THE POLITICS OF THE GOLDFIELDS WATER SUPPLY SCHEME

Sir John Forrest officially opens the Scheme by turning on the water at Coolgardie on 24 January 1903. BL 001000D

The Goldfields Water Supply Scheme, built between 1898 and 1903 to deliver water 560 km from Mundaring to Kalgoorlie, has been a lifeline to the arid interior of Western Australia for 100 years and was central to the development of the State. The scheme's inception and construction were controversial and full of drama and intrigue.

A CHANGING COLONY

Western Australia in the early 1890s was entering a period of great change. The sparsely populated and isolated colony had recently achieved self-government and Premier Sir John Forrest, a dominating influence on the political scene, was determined to expand the colony. In 1891 he employed CY O'Connor, an Irish born engineer working in New Zealand, as Engineer-in-Chief and told him the colony required 'Railways, harbours, everything'. O'Connor immediately began work on Fremantle Harbour and improving the colony's rail system.

GOLD AND WATER

When gold was discovered at Fly Flat near Coolgardie in 1892, then at Hannan's (later Kalgoorlie) in 1893, thousands flocked to the arid Goldfields. The lack of fresh water was a huge problem and resulted in poor sanitation, diseases such as typhoid and many deaths. Alternatives such as carting water, condensation plants and drilling bores failed to provide an adequate supply. Premier Forrest visited in 1895 and saw for himself the enormity of the problem and, as more than half the colony's population now resided in the Goldfields, he was under considerable pressure to find a solution to the water crisis.

Following this visit, Forrest formally requested O'Connor to investigate the problem. Earlier proposals had included pumping water from the Avon River near Northam to the Goldfields. After exhaustive enquiry O'Connor and his team recommended a scheme to pump water from a dam east of Perth through a pipeline to Coolgardie.

COST OF THE SCHEME

The cost was enormous but Premier Forrest was determined the scheme should go ahead and in July 1896 put the proposition to Parliament. There was criticism from several politicians and after long debate Parliament approved the raising of a loan from England of £2 500 000, (5 million dollars), more than WA's entire annual budget. However, there was a lengthy delay as the funds proved difficult to raise and approval from a British engineering advisory committee took months. Criticism of the scheme began to mount.

REGIONAL ANTAGONISM

There was ill-feeling about the size of the scheme. Perth did not have its own water supply and many felt that Forrest was putting a huge financial stake into the Goldfields. In the eastern states and in other countries it had already been seen that gold could run out as quickly as it had appeared. The Goldfields were populated with 't'othersiders' (people from Australia's Eastern colonies) who, aware of the importance of gold to the colony, considered that the wealth they

The Goldfields strongly supported Federation, 31 July 1900 BL 54425P

were generating should be used to improve conditions in the Goldfields - starting with a reliable supply of water.

CRITICS OF THE SCHEME

Critics in the press and Parliament attacked the scheme from the beginning because of the amount of public money being spent. O'Connor was also accused of giving jobs to former colleagues from New Zealand. Sunday Times editor FC Vosper, who was also a politician, ran a personal attack on O'Connor's integrity and ability through the paper.

Parliamentary debate over a contract for caulking the pipes and controversy over land dealings along the pipeline route prompted a formal Government enquiry into the entire scheme in February 1902. O'Connor was in South Australia at the time of the enquiry and returned to face more press accusations of corruption and incompetence. With Forrest's move into Federal politics, O'Connor now lacked political support. The new Premier, George Leake, had long been an opponent of the Goldfields Water Supply Scheme.

O'Connor came under increasing strain from the attacks on his personal and professional integrity and, tragically, took his own life on 10 March 1902, just a month before pumping began.

In May, the Government enquiry into the scheme found no basis for press accusations of corruption against O'Connor. The enquiry was critical of the land dealings of his deputy, TC Hodgson. Although no charges were laid, Hodgson was suspended and later resigned from his position.

Lord and Lady Forrest officially opened the scheme ten months after O'Connor's death, in three separate ceremonies at Mundaring, Coolgardie and Kalgoorlie on 22 and 24 January 1903. The scheme cost £2 655 220, only slightly more than O'Connor's estimate made seven years earlier (which did not include the extension to Kalgoorlie). Water has flowed to the Goldfields ever since.

FOR FURTHER INFORMATION GO TO

GOLDEN PIPELINE WEBSITE:
www.goldenpipeline.com.au
WATER CORPORATION WEBSITE:
www.watercorporation.com.au

READ

Cyril Ayris,
CY O'Connor: the man for the time,
Cyril Ayris Freelance, 1996

Anthony Evans,
CY O'Connor: his life and legacy
UWA Press, 2001

Frank Crowley, *Big John Forrest 1847-1918*, UWA Press, 2000

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J Lefroy, D Frylinck and M Duke,
The Pipeline CY O'Connor Built.
Fremantle Arts Centre Press,
Western Australia, 2003

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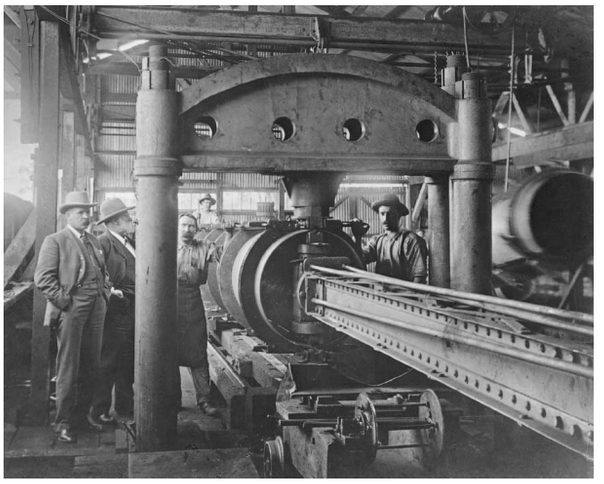
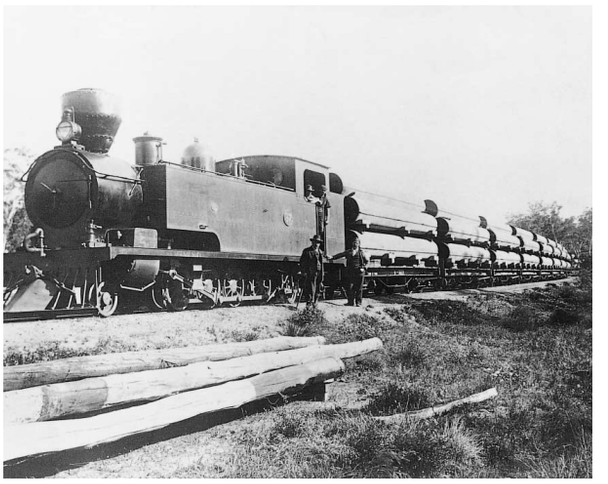
PIPES OF THE GOLDFIELDS WATER SUPPLY SCHEME



Mephan Ferguson factory. Closing the locking bar, 1901 BL 213427P



The pipes were 28 feet (8.5 m) long to fit the railway wagons BL 3359B

The Goldfields Water Supply Scheme was built between 1898 and 1903 to pump fresh water from the Darling Range near Perth 560 km east through a pipeline to the arid Goldfields. The pipes were the most expensive component of the scheme. Today, the pipeline continues to supply water to Western Australia's Wheatbelt areas and the Eastern Goldfields. The pipes have undergone some changes, replacements and upgrades.

THE ORIGINAL PIPES

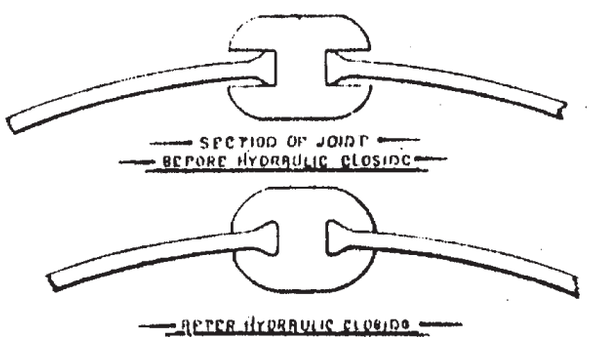
The original pipes were made of steel and constructed using the innovative locking bar system invented by Mephan Ferguson. Two steel plates were each bent into a semi-circle. The long edges were given a dovetail shape. These edges were inserted into an 'H' shaped long bar which was then pressed closed under great pressure to form a joint that ran the length of the pipe. This locking bar system replaced the need for riveting the plates together and therefore minimised the risk of leakage as no holes were drilled into the pipes. There were also no rivet heads to slow the flow of water through the pipe.

The pipe was then coated with tar and bitumen to help protect the steel from corrosion. This coating was sprinkled with sand to prevent the tar melting in summer heat. The pipes were 28 feet (8.5 m) long to fit the railway wagons which transported the pipes to where they were laid.

STATISTICS OF ORIGINAL PIPES

Pipe thickness	*¼" (6.355 mm)*
Pipe diameter	*30" (76.2 cm)*
Pipe length	*28" (8.5 m)*

The steel plates were imported flat from Germany and the United States of America and the locking bars and joint rings came from England. Pipes were manufactured by two contractors who established factories in Perth - Mephan Ferguson, the inventor of the locking bar system, and G&C Hoskins. Hoskins developed new machines to speed up the production process and a pipe could be produced every 6 minutes.



From plans by G &C Hoskins 1901

Caulking Machine, 1902 BL 000839D

LAYING THE PIPES

The pipes were laid in trenches to avoid contraction and expansion caused by temperature extremes. Lengths of pipe were joined together as they were laid, using a process which packed the joint with lead, known as 'caulking'. A ring of steel was fitted around the butted ends of the pipes. A 6 mm clearance left between the ring and the pipe was packed with rope, then molten lead was poured into the joint and hammered into place as it cooled to form a waterproof seal. This process was done by hand until in 1901 James Couston invented a caulking machine that produced a more consistent lead joint and also saved time, labour and costs.

CHANGES TO THE PIPES

Over the years major corrosion and leakage problems occurred. During the 1930s the pipes were lifted, repaired or replaced, lined with concrete and re-laid above ground on concrete blocks. Corrosion was particularly severe at the lead joints and these were replaced with welded joints.

Over half of the original locking bar pipes are still in use today and all pipes are now coated with tar and aluminium paint to prevent corrosion.

WOOD STAVE PIPES

Laying the pipeline above ground was undertaken during the Great Depression when unemployment was very high. The Goldfields Water Supply Department came under political pressure to replace damaged steel pipes with wood pipes as this would provide jobs, boost the timber industry, and also save costs as they were cheaper. The wood pipes were made of karri staves (small planks) that were bound together with galvanized wire, then heavily coated with tar and bitumen.

A total of 64 km of wood stave pipes were used in low pressure sections of the pipeline between 1933-37. They were plagued with problems of leakage, the threat of termite damage and dry rot and all were replaced by 1971.

FOR FURTHER INFORMATION GO TO

GOLDEN PIPELINE WEBSITE:
www.goldenpipeline.com.au
WATER CORPORATION WEBSITE:
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READ

JM Ferguson, *Mephan Ferguson: A Biography*, 1992

National Trust, *The Golden Pipeline Heritage Trail Guide*, 2002

J Lefroy, D Frylinck and M Duke, *The Pipeline CY O'Connor Built*. Fremantle Arts Centre Press, Western Australia, 2003

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CHARLES YELVERTON (CY) O'CONNOR

The work of CY O'Connor changed the face and fortunes of Western Australian society. He was responsible for planning and building major public works during the 1890s that stimulated the development of Western Australia. CY O'Connor achieved one of Australia's greatest engineering feats of the nineteenth century when he designed the Goldfields Water Supply Scheme. This scheme still operates today, testimony to his skill and foresight. The National Trust of Australia (WA) is committed to conserving and interpreting the scheme through its Golden Pipeline Project.

IRELAND AND NEW ZEALAND

CY O'Connor was born on 11 January 1843 in Ireland. He trained as a civil engineer and worked on Irish railways. Opportunities in the British colonies beckoned and O'Connor left for New Zealand in 1865 where he worked for 26 years and became the colony's Marine Engineer. In 1891 O'Connor accepted Premier John Forrest's offer to come to Western Australia, to work on what Forrest described as 'Railways, harbours, everything'.

ARRIVAL IN WESTERN AUSTRALIA

Western Australia in the 1890s was a changing society. The colony had achieved self-government and Premier Forrest was keen to implement a vigorous policy of development. O'Connor took up the positions of Engineer-in-Chief of Public Works and Manager of Railways.

HARBOUR AND RAILWAYS

The lack of a deepwater port near Perth was stifling the colony so O'Connor's first project was to build a harbour at Fremantle. The colony's railways were also in urgent need of overhaul. Aspects of O'Connor's plans for both the harbour and the railways attracted criticism, but both proved successful. Although O'Connor had Forrest's support, others regarded him as an 'outsider'.

GOLD AND WATER

Gold was discovered firstly at Coolgardie in 1892, then at Kalgoorlie in 1893 and thousands flocked to the arid Goldfields. Water was scarce and became more expensive than whiskey. Water supplies, such as artesian bores and condensing plants, provided some but there was not enough for the thousands of diggers and their families. The lack of fresh water led to poor sanitation and diseases such as typhoid, which caused

CY O'Connor c.1897 *BL 54379P*

PERSONAL DETAILS:

O'Connor was an Irish Protestant. He married Susan Ness in New Zealand. He was the father of eight children, one of whom died at an early age. He was compassionate, generous and an advocate of workers rights. He instigated an eight hour working day and better wages for his staff and encouraged them to form their own union.

CY O'Connor and family, 1891 *BL 009044D*

many deaths. Goldfields residents agitated politicians for a reliable supply and in 1895 Forrest requested O'Connor devise a plan.

GOLDFIELDS WATER SUPPLY SCHEME

O'Connor devised a simple solution but one of great magnitude and cost. Using hydraulics and steam, water would be pumped from coastal storage in the Darling Range, through a pipeline 520 km to Coolgardie. Due to the growth of Kalgoorlie, it was extended to 560 km. His plan incorporated new technology and methods and also utilised the new harbour and railway to receive and transport supplies and equipment.

The scheme faced many hurdles - delays in funding; political resistance; and extreme criticism, particularly from the media. A formal government enquiry into the scheme, along with accusations of corruption, took a heavy personal toll on O'Connor and tragically, he took his own life on 10 March 1902.

Ten months after his death, the pipeline was completed and officially opened at Mount Charlotte, Kalgoorlie on 24 January 1903. Water has flowed to the Goldfields ever since. The corruption charges against O'Connor were unfounded and the final cost of the scheme was just over the original estimate made seven years earlier, despite taking longer than anticipated and traveling a further 40 km to Kalgoorlie.

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Golden Pipeline Heritage Trail,
Fremantle Harbour and
O'Connor's statue,
Railway Tunnel at Swan View

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MUNDARING WEIR

Building the weir wall showing 'plums' in the concrete 1900 BL 000804D

Mundaring Weir was built between 1898 and 1902 to store water to be pumped to the arid Eastern Goldfields as part of the original Goldfields Water Supply Scheme, designed and constructed under the direction of CY O'Connor. Today, Mundaring Weir still supplies water to the Wheatbelt agricultural areas and the Goldfields.

CHOOSING THE SITE

O'Connor's assistant TC Hodgson considered 17 sites for a reservoir before choosing the current one on the Helena River in the Darling Range near Perth. Investigation revealed all the requirements for a dam - a river in a narrow valley with steep sides, foundations of bedrock, and a large catchment area of reliable rainfall.

BUILDING THE WEIR

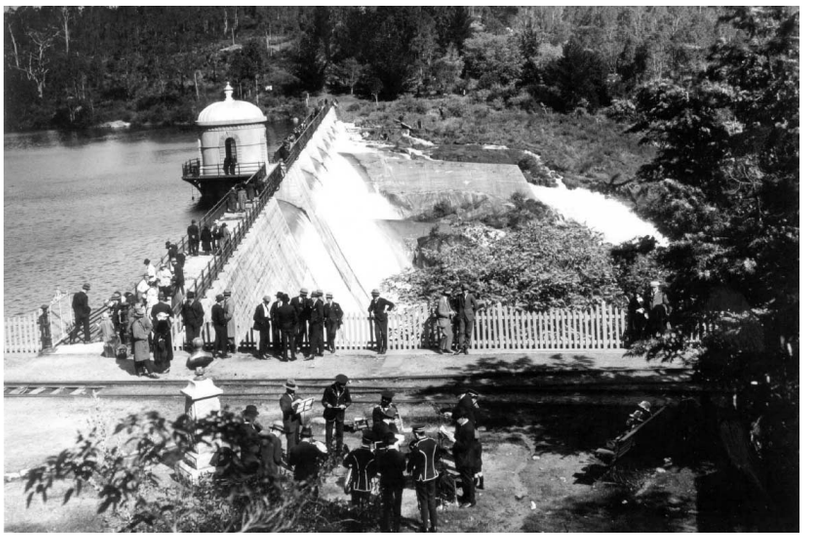
Firstly a branch railway line was built from Mundaring to the weir site to transport the materials required for building the weir.

Next, trees were cleared and excavation of the foundations began. In one section, what was thought to be bedrock was a large boulder. When it was removed a deep fault in the bedrock was found. Fixing both of these problems delayed construction for one year. To help overcome the delay, eight electric arc lamps were installed on the site. This allowed the hours of work to be extended.

Work began on the wall in February 1900. Concrete was prepared at the site and transported to the wall in wheelbarrows or on a conveyor. As the height of the wall grew, a steam crane was used to move the concrete in skips. Large granite rocks called 'plums' were inserted into the concrete as the wall was built to provide stability and to save on the amount of concrete required. Tragically, a labourer named William Aldridge was killed when he fell while working on the wall in February 1901.

Two valve houses were built for the valves that regulated the flow of water from the weir. It took one thousand turns of the valve wheel to fully open or close one of these valves.

The weir wall was completed in June1902. It was 100 feet (30.5 m) high, 755 feet (230 m) wide and the storage capacity of the reservoir was 4 655 million gallons (21.16 million cubic metres). This is equivalent to the water in 10 000 olympic-sized swimming pools!



Overflow c.1923 *BL 12142P*

CHANGES TO THE WEIR

The weir's storage capacity was trebled when the wall was raised 10 m (completed in 1951) as part of a post-war scheme (Comprehensive Water Supply Scheme) promoting further agricultural expansion into inland areas.

As part of raising the weir wall, the upper valve house was dismantled from the original wall and re-erected on the raised one to preserve the appearance of the original wall.

The southern side of the wall had a series of openings to allow for overflows. In 1959 steel gates were installed to block the openings when required. In effect, this raised the wall and allowed for more water to be stored. The gates were hardly used due to low water levels in the dam and for safety reasons were removed in 1997.

WEIR WORKFORCE

Over 300 people were involved in the original weir construction between 1898 and 1902. Men flocked to the site for work - many were newly arrived to Western Australia - and a camp quickly sprang up near the weir. Families often joined the men at the camp and a school opened in November 1898 with 48 students.

In 1951, displaced persons from war-torn Eastern Europe were employed for the raising of the weir wall. Many of these workers lived in a construction camp located on almost the same site as the original camp.

WEIR OVERFLOW

Mundaring Weir attracted hundreds of sightseers when it first overflowed in 1903 and has been a tourist attraction ever since. The Weir last overflowed between September and October 1996 and drew large crowds. An overflow of this kind is unusual now as the Water Corporation manages the storage of water between dams throughout the State.

FURTHER INFORMATION GO TO

GOLDEN PIPELINE WEBSITE:
www.goldenpipeline.com.au
WATER CORPORATION WEBSITE:
www.watercorporation.com.au

READ

Ian Elliot, *Mundaring: A History of the Shire*, Shire of Mundaring, 1983

Edward Quicke, *Mundaring Weir Among the Hills*, Mundaring and Hills Historical Society Inc, 1996

National Trust, *The Golden Pipeline Heritage Trail Guide*, 2002

J Lefroy, D Frylinck and M Duke, *The Pipeline CY O'Connor Built*. Fremantle Arts Centre Press, Western Australia, 2003

VISIT

Golden Pipeline Heritage Trail,
Other Dams: Canning Dam, Churchman Brook Dam, Serpentine Dam

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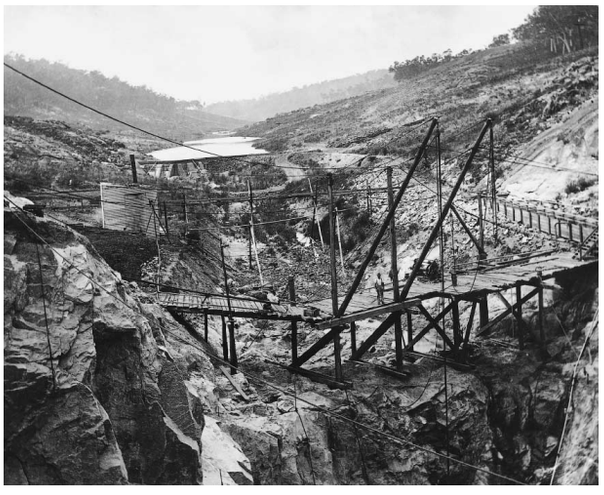
BUILDING THE GOLDFIELDS WATER SUPPLY SCHEME



Building the weir wall 1900 BL 816Bc6844

Pipe-laying across Darling Range c.1900 BL 001284D

The Goldfields Water Supply Scheme was designed and built under the supervision of CY O'Connor between 1898 and 1903 to pump fresh water from the Darling Range near Perth 560 km east to the arid Goldfields. The scheme was designed with eight separate sections to overcome the difficulty of pumping water uphill over such a great distance. A dam, the pipeline and eight pump stations were the main components of the scheme.

FACTS AND FIGURES OF THE ORIGINAL SCHEME

Cost of scheme	£2 655 220 ($5 310 440)
Number of pipes	60 000
Amount of water pumped daily	Up to 5.6 million gallons (25.5 million kilolitres)

MUNDARING WEIR

A dam, known as Mundaring Weir, was built on the Helena River to store water to be pumped to the Goldfields. O'Connor's assistant, TC Hodgson considered 17 sites before choosing this one. In 1898, during the excavation of the weir foundations, a huge boulder was unexpectedly revealed. When it was removed a deep fault in the bedrock was found. Overcoming these problems delayed construction for one year. The concrete wall was completed in June 1902. A construction camp on the site was home to around 300 workers and their families during the building of the weir.

PIPELINE

The pipes were made of steel plates imported flat from Germany and America. Two steel plates were bent to form semi-circles and joined using the innovative locking bar system invented by Mephan Ferguson. The locking bar replaced the practice of riveting the plates together. This new system minimized the risk of leakage as no holes were drilled into the pipes and it also reduced internal friction as there were no rivet heads to slow the flow of water inside the pipes.

Where possible the pipeline was built alongside the route of the existing railway line to enable the pipes to be easily transported. The length of the train carriages determined the length of the pipes (28 feet or 8.5 metres). The pipes were laid in trenches to reduce contraction and expansion caused by temperature extremes. Lengths of pipe were joined as they were laid using a process that packed the joint with lead, known as caulking. Over 60 000 joints were required and this process was done by hand until a caulking machine that produced consistent joints and saved time and labour was invented by James Couston in 1901.

PUMP STATIONS

Eight pump stations were built along the length of the pipeline. The water had to be pushed up and over the height of the Darling Range and then to the Goldfields - a total lift of 340 m and a distance of 560 km. No 1 Pump Station drew water directly from Mundaring Weir and No 3 used an existing railway dam. The other six stations had a large

Mt Charlotte opening, 1901 *BL 000862D*

concrete receiving/suction tank to hold water which flowed from the previous pump station and from which water was then pumped to the next.

APPROXIMATE DISTANCES FROM NO 1 PUMP STATION

No 1.	*Mundaring Weir*	
No 2.	*O'Connor*	*2 km*
No 3.	*Cunderdin*	*120 km*
No 4.	*Merredin*	*220 km*
No 5.	*Yerbillon*	*270 km*
No 6.	*Ghooli*	*345 km*
No 7.	*Gilgai*	*395 km*
No 8.	*Dedari*	*465 km*

DEVELOPMENT OF THE SCHEME SINCE 1903

The pipeline has been upgraded and the scheme extended since it was first built. The pipes were reconditioned or replaced during the 1930s and 40s to overcome corrosion problems. They were lined with concrete, placed above ground and the lead-packed joints were replaced with welded joints. Several sections of the pipe - totaling 64 km - were temporarily replaced with wood-stave pipes made of karri, which were used for 30 years.

The original Goldfields Water Supply Scheme became the basis of the northern section of the Comprehensive Water Supply Scheme, completed in 1973. This post-war scheme promoted the expansion of agricultural areas by providing water for stock and domestic purposes. As part of this scheme the storage capacity of Mundaring Weir was trebled when the weir wall was raised 10 m in 1951. Sections of the main pipeline were enlarged and branch mains were extended north and south. Between 1954 and 1969 the first seven original pump stations were replaced by electric pump stations. No 8 Pump Station at Dedari was replaced by a diesel station in 1970 and converted to electric power in 1984.

THE SCHEME TODAY

Now known as the Goldfields and Agricultural Areas Water Supply Scheme, it supplies water for domestic, stock and mining purposes to 33 000 rural and town services through 8 000 km of pipe mains.

Today water takes 5-11 days to reach Kalgoorlie. An average of 90 million litres of water is pumped daily. The pipe network holds 300 million litres of water.

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