M.R.O. 1—77,006—3-6-37.

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(2) Date of repair_____

(3) Initials of the Referencer_____

MADRAS RECORD OFFICE.

Government of Madras.

Public works **DEPARTMENT.**

G.O. No. 3698	Press ~~Mis.~~
400-C1	
Dated 19 11	1869.

Not to be folded or roughly handled

No. 400. Read the following letter from the Acting Superintending Engineer, 4th Division, to the Acting Chief Engineer for Irrigation, dated Madras, 14th October 1869, No. 3,664:—

I HAVE the honour to forward, at Assistant Engineer Mr. Bell's request, a memorandum drawn up by him on the method of utilizing the spring water in the beds of rivers by means of masonry sub-soil drainage pipes and culverts, suggested by the late visit of the Governor to the Madras Water Works, and by the remarks drawn out in paragraph 3 of G. O., No. 2,708, dated 17th August 1869.

1 Memorandum, No. 109, 1st September 1869.
1 Letter, No. 132, 30th September 1869, (to be returned).

2. As far as I can understand Mr. Bell, I believe he suggests that a line of earthenware pipes, on a slight rise of four feet a mile or thereabouts, should be carried for one and a half miles, or two miles, up the river from the anicut, and that the water in the bed at the depth attained should be delivered into this pipe by means of masonry egg-shaped drains sunk below the bed, radiating from the pipe, and with brick-in-clay side walls to allow of percolation of water into these drains.

3. He calculates that 400 yards of tunnel would allow an eighteen-inch pipe on the above fall to run full, and that each yard of masonry drain would cost 25 to 30 rupees. On this data I calculate the pipe would feed 560 acres, at a profit of Rupees 2,800, and a cost of Rupees 12,000, or a net return of 23 per cent., but the pipe must discharge the whole year to obtain this result.

4. I am afraid this proposal is put forward in a very crude form, and there is no affirmed data to go upon, nor have contingencies interfering with the returns been calculated upon.

5. The rivers in this part of India are invariably made use of in the hot weather for the supply of spring channels, and it may be seen in the Palar and Cheyaur rivers that such channels are carried miles up the beds at close intervals. I am afraid Mr. Bell's proposals will interfere with this system of irrigation which already provides to a certain extent for the utilization of the very water which he proposes to collect.

No. 109.

Memorandum on the Spring Water of the Narrainaveram River.

IN a recent Government order attention is called to the almost inexhaustible supply of spring water which the bed of the Cortilliar River contains, and as it would appear that the delivery from that source has not previously been fully calculated upon, the Officer in charge of Madras Water Supply Project is ordered to devise means for utilizing it. Under these circumstances, it has been thought that such information as has been collected on the Narrainaveram River, which offers similar conditions, and where this valuable supply has from time immemorial been made use of, should at once be laid before the departmental authorities.

The whole of the Narrainaveram valley appears to be under-laid by a water-bearing stratum of sand, or gravel and sand mixed, at a depth of from six to twelve feet from the general surface. This is tapped by a great many wells and kullums or cattle pits, and as the river cuts down to it through the clay the filtration water can be led thence to the surface by gravitation. The service thus obtained is sometimes led to the land direct, and in other cases is used to supplement the tanks

under it. In all cases means are arranged for leading it to the land direct, when the tank shall be exhausted below a given level, and it is ultimately applied to the cultivation of second crops.

The conditions required for locating the heads of such channels as are used for collecting spring water are, first, that the river-bed at that point should be as permanent as human foresight can select; and, second, an adequate supply of water should be readily accessible.

To insure the first condition most of the ancient channels have been carried for a considerable distance within the river along the foot of the slope, separated from the stream itself by a low bund or currumboo.

Many instances occur of the river having deepened itself alongside of that bund, in which case considerable leakage occurs. The best sites for permanence are either immediately above a reef of rocks, or where the river beats direct upon a rocky or stony bank.

The embouchure of a branch stream is a favourite location, and has great merits under both the first and second conditions.

The second condition is admirably fulfilled in the last named case. The direct delivery of the balance of spring water collected by the torrent itself is of course insured, and, moreover, the junction of such a branch with the main stream always creates a deep scour, leaving a pot-hole or cess-pit which collects the filtration from the water-bearing stratum long after the water level has fallen below the surface of the river-bed.

Failing this class of head, a reef of rock should be selected, and if there is no such natural dam, a position where the sand banks are on the opposite side of the river, and when for some considerable distance the water is not led off by existing channels, is the only remaining class of site.

The latter does not on this river last all the year round, and considerable pains are necessary to deepen the rivulets leading to it. In Zemindary property, near Narrainaveram, the Ryots turn out in great force to perform this duty; but whether Government villagers are better off for water from other sources, or are less industrious and self-reliant, it is not observed that they take this trouble.

It will be noted that, whether from a natural medevoo or pot-hole in the river bed, or from an extended length of the rivulet, *depth* is the very essence of the conditions, and, after that, extended surface. This will be the more evident when it is considered that this is not spring water, in the proper sense of the word, forcing itself downwards from some subterranean reservoir on a considerably higher level, but it is merely water of percolation, both from local rain and river-floods, retained in the pores of the absorbent sand stratum until it can find its way to some point at which there is fall enough to overcome capillary cohesion.

The manner in which this supply is gathered, and again partly lost by leakage, is so intricate, that the accurate determination of the quantity derivable from a given construction would be very difficult.

The undersigned has, however, no hesitation in affirming that at a depth of eight or ten feet below the river-bed a very considerable perennial supply could be readily obtained; but the quantity would be liable to very serious loss from evaporation if exposed during the whole course of the wide channel and in the bed of the extensive tanks of the Madras Water Works.

This difficulty can, however, be to a great extent obviated by simple means, and the present writer would beg respectfully to submit to those in authority in this matter a method which he ventures to hope would ensure, at a moderate expense, a pure and permanent supply.

The construction he suggests would be as follows:—Say an eighteen-inch earthenware socket pipe, with joints set in cement or clay, should be laid on a very slight rise from the present head works for a distance of a mile and a half or two miles up the river. This pipe, having considerably less fall than the river-bed, would gradually attain a considerable depth, and from the amount of drainage into the trench, (which would be excavated in short lengths, and, when necessary, kept open till the pipes were laid by an arrangement of timber,) a judgment could be formed of how far it would be necessary to go for an adequate supply.

Proceedings of the Madras Government, Public Works Department, 19th November 1869.

Having carried the pipe into a depth of some eight or ten feet at the very utmost, a tunnel, built of dry vitrified bricks, and surrounded by a layer of screened gravel, should be laid so as to cross the river once or twice. This tunnel would act much as the gathering drains under a large filter bed, and there can be little doubt would collect a very great body of water in all weathers.

The tunnel should, for strength and to avoid making too wide an excavation, be egg-shaped in section, and it would be preferable in a bad foundation to build the bottom of it in cement blocks on concrete, leaving the percolation to take place only through the sides. The roof should also be in cement, and at the three points where the tunnel touches the river bank ventilating shafts with manholes would be requisite, and also ventilating pipes on the eighteen-inch main at regular intervals of 100 yards. The accumulation of air to a dangerous extent could thus be avoided, and no risk would occur to the works even when the river is in flood. The bed of the Madras Water Works channel might be dished in the middle, so as to keep the minor stream from this arrangement together during the dry season, and a channel in the beds of the Cholaveram and Red Hills tanks leading direct to the delivery sluices would also be a desideratum. The manufacture of pipes would perhaps be the main difficulty, but as there is said to be excellent fire clay found in this Presidency, and the people are such expert potters, this would not be serious.

In England such pipes laid complete in wet sandy soil can be executed for about Rupees 6 per yard forward, and it need not cost more here. The pipes are laid so as to drain the excavation all the way; the tunnel should also be on a rising gradient, so as to get rid of both air and water, and if the water presented very great difficulties to the construction of the tunnel it may be made all the shorter, and the percolating joints temporarily rendered with clay to keep back the drainage.

A similar work under a river in England, from which the supply percolates through the sand, has been executed, and though it is difficult to hazard an estimate when one is not perfectly acquainted with the circumstances, nor the source of materials, yet it may be taken that the tunnel complete might be made for Rupees 25 to 30 per yard forward if of nine-inch brick-work 3 feet 6 × 23 inside, with the invert 10 feet below the river bed.

It is of course matter for experiment what supply can be obtained in this manner, but the undersigned can only offer his opinion, based upon observation of the spring channels of Narrainaveram river,—namely, that an eighteen-inch pipe flowing full can be had with about 400 yards of tunnel or even less.

In a sanitary point of view better and purer water cannot be found than can thus be procured, the only precaution requisite being to prevent the steeping of flax or gunny in the pot-holes of the river immediately above the work. Should the earthenware pipes not be approved of, tubes made of a core of rivetted sheet-iron, coated with a bituminous composition, might be substituted. These have been used very successfully by French Engineers for both gas and water, and must be pecuniarily satisfactory in countries where asphalte can be got and iron and freights are dear.

CAMP AT VADAMADURAY,
1*st September* 1869.

(Signed) J. M. BELL, C.E.,
Assistant Engineer in charge of Narrainaveram Project.

From J. M. BELL, Esq, C.E., Assistant Engineer in charge of Narrainaveram Project, to the Superintending Engineer, 4th Division, dated Madras, 30th September 1869, No. 132.

IN reply to your No. 3,279, dated 24th September, I have the honour to observe.

That the project for collecting spring water, set forth in my Memorandum, No. 109, dated 1st instant, is based upon two assumptions, which are, as far as my experience goes, quite reliable,—namely, first, that in the course of a season the level of the water in the permeable stratum referred to generally sinks below the lowest point of the river bed at any given cross section.

And, second, that the strong capillary action between the water and the grains of sand renders it necessary to expose a considerable surface of the wet stratum in order to drain a tolerable supply of water from it.

Both these propositions are established, (1) by the great length to which collecting channels in the beds of river have to be run, so as to acquire a reasonably large supply, (2) by the fact that natural pits or pot-holes in the river bed give better results than long channels of small depths. (I have not known them to fail.) And, third, by the fact that surface-channels fail very soon after, what may be called, the supersaturation of the wet stratum is expended, although water still remains in suspension a few inches lower.

It follows from these considerations that a long and deep trench would give a copious and probably continuous supply, and I should add that as there are some grounds for believing that the under-ground stratum of water slowly gravitates to the sea, it would be best to let this trench traverse the river bed and intercept the flow.

The objections to this construction mainly two,—namely,

1*st*.—That as to bring supply to the surface a gradient must be given to the trench considerably less than that of the river, the collected supply would be liable to be re-absorbed by the sand, whereas near the surface of the river-bed the saturation is not complete.

2*nd*.—The whole arrangement would be silted up more or less by every flood in the river.

It is to avoid these objections that my design has been framed.

The tunnel keeps open as much as is desirable of the deep trench, intercepting the subterranean flow which would enter it in small streams at every joint, while the arrangements detailed relieve any back pressure either of air or water.

The tunnel is in fact merely a magnified drain pipe, such as would be laid in swampy land at home.

The socket pipes, laid in clay or cement, carry off all that enters it from the tunnel or collecting chamber, and being water-tight admits of no leakage back into the sand.

The clayed joints of the tunnel are suggested as a temporary measure, to keep back the flow of water while the work is in progress, and, if used, the clay must be partly raked out after completion.

In actual execution I would prefer using bricks, with perforations right through them for permitting percolation, and setting the joints in cement, so as to gain more stability for the structure, and perhaps small round holes would be found more efficacious in keeping back the sand from entering the conduit.

In conclusion, I have the honour to express a hope that if this explanation succeeds in elucidating the original memorandum, you will be good enough to let the one accompany the other in any references you may be pleased to make.

No. 401. ORDER THEREON, 19th November 1869, No. 3,698.

IRRIGATION, No. 19.

THE Government will, with reference to paragraph 3 of the Order of the 17th August last, No. 2,708, await the report and opinion of the Executive Engineer of the Madras Water Supply Works, as to the quantity of water available in the dry season in the Cortelliar, and as to the best means of making this supply available. The system of drainage of the river-bed proposed by Mr. Bell would, it is considered, be too expensive to allow

Proceedings of the Madras Government, Public Works Department, 19th November 1869.

of its application under the circumstances of the case, but the Government are much obliged to that officer for his suggestions, which will be communicated to Captain Scott through the Superintending Engineer of the 4th Division.

(True Extract.)

Colonel, R.E.,
Secretary to Government.

To the Superintending Engineer, 4th Division.

Exd. S. T. Augustin.

No. 132.

From

The Assistant Engineer
In charge Narrauaveram
Projects

To

The Superintending Engineer
4th Division Madras

Sir,

In reply to your No 3279 dated 24th September I have the honor to observe—

That the project for collecting spring water set forth in my Memorandum No. 109 dated 1st Instant is based upon two assumptions which are as far as my experience goes quite reliable viz 1st That in the Course of a season the Level of the water in the Permeable strata referred to Generally sinks below the lowest point of the River Bed at any given Cross section.

And 2nd that the strong Capillary action between the water and the grains of sand renders it necessary to expose a Considerable surface of the wet strata in order to drain a tolerable supply of water from it.

Both these propositions are established (1) by the great length to which Collecting Channels in the Beds of Rivers have to be run so as to acquire a reasonably large supply (2) by the fact that natural pits or pot-holes in the

(River Bed give better results than long channels of small depths I have not known them to fail) And 3rd by the fact that surface channels fail very soon after what may be called the Supersaturation of the water-stratum is expended - although water still remains in suspension a few inches lower

It follows from these Considerations that a long and deep trench would give a copious & probably Continuous supply. & I should add that as there are some grounds for believing that the underground stratum of water slowly gravitates to the sea - it would be best to let this trench traverse the river bed & intercept the flow

The objections to this Construction are mainly two viz -

1st that as to bring the supply to the surface a gradient must be given to the trench - Considerably less than that of the River - the Collected supply would be liable to be reabsorbed by the sand where as near the surface of the River Bed the Saturation is not complete -

2nd The whole arrangement would be silted up more or less by every flood in the River

It is to avoid these objections that my design has been framed.

The tunnel keeps open as much as is desirable of the deep trench - intercepting the subterranean flow which would enter it in small streams at every joint - while the arrangements detailed relieve any back pressure either of air or water

The tunnel is in fact merely a magnified drain pipe such as would be laid in swampy land at home.

The socket Pipes laid in clay or Cement - Carry off all that enters it from the tunnel or Collecting Chamber & being water tight admits of no leakage back into the sand

The clayed joints of the tunnel are suggested as a temporary measure to keep back the flow of water while the work is in progress - & if used the clay must be partly raked out after Completion.

In actual execution I would prefer using bricks with perforations right through them for permitting percolation & setting the joints in Cement so as to give more stability for the structure & perhaps small round holes would be found more efficacious in keeping back the sand from entering the Conduit

In conclusion I have the honor to express a hope that if this explanation succeeds in elucidating the original Memorandum you will be good enough to let the one accompany the other in any references you may be pleased to make.

I have the honor to be Sir
Your most obedient Servant
James Bell C.E
Asst Engineer

Asst Engr's Office
Dated 30th September

Letter explaining that Memorandum on the Spring water of the Narrawaeram River No 109 dated 12th September 1865

Recd 22/11

No 109

Memorandum on the Spring water of the Narrawaeram River.

In a recent Government order attention is called to the almost unexhaustible supply of Spring water which the Bed of the Cortillian River contains & as it would appear that the delivery from that source has not previously been fully Calculated upon - the Officer in charge of Madras water Supply Project is ordered to devise means for utilising it. Under these circumstances it has been thought that such information as has been collected on the Narrawaeram River which offers similar Conditions & where this valuable supply has from time immemorial been made use of - should at once be laid before the departmental Authorities.

The whole of the Narrawaeram valley appears to be underlaid by a water bearing Stratum of Sand or gravel & sand mixed at a depth of from 6 to 12 feet from the general surface. This is tapped by a great many wells & Rullums or Cattle Pits. & as the River cuts down to it through the clay the filtration water can be led thence to the surface by gravitation. The service thus obtained is sometimes led to the land direct & in other Cases is used to supplement the Tanks under it. In all Cases means are arranged for leading it to the

land direct when the tank shall be exhausted below a given level - & it is ultimately applied to the Cultivation of second crops.

The conditions required for locating the heads of such Channels as aimed for Collecting Spring water are (1st) that the River bed at that point should be as permanent as human foresight can select & (2nd) an adequate supply of water should be readily accessible.

To insure the first condition most of the ancient Channels have been carried for a Considerable distance within the River along the foot of the slope - separated from the stream itself by a low bund or Curumbee.

From this circumstance occurs of the River having deepened itself along side of that bund in which case Considerable leakage occurs.

The Best sites for permanence are either immediately above a Reef of Rocks or where the River beats direct upon a Rocky or stony Bank.

The Embouchure of a branch stream is a favourite location & has great merits under both the first & second Conditions.

The 2nd Condition is admirably fulfilled in the last named case. The direct delivery of the Balance of Spring water collected by the torrent itself is of Course assured & moreover the junction of such a branch with the main stream always Creates a deep scour leaving a Pot hole or Cesspit which Collects the Filtration from the

water bearing stratum long after the water level has fallen below the surface of the River Bed.

In Taking this class of Head a Reef of Rock should be selected and if there is no such natural dam - a position where the sand banks are on the opposite side of the River & when for some Considerable distance the water is not led off by existing Channels is the only remaining class of site.

The latter does not ow this River last all the year round and considerable Channels are necessary to deepen the Rivulets leading to it. The Zemindary property in great force to perform this duty - but whether this Government villagers are better fit for water from other sources or are less industrious & self reliant it is not observed that they take this trouble.

It will be noted that whether from a natural Incidence or Pot Hole in the River bed or from an extended length of the Rivulet. Depth is the very essence of the Conditions & after that extended surface. This will be the more evident when it is considered that this is not Spring water in the proper sense of the word forcing itself downwards from some subterranean Reservoir on a Considerably higher level - but it is merely water of percolation both from

local rain & River floods - retained in the pores of the absorbent sand stratum until it can find its way to some point at which there is fall enough to overcome Capilliary Cohesion.

The manner in which this supply is gathered & again partly lost by leakage is so intricate that the accurate determination of the quantity derivable from a given construction would be very difficult.

The undersigned has however no hesitation in affirming that at a Depth of 8 or 10 feet below the River bed a very Considerable perennial supply Could be readily obtained but the quantity would be liable to very serious loss from Evaporation if exposed during the whole Course of the wide channel and in the bed of the extensive tanks of the Madras water works.

This difficulty can however be to a great extent obviated by simple means and the present writer would beg respectfully to submit to those in authority in this matter a method which he ventures to hope would ensure at a moderate expense a pure & permanent supply.

The Construction he suggests would be as follows - say an 18 inch Earthen ware Socket pipe with joints set in Cement or clay should be laid on a very slight rise from the present Head works - for a distance of a mile & half or two miles up the River. This pipe having Considerably less fall than the River bed would gradually attain a Considerable depth & from the amount of drainage into the trench (which would be Excavated in short lengths & when necessary kept open till the pipes were laid by an arrangement of timbers) a judgement Could be formed of how far it would be necessary to go for an adequate supply.

Having Carried the pipe into a depth of some 8 or 10 feet at the very utmost a tunnel built of dry vitrified bricks & surrounded by a layer of screened gravel should be laid so as to cross the River once or twice. This tunnel would act much as the gathering drains under a large filter bed & there can be little doubt would collect a very great body of water in all weathers.

The tunnel should for strength and to avoid making too wide an excavation be egg shaped in section and it would be preferable in a bad foundation to build the bottom first in Cement blocks on concrete leaving the perpendicular Collations to take place only through the sides. The roof should also be in cement & at the 3 points where the tunnel touches the River bank ventilating shafts with manholes would be requisite & also ventilating pipes on the 18 inch pipe at regular intervals of 100 yds. The manholes would be a precaution of use to a dangerous extent & there can be little doubt would collect a Could they be avoided & no risk would occur to the works even when the River is flood. The bed of the Madras water works channel might be dished in the middle so as to keep

the minor streams from this arrangement together during the dry season & a channel in the beds of the Cholaveram & Red Hills tanks leading direct to the delivery sluices would also be a desideratum. The manufacture of pipes would perhaps be the main difficulty but as there is said to be excellent Fire clay found in this presidency & the people are such expert potters this would not be serious.

In England such pipes laid complete in wet sandy soil can be executed for about Rs 6 per yard forward and it need not cost more here. The pipes are laid so as to draw the excavation all the way - the tunnel should also be on a rising gradient so as to get rid of both air and water & if the water presented very great difficulties to the Construction of the tunnel it may be made all the shorter & the percolating joints temporarily rendered with clay to keep back the drainage.

A similar work under a River in England from which the supply percolates through the sand has been executed & though it is difficult to hazard an estimate when one is not perfectly acquainted with the circumstances nor the source of materials yet it may be taken that the tunnel complete might be made for Rs 25 & 30 per yard forward if of 9 inch Brick work 3 feet 6 & 2-3 inside with the invert 10 feet below the River bed.

It is of course matter for experiment what supply can be obtained in this manner but the undersigned can only offer his opinion based upon observation of the Spring channels of Narrainaveram River viz. that an 18 inch pipe flowing full can be had with about 400 yds of tunnel or even less.

In a sanitary point of view better and purer water cannot be found than can thus be procured. the only precaution requisite being to prevent the stopping of flax or gunny in the pot-holes of the River immediately above the work. Should the earthern ware pipes not be approved of tubes made of a Caste of riveted sheet-Iron Coated with a Bituminous Composition might be substituted. These have been used very successfully by French Engineers for both Gas & water and must be pecuniarly satisfactory in Countries where asphalte can be got & Iron & Fights are dear.

Assistant Engineers Office
Camp at Padamadevy
Dated 1st September 1865

James Bell A.E.
Asst Engineer
In charge Narrainaveram Project

No. 3864.

Asst. Engr. Office, Madras 4th October 1869.

From

Lieut. Colonel J. Bann R.E.

Offg. Superintending Engineer, 1st Div.

To

Major John Mullins R.E.

Offg. Chief Engineer for Irrigation.

Sir,

I have the honor to forward for your information a Memorandum drawn up by Mr. Bell regarding the Memorandum drawn up by him on the method of sinking wells through water bearing sand in the beds of rivers, and to request that you will be pleased to move Government to sanction the employment of a Diver on monthly allowance of Rupees for the purpose of submerging sand bags filled with cement concrete, as described in the accompanying Memorandum.

2. The Madras Water Works and Irrigation Co. have applied for the services of a Diver to examine the foundations of their Anicut across the Kistna river.

I have &c.

(Signed) J. R. Bann Lieut. Colonel

Asst. Engr.

(Enclosures returned)

Enclosures

1 Memo No. 109 12th September 1869

2 Letter No. 432 30th September 1869.

No. 109 dated 12th September 1869.

From

J. R. Bell Esqr

Asst Engr.

Memorandum on Spring water at Nanauer am Rivers with a suggestion applicable to the Contellian.

P. W. 4522/69

attained should be delivered into this pipe by means of masonry egg shaped drains sunk below the bed, radiating from the pipe, and with brick in clay side walls to allow of percolation of water into these drains.

3 He calculates that four hundred yards of tunnel would allow an 18 inch pipe on the above fall to run full, and that each yard of masonry drain would cost 25 to 30 Rupees. On this data I calculate the pipe would feed 560 acres at a profit of Rupees 2800, and a cost of Rupees 12000, or a net return of 23 per cent but the pipe must discharge the whole year to obtain this result.

4. I am afraid this proposal is put forward in a very crude form, and there is no affirmed data to go upon, nor have contingencies interfering with the returns been calculated upon.

5 The rivers in this part of India are invariably made use of in the hot weather for the supply of spring Channels, and it may be seen in the Palar and Cheyaur Rivers that such Channels are carried miles up the beds at close intervals. I am afraid Mr. Bells proposals will interfere with this system of irrigation which already provides to a certain extent for the utilization of the very water which he proposes to collect.

I have the honor to be
Sir
Your most obedient Servt
W. Kean Lt Colt
Actg Supt Cuff & Dn

Public Works Department

No 3698

Proceedings of the Madras Government

Under date the 19th Nov 1864

Read the following

From Major Gullmus Superintending Engineer
4th Division

Dated Ootacamund 14th Oct 1864

With reference to the Government order of the 17th August last No 2718 transmitting the opinion of the Secretary of State for India in Council on the question of utilizing the spring water in the beds of rivers by means of draining pipes and culverts with remarks thereon

No 3698 - 19 - Nov 1864.

To

Major J Mullins RE
Ag Chief Engineer
for Irrigation

Dated 14 Oct 1864
Rec'd 22 Oct 1864
Encls 2 - √

No 3664

Forwards a plan drawn up by Mr Bell Asst Engr in the matter of utilizing the spring water in the beds of rivers by means of draining subsoil drainage pipes and culverts with remarks thereon

No 1400

C 30th Oct 1869 No 5 Inwd

for expensive to allow of
its application under the
circumstances of the case,
but the Portia are much
obliged to that Officer for
his suggestions, which
will be communicated
to Capt. Scott through the
Superintendent of the 4th Divn.

To Supt Engr 4th Divn

Despd 28/11/49

Rec 4522

Govt. of {1869} Madras.

PUBLIC WORKS.

To The Superintending Engr.
4th Division.

Dated

Rcvd. Encl. 2

G. O 19th Nov. 1869. No. 3698

Nos. 400–401

Spring levels in the beds of rivers

Papers noted in the letter from the Supg Engr. 4th Div. submitting notes remarks & memo. drawn up by the Asst Engrs Belle on the method of utilizing the Spring levels in the beds of rivers by means of masonry subsoil drainage pipes & culverts