A panoramic view across the Clarence River entrance to the Iluka Training Wall with the landward end of the South Breakwater and Turner's Beach in the foreground. The first 1000 feet of breakwater was built in the early 1860s. It was 100 years before construction was restarted to finish it. *Photo: Ian McNeil*

The Clarence River Breakwater Story

Part 1 – The South Head Quarry Railway

by Ian McNeil

Preamble

Most visitors to the coastal resort towns of Yamba and Iluka on the NSW North Coast cannot help but notice the dominating presence of the two huge breakwaters that extend into the sea at the mouth of the Clarence River. The more perceptive may also spot the half-submerged and apparently ruinous rock walls extending a long way upstream in the middle of the river, and speculate as to their purpose. Few realise that both the breakwaters and the mid-stream walls are essential parts of an integrated system that still regulates tidal flows and river currents at the river mouth.

The history of the Clarence River breakwater system is wide-ranging and spans a period of over 110 years. It is a multi-threaded story of hard work and enterprise, of financial constraint and political indecision, and of engineering expertise and armchair criticism. It is a long story, and to do it justice it is being told in five parts in chronological order, each part centring around one of the quarry railways which supplied stone for the various breakwaters and training walls.

Part 1 covers the early breakwater works at Yamba which were the southern part of Edward Moriarty's 1860s scheme to improve the Clarence River entrance, and the role of the 1½ mile South Head Quarry Railway in its construction.

The Clarence River

In the early days of European settlement on the NSW North Coast, roads were non-existent and all communication and transport was by sea. There were no natural harbours, and settlements developed where navigable rivers and waterways gave access to the sea. The off-shore bars and shoals that obstructed their entrances were responsible for multiple shipwrecks amongst the fleet of sailing vessels and early steamships that plied the coast.

Pressure mounted on the NSW Colonial Government to improve conditions, and in response the Harbours and Rivers Branch of the Public Works Department[1] began a program of breakwater and training wall construction up and down the coast. The Government used a sizable portion of its loan funds from 1860 until the early 1900s in often futile attempts to render river entrances safer to navigate.

The Clarence River is the largest coastal river system in NSW. It rises near Tenterfield on the eastern slopes of the Great Dividing Range and flows for nearly 250 miles to the sea. It drains an extensive area of north-eastern NSW extending from the Queensland border down to Coffs Harbour. Many tributary rivers and creeks add to its flow.

Towards the coast the river passes through an extensive flood plain containing two large anabranch lake complexes and several large islands bounded by secondary channels. It flows into the sea at Clarence Heads between the towns of Yamba and Iluka.

European settlement in the Clarence River valley began in the 1830s. The highly fertile soils of the alluvial flood plain along the lower reaches of the river were once thickly covered in sub- tropical rainforest and immense red cedar brushes. The first to arrive were the cedar cutters who were attracted by the wealth of this red gold. After the Robertson Land Act of 1861, large numbers of free selectors settled in the Clarence valley, clearing the land and raising crops of maize and sugar cane.

Grafton was established 40 miles upriver at the head of deep-water navigation, and grew to become the most important town on the river. Coastal steamers came up the river to Grafton while shallow-draught vessels could push on a further 25 miles to Copmanhurst. For nearly 100 years the river was a major highway for the export of timber and agricultural produce to city markets. From the mid-1860s onwards there was a twice-weekly passenger steamer service to Sydney, while river boats serviced the smaller settlements up and down the river.

The mouth of the Clarence River was difficult to navigate and required a high degree of skill by river pilots and ship captains. Like most rivers on the NSW coast the entrance was obstructed by an off-shore bar of shifting sand. The channel across the bar constantly varied in direction and depth. There was also a pair of shallow reefs just inside the entrance with only a narrow passage between them. To negotiate the reef and the bar often required vessels to sail close inshore with the attendant risk of being driven onto Iluka beach in heavy seas.

Before the construction of the ocean breakwaters and river training walls seen today, the configuration of the entrance to the Clarence varied considerably. Its southern limit was fixed by the rocky headland of South Head at Yamba, but its northern extent was poorly defined by the unstable Iluka Peninsula. In years of low to average rainfall, the interaction of river flow and the north to south longshore current built up sand and sediment to form the North Sand Spit. This extended the Iluka peninsula southwards, at times reducing the entrance to less than 800ft wide.

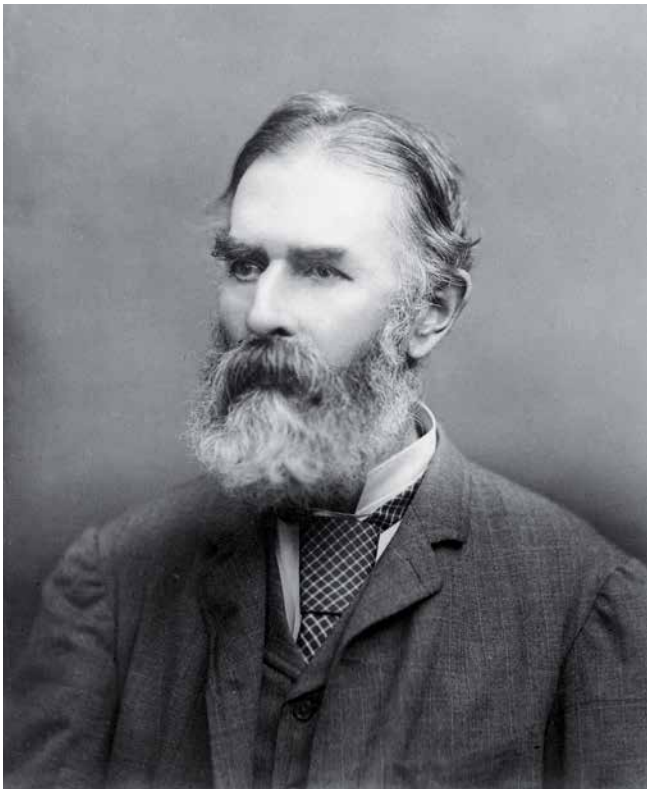
The catchment area was, and still is, subject to extremely intense rainfall events which can cause river flows to temporarily reach levels equivalent to some of the largest rivers in the world. During major floods the North Sand Spit would wash out, opening up the river entrance to form a 1½ mile wide maze of sandbanks and shallow shifting channels. This was the situation in 1845 when James Burnett carried out the first detailed survey of the Clarence. He reported that it was navigable only by the smallest class of sailing vessels and then only with great difficulty.

Edward Moriarty's scheme for the Clarence River

Edward Orpen Moriarty was a civil engineer who spent most of his working life in the employ of the NSW Government. He was born in Ireland, educated at Trinity College, Dublin, and emigrated to NSW where he set up as a consulting engineer and surveyor. He studied flood control and breakwater works in England and North America, and recommended similar schemes to improve NSW river entrances and harbours. He held various posts in government service, steadily rising in rank to become the influential Engineer-in-Chief of the NSW Harbours and Rivers Branch in 1858. He held this position until he retired to England in December 1888. [2]

When Moriarty turned his attention to the Clarence River in 1860, the river flowed into the sea through a relatively deep channel 800 feet wide beside South Head. The northern part of the entrance was blocked by the North Sand Spit, which by then was well established and partly covered in low scrub. Moriarty considered this to be the natural state of the river entrance and his scheme centred on maintaining the status-quo with a permanent shipping channel paralleling the south bank.

On 26 September 1860 Moriarty presented a detailed proposal to the NSW Undersecretary for Works entitled *Proposed Improvements at the Clarence River.*[3] He proposed to construct two ocean breakwaters about 1400ft apart, one on each side of the entrance. They would, he said, fix the position of a permanent channel across the entrance bar which would be kept open by tidal scour and river flow. They would also give protection from the large ocean waves which rolled unimpeded across the reef into the river mouth as well as reducing the amount of sand swept in during flood tides. His early survey plans show these breakwaters would have projected into the sea in a north-easterly direction, quite different from the modern-day breakwaters which run straight out to sea.



Edward Orpen Moriarty (1825–1896), Engineer-in Chief of the Harbours and Rivers Branch of the NSW Public Works Department. Photo: NSW State Library

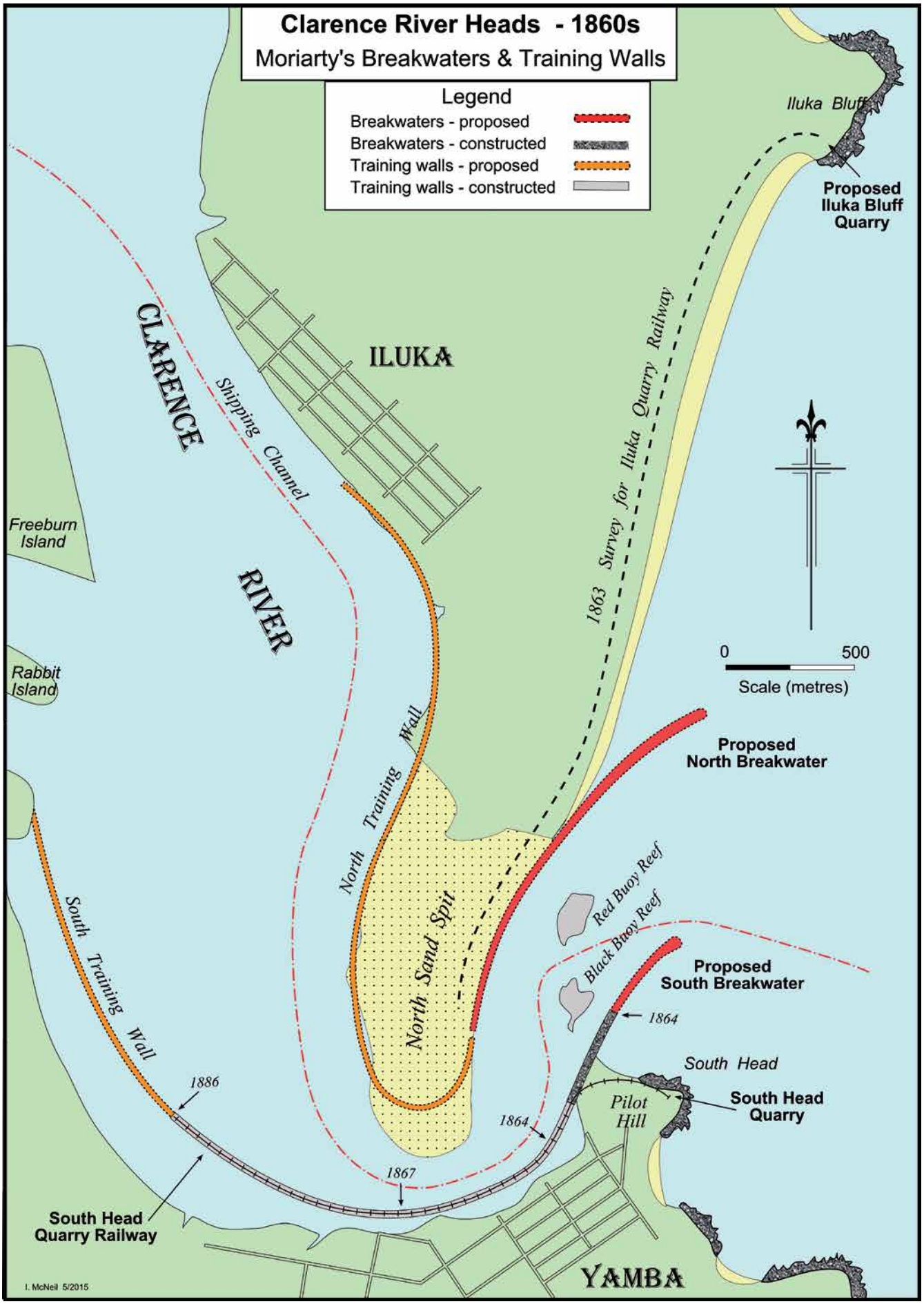
Inside the entrance he specified training walls to confine the shipping channel as well as to protect the river banks from flood damage and erosion. On the south side a two mile long training wall along the Yamba shore would extend in a sweeping curve from the base of Pilot Hill nearly all the way up to Rabbit Island. On the north side another long wall would train the current down the inner side of the North Sand Spit.

Moriarty said his proposed works would also have the benefit of creating a harbour of refuge. He pointed out that for ships in distress there were no safe havens between Port Stephens in NSW and Moreton Bay in Queensland. He estimated the works would cost £117,237, an enormous sum at the time and probably worth several hundred million dollars in today's currency. He added that if prison labour could be employed, as was then being done on the Portland breakwater in England, the cost could be much reduced.

In February 1861 the NSW Legislative Assembly voted an initial sum of £20,000 to be raised from loan funds to begin work on Moriarty's recommended works. This vote was for the erection of two stone dykes running out to sea for the purpose of fixing the channel.[4] Eight months later the Department of Public Works advertised for tenders for the construction of the first 1000ft of the South Breakwater at Clarence Heads.[5]

The first breakwater contractor – John White and Company

The successful tenderer for the South Breakwater was John White and Company, a partnership between John White and James Spiden. White had previously completed four government roadwork contracts on the Great Southern Road north of Goulburn, and had just begun a contract for the construction of a river training wall at the entrance to the Moruya River on the NSW South Coast.[6]



The unstable North Sand Spit dominated the entrance of the Clarence River before the construction of river training walls and ocean breakwaters. Navigation was difficult and dangerous as the entrance channel shifted erratically through shallow sand banks.

John White was awarded the Clarence breakwater contract in January 1862 on a cost per ton basis. His rate was 3s 6d per ton of stone for the breakwater approaches and 3s 4½d per ton for stones over three tons in weight for the breakwater. For stones under three tons the rate dropped to 2s 6d.[7] In total his contract was worth £8930.

The conditions of the contract specified posting a bond of £1,000, repayable upon completion of the works, and the nomination of two responsible persons as sureties answerable for the due performance of the contract.[8] White's guarantors were Thomas Henry Wiseman, a Sydney marine engineer, and William Howard Rolfe, a wealthy Sydney timber merchant. 9

White arrived at Clarence Heads accompanied by '*an efficient body of men and a great deal of material to be used*' in April 1862.[10] The remainder of his plant arrived from Melbourne shortly after on board the brig *Esperanza*. The exact size of White's workforce is not known, but he intimated to a reporter before his arrival that up to 100 workmen and their families would take up residence at the Heads.

At that time the European population consisted only of the Captain Francis Freeburn and his staff at the Pilot Hill Signal Station. The arrival of White and his workforce marked the beginning of Yamba, which was formally proclaimed as a township two years later in 1864. For the next 30 years the small population was made up mostly of Government employees and breakwater labourers. When the works were in full swing up to 150 people lived at Yamba. When the works were stopped or suspended, as they often were, it dropped to fewer than 50.

One of the first buildings erected in the embryo township was the Woolli Hotel near the foot of Pilot Hill. The enterprising hotelier, Walter Black, was granted a publican's licence in August 1862 and no doubt had plenty of thirsty customers amongst White's workforce as many of the men lived in tents pitched nearby.

Grafton Police Court reports indicate that John White was a rather ruthless employer. He hired labourers in Sydney and advanced them passage money for the sea voyage to Clarence Heads, which they had to repay by way of labour. If they worked for six months they would have their fares refunded. He paid them between 7s. 6d. and 9s a day less deductions for food and supplies which had to be purchased from his company store. His men were paid by cheque once every six weeks, that is, if there was anything left over after deductions. Each man had a pass-book in which the items they drew from the store were entered. Many were illiterate and had no idea of what was written in their books or how much they owed.

Some men found themselves getting deeper into debt each month. Those who were caught trying to abscond were arrested and charged under the Master and Servants Act. The inevitable guilty verdict at Grafton Police Court was followed by a sentence of two months hard labour. Upon release they were sent back to Clarence Heads to finish working off their debt.[11,12]

A similar employment situation was probably in force at White's Moruya worksite, where resentment within the workforce resulted in three determined attempts to blow up the powder magazine containing over four tons of gunpowder. The first two attempts failed when lit fuses went out inches away from opened gunpowder casks. The third attempt was foiled when the night watchman fired a shot at an intruder trying to force the magazine door using tools stolen from the blacksmith's shop. In another incident a tram of wagons was let go to run down an incline into the sea.[13]

At Yamba, John White built himself a comfortable 6-room residence near Pilot Hill, complete with stables, hayshed, tool-room, blacksmith's shop and a powder magazine close by. No doubt with the attempted sabotage events at Moruya still fresh in his mind, these works facilities were located where he could keep a close eye on them.

Less than 18 months into his contract John White was in financial trouble. In August 1863 his overseer at Clarence Heads sued him in Grafton Police Court for £77 in unpaid wages. A local carter also sued him for unpaid freight of goods to the breakwater works.[14] The butcher contracted to supply meat for his workforce refused to continue until he was paid.

But his real troubles stemmed from his Moruya breakwater contract. Back in August 1861 White had tendered to construct this breakwater at the rate of 2s. 2½d. per ton of stone, the contract being worth some £8260. White supplied all the plant but sub-let the work to his superintendent, Macnamara, who was to get 1s. 6d. per ton out of which he paid the men's wages. The Government built a weighbridge on the wooden-railed tramway between the quarry and the breakwater and appointed a clerk of works, Thomas Price, to record the weights of all wagon loads of stone passing over it. Unfortunately for White there was collusion between Macnamara and Price, resulting in the Government being over-charged for 38,000 tons of non-existent stone.[15]

Engineer-in-Chief Edward Moriarty became suspicious and in May 1863 ordered all work stopped on the Moruya contract. He refused to approve outstanding payments to White and dispatched three of his engineers to Moruya to investigate. They reported that Price was often drunk and absent from his post, and had falsely and collusively signed certificates for stone that was neither quarried nor delivered. They re-surveyed the quarry and concluded that it could not possibly have supplied the large quantities of stone charged for. Moriarty cancelled the contract and informed White he would not receive the 10% of the contracted amount, £826, that the Government was withholding until the contract had been satisfactorily completed.

Rumours began to circulate that White had failed his Clarence breakwater contract. In August 1863 his creditors obtained a court ruling in Sydney requiring him to show cause why his estate should not be sequestrated to pay his debts.[16] The rumours were correct. Within days John White and James Spiden had been forced to sign over their company and all its assets to three trustees - Joseph Burdekin Holdsworth, John Taylor and Archibald Ashdown - appointed by the creditors.[17]

White's trustees took over the works at Clarence Heads and completed the breakwater contract in order to redeem the £1000 performance bond. After this was completed in June 1864, they advertised a sale by auction of White's entire construction plant, also his house and furniture at Clarence Heads.[18]

The trustees also sued the Crown for breach of contract over White's Moruya breakwater, claiming damages and the recovery of withheld payments. The Full Court heard the well-publicised case and an 8-day marathon hearing ensued. Expert witnesses, including Moriarty himself, were called by both sides and a model of Moruya Breakwater Quarry figured prominently in the list of exhibits. The trustees won £361 in back payments, but lost their claim for £5000 damages.[19]

The South Head Quarry at Yamba

William Henry Baron, an engineer on Moriarty's staff, was appointed as the resident engineer at Clarence Heads in 1862 with an annual salary of £550.[20] He surveyed a quarry site on the north east side of South Head, right on the water's edge, about 300 yards east of the start of the breakwater.

The South Head Quarry was ideally located as a convenient source of stone for breakwater construction but it was not an

ideal source of stone. The thick upper beds were composed of softer rock types which fragmented when quarried and most was unsuitable for breakwater use. 40,000 tons of this material were removed during the initial stripping operations with 25,000 tons of it having to be run to spoil. The underlying rock strata were composed of a hard blue sandstone, which was suitable for breakwater construction. In fact it was so hard that it was some time before White's blacksmith could get the tools properly tempered to work it.

Quarrying operations started on the eastern-most point of South Head and worked back westwards. The quarry was opened up to provide a working face 250ft long by up to 20ft high. Quarry men hand-drilled holes down through rock at the top of the working face, filled them with gunpowder and blasted out large blocks weighing up to 30 tons. Anything too heavy for the lifting gear was broken down into smaller sizes. Two 12-ton capacity cranes and three 15-ton capacity shear-leg derricks were employed in the quarry.[21] Quarried stone blocks were lifted onto 4-wheel railway flat-top tip trucks for the short journey to the breakwater tip site. About 160 tons of quarried stone were produced daily.

Messrs P N Russell and Co, Sydney, supplied a weighbridge which was installed near the entrance to the quarry for an all-up cost of £315. Stone destined for breakwater and training walls was weighed by the Government-appointed weighbridge clerk, George Venable Jones, who also recorded the number of trucks and men employed at the works. For this Jones was paid £3 per week, but was able to supplement his modest income by £12 a year as the resident postmaster.[22] He also earned commission on all stamps he sold.

South Head Quarry was worked on and off over a period of 25 years. During the initial phase, 1862-67, it produced stone for the South breakwater and for the start of the South Training Wall. In the second phase, 1877-86, stone went to extend the training wall to its current length and for a short extension of the breakwater. During the final short phase, 1888-89, stone was used for wall repair and quarry strippings were used to form up the preliminary earthworks for the Angourie Quarry Railway. By then the quarry was essentially worked out. The floor had been excavated to 6ft below sea level and water inflow was creating problems. The cost of stripping off thickening layers of overburden to get more stone was deemed too expensive.

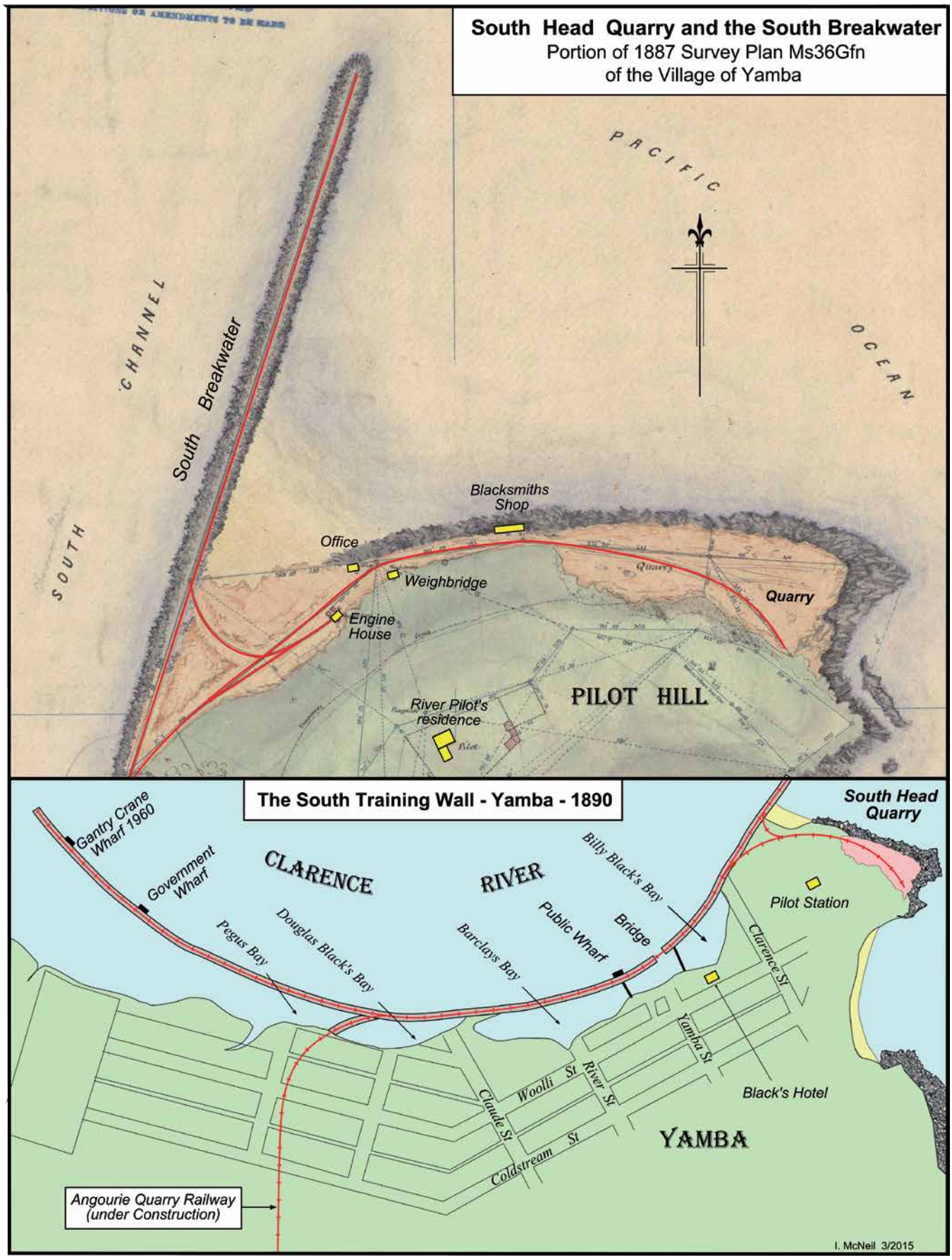
After abandonment, the quarry pit filled with water and for many years was used as a popular swimming hole. It also played a part in the annual week-long 'Tim the Bream' competition run by Ampol Petroleum and compered by the legendary radio and TV personality Jack Davey. Anglers were offered a £10,000 prize if they could catch a tagged bream, affectionately known as Tim. It was a wildly popular event but in spite of the determination shown by hundreds of anglers, Tim was never caught. One of the highlights was Jack Davey's Fishpool, organised especially for mums and kids. The quarry pit was stocked with hundreds of tagged fish which carried prizes worth £1,500.

The pit was filled in in the 1960s and now sees use as a parking area for visitors to Turners Beach and the breakwater wall walk.

The South Head Quarry railway

All quarried stone was transported over a short horse-operated standard-gauge railway to the South Breakwater and the South Training Wall. There were several sidings within the quarry including temporary lines to convey overburden and quarry waste to spoil banks at the water's edge. The Government weighbridge was sited close to the quarry where full trucks of stone and spoil were weighed on their way to the various tip sites.

South Head Quarry circa 1888. Empty standard gauge tip wagons stand on the quarry sidings while in the background is a small steam derrick crane and a steam drilling rig. *Photo: Port of Yamba Historical Society*



Top: South Head Quarry in 1887. The Engine House was built in 1883 by the PWD in anticipation of a steam locomotive being brought in for the works on the south side.
Bottom: The South Training Wall after construction finished in 1886. The bays behind the wall were later named after local identities. The latter-day Gantry Crane Wharf had a 40-ton transporter crane to lift concrete blocks and boulders from barges onto rail wagons for the 1960 – 1973 completion of the South Breakwater.

The rail connection to the siding on the breakwater was laid out by William Baron. It was a tight 2-chain radius curve on a low embankment squeezed in between the side of Pilot Hill and the breakwater's starting point on the river bank. The curve formed an almost complete half-circle, permitting stone trucks to proceed directly onto the breakwater without having to unhitch horses to change direction.[23]

White owned the rail sidings inside the quarry. When his assets were auctioned off in July 1864, they included '*40 tons, more or less, of iron rails with sleepers, etc., complete as now laid down to the quarries*.'[24] The Public Works Department owned the sidings on the breakwater and training walls, the usual practice being to supply materials for the contractors to use. For White's contract it invited tenders in February 1863 for the supply of 1000 sleepers of approved colonial hardwood, to be stacked at the approach to the Clarence River South Breakwater.[25]

John White employed a small fleet of 4-wheel tip trucks to convey stone and quarry spoil. The 1864 auction inventory listed 12 heavy stone trucks, 10 heavy box wagons, 3 heavy side-tip wagons and '*2 large 10-ton trucks, complete, nearly new, having been lately purchased in Sydney at a cost of £150*.'[26] An earlier newspaper report on the works offered up details that the wagons each had 7ft square platforms and weighed between 1½ tons and 2½ tons.[27]

The South Training Wall was an upriver extension of the South Breakwater. To access this construction site the quarry line was extended to give a simple end-on connection onto the training wall, by-passing Baron's tight 2-chain radius half-circle connection to the South Breakwater.

The rail sidings on top of the breakwater and river training walls were extended as required to keep up with the rate of construction. Draught horses provided the motive power, hauling stone trucks out to the tip face where they were trained to step aside just before the tip. There were no grades to speak of; the whole rail system was all basically at one elevation, a few feet above high water mark.

When breakwater construction edged out into open water, large rocks were placed on top of the outer edges of the wall to protect the rails and sleepers from heavy waves, which washed over the wall during winter storms.

The South Breakwater

The South Breakwater was constructed on the line of a submerged reef, which projected into the ocean in a north-east direction from South Head. Construction of the wall began 900ft west of the quarry, and by mid-August 1862 over 18,500 tons of stone had been deposited to form the approach to the breakwater.

Celebrations to mark the laying of the foundation stone of the breakwater took place on 29 September 1862. The paddle steamer *SS Grafton* brought over 400 people down river for the festive occasion. At 1pm the wife of Captain Hill (the Grafton Police Magistrate) smashed a bottle of champagne over three large stone blocks as they glided off a tip-truck into the water. Three cheers were given for the Clarence River Breakwater and for John White, the contractor. Selected guests were invited to White's residence for a sumptuous lunch interspersed with many toasts and speeches.[28]

The breakwater was constructed with an initial side slope of 1 in 2, with the intention of letting natural wave action determine the final stable slope. Moriarty estimated the final slope would be 1 in 5 and as he stated in evidence to the NSW Legislative Assembly a few months after construction began: '*We always expect breakwaters to wash down to the inclination at which it will resist the sea*.'[29] This required top-up stone added from time to time as the breakwater wall settled into a stable configuration.

Stones used in breakwater construction ranged from three to ten tons each. The minimum acceptable weight was three hundredweight with the smaller stones being used for packing into the interstices between larger ones.

The workmanship was described as '*rough, but extremely solid*.'[30] John Connell Laycock, the local Member of Parliament, was less complimentary in a scathing letter he wrote to A.T. Holroyd, the Secretary for Public Works, a year after construction started:

The breakwater now in the course of construction is only in width barely sufficient to allow one truck to traverse to and fro along its surface at a time. Portions are occasionally washed away by the heavy seas, and always will be washed away at its present height and width, more particularly as the work progresses, as it will be continually subject to incessant shocks and lashed by terrific waves which would require a breakwater of thrice the present width to withstand in perpetuity. Far better to proceed … making it wider, higher, and strengthen it as you proceed with stones of heavy calibre, not less than 15 tons (the heaviest required by the present contract being 10 tons).[31]

Progress slowed as the breakwater inched out into deeper water, requiring considerably more stone for each extra foot gained. At the final 1000ft tip-face, the wall was 36ft high, 100ft wide at the base and 15ft wide at the top.

When White's contract was completed in June 1864, 400ft of approach wall and 600ft of breakwater wall had been constructed. There remained £4114 unspent of the £20,000 vote, but Engineer-in-Chief Moriarty did not consider it advisable to extend the breakwater further seawards until the northern breakwater was proceeded with.[32]

Twenty years later the Government authorised a 300ft extension of the breakwater. The work was assigned to Smith and Rowe who already had a contract underway to complete the South Training Wall. The railway line on the South Breakwater was relaid and ballasted, and by October 1884 Edward Moriarty was able to report to the Parliament that the breakwater had been extended by 160ft.[33] When all construction was suspended at Clarence Heads in July 1886, Moriarty's breakwater was 1250ft long and there it stayed until the final construction phase began in 1953.

The South Training Wall – first construction phase 1862–67

Moriarty's improvement scheme specified a 10,170ft long training wall along the Yamba shore to channel the current and protect the river bank from erosion. The wall was to stretch in a continuous curve from the start of the South Breakwater at the foot of Pilot Hill and run for two miles upriver towards Rabbit Island. As it would not be exposed to the destructive forces of ocean waves it would be smaller than the breakwater wall and could be constructed with smaller stone. Moriarty estimated that only three tons of stone would be needed for each lineal foot of training wall as compared to 95 tons for each foot of breakwater.

John White began construction of the South Training Wall along with the breakwater, utilising quarry spoil and reject stones. Some 500ft had been built when he was bankrupted in mid-1863. His trustees completed a further 200ft at the finish of the breakwater contract in June 1864.[34]

In May 1864 the Department of Public Works invited tenders to extend the training wall another 1000ft, specifying that the successful tenderer would be required to post a penal bond of £200.[35] Tenders closed in July and next month the contract was awarded to James W. Wiseman.[36] Wiseman was in partnership with his nephew, Henry Parker Wiseman, and

Top: *THEN: Yamba public wharf on the South Training Wall circa 1910. Yamba was a popular summer holiday destination in earlier times.*
Photo: Port of Yamba Historical Society

Above: *NOW: The same location on the Yamba waterfront in 2014. The course of the old railway is now a pleasant riverside walk.*
Photo: Robin Knight

South Head Quarry, 2013, with the South Breakwater in the background. The quarry floor is now a car park and a picnic area. Rock was quarried out to below sea level, leaving only a narrow rim as protection against breaking waves. *Photo: Robin Knight*

with William Howard Rolfe, the wealthy Sydney timber merchant who had been associated with John White. Henry Parker Wiseman moved to Yamba to manage the contract and took up residence in John White's house near Pilot Hill. The Wisemans were able to start work almost immediately, an indication that they had acquired the quarry plant that White's creditors had put up for auction at Clarence Heads.

Henry Wiseman's quarry workers spent the first couple of months stripping overburden at South Head Quarry to expose fresh stone. In early November the local paper reported that a monster blast, '*one of the largest in the colony*' had taken place in the quarry. Two 33ft deep shafts had been sunk 30ft behind the quarry face and packed with 520lbs of gunpowder. When set off, upwards of 5000 cubic yards, or about 10,000 tons of stone, were lifted several feet in the air. Unfortunately, the paper reported, half of this fell into the sea.[37]

The South Training Wall now forms part of the Yamba foreshore. Originally it was constructed some 100ft offshore, the area behind it being reclaimed with dredge spoil in the 1950's. During construction the course of the wall was marked out by one inch diameter iron bars driven firmly into the river bed. The tops were a few inches under water at high tide which caused some consternation amongst local boatmen, nearly impaling their craft on several occasions.[38]

The rail line from the quarry was extended along the top of the training wall, keeping pace with the tip head. Quarried stone was loaded onto 4-wheel tip trucks and hauled by draught horse to where it was to be tipped. One of the few accidents reported during this period occurred on the training wall. A young lad named William Frame was run over by a stone truck, gashing his leg severely and smashing his fingers.

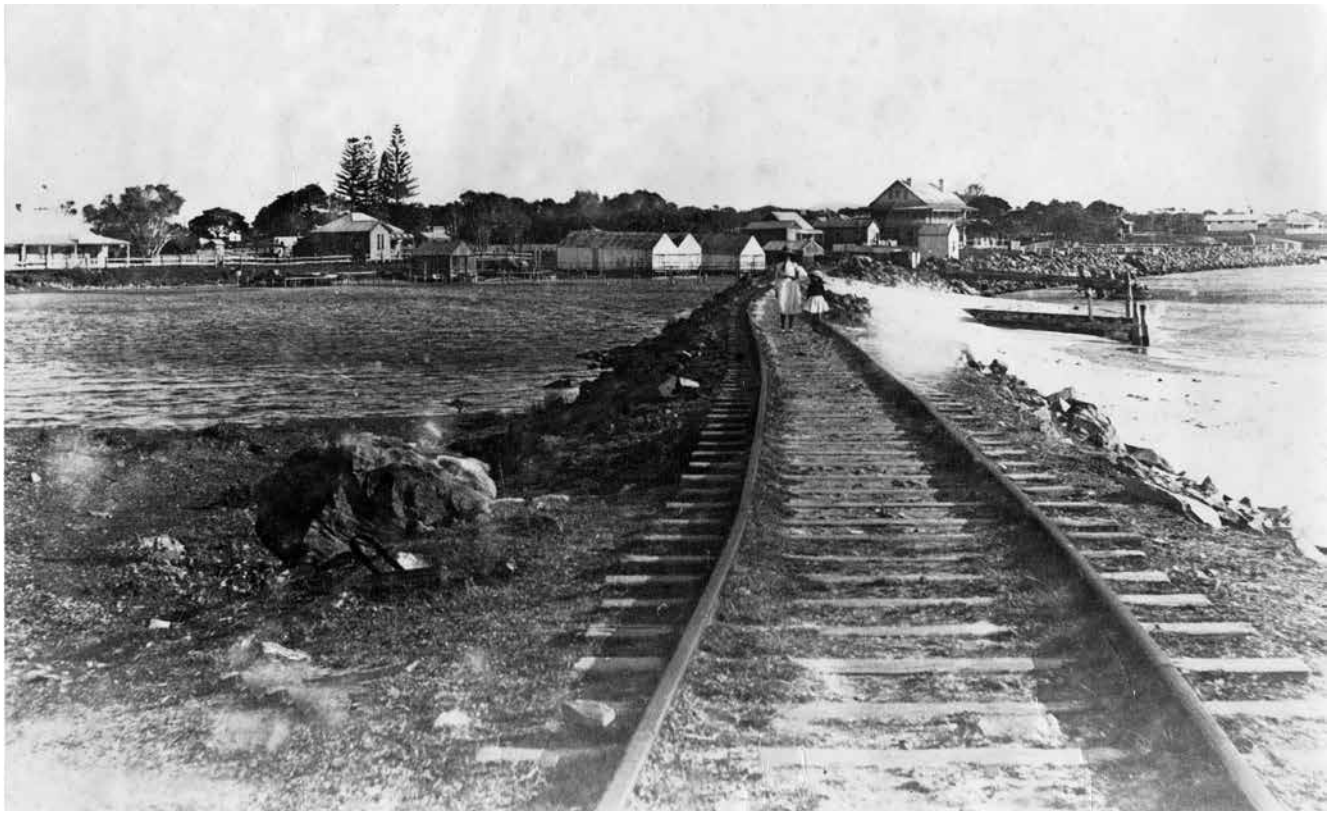
The Wisemans completed their first contract for 1000 feet of training wall at the end of 1865 for which they were paid £4415.[39] They were awarded a further contract for an additional 1000 feet in April 1866 for payments totalling £4532.[40] When this contract was completed in March 1867, the South Training Wall extended for 2700ft along the Yamba foreshore, but it was a long way short of Moriarty's planned 10,170ft.

Although £4,100 of the original vote remained, Moriarty elected to wait before doing any more work until it became clear what effects the South Breakwater and the South Training Wall had made on the river entrance. Nine months later the brig *Alpha* took shelter in the Clarence River during inclement weather. While there her master accepted a charter to remove the whole of the plant used in the breakwater construction.[41]

The South Training Wall – second construction phase 1877–86

It was ten years before construction resumed on the South Training Wall. Conditions at the entrance began to deteriorate from 1870 onwards. Heavy floods washed away the lower parts of the North Sand Spit and by 1873 the river entrance had doubled in width and was shoaling. Three ships (the brig *Sarah*, the steam barque *Examiner*, and the schooner *Coquette*) were wrecked at the entrance between 1870 and 1873. Two years later the screw steamer *Helen McGregor* was wrecked on the Black Buoy Reef just inside the heads with the loss of eight lives.[42]

The deteriorating conditions focussed the Government's attention back to the task of improving conditions at Clarence Heads. It authorised work to start on the northern breakwater in January 1873 but preparations were tardy and it took another three years before tenders were invited. The contract went to Macquarie, Noble and Co, a partnership between Daniel Macquarie, an experienced contractor, and James Harvey Randall Noble, a Sydney businessman.[43]



Top: *THEN: The standard gauge South Head Quarry Railway on the South Training Wall with Billy Black's Bay on the left and the Clarence River on the right. The quarry, breakwater and river entrance were behind the photographer. Photo: Port of Yamba Historical Society.*
Above: *NOW: The same location in 2015. The South Training Wall is now a foreshore river walk. Billy Black's Bay was filled in with dredge spoil in the 1950s and is part of Yamba Caravan Park. Photo: Rob Knight*

An 1888 panoramic view of the South Training Wall extending up river towards Rabbit Island. The two small coastal steamers are docked at Yamba's public wharf. The bays behind the wall were filled in with dredge spoil during the 1950s and 60s. Photo: Port of Yamba Historical Society

As well as authorising work on the north breakwater, the Government also voted £10,000 in July 1876 for the completion of the South Training Wall. This contract also went to Macquarie, Noble and Co but without going to public tender. The Secretary for Public Works, Mr. Lackey, defended this course of action in Parliament, explaining that tenders were not invited in order to save time, to prevent the vote from lapsing, and to obtain the advantage of having the same contractor working on both sides of the river.[44]

Payment and conditions for the South Training Wall were the same as those granted for the northern works; 3s 6d per ton for stripping, 3s per ton of stone tipped to form walls, 7½d per ton railway haulage for distances under half a mile with an additional 7½d per ton for every half mile beyond that distance. For re-laying the railway on the training wall the contractor would get 2 shillings per lineal yard with the Government to supply the sleepers, rails and dogs, and place them on site.[45] In January 1877 the Public Works Department invited tenders for the supply of 3000 sleepers for the contract.[46] A few months later the *Southern Cross* delivered '*100 tons of railway irons and 2 boxes of powder*' for the south wall extension.[47]

Macquarie and Noble started work on the south side in June 1877. The company re-opened South Head quarry and advertised for tenders to re-lay the railway from the quarry to the South Training Wall.[48] Once again draught horses hauled stone trucks between South Head Quarry and the advancing tip face on the South Training Wall.

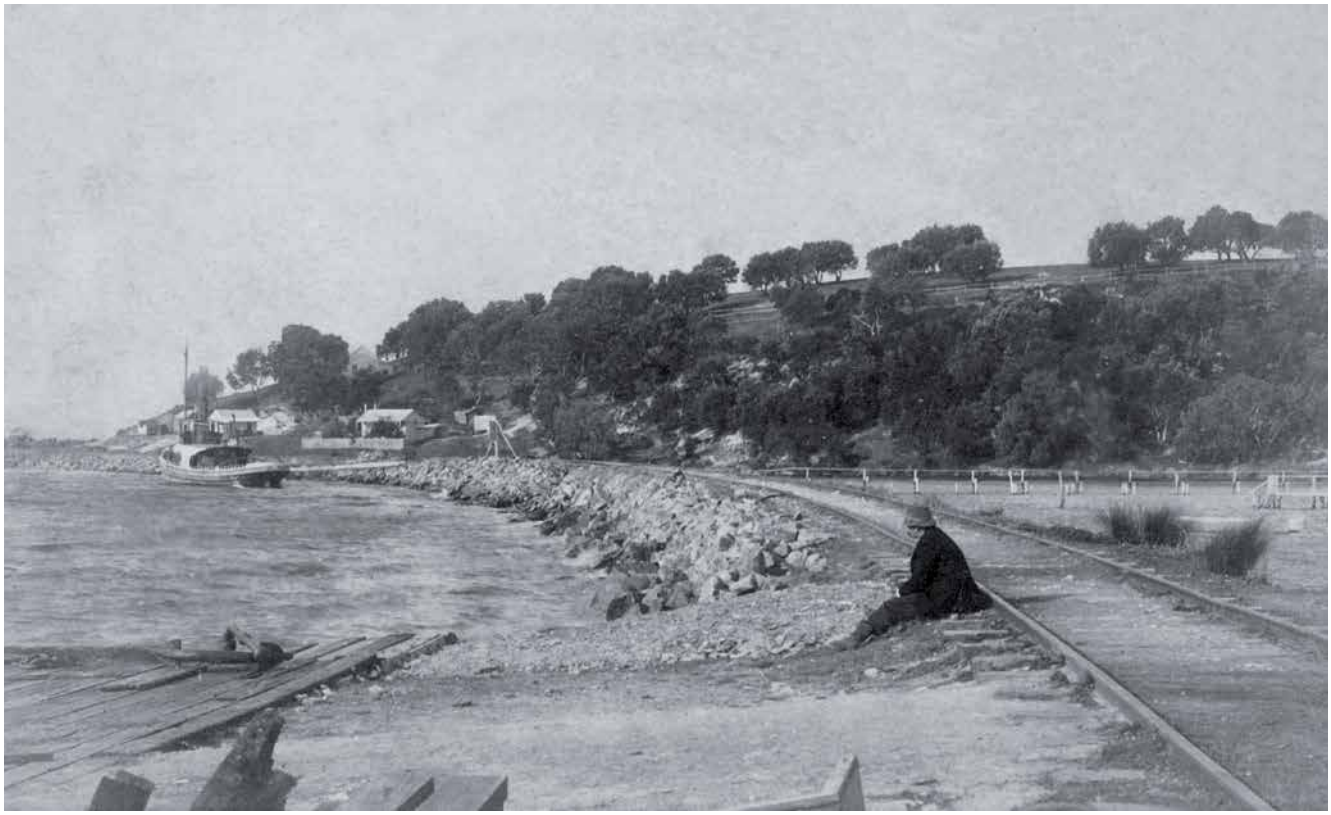
One of the horse drivers was unfortunately killed on the line in August 1878. Andrew O'Neill had discharged a load of stone at the tip head and was returning to the quarry with the empty truck. He attempted to jump on to the moving truck sideways and missed his footing. After two or three attempts to recover himself he fell under the heavy truck and the two rear wheels passed over his back. His shocked off-sider saw him jump up off the rails and exclaim '*I'm done for!*' In great pain he was taken on a stretcher to the nearby Black's Hotel in Yamba and given some brandy. A doctor and a priest were summoned but O'Neill succumbed to his injuries shortly after they arrived. At the inquest a verdict of accidental death was returned, a reflection of the *laissez faire* attitude to workplace safety prevalent in earlier times.[49]

Daniel Macquarie dissolved his partnership with James Noble in October 1879[50] and carried on the contract by himself. By early 1882 he had extended the South Training Wall by another 2000ft bringing up its total length to 4750ft, still short of Moriarty's 10,170ft. Although Macquarie continued to work on the north side of the river, the Government elected in May 1882 to invite fresh tenders to continue the extension of the South Training Wall.[51] This contract was won by the Sydney contracting firm of Rowe and Smith.[52]

Rowe and Smith had begun its partnership earlier in the year with a government contract to construct a section of the main Southern Sewer in Sydney. It won its biggest contract the following year, in July 1883, for the construction of Section No 2 of the Illawarra railway, which was worth £440,000. It was a huge job, involving the construction of seven tunnels and the excavation of over a million tons of rock.[53] Mr. Rowe, the senior partner, moved to Otford to supervise the job. The Clarence contract must have seemed small beer by comparison.

Mr. W. Smith, the junior partner, moved up to Yamba and wasted little time getting started. By November 1882 he was getting stone out of South Head Quarry at the rate of 3000 tons per week, one third above the amount stipulated in the contract.[54] In May 1884 it was announced that work would also begin to extend the South Breakwater, and Rowe and Smith got the job. The railway line on the breakwater was relaid and ballasted, and by October Edward Moriarty was able to report to the Parliament that the breakwater had been extended by 160ft.[55]

Twelve months later a visitor to the Clarence reported on the activities of Rowe and Smith at the Heads. Large blocks from South Head Quarry were going to the breakwater and smaller stone was sent to the training wall. The breakwater will be continued, he wrote, for a further 250ft while the 6150ft long training wall was to extended a further 4000ft.[56]



Top: *THEN: The South Training Wall looking towards Pilot Hill and South Head circa 1895. The start of the South Breakwater leads off in the left background. Photo: Port of Yamba Historical Society*

Above: *NOW: The same scene in 2013 with Yamba Ferry Wharf on the left. The railway is long gone and the route is now a very popular riverside walk. Photo: Rob Knight*

Right (page 15): *Vale and Lacy No 1 of 1866 abandoned on the old Angourie Quarry Railway south of Yamba in the 1930s. Unfortunately no photographs of the locomotive in service have been found. Bart Wiles Photo – Richard Horne collection*

The South Head Quarry railway locomotive

In 1883 the PWD spent £181 to erect a locomotive shed at South Head Quarry and the same year spent another £1418 on purchasing and repairing plant for the south side works.[57] This included the cost of repairing and overhauling a locomotive in Sydney in preparation for work being resumed on extending the South Training Wall.

The locomotive in question was a small second-hand 0-4-2 saddle tank, Vale and Lacy No 1 of 1866 (V&L),[58] which had the distinction of being the first locomotive manufactured in the colony of NSW. It was built for railway contractors Larkin and Wakeford, who used it for construction work on the Great Western Railway across the Blue Mountains, then on the Great Northern Railway in the Upper Hunter Valley. It was acquired by the PWD in 1874 to haul stone from Iluka Bluff Quarry to the breakwater works on the north side of the Clarence River.

The V&L proved to be a poor investment. During its nine months of operation on the Iluka Quarry Railway it broke down on a regular basis, bringing breakwater construction work to a halt for up to weeks at a time. It was the brunt of some stinging criticism, including this letter to the editor from a correspondent signing himself '*Vitrol*':[59]

'*The many obstacles which have been thrown in the contractor's way, first and most important, has been the systematic breaking down of the locomotive which again occurred yesterday about 5pm. Since the 2nd of October last to the present time, not less than 55 days have been lost to the contractor, and the navvies whose wages alone would amount for that period to nearly £600 sterling. Now, sir, it appears that this so-called engine was condemned 7 years ago, but through some hanky-panky was foisted upon the Government for £500! (not worth £100), since which repairs, alterations, and other outlays bring up the cost of this wretched specimen of decayed mechanism to about £1000! And she, or it, is now worthless.*'

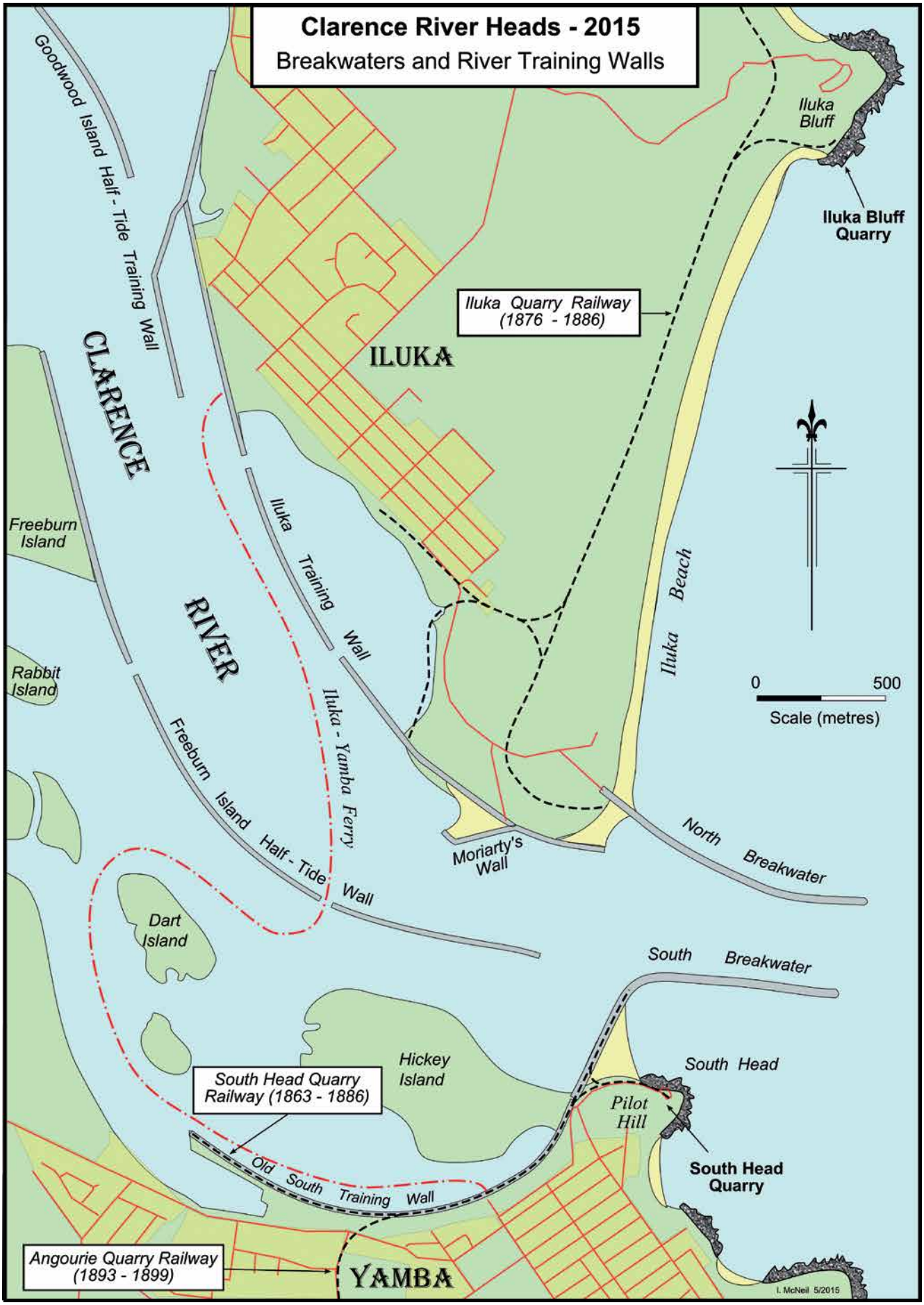
A replacement locomotive, ex Waratah Coal Coy's 0-6-0ST Manning Wardle (163 of 1865), was dispatched from Newcastle in March 1877.[60] It is doubtful if the V&L saw any further service on the Iluka Quarry railway as traffic was light and intermittent due to serious setbacks in breakwater construction.

The V&L locomotive was sent to Sydney for repairs and an overhaul, and was returned to Yamba in 1883 to haul stone from South Head Quarry to extend the South Training Wall. According to newspaper reports, it was an ignominious failure:[61]

Work has not been commenced yet at the Heads for the extension of the southern dyke. It is said the contractor has been up and ready to commence work for upwards of two months. The Government locomotive was sent to Sydney for repairs and to undergo a thorough overhaul; but when it was returned and steam was got up, I hear it would not work, only in a very perverse manner, by forcing water into the cylinders and steam into the funnel. I don't know very much about locomotives, and this may be the way they commence their work, but if such is the case the people at Yamba do not understand it either, and at any rate could not get it to work.

It appears the V&L was banished to the engine shed and horses were substituted to haul the stone trucks instead. When construction of the Angourie Quarry Railway was about to begin in early 1891 reference was made to '*the unused locomotive at the Clarence Heads*'[62] being made available to the contractor. Although there is no record of this having occurred, it may have been the last time the locomotive turned a wheel in anger.

The unloved and unwanted locomotive was abandoned on an unrecovered section of the Angourie Quarry Railway south of Yamba after that railway closed in 1900. It was still there in October 1918 when the PWD invited tenders for its purchase.[63] There were no takers and there it stayed. Its decaying remains were photographed by the late Bart Wiles in the 1930s, and the rusted remnants of its saddle tank by Dr John Kramer some 50 years later.



The construction of the 19th century river training walls and the modern breakwaters at the entrance to the Clarence River radically altered its shape. The North Sand Spit disappeared. Hickey and Dart Islands were formed on the south side of the river by massive quantities of tide-deposited sand.

An aerial view of the South Breakwater. The straight section in the foreground was built on Moriarty's watch in the 1860's, the remainder 100 years later. The short stub projecting into the river is the T-piece, formed in the 1890's when a storm washed away the end of the breakwater.
Photo: Rob Knight collection

Abandonment of the southern works

Between 1862 and 1885 over £117,000 had been spent on river improvement works. While construction on the south side of the river had been relatively straightforward, the engineers had experienced enormous difficulties on the north side. Government procrastination, lack of funds, the instability of the North Sand Spit and difficulties in obtaining sufficient stone meant little progress had been made. Conditions at the entrance were arguably worse than back in 1862.

When Sir John Coode, the pre-eminent British harbour engineer of his time, visited Australia in 1885 the Government engaged him to examine several of its problem river entrances, not least of which was the Clarence. He visited Clarence Heads in October 1885, inspected the river entrance and Moriarty's harbour works, and interviewed a number of veteran steamer captains.[64] He requested a large number of detailed measurements and hydrographic surveys to be carried out and the results sent to him back in England. Pending the receipt of Sir John's report, the Government suspended all work at Clarence Heads in July 1886, and the men paid off.[65]

Sir John Coode submitted his report to the NSW Government in November 1887. He recommended a significantly different scheme of improvement works for the Clarence,[66] which was duly accepted. This marked the end of Moriarty's scheme and of his 30-year career with NSW Public Works. He retired the following year[67] and returned to England to live out his retirement.

When work resumed several years later, only Moriarty's short South Breakwater was incorporated into Sir John Coode's scheme. The partly-completed north-side walls were dismantled and their stonework was recovered to use in the new works. The long South Training Wall was retained but only to protect the Yamba river bank from flood damage. The space behind it was eventually filled in with dredge spoil, and it now forms the modern-day Yamba foreshore with a very pleasant riverside walk along its course.

The railway line on top of the training wall remained in use for many years. There was a Government wharf located near the western end of the wall. During the 1890s a branch line connection to the Angourie Quarry Railway enabled stone blocks from Angourie Quarry to be railed to the South Breakwater to repair storm damage.

When the modern-day Yamba breakwater was finally constructed in the 1960s (almost 100 years after first being proposed) the training wall was strengthened and the railway relaid along its entire length to the breakwater. 40-ton concrete blocks and sandstone boulders were barged 18 miles downriver from Woodford Island Quarry and unloaded by a diesel gantry crane at the old Government wharf site. They were hauled on 4-wheel tip trucks by small diesel locomotives 1½ miles to the tip head on the breakwater. It could be said that of all the Clarence River breakwater railways, the South Head line was the longest-lived.

Acknowledgements

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Panoramic view of the quarry face of South Head Quarry 2015. The dark-coloured lower layers of rock were the hard blue sandstone used for breakwater construction. The lighter coloured upper layers were softer rock which had to be run to spoil. *Photo: Ian McNeil*

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