1913.

NEW ZEALAND.

REPORTS ON RAILWAY ROUTES FROM WELLINGTON TO WAIRARAPA

MADE BY SURVEYORS YEARS AGO.

Return to an Order of the House of Representatives dated the 9th July, 1913.

Ordered, "That there be laid before this House the reports made years ago by surveyors of the various suggested railway routes from Wellington to the Wairarapa."—(Dr. A. K. NEWMAN.)

WELLINGTON-NAPIER RAILWAY: REPORTS ON ALTERNATIVE ROUTES FOR RIMUTAKA DEVIATION.

(APPENDIX J, PUBLIC WORKS STATEMENT, 1899.)

WELLINGTON-NAPIER RAILWAY: REPORT ON ALTERNATIVE ROUTES FOR DEVIATION OF LINE IN ORDER TO AVOID THE FELL INCLINE OVER THE RIMUTAKA, BY MR. P. S. HAY, M.A., M.INST.C.E.

Mr. P. S. HAY to the ENGINEER-IN-CHIEF.

SIR,— Public Works Office, Wellington, 19th August, 1899.

I have the honour to make the following report on the various possible routes for the proposed deviation of the railway-line over the Rimutaka, to avoid the steep gradients and sharp curvature between the Upper Hutt and the Summit Station and the Fell Incline. This report is based on the results of Mr. J. H. Dobson's surveys and explorations, and on my own inspections of the country through which the proposed deviations via the Coach-road Saddle and the Tauherenikau would pass.

To avoid the Fell Incline a trial line was surveyed by Mr. Dobson, starting from a point about three-quarters of a mile beyond Kaitoke Station and ending at Featherston. This line follows the coach-road gullies; it has been levelled and cross-sections have been taken, so that the quantities and estimates may be taken as correct, except in so far as they might be altered by minor deviations of the finally located line. From about the two-mile peg on the above line a traverse has been run via the Tauherenikau River to Woodside Station, but only aneroid levels have as yet been taken along this route to determine the heights of the principal points.

To avoid the 1-in-35 grades and numerous 5-chain curves on the existing line from the Upper Hutt to Kaitoke, a trial traverse with aneroid levels has been run from the Upper Hutt Station along the slopes of the Hutt Valley and through a low saddle near Kaitoke into the Pakuratahi Valley, to join the Road Saddle and Tauherenikau routes near the Pakuratahi River; this is No. 1 line on the plan. A variation of this line, No. 2 on plan, has been run to get flatter grades and a crossing of Mungaroa Valley without a viaduct. These lines do not utilize any portion of the existing line. To ascertain if any portions of the existing line could be advantageously used, No. 3 trial line was run, and a variation of it, No. 4. The ruling gradient adopted in running all these lines was 1 in 60, and the sharpest curve allowed for was 10 chains radius. The gorge of the Hutt River was also examined to ascertain if it was possible to take the line via the Hutt River and Pakuratahi River to join the Tauherenikau or Road Saddle routes.

In addition to the above, Mr. Dobson examined a suggested route starting from the existing line at Ladle Bend and crossing the Rimutaka by Lucena's Pass. This he reports impracticable. He also examined a suggested route starting from the Mungaroa flats, and thence through the lowest country to Cross Creek and Pigeon Bush; this he reports impracticable, except with a five-miles tunnel. He also examined the proposed route via the Wainuiomata, Orongorongo, and Wairongomai, and confirmed Mr. Rochfort's condemnation of it. The length of line to be constructed by this route would not be less than thirty-four miles, of which over twenty miles would be on 1-in-40 gradient. It is evidently not a promising route, though it is urged in his favour that it would be better for settlement than any of the other routes, and would not cut off any of the country now served by the railway.

The trial line from Kaitoke to Featherston via the Road Saddle shows that a line can be got of the following general character: Grades—Kaitoke to the Summit Tunnel, 1 in 55; sharpest curve on this gradient, 10 chains radius; Summit level, 995 ft. above datum (present Summit 1,244 ft. above datum); length of Summit Tunnel, 143 chains; grade in tunnel, 1 in 60, falling

towards Featherston (in the final location this grade would be put all on the straight, a flatter grade being put where the curve occurs); grade tunnel to Featherston, 1 in 40; sharpest curve on this grade, 10 chains radius. In addition to the tunnel 143 chains long, the other works of any note are a bridge across the Pakuratahi River, also bridges over the Rimutaka, Tidswell's, Beal's, and Cave's Creeks. There are no particularly heavy earthworks. The line joins the existing railway about 23 chains south of the Featherston Station. Its length is about 9 miles 66 chains, and the estimated cost is £181,200.

To get a grade of 1 in 55, with perhaps somewhat sharper curves than 10 chains radius, it would be necessary to lengthen the deviation and join the existing railway about three-quarters of a mile beyond the Featherston Station. This would increase the cost of this deviation to about £194,000, as estimated by Mr. Dobson; but I think this amount is rather little.

The grades obtainable on either of the above lines do not compare favourably with those obtainable by the Tauherenikau route, and I have examined the country between Abbott's Creek and Fernside and Woodside Stations to ascertain approximately what grades could be got by running the line either to Fernside Station or to Woodside Station—in this latter case crossing the Tauherenikau River at as high a level as possible in order to get the flattest possible grade.

If a line were constructed from the Road Saddle Tunnel down the left side of Abbott's Creek, and along the hillsides beyond Featherston to Fernside Station, the continuous grade obtainable, assuming the grade through the tunnel was 1 in 70 on the straight, would be about 1 in 75; with the grades where on curves flattened proportionately to the curvature, this line would probably give a working gradient no worse than 1 in 66 on the straight, depending on the relative amount of straight to curved line in the section. The works would be much heavier than for the 1-in-55 line; in addition to larger bridges or viaducts being required for the tributaries of Abbott's Creek, a viaduct of about 150 ft. in height and of considerable length would be required over Boar Bush Creek behind Featherston. On the hillsides to the south of this creek there is a large slip, or, rather, dislocation of the ground, reaching up to about the grade-level; but I do not know that this would be an important factor, as probably a moderate cutting would take the line back into solid ground. The cost of this alternative deviation, Kaitoke to Fernside, may be taken as £260,000. Better grades than those on the trial line would be required between Kaitoke and the Summit Tunnel to get approximately balanced grades for the probable up- and down-country traffic. Though not quite so good, this route approaches very nearly the Tauherenikau route as regards grades.

If, as another alternative, a line were constructed like the preceding from the Road Summit Tunnel, down the hillsides on the left bank of Abbott's Creek, then along the hillsides between Featherston and the Tauherenikau River, crossing the river at a level of 70 ft. to 80 ft. above the level of Woodside Station, and then running along the terraces and flats to Woodside, the continuous grade obtainable, assuming that the grade in the Summit Tunnel is 1 in 90 on the straight, would be about 1 in 95. With the grades on the curves suitably and proportionately flattened, according to the sharpness of the curve, it is probable that a working gradient of 1 in 82, or perhaps better, could be obtained by careful location of the line, depending on the relative lengths of curved and straight line on the section between the Summit Tunnel and the Tauherenikau River crossing. The bridges over Tidswell's Creek, Beal's Creek, Cave's Creek would become viaducts of some size, and the viaduct required to cross Boar Bush Creek would be 250 ft. high, though the line could, I think, be run up the gully to avoid the viaduct; also there would be either a smaller viaduct or a high bank required for a gully about halfway between Featherston and the Tauherenikau. There would likely be some short tunnels required at some of the gullies; the bridges or viaducts might be considerably reduced by these tunnels, but I have not assumed that this would be so in the approximate estimate given below. The worst part of the country along which this alternative route runs is, I think, that around the sides of Cave's Creek. The hillsides are much more favourable, I think, for railway-construction than those along which it is proposed to construct some portions of the Midland Railway, and more so than some other places where railways have been already constructed in New Zealand. The best grades from Woodside to Kaitoke are obtainable by this route, and the worst parts of the line would be safer than the worst parts along the Tauherenikau route. The cost of construction from Pakuratahi to Woodside would be very heavy—say, £350,000. In this I have included a sum of £25,000 for short tunnels in addition to the cost of the Summit Tunnel, and £93,000 for bridges and viaducts. There would be some difficulty in getting grades from the Upper Hutt to the Summit sufficiently flat to avoid the use of assistant engines with the present ratio of up- to down-country traffic on a line with so flat a gradient as this one between Woodside and the Summit Tunnel. A possible variation of this route would be to run up Boar Bush Gully and tunnel through to Cave's Creek watershed; this would make the grade steeper, perhaps not much better than the grade via the Tauherenikau; but I have no reliable data for determining the grades or the amount of tunnelling required.

The line via the Tauherenikau would branch off from the Abbott's Creek route at a point about two miles and three-quarters beyond Kaitoke. After crossing the Rimutaka Creek by a small bridge this line runs for a little over two miles along the spurs and intervening flats, until the tunnel through the main range is reached. This length of line is fairly easy, and should only require moderate banks and cuttings, and a number of culverts. If put on the grade suggested by Mr. Dobson, the tunnel would be about 70 chains long. It will probably be through slate rock, and will require to be lined throughout. If, however, the tunnel grade is made to fall instead of rise to the south end, the saving in rise and fall, curvature, and length of line between the Pakuratahi and the tunnel will be likely to justify the lengthening of the tunnel sufficiently to give an easy up-grade from the south to the north end; this will also be of considerable advantage in constructing the tunnel. At the north end there is a large creek, which will be likely to give trouble similar to that experienced at the ends of the Spooner's Range Tunnel. The approach cutting at this end will be long, through a piece of comparatively flat ground; the upper end of this flat forms the virtual summit for this route. Beyond the tunnel the line will run down the right bank of a tributary of the Tauherenikau to its junction with the river. At the end of the

first mile the grade is not very high above the creek, but for the last three-quarters of a mile or so the creek falls rapidly, and at its junction with the river the grade-line is about 180 ft. above the river-bed. Along this last section the creek is cutting into its banks, and there are a number of slips, one or two of some size: in one case what appears to be an old slip, overgrown with small scrub, reaches above the grade-line; in all the other cases the upper edges of the creek-banks where cut away and fallen in are well below the grade-line. Judging from the slopes of the hillsides, the works required along the tributary to form a railway-line would not be very heavy for the first mile, but would be somewhat heavy for the last three-quarters of a mile or so. Cuttings, banks, and culverts, with perhaps one or two small bridges, would be the works required.

After leaving the tributary creek the line would follow the right bank of the Tauherenikau for about four miles and a half. There will be some heavy work on this section, especially on the first three miles. The cuttings will be heavy; some short tunnels at bluffs and bridges over tributary creeks will be required. The works would be lighter on the last mile and a half as the gorge opens out more, and generally the slopes of the hillsides seem not to be so steep. About three miles from Woodside Station the line would cross the Tauherenikau River either on a bridge or on a viaduct, according to the grade adopted, and would then run on the terraces or on the hillsides, as the grade may require.

The continuous grade obtainable from Woodside to the tunnel will vary from 1 in 60 to about 1 in 81, according as the grade begins near the crossing of the river or near Woodside Station. When the grades are suitably flattened on the curves in proportion to their radius, I think it is probable that a ruling grade not worse than 1 in 70 on the straight can be got from Woodside to the tunnel. The corresponding ruling grade for the proposed 1-in-60 line would be about 1 in 56. The volume of the present traffic fully justifies the adoption of the 1-in-70 grade, and if a new line is worth making the best obtainable grade should be adopted. The 1-in-70 grade would, of course, be a little more costly, owing to the line having to run for some distance on the hillsides after crossing the river instead of on the flats; the viaduct across the river should not cost much more, if anything more, than the tunnel, cuttings, and bridge that would be required for the line with the steeper grade. Against this extra cost it will be a distinct advantage to have the grade-line as high above the river as it can be got in the lower length of the tributary creek and the upper two miles or so of the gorge. The additional height gained by the 1-in-70 grade on these sections will be from 30 ft. to 70 ft., and will give a safer if not a cheaper line.

The hills are of slate along the tributary creek and the Tauherenikau, and where it is exposed to the atmosphere it does not seem to be of a very stable character. I only saw some small slips on the banks of the Tauherenikau, along which the proposed line would run. These at present are not of any great moment. The line will avoid the large slip just above Buck's house, which I take to be the one Mr. Rochfort refers to in his report. The occurrence of a slip as large as this on the line after it was made would necessitate a heavy expenditure in making a tunnel to avoid it. The cuttings in this slate rock will, I think, weather considerably, and all tunnels will have to be lined throughout. Until, however, the grade-line is defined along the hillside, and the character of the works approximately determined, it will not be possible to make any very definite statements as to the probable stability of the works that will be required to form a railway-line down the Tauherenikau for the first three miles, or as to their probable extent and cost.

Woodside, being the highest point on the existing line between the Waiohine and Tauherenikau Rivers, is the proper ending-point for the deviation. Better grades than the 1 in 70 on the straight could only be got by keeping the line on the hillsides and crossing the Waiohine at a higher level than at present. The Tauherenikau Valley does not afford facilities for doing this except at great cost.

The above-described deviations do not cut out the steep gradients and numerous curves of only 5 chains radius between the Upper Hutt and Kaitoke. This will best be accomplished, I think, by a combination of No. 1 and No. 3 trial lines, described below.

No. 1 trial line starts from the Upper Hutt Station, and runs for about a mile over the flats; then it rises for about six miles on a 1-in-60 gradient, broken by a short length of 1-in-550 grade. The Mungaroa Stream and Valley would be crossed by a long viaduct, from 50 ft. to 140 ft. high. The line is on steep sideling ground for a short distance south of the Mungaroa Stream, and also on steep sidling ground from Mungaroa to a point opposite Kaitoke, seven miles from the Upper Hutt, where it passes over a low saddle requiring a tunnel at least 20 chains long. From the saddle the line runs through easy country to join the Kaitoke–Featherston trial line near the Pakuratahi, the length from the Upper Hutt to the Pakuratahi crossing being about nine miles. The estimated cost of this line is, say, £111,000, in round figures, for the nine miles. No. 2 line is an alternative to the lower portion of No. 1 line, but it increases the length by a mile and a quarter, while it is estimated that the cost of construction would only be lessened by £5,000 to £6,000; this is too small a saving to justify the increased length, except the extra length where required for the purpose of getting a flatter ruling grade to meet possible traffic requirements.

No. 1 trial line is quite independent of the existing line; but No. 3 line was run to determine how much of the existing line between the Upper Hutt to Kaitoke could be made use of. This line begins to rise on the hillside immediately after leaving the Upper Hutt Station, and joins the existing line just south of the Mungaroa Railway-station. A short length of the line and the station would be utilized. The line leaves the existing railway about 15 chains beyond the Mungaroa Station, and joins it again about a quarter of a mile south of the Kaitoke Station. The length of new line required is eight miles and a quarter, the estimated cost of which is £105,000. No. 4 line is an alternative of part of No. 3 line; it uses a portion of No. 2 line; it lengthens No. 3 line by about one mile, at an estimated saving in cost of £5,000, which is too little to justify the additional length.

The levels taken and the examination made show that the Hutt Gorge below the junction of the Pakuratahi is very rough, and it is only possible to take a railway-line up the gorge at great cost. The extra length puts this route out of the question for any line going through the Road Saddle.

For the Tauherenikau route a good grade could be got from the Upper Hutt to the Summit Tunnel. There would be about two miles and a half of very rough heavy work required in the Hutt and Pakuratahi Gorge, and a high viaduct over the Pakuratahi River; the line would run at a considerable distance from the trial line run from the Pakuratahi to the Tauherenikau River, and pass through the range by a tunnel most likely at some distance from the tunnel-site as surveyed. The only advantage offered by this route is a uniform grade from the Upper Hutt to the Summit, but the cost to get a safe line up the Hutt Gorge would be so great that it would be better to get whatever improvements in grades that may be deemed necessary by lengthening the tunnel through the saddle opposite Kaitoke.

The working gradients stated in each case make sufficient allowance for lengths of level required for passing-places. In the case of the up-grade on the Tauherenikau route—Woodside to the tunnel—two passing-places are allowed for. These will very considerably increase the traffic-capacity of the line; they will hardly ever be likely to be required as stations, as the settlement in the valley must always be small or nil under existing conditions. The passing-places cause a considerable steepening of the ruling working grade, which will spoil the line if ever a double line is required to be made, as a double line would probably be made with continuous grades from Woodside to the Summit Tunnel. A continuous working grade of 1 in 73 from Woodside to the tunnel would be sufficient for a much greater traffic than the present; and it is a question to be settled whether it would not be the better course to omit these passing-places if the line is made by this route. The passing-places are shown at approximately equal distances apart between Woodside and Kaitoke, and making the Mungaroa Station equidistant between Upper Hutt and Kaitoke put in on perhaps a bad site. Two passing-places are shown on the Road Saddle–Woodside route; one would serve as a station for the Featherston traffic, the other would be merely a passing-station.

It would be necessary, in order to avoid, if possible, any necessity to use assistant engines, to get sufficiently flat grades from the Upper Hutt to the Summit Tunnel on the deviation line adopted. For the ratio of up- to down-country traffic given in the General Manager's memorandum (attached) the grades required for the Tauherenikau route would be 1 in 64 on the straight; for the Road Saddle–Woodside route, 1 in 74 on the straight; and for the route ending at Fernside Station, 1 in 60 on the straight. Purely passenger traffic would require equal grades both ways, so would heavy excursion traffic to the Wairarapa. There will be some difficulty experienced in getting the 1-in-64 grade from the Upper Hutt to the Kaitoke Tunnel, and still more in getting the 1-in-74 grade without unduly lengthening the line or lengthening the Kaitoke Tunnel.

I think the choice of routes for the deviation will be found to lie between (1) a line from the Upper Hutt through Kaitoke Saddle, following somewhat closely the first two miles of No. 3 line and the last seven miles of No. 1 line so as to get a uniform working grade, combined with the Tauherenikau route, with 1-in-70 grades on the straight; and (2) a line with suitable grades between the Upper Hutt and Kaitoke Saddle, combined with the Road Saddle–Woodside route, with 1-in-82 grades on the straight. The only objection to this latter route is its much greater probable cost.

It would be possible to adopt either of these alternatives, and for the present, if it is thought advisable, only construct a section of the permanent deviation from about the Pakuratahi River crossing to Woodside, and form a temporary connection to the existing line between Kaitoke and the Pakuratahi, leaving the Upper Hutt–Pakuratahi section of the deviation to be done at some future time. This would involve the loss of some £8,000 or £9,000 required to form the temporary connection.

The advantages to be expected to be got from the construction of the deviation with 1-in-70 grades or 1-in-82 grades on the straight against the down-country traffic with properly balanced grades against the up-country traffic, would be: A much quicker service between Wellington and Woodside; a saving of seven miles in length of journey, and of over 1,100 ft. of rise and fall to be surmounted by each train; a greatly diminished number of goods-trains required to haul a given amount of traffic; a considerable saving in rolling-stock maintenance by the cutting-out of the 5 miles 8 chains of curves of 5 chains radius, and 1 mile 46 chains of curves of 5½ to 7 chains radius, on the existing line between the Upper Hutt and Cross Creek Stations (the limits of curvature on the new line being, say, 10 chains radius Upper Hutt to the Summit, and 7½ or 8 chains Summit to Woodside); the saving of the expenditure required to keep up the Cross Creek Station; the saving of the useless haulage of Fell brake-vans, weighing 12 to 18 tons, for each train up or down the Fell Incline; the saving of expense of running assistant engines between the Upper Hutt and the Summit, and between Cross Creek and Pigeon Bush, and some saving in maintaining the permanent-way on the Fell Incline. The grade of 1 in 70 on the straight will enable fully loaded engines to be run through from Woodville to Wellington (this grade offering about the same resistance to traction as the 1 in 76, with curves of 15 chains radius, between Woodville and Woodside), or the grade of 1 in 82 on the straight would enable an engine to take up some additional loading between Eketahuna and Woodside, in addition to its full load from Woodville to Eketahuna, and take this additional load through to Wellington without assistance.

The probable saving in working-expenses on the present annual traffic should be at least £12,000 to £13,000, but against this there would be, in the case of the Tauherenikau route, the cost of working a branch line to Featherston or Pigeon Bush; with the Road Saddle–Woodside route, this, perhaps, might be avoided, though it must be admitted that the station on the hills about 370 ft. or so above Featherston would be somewhat inconvenient. There would also, for some time at least, be an increased cost in earthwork maintenance. With increasing traffic, such as may reasonably be expected, there would be correspondingly greater saving in working-expenses.

The deviation via the Tauherenikau will reduce the distance from Woodville to Wellington to about 107½ miles, as against 105 miles by the Manawatu line; but in view of the slower speeds through the Manawatu Gorge, and the slow rate of travelling from Tawa Flat to Wellington, the time from Woodville to Wellington via the Tauherenikau deviation would, I think, be a little shorter, as it also should be by the Woodside–Road Saddle route—in both cases for passenger-

trains. The ruling gradient via the Manawatu line against traffic to Wellington is 1 in 56, with 42-chain curves, as against 1 in 70 on the straight by the Tauherenikau deviation.

I have endeavoured to condense into the attached table all the information available as to the costs as estimated and the salient features of the several routes. The costs given for hauling 100,000 tons of gross loads of goods-trains (*i.e.*, the weight of wagons and their loads only, exclusive of the weights of the engines) from Woodside to the Upper Hutt, over the several routes, are computed on the supposition that engines of about the power of the new B engines will be run on the deviation, also that the gross weight of the trains up the 1 in 15, exclusive of the weights of the Fell engines and Fell brake-vans, is 110 tons. The average weight of the trains up the incline is, for the last year, just under 100 tons, so the comparison should not be unfair to the existing line. It would, however, be possible to get Fell engines capable of taking up greater loads; but, on the other hand, it would also be possible to get more powerful engines than the B engines, and I have no doubt by the time the deviation is made that such engines will be in use.

The volume of the present traffic over the Rimutaka Incline is given in the attached memorandum from the General Manager of Railways.

The information regarding the Wainui-o-mata–Wairongomai route is hardly complete enough to enable any very definite comparisons being drawn between it and the other possible deviations between the Upper Hutt and Woodside. The estimated cost of this deviation is given by Mr. Dobson at £378,000, and is so high that the route will not at all compare with the Road Saddle–Featherston route, with equal grades 1 in 40, but for which the ascertained cost is only £181,200. In addition to this the distance would be ten miles longer. The great cost, the steep ruling grade, and the great extra length are, I think, quite sufficient to condemn this route.

A considerable time will be required to make the permanent survey of the whole deviation from the Upper Hutt to Woodside—say, eighteen months to two years for a party as ordinarily constituted; therefore, if anything is intended to be done in the near future, the survey should be put in hand soon. The first work to be done should, I think, be the running of a grade-line from the north end of the tunnel down the Tauherenikau to Woodside on the 1-in-70 grade. This, with a sufficient number of cross-sections at suitable points, would enable the general character and amount of the works required to be approximately ascertained. Then a similar survey should be made from the east end of the Road Saddle Tunnel to Woodside. The limits of curvature should be 10 chains radius, except for the worst parts of the Tauherenikau, when 7½-chain as well as 10-chain curves should be tried. In the final location of the adopted line all grades on curves should be reduced to make the probable traction on each curve no worse than on the steepest grade on the straight. I think also that provision should be made for putting transition curves at the ends of all curves. As there is no very reliable information available for curve-resistance on 3 ft. 6 in. gauge lines, I would recommend that some measurements of curve-resistance be made sufficiently numerous and accurate to enable the results to be used with confidence in all future railway locations.

P. S. Hay.

PROPOSED DEVIATION, WELLINGTON–NAPIER RAILWAY, OVER RIMUTAKA.

Summary of Leading Features of the Several Routes between Upper Hutt and Woodside Stations.

Route.	Ruling Gradients.		Ruling Grade to Wairarapa required for Existing Ratio of Traffic for Grade in (1).	Length: Upper Hutt to Woodside.	Rise and Fall: Upper Hutt to Woodside.	Estimated Cost.	Estimated Number of Trains required for Haulage of 100,000 Tons of Gross Engine-load from Woodside to Upper Hutt, and Cost of Haulage.				Lengths of Tunnels.		Height of Summit above Sea-level.
	Wairarapa to Wellington.	Wellington to Wairarapa.					B Engines.	Two Fell Engines.	Number of Train-miles.	Cost.	Summit Tunnel.	Other Tunnels.	
	(1)	(2)		Miles.	Ft.	£	Trains	Trains		£	Yd.	Yd.	Ft.
Upper Hutt to Featherston, via No. 1 line and Road Saddle	1 in 40 + 10-chain curves 1 in 50 on straight	1 in 55	1 in 34 on straight 1 in 45 on straight	22¾	1,585	285,000 298,000	538 380	.. ..	12,235 8,645	1,835 1,297	3,146 3,146	440 440	897
Upper Hutt to Fernside, via No. 1 line and Road Saddle	1 in 66 on straight	1 in 55	1 in 60 on straight	23	1,419	370,000	287	..	6,601	990	3,120	440 + 500*	897
Upper Hutt to Woodside, via No. 1 line and Road Saddle	1 in 82 on straight	1 in 55	1 in 74 on straight	23¼	1,279	460,000	235	..	5,464	820	3,100	440 + 800*	897
Upper Hutt to Woodside, via No. 1 line and Tauherenikau	1 in 70 on straight 1 in 56 on straight	1 in 60 on str.	1 in 64 on straight 1 in 53 on straight	22½	1,347	325,000	272 338	.. ..	6,120 7,605	918 1,041	1,540 to 1,650	440 + 800*	979 to 927
Existing line ..	1 in 15 + 5-chain curves	1 in 35 + 5-chain curves	..	29¾	2,485	..	..	910	..	5,200	..	..	1,144

* Assumed aggregate length of short tunnels.

MEMORANDUM for the GENERAL MANAGER, New Zealand Railways.

Public Works Office, Wellington, 9th June, 1899.

RIMUTAKA DEVIATION.

COULD you please give me information on the following points:—

Passenger-trains each way per day.
Goods-trains each way per day.
Total number of trains Cross Creek to Featherston in a year.
Total number of trains in a year, Featherston to Cross Creek, to be sent up incline.
Gross tonnage of same, exclusive of engine-weights.
Total number of trains down incline in a year.
Total number of trains up incline in a year.
Gross tonnage of same, exclusive of engine-weights, and exclusive of incline brake-van. Is this van always used, and what is its weight?
Total number of trains in a year Summit to Upper Hutt.
Total number of trains in a year Upper Hutt to Summit.
Gross tonnage of the same exclusive of engines.
Assistant-engine mileage, Upper Hutt to Summit.
Assistant-engine mileage, Pigeon Bush to Cross Creek.
Is there any marked increase in cost of rolling-stock maintenance on Wellington–Woodville Section due to sharp curvature Upper Hutt to Cross Creek?
1899 returns, wool, sheep, cattle, timber, firewood, general merchandise (Wellington–Wairarapa).

P. S. HAY,
Superintending Engineer.

New Zealand Government Railways, Head Office, Wellington, N.Z.,
22nd June, 1899.

MEMORANDUM for Mr. P. S. HAY, Superintending Engineer, Public Works Department, Wellington.

THE following information is forwarded in response to your memorandum of the 9th instant:—

Average number of passenger-trains each way per day, Cross Creek and Summit	2
Ditto goods-trains	6
Total number of trains from Cross Creek to Featherston in a year	1,792
Tonnage of ditto (approximate)	174,323
Number of trains in a year from Featherston to Cross Creek to be sent up incline	1,756
Tonnage of ditto	197,348
Number of trains down incline in a year	2,303
Tonnage of ditto	180,653
Number of trains up incline in a year	1,982
Tonnage of ditto	197,348
Number of trains from Summit to Upper Hutt in a year	1,939
Tonnage of ditto	197,348
Number of trains from Upper Hutt to Summit in a year	1,938
Tonnage of ditto	180,653
Assistant-engine mileage from Upper Hutt to Summit, including return	5,863
Assistant-engine mileage from Pigeon Bush to Cross Creek, including light running to Pigeon Bush	7,785

Traffic over Rimutaka for year ended 31st March, 1899:—

——	Cattle.	Sheep, &c.	Wool.	Firewood.	Timber.	Grain.	Merchandise.	Minerals.
	No.	No.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
North ...	222	1,873	3	48	130	4,978	11,367	2,640
South ...	1,792	421,197	5,947	5,298	25,852	691	4,516	405
Total ...	2,014	423,070	5,950	5,346	25,982	5,669	15,883	3,045

Tonnages are exclusive of weights of engines and Fell brake-vans. The weight of Fell brake-van is 6 tons; and one, two, or more, according to train-load, are put on all trains either ascending or descending the incline. With the exception of that for Cross Creek – Summit, the tonnages are approximate.

In addition to traffic given under heading of "Traffic over Rimutaka," a large quantity of coal for locomotives, timber, ironwork, cement, &c., for maintenance works, is conveyed over the incline. The tonnage of this departmental traffic is, however, included in that for trains given on first page of this memorandum.

An answer to your inquiry in regard to increase in cost of rolling-stock maintenance will be sent in a few days.

T. RONAYNE,
General Manager
(per T. W. W.).

New Zealand Government Railways, Head Office, Wellington, N.Z.,
15th July, 1899.

MEMORANDUM for Mr. P. S. HAY, Superintending Engineer, Public Works Department, Wellington.

RIMUTAKA DEVIATION.—With further reference to your memorandum of the 9th ultimo, the Locomotive Superintendent of this department states that wagon-tires and brasses will run about four times as long on a fairly straight road, in comparison with such a road as between Upper Hutt and Cross Creek.

T. RONAYNE,
General Manager,
(per T. W. W.).

(APPENDIX K.)

WELLINGTON-NAPIER RAILWAY: REPORT ON PROPOSED ROUTE FOR DEVIATION OF LINE IN ORDER TO AVOID THE FELL INCLINE OVER THE RIMUTAKA, BY MR. R. W. HOLMES, M.INST.C.E.

Public Works Office, Wellington, 11th September, 1899.

Hon. the Minister for Public Works.

MR. R. W. HOLMES, Resident Engineer, having made an examination of the country from Petone to Pigeon Bush, in the Wairarapa Valley, with a view of ascertaining if a practicable route for a railway is obtainable by way of the Wainuiomata, Orongorongo, and Wairongomai Valleys, his report and plans are submitted for your information.

It will be seen by the report and plans that the country between the Lower Hutt Valley and the Wairarapa Lake is of a very rough character, being intersected by high ridges, through which, in order to obtain a line with moderately easy grades, it will be necessary to construct two large tunnels, one through the Wainuiomata Ridge being one mile in length, and the other through the Orongorongo, between the head of the Wainuiomata and the Wairongomai Valley, will require to be 3 miles 50 chains long, the latter on a grade of 1 in 100. This latter tunnel, on account of its great length, will be costly to construct, and will take a long time to excavate, besides the difficulty of working such a length of tunnel with heavy trains on a grade of 1 in 100, unless very efficient means of ventilation are provided.

Mr. Holmes estimates the cost of constructing the 30 miles 60 chains of new railway at £463,547, but has probably underestimated the value of the work in the long tunnels, for which I consider £35,000 should be added. The construction of the railway along the Wainuiomata Valley is likely to interfere considerably with the source and head-works of the Wellington City water-supply, consequently some objection to the work may be expected from the Corporation.

WILLIAM H. HALES,
Engineer-in-Chief.

MEMORANDUM for the ENGINEER-IN-CHIEF, Public Works Department.

WELLINGTON-NAPIER RAILWAY: PROPOSED DEVIATION BETWEEN PETONE AND PIGEON BUSH VIA WAINUI-O-MATA—LOW-LEVEL LINE.

SIR,— Public Works Department, Wellington, 9th September, 1899.

I have the honour to inform you that I have examined the country between the Petone Station and Pigeon Bush Station, via the Wainuiomata and Wairongomai Valleys, with the object of seeing whether or not a practicable route exists for a deviation of present line of railway, and now report upon the same as follows:—

The obstacles to the construction of a line are three watershed-divides—namely, Hutt-Wainuiomata, Wainuiomata-Orongorongo, and Orongorongo-Wairongomai.

The saddles in these divides cannot be made use of because the mountain-sides are too precipitous, too broken by branch valleys, and too liable to slip to permit of the construction of a railway-line in the position that would be necessary to allow of grading over them; also, there is not sufficient distance to grade down in from the Orongorongo River to the Wainuiomata River with a 1-in-60 grade, while a Fell incline on a very unstable foundation would be required on the Wairongomai side. The summit-level of a graded line would be about 1,400 ft. above the sea, and situated at the head of the Wainuiomata River.

The difficulties presented by these divides can be surmounted by the construction of two tunnels, one 80 chains (one mile) long between Lowry Bay and Wainuiomata, the other 3 miles 50 chains long between Wainuiomata and Wairongomai Rivers, passing under the Orongorongo River at a depth of 800 ft. below the bed.

There will be two miles of heavy work grading up to the first tunnel from the Hutt Valley, and three miles of heavy work grading down the Wairongomai Valley from end of second tunnel; the rest of the formation-works will be very easy, and situated on flat ground.

With the exception of three miles in the Wairongomai Valley the formation-works will be very stable, neither liable to slip nor suffer damage by flood, consequently the maintenance of line will be very light.

The position of line is indicated on the accompanying plan.

The distance from Petone to Pigeon Bush is 30¾ miles, which is the length of deviation or new line to construct.

The distance from Wellington to end of deviation at Pigeon Bush via constructed line is 41 miles, and via deviation is 37 miles 33 chains, a saving of 3 miles 47 chains being effected on the actual distance, and 10¼ miles on the present paying distance.

The highest point or summit of the line is at the Wellington end of the long tunnel, its height above sea-level being 560 ft., and 584 ft. below summit of constructed line.

The maximum grade required is 1 in 70 against the traffic to the Wairarapa, and 1 in 80 against the traffic from the Wairarapa, which is the larger quantity: they are therefore situated in the most advantageous position. The accompanying section indicates the extent and rates of the grades.

The maximum curvature required is 7½ chains radius, which may possibly be reduced to 10 chains radius. The sharp curvature is confined to two parts of the line, situated between the 3rd and 6th mile pegs, and between the 16th and 20th mile pegs, which aggregate a length of seven miles; the rest of the line consists of long straights with flat curves: the line will therefore be an extremely favourable one for fast travelling, both as regards grades and curvature.

The estimated cost of deviation, complete with all equipment, is £463,547, made up as follows:—

From	To	Distance.	Item.	Rate.	Amount.
M. CH.	M. CH.	M. CH.		£	£
0 0	3 0	3 0	Mile	7,000	21,000
3 0	6 40	3 40	"	30,000	105,000
6 40	12 50	6 10	"	5,000	30,625
12 50	16 20	3 50	"	59,840	216,922
16 20	19 60	3 40	"	10,000	35,000
19 60	30 60	11 00	"	5,000	55,000
					£463,547

Average rate, £15,075 per mile.

The long tunnel must be on a grade of 1 in 100, descending towards the Wairarapa. Should the products of combustion emitted by the locomotives prove troublesome, ventilation may be effected by sinking a shaft from the Orongorongo Valley, and driving a current of air down it into the tunnel by means of a small stream of falling water derived from the river, and delivered near bottom of shaft at a high pressure by means of piping, a pressure derived from a head of 800 ft. being available; or the water may be led to the lower adit of tunnel from the point marked X on plan, and there, with an available head of 700 ft., be used to either drive air through tunnel by means of fans, or to generate electricity and work the up-traffic by means of electrical locomotives.

The country between the reservoir in the Wainuiomata Valley and the narrow belt of flat country along the Wairarapa Lake is quite unfit for settlement; it is only fit for a forest reserve, or to act as a catchment-basin for supplying Wellington with water and power as far as the Orongorongo Valley is concerned. The Wairongomai Valley is merely a precipitous mountain-gorge.

The chief points in favour of this route are: (1) Shorter by 3 miles 47 chains than constructed line; (2) low summit-level—viz., 560 ft. above sea-level; (3) only one bridge of any magnitude—viz., that over the Hutt River; (4) easily maintained; (5) very easy grades; (6) does not interfere with present line through Featherston.

R. W. Holmes, Resident Engineer.

Approximate Cost of Paper.—Preparation, not given; printing (1,400 copies), £5 10s.

By Authority: John Mackay, Government Printer, Wellington.—1913.

Price 9d.