11. ASSESSMENT OF CULTURAL HERITAGE SIGNIFICANCE

Cultural heritage significance means aesthetic, historic, scientific, social or spiritual value for individuals or groups within Western Australia.

In determining cultural heritage significance, the Heritage Council has had regard to the factors in the *Heritage Act 2018* and the indicators adopted on 14 June 2019.

11(a) Importance in demonstrating the evolution or pattern of Western Australia's history

The construction of the *Goldfields Water Supply Scheme* was one of the greatest engineering and infrastructure schemes of the late nineteenth century. The successful completion of the scheme was pivotal in the growing confidence and economic importance of the state of Western Australia.

In providing a continuous and reliable water supply to Eastern Goldfields, the *Goldfields Water Supply Scheme* was fundamental to the continued development of the Western Australian mining industry, reflecting its importance to the regional and state economy at the end of the nineteenth century.

The construction of the *Goldfields Water Supply Scheme* allowed for the successful development of the Wheatbelt region throughout the twentieth century. The installation of branch mains off the Pipeline began in 1907 and continued for the next forty years, servicing what has become the most productive wheatfields in Australia.

The construction and continued maintenance and expansion of the *Goldfields Water Supply Scheme* provided direct employment for a large number of men, particularly in the nineteenth century construction of Mundaring Weir, the laying of the conduit and branch extensions at the turn of the century. The raising of the pipeline as part of the sustenance program during the 1930s Depression and the raising of the Mundaring Weir from 1946-1951 utilised considerable numbers of immigrant labourers, particularly southern Europeans, who were accommodated in camps near the Weir.

The *Goldfields Water Supply Scheme* is recognised as a symbol of State pride that, at the time of construction when federalism was being established, was utilised as an example of the infrastructure capabilities of one of the least populated colonies.

11(b) Importance in demonstrating rare, uncommon or endangered aspects of Western Australia's heritage

The *Goldfields Water Supply Scheme* was a unique combination of attested technology and infrastructure combined with innovative engineering and technological advances at the time of construction.

The *Goldfields Water Supply Scheme* retains exceptionally important individual components associated with the largest Australian engineering scheme of its type at the time, and the continued innovations undertaken to maintain its successful operation over 120 years.

Individual components of the *Goldfields Water Supply Scheme*, in particular the archaeological sites and remaining buildings at Mundaring Weir, Mount Charlotte, the original eight and later generation pump stations and staff housing, and workers camps, reflect the distinctive way of life of those who lived and worked on the construction and operation of the Pipeline from 1898 to the 1970s.

11(c) Potential to yield information that will contribute to an understanding of Western Australia's history;

The *Goldfields Water Supply Scheme*, in association with the interpretation along the Golden Pipeline Heritage Trail, demonstrates the exceptional historical importance of the provision of water to the towns along the route from Mundaring to the Eastern Goldfields.

Along with the existing interpretation associated with the Golden Pipeline Heritage Trail and the museum facilities at No 1 Steam Pump Station Mundaring and No. 3 Steam Pump Station Cunderdin, the *Goldfields Water Supply Scheme* has exceptional potential as a benchmark site to communicate the history of the Goldfields Water Supply Scheme and its importance to the Wheatbelt, the Eastern Goldfields and Western Australia.

Comprising a comprehensive collection of archaeological sites, buildings, infrastructure and technology, the *Goldfields Water Supply Scheme* has outstanding importance for its ability to demonstrate engineering and technological advances across the nineteenth, twentieth and twenty-first centuries.

The discontiguous individual components, including archaeological sites, decommissioned and operational infrastructure, steam pump stations, electric pump stations, tanks, portions of conduit, valves and reservoirs, have the potential to educate the public on the operational aspects associated with the delivery of water from Mundaring Weir to the Wheatbelt and Eastern Goldfields via the *Goldfields Water Supply Scheme*.

Archaeological sites associated with the residences, workers camps, school buildings and other community facilities within the pump station complexes have the potential to yield information on the lives of the individuals who worked on and lived near the *Goldfields Water Supply Scheme*.

11(d) Its importance in demonstrating the characteristics of a broader class of places;

The original *Goldfields Water Supply Scheme* is representative of the ambitious engineering and infrastructure schemes of the late nineteenth century, and was Australia's boldest project to that date. *Goldfields Water Supply Scheme* comprises a series of places that individually and collectively demonstrate the characteristics of water supply across a distance of 560km from Mundaring to Kalgoorlie, including the remaining and semi-ruined Steam Pump Stations, Electric Pump Station, tanks, portions of conduit, valves and reservoirs.

The remaining Steam Pump Stations at Mundaring, Cunderdin, Merredin, Ghooli, Yerbillon and Dedari, are a recognisable discontiguous group of industrial buildings of considerable architectural refinement, designed by renowned architect George Temple Poole, and intended to demonstrate the social and political importance of the *Goldfields Water Supply Scheme*.

11(e) Any strong or special meaning it may have for any group or community because of social, cultural or spiritual associations;

Established in the late nineteenth century and operating at a far greater capacity in the twenty-first century, the *Goldfields Water Supply Scheme* represents an exceptional technical achievement held in high esteem by the Western Australian community.

The successful construction and operation of the *Goldfields Water Supply Scheme* had considerable importance in contributing to the sense of place for the people of Western Australia. Creating employment opportunities and shaping local patterns of land use, farming, transport, and education, the Scheme was pivotal in the continued success of goldmining in the Eastern Goldfields, the development of small long-lasting rural communities along its breadth and allowing for permanent settlement inland.

The *Goldfields Water Supply Scheme*, and the complementary Golden Pipeline Heritage Trail, is highly valued as a tourist destination with educational, cultural and aesthetic aspects appreciated by history and engineering enthusiasts, teachers, Western Australians and visitors to the state.

The *Goldfields Water Supply Scheme* has special meaning for many former Public Works Department, Goldfields Water Supply and Water Corporation employees and their descendants, including the communities of workers and their families who lived alongside the original Steam Pump Stations. For some descendants of the men employed in the construction and raising of the reservoirs and weir, the laying the original Mundaring to Kalgoorlie conduit, the 1933 raising of the conduit, and the runners who monitored the pipeline for leaks, the continued operation of the Pipeline is a demonstration of their skill and perseverance, and part of the family folklore and pride.

11(f)[1] Its importance in exhibiting particular aesthetic characteristics valued by any group or community;

Many of the individual components associated with the *Goldfields Water Supply Scheme*, including the remaining and semi-ruined steam pump stations, electric pump stations, tanks, portions of conduit, valves and reservoirs individually have landmark qualities in their rural and country town settings. Collectively they form a significant precinct that is recognisable across the changing landscape from the Perth Hills, the Wheatbelt and Eastern Goldfields of Western Australia.

The use of architectural design in the construction of the eight original Steam Pump Stations reflects the cultural importance and ambition of the *Goldfields Water Supply Scheme* to the Western Australian government at the time. The remaining Steam Pump Stations at Mundaring, Cunderdin, Merredin, Ghooli, Yerbillon and Dedari, are a recognisable discontiguous group of industrial buildings of considerable architectural refinement, reflecting the style of architect George Temple Poole.

The retention of original superseded and retired pump stations and storage tanks, alongside second and third generation replacements in discrete groups at Merredin, Yerbillon, Dedari and other locations along the route of the main conduit, form individual precincts that demonstrate the transition to utilitarian and functional architectural design during the ongoing operation, maintenance and upgrading of the *Goldfields Water Supply Scheme* throughout the twentieth and twenty-first centuries.

The individual precincts at Mundaring, O'Connor, Cunderdin, Merredin, Yerbillon, Gilgai, Ghooli and Dedari, established to maintain the *Goldfields Water Supply Scheme,* vary widely in terms of condition, conservation and retention of remaining operational infrastructure and buildings, residences, and the presence of additional facilities such as halls, schools, gardens and playgrounds. Collectively, they demonstrate and are evocative of the self-contained nature of the small communities established near the main conduit.

The archaeological sites of former Steam Pump Stations at O'Connor, picturesque and encroached by the surrounding Perth forest, and Gilgai, exposed and open to the elements in the Wheatbelt region, are striking in their individual landscape, but also demonstrative examples of the different types of sites and environments within the *Goldfields Water Supply Scheme* that are valued by visitors to the Golden Pipeline Heritage Trail for aesthetic, evocative and educational reasons.

The scale of construction of both the Mundaring Weir and Mount Charlotte reservoirs in addition to the associated facilities, buildings, interpretation and surrounding natural landscapes in both locations combine to form a significant recreational landscapes in two vastly different environments at either end of the *Goldfields Water Supply Scheme*.

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[1] For consistency, all references to architectural style are taken from Apperly, R., Irving, R., Reynolds, P. *A Pictorial Guide to Identifying Australian Architecture. Styles and Terms from 1788 to the Present,* Angus and Robertson, North Ryde, 1989.
For consistency, all references to garden and landscape types and styles are taken from Ramsay, J. *Parks, Gardens and Special Trees: A Classification and Assessment Method for the Register of the National Estate,* Australian Government Publishing Service, Canberra, 1991, with additional reference to Richards, O. *Theoretical Framework for Designed Landscapes in WA*, unpublished report, 1997.

The location of the reservoir at the top of Mount Charlotte, and the visibility of dual conduits undulating down the hill, both transporting water to the reservoir from Coolgardie and distributing it out to Kalgoorlie creates a landmark feature in the Kalgoorlie landscape and a symbol of the purpose of the *Goldfields Water Supply Scheme*.

11(g) Any special association it may have with the life or work of a person, group or organisation of importance in Western Australia's history;

Goldfields Water Supply Scheme is associated with a number of notable figures in Western Australian history, including the Scheme's designer CY O'Connor, State and Federal politician Lord John Forrest, the Director of the Public Works Department HW Venn and former Superintendent of Public Works, architect George Temple Poole, who each contributed to the successful completion of the Scheme.

The longevity of the *Goldfields Water Supply Scheme* is associated with innovators Mephan Ferguson, inventor of the locking-bar pipe; James Couston, inventor of the caulking machine, whose designs allowed the successful construction and laying of the original main conduit; engineers Norman Fernie and Reg Keating, proponents of the 1930s scheme to lift and relay the conduit above ground to combat ongoing issues with corrosion; and Frank Mather, who devised the repurposing of the locking bar pipe as Kellerberrin Pipe.

The place has importance for its close association with the talented and committed engineers employed by the Goldfields Water Supply Branch, Public Works Department and other iterations of the Water Corporation, whose pioneering research and innovations were instrumental in the successful construction and continued operation of the *Goldfields Water Supply Scheme* throughout the twentieth century,.

11(h) Its importance in demonstrating a high degree of creative or technical achievement;

The *Goldfields Water Supply Scheme* has exceptional importance in demonstrating a series of highly original technical achievements in the successful completion of one of the longest overland pipeline schemes attempted in the nineteenth century. The construction of two reservoirs connected by 560km below-ground pipeline, supported by eight steam pump stations and associated infrastructure utilised new technology, and exceptional engineering and architectural design. The completion of the scheme was recognised as one of the largest and outstanding engineering achievements at the time.

The use of Mephan Ferguson's innovative locking bar technology and James Couston's caulking machine was pivotal in ground-breaking decision to construct the main conduit of the *Goldfields Water Supply Scheme* in steel. The scale of the scheme was such that an unprecedented 70,000 tons of steel was required, necessitating the contract to manufacture the pipes was split between two contractors. The most expensive Australian construction scheme undertaken produced the longest steel pipe in Australia and the world at the time.

As a precinct, *Goldfields Water Supply Scheme* is an exceptional example of applied science, technical excellence and innovative design in the nineteenth and twentieth century. A series of innovative solutions to corrosion and increased capacity requirements were undertaken in the 1930s, including the successful raising of the pipeline using reinforced concrete anchor blocks to provide stability; most extensive use of wooden pipes in Australia with the installation of 63km of Karri timber in timber stave pipes; and the raising of the Mundaring Weir via the additional of grouted aggregate concrete buttresses to the downstream wall of the Weir. Ongoing maintenance of the *Goldfields Water Supply Scheme* has continued to utilise cutting edge technology and expertise to ensure the optimal delivery of water across the Wheatbelt and Eastern Goldfields region.

12. DEGREE OF SIGNIFICANCE

12. 1 CONDITION

Due to the scale and quantity of the various physical components of *Goldfields Water Supply Scheme,* the condition inevitably varies across the site depending on type of structure, age and crucially if it is still in use or not. The condition of key components of the place are summarised below:

Reservoirs, Dams and Rock Water Catchments

Mundaring Weir and Mount Charlotte Reservoir are both overall in good condition due to still being in use for their original purpose. They are well maintained with appropriate hard and soft landscaping allowing public access. The old Meter House at Mount Charlotte is in disrepair.

The Rock Water Catchment at Karalee is in a fair to good condition having had recent repair works undertaken to the timber structure supporting the aqueduct. The adjacent dam is filled and appears to be in good condition. The perimeter stone walls are in fair condition considering their age.

Pump Station Complexes

The condition of the remaining six original Steam Pump Stations at Mundaring, Cunderdin, Merredin, Yerbillon, Ghooli and Dedari varies. Mundaring and Cunderdin are occupied and used as museums and are in good condition due to ongoing conservation. The unoccupied stations vary in their condition. Some have undergone conservation works while others have not. No. 4 Steam Pump Station Merredin has had the external brickwork recently re-pointed, roof sheeting replaced and the ornate entrance canopy re-instated. No. 6 Steam Pump Station Ghooli, is in very poor condition and in urgent need of conservation to prevent further decay of significant building fabric. Damage is largely due to water ingress through failure of the roof sheeting and poor site drainage resulting in water logging at ground level.

The second generation pump station at Merredin is in a fair condition and remains unoccupied. The building appears to be watertight and typically in need of general maintenance of a structure that age.

The sites of the original Steam Pump Stations at O'Connor and Gilgai both comprise above ground remnants of buildings and other infrastructure. There is high potential for sub-surface archaeological deposits and artefacts associated with both the operation of the pump stations as well as the lives of pump workers

and their communities to be present at both sites. There is high potential for the areas surrounding the station complexes at Mundaring, Cunderdin, Merredin, Yerbillon, Ghooli and Dedari to comprise sub-surface archaeological deposits and artefacts.

Surface and sub-surface finds associated with tourists may also be expected.

Tanks

The tanks in operation at Bakers Hill, West Northam, Yerbillon and Ghooli are in fair to good condition through being maintained and importantly are covered and protected from the weather. Superseded tanks at Sawyers Valley, Koorarawalyee Tank, near Gilgai, and Bronti, were also covered after construction, and are occasionally used for overflow storage. In 2021/2022 the cover of Koorarawalyee Tank was removed, after storm damage, for safety reasons.

Where tanks are not in use and are uncovered and remain empty, at Toorak, Merredin, and Gilgai, the concrete lining is in poor condition with typical evidence of cracking, graffiti, staining, debris and vegetation growth. The receiving tank at the site of No. 2 Steam Pump Station O'Connor has recently been infilled for safety reasons.

12. 2 INTEGRITY

This section explains the extent to which the fabric is in its original state.

Due to the scale and quantity of the various physical components of *Goldfields Water Supply Scheme,* the integrity inevitably varies across the site depending on type of structure, age and crucially if it is still in use or not. The integrity of key components of the place are summarised below:

Reservoirs, Dams and Rock Water Catchments

As a whole, all these elements have a high level of integrity with original structures, landscapes and formations remaining. The exception is Mount Charlotte Reservoir, which has been compromised with the addition of modern contemporary structures of shelters and telecommunication masts.

Pump Station Complexes

All original Steam and second generation Electric Pump Stations, retain a high degree of integrity with their original form, structure and openings still extant, allowing a clear expression of the original design intent. They have remained relatively unchanged with their integrity able to be preserved by a program of conservation and use of the overall place. There have been minimal changes to the buildings over the years, and typically the only items of note being removed have been ablutions blocks and internal machinery and equipment. As such they all still have a high level of integrity due to their primary building fabric remaining in its original state.

The integrity of the pump community settlements associated with the eight Steam Pump Stations is low. Some buildings and structures associated with staff housing and other facilities such as schools are located at Mundaring, Merredin, Yerbillon, Ghooli and Dedari, however these are generally in poor condition or compromised by asbestos contamination. Fabric associated with the lives of

pump workers and their communities is mostly likely to be found in a fragmented state through investigation of archaeological deposits and artefacts at each site.

Tanks

All tanks retain a high degree of integrity with their original form, structure and landscape surround still extant, allowing a clear expression of the original design intent. The integrity of the operational tanks have been compromised to some extent with the addition of roof coverings and associated structures. This has been necessary however for their function and historically would have been implemented for many years.

Pipeline (Main Conduit)

Small portions of above ground pipeline conduit associated with the original Steam Pump Stations, Tanks and Reservoirs are included in the *Goldfields Water Supply Scheme*. The majority of the main conduit extending from Mundaring to Kalgoorlie is not included.

However, as a whole, the pipeline, or main conduit, has a low to medium level of integrity due to constant upgrades and maintenance. In response to failures or to increase pipeline capacity, much of the original locking bar pipe has been replaced over its lifetime. In addition to this, the process of raising it above ground from its original underground location has inevitably led to much of the original fabric being replaced. It is inevitable that with the advent of time, pipework will continue to be replaced by more modern materials and technology to improve efficiency, performance and minimise maintenance.

12. 3 AUTHENTICITY

This section explains the extent to which the original intention is evident, and the compatibility of current use.

Due to the scale and quantity of the various physical components of *Goldfields Water Supply Scheme,* the authenticity inevitably varies across the site depending on type of structure, age and crucially if it is still in use or not. The authenticity of key components of the place are summarised below:

Reservoirs, Dams and Rock Water Catchments

Mundaring Weir and Mount Charlotte Reservoir have a high level of authenticity due to their continued use as water storage facilities at the start and end of the pipeline. Although the Rock Water Catchment elements at Karalee[2] are no longer in use or connected to the conduit, they nevertheless also retain a high level of authenticity. Their original fabric and unique expression remain unaltered that allows their original use to be readily apparent.

Pump Station Complexes

All original Steam and second generation Pump Stations retain a high degree of authenticity since their decommissioning and closure. As buildings, they are almost complete and continue to reflect their historical use, with the original fabric remaining unaltered except in relation to changing work methods during the site's operation. Where equipment has been removed, the buildings' primary structure

2 P10062 *Karalee Reservior, Rock Catchment & Aqueduct* (RHP)

still remains, which allows the original design intent as an industrial building to be readily apparent. The immediate wider context of each pumping station still functions as operational pumping sites with modern technology and infrastructure that ensures the enduring use of the area and pipeline into the future.

The authenticity of the pump community settlements associated with the eight Steam Pump Stations varies across the *Goldfields Water Supply Scheme*. The buildings associated with the pump community settlements at Mundaring (Mundaring Weir Hotel, Mundaring Weir Hall and the former school) and the extant staff housing at Merredin, Ghooli and Dedari, though in poor condition, have high authenticity.

Tanks

All tanks retain a high degree of authenticity. They remain largely unaltered apart from the tank at the site of No. 2 Steam Pump Station O'Connor that has been infilled. Even so, and with some of the other tanks having a roof covering, the original structures remain clearly evident that continues to reflect either historic or ongoing use.

Pipeline (Main Conduit)

Small portions of above ground pipeline conduit associated with the original Steam Pump Stations, Tanks and Reservoirs are included in the Mundaring to Kalgoorlie Pipeline. The majority of the main conduit extending from Mundaring to Kalgoorlie is not included.

However, as a whole the main conduit has an exceptionally high level of authenticity due to its continued operation serving the community. This cannot be overstated enough due to the pipeline remaining in use ever since it was built and will continue indefinitely into the future. Its original design intent is unaltered and would seem has permanent longevity.

13. SUPPORTING EVIDENCE

The documentation for this place is based on the physical heritage assessment completed by Department of Planning, Lands and Heritage and Dar Studio, in March 2020, March 2021 and June 2021, with amendments and/or additions by the Heritage Council and the Department.

The supporting documentation does not aim to give a full history of *Goldfields Water Supply Scheme*, nor a full description of its components. For further information, refer to the documents in the Key References in Section 13.4.

13. 1 DOCUMENTARY EVIDENCE

The *Goldfields Water Supply Scheme* comprises a discontiguous precinct across the 560km linear water pipeline, commencing at Mundaring Weir in the Helena Valley and terminating at Mount Charlotte Reservoir in Kalgoorlie-Boulder. The discontiguous portions include buildings, archaeology and equipment associated with the construction and operation of the *Goldfields Water Supply Scheme* from 1902 to the present These include six extant original Steam Pump Stations at Mundaring, Cunderdin, Merredin, Yerbillon, Ghooli and Dedari; the sites of two demolished Steam Pump Stations at O'Connor and Gilgai, including archaeological features and buildings associated with the pump communities, and small portions of the main conduit in discrete locations. A second generation Electric Pump Station at Merredin and a selection of original and second-generation Reservoirs and Tanks at O'Connor, Sawyers Valley, Bakers Hill, West Northam, Cunderdin, Merredin, Yerbillon, Ghooli, Bronti, Gilgai, Koorarawalyee, Dedari, Toorak, and Bullabulling, ancillary structures, associated equipment and machinery are also included.

Aboriginal History

Archaeological evidence suggests Aboriginal people have occupied Australia for at least 65,000 years.[3] Aboriginal people believe the connection is much longer. Evidence indicates that the number of people in the Eastern Goldfields and Wheatbelt regions before colonial times contracted and expanded over time in response to the changing environment.[4]

The main conduit of the *Goldfields Water Supply Scheme* appears to traverse the traditional lands of at least five language groups in its passage from Whadjuk land in Mundaring to Kalgoorlie, home to the Wongi people of the Western Desert. The main conduit passes through Whadjuk, Ballardong and Njaki Njaki dialectal

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3 The National Museum of Australia, 2021, Source: https://www.nma.gov.au/defining-moments/resources/evidence-of-first-peoples#:~:text=Aboriginal%20occupation,of%20Europe%20and%20the%20Americas., Accessed May 2021.

4 Government of Western Australia, Western Australian Museum WA Goldfields, Source: http://museum.wa.gov.au/explore/wa-goldfields/, Accessed March 2021.

groups[5], as well as the traditional lands of the Kalaamaya, also known as the Gubrun/ Kaprun people[6], and the Wangkathaa people.[7]

Aboriginal people lived virtually undisturbed in these areas until the 1840s when colonial setters and surveyors began to penetrate the inland Wheatbelt region. By the 1860s, expeditions regularly utilised Aboriginal guides, sometimes forcibly and brutally, to find water and travel routes as they gradually extended further east. As a result, many of the names of towns and features along the Pipeline are based on Aboriginal names and places.[8] The establishment of the Hunt's Wells[9] route from Perth to Kalgoorlie encouraged prospectors into the region in pursuit of gold, the 1893 discovery of which was to permanently change the region, and the lives of the Aboriginal people living there, immeasurably.

Mining activities and the establishment of agricultural and pastoral stations took advantage of Aboriginal people's knowledge and relationship with the environment and caused their displacement from their traditional lands.

The Water Problem

The 1890s gold boom in the Yilgarn and Coolgardie areas saw an unprecedented number of people flood into Western Australia. Demand for a reliable water supply soon became a priority for the Western Australian government. Water had always been difficult to source on the goldfields due to the isolated and arid nature of the location. A typhoid epidemic, caused by contaminated drinking water, highlighted the need for a secure uncontaminated supply. In addition to drinking water, water was also required in mining and processing ore.[10]

The *Goldfields Water Supply Scheme* was the government's solution to the 'water problem'. Championed by Premier John Forrest, and designed—in concert with other experts—by the Chief Engineer, Charles Yelverton O'Connor, the scheme was an ambitious plan to pump water to the Coolgardie goldfields from the hills above Perth, by way of pumping stations and reservoirs along the route.

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5 AIATSIS 1996, David R Horton (creator), *The AIATSIS Map of Indigenous Australia,* Source: https://aiatsis.gov.au/explore/map-indigenous-australia; Central Wheatbelt Visitor Centre, 2019, Welcome to Country, Source: https://www.wheatbelttourism.com/heritage-the-arts/aboriginal-heritage/, Accessed March 2021; South West Aboriginal Land & Sea Council 2021, Kaartdijin Noongar – Noongar Knowledge, Source: Kaartdijin Noongar (noongarculture.org.au), Accessed May 2021.

6 Also known as Ka'la mai, Kalamaya, Kalama. AIATSIS 1996 op cit.; Goldfields Aboriginal Language Centre, Kaalamaya, Source: https://wangka.com.au/kaalamaya/, Accessed March 2021; Central Wheatbelt Visitor Centre, 2019, op cit.

7 Also known as Wangkatj, or Wongutha. AIATSIS 1996 op cit.; Goldfields Aboriginal Language Centre, *Wangkatja*, Source: https://wangka.com.au/wangkatja/, Accessed May 2021; Bolton, S, 2009, Just Passing Through, p. 24.

8 'Exploration', *The Perth Gazette and Independent Journal of Politics and News*, 19 March 1858, p. 2; 'Correspondence', *Inquirer*, 21 September 1842, p. 4; 'Notes from His Excellency Sire James Stirling's Journal of Expedition to King George's Sound', *The Perth Gazette and Western Australian Journal*, 19 December 1835, p. 2., *The Perth Gazette and Western Australian Journal*, 21 May 1836, p. 4; *The Perth Gazette and Western Australian Journal*, 12 December 1840, p. 2

9 P24806 Hunt's Wells Group (Assessment Program). The construction of at least 16 wells in the 1860s by the Charles Hunt's team of surveyors, Aboriginal guides and convicts established a path from Perth to Kalgoorlie. The wells making up *Hunt's Well Group* are based on the list gazetted by Hunt in 1865, with a small number of additional wells constructed by Hunt added to the group where their identity could be verified.

10 Curtin Institute, 1999, Conservation Plan for Goldfields Water Supply Scheme Vol. 1, for the National Trust of Western Australia, pp. 31-37.

The Golden Pipeline

Construction of the *Goldfields Water Supply Scheme,* also known as the Golden Pipeline, began in 1898 and it was operational by the end of 1902. The *Goldfields Water Supply Scheme* was officially opened in January 1903. Over more than 115 years the Scheme has distributed water from Mundaring to the Goldfields and Agricultural region.

The *Goldfields Water Supply Scheme* was fundamental to the continued success of the goldmining industry and economic and social development of Western Australia. The construction of the longest freshwater pipeline in the world utilised innovative engineering solutions and was a source of pride for the state and its politicians.[11] Although the provision of water to the Eastern Goldfields was the immediate aim, the Scheme was also intended to stimulate expansion of the Wheatbelt as an agricultural region.[12]

The following timeline addresses the key events and phases in the construction and operation of the *Goldfields Water Supply Scheme* throughout the twentieth century and its emerging recognition as a tourism icon in the twenty-first century. The influential historical figures and events are also identified.

Phase I - *Construction of the Goldfields Water Supply Scheme*

1887 Gold discovered in Yilgarn (Southern Cross), beginning the Western Australian gold rush. Asian, African, and Aboriginal people are prevented from working in the goldmining industry under Western Australian legislation.[13]

1891 Charles Yelverton O'Connor takes the position of Engineer-in-Chief of the Swan River Colony.

1892 Gold discovered in Coolgardie. Typhoid outbreaks repeatedly occur in the goldfields due to the lack of clean water and health services. The official death toll for the period 1882 to 1900 is 1879.[14]

Public Works Department begins planning a water scheme to service the goldfields.

1895 O'Connor submits his proposal for the Goldfields pipeline scheme.

1896 *Coolgardie Goldfield Water Supply Loan Bill* is passed to raise a loan of £2.5 million to finance construction.

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11 National Trust of Australia (WA)/Tourism Western Australia, March 2004, *The Golden Pipeline Heritage Trail Guide – Car and Coach Touring*,

12 Curtin Institute, 1999, Vol.1, p. 63; Curtin Institute, 1998, No. 3 Cunderdin, p. 64; Hartley, 2007 , *River of Steel*, Access Press, Bassendean, p. 5

13 *Goldfields Act 1886* – Miner's Rights 3; replaced by the *Mining Act 1904* – Part XI – General Provisions (290, 291).

14 The National Trust, WA, *The Golden Pipeline*, Source: https://www.goldenpipeline.com.au/the-scheme/need-for-the-scheme/typhoid/, Accessed October 2021.

1896 Melbourne engineer Mephan Ferguson devises the Locking Bar Joint. The design allowed the manufacture of steel, rather than cast or wrought iron, pipes with leak-free joints, reducing potential issues associated with temperature and water pressure fluctuations along the pipeline conduit.[15]

1897 Karalee Rock Catchment and Reservoir[16] is constructed as a water catchment system to supply water for use by the Eastern Goldfields Railway.

1898 Work begins on the reservoir and dam at Helena River, Mundaring.

Large numbers of men relocate to the Mundaring area with their families to work on the dam. The Reservoir Hotel (now the Mundaring Weir Hotel) is constructed onsite and O'Connor uses a room in the Hotel as his office when inspecting the site.[17] A small school is established for the children of workers.[18]

Official approval for the *Coolgardie Water Supply Bill* is passed.

1899 James Couston, a Victorian contractor, develops a prototype machine for caulking lead joints of steel pipes in his workshop in Highgate, in Perth.[19]

1900 Approximately 90, 000 tons of materials are imported from overseas: 76,000 tons of steel plate are imported from America and Germany, and the locking bars and joins are manufactured in England. Two local factories are established in Maylands and Midland Junction to undertake the joining work, using Mephan Ferguson's patented locking bar innovation.[20]

Laying of underground pipeline begins. Approximately a quarter of the entire pipeline route requires blasting to create the pipe trench. At the height of works, a gang of 42 men are working 8 hour days laying the pipe[21]. The work crews move along the pipeline, accommodated in tents.

It is not known how many Aboriginal people worked on the scheme, although there is photographic evidence of one Aboriginal man within a crew on the pipeline.[22]

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15 Curtin Institute, 1999, Vol 1, p. 43; Hartley, 2007, pp. 20-21; National Trust of Australia (WA), 2002, *The Golden Pipeline Heritage Trail Guide*, National Trust of Australia (WA), p. 10

16 P10062 *Karalee Reservoir, Rock Catchment & Aqueduct* (RHP)

17 P1675 *Mundaring Weir Hotel* (RHP) – Assessment Documentation

18 PP8540 Mundaring Weir School & Quarters (fmr)

19 Caulking is the application of a sealant, or caulk, to fill gaps or seams in pipe joints to ensure the conduit is watertight. Prior to the use of Couston's machine, molten lead was consolidated into the sleeve of the locking bar joint by use of hammers and other tools. Hartley, 2007, pp. 74, 76.

20 'A brief Handout to tourists at Cunderdin Control Centre, put together by Alf Daniel', document provided by Damien Wood, Water Corporation; National Trust of Australia (WA), 2002, p. 10

21 ibid.

22 National Trust 2001, cited in Griffiths Architects, 2016, Goldfields Water Supply Scheme Heritage Management Plan, p. 33.

The pipeline transverses the traditional lands of the Noongar and the Wongi people. Although there are some known Aboriginal sites located along or in proximity to the Pipeline, others are likely to have been destroyed or impacted by the pipeline construction or subsequent mining and agricultural expansion. Aboriginal people displaced as a result of diseases, mining, pastoral activities or work on the *Goldfields Water Supply Scheme,* move to established town centres at Southern Cross and Coolgardie, reliant on food supplied by Europeans.[23]

Western Australia became the final Australian colony to vote for Federation on 31 July 1900. Up until this time there was uncertainty within the State as to the implications of a strong Eastern State presence within a unified nation.[24] The *Goldfields Water Supply Scheme* was a symbol of State pride as despite being a comparatively small colony the Scheme exemplified the infrastructure capabilities of Western Australia, which was an important reminder during the period leading up to Federation.

1901 Work begins on the Steam Pump Stations, reservoirs and regulating tanks.

Architect George Temple Poole is instrumental in the design and siting of the original eight Steam Pump Stations[25]. Although the former Principal Architect for Western Australia had retired to private practice, he was engaged as a consultant on the scheme. The stations at Mundaring, Cunderdin, Merredin, Yerbillon, Ghooli, Gilgai and Dedari are built as variations to the standard plan developed by the Public Works Department and Temple Poole. Each is an industrial building of considerable architectural refinement, reflecting Temple Poole's eclectic and distinctive style and intended to demonstrate the importance and ambition of the Goldfields Water Supply Scheme.[26]

James Couston is appointed in May as works manager for pipe-laying and caulking, overseeing the use of the mechanical caulking machine. However, by December, due to difficulties associated with his split responsibilities, he asks to complete the remainder of the work as a contractor. O'Connor's efforts to award the contract precipitate a series of attacks on his integrity by members of the WA Parliament and the Press.[27]

1902 Mundaring Weir wall is completed. At the time of construction, it is the largest concrete dam in Australia.[28]

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23 Bolton, 2009, p. 47.

24 'The Reluctant State', Federation 1890-1910, State Library of Western Australia, https://exhibitions.slwa.wa.gov.au/s/federation/page/reluctant , accessed 14 October 2022.

25 Thomas Hodgson, O'Connor's deputy and Engineer-In-Charge, George Hawke (engineer with James Simpson & Co) and other officials were also involved in the siting of the infrastructure along the route.

26 Curtin Institute, 1999, Vol 2, Place I, pp. 32-33; Curtin Institute, 1999, Conservation Plan for Goldfields Water Supply Scheme Vol II Place G. No. 4 Pumping Station - Merredin, p. 16.

27 Hartley, 2007, pp. 90-95.

28 It was surpassed by the construction of Umberumberka Dam in NSW in 1915. Hartley, 2007, 71.

10 March – O'Connor commits suicide, five days after the commencement of the Royal Commission into accusations of mismanagement and corruption associated with the Goldfields Water Supply Scheme.[29] Contrary to the pervasive myth that he took his life because he thought the scheme had failed, O'Connor died believing the project could be completed successfully.

The pumping of water along the pipeline begins at the No. 1 Steam Pump Station in Mundaring on March 31, with water reaching Northam on April 18. It progressively moves through Cunderdin, Merredin, Yerbillon and Southern Cross, reaching No. 8 Steam Pump Station Dedari near Coolgardie in December.[30]

The Royal Commission concludes Thomas Hodgson, Engineer-in-Charge and O'Connor's deputy, acted improperly, and contributed to O'Connor's 'overstrained mind'. Professionally discredited, he is suspended from duty in May and resigns from the Public Works Department in August.[31] (Later studies vindicate both O'Connor and Hodgson and their legacy in the construction of the scheme.)

The existing railway water tanks (1893-1898) along the Eastern Goldfields line are connected to the scheme. The existing rock water catchments and other dams along the line, are maintained as the main railway water supply, with water from the pipeline used for the railway in emergencies.[32]

1903 Goldfields Water Supply Scheme officially opened by Sir John Forest at Mt Charlotte Reservoir, Kalgoorlie, providing the Eastern Goldfields a better quality water supply than the Metropolitan area.

At the time of construction, the main conduit from Mundaring to Kalgoorlie for *Goldfields Water Supply Scheme* is the first steel pipeline ever built. In 2021 it remains one of the longest freshwater pipelines in the world.[33]

Phase II – *Problem Solving and Agricultural Expansion*

1904 Chief Engineer of the Goldfields Water Supply Administration (GWSA), William Reynoldson, establishes a comprehensive maintenance and inspection system for the entire conduit, utilising 'runners' patrolling 7-10 mile portions of conduit daily on purpose made bicycles.[34]

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29 The National Trust, WA, *The Golden Pipeline*, Source: https://www.goldenpipeline.com.au/the-people/cy-oconnor/, Accessed February 2021.

30 The original eight steam pump stations are referenced in different ways depending on the source and in different heritage listings. For the purposes of this assessment, the original number and the location is provided for consistency, eg. No. 3 Steam Pump Station Cunderdin. This system is used for other elements such as summit tanks and reservoirs, where known.

31 Engineering Heritage WA, 2011, p. 5; The National Trust, WA, *The Golden Pipeline*, Source: https://www.goldenpipeline.com.au/the-people/thomas-cowley-hodgson/, Accessed February 2021.

32 P3933 Bullabulling Rock Water Catchment and Dams (RHP) – Assessment Documentation.

33 Engineering Australia WA, 2011, Goldfields Water Supply Scheme – One of Western Australia's Engineering Heritage Treasures, p. 3.

34 Hartley, 2007, pp. 140, 146-147.

The crews employed in laying the original Mundaring to Kalgoorlie conduit now continue to lay reticulation pipework servicing domestic, commercial, railway and mining customers.[35]

Despite the original intent to power the steam pumps with Collie coal, most stations are now using firewood, supplied via horse-pulled drays and stored in the coal bunkers adjacent to the boilers.[36] Each station employs a staff of eleven, including engineers, firemen and greaser, who work across three eight-hour shifts.[37] Workers mostly live on site with their families, in what become known as pump communities.

1906 GWSA observes internal and external corrosion of pipes is impacting efficiency. Rust nodules, or tubercles, form inside the conduit, increasing friction and putting pressure on pumps.[38]

1907 Branch extensions to Goldfields Water Supply Scheme provide water to country towns along the pipeline route. The town councils of Northam and Southern Cross are the first to utilise the additional water supply.[39]

1908 Due to the popularity of Mundaring Weir with tourists, the former Reservoir Hotel, renamed the Goldfields Weir Hotel (now Mundaring Weir Hotel), obtained special permission to open on Sundays. The small community of pump station workers and their families living at Mundaring Weir raise funds and construct a Mechanic's Institute building, now known as Mundaring Weir Hall.[40] Soon after, a bi-weekly passenger train is established between Mundaring and the Weir, catering for residents and tourists.[41]

1909 An external investigation into pipe corrosion finds oxygen in the water is causing tuberculation. The resulting 'Binnie Report' recommends the installation of a lime treatment plan at No. 1 Steam Pump Station Mundaring; construction of summit tanks at the highest points between each pump station; and establishing by-pass testing points along the conduit for the purpose of testing the efficacy of the proposals.[42]

1910 *Goldfields Water Supply Act* amended to allow supply for agriculture outside of the goldfields

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35 Hartley, 2007, pp. 166-169.

36 Curtin Institute, 1999, Conservation Plan Goldfields Water Supply Scheme, Vol II, Place G – No. 4 Pumping Station, Merredin, p. 16

37 Hartley, 2007, p. 189.

38 Curtin Institute, 2001, (Draft) Conservation Plan Sawyers Valley Summit Tanks (Goldfields Water Supply Scheme – Place R), p. 10

39 Alf Daniel Handout, op cit, *West Australian*, Thursday 6 February 1908, 'Goldfields Water Supply. Extension to Beverley'.

40 P1676 *Mundaring Weir Hall* (RHP), constructed 1908. Tennis courts were added later.

41 P1675 *Mundaring Weir Hotel* (RHP) – Assessment Documentation

42 Authored by Sir Alexander Binnie, Sons and Deacon, Sir William Ramsay and Mr Otto Hehner. Curtin, 2001, Place R, pp. 7, 10; Hartley, 2007, p. 189.

1911 A wooden by-pass pipe is installed at Toorak tank to supply water to Coolgardie. Readily-available Oregon timber, previously used water pipes in the eastern states, is trialled to test its endurance and efficacy in Western Australian conditions.[43]

In response to the Binnie Report, six 250,000 gallon capacity summit tanks are constructed at the high points between the eight pump stations, at Sawyers Valley (Summit Tank No. 1 (circular)); Kellerberrin (No. 2 Bungulla); Merredin (No. 3 Booran); Nulla Nulla; Bronti; and Koorarawalyee.[44] This reduces the length over which water is required to be pumped, changing the scheme to a gravity main system.[45]

1912 The use of lime to combat corrosion is unsuccessful and requires the cleaning and repair of 3.44 kilometres of conduit between the No. 2 and No. 3 Steam Pump Stations. The process of using lime is discontinued by 1915.[46]

A comprehensive scheme for watering agricultural areas via branch mains extensions off the *Goldfields Water Supply Scheme* is developed and implemented over next 30 years.

1913/ 1914 The steel chimneys in Steam Pump Stations at Yerbillon, Ghooli, Gilgai and Dedari are all replaced, due to corrosion issues associated with the use of timber instead of coal.[47]

1917 A vacuum water deaerator, the first of its kind in Australia, is installed at Mundaring Weir to reduce pipeline corrosion.[48]

1918 Percy O'Brien, Engineer for the Goldfields Area, Public Works Department, is the first Australian to be presented with the George Stephenson Medal and Telford Premium awards by the Institution of Civil Engineers. The awards recognised the service provided by O'Brien in the presentation of two papers, one written with colleague John Parr, on the construction and maintenance of the Goldfields Water Supply Scheme. The summary of the investigations into the ongoing issues associated with corrosion provided valuable information and implications for engineers around the world.[49]

1920 Mundaring Weir becomes a fashionable picnicking spot popular with Sunday drivers and motorists.

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43 It remained in service for over thirty years, although requiring considerable service in 1940s. When it was replaced with steel pipes in 1945-1946, the timber staves were bought for use in furniture construction. Curtin, 2001, Place V, p. 11; Hartley, 2007, pp. 246, 370-371

44 Curtin, 2001, Place R, pp. 11-12; Hartley, 2007, p. 188.

45 Hartley, 2007, pp. 188-189.

46 Curtin, 2001, Place R, p. 11; Hartley, 2007, p. 187

47 When chimneys were replaced, good portions were occasionally reused at other pumping station locations or sold for private use. Both steel and brick were used in the replacement chimneys, depending on a variety of site-specific factors.
Curtin Institute, 1999, Conservation Plan Goldfields Water Supply Scheme, Vol II, Place H: No. 5 Pumping Station, Yerbillon, p. 45; Hartley, 2007, pp. 210-211.

48 Engineering Heritage WA, 2011, p. 4.

49 Hartley, 2007, pp. 200-201.

1922-1923 A four mile portion of replacement conduit is installed in East Northam to deviate the main conduit away from the centre of Northam's business district.

1924 No. 8 Steam Pump Station Dedari is temporarily closed (until 1938) as part of ongoing program to reduce aeration (and corrosion) of pipeline water. Other measures include installation of floating covers on summit tanks at Nulla Nulla, Bronti and Koorarawalyee; and by-passing the Bullabulling and Toorak Hill reservoirs.

1928 Approximately 1 million acres of farmland are now served via the branch mains off the main conduit.

Mild Steel Cement Lined (MSCL) pipes, produced by Hume Pipe Company, are used as replacement conduit or in branch mains in place of locking bar pipe. Mephan Ferguson's Maylands factory closes and locking bar production ceases.[50]

1929 The Great Depression is triggered by the collapse of the New York stock market in October. The collapse of world markets sees prices for raw materials like wool, wheat and gold plunge and unemployment numbers surge.

1933 Lifting the pipe and re-laying of the conduit above ground begins to combat the ongoing issues associated with pipe corrosion and leaks.

As a result of pioneering research by Norman Fernie, District Engineer at Northam, 565 kilometres of pipe are excavated, cleaned, lined with cement mortar, and re-laid, now with oxy-welded joints, on reinforced concrete anchors.[51]

The innovative use of anchors spaced at 50 metre intervals allows large diameter conduit to be laid above-ground for the first time in the world.[52] The process, the majority of which is undertaken by unskilled sustenance workers, paid minimum wage, is largely completed by 1943.

In order to install the refurbished conduit, above ground diversions across a total distance of 64km, were laid made from Karri (*Eucalyptus diversicolor*) boards using tongue and groove construction. The wood-stave pipes, bound with 5/16" wrought iron wire and coated with tar, were the most extensive use of timber pipes in Australia at the time. It is approximately 30 year before they are replaced with steel pipe.[53] Portions of wood-stave pipe are on display at Water Corporation offices in West Leederville, Cunderdin Museum (the former No. 3 Steam Pump Station) and WA Museum Boola Bardip in Perth.

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50 Ferguson successfully tendered to provide locking bar in New Zealand and India following the success of the Goldfields Scheme and was no longer based in Perth. Griffiths, 2016, p. 34. Hartley, 2007, p. 185.

51 Curtin Institute, 2001, Conservation Plan for Toorak Tank (Goldfields Water Supply Scheme – Place V), for the National Trust of Western Australia, p. 9; Engineering Heritage WA, 2011, p. 7.

52 Griffiths, 2016, p. 27; Water Corporation, 2021, Preliminary Documentation, p. 26

53 National Trust of Australia (WA), The Golden Pipeline Information Sheet Number 5: Building the Goldfields Water Supply Scheme; Hartely, 2007, p. 246.

1935 Norman Fernie, and colleague Reg Keating, are awarded the RW Chapman Medal for advances in structural engineering by the Institution of Engineers Australia for their paper on the continuously welded pipeline.[54]

A 2,000,000 gallon capacity circular summit tank replaces the No. 1 Summit Tank at Sawyers Valley. Construction work is undertaken as part of the Trust Item Commonwealth Employment Scheme Works.[55]

1937 Kellerberrin man Frank Mather devises a method of reusing partially corroded locking bar pipes. Often the bottom half of the pipe would be corroded but top half could be reused. Mather created a machine that could remove the locking bar and welded lengths of non-corroded portions together. Following a successful trial of his process, Mather establishes the Electweld Steel Company from the family farm.

The repurposed Kellerberrin Pipes are slightly smaller (28¾ inch) in diameter than the original 30 inch pipes and are produced until 1958.[56] In 2015, approximately 4.6% (29.5 km) of conduit comprised Kellerberrin pipe.[57]

1939 Full service resumes at No. 8 Steam Pump Station Dedari due to increased water demand.

1940 As a wartime precaution, public access to *Goldfields Water Supply Scheme* conduit and infrastructure is prohibited, and the place is taken under Commonwealth control.[58]

Some experienced pipe-laying crew are redirected to assist on defence works in Fremantle, Albany and Onslow.[59]

Highlighting the importance of the water supply to the agricultural regions of the Wheatbelt, the individual pump stations and reservoirs are guarded from potential attack throughout World War II. At Mount Charlotte Reservoir, two caretakers share an around the clock watch, while an armed guard is posted at Mundaring Weir. In Ghooli, this role is undertaken by locals from the nearby town of Southern Cross.[60].

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54 Engineering Heritage WA, 2011, p. 7; Hartley, 2007, 236

55 A third tank is constructed in 1975. Curtin, 2001, Place R, pp. 7, 13.

56 Griffiths, 2016, pp. 34, 37; The Golden Pipeline, Mather Pipes, Source: https://www.goldenpipeline.com.au/the-scheme/pipes/mather-pipes/, Accessed September 2021.

57 Griffths, 2016, p. 37.

58 Curtin, 2001, Place R, p. 14

59 Hartley, 2007, p. 325.

60 Curtin Institute, 2000, Conservation Plan for Mount Charlotte Reservoir (Goldfields Water Supply Scheme – Place O), for the National Trust of Western Australia, p. 6; Hartley, 2007, p.324; The Golden Pipeline, No.6 Pump Station, Source: https://www.goldenpipeline.com.au/place/no-6-pump-station/, Accessed March 2021

Phase III – *Comprehensive Water Supply Scheme, Upgrades & Refurbishments*

1946 Preparation begins for the raising of Mundaring Weir to increase capacity. A construction camp for workers, including returned servicemen and Eastern European migrants, is established near the original 1898 construction camp, utilising second-hand huts from the military.[61]

1948 The first stage of the Comprehensive Agricultural Areas and Goldfields Water Supply Scheme (1947–1961) has begun.

Approximately 4 million acres of farmland are now served as additional branch extensions to the *Goldfields Water Supply Scheme* expand into the Great Southern Region.

1949 Construction of new quarters at No. 3 Steam Pump Station Cunderdin and other pump stations.[62]

1951 Works to raise Mundaring Weir wall by 10m completed, promoting agricultural expansion into inland areas.

The addition of concrete buttresses to the downstream side to raise and strengthen the dam is a relatively new concept, previously only used in Egypt and USA and at Burrinjuck Dam, in New South Wales. The use of grouted aggregate to bind the concrete is an innovative method unique to Australia. The weir is considered a nationally significant example of an early twentieth century ogee spillway

Care is also taken to retain the style of the original structure, including reusing the original footpath across the weir and reconstructing the control tower at the centre of the wall. [63]

Upgrades to the capacity of the conduit are undertaken between Mundaring and Kellerberrin. Sections of Kellerberrin Pipe are added to the system, running parallel to the existing conduit. In other portions, the conduit is replaced with the larger 36 inch MSCL pipe.[64]

1953 Electricity is installed at No. 5 Yerbillon, No. 6 Ghooli and No. 7 Gilgai. No. 1 Electric Pump Station, Mundaring (Pumping Station A) is officially opened.

With the introduction of diesel locomotives to the Eastern Goldfields railway line, Karalee Reservoir is no longer required as a water supply for steam locomotives and becomes a supplementary water source for the *Goldfields Water Supply Scheme.*

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61 Hartley, 2007, pp. 343-351.

62 Curtin Institute, 1998 (No. 3 Cunderdin), p. 62.

63 Griffiths Architects, 2016, p. 28, Hartley, 2007, p. 354, Kinstler, Frank,1999, Buttress Dams in Cole, B (ed),1999 *A history of dam technology in Australia 1850-1990*, Institution of Engineers, Australia. Australian National Committee on Large Dams, p.151.

64 Griffiths, 2016, p. 34

1954-1956 No. 1 Mundaring, No. 2 O'Connor, No. 3 Cunderdin and No. 4 Merredin Steam Pump Stations cease operation.

Electrically powered pumps commence operation at Kellerberrin Booster Station (BS), and new stations at Cunderdin and Merredin.[65]

1960 The majority of the original staff housing settlement at the Merredin station complex is demolished, although one former house remains on site.

Aboriginal men are included in the construction gangs laying new and refurbished pipes for *Goldfields Water Supply Scheme*.[66]

1961 Upgrades to the main conduit for the northern Comprehensive Scheme are completed. Due to steel shortages, removed portions of conduit would be recycled and reused, either in the construction of Kellerberrin pipe, or for reinforcement, or in patching and repairs. The wooden stave pipes are also refurbished, extending their operational life another ten years.[67]

1963 The former No. 1 Station Mundaring opens as O'Connor Museum.

The second stage of the Comprehensive Scheme (1963–1974) begins, during which the water pumped from Mundaring is increased by 51%. Supply is boosted to agricultural areas, including Dalwallinu and Quairading, as well as for nickel extraction, smelting and other mining operations in Kambalda, Binduli, and Kalgoorlie.[68]

1964 The former No. 3 Steam Pump Station Cunderdin is used as a cement factory.

1967 A fireman, Louis Odgers, is killed in an explosion in the economiser in the boiler house of No. 7 Steam Pump Station Gilgai, the first accident of its kind associated with the Scheme. Blow-out doors are fitted on all remaining original economisers still in use.[69]

1968 Water fluoridation is introduced in Western Australia under the *Fluoridation of Public Water Supplies Act 1966*. A fluoridation plant is constructed at Mundaring Weir for the purpose of adding fluoride to public drinking water.[70]

Closure of No. 6 Steam Pump Station Ghooli. New electric pumping station constructed at Yerbillon, replacing the original No. 5 Steam Pump Station.[71] Closure and demolition of No. 2 Steam Pump Station O'Connor.

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65 Curtin Institute, 1998 (No. 3 Cunderdin), p. 63.

66 Hartley, 2007, p. 303.

67 Hartley, 2007, pp. 362-365.

68 Hartley, 2007, pp. 378, 382-3.

69 Hartley, 2007, p. 400.

70 Hartley, 2007, p. 414-415; Water Corporation, 2019, Drinking Water Quality Annual Report 2018-19.

71 Curtin Institute 1999 Conservation Plan for Goldfields Water Supply Scheme, Vol II Place H – No. 5 Pumping Station Yerbillon, p. 45.

On the 14 October an earthquake measuring 6.9 on the Richter Scale hits the town of Meckering. The impact severely impacts the town and surrounding areas, damaging the main conduit. Water service is restored within 15 hours of the incident, demonstrating the skill and dedication of the pipeline gangs.[72] (Portions of the 'telescoped' steel pipes created by the earthquake are displayed in the local Memorial Park, along with other interpretation addressing the impacts of the earthquake.)

1970 Closure and replacement of No. 5 Steam Pump Station Yerbillon with nearby modern pump station. As part of the upgrades to the pumping facilities at Yerbillon, including decommissioning of the original pump house and construction of a new pump house, the site was progressively de-manned and the settlement demolished.

No. 8 Steam Pump Station Dedari replaced by a diesel station, located adjacent to the original.

1970–1973 Six electric pump stations constructed along the main conduit at Wundowie, Meckering, Baandee, Walgoolan, Southern Cross and Koorarawalyee. Additional pumping units are added to existing electric stations at Mundaring, Chidlow, Grass Valley, Cunderdin, Kellerberrin, Merredin, Yerbillon and Ghooli.[73]

Portions of conduit are upgraded between Mundaring to Coolgardie. At the peak of works, over 200 men are employed. The remainder of the wooden stave pipes installed in 1930s are removed due to dry rot and termite damage.[74]

The former No. 3 Steam Pump Station Cunderdin opens as No. 3 Cunderdin Pumping Station Museum, focusing on the Goldfields Water Supply Scheme and local Wheatbelt history.[75]

Closure of No. 7 Steam Pump Station Gilgai. As a result of the electric pumps, water can be pumped direct from No. 6 to No. 8. The site and associated settlement are demolished over the next decade.

1974 Completion of the Comprehensive Agricultural Areas Water Supply Scheme

1977 The *Goldfields Water Supply Scheme,* now known as the Western Australian Goldfields and Agricultural Water Scheme (G&AWS), is primarily operated through electrical power, and each station is staffed 24 hours a day by a crew of 4 to six men.[76]

The Public Works Department researches and tests models for remote control of pumps, valves and tanks.

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72 Some additional repairs were required to deal with a consequent aftershock and associated tensile stresses on the pipeline in the area.
Curtin Institute, 1999 Vol II Place G, p. 39; Hartley, 2007, pp. 405-6

73 Hartley, 2007, p. 393

74 Hartley, 2007, pp. 393-4; National Trust of WA, The Golden Pipeline Information Sheet No. 2 – Pipes of the Goldfields Water Supply Scheme.

75 Curtin 1998 (No. 3 Cunderdin), p. 63.

76 Hartley, 2007, p. 408.

1980 The Control Centre, Cunderdin is officially opened, trialling the remote control facilities. As the remote control system becomes fully operational, the station managers at Mundaring, Cunderdin, Merredin and Yerbillon are redeployed as controllers at the Control Centre, which is staffed for 24 hours a day with three rolling shifts.[77]

1984 The second No. 8 Station Dedari transitions from diesel powered pumps to electric power.

Operations along the length of the main conduit are managed by remote control from the Control Centre at Cunderdin. Staff housing and residences at Merredin, Mundaring and Yerbillon are vacated as staff retire or are redeployed to other employment.[78]

Galvanised permanent roofs are added to all tanks along the Pipeline.[79]

1987 The Goldfields and Agricultural Water Supply, Public Works Department and the Metropolitan Water Authority are merged into the Western Australian Water Authority (WAWA).

1990s The operational system for the G&AWS is converted to fully automatic control. Remote access is retained at Cunderdin as required.[80] Control of the scheme was transferred to Perth in 2006.

WAWA undertake a comprehensive program to inspect and refurbish the locking bar pipes along the breadth of the main conduit. Additional booster pumping stations (Walgoolan, Nulla Nulla and Boondi) and storage tanks (Sawyers Valley, West Northam and Nulla Nulla) are constructed.[81]

The Water Corporation of WA begins operation.

2013 A 5.8km portion of MSCL conduit near Meckering is installed underground. The non-operational portion remains in situ

Phase IV - *Heritage Recognition and The Golden Pipeline*

1992 *No. 6 Steam Pumping Station (fmr), Ghooli* and *Old Pumping Station* (Dedari) entered on State Register of Heritage Places

1998 *No. 3 Pumping Station* (Cunderdin) entered on State Register of Heritage Places

The Water Corporation and the National Trust of Western Australia reach an agreement whereby all heritage aspects of the former *Goldfields Water Supply Scheme* would be managed by the National Trust under the name of the Golden Pipeline Project.

77 Hartley, 2007, pp. 420-421.
78 Hartley, 2007, pp. 420-22.
79 Curtin, 2001, Place R, p. 13
80 Hartley, 2007, p. 429
81 Hartley, 2007, p. 432-35

1998 Conservation works undertaken at No. 8 Station Dedari.[82]

1999 The Water Corporation transfers significant portions of original phase infrastructure and assets under the management of the National Trust of Western Australia.

The National Trust commission a Conservation Plan for the *Goldfields Water Supply Scheme* as part of the Golden Pipeline Project.

2000 *No. 1 Pumping Station Museum* (Mundaring)*; Mount Charlotte Reservoir* entered on State Register of Heritage Places

2001 *Mundaring Weir Hall* entered on State Register of Heritage Places

2003 The National Trust of Western Australia launches the Golden Pipeline Heritage Trail on the 100th anniversary of the opening of the Goldfields Water Supply Scheme. The trail utilises historical research, personal recollections of former workers and residents of the pipeline communities across a range of mediums including on-site interpretation, publications and website.

Mundaring Weir Hotel entered on State Register of Heritage Places

2005 *Goldfields Water Supply Scheme* placed on the Heritage Council of Western Australia's Assessment Program.

2009 *Goldfields Water Supply Scheme* recognised by the American Society of Civil Engineers as an International Historic Civil Engineering Landmark

2011 *Goldfields Water Supply Scheme* listed on the National Heritage List in recognition of the outstanding heritage value of the place to Australia. The sites of the original eight steam pump stations were included within the definition of the place.[83]

Ongoing Operations

The pipeline has been continually upgraded and maintained with pipes replaced or repaired as necessary. A notable feature is where older pipes have had patches welded to seal previous leaks, which is typically accompanied with a signature in the steelwork of the person who undertook the welding.

Isolation valves located at approximately 5km intervals used to isolate sections of the pipe to undertake repairs and maintenance. There is a plethora of other ancillary equipment and structures that also exist, including decommissioned elements which remaining in-situ; an eternal expression of a stage in technology that is now superseded and replaced with more modern means. The retention of superseded structures and equipment also reflects the isolated nature of many of the facilities along the *Goldfields Water Supply Scheme*.

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82 P583 *Old Pumping Station* (RHP) Curtin Institute 1999 Conservation Plan for Goldfields Water Supply Scheme, Vol II Place M – No. 8 Pumping Station Dedari, p. 32

83 Department of Agriculture, Water and the Envirnoment, National Heritage Places - Goldfields Water Supply Scheme Gazettal Notice, Source:https://www.environment.gov.au/system/files/pages/72f536d0-007a-4d75-978b-eb7dca71fef9/files/1060075.pdf, Accessed March 2021.

Portions of the main conduit are reaching the end of their service life. Some portions have been installed below ground as part of ongoing maintenance by the Water Corporation. The Water Corporation proposes to remove the extant above-ground conduit and progressively install new pipe below ground, over an estimated 50-year period, retaining portions for public education and interpretation purposes.

13. 2 PHYSICAL EVIDENCE

Overview

Goldfields Water Supply Scheme begins at Mundaring Weir in the Helena Valley and spans just over 560km to Mount Charlotte Reservoir, northeast of Kalgoorlie. It is located within an operational water catchment, storage and delivery system that provide water supplies to the Wheatbelt and Goldfields regions of Western Australia. The pipeline (commonly referred to as the 'main conduit') originally formed part of a system along with a dam and eight steam pump stations designed to overcome the difficulty of pumping water uphill over such a great distance. Reservoirs were also built along the pipeline to act as receiving and suction tanks, to regulate water flow in the main conduit and for service or storage purposes. Today, the system works in the same way but with the use of modern electric pump stations, equipment, treatment plants and storage tanks. A network of pipes also branch off the main conduit in a north and south direction to feed agricultural areas.

The place comprises a discontiguous precinct between Mundaring Weir and Mount Charlotte Reservoir, comprising built structures, items of equipment and machinery, archaeological sites; and small portions of the main pipeline conduit in the vicinity of the steam pump station sites associated with the construction and operation of the Pipeline from 1902 to the present. It also includes modified and intact natural features which all contribute to the functionality of the system and importantly the significance of the place. They combine to create a large and tangible piece of infrastructure that was a direct result of the discovery of gold in Western Australia. It became an engineering scheme of national and international technological importance that continues to be used to the present day. All physical components are a direct result of the functional needs to transport water safely and efficiently.

The overall character and built fabric of *Goldfields Water Supply Scheme* varies across such a huge site, however the place reflects the continuing operation of the Pipeline and its importance as a major working piece of public infrastructure that is continually changing over time. Advances in technology and increased demand over the years have created a continually evolving system. Never static, it continues to change in its physical manifestation through necessary upgrades, new structures and repairs. Structures that are no longer in use and superseded have typically not been removed and remain in-situ as physical remnants across the site.

Place Identification

To define the curtilage of *Goldfields Water Supply Scheme* it is necessary to understand the pre-existing infrastructure that established its route, and how the system was originally designed and operated in its geographical context. It is these aspects that fundamentally inform the significant physical structures for inclusion.

Pre-existing Infrastructure

The route of the *Goldfields Water Supply Scheme* was fundamentally determined by the original railway line to the Goldfields, which in turn was largely dictated by the establishment of natural features of wells and rock water catchments along its course. These provided a seasonably reliable supply of water with many in fact already previously used by Aboriginal people as watering holes. This aided the construction of the railway and the efforts of collecting and supplying water for steam locomotives, which became inextricably linked to the establishment and construction of the pipeline. Portions of steel pipe manufactured in Perth were transported along the route with the size of railway wagons determining the length of pipe. To minimise on site transportation, pipes were simply rolled off the train directly into trenches.

Original Design and Context [84]

Drawing on natural resources, the system was based on a simple 'pump up, gravity feed down' design, using eight pump stations and a series of concrete tanks that acted as combined receiving and suction tanks. The water from Mundaring Weir was lifted 126.5m over about 2.4km into an open concrete tank at No. 2 Steam Pump Station O'Connor. From there the water was pumped about 37km and lifted 103.3m to a concrete regulating tank at Bakers Hill. From here the water was gravity fed 28.6m over 19.3km to the second regulating tank at West Northam. From here the water travelled another 66km on a slight decline to the existing railway dam (acting as a receiving tank) in close proximity to No.3 Steam Pump Station Cunderdin. It was then pumped through to Steam Pump Stations Nos. 4, 5, 6, 7 and 8 against a steady rise over 349km to an elevation of 444m. From the last station at Dedari, the water was pumped another 19.3km to the main service reservoir at Bulla Bulling. Water flowed from there for 29km to a minor service reservoir on Toorak Hill, overlooking Coolgardie at the elevation of about 465m. This was in fact the original planned termination point of the pipeline but was changed whilst under construction and extended to Mount Charlotte Reservoir at Kalgoorlie.

Curtilage

Associated and connected with the main conduit that form part of the historic and in some cases the current functionality of the place is a vast number of built structures, features and components dispersed across the site. Due to their historical, engineering or technological innovation, the following individual elements contribute to the cultural significance of *Goldfields Water Supply Scheme*:

- The main reservoirs of Mundaring Weir and Mount Charlotte Reservoir;
- The sites of the eight original steam pump stations, including:
    - The six extant buildings, associated infrastructure and equipment (No. 1 Steam Pump Station Mundaring, No. 3 Steam Pump Station Cunderdin, No. 4 Steam Pump Station Merredin, No. 5 Steam Pump Station Yerbillon, No. 6 Steam Pump Station Ghooli and No. 8 Steam Pump Station Dedari)

84 All distances and heights are extracted from Curtin Institute, 2001, Conservation Plan for Goldfields Water Supply Scheme, Vol II Place S - Bakers Hill Regulating Tank, p.7.

    - The sites of the two demolished stations (No. 2 Steam Pump Station O'Connor and No. 7 Steam Pump Station Gilgai);
    - The pump community buildings associated with the original construction and early operation of the Scheme at Mundaring Weir Village (1898-1909), including Mundaring Weir Hotel (1898; 1906), Mundaring Weir Hall and the former school;
- The second generation electric pump station (1956) located at No.4 Merredin;
- The remaining original receiving tanks located at No. 2 Steam Pump Station O'Connor, No. 4 Steam Pump Station Merredin, No. 5 Steam Pump Station Yerbillon, No. 6 Steam Pump Station Ghooli, No. 7 Steam Pump Station Gilgai and No. 8 Steam Pump Station Dedari;
- The three regulating tanks located at Bakers Hill and West Northam, in addition to the archaeological remnants associated with the work depot site at West Northam;
- Summit tanks (1911) located at Sawyers Valley (No. 1), Bronti (No. 5) and Koorarawalyee (No. 6);
- The two storage tanks (reservoirs) located at Bullabulling and Toorak Hill;
- The Karalee Reservoir, Rock Water Catchment Aqueduct[85] (1897); and
- Portions of main conduit in close proximity to the above.

Pipeline (Main Conduit)

The original pipeline commonly referred to as the 'main conduit' is approximately 560km in length and commences at Mundaring Weir and terminates at Mount Charlotte Reservoir in Kalgoorlie. Much of the pipeline is aligned with the current Great Eastern Highway and sits above ground.

Currently the pipeline consists of different construction types that have been developed over the years, which are supported on reinforced concrete anchor blocks at approximately 50m intervals. For identification and management purposes, the Water Corporation has installed a numerical marker at 1km intervals along the pipe starting at Mundaring. Still in use today, the pipeline is in operating condition and continues to service the community.

Sourced from Water Corporation data obtained in 2015,[86] the table below sets out the different construction types of pipe, the percentage it makes up of the whole main conduit, dates installed and corresponding length. It is also noted that of 2015, 90.6% of the pipeline was above ground.

Pipe Construction Type	% of Main Conduit	Dates Installed	Length
Locking Bar	43.4 %	1901-1920s	280 km
Kellerberrin Pipe	4.6 %	1938-1958	29.5 km
MSCL (Mild Steel Cement Lined)	52 %	1926-Present	335 km

85 P10062 *Karalee Reservoir, Rock Catchment & Aqueduct* (RHP)

86 Water Corporation. "Goldfields and Agricultural Water Supply Main Conduit Pipe Age."

Small portions of above ground pipeline conduit associated with the original Steam Pump Stations, Tanks and Reservoirs are included in the *Goldfields Water Supply Scheme*. The majority of the main conduit is not included.

The following representative portions of the main conduit are included as examples of the extant conduit, recognising that different construction types, and portions demonstrating historic repairs, welding signatures, and sections connected to key pieces of infrastructure, might also be considered to exemplify the conduit and *Goldfields Water Supply Scheme* as a whole.

- Portions of decommissioned pipe on Mundaring Weir Road in proximity to the site of No. 2 Steam Pump Station O'Connor.
- Section of pipe to the north of No. 5 Steam Pump Station Yerbillon. Approximately 100m in length.
- Section of pipe to the north-west of No. 6 Steam Pump Station Ghooli. Approximately 100m in length.
- Section of pipe to the south of receiving tank at site of No. 7 Steam Pump Station Gilgai. Approximately 100m in length.
- Section of pipe to the north of No. 8 Steam Pump Station Dedari. Approximately 100m in length.

Mundaring Weir (1902)

Mundaring Weir (Dam) marks the start of the *Goldfields Water Supply Scheme* and is a large dam built in 1902 to store water to be pumped along the pipeline. It is located at Weir Road, Mundaring in the valley of the Helena River on the western slopes of the Darling Range, 30 km east of Perth and 8 km south of Mundaring. The weir dams the Helena River and is positioned at the narrowest part of the valley with the lake stretching in a south-easterly direction for 16km. The two main arms of the lake to the east and south-east are fed by the Helena River and the Darkin River respectively. Mundaring Weir comprises the weir wall, spillway, foot walk across the crest of the weir (reconstruction of the original), Valve House (1946-51), Lower Valve House (no longer in use); and Stilling Pond at wall base (1946-51).

The weir wall and spillway is a concrete structure and when completed in 1902 measured 41m in height above the lowest foundation level.[87] The height of the wall was raised to 71m in 1951 to increase the dam's capacity. While the weir wall has been raised, it retains its original 1902 appearance and profile. The distinctive feature of the works were the measures taken to ensure that the original and new concrete bonded together to act monolithically. When the wall was raised the steel walkway and railings together with the turret like roof of the Valve Tower were re-fitted on the new wall to replicate the original appearance. The spillway is located on the west side of the weir and allows the discharge to flow over the dam face onto the granite rock foundations. It has been identified as a nationally significant example of an early twentieth century ogee spillway[88].

87 Doherty, L (2000) 'Gravity dams', in Cole, B (ed) (2000) Dam technology in Australia 1850-1999. Australian National Committee on Large Dams Inc, Penrith.

88 Kinstler, Frank (1999): "Buttress Dams" in Cole, B (ed) (1999) A history of dam technology in Australia 1850-1990, Institution of Engineers, Australia. Australian National Committee on Large Dams, p.151.

Mount Charlotte Reservoir (1902)

Mount Charlotte Reservoir marks the end point of the *Goldfields Water Supply Scheme*, and was constructed in 1902 at the top of Mount Charlotte located to the east of Kalgoorlie. It is a naturally existing geological landscape formation within which a reservoir tank has been built for the storage and delivery of water. It has a landmark presence and is currently still in use and operated by the Water Corporation for the supply of water to the town.

The reservoir is also a tourist attraction as the end point of the Golden Pipeline Heritage Trail, with clearly delineated areas for public and restricted access. It is accessed via a bitumen road off the Great Eastern Bypass from the north-east side of the site. Pipelines that feed water in and out of the tank come from the south and west. There is evidence of foundations and remains of other structures used during the years to control water delivery. Rows of trees line both sides of the pipeline with paths, benches and other similar landscaping. As per other areas, there are remnants of discarded pipework and equipment dispersed across the site.

Excavated into the top of the hill, the structure of the reservoir was constructed of rendered reinforced concrete. Water enters the reservoir through an inlet pipe and is stored in the tank with a two million gallon (9 million litre) capacity.[89] An overflow channel extends from the western edge of the reservoir. Originally the water was used for mining sites and residences in Kalgoorlie with it now having additional water mains to feed other areas.

Very little of the tank is visible as it is covered with a steel deck roof of unknown date that was installed to prevent fouling of the water. The circular reservoir is ringed with modern security fencing ensuring public safety and preventing access. The summit houses a number of communication aerial masts and associated buildings. To the north west of the site is a stone cairn, which may have once held a flagpole. To the east there is a newly created landscaped access to the summit with a number of shelters, seating and interpretation boards dedicated to the importance and history of the pipeline to the community. There are also some ancillary structures to the south of the hill that are accessed via steps, bitumen pathways and a dilapidated old brick meter house.

The reservoir is still in use today serving as a reserve to another tank that has been built on Mount Percy to the north, which serves as the main holding tank for pumping water out. The place is also used for recreational purposes as a lookout where a contemporary structure has been built.

Steam Pump Stations (1902)

These are prominent and historic landmark structures that all form an integral part of the *Goldfields Water Supply Scheme*. There are six remaining of the original eight built in 1901-02 that used steam powered engines to push water up and over the height of the Darling Range and then onto the Goldfields – a total lift of 340m and a distance of 560km.[90] Stations were positioned so that water could be lifted

89 Curtin University Research Institute for Cultural Heritage, Conservation Plan for Goldfields Water Supply Scheme, Place Mount Charlotte Reservoir, prepared for the National Trust of Australia (WA), 2000, p.23.

90 The Golden Pipeline, Information Sheet Number 5, Building the Goldfields Water Supply Scheme, prepared by the National Trust of Australia (WA).

the same height between each of them. Close proximity to the railway was also important for the delivery of building materials and machinery.

The table below lists the steam pump stations in linear order starting from Mundaring Weir moving eastwards towards Kalgoorlie with their approximate distance from the start, net lift and notable features.[91]

Location	Distance	Net Lift	Notes
No. 1 Mundaring Weir	0 km	126 m	Drew water directly from Mundaring Weir via a standpipe. First of eight similar stations. Current use: Museum.
No. 2 O'Connor	2 km	104 m	Demolished 1968. High archaeological potential. Pumped water to Bakers Hill Regulating Tank from where it gravitated to West Northam Regulating Tank before flowing down to the reservoir serving No.3 Pump Station.
No. 3 Cunderdin	119.2 km	66 m	Did not have a receiving tank adjacent to the building. Instead, use was made of a railway dam a short distance away. Current use: Museum.
No. 4 Merredin	219.1 km	101 m	Last in line of the larger pump stations (three pumps). Had a circular receiving tank rather than rectangular. Current use: Unoccupied.
No. 5 Yerbillon	270.5 km	16 m	First of the smaller pump stations (two pumps). Current use: Unoccupied.
No. 6 Ghooli	342.5 km	32 m	Tall steel chimney a dominant marker. Originally fuelled by coal. Weighbridge and children's playground equipment still remain. Current use: Unoccupied.

91 Distances taken from Water Corporation G&AWS Main Conduit Pipeline Kilometer Mark, Changes, Localities and Facilities, dated May 2018.

Location	Distance	Net Lift	Notes
No. 7 Gilgai	393 km	17 m	Demolished c. 1970s. High archaeological potential. Known as Siberia due to remote locality. Receiving tank still remains.
No. 8 Dedari	465.4 km	55.7 m	Pumped water to Bullabulling Tank where it gravitated to Coolgardie. Most intact of all the Pump Stations with machinery and boilers still remaining. Current use: Unoccupied.

Each pump station was constructed between 1901 and 1902 and comprise brickwork masonry construction with a pitched roof of corrugated iron sheeting. No.1 drew water directly from Mundaring Weir and No.3 Cunderdin used an existing railway dam. The other six stations were constructed with an adjacent large concrete receiving tank (or suction tank) to hold water that flowed from the previous station and from which water was then pumped onto the next.

The first four stations are approximately three stories in height with the last four being smaller in scale due to the lesser amount of work demanded of the facility. The buildings are simple functional structures designed by the Public Works Department with the involvement of architect George Temple Poole. Standardisation was a guiding principle in designing the machinery for the pumping station, so that parts would be interchangeable. However the various Pump Stations that housed the machinery were all slightly different.

The buildings are not readily categorised into a particular architectural style but do display characteristics of utilitarian industrial structures built in the Federation era of load bearing walls and brickwork piers. There are also affinities with Romanesque architecture with the detail of arched and circular openings, Renaissance style entrance canopies, timber eaves brackets, and Georgian style cast iron windows. With standardisation being a guiding principle, the design and layouts of each station are similar consisting of open volume spaces of a boiler and engine room separated by a passage. As an independent structure adjacent to the boiler room, each station has a tall brick or steel chimney, which became dominant features in the landscape.

The external materials of the station buildings are red brickwork in English bond with cast iron frame windows and timber doors. The roofs are made up of a series of steel trusses with timber purlins that are expressed in the gable ends to create deep overhanging eaves. The designs are essentially functional but do indicate that there was considerable pride in the housing of the machinery and the system in general. The buildings are both expressive and representative of the ambitious engineering and infrastructure schemes of the time of its construction. Most of the buildings remain relatively unchanged from their original design and function.

Since their decommissioning and closure in the 1950-60s, the steam pump stations have either been converted into museums, demolished or remain

unoccupied. The Steam Pump Stations at Mundaring and Cunderdin have both been conserved and adapted into museums open to the public exhibiting original equipment and memorabilia associated with the pipeline. The station at O'Connor was demolished in 1968, with the only remains being that of a retaining wall of the coal bin and the engine mounts showing through the soil indicating its former presence. It is described as probably one of the most traditionally picturesque of places along the *Goldfields Water Supply Scheme* with its surrounding woodland setting.[92] In contrast the site of No. 7 Steam Pump Station Gilgai, which was demolished in the 1970s has few visible physical remains of where the building once existed and is in a very remote and arid landscape. The unoccupied Steam Pump Stations at Merredin, Yerbillon, Ghooli and Dedari remain unoccupied and have been made secure with a perimeter security fence to prevent unauthorised access.

In relatively close proximity to all stations, there are many notable remnant structures and features associated with the history of the place such as coal bins, railway formations and weigh bridges. There are also modern utility structures used by the Water Corporation, as the areas surrounding the stations typically continue to be used as operational pumping sites. Of particular historic note with regards to the immediate context of the more remote stations, are the communities that developed around each site comprising houses for the work force, schools, children's playgrounds, gardens and tennis courts. Little of this fabric remains in some locales, and none in most, but where extant it presents a small but somewhat poignant reference into the lives of people who lived and worked at each site.

Due to the nature of the operational use of the buildings, constant inspection and maintenance led to a lot of repairs and replacement of tools and components that in turn created a number of dumping sites. Where present, these former rubbish tips and ash dumps are highly likely to comprise archaeological artefacts and deposits associated with the operation of the stations and the people who lived there, but are also contaminated with asbestos.

Later Generation Pump Stations

As pump technology advanced, electrically driven machinery replaced the steam pumps and as such new pump stations were built to replace the original structures. Replacement stations were built adjacent to the originals but additional electrically powered stations were also dispersed along the pipeline to meet growing demand associated with population growth and the branch main extensions. Some were built as Booster Stations to supplement the intermediate power that was needed. Later stations built in the 1950-60s are all typically of rudimentary brickwork masonry construction, concrete floor slabs and shallow pitched metal roofs. More recent stations built from 1980s onwards are all typically steel framed with metal cladding and of utilitarian architectural expression.

As an example of the changes in technology across the pipeline and ongoing use, the second generation pump station constructed in Merredin, located close proximity to the original steam pumping station complex forms part of the *Goldfields Water Supply Scheme.*

92 Curtin Institute, 1999, Place B, p.15.

Electric Pump Station at Merredin (1956)

Located at the 219 km mark from Mundaring Weir along the course of the pipeline is the now redundant second generation pump station located at Merredin. It is located directly to the south of the original No.4 Steam Pump Station and circular receiving tank. It is also located in close proximity to the current operational pump station built in 2001, which helps to physically represent the changes in technology over the years of essentially the same function. The building was built in 1956 and is of brickwork masonry construction and of similar scale and mass as the original 1902 pump station. It is L-shape in plan with a pitch metal roof sheet covering and vent along its ridge. Similar to the original pump station, it has low and high level windows that indicate the continuing need for natural light to operate the equipment. Much of the machinery appears to be remaining inside with pipework to its perimeter.

Tanks

There are a variety of tanks built along the *Goldfields Water Supply Scheme* that serve to act as receiving, holding and or suction tanks, to regulate flow in the main conduit and for service or storage purposes.

The table below lists the tanks that are included as exemplars within the *Goldfields Water Supply Scheme,* starting from Mundaring Weir moving eastwards towards Kalgoorlie with their approximate distance from the start, type of tank and notable features.[93]

Location	Distance	Type	Notes
O'Connor, Mundaring	2 km	Receiving Tank	Shape: rectangular. Current use: Not in use and uncovered. Infilled for safety reasons.
Sawyers Valley	5.5 km	Summit Tank	Shape: circular. Current use: Not in use, uncovered and remains empty. Built 1911 as a remedial component. Superseded by the later construction of two later tanks built in close proximity in 1935 and 2007, both operational. [These are not included in the curtilage of the place]
Bakers Hill	36.6 km	Regulating Tank	Shape: square. Current use: Empty but remains operational with roof covering.

93 Distances taken from Water Corporation G&AWS Main Conduit Pipeline Kilometer Mark, Changes, Localities and Facilities, dated May 2018.

Location	Distance	Type	Notes
West Northam	55.5 km	Regulating Tank	Shape: rectangular. Current use: Empty but remains operational with roof covering.
Merredin	219.1 km	Receiving Tank	Shape: circular. Current use: Not in use, uncovered and remains empty.
Yerbillon	270.5 km	Receiving Tank	Shape: rectangular. Current use: Operational with roof covering.
Ghooli	342.5 km	Receiving Tank	Shape: rectangular. Current use: Operational with roof covering.
Bronti		Summit Tank	Shape: circular. Current use: Decommissioned, uncovered and remains empty. Built 1911 as a remedial component.
Gilgai	393 km	Receiving Tank	Shape: rectangular. Current use: Not in use, uncovered and remains empty.
Koorarawalye e Tank		Summit Tank	Shape: circular. Current use: Decommissioned. Built 1912 as a remedial component; roof added c. 1981; removed for safety reasons in 2022.
Dedari	465.4 km	Receiving Tank	Shape: rectangular. Current use: Not in use, uncovered and remains empty.
Bullabulling	482.6	Storage Tank (Reservoir)	Shape: rectangular. Current use: Not in use, uncovered and remains empty.
Toorak Hill, Coolgardie	514.6 km	Storage Tank (Reservoir)	Shape: circular. Current use: Not in use, uncovered and remains empty.

Receiving Tanks (1902)

Receiving tanks (also referred to as holding or suction tanks) were built adjacent to the steam pump stations into which water was delivered from the previous station. When required, pumps would draw from the receiving tank to send water further along the pipeline to its next destination. Each of the original structures built at the same time as the pump stations during 1901-1902 are extant, although only the tanks at Yerbillon and Ghooli remain operational.

All receiving tanks are located directly adjacent to their corresponding pump station. Rectangular tanks all constructed in the same fashion being a raised concrete structure supported by earth battered retaining walls to all four sides. Where covered they have a pitched metal roof covering to reduce evaporation and contamination. The tank at Merredin is unique in that it is circular in form and set down approximately two thirds of its depth below ground.

Where tanks are not in use there are perimeter security fences in place. The tank located at No. 2 O'Connor recently been infilled for safety purposes. It has a stone gravel top surface with the concrete kerb retained for interpretation that recognises its footprint. As the only remaining intact structures on site, the receiving tanks at the No. 2 O'Connor and No. 7 Gilgai are of particular physical importance in communicating the story of the *Goldfields Water Supply Scheme*.

Regulating Tanks (1902)

Regulating tanks were built as part of the original design along the *Goldfields Water Supply Scheme* in 1902 and served an important functional need to reduce extreme pressures along the pipeline. One was built at Bakers Hill to control water pressure in the main conduit as it left the highest point on the Darling Range after No.2 O'Connor on its way down to the railway dam at Cunderdin. The other regulating tank was built at West Northam to reduce the extreme possible pressure on the pipes in the Avon Valley and regulated the flow to keep pressures at a minimum and in regular working order. The regulating tanks were also used for emergency storage and although both currently empty, they still remain operational as a reserve facility whilst undertaking maintenance works.

Both tanks comprise a reinforced concrete structure set into an earthen bank with a pitched metal sheet roof covering. The sides of the tanks have a stepped slope in much the same way as the other below ground tanks are built. They have a 500,000 gallon (2,275,000 litre) capacity, approximately 5m depth and are excavated 3m below ground.[94] The tank at Bakers Hill is located adjacent to the old railway line, just off the Great Eastern Highway with an old working depot in close proximity[95]. Historically both places had housing to accommodate a permanent workforce on the site, which is no longer extant, although above-ground and subsurface archaeological evidence and exotic plantings at the West Northam location are evident. The area adjacent to the tank at West Northam is currently used as storage for replacement pipework.

Summit Tanks

Six summit tanks were constructed at the high point between the original steam pump stations at Sawyers Valley, Kellerberrin, Merredin, Nulla Nulla, Bronti and

94 Curtin Institute, 2001, Place S, p.8.

95 The working depot is not included in the curtilage.

Koorarawalyee. They were built following reports of corrosion of pipework that recommended the building of tanks at the highest point between each station. Although of later construction than the original components, they served an integral part of the *Goldfields Water Supply Scheme,* designed to eliminate a particular problem, which improved upon the performance of the original design.

Summit Tank No.1 was built at Sawyers Valley; the highest point between No.2 Steam Pump Station O'Connor and Bakers Hill. Similarly, the summit tanks at Bronti and Koorarawalyee are located between the stations at Ghooli, Gilgai and Dedari. The purpose was to maintain the head of water in the tank to keep the pipeline full at all times. This prevented additional air being absorbed into the water and also took some of the pressure off the pump station. The tanks are above ground, circular, straight sided and of reinforced concrete structure. The imprint of the formwork is still evident in the surface of the concrete. Water was supplied and discharged via valve pits to each tank. The tanks are expressed as purely functional engineered structures with their stark industrial form and materiality contrasting with their natural setting. The tank at Sawyers Valley previously had a floating roof to reduce aeration and contamination, which has since been removed. The roof of the Koorarawalyee tank was removed in 2022 due to safety concerns.

Storage Tanks (Reservoirs)

There are currently many storage tanks (also referred to as reservoirs) located along the *Goldfields Water Supply Scheme* that have been added to meet growing demands. Of particular note and significance are the original tanks at Bulla Bulling and Toorak Hill built in 1902 that were a key component of the original system. Both have since been decommissioned and remain empty and uncovered.

Bullabulling Reservoir is a rectangular tank of sloping concrete sides located on a hill part way between No. 8 Steam Pump Station Dedari and Coolgardie. It had a capacity of 12 million gallons (45.4 million litres)[96]. Originally, the task of this holding reservoir was to store water before it was gravity fed, when needed, to Toorak Hill Reservoir at Coolgardie. Its particular location was chosen for its elevation to support the gravity feed. The former inlet pipe enters the tank from the south and the outlet pipe leaves via a deep trench. There is an overflow to the centre of the north wall. An interesting design feature is the use of barbed wire reinforcement to prevent cracking in the concrete. Expansion joints are also evident to address movement and temperature change. There are remnant structures around the site of previous housing. Due to its size it has a commanding presence in the landscape which demonstrates its importance to the *Goldfields Water Supply Scheme.*

Toorak Hill Reservoir (or tank) was originally intended as the endpoint of the pipeline, but by the time it was completed and operational in 1902, Kalgoorlie replaced Coolgardie as the centre of the Goldfields. Its location was determined because of its elevation to provide sufficient fall for the reticulation of Coolgardie. The construction involved excavation of the crown of Toorak Hill to form a pit, with fill used to form an embankment approximately 6m high to protect the sides. The tank is a round concrete structure of straight sides, approximately 100m in

96 Curtin University Research Institute for Cultural Heritage, Conservation Plan for Goldfields Water Supply Scheme Volume II Place N Bulla Bulling Reservoir, prepared for the National Trust of Australia (WA), 1999, p.6.

circumference (31m in diameter)[97]. There is evidence of significant historic cracking and patch repairs throughout the lining of the tank. There are various remnant trenches, pipework and valve pits around the site. Of particular note is the remains of a concrete walled structure with roof missing that used to be the Break Pressure Well. The high elevation of the reservoir's location provides a vantage point over Coolgardie and as with other concrete tanks it expresses a purely functional engineered structure, with its stark industrial form and materiality contrasting with its natural setting.

Rock Water Catchments

Rock Water Catchments were a system using gravity and the rock surface of naturally occurring granite outcrops to divert heavy rainfall to collection areas such as wells and storage reservoirs. Water was a scarce commodity, so to ensure regular supply for the functioning of the eastern railway line; innovative water catchments were devised in land using the outcrops. Granite does not contain any salt so the water was almost salt free which was advantageous to the railways as it prevented scale build up in the locomotive boilers. Many of these reservoirs were in fact constructed for the railways and are often referred to as railway dams. Although not a purpose-built component in the operation of the *Goldfields Water Supply Scheme*, they represent key pieces of pre-existing infrastructure that was used to assist with the functioning of the railway and supported the route and construction phase of the pipeline, and provided supplementary water supply and storage as required.

Karalee Rock Water Catchment (1897)

A notable example of a rock water catchment is at Karalee, located approximately 55km east of Southern Cross. *Karalee Reservoir, Rock Catchment & Aqueduct* (RHP) consists of an intriguing array of natural and constructed elements that was designed to harvest water to supply to the railway stretching between Southern Cross to Coolgardie.

The catchment area consists of two large granite outcrops. Water flowing off the rocks is dammed by approximately 6km of stone perimeter walling, from which water is directed to an outlet at the lowest point of the rock that becomes the entry to a flume. Of the two rock formations, the larger one referred to as No.1 still retains the flume consisting of a stone sluice with water gates and a steel aqueduct supported by a timber frame structure. There are no remains of these structures for the other smaller rock formation referred to as No.2. From the end of the aqueduct, water is diverted to a large earthen sunk reservoir, which stored water to be pumped to nearby railway tanks. Although no longer in use the reservoir currently contains water with the overflow ramp still remaining. The site also contained many other interesting structures that are no longer extant, including two hotels and a historic stone lined well located to the south west of the reservoir. The catchment supplied water for steam locomotives until the 1950s, after which it was connected to the *Goldfields Water Supply Scheme* as a supplementary storage and supply until the 1980s.

97 Curtin University Research Institute for Cultural Heritage, Conservation Plan for Goldfields Water Supply Scheme Volume II Place V Toorak Tank, prepared for the National Trust of Australia (WA), 2001, p.35.

With its remnant engineered structures, in particular the elegant aesthetic of the aqueduct, the place is a representative form in an evocative setting describing the importance of water collection and storage in a remote and arid landscape.

Pump Communities

Due to the isolated nature of the *Goldfields Water Supply Scheme*, most of the workers associated with the original construction, and the first 70 years of operation, lived in close proximity to the place. Work camps, offices, depots, schools, family residences, and caretaker's cottages were constructed near the original eight steam pump stations, in Mundaring and Mount Charlotte, reservoirs, regulating tanks and other infrastructure.

The pump community buildings at the Mundaring Weir Village include Mundaring Weir Hotel, Mundaring Weir Hall, and the Mundaring Weir School & Quarters (fmr)[98] and are associated with the period when Mundaring Weir was a flourishing community chiefly made up of workers associated with the pumping stations, and their families.

While there are a few residences still remaining at some pump stations complexes, including Dedari, Ghooli and Merredin, these are generally in poor condition. The cottage at No. 8 Dedari remains in use and is in good condition.

The various sites of the original pumping stations and the surrounding pump community complexes have the potential to provide further information regarding both the operations and the lives of those who lived there, through investigation of surface and sub-surface archaeological artefacts and deposits. This would vary depending on the nature of later development in the vicinity, as well as the level of asbestos contamination and consequent remediation that has been undertaken at each site. Exotic plantings in the location of former accommodation also provide evocative evidence of the communities of families established by those living in isolated areas.

Sites comprising archaeological evidence of former accommodation and other community structures include the station sites in and nearby to No. 5 Yerbillon, No. 6 Ghooli, and No. 7 Gilgai. The regulating tank at West Northam was also the site of a work depot and comprises both above ground and sub-surface remains of former accommodation, including exotic plantings, and service equipment in proximity to the existing conduit.

98 P1675 *Mundaring Weir Hotel* (RHP); P1676 *Mundaring Weir Hall* (RHP), P8540 Mundaring Weir School & Quarters (fmr).

13. 3 COMPARATIVE INFORMATION

Principal Australian Historic Theme(s)

- 2.2 Adapting to diverse environments
- 3.4.5 Utilising natural resources
- 3.5.3 Developing agricultural industries
- 3.11.5 Establishing water supplies
- 3.14.1 Building to suit Australian conditions
- 3.14.2 Using Australian materials in construction
- 3.16 Struggling with remoteness, hardship and failure
- 3.17 Inventing devices
- 3.2 Supplying urban services (water)
- 4.6 Remembering significant phases in the development of settlements, town and cities
- 8.10.5 Advancing knowledge in science and technology
- 8.11 Making Australian folklore

Heritage Council of Western Australia Theme(s)

- 106 Workers
- 107 Settlements
- 108 Government Policy
- 110 Resource exploitation and boom
- 111 Demographic settlement and mobility - Depression and boom
- 112 Demographic settlement and mobility - Technology and technological change
- 303 Mining
- 309 Occupations - Technology and technological change
- 310 Manufacturing and processing
- 311 Hospitality industry and tourism
- 506 Tourism
- 507 Water, power, major transport routes
- 604 Innovators

Comparative Analysis

The *Goldfields Water Supply Scheme*, also known as the Golden Pipeline, is recognised and valued as one of the greatest engineering and infrastructure schemes of its time.

In the eighteenth century, most water pipelines were constructed in cast iron. By the nineteenth century, rapid industrialisation in steel processing, mass-production, assembly lines necessitated and expedited the delivery of water, gas, and oil to residential areas and factories. This led to the development of the steel pipe in the 1860s. O'Connor's design for two reservoirs connected by 560km below-ground steel pipeline, supported by six steam pump stations and associated infrastructure utilised traditional, new and custom-built technology, engineering and architectural design.

At the time of construction, it was the longest steel pipeline built not only in Australia, but the world, for water, gas or oil. It is also significant for the continued use of attested design and technology as well as innovative solutions, trialling and implementing numerous purpose-built features to ensure the longevity of the

scheme. In 2021, the main conduit remains one of the longest freshwater pipelines in the world, servicing more than 100,000 customers, farms, mines and other enterprises in the Wheatbelt and Eastern Goldfields regions.[99]

There are few places in Australia that are directly comparable to the *Goldfields Water Supply Scheme*.

Two gas pipelines constructed in Western Australia that are comparable in length, however both were constructed in the late twentieth century, representing much later technology. The 1,488km Dampier to Bunbury Natural Gas Pipeline - Withnell Bay to Wagerup section was constructed from 1983. The 1,378km Goldfields Gas Pipeline began transmitting in 1996. Both are buried steel pipelines.

SA Water in South Australia manages five major pipelines distributing water from the Murray River, the majority of which were constructed after 1940. The most comparative pipeline is the 641km Morgan to Whyalla Pipeline which comprises two lines built in the 1940s and 1960s and supplies a number of small towns and farming districts from the River Murray *en route* to Whyalla.[100] The town of Whyalla was established in the early 1900s as a base for iron ore workers for a local mine. The growth of the mine and industry was dependant on a potable water source, hence the construction of the pipeline in 1940. This pipeline is similar to that of the Kalgoorlie pipeline in that it contributed to the development and growth of a remote mining community and supplied fresh water from a long distance away. It is likely that the *Goldfields Water Supply Scheme* was considered as an example at the time of design and construction.

As an engineering and architectural achievement, *Goldfields Water Supply Scheme* was unique to Western Australia and Australia at the time of construction, as demonstrated by its recognition by the American Society of Civil Engineers as an International Historic Civil Engineering Landmark.

Other comparable places of engineering achievements relating to the provision of freshwater in Australia in the nineteenth century include:

- Goulburn Historic Waterworks Museum, at Marsden Weir, Goulburn, NSW. Built between 1883 and 1885, the steam operated pumping facility provided Goulburn's first reticulated water supply, and is a rare intact example of steam powered municipal water supply. The buildings and engine are listed on the NSW State Heritage Register and recognised by the Australian Engineering Heritage Recognition Program.
- Evandale to Launceston Water Supply Scheme, Tasmania. Intended to transport water from the south Esk River via an open channel to Launceston, providing irrigation for farms and powering flour mills, the scheme began in 1836 but was never completed. Recognised by the Australian Engineering Heritage Recognition Program.
- Launceston Water Supply, Tasmania. Established in 1857 the gravity scheme consisted of a diversion weir, water race and tunnel delivering water into Distillery Creek whence it was piped to the High Street and Hill Street

99 Water Corporation - Preliminary Documentation August 2021, p. 24

100 SA Water, Government of South Australia, Source: https://www.sawater.com.au/water-and-the-environment/how-we-deliver-your-water-services/the-pipeline-network, Accessed October 2021.

reservoirs and provided Launceston its first reticulated supply. . Recognised by the Australian Engineering Heritage Recognition Program.

- Hunter River District Water Supply, the Walka Water Supply Scheme, NSW. Constructed in 1880 and in use until 1945, the flexible pumping system allowed the one set of pumps to be used for all pumping at the source (suction from the river, pumping to and from the storage lagoon and the various tanks, and pumping onwards to the high level reservoir). The system was unique at the time for the design and building of filters to treat the water.
- The Stawell Water Supply, Victoria. Following the 1850s discovery of gold in the Stawell area, the need for a reliable water supply was first met by the construction of two large dams. However limited catchment area and pollution from the nearby mines compromised the system. The construction of the Stawell Water Supply system, which diverted water from the Grampians-fed Fyans Creek, commenced in the early 1870s, designed as an entirely gravity-delivered system without any pumping plant. Some of the components of the original water supply system are still in operation today.

Two comparable examples of engineering achievements relating to the provision of freshwater in the United States around the same era, include the excavation of the Main Channel of the Sanitary and Ship Canal between Chicago and Lockport in Illinois to dilute sewerage being dumped into the river in 1900. In 1913, the Los Angeles-Owens River Aqueduct was constructed to the design of another Irish immigrant and transported water 380km from the Owens River to Los Angeles.[101]

The above examples demonstrate that there was a commonality in the requirement for secure water supply for growing populations across Australia and elsewhere at the turn of the twentieth century. However, the successful construction and sheer scale of the *Goldfields Water Supply Scheme,* was a rare example of its type in Australia.

13. 4 KEY REFERENCES

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13. 5 FURTHER RESEARCH

There are likely to be further references to many aspects of the Goldfields Water Supply Scheme in diaries, correspondence, family albums, publications, oral histories and newspaper articles. Research into these would improve the understanding of the social significance of the *Goldfields Water Supply Scheme* to Western Australia.

After the closure of the steam pump stations along the *Goldfields Water Supply Scheme*, much of the machinery and equipment was removed, as were some houses and associated structures. Archaeological investigation of these areas is likely to provide more information about the operation of the individual places, and the way of life for the workers and the families that lived near the sites and participated in the ongoing operation of the Pipeline throughout the twentieth century.

The gold mining industry required massive amounts of timber for construction and fuel. Boilers, including those powering the steam pump stations along the Pipeline, required a continuous supply of fuel[102]. By 1900 most of the timber surrounding Kalgoorlie had been cut, leading a large timber cutting and supply industry that took advantage of the railway and access to thick stands of Australian timber.[103] Large temporary settlements were established alongside the railway lines, including sawmills and other facilities, as well as residences for workers for up to 500 men. Wood produced from cutting camps was hauled to the railhead by horse drawn

102 Throughout the design of the scheme and during the original operation, Collie coal was the main source of fuel for the pumps. Hartley, 2007, p. 15

103 Saunders, S. J. 1956, 'The history of the Woodlines and their association with the Gold Mining industry, Address to members of the WA Historical Society, document provided by Damien Wood, Water Corporation; Western Australian Museum, 2017, WA Goldfields, The Woodlines, Source: http://museum.wa.gov.au/explore/wa-goldfields/environmental-impacts/woodlines. Accessed July 2021.

vehicles and delivered to main mining centres via narrow gauge railway lines or 'woodlines'.[104] Portions of the vast network of 'woodlines' established between 1892 and 1960 are occasionally visible from the existing pipeline conduit or the adjacent original pipe trench, and the original Goldfields railway line, demonstrating the relationship between the industries. Further research into the relationship between the woodlines, railway lines and the original route of the main conduit prior to the 1933 raising may demonstrate additional information in the form of landscape and archaeological features and deposits.

104 Saunders, S. J. 1956, 'The history of the Woodlines and their association with the Gold Mining industry, Address to members of the WA Historical Society, document provided by Damien Wood, Water Corporation.