

P A P E R S

RELATING TO

THE CONSTRUCTION OF RAILWAYS.

IV. RAILWAY BRIDGES.

PRESENTED TO BOTH HOUSES OF THE GENERAL ASSEMBLY, BY COMMAND OF
HIS EXCELLENCY.

WELLINGTON.

—
1871.



SCHEDULE OF CORRESPONDENCE.

SELWYN BRIDGE.

No.	1871.				
1	March 24	Mr. Blackett	...	Hon. Col. Secretary...	Report on site and mode of construction suggested by Provincial Engineer approved. Examination by Mr. Bray corroborates report.
2	March 6	Mr. Thornton	...	Hon. Col. Secretary...	Report mentioned in No. 1.
3	March 13	Mr. Blackett	...	Hon. Col. Secretary...	Approval mentioned in No. 1.
4	March 22	Mr. Bray	...	Hon. Col. Secretary...	Agreeing with Mr. Thornton's plan and report.
5	April 21	Superintendent of Canterbury	of	Hon. Col. Secretary...	Can the cost of bridge be paid for out of the £7,000 voted by Provincial Council?
6	April 28	Mr. Bray	...	Mr. Blackett	Tenders for bridge will be sent in on 8th.*

* The lowest of twelve accepted (£4,689).

RAKAIA BRIDGES.

7	1871. March 2	Mr. Blackett	...	Mr. Gisborne	...	Iron railway bridge and wooden bridge for ordinary traffic would cost £43,000; a wooden bridge for both purposes, £32,000; alterations to present structure, about £9,000.
8	March 14	Superintendent of Canterbury	of	Hon. D. Bell	...	Requesting assurance that Government will recommend cost of railway bridge to be refunded as part of cost of Southern Railway. Mr. Blackett reports that tender for alterations is £8,564, and may be accepted.
9	March 14	Hon. D. Bell	...	Superintendent of Canterbury	of	Government will recommend to the Assembly to take over bridge as part of Southern Railway, and redeem the tolls.

WAITAKI BRIDGE.

10	1871. Feb. 21	Messrs. Blackett, Bray, Tancred, and Millar		Hon. Col. Secretary...		Report on site. Crossing at telegraph line recommended.
11	March 30	Hon. W. Fox	...	Superintendents of Canterbury & Otago		Forwarding above report.
12	April 24	Superintendent of Canterbury	of	Hon. Col. Secretary...		Acknowledging receipt.
13	April 27	Superintendent of Otago	of	Hon. Col. Secretary...		Acknowledging receipt.
14	March 31	Mr. Blackett	...	Hon. Col. Secretary...		At a Conference of Ministers, Superintendent, and others, it was decided to have a wooden bridge of jarra and totara, with iron girders.
15	April 1	Mr. Bray	...	Hon. Col. Secretary...		Estimate of quantities; iron girders required for present and future orders.
16	April 3	Mr. Cooper	...	Mr. Morrison	...	To execute order enclosed for iron girders if Hon. Mr. Vogel has returned to England. Letter for Mr. Vogel enclosed.
17	June 1	Mr. Morrison	...	Hon. Col. Secretary...		Mr. Cooper's letter has been brought under Hon. Mr. Vogel's attention. He is still in England.
18	May 13	Mr. Blackett	...	Hon. Col. Secretary...		Suitable totara timber can be obtained in the Waimate Bush; recommends it in preference to jarra timber, as only half the cost. Mr. Bray will prepare estimate of quantities and plans.
19	May 16	Mr. Bray	...	Mr. Blackett	...	Forward quantities.
20	July 10	Mr. Blackett	...	Mr. Millar	...	Inquiry whether the line of railway is laid out to a different site than that decided by Engineering Commission (No. 10).
21	July 11	Mr. Millar	...	Mr. Blackett	...	Line has been laid with reference to site, but, from observations made during last three months, thinks an alteration desirable. Question can be considered by Commissioners when they meet in Wellington. Has made survey of shingle beds.
22	July 11	Mr. Blackett	...	Hon. Col. Secretary...		The above should be communicated to the other members of the Commission.
23	July 12	Mr. Blackett	...	Messrs. Tancred and Bray		Forwarding copy of Mr. Millar's telegram.
24	July 17	Mr. Millar	...	Hon. Col. Secretary...		Detailed explanation relative to the second site proposed.
25	July 17	Mr. Millar	...	Mr. Blackett	...	Result of borings taking by Mr. Forester in Waitaki River, and of lock spitting completed.
26	...	Mr. Blackett	...	Hon. Col. Secretary...		Memorandum on borings.
27	July 21	Mr. Bray	...	Mr. Blackett	...	Pending arrival of promised tracings of site from Mr. Millar, bridge plans cannot be prepared.

PLANS.

Plans 1 and 2, illustrating Commissioners' Report on site of Waitaki Bridge No. 10.

SELWYN BRIDGE.

No. 1.

From Mr. BLACKETT to the Hon. W. GISBORNE.

Public Works Office,
Dunedin, 24th March, 1871.

SIR,—

I have the honor to forward telegrams from W. B. Bray, Esq., having reference to a proposed wooden bridge over the river Selwyn, on the line of the Rolleston and Southbridge tramway.

During my stay in Christchurch, the report of the Provincial Engineer on this bridge and its site, was laid before me, and I made a memo. on the report approving of the site and the manner of building the bridge; such approval to be contingent on Mr. Bray's inspection of the site, and confirmation of the report. It will be seen by his telegram that he has found everything as described in the report, and the Provincial Government will now be at liberty to construct the bridge (suitable for future railway traffic) and the roads leading to it.

I have, &c.,
JOHN BLACKETT,
Acting Engineer in Chief.

The Hon. the Minister of Public Works,
Wellington.

Enclosure to No. 1.

(Telegram).

Christchurch, 23rd March, 1871.

I HAVE just returned from Selwyn Bridge. I found all correct as stated in report, which I shall approve to-morrow.

W. B. BRAY.

No. 2.

Mr. THORNTON to the Hon. W. GISBORNE.

Christchurch, 6th March, 1871.

SIR,—

From the data furnished me by Messrs. Triphook and Crawford, and the detailed survey of the locality of the present bridge over the Selwyn, on the line of the Leeston road,

I am now enabled to report that, keeping in view the desirability of adapting the bridge for both railway and ordinary traffic, the combined advantages would be met by constructing the bridge on the line marked A.B. on the accompanying plan.

Being situated only 8 chains distant from the line of tramway selected by the Chief Surveyor, as indicated by the blue line, it can be easily connected with it by curves of 40 and 10 chains radii, as colored brown. It also agrees in direction with the road on the south bank of the river.

It will require a new road on the north bank of the river; also, a small bridge of 40 feet long over creek at D on plan.

This road will be perfectly safe from the effects of freshes, and the length of bridge will occupy the whole of the the river bed at such times, and will be placed at right angles with the stream, which is here confined between safe banks.

A comparison of the 3 sections taken across the river, as shown on drawing, gives the following lengths of bridging necessary.

On tramway line	...	...	...	...	1023 feet
Line A.B.	...	...	...	...	900 "
Present road	...	...	...	...	1716 "

Whilst the line A.B. is shorter for bridging, it possesses the further advantage of being readily connected with existing lines of main roads, and is quite safe from scour or inundation.

The increased distance by the deviation of the road, as compared with the present road from Christchurch to Leeston, is 47 chains; but this would be compensated by the shortening of the route to Burnham Station by about the same distance, which could then become the outlet for the Leeston traffic.

With reference to the existing bridge, supposing this route to remain open for traffic during all freshes, as in former case, it will be necessary to construct an addition to the present bridge of 1716 feet, besides strengthening and adapting it to the altered traffic.

As the land south of the bridge to the terrace at L is liable to inundation during ordinary freshes, whilst it is certainly unsafe to embank any portion of the river bed so as to diminish the water way.

The description of bridge that I would recommend is an ordinary timber structure, sufficiently rigid to carry a railway train, with spans of 15 feet wide, and with a roadway that can be adapted when required for the railway, and made available for both by packing between the rails to bring the planking level with them, the underside of girders being kept well above flood level; the planking being carried by cross joists, in order to prevent the girders being injured by direct contact with it.

RAILWAY BRIDGES.

The following is the estimated cost of bridges, &c., on the several lines referred to.

On Line A.B.			
900 feet lineal of bridge	...	...	£4,500 0 0
Road formation and metalling on north bank, 55½ chains	...	...	329 0 0
" " " " on south bank, 31½ "	...	...	90 0 0
40 feet of bridging over creek at D.	...	...	160 0 0
Land purchase of freehold, leasehold and severance, 3 acres, 3 roods, 6 perches	...	...	61 15 6
			£5,140 15 6
Estimate of Bridge on present road.			
1,716 feet level of bridge	...	...	£6,864 0 0
Strengthening, &c., of present bridge	...	...	750 0 0
			£7,614 0 0
Estimate on Chief Surveyor's line.			
1023 feet level of bridge	...	...	£5,115 0 0
Road formation and metalling on north bank, 60½ chains	...	...	340 10 0
" " " " on south bank, 41 "	...	...	115 10 0
Land purchase of freehold, leasehold and severance, north bank	...	...	66 15 6
			£5,637 15 6

I have, &c.,

GEORGE THORNTON,
Railway Engineer.

The Secretary for Public Works.

No. 3.

MEMORANDUM by MR. BLACKETT.

I SHOULD agree with Mr. Thornton's proposal for building the bridge on the line A.B. on the plan, provided that after Mr. Bray has examined the place he also agrees with it.

I also approve of the proposed mode of construction.

JOHN BLACKETT,
Acting Engineer-in-Chief.

Christchurch, March 13, 1871.

No. 4.

MEMORANDUM by MR. BRAY.

HAVING examined the site for the proposed bridge and road, I quite agree with Mr. Thornton's plan and report.

W. B. BRAY,
District Engineer.

22nd March, 1871.

No. 5.

HON. W. ROLLESTON to HON. W. GISBORNE.

Superintendent's Office,
Christchurch, 21st April, 1871.

SIR,—

In the Resolution of the Provincial Council, with reference to the extension of railways, copies of which have been already forwarded to you, it is proposed that if the General Government will undertake the construction of the Rolleston and Southbridge Line, under the "Public Works and Immigration Act," the Province will contribute a sum of £7,000 towards the cost of the same.

It is presumed that no decision can be arrived at with regard to the whole line before the meeting of the General Assembly; but in the meantime, it would be most desirable to erect a bridge at the point where the line crosses the River Selwyn, for the purposes of ordinary traffic, the bridge being so constructed as to be available for railway traffic.

Mr. Blackett and Mr. Bray have both approved of the site of the bridge, and the mode of its construction; and now the Provincial Government desire to obtain the assurance of the General Government that, should the terms contained in the above mentioned Resolutions be accepted by the General Assembly, the cost of the bridge, which will be adapted for railway traffic, will be taken as part payment of the contribution of £7,000 which it is proposed the Province should provide under the terms already stated.

I have, &c.,

W. ROLLESTON,
Superintendent.

The Hon. the Minister for Public Works,

NOTE—The tender of Mr. Edward G. Wright, being the lowest of the twelve tenders received, has been accepted.

No. 6.

MR. BRAY to MR. BLACKETT.

(Telegram).

Christchurch, 28th April, 1871.

THERE has been no delay respecting the Selwyn Bridge. The plans have been before contractor since Monday, 24th inst. To-morrow's coach will take tracings to Dunedin for contractor there to see. Tenders are to be in on the 8th of May.

J. Blackett, Esq., Dunedin.

W. B. BRAY.

RAKAIA BRIDGE.

No. 7.

Mr. BLACKETT to the Hon. W. GISBORNE.

SIR,—

Christchurch, 2nd March, 1871.

I have already reported on the Rakaia Bridge to the Superintendent of Canterbury to this effect, viz. :—That I could not accept it with the alterations, as proposed (assumed to cost £5,000), as fit for railway purposes, but that if certain other additions were made to the alterations, it might be accepted as fit for railway traffic. The additions I proposed were joists between the main bearing beams and the floor planks, at an approximate estimated cost of £1,750.

At this time the real cost of the first intended alterations had not been worked out, nor, it appears, had I rightly estimated the cost of the second additions; the estimate was made out yesterday for all the additions, and came to a total of £8,942, or close on £9,000.

Supposing thus, that within two years the bridge be used for railway purposes, and taken out of the contractor's hands, paying him at the schedule rate for the redemption of his tolls, the total cost of the bridge will stand thus :—

Original payment cost	...	...	...	...	...	£10,000
Contemplated additions	...	...	...	...	...	9,000
Redemption of tolls, £11,000, but more probably greater on account of delay to contractors, say	...	...	...	...	...	13,000
Total	...	...	...	...	...	£32,000

(It would be a question as to how much of this sum could, or would be charged to railway account).

We should then have a wooden bridge, not of the most approved form, but capable of carrying railway traffic a certain but indefinite number of years, and to be used also for ordinary traffic as well.

The Superintendent and Executive appear to regard this as the only way in which practically, for financial reasons, a railway bridge can be secured to the Province; but Mr. Bray and myself think that before any decision is arrived at, it should be considered in another light. We estimate that by adopting 20 feet spans (the same as proposed for the wooden bridge) we could erect apart, and at a short distance from the other, an iron bridge, that is with iron piers and iron girders, for a sum not exceeding £19,000 or £20,000 complete, and thus supposing that the wooden bridge shall be completed on its original design, for ordinary traffic, the comparative cost would stand thus, viz. :—

New iron railway bridge, say	...	...	...	...	...	£20,000
Original cost of wooden do	...	...	...	...	...	10,000
Redemption of tolls as before	...	...	...	...	...	13,000
(This is included in equity as White's income would practically cease on opening a railway bridge.)						
Total	...	...	...	...	...	£43,000

For which sum we should have a separate railway bridge, and a bridge for ordinary traffic, as compared with (according to the first estimate) a wooden bridge for combined traffic at cost of £32,000. Making a difference of £11,000.

I beg to submit the above for your consideration, and meanwhile will inform His Honor that, until you have considered it, no orders should be given to proceed with the alterations.

I have, &c.,

JOHN BLACKETT, C.E.

No. 8.

MEMORANDUM by His Honor W. ROLLESTON for the Hon. D. BELL.

THE attached letter from Mr. Blackett gives the Engineer's approval of the plans for the conversion of the Rakaia Bridge into a railway bridge. The approval of the Minister for Public Works is required, to enable the Province to go on with the work, with the assurance that the bridge will be recommended to the General Assembly, to be taken over as a railway bridge by the Colonial Government on its being required to be used for railway purposes, as part of the Southern Railway. The cost will then be refunded to the Province on the same terms as the cost of the Northern Railways, the work having been certified by the Resident Engineer of the General Government to be in accordance with the plan now approved.

It is understood that the cost of the bridge so to be refunded will include the redemption of the tolls and additions, as estimated by Mr. Blackett in his letter of 2nd March, amounting in round numbers to £32,000.

14th March, 1871.

W. ROLLESTON,
Superintendent.

RAILWAY BRIDGES.

Enclosure to No. 8.

Mr. BLACKETT to His Honor W. ROLLESTON.

SIR,—

Christchurch, 13th March, 1871.

I have the honor to inform you that I have, in conjunction with Mr. Thornton, estimated the cost of converting the Rakaia Bridge into a structure fit to carry railway traffic, embodying those alterations assented to by Mr. Bray, as well as those which I have pointed out as being necessary before it can be accepted for railway purposes; and that I consider Mr. White's tender for all the additional work is reasonable, and may be accepted. Amount of tender—Eight thousand five hundred and sixty-four pounds.

I have, &c.,

JOHN BLACKETT,

Acting Engineer in Chief.

His Honor the Superintendent, Canterbury.

No. 9.

MEMORANDUM by the Hon. F. D. BELL, for His Honor W. ROLLESTON.

Mr. ROLLESTON,—

Christchurch, 14th March, 1871.

Adverting to your Honor's minute of this date, on the subject of completing the present wooden bridge over the Rakaia River so as to make it a railway bridge, I have communicated to the Minister of Public Works the substance of what took place between your Honor and myself with the Acting Engineer, Mr. Blackett; and Mr. Gisborne having signified his concurrence therein I have now to convey to you the approval of the General Government to the proposal for executing the work. The Minister for Public Works will accordingly recommend to the General Assembly to take over the bridges as part of the Southern Railway, and redeem the tolls according to the estimate made by Mr. Blackett.

F. D. BELL,

In the absence of Mr. Gisborne.

WAITAKI BRIDGE.

No. 10.

Messrs. BLACKETT, BRAY, TANCRED & MILLAR, to the Hon. W. GISBORNE.

SIR,—

Christchurch, 21st February, 1871.

Having been instructed by the General Government to determine what point on the Waitaki was most suitable for the erection of a bridge, for a railway from Christchurch to Dunedin, which bridge might be used for ordinary traffic as well as for the railway.

We met on 1st January, at the Waitaki, and proceeded to examine the river in the vicinity of the proposed railway, and to decide what sections of the river would be requisite for our guidance, when we could meet with Mr. Blackett to consider the several lines, and determine on the best.

The general character of the Waitaki is the same as most of the rivers on the East Coast, frequently varying its channel over a wide shingle bed, the whole of which is liable to be flooded in high freshes, though the width occupied by these flood waters in the vicinity of the sea is less than higher up.

As far as we have been able to ascertain, the river is free from large drift timber, the passage of which has not to be provided for in constructing the bridge.

The several sites which we have found it necessary to consider more particularly are as follows:—

- 1st. At $9\frac{1}{2}$ miles from the sea, at the outcrop of a thin bed of stone, opposite Mr. Buckley's.
- 2nd. At $6\frac{1}{2}$ miles from the sea, at Brown's ferry, where the coach road now crosses.
- 3rd. At $2\frac{1}{2}$ miles from the sea at the Telegraph line. The bridge at the upper site, section No. 1, would be 4,276 feet long, and estimating it at £10 per lineal foot would cost £42,760. This site requires the railway to make a detour which lengthens the line $5\frac{1}{2}$ miles at an expense, say of £28,750, exclusive of land purchase.

The bridge at Brown's ferry, section No. 2, would be 6,930 feet long, costing at £10 per lineal foot, £69,300.

The railway on this line would not be lengthened, but land would have to be purchased in Otago.

The bridge near the telegraph line, section No. 3, would be 3630 feet long, costing at £10 per lineal foot, £36,300.

The railway would be most direct on this line, and owing to the reserves made in both Provinces, no land would require to be purchased.

The site at the telegraph line is therefore, estimated at £33,000 less than the bridge at Brown's ferry, and £35,210 less than the bridge and extra length of railway at the upper site, or £6,460 less than the bridge alone at that site.

We therefore recommend the telegraph line, as the most direct and economical for a railway bridge for the Christchurch and Dunedin Railway.

By adopting short spans of say 33 feet, and a narrow roadway of about 18 feet for the railway, but available for ordinary traffic, except at train times, the cost of the bridge may be brought within the sum allotted to the work, viz., £35,000. But as there can be no doubt that it would be better to adopt larger spans and separate platforms for the railway and ordinary traffic, fenced off from each other, which form of construction would be more costly and would probably exceed the allotted sum, unless the most recent improvements in iron bridge building be adopted. We are of opinion that it would be wise to obtain in England plans and tenders for the construction and erection of such a bridge, adapted to light railway traffic, designed in the cheapest and plainest form, compatible with the necessary strength, as by such proceeding we may obtain the improved construction, possibly even within the allotted sum.

We therefore recommend that accurate plans and sections of the site for the proposed bridge be forwarded to England, with description of the nature of the ground, for the purpose of obtaining designs and tenders for such work.

We have, &c.,

JOHN BLACKETT.
W. B. BRAY.
T. S. TANCRED.
J. MILLAR.

The Hon. the Minister for Public Works.

No. 11.

The Hon. W. FOX to SUPERINTENDENTS of CANTERBURY and OTAGO.
Colonial Secretary's Office,

Wellington, 30th March, 1871.

SIR,—

I transmit herewith for your Honor's information the accompanying copy of Report by Messrs. Blackett, Bray, Tancred and Millar on the Waitaki Bridge, and also a tracing relating to the same.

I have, &c.,

His Honor the Superintendent, Canterbury.

WILLIAM FOX,
In the absence of Mr. Gisborne.

NOTE.—A similar letter was forwarded, with Enclosures, to His Honor the Superintendent of Otago.

RAILWAY BRIDGES.

No. 12.

His Honor W. ROLLESTON to the Hon. W. GISBORNE.

SIR,—
 Superintendent's Office,
 Christchurch, Canterbury, N.Z., 24th April, 1871.
 I have the honor to acknowledge the receipt of your letter, No. 76, dated 30th March, 1871, and to thank you for the copy of the Report by Messrs. Blackett, Bray, Tancred and Millar on the Waitaki Bridge, and the tracing relating to the same transmitted therewith.

I have, &c.,

The Hon. the Colonial Secretary.

W. ROLLESTON,
Superintendent.

No. 13.

His Honor J. MACANDREW to the Hon. W. GISBORNE.

SIR,—
 Province of Otago, N.Z.,
 Superintendent's Office, Dunedin, 27th April, 1871.
 I have the honor to acknowledge the receipt of your letter of the 30th March, 1871, enclosing copy of Report by Messrs. Blackett, Bray, Tancred and Millar, on the Waitaki Bridge, and also tracings relating to same.

I have, &c.,

The Hon. the Colonial Secretary, Wellington.

J. MACANDREW,
Superintendent.

No. 14.

MEMORANDUM by Mr. BLACKETT.

Public Works Office,

Dunedin, 31st March, 1871.

At a meeting in Dunedin, on the 22nd March, at which were present the Hon. Mr. Gisborne, the Hon. Mr. Bell, His Honor the Superintendent of Otago, the Hon. Mr. Holmes, and myself, the question was considered as to whether the Waitaki Bridge might not be constructed entirely of wood, say Jarra and Totara, a quantity of the former wood being at once available for purchase in the Province; and the latter, it was averred, could be obtained in any quantity at Waimate, about twelve miles from the Waitaki.

It was urged by Mr. Holmes that much time would be saved by building a wooden bridge, and that much unnecessary delay would be caused by adopting the suggestions of the Commissioners who reported on the bridge, viz., that designs for an iron bridge should be obtained from England before proceeding with the work. The Ministers present expressed their willingness to sanction a wooden bridge, provided a favorable expression of opinion was received from the Engineers who reported on the bridge, as to the use of wood in its construction.

I was therefore instructed to confer with Messrs. Bray, Tancred, and Millar on this subject, and ascertain their opinion on this point, and also as to the minimum width of spans to be adopted.

Mr. Millar offered no objection to the erection of a wooden bridge, with spans not less than thirty-three feet. Messrs. Bray and Tancred agreed on thirty-three feet as a minimum span, and that the piers should be of iron, as being much more safe and permanent, and capable of being erected as quickly as if of wood. In this I concurred, expressing a strong opinion that this would make an excellent bridge, and infinitely preferable to one entirely of wood, and I pointed out that if iron girders were sent for at once they would be out in time to make little or no difference in the time the bridge might be opened for traffic.

The Hon. the Minister for Works thereupon decided that the Waitaki Bridge should be built with wooden piles and iron girders; and I was instructed to prepare a list of iron girders and the necessary fittings in time to be sent by the first English mail, leaving Dunedin on the 1st April. The entire number of girders required for a compound bridge, as described in "The Public Works Act, 1870," would be 330, which would cost, landed in New Zealand, the sum of £12,375, but by arranging that while the whole number of piers should be driven the superstructure should for the present be completed for ordinary traffic only. It would be sufficient to send for two-thirds of that number of girders immediately. I was accordingly instructed to order the less number only at first, viz., 220, at a probable cost of £8,250.

I have, &c.,

JOHN BLACKETT,

Acting Engineer-in-Chief.

No. 15.

MEMORANDUM by Mr. BRAY on Waitaki Bridge.

THE bridge to be erected across the Waitaki is to consist of a railway 12 feet wide and a cart road 18 feet wide. These together will form a platform 30 feet wide and 3,630 feet long, on joists supported by 3 lines of iron girders, resting on piers of timber piles and capsills.

The girders are to be 33 feet long and 2 feet 6 inches deep, similar to those designed by Mr. Hemans for the Canterbury Northern Railway, omitting the iron cross girders.

The present order is to include only two lines of girders to support the cart road. These are to be 15 feet 4 inches centre to centre, resting on cast-iron bed plates, secured to the capsills with bolts 18 inches centre to centre, so as to clear the heads of the piles.

As the roadway lies on the tops of these girders, they will require lateral bracing from the bed plates, and the horizontal bracing must be attached to the top web rather than the bottom. The joists, 5 x 12 inches, and 29 inches centre to centre, are to be secured to the girders by $\frac{3}{4}$ inch clip bolts.

For convenience of erection, the girders are to be connected in lengths of three, before being rolled to their place, and these lengths may then be joined by coupling plates with oblong holes to allow for contraction and expansion.

The 3rd line of girders and its horizontal bracing will form a subsequent order, but provision must now be made for attaching the bracing of this 3rd line of girder, which will be 7 feet 8 inches centre to centre from the middle line.

Each line of girders will consist of 110 spans of 33 feet, that is 220 girders under the present order.

The erection will be commenced from the South end, and the 3rd line of girders will be placed to the East of those now ordered.

Schedule for one pair of Girders, 33 feet span, 14ft. 8in. centre to centre.

				Tons	cwts.	qrs.	lbs.
2 wrought iron plate girders	...	...	...	4	7	1	14
Horizontal bracing	...	...	...	0	2	2	8
Lateral bracing to the ends	...	...	...	0	0	1	12
4 connecting plates	...	...	...	0	2	0	14
2 cast iron bed plates	...	...	...	0	5	0	22
Bolts, viz.—4 bed plates to capsill,		$1.7 \times 1\frac{1}{4} = 37\frac{1}{2}$	lbs.				
8 girders to bed plates		$5\frac{1}{2} \times \frac{7}{8} = 14\frac{1}{4}$					
14 horizontal bracings to girders		$2\frac{1}{2} \times \frac{7}{8} = 18\frac{1}{4}$					
2 bracings to each other		$1\frac{3}{4} \times \frac{7}{8} = 2$					
Lateral bracing to girders		$2\frac{3}{4} \times \frac{7}{8} = 4$					
72 to coupling and bearing plates		$2\frac{3}{4} \times \frac{7}{8} = 97$					
12 to girder ends		$2\frac{1}{8} \times \frac{7}{8} = 15$					
			188 lbs. =	0	1	2	20
24 clip Bolts to secure joists to girders				0	0	2	0
Extra Bolts	...	...	...	0	0	0	22
Weight per pair of Girders...	...	...	...	5	0	0	0
110 Spans at 5 Tons each	...	...	...	550	0	0	0

NOTE.—2 extra cast iron bed plates and holding-down bolts will be required with the last pair of girders.

1st April, 1871.

W. B. BRAY,
District Engineer.

Enclosure 1 in No. 15.

WAITAKI BRIDGE.

Present Order.	Estimate of Cost of Iron Girders for cart bridge.		
110 Spans at 5 ton per Span=550 tons at £13 5s.	£7,287 10 0
Freight on 550 tons at 30s.	825 0 0
			<u>£8,112 10 0</u>
Future Order.	Estimate of 3rd line of Girders for Railway.		
110 Spans at 2 tons 10 cwt. 3 qrs.=279 tons 2 cwts. 2 qrs.			
Say 280 tons at £13 5s.	£3,710 0 0
Freight on 280 tons at 30s.	420 0 0
			<u>£4,130 0 0</u>

The weights of the above ironwork are the same as in the particulars furnished us of the iron work sent per "Crusader," omitting the cross girders and bolts not required, and adding to the weight where required for the Waitaki bridge.

1st April, 1871.

W. B. BRAY,
District Engineer.

RAILWAY BRIDGES.

Enclosure 2 in No. 15.

WAITAKI BRIDGE.

Schedule for 3rd line of Girders for 1, 33 feet span, 7ft. Sin. east of former line.

			Tons	cwt.	qrs.	lbs.
1 wrought iron plate girder ... ..	...	...	2	3	2	21
Horizontal bracing ... ..	...	...	0	1	3	0
Lateral bracing to the ends ... ..	...	...	0	0	0	20
2 connecting plates ... ..	...	...	0	1	0	7
1 cast iron bed plate ... ..	...	...	0	2	2	11
Bolts, viz.—2 bed plates to capsills ...	17 x 1½ = 19 lbs.	...				
4 girders to bed plates	5½ x 7/8 = 7	...				
14 horizontal bracing to girders ...	2½ x 7/8 = 18	...				
2 bracing to each other	1½ x 7/8 = 2	...				
Lateral bracing to girders	2½ x 7/8 = 2	...				
36 to coupling and bearing plates ...	2½ x 7/8 = 49	...				
6 to girder ends	2½ x 7/8 = 7	...				
		104 lbs. =	0	0	3	20
24 clip bolts to secure joists to girders ...	...		0	0	2	0
			2	10	2	23
110 spans at 2 tons 10 cwt. 3 qrs. ... ..	...	...	279	2	2	0
1 extra cast iron bed plate and holding-down bolts will be required with the last pair of girders.						

No. 16.

Mr. COOPER to Mr. MORRISON.

Colonial Secretary's Office,

Wellington, 3rd April, 1871.

SIR,—

I have the honor by direction of Mr. Gisborne to transmit to you the enclosed copy of a memorandum from the District Engineer in Canterbury,* shewing the quantity and description of iron girders required in the construction of the Waitaki Bridge, and to request you to be good enough, in the event of the Hon. J. Vogel having left England to return to New Zealand, to take the necessary steps for the execution of the order in accordance with the instructions contained in a letter addressed to Mr. Vogel, a copy of which I enclose.

Before payment is due, Dr. Featherston, Agent-General, will have taken steps for providing the funds.

I have, &c.,

G. S. COOPER,

Under Secretary.

J. Morrison, Esq., 3 Adelaide Place,
King William Street, London.

Enclosure in No. 16.

Colonial Secretary's Office,

Wellington, 3rd April, 1871.

SIR,—

The Government have determined to proceed without delay in the construction of the Waitaki Bridge, as a wooden bridge, with iron girders, and I enclose a copy of a memorandum from the District Engineer in Canterbury, showing the quantity and description of the girders required; and I have to request you to be good enough to procure them, in accordance therewith, for the Government.

Similar girders have been provided to the Canterbury Government for the Waimakariri Bridge, under the inspection, and subject to the approval of Mr. G. W. Hemans, C.E., No. 1, Westminster Chambers, Victoria Street, S.W., and I am informed that they have proved to be suitable, and satisfactory in every respect. It would, therefore, be advisable that the iron girders which you procure should be also subject to the inspection and approval of that gentleman.

The girders should be procured as soon as possible, and sent, after inspection and approval, by the first opportunity, to the care of Mr. W. B. Bray, District Engineer, Christchurch, with a letter of advice, stating that they are for the Waitaki Bridge.

The Colonial Treasurer addresses you by this mail as to the provision of the necessary funds for meeting the cost of these girders, which is estimated at about eight thousand five hundred pounds, (£8,500), including freight, and Mr. Heman's commission. In the event of your absence, the Agent-General will receive instructions to provide these funds.

I have, &c.,

W. GISBORNE,

The Hon. J. Vogel,
Care of John Morrison, Esq.,
3 Adelaide Place,
King William Street,
London, E.C.

P.S.—The makers of Canterbury girders are Kennard, Brothers.

W. G.

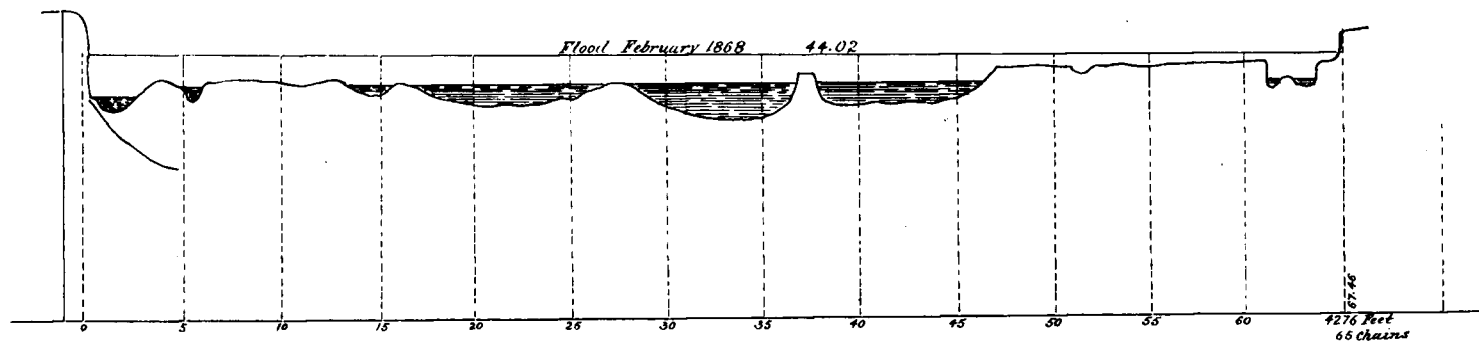
* See No. 15, Enclosure 1.

ON

SITE OF WAITAKI BRIDGE.

N° 1.

SECTION OF WAITAKI RIVER OPPOSITE SECTION N° IV.



Section N° 1. 9 3/4 Miles from the Sea.

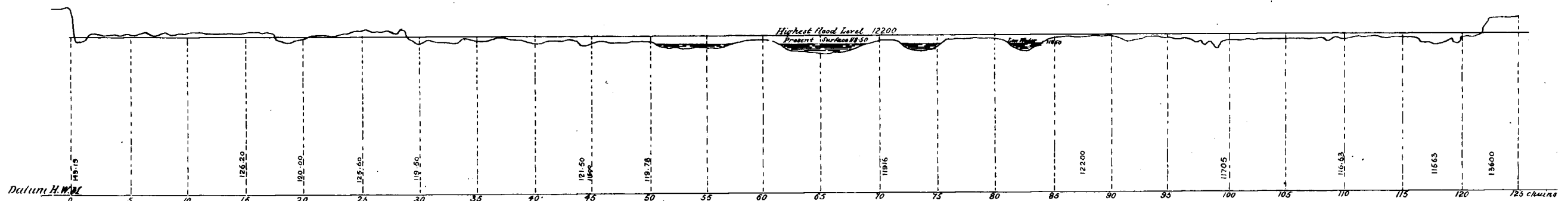
SCALE.

Horizontal. 10 chains to 1 inch.

Vertical. 30 feet to 1 inch.

N° 2.

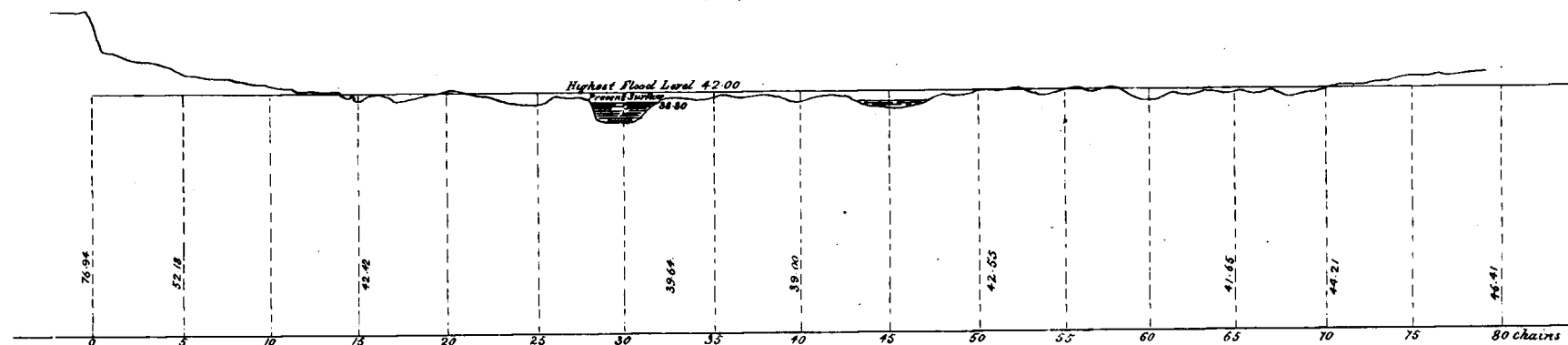
BROWNS FERRY SITE.



Section N° 2. 6 1/4 Miles from the Sea.

N° 3.

SITE NEAR LINE OF TELEGRAPH



Section N° 3. 2 1/4 Miles from the Sea.

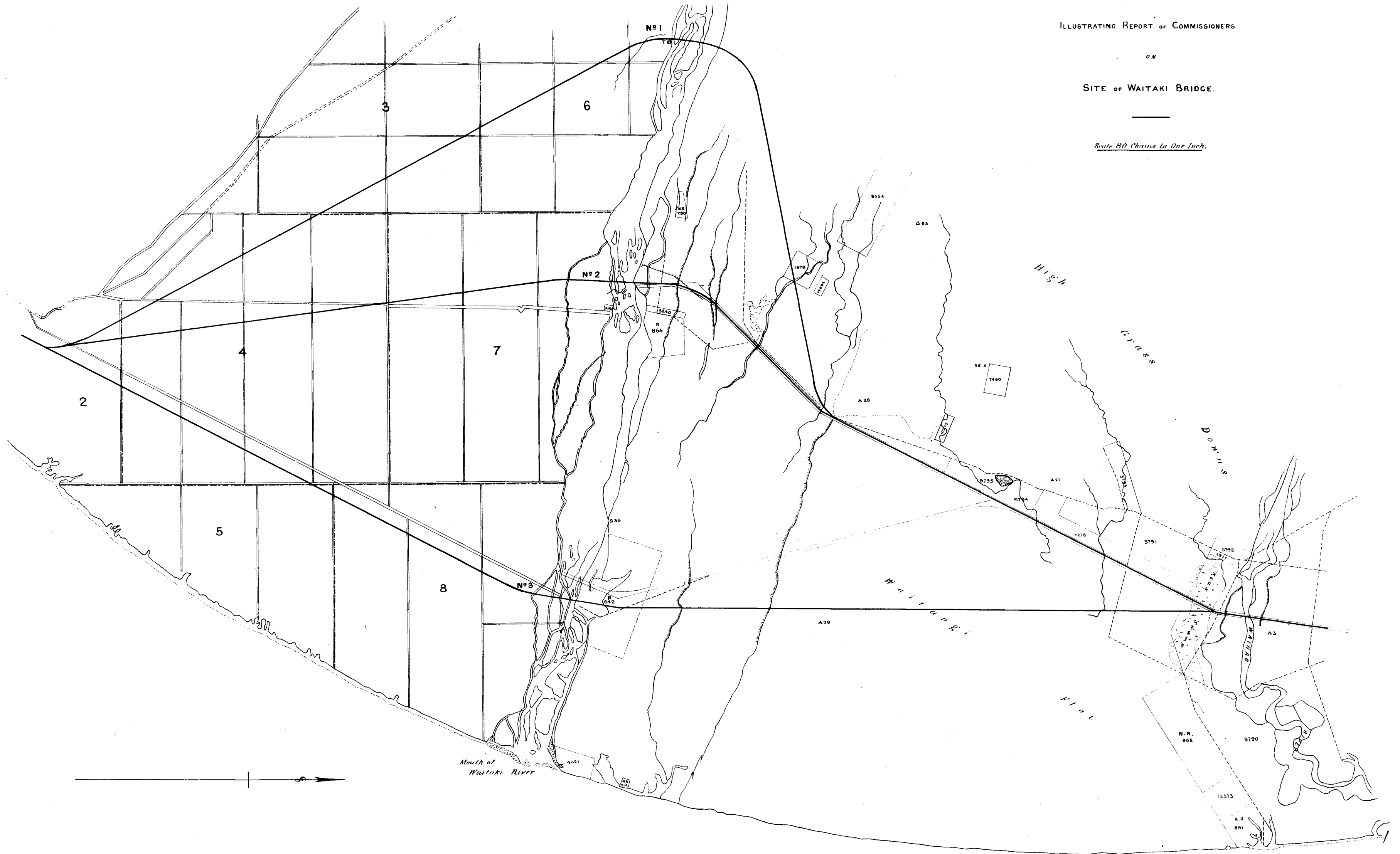
PLAN N°2

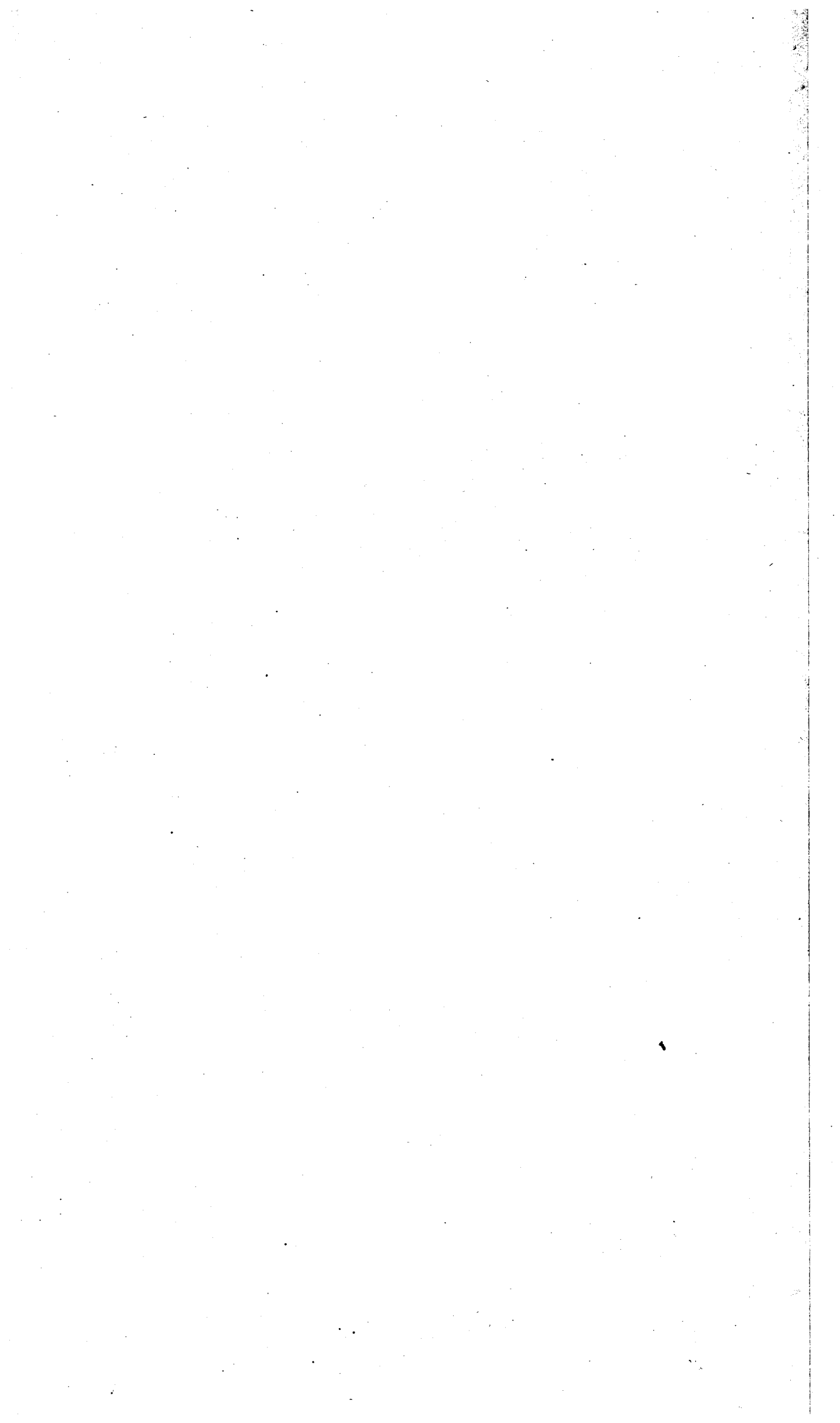
ILLUSTRATING REPORT OF COMMISSIONERS

ON

SITE OF WAITAKI BRIDGE.

Scale 80 Chains to One Inch.





RAILWAY BRIDGES.

Brought forward	...	...	...	...	£4,674 13 6
Pile Shoes	666 at 40lb.	26,640 lbs.			
Spikes to do.			1998 lbs.		
$\frac{3}{4}$ in. Wale Bolts	666 at $3\frac{1}{2}$	2,198			
$\frac{3}{4}$ bolts to raking pile heads	222 at 6	1,332			
3 x $\frac{3}{8}$ in. wale straps	11 at 13	1,443			
Spikes to do.			111		
3 x $\frac{3}{8}$ in capsill straps	666 at $7\frac{1}{2}$	4,995			
Spikes to do.	1332 at $\frac{1}{2}$		666		
Spikes to braces	1332 at $\frac{1}{2}$		666		
Spikes to posts and strutts	6956 at $\frac{1}{2}$		1,912		
Spikes to planking			12,870		
Pile Shoes, Bolts and Straps	...	...	36,608 & 18,323 lbs.	Spikes	
			Tons 8 3 2 11	say at 10s. ...	81 16 0
If 70 lb. Pile Shoes add 19,980=56,588lbs.			25 5 20 0	say at 14s. ...	353 12 6
Total say	...	...	...	...	£5,110 2 0

No. 20.

Mr. BLACKETT to Mr. MILLAR.

Wellington, 10th July, 1871.

(Telegram).
It is reported by Mr Tancred that your surveyors have not laid out the line of railway from Moeraki to Waitaki to meet the exact crossing place for a bridge selected by the Commissioners on that river, and that the line as lockspitted is about 25 chains too high up the river, being above a branch stream or storm-river, instead of below it. The gravel discharged by this stream formed a mound or foreshore, which offered a natural protection to the bridge site which was thus fixed to be below it.

Please see to this, if statement is correct your line may easily be made to join by producing straight part of line from the South, and using a smaller curve.

J. Millar, Esq., C.E., Dunedin.

JOHN BLACKETT.

No. 21.

Mr. MILLAR to Mr. BLACKETT.

Dunedin, 11th July, 1871.

(Telegram).
In reply, scrupulous nicety was observed in laying off the railway line in immediate connection with the site for bridge. Crossing over the river Waitaki in order to rigidly comply with the unanimous report agreed to by the Commissioners on the 21st February, and as shown upon a tracing of the boundaries of Canterbury and Otago, posted by myself to Mr Bray, with duplicate, to the Chief Surveyor of Canterbury, on the 10th March, whilst you were at Christchurch. From mature study of the shingle beds, founded upon repeated observations during and since three months residence in the locality of the river, and whilst it was at its lowest level, I am, in consequence, now of opinion that the site as agreed upon is too far East, *i.e.*, not high enough up the river by five chains. This I propose bringing before you when all the Commissioners meet, as doubtless they will at Wellington, in September. In the meantime, in accordance with last paragraph of our joint report, which see, "We recommend that an accurate plan and section of the site for the proposed bridge, with description of the nature of the ground be made." This I have had done by a careful traverse of the shingle bed, whilst exposed, their position fixed, together with course of the deepest stream so as to incontrovertably prove that my modified and more mature opinion is correct. Of this survey, since I had your telegrams, I am having a tracing made for your inspection, showing first Messrs. Paterson's and Dobson's; second, the Commissioners' line as laid off; third, the line as it ought to be. This tracing with record of borings will be forwarded to Wellington by the first mail hence, together with further explanations. Come what may, your suggestions simplify the matter, as thereby the bridge site may be moved up or down the river, by simply increasing or reducing the radius of joining curve.

N.B.—By Mr Tancred's recent idea of 25 chains further down the river, the length of bridge would be increased 455 feet, at a cost of £4,550. Paterson's and Dobson's site 924 feet, at an increased cost of £9,240.

J. Blackett, Esq., Wellington.

J. MILLAR, F.S.A.

No. 22.

MEMORANDUM by Mr. BLACKETT on Mr. MILLAR'S Explanations respecting his reasons for changing the site of the Waitaki Bridge.

It will be necessary to send a copy of Mr. Millar's telegram to Messrs. Tancred and Bray for their consideration, in order that they may confirm or otherwise Mr. Millar's altered opinion on the subject. The receipt of Mr. Millar's plans of the Moeraki and Waitaki Railway will assist them in forming an opinion, as a tracing of the new section of the river may be supplied to them from these plans. The alteration of site will not affect the cost of the railway itself (only the bridge) as the ground is almost quite level, and the line of railway, as laid out on a curve, can be made to adapt itself to the site, if altered by reducing the radius of the curve.

With reference to that portion of the telegram recommending that an accurate plan should be made of the site of the proposed bridge, I find that Mr. Millar has made the survey proposed in joint Reports of Commissioners, without any special authority. This, I suppose, will be granted, as his impromptu survey will save time if his new site *should be adopted*.

11th July, 1871.

J. BLACKETT, C.E.

No. 23.

Mr. BLACKETT to Mr. TANCRED and Mr. BRAY.

Public Works Office,

SIR,—

Wellington, 12th July, 1871.

I have the honor to forward for your information and remarks a copy of a telegram received from J. Millar, Esquire, C.E., in reference to the site he has chosen for the Waitaki Bridge; and in answer to a telegram from me informing him of your statement, that his surveyors had marked off the railway line about twenty-five chains above the site fixed on by the Commissioners.

Mr. Millar informs me that he has taken correct sections and other information connected with the site of the bridge, as we suggested in the Commissioners' Report should be done, and that he will forward tracings of these to me. When received copies will be taken and sent to you for your further information, and it will be better to withhold any remarks until you have received these tracings.

I have, &c,

J. BLACKETT,

Acting Engineer-in-Chief.

T. S. Tancred, Esq., Geraldine, near Temuka.

NOTE.—A letter similar to the above was also forwarded to Mr. Bray.

No. 24.

Mr. MILLAR to Hon. Mr. GISBORNE.

SIR,—

Dunedin, 17th July, 1871.

In accordance with my telegram of the 11th instant, to the Acting Engineer in Chief, and in reply to his of the previous day touching upon Mr. Tancred's report: "That the line as lock-spitted is about 25 chains too high up the river, being above a branch stream or storm river, instead of below it. The gravel discharged by this stream formed a mound or fore-shore, which offered a natural protection to the bridge site which was thus fixed to be below it." I have now the honor to enclose you herewith tracings of my survey of the Waitaki river bed and banks in both Provinces, and for half a mile east, and half a mile west of the crossing place selected and reported on on the 21st February last, by the Commissioners consisting of Messrs. Blackett, Bray, Tancred and myself.

The traced map now submitted is, as I conceive, in accordance with that report, as, likewise, in accordance with a tracing of the boundaries (duplicate herewith) of Canterbury and Otago submitted by me on the 10th March to Mr. Bray, for the mutual inspection of himself, Mr. Tancred, and Mr. Blackett, the Engineer in Chief being in Christchurch upon that date. Upon that tracing (a duplicate of which was forwarded to the Chief Surveyor for Canterbury) I depicted the railway lines since laid off, a portion of which (the 800 chain radius curve) has been partially lock-spitted. It will be observed that in laying down the line I took advantage of the railway reserves within the Province of Canterbury.

The map survey of river bed now sent, shows, in addition to the line recommended by the Commissioners, the line surveyed in 1864 by Messrs. Paterson and Dobson, together with the improved electric telegraph line as now existing, and also the position of the original telegraph posts in the vicinity of the river, several of which were abandoned upon the reconstruction of those now across the river.

Having had frequent opportunities during the months of February, March and April, whilst the river was at its lowest level, of inspecting the shingle beds and numerous courses of the several streams, I embraced the opportunity whilst my survey party were in the locality, to traverse the same, and the department have now the result on the tracings alluded to.

During the time named I should mention that I had advantages for observation never afforded to my colleagues Messrs. Bray and Tancred, I therefore considered it my duty towards those gentlemen, as brother professionals, to turn those advantages to account by making the subject a study with a view of reporting such to them and to Mr. Blackett, which I now do through the head of the department. The result of my observations is, that the bridge site should be shifted five chains west of that formerly reported on, i.e. five chains higher up the river, for the reasons which I now adduce: When the river ebbed—as it did—to an *unusually low level* during my repeated inspections, it exposed the principal and deepest stream—tinted a deeper blue on the map—as running from north to south, that is, almost parallel to the proposed line, thereby bringing the strongest force of the river athwart, i.e. *at right angles with the piers* of the proposed bridge. Moreover, the line continued, struck the Canterbury High Terrace, within a chain or so of the Bluff, which Mr. Blackett will recollect my pointing out to him whilst on the ground, and marked in the accompanying pencil sketch by the letter M. This line, when continued in a northerly course, ran across an open gully of considerable extent, evidently subjected to be periodically torn up by heavy floods, the banks upon the eastward rapidly eroding, and evidently considerably so during the last seven years, since Messrs. Paterson and Dobson completed their survey (a copy of which I hold), inasmuch as that the banks as plotted by them are washed away, and what then was terrace is now a portion of the boulder creek bed of a periodic torrent which would wash over any light railway line constructed there (except at an unadvisable expenditure). These practical evidences to me, as doubtless they will be to Messrs. Blackett, Bray, and Tancred, are indisputable evidences that the site should be slightly shifted

somewhat westward in preference to eastward, as affording a preferable site, all things considered, for the bridge, and where the stream would be in a direct line with the piers, having a clear uninterrupted run at right angles with the longitudinal line of the bridge. The 5 chains westward sought for can be obtained by increasing the curvature to a 1000 chain radius, instead of 800 chains, still keeping the tangent line as at present, which line continued northward into the Province of Canterbury would avoid the Moraine gully described and shown on the sketched map herewith.

I have, &c.,
J. MILLAR, F.S.A.,
Consulting Engineer.

To the Hon. the Minister for Works.

No. 25.

Mr. MILLAR to Mr. BLACKETT.

SIR,—

Dunedin, 17th July, 1871.

I have the honor to enclose the result of the borings taken in the bed of the river Waitaki.

I may add for your information that the report of Mr. Forrester (the Clerk of Records of Boring Work, whom I engaged under authority from you) is quite trustworthy, he being a very painstaking and reliable man.

I have, &c.,
J. MILLAR, F.S.A.

John Blackett, Esq., Engineer-in-Chief.

N.B.—The work has cost the Contractors quite double their contract, even with allowance for the extra bores. Certificates next mail.

Enclosure 1 to No. 25.

Mr. FORRESTER to Mr. MILLAR.

SIR,—

Oamaru, 26th June, 1871.

I have the honor to report the completion of borings, &c., at Waitaki River, as test for foundations of railway bridge.

I herewith send you Schedules of Borings, as check upon Contractor's record, together with memorandum of lock-spitting completed to date.

As you will further gather from my notes no correct sample of strata could be got on account of great influx of water. I have, nevertheless, kept such samples as could be procured for your use or reference, and which I will leave at your office in Oamaru, together with Provincial Government boring rods, as per list.

I have, &c.,
THOS. FORRESTER,
Clerk of Record of Borings.

J. Millar, Esq., F.S.A.

Enclosure 2 to No. 25.

NOTES OF OBSERVATIONS ON BORINGS.

No. 1. Is situated on first island on Otago side, and during winter can be approached by land. Is near peg marked 9400, and was originally intended to be finished at the depth of 21 feet, being subsequently carried to the depth, as stated in schedule annexed (by your instructions).

The material in its boring is very uniform and compact in alternate beds of shingle and gravel and sand, to the depth scheduled. The rock found appears to be of a gritty nature, as it wore the side of chisel bit rapidly, without blunting edge. I enclose sample of rock, which I found sticking in valve of sludge pump during my endeavors to find portions of rock; these samples are quite unlike any of the stones composing shingle bed of river.

No. 2. Is situated on second island from South or Otago side of river, at peg 10 on line of curve (South), top of boring being at winter level of river. This boring was carried to the depth of 18 feet 5 inches, with 3-16 tubing, which at this depth got burred up at bottom upon what seemed large shingle. As the tube could not be driven in further, the boring was completed with "gad" to the depth stated in schedule.

No. 3. Is situated at peg 30, North, on 800 chains curve, and is at top about 6 feet above level of river in winter (lower level), was sunk to the depth of 21 feet, and subsequently by your instructions sunk to the depth of 30 feet 3 inches, tubing $\frac{1}{4}$ inch in thickness was used for the lower lengths, which got burred at the depth of 24 feet, and could be driven no further. To ascertain whether rock could be found at full depth required, an inch round iron "gad" of required length was procured and driven to the depth stated in schedule, the gad being left in boring.

The material in this boring exhibited a marked difference in condition from other borings, the upper layers of shingle being loosely bedded in sand mixed with vegetable soil, the whole material of boring being more easily penetrated than on Otago side.

In this boring, occasional pieces of thin pare or crust of cemented shingle were broken by the chisel, but as they were very thin and presented no material resistance to the boring tools I have not scheduled them separately.

No. 4. Is situated on low middle spit of river, and in ordinary circumstances (say summer level) will be under water. Consists of the largest class of shingle in this part of the river, closely packed together, as stated in schedule. An unsuccessful attempt was made to sink with 3-16 inch plain tubes, which was followed by a trial with steel-pointed tubes with same result. At length, by repeated trials a tube was got to the depth of nearly nine feet, and the boring was continued to a depth of 17 feet 6 inches with "gad" only, at which point the "gad" got so stiff to work that it had to be suspended, and at this depth it remains.

No. 5. Is situated on large island next to Canterbury shore, top of boring being about summer level of river, was also the scene of failure with thin tubes (3-16 inch), both plain and pointed with steel.

The material in this boring being mixed shingle and gravel (shingle of medium size) was very compact and uniform, and with $\frac{1}{4}$ or $\frac{3}{8}$ inch tubes might have been bored to full depth. After repeated withdrawals, the tube was driven to the depth of 14 feet, the remaining depth being easily penetrated with "gad" only.

No. 6. Is situated on Canterbury shore near edge of boring, and was, as may be seen from schedule, composed of sand and shingle and gravel, loosely compacted and easily penetrated.

The tube (3-16 inch) was driven to the depth of 14 feet, the remaining distance being tried with "gad" only.

No. 7. Is represented by shallow borings placed as you directed, with flag staves fixed in them, and having 5 feet of cast iron tube inserted to retain flag staves.

Enclosure No. 3 to No. 25.

SCHEDULE of Borings at Waitaki River, being test of Foundations for Railway Bridge.

No. of Bore.	Date.	Stratification.	Chisel.	Chisel.	Shell.	Iron Tube.	Depth of Strata.	Depth of Bore.	Total Depth of Bore.	Remarks.
							ft. in.	ft. in.	ft. in.	
No. 1	1871. May 10	Shingle and sand	Star	...	3 inch diam. $\frac{3}{8}$ wrot.	...	4 0	...	On line of borings laid off on 27th April, and near peg 9400.
"	11	" " ...	...	"	...	"	6 0	2 0	...
		Gravel ...	...	"	...	"	0 3	0 3	...
		Sand ...	...	"	...	"	0 3	0 3	...
		Coarse sand ...	...	"	...	"	0 3	0 3	...
		Fine " ...	...	"	...	"	2 3	2 3	...
"	13	Shingle and sand ...	...	"	...	"	...	2 6	...
"	15	" " ...	...	"	...	"	...	1 0	...
"	22	" " ...	...	"	...	"	...	2 2	...
"	24	12 noon, shingle and sand	...	"	...	"	...	1 6	...	
		5 p.m., " ...	...	"	...	"	10 0	2 10	...
"	June 16	Gravel and sand ...	...	"	...	"	3 6	3 6	...
		Shingle and sand ...	...	"	...	"	...	1 6	...
"	17	" " ...	...	"	...	"	3 0	1 6	...
		11 a.m., came on rock	...	"	...	"	...	0 8 $\frac{1}{2}$...	
		12 p.m., rock ...	...	"	...	"	...	0 6 $\frac{1}{2}$...	
		2 p.m., " ...	...	"	...	"	...	0 5 $\frac{1}{2}$...	
		5 p.m., " ...	...	"	...	"	1 10 $\frac{3}{8}$	0 2	27 4 $\frac{3}{8}$
No. 2	May 22	Sand	"	...	"	1 6	1 6	...	Situated on second island from south, or Otago shore, summer level, and at peg 10, south on 800 chain curve.
		Shingle ...	...	"	...	"	3 0	3 0	...
		Gravel and sand ...	...	"	...	"	...	0 4	...
"	24	" " ...	...	"	...	"	1 10	1 6	...
		Shingle and sand ...	...	"	...	"	4 0	4 0	...
"	30	Shingle and gravel ...	...	"	...	"	3 9	3 9	...
		Gravel and sand ...	...	"	...	"	0 6	0 6	...
"	June 1	Shingle and sand ...	...	"	...	"	...	3 19	...
"	13	" " ...	With	gad	only	...	6 5	2 7	21 0	
No. 3	May 23	" "	"	...	$\frac{1}{4}$ wrot.	6 0	6 0	...		Situated main terrace at peg 30 on 800 chain curve, North, or Canterbury shore.
		Sand ...	...	"	...	"	1 6	1 6	...
		Fine shingle and sand ...	...	"	...	"	...	4 6	...
"	25	" " ...	...	"	...	"	...	9 0	...
"	June 15	" " ...	...	"	...	"	...	4 6	...
"	18	" " ...	With	gad	...	...	22 0	4 0	29 6
No. 4	" 2	Shingle and sand	"	7 0	7 0	...	Situated on spit in middle of river on line of borings, and is second boring on that line.
"	3	Heavy shingle ...	...	"	...	...	1 9	1 9	...
"	13	Shingle and sand ...	With	gad	...	...	8 9	8 9	17 6
No. 5	June 3	Made an attempt to bore	without	success	Situated on large island, next to Canterbury shore, on line of borings, and is third on that line.
"	6	Shingle, sand, and gravel	...	"	...	...	8 9	8 9	...
"	7	Shingle and gravel ...	...	"	...	...	...	3 3	...
"	8	" " ...	...	"	...	...	...	2 0	...
"	13	" " ...	With	gad	...	...	12 0	6 9	20 9
No. 6	June 13	Sand and gravel	"	3 0	3 0	...	Situated on North, or Canterbury side of line of borings, being fourth on that line.
"	"	Sand and loose shingle ...	...	"	...	...	10 0	10 0	...
"	"	Cemented Shingle ...	...	"	...	...	0 6	0 6	...
"	"	Shingle and sand ...	...	"	...	...	7 6	7 6	21 0
No. 7	...	Shallow borings for flag	staves	at 10	chains,	pegs	across	river.	...	Placed to indicate line of curve in flood time.
"	May 19	Shingle No. 10, South	...	...	...	cast iron	4 0	4 0	...
"	"	" No. 20, "	...	...	...	"	4 0	4 0	...
"	25	" No. 0, "	...	...	...	"	4 0	4 0	...
"	"	" No. 10, North	...	...	...	"	4 0	4 0	...
"	27	" No. 20, "	...	...	...	"	4 0	4 0	...
"	"	" No. 10, South, on 1,000 chain curve.	...	...	...	"	4 0	4 0	28 0
"	"	" No. 20, "	...	...	...	"	4 0	4 0	28 0

THOS. FORRESTER,
Record Clerk.

27th June, 1871.

RAILWAY BRIDGES.

Enclosure No. 4 to No. 25.

LOCK-SPLITTING completed by Messrs. MACKAY and CONNOR on Northern Trunk Railway.

Date.	Number and Position of Pegs.	Canterbury.	Otago.	Total.
1871.	3RD MILE SOUTH—SOUTHWARDS.			
May 8	From 50, commencement of 800 chain curve ... ..	...	600	...
	3RD MILE SOUTH—NORTHWARDS.			
„ 9	From 50, commencement of 800 chain curve ... ..	...	500	...
„ 12	At 40 and half of 50, 1st mile ... ..	...	150	...
„ 18	„ half of 50, 60, 70, and 80, 1st mile ; and 20 and 30, 2nd mile ...	...	650	...
„ 19	„ 20 and 30 1st mile ; 40, 50, and 60, 2nd mile ... ..	...	500	...
„ 20	„ 70 and 80, 2nd mile ; 10, 20, 30, and 40, 3rd mile ... ..	...	600	...
„ 27	From peg 30 on 1000 chain curve, in continuous line ... ..	...	825	...
	At peg 80 1st mile, and 80, 2nd mile, 1000 chain curve ... ..	...	240	...
June 2	From 30 to 40, 1st mile, 800 chain curve in continuous line ... ..	...	350	...
	Cross trenches on 800 chain curve ... ..	...	60	...
				4,475
May 17	At Jarrah post, between 30 and 40, 1st mile	60	...	
„ 23	„ 30, 40, 50, 60, 70, and 80, 1st mile ; 10 and 20, 2nd mile	480	...	
„ 25	„ 30, 40, 50, 60 70, and 80, 2nd mile ; 70 and 10 to 80, 3rd mile...	840	...	
„ 26	Continuous from Terrace to peg 40, 1st mile	700	...	
June 9	From 50 towards 70, 1st mile	1640	...	
„ 18	Circle at 50, 3rd mile, end of 800 chain curve	60	...	
				3,780
	TOTAL—NORTH AND SOUTH ... ..	...	...	8,255

The 800 chain curve is lock-spitted at every 10 chain peg, with cross trenches at mile pegs and circle at South end, besides pieces of continuous line from river, North and South, as Scheduled.

27th June, 1871.

THOS. FORBSTER,
Record Clerk.

No. 26.

MEMORANDUM by Mr. BLACKETT on the Borings taken in the bed of the River Waitaki. RESULT is satisfactory. The depths of the seven borings being respectively, and apparently all through, ordinary river drift or shingle.

7 Borings respectively.	}	ft. in.
		27 4 ³ / ₈
		21 0
		29 6
		17 6
		20 9
		21 0
		28 0

22nd July, 1871.

JOHN BLACKETT, C.E.

No. 27.

Mr. BRAY to Mr. BLACKETT.

PENDING the arrival of the promised tracings of the Waitaki Bridge site from Mr. Millar, the bridge plans cannot be definitely settled. * * * * *

J. Blackett, Esq.

Christchurch, 21st July, 1871.

I have, &c.,
W. B. BRAY.