of these works were designed and constructed, and are operated and maintained, by the Commission. Specialised services to these branches are provided by the finance, accounts, stores, personnel, property and legal services, valuations, and secretarial branches of the Commission.

Outside the Melbourne metropolitan area there are now 464 reticulated town water supplies of which 147 come under the direct control and management of the Commission and the remaining 317 town supplies are administered by 207 local water authorities. There are 128 sewerage authorities, 27 river improvement trusts, and 4 drainage trusts in Victoria outside the Melbourne metropolitan area.

The Commission has also developed, patented, and arranged for the manufacture under licence, of small control structures, of both manual and automatic operation, for use on farm (terminal) channels.

Major water supply projects completed between 1968 and 1977 included:

Project	Features
Lake William Hovell	Earth and rockfill dam, storage 13,500 megalitres
Merrimu Reservoir Stage 1	Earth and rockfill dam, storage 19,000 megalitres
Merrimu Tunnel Stage 1 (Goodmans Creek to Coimadai Creek)	Tunnel 2 kilometres long, 2.3 metres diameter
Merrimu Tunnel Stage 2 (Lerderderg River to Goodmans Creek)	Tunnel 4 kilometres long, 2.7 metres diameter
Campaspe Irrigation and Drainage District	9,000 hectares
Barr Creek Salinity Lake Hawthorn Salinity	Salinity control on Murray River
Pyramid Creek and Broken Creek	Improvement by dredging of 130 kilometres of natural water course used as major supply and drainage carriers
Lake Mokoan	Earth and rockfill off-river storage, capacity 365,000 megalitres
Rosslynne Reservoir	Earth and rockfill dam, storage 24,500 megalitres
South Otway Pipeline	55 kilometres concrete-lined mild-steel pipeline of 500 mm diameter
Tarago-Western Port Pipeline	65 kilometres concrete-lined steel pipeline of 1,100 mm diameter

Still under construction in 1978 and due for completion at the end of that year was the Dartmouth Dam, an earth and rockfill dam of 4 million megalitres capacity.

Other services for which the Commission is responsible cover irrigation and agricultural extension work, including surveying, irrigation, land layout, surface and underground drainage layout, salinity control; licensing and control of diversions from rivers and streams and from underground resources throughout Victoria; and the assessment, licensing, and policing of discharges to water throughout most of Victoria.

Water pollution control

The Commission's Pollution Control Section was established in 1973 to implement powers delegated to the Commission by the Environment Protection Authority. These powers entailed the control of water pollution in country areas, excluding the La Trobe valley and the Yarra valley.

Pollution inspectors are located at Wodonga, Wangaratta, Shepparton, Bendigo, Ballarat, Frankston, Geelong, and Warrnambool. The inspectors at Shepparton and Bendigo work under the direct supervision of the local district engineer in close liaison with the Pollution Control Section. The inspectors have a wide range of experience in work, such as health inspection, waste treatment, laboratory work, inspection or pollution control duties in other departments, and technical teaching. On appointment, inspectors undertake an intensive two to three months training programme at the Commission's Head Office before working in the field. Bi-monthly training programmes then follow, so that the activities of inspectors throughout Victoria can be co-ordinated.

Policy on many discharges, such as farming operations and discharges from garages and car washes, are still under consideration. Septic tanks are now controlled by regulation rather than licence and this may be extended to include garages and car washes. It is now generally agreed by dairy and piggery farmers that wastes from such activities are unacceptable in streams. For the most part, effluent from these activities is being disposed of on land, a practice which is universally encouraged including on the smaller farms which are currently exempt from discharge licensing. To cope with the additional laboratory work involved, extensions have been carried out on the Commission's laboratories at Head Office.

Future programmes

The Commission's current Six-Year Programme of capital works for the period 1978–79 to 1983–84 reflects the continuing change in emphasis towards increasing expenditure on

urban water supply, sewerage, environmental protection, and water quality. The programme requires an allocation of $351m (at December 1977 prices) over the programme period, subject to availability of funds.

Major provisions in the programme include:

(1) The commencement of four major water conservation dams estimated to cost in excess of $76m for urban, industrial, and irrigation supply, and including Stage 3 of the Merrimu Reservoir Project;

(2) expenditure in excess of $20m for the construction of large trunk pipelines to augment supply to the Mornington Peninsula water supply system and to enhance the operating capabilities of the system;

(3) allocation of funds aimed at substantially reducing the backlog of deferred works (owing to lack of funds) in country water supply and sewerage programmes;

(4) continuance of groundwater control programmes by extraction and disposal with partial re-use, in the Shepparton region, subject to the approval of a current inquiry by the Parliamentary Public Works Committee (PPWC);

(5) commencement of salinity control works in the Sunraysia and Kerang regions for the interception of saline groundwater flows to the Murray River, and the disposal of saline drainage to evaporative disposal areas. Priority works for which Government approvals are available are expected to be completed by 1979–80 and the total programme, currently subject to an ongoing inquiry by the PPWC, is estimated to cost $60m (at December 1977 prices);

(6) continuance of surface drainage programmes in the Northern Irrigation Districts, including those programmes associated with groundwater extraction in the Shepparton region. These programmes are estimated to cost $2m to $3m per annum;

(7) a continuing programme estimated to cost $500,000 per annum for the roofing of storages within the Commission's major urban water supply systems as a prerequisite to future long-term programmes of comprehensive water treatment; and

(8) allocations for improvements to and for water treatment at urban centres within the Commission's irrigation and waterworks districts, particularly those on the Murray River and in the Wimmera–Mallee areas. Water treatment plants are programmed for completion at Red Cliffs and Robinvale within the programme period.

Storages

Dartmouth

The Dartmouth Dam, an earth and rockfill embankment 180 metres high, is being constructed on the Mitta Mitta River in north-eastern Victoria. It will be Australia's highest dam, and will impound a storage of 4,000,000 megalitres, 20 per cent more than Lake Hume, the River Murray Commission's largest storage to date. A 150 megawatt State Electricity Commission power station is being built at the foot of the dam to provide an annual output of 330,000,000 kilowatt-hours of electric power for Victoria, as well as a re-regulating dam downstream of the main dam to pond irregular discharges from the power station so that more constant flows of water can be passed downstream. (See also *Victorian Year Book* 1977, pp. 379–81).

Eildon

Located on the Goulburn River, immediately below its confluence with the Delatite River, Eildon is Victoria's largest dam. The lake extends over an area of some 13,000 hectares and is the main storage for the Goulburn Irrigation System, the oldest and most developed irrigation system in Australia. The original dam was constructed between 1915 and 1927 and modified during the period from 1929 to 1935. Maximum height of this structure was then 47.5 metres and its reservoir capacity was 377,000 megalitres. Between 1952 and 1955, a new embankment 79 metres high was constructed immediately downstream of the original dam to impound 3,390,000 megalitres.

Hume

Hume Dam is situated 8 kilometres upstream from the City of Albury, immediately below the confluence of the Mitta Mitta River with the Murray River. The reservoir, known as Lake Hume, covers an area of some 22,500 hectares, and is the main regulating

storage for the Murray River system. Constructed for the River Murray Commission by the Department of Public Works, New South Wales, and the Victorian State Rivers and Water Supply Commission, the dam is a popular tourist attraction for travellers between Melbourne and Sydney. It is close to the site where the explorers Hamilton Hume and William Hovell crossed the river in 1824. Water from the dam is used for town and irrigation supplies along the Murray River.

Waranga

Waranga Basin was first built in 1905 as an off-river storage filled with water diverted from the Goulburn River at Goulburn Weir. It is filled via the Stuart, Murray, and Cattanach Canals and is one of the largest storages in the system. Waranga Basin has a small catchment area of its own and supplies water to irrigation areas west of the Goulburn including Rodney, Rochester, and Tongala.

Mokoan

This large artificial lake with an area of 79 square kilometres was formed by an earthen dam 10 metres high and 7.2 kilometres long. It was built in 1970 across the end of the Winton Swamp near Benalla in north-eastern Victoria. In conjunction with the 40,000 megalitre Lake Nillahcootie, this off-river storage harnesses the flows of the Broken River and its tributaries. Special facilities were provided to maintain breeding areas for bird life. Storage capacity is 365,000 megalitres.

Rocklands

Located on the Glenelg River, 14.5 kilometres upstream from Balmoral, this is the major storage of the unique Wimmera-Mallee domestic and stock supply system in north-western Victoria. It marks the first example in Victoria where a south-flowing stream was diverted northwards via a tunnel. Storage capacity is 336,000 megalitres.

Eppalock

Situated on the Campaspe River, upstream from Axedale near Bendigo in north-western Victoria, Eppalock Dam was built between 1960 and 1962. Waters of the reservoir are released downstream to irrigate farms along the river and within the Campaspe Irrigation District south of Rochester. At periods of peak demand in the Goulburn Irrigation System, supplementary supplies are pumped from the river to the Waranga Western Channel. Eppalock water is also conveyed by pumping to Bendigo in a 26 kilometre pipeline. The lake is a popular recreation location, especially for speedboat enthusiasts.

Glenmaggie

The keystone of the Gippsland irrigation areas, Glenmaggie Dam is situated on the Macalister River in Gippsland, eastern Victoria. The reservoir supplies irrigated properties in the vicinity of the towns of Maffra, Heyfield, Stratford, and the City of Sale. Soldier settlement after the Second World War necessitated an increase in irrigation areas, and the storage was enlarged from 61,700 megalitres to 190,000 megalitres.

Bellfield

Built as a reserve storage for the Wimmera-Mallee domestic and stock supply system in north-western Victoria, Bellfield Dam was constructed between 1963 and 1967 on Fyans Creek upstream of Halls Gap in the Grampians region. The dam is normally kept full and is depleted only at the end of a dry period in the Wimmera-Mallee region. Water from the dam is used primarily for stock and domestic purposes in the system.

Devilbend

Constructed to supply the rapidly growing urban and industrial demands of the Mornington Peninsula, this earth and rockfill dam 27 metres high, was completed in 1964. The project includes a pumping station below the dam and catch drains around the reservoir periphery to prevent pollution. Storage capacity is 14,500 megalitres.

Tarago

The Tarago earth and rockfill dam, 34 metres high, on the Tarago River was constructed in 1968 to provide a new storage for the Mornington Peninsula system to supplement the previously adequate aqueduct diversions. The design made provision for

raising the height of the embankment to give a 50 per cent enlargement of the storage capacity, which was completed in 1972.

Rosslynne

The Commission's most recent large dam is Rosslynne Reservoir on Jacksons Creek, near Gisborne. It was built to provide additional water supplies to the rapidly expanding townships of Sunbury and Gisborne, and to support irrigation development by diverters along the Maribyrnong River. The dam has a storage capacity of 24,500 megalitres.

Buffalo

Set at the foot of the western flank of Mt Buffalo and its national park, this dam was constructed in 1965. The storage impounded by this earth and rockfill dam, 30 metres high, safeguards pumped supplies to growers of high-value crops and the City of Wangaratta in north-eastern Victoria.

Pykes Creek

Situated 72 kilometres west of Melbourne, Pykes Creek dam impounds a storage for irrigation and domestic requirements in the Bacchus Marsh and Werribee areas. The Western Highway crosses the site by an embankment constructed below the dam. An earthen dam, 39 metres high, it was first built in 1911 and raised in 1930.

Merrimu

Merrimu Dam was constructed on the Coimadai Creek north-east of Bacchus Marsh as the first stage of an irrigation and town supply project. The existing first stage storage impounds water diverted by means of a tunnel from Goodmans Creek, provides a reserve for the Bacchus Marsh and Werribee irrigation districts, and will supplement urban water supply for the Melbourne satellite development at Melton. The second stage of the project provides for the diversion of the Lerderderg River by another tunnel to connect the river to Goodmans Creek. This tunnel has now been completed, and the construction of the concrete diversion weir on the Lerderderg River is well advanced. In the third stage, it is proposed to raise the dam embankment to provide storage capacity of 74,000 megalitres.

William Hovell

Lake William Hovell is located on the King River, 24 kilometres upstream from Whitfield in northern Victoria. It takes its name from the explorer William Hovell who passed through the region in 1824 with Hamilton Hume. The dam consists of an earth and rockfill embankment and a concrete-lined chute and ski-jump spillway. Water from the dam is used for irrigating tobacco, hops, and grazing areas lower down the King River and in the Ovens River Valley. Storage capacity is 13,500 megalitres.

Irrigation

Most irrigation is carried out in districts directly controlled by the Commission, although there is an increasingly large proportion of "private diverters", irrigators who are authorised to take water from streams, lakes, etc., but who do not come within the boundaries of an irrigation district. A feature of the districts is the system of "water rights" under which a certain quantity of water is assigned to each district and allotted to the lands commanded and suitable for irrigation. The irrigators pay a fixed sum for this water each year, whether they use it or not. Water rights are available in all except the very driest years and water in excess of the water right can be bought in most seasons. The water right system assures irrigators of a definite quantity of water each year, and the Commission can rely on fairly constant revenue to meet the cost of district operations. Water usage varies according to seasonal conditions and the water right system provides a constant minimum income to the Commission.

A feature of Victorian irrigation policy has been the development of closer settlement by intensive irrigation, that is, by allocating relatively large quantities of water per holding instead of limiting the allocation of water to a portion of each holding. This has meant that Victorian irrigation is predominantly devoted to dairying and horticulture, rather than to sheep raising. The advantage of intensive irrigation is that much higher returns are available from a given quantity of water and, consequently, a much larger rural

VICTORIA—LANDS UNDER IRRIGATED CULTURE: EXTENT OF IRRIGATION AND AREAS WATERED, 1976–77

Name of district, area, etc.	Total area of holdings in irrigation districts	Area classified as suitable for irrigation	Water rights apportioned including extra water right	Area irrigated, including lands adjoining a district										
				Total	Cereals	Lucerne grown for pasture and hay	Sorghum and other annual fodder crops	Pastures			Vineyards	Orchards	Market gardens	Fallow and miscellaneous
								Native	Annual	Perennial				
	hectares	hectares	megalitres	hectares	hectares	hectares	hectares	hectares	hectares	hectares	hectares	hectares	hectares	hectares
GOULBURN–CAMPASPE–LODDON SYSTEM—														
Shepparton	90,356.1	83,435.5	190,683.0	43,047.8	1,194.1	742.7	801.7	254.3	15,170.9	19,338.4	96.3	3.896.0	484.1	1,069.3
Rodney	109,257.1	100,972.2	253,546.0	63,381.0	445.0	1,147.0	354.0	785.0	25,550.0	30,114.0	82.0	3,213.0	1,281.0	410.0
Tongala-Stanhope	30,938.6	28,351.7	104,725.0	22,047.0	21.0	100.0	140.0	—	6,075.0	15,395.0	—	215.0	55.0	46.0
Deakin	63,790.7	41,764.8	43,425.0	14,048.0	433.0	287.0	58.0	28.0	7,128.0	5,476.0	—	6.0	292.0	340.0
Rochester	75,725.0	68,883.0	147,872.0	39,057.0	996.0	385.0	433.0	100.0	15,540.0	20,677.0	—	25.0	341.0	560.0
Dingee	4,254.0	3,710.6	10,026.0	2,650.0	8.0	26.0	—	13.0	1,039.0	1,564.0	—	—	—	—
Calivil	26,592.0	24,596.6	39,842.0	12,161.0	286.0	440.0	303.0	221.0	6,779.0	4,037.0	—	—	2.0	93.0
Tragowel Plains	88,634.4	76,081.6	121,198.0	50,929.0	1,803.0	207.0	2,296.0	4,140.0	33,204.0	7,228.0	—	—	—	2,051.0
Boort	45,877.0	39,120.1	51,811.0	23,233.6	3,410.0	1,041.0	767.0	36.0	12,037.0	2,787.0	—	—	23.6	3,032.0
Campaspe	8,673.6	8,221.3	16,850.0	4,359.0	25.0	482.0	151.0	91.0	755.0	2,594.0	—	—	261.0	—
East Loddon	—	—	—	241.0	—	—	—	10.0	124.0	107.0	—	—	—	—
West Loddon	—	—	—	1,628.0	312.0	103.0	80.0	—	625.0	34.0	—	—	—	474.0
Total	544,098.5	475,137.4	979,978.0	276,782.4	8,933.1	4,960.7	5,383.7	5,678.3	124,026.9	109,351.4	178.3	7,355.0	2,839.7	8,075.3
MURRAY RIVER SYSTEM (Torrumbarry Weir)—														
Cohuna	50,444.2	47,191.4	131,418.0	39,919.0	194.0	619.0	250.0	1,602.0	17,347.0	19,677.0	—	7.0	84.0	139.0
Koondrook	38,088.4	32,738.2	72,668.0	27,285.0	3,674.0	102.0	958.0	259.0	16,604.0	4,983.0	—	181.0	7.0	517.0
Swan Hill	15,593.7	14,874.9	56,068.0	11,924.6	81.4	407.2	9.3	1,063.4	1,227.1	6,725.1	1,249.3	451.6	349.2	361.0
Third Lake	8,500.3	7,799.2	12,145.0	3.338.0	199.0	182.0	67.0	30.0	2,469.0	268.0	—	—	—	123.0
Mystic Park	8,408.0	7,470.1	11,291.0	3,157.8	363.1	48.8	24.7	76.9	2,097.4	441.5	17.4	13.3	4.7	70.0
Tresco	1,857.0	989.2	5,067.5	980.5	—	48.7	—	—	6.9	3.0	719.7	99.4	77.7	25.1
Fish Point	7,431.2	7,045.3	9,894.0	2,901.3	411.2	6.4	39.2	809.8	1,072.7	328.2	—	—	17.3	216.5
Kerang	34,323.1	29,753.4	61,914.0	22,465.0	963.0	112.0	819.0	2,059.0	13,428.0	4,313.0	—	—	4.0	767.0
Kerang North-West Lakes	—	—	—	907.0	50.0	117.0	26.0	47.0	464.0	63.0	65.0	61.0	4.0	10.0
Total	164,645.9	147,861.7	360,465.5	112,878.2	5,935.7	1,643.1	2,193.2	5,947.1	54,716.1	36,801.8	2,051.4	813.3	547.9	2,228.6
Murray Valley (Yarrawonga Weir)	121,853.1	106,804.9	245,539.0	58,552.9	1,811.1	1,227.0	764.8	112.4	24,382.7	22,951.0	135.0	1,896.0	489.9	4,773.0

VICTORIA—LANDS UNDER IRRIGATED CULTURE: EXTENT OF IRRIGATION AND AREAS WATERED, 1976–77—*continued*

Name of district, area, etc.	Total area of holdings in irrigation districts	Area classified as suitable for irrigation	Water rights apportioned including extra water right	Area irrigated, including lands adjoining a district										
				Total	Cereals	Lucerne grown for pasture and hay	Sorghum and other annual fodder crops	Pastures			Vine-yards	Orchards	Market gardens	Fallow and mis-cellaneous
								Native	Annual	Perennial				
	hectares	hectares	megalitres	hectares	hectares	hectares	hectares	hectares	hectares	hectares	hectares	hectares	hectares	hectares
Direct from river by pumping—														
Nyah	1,565.5	1,321.2	9,152.9	1,081.0	—	13.6	7.6	73.1	—	160.0	647.2	56.2	97.1	26.2
Red Cliffs	5,509.3	5,201.4	43,743.5	4,938.6	2.5	4.1	12.3	—	—	42.4	4,641.5	189.3	2.3	44.2
Merbein	3,731.9	3,506.0	30,256.2	3,567.0	54.0	40.2	23.6	37.3	43.3	24.8	2,971.2	316.6	5.8	50.2
Robinvale	3,608.4	3,075.9	17,525.8	2,206.0	—	—	—	—	—	—	2,047.0	159.0	—	—
Total	14,415.1	13,104.5	100,678.4	11,792.6	56.5	57.9	43.5	110.4	43.3	227.2	10,306.9	721.1	105.2	120.6
First Mildura Trust	15,863.7	8,003.3	73,182.2	8,003.3	—	—	—	—	—	270.0	6,296.3	311.0	—	1,126.0
Murray River System Total	316,777.8	275,774.4	779,865.1	191,227.0	7,803.3	2,928.0	3,001.5	6,179.9	79,142.1	60,250.0	18,789.6	3,741.4	1,143.0	8,248.2
OTHER NORTHERN SYSTEMS—														
Coliban	—	—	—	4,217.1	11.8	117.5	—	242.3	854.5	2,427.5	15.0	410.0	59.5	79.0
Wimmera	—	3,048.0	—	3,236.8	—	68.8	68.1	—	10.1	3,012.7	0.2	67.8	9.1	—
Total	—	3,048.0	—	7,453.9	11.8	186.3	68.1	242.3	864.6	5,440.2	15.2	477.8	68.6	79.0
SOUTHERN SYSTEMS—														
Bacchus Marsh	2,416.1	1,346.9	3,884.6	1,170.0	—	46.0	16.0	—	—	686.0	—	177.0	245.0	—
Werribee	3,815.9	3,604.1	9,716.0	3,186.0	—	78.0	—	—	—	1,311.0	—	40.0	1,757.0	—
Maffra-Sale	34,674.1	28,397.3	64,395.0	18,435.0	23.0	80.0	31.0	294.0	—	17,986.0	—	—	21.0	—
Central Gippsland	17,897.1	15,330.0	38,726.0	11,978.0	—	—	—	115.0	—	11,863.0	—	—	—	—
Mornington Peninsula	—	—	—	118.4	—	—	—	—	—	—	—	—	68.4	50.0
Bellarine Peninsula	—	—	—	125.0	—	—	—	—	—	—	—	—	105.0	20.0
Total	58,803.2	48,678.3	116,721.6	35,012.4	23.0	204.0	47.0	409.0	—	31,846.0	—	217.0	2,196.4	70.0
PRIVATE DIVERSIONS THROUGHOUT THE STATE	—	—	—	78,339.0	2,035.0	5,441.0	1,998.0	1,291.0	13,044.0	34,581.0	3,931.0	3,609.0	8,156.0	4,253.0
GRAND TOTAL 1976–77	919,679.5	802,638.1	1,876,564.7	558,814.7	18,806.2	12,720.0	10,498.3	13,800.5	217,077.6	241,468.6	22,914.1	15,400.2	14,403.7	20,725.5
GRAND TOTAL 1975–76	917,998.8	801,200.2	1,872,020.8	578,200.1	6,431.6	13,577.7	10,570.4	15,627.4	216,225.6	243,420.8	22,649.5	16,711.6	12,899.5	20,086.0

population is supported. Delivery of irrigation water totalled 2,896,382 megalitres for 1977-78.

In 1977-78, the area watered by private diversion from rivers, lakes, etc, was 68,879 hectares and the number of private diversions authorised was 11,526. The water delivered was used mainly to produce annual and perennial pastures and fodder, as well as potatoes, tobacco, hops, vegetables, vines, fruit, and cereals. About half the area privately watered is supplied from streams regulated by storages, the other half being from streams wholly dependent on rainfall. Many private storage dams are being built, frequently at substantial cost, to insure against low flows in the streams normally used.

The following table shows the area irrigated in Victoria for the years 1972-73 to 1976-77:

VICTORIA—AREA IRRIGATED
(hectares)

Source of supply	1972-73	1973-74	1974-75	1975-76	1976-77
Goulburn-Loddon system	276,172	234,074	264,673	262,306	276,782
River Murray system	193,963	183,488	188,045	188,298	191,227
Other northern systems	7,360	7,316	7,341	7,475	7,454
Southern systems	33,789	34,988	35,345	35,566	35,012
Private diversions	87,710	85,176	90,439	84,556	78,339
Grand total	598,994	545,042	585,843	578,201	588,814

COUNTRY TOWN SUPPLIES

Introduction

During the gold rushes of the 1850s, large numbers of people migrated to areas without adequate water supply either for domestic or for mining purposes. The mining population was too unsettled to accept responsibility, and no suitable supply authority existed. The Victorian Government, therefore, constructed reservoirs where needs were most pressing. The earliest reticulated supplies were to Bendigo in 1859, Ballarat in 1862, and Geelong in 1865. As early as 1872, a number of municipal corporations received government loans with which many waterworks of permanent value were constructed.

The first comprehensive legislation for the supply of water to country districts was the Water Conservation Act of 1881. This provided for the constitution of Waterworks Trusts to construct and manage supply works throughout Victoria. More detailed legislation to control supplies in urban areas was added in 1884. At the end of the Second World War there were 258 country towns in Victoria with water supply systems, providing reticulated supplies to 51 per cent of Victoria's population outside the Melbourne metropolitan area. Country urban communities with reticulated water supplies now number 446. Supplies to 148 of these towns are managed directly by the State Rivers and Water Supply Commission—either as part of its major urban supply systems, or as isolated towns in areas supplied for irrigation or for rural domestic and stock purposes. The remaining 298 town supplies are managed by local water authorities especially constituted for the purpose under the Water Act.

The 148 town supplies managed directly by the Commission fall into two categories—those forming part of the large main urban supply systems, and those located within irrigation or waterworks districts and operated as part of those systems. The main urban supplies comprise towns in the Mornington Peninsula, the Bellarine Peninsula, the Otway System, and the Coliban System. All these systems were constructed principally for the supply of towns only, although the Coliban System also provides substantial irrigation supplies to the Bendigo-Castlemaine area. The general responsibilities of the Commission in the supply of water to country towns are essentially similar to those noted in the following section on local authorities.

Local authorities

The establishment of separate authorities to provide water and sewerage services to country towns is unique to Victoria. These authorities are independent responsible

statutory bodies which make their own decisions, engage their own staff, and construct and manage their own works. However, as the Victorian Government usually provides a substantial degree of financial assistance, all their operations and proposals are subject to general review by the Commission. At June 1978, there were 207 local water authorities throughout Victoria at present supplying 317 country towns. Four of these authorities operate under special Acts. The remainder have been constituted under the Water Act, which provides several different ways in which such a local authority could be constituted so as to meet a variety of local conditions.

Organisation

There are two broad classes of local water authority:

(1) "Local governing bodies", which are municipal councils constituted as local governing bodies under the Water Act; and

(2) "waterworks trusts", the commissioners of which might comprise:

(i) councillors for the time being of the municipality concerned plus one Victorian Government nominee;

(ii) councillors of one or more municipal ridings plus up to three nominees; or

(iii) commissioners elected directly by the water ratepayers.

Local governing bodies (25) are usually limited to cities or boroughs as their water supply districts must be essentially urban in character. Although a local governing body may be composed entirely of councillors and use the Council's name, it is a separate legal entity and its business and accounts must be kept quite apart from the administration of municipal affairs. Waterworks trusts usually comprise about six commissioners, and have jurisdiction over a waterworks district, within which there may be one or more urban districts.

Several local water authorities operate under special Acts which are usually supplementary to the Water Act. These special authorities include the Mildura Urban Waterworks Trust, the Geelong Waterworks and Sewerage Trust, the Latrobe Valley Water and Sewerage Board supplying water in bulk to towns and industries in the La Trobe valley, and the West Moorabool Water Board which supplies water in bulk to the local authorities at Ballarat and Geelong. A number of small townships in Victoria are still supplied by local municipal councils under powers conferred by the Local Government Act. However, the provisions of that Act in relation to water supply are insufficiently specific for the management of any substantial town water supply system. Although such supplies can receive consideration for a capital grant under the town water supplies assistance formula, the remainder of the costs must be found by the municipality concerned from its normal sources of loan funds.