

1891.

LEGISLATIVE ASSEMBLY.

NEW SOUTH WALES.

MACLEAY RIVER.

(REPORT BY SIR JOHN COODE, K.C.M.G., ON ENTRANCE TO.)

Ordered by the Legislative Assembly to be printed, 26 May, 1891.

Sir John Coode to The Secretary for Public Works.

Sir, Westminster Chambers, 9, Victoria-street, London, S.W., 18 December, 1890.

Having carefully considered the several plans and documents relating to the Macleay River Entrance, prepared in accordance with the memoranda framed by me when in the Colony, I have now the honor to submit my report thereon, with especial reference to the works which I have to recommend for its improvement.

I should here remark that the results of the survey and investigation, embodied in the plans, sections, diagrams, and descriptive notes, upon which this report and the accompanying drawings are based, have been obtained and prepared by Captain Howard in a very skilful and complete manner, enabling me to fully comprehend the physical conditions of the case, and to devise, with confidence, the works for the improvement of the entrance which I now put forward for adoption.

Captain Howard has prepared for my information a description of the Macleay from Belgrave Falls (where the tidal influence ends) about 43 miles above the entrance to the sea, wherein he touches on all the salient features of the river, the condition of its banks, the general character of the wharfage, and the navigable depths available, and also the particulars of the townships. It will not, therefore, be necessary that I should add anything by way of description, except in connection with the entrance and its channels, inasmuch as I append to this Report a copy of Captain Howard's memorandum, from which full details of the present condition of the Macleay throughout the length of its tidal compartment can be ascertained and referred to.

Description of river.

This Report is accompanied by two drawings. No. 1 is a plan of the river, at a scale of 2 inches to the statute mile from Bungay Creek, just above Belgrave Falls, to the sea; it shows also the coast-line from the North Head, near the entrance of the Macleay, around to the southward of Korogoro Point. For that length of the river between Rainbow Reach and North Head, this plan has been compiled from the special survey made by Captain Howard in 1887, the remaining portions having been taken from parish maps supplied to me by the Harbours and Rivers Department of the Colony.

Drawings.

Drawing No. 2, prepared from Captain Howard's special survey of 1887, shows in full detail, and in a convenient form, the results then obtained for the purpose of my study and investigation, to which reference has been made above. This drawing has been plotted to a scale of 500 feet to an inch, and shows that portion of the river which calls for treatment in connection with the improvement of the entrance, and also the coast-line from North Head to South-west Rocks, together with the soundings, borings, and other observations, which were taken with a view to the consideration of alternative sites, viz., for an entrance near its present position, just to the south-west of the North Head, as compared with a possible site involving a channel of considerably-reduced length, which channel would pass to the northward of Rudder's Hill, and the range of rocks adjacent thereto, discharging into the sea near the South-west Rocks.

The river in its present state, and under the most favourable conditions, cannot be considered as navigable for craft drawing over 9 feet—in fact, vessels of 8 feet draught have to wait for high-water to get up to Kempsey, about 32 miles from the entrance.

Available depth in the river.

Captain Howard remarks that the Macleay Bar may be regarded as a smooth one, compared with other bars on the coast of New South Wales. During strong south winds it is frequently smooth on the bar when a high sea is running in the offing. It is only when the wind gets round to south-east that the sea breaks heavily on the bar. With west winds, Captain Howard has seen the bar free of breakers for some days continuously, during both flood and ebb.

Entrance and bar.

The position of the entrance varies considerably, dependent upon the force and direction of the sea, and the existence of more or less "fresh" in the river. There is still an old beacon, rather more than a mile to the southward of the North Head, which marks the site of a former channel. It has also been stated that since 1864 channels have been formed in several positions between the North Head and a point distant nearly 2 statute miles to the southward thereof. It is important to note that the entrance has been much deeper and more constant in direction when the channel has been either under or near to the North Head than in any other position.

Under existing conditions, the fluctuations which occur in the entrance necessitate the frequent changing of the leading-marks. Towards the end of 1887, during a period of three months, these marks were moved northward nearly 1,000 feet.

In a memorandum, dated September, 1889, Captain Howard states that the entrance was, at that date, about a quarter of a mile to the northward of its position during the survey of 1887, which last-named position is that indicated on the accompanying drawings. He also observes that it seemed then only to require time (probably not more than two or three years), or the occurrence of a heavy flood, to sweep away the North Spit and bring the fairway out under the North Head, somewhat on the line which it occupied in 1864, or practically in the position which I have selected as the best site and aspect for the improved entrance, shown on the accompanying drawings.

Under the present untrained condition of the entrance, the depth on the bar fluctuates considerably. In September, 1887, during Captain Howard's stay in the locality, there was a good bar, having a depth over it of 10 feet at low-water of spring tides, with a straight run in. About a month later, in consequence of the occurrence of heavy north-east winds, this depth was reduced to 3 feet 6 inches at low water, or 8 feet at high water.

During freshes, discoloured water can be seen to trend around to the northward, well outside the bar; it has also been observed that wreckage from Trial Bay, or South-west Rocks, is deposited on the beach close to the North Head, or on the sands northward thereof. These circumstances point to the existence of a northerly eddy, shoreward of the constant south-going current which sets along the coast outside the capes. This eddy is an important feature as affecting the direction and aspect of an improved entrance, which clearly should conform with this northerly set, and thus have a slight "bias" in the same direction, rather than point directly seaward at a right angle to the shore-line.

At the time of my visit, Pilot Jamieson informed me that the least depth available at ordinary high water was 5 feet, but that these unfavourable conditions only existed for two or three days concurrently; the greatest depth he had experienced was 14 to 15 feet at high water over a month's duration, but only after the occurrence of a fresh. The average depth on the bar generally was from 8 to 9 feet at high water.

The sources of the Macleay run through a very broken country, consequently the river is subject to sudden freshes of short duration.

The information with reference to floods is very contradictory. That which occurred in March, 1875, appears to have been the highest on record, when at Gladstone Wharf the flood then rose 14 feet 6 inches, or thereabouts, above ordinary high-water level. Such works of improvement as may be undertaken with a view to fix the entrance, and the channels adjacent thereto, cannot fail to exercise a beneficial effect on the discharge of the flood-waters. I do not propose to consider further, in this Report, the effects of flooding, or the mitigation thereof, beyond the influence of the entrance works above referred to—in fact, the data available here are not sufficient to enable me fully to enter upon this matter, neither is it clear that inconvenience and loss have been thereby occasioned to an extent that would justify the construction of works having for their special object the prevention of flooding in the upper reaches, more particularly in view of the pressing need of expenditure on the river entrance. Having regard to the presence of such immense masses of easily-moved sand, works for the effectual treatment of the bar and entrance must of necessity be of considerable magnitude, and entail proportionate outlay.

Before describing the works for the improvement of the entrance which appear to me to be best adapted to meet the requirements of the case, it is desirable that I should here refer, in general terms, to the four possible projects which I have deemed it right to consider, and to some extent work out, in connection with this investigation. They are marked Nos. 1, 2, 3, and 4 respectively, on drawing No. 1, upon referring to which it will be seen that proposal No. 1 contemplates the formation and fixing of the entrance close to the North Head, about half a mile northward of the fairway surveyed in 1887, and shown on the accompanying drawings. The position and aspect of the entrance as contemplated under this proposal, taken in conjunction with the extent and character of the moles and training-works as designed and shown in red, would ensure, with certainty, the attainment of satisfactory results, as to the provision and maintenance of a sufficient navigable depth, and would also provide for the free discharge of all the flood-waters of the district. Moreover, as before stated, experience has shown that when the entrance fairway has hitherto been in about the position of No. 1, the depth over the bar has been greater for a longer period than at any other site. Again, the North Head, or thereabouts, having regard to the northerly drift of the sand, would appear to be a specially advantageous position for the entrance to the Macleay, because sand passing the entrance would readily travel unimpeded to the northward, along the length of coast embayed between the North Head and Scott's Head.

Entrance No. 2 would also provide for the discharge of the whole of the flood-waters of the district; but, in consequence of the northerly drift of the sand, there is an element of uncertainty associated with this design, from which No. 1 is free, as regards the lengths of the sea moles, which would be eventually required for the maintenance of the requisite depth, having regard to the accumulations which would inevitably occur to the southward of the South Mole. Moreover, the diversion of a river of this magnitude, from its existing course into a new channel such as that leading to No. 2 entrance, would be a work attended with much difficulty. Again, the extent and cost of the works required, including the formation of the new channel from the moles to the point where it would join the river to the westward of Shark Island, would be fully equal to that of project No. 1.

Each of the projects 3 and 4 contemplates the formation of an entrance near the South-west Rocks. Either of these positions would be partially sheltered by Lager's Point, but each is associated with the grave defect of not providing for the discharge of the whole of the drainage from the district, inasmuch as the considerable volume of water now passing through Clybucca Creek, including also that which flows into the latter from the Macleay during floods, as described by Captain Howard, could not, unless at very great cost, be diverted through the new fairway. Further, bearing in mind the excavation and dredging of the new channel, it is not improbable that the cost of either of these undertakings would be fully as great as that of No. 1.

Line No. 4 has been set out on the ground, and carefully bored and examined. In the position indicated on drawing No. 1 a sufficient depth would be available over the rock surface on this line, but the curves of the channel would of necessity be inconveniently sharp, and the works generally partake of an experimental character.

For the reasons above given, I entertain an undoubted preference for project No. 1, which, as I have before stated, is associated with no element of uncertainty as to the production of satisfactory results. Moreover, to ensure the maximum scouring effect, it is of the utmost importance that the whole of the discharge, including that contributed by the Clybucca Creek, should pass seawards through one entrance, which would be impracticable if either of the partially-sheltered projects Nos. 3 and 4 was adopted.

Proposed

Floods and freshes.

Alternative projects.

Proposed Works.

The works which appear to me to be best adapted to fulfil the requirements of the case are those coloured red on drawing No. 2; they may be briefly described as follows:—

This work would commence at the north-west angle of the South Spit, and extend therefrom in a north and easterly direction for a length of 4,000 feet. The termination in the first instance is indicated on the plan by the letter X; hereafter, when funds are available, it is proposed to extend this Breakwater 500 feet, making its total length 4,500 feet, as shown. It would consist throughout of a rubble mound, the inner portion, as far as practicable—probably for a length of 2,500 feet—being formed as an "end-and-side" tipped embankment, the remainder being deposited from a temporary stage.

This work would commence on the southern face of the North Head, and extend therefrom in a south and easterly direction for a length of 1,000 feet, terminating, in the first instance, at the point marked Y, and forming, with the South Breakwater, an entrance of 700 feet in width at low water. It is believed that this width will be sufficiently restricted to produce the requisite scour necessary for the maintenance of a navigable depth of about 12 feet at low water, or 16 feet 6 inches at high water of ordinary spring tide, the latter being equal to the navigation (allowing for "scend," or undulation) of vessels drawing say 12 feet.

The lines of the moles have been so arranged that the proposed width of entrance, viz., 700 feet, may be varied by modifying the curve of the North Breakwater, should experience show, during progress, that an alteration is necessary with a view either to increase the scour, or, conversely, to prevent a throttle in the discharge of the flood-waters.

Like the South Breakwater, this mole would consist of a rubble mound, but in this case it will be advisable to deposit the stone from a stage throughout the entire length of the work.

Although it is probable that the improved entrance, with the moles carried to the points X and Y respectively, would meet all the requirements of the navigation for a considerable period, the changes which would be produced thereby, in the configuration and disposition of the existing sandbanks, might possibly render an extension desirable, when each mole should be simultaneously and equally prolonged, say 500 feet, thus rendering the total length of the North Mole 1,500 feet.

With a South Mole of 4,500 feet and a North Mole of 1,500 feet there can be no question as to the entirely satisfactory character of the results produced, nor as to the permanent maintenance of a navigable depth of from 12 feet to 15 feet at low water.

To obviate the escape of water through the old channel between Shark and Fisherman's Islands, and at the same time to prevent the river from breaking through the Sandspit during floods, and thus outflanking the new entrance, I propose, on the right or eastern side of the channel, to form a turn-water training-bank for a length of 11,000 feet, commencing to the north-west of Shark Island, and terminating opposite the coal-store of the Clarence and Richmond Steam-boat Company. The formation of this bank would render the breaking through of the Sandspit during floods, or the formation of subsidiary channels, an impossibility, thus ensuring the fixing of the entrance in the position shown, and the utilisation to the utmost extent of the scour produced by the flood discharges.

The proposed bank would consist of rubble deposited from barges, the top being 8 feet in width, and at the level of high-water spring tides.

It is very important that the old channel which skirts the west side of Shark Island should be effectually closed. I have, therefore, shown a training-bank of 5,600 feet in length to effect this object, and at the same time to guide the current into its proper course, viz., to the western bank of the river near the outfall of Clybucca Creek. The construction of the work would correspond in character with that of the bank proposed at Fisherman's Reach.

Leading-lights would be provided for the new entrance as shown on drawing No. 2. The lower reaches would also be effectually buoyed.

The effect of the currents passing in and out through the new fairway, unaided by the West Training-bank, would be to create a channel on about the line shown on the plans; the sand accumulating to the north-west of the said channel would assist to some extent in training these currents. During floods and gales, and in the absence of the training-bank, disturbance of this sand would inevitably arise, causing consequent fluctuations, but not to a very serious extent, in the depth of the channel.

Were the funds available for the execution of the West Training-bank, the work might with advantage be carried out simultaneously with the execution of the sea-moles, but, looking at the large outlay required on the more important structures, the execution of this bank could, if desired, remain in abeyance for a time, without material prejudice to the success of the undertaking.

As will be seen from drawing No. 2, the bank would be 7,000 feet in length, the seaward end being 300 feet distant from the river slope of the North Breakwater, thus forming a wave-trap, or spending-beach, of a valuable character. The bank should be of rubble stone, the outer portion being 4 feet above high water of spring tides, and 10 feet wide, whilst the inner length would be of the width and at the level described for the other training-banks.

First instalment of the works.

South Breakwater, 4,000 feet in length	£133,000
North Breakwater, 1,000 feet in length	48,700
Training-bank at Fisherman's Reach, 11,000 feet in length	62,800
Training-bank at Shark Island, 5,600 feet in length	21,800
Buoying and Lighting Channel	2,000
Total expenditure for first instalment of works	£268,300

Extension works required to complete design as before described.

West Training-bank at entrance, 7,000 feet in length	£48,400
South Breakwater, additional length, 500 feet	39,000
North Breakwater, additional length, 500 feet	27,000
Cost of extension works	£114,400

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The foregoing estimates are based upon what are believed to be liberal rates, and they cover contingencies and engineering charges.

Order of procedure. The South Breakwater should first be proceeded with until reaching the point X. The construction of the North Breakwater should then be taken in hand, and simultaneously therewith the training-bank at Fisherman's Reach, to be followed by the bank at the south end of Shark Island.

Materials. There would appear to be an abundant supply of material for the work at the North Head and in vicinity thereof, and at Rudder's Hill and the adjacent ridges. Before finally determining on the works, these sites should be carefully examined, and the precise character of the material available fully investigated.

Borings on site of entrance. No borings have been made on the site of the proposed entrance. It is more than probable that rock does not exist within the proposed fairway at a depth which would interfere with the navigation. This question, however, should be definitely set at rest, by fully boring the site, more especially along the line of proposed channel, before arrangements are made for the execution of the works.

Conclusion. It may possibly be considered that the sum required for the completion of the first instalment of the works, viz., £268,300, is altogether disproportionate to the extent and character of the trade carried on at present in connection with the Macleay. I have no means of judging of this point, nor does it, in fact, fall within my province to do so; I may, however, state, very emphatically, that works of a more limited character and extent than those contemplated under this expenditure would not suffice to fix the entrance and to train the currents under the unfavourable conditions which prevail at the Macleay. As previously pointed out, to render the undertaking complete, the extension works are desirable, and until funds are available for their execution the small fluctuations in depth in the entrance channel, which will in all probability be experienced, must be borne with.

I have indicated by red dotted lines on the plans the approximate line of a future deep-water channel, but of course do not now contemplate any expenditure on dredging or artificial deepening, the means for which will not, I presume, be available, in view of the large outlay required on the structures herein described. The training and guiding of the currents by the proposed banks at Fisherman's Reach and the south end of Shark Island cannot, however, fail to produce very beneficial effects, although the 12 feet navigation, for which the entrance is adapted, as described, cannot be fully utilised until the improved scour has been aided to some extent by dredging. To what extent, however, the proposed aid will be required it is impossible now to predict.

I have, &c.,
JNO. COODE

NEW SOUTH WALES HARBOURS AND RIVERS.

MACLEAY RIVER.

General description of the Macleay River, by Captain Howard, R.N.

Appendix to Sir John Coode's Report, dated 18th December, 1890.

The Macleay River entrance is (1888) about $\frac{1}{2}$ mile south of a smooth grassy headland, which lies north-west (mag.) 6 sea miles from Laggans Point, the outer extreme of Trial Bay.

This headland, known as the North Head, is a rocky peninsula, joined to the mainland by a low sandy isthmus 500 feet across, and covered with Banksia scrub. The headland, which is 1,600 feet in extent east and west, and 800 feet north and south, is precipitous on its three sides facing the sea, and 140 feet above low water near its south-eastern corner, where the old signal-staff, in use when the channel was immediately south of the head, still stands.

Southward from the head is a flat of drift-sand about 1,000 feet wide, known as North Spit, which extends to the present channel, the centre of which is 3,000 feet south from the old signal-staff.

Near the south-west corner of the head the north-east wind has heaped up a quantity of sand in a pyramidal form, the apex of which is 60 feet above low water. This sand-drift is a good mark for making out the North Head from seaward, showing like a white triangle against the dark cliffs of the head.

Westward of the North Head the sandy shore curves round to a small rocky point, the extreme of a narrow rocky ridge which runs eastward from Yarrahapini Hill. This point, known locally as Razorback, is 1,200 feet west-south-west (true) from the nearest part of North Head.

What was formerly the river channel is now a pool of quiet water between the North Spit and the western shore, the action of the tidal streams having thrown up sandbanks westward from the south end of North Spit, leaving only a narrow winding boat-channel, nearly dry at low water.

I have not been supplied with a plan showing the soundings obtained during former surveys, but have been informed that the old fairway was close past Razorback Point; from thence straight across to North Head, and along its southern side; that in this portion of the channel there were no outlying rocks, and after freshes a depth of 20 feet at low water, over a sandy bottom. There is, however, one pinnacle rock about 100 feet east of the end of shelving rocks at Razorback Point. This rock is very small, and at low-water springs its summit is within a few inches of the surface. The pilot informed me that it is quite isolated, very steep too, and that there are no rocks whatever outside it above a depth of 20 feet at low-water; also, that he has sounded all round it, and obtained 25 feet at low water. In the event of this rock being in the way of a fixed channel it could easily be removed.

The pilot-station, with the houses of the pilot and his crew, are on the flat between Razorback and the North Head. Attached to the pilot's house is the Post and Telegraph Office. A few hundred feet westward the land rises to the thickly-timbered spurs of Yarrahapini.

At the river entrance the distance between the high water of the North and South Spits is nearly 2,000 feet, but a sandspit projects northward from the South Spit, which contracts the navigable entrance to a width of 300 feet, and depth of 22 feet. Further out, where the navigable water is broader, the depth becomes uneven, with from 8 $\frac{1}{2}$ to 10 feet at low water, right to the bar, which is 3,000 feet outside the point of North Spit. The bottom throughout this space is very uneven, in ridges like waves.

Outside the bar the water deepens to over 30 feet very quickly.

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The South Spit is the northern end of the long narrow tongue of land separating the Macleay River from the sea. Its outer side is one gradual curve to South-west Rocks, Trial Bay, a distance of nearly 6 English miles. The South Spit is about 1,200 feet wide near the entrance, but further up the river the tongue of land gets very narrow, and in several places is under 200 feet from high-water inside to the sea. For nearly a mile from the entrance the spit is drift-sand and low hummocks nearly bare, but above Stewart's Point thick vegetation commences.

Stewart's Point is a sandy point, projecting slightly from the western shore. It is the first stopping-place inside the river for sea-going vessels. There are two saw-mills, a Post and Telegraph Office, a good Government wharf, and a number of weatherboard houses at Stewart's Point. This place was the head-quarters of numerous fishing-boats; here the fish netted in the river were packed in ice, and sent by steamer to Sydney, but during the stay of the survey party this industry seemed to fail, and most of the fishermen left the river.

The Stewart's Point Government wharf is 9,000 feet south of Razorback Point; the foreshore between these places is a steep sandy bank or cliff about 20 feet above low water, inside which the land is flat, or in slightly-undulating ridges parallel to the coast, and covered with thick scrub, or, where cleared, with fern. From abreast the entrance southwards for nearly 3,000 feet the sea at high water dashes against the foot of this bank, a considerable quantity of which, with the timber growing at its edge, was washed down whilst the survey was in progress.

The river at Stewart's Point is 1,400 feet wide, and from 8 to 12 feet deep, over a clear sandy bottom, the fairway channel being well on the eastern side. Above Stewart's Point the river trends about south by east $\frac{1}{2}$ east (true), the western shore being low and swampy, with a growth of thick mangroves, and fronted with extensive sand and mud flats. The eastern shore is a nearly-straight sandy beach; the narrow strip of land inside being covered with thick scrub.

The Clarence and Richmond Steamship Company, whose steamers run to the Macleay River, have a coal-store on the north-east end of a mangrove island, 7,000 feet above and on the same side as Stewart's Point. Directly opposite this store, on the eastern side of the river, is the hull of a small iron steamer—I believe, the "Atlas."

All soundings above the coal-store on the plan are reduced to low water at No. 2 tide-gauge, or 8 inches above low water at the entrance.

Above the coal-store 4,600 feet is Fisherman's Island, of low alluvial soil, and covered with swamp oak and grass. The greater part of the island, which is 800 feet east and west, and 1,500 feet north and south, is awash at high water. Here the sea-reach of the Macleay may be said to end, the river forking round Fisherman's Island, and the much larger Shark Island.

Until quite lately the ship channel was round the east side of Fisherman's Island, and along the north side of Shark Island, till close under the bank on the west side of the river; but a cutting has now been dredged westward of Fisherman's Island, and more in a direct line up and down the stream.

This cutting is about 5,000 feet in length, and was said to be 60 feet wide, but according to our soundings was of very irregular width and depth.

After the soundings shown on the plan were obtained, the dredge was again working here, cutting off some of the corners. The depth in the cutting was from 7 to 10 feet at low water, and the bottom very uneven. The Dredge-master was working entirely by eye, having no plan of the proposed work or of the river. The sea-going steamers rarely passed through without grounding, either in the cutting or on the shoals formed in the river northward of the coal-store, where the silt from the cutting was deposited. As the cutting is on a curve, there are two sets of leading-marks—one over on the eastern side, near wreck of "Atlas," for entering or leaving the northern end; and the other on western bank above the cutting for the southern end.

The southern end of the cutting is near the south-west end of the old channel, and at certain times of tide, when the flood streams from each channel meet, an eddy is formed, which, I believe, will leave a deposit of sand across the end of the cutting.

The former ship channel between Fisherman and Shark Islands is said to be gradually shoaling up. There are leading-beacons on the eastern shore to lead through it; but the deepest water is well to the northward of the leading-line. The ruling depth in the channel is 5 $\frac{1}{2}$ feet at low-water springs.

Shark Island is about 1 land mile in extent east and west near its north end, and 2 $\frac{3}{4}$ miles north and south, tapering off gradually to a sharp point at its southern end. The north end is either covered with mangroves or extensive grass or swamp oak flats, and no part of it is more than a few feet above high-water mark. The middle portion of the island along the western side is occupied by several farmers, and is said to grow very good maize crops.

The channel north-west of Shark Island is about 800 feet wide, and from 8 to 18 feet deep at low water above the cutting.

The western shore of the river is a sandy bank or cliff from 12 to 20 feet high, with flat sandy land thickly timbered behind. This country is marked on the parish maps as a reserve, but there are several families living on it, and it has lately been surveyed. From abreast Fisherman's Island, southward for 10,000 feet, the western shore continues of the same character to the mouth of the Clybucca Creek, a large opening over 700 feet wide at its mouth and opening out inside to a large lagoon. The Clybucca Creek runs into the eastern side of this lagoon. For about 4 miles from its mouth the Clybucca Creek is about 200 feet wide, and from 10 to 15 feet deep, with low swampy land on its eastern side, and thick forest of gum-trees on its western side. Its course is nearly parallel to the Macleay River, and, according to the parish maps, after a length of 12 miles, it ends in large swamps.

I am informed that during floods a large quantity of water makes its way across from the Macleay River, and down the Clybucca Creek. A portion of this creek is included in the area marked by Sir John Coode for survey, but could not be done in the time allowed.

Northward of the mouth of Clybucca Creek the Macleay is contracted by two islands, both thickly wooded, low, and of alluvial soil. The fairway is between them and Shark Island, and above them, close over to the western bank, it is in places not more than 200 feet wide, with from 8 $\frac{1}{2}$ to 20 feet water.

Southward of the two above-mentioned islands is a large sand and mud bank, which dries at low water, and extends nearly across the river, which is here 2,000 feet wide. The ship channel is round the western end of this bank. A cutting has been dredged along its southern side across to Shark Island, in an east-south-east (true) direction for about 3,000 feet.

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This cutting has a depth of from 12 to 7½ feet at low water. The fairway through is marked by leading-beacons at each end.

Towards the close of the survey the sea-going steamers were continually grounding here, the marks leading too close to the southern side of the channel, which is gradually shoaling.

I may here remark that although most of the dredged channels in this river appear to be cut across, yet the tidal streams set fair up and down them.

At the south end of Shark Island, looking up, the river presents a pleasing aspect; the grassy and wooded slopes of Rudder's Hill appear quite close to the shore, and both banks in Rainbow Reach are cleared, cultivated, and studded with farm buildings.

The channel eastward of Shark Island is narrow, and was at one time the outer part of Spencer's Creek, Shark Island being, twenty-five years back, a peninsula.

I am informed that a Mr. Salmon, seeing that the isthmus near Rudder's Hill was low and narrow, made a small cutting through it to admit his boats to the main river. The times of high and low water in the creek being earlier than in the river, caused a great scour in this opening, and now, in 1888, it is 1,800 feet wide, and what twenty-five years ago was dry land is now the middle of the ship channel, with 15 to 17 feet at low water.

The channel on the east side of Shark Island is of the average width of 700 feet; it is full of shoals, and only navigable by boats, some parts of it being less than 1 foot deep at low-water springs.

I am informed that this channel was at one time navigated by schooners, but having been constantly used as a depositing-place for the silt dredged from the main channel, is now nearly blocked up. The sides of the channel are generally fronted with belts of thick mangrove, and the Shark Island side densely wooded with large timber. On the eastern side there are four shallow inlets running to within a short distance of the sea-beach, giving the impression that at some time the river has run through them into the sea. The southern of these inlets which I call here South-west Creek starts from the eastern channel of Macleay River, at a point 5,000 feet below the southern point of Shark Island; it is 9,000 feet in length, and from 200 to 500 feet broad, running through swamps; its banks are mostly belts of thick mangroves, except in two places, where the points of rocky spurs of Rudder's Hill come to the water's edge.

This creek during the survey flowed into the sea, but it has not always done so. The first time I saw it, in the year 1885, the water of the creek did not reach high water on the sea-beach by 300 or 400 feet, but since then, in March, 1887, I am informed, the creek and surrounding swamps being full of flood-water, a gutter was dug through to the sea-beach to run it off, and this quickly became a wide gap forming a good entrance. In September, 1887, it was over 200 feet wide, and 2 to 3 feet deep at low-water springs, and although during the survey it once or twice nearly silted up, it never entirely did so, and was wider in July, 1888, than during the preceding summer.

A cutting through the mangroves was made about twenty years back, 1,000 feet inside the entrance; this at the time was 200 feet long and 10 feet wide, with a depth of 18 inches; it is now 30 feet wide, and over 5 feet deep at low-water springs. In September, 1887, the tidal stream rushed through this place at the rate of 4 to 5 knots per hour.

At the western end of South-west Creek two small islands have formed outside the entrance, and, with the shoals surrounding them, nearly block the creek, which can only be entered between three-quarter flood and one-quarter ebb. The water in the creek at low-water springs is from 3 feet at the western end to 2 feet at the eastern above low-water springs outside.

South-west Rocks Point is a double rocky head, east of South-west Creek, the bar of which is at its extreme north-west point. It rises to a height of 64 feet above low water, and is grassy, with open Banksia scrub. This point is a favourite camping-ground for the Macleay River farmers, who, with their families, camp here from Christmas to the end of January. There must have been nearly 200 people camped here in January, 1888.

There are only two houses at South-west Rocks Point—one a two-story stone house, the other a weatherboard cottage. The stone used in building, a soft freestone, was obtained from the summit of the wooded ridge, a short distance southward of the point. The rock cropping out at the point is either conglomerate or a hard slaty rock of a blue colour.

The South-west Rocks are a cluster of large granite boulders lying about 400 feet east of the Point, and mostly surrounded by shelving rocks; awash in patches at low water.

The largest and most eastern is 15 feet above low-water springs, and can be reached by wading at low-water springs in fine weather.

The water deepens quickly outside these rocks, the 5-fathom line being only from 400 to 500 feet north of them, over a clear sandy bottom. Westward of South-west Rocks Point the 5-fathom line is from 1,200 to 1,500 feet off the low-water line.

Only one detached rocky patch was discovered, the least water on it being 21 feet; it lies north of the western side of the Point about 700 feet, and can be seen from the shore in very fine clear weather only.

As the surrounding sea has been closely watched from the Point for many years by fishermen and others, and the above is the only rocky patch that has ever been seen off it to seaward, it is fair to suppose that no other outlying patches exist.

Eastward of South-west Rocks is the beach of Trial Bay, extending round to the Labour Prison, at Lagger's Point.

On a small knoll near the north-east extreme of the Point is an obelisk to the memory of a number of people drowned from wrecks on South-west Rocks and on the Point during easterly gales.

The ridge of the South-west Rocks Point extends in a southerly direction until it meets one of the spurs of Rudder's Hill; it is about 1,200 feet wide of thick forest, the land on each side being a grassy swamp.

The only boring-tool with the survey party was a 16-foot pricker, and with this I one day took some probings off the two rocky points jutting into south-west creek. The pricker went down easily to its end, through sand and ooze, without coming to rock. Mr. Pilot Jamison, however, made a statement to me that "there is granite under all the swamps between South-west Creek and Macleay River." He says, "I have seen it and felt it when using sounding-pole."

All the land about South-west Creek inside the line of sand hummocks is under water during heavy freshes in the river, or after a high spring tide. Most of it is covered with grass, and there are extensive forests of swamp oak, which in places grow to a great height. A great number of the trees appeared to be dying, or were already dead, in July, 1888.

Rudder's

Rudder's Hill, on the east bank of the Macleay, is a grassy hill, thickly timbered near its summit, which is 248 feet above low water. The summit is about 2,000 feet from the river, and from thence it runs nearly level to the south-eastward, along the right bank of Spencer's Creek, and gradually falls to the northward towards South-west Creek. The soil of the hill seems poor and stony, but there is a flat of alluvial soil of a sandy nature between the west side of the hill and Macleay River; this flat is for the most part a swamp, part grassy and part covered with thick forest of ti-tree, swamp-oak, and mangrove. Along the river-bank the land is higher, and cultivated with maize and vegetables.

The foot of the slope of Rudder's Hill facing west, right round to South-west Creek, was evidently at one time the coast-line of a bay or estuary, the rock with which it is lined being in places covered with oyster and other shells.

The bottom of the river, generally about Shark Island, is soft dark sand and ooze, but abreast the entrance to South-west Creek it is hard and full of shells.

Southward of the south point of Shark Island the main river was surveyed for 11,000 feet, to where it curves round to the eastward in Rainbow Reach. The average width of this part of the river is from 1,000 to 800 feet, with a depth of from 9 to 17 feet in the straight reach, and as much as 25 feet rounding the bight of Rainbow Reach.

The left bank of the river in this reach is cultivated nearly to the water's edge. The bank itself is perpendicular, and in the bights, or where steep, is continually falling away. The land on the point in Rainbow Reach is at the same time encroaching.

Spencer's Creek runs into the river on the eastern side, southward of Rudder's Hill. It is at present about 300 feet wide at its mouth, but gets wider inside, and after a course of about 18,000 feet joins the main river again at Pelican Island. The tidal water that flows into Spencer's Creek, however, runs into a large lagoon 13,000 feet above the lower entrance. This lagoon is filled by the flood-tide from both ends of the creek at the same time, and during the ebb is emptied in the same manner. There is a range of low stony hills running along the east side of Spencer's Creek and the lagoon, apparently a continuation of Rudder's Hill range.

The land between Spencer's Creek and the Macleay is an alluvial flat, and where not swamp all under maize cultivation.

There is a depth of 8 to 10 feet water at the lower end of Spencer's Creek, but where it widens out it becomes much shallower. The flat-bottomed steam-droghers, however, ascend the creek as far as the bridge, 10,500 feet from its mouth. Between the lagoon and the Pelican Island end of Spencer's Creek there is not more than 6 inches water at low-water springs.

Pelican Island divides the river 11½ English miles from the entrance. It is a low alluvial island, densely wooded, especially at the upper end. This island is set apart for the use of the Aborigines, who have cleared a considerable area, and cultivate maize. The island is about 3,500 feet long, north and south, of oval shape, and its greatest breadth is 1,300 feet.

Just below Pelican Island, on the right bank of the river, is a Government wharf, known on the river as Pelican Island or Robertson's Wharf. There is a punt and a ferry across the river a short distance above the wharf. All sea-borne heavy goods for the prison or Trial Bay breakwater works are landed on this wharf and taken overland to Trial Bay.

During the survey a quantity of rails which had been landed caused it to droop, and nearly brought the wharf bodily down. The jetty at Trial Bay is useless as a landing-place.

The fairway is along the west side of Pelican Island, and after passing it there is a shoal water of not more than 7 feet at low water turning into Long Reach. The channel east of Pelican Island is only used by boats, being blocked by shoals about its upper end.

Long Reach runs in a south-westerly direction for 3½ miles, with an average width of 1,000 feet. The middle of the reach broadens to 1,300 or 1,400 feet, and the centre is occupied by a shoal, dry in places at low water.

The fairway is on the right side of the river until after passing the above shoal, where a cutting has been dredged across to the left bank, the least water in which is 7 feet at low-water springs. This cutting is marked by leading-beacons at each end.

There is a Government wharf on the left or western side of Long Reach, about 2½ miles above Pelican Island.

The shores of Long Reach are cleared and cultivated from end to end, and present a pleasing appearance, with numerous farm-houses along the banks.

During floods the water flows over the western bank, which is low in places, and finds its way into the Clybucca Creek.

Above Long Reach the river gets narrow for a time, and takes a winding southerly course to Kinchela Creek, which joins the river from the south-eastward, about 2 miles above Long Reach.

The soundings in these narrow reaches are from 16 to 25 feet in the fairway, or centre of river, over a dark sandy or oozy bottom.

Half-a-mile down the river from Kinchela Creek, and on the right bank, is Kinchela Government wharf, and a quarter of a mile further down, on the left bank, is Summer Island Government wharf. The horse-punt and ferry is midway between these wharves. The Government township of Kinchela is on a point 1 mile below the creek. Apparently, very little of this township is in private hands, and is at present occupied by Aborigines.

The houses are mostly along the river-bank, towards and close to the creek.

Kinchela Creek, after a very winding course of 9 miles, ends in extensive swamps, southward of Korogoro Head. Its banks are under cultivation of maize, and it is navigated by steam-droghers for about 5 or 6 miles. There is a punt and ferry across the creek, near its mouth.

The banks of Kinchela Creek gradually decrease in height as it is ascended, and in time of flood the water runs up the creek from the river, and spreads over the swamps.

An extensive shoal lies off the upper side of the entrance to Kinchela Creek, the entrance fairway being close round the lower point. A cutting has been dredged through the tail of the above shoal for the navigation of the main river. It is marked by sets of leading-beacons above and below, on the right bank. The least water on the leading-line is 7½ feet at low-water springs.

There is a small Government wharf, locally known as Ross's Wharf, about 500 feet below the creek.

Above

Above Kinchela Creek the river bends gradually to the westward for nearly 2 miles, with an average width of 1,000 feet, and depth of water in the fairway of $9\frac{1}{2}$ to 23 feet. It then sweeps round in a southerly reach to the mouth of the Belmore River.

In the bend are the two Fatorini Islands, which extend along 4,000 feet of the channel.

These islands are thickly wooded at their southern ends, the northern portions being cultivated and occupied by the Aborigines.

There is a Government wharf on the right bank of the river, 4,000 feet above Kinchela Creek, locally known as Partridge's. The "Teredo navalis" is very destructive to timber in the brackish water of the Macleay River, and at the time of our survey this wharf was very shaky through some of the unsheathed piles being nearly eaten through.

The town of Gladstone is on the right bank of the Macleay and Belmore Rivers, and the mouth of the latter. This is a Government township, with Court-house, post and telegraph office, &c., and is 22 land miles from the entrance. There is a Government wharf here, and punt and ferry across the Belmore, about $\frac{1}{2}$ mile up that river.

The Belmore River is more often called the Darkwater Creek, its first name. It runs in a southerly direction, and its first reach is directly in line with the Macleay River. After a winding course of about 12 miles, it ends in swamps near the coast. It is navigated by steam-droghers a long way up.

Like Kinchela Creek, the banks of Belmore River, which are about 15 feet above low water at Gladstone, gradually decrease in height as the river is ascended, until they are level with the surrounding country.

In floods the stream sets up this river.

At Gladstone the Macleay River takes a very sharp turn north-west round a peninsula, on which is the private township of Smithtown.

The Smithtown Government wharf, on the left bank of the river, is nearly three-quarters of a mile below Gladstone wharf, and immediately above it is a punt and ferry across the Macleay.

At Smithtown is the first station (telegraph) above Stewart's Point.

The fairway is between Fatorini Islands and the left bank. The channel is narrow, but deep, until south of the northern island, when, for nearly 1,200 feet, there is a flat with only $7\frac{1}{2}$ feet at low water in places; the depth then gradually increases till off Gladstone Wharf there is a depth of 34 feet in mid-stream, with a dark sandy bottom.

Passing the North Fatorini Island, the lead showed a bottom of soft yellow clay for a few casts, and the same bottom was observed off Partridge's Wharf.

Above Gladstone the river trends about north-west for $2\frac{1}{2}$ miles to Seven Oaks bend, with deep water throughout.

There is a Government wharf on the left bank of the river, about half a mile below the bend, called Seven Oaks Wharf.

The width of the river between Smithtown and Gladstone wharves is from 600 to 400 feet, but above Gladstone it widens again to 700 or 800 feet. I may here remark that the widths above the limit of our survey are estimates by eye. The parish maps are not to be trusted, and no two of them agree. They are marked only "approximately correct."

At Seven Oaks bend the river turns sharply round to about south by west, and then runs in one long reach, curving westward for 4 miles to the town of Frederickton.

At the Seven Oaks bend great changes have taken place; the concave left bank is continually washing away, and the opposite point growing out. I am informed that what is now the ship channel was once dry land.

The bank is low about the middle of the bend, and during floods great quantities of water flow over it and strike across the low swampy ground to the Clybucca Creek.

Just above Seven Oaks bend is a shoal in mid-channel nearly awash at very low tides. A cutting has been dredged through the shoal water surrounding it, the fairway being on its west side, and marked by a buoy and leading-beacons at each end. The least water in this cutting is 8 feet, $\frac{1}{4}$ mile above the buoy.

On the peninsular between Seven Oaks and Smithtown, the flat country is relieved by two or three rocky mounds, apparently from 30 to 50 feet high, grassy, and about $\frac{1}{2}$ mile inland. These rise abruptly from the plain.

The reach between Seven Oaks and Frederickton is about 1,000 feet wide; the western bank is fronted with a weedy shoal nearly the whole way, and the fairway on the eastern side has from 11 to 14 feet water, with a dark sandy and oozy bottom. There is a channel for small craft east of the shoal at Seven Oaks, leading close round the point.

Frederickton is a conspicuous town on the left bank of the river, immediately below Christmas Creek, a narrow stream which runs a long distance into the hilly country, but is apparently not navigable.

A spur of the hills coming down to the river at Frederickton, and a number of buildings being on its slopes, the town shows to more advantage than those built on the alluvial banks below. As seen from the river, the most conspicuous places are the churches and cemetery.

Here houses of brick may be seen, those lower down the river being all of wood, with the exception of one or two at Seven Oaks and Gladstone. There is a saw-mill at Frederickton, which, however, was not working when we left. A short distance below the creek is the Government wharf, and another opposite on the right bank. Close to the wharf, and below it, is the usual punt and ferry.

From Frederickton the Macleay River runs in one curving reach to Kempsey, a distance of 4 miles in a south-south-west direction.

Kempsey is the principal town on the Macleay River; nearly all the Government officials reside and have their offices there, and the public buildings are large and numerous.

The town is very much scattered, the Government townships of East and West Kempsey being on opposite sides of the river, nearly north and south of each other. The principal business is done at Central Kempsey, a private township on the left bank of the river. There is a good Government wharf at Central Kempsey, and another on the opposite side of the river; a punt and ferry cross just above the wharves.

The Central Kempsey Government wharf is the terminus of the Clarence and Richmond S. S. Co.'s steamers, which, plying weekly, carry the larger portion of the produce of the district to Sydney.

The

The Central Kempsey Government wharf is 32 land miles from the entrance. The river-bank above the wharf is about 20 feet above low water. At West Kempsey the land is much higher, and some parts must be nearly 100 feet above the water. The right bank of the river is also very high and steep to between East Kempsey wharf and the Government township, which is a mile further up the river. The Macleay River here takes a wide bend to the westward and north-west.

Between Frederickton and Kempsey the fairway is close to the left bank for $2\frac{1}{2}$ miles, the opposite side having shoal water stretching a long way into the river. The soundings vary from 8 feet off the mouth of Christmas Creek to 30 feet, $1\frac{1}{2}$ mile above it, with a dark sandy bottom.

Within a mile and a half of Kempsey wharf the fairway has been dredged across to the right bank, and then between two wooded islets, which have been formed by floods, and lie near the right bank, between $\frac{1}{2}$ mile and 1 mile below Kempsey wharf. The channel is then cut between the upper islet and the right bank close in shore, and is about 70 feet wide.

The cuttings are marked by sets of leading-beacons at each end, and a red buoy in mid-stream. A vessel coming up the river steers on the lower line until abreast the red buoy, and then turning sharply westward gets on the upper lines of beacons, which leads between the islets mentioned above. The ruling depth in these cuttings is 8 feet, and I should imagine they would silt up partially after every heavy fresh.

Above the islets the water deepens quickly, and above the Government wharves under the high steep bank on the right side of the river, there is as much as 52 feet water over a dark sandy bottom.

There is another wooded islet near the right bank, 2,000 above Kempsey wharf, and a set of leading-beacons for a crossing immediately below it. The least water on the line of beacons is 6 feet.

West Kempsey Government wharf is on the left bank below the rounding point, and about $\frac{3}{4}$ mile above Kempsey wharf. During the time of our survey the approach to this wharf was silted up, and boats could not reach it or float alongside at low-water.

About 900 feet above West Kempsey wharf is a slip for hauling up the hopper punts used with the Government dredge. The dredge herself is constantly at work on the different cuttings and approaches to wharves. There is a Government dry dock at East Kempsey, about 700 feet below East Kempsey wharf. This dock is intended to take in the dredge for repairs, and has been in use for that purpose. It is merely a trench dug in the bank here, from 40 to 50 feet high, and with a very steep slope from the surface of ground to the bottom of the dock. The boiler and pump are fixed on the slope about half-way up. Every flood fills the dock to high-water mark with silt; and at the time I saw it (March, 1888) a considerable portion of the soil on the lower side loosened by heavy rains had fallen into the dock, leaving a perpendicular side, and more seemed likely to follow.

The Euroka Creek (only navigable by boats for a short distance) enters the river on its right side $1\frac{1}{4}$ mile above Kempsey wharf, and runs nearly parallel with the river for $\frac{1}{2}$ mile. On the point made by the creek entering the river is a Government wharf, and just above it a punt and ferry across the Macleay to West Kempsey.

About $\frac{1}{2}$ mile north-west of the above ferry is a shoal patch covered with weeds, in the centre of the channel. Of the leading-beacons at one time in position to mark the fairway between this shoal and the left bank, only one remained in June, 1888. The least water passing this shoal was 9 feet.

Greenhill's Government wharf, at the end of the north-westerly reach before mentioned, is $3\frac{1}{2}$ miles above Kempsey wharf, on the left or northern bank of the river. This bank is very high and steep, the slope being thickly covered with scrub. The opposite side is low, gradually rising to a well-cultivated plain. There is a punt and ferry immediately above Greenhill's wharf.

The river at Greenhill's is about 400 feet wide, and the depth in the reach between Euroka Creek and Greenhills from 9 to 25 feet.

Above Greenhill's the river curves round to the southward. A little more than half-a-mile above the wharf is a dredged crossing, with only 6 feet water on it, marked by leading-beacons on each side. Abreast the upper beacon on the left side of the river is the first large shingle-bank. It is now covered with vegetation. From here upwards the river is much encumbered by shingle, which forms large banks on either side, sometimes covered with vegetation. These banks are all liable to change their form and position during floods or heavy freshes, and most of the soundings were over a shingle bottom.

One and a quarter miles above Greenhill's Wharf, on the left side of the river, on a high, steep bank, is the hamlet of Warneton.

The fairway crosses again to the left side of the river, and there is as much as 30 feet of water under Warneton.

Still, on the left bank of the river, three-quarters of a mile above Warneton, at a place where the land slopes gradually to the river, is another Government wharf, with only enough water alongside it to allow droghers to lie there.

The river here has entirely lost its alluvial character. The banks are high on both sides, and in places rocky, and the points all shingles and boulders.

Just above the last-mentioned Government wharf, on the right or east side of the river, is a rocky, isolated hill, its cliffy side towering over the river, and 50 feet of water over a rocky bottom abreast of it. The river here takes a sharp turn to the westward, and about a mile above the rocky hill occur the first rapids, locally called falls.

Navigation by droghers drawing 4 feet ends a quarter of a mile below the rapids, or 39 miles above the entrance. A vessel drawing 6 feet can come as far, taking the bad places at high water.

The rapids are formed by banks of shingle, which nearly block up the river; at high-water a light boat will float over them, but within 2 miles are four others, known as the Belgrave Falls, each only a few inches in height. Above these, or 43 miles from the entrance, tidal influence ceases.

The river was seen by the surveyor for only a few miles above Belgrave Falls, as far as Yarravale. It continued to be of the same character.

The Upper Macleay is not yet properly charted, the Government plans only showing portions of the river here and there. The country through which it runs, however, looks very wild and broken, as viewed from the Macleay Valley.

The Macleay River cannot be deemed navigable for vessels of over 9 feet draught, and drawing 8 feet would have to wait for high water to get up to Kempsey. The Company's steamers sometimes load up to $8\frac{1}{2}$ feet draught, but part of the cargo is put on board at Stewart's Point, below all the cuttings.

Sometimes, in very fine weather, when the bar has shoaled up to 8 feet, at high water the tender goes outside and discharges her cargo into the Sydney steamer in the open sea.

The Macleay River produces a large quantity of maize, but during the survey its price was so little

little that not much was exported. A quantity of hardwood timber, sawn and in logs, is also exported. There is no pine or cedar on the river. At one time a quantity of sugar-cane was grown, and there are still several old-fashioned mills to be seen; but this industry died out, and the only crop seen was at Smithtown. It appeared to be doing well until the winter frosts completely killed it.

The ranges north and west of the Macleay are reported to be rich in gold, silver, lead, and other metals, and numerous prospecting parties have been exploring them lately, but nothing very valuable appears to have been discovered.

The metal-bearing country is too much broken to contain continuous payable reefs. The ores are found in small veins and pockets, and contain a great mixture of metals.

Early in 1888 the greater part of the grassy North Head was pegged out in gold claims, traces of that metal having been found there.

A small quantity of gold has also been obtained from the sides of Smoky Cape peaks on the coast.

Entrance and Bar.

The entrance to the Macleay River was close round the south side of the North Head, as shown on Mr. Baron's plan, dated November, 1861, until the heavy flood of August, 1864. This flood came down during a heavy east-south-east gale.

My informant states that a great quantity of land on each side of the river had just been cleared, the timber lying on the ground till the flood swept it away down the river.

On reaching the bar all this timber was met by the heavy breakers outside and forced back, until such a mass had accumulated that the entrance was completely blocked, and the river broke through the narrow neck of land between itself and the sea in several places, whilst the old entrance quickly sanded up. One of the new channels was about 10,000 feet above the old entrance, and above Stewart's Point.

At various times since the channel into the river has shifted north and south, but has never gone back to its former site under the North Head.

A shipmaster of one of the trading schooners informed me that in July, 1876, being at anchor on the north side of Stewart's Point during an easterly gale, the sea broke through the sand abreast his vessel, and the flood-water quickly scoured a deep channel, so that the heavy sea came right into the river and broke over his vessel, obliging him to weigh and run up stream.

There is still an old beacon on the outer part of South Spit marking the edge of the former channel, which must have been over half-a-mile southward of the present one.

I am informed that the bar was much deeper and more permanent in direction when the channel was under the headland.

Now the leading-marks have to be shifted nearly every spring tide; and during the last three months of the year 1887 were moved nearly 1,000 feet northward of their position in September of that year. During these months there was a good opportunity of observing the action of the wind and sea on the formation of the spits and bar. In September there was a good bar with 10 feet at low-water springs, and a straight run in. The Pilot informed me that the bar had not altered since March, 1887, when there was a heavy fresh in the river. Early in October some heavy north-east winds occurred, the effect of which was to alter the shape of the North Spit, which began to form across the bar outside the extreme of the South Spit. By the middle of December, the strong north-east winds had brought so much sand across the entrance that there was for some time only 8 feet at high water over the bar, North Spit then quite overlapping the South Spit, the fairway being from the southward, in a north-westerly direction until inside the break; and two sets of leading-beacons being necessary for entering. This state of things lasted until a strong fresh broke through the North Spit, and the fairway was nearly, as in September, 1887, viz., straight out. Afterwards the bar altered continually. Several days strong north-east winds, shoaling up the depth of water 2 or 3 feet, and westerly winds, deepening it.

During the winter, the Pilot informed me that at one time a channel seemed likely to form in the old position under the Head, the sea coming in and making a gutter in the sand to within 30 feet of the inside water. If it had once broken through there was every probability of a deep channel being scoured out, as the water was high, and the river in fresh at the time.

The Macleay bar may be considered in comparison with others on this coast as a smooth one. It is in a large bight, and sheltered from the southward round to south-east by Trial Bay and Smoky Cape. During strong south winds it is frequently smooth on the bar when a high sea is running in the offing. It is only when the wind gets round to south-east that the bar breaks heavily. In moderate north-east winds there is little break during the flood stream, and with continued west winds I have seen the bar free of breakers for days on both ebb and flow.

The wreck of the "Agnes Irving," an iron steamer, has been lying in 11 feet of water outside the South Spit, and over a cable's length south of the fairway, since December, 1879. It is partially sanded up with 9 to 11 feet at low water inside the hull, but amidships some ironwork stands above the sand, and one piece has a depth of only 5½ feet over it. A spar buoy was placed outside this wreck in October, 1887, but it was repeatedly washed away, and sometimes found miles up the river.

No perceptible current was observed immediately outside the soundings obtained, but the flood stream was observed to set towards the entrance from either side.

During freshes the discoloured water could be seen when well outside the bar to trend round to the northward and inshore.

The Pilot informs me that all wreckage from Trial Bay or South-west Rocks is deposited on the beach, either close to North Head or along the beaches north of it, which would seem to indicate a northerly eddy inside the constant southerly current which sets along the coast outside the Capes.

Of Floods and Freshes.

The Macleay River having its sources in the New England Range, 80 or 90 miles inland, runs through very broken country for the first part of its course, and is joined by many mountain creeks, consequently it is subject to sudden freshes of short duration.

Very heavy rains along the coast do not affect the river much, and I am informed that the only floods known have been during gales between south-east and north-east, when the rain clouds, being driven inland against the mountain barrier, discharge their contents there, and fill up the numerous creeks which feed the river.

All information regarding floods was very contradictory; the river-banks and all landmarks of the old times seem to have changed or have been removed. The buildings on the lower part of the river being all of

of timber have decayed, or been swept away and replaced by others. I was given no time to make inquiries above Kempsey, but at Central Kempsey I was shown a flood-mark said to have been levelled to by a surveyor, and 25 feet above the ordinary high water. This was in the flood of 1875; the mark has since been built over.

The best information as to frequency and duration of floods and freshes was obtained from some old diaries kept by Mr. Croad, of Smithtown, who kindly allowed extracts to be made. He appears to have noted down all freshes of consequence.

Unfortunately, his house, which was a chain from the river-bank, was pulled down some years since, and his later journals mislaid or lost. The following extracts extend over a period of fifteen years:—

1863.		
26 January	...	River rose 4 feet.
27 January	...	River bank high (14 feet above datum).
28 January	...	River falling.
14 February	...	River rising; wind south-east to north-east, very strong.
15 February	...	River running over bank.
16 February	...	River over sleepers of house.
17 February	...	River falling, but still bank high.
18 February	...	River fell 3 feet.
19 February	...	River falling fast; ten men drowned up river.
3 April	...	River bank high; southerly gale.
1864.		
10 February	...	River rising; wind south, heavy rain.
11 February	...	River rising; wind south-east, heavy rain.
12 February	...	At 10 a.m. over banks, and soon after falling.
1 March	...	River rising; strong north-east wind and heavy rain.
2 March	...	River bank high.
3 March	...	River bank high all day.
4 March	...	Fresh abated slowly till 12th March, when river was not yet at ordinary level.
19 March	...	River rising again; strong southerly winds and heavy rains. The river was again very high on 30th and 31st March.
2 May	...	Strong fresh in river; wind south-east.
3 May	...	Strong fresh in river; wind strong.
4 May	...	Fresh abating.
4 June	...	River running bank high; south-east wind strong.
20 June	...	A high fresh in river.
14 July	...	Heavy rain and gale from north-east; river rising fast.
15 July	...	River over banks at 8 a.m., and still rising at 9 p.m.; wind north-east to south-west.
16 July	...	1 p.m., river falling slowly.
20 July	...	River still falling; wind north-west.
6 August	...	Continuous heavy rain.
7 August	...	Continuous heavy rain.
8 August	...	Heavy rain; east-south-east gale all night and day.
9 August	...	Flood over sleepers of house; strong south-east gale.
10 August	...	Eight inches of water in house (17 feet above datum).
11 August	...	Water falling; light south-west wind.
13 August	...	Water had fallen 2 feet.
1866.		
13 July	...	River in fresh over bank; strong south-east gale.
14 July	...	River in fresh over bank; strong south-east gale.
1867.		
11 April	...	River rising; strong north-east wind.
24 April	...	River rising; strong north-east wind shifting to east.
25 April	...	River up to stump (16½ feet above datum).
26 April	...	River falling; strong south-east wind.
27 April	...	River falling; strong south-east wind.
28 April	...	River rising.
29 April	...	River rising; over bank.
30 April	...	River falling.
1869.		
19 March	...	River rising, in strong south-east gale.
19 April	...	River rising, in strong south-east gale.
1870.		
9 March	...	River rising; strong north-east wind.
10 March	...	River falling.
13 March	...	River rising; heavy rain and south-east gale.
14 March	...	River rising; heavy rain and south-east gale.
15 March	...	River rising; heavy rain and south-east gale.
16 March	...	River rising; heavy rain and south-east gale.
17 March	...	River rising; heavy rain; wind south.
18 March	...	River bank high.
19 March	...	River bank high; gale from south.
20 March	...	Black Sunday. River running over banks; all sugar torn up by roots and corn submerged.
21 March	...	River over banks; fine north-east wind.
22 March	...	River slowly falling; fine north-west wind. The water continued to fall and reached ordinary level on 27th March.
12 May	...	River rising; wind north-east to south-east.

1872.
22 December ... River rose 6 feet; wind south-south-west, with rain.
1873.
25 February ... River bank high; south-east gale.
26 February ... River bank high; falling.
15 June ... River rising; wind east, with rain.
16 June ... River rising; gale from north-east.
17 June ... River bank high at 7 a.m.; north-east gale. After that the flood-water fell slowly till the 20th, with fine weather and west winds.
29 December ... Fresh in river; heavy gale from north-east, with rain.
30 December ... River rising; heavy gale from south-east.
31 December ... River falling.
1874.
27 January ... River rising; south-east gale and heavy rain.
28 January ... River rising; south-east gale and heavy rain.
29 January ... River rising; south-east gale and heavy rain.
30 January ... River rising; south-east gale and heavy rain.
31 January ... River falling.
1875.
25 February ... River rising; strong south-east and rain.
26 February ... River rising; strong south-east and rain.
27 February ... River rising; strong south-east and rain.
28 February ... Flood water in house; south-east gale, blowing barn, outhouses, and trees down. This is the most disastrous flood known on river.
1 March ... Water 18 inches in house (18 feet above datum); south-east gale still blowing.
2 March ... Flood water slowly falling; south-east gale.
3 March ... Flood water slowly falling; north-east showers. The river continued to fall till the 7th March, with north-easterly weather.
1876.
11 April ... Heavy rain and south-south-east wind till 14th.
14 April ... River rising fast.
26 June ... River rising; strong south-east wind.
27 June ... River falling.
14 July ... Heavy rain: south-east gale.
15 July ... River rising; easterly gale.
16 July ... River rising; easterly gale; heavy rain, ended 7 p.m.
17 July ... River up to top of bank; south-westerly wind.
18 July ... River falling; south-east gale.
19 July ... River rising; south-west gale.
20 July ... River falling slowly; south-west gale.
21 July ... River falling slowly; south-west gale.
22 July ... River falling slowly; south-west gale.
23 July ... River falling slowly; less wind
1877.
21 December ... Very heavy rain and hail south-east; strong fresh in river.
1878.
7 February ... River up 8 feet; north-east wind.
9 February ... River falling.
16 February ... River rising; south-east gale.
17 February ... River up 8 feet; south-east gale.

From the above date the books containing the entries were not to be found.

During the survey the river was in fresh more or less from the 26th December, 1887, to the end of April, 1888.

Early in January, 1888, the flood-water was over the Government wharf (about 6 feet rise) for some days at Smithtown, and frequently afterwards 1 or 2 feet above ordinary level, but nothing that could be called a flood took place.

No rainfall has been noted at the Macleay Heads, the nearest meteorological station being West Kempsey, where the rainfall has been registered since 1882. The average for five years has been a fall of 37·75 inches, which would be about two-thirds of the rainfall at the Heads.

I was unable to obtain any information as to the winds during the last ten years, and any records from West Kempsey would fail to show how the winds blew at the entrance.

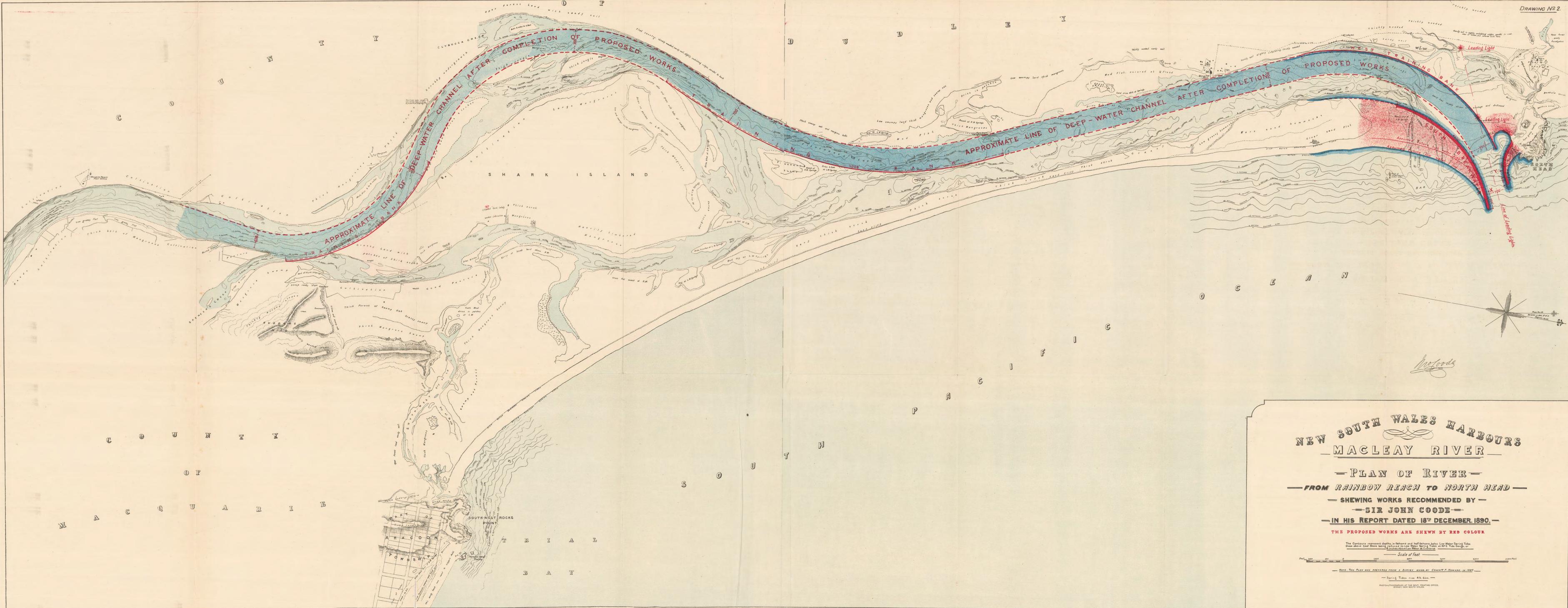
On February 8th, 1888, a strong north-east wind was blowing at the entrance and some distance up the river; at Kempsey it was calm till about 1 p.m., when a very heavy rain squall came from the westward. This met the north-east wind at Seven Oaks, and from thence to Kinchela Creek caused a cyclone, which levelled all crops along the river banks, tore up trees, barns, &c., and unroofed or otherwise damaged most of the houses at Smithtown.

The works on the Macleay River carried out by the Harbours and Rivers Department are the Government wharves, dry dock, and dredged cuttings, and I doubt the existence of any plans of these works. I am informed that a breakwater is to be run from Lagger's Point across Trial Bay by prison labour, but the plans have not been made public. A large quantity of rails, trucks, &c., for this work was landed at Pelican Island wharf during the survey.

With regard to materials, prices, &c., there has been a Resident Engineer of the Harbours and Rivers Department at Trial Bay for many years who can best furnish that information.

COMMANDER F. HOWARD, R.N.,
Hydrographical Surveyor,
Harbours and Rivers Branch,
Department of Public Works.

[Two Plans.]



**NEW SOUTH WALES HARBOURS
MACLEAY RIVER**

— PLAN OF RIVER —
 — FROM RAINBOW REACH TO NORTH HEAD —
 — SHEWING WORKS RECOMMENDED BY —
 — SIR JOHN COODE —
 — IN HIS REPORT DATED 18th DECEMBER 1890. —
 THE PROPOSED WORKS ARE SHEWN BY RED COLOUR

The Contours represent depths, in fathoms and half fathoms, below Low Water Spring Tides above Mean Sea Level, reduced to Low Water Spring Tides at 1872. The depth of 1 fathom about Low Water at Tallowra.

Scale of Feet
 0 100 200 300 400 500 600 700 800 900 1000

Work. This Plan was prepared from a Survey made by Commr F. Rowland, in 1887.

Spring Tides, mean 4th. Est.

Photographed at the Govt. Printing Office, Sydney, New South Wales.

NEW SOUTH WALES HARBOURS — MACLEAY RIVER —

— GENERAL PLAN OF RIVER —
— FROM BELGRAVE FALLS TO THE SEA —

— SHEWING WORKS RECOMMENDED BY —
— SIR JOHN COODE —

— IN HIS REPORT DATED 18th DECEMBER, 1890. —

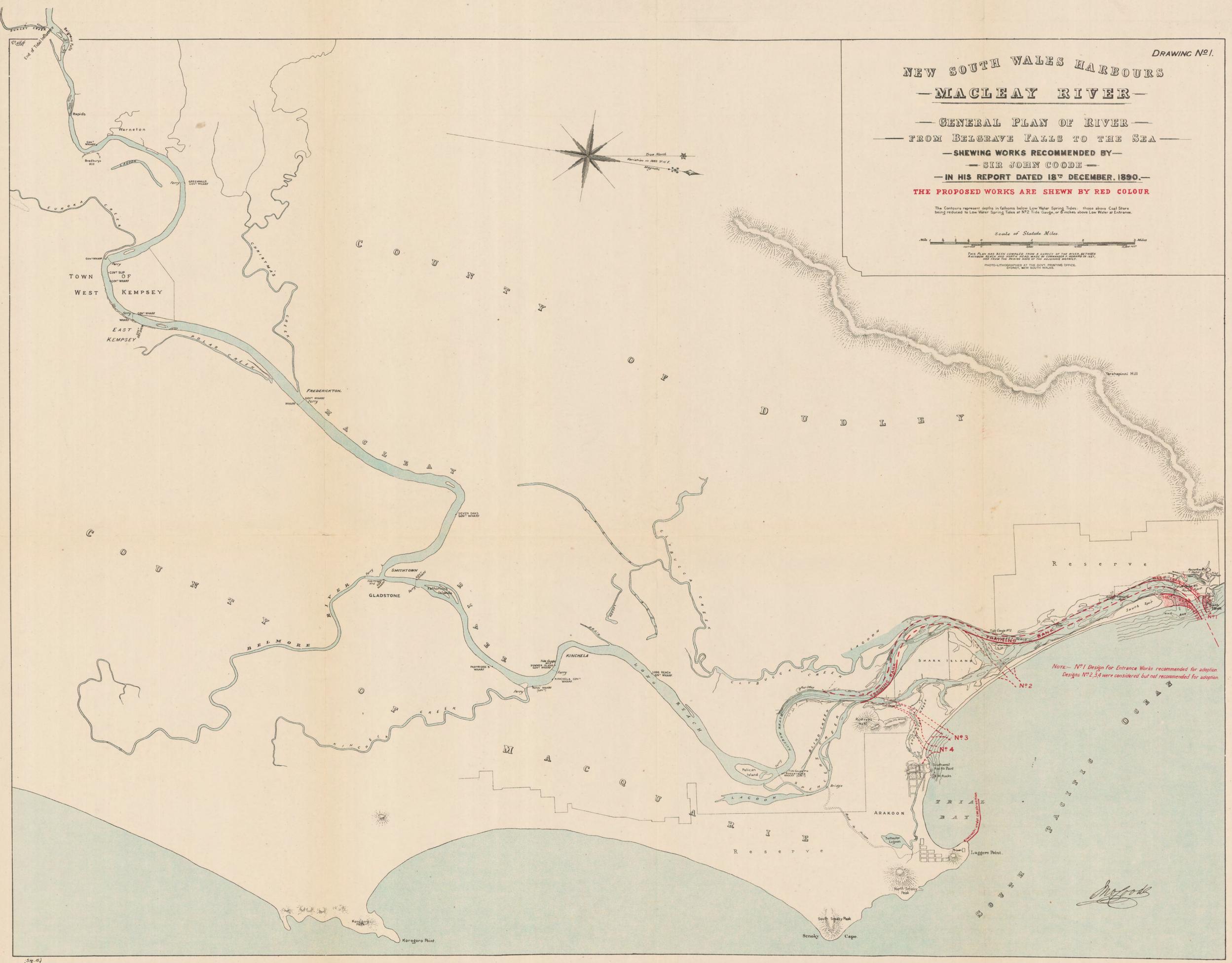
THE PROPOSED WORKS ARE SHEWEN BY RED COLOUR

The Contours represent depths in fathoms below Low Water Spring Tides - those above Coal Store being reduced to Low Water Spring Tides at N^o 2 Tide Gauge, or 2 inches above Low Water at Entrance.

Scale of Statute Miles.



THIS PLAN HAS BEEN COMPILED FROM A SURVEY OF THE RIVER BETWEEN
RAINBOW BEACH AND DART'S HEAD MADE BY COMMANDER J. COODE IN 1887,
AND FROM THE CHARTS MADE BY THE ROYAL NAVY.
PHOTO-LITHOGRAPHED AT THE GOVT. PRINTING OFFICE,
SYDNEY, NEW SOUTH WALES.



NOTE.— N^o 1 Design for Entrance Works recommended for adoption.
Designs N^o 2, 3, 4 were considered but not recommended for adoption.

J. Coode