Water and Gold: Interpreting the Landscape of Creswick Creek

Peter Davies, Susan Lawrence and Jodi Turnbull
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Abbreviations

BFP – Bathurst Free Press and Mining Journal
BS – Ballarat Star
CA – Creswick Advertiser
DMR – Dicker’s Mining Record
GG – Victorian Government Gazette
ISN – Illustrated Sydney News
MSR – Mining Surveyor’s Report
OMA – Ovens and Murray Advertiser
SAB - Sludge Abatement Board
SMH – Sydney Morning Herald
WRL - Water Right Licence

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1 Introduction – A Landscape of Water

The hills south of Creswick do not immediately disclose the role that water once played in the human history of this landscape. Gold mining and forestry are the better-known stories that people now associate with the European history of Creswick. There are vague hints though – the campground beside Slaty Creek, Russells Reservoir glimpsed through the trees beside the Creswick-Bungaree Road, and the swimming, boating and picnicking at St. George’s Lake all suggest that water is there and is valued.

Water was as important as gold in these hills in the 19th century. Miners on Victoria’s colonial goldfields needed substantial quantities of water to wash gold from the earth. Variable rainfall and limited supplies in creeks and rivers, however, meant that miners often had to construct storage dams and lengthy races to bring water from where it was available to where it was needed. During the 1850s and 1860s miners at Creswick constructed dozens of dams and several hundred kilometres of water races. In the process they rapidly became water merchants, manipulating and trading the water supplies they controlled. Many of the races and dams they built are well preserved on the goldfield today. The remains indicate the ways in which miners came to terms with the possibilities and limits of the natural world and in the process created extensive landscapes of water management.

In 1868 the Victorian Secretary for Mines, Robert Brough Smyth, calculated that 2434 miles (3916 km) of water races were in use on the colony’s goldfields, and this at a time when the early alluvial rush was waning and many races had already been abandoned (Smyth 1979:547). These races, dams and other elements of water infrastructure took months and often years to build, dug with pick and shovel through clay, gravel and rock. They demonstrate a commitment to place that defies the mobile, migratory reputation of the early gold rush years (Goodman 1994; Lawrence 2000). Races are also important evidence for the commercialisation of water, where a natural resource came to be measured and traded as so many ‘sluice-heads’ to be leased and sold. In addition, the miners’ use of water was instrumental in the development of water law, as competing users in Victoria looked to government and the courts to arbitrate disputes over water access and entitlements. By the mid-1860s a system had evolved to regulate flows of water for mining purposes, creating a legal framework that the other colonies soon followed and that showed the way for later irrigation agriculture (Armstrong 1901:220; Davies and Lawrence 2014). The infrastructure itself often provided the foundations for modern municipal supplies and recreational amenities, the heritage values of which have recently been acknowledged (Context 2007a, 2007b).

In this book we present the results of archaeological and historical research undertaken at Creswick as part of an Australian Research Council-funded project, ‘Cultural Landscapes of Colonial Water Management in Victoria’s Central Highlands’, supported by the Archaeology Program at La Trobe University in Melbourne. Archaeological and historical research carried out between 2011 and 2013 revealed over 160 km of races and several dozen storage dams on the Creswick alluvial goldfield. While some of the races no longer exist, the vast majority of major channels are extant, with long sections substantially intact.

Here we consider these dams and channels as integrated parts of a wider landscape of water use. Landscapes bring together human activity and thought at a regional level, connecting distant places through networks of movement, purpose and associations and particular ways of understanding how the land is to be used. For more than 50 years, from the discovery of gold until the eve of the First World War, people around Creswick agreed that water should be used for mining. This understanding led them to create a landscape of water that extended from the dams built on the upper catchments of Creswick Creek high in the Great Dividing Range, downstream through networks of races to the mine workings and then through the town of Creswick itself and out across the plains to the north, to Laanecoorie Reservoir and the Loddon River.

This volume describes the physical traces of water management associated with prominent local mining parties such as George and William Russell, John Roycroft, James Robertson and the St George’s Sluicing Company, Charles and Benjamin Eaton, John Bragg and the Humbug Hill Sluicing Company and several other groups. Alongside the activities of these water merchants were less visible groups of Chinese miners who preferred to lease water for their operations, while the Creswick municipal council built a town supply that gradually incorporated many of the water resources of the larger mining parties. As surface alluvial mining faded from the Creswick goldfield during the 1870s, the legacy of the miners included extensive networks of races and dams often integrated into complex systems of water management.

We selected the Creswick Regional Park as a research focus for several reasons. The archaeological evidence for water management is generally well preserved, with relatively little subsequent disturbance. Features date from the beginning of the gold rush in the 1850s and continued in use, in some cases, until the 1930s and later. In addition, most of the area is accessible as public land, while controlled burning of the forest in recent years means surface visibility has been very good.
1. Introduction – A Landscape of Water

Our focus of investigation has been an area bounded by Slaty Creek to the west and south, Creswick Creek (originally known as Back Creek) to the north, and the Creswick-Bungaree road to the east (see Figure 1). This includes an area of approximately 16 km². We have not attempted, however, to consider every example of water management identified in the study area. Instead, we have targeted races and dams which constituted water systems, i.e. interconnected networks of water use, which we have been able to identify in archaeological and historical contexts.

We have examined a wide range of historical sources in this study, including the Ballarat Star and Creswick Advertiser newspapers, and papers in the E. J. Semmens Collection held by the University of Melbourne Archives. In addition, Council Minute Books and Mining Wardens’ Registers held by the Ballarat Archives Centre (Public Record Office of Victoria), and records of the Creswick and District Historical Society, have also been invaluable. Important maps include Krause’s (1880) Creswick Gold Field, the Henderson Map (2009), the Creswick Parish Map (VPRS 16171), Creswick Diggings orienteering map (1995) and mining lease maps (Public Records Office of Victoria). Kevin Tolhurst (University of Melbourne) has also conducted extensive surveys of water races in the district, and he has very generously made the results of his work available to us.

Our focus in this book is thus to explore the archaeology of water management and understand how miners became water merchants by manipulating available supplies of water, rather than to provide a history of Creswick or a study of mining technologies. We focus mainly on the period of alluvial mining from 1851 to the 1870s, with limited discussion of later large-scale hydraulic sluicing and dredging activities. We begin with a brief discussion of the ways that water was used in mining, followed by an overview of the physical landscape of the Creswick alluvial goldfield, along with details of Aboriginal occupation and pastoral activity in the pre-gold rush years. A historical summary of alluvial mining at Creswick is followed by a description of gold mining and water law in colonial Victoria, much of which was worked out with reference to disputes in Creswick. We then present the main results of our research into the major sluicing companies and water networks on the Creswick goldfield and conclude by following the water downstream to describe the environmental impacts of mining and the problem of sludge.

Our work has focussed on Creswick but the processes we describe were happening all across the Victorian goldfields at this time. Securing access to water was as important during the gold rush as it is to people today. The challenges faced by the early gold miners and the solutions they developed – the infrastructure of water storages and channels, the customs and laws that governed rights to water, the steps to protect downstream users – all continue to shape both the physical landscape of the central goldfields and the culture of water use in Victoria.

Figure 1: Locality map of Creswick showing natural drainage and historic mining locations
2. Gold Mining and the Need for Water

Water was vital to all branches of gold mining, being used to separate the gold from its surrounding matrix. Water was used in crushing quartz, in puddling heavy clays, and in washing silts and gravels. Most work on the shallow alluvial goldfield south of Creswick was done with ground and hydraulic sluicing methods. This branch of mining required more water than others but the need for water was universal.

At the beginning of the gold rush miners mixed soil and water in pans and cradles to loosen the dirt and separate the gold. By the mid-1850s miners had introduced more efficient ways of washing sands and gravels using ground sluices and puddling machines; ground sluicing in particular used much greater volumes of water than had previously been required (Birrell 2005:306-310; Davey 1996; Smyth 1979:126-129). Ground sluices channelled water through a system of races or ditches and miners either directed it over the working face to loosen and wash away the soil or shovelled the soil into the race for the water to wash away. They also used puddling machines, ring-shaped troughs in the ground into which soil and water was placed. Paddles or harrows suspended from a rotating central arm were then dragged through the mud to break up the soil and loosen the gold which was recovered when the muddy water was released.

Hard rock mining also needed water. This branch of mining emerged in the late 1850s as miners developed the technology to extract gold from quartz reefs. Stamp batteries that crushed the rock beneath heavy cast-iron weights were in general use by the mid 1850s and the miners began to follow the reefs underground (Birrell 2005:352-354; Davey 1996:56). Water was used to carry the ore through the sequence of treatments and to provide the means of washing out the gold. Water also provided the motive power for crushing, either by supplying steam engines and boilers or by turning waterwheels (Davies and Lawrence 2013b).

Building the races

Miners began building races and diams from the early 1850s to supply their water needs. Among the first races recorded in Victoria was one built at Yackandandah by Mr Reilly and party in 1853. The 1¾ mile race ended in a reservoir and the water was used in a 130-feet-long sluice (The Argus 13 May 1853; Report 1860-61:1). Races were being constructed in Creswick in 1854, the year following the discovery of gold at Slaty Creek, and a decade later the major catchments around Creswick had all been tapped. By 1868 Robert Brough Smyth (1979:547), the Secretary for Mines, calculated that more than 3900 km of races had been constructed in Victoria’s principal mining districts (Table 1) as well as 44 major water reservoirs, some holding more than 300 megalitres of water. Countless more private storages had also been constructed by this time.

Races were simple earthen channels excavated by pick and shovel, usually about 1.5 metres wide.
and up to one metre deep. Some were only a few hundred metres long, but others were 20 kilometres or more in length. Races followed the contours of hills, winding in and out of gullies, and falling at a very slight gradient to ensure the controlled flow of water. Tunnels, flumes and siphons were also used where necessary. Large races often required construction of a dam in a creek or gully to maintain the water supply, while smaller races relied on seasonal water flows. Dams were usually built of earth, rock and clay with water flowing out through a by-wash at one side or through a piped valve at the base of the dam wall (Pearson and McGowan 2000: 152). Water was drained from the diggings through tail races and either reused for mining further downstream or released back into the waterways. The use of water in this way is not unique to Victoria. Similar networks of water races have been recorded on the Lisle-Denison goldfields in north-eastern Tasmania (Coroneos 1993), the Shoalhaven River in New South Wales (McGowan 1997; Tracey 1997) and at Otago in New Zealand (Ritchie 1981; Carpenter 2012).

**Archaeology of water management at Creswick**

The main archaeological features of water management preserved on the Creswick alluvial goldfield are water races, dams, and reservoirs. These include major supply races, branch races, head and tail races, mining dams, holding dams, settling ponds, sludge channels and reservoirs. Other components of these features include pipe tracks, fluming, chutes, earthen and stone dam walls, gauge box locations, gauges and race spoil. Sections of piping (iron and bitumen paper) have also been identified, along with concrete regulators in several dams. In addition, some areas have been heavily scarred by ground sluicing, including Humbug Hill and along the sides of Lincoln Gully, and around Mopoke and Tavistock Hill. Modifications to water races are also common, including barriers, repairs and diversions. Water races at Creswick are generally well preserved, but major localised disturbances due to logging and road construction, the use of heavy machinery and urban residential and recreational developments occur in some areas.

Supply races delivered water from a water source such as a reservoir or water course. Most supply races were originally excavated on a slight gradient across a gentle slope, with a U-shaped, v-shaped or square profile. Excavated soil (spoil) was placed on the down slope acting as a barrier (Figure 2). Races range from narrow trenches 20 cm wide to more substantial trenches up to 2 metres in width. Depths varied from 20 cm to 1.5 metres. Some were excavated deeply into bedrock. Many of the races change dimensions over their length as a result of terrain, but also to regulate flow. Silts from the flowing water may have helped to seal the channel and reduce leakage. In some cases the amount of clay and soil piled on the lower side of races is much greater than the volume of the race itself. This suggests that silt and debris was cleaned out at intervals to maintain the flow of water. Len Goldsmith recalled cleaning water races around Wolfe’s Hill in the 1930s:

> You had to keep up with the water, at the same time as scooping the race clear of rubbish all the way. If you didn’t keep up, the rubbish would dam up and the race would overflow. The water wouldn’t flow any further then so to get the job done quickly you had to keep up. (Goldsmith 2000:4)

Goldsmith also noted that yabbies in the water could dig holes in the races that would leak and then wash out, while early miners on Back Creek also complained of the same problem with crawfish (i.e. yabbies; BS 10 August 1858).

Construction of a water race meant maintaining a constant slight fall across the contour of the land. If the fall was too shallow the water would not flow and more silt was deposited, but if the fall was too steep the water would flow too fast and erode the race. It is uncertain if miners aimed for a constant or variable gradient. It is possible that a minimum gradient was established, with spare height kept ‘in hand’ should obstacles such as large rocks or trees need to be avoided with a sudden drop.

The hydraulic performance of water races is uncertain, given the range of variables affecting the flow of water from source (dam) to discharge (mining claim). Flowing water was subject to infiltration, or

![Figure 2: Profile of typical water race and excavated spoil](image-url)
seepage into the surrounding subsoil, along with friction, evaporation and turbulence. There were also accidental ruptures in the wall of the race and theft by rival mining parties. A rough lining of the race caused drag and friction and reduced the velocity of water flow (Hodge 2002:219). It is unclear, however, whether the debris-filled races we see today were the same as in the past when the races may have been clean and well maintained.

In 1870, British engineer Richard Sankey calculated the hydrological performance of the River Loddon Company’s race, which extended 10½ miles (16.9 km) from the Loddon River to Fryerstown, near Castlemaine. The race was comparable in capacity and length to those on the Creswick goldfield, being fairly small (about 3 feet wide and 2 feet deep) and cut through schist rock. Measurements indicated a water loss of about 18.5% over the total length of the channel by soakage and evaporation (Sankey 1871:103). Creswick Council races were often reported as inefficient as well, due to leakage, blockages and evaporation.

While silt carried in the water may have sealed the lining of the race, the channel would need to be in constant use for this effect to be sustained. The probable seasonality of ground sluicing, however, meant that races were generally subject to a cycle of wetting and drying. This would result in water loss as the surrounding soil matrix absorbed water from the race as it flowed again after a dry spell. Volumes of water measured by ‘sluice-heads’ at the head of a race were thus likely to be much reduced by the time they flowed all the way to a mining claim.

The amount of water needed for sluicing varied according to the type of soils. Richard Sankey requested trials to be conducted in several mining districts to determine how much water was needed ‘for reducing a cubic yard of auriferous soil of different character’ (Sankey 1871:42 [Appendix No 10]). James Stevenson, the Creswick Mining Surveyor, carried out trials on washing different types of soils. He found that one cubic yard (0.76 m³) of easily worked soil required 2325 gallons (10,570 litres) of water, and one yard of medium soil required 3321 gallons (15,100 litres). Stiff clayey soil, however, was ‘scarcely ever sluiced in the district, as it would require too much labour, and would not effectually extract the gold’ (Sankey 1871:43 [Appendix No 10]). Sankey concluded that on average, easily worked soil required 2000 gallons, medium soil needed 5000 gallons, and clayey soil required 10,000 gallons per cubic yard.

The velocity of water flow in a race, and the rate of discharge at a mining claim, depended in part on the head and hydraulic gradient. A traverse of the Humbug Hill Sluicing Company race from Lincoln Gully Dam to Humbug Hill during 2012 with an automatic level showed a fall of 1.92 m over 1.481 km, with an average gradient of 0.1296%, or 1.29 m per km (c. 7 feet per mile). Using Len Goldsmith (2000:4) as a guide, the speed of water flowing in a race may have been a slow walking pace, say 2-3 km per hour. This velocity is also suggested by Michael Tracey (1997:7), who argues that an ‘acceptable’ rate of flow for races is 60-90 cm (2 to 3 feet) per second, which required a slope of 90-213 cm per 1.6 km (3 to 7 feet) per mile.

There were several ways to maintain a gradient, although perhaps the simplest was by line of sight and a spirit level (Salmon 1963:120). Not all races were well constructed and many were cut expediently and too shallow to be effective (Mining Surveyor June 1859), while others did not sustain a flow due to an incorrect gradient (VPRS 3730, 7 Dec. 1859). Len Goldsmith, who sluiced the area around Wolfe’s Hill near Slaty Creek in the 1930s, recalled that the races ‘... were all done the same way, digging with the water coming along behind them so that they had the right amount of fall for the water to flow along’ (Goldsmith 2000:4). Measurement was also possible with boring rods, where two T-shaped rods were inserted along the route and their horizontal surfaces used to level a third intermediate rod. It is also feasible that a miner’s level was used, which consisted of an A-frame with cross-piece and a plumb line suspended from the apex. When the feet of the frame were set on a level surface, the plumb line intersected with the middle of the cross-piece (Hodge 2002:204-205).

During the 1850s on the Victorian goldfields there was no formal requirement for races to be laid out by a surveyor and local mining surveyors were presumably far too busy dealing with mining claims. Miners themselves pegged out their proposed route and either constructed the race themselves or employed contractors. Following the 1862 Amending Act, however, applications for water licences had to be accompanied by an accurate scale plan of the race and dam locations (Smyth 1979:399-400). It was, however, still the responsibility of the miner to peg out the route prior to the surveyor making an official plan (Langtree 1888). Orders in Council (under the Mining Statute of 1865) indicate that the applicant for a race was required to erect or cause to be erected on the course of the race, posts not less than 3 inches square, standing at least three feet in height above the surface, not more than 20 chains from each other. The applicant was also required to deposit ten pounds as a guarantee for the payment of survey. The warden then directed the surveyor to the applicants’ lease, who ascertained whether there were sufficient posts to indicate the ground applied for, and if not, the applicant was directed to erect additional posts. Only then did the surveyor make an official survey and plan.

A long race was thus expensive to survey. Fees for surveying a water right in most mining districts were £2 for under half a mile in length, then £3 for each additional mile. Survey of a reservoir for any area
under 5 acres was £3.3.0. In certain areas of Beechworth and Gippsland the fees were considerably higher. Travelling expenses were also charged for any distance after the first 3 miles from the mining surveyor’s office at 4 shillings per mile one way (Langtree 1888). At Ballarat around this time hired miners received 45 shillings per week or £117 per annum (Coghlan 1918 vol.2:1047). A five-mile race and small reservoir would cost at least £20 to have surveyed, equal to two months’ wages for the average miner.

Flumes were constructed at times to carry water across gullies or low land as a way of minimizing the length of race to be excavated. These were generally open-top timber boxes, possibly lined with sheet metal and supported on crossed timber pylons. The flumes had to be checked and cleaned along with the races and they tended to leak as well. Several flumes are recorded historically in our study area, including one built by James W. Robertson at Humbug Hill, Council flumes at Creswick and Adekate Creek, and several at Butcher’s and Mason’s Gullies described by Goldsmith (2000:4). No physical remains of these flumes have yet been identified.

At least two inverted siphons were also built to convey water on the Creswick goldfield. Members of the Humbug Hill Sluicing Company and the St. George’s Sluicing Company each laid long sections of bitumen-paper pipe in 1862 to deliver water across low ground towards their mining areas.

Two forms of dam are common on the Creswick goldfield: holding and mining dams. Holding dams were generally small dams built off the watercourse and fed by races to supply individual mining claims. Mining dams, on the other hand, were constructed across a watercourse to impound water in a reservoir. Examples on the Creswick goldfield are generally simple constructions of clay excavated from adjacent creek banks. Smaller dams are typically 20-30 or so metres across and up 1.5 metres deep. Larger dams have steep clay walls 4-5 metres high with a base 10-12 metres wide. The inverted v-shape of dam walls was straightforward to build and it had the advantage of resisting water pressure. As water pressure increases with depth, it exerts pressure both horizontally and vertically on the dam wall, which tends to slide from its base (Wilson 1907:85-86). The broad sloping base of clay dam walls provided mass to resist this water pressure. Although they were intended to be temporary constructions, the remains of several dozen mining and holding dams have survived in the Creswick area.

Water in the dam served as a reservoir to maintain supply to races and in some cases to boost flows. Outlets or by-washes could also be located at each end of a dam wall. These prevented floods from flowing over the top and damaging the dam and created a maximum depth and volume of water within the dam. In some cases an iron pipe with a valve was inserted near the base of the dam to control the outward flow of water.
3 Creswick Landscape History

The town of Creswick is located about 18 km north of Ballarat in central Victoria, on the northern fall of the Great Dividing Range (Figure 3). A large alluvial gold rush occurred in the area from late 1851, with extensive surface alluvial mining claims on the creek and gully country extending south and south-east of the township. Later deep lead and quartz mining in the area was associated mainly with the basalt geology north of the town, while dredging and hydraulic sluicing took place along Creswick Creek and Slaty Creek from late in the 19th century.

Geology and hydrology
Creswick sits at the boundary of two major geological formations. Land to the north is relatively flat, characterized by localized basalt flows of geologically recent age (6 – 1 million years ago). This region is studded with the rounded hills of ancient volcanic cones. The basalt flows have buried gold-bearing gravels and quartz reefs at considerable depth which were worked from about 1860 onwards as deep lead mines. The surface basalt has weathered to form excellent agricultural soils.

The gentle hill country to the south of Creswick along the Great Dividing Range is characterized by low hills and ridges cut by numerous creeks and gullies. The area was originally known as the Sulky ranges (Semmens 1945:1). The terrain is generally of Ordovician age (490 – 450 mya), characterized by deep sedimentary horizons of slate and sandstone, covered with thin acid soils of low fertility. The gold-bearing matrix is alluvial gravel that consists of iron sulphide cemented quartz boulders in a quartz silt or clay matrix. It contains gold flakes and nuggets that have eroded by alluvial pressure (Bradford 1902:26; Taylor 2000).

Watercourses on the Creswick (or Back) Creek alluvial goldfield generally flow in a south-east to north-west direction. Creswick Creek rises in hills to the south-east of the township, fed by numerous small gullies from the south. These include Adekate (or Atticott) Creek, Ashwells Gully, Lincoln Gully and Slaty Creek, all of which were associated with water races and sluicing. Slaty Creek, Adekate Creek and Birch Creek all rise in elevated country near the township of Dean, around 600 metres asl.

The average annual rainfall recorded at Creswick during the 20th century was 734 mm, most of which falls during the winter months (www.bom.gov.au/climate/data retrieved 8 Feb. 2012).

North of the township, Creswick Creek flows north-westward to join Birch Creek (or Bullarook Creek) at Clunes and becomes the Tullaroop Creek. From here the Tullaroop Creek flows north into the Loddon River east of Maryborough. The Loddon flows north through Kerang and into the Murray River at Swan Hill.

Vegetation
The geology, soils, rainfall and topography of the Ordovician ranges to the south of Creswick support an open forest community dominated by messmate, narrow-leaf peppermint, broad-leaf peppermint and

Figure 3: 3D surface model of Creswick and surrounding areas
scent bark. Along the creek flats there are manna gum, swamp gum, blackwood and silver wattle. A variety of understorey shrubs and grasses also occur, depending on soil, aspect, disturbance, etc. These typically include prickly tea tree, common cassinia, austral bracken, common heath, tussock grass and others. A deposit of Permina glacial tillite at Humbug Hill carries vegetation that includes candlebark, silver banksia and black sheoak (Youl et al. 2010:2).

Descriptions of the natural environment around Creswick at the onset of the gold rush depict a mosaic of open plains, wooded hills and fertile creek flats. A Mr. von Harten, for example, who arrived in Creswick in June 1854, described Slaty Creek as ‘a clear stream of water running through a broad and fertile flat covered by luxuriant and vividly green grass. Huge white and other gum trees with healthy foliage studded the valley, which presented the appearance of a lovely park in the midst of heavily wooded ranges’ (Graham 1987:240-1). This was just as miners began to work the creek beds and terraces of the area for gold. In 1858, Eugène von Guérard drew a pen and ink sketch of the country west of the Bald Hills near Creswick (Tipping 1982:55). From the grassy hilltop the terrain slopes down to a timbered plain interspersed with open clearings, with the Pyrenees ranges in the distance.

The 1850s and 1860s, however, saw ‘a great slaughter’ of trees as the miners stripped the wooded foothills and gullies of almost all available timber. Sluicing parties also destroyed acres of saplings to expose the gold-bearing soils beneath (Taylor 1998:3, 90). The Ballarat-Creswick State Forest was proclaimed in 1862 but it only included 1000 acres. In 1872, 13,822 acres were set aside in the forest for timber protection and growth. The *Argus* (16 Dec.) reported in 1876 that the original forest had been cut down, with parts of the reserve now covered with a dense regrowth of saplings and suckers. Ongoing demand for mining props, slabs, laths, fence pots and firewood, however, meant the destruction of forest resources continued in the following years. Woodcutters even removed old stumps and roots in their search for firewood (Taylor 1998:164). The Ballarat Water Commission was established in 1862 and began setting aside land in the area for water supply, reafforestation and timber production (Nathan 2007:25-45; Youl et al. 2010:3).

The eucalypt species that dominate the ranges in this area tend to regenerate from lignotubers or coppice shoots, which produce new stems when the main trunk is cut or burnt (Figure 4). In the 1880s forester John La Gerche began to make slow progress in protecting the forest regrowth from illegal destruction by splitters and prop-cutters. By 1890 the remnant eucalypt forest was a mosaic of clearings, stumps, thick stands of saplings and old trees in the more inaccessible gullies (Taylor 1998:38-9). La Gerche also arranged for thinning work in much of the Creswick State Forest to remove poor quality trees and promote the growth of straight stems, as well as establishing a forest nursery in Sawpit Gully in 1887, and establishing plantations of introduced trees.

The Creswick School of Forestry opened in 1910 and working plans were later established for the eucalypt forests to the east and south of the town.
while further pine plantations were also established. The proximity of the alluvial goldfields to the forestry school means that the forested ranges have been among the most closely studied and managed areas of forest in Victoria. The messmate-stringybark forests on the hills south of Creswick were logged for firewood in the 1950s, and subsequently rated as low to moderately productive in the 1970s for hardwood production (Land Conservation Council 1980:163, 255). The vegetation of the hills today represents a created forest landscape, one which has been used, abused and managed by settlers for more than 160 years.

Aboriginal community

Creswick lies in the southernmost part of the lands of the Djadjawurrung people, whose country extends northward from the Dividing Range and includes the watersheds of the Loddon and Avoca Rivers. The Munalgundidj clan occupied the Daylesford area, and the Tureet [Durid] balug clan was recorded at Mt Moorookyle near Smeaton, and may have been associated with the Creswick area as well. The latter clan often camped on a plain near Smeaton Hill (Clark 1990:152-66). Clark (1995:85-101) has profiled 13 massacres and killings of Aboriginal people in the Djadjawurrung country between 1838 and 1841, involving the deaths of at least 43 people, although possibly many more.

George Augustus Robinson served as Chief Protector of Aborigines in the Port Phillip District from 1839 to 1849. In 1840 he sent out an assistant, Edward Stone Parker, to investigate acts of ‘cruelty, oppression and injustice’ between settlers and Aborigines on the ranges west of Mount Macedon. In his report Parker noted that a ‘considerable portion of the country ranged by the Jajowrong...is also taken up by sheep or cattle runs...The very spots most valuable to the Aborigines for their productiveness – the creeks, water courses, and rivers – are the first to be occupied’ (Parker 1840:692). One of the first acts of water manipulation by Europeans in the Central Highlands was thus to deprive Aboriginal people of their right to access water and the abundant supplies of food associated with it.

G. A. Robinson travelled through the area between January and March 1840. Captain Hepburn showed him ‘a small plain with some open forest upon it, 3 miles from his house in N. direction, where he [Hepburn] said the natives usually camped. Said it was a favourite place for the natives. He has seen 30 women on the plains at a time, picking murnong [Microseris lanceolatae, a tuberous root] whilst the men went into the forest to hunt kangaroos, opossums, etc’. Nearby were the remains of ’30 to 40 screen or shelters of boughs where the natives had been’, with the tree and grass cover in the area having ‘a park-like appearance’ (Clark 1998:170).

In 1840 the area around Mount Franklin, to the north of Daylesford, was reserved for the Loddon Aboriginal Protectorate Station. Known as Franklinford to Europeans, it was called Larnnebarramul (home of the emu) by the Aboriginal occupants (Marshall 2005; Morrison 1971). Edward Parker was appointed Protector of Aborigines for the Loddon district and he gathered about 130 Djadjadj people to the site. The station flourished for a few years, but with the discovery of gold at Mount Franklin the station was relocated a few kilometres to the west and parcels of lands were gradually sold off to white settlers in the following years. The station was closed in 1864 and the remaining Aboriginal people were removed to Coranderrk Station at Healesville.

While the gold rush brought devastation to Aboriginal society, David ‘Fred’ Cahir has recently argued that it also provided opportunities for those who could survive and adapt to the new circumstances (Cahir 2006). He identifies the participation of Aboriginal people in farm work, carrying post and messages, police work, fishing, possum skin rug trading, and child minding. Djadjawurrung farmers at Mount Franklin sold excess produce to the nearby goldfields. There are also numerous accounts of Aboriginal people prospecting for and discovering gold on their own account (e.g. Bancroft 2001; Blainey 1963:26; Clark and Cahir 2004:26-7). Korzelinski, a central Victorian miner, made many references to Aboriginal people passing through the goldfields between 1852 and 1865 (Korzelinski 1979). In the Loddon district, it was claimed that gold was first discovered in the area in 1849 by an Aboriginal boy, who picked up a stone to throw at a bird but it turned out to be a nugget of gold (Morrison 1971:51). Local recollections also refer to Aboriginal corroborees on Slaty Creek (Family History Talks 1988-92).

Archaeological evidence for prehistoric or contact-period Indigenous occupation of the Creswick area is slight. In large measure this is because little survey has been conducted so far. Kaskanadis (2007) assessed Aboriginal cultural heritage at the old Black Lead dredge mining site on Creswick Creek. No archaeological evidence was identified, attributed to the extensive ground disturbance wreaked by gold mining. In 2007 an archaeological survey for the Goldfields Superpipe [Water] Project was conducted along a line that passed approximately nine kilometres to the east of Creswick, with a small number of lithic scatters identified (Paterson and Clark 2007). The survey also recorded several lithic scatters in the headwaters of Cotty Creek, close to Goldsmith’s race. Taylor’s (1998:3) assertion that Aboriginal people ‘did not live’ in the forested ranges along the Great Divide appears unfounded, with the identification of Indigenous artefacts in the area and likely movement along tracks through the ranges.
Squatting

The European history of the area began in 1837 with the occupation of a squatting run between Creswick and Daylesford by Arthur Birch and Alexander Irvine. The run was called Seven Hills Estate for the volcanic hills that surrounded it (Lynes 1987:9). In the following year Captain John Hepburn occupied Smeaton’s Hill (Mt Koorooucherang) nearby, while the Coghill brothers grazed Glendaruel to the north-west and the Learmonth brothers held grazing country around Ballarat (Billis and Kenyon 1932; Sayers 1969:69-70). Scottish pastoralists were thus prominent in the area (Quinlan 1967:85). In 1839 W. J. T. ‘Big’ Clarke obtained a lease over 7600 acres called ‘Bean Bean’ near today’s Creswick (Clarke 1994:16). In 1842, John, Charles and Henry Creswick took up a squatting run in the forest country around ‘Creswick’s Creek’, although they only appear to have held the area until 1844, when it was absorbed into other runs (Graham 1987:20). Beginning in the 1850s, parts of the squatting runs began to be sold at auction under the 1847 Orders-in-council. Land sales in the district, combined with the gold rush, resulted in the development of a complex farming landscape of smallholders, squatters and farming tenants (Anderson 2002:20).
4 Alluvial Mining at Creswick

Gold was first discovered at Creswick Creek towards the end of September 1851 (Figure 5). By April 1852 there were 600 people in the vicinity (Flett 1970:407-16). Miners focused on shallow auriferous leads around the site of the present town and adjoining ground to the north and east. Slaty Creek was opened in 1853 (Flett 1970:415) and in 1854 the mining population expanded dramatically when a series of shallow leads was opened to the west and south of town. The low hills that were the focus of the 1854 rush included Grahams, Bald, Clarke’s, Hard, White, Humbug and Lucknow, and the associated gullies such as Long, Mopoke, Nuggety and Spring (Bannear 1996; Graham 1987).

At this time the local gold commissioner estimated a population of 4000 diggers at Slaty Creek, Cabbage Tree and Humbug Hill (Flett 1970:416). The 1854 Census recorded a total of 3420 inhabitants of Creswick’s Creek, while the 1857 Census found 4589 inhabitants. The population peaked in the mid 1850s, when it was alleged up to 40,000 people were present at Creswick (including Chinese, see below), but this total is difficult to verify and probably very exaggerated (Graham 1987:59, 251; McCrae 1855:125 [Q2508]). Charles W. Sherard, the Resident Warden for Ballarat, reported in July 1856 that there were 8700 people on the Creswick goldfield (Sherard 1856:1). The 1861 Census recorded 991 people (779 males and 212 females) living in the Cabbage Tree, Mopoke and Slaty Creek area, along with 515 (455 males and 60 females) around Humbug Hill, Portuguese Flat and Sawpit Gully.

The hills opened during the 1854 rush were well suited to sluicing, being covered with up to 30 feet (10 m) of gold-bearing soil (Figure 9). At Portuguese Flat, several miners were reported to earn ‘an aver-
Figure 6: Major supply races at Creswick
age of £800 per man’ (Sherard 1856:4). Good supplies of water were needed to work the claims, and even though the area was known in winter as a ‘wet diggings’ (McCrae 1855:129 [Q2555]), miners soon began constructing dams and races to capture, store and divert the water needed for washing and sluicing. Possibly the first water permit at Creswick was issued to Davis and Co, which was purchased by George and William Russell in 1854 (see page 23). The remains of dams from this period have been located on Back (Creswick) Creek (Bragg’s Dam and Eaton’s Dam), Lincoln Gully, Long Gully, Ashwell’s Gully (Russells Dam) and other minor tributaries (Figure 7). Water races were also a prominent feature of the Creswick goldfield (Figure 8). Figure 6 indicates several, but not all of the known major races in the Creswick Regional Park area. Races to the south-west and west of Creswick have not been mapped. Robert Brough Smyth (1979:548) recorded the total length of water races constructed in the Creswick Division by 1868 as 108 miles 49 chains (175 km) at an approximate cost of £13,535. Further details of mining companies, water merchants and the races they constructed are provided in Chapter 6 of this book.

Puddling was also widespread on the Creswick field. Although horse puddlers could only process a fraction of the ground that could be worked by sluice parties, they required much less water than sluicing and could generally be used all year round. The Mining Surveyor reported 159 of these machines at work in August 1859, and this number remained fairly constant until drought in the mid-1860s forced many puddlers out of business (Bannear 1996; Mining Surveyor 1859). The practice soon resumed, however, with better rainfall and the construction of dams, as there were 180 puddlers reported in the Creswick Division in 1866 (Mineral Statistics of Victoria 1866:23). By 1881 there were only 18 puddlers reported working at Creswick, which reflects the decline of surface alluvial mining by this period (Mining Surveyor 1881:3). Very few archaeological remains of puddlers survive at Creswick today and it is likely they were filled in by forester John La Gerche and his men in the 1880s.

The Creswick goldfield was a very multi-national place. Along with Australian-born miners and immigrants from the United Kingdom, there were also groups of Germans, Italians and French working...
claims in the foothills to the east of town and along Slaty Creek. Hundreds of Chinese men worked in and around the township, while Portuguese miners and ‘Manila men’ worked at a number of locations. Manila men or ‘Malays’ were Filipino men who began arriving in Victoria in the 1850s. Americans and those with experience of the Californian goldfields were also prominent and played a major role in commercialising water (Bate 1978:416-7; Davies and Lawrence 2013a).

Gold yields from surface alluvial claims began to dwindle by 1860 and in the following years many miners from Creswick departed for other fields in Victoria or joined the rush to Otago in New Zealand (Mining Surveyor 1863). This trend was exacerbated by very dry conditions in 1864-65. Others remained at Creswick, sometimes combining fossicking and cradling with small-scale agriculture, especially after the Land Acts of the 1860s began to make land ownership more accessible to ‘yeoman’ farmers and holders of Miner’s Rights (Lawrence 2000; Powell 1970). Horticulture in the hills south of Creswick during the 1860s included tobacco-growing (CA 15 August 1864:2) and wine grapes, grown by a former French army officer (Dunstan 1994:64).

Deep lead mining north of Creswick began in the late 1850s as the miners sank shafts to reach the shallow alluvial leads angling down the hills and under the basalt flows to the north. These companies met with mixed success in the following years, although by the 1880s mines including the Madam Berry, Berry Consols, Lone hand, Ristori Freehold and New Australasian were among the richest deep leads in Victoria (Bannear 1996; Fahey 1986). By the early 1890s, however, these mines were almost worked out, and the machinery was removed and sold. A limited amount of quartz mining also occurred in the Creswick area from the 1880s, especially around Allendale.

By the early 1880s there were still several hundred people living in the forested ranges south of Creswick. Most eked out a living as miners or fossickers, wood-cutters, prop-cutters, charcoal burners and small farmers. A small primary school at Cabbage Tree Flat (No. 161), which was first established in 1859, operated near the junction of Long’s Gully with Slaty Creek until 1930 (Blake 1973:633). Artist Daryl Lindsay recalled from around 1900

‘... the old timers, weather-beaten, bearded old fossickers who lived in wood and bark huts in the gullies. These were kept scrupulously clean but were blackened by smoke. They lived a leisurely life going over the old workings in the vain hope of striking a patch missed by the earlier men.’ (Lindsay 1965:24)

Many occupied a hut and a small patch of land on a Miner’s Right, while several dozen Chinese men cultivated gardens at Creswick Creek, Slaty Creek and Mopoke (La Gerche 1885).

In trying to reclaim the forest for trees, forester John La Gerche preferred to buy up the improvements made to remote holdings when their occupants died or moved away. This meant that the physical evidence of miners’ huts, fences, gardens, etc, was often removed in the 1880s and 1890s, leaving few remains of occupation. When Mary Cutler’s house burnt down in 1892, for example, La Gerche sold off not only the chimney bricks but the burnt debris as well (Taylor 1998:111-112).

Bucket dredging began in the bed of Creswick Creek around 1899, and preparations were also underway for the first hydraulic sluicing in the Creswick division. By 1903 there were two dredges at work along the creek, operated by the Creswick Creek and Enterprise Bucket companies. The industry peaked during 1906-08, with the two dredges operating and at least eight sluicing plants at work. These included: the Great Creswick Sluicing Company, Creswick Gold Estates Sluicing Company, Creswick Sluicing Company (Slaty Creek), Portuguese Flat Sluicing Company, Creswick Spring Gully Sluicing Company, Creswick Black Lead Sluicing Company and Creswick Nuggety Gully Sluicing Company (Bannear 1996). The industry fell away in the following years, however, as profits from dredging and sluicing rapidly declined.

Chinese at Creswick

William Howitt encountered a group of Chinese miners travelling from Ballarat to Creswick in 1853. He described their exotic appearance in terms of the long poles they used to carry their goods, their loose blue clothing and large straw hats. He also admired the loads they carried, noting one man who ‘... had at one end of his pole a working cradle, and at the other end a puddling-tub. These must have weighed at least a hundred-weight. Others had shovels, picks, tin dishes, provisions, boots, and the like. Others had huge bundles, done up in Indian matting’ (Howitt 1972:269-270).

The centre of the Chinese community in Creswick was at Black Lead, located just south of Creswick Creek (Denny 2012). The area was later dredged and is known today as Calembeenk Park. There were also satellite Chinese communities at Portuguese Flat, Hard Hills, Clarke’s Flat, Bloody Gully, Mopoke and Slaty Creek. The number of Chinese miners rose steadily during the 1850s as reported by mining wardens and census results, from 85 in 1854, to 300 in 1856, 759 by 1857, and 1252 by 1861. During the 1860s and 1870s the Chinese population of Black Lead remained fairly stable with around 400 individuals.

Around 390 Chinese were buried in the new cemetery at Creswick, while approximately 20 Chinese burials have been recorded in the old cemetery. Study of the inscriptions on surviving headstones
has revealed that many of the Chinese at Creswick came from villages in the County of Toishan (or Taishan) in Guangdong Province in south-eastern China. Most were people of the same clan (surname) and extended family groups of cousins, brothers, uncles and nephews who provided the proposed labour for the attempt to break the strike at the Lothair Mine, an event that gave rise to the Clunes riots of 1873 (Chin et al. 2009:85-86; Markus 1979:76).

As the number of Chinese dwindled in the 1880s and 1890s, some continued to live in huts and grow vegetables as they had for many years. They were recognised as expert gardeners and were generally industrious, honest, generous, and law abiding (Graham 1987:63). John La Gerche (1885) recorded the names and locations of some Chinese during his patrols through the Creswick forest in 1885:

- Ah Li You (hut) Mopoke 13 years
- Ah Loch (hut) Slaty Creek 13 years
- Fat Yet (hut) Mopoke 8 years
- Ah Kam (hut) Mopoke 14 years
- Gat You (1 acre garden & hut) Forty Foot 18 years
- Lou Hem (1 acre garden & hut) Forty Foot 18 years
- Li Ha (hut) Slaty Creek 18 years
- Ah Chow (hut) Slaty Creek 18 years
- Ah Yat (hut) Mopoke 18 years
- For Chong Ki Fong (hut) Mopoke 18 years
- Chong For Hi (hut) Mopoke 18 years

In 1891 a dispute emerged over the illegal occupation of a site on Back Creek by four Chinese men: Hock Nea, Ah Coon, Mosen Yen and Li Coon. Forster John La Gerche arranged for Hock Nea to be deprived of his garden licence but for the three others to remain in occupation with the necessary permits (Taylor 1998:102-105).

Ah Chow came to be associated with a bend on Slaty Creek at the Ironstone location, probably around the turn of the century. Len Goldsmith (2000:2) recalled ‘An old Chinaman lived up on the bank there. Lived there for years. He had his garden down there on the flat and surfacing work surrounded it.’

Daryl Lindsay described the Chinese camp in Creswick at the beginning of the 20th century as:

‘... a straggling little settlement with a population of five hundred, consisting of two streets of low ramshackle wooden and galvanized iron buildings. There were two joss houses with brass Buddhas, red and yellow hangings with Chinese characters and a strong smell of incense. But the centre of attraction was the two Chinese stores; the largest presided over by Ah Foo who was a kind of mayor and directed the affairs of the camp. Ah Foo was a well-fed Cantonese with a huge paunch who sat behind a well-polished counter and dispensed conversation in smiling monosyllables or sold exotic Oriental foods – lychees, preserved ginger, cumquats and small pies and hard biscuits with Chinese characters stamped on them in red. The little store was dark with one small window, and leading out of
it, was a long low passage that disappeared into utter darkness. On each side of the passage were small, evil smelling cubicles where old Chinese men with listless eyes reclined on low wooden benches sucking at their bamboo opium pipes, gambled at fan tan, marked tickets in Chinese lotteries or tossed dice.’ (Lindsay 1965:19).

The 1901 Census of Victoria recorded only 29 Chinese people residing in the Shire of Creswick. The Chinese were adept water managers, not only for mining but also for market gardening. They owned races, leased races, sold water to European miners and were often employed to cut and repair races and dams at Creswick.
5 Rights to Water

The legal right of miners to store and divert water on the Victorian goldfields was negotiated and established during the 1850s and 1860s. A mix of English common law and American legal doctrine was drawn on and adapted to conditions on the colonial goldfields in response to disputes that quickly emerged over the nature and scale of water diversions, priority of access and the sale of water rights. The creation of laws, by-laws and regulations gradually established the legal status of water as a public resource which individuals and groups could extract and utilise for private purposes. The government asserted increasing authority over the distribution of water in this period, laying the foundations for the effective public ownership of water rights by the 1880s and the development of irrigation agriculture. The Victorian experience provided leadership in establishing water regulations which the other Australian colonies later followed. In this section we briefly describe the development of gold mining and water law, drawing on a longer discussion presented in Davies and Lawrence (2014).

The legal principles of ‘prior appropriation’ and ‘riparian access’ were introduced from England and the United States and applied in the Victorian colonial context. The traditional English riparian doctrine held that rivers and streams belonged to everybody, with property owners along the banks granted rights to use the flow for drinking, washing or watering animals, but they were unable to seize the water for personal use and deprive others of its benefits. Riparian owners belonged to a community of users, whose right of access to water was an incident of owning land that included or abutted the bank of a river or lake (Getzler 2004:31–34).

The English appropriation doctrine emerged in the 18th century with the rapid growth of capitalism and competitive markets, as water and other natural resources increasingly became instruments of production and wealth. This notion of ‘prior use’ was based on the idea that first usage created a title to the water flow, and it came to replace the older principle of ancient use and natural flow as a basis for determining water disputes. The English appropriation model had a number of features which were later incorporated in American and Australian water law. These included the existence of prior usage rights for a given water source; limits on volumes of water diverted; the need to use water ‘beneficially’; and the forfeiture of water rights for non-use (Harris 2010:4-5). In England, however, rights to appropriate water could only be asserted by landowners adjacent to watercourses whereas in Australia and the United States these rights were unrelated to land ownership.

In the United States the discovery of gold in California in 1848 led to the development of water rights that recognised both English riparian law and prior appropriation to support hydraulic mining, a hybrid system known as ‘the California doctrine’ (Kanazawa 1998:159-161). Courts promoted appropriation (diversion) claims to encourage the productive use of water from existing riparian rights in ways that resonated on the Australian goldfields a few years later. Under this doctrine, the first person who came to a stream and claimed its water, or part of it, acquired a vested right to the water, making it a form of personal property – the first in time was the first in right (Worster 1985:88). Elements of the California doctrine were soon applied in the Victorian context as well, including the extraction of water for mining purposes by non-landowners, water trading, seniority of water rights (privileges), and the forfeiture of unused water (Harris 2010:4).

In the first years of the Victorian gold rush in the 1850s miners washed alluvial gold from creek beds and gullies. When these were worked out they cut races and dug reservoirs to bring water from higher sources to wash gold from the dirt. Those with experience of the Californian fields often took the lead in applying water to local gold extraction. The custom of prior appropriation was effectively introduced in Victoria in 1853 when miners at Beechworth asked local goldfields commissioners for a permit to construct a race and be given freedom to divert water from a stream (Report 1860-61:1-2; Smyth 1979:397). This developed into a system of permits whereby one source could have many miners diverting water in order of priority or privilege. These permits were known by the source name followed by the privilege - e.g. Back Creek No.1, 2, 3 etc. In this book we use (P) to distinguish the early water permit numbers from the later water right licence (WRL) numbers.

The first permits were issued verbally, often without a clear definition of the extent of privileges conferred. Subsequent written permits were often posted on a nearby tree, but there were no maps or plans defining their extent, and the scant wording of permits did not sufficiently connect the ‘right’ with any area of land (Royal Commission of Enquiry 1862-63:341). Many of the permits changed hands, and large sums of money, sometimes several thousand pounds, were exchanged in the belief that the permits gave good legal title to the water rights taken out. Conflict emerged when the permit holder changed the scene of his operations or diverted the water he was authorized to use into another drainage area. During times of water scarcity these permits and their order of priority became fiercely contested.
The legal validity of permits and water diversion in this early mining stage was thus uncertain. It was based on vaguely worded gold regulations, rulings by local courts, and by-laws and understanding of local conditions. Nevertheless, as miners invested large amounts of time, money and effort in these constructions, they believed that their rights to races and reservoirs were as secure as their titles to mining claims (Smyth 1979:398).

Gold regulations issued by the colonial government in 1853 specified that ‘sluice washing will be permitted, at running streams’, but made no mention of water storage and diversion (GG 8 April 1853:483). Regulations in 1855 indicated that ‘sluice washing or other water privileges will be allowed only by special sanction’, which may have been understood to encompass water races (GG 13 June 1855:1420). The Goldfields Act of 1855 (18 Vict. 37), which provided for the issue of Miners’ Rights and the establishment of Local Courts, made no explicit mention of water diversion. This was in spite of urging by the 1855 Goldfields Commission for the government to deal with the lack of water supply on the various goldfields, and that individuals diverting water for their own ends ‘should receive direction and encouragement’ (Commission 1978 [1855]:76). Local court regulations at Creswick in 1856, however, recognized the use of water races, priority claims in times of water scarcity, and abandonment after non-use for 14 days (GG 12 Sept. 1856:1541). In 1857, colonial laws also began to catch up with the reality of mining, when the Goldfields Amendment Act extended the provisions of the Miner’s Right to allow miners:

‘...to cut construct and use races and dams for mining purposes through and upon any Crown lands and to divert and use for mining purposes any water which Her Majesty could lawfully divert and use...’ (21 Vict. 32; s.3).

Despite this there was still great difficulty in understanding what water Her Majesty could lawfully divert and use, and new powers of the warden to decide the validity of prior water privileges caused much tension and conflict during 1858. Disputes were previously heard by a Justice of the Peace and dealt with expeditiously, often at the site of the water privilege in dispute. The new Act required disputes to be heard in the court and the ensuing cases saw the legality of prior water privileges closely examined, particularly in Beechworth (August 1858) and Creswick (November 1858).

Confidence in the legal validity of water rights and permits was shaken in August 1858, when Judge Thomas Cope of the Beechworth Court of Mines found in the case of Hooper v. Mayzen that the use and diversion of water were illegal if such water was taken from a creek or a river running through alienated lands, or lands lawfully held for mining purposes, such as with a Miner’s Right. Cope judged that water permits granted before the 1857 Goldfields Amendment Act had no legal value, prompting much anguish and demonstration among the miners affected (Argus 24 August 1858:4; OMA 18 August 1858:2). Contemporary opinion varied as to the impact of this decision. Members of the 1862-63 Royal Mining Commission felt the judgment was legally doubtful but that it still had the effect of destroying the legal validity of water permits, which ‘were not worth the paper on which they were written’, and excited great fears among the miners about the security of their water rights (Woods 1985:98). As the case in Creswick showed, previous water privileges granted by local courts were overridden, and the conflicting parties were granted equal shares of water.

Others, such as Secretary of Mines Robert Brough Smyth, suggested a few years later that Judge Cope’s decision had an impact in places where it appeared to apply very closely, but otherwise races were cut and rights were established under by-laws in the old way. Miners believed they had at least some rights by occupying Crown lands for cutting races and diverting water, and hoped that the laws would soon be amended (Smyth 1979:398).

This quickly and inevitably resulted in conflict between miners and the new ‘water merchants’ who held access to water races. The latter could, if they chose, decide which miners received water and who did not. Miners tried to thwart them by cutting and diverting the water channels, leading to disputes and litigation. For the permit holders, their claims gained a greater sense of legitimacy when they were transferred from one miner to another. When a miner moved between claims he would take ‘his’ water with him and then sell the right to the water (which included its original order of priority) when he moved out of the district. Shares in water permits could also be purchased and traded, and often changed hands for substantial amounts of money (Smyth 1979:339).

Tension also arose among miners in the 1850s and early 1860s when claiming first, second and subsequent water rights under the permit system, based on the date of registration, a process which reflected the prior appropriation model used in the United States. By-laws in the Beechworth district, for example, specified that ‘superiority...shall be determined by priority of occupation, the earlier occupant having the superior right’ to available water. According to Judge Cope, however, the law recognised no such hierarchy of rights, and he was unsure how to deal with them (Royal Commission of Enquiry 1862-63:371).

The Ballarat By-law No. 72 of 1858 spelt out the priority of water permits:

‘Order of Priority of Rights. Holders of water rights who shall take or divert water from a common source, shall take precedence in respect
thereof in the order in which they shall have been registered for the same; and if at any time the water becomes insufficient to supply all the persons registered in respect of the same, the person or persons lastly registered shall forego their rights during such deficiency of water, as against persons previously registered.

Earlier, the Creswick Local Court Rules of 1856 specified that:

Where one or more race is cut from a creek, in case of scarcity of water, the supply of water shall be reserved for the use of the party first on the creek, and so on in succession according to priority, and in all cases the tail water shall be the property of the person from whose race it runs.

An Amending Act in 1862 clarified the legal situation relating to water diversion for gold mining and introduced the Water Right Licence (WRL). It conferred authority to grant licences for up to 15 years:

‘to cut construct and use races dams and reservoirs through and upon any Crown lands whether the same shall or shall not have been demised [leased]... and take or divert water from any spring lake pool or stream situated or flowing upon or through or bounded by any such Crown lands... in order to supply water for gold mining purposes to such person or any other person who may be engaged in mining for gold and it shall be lawful for the person to whom any such license shall be granted to take or divert water to the same but no greater extent as and than he might do if he were the owner of such Crown lands’ (25 Vict. 148; s. 11).

Regulations based on the amending legislation were issued in December 1862. These included provisions to make the water rights licence much more clear and distinct than the earlier permits, with an accurate scale plan endorsed on the grant (Smyth 1979:399-400). Separate leases for reservoirs and gathering grounds were issued to the highest bidder for a term not exceeding 15 years. In essence, water rights licences included the provision that land used for a race (known as ‘gathering ground’) should not exceed four acres for every mile in length of the race (equal to land width 33 feet wide); an annual rent of not less than £5 per annum; and a charge of ten shillings per annum for every one million gallons of water drawn from a reservoir. The regulations also clarified priority of access in the case of diminished water flows, with licensees permitted to take water in order of priority of the dates of the respective grants (Smyth 1979:399).

The Mining Statute of 1865 was a landmark in water laws on the goldfields, spelling out water rights in detail, and specifying the privileges and penalties associated with the Miner’s Right and Consolidated Miner’s Right (for groups or companies), and the jurisdiction of Mining Boards, which had replaced the local courts under the 1857 amending legislation. The holder of a Miner’s Right or Consolidated Miner’s Right was entitled to:

‘cut construct and use races dams and reservoirs for mining purposes through and upon any Crown lands and to take or divert water from any spring lake pool or stream situate or flowing through or adjoining Crown lands and to use such water for mining for gold and for his own domestic purposes’ (29 Vict. 291; s. 5)

The penalty for wrongfully taking water from a race or reservoir as a first offence was a fine of up to £5 or imprisonment for up to one month, with subsequent offences attracting penalties of up to £20 or three months in prison (section 33). Pollution of races and reservoirs with sludge or other ‘noxious matter’ attracted similar penalties (section 34).

Licences of up to 15 years were also available to construct water races on Crown lands irrespective of whether such land was held by a Miner’s Right. Such licences permitted the holder to:

‘deepen widen clean repair or otherwise improve any race drain dam or reservoir cut or constructed through or upon any Crown land and to take or divert water from any spring lake pool or stream situate or flowing upon or through or bounded by any such Crown lands... for the purposes of mining for gold or any metal or mineral’ (29 Vict. 291; s. 36).

Damage to land by the construction of a race required the payment of compensation to the landholder. In addition, the property and interest in any race or dam conferred by a licence was deemed to be ‘a chattel interest’ (i.e., an article of property) and thus transferrable. Under the 1865 Statute, Mining Board by-laws for each district included provision for the drainage of mines and the disposal of waste water and sludge (Orders in Council 1866:7). The legality of the earlier permits issued under local by-laws still remained in doubt, but while the new water rights licences were an improvement they were not taken up as readily as may have been expected (Smyth 1979:399) and indeed the records from Creswick support this. Many miners continued to divert water under the entitlement of their annual Miner’s Right rather than the longer term 15-year licence of a water right (Prospecting Board 1879-80:41-42).

Local by-laws were also developed by district Mining Boards, subject to the wider framework of colonial legislation, to regulate mining practices and water diversion in light of different regional conditions. These were often minor distinctions, such as the requirement for water licence applicants in the
Ballarat District to mark out the course of a proposed race with painted posts one mile apart, but markers at Beechworth were to be no more than 100 yards apart. By-laws could also reflect, however, the development of activities and technologies, as well as environmental pressures, in different places. Holders of water rights around Ballarat, for example, had their races protected by an easement 20 feet wide, whereas easements in Beechworth extended only five feet to each side of the race. The Beechworth Mining District had the greatest extent of water races in the colony, with 1011 miles (1627 km) constructed by the end of 1868 (Smyth 1979:547). The cutting of parallel water races close together in this area during the 1860s may have meant that a wider easement was rarely feasible without overlap by competing licence holders. By-laws in the Beechworth District also distinguished between different kinds of water rights. These included creek, bank and motive-power rights, along with day, night, and spring rights (Prospecting Board 1879-80:41).

The amount of water to be diverted for mining purposes was also regulated by district by-laws (Figure 10), with volumes varying widely depending on competition for gold deposits, natural flows in water courses and storage volumes in reservoirs, and the technology employed to extract gold. Volumes were measured by ‘sluice-heads’ passing through a ‘sluice-box’, the latter consisting of a wooden box of specified dimensions and incline, through which water flowed at a certain pressure.

Tests were conducted on the Ovens goldfield in north-east Victoria in 1858 to determine how much water passed through sluice-boxes of various sizes and inclines, with the results reported in the Ovens and Murray Advertiser (see BS 30 July 1858:3). In the case of a sluice-box six feet long placed on a dead level, with an orifice 12 inches wide and 1½ inches high, the result showed that 124 gallons (563.7 litres) passed through in 60 seconds (a total of 178,560 gallons (0.81 ML) in 24 hours). A sluice-box of the same size and incline but with only a one-inch gap at the bottom allowed 112 gallons (509 litres) to pass through in 64 seconds.

A sluice-head at Creswick thus amounted to water flowing through a sluice-box opening of 16 inches width by one inch depth, with a head of six inches, over 24 hours. ‘Head’ in this context referred to the constant height of water that backed up behind the partition in the sluice-box (Figure 11).

District by-laws also specified the scale of water rights that applied for different mining purposes. In the Ballarat district (and thus the Creswick division), water was available in the following quantities:

- for sluicing purposes – for every three men employed 1 sluice-head
- for puddling with horse-power – per horse ½ sluice-head
- for puddling with steam-power – up to 2 sluice-heads
for pumping with water wheels – up to 1 sluice-head
for crushing – for every 2 tons stamping – ¼ sluice-
head
for steam engines – as needed
(Parliament of Victoria 1862:132)

In 1864 Creswick Council offered to supply miners
with water. The 5-inch pipes from Bullarook Reser-
voir carried about three sluice-heads, with the col-
lection along the open race increasing this amount
to four sluice-heads during wet weather. The Council
invited tenders for the renting of water with appli-
cants to state the number of sluice-heads wanted,
the hours the water would be required and the terms
per week. Each sluice-head consisted of 16 x 1 inch
with a head of water of 6 inches and cost approxi-
mately £2 10 shillings per sluice-head (VPRS 3730, 27
May 1864, 7 June 1864).

By 1868, the seven mining districts in Victoria had
the size and flow rate of sluice-heads specified in lo-
cal by-laws. This gave rise to anomalies in the deliv-
er of water volumes. Up to 2.3 million gallons (10.5
ML), for example, were available per sluice-head
each day in the Ararat District, but only 211,500 gal-
gons (0.96 ML) at Ballarat. The cost of such water, if
provided by a water merchant or company, also var-
ied substantially from place to place. In Creswick, the
average cost of water for ‘general sluicing’ was a little
more than one-third of one penny for 1000 gallons.
At Beechworth, however, the cost was less than one-
sixth of a penny for 1000 gallons (Sankey 1871:45
[Appendix No 11]).

In spite of variations among local by-laws, leg-
islation relating to water diversion for mining in
Victoria was fairly well established and widely un-
derstood by the late 1860s and remained in place
largely unchanged for the next few decades (Arm-
strong 1901:220-7). The Crown issued licences for
the private construction and maintenance of races
and reservoirs for mining purposes while retaining
notional ownership of the water as a resource. A li-
cence to construct a race across land alienated from

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Figure 11: Plans and sections of sluice-boxes (from Sankey 1871: Plate 10)
the Crown could also be granted after the *Mining on Private Property Act* 1884 (48 Vict. 796; s. 36), with the rent for the land fixed at one shilling per acre per annum. The *Mines Act* of 1890 (54 Vict. 1120) subsequently consolidated many of the water-related mining provisions of the 1865 *Mining Statute*. A water-right remained analogous to an easement and the licence-holder was expected to construct the race with sufficient skill and efficiency so that no overflow or percolation should affect a neighbour’s land. The 1890 legislation also specified that a dredging claim carried with it the right to use the water in a river if it was the only practical way of working the claim and did not interfere with private rights.

Mining laws relating to water use established the expectation that the Crown would regulate access to this most vital of resources. Miners looked to legislators and the courts to create a workable system of water diversion that balanced the needs of the mining industry with domestic and municipal supplies. By the 1880s the thrust of Victorian legislation relating to water was directed increasingly towards irrigation on the northern plains and the expansion of rural settlement. The Royal Commission on Water Supply in 1884-1886 acknowledged that Victorian legislation had ‘already recognized the power of the State over all sources of water supply’ (Deakin 1885:55). Thereafter the *Irrigation Act* 1886 effectively nationalized State ownership of Victoria’s surface water, reserving to the Crown the right to use all surface waters, while creating statutory rights of access for domestic and stock supply. This legislation was among the first in the world to declare State ownership of water use rights and to abolish previously recognized riparian rights in order to assert State management (Powell 1989:113-14).

Water clauses in the Victorian mining acts thus represented a gradual process of regulating and re-claiming State control over water rights. They were an early move towards the principle of public control and ownership of a crucial resource, establishing an important precedent for future management. Laws and by-laws represented a mix of English and American doctrines and practices that were applied and adapted to local circumstances. By the 1860s and 1870s there was an increasingly elaborate and specific set of regulations determining the nature, extent, costs and circumstances of water rights for mining purposes. These were expressed variously in statute law, orders in council, and by-laws issued by the seven mining districts in the colony. While district by-laws had to conform to the *Mining Statute* of 1865, they provided scope to regulate mining and water rights which recognized the development of local environmental and mining conditions.
6 The Water Merchants

Water merchants of the Creswick goldfields manipulated and traded water supplies. The races and dams they built stretched across the watershed of the Great Dividing Range to the south and east of the town, forming a landscape of water management. This chapter presents the stories of those individuals and parties who shaped this landscape and the networks of races and dams they created. There are other players and other sites not included here, as we have not attempted an exhaustive survey of the entire water use system of the Creswick area, nor a complete history of mining activity. The stories related below are those for which good archaeological and historical evidence is preserved. The combination of written records and archaeological remains has enabled us to unravel the complexities of these race networks and build coherent narratives about their construction and use. Our focus is on the interconnected systems of water features and places that were built and controlled by the miners. These case studies illustrate the challenges faced by colonial Victorians who sought to harness water for gold mining, while the archaeological evidence reveals the extent of their activities. The studies are arranged in approximate chronological order of Water Privilege numbers, although this was a confusing issue in the early years of alluvial mining at Creswick (see Appendix 1).

George and William Russell

The Russell family played an important role in the early development of water resources on the Creswick alluvial goldfields, and were among the first builders of water races in the district. The two brothers had mining and water interests on numerous creeks and gullies in the area which often caused conflict with other parties. Substantial archaeological evidence of their activities remains intact, including lengthy races, dams and areas of sluicing. A well preserved race extends from Russells Dam on Ashwell’s Gully around Lincoln Gully and Long’s Gully to Humbug Hill.

George Russell was born c.1815 in Dublin, and arrived in Adelaide in 1855 with his wife Mary-anne (née Martin) and their six children. In February 1856 he was elected as a member of the Creswick Local Court, a body which regulated mining disputes under the Gold Fields Act 1855 (Birrell 1998:34). George Russell promoted social stability on the goldfields, urging other miners to resist the ‘migratory fiend that whips you about from diggings to diggings’ (BS 4 Nov. 1856:1). Two years later he was appointed as territorial magistrate for Creswick, serving regularly as a Justice of the Peace (Clarke 1994:34; GG 15 Oct. 1858:1986). He appears to have been a socially conscious, forward-thinking man. In August 1856 he chaired a meeting of 400 men protesting against the further release of public land to wealthy squatters and on the 4th November 1856 he sent a letter to the Ballarat Star lamenting miners’ apathy and mindless opposition to capitalism and land ownership. Both George and William Russell were blacksmiths by trade and the brothers worked together for 14 years on their alluvial claims at Creswick, aided by their older sons. George Russell died in Melbourne in 1889 at the age of 74, while his wife Maryanne died at Warrnambool in 1875, aged 61 (Clarke 1994:136-53).

William Russell, younger brother of George, was born c.1817 in Dublin, and was transported to Sydney as a convict in 1835. He came to Creswick in late 1852 or early 1853, and married Sarah (Forward) Jeffery as a convict in 1835. He came to Creswick in late 1852 or early 1853, and married Sarah (Forward) Jeffery at Creswick in 1856 (Clarke 1994:30). The family had 12 children. He was elected as a member of the Creswick Local Court in February 1857. Sarah died of pneumonia at Creswick Creek in 1867, aged just 44, while William died two years later, aged 52.

William and George Russell purchased shares in the first water privilege on Creswick Creek from Davis & Co in 1854 (Back Creek Privilege No.1), and worked a large claim downstream of the Eaton brothers (BS 4 Dec. 1858). They were involved in a major dispute over water privileges on Back Creek involving John B. Bragg and the Eaton brothers, which was notorious in the Ballarat region for the litigation involved (BS 26 Nov. 1858:2; Appendix 1). Minor disputes were also very common. In 1857, for example, the Russells were involved in a dispute in the Creswick Local Court over the Back Creek race. Mr Guscott argued that the Russells’ tail water was filling up his race but George Russell argued that the portion of race being used by Guscott actually belonged to him (Russell) and was only being lent to Guscott. The latter claimed he had obtained the right to this portion from a party of Germans, previously owned by Edward Mitchell. The portion of race where the damage was done, however, was in fact Russell’s portion, which he merely let Guscott use whenever he had sufficient water for his own use, but Russell had never forfeited his right to it. The court ordered both parties to contribute to repairing any damage (BS 14 Nov. 1857:2).

In May 1861 the Russell brothers were in dispute with John Roycroft over water privileges No.1(P) and No.6(P) on Creswick Creek (BS 2 May 1861). George William Russell (jnr) was accused of stealing water from Roycroft and Ralph Camden’s No.6 race by cutting into it at night and draining it into Russell’s sluicing works and No.1 race. Benjamin Eaton was the manager of the No.6 race and used half the wa-
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Figure 12: Russells Reservoir

ter himself and let half to Chinese miners for £5 per week. George Mason was employed to look after the race for 30 shillings per week due to it being frequently cut off. The case was considered very serious but the charges could not be proven.

The Creswick Creek area was also worked by many Chinese miners. George Russell’s attitude to the Chinese at Creswick was ambivalent. In 1857 he moved a motion in the Local Court objecting to Chinese applicants for claims, until the Government could give an assurance of preventing an influx of Chinese settlers (Semmens Box 7, Notes on Mining, p.21). Some years later, however, he appealed on behalf of a Chinese party working on Creswick Creek against accusations that they were damaging the Borough water race and it was agreed to use boxes to convey the Chinese water over the race (BS 22 Sept. 1864).

In the early 1860s the Russell brothers expanded the family mining enterprise by building Russells Dam in Ashwell’s Gully, a minor tributary of Creswick Creek. A short race from the headwaters of Slaty Creek fed into the dam from the south-east while a delivery race brought water to the Russells’ alluvial mining claims at Lincoln Gully and Humbug Hill, where they had another dam for sluicing. The race probably also supplied fresh water to Russell’s residence at Cabbage Tree Flat. In 1863 George Russell wrote a long letter to *The Argus* bemoaning the insecure state of tenure for establishing reservoirs, but with good faith announced he had built Russells Reservoir. Only a few weeks later (unbeknown to Russell at the time of writing) regulations giving security of tenure were passed (*The Argus* 8 April 1863:6).

George and William Russell applied for a 15-year licence for the races and reservoir in 1864, under the 1862 *Amending Act*. The reservoir covered about 5 acres, and the height of the dam wall from the surface was 18 feet, with a capacity of 11 million gallons (50 ML). The daily inflow was approximately 2 million gallons (9 ML). The brothers claimed to have been in possession of the race for the past four years and the dam for the previous three years, suggesting Russells Dam was built around 1861 (CA 2 Dec. 1864:3). The modern Russells Reservoir on the same site, which has a capacity of 64 ML and forms part of the Creswick town supply, was built in 1930 (Figure 12).

Russells’ water race passed around Lincoln Gully, where it entered a small reservoir at around 510 metres asl. The dam was originally part of Bishop’s claim around 1857. It was made of clay, about 15 metres long and 2 metres high, and at some time has been breached in the centre. Russell had an alluvial claim here, as well as others at Humbug Hill and sluicing operations on Back Creek. The race then continued along the west side of Lincoln Gully and rounded the spur overlooking Humbug Hill to the west. From this point the construction and flow of races is complicated and uncertain (Figure 13).
A likely interpretation, however, is that the Russell brothers sought to bring water to their alluvial claims below Humbug Hill. An initial attempt to direct the water northward straight down the spur may have resulted in a fast flow and erosion. A long detour race was constructed instead, directing water southward into Long’s Gully, where it entered a dam around 490 metres asl, and then another race flowed north at a lower level (c. 480 metres asl) to bring the water closer to their mining claims and dwelling south of Humbug Hill. The sequence is also confused by the presence of an Italian mining group (Polinelli) working a claim in this area, and the need to accommodate each party’s water needs. The dam on Long’s Gully was a substantial construction of clay, about 12 metres wide at the base and up to 5 metres in height. The wall is about 50 metres long, and has been breached in the centre. At the base of the breach an iron pipe remains in situ in the rocky bed of the creek. The pipe has an internal diameter of 24 cm (c. 9½ inches), with sections between flanges being 2.76 metres (9 feet) long.

George and William Russell developed a number of sluicing claims at Creswick. One of the largest and earliest of these was at Creswick Creek in 1860, near the junction with Lincoln Gully, where an alluvial claim of more than 44 acres was granted to Russell and Party, providing work for 65 men. The Ballarat Star (26 Nov. 1860) reported that Russell had obtained the largest alluvial sluicing claim on Creswick Creek; the area for 65 men being 1,947,747 feet (44.7 acres or 18 ha) and in 1864 Russell’s sluicing on the Creek was causing the Lincoln Gully bridge to sink (BS 9 June 1864). It is likely that this was known as the Perseverance Sluicing Company (CA 21 June 1861:2).

They also had a small alluvial claim on the headwaters of Lincoln Gully, just below Halfway Dam, although it is unclear when this dates to. Another area of significant works was on the west side of Humbug Hill above Slaty Creek where the family had connections into the 20th century. Remnants of dams, races and sluiced areas are preserved immediately to the south of Ah Young’s gardens, while David Henderson (nd:2) refers to a blacksmith site and office nearby, along with a cottage site associated with Mary Metzner, wife of miner Christopher Russell (fourth child of William and Sarah Russell; Clarke 1994:136). In later years the Russell family were engaged in hydraulic sluicing along Slaty Creek, with a large sluice pit preserved near the Slaty Creek Road. George and William Russell also acquired land in the area during this period. William Russell obtained 20 acres of land south of Back and Adekate Creeks in 1865, while George and his sons took up three adjoining blocks of 20 acres each between Wattle Flat and Dean (Clarke 1994:44).

Water was a source of contention between the Russell brothers and the Creswick Council. The Council invited suggestions for a water supply from the com-
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Community in 1859. Eight suggestions were received, including one from William Russell who urged

‘the council to arrange with the owners of water rights at Back Creek, especially those of No 1 and 3 races which alone are supplied with pure water. Either could be extended to the township, and it is probable that the proprietors would supply the town from a mere nominal sum per house per week’ (VPRS 3730, 25 Oct. 1859).

It appears the Council members ignored this suggestion and in 1864 the Council secured a source of water from Bullarook (Dean) Reservoir. Detailed plans were released and protested by William Russell, as the proposed Government race would run through his lease and would prevent him from mining (VPRS 3730, 26 April 1864). Russell successfully negotiated alterations to the council race, provided he pay some of the cost.

George Russell was in poor health by 1868, and his income from gold mining had diminished so much that he had been unable to earn a living from it since 1864 (Clarke 1994:45). In 1880 Russells’ race was being used by the Council, after William Howard, whose property the race ran through, granted permission to use it. The history of the race and dam is not known between 1864 and 1879; however the dam and race were in need of repair by the 1880s so it may have fallen out of use during this time.

A diversion channel is preserved which extends from Russells’ race down a spur to the Lincoln Gully Service Reservoir. This appears to be part of the link between the Russells’ water system and that of Bragg and the Creswick Council. By 1880 the Council had also obtained Bragg’s Dam and races, and they were selling surplus water from Bragg’s and Russells Dams back to Chinese miners. Water from Russells Dam and the St George’s water right was leased in December 1880 to Ha Son (Ah Soon) for three years for the sum of £20 cash advance.

In the 1890s the sons of William and George Russell continued to work mining claims around Creswick. A partnership between Chris and Edward Russell, Arthur Wade and John Hutchinson in 1891, for example, worked the Back Creek area near Bragg’s race, with permission from the Shire Council (Clarke 1994:70-71). Edward Russell took out lease No.2695 in late 1894 for 15 years, with scope to employ 11 men (GG 5 Oct. 1894). In 1905 the Register of Surveys at Creswick lists Chris Russell and James William Russell applying for surveys of leases No.1276, 4043 and 119 in Jackass Gully, a northern tributary of Back [Creswick] Creek just west of Eaton’s Dam (VPRS 3562/3). A map from the Register of Surveys at Creswick from 1913 also shows clearly that the Russell family still had sluicing interests on Slaty Creek at this time (Figure 14)

In 1928, Albert Russell, the grandson of William Russell, was killed when working on the family’s hydraulic sluicing claim at Cabbage Tree Flat. He had put down the nozzle to retrieve a pick when the face of the cut fell and fatally wounded him (The Argus 25 Oct. 1928:16).

James Robertson / St. George’s Sluicing Company

James Robertson was a pioneer of water harvesting on the Creswick alluvial goldfields. He described the various sluicing activities and water races in which he was involved in a series of letters he wrote to his father between 1855 and 1861 (Wynn 1979). Robertson was in partnership with William Mitchell, and together they held the second water privilege on Back Creek in 1855, which they sold in 1857 to the Eaton brothers. Robertson had several races operating at once and he was involved in sluicing at Humbug Hill and Cabbage Tree Flat. In 1861 Robertson sold his interest in part of a race to the St. George’s Sluicing Company, while in 1865 the upper part of the race (at Bullarook) was acquired by the Creswick Council. Frawley’s (2013) archaeological survey of this water system has revealed a complex sequence of race diversions and intersections associated with these groups during the 1860s and 1870s.

James William Robertson was born in 1823 near the port of St. John in New Brunswick, Canada. He was the first of seven children, and worked both in farming and the timber industry as a young man. When the economy of New Brunswick fell into re-

Figure 14: Plan of sluicing claims along Slaty Creek held by the Russell family in 1913 (VPRS 3562/3)
cession in the late 1840s, Robertson left his birthplace, ostensibly to pursue a career in the merchant marine, but he went to California and arrived in Australia a few years later. For the next decade he pursued his fortune, firstly on the Turon goldfield (where he may have known the Eaton brothers) and around Melbourne, Hobart, Ballarat and Bendigo. He also developed successful sluicing ventures on the Creswick goldfield. Later he moved to the Otago goldfields in New Zealand where he made a fortune based on flour and sawmilling and servicing the needs of the region’s gold miners. Known locally as Daddy Robertson, he was the first mayor of Queenstown and in 1871 he was elected to the Provincial Council. He also operated steam ships on Lake Wakatipu, before he died on 23 January 1876 (Millar 1966:123-4; Scholefield 1940:246-7). Robertson spent the years 1855 to 1861 at Creswick, actively engaged in water works and sluicing. His letters reveal many aspects of his life as well as important details of the water races and sluicing operations he developed.

In September 1855 Robertson wrote to his father from Creswick about his share in a sluicing party ‘which promises verry [sic] well there is five of us, we have made fifty pounds a week for the last three [sic] weeks’ (Wynn 1979:262). The following year he wrote that he was ‘engaged in sluicing and puddling machines which is the surest way of making money here at present’.

In December 1857 Robertson described his party’s substantial water management complex that was under construction, bringing water from the Bullarook Forest to the headwaters of Slaty Creek, and from there to Humbug Hill. He wrote:

‘We have had a fine winter here for sluicing, and have done so well that I intend stopping here a while longer. We lengthened our race and built a floom 800 ft. long and 25 ft. high which carries our stream on a hill that will pay good wages for years to come – we have employed 16 men – wages three pounds per week on this hill. Races that could be bought six months ago for fifty pounds have been sold as high as five hundred pounds – wages have been sold as high as five hundred pounds and I have managed with two others to secure the best water privilege in this district. [It] runs all the year and is high enough to take to Ballarat we are getting it cut by contract at 50p per mile there is 40 men at work on it and 6 miles are to be finished by 15th Jany then we will let the water in our old race all summer while we finish the remainder before next winter …’ (Wynn 1979:264)

The group also faced other challenges around this time. In July 1857 William Mitchell claimed that a miner called Bishop was stealing water from their race. Hitchcock was set to watch the race and claimed to see Bishop place a board across the channel during the night and direct the water downstream into his own dam (BS 27 Nov. 1857). Bishop had a puddling machine and built the dam to catch the sludge, with a trench to carry it past the one above them.

The following year Robertson described the long water race that now stretched 14 miles (22 km) back into the Bullarook Forest. In May 1858 he wrote

‘... the winter has sett in early, we begun sluicing with the old race on the 7th we have our new race cut to slaty creek a distance of fourteen miles, we intend to employ about one hundred men at both races in eight parties the best men we give 10s per day to work the ground [sic], some we get to work for half a share we finding huts and tools with power to discharge any man at any time our new race has been cut mostly by chinamen they are satisfied with 6 or 7s per day and very steady men to work. The land through which our race runs has become of great value being heavily timbered some of our squatters managed to get the best part of it advertised for sale, a hasty meeting was called a petition drawn up and signed by 1400 persons I was sent to Melbourne with the petition which had the effect of causing the land to be withdrawn from sale a bill is now being brought in our Parliament which will prevent the forest from being sold for years to come and our grants for our races have been sanctioned by government so that if the land is ever sold we still own the race as separate property.’ (Wynn 1979:264-265)

Robertson’s race was the highest in the district, starting at 610 metres asl, and was high enough to divert southward to Ballarat (Figure 15). The upper section of the race is not well understood, but the lower section, from the hillside adjacent to Russells Reservoir and along to Humbug Hill, is well preserved. It extended for five miles (8 km) and may have drawn water from a small reservoir on the upper part of Slaty Creek (DMR 1864, vol. 3(10):180), passing through the head of Lincoln Gully on the way to Humbug Hill (Frawley 2013:49). No sign of the wooden flume has been identified, but a small header dam at the commencement of the flume is extant. For the most part the race itself follows a gentle gradient, but one section opposite Humbug Hill descends rapidly (15 m fall in less than 150 m). This section of race is consequently deeply eroded. We do not know why the construction of St. George’s race required this rapid descent, which seems to defy sound race construction practices. One possible explanation is that the eroded section was a subsequent diversion.

In 1858 Robertson proposed to erect a sawmill in the forest to take advantage of good timber prices,
with £12 paid per 1000 superficial feet in Creswick. The following year, however, he expressed his disappointment in the government that 'will not allow the water to be used for any purpose except in a mining district' (Wynn 1979:266). Instead he hired on with the Anderson brothers to superintend 'the hewing and framing' of their new steam sawmill at Dean (Houghton 1980:17; *The Age* 6 June 1866). In the meantime he paid a man £3 per week to work his share in the old race.

It is also likely during this time that Robertson's race supplied water to Quinn's Brewery at Cabbage Tree Flat. The *Creswick Advertiser* (29 June 1860) described the substantial complex as a three-storey building with malt-house, kiln, boiler and chimney, the whole measuring 48 feet by 14 feet. A 'constant supply of pure water' was brought down from the Bullarook Forest, and the only documented water system connecting the two areas at this stage was Robertson's race. Charles Mayes expressed admiration in a prize essay in 1860 for the abundant water flowing into the cellar of the brewery 'to encircle the fermenting and ripening tuns' as a means of improving the quality of local beer production (Mayes 1861:271-2). The exact location of the brewery has not been identified, although it is likely to have been on the east side of Slaty Creek near Humbug Hill (Henderson nd:1, 3). In September 1873 the Creswick Brewery Co. Ltd was incorporated but the business was wound up two years later (Deutsher 1999:114).

By 1860 Robertson was still working for the Andersons, and his interest in sluicing appears to have been waning. He became involved in a small gold mining company with a lease over 56 acres, but he was cautious about its prospects. In October 1860 one of his old sluicing workers, Richard Martin was killed by 'a quantity of ground falling on him, we gave his widow £100' (*CA* 2 Nov. 1860:3; Wynn 1979:267).

In 1861 Robertson sold his shares in water races for £200 to his old mates, as mining was now interfering with his other interests. He continued working for the Andersons, who were planning to build a water-powered flour mill at Smeaton on Birch Creek. Soon he left Victoria for the gold rush to New Zealand.

The water race from Slaty Creek which Robertson had helped develop became known around this time as the St. George's race. Robertson’s ‘old mates’ must have included William L. Jones, who in 1864 applied for a water right licence (WRL No.31) to the race and reservoir, claiming a pre-emptive right held with mates for the last seven or eight years.

**St. George’s Sluicing Company**

Documentary evidence for the St. George’s Sluicing Company is scarce but archaeological evidence of dams and races is well preserved. The company...
used patent bitumen pipes to replace the wooden flume built by Robertson. Their early work at Humbug Hill was described in the *Creswick Advertiser* in 1862:

‘... the St. George’s Sluicing Company have adopted paper pipes (6-inch) for conveying their water across the western slope of Lincoln Gully, enabling them to command the top of Humbug Hill, and, perhaps, the highest sluicing ground in the locality. The pipes will extend 560 yards and cost £500, including laying, and it is expected to-morrow night will witness completion of the contract, all the pipes having arrived on the ground.’ (12 Sept. 1862:2)

‘The St. George’s Sluicing Company yesterday afternoon, for the first time, conveyed their water in bitumenized pipes from Lincoln Gully to the top of Humbug Hill, an operation which took 16 minutes. About 50 people were present. Three cheers were given to Mr Moore, the head engineer of the pipe company, and a similar compliment was paid to Mr Oliver Snaithe, who superintended the laying of the pipes.’ (16 Sept. 1862:2)

‘The St. George Sluicing Company have also conveyed their water by similar [i.e. bitumenized] pipes a distance of nearly 1700 feet, from Lincoln Gully range to the top of Humbug Hill. The bore of this company’s pipes is only 6 inches and the perpendicular height 75 feet, and everything seems to indicate that it will be quite successful.’ (7 Oct. 1862:2)

‘The defective paper pipe is still a source of annoyance and loss to the St. George’s Company; they have, however, cleaned up, and five weeks work has yielded a dividend of £1 per man per week.’ (24 Oct. 1862:2)

The St. George Sluicing Company divided £5 per man. £100 has been offered for a share. The bitumenized paper pipes are in good condition and carry the water well, a former breakage having been only of a slight nature and easily repaired.’ (11 Nov. 1862:2)

The pipeline began at a very small header dam (still extant) on the side of Lincoln Hill and extended north-north-west (347°) for about 512 m to Humbug Hill. There is no suggestion in the newspaper accounts that the pipes were carried on elevated trestles, so it is likely that the pipeline was in the form of an inverted siphon, similar to the line built by the Humbug Hill Sluicing Company at the same time. This agrees with the reported ‘perpendicular height 75 feet’ (7 Oct. 1862:2), which may refer to a head of 22.86 m. No sign of the bitumen pipe has been identified in situ, although a section is preserved in the Creswick Museum.

Previously, the company had caught two Chinese miners stealing gold from their sluice-boxes:

‘The St. George Sluicing Company, Humbug Hill, finding that gold was taken out of their sluice-boxes every Sunday, determined to watch. On Sunday morning last they saw two Chinamen come to the boxes, and after looking round them, and perceiving no one looking, one remained on the watch, and the other with a piece of damp clay in his hand, began to pick up the gold out of the box. One seeing two Europeans approaching, the Chinaman on the watch gave the alarm to the other one in the sluice-box, who jumped out and ran away. He was, however, caught with the piece of clay in his hand, which was washed, and a quantity of gold taken out. He was given into custody, and on Monday morning the Bench, considering the case clearly proved, sentenced him to six weeks’ hard labour.’ (Argus 25 Sept. 1861:7)

In the following few years the group reported good results, washing up 47 ounces (1332 g) of gold in July 1863, and 55 ounces (1559 g) in September 1863 (85 21 July 1863:4; 15 Sept. 1863:2). In 1864 the company applied to the Minister for Mines for a 15-year licence to a race and reservoir under the 1862 *Amending Act* (25 Vict. 148). The dam was located on Slaty Creek and the race extended for five miles (8 km) to Humbug Hill, delivering 800,000 gallons (3.6 ML) per day. The company claimed to have a pre-emptive right to the water ‘for this last seven or eight years’ and to have spent more than £2000 on water works (CA 2 Dec. 1864:3). Applicants (and presumably shareholders in the company) for WRL No.31 included: William Llewellyn Jones, Michael Heir, Martin Meany, Jonathon Hodge, J. Whitbourn, John Manley, Thomas Hogburn and William Myers King. W. Llewellyn Jones owned a store at the foot of Long’s Gully near Cabbage Tree Flat and served as the Creswick representative on the Ballarat Mining Board and as a Crown Lands Bailer (and precursor to John La Gerche). He was thrown from his horse and killed in 1879 (Graham 1987:220). John Manley may be the same individual who survived the disaster at the New Australasian Gold Mine in 1882, when 22 men perished (Graham 1987:90; Williams 1982:59-65). Martin Meany was a forest dweller who was later fined for illegally carting sappings with firewood (Taylor 1998:32). William King later became a prominent in business and public life in Brisbane (Graham 1987:144).
and Party. This part of the race was numbered Water Right No.32. The Engineer also recommended that the Council clean out the race from Bullarook Creek to Andersons Saw Mills and make a new cut from the Pipe Track where crossed by the gully from Andersons Mill, thereby increasing the supply of water by an additional 1 to ½ sluice heads.

By 1873 the St. George’s Sluicing Company, registered as Block Alluvial Claim No 2310, was run by a party of Chinese miners. Court records indicate that on 19 July 1876 the Chinese miners complained that Europeans had trespassed and interfered with their dam by damming back the water and thus preventing them from using their water, and also cutting the dam in another place, thereby diverting the water (VPRS 3372).

In 1879 the Council gained control of William Jones’ WRL No.31, when William Howard leased to the Council the race known as St. George’s Race, and allowed the use of Russell’s Race both of which ran through Howard’s property at Wattle Flat. William Howard was appointed to take care of the Council’s water right at Wattle Flat. In 1880 the Council let the St. George’s Water Right (renumbered WRL No.421) to Ha Son for three years for the sum of £20 cash advance with conditions to repair Russells Dam and all races.

St. George’s Lake (originally the Government Dam) on Creswick Creek was renamed after St. George’s Reef Mine established nearby.

**Benjamin and Charles Eaton**

The American brothers Benjamin Franklin Eaton and Charles Lafayette Eaton began their gold mining career in Australia on the Turon goldfield near Bathurst in New South Wales late in 1853, having arrived from California with some knowledge of sluicing (BS 4 August 1858:2). Known as the ‘American Company’, they commenced their operations at Paterson Point ‘on a gigantic scale’, sluicing a stretch of the river with a ten-feet-deep (3-metre) race lined with boards and supported with slabs (ISN 5 Nov 1853:3; BFP 24 Dec. 1853:2). They also washed gravel from their race in long toms (BFP 31 Dec. 1853:2). After six months they were recovering 20 to 30 ounces per day and paying weekly wages of £3 per man (ISN 3 June 1854:7). For a brief period their gold production doubled, but then declined and for several weeks in October 1854 they only made enough to meet one third of expenses, after paying wages to more than 20 workmen (BFP 9 Sept. 1854:3; Potts and Potts 1974:55; SMH 25 Oct 1854:3). By December the brothers employed 50 to 60 men, with expenses of £200 per week, and were working one and a half miles of the river. Shortly afterwards, however, their fortunes declined, most of the hired men were discharged, and the brothers took themselves off to Creswick in Victoria.

The Eaton brothers soon became active participants on the Creswick goldfield, entering into partnerships with John Roycraft and William and George Russell, and disputing with John Bragg and the Humbug Hill Sluicing Company (see Appendix 1). The history and details of the water claims and privileges among these groups is complex and reveals the complications faced by miners and authorities in regulating water supply. Among the earliest references to the Eaton brothers’ activities were two cases in 1856 in the Creswick Local Court concerning claims of prior water access against Stovel and party and Hitchcock and party (BS 6 Dec. 1856:1). The Eatons’ main field of operating appears to have been along Creswick Creek itself, where they obtained the second privilege on this creek from William Mitchell and James W. Robertson, who had built a dam around 1854. The Eatons were granted water privileges under different applications; Eaton Brothers and Party held water privilege No.6(P) (1857) and one of the Eatons held water privilege No.2(P) (BS 3 Dec. 1858:2).

In November 1857 they purchased the Yankee Dam and water race on Creswick Creek for £500 (BS 14 Nov. 1857:2; Figure 16). The Eaton brothers also made arrangements to use tail water from Humbug Hill and employed up to 50 men at 25 shillings per week (BS 14 Nov 1857:2).

In 1859 the Eatons submitted proposals regarding the Creswick water supply. They also applied for an abandoned water race and dam on Bullarook Creek near Clunes, known as Grenfell’s race (CA 2 Dec. 1859:6). This activity coincided with a dry period which restricted their sluicing operations, and in December 1859 they were declared insolvent, with debts of £968 and assets of only £525 (CA 20 April 1860:2). Several months later, shares in their water races and dams on Creswick Creek and Birch Creek were offered for sale. At least one of the brothers re-
mained active during 1861 when he managed a race on Creswick Creek. He used half the water from this race and employed 5-7 men (BS 20 August 1861). The Eaton brothers and John Roycraft were also active at Bald Hills. According to Creswick court records (VPRS 3372, 3 Feb. 1865), an 1862 water right at Bald Hills held by Roycraft, Eaton and eight others was contested as abandoned by J. B. Bragg and nine others.

The brothers’ financial distress, however, must soon have been resolved, as in 1862 they began construction of a large new dam on Creswick Creek. This is one of the most striking and best preserved archaeological features on the Creswick goldfields. It became known as Eatons No.1 Dam, while the earlier Yankee Dam was Eatons No.2 Dam (Figure 17). The Eaton brothers began dismantling this smaller No.2 (Yankee) Dam in 1862 to permit washing the creek bed for gold, and to sluice the tailings which had accumulated in the dam from earlier sluicing upstream (Argus 8 April 1863:6; BS 11 Sept. 1862).

Eatons No.1 Dam is located about 500 metres downstream (westward) from Cosgrove Reservoir, built on a rocky choke in the creek bed. The dam is unusual in the district for having been built with a substantial vertical stone facing downstream and a clay embankment on the upstream (water) side. The dam wall is approximately 70 metres long, about 8 metres wide at the base and generally 4-5 metres in height. The top of the dam wall is about 1.5 metres wide and was originally secured with a frame of heavy timbers (BS 2 July 1862:4). The lowest courses of stone extend outward slightly from the base. Above these the masonry consists of large schist slabs laid horizontally and overlapping, with small rock infill. The central section of the wall features a steep buttress on the downstream side about 4 metres in height (Figure 20). There is a bye-wash at both ends of the dam wall, and a plan of the dam from John Roycraft’s WRL No.950 indicates that water was discharged from the centre of the wall, probably through a pipe and valve.

In 1863 the dam was still under construction when it was damaged by floods, causing £400 worth of damage (BS 19 Oct. 1863:2). The following year its capacity was described as approximately 15 million gallons (68 ML; DMR 1864:180). In 1869 the dam was flooded again, while the smaller No.2 (Yankee) dam was destroyed (CA 5 Dec. 1933).

Eatons Dam is unusual in its design and construction. The simplest gravity dams normally consist of a mound of clay heaped across a watercourse, with a roughly symmetrical profile (Smith 1971:195-207). Ideally the clay should be puddled to remove impurities and consolidate the mass, with a central clay core dug down and inserted into bedrock to provide a seal. The dam or embankment provides a physical wall to resist the vertical and horizontal pressure exerted by the depth of water stored behind. The pro-

Figure 17: Plan of Eatons’ No.1 Dam and water race, from John Roycraft’s application for WRL No.950 in 1909
The Water Merchants

6. The Water Merchants

The Eatons utilised a water race that extended two miles (169 chains, or 3.4 km) downstream from their dam along the south side of Creswick Creek to Portuguese Flat via Lincoln Gully. Much of the area has been extremely disturbed by surface working over the years which has destroyed some sections of the race. This race was held as WRL No.2 (only the second to be issued in Victoria), and appears to have been leased jointly by Benjamin Eaton and John Roycraft. The pair applied successfully for another licence (No.30) to the race and reservoir in 1865 (GG 16 April 1866:818-19). In 1879, at the expiry of WRL No.30, Roycraft obtained another 15-year WRL (No. 414), this time without the Eatons’ involvement. The licence specified a total quantity of water to be diverted of 2 million gallons per day (Mineral Statistics of Victoria 1884:54). Roycraft renewed WRL No.414 in 1894, which was renumbered No.701, as well as gaining a permit to sell surplus water from the race.

In 1900 the warden or town clerk at Creswick informed Roycraft that his dam was in a dangerous state of repair (VPRS 7873/P/0001, Unit 1). In 1909 flood damage to the dam wall included the loss of ‘about 3 feet of earth work by 12 ft deep taken away on top of the stone work’. Roycraft blamed a rush of water from upstream at ‘Bragg’s Dam’ that caused the damage (VPRS 6784/4/1, 11 Sept. 1909). This dispute also reveals that the dam wall at this stage was still ‘protected at crest by a framework of timber bolted together’.

Roycraft was keen to take advantage of the new dredging boom taking place and advertised that his water was available for use to any company that may desire it. WRL No.701 was again renewed for 15 years in August 1909 and re-numbered No.950. This water right expired in 1924 (GG 10 September 1924:2904) and this seems to bring to a close Roycraft’s long association with water dealing in Creswick.

By the late 19th century Eatons Dam (as well as Bragg’s Dam) had become a popular site for picnics, bird watching, shooting parties and fishing (Graham 1987:124; Lindsay 1965:24; Taylor 1998:29, 72). In 1933, however, the creek flooded and destroyed the dam:

Flood started Wednesday 29th November. 6½ inches of rain. Waters dissipated quietly after initial flooding. Again those who had been flooded began cleaning up preparations but by 1 pm they were disturbed by the ringing of the firebell. Quickly the alarm had spread that Eaton’s Dam had gone. Hundreds of people hurried down to the creek to watch for the on rush of waters but the alarm was false. Eaton’s dam had gone but no one knows exactly when, for reports were most contradictory. Sifting them all through however, it seems that a small piece of the bank must have given way about 6 am and that through-
out the day the cut wore deeper. There is ample evidence that at one stage the water was flowing over the embankment for its whole width. One man who went up to investigate reported that at 9 am the bank was still holding but a small hole had appeared in the top and further showers would probably cause the dam to burst. Another person saw the dam on Saturday when it still penned back a huge quantity of water. By Sunday morning however, the cut had eaten down to the bottom of the bank and the creek was flowing the old course (CA 5 Dec. 1933).

In 1857 the Eaton brothers applied successfully for a patent with the Victorian Patent Office, which had been established in 1854 as part of the Colonial Secretary’s Department. The ‘Patent for Improvements in Machinery for Puddling and Washing Earthy Matters so as to obtain Gold therefrom’ appears to have been basically a mechanised sluice-box (Figure 21). It consisted of a long wooden trough, up to 100 feet (30.5 metres) in length, four feet wide and two feet deep, placed upon an incline of four degrees, or one foot in 19½ feet. A perforated metal plate was set in the lower end, with a ‘ripple box’ placed underneath to catch all ‘the fine stuff’ as it passed through. A large roller, up to four feet in diameter, was set at the lower end of the machine, with a smaller roller (two feet in diameter) at the upper end, and a series of guide rollers in between. The rollers supported and turned an endless chain, to which were attached rakes for puddling (Archer 1868:85; BS 26 March 1857:3; GG 31, 27 March 1857:570). A pulley linked the large roller with a steam engine or horse whim to provide power. Washdirt and water were fed in at the top of the trough, with the rakes pushing and harrowing the ‘earthy matter’ down to the lower end, with fine material passing through the perforated plate and into the ripple box for washing out the gold. Stones and large debris passed out the lower end of the trough. Provision was also made for a sluice-box to be placed at right angles to the ripple box to ensure all the water and fine material should be processed thoroughly. In July 1857 the brothers began erecting one of their patent puddlers at Pennyweight in the Ballarat area – a machine 55 feet (16.8 m) in length, with an arrangement of chains, harrows and drums. Power came initially from a horse but a steam engine was preferred. This operation was conducted in association with the American miner John Kirk, with the Eatons arranging to capture and store the waste water from Kirk’s sluicing operations at Pennyweight, using a series of small dams (BS 4 July 1857:2; 4 August 1858:2). Kirk himself was instrumental in establishing a domestic water supply in Ballarat, with the construction of a 17-acre dam for sluicing purposes (Nathan 2007:14). The dam was transferred to the Department of Mines in 1861 before passing to the councils of Ballarat and Ballarat East in 1862, and remains today as part of the city’s water supply (Nathan 2005:59).

Benjamin Eaton was involved in leasing the Creswick water supply. In February 1866 he proposed...
taking charge of and maintaining the waterworks to supply the town with domestic water while utilising the excess for mining purposes. His proposal was accepted several months later and he paid an annual fee of £120 for the privilege (CA 8 Feb. 1866:4; 12 July 1866:4). In the same period he proposed transferring the pipes used by the St. George’s Sluicing Company from Lincoln Gully to Humbug Hill where he could greatly increase the water supply but the outcome of this plan is unknown (CA 22 Feb. 1866:2s).

Charles Eaton also claimed familiarity with the process of removing logs and snags from river beds, with particular reference to the Mississippi and its tributaries, and in 1858 he submitted his thoughts to a NSW Select Committee on Murray River Navigation (Select Committee 1858:772). Eaton at this time may also have been associated with, perhaps as a local agent, the large American trading house of Wilkinson Brothers in Sydney and Melbourne. The Eaton brothers appear to have ceased their involvement with Creswick mining and water management by the 1870s.

John Roycraft

John Roycraft was a prominent member of the Creswick community who held substantial mining interests during the 19th century. As early as 1856 he was involved with fund-raising for the Creswick Medical Dispensary, and in 1858 he signed a petition urging the creation of a Municipality of Creswick (Clarke 1994:31, 109-110). From 1859 Roycraft served as a trustee of the Creswick Anglican Church (BS 19 Sept. 1859:2; Graham 1987:96) and as a committee member of the Mechanics’ Institute (BS 14 June 1859:4). He was also an Electoral Registrar for Creswick in 1863 (BS 16 July 1863).

Roycraft was a also major water trader and he and subsequent family members held water rights in Creswick from the 1860s to the 1930s. His main supply of water came from his lease of Eatons Dam. Roycraft and the Eaton brothers were partners in the early gold mining period at Creswick.

In 1861 Roycraft, in partnership with Ralph Camden, alleged in the Creswick Police Court that George Russell and his son (also George) deliberately cut one of Roycraft’s races and diverted the water into the Russells’ sluicing claim (BS 2 May 1861:1). The charge was regarded as very serious but could not be proven in court (see page 23).

In 1863 John Roycraft and Benjamin Eaton were granted the second Water Right Licence (WRL) issued in Victoria, for a race and reservoir (BS 5 Aug. 1863:2).

A preserved section of one of Roycraft’s water races extends along the north side of Creswick Creek to St. George’s Lake (Figure 23). Archaeological features include the race alignment, spoil and sediment deposits, dams, diversions, sluice points and potential gauges, flume remains, pipes and sluice lining materials.
John Bragg and the Humbug Hill Sluicing Company

The Humbug Hill Sluicing Company represents one of the best preserved water management systems on the Creswick alluvial goldfield. The archaeology of the group’s activities includes Bragg’s Dam on Adekate Creek, a substantial and well preserved water race to Humbug Hill, several small dams, and extensive evidence of sluicing in Lincoln Gully and on Humbug Hill itself. The large cut on the western side of Humbug Hill, however, which was later used as a clay pit by the Eureka Terra Cotta and Tile Company and by Selkirk’s brickworks in Ballarat has obliterated all traces of mining activity in the immediate area. Other archaeological features include race cuts, spoil, diversions, remains of bitumen paper pipe, pipe tracks, regulators and small dams.

Alluvial mining began at Humbug Hill towards the end of 1854, when several thousand miners arrived to work the adjacent Cabbage Tree, Mopoke and Humbug fields (Flett 1970:416; Graham 1987:176). The name ‘Humbug’ derived from the way miners were deceived by the irregular distribution of gold through the strata of the hill (BS 16 Sept. 1858:2). Humbug Hill is located three kilometres south-east of the Creswick township, forming a low rocky rise that separates Slaty Creek to the west from Lincoln Gully to the east.

The Humbug Hill Sluicing Company began operations in 1856 under the management of Irish-American John Boadle Bragg. Bragg obtained water privilege No.3(P) for Adekate Creek, with the Russells and the Eaton brothers having prior privileges No.1(P) and No.2(P) respectively to this water. Davis and Co sold shares in (or consented to the use of) the first right to the Back Creek water to all three parties, which was to cause considerable conflict over the next few years (Appendix 1).

Around November 1856, Bragg suffered a serious accident when a mass of earth fell and broke his leg. His partners in the company paid compensation to him of five shillings per week for the next six months, after which they declined to pay any more. Bragg fought their decision in the Creswick Local Court, but he lost the case and apparently received no further monies (BS 30 May 1857:2).

In August 1858 the Humbug Hill Company applied for permission to build a race and extension, which was granted subject to the prior rights of Russell and party and the Eaton brothers. The gauge was 12 ft long, 12 inches wide and 6 inches deep, with an orifice 1½ inches across the bottom allowed as one sluice head, providing four sluice heads of water (VPRS 3730, 25 Oct. 1859). Around the same time, Bragg also appears to have been involved with another sluicing group, Muir and party, which was working at Long Gully with ‘dams, and puddling machine’ (BS 11 Aug. 1858:2).
By 1859 the company had completed construction of a large dam on Adekate Creek at a cost of £1000, which could hold 15 to 20 million gallons (68 to 91 ML) of water (CA 3 June 1862:2). The reservoir covered a little over 9 acres (Figure 24). Originally, the dam wall was ‘substantially built of wood’ (CA 4 Nov. 1859:4), but was later replaced with clay. The dam wall is well preserved, although the reservoir has silted up and holds much less water than it did originally. The wall is made from clay, excavated in part from a cutting on the northern side of the gully, and extends for about 110 metres in length. The modern outlet is also at the south end of the dam, and part of a concrete regulator remains in situ. Given the very basic state of concrete manufacture in Victoria in the 1850s and 1860s, however, this feature probably relates to the later Council use of the reservoir (Lewis 1988:3-5).

The dam wall has a gently sloping profile, unlike others in the study area where dams were often built at a steep angle in narrower gullies. The low gradient of Bragg’s Dam, around 32 degrees, was determined in part by the width of the creek valley, while its substantial mass has contributed to its good rate of survival. The dam wall stands around 4.7 metres in height, and contains approximately 3500 cubic metres of fill.

Much of the race between Bragg’s Dam and Humbug Hill remains in an excellent state of preservation, despite disturbance in several small sections by road construction and logging. In addition, construction of Cosgrove Reservoir in 1977 inundated approximately one kilometre of the race upstream of Eatons Dam. Bragg’s race is generally about one metre wide and up to 1.2 metres deep, curving around Ashwell’s Gully and Lincoln Gully en route to Humbug Hill (Figure 25). Extensions of the race to the White Hills, and beyond to Long Point and the Bald Hills, are poorly preserved, with only small sections still extant. The
good state of preservation of the Humbug race almost certainly relates to its later reuse as part of the municipal water supply, where the channel was cleaned out and possibly widened, until the 1960s.

A small holding or settling dam was also constructed on the east side of Humbug Hill (Figure 26). Such dams could serve to lower the velocity of water flowing through the race by spreading it over a wider surface before the water was then distributed to the working site (Tracey 1997:7). The dam is located about 60 metres south-west of Bragg’s race, and the dam wall is 45 metres wide. The floor of the dam is covered with numerous pot-holes, usually about one metre in width. A small blockage in Bragg’s race diverted water through a secondary race into the holding dam, from where it was used in ground sluicing on the southern slopes of Humbug Hill. It is not clear when this small dam was used, although it appears to post-date construction of Bragg’s race.

In 1859 the District Mining Surveyor, James Stevenson, reported the activities of the Humbug Hill Sluicing Company:

The Ground was washed from the surface to the bottom - a depth of 30 feet, the lower 10 of which were a soft clayey red reef, and had to be thrown up into the sluice streams. The mode of working adopted was first to cut a face on the ground, and then to turn on the water along its base. Thus the water assisted in cutting down the ground, and frequently blocks of from 20-50 tons were so taken down. The shifts were 6 hours on and 12 hours off, and the work was kept going night and day.

The number of days, of which the following are the results, were 1,777; the area of ground washed, 1500 cubic yards, being about 8½ cubic yards per man per day; the yield of gold was 245oz., and the estimated quantity of water used per minute was about 300 gallons. At the higher levels the water was used again by the same company, but in a different operation. The ground was poor, yielding less than eight grains to the cubic yard; and it is very unusual to wash such a depth; yet, notwithstanding, the returns gave about 11s. per man per day. (MSR 1859 (July):8)

Bragg also submitted a proposal in 1859 to supply Creswick with town water using the Humbug Hill Sluicing Company resources, with the Council to construct a reservoir at White Hills:

The Humbug Hill Sluicing Co propose to keep said reservoir full during the winter season from their race running from Adekate Creek past the White Hill to the Bald Hill Diggings, leaving the same full at the commencement of the summer

Figure 27: Plan of race from Bragg’s Dam to Humbug Hill, with extension to the Bald Hills indicated on Krause (1880).
season and retaining in their dam on the Adekate Creek the additional quantity of 6 million gallons as reserve in case of a long continued drought. The water shall be carried in an open race, thus saving piping costs. The Humbug Hill SLuicing Co intend to keep one man continually looking after their race for the purpose of preserving the same in repair and preventing the intrusion of impure matter [all for the sum of £500 pa]. (VPRS 3730, 22 Nov. 1859)

Bragg’s proposition was not taken up although in 1864 the company was supplying water to White Hills. It was thought that without large stone walls Bragg’s Dam would not be reliable.

In 1860 the company was affected by several serious problems. Heavy rainfall during September badly damaged Bragg’s Dam on Adekate Creek (CA 28 Sept. 1860:3). The eight partners in the Humbug Hill SLuicing Company also came to blows at this time over plans to extend the party’s operations (CA 10 August 1860:4). Construction of a race from Slaty Creek to the Bald Hills was well advanced by April 1860, but the members argued about whether this was the best approach (Figure 27). John Bragg, Thomas Lake, C. H. Lewis and Jacinto De Lima claimed in the Creswick Court of Mines that they had wanted to push ahead with the race, but the other four (John Williams, James Videau, Domingo Francisco and John Keating) preferred to keep sluicing at Humbug Hill. On one particular day, a dispute over water supplies for the sluicing resulted in a fist fight and police summons. John Williams, it was alleged, ‘often challenged members of the party to fight’. An application was made to dissolve the company, which resulted in Bragg and his supporters buying out the others for £480 and the resumption of work on the race to Long Point.

Legal and financial problems continued in 1861. The partners were back in court on two occasions to defend their claim at the Bald Hills, when rival parties argued (unsuccessfully) that the Humbug Company was preventing other people from working the ground (CA 14 May 1861:2; 23 August 1861:2). Money was also an issue. In June 1861 John Bragg issued a prospectus advertising shares in the Creswick Extension SLuicing Company, seeking capital of £2500 in 500 shares of £5 each (CA 11 June 1861:3). The prospectus claimed that a race had already been cut from the Adekate Creek dam to the Bald Hills ‘with the exception of the connections between Humbug Hill and the opposite range on Slaty Creek which will require 800 yards of pipes or fluming ...’. Further works were also needed to convey water around or across Nuggety Gully, Cobbler’s Gully and Diamond Gully. While the company’s plant and claim were valued by the Mining Surveyor at £1500, it also seems that workings at Humbug Hill were ‘now barely giving a living’ (BS 25 Dec. 1861).

The main barrier to completing the company’s water system was Slaty Creek, where the broad creek flats were more than 20 metres below the company’s lowest operation on Humbug Hill. Eight hundred yards (730 metres) of piping were needed to convey the water across by gravity at sufficient pressure. The company contracted with the Patent Bitumenized Pipe Company of Melbourne and Bendigo to lay eight-inch pipes across Slaty Creek in an inverted siphon carried on braces or trestles. The pipe began on the hillside about 114 feet (34 metres) above the height of the creek. Krause’s (1880) map indicates a dam on the west side of Humbug Hill that would have served as a header dam for the pipeline, but this has been destroyed by excavation of Selkirk’s clay pit (Figure 28). The pipeline descended into the valley and ascended to discharge the water into an open race on the other side. The head was reported as about 25 feet (7.62m), which provided a hydraulic gradient of 1.1% (BS 12 Sept. 1862:2). This gradient is much steeper than the company’s water race, which fell at an average rate of approximately 1.30 m per kilometre, or 0.13%. The difference in gradient may have been necessary to overcome the retarding effect of friction within the pipe. Trestles across the creek, however, reduced the head and thus the pressure within the pipe, although this did not prevent leaks and the pipe bursting ‘at the lowest level’ (CA 7 October 1862:2).

The pipes, made from paper sealed with bitumen, were cheaper and much lighter than iron pipes, and were used on the goldfields for draining and pump-
ing (DMR 1862 (Feb.):16). They also had the advantage of not rusting. Manufacture involved passing a roll of paper through a vat of molten bitumen, and then coiling the paper tightly around a mandrel to form a tube (The Argus 27 Aug. 1860:5). The walls of the pipe were up to 30 mm thick. Pipes used by the Humbug Company featured flanged joints and a T-piece at the lowest point for blowing out any accumulated sediment. They were supported in iron-braced wooden boxes, and relied on gravity, rather than steam engines, for water pressure. The entire outlay for the company amounted to £3000 (CA 3 June 1862:2; 12 Sep. 1862:2).

Water was laid through the pipes and across the creek for the first time on Wednesday, 10 September 1862 (the St. George’s Sluicing Company achieved a similar feat five days later). The event caused great excitement, with the Creswick Advertiser reporting that:

The operation began at Humbug Hill at 4 p.m., and 35 minutes afterwards the water made its appearance on the White Hills, and intelligence which was transmitted through the firing of a gun and received with cheers at the starting point. A great many strangers were present on this interesting occasion and the whole company enjoyed themselves heartily to celebrate the event. (CA 12 Sept. 1862:2)

With this connection made, the Humbug Hill Sluicing Company had succeeded in delivering water from its reservoir on Adekate Creek all the way westward to Long Point and the Bald Hills, a distance of approximately 14 miles (22.5 km). From the White Hills to the Bald Hills there were also 2200 feet (670 metres) in fluming and 800 feet (244 metres) of tunnelling (CA 12 Sept. 1862:2). In the following days, however, there were reports that some of the lower level pipes had burst under the pressure of water (CA 7 Oct. 1862:2). The bitumenized pipes were advertised as withstanding pressure up to 400 lb. per square inch, but repairs and replacements with thicker pipes in some sections were needed. In spite of these efforts, the ‘paper and pitch’ pipes do not appear to have been very successful, and by 1864 the company had replaced them with conventional 7-inch iron pipes (CA 5 Sept 1864; DMR 1864 (Oct.):180). The replacement was carried out by the firm of Cairns, Wilson and Amos of Melbourne, and the new pipes permitted a flow equal to two sluice heads of water (CA 5 Sept. 1864:2).

The technology of bitumen pipes appears to relate to separate but very similar patents taken out in Victoria by Charles Lyon and Charles Newbold in 1860, based on inventions in Paris and London (Newbold 1860). Both processes involved the manufacture of vessels including pipes and tubes from paper and bitumen. Rolls of paper were passed through a tub of heated bitumen and then rolled in layers around a cylinder of the required diameter. Newbold’s bitumen pipes could also be strengthened with bands of wire wrapped around the exterior. Local manufacture was carried out by the Patent Bitumenized Pipe Company, which established a factory in Flemington in Melbourne in 1860. The company held the colonial rights to Charles Lyon’s patent process. Several other patent applications were made around this time by Paul and Alexander Joske, for manufacturing pipes from bitumen, but these were not granted by the Victorian Patents Office.

Bitumen paper pipes appear to have been a largely experimental technology, and they do not appear to have been widely adopted in Victoria or elsewhere in Australia. The most common materials used for pipes at this time were terracotta, wood, lead, cast iron, galvanized iron and concrete (Blackburn 1999:218). Herbert Abraham’s (1929) major study of asphalt and coal-tar products makes no mention of bitumenized paper pipes, although bitumen was used for lining iron and steel pipes. The Patent Bitumenized Pipe Company appears to have ceased operation around 1864 or 1865.

The route of the 1862 bitumen pipe and the 1864 iron pipe created by the Humbug Hill Sluicing Company is represented archaeologically by a shallow trench or depression preserved on the hillside west of Slaty Creek (see Krause 1880). The trench extends 186 m from the west bank of the creek uphill to a point where the pipe discharged into another section of open race. The trench is generally about 1 m wide and up to 0.5 m deep. Fragments of bitumen pipe are preserved in the surface of the Gardiner Street track near the western end of the pipe. The iron pipes from 1864 may have been re-used by members of the Russell family, who had extensive sluicing works in the vicinity in the 1880s.

There were also other parties involved in sluicing at Humbug Hill during this period, and the sluicing scars that cover much of the hill reveal the extent of their activities. These groups included the Lost and Found Company and Neal, Devonshire and Party (BS 3 June 1862; CA 10 June 1862:2; 1 July 1862:2), along with the California Sluicing Company under Thomas McBride (CA 2 Sept. 1859). There were also the St. George’s Sluicing Company and the Lucknow Company (BS 15 Sept. 1863), along with several parties of Chinese miners, including Ah Hing and Company and Ah Kit, who were in dispute over claims on Humbug Hill in 1863 (BS 30 April 1863). In 1864, Ah Fee and party had a claim surveyed at Humbug Hill that measured 160,000 feet (3.67 acres) (CA 21 March 1864:2). In 1866 Dicker’s Mining Record reported that a party of 12 Chinese miners working on Humbug Hill had recently washed 150 ounces of gold (DMR 1866 (no.64):243). In later years, the South Creswick Gold Mining Company operated at Humbug Hill in 1877-
In 1865 Bragg took over Roycroft and Eaton’s abandoned WRL at the Bald Hills (VPRS 3372). On 13 June 1865, however, Bragg himself died from ‘a disease of the brain’. His energy and enterprise (and willingness to litigate) had played a key role in the operation of the Humbug Hill Sluicing Company over the previous nine years. Born in Ireland around 1823, he later emigrated to the United States. In the early 1850s he was working as a tanner in New Orleans, before travelling to New York to depart for Australia on the Baltimore in May 1853 at the age of 32. His movements for the next few years are unknown, but he had arrived in Creswick by 1856, where he resided at Anthony’s American Hotel until his sudden death in 1865 (CA 14 June 1865:2; 16 June 1865:2). He was buried in the Presbyterian section of the Creswick Cemetery in an unmarked grave.

In spite of Bragg’s death the Humbug Company continued in operation, apparently under the management of Thomas Hassall. In August 1865 the partners reported washing out 38 ounces of gold (CA 21 August 1865:2), and in December 1865 a share in the Humbug Hill Sluicing Company fetched £270 at auction (CA 11 Dec. 1865:2). One of the founding partners, Thomas Lake, died of a chest complaint in September 1869. Two years later, the District Mining Surveyor James Stevenson reported that the Humbug Company leased out two sluice heads of water at £2 10s. each per week (MSR 1871 (No.103):24).

Little more is known about the Humbug Hill Sluicing Company during the 1870s except that Thomas Hassall’s application in 1879 for the company’s race and reservoir was refused after the Council objected. Under the Local Government Act 1874, Council could compulsorily acquire land for municipal works and as the Council paid Hassall £100 for compensation due to the loss of his right (VPRS 3730, 13 July 1880), it is thought that the Council acquired Hassalls’ right in this way. In April 1880, Hassall negotiated to sell the remaining assets of the Humbug Company to the Creswick Council as part of its water supply system. By this stage the company is referred to as ‘late’ and had ceased to operate in its former capacity. Hassall initially offered the whole of the plant belonging to the Humbug Company, including 68 tons of seven-inch pipes and races and reservoirs, for the sum of £500 payable over five years at 7% interest, while allowing Son Zen and Party to have the water for the five years at £85 per year. John Roycroft objected on the grounds that the Humbug Company was responsible for damage done to Roycroft’s Lincoln Gully race by Chinese miners using the Humbug Company’s water. Hassall replied that as the Council had owned Bragg’s reservoir for the past four months, any men using the water from the dam were trespassing on Council land and outside the late Humbug Company’s power. Hassall nevertheless agreed to point out the offending Chinese and have them make good the

Figure 29: Deep sluicing gullies on the southern slopes of Humbug Hill

78 (The Argus 26 July 1878:8; CA 18 April 1877). In the 1890s, Humbug Hill was also home to Humbug Sarah, ‘a lady of easy virtue with many clients in the Chinese Camp’ (Lindsay 1965:24).

Most of the slopes around Humbug Hill bear the scars of deep alluvial sluicing (Figure 29). This technique involved directing the flow of water over the working face to dislodge the washdirt. The face was typically 20 to 30 feet (6 to 10 metres) high, and the miners stood at the base to rake and pick the loosened washdirt onto the working floor. The wash disintegrated and was carried by the flow of water into a sluice channel. Stones or blocks placed in the sluice assisted the break-up of the wash-dirt, permitting the deposition of the heavier gold particles (Tracey 1997:7-8). The sluice emptied into a tailrace that assisted the break-up of the wash-dirt, permitting the rapid flushing of water into the channel. This technique could, however, be very dangerous. Working faces sometimes fell in slabs, bringing down tons of earth, rock and clay onto the miners below. At Humbug Hill, at least seven men were killed by earth falls during the 1860s and 1870s, including Martin Richard (1860), Fun Wagh (1861), Yung Lan (1863), Ah Hik (1866), Ah Luke (1877) and Fun Gwan (1879 [Chin and Scott 2009]).

In 1864 Bragg took up several water rights, including No.12 and No.17 (formerly Privilege No.3; GG 16 April 1866:818-19). In the same year the Creswick Council was also being supplied with water from the Humbug Hill Sluicing Company’s race (WRL No.17; BS 10 Nov. 1864:4). The Council used the extra water to fill the Lincoln Gully Service Reservoir, using a concrete regulator and a brick-lined channel to divert water from Bragg’s race (see page 54; VPRS 3730, 1 Nov. 1864). Lincoln Reservoir is well preserved today, extending approximately 150 metres east-west and up to 25 metres north-south. It held roughly 5 ML of water, and the diversion features from Bragg’s race are in reasonable condition (see Creswick Municipal Water Supply below for further details on the Lincoln Gully Reservoir).
damage (VPRS 3730, 23 April 1880).

In May 1880 the District Mining Surveyor reported that Hassall’s pipes were less in quantity than he had claimed and that Bragg’s Dam was in fair condition except the by-wash at the south-western end required repairs. In July the Council considered Hassall’s offer again. They did not need the pipes belonging to the late Humbug Hill Sluicing Company, but as a fair and equitable settlement the Council offered the sum of £100 as compensation for the loss of the WRL, on condition that the Company transfer the whole of their race and plant except pipes to the Council. Agreement was reached on these terms in September 1880, while surplus water from Bragg’s Dam was leased to Ah Fee for 12 months free of rent in return for cleaning out and repairing the entire race as far as Humbug Hill (VPRS 3730, 13 Dec. 1880).

In 1899 there was a proposal to expand the capacity of Bragg’s Dam to 300 million gallons to supply water for dredging along Creswick Creek. Thomas Quin argued that ‘Bragg’s Flat’ provided a ‘natural storage basin’ that required only an embankment 10 chains (201 metres) in length. Nothing seems to have happened until 1914, when the proposal was revisited by the State Rivers and Water Supply Commission, but the scheme was never taken up (The Argus 2 Oct. 1899:3; 8 Oct. 1914:6).

The Humbug Hill Sluicing Company represents an important early example of corporate alluvial gold mining in Victoria, with a strong emphasis on water management. The company held an early and significant water privilege and was very active in developing and trading its water resources. The partners were innovative, willing to apply new technologies in the form of bitumenized pipes to carry water for hundreds of metres over a nearby creek, and enterprise, conveying water through more than 20 kilometres of races around a number of watersheds. They were commercially astute, selling shares in the company and floating the Creswick Extension Sluicing Company in 1861 to raise money for expanding their operations, as well as litigious, often engaged in legal actions with other parties in the local Wardens’ Court, Police Court and the Creswick Court of Mines. The partners were also confident of success. When many others deserted the Victorian goldfields in 1861 to join the rush to New Zealand, the Humbug Hill Sluicing Company continued to develop and invest its resources in local mining operations. Their activities played a major role in transforming the natural environment and capturing water for human use.

John Wolfe, Wun Yee and the Slaty Creek Hydraulic Sluicing Company

The Mopoke area contains well preserved archaeological evidence of alluvial mining and sluicing operations carried out by a number of parties from the 1850s to the early 20th century. Remains include water races, spoil, diversions and dams. The area was still being sluiced in the 1930s (see Goldsmith 2004).

John Wolfe (or Woofe) operated the Kangaroo Hotel, Slaty Creek as early as 1856 and was a successful miner in the Mopoke area. In 1860 Wolfe and Co applied for a quartz claim between Drakes and Slaty Creek (Lease No.132): ‘The land is presently unoccupied and in the opinion of the surveyor could profitably be worked by a large company’ (VPRS 7842/0000/0002). Wolfe’s party at Ironstone Hill appeared to do well. He averaged 30 ounces from each puddling machine, and as Wolfe had several shares, the Ballarat Star reported that ‘he will clear at least £500. This he deserves for his enterprise and perseverance’ (BS 17 June 1862:2). In 1863 Wolfe had a race surveyed for the purpose of ground sluicing from the head of Petticoat Gully to Mopoke (BS 2 June 1863:2). The race location has not been determined, possibly due to plantation disturbance. Wolfe’s success continued and in 1874 he was granted WRL No.369 for a race and reservoir at Drakes Creek, Forty Foot Hill and Bullock Gully, with 700,000 gallons per day. Meanwhile Ah Tan of the Temperance Company applied for a race and reservoir in 1875 utilising the same water source as Wolfe (Figure 31). Wolfe objected but the licence was granted (WRL No.400) and the following year Ah Tan constructed a race five miles long, drawing water from the same source. Wolfe’s WRL No.369 continued to be in force until 1884.

Ten years later, in 1894, part of Wolfe’s race was re-surveyed for Wun Yee and renumbered as WRL No.319 (Figure 30). This race extends for five miles from Schicer Gully (also known as Butcher’s Gully) at 520 m asl, around Mason’s Gully and then to Mopoke Gully, ending at a dam at 480 m asl. John Lynch noted on the survey plan that this race appears to interfere with the water right of Tommy Dodd and Tung Wah. Tommy Dodd had a small alluvial claim just to the north of Wun Yee’s dam. This entire race is still extant as is the small dam (500 m asl) at the end of the race.

Wun Yee’s race was also being utilised in the early 20th century by the Slaty Creek Hydraulic Sluicing company (WRL No.884). It is not clear if Wun Yee was still operating concurrently with the Slaty Creek Hydraulic Company. WRL No.884 supplied the Company’s ground along Slaty Creek (Figure 32). The race follows the same route as Wun Yee’s race then continues for several miles to the west, supplying a large holding dam near Tavistock Hill (VPRS 14969/0000/86). This race may have supplied other sluicing companies in Kangaroo Gully such as the Creswick Proprietary Hydraulic Sluicing Co. Almost all of this race is extant and in good condition.
Figure 30: Location of Wun Yee’s race

Figure 31: Wolfe’s race (WRL No.369) and Ah Tan’s race (WRL No.400; VPRS 14969/P0001/62)
Ah Tan / Len Goldsmith

Ah Tan’s water race comprises a 6.9-kilometre section of extant water race commencing near James Hill, following contours around Butchers and Mopoke Gullies. The race is well preserved with archaeological features including race cuts, spoil and dams.

In 1875 Ah Tan (Temperance Company) applied for a race and reservoir. John Wolfe objected as he already drew water from the same source but the lease was granted. The following year Ah Tan constructed a five mile race from Bungaree to Masons Gully (WRL No.400). The 15-year lease was for 15 acres of ground in total and a dam capacity of 500,000 gallons, and it expired on 15 May 1891.

In the 1930s Len Goldsmith, who was sluicing in the Wolfe’s Hill area near Mopoke, leased Ah Tan’s WRL No.400 under the new WRL No.616. According to Goldsmith (2000:4), the race was government-owned and leased. A section of race follows around the head of Sawpit Creek (Masons Gully). The race here was cut into bedrock for a long distance. Many flumes were required to cross Butchers and Masons Gully, which had to be cleaned and checked as well. Some were made of metal, others nailed and bolted together with crossed timber pylons (Goldsmith 2000:4). Goldsmith suggests the races were all dug the same way in the past, by digging with the water coming along behind so the race had the right amount of fall. He describes sluicing as follows:

... we would do two shifts per winter. We only had a limited number of pipes and they had to come down the hill from the race as well as reach to where we were working ... We could only go as far as our total pipes. We just made the pipe longer as we worked up the creek doing each paddock until we ran out of pipes. So we had to shift everything up creek and put it together again at a new site. We had four or five shifts in total ...

We would dig a new sump hole about a yard across for the elevator pipe into the race boxes. The hole sides were tapered to nothing. The hole had to go in the lowest place so that what we washed would drain to it and be thrown up to the boxes by the elevator jet. We had to work in the creek and dig the hole into the rock bottom.

We had to sand bag the pump-hole so we could dig it because of the creek. The pressure pipe went into the bottom of the hole and there was a jet from it that shot straight up out of the hole. This blasted up a six-inch pipe. As stuff washed down into the pump hole, the high-pressure jet would throw it all up the elevator pipe and into the race boxes. We had to make sure no big stones got down into the sump hole and block the pipe. You had to lift the pipe and crow bar the brutes back out of the hole again.
We could use the water jet from the nozzle to blast any rocks away from the elevator sump. You couldn’t use the elevator and nozzle at the same time. There was not enough water coming down the race to run both.

... The race boxes were seventeen or eighteen feet above the ground. You needed that height so the gravel and sand could run away from the end of the boxes. If you didn’t then the boxes very quickly got clogged and buried under sand and gravel ... The boxes were four foot wide and all steel. They could have killed the man handling them to get them up on the props. (Goldsmith 2000:4-5)

Goldsmith’s plant comprised seven-inch pipes and a ‘proper’ nozzle with working pressure of about sixteen pounds from the two inch nozzle:

When we had plenty of water such as when it was raining, we would set the nozzle at the bank over night. The next morning it would have cut in several yards.

... If it wasn’t raining there would be no water in the race at all and it would take four and half hours to get to us once it was turned on ... It had seven miles to travel before it got round to us. Right around Butchers, Mason’s, around to Wolfs Hill ...

At the end of the dry times ... the first water put down the race would have to be checked ... I had a pitchfork to scoop out all the sticks and branches. God you were going seven miles of race to clean out.

You had to keep up with the water, at the same time as scooping the race clear of rubbish all the way. If you didn’t keep up, the rubbish would dam up and the race would overthrow ... Our dam was up near the top end of Drake’s [Creek] ... It was the start of all the water races in that area (2000:3-4).

Smokeytown (Armagh Reef) race

The Smokeytown race commences on the western bank of Creswick Creek and is one of the longest races recorded in the region. The mapped distance is 26.3 kilometres, from a starting elevation of 520 m asl down to 500 m asl at the Smokeytown end, three kilometres north-east of Creswick (Figure 33).
The race is well preserved and has been marked with interpretive signage where it runs adjacent to the La Gerche Forest Walk in the old Creswick Landcare Centre. It is also clearly indicated on Krause’s (1880) map. The preservation of the race through a recently clear-felled pine plantation about one kilometre north-west of Eatons’ Dam suggests that water races can often withstand major ground disturbance. Archaeological features include race cut, spoil, diversions and dams.

The origins and history of this race are uncertain. Tropman and Associates (1991) suggest that construction of the race commenced in 1870 and took two and a half years to complete, with fluming used to cross creek gullies in several sections. It ended at the site of a quartz mine at Armagh Reef near the head of Frenchmans Gully where it supplied water to a crushing battery. Later, during the 1930s Depression, the race was cleaned out and supplied enough water pressure for sluicing. This ceased after four years due to the amount of sludge entering Creswick Creek.

Alternatively, there is historical evidence that the race dates from an earlier period. In September 1860 the Chairman brought to the notice of the Creswick Council an abandoned water race that had been cut some time earlier from Birch Creek around by Spring Gully and the Eastern Hill (VPRS 3730, 4 Sept. 1860). It passed through the property of Mr Birch, Mr Riley and Mr Cameron. The race could, it was noted, be cleaned and repaired for about £100, with a reservoir built on Eastern Hill to supply domestic water to the township, along with water to miners around Clark’s Hill. The council obtained WRL No.153 for this race but the plan to supply water from this source was never carried out (VPRS 3730, 5 March 1861).

There were several abandonments and takeovers of this water right during the 1860s (e.g. VPRS 3372, 28 July 1863).

Ah Young’s Gardens, Humbug Hill

Ah Young created a series of small terrace gardens on the south-western slopes of Humbug Hill in the 1880s and 1890s. He was forced to work at this elevated location because hydraulic sluicing companies had taken over the rich alluvial flats along Slaty Creek. Ah Young was one of at least 30 Chinese men working a garden in the Slaty Creek and Mopoke area at this time. Most had held a Miner’s Right for many years, and occupied a hut and a small patch of land up to one acre in size (La Gerche 1885). Forester John La Gerche kept a close eye on the Chinese gardeners and fossickers scattered through the Creswick forests and at times he intervened on their behalf to ensure they received fair treatment (Taylor 1998:102). Henderson (nd.:13) indicates that Ah Young had a European wife but no children, and that he returned to China when his wife died.
part of this rush. Historical sources from the 1860s suggest that the area was mostly taken up by small groups of miners, including Europeans, Chinese, Malays and Filipinos (e.g. BS 5 April 1862:1; 17 June 1862:2; 13 Jan. 1863:2). The name Tavistock may relate to early miners in the area who came from the town of Tavistock (near Plymouth) in England (Graham 1987:251). The town is part of the extensive copper and tin-min-
6. The Water Merchants

...ing region of Devon and Cornwall so any gold seekers from there may have had previous mining experience. Tracing the source of water for the extensive sluicing operations that occurred at Tavistock is complicated by the disturbance of races by pine plantations, but it is likely that water was sourced from several gullies and holding dams to the north, west and south (Figure 37). Despite the extensive and impressive sluicing remains at Tavistock Hill, very little is known about the history of mining in this locality. Alluvial mining continued in a small way, using race and dams, until at least the 1930s (Goldsmith 2000).

Occasional newspaper references hint at mining activities occurring at Tavistock Hill in the late 1850s and early 1860s. The Tavistock Quartz Mining Company, for example, was wound up in 1858 (BS 6 Dec. 1858). Joseph De Lima and Party applied in 1859 for a permit for a race from their dam in Petticoat Gully to Tavistock Hill (CA 11 Nov. 1859). The Tavistock Company wanted to carry water to Bald Hills from Slaty Creek, with the involvement of a party of Portuguese and Italian miners (CA 3 Jan. 1862).

A court case in May 1861 reveals tensions between European and Chinese parties at Tavistock. By this stage much of the Mopoke/Tavistock area had been taken up by Chinese miners (CA 15 Jan. 1861:2). Charles Minner registered claim No.518 at Tavistock Hill on 27 July 1860. He accused Ah Bow and party of building a puddling machine on his claim, and covering his hole with sludge. The case was postponed and the outcome is uncertain (CA 10 May 1861:2).

Two sluicing parties at Tavistock Hill were averaging £7 per man per week in 1862 (CA 12 August 1862:2). Several Malay parties were also working in Ware’s paddock at Tavistock Hill at this time (BS 17 June 1862), while a few months later a party found 12 ounces, mostly in nuggets, in the area (CA 11 Nov. 1862).

In 1863, Chinese miner Ah Yem and four companions were excavating drives in a pit 30 feet deep at Tavistock Hill. A quantity of earth and gravel collapsed on Ah Yem, which resulted in internal injuries and he died the next day (Chin and Scott 2009:53).

Han Kee’s race extends from Petticoat Gully north-east towards Tavistock Hill and on to Slaty Creek below Humbug Hill (Figure 38). Much of the race is cut along a very steep slope, unlike many of the races in the area. Archaeological features include the race and spoil. The race is indicated as current on a lease map post-dating 1876 (VPRS 14969/1), which shows the race as approximately three kilometres in length leading to Han Kee’s alluvial lease at Cabbage Tree Flat.

In 1907 Thomas Maxwell Haines obtained a large 120 acre lease along Slaty Creek below Tavistock Hill. Lease No.6614 was declared void, however, in 1908. Haines had been sluicing the Kangaroo Gully...
6. The Water Merchants

**Figure 39**: Square cutting, possibly for sluice-box, at terminus of water race south of Tavistock Hill

**Figure 40**: Tail race with three sharp turns at Tavistock Hill

**Figure 41**: Remains of sluicing on Tavistock Hill
A water race extending towards Tavistock Hill from the south has several unusual features. The final 150 metres or so of the race has been broadened up to 4 metres in width to form a shallow holding dam. The widening appears to have been a means of storing a larger quantity of water than could be held in a normal water race. The northern end of this section is blocked with a bund of clay, up to one metre high, from where the water may have been diverted for sluicing a nearby gully. A square opening 7 x 7 inches across (18 x 18 cm) preserved at the base of this bund may be the original location and cutting for a sluice gauge of some kind, inserted to control and measure the flow of water (Figure 39).

Several prominent tail races extend downhill from the sluiced area at the summit of Tavistock Hill, and these provide some of the clearest evidence in the study area of features related to sludge. On the north and east margins of the hill the tail races take the form of heavily eroded gullies up to five metres deep and several metres across. They reach from the former ground surface to the floor of the sluice pit and extend down slope for several hundred metres. The gully floor at the base of the hill shows an unusual profile that is likely the result of sludge accumulation.

On the south-eastern margin of the sluice pit a second form of tail race has been preserved, featuring three dog-leg turns. The race is only about 50 cm wide and is up to one metre deep (Figure 40). It may have been used as a sluice-box to reduce the speed of water and collect gold from the corners. Figure 41 shows the impact of sluicing on the summit of Tavistock Hill.

Creswick Municipal Water Supply
The years 1859 to 1864 witnessed a great deal of debate concerning the provision of a town water supply for the residents of Creswick. Numerous proposals, revisions, complaints and petitions were received by Council members before a reliable supply was secured in 1864 from Bullarook Reservoir, located about 7 miles to the south-east. The process was complicated by the competing interests of miners, farmers, sawmillers and others, as each tried to protect their interests and, if possible, benefit from the establishment of a water supply. Development of a water scheme was also closely associated with the pre-existing water entitlements of alluvial mining parties, several of which the Council later incorporated into the town supply. The following discussion briefly traces the development of the system that emerged during this period and beyond, and then notes the surviving archaeological features.

As the town developed during the 1850s, water supply remained a relatively ad hoc affair that depended on wells and old mining shafts, and water drawn from creeks was often fouled with sludge and...
other debris. In 1859 the Council formed a committee to determine the best method of supplying the township with water and advertised a prize of £25 for the best plan to achieve this. Proposals were received from J. D. B. Williamson, Charles Eaton, ‘Lone Aquarius’, ‘Aqua Pure’, John Bragg and Party, William Russell, H. H. Jackson, and Mitchell and Party (VPRS 3730, 25 Oct. 1859). Several of these schemes, including Eaton, Bragg and Mitchell, have been noted in the relevant sections above. The other plans included:

- J. Williamson suggested taking water from his race opposite the township;
- Lone Aquarius suggested taking water from the north of town, either at Red Streak, Slaughteryard Hill, Hard Hill or Union Hill;
- Aqua Pure recommended bringing water from Birch Creek and conveyed by a race already cut to Spring Gully;
- Russell suggested the Council make arrangements with the owners of water rights on Creswick Creek, especially races No.1 and No.3. Either of these could be extended to the township for a nominal sum per house per week;
- Jackson proposed a dam in Spring Gully, to the north-east of town.

The proposals were followed up with a range of costings and surveys, and Bragg, Eaton and Williamson met the Council in November 1859 to present their ideas in detail. In the following month the Council Surveyor presented his report on the merits and limits of the various plans. He also recommended that the Council secure the first right to water on Birch Creek and declare water reserves near the source, and that a new race would need to be cut from the creek to the town, at a projected cost of £4440 (VPRS 3730, 6 Dec. 1859). The £25 prize seems to have been awarded to both Eaton and Williamson, suggesting that the prize was for the best idea rather than a plan that would necessarily be carried out. In the event, it appears that the Council effectively took ideas from numerous sources to establish the water supply.

In February 1860 the Council requested that three allotments in the Parish of Dean advertised for sale in the Government Gazette (No.18, 7 Feb. 1860:263), a total of 331 acres, should be sold subject to the right of the Council to cut a water race through them, or that they should be withdrawn from sale. This land was contiguous with the Bullarook (Dean) Reservoir, and it is clear that the Council was by now largely committed to this site for a source of supply.

Discussions in 1861 and 1862 focussed on diverting water from Birch Creek via an existing race that passed through the land of several property owners, and the need to clean the race and divert it past dissenting landowners. The Anderson brothers, who had recently built a new water-powered flour mill further downstream at Smeaton, objected to the

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**Figure 43**: Creswick water supply routes c.1880
possibility of losing water to Creswick (Jones and Jones 1990:222). It appears that this scheme did not eventuate. In the following months concerns were expressed about ways to attract money from the Victorian Government, which had made £75,000 available to supply water to country towns.

By July 1862 the Victorian Government had agreed to contribute up to £3000 to the Creswick scheme as the Council sought to secure its legal entitlement to the Bullarook Reservoir which lay outside the municipal boundaries. This legal headache appears to have been resolved by the end of 1862 after which attention turned to details of construction and cost. James Stephenson, the local Mining Surveyor, was appointed as supervising engineer of the water works at a rate of 5% of the gross cost including previous charges for survey plans and specifications.

The scheme basically involved connecting the Bullarook Reservoir to Creswick via a series of pipes, flumes and open-cut races (Figure 43). In 1863 it was found that Bullarook Reservoir needed to be cleaned of dead timber before it could be suitable for domestic water storage. The clearing proceeded slowly, however, and added to the cost of the project. In August 1863 the valve on the reservoir was closed to allow it to start filling while the main race continued to be cut. Progress over the next few months saw the construction of fluming at Ashwell’s Gully, the Pipe Track under construction, pipes brought to Bullarook, and the reservoir at White Hills cut to the specified depth.

A trial on 16 February 1864 let water flow from Bullarook for the first time, and it ran clear for 45 minutes with scarcely any sediment. Two months later Mr Russell applied to shift the position of the Council’s water race, at a point where three races ran parallel to each other. The deviation, he indicated, could be made without injury to the Council works but it would bring the race outside the area reserved by the Government, and would thus require a fresh survey of the proposed route. The proposed length of deviation was 5 chains (117 metres) and the greatest width was 100 feet (30.5 metres). The Council agreed to the proposal on the basis that Russell paid all expenses, to which he agreed.

In May 1864, with the scheme nearing completion, discussions were held on letting the water. The 5-inch iron pipes would carry about three sluice-heads of water, while collection along the open race would amount to another four sluice-heads during wet weather. The Council issued 100 posters inviting tenders to rent the water, either on the Lincoln Gully side or from the White Hills reservoir, with each sluice-head to consist of 16+1 inch with a head of water of 6 inches. Most of the tenders received were from Chinese miners, while John Bragg also applied to rent three sluice-heads of water at £2 10s per week, provided the Council would deliver the water into their race at the White Hills (VPRS 3730, 7 June 1864). Russell’s deviation of the race at Back Creek was completed satisfactorily by this stage.

In June 1864 the water works were complete except for the valve at the Lincoln Gully Service Reservoir. The newly appointed Inspector of Water Works reported that fluming between Adekate Creek and Ashwell’s Gully was full of rubbish that allowed a good deal of water to escape. The following months saw a range of problems with the water supply, including burst and blocked pipes, races cut and the fluming choked with branches. The race was also found to be in a very dilapidated condition where it crossed the Humbug Hill Sluicing Company’s race. Water pressure at the White Hills reservoir was also proving difficult to gauge, complicated by a Chinese sluicing claim in the vicinity. The Chinese were not getting the full two sluice-heads requested and refused to pay for any less, but the pipes could not supply this amount.

By September 1864 the gauge problem at White Hills had been fixed and the Chinese were now receiving two sluice-heads of water. Ongoing problems with the pipes, however, meant that the Humbug Company was getting more than its three sluice-heads while the supply to the Borough Water Works was only two sluice-heads. The problem of measuring water pressure and volumes was ongoing and the Inspector frequently had difficulty in letting water at constant rates.

The Council also sought to acquire part of the St. George’s race, starting just below Bullarook Reservoir. Council minutes (VPRS 3730, 27 Sept. 1864) reported the Water Works Engineer’s recommendation that the Council apply to the Government for the race formerly held by Jones and Party (WRL No.31), taking water from the site of the reservoir at Bullarook and purchased by the Government from that party.

Further problems emerged in November 1864, when the town clerk revealed that nearly all the catch water along the open race had been cut off by a new race recently cut by Matthew Mills and Party, who had a sluicing lease in Lincoln Gully on the St. George’s race. There were also problems gaining adequate pressure out of the Lincoln Gully Service Reservoir, which was kept full by water diverted from the Humbug Hill Sluicing Company’s adjacent water race (VPRS 3730, 1 Nov. 1864).

At this stage water was still not being piped into the centre of town. It could be purchased by the barrel at the White Hills reservoir for one shilling per load. This was a source of friction between town dwellers and (Chinese) miners, as the latter received hundreds of thousands of gallons of mining water for the cost of a few pounds, while domestic users needed a horse, cart and barrel to secure a modest supply (VPRS 3730, 29 Nov. 1864). By the end of 1864
plans were afoot to bring water from the White Hills down to Market Square.

The summer of 1864-65 was the beginning of a prolonged drought, and the Council began to consider the rates to be charged for water supplied by meter or standpipe. A standpipe was installed by April 1865 on the south-west corner of Victoria and Napier Street, and this was followed by a celebration of ‘The Starting of the Water Works’ (CA 12 April 1865). The fire brigade decorated and paraded their engine and the principal inhabitants of the town sat down to a champagne luncheon. The original contract for bringing water from Bullarook to the White Hills reservoir was £5385, while bringing water to the town cost £1762, making a total of £7147, of which £3000 was granted by the Government and the balance raised by the sale of debentures [bonds] at 8% on the security of a special rate.

John Roycraft was one of the first town dwellers to apply to lay a ½-inch service pipe from the water main to his premises in Albert Street (VPRS 3730, 25 April 1865), while most residents still drew water from the standpipe or the hydrant. Thereafter, however, service pipes of ¾-inch or ½-inch gradually began to be laid through the streets according to the willingness of ratepayers to pay. The Chinese community at Black Lead petitioned for water in 1871 (Figure 44; Denny 2012).

In 1868 the Secretary of Mines, Robert Brough Smyth, recorded the total storage capacity of Creswick’s ‘government reservoirs’ as 35 million gallons (159 ML; Smyth 1979:550). An abundance of water at this time meant the council could lease surplus water, and in 1869 John Roycraft leased surplus water to miners. The council, however, was struggling to meet the demand for water in the 1870s and it was forced to purchase water back from Roycraft (CA 15 August 1870). A notice dated 4 January 1877 pasted in the Council Minutes book indicates continuing water shortages (Figure 45). Water Inspectors were employed with the authority to take action against all persons found wasting water (VPRS 3730, 2 Jan. 1878). Much discussion occurred in the 1870s as to how to supplement water sources.

The Council water supply was supplemented by the acquisition of Russells Dam and race in 1879, St. George’s (WRL No.421) race in 1880 and by the Humbug Company’s dam and race in 1880 (see sections above for further details). The council made modifications to races, sometimes replacing sections with pipes.

An undated parish map indicates that Bragg’s and Russells’ race were gazetted in 1905 as municipal water races (Figure 46). Curiously St. George’s race does not appear on this map, indicating that by the early 20th century the race was not required. The relationship between St. George’s race and Russells’ race is intriguing and not fully understood. The two races drew water from different sources, Russells’ from Slaty Creek and St. George’s from Dean Reservoir, and intersected just south of Russells Dam. Diversions from St George’s race into Russells’ race near Halfway Dam suggest St. George’s race supplemented Russells’ race below this point when required. In 1880 during a search for a drowned man in Russells Dam two million gallons were released from the reservoir (VPRS 3730, 1 Jan. 1880). St. George’s race may have provided a temporary water supply when Russells Dam was low or races were being repaired. Water from Russells’ and St. George’s races was leased to Ha Son for 3 years for £20 in advance of repairs and cleaning (VPRS 3730, 13 Dec. 1880).

By 1888 there were four main storages vested in the Creswick Borough: Bullarook (45 million gallons), Russells (8 million gallons), Adekate (or Bragg’s, 18 million gallons) and the White Hills Tank (680,000 gal-
Russells Dam on Ashwell’s Gully was upgraded to a larger reservoir in the 1930s, while Cosgrove Reservoir on Creswick Creek was completed in 1977.

Much of the physical infrastructure of the original Creswick Municipal Water Supply scheme remains intact, although many elements were upgraded and added in the years following the system’s completion. The main elements still to be found include the Bullarook (Dean) Reservoir, parts of the race along Creswick (Back) Creek, the Lincoln Gully Service Reservoir, and a small dam on the White Hills Water Reserve. In addition, features such as Bragg’s Dam and Russells Dam and the associated water races, which were acquired by the Council to augment the town water supply, are also intact.

**Figure 46**: Creswick municipal water races indicated on undated parish plan

**Figure 47**: Location of Lincoln Gully Service Reservoir adjacent to Bragg’s water race
Perhaps the most striking extant feature of the Creswick water supply scheme is the Lincoln Gully Service Reservoir, which was completed by 1864 (Figures 47-49). It is located on the eastern side of Lincoln Gully about 25 metres south of the Creswick-Bungaree Road. The reservoir is approximately 150 metres in length and up to 25 metres in width, with a maximum wall height of 3 metres. The reservoir is not built within a gully or depression but on the side of a gentle slope. It functioned as a service reservoir within the system, maintaining water flow to the White Hills. It appears to have held approximately 7.5 ML of water, which was only a fraction of that contained, for example, in Bragg’s Dam.

The water race of the Humbug Hill Sluicing Company (Bragg’s race) passes along the south side of the Lincoln reservoir, with a regulator to divert water into the dam (Figure 49). This feature is built from hand-made, wet-pressed bricks, with a cement lining, and is 47 cm wide with a hemispherical cross-section. An iron sluice gate fitted into concrete buttresses is set within the race. A concrete overflow, at the southwest corner of the reservoir, is 5.90 metres long and 2.0 metres wide.

The White Hills Water Reserve is located on elevated terrain opposite the corner of Gardiner and Orr Streets at the southern edge of Creswick. This was the original terminus of the municipal water supply system. The reserve is approximately 1 hectare in size, and is largely cleared of vegetation except for eucalypt trees around the remains of a small dam at the south end. The dam is about 30 metres by 10 metres across, and is quite shallow and dry. Local informants suggest that the dam was decommissioned when Cosgrove Dam was built in the 1970s.
Water flowing through races down to the mines picked up silt and clay and gravel that had held the gold and washed it away. This was the purpose of the water that miners worked so hard to control. Once they had extracted the gold, the miners had no further interest in the water and left it and its muddy burden to flow where it would. Water from the mine workings had been turned into sludge, creating a major environmental problem. Sludge plagued Victoria for more than half a century, from the early years of the gold rush until the eve of the First World War. The sludge problem had profound impacts not only on mining districts but also on downstream communities well beyond the goldfields (e.g. Bate 1978:99-101; Context 2007a:45; Cusack 1973:117-119; Hansen et al. 2003:170-180; Russell 2009:56). All branches of mining relied on water and each method released the polluted water as sludge at the end of the process.

Sludge was a problem on many other 19th-century goldfields including California (Kelley 1956), New Zealand (Hearne 1982) and Queensland (Wegner 2009) as well as in the tin mining districts of north-east Tasmania (Knighton 1987). Recent discussions of the environmental impact of gold have emphasised the high-profile and highly damaging effects of hydraulic sluicing and dredging in north-eastern Victoria around the turn of the 20th century (Garden 2001; McGowan 2001) but the problem was much more widespread and long-lasting. In the late 1850s Bendigo’s puddlers produced sludge that inundated thousands of hectares of agricultural land downstream from mining areas (Petersen 1996). Tailings from stamp batteries choked rivers in the 1860s and 1870s and in the 1880s the epicentre of the sludge debates was Creswick and its rich deep lead mines.

The encompassing term ‘sludge’ is used for the water-borne waste products of mining (Sludge Act 1885). In general use the term includes tailings, slime and slurry, with different kinds of sludge produced by the different branches of mining (Shakespear et al. 1887:viii-xiv; Birrell 1998:173-175; Powell 1989:49; Table 3). Sludge from puddling machines that treated heavy clay soils was typically high in clay content, resulting in ‘slums’ or ‘slimes’ that did not easily settle out and could not readily be stacked or piled on site. Stamp batteries crushing quartz produced a coarse sand that settled out quickly when stacked or retained in a settling dam. Sluicing produced a combination of fine clayey slimes and heavier tailings ranging in size from sand to large cobbles. Large cobbles were usually stacked on site, but the sand and clay ran off as sludge which was carried great distances from hydraulic sluices in particular due to the large volume of water used.

In the 19th century ‘sludge’ referred principally to the sediment content of waste water and not to any possible chemical content. It was only in 1906 that the first reference to ‘poisonous matter’ appears in association with regulations to contain sludge (Davey 1996:60; Ritchie and Hooker 1997:19, Annual Report on Dredge Mining and Hydraulic Sluicing 1906). The likely presence of mercury in sludge was overlooked even though ‘quicksilver’ was in widespread use from the outset of the gold rush and it was known that a portion was dispersed in the sludge (Birrell 2004; Bowie 1905; Smyth 1979:349-351; Jobling 1984; McQueen 2011; Paxton 1984; Underwood 1985). There was some concern about the potentially hazardous nature of groundwater being pumped out of the deep lead alluvial mines due to possible chemical content. It was admitted that the water from some mines had a distinctive ‘sweet’ taste and was not favoured for watering stock but on the whole these concerns were muted and the groundwater, like the sludge, continued to be discharged directly into waterways (Shakespear et al. 1887:27; Sludge Abatement Board 1907:75).

Arsenic and cyanide are also harmful substances associated with processing gold. Arsenic occurs naturally with gold in the environment. From the 1860s miners experimented with ways of roasting quartz to remove the arsenic and in the process released the poisonous gas arsenic trioxide. This condensed as a powder that fell on surrounding land and buildings and the tailings sands from the roasting plants also contained arsenic trioxide residues. The deaths of animals which had grazed on affected land were reported but little action was taken (SAB 1910). Cyanide was introduced as part of the processing of ores from 1892. A weak solution of potassium cyanide was used as a solvent to dissolve finely-crushed gold ore which was then precipitated onto zinc shavings. The cyaniding process was so successful that it became economical to retreat old tailings. Most Australian cyanide vats were located in the open air which enabled the toxic vapours to disperse (Birrell 2005:175; Ritchie and Hooker 1997:19).

Although the need to control chemical discharge was eventually included in sludge regulations, the lasting effect of mining-related chemicals in the Victorian environment remains largely unrecognised. The level of mercury in Victoria’s rivers is generally unknown but in California, where similar mining methods were used, mercury contamination in mine sites and downstream waterways is substantial (Alpers et al. 2005). Studies in Victoria by environmental scientists have demonstrated that mercury remains in the soils composed of mine tailings around Bendigo (Jobling 1984; Paxton 1984) and in waters of the Upper Goul-
7. Sludge in Victoria

burn catchment (McCredie 1982) and it is likely that similar contamination exists elsewhere (Rae 2001). Studies of arsenic in Victoria’s central goldfields have found that arsenic levels in surface water were not high except immediately around mine tailing dumps but were elevated in plants grown on soils contaminated by mining (Sultan 2006:i). In the 1990s dingoes at a dingo farm in Chewton died after the accidental placement of tailings sands in their pens (Environmental Protection Agency 1998). Human health studies have also revealed elevated levels of arsenic in nail clippings from school children in the central goldfields and higher than expected rates of cancer in modern residents (Pearce et al. 2008, 2010).

**Damage**

Downstream water users felt the full effects of sludge and it is clear that the damage continued for many decades. Several parliamentary enquiries and Royal Commissions were convened in order to deal with the problem. The first was in 1859 when evidence was taken around Bendigo, followed by subsequent enquiries in Bendigo again in 1861 (Select Committee 1887), in Inverleigh near Geelong in 1872 (Morr 1872), in Heathcote in 1885 (Shackell 1885), and across the whole colony in 1886 (Shakespear et al. 1887) and 1914 (Davidson et al. 1914). These sources as well as items in the press (The Argus alone had 1500 stories on sludge between 1855 and 1901, the Bendigo Advertiser had 4000) provide graphic and detailed evidence of the damage done by the sludge and the ongoing failure of attempts to mitigate it.

The first complaints of major disruption came in the late 1850s from businesses in the goldfields towns. Residents in Creswick wrote to the Council complaining that Victoria Street below Cambridge Street was impassable because of the sludge, and shopkeepers in Albert Street complained that the sludge was keeping their customers away (VPRS 3730, 7 June 1859; Royal Commission 1859:3-5). Continual flooding in Ballarat caused municipal authorities to raise the road levels repeatedly in order to avoid inundation, which meant shopkeepers had to elevate their premises on stilts, while in Bendigo petitioners also complained about repeated flooding (Bate 1978:99-101; Cusack 1973:117-119). Witnesses at the 1859 Royal Commission in Bendigo calculated that sludge from the 200 puddlers in operation discharged some 67 megalitres of water carrying 44,700 tonnes of dirt into Bendigo Creek each day (Royal Commission 1859:26). The sludge interfered with mining as it buried old diggings that could no longer be worked; it filled in supply dams used by the puddlers; and in some cases it damaged the puddlers themselves. At least 100 puddling machines were said to be submerged and the old workings were buried by up to 12 feet of sludge where the major gullies joined Ben digo Flat (Royal Commission 1859:3-4). Even downstream near Rochester and Elmore the creeks were affected, with pastoralists claiming that they were filled ‘to within two feet of the banks by the sludge’ making it impossible to water stock (Royal Commission 1859:5).

Two years later the most severe damage was immediately downstream of Bendigo at Epsom and Huntly where there had been a thriving market garden industry along Bendigo Creek. Landowners described the deep, clear creek that used to run through their properties and the acres of vineyards, fruit trees and vegetable gardens they grew. They condemned the rising tide of sludge that flowed down the creek, coming over the top of 1.5 metre embankments built around their properties. Resident James Sandison reported of the damage that ‘The finest garden in Victoria ... is a perfect sea of sludge, and a great many of the trees are dead’ (Select Committee 1887:16, Q.468). Irrigation dams were filled, vegetables were submerged by more than a metre of sludge, and the fruit trees and vines were killed. The Epsom Hotel, previously a pretty place next to the creek, was abandoned when it was filled to the window sills with sludge. The landowners presented the government with claims for thousands of pounds in compensation for the damages suffered.

The reports of Epsom and Huntly farmers were echoed across the colony in the following decades. In the 1860s and 1870s much damage was done by the tailings that flowed from stamp batteries used to crush quartz and cemented alluvial gravels. In some instances tailings sands accumulated on-site but generally flows of water were sufficient to discharge the tailings into nearby watercourses. By the 1880s Bendigo Creek, Yarrowee Creek and the Loddon River were all largely filled with sludge from battery sands discharged by the stamps in Bendigo, Ballarat and Creswick (Shakespear et al. 1887:viii-x).

In the north-eastern mining district the major source of damage was sludge from sluicing and dredging. At Tarrawinge, near Wangaratta, shire councillors estimated that 4000 hectares of agricultural land were inundated by sludge from the sluices upstream at Beechworth (The Argus, 7 Sept. 1875). Creeks around Heathcote were choked with sludge which flowed downstream into the Campaspe River (Shackell 1885). In Melbourne the Legislative Assembly heard that hydraulic sluicing at Warrandyte sent sludge into the Yarra River which silted up Port Phillip Bay and caused problems for shipping (The Argus 18 Oct. 1876). In 1887 the Board inquiring into the sludge question calculated that if all 15 ‘Giant Nozzles’ for hydraulic sluicing then planned actually went into production, they would collectively discharge 15,247 megalitres of sludge in a single year, which would fill a stream one metre deep, 32 metres wide and 51 kilometres long (Shakespear et al. 1887:xiv). Hydraulic sluicing and dredging did have an effect:
in one year, 1909, the two techniques were responsible for processing 20 million tonnes of soil from 300 hectares of land in the north-east of the state, creating canyons over 20 metres in depth (Annual Report on Dredge Mining and Hydraulic Sluicing 1909:10).

By the 20th century the sludge question had still not been resolved and damage was still being done. At Guildford, on the Loddon River near Castlemaine, 50 years of discharging sludge from sluicing had resulted in river flats covered to depths of up to 1.5 metres, with creek beds raised and the construction of new roads and bridges as the old ones were covered over (SAB 1907:75). Over the same period quartz sands from the stamp batteries at Ballarat caused problems downstream for graziers 64 kilometres away at Shelford (SAB 1907:75; The Argus 23 May 1872). As late as 1909 landowners in the district reported dried sludge nearly a metre deep in their paddocks and blown by the wind as much as 18 metres up the surrounding hillsides (SAB 1910:108-111). The sludge was carried down by Leigh (Yarrowee) Creek, where government inspectors in Ballarat measured 6159 grains per litre in samples of sludge being discharged directly from the mines (SAB 1910:92). Buninyong Shire Council had to close the road from Buninyong to Sebastapol because the sludge filled the creek to the top of the bridge.

The sludge from Creswick flowed north along Tullaroop Creek to join sludge flowing into the Loddon from Castlemaine, Daylesford, and Maryborough and by the early 20th century this was causing concern for those involved in the development of infrastructure for irrigated agriculture. The irrigation industry was becoming a powerful interest group and in addition to objecting to the inundation of agricultural land adjacent to the sludge-choked rivers, irrigators were afraid that the sludge would be carried into the new dams being constructed as irrigation storage. They feared that sediment from the sludge would settle out in the dams with the potential to significantly diminish storage capacity. This anxiety was borne out by evidence presented to the Sludge Abatement Board in 1908 when witnesses testified that Laanecoorie Weir, built on the Loddon in 1891, had already accumulated more than three metres of silt in its basin (SAB 1909:92).

The threat to agriculture and the damage caused by dredging and large-scale sluicing generated sustained public outcry in the early 20th century (Garden 2001; McGowan 2001). Community opposition had become more organised, led by groups such as the Australian Natives Association and the Ovens River Anti-Sludge and Pollution Association (McGowan 2001:92-93). These organisations, supported by regular coverage of the issue in The Age and The Argus newspapers, presented petitions to the State Rivers and Water Supply Commission, the Chamber of Agriculture and the Waterworks Trust Association. The time had come to implement more effective measures for the control of sludge.

### Solutions

There were two approaches to solving the sludge problem. The earliest approach was to limit its impact in specific areas by building infrastructure that protected land and property and/or moved the sludge somewhere else. This approach dominated for several decades as individuals and local councils focussed on infrastructure solutions that moved the sludge along. It was not until the 1890s that opinion seriously shifted in favour of controlling sludge at its source by regulating the activities of miners.

It is not surprising that early efforts were directed principally at physically removing sludge. The early diggings were usually concentrated along the flood plains of waterways, and homes and businesses clustered there as well. As the natural drainage systems were disrupted by mining activity, these low-lying homes, businesses and roads were vulnerable to flooding from stormwater and inundation from sludge. In the late 1850s individuals took what steps they could to protect their property, elevating businesses on pilings along Ballarat’s Main Road (Bate 1978:99-101), and constructing levees up to five feet (1.5 m) high around their market gardens at Epson and Huntly (Shakespear et al. 1887:3-4). Ratepayers and businesses also demanded that municipal councils provide better drainage, holding local meetings, writing to the press, and sending petitions to any branch of local or colonial government they could think of (Cusack 1973:117-119; Hansen et al. 2003:170-180, VPRS 3730, 1859).

Councils desperately wanted to build sludge and storm-water channels to divert the waste but lacked the funds to do so. The Bendigo Mining Board attempted to raise money for its channel by imposing a levy on the puddlers, but this was roundly defeated on the grounds that it was a public work and should be paid for at public expense (Cusack 1973:118). Following the official inquiries into sludge at Bendigo in 1859 and 1861, the colonial government responded

<table>
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<td>Bendigo, Creswick deep leads</td>
<td>1850s-1860s</td>
<td>Clay, silt</td>
</tr>
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<td>Stamp batteries</td>
<td>Bendigo, Ballarat, Castlemaine</td>
<td>1870s-1900s</td>
<td>Sand</td>
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<td>Sluicing and dredging</td>
<td>North-east Vic.</td>
<td>1860s-1900s</td>
<td>Clay, silt, sand, gravel</td>
</tr>
</tbody>
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Table 2: Mining practices and characteristics of sludge in places of greatest controversy
by providing funds to assist councils with the construction of sludge channels. By the early 1860s Creswick was just one of many municipal councils that had constructed sludge channels (Bradfield 1972:30; VPRS 3730, 10 Dec. 1861; Cusack 1973:118; Powell 1989:75). In Beechworth and Yackandandah, mining companies blasted drainage channels through solid rock, which also diverted sludge from the towns (Smyth 1979:130; McGowan 2001:94). For most councils, however, this was merely the start of a lengthy process of deepening, straightening, redirecting and lining the old creeks and water holes and turning them into drains (see Hansen Partnership et al. 2003 for history of Ballarat’s storm water channels). In 1873 Parliament was still making regular grants of funds for work on sludge channels in goldfields districts, approving money for Ballarat, Benegrants of funds for work on sludge channels in gold-nells). In 1873 Parliament was still making regular grants of funds for work on sludge channels in goldfields districts, approving money for Ballarat, Bendigo, Castlemaine, Carisbrook, Chewton, Chiltern, Clunes, Creswick, Newstead, North Ovens, Maryborough, St. Arnaud, Tarnagulla, and Tullaroop (The Argus 15 August 1873).

The control of sludge through regulation began in the late 1850s. Under the Gold Fields Act passed in 1855 following Eureka (18 Victoria 37), much of the detailed regulation of the different goldfields was left to the discretion of Mining Boards established in each locality. Water management was one of the issues delegated and the first regulations regarding sludge were by-laws of the local Mining Boards. The Ballarat Board introduced its first by-law regarding sludge in 1858 (GG 15 June 1858). It enabled the mining surveyor to issue orders that stopped parties from creating sludge where it could be shown that the sludge was causing damage to mining infrastructure, public roads or public watercourses, and it also enabled the warden to award compensation in such cases. In 1861 this by-law was amended and weakened considerably when the ability to award compensation was removed and damage to watercourses was no longer included, leaving only interference with mining claims and roads as grounds for complaint (GG 2 May 1862).

The Mining Statute 1865 (section 34) introduced penalties for allowing sludge to pollute a reservoir. This protected people like the Russells, the Eatons, and John Royce, water merchants with recently acquired water licences, but it did not help market gardeners and farmers downstream. Further regulation of sludge was again left to local Mining Boards to determine what was appropriate in their district but the legislators did provide some direction, demonstrating the particular concerns of the period. The main fear was that sludge would be allowed to build up in one location, so Mining Boards were instructed to make by-laws that prevented sludge from accumulating and facilitate its removal. These instructions related specifically to sludge from puddling machines and quartz-crushing, suggesting that these were the main sources of sludge at this time. Although ground and hydraulic sluicing were widespread by this period there is no mention of them in the legislation, perhaps because the volumes of sludge produced were not as great, or perhaps because the waterways affected were not flowing into built-up areas where downstream users were significantly troubled.

The regulations, however, were far from effective and problems with sludge were contested in the courts, in parliament and in newspapers. As a result of decisions in several cases, an 1871 legal commentary on the 1865 Mining Statute stated that ‘Water-rights must not be used to the prejudice of the land or water of others. A person has no right to discharge the water used by him loaded with sludge, on the land, or into the water, of another ... and may be restrained by injunction from doing so’ (Atkins 1871:13). Injunctions accordingly became the tool of choice for those seeking to protect themselves from damage by sludge, and were used effectively by landowners in many places, including Clunes, Maryborough and Mt. Egerton (The Argus 9 August 1870; 2 Oct. 1875; 13 Dec. 1875; 14 Nov. 1881).

The rapid growth of hydraulic sluicing in the 1870s, particularly around Beechworth, caused further problems as it was not covered by existing legislation. Throughout the 1870s, sludge from the hydraulic sluices in Beechworth Shire caused problems for its downstream neighbour, North Ovens Shire. Deputations from the agriculturally-based North Ovens Shire put their case before various ministers and the parliament throughout the decade, requesting funding for a proper sludge channel at Tarraweegeeside. The parliament throughout the decade, requesting funding for a proper sludge channel at Tarraweegee (The Argus, various reports between 14 June 1870 and 1 May 1880; McQuilton 1979:15-16). The use of injunctions to limit sludge caused great alarm among miners and their supporters, with the Maryborough Advertiser (1 Oct. 1875) proclaiming that ‘It appears that any person, no matter who, can at any time ruin a mine in this way. The thing seems very laughable and absurd, but law is law’.

Matters finally came to a head among the deep lead mines north of Creswick in 1881 when an injunction was brought against the Madam Berry No.1 Mine, then the richest mine in the colony (The Argus 14 Nov. 1881; 13 Dec. 1885). Landowners protested against sludge from the mine that was contaminating Birch Creek where they watered their stock. This action ultimately resulted in the passage of the Sludge Act 1885. Although it ultimately proved ineffective this was the first anti-sludge legislation in the world, pre-dating the better-known and more effective Californian regulations, the Caminetti Act of 1893 (Hearn 1982:50).

The bill was brought before Parliament and debated during December 1885, ironically in the same session that passed the Water Conservation Act deal-
ing with the nascent irrigation industry (The Argus 11 Dec. 1885; 30 Dec. 1885). Although the intention of the bill was to address the whole of the sludge question as it then existed across the colony and encompass quartz reef and alluvial mining, in the end the parliamentarians, sitting late on the evening of the last day before the Christmas breakup, ‘objected to hastily passing legislation affecting the whole colony’ and limited the act to the Creswick district only.

The resulting ‘Act to Provide for the Disposal of Sludge from Alluvial Mines in Creswick’ (Sludge Act 1885, 49 Vict. 874), was thus not nearly as revolutionary as it might have been. While it did provide clear definitions of sludge (i.e. sediment-bearing water) and polluted water (i.e. water containing mineral or metallic salts in solution at harmful levels), it did not actually seek to reduce sludge, even in Creswick. Most of the S9 sections in the Act dealt with arrangements for establishing a Sludge Abatement Board whose role was to construct and manage channels to carry sludge away from the mines, and even this Board would only come into effect if the owners of mines in the electoral district of Creswick petitioned to have that electoral division declared a sludge district. Life in Creswick and elsewhere went on as before and it was left to the 1886 ‘Board Appointed to Inquire into the Sludge Question’ (Shakespear et al. 1887) to recommend more effective action.

The Board visited all mining districts in Victoria, inspected quartz and alluvial mines, heard evidence from miners and other community members, and tested water quality in the major affected rivers. As a result of their investigations the Board concluded that ‘the damage caused by mining sludge throughout the colony is of a far more serious nature than was generally supposed, whilst it has made manifest the fact that the injury is likely to be greatly increased in the future ... unless remedial measures are immediately taken’ (Shakespear et al. 1887:viii).

The Board members were also aware of the situation in California at the time, referring to the damage that hydraulic sluicing had done to agriculture there and to the fact that Giant Nozzles had been banned. In consequence the Board made a series of recommendations and even went so far as to draft a bill on the subject to be put to Parliament. Some of the measures the Board recommended were that mines be prevented from discharging sludge into waterways, that licences not be issued unless there was enough land to retain the sludge, that no dams be allowed across watercourses, and that Sludge Inspectors be designated in each district to investigate claims of damage and determine the actions taken by mining companies.

Had these measures been adopted it is likely that the general discharge of sludge around the colony would have ended in the 1890s. Unfortunately, the bill drafted by the Board did not go ahead and while some of the recommendations made their way into law they were greatly weakened. Versions of two of the Board’s recommendations were included in the Mines Act of 1890. Section 106 directed local Mining Boards to make by-laws preventing the accumulation of sludge and carrying it away, effectively repeating but not strengthening the provisions made in the 1865 Act. Section 109 empowered Boards to appoint officers to inspect sludge and water channels and ensure they were functioning properly, but the Inspectors were not asked to ensure that sludge was not discharged or given the power to investigate claims of damage. Further weakening the provisions, even these sections referred only to sludge from puddlers and quartz crushers and they had no effect on sludge from hydraulic sluicing.

The Mines Act of 1897 likewise ignored issues to do with sludge and it was not until 1904 that legislation was finally enacted with the intention of resolving the sludge question. Mining degradation of waterways in the north-east of Victoria had been exacerbated by the introduction of dredges from New Zealand in 1900, which affected the growth of the irrigation industry downstream, and legislators were at last forced to take action (McGowan 2001). The Mines Act 1904 introduced a whole new section on ‘Sludge Provisions’, while the act that amended it in 1907 was almost entirely concerned with the regulation of sluicing and dredging operations and the elimination of sludge. These Acts established a Sludge Abatement Board (SAB) with inspectors in each district, imposed penalties for polluting waterways, and sought to prevent damage to grazing and agricultural land. The SAB was to regulate any form of mining that sent sludge into waterways, with the explicit inclusion of hydraulic sluicing and dredging. The board was very prescriptive in its instructions for how to construct sludge retaining dams. It was no longer enough to carry sludge away – for the first time it was illegal to discharge it at all.

It took several years for the effect of the new legislation to be fully felt and the SAB encountered numerous challenges in carrying out its tasks. Most mines and mining districts complied reasonably well but in other areas companies directly flouted the regulations by continuing to release sludge (SAB 1909:92). Ballarat in particular was a centre of opposition, possibly because returns from its mines were diminishing and the expense of building settling dams was felt more keenly. Several companies were still sending waste from their stamp batteries directly into Yarrawee Creek and when challenged, took the SAB to court, where the miners won on a technicality (SAB 1909, 1910, 1911). The legal loophole revealed by the court decision was quickly closed and the Ballarat mines were brought into line. The other group that resisted regulations were the small-scale hydraulic sluicing operations run by individuals or
small groups. The ‘hill sluicers’ around Beechworth and Castlemaine would simply cease operation and move somewhere else when the inspectors arrived, but as the volume of earth moved was comparatively small the SAB saved most of its attention for the big operators.

Despite real gains by the SAB public concern continued and in 1913 the government convened the Dredging and Sluicing Inquiry Board, this time with a broad membership that included representatives from departments responsible for water, agriculture and land, as well as those with mining and engineering expertise (Davidson et al. 1914). Like its predecessor in 1887, the Board heard testimonies around Victoria and members also visited operating dredges in several districts. They found widespread evidence of siltation caused by gold seeking but concluded that much of this was the result of past mining practices and was not all directly attributable to dredging (Davidson et al. 1914:12). The Board noted that the SAB had been effective in stopping the discharge of sludge from quartz tailings at Ballarat and Bendigo (Davidson et al. 1914:15), and that in the case of bucket dredging the major problems with sludge occurred before the passage of the 1904 Act (Davidson et al. 1914:5-7). In no small part this was because the 1904 Act prohibited dredges from working directly in waterways and insisted that tailings from dredging be contained and prevented from flowing into waterways. Of greatest concern to the Board was the damage being done to agricultural land. The Board saw that the local effect of dredging was devastating on the ground occupied, was generally dismissive of claims that dredged land could be rehabilitated, and was adamant in recommending that land with any agricultural value be reserved from dredging (Davidson et al. 1914:15-18). While the Board felt that improvements could be made in the way the SAB operated, the fact that it focussed its criticism on the impact on agricultural land rather than on water quality was an implicit endorsement of the SAB’s efforts to control sludge.

After five decades of struggle the report of the Dredging and Sluicing Inquiry Board makes clear that legislation was finally having an effect on controlling sludge. The many attempts to solve the problem by shifting the sludge elsewhere had failed and it was apparent that the only real solution was to control sludge at its source, making the mines treat the water in settling dams before release into waterways. This approach is not without its own problems, particularly during flood events, but it is the approach that has been taken around Australia ever since (Wegner 2009:211-212). By the time the Board published its report in 1914 the gold mining industry in Victoria was in its last days. Dredging continued sporadically in Victoria until the 1980s but large scale quartz and alluvial mining effectively ended at the time of the First World War, when a combination of falling gold prices, declining yields, and increased costs made the industry unviable.

Archaeological evidence

Archaeological evidence of sludge in the Creswick region takes several forms including built structures, landscape features and altered water courses. Recognition of changes wrought by sludge at the time and of its continued presence in the environment is a significant part of interpreting and managing modern landscapes in Victoria, not only in the former goldfields districts but downstream as well. The work of historical geographer Lynette Peterson has demonstrated that sludge from Bendigo’s puddlers is still an identifiable soil layer across more than 700 square kilometres of agricultural land around Elmore and Rochester (Peterson 1996:96-97). This hard clay capping blocks access to more fertile soil layers beneath and continues to have an impact on modern farming methods in the area. Detailed environmental reconstruction of this nature has not been conducted elsewhere in Victoria but it is expected that similar sludge-related soil layers are widely distributed around the state.

Built structures are a more traditional type of archaeological site and those structures associated with sludge can be readily identified. Walls, bridges and stone-lined channels form part of the infrastructure created to control the effects of the sludge and to move it elsewhere. Today these are the most easily recognisable features associated with sludge yet in many cases their original purpose is not well understood and they are perceived simply as part of more generalised stormwater management systems. Creswick Council built a sludge channel in 1859 in order to redirect sludge from the Nuggety Gully workings away from the centre of town, carrying it directly to Black Lead and joining Creswick Creek at a point below the main business district. This channel along Drummond Street between Raglan Street and Cush-
ing Avenue is now lined with bluestone on the base and sides and spanned by bluestone bridges at Raglan and Victoria Streets (Figure 50). The Council has also straightened and widened Creswick Creek itself between South Street and where the creek crosses the Midland Highway (Figure 51).

Landscape features are more subtle and consist of gullies and flood plains where sediments have accumulated. One example within the Creswick Regional Park is immediately below the tail races of the Tavistock Hill sluice pit, where the modern gully profile is much shallower and broader than would originally have been the case (Figures 52). Sediments have also accumulated along the lower reaches of Mopoke and Slaty Creeks. Changes to Slaty Creek at Cabbage Tree Flat are documented by the recollections of long-time local resident and miner Christopher Russell who gave evidence to the 1886 Inquiry (Shakespear et al. 1887:22). Russell recalled that in the 1850s there was no sand or tailings and the creek flowed across the flat in a broad channel. By the 1880s there were 50 cm of sand over the flat through which the creek had cut a distinct path, leaving sand and sediment above the level of the creek bed. The modern topography of Cabbage Tree Flat is thus a product of sludge deposition in the 19th century.

Sand slugs along watercourses are further landscape evidence of sludge. Sand slugs are deposits of sand and silt that are carried along a watercourse over a long period of time, being lifted and re-deposited further downstream by flood events. In the 19th century residents observed this process as the streams cleared themselves of their sludge burden.

Figure 51: Current and historical creek lines in central Creswick

Figure 52: Main tail race, Tavistock Hill
Joseph Reed, the Creswick Town Clerk, told the 1887 Inquiry that ‘the old debris, that settled in the creek, is being shifted down every year ... the accumulation of quartz tailings is being shifted lower down the creek with every flood’ (Shakespear et al. 1887:22). In the study region sand slugs have been identified in Slaty Creek at Cabbage Tree Flat (Figure 53) and in other watercourses in the Creswick region including tributaries of Glendonald Creek where they are being washed out of tailings piles from the Berry Deep Lead mines.

The tailings piles from the deep lead mines on the plains north of Creswick are themselves evidence of sludge. At most mines there are two kinds of material in the piles. The high piles consist of large gravels, the mullock or overburden removed from the mines in the process of reaching the washdirt.

The low piles consist of fine clay and sand and are the tailings from the puddling machines and quartz crushers used to process the washdirt. As a result of the sludge controversy the tailings were impounded in settling areas and held back by barriers of palings and wattle. The barriers have generally decayed but the sharp edges of the piles where the semi-liquid sludge rested against the barriers are still readily observable (Figure 54).

Finally, the sludge layers identified at Laanecoorie Weir are also evidence of mining sediment from the Creswick goldfield (Davis et al. 1997:12). This is much further afield and not part of the study region, but the two are connected by Creswick Creek which carried the sludge from its origins in the sluices around Slaty Creek downstream until it settled out in the weir (Figure 55).
8 Conclusion

Water flows from the Dividing Ranges above Creswick out across the plains to the Loddon River and north to the Murray. Today people talk about environmental flows and the needs of agriculture. In the 19th century the needs of the gold mining industry were paramount. Water merchants built dams and races in the ranges and sold the water to miners downstream. The miners filled the water with their waste and sent it all downstream again to townsfolk and farmers and graziers. The entanglement of mining and water created a landscape in which competing interests struggled for control, much as they do today. The significance of water in 19th-century gold mining has largely been forgotten but its legacy is still present in legislation, infrastructure, and the landscape itself. The Creswick Regional Park encompasses an extensive landscape of colonial water management. The remains of approximately 160 kilometres of water races and several dozen storage dams are well preserved, along with diversion channels, sluice pits, tail races and other features related to alluvial mining from the 1850s to the 1880s and beyond. The archaeological evidence of these features has survived in the forests around Creswick with relatively little disturbance, and represents a vital resource in helping to understand how miners and other settlers came to terms with the opportunities and limits of the natural environment they encountered.

Our research has focused on the integration of diverse sources of evidence relating to water management on the Creswick alluvial goldfield, with field survey to check and identify races, dams and other archaeological features. Important historical sources include 19th-century geological maps (e.g. Krause 1880), historical survey maps, mining lease plans and parish plans, along with Council Minute Books and Mining Warden’s Registers, which provide important evidence for the development of dams and races by mining parties and the location of alluvial claims. Further details have been gleaned from newspapers including the Ballarat Star and the Creswick Advertiser. Many of the water races have also been mapped in considerable detail by orienteering groups, revealing the survival of these features over 150 years. Our integration of these diverse sources using MapInfo GIS software has greatly facilitated our capacity to locate, verify and interpret spatial relationships between features on the ground in this complex landscape of mining and water management.

Water was vital to the success of the mining industry. All branches of gold mining and ore processing used in Victoria relied heavily on water to extract gold from the earth. The manipulation of water supplies involved transferring water from where it was available to where it was needed. This typically involved construction of extensive water races, which often extended for miles around hills and gullies from source to mining claim. The longest races in Victoria were located in the Beechworth district, with some reported as more than 60 kilometres in length (Report 1867:5). Those around Creswick tended to be shorter, normally two to five kilometres long. The longest recorded race system at Creswick was the Smokeytown race, with a channel extending 26 kilometres from Creswick Creek to its terminus near Spring Hill.

Water races represented an enormous investment in time, labour and money. They were excavated with pick and shovel through soil, clay, gravel and rock, held at a constant slight fall across the contour to maintain a steady rate of flow. Initially races were surveyed and pegged out by the miners themselves, but later they were mapped by qualified mining surveyors.

Water and water races were valuable commodities on the goldfields, and quickly came to be recognised as articles of property that could be bought, leased and sold. The first permits to divert water were simple verbal statements from goldfields commissioners, and although vaguely defined, such permits were often exchanged for thousands of pounds. By 1862, water rights licences were introduced which permitted the holder to construct and maintain races and dams for up to 15 years. John Roycraft and Benjamin Eaton held the second Victorian licence, issued in 1863, while John Bragg’s Humbug party held licences No. 12 and No. 17 (GG 16 April 1866:818).

Volumes of water were measured in ‘sluice-heads’, which referred to the amount of water that flowed through a sluice-box of specified dimensions over a 24 hour period. In the Ballarat mining district, which included Creswick, sluice-boxes were meant to be 16 inches wide with a one-inch gap at the bottom, permitting a daily flow of 211,500 gallons (Smyth 1979:405). In practical terms, however, there was a great deal of local variation, with miners at Creswick finding that sluice-heads varied widely between different claims (BS 11 August 1858:2).

Miners co-operated to use water when it was in their interests to do so, but otherwise jealously guarded their water privileges. Newspapers of the time were filled with the legal battles of stolen water, cut races, over-sized sluice-boxes, ‘abandoned’ races, sludge flows and other disputes. Some miners became water merchants, developing and trading the water resources they controlled, and making substantial profits in the process. Chinese parties also became water traders, asserting their rights to full water entitlements and often selling water at high prices.
Waters discharged from mining claims as sludge was highly polluted with sediment and poisons. All mining districts and regions downstream had significant problems with sludge, and ‘the sludge question’ was a major controversy throughout the second half of the 19th century. Governments, individuals and mining companies responded by investing heavily in infrastructure to mitigate the effects of sludge. The problem was only regulated effectively in the early 20th century with the establishment of the Sludge Abatement Board.

As the early alluvial rush declined in the 1860s and 1870s, the water networks created by the miners were reused for domestic supply. Local councillors, many with close connections to the mining industry, sought to acquire for public benefit both the legal rights and the physical infrastructure of races, dams, pipes and other elements to augment town supplies. By the 1880s the Creswick Council had purchased water rights from the Humbug Hill Sluicing Company, St. George’s Sluicing Company and the Russell family, using these to increase domestic supply. As water systems expanded in the following years, dams and races originally built by the miners were upgraded or abandoned, creating a history of water management etched in the landscape today.
Appendix 1

Bragg versus Eaton and Russell – Water Rights Dispute Case of 1858 – Summaries and Extracts of reports published in the Ballarat Star.

10 August 1858
Creswick Water Grants. Russell and Party (Back [Creswick] Creek race) apply for a grant. Humbug Hill Sluicing Company objects. Due to the complicated nature of the dispute the board could not come to a decision.

11 August 1858
The board decide to grant Russell, Eaton and Bragg equal gauges, however Bragg’s right was subject to the prior right of Russell and Eaton. Bragg is unhappy with this decision and takes the matter to court.

16 September 1858
Bragg and party v Eaton and party and Russell and party.
The grant of the Back Creek to Mitchell and party was prior to the grant of the Atticot [Adekate] Creek to Bragg and each enjoyed their respective rights.
Mitchell, Robertson and party (Back Creek – 2nd Privilege) transferred their grant to Eaton Brothers (December 1857).
Eatons lay claim to Atticot Creek. The local Creswick Court decided in confirmation of Bragg’s right. Eaton claims the case was withdrawn not dismissed in favour of Bragg.
The claim against Eaton and Russell was that they had diverted Bragg’s water by cutting a race from Atticot to Back Creek.
Eaton had allowed an intermittent supply of water to run into Bragg’s race. Russell had been privy to this. Russell and party cut a race in October 1854 and benefitted from Eaton’s diversion of Bragg’s water [as Russell and Eatons shared rights in Water Right No.1].
The races of Mitchell and Russell were from Back Creek and Bragg’s from Atticot Creek.
Eaton contends that Bragg has not made out his right to Atticot water. Russell used by right the whole of Atticot water when wanted and Eaton had done no more; Russell having carried on beyond the Back Creek and Eaton’s ground the water which had previously flowed down for Eaton’s use.
Thus two separate supplies (quantities) were being drawn off Atticot Creek and therefore Bragg believed he had a case against interference. Eaton claimed he had the prior right [first right] with Russell and could take a sufficient supply even if that include all the water of the Atticot whenever Eaton’s exigencies required such removal.
Eaton was accused of cutting away Bragg’s race at night; however there was no actual proof of this and therefore no grounds for the injunction. The judge claimed someone was lying and this was more important than the right to water. Russell added that he had the prior right and it had been his undisputed practice to divert the whole of Atticot water when necessary.
Eaton had purchased half [11 of 21 shares] of Russell’s right (No.1) and had diverted one half of his supply from No.1 Race into his own (No.6) race. Bragg argued that the Russells and Eaton were trying for a monopoly as they claimed an adequate supply for 60-100 men. The court never would sanction a monopoly of public waters. As to a ‘reasonable supply’ his Honour could not lay down what that was without making Bye Laws or other regulations defining what water gauges should be allowed. His Honour said he could only determine the matter by deciding upon the priority of possession: the wardens and Local Courts grants not being recognisable. The priority lay with Russell, then Eaton, and then Bragg but referred to two sources of supply. The court could not decide on the question of gauge but it must determine the equities of the different claims; and if there had been a wrong interference, the court could not allow that interference to continue.
Russell, by giving (selling half shares in his right) to Eaton gave away what he did not want and therefore was giving away what belonged to Bragg. It was a clear trick by Eaton to secure water he had no title to.
His Honour said that it was clear Russell had no right to carry his race beyond the point it was in 1856. The partnership between Russell and Eaton did not permit Russell to extend the race. His Honour Judge Atkins intimated that the order would restrain Russell from diverting more water than they were entitled to in February 1856. All parties were satisfied.

19 November 1858
The Ballarat Star reports that the injunction had been broken and Eaton and Bragg had hostile attitudes toward each other; an array of armed physical strength been resorted to.

4 December 1858
The case is heard again at the Creswick Court of Mines by his Honour Judge Clarke.
Appendix 1. Bragg versus Eaton and Russell

Eaton and Russell had prior rights to two races [No.1 and 2] taking water from Back Creek, but did they have the right to intercept the water in that branch of the Back Creek called Adekate Creek (or right branch of Back Creek) and prevent it from going to supply the races of Bragg? According to priority the races were numbered on the different plans placed before the court: Russell No.1 (1854), Eaton No.2 (1855), Bragg No.3 (1856), Eaton Brothers No.6 (1857).

Bragg argued that earlier rights did not exist legally, nor did possession previous to the 1st January 1858 confer any rights whether obtained by permission of the Warden or the Local Court were all void; that by the 3rd section of the current Act all parties became legally entitled to whatever races they were then in possession of – at which time Bragg had a race from Adekate Creek. Bragg argued that Russell had given him permission to take all the water of the Adekate Creek.

Evidence from Edward Mitchell: February 1856 Mitchell asks permission to cut a race 150 yards above No.1 race. Davis objected to our cutting the race from Back Creek so we cut from Adekate Creek by going back some 300-400 yards by agreement with Davis. We began cutting in Feb 1856 and finished about July 1858. During that time Davis asked us permission to have the water from our races. We gave it to him in the day time. He took the water about two miles on in our race. I did not sell my share; I gave it to him in the day time. He took the water about two miles on in our race. I did not sell my share till December 1857. No one objected to us using the water from 1856 to that time.

Davis and me the day of the conversation, it took place a fortnight after we commenced cutting. We had cut two miles then, and the conversation was at that place. Our party were all present. Several were spokesmen, principally Captain Hitchcock. He said he would not agree unless the agreement was in writing. The agreement was not reduced to writing. When Davis asked to take the water from our race, he was saved three miles to go back and take it from the creek. We were working three weeks longer in the season of ‘56 and ‘57 than No.1 race. No.2 race never interfered with us till sold to Eaton Brothers in November 1857.

Sergeant Orridge sworn – In consequence of instructions from my officer, Mr Chomley, I went in February to the Back Creek. I saw there Mr Davis and Mr Hitchcock. They were the spokesmen of their parties. I told Hitchcock that I came down to stop him from cutting the race. Davis and Hitchcock had some conversation. They made some arrangement, but I cannot state what the exact nature of it was. I know that Davis told me coming away that the dispute was amicably settled.

James Witbourne sworn – I was one of the plaintiffs’ party when they were cutting No.3 Race – I was present when Sergeant Orridge came to our party, he told us he was come to stop us. Davis gave us the choice of the Creeks—we took the Adekate Creek. We cut it in a few days after Davis interfered with us in the latter end of the season we first commenced sluicing, in December 1856, by cutting our race—I did not see him do it; our party summons him to the Local Court, the case was not heard.

Cross examined: - I saw where the water was cut from our race; it went to Davis’s ditch. It was 5 months from the time we gave him consent to cut our race to when he cut it without consent.

John Whitbourne sworn – I was present at the interview with Davis and company when Sergeant Orridge came to stop us; we agreed to take the Adekate or right-hand branch; there was no condition mentioned about the prior right at that time, when we were going to take our race from the junction, I thought that Davis’s or No.1 race, would have a prior right when water was scarce.

James Videan [or Videau] sworn – I was present at the interview with Sergeant Orridge, he came to stop us, it was arranged that we should take the water from the right hand branch, and Davis from the left branch. During the sluicing season of ’56 and ’57, No.1 and No.3 had plenty of water as well as I remember. There was no interference by No.2 till November 1857, after it was purchased by Eaton. Russell’s race, or No.1, has been enlarged this last season. No.2 race carries the largest supply of water.

Cross-examined -I cannot say that the mouth of No.1 is larger than in 1856, not that it can receive more water. No.6 is supplied from No.1. I consider it larger than No.1 was in 1856. The latter race has been widened in some parts. I have not seen all the race.

John Bragg sworn – I joined plaintiff’s party in July, 1856. I acted generally as Secretary for the party. Had no connection with Mitchell when he held No.2. In 1856 we worked later in the season than No.2. After Eaton bought into No.1, it was widened about 10 inches, it should carry double the quantity of water. The head of it is about three feet wide, sufficient to take all the water off Back and Adekate Creek. Our supply of water from Adekate Creek has been frequently cut off by defendants. We had about 12 inches by 7 inches, when it was cut off in August. After it was cut off there was 23 inches by 10 inches running in No.6. No.1 had 36 inches by 14 inches at the head, the effect of the cut above our race as shown on the plan, is to cut off the water from the mouth of our race.

Cross examined – We have altered our race since we first cut it. It has been widened from what it was originally. No.1 is wider than No.3. The other may be deeper; at the head of No.1 the cutting is deeper, perhaps 4 feet; the banks may have fallen in there, and been cleared out. In August last there was a
gauge in No.2; there was none in ours: the Mining Board fixed a gauge of 12 inches by 6 inches for all of the races - 1, 2, and 3. At that time No.2 had not its gauge full; previous to this the district surveyor requested us to turn off the water from Adekate to Back Creek to supply No.2; we refused to do so.

Domingo Francisco, sworn – About the 18th of November I was at the head of our race; it had been stopped by a dam. I removed the dam, and let the water into our race. Russell and eleven others came up and replaced the dam, and stopped off the water from the mouth of our race, and let it flow down the Adekate Creek.

This closed the Plaintiff’s Bragg’s Case.

Trench, for defendants, argued that his Honour should give a nonsuit, as he had no power to grant the order prayed for, viz., to give a perpetual injunction to restrain the defendants from taking water from the Adekate Creek. By the Gold Fields Act the Governor only could confer a water right, subject to a lease of ten years and a rent. The 3rd section allows a person holding a miner’s right (subject to by laws to be made) to cut a race and use the water. There are no by laws in existence under which any of these races are held, therefore neither party had any standing in this Court. With reference to claims, there were by laws which exactly show what a miner’s right will entitle the holder to legally hold. If he wishes for more he must apply to the Governor. In this case both parties have made application to the Governor, on the recommendation of the Mining Board. If the plaintiffs were to obtain what they asked, it would supersede the power of the Governor. Mr McDermott had argued against the existence of prior rights to 1858, but had given no evidence to prove such. He (Mr Trench) would also do so; but if such evidence, and the equitable rights existing previous to that time, were not recognised, he would show that his clients had only done the same thing the plaintiffs had done-viz., go higher up the creek and cut a race-and the same practice might be extended as high up as there was water, either party going alternately above the other.

John Ramsbottom sworn – The document produced was the sale of race No.2 by myself and mates to Eaton Brothers. Plaintiff’s (Bragg’s) race was not cut when we cut ours, No.2; we always had a sufficient supply of water when we were sluicing. When I cut my race, the right branch, which is now called Adekate, was called the Back Creek. We received a supply from one branch as well as the other. We sold in 1857, before the dry season.

William Mitchell sworn, corroborated last witness.

C. L. Eaton sworn – I purchased the water race No.2 from Ramsbottom.

I produce the grant made to him by the Local Court, Creswick, signed by the Chairman, G. A. Amos; also the recommendation of the Mining Board, giving us a gauge of 6 in. by 12 in, subject only to the right of No.1. On the 18th of August we were short of water in No.2; we had only 1/14 in. our box. We got an order from the District Surveyor to allow the water to pass to us.- Mr Bragg refused to obey the order, and then I went and made a cut from Adekate Creek, and carried it past the mouth of No.3, and allowed it to run in its natural channel again. We purchased in August, 1858, 11-21 parts of No.1, and our share of water of No.1 we only took and conveyed it by means of a portion of No.6 to our workings, as it saved us cutting a mile or two of race. We had about 70 men at work at the most; but only a third worked at any one time. We never turned off the water of the Adekate Creek except when we had a deficient supply in Nos. 1 or 2.

Cross-examined – I purchased No.6 in April, 1858. I gave £100; at least a promissory note. The note is not paid; it is only to be paid at the end of this sluicing season. I did not jump or take it before purchasing it.

Benjamin Eaton sworn – I have an interest Nos. I and 2. We never turned off or interfered with the water in the Adekate Creek till we were short of water in Nos. 1 and 2. Our share of the water of No.1 we carried in No.6 to our claim. I directed the men whom I left in charge of our cutting, when rain would come sufficient to supply Nos. 1 and 2, to let the water run into No.3. I have reason to believe they obeyed those instructions.

George Russell sworn – I remember the plaintiff’s party, known as the Humbug party. I had an interest in No.1 when the Humbug Hill Party first went to cut a race on the Back Creek. We objected, and the Warden refused to allow them unless we were satisfied. We said we would allow them, provided when water was scarce that we had the priority. We meant by that, when water was insufficient for two races, that No.1 should have the water. Since No.3 has been cut, whenever we required water we turned the water from Adekate Creek into our race. We did so several times, without any interference.

James Stevenson sworn – I am District Mining Surveyor for Creswick. The document produced is signed by me. (It was the surveyor’s order under by law 3, clause 87.)

Mr Trench then briefly summed up, and Mr McDermott replied, using nearly the same arguments as in his opening address. His Honour said that as the case was a novel and important one he would reserve judgment, in the meantime the order of Judge Atkinson be in force.

3 February 1859

The case is continued on Feb 3rd 1859 and the decision given by Judge Clark. His Honour said that all parties having their water races on the 1st of Janu-
ary, when the Gold Fields Act gave for the first time a legal claim, and in the absence of any other rules being made by the mining board, he considered them equally entitled and would order that each party owning races No.1, 2 and 3 should have an equal volume of water, he would grant an injunction restraining the owners of No.1 and 2 taking more water at any time than enjoyed by No.3. Mr Eaton asked if No.6 would not be entitled also to an equal quantity having equal rights. His Honour said that No. 6 was not before him, nor was the evidence very clear about it; he would not express an opinion about it, nor about the rights of No.4 or 5.
Appendix 2

Creswick water grants and rights

Miners applied for and objected to the issuing of water right grants before the Mining Board and the Local Court. The applications below cover only parts of 1857 and 1858 but the numbers indicate the scale of water diversions around Creswick at the time.

Hawkins, D. and party – water race
Whalley, Brereton and party – water race, Slaty Creek
Little and party – water race, Spring Gully
(source: Ballarat Star 24 April 1857:3)

Hay, James – water race, Slaty Creek
Campbell and Co – water race, Clark’s Flat
(source: Ballarat Star 30 May 1857:2)

Ramsbottom and party – dam and water race, Back Creek
Sampson and party – Seven Stars
Fidler and party – junction of Creswick Creek and Back Creek
Plewnight and party – Sulky Gully
Vallon and party – dam, Slaty Creek
(source: Ballarat Star 14 November 1857:2)

Russell and party – race, Back Creek (the first water right grant on Back Creek, which was originally issued to Davis and party in October 1854)
(source: Ballarat Star 10 August 1858:2)

Crump (or Robertson) and party – Slaty Creek race
Moyle and party – Back Creek race to Portuguese Flat
Hitchcock and party – Birch Creek
Pierce and party – races, dams and puddling machine, Bald Hill Swamp and Sulky Gully
Sheils and party – dams and puddling machine, Long Gully
Muir and party – dams and puddling machines, Long Gully
Brawn and party – Long Gully to Long Point
Whalley and party – dam and race, tributary to Slaty Creek
Hamilton and party – dam and puddling machine, Surface Gully
Kelly and party
Pinch and party
Shepherd and party – dam and puddling machine, Surface Gully
Wood, Lafferty and party – race and extension, Slaty Creek
Jenkins and party and Butt and party – dam and race, Bullock Gully
Keen, Frazer and party – dam, race and extension, Cabbage Tree Hill
Duval and party and Simoney and party – dam and race, Mopoke
Neilson and party – dam, puddling machines and race, Spring Gully
Little and party – race, Spring Gully
Perry and party – dam, Mopoke Gully
Giles and Mace – race, Creswick Creek
Fidler and party – dam and race, Birch Creek
Martin and party – dam and race, Creswick Creek
Samuel Moyle – race, Hammonds’ Bridge
Silvo and party – race, Slaty Creek
Silva and party – dam, Petticoat Gully
Duprat Martin and party – dam and race, Drake’s Creek
Hawkins and party – race, Slaty Creek and Drake’s Creek
Stanbury, J. F. – race, Back Creek to Long Point
Sampson and party – dam, Bloody Gully
Sampson and party – race, (?) Creek to Seven Stars
Fisher and party – dam, Birch Creek to Long Point
Sharpe, Thomas C. – race, Back Creek to Bald Hills
Jamieson and party – race, Myer’s Swamp to Tipperary Gully
(source: Ballarat Star 11 August 1858:2)

Creswick Water Right Licences in force in 1866
(published in the Victorian Government Gazette)
WRL No.2. 23 July 1863; 15 years; lessee, J. Roycroft and B.F. Eaton; 15a, 1r, 6p race and reservoir; Rent: 15 pounds per annum (GG 16 April 1866:818-819).
WRL No.12. 2 Sept. 1864; 15 years; lessee, J. B. Bragg, C.H. Lewis, J.J. de Lima and T. Lake; 22a, 1r, 3p race and reservoir; Rent: 11p 5s pounds per annum (GG 16 April 1866:818-819).
WRL No.17. 2 Sept. 1864; 15 years; lessee, J. B. Bragg, C.H. Lewis, J.J. de Lima and T. Lake; 22a, 1r, 3p race and reservoir; Rent: 5 pounds per annum (GG 16 April 1866:818-819).
WRL No.30. 2 March 1865; 14 years; lessee, J. Roycroft and B.F. Eaton; 4a, 0r, 36p race and reservoir; Rent: 5 pounds per annum (GG 16 April 1866:818-819).
WRL No.31. 29 March 1865; 15 years; lessee, W. L. Jones and J. Hodge; 9a, 3r, 8p race and reservoir; Rent: 15p 10s per annum (GG 16 April 1866:818-819).
WRL No.31 application for renewal published 31 March 1880 (GG 6 April 1880).
Appendix 2. Creswick Water Grants and Rights

WRL No.32. 29 March 1865; 15 years; lessee, Borough Council of Creswick; 4a, 2r, 0p race; Rent: 5 pounds per annum (GG 16 April 1866:818-819).
WRL No.37. 18 Jan. 1866; 15 years; lessee, Ah Cum, Slaty Creek; 14a, 3r, 3p race; Rent: 5 pounds per annum (GG 16 April 1866:818-819).
WRL No.38. 25 Oct. 1865; 10 years; lessee, Ah Tan; 15a, 1r, 35p race; Rent: 7 pounds per annum (GG 16 April 1866:818-819).
WRL No.47. 27 Sept. 1865; 10 years; lessee, Ah Tan; 13a, 1r, 5p race; Rent: 10 pounds per annum (GG 16 April 1866:818-819).
WRL No.78. 25 Oct. 1865; 15 years; lessee, R.H. Bland; 27a, 2r, 36p race; Rent: 15 pounds per annum (GG 16 April 1866:818-819) [later taken over by Tommy Dodd and Tung Wah].
Public Reservoir Lease – 1 Jan. 1864; 99 years; lessee, Creswick Borough Council, Creswick Public Reservoir, 1 pound per annum (GG 16 April 1866:818-819).

Creswick Water Right Licences in force in 1884 (published in the Victorian Government Gazette [GG])
WRL No.400. Ah Tan. 9 May 1876 for 15 yrs. Bungaree 7a, 2r, rp 500,000 gallons.
WRL No.421. J. Reed. 9 August 1881 for 10 years. Bungaree 9a, Or, 4p 800,000 gallons.
WRL No.414. J. Roycraft. 25 August 1879. Back Creek 14a, 2r, 36. 2,000,000 gallons.
WRL No.369. J. Woolfe. 26 January 1874. 15 years Drakes Creek 16a, 1r, 23p 600,000 gallons. (not in force in 1886).

Other sources
WRL No.212 Tributary to Adekate Creek. 17 May 1872 WRL Hassall (No.212 Tributary to Adekate Creek) and Party and Braggs declared Void Gaz p.968 (Tenders and Gazette Book VPRS 5921).
WRL No.701. Held by John Roycraft and given permission to sell surplus water from this right in 1903 (VPRS 3561).
WRL No.950. John Roycraft. A renewal of Licence No.701 for fifteen years from 27 August 1909 (VPRS 3561). This right expired on Sept. 10 1924 (see VPRS 6784/4/1).
WRL No.31. 22 March 1880 Council apply for a renewal of WRL No.31. 19 April 1880 The necessary number of posts has been painted and lettered and fixed along St George’s water race and application made for a renewal of the WRL for a further term of 15 years (Council Minute books VPRS 3730 Unit 14). This race is reissued with No.421 (VPRS 6784/4/1).
WRL No.418. 3 Dec. 1880 Hassall application for WRL No.418 Back Creek refused. GG p. 2897.
WRL No.102. Fiddlers Gully (Creswick Advertiser 2 May 1862).
WRL No.369/555. Masons Gully (undated Map VPRS 14969/1).
WRL No.400/616. (undated Map VPRS 14969/1).
WRL No.168. 1863 Clarkes Flat (Cause List Book VPRS 1387).
Appendix 3

Mining legislation and water regulation in colonial Victoria

**Mining on Waste Lands** 1852 (An Act to restrain by Summary Proceeding unauthorized Mining on Waste Lands of the Crown) 15 Vict. 15


**Act for the Better Management of the Gold Fields** 1853 (17 Vict. 4)

**Gold Export Act** 1855 (18 Vict. 27)

**Gold Fields Act** 1855 (An Act to amend the Laws relating to the Gold Fields) 18 Vict. 37

**Gold Fields’ Commission of Enquiry. Report of the Commission Appointed to Enquire into the Condition of the Gold Fields of Victoria** 1855, Melbourne

**Amending Act** 1857 (An Act for Amending the Laws relating to the Gold Fields) 21 Vict. 32

**Beechworth Water Rights** 1860-61 *Report of the Commission Appointed to Enquire into the Subject of Water Rights in the Beechworth District*, Melbourne

**Amending Act** 1862 (An Act to amend the Law relating to Leases of Auriferous Lands and for other purposes) 25 Vict. 148

**Land Act** 1862 (An Act to consolidate and amend the Laws relating to the Sale and Occupation of Crown Lands) 25 Vict. 145

**Drainage Act** 1862 (An Act to amend the Law relating to the Drainage of Quartz Reefs) 25 Vict. 153


**Mining Statute** 1865 (An Act to provide for the Management of and the Administration of Justice in relation to Mining Interests) 29 Vict. 291

**Waterworks Act** 1865 (An Act to authorize Works for Supplying Water to certain districts and places in Victoria) 29 Vict. 288

**Report of the Board Appointed to Enquire into and Report on Applications for Water Rights at Beechworth** 1867, Melbourne

**The Victorian Water Conservation Act** 1881 (An Act to provide for the Conservation and Distribution of Water throughout Victoria) 45 Vict. 716

**Mining on Private Property Act** 1884, 48 Vict. 796

**An Act to Further Amend the Mining Statute** 1865 and to amend the Act No. CCCCLXVI And also to amend The Mining on Private Property Act 1884 1885 49 Vict. 861

**Sludge Act** 1885 (An Act to Provide for the Disposal of Sludge from Alluvial Mines in Creswick) 49 Vict. 874

**Mines Act** 1890 (An Act to Consolidate the Law Relating to Mines) 54 Vict. 1120

**An Act to Amend the Mines Act** 1890, 1890 54 Vict. 1189

**An Act to Amend the Law Relating to Mining** 1897 61 Vict. 1514

**An Act to Further Amend the Mines Acts** 1904 4 Edw. VII 1961

**An Act to Further Amend the Mines Acts** 1907 7 Edw. VII 2127

By-laws passed by the Mining Boards in each Mining District were published regularly in the *Victorian Government Gazette* from 1856. Those from the 1850s and 1860s are summarized in Smyth (1979:572-595). For a fuller discussion of Victorian mining laws in the colonial period see Atkins (1871), Armstrong (1901), Birrell (1998) and Davies and Lawrence (2014).
Glossary

This glossary defines terminology relating to water management on the Victorian goldfields. Definitions have been drawn from various sources including Pearson and McGowan (2000); Ritchie and Hooker (1998); Smith (1971); Smyth (1979); and Tracey (1997). Some definitions have also been coined by the authors for features observed in the field where no previous definition has been identified.

Acre-foot: a unit of water volume where the surface area is 1 acre and the depth is 1 foot, equal to 43,560 cubic feet, or 272,000 gallons (1.236 ML). The term was commonly used in Britain and North America in the 19th century but less so in Australia, where gallons were the standard measure of water volume.

Chute (Drain, Channel): short channel cut from a race to divert water often at a right angle from one race to another.

Collection Point: a catchment area along a race where seasonal rainfall is naturally funnelled into the race, characterised by a shallow entry point into the race on the uphill side. This feature is noted on dry races (i.e. races that rely on seasonal rainfall only).

Dam:

Mining Dam: a structure or embankment of earth, clay, masonry, concrete or timber built across a watercourse to impound water in a reservoir, usually for the purpose of alluvial mining. These dams typically have a triangular cross-section. Larger mining dams served to store water from wet seasons to ensure a continual supply of water through dry periods. Reservoirs tend to be used for the storage of potable water supplies. On the goldfields there appears to be little distinction between the two.

Header Dam: Small dam at the head of a flume, syphon or pipe used to maintain constant flow.

Holding Dam: water drawn from a supply race was stored in holding dams from where it was conveyed by head races to individual claims (Ritchie and Hooker 1998:7). Such dams could serve to lower the velocity of water flowing through the race by spreading it over a wider surface, before the water was then distributed to the working site (Tracey 1997:7). Sluicing claims often worked throughout the night to take advantage of available water; however the construction of holding dams enabled the storage of night water so that it could be used in the day time (Smyth 1979:131). Several shallow elongated holding dams have been noted on the Creswick goldfield, including an example to the south of Tavistock Hill.

Sluice Dam: small dam (not more than 100 gallons) on the top of the bank above a sluicing claim into which water runs constantly, and from which the hose extends down to the bottom of the claim (Smyth 1979:141).

Retaining Dam: dam wall across settling basin, often made of brush or timber, usually associated with hydraulic sluicing.

Slum Dam: settling basin for sludge.

Diversory Channel or Tunnel: cutting that diverts water from its original stream bed, in order to allow the working of the stream bed; often used at horseshoe bends in creeks.

Dredge: floating vessel consisting of one or more pontoons on which various forms of dredging equipment were mounted in order to extract auriferous gravels from river beds, margins and terraces (Ritchie and Hooker 1998:5-6). The term ‘Dredge Mining’ in Victoria includes the following systems: Bucket Dredges, Pumps/Hydraulic Sluices (Port Runner, Hydraulic Sluicing by Centrifuge), Jet Elevator and Rotary Hydraulic (Annual Report of the Secretary for Mines and Water Supply for the Year 1903:56). Bucket dredges, hydraulic pump sluices and jet elevators were the systems most commonly in use in Victoria.

Face: the working face of an alluvial claim. Diggings typically commenced at or near a water source and extended back into older deposits, the working areas being referred to as the face. The height varied considerably, depending on the technology used. Ground sluicing generally produced faces with gradual slopes, hydraulic sluicing produced high steep faces.

Flume: wooden channelling used in conjunction with water races to convey water to a claim. Fluming was typically built on timber trestles and used to span gullies and depressions. A flume was also known as a ‘launder’ in Britain.

Ground Sluicing: a mining technique where a flow of water was used to break down gold-bearing deposits and assist their manual excavation. The dislodged material was then directed through a sluice-box in which the gold was trapped in riffles, or in earthen or stone lined channels. They were used only where the bottom was sufficiently high to provide the necessary fall and were the main method of working elevated ground. This was sometimes referred to as ‘flooding off’. Ground sluicing landscapes are characterised by several sluice points and gentle debris slopes at the points where the water has been run over the face. Tailing mounds were sometimes arranged to facilitate the
placement of sluices and allow drainage into one or more tail races. The height of the face is rarely more than five metres, but this varies considerably and can be much less. Ground sluicing landscapes may have been reworked by hydraulic sluicing. In California ground sluicing was most advantageous for washing when water was abundant for only a few weeks after heavy rains, and where it would not pay to erect large sluices (Smyth 1979:143).

**Hydraulic Sluicing (Hydraulicking):** a mining technique that directed a jet of high-pressure water against an alluvial deposit to break it down. Hydraulic sluice workings usually have steep working faces (compared to ground sluicing) because the water was directed upslope to undermine the work faces (Ritchie and Hooker 1998:6).

**Miner’s Right:** a document created in 1855 under the Act to Amend the Laws relating to the Gold Fields (18 Vict. 37, section 3), which granted the holder the right to occupy land for a dwelling and to occupy a mining lease on Crown land under the mining by-laws of the district at the cost of £1 per year (later reduced to 5 shillings). Amendments in 1857 permitted the holder to construct and use races and dams for gold mining. A consolidated miner’s right could be taken out for all the land held by a mining company on payment of an equal sum to that which would be paid for all the miners’ rights that the consolidated right represented (Birrell 1998:33-34, 60; Smyth 1979:615-616; Mining Statute 1865, clause 4-8).

**Paddock:** alluvial mining technique involving the systematic removal of topsoil from a claim and the excavation of washdirt down to bedrock. Paddocking was often associated with Chinese miners (Patterson 1862:318). Paddocks resemble large open pits or quarries, square or rectangular in form, up to 40 metres by 40 metres in area, with a face of about two metres, though the size and height can vary. They are located primarily on the lower water course and stream terraces where the wash is generally boulder free, but can also be found on high-level auriferous drifts.

**Polluted Water:** first defined in the Sludge Act 1885 as ‘water containing in solution mineral or metallic salts or other mineral or metallic matters (derived from mineral or metallic products whilst under treatment) in such quantity as to render such water injurious’, and refined in 1915 to specify ‘water containing any poisonous matter of more than 50 grains to one gallon or any noxious matter in such quantity to be injurious or detrimental to the public health, and water containing in suspension or solution any earthy or mineral substance more than 800 grains to the gallon’ (Mines Act 1915: section 488 (1) a, b). Other early definitions refer only to sludge, that is, sediment load, without reference to possible poisons.

**Puddler:** a puddler or puddling machine consisted of a large ring-shaped trench up to 10 metres in diameter in which the washdirt and water were mixed. A water source or race must be close by and an outlet for the water from the puddler should be evident. In the centre of the puddler was a mound with a tall wooden pole acting as a pivot, to which was attached a wooden shaft extending over the hold and to which a horse was yoked. Smaller man-powered puddlers may also have been used.

**Race:** see Water Race.

**Reservoir:** body of water stored and retained by embankments or walls (generally used to store potable water).

**River/Creek right:** the privilege of diverting water from a river or creek to work a claim (see also Water Permit).

**Settling Basin:** basin for letting sediment settle out of sludge.

**Siphon:** pipe used to convey water over or across an obstacle to a lower level. Inverted siphons descended into a valley and up the other side in a U-shape (see Hodge 2002:147-160).

**Slime:** clayey portion of sludge (Royal Commission 1859:8).

**Sludge:** thick semi-fluid waste water from alluvial mining or ore processing, carrying sediment comprised variously of clay, sand, and gravel.

1. ‘water holding in suspension particles of mineral matter derived from mines’ (Sludge Act 1885);
2. mining debris containing more than 75 grains per gallon of poisonous matter or 300 grains of insoluble material (clay, mineral, metal) [must use sludge paddocks, settling basins, precipitating tanks] (Annual Report on Dredge Mining and Hydraulic Sluicing for the year 1906);
3. debris consisting of the overburden, and the underlying wash, composed of quartz boulders and gravels, intermixed with clay and earth (Dredging and sluicing Inquiry Board 1914).

(See also Slime, Slum and Tailings)

**Sludge Channel:** a channel constructed to divert and remove sludge. Local councils constructed sludge channels as a necessity to prevent the inundation of residential and business areas from mining sludge.

**Sluice-Box:**

1. long trough with riffles in the bottom, where washdirt was passed through with flowing water...
and gold was trapped against the riffles. Commonly termed box sluicing and used where the bottom of the workings was below the adjacent creek bed and where, therefore, there was insufficient fall to get rid of the water and tailings. Water was conveyed into the box or sluice from a race or by hose, the wash dirt was thrown in with shovels, and stones were removed by use of a sluicing fork.

Sluice-head: a measure of water flowing through a sluice-box in 24 hours, measured in gallons (Smyth 1979:405). The gauge box was positioned at the point where the claim head race drew water from a branch or supply race. The exact measure of water was determined by local by-laws; the measure of one sluice-head varied substantially between the various mining districts of Victoria. The miner could divert one or more slice-heads, according to the extent of his permit.

Sluice Point (race entry point): point where race empties over the working face at ground sluicing claims. Ground sluicing claims generally have many sluicing points and gentle debris slopes at and near the points where the water has been run over the face.

Slum: colloquial reference to slime.

Tail Water Right: licences to cut races for the use of tail water under section 36 of the Mining Statue 1865 (29 Vict. 291 Regulation No. 24). These were styled a water right.

Tailings: the solid waste from alluvial mining or ore processing. In alluvial mining finer material was generally washed away into water courses as sludge; cobbles and boulders remained either within the claim or adjacent. Alluvial tailings can be grouped into three basic categories: hand-stacked, mechanically-hydraulically stacked and dredge tailings (Ritchie and Hooker 1998:8). Ore processing including quartz-crushing also produced tailings defined as ‘any sand, slime, slum or other mine material produced by mining operations or by the crushing or treatments of mine material’ (1916 Regulations Relating to Mining Leases).

Water Permit: verbal agreement or written permission (1853 to 1857) to use water for sluicing, granted by the relevant goldfields commissioner.

Water Privilege or Right: the right to divert water from a spring, lake, creek gully or reservoir and cut, construct and use races and dams for mining purposes conferred by holders of a Miner’s Right, under the Amending Act 1857 (21 Vict. 32). The terms permit, privilege and water right were often used interchangeably.

Water Race: a channel or aqueduct for conducting water to a mining site. Major (main, supply) races commence from a permanent source such as a dam or reservoir. Water was typically drawn from a major race and stored in shallow holding dams from where it was conveyed by head races to individual claims. Minor (branch, subsidiary) races generally diverted water from a major race to localized diggings. Races are generally cut into the earth with spoil placed on the lower side. Stone revetments were used to support races along the sides of steeper hills. Races typically followed the contours of hills, using tunnels, culverts, and metal and wooden fluming to cross gullies where necessary. Some races may also convey water for domestic uses and market gardens. Races are occasionally referred to as ditches, an American term, in some early Australian mining literature.

Parallel Race: races running parallel in close proximity (< 3m) for varying distances. Robert Brough Smyth described the early practice of wasteful diversion where each miner took water where he could get it, cutting races parallel to one another and close together (1979:398). A parallel race may also be evidence of race repair where it was more convenient to cut a new section of race than repair sections.

Tail Race: channel below claim area for rapid discharge of water and sludge; typically built at steeper pitch than water race to increase rate of flow (Tracey 1997:8). Tail races may be boxed with riffles in the upper section and paved with wooden blocks or flat rocks in the lower reaches to capture escaped gold. The tail race water could be diverted for reuse downstream by other miners.

Head Race: race transporting water from the supply race to individual mining claims. The head race was usually fitted with a gauge or sluice-box to regulate the flow of water (as opposed to branch races which diverted water from the supply race to other parts of the mining field).

Dry Race: a race with no water storage facilities. The race collected water from seasonal rainfall only.

Water Race Diversion Barrier: a barrier placed in a race to divert water. A barrier could be constructed from any suitable material. Earthen examples have been noted at Creswick and historical documents refer to boards being placed across races for temporary diversions.

Water Race Spoil: mound of dirt excavated from the race during construction and placed on the down slope side of the race. This spoil can be eroded.
away or be quite obvious and in some cases the spoil mound may be greater than the expected excavated volume, suggesting the subsequent removal of accumulated silt from the race during the period of use.

**Water Right Grant:** conferred to holders of a Mining Lease under the *Amending Act 1857* (21 Vict. 32). Also styled a water right.

**Water Rights Licence (WRL):**

(1) introduced under the *Amending Act 1862* (25 Vict. 148), with applications forwarded to the Minister for Mines via the district Mining Wardens. Each application was registered in a single number sequence in chronological order. The last application in the volumes extant was registered in October 1947, although information was added to the entries until at least 1961.

(2) issued under the *Land Act 1862* (s.53(2)). Very similar to Water Rights Licence (1). Each application was also registered in a single number sequence in chronological order starting at No. 1.

**Weir:** a dam in a river used to raise the level of water, which is diverted for milling, irrigation, etc. A dam constructed to raise the water level and thus elevation of a race.
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