HUNTER WATER
SECTION s170 REGISTER

ITEM NAME:

Tomago Sandbeds Scheme

Contents:

Item details
Historical Overview
Heritage Status
Heritage Significance
Description
Management
Key Images
References

ITEM DETAILS

Item Name	Tomago Sandbeds Scheme
Other / Former Names	Tomago Sand Scheme
NSW SHI No.	3630052
Plant No.	Multiple
Local Government Area	Port Stephens
Lot and DP	Multiple (refer to associated mapping/GIS data)
Address	Multiple (refer to associated mapping/GIS data)
Curtilage	The curtilage of this asset is defined by its physical extent and corresponds only partially to associated legal allotment boundaries. Though Campvale 8 (Tomago) Vacuum Pumping Station is located outside of the curtilage for the Scheme due to land ownership configurations, it is still considered to form part of the Scheme as a Hunter Water heritage asset.

View of the Water Treatment Plant

Asset location and curtilage (red boundary) (refer to Figure 1 for additional detail)

Current Use	Water extraction, treatment and distribution
Former Use	N/A
Designer / Builder	Hunter District Water Board

Historical Notes

The idea of obtaining a supply of water from sand beds to meet the needs of the Newcastle area was first born in mind of J.B. Hensen, the first Board Engineer, as early as 1907-08. At this time however, referring to the existence of extensive sand beds north of the Hunter River Estuary, Henson's suggestions were largely ignored. The matter of the sand beds was again raised in the mid to late 1910s, during investigations by the Parliamentary Standing Committee for Public Works into a proposal to obtain a supply of water from the Chichester River. The sand beds idea was raised in response to local interest in the provision of a supply of cheap water for industrial purposes.

The Board had met with great difficulty in satisfying the requirements of the recently established BHP Co. Ltd. Under the Walka Water Supply Scheme, and consequently, BHP made determined attempts to establish a private water supply from the Stockton Sand beds, believing that such a supply of second-class water would be far cheaper than Chichester. At first, the State Government rejected all suggestions that the sand beds be used as a source of water, and the Board was prepared to fight the issue, as the granting of permission to obtain water from the sand beds would be highly detrimental to its interests. Additionally, the Board had already obtained control over much of the Tomago Sandbeds area by 1916, thereby posing another obstacle to BHP's plan of establishing a private source.

However, despite the State Government going on to approve the Chichester Scheme, the debate continued, and the prospect of obtaining a cheaper water supply from the sand beds for the all-important industries of the region could not be ignored. As such, on 16th January 1920 the Public Works Department published a report on the Newcastle and Hunter River District Water Supply, which ultimately authorised the investigation of the sand beds' potential. In this report, the Parliamentary Standing Committee recommended the investigation of the sand beds as a result of the strong representations made by industrial and manufacturing parties in Newcastle.

The Committee declared that the evidence was unanimous that an ample supply of fresh water for manufacturing purposes was vital to the development of the district by greatly aiding industrial expansion. It reported that supporters argued that water pumped from sand beds situated on the Stockton side of the Hunter River would be of a suitable quality for manufacturing purposes and could be delivered at a lower cost than water from the Chichester River Gravitation Scheme. As such, J.B. Henson was authorised to investigate the sand beds as a potential source of water supply.

Following initial experimentation, investigations were carried a step further in 1922 with the installation of a small pumping station. This original trial pumping plant comprised of a horizontal duplex steam pump with boiler, suction and delivery pipes. The suction pipe was connected to twenty 2-inch tube wells with strainers at bottom and was sunk into the water-charged sand. Whilst the site of operations was flooded in May 1921 for several months following heavy and frequent rainfall, the pumping plant was eventually drained and operated for about three months. The 111-day trial found the water to be of a very good quality, being both soft and of a high purity. Initial investigations also proved the depth of water bearing sand to be 15 to 20 m.

However, despite the success of these early tests, prejudice against groundwater as a source of supply was still alive. Investigations into the possibility of obtaining a water supply from the sand beds were to continue for over 30 years before the first water from the Tomago Sandbeds was to enter into the Board's water supply system, with most of the research undertaken by the Board in the 1920s and 1930s oriented to learning about the characteristics of the Tomago ground-water area.

In the 1933-34 Annual Report it was announced that a scheme was being formulated by the Board's officers, by which groundwater would be pumped from shallow wells sunk in the water bearing sand strata of the sand beds area at Tomago into the Board's water supply network. The extensive investigations that led to the formulation of this scheme consisted mainly of topographical surveys of the area and the sinking of trial bores to test the underlying strata, the behaviour of the water level, and its quality under pumping conditions. Water samples were regularly collected and analysed by the Board's chemist to check quality and movement of groundwater.

The route of a delivery pipeline was investigated and selected, and an access road into the pumping station site from the Hexham-Williamstown Road surveyed and levelled. Extensive aeration experiments to eliminate dissolved gases in the groundwater were carried out, and the best means of sinking the casing in which the well points would be placed investigated. The best method of gravel packing the points to obtain the optimal yield and the type of screen for the wells, amongst other things, was also investigated. 1933-34 also saw a suitable site for the first pumping plant at Tomago selected, and surveys plotted and used to determine suitable locations for the layout of future plants. Estimates of capital and annual expenditure of various alternative schemes were also prepared at this time, which saw the conclusion being drawn that electrical power appeared the most advantageous way to power the pumping plants.

The final scheme design, completed in 1935-36, suggested that the water from the sand beds area was to be kept separate from the Chichester supply. This entailed the laying of a separate pipeline direct from the sand beds area to Waratah, where it was proposed one of the existing reservoirs would be used for storage. As such, the water from the Chichester System would be used to full capacity, with supply from the sand beds area only brought into use during limited periods.

Construction on the scheme began in 1936-37, with work carried out under the Relief Works Scheme. During the 1938-39 financial year, drought conditions saw construction on this first unit (Pumping Stations No's. 1 and 2) of the Sandbeds Scheme sufficiently advanced to permit the delivery of water from the Tomago Pumping Station to Waratah Reservoir on the 3rd January 1939, an event in itself, being the first time that water from the sand beds had entered the system.

Officially completed by the close of the 1938-39 financial year, Vacuum Pumping Stations No's. 1 and 2 comprised two electrically driven pumping plants which, after drawing water from the sand beds, delivered it into a common spray basin (Spray Basin No. 1), before it was delivered by secondary pumps in the No. 1 Pump House or the Main Pumping Station (officially completed in 1939) through five miles of 20-inch pipeline to Sandgate.

The effect of the drought on the Stockton-Raymond Terrace Sandbeds Scheme extended beyond this first pumping station. With the fall of the water level in Chichester Dam, the Board gradually approved the extension of the sand beds scheme to a total of fifteen pumping stations in the wake of fears of serious water shortages. Tomago Pumping Station No's. 3 and 4, authorised in June 1939, were completed in December 1940, with pumping commencing in March 1941.

Whilst delays in the construction of the remainder of the extended scheme were experienced due to the war situation, all units of the major extension and a second trunk delivery main were available for use by the close of the 1941-42 financial year. On 4th November 1944 the Tomago Sandbeds Scheme was officially opened by the then Premier William McKell. On 29th May 1945 the then retiring Vice-President Mr T.J.D. Kelly placed a casket containing records from the investigation and development of the Tomago Sands Scheme in the wall at No. 2 Spray Basin during an inspection.

Almost from the time of the official opening of what would be only the first phase of the Tomago Sands Scheme, investigations continued into the future development of the sand beds as a major source of water supply. On the 19th May 1944 Board was furnished with a report, which suggested the acquisition of the remaining viable property in the area, including the area between Pumping Station No. 2 and the Pacific Highway. The necessary action was subsequently carried out to resume the land and attain covenants over land bordering on the acquired land in order to protect the Board's interests. These works were largely completed by the 1950s.

Observations in connection with the utilisation of Grahamstown Channel as an auxiliary to the Tomago Water Supply Works were also carried out at this time. To increase the quantity of water available to Board the Tomago Sandbeds Scheme was again strengthened in 1951, with five new primary pumping stations constructed, bringing the total to twenty. In 1953-54 investigations into the determination of sites for Vacuum Pumping Stations No's. 16 and 17 (which had commenced in 1952) were underway. Pipelaying for these stations commenced on 7th October 1954 and the bore pump wells were sunk between 20th June and September 1955.

Boring to fix the location of Primary Pumping Station No. 18, which was designed to operate similarly to Station No. 19, as a deep bore type operating through a common booster pump, commenced in December 1953. Construction at the site commenced on 30th April 1954, with pipe laying starting on 25th May. This primary pumping station was completed in 1955-56, with one production bore at this location re-sunk in May 1970.

Construction of Station No. 19 commenced on 18th June 1953, and was completed during October 1954. The station was placed in operation on 8th December 1954; however a second booster pump was not installed until the following year.

Investigations into the erection of Station No. 20, situated near the Blue Lagoon, were completed in 1952-53 and on 6th February 1953 construction commenced. The first bore of this station was sunk on 25th August 1953, and the last on the 11th December 1953. With the pipe work having been completed on 28th August, the station first contributed water to the system on 4th December 1953. Several tube wells were also converted to deep bore pumps during this period (see details of modifications to Vacuum Pumping Station, outlined below).

As a consequence of these expansions the sand beds assumed precedence over Chichester Dam as the greater water produced for a number of years in the 1950s. After this time however, the delivery of water from Chichester was increased by completion of gravitation main amplification. An additional four miles of 20-inch cast iron cement lined pipeline running parallel with existing primary pipeline at Tomago was completed in May 1956. In the mid-1960s, it was decided to construct 36, 42 and 48-inch pipelines to connect No. 2 Spray Basin to the 12 million gallons a day Tomago Water Treatment Plant and Tomago-Grahamstown Pumping Station. New outlets were also provided at this time from the spray basin.

In the late 1960s it was discovered that extensive deposits of mineral sands occurred within the catchment area of the Tomago Sandbeds, which fell within land held under prospecting leases by Rutile and Zircon Mines (Newcastle) Pty Ltd. Whilst originally objecting to applications by the mining company to mine two areas partly within the catchment, the Board later withdrew these objections. Consequently, the company were permitted to extend their mining operation into the western fringe of the Board's areas to enable the Board to assess the effects of mining on the sand beds.

The results of these investigations were made available to the Board, and it was concluded that the mining as carried out, caused significant increases in groundwater iron content. The increase in iron content appeared to have been mainly due to a reaction occurring within the slimes layer deposited at the bottom of the dredge pond. There was no significant change in permeability of the sand recorded in the area being mined, however. Overall, the consultants were of the opinion that mining could be carried out within the Tomago Sandbeds provided the company removed all slimes from their dredge pond. As such, the consultants for both the Board and company, together with the Board's staff and the Department of Mines, formulated a set of special conditions which were to be applied to mining carried out within the sand beds area.

These conditions were set out in 1970-71, and in the Annual Report from 1971-72 it was noted that the mining company had accepted the conditions imposed and lodged financial guarantees with the Board and the Department to ensure their compliance.

As such, Rutile & Zircon Mines (Newcastle) Ltd. Commencing extractive mining within the restricted lease areas on 8th November 1972. In 1978-79 the No. 6 Vacuum Pumping Station was relocated in order to allow the sand mining to continue, with the No. 1 Bore at No. 3 Primary Field Station reconstructed the same year, following the completion of rutile mining in that immediate area.

The sedimentation tanks at Tomago No. 1 and No. 2 Water Treatment Works were both inspected and cleaned, and the underwater steelwork was repaired as required in 1971-72, as well as extensive overhauls and repairs being carried out on the flocculator paddles of No. 2 Water Treatment Works. The late 1970s saw the commencement of work on the reconstruction of tube wells and interconnecting pipework at both the No's. 7 and 9 Primary Field Stations. Under these works, the tube wells and pipes were withdrawn and replaced in PVC tubing fitted with stainless steel screens. In the 1977-78 Annual Report it was noted that this was work which needed to be systematically carried out in the following years at most Tomago Field Stations.

In January 1981 construction of a new field station, No. 21, was commenced. With work entailing the sinking of sixteen bores with an average depth of 20 m the station was fully operational by early 1981/82. In the 2000-01 Annual Report it was announced that works to expand the Tomago Borefield capacity with the completion of new bores, a new booster station, treatment plant upgrades and other refurbishment works had been completed. Contracts for this work had been let in 1999-2000, with design work for the expansion of the assets having been completed in 1998-99.

The Main Pumping Station at Tomago

Secondary Pump House No.1 or the Main Pumping Station at Tomago, was officially completed in 1939, and has since undergone progressive alterations and improvements. In the late 1940s it was found that this secondary pumping plant was not sufficient to deliver the designed capacity of 25 million gallons per day, and as such, approval was given for its amplification by the installation of three additional electrically operated pumping units, each capable of delivering approximately seven million gallons per day, including switch gear and all ancillary work.

The necessary extensions to the northern end of the building were completed in 1949-50, with the installations of the pumping units finished in 1951-52. A control room was constructed at the Main Pumping Station in 1963-64, and from 1966 new pumps were installed to provide for the delivery of extra supplies facilitated by the extension of pipelines and the inclusion of Grahamstown water into the system. A Hydraulics Laboratory was also established on the site around this time.

Details of Vacuum Pumping Station Modifications

Vacuum Pumping Station No. 2, officially completed by the close of the 1938-39 financial year, was renovated and painted in the early 1950s. Vacuum Pumping Stations Nos. 3, 4, 5 and 6 were selected in 1954 to be converted from tube well pumping stations to deep bore pumps. With work commencing in July 1954, Stations 3 and 6 were completed in October of the same year. Construction on Pumping Stations No's. 4 and 5 however, was suspended during the summer periods to enable the existing stations to be available. As such, Station No. 5 was not completed until 1955-56, and Vacuum Pumping Station No. 4 was only completed in 1959, and the station placed in operation on 17th January 1959.

In 1980-81 two bores at Vacuum Pumping Station No. 4 were reconstructed.

Tomago-Grahamstown Water Treatment Works

The first unit of a Water Treatment Plant (the Tomago-Grahamstown Treatment Works) was constructed at Tomago under contract for the Board in the late 1950s. The plant was installed with the plan that it would treat up to six million gallons of water per day from Grahamstown Dam, at that time in the process of construction, in the future.

The Treatment Plant was constructed adjacent to No. 1 Secondary Pumping Station, Tomago, with work commencing during October 1957. Another element of the works associated with the construction of the Water Treatment Plant at Tomago, also situated adjacent to No.1 Secondary Pumping Station, was the Clear Water Reservoir. A 2,000,000 gallon circular reinforced concrete tank, the Clear Water Reservoir was constructed to receive treated water from the Water Treatment Plant, to provide a suitable pumping well for the No. 1 Secondary Pumping Station and to provide an emergency storage of treated water. Construction on the Reservoir also commenced in 1957-58.

The Water Treatment Plant was officially opened on 6th February 1959, by the Hon. J. J. Cahill, MLA, Premier and Colonial Treasurer after several experimental runs. It was not handed over to the Board for some time however, as the contractors carried out a number of equipment adjustments and attended to some constructional deficiencies. The plant treated Tomago Sandbeds water until October 1964, when it began treating Grahamstown water. The treatment processes carried out at the Tomago-Grahamstown Treatment Works included dosing with aluminium, lime and chlorine. After a flocculation and sedimentation process, the water was filtered through rapid sand filters, then passed to the Clear Water Reservoir ready for delivery to service reservoirs at Waratah and North Lambton.

On 12th November 1963 a contract was let with John Thompson (Australia) Pty Ltd for the design and construction of a 12 million gallons per day water treatment plant, to be erected adjacent to the existing water treatment plant at Tomago. This second treatment plant was placed in service on 25th March 1965, opened by the then Premier, the Honourable R.W. Askin.

Subsequently it was decided that an additional treatment works was required to increase supply from Grahamstown Dam, and the design for new treatment works, to be situated on a high site at Tomago known as Boy’s Home Hill, completed. The clearing of sites for sludge lagoons and the treatment plant, as well as the construction of roads, started on 31st May 1967. Construction work was nominally completed on 2nd April 1971. As both water treatment plants at Tomago came to be required to treat Grahamstown water in the summer of 1967-68, it became necessary to treat the water from Tomago Sandbeds in the North Lambton Reservoir. This practice of treating only Grahamstown water at Tomago-Grahamstown Nos. 1 and 2 Water Treatment Works continued for the greater part of 1970-71 also, as it was found to be economically preferable.

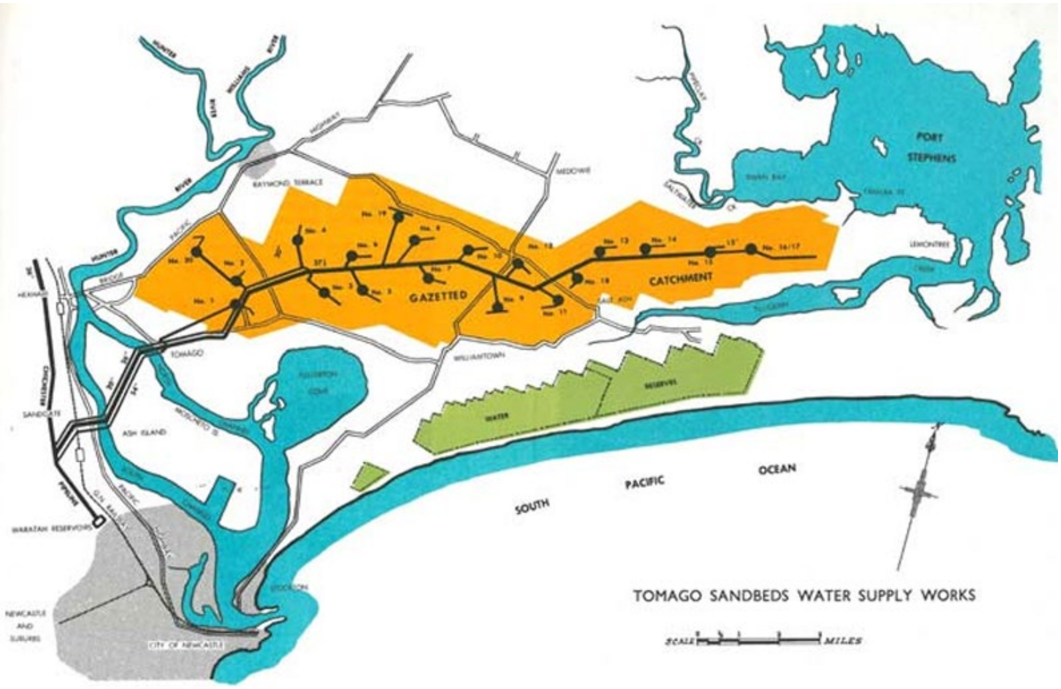


Figure 2: Historical plan of the Scheme

Source: Hunter Water Corporation

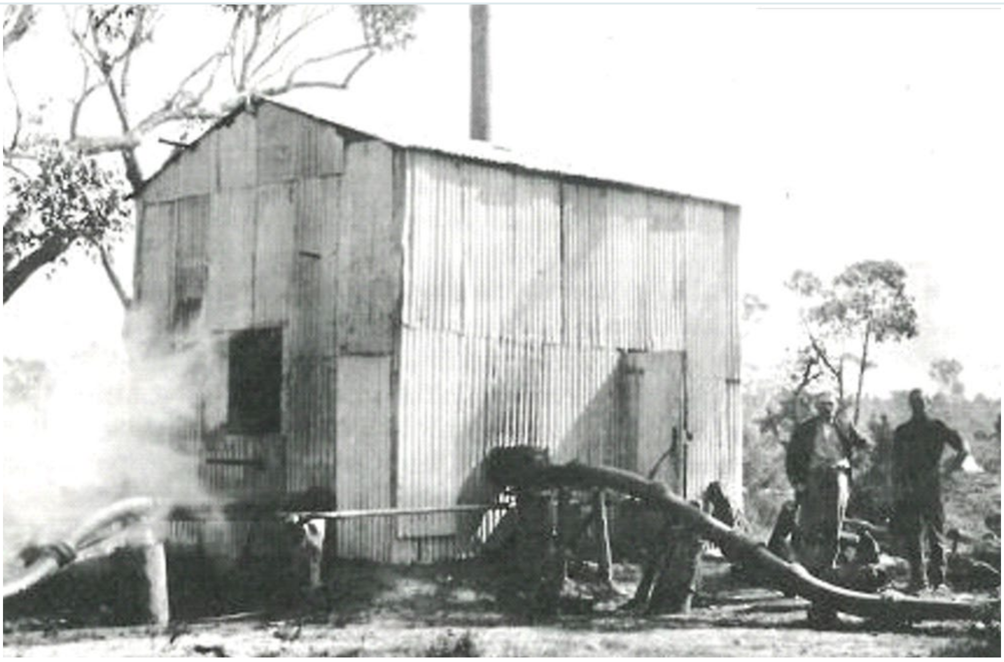


Figure 3: First pumping trial in 1922

Source: John. W. Armstrong, "Pipelines and People"

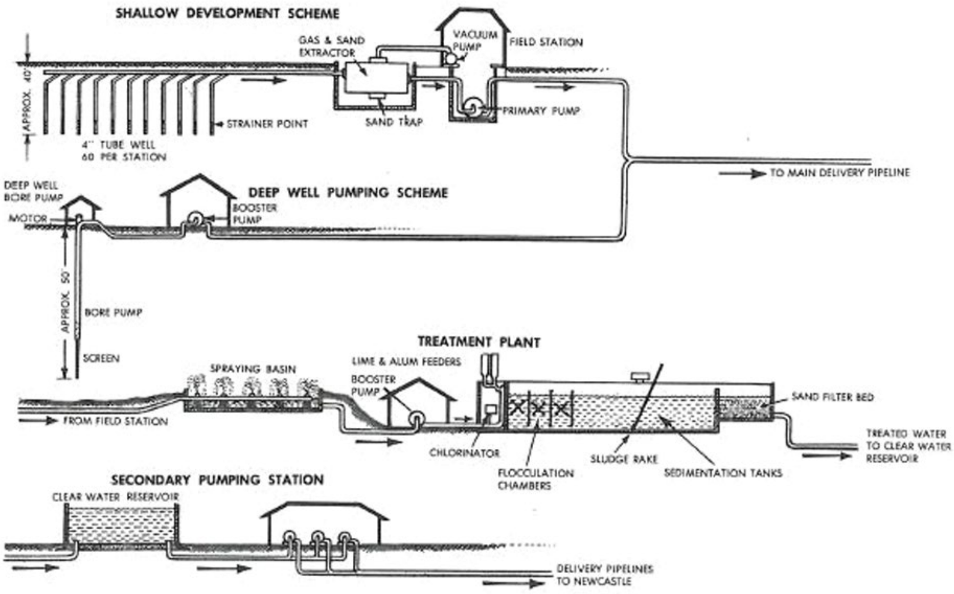


Figure 4: Historical section of water extraction and treatment processes

Source: John. W. Armstrong, "Pipelines and People"

HERITAGE STATUS

Listing Details	☒ S170 Heritage and Conservation Register ☐ Local heritage listing ☐ State heritage listing
Conservation Management Plan	☐ N/A
Heritage Asset Action Plan	☐ N/A
Aboriginal Sites Registered within the Site	AHIMS search undertaken on 12 July 2023 for the asset curtilage with a 50 m buffer. Six Aboriginal sites were registered within the search area.
Historical Archaeological Potential	Not assessed. It is assumed that any historical archaeological potential associated with the curtilage of this asset will be associated with structures/elements of the Sandbeds Scheme that have been removed over time.

HERITAGE SIGNIFICANCE

Level of Significance	Local
Statement of Significance	The Tomago Sandbeds Scheme is of local significance as the third major expansion of the water supply system within the Newcastle area. It was innovative in its approach, eschewing the large-scale engineering which as required for the construction of the Chichester Scheme, opting instead for a series of small-scale bores and pumping stations which extracted water from the aquifer rather than storing it within a reservoir. The Scheme continues to supply a significant portion of the potable water for Newcastle. Supplemented and altered over time, some early elements of the Scheme survive, such as the spray basins (No. 1 and No. 2) and Campvale 8 (Tomago) Vacuum Pumping Station, while other elements have been upgraded, replaced or been rendered redundant. As a collective resource, the Scheme is of historical value, represents the technical achievement of the Scheme as an innovation, and has aesthetic value as a cohesive collection of interrelated infrastructure, some of which is unusually decorative.
NSW SHR Criteria	☒ a) Historical ☐ b) Associative ☒ c) Aesthetic / Technical ☐ d) Social ☐ e) Research Potential (yield new information) ☐ f) Rare ☒ g) Representative
Significant Elements	• The overall layout and configuration of the Scheme and the visual interrelationship between buildings/structures of significance (see below). • Spray Basin No. 2 (late 1930s/early 1940s) (see **Addendum 1**). • Tomago No. 8 Vacuum Pumping Station (see **Addendum 2**). • Round concrete reservoir.

- Water Treatment Plant (1950s).
- Tomago 1 Water Pump Station (Main Pumping Station) (late 1930s).
- Stone Survey Marker.
- The Chichester Dam Model (located within the Hydraulics Lab) (subject to individual s170 listing).

Though both Spray Basin No. 1 and Spray Basin No. 2 remain intact, Spray Basin No. 2 is considered to be the more elaborate and ornate example, particularly given its associated gardens and the installation of a casket containing historical records within its wall, it also remains operational. Spray Basin No. 2 has therefore been identified as the more significant and representative example of the two.

Similarly, a number of vacuum pumping stations remain extant in association with the Scheme. Though the No. 2 Vacuum Pumping Station remains extant, it has been completely refurbished and contains little original fabric. Campvale 8 (Tomago) Vacuum Pumping Station therefore represents the oldest, intact vacuum pumping station remaining within the Scheme.
Other vacuum pumping stations are understood to remain extant, noting that Campvale 8, as a result of its age and integrity, has been identified as the most significant example of this building type remaining.

The remaining buildings, such as the round concrete Reservoir, Tomago 1 Water Pump Station and Water Treatment Plant reflect the historical development of the Scheme over time, and represent aesthetically distinctive examples of the kinds of architectural styles employed in association with the Scheme. The scale and collective configuration of these buildings contributes to an understanding of the Scheme's history.

The stone survey marker present within the curtilage is reported to date from 1841 and is inscribed as such.

DESCRIPTION

Setting

The Tomago Sandbeds Scheme covers 130 square kilometres of largely uncleared land adjacent to the Grahamstown Dam, roughly from the northern shore of the estuary of the Hunter River to the southern shore of Port Stephens and Stockton Bight on the Pacific Ocean.

Whilst the sand beds form bare dunes near the beach, elsewhere they appear as low hills, moor and swamps covered by scrub and timber.

External Appearance

The Tomago Sandbeds Scheme includes a variety of components, not all of which are original or significant. These components include:

- the bores and bore pumps, which draw water from the sand beds
- the vacuum pump stations which draw the water to the other end of the Scheme
- the spray basins (# 1 is decommissioned) which aerated the water
- the water treatment plants (decommissioned) which treated the water, and the pumping stations which pump the water into the reticulation system.

The overall Scheme is a complex network of multiple elements, with the original layout and configuration of the Scheme remaining readily legible from an aerial perspective. Based on the ongoing changes and upgrades that have occurred to the Scheme over time, significant fabric/elements are now relatively limited, with the overall significance of the Scheme as a whole being derived primarily from its historical significance and representative value as an innovative, technical achievement on a large-scale. The curtilage of the asset reflects the remaining, intact physical elements of the Scheme.

	A stone survey marker has been identified within the curtilage of the Scheme. It is inscribed with 'W. BRETT A.D. 1841'. A plaque installed below it notes: *Hunter District Water Board* *This stone marks the northeastern corner of Portion 11 Parish of Stockton originally granted to Thomas Walker on 31st January 1839. It is presumed to have been placed by the third owner William Brett when he acquired the land from Charles Croker on 14th October 1841.*
Internal Appearance	N/A
Overall Condition	Good
Moveable Heritage Objects	Various moveable heritage items are stored within buildings across the Scheme. To better understand moveable heritage associated with this asset, targeted investigation, assessment and cataloguing is required. Known moveable heritage objects include: • Scale models including the Chichester Dam Model. • Venturi Water Meter. • Historical photographs. • Salvaged equipment. • Miscellanea such as padlocks, bottles, maps, etc. The majority of these objects are stored within the Hydraulics Lab.

MANAGEMENT

Approval and Assessment Requirements	Minor or inconsequential impacts: Anything other than routine repair and maintenance must be discussed with the Environment Team to determine the level of heritage assessment required. More than minor or inconsequential impacts: As above. Additionally, consultation with the relevant local council is required. Demolition or removal from the register requires consultation with Heritage NSW and archival recording.
General / Ongoing Management	• Changes within the defined curtilage should be preceded by the appropriate level of heritage assessment and approval. Advice and/or confirmation should be sought from the Environment Team prior to undertaking any works. • Changes to fabric may be supportable if no feasible alternative is available to ensure ongoing operation and/or safety. • Removal of non-significant elements (such as contemporary equipment, buildings, etc.) is supportable. Any replacements must be appropriate/sympathetic. • Consider the preparation of a Heritage Asset Management Plan (HAMP) or Conservation Management Plan (CMP) for the entirety of the Tomago Sandbeds Scheme. This is necessary to fully understand the extent of significant fabric, structures and elements associated with this asset.

Priority Conservation Works	• Undertake investigation, assessment and robust cataloguing of moveable heritage items stored in buildings within the asset curtilage. • Undertake inspections and assessments of the structure and condition of significant elements identified within this inventory sheet and repair/replace elements as required. Priority should be given to structural stability, weatherproofing and safety. • Investigate concrete failure/cracking to the round concrete Reservoir and repair/stabilise as required. • Investigate spalling to aggregate concrete façade of Tomago 1 Water Pump Station and patch/repair as required. • Check over metal elements to Tomago 1 Water Pump Station and investigate rust/corrosion. Undertake repairs/treatment as required.

KEY IMAGES

Image 1: Water Treatment Plant

Image 2: Tomago 1 Water Pump Station (Main Pumping Station)

Image 3: Interior of Tomago 1 Water Pump Station (Main Pumping Station) showing roof form and ceiling detail and contemporary equipment

Image 4: View of round concrete Reservoir

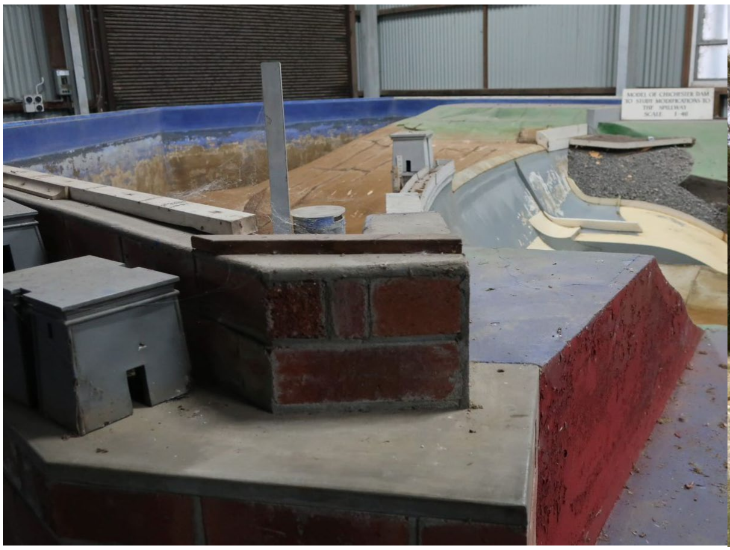


Image 5: Scale model of Chichester Dams stored within the Hydraulics Lab

Image 6: Campvale 8 Vacuum Pumping Station

Image 7: Tomago Spray Basin No. 2

Image 8: Tomago Spray Basin No. 1

Image 9: Stone survey marker

Image 10: Plaque beneath stone survey marker

REFERENCES

- Clem Lloyd, Patrick Troy and Shelley Schreiner 1992, For the Public Health. The Hunter District Water Board 18921992. Publisher: Longman Cheshire Pty Ltd, Melbourne.
- Department of Public Works, Annual Reports, 1888 to 1892 and 1893-94 to 1960-61.
- Futurepast Heritage Consulting Pty Ltd, 2010, 'Hunter Water Conservation and Heritage Register Study'.
- Glennie Jones 1967, The Movement for Newcastle's First Water Supply 1875-1885, Newcastle History Monographs No. 2. Publisher: The Council of the City of Newcastle, Newcastle.
- Hunter District Water Board, Annual Reports, 1938-39 to 1987-88.
- Hunter District Water Supply and Sewerage Board, Annual Reports, 1897-98 to 1937-38.
- Hunter Water Board, Annual Reports, 1988-89 to 1990-91.
- Hunter Water Corporation, Annual Reports, 1991-92 to 2008-09.
- John W Armstrong 1967, Pipelines and People. The History of the Hunter District Water Board Newcastle, New South Wales. Publisher: The Hunter District Water Board, Newcastle.
- Mal Hindley 1983, 'From Weirs, Dams and Sand', in Shaping the Hunter. Publisher: The Newcastle Division of the Institute of Engineers Australia, Newcastle.

umwelt

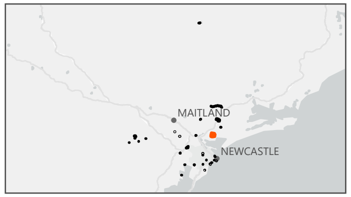
FIGURE 1

S170 Review - Heritage Curtilages

Legend

- Road
- Railway
- Lot Boundary
- Heritage Curtilages
- NPWS Reserve

Tomago Sandbeds Scheme



0 500

Metres

Scale 1:12,500 at A4

GDA 1994 MGA Zone 56

Image Source: ESRI Basemap (2022) **Data source:** NSW DFSI (2022)