CONTRACT AND SEPCIFICATIONS OF
DITCH NO. 53
Anoka County, Minn.
James Corr, Engineer.

THIS AGREEMENT, Made and entered into this 31st day of August A. D. 1915 between the County of Anoka in the State of Minnesota, party and The Berger Mfg. Co. of Minneapolis, Minn. party of the second part:

WITNESSETH, That for and in consideration of the payments to be made by the said party of the first part, at the times and in the m manner as hereinafter mentioned; the said party of the second part c covenants and agrees with the said party of the first part to construct, complete in every detail and in manner hereinafter specified the following described work; Clean open ditch from Golden Lake to end of upper tile line at station 126x90 of Main Ditch and to install Complete in every detail # 12 U S. Gauge nO-co-r metal corrugated galvanized iron pipe, some construction of 24 inch core inside of corrugation. Calked joints and recovered with 5 ft. of dirt and to furnish all tools labor and material necessary in and about said work for as many lineal feet as the County Board may direct for the sum of $4.50 per lineal foot for pipe and instalation and the lump sum of $1200.00 for cleaning open work, as given in my bid, submitted for the said work on the 31st day of August A. D. 1915. The said work being - - - - - - - - - The repair of the public County Ditch No.53 insaid County.

AND IT IS AGREED That the work shall be done within the time as hereinafter specified, and in the manner specified and in accordance with the report of the Civil Engineer, plans and specifications and profile of said ditch, which are on file in the office, of the Auditor of said Anoka County, and in accordance with the laws of the State of Minnesota relative to the repair of public ditches in the said State.

AND IT IS FURTHER AGREED, That the said party of the second part shall commence work within on or before Oct. 1st, 1915, and shall complete the above described work on or before the 31st day of December A. D. 1915.

AND IT IS FURTHER AGREED, that the said party of the second part will furnish all material, tools, labor and appliances necessary for t the construction of the said work in the manner and within the time as set forth in this agreement.

AND IT IS FURTHER AGREED, That time shall be the essence of this Agreement and should the said party of the second part fail to complete the work, as hereinbefore described, in the manner herein described or within the time as herein set forth or according to the terms of this agreement; then the said party of the seco d part shall forfeit to the said County of Anlka the sum of ten (10) Dollars for each and every day that the said work remains in an unfinished condition after the time above specified.

TERMS.

COUNTY COMMISSIONERS.
The term "County Commissioners" however used in this Agreement is intended to designate a majority of the members of the Board of County Commissioners of the County of Anoka in the State of Minnesota.

CONTRACTOR. The terms "Contractor" wherever used in this agreement is intended to designate the party or parties who may contract with the County for the construction of any part of this work.

ENGINEER. The term "Engineer" wherever used in this agreement is intended to designate the civil engineer who has been appointed by the County Commissioners for the survey and superintendence of this work.

PLANS. The plans, reports, specifications and the general laws of the State of Minnesota relative to the repair of public ditches must be considered in submitting bids on this work and for the repair of same.

TIME Work shall commence on or before the 1st day of Oct. 1915 and shall be pushed with due diligence until it is completed which completion shall occur before the Dec. 31,1915.

MATERIAL From open ditch. All material shall be removed from the Deposited prism of the ditch and deposited on either side thereof unless otherwise directed by the Engineer, and uniformly deposited on the dikes to a uniform thickness and to a width of the right of way as required, and in no place shall be more than four feet deep.

In a covered trench. The material shall be piled on either sides of the ditch and when the work is completed, and upon direction of the engineer it shall be used to refill the tranch. All surplus earth and suitable material shall be deposited on the road bed if the ditch is within the limits of any travel of laid out highway.

BERM. No earth or other material shal l be left on the side of the ditch within eight (8) feet of either side of the completed ditch. This space of eaight (8) feet shall be, when the ditch is completed, free from earth or any material or roots or stumps.

STAKING The Ditch and its branches has been staked by placing stakes numbered at each ONE HUNDRED (100) feet. These Stakes are on the center line of the proposed ditch, and its branches and and should be closely followed in the construction of the same. except at angles in the center line which shall be curves as direct by the Engineer.

EXCAVATION The ditch and its branches will be excavated to the depth, the width on top, the width on the bottom and have the banks of the slope as given and set forth in the report of the Engineer on file in the office of the Auditor of the County of Anoka. The bottom between each one Hundred (100) feet station will be made smooth and straight and the banks will have a uniform clope of one and one-half (1½) to one (1) between each of s id poi ts of main ditchand one (1) to one (1) on all branches and laterals. Levels have been taken at the uneve points between one hundred (100) foot stations and quantities extimated for such unevenness so that the contractor will receive payment for each cubic yard removed.

LAYING PIPE All pipe shall be laid in the presence of the Engineer and by means of lines strung on the center line of the pipe and at the some feet above the grade of the bottom; then by means of plumb and pole the pipe shall be properly placed on the line and grads.

OPEN All pipes shall be laid straingt and on the proper grade. At the angel the pipe may be laid on a curve to be staked out by the Engineer.

LAYING PIPE. The general form of the open ditches shall be of the required depth and having the side slopes of one and one half (1½) to one (1) betweenthe stations and shall be sufficient width on top to securethat slope.

Work to be done under these specifications consists of cleaning open ditch and replacing clay tile with corrugated galvanized iron pipe.

OPEN DITCH From the station 160 to staion 148-70 and from station 144-46 to station 126-92 the bottom of the ditch has raised above grade and the work will be excavating this part of the ditch to its original grade and depositing the material so excavated on the origina spoil bank in every way conforming to the original specifications for excavation said ditch.

CORRUGATED GALVANIZED IRON PIPE From Station 126-92 to Station 110-20 the 24 inch clay pipe now place has become cracked and broken and the work to be done ~~between those stations shall be the replacin~~

between those stations shall be the replacing of the clay pipe with corrugated galvanized iron pipe of not less than 24 inch diamter clear of the corrugations on the inside of bore. The iron used in said pipe shall be not thinner than twelve (12) gauge and must be well galvanized.

The iron used in the manufacture of said pipe must have a chemical analysis of not less than 99.90 pure iron, and be of such brand of manufacture as will be satisfactory to the Engineer.

If in rivited sections the sheets must be well rivited and sand tight joints made with iron bands engaging not less than three corrugations on each joint of pipe. The bands must be well bolted with heavy bolts.

If sectional pipe is used the sections must be put together with broken joints and bolted with heavy bolts. The work to be under the direct supervision of the Engineer and be done satisfactory to said Engineer.

BIDS. Contractors shall bid a lump sum for cleaning the open ditch and shall bid by the lineal foot for replacing the clay pipe. The price bid per lineal foot shall include the furnishing of the corrugat3d galvanized iron pipe, all tools, labor material and supplies and the excavation necessary to replace said clay pipe with the said iron pipe and the covering of said iron pipe with five feet of earth after the work is satisfactory to the Engineer.

AMOUNT OF PIPE TO
BE REPLACED The County Commissioners shall require the Contractor to replace as many lineal feet of the clay pipe with the said iron pipe as they in their judgment may deem necessary and they reserve the right to stop the work under said contract and cancel and annul the same at any time they consider it advisable to to do andit work be stopped the contractor shall then be apid only for what work shall be done and material in place at the time work is stopped.

AND IT IS FURTHER AGREED THAT AS THE WORK progresses the Engineer may alter or change the plans, specifications or the manner of conducting the work but it is agreed that notchange will be made that will increase the cost of the work about two (2) per centum of the total original contract price. Any change so made will be done only on the written instructions of the Engineer.

PAYMENTS. AND IT IS FURTHER AGREED That the payments will be made by the said party of the first part by orders drawn on the treasurer of the County of Anoka in the manner and at the time as extablised by the laws of the State of Minnesota relative to the drainage of lands by the Counties of the said State.

In witness whereof, the said parties to this agreement have hereunto set their hands and seals the day andyear first above written.

Witnesses

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REPORT

ON THE SAND-CUT NEAR THE OUTLET OF MAIN DITCH OF COUNTY DITCH Nº 53, ANOKA COUNTY, TOUCHING UPON CERTAIN QUESTIONS OF DESIGN, INSTALLATION &C. WITH SUGGESTIONS AS TO A REMEDY, BY W. R. HOAG C. E.

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Minneapolis, Minnesota,
November 23, 1916.,

To W.H. Bradley, Chairman Co. Board Anoka Co.,
Anoka, Minnesota.

Dear Sir:-

Following instruction recently furnished me by you, I desire to report that I have visited the sand-cut at the outlet of Ditch No. 53, making all required observations and measurements and taking what levels I deemed necessary to enable me to pass professional judgement on the following points:

F I R S T- as to the faithful execution of the contract for the installation of the culvert-line so far as installed.

S E C O N D- as to the effieiency of the pipe-line in discharging the quantity of water which it might reasonably be expected to discharge working under present conditions as to head of water at the upper bulkhead and evident obstructions at the latter place also at the westerly man-hole.

T H I R D - as to a 24 inch pipe-line of this length furnishing the discharge capacity required to properly care for the run-off from a drainage area of 3500 acres.

F O U R T H - as to what discharge capacity at the point of this pipe-line would ordinarily be provided in good practice under the conditions present in number 53.

F I F T H - as to the most economical method of providing for this capacity.

In the above I am assuming that the system of ditches was dug as shown on the map and that the gradients of the bottom ditch-line were followed substantially as shown on the profiles.

And further, I am assuming, that the culverts satisfy the conditions named in the specifications as to quality of metal and workmanship.

I am also assuming that I am at liberty to make use of any information now in the formal posession of your board - being public property- and to give it whatever weight, in reaching my conclusions, that my knowledge of the conditions present and the means and methods employed in obtaining that information would, in my judgement, justly entitle it.

I am also accepting as a fact that the system of ditches is now or may be in the near future the only drainage outlet for water coming from about 3500 acres.

I am further assuming that the location of the present sand-cuts and pipe-lines is the most economical route for the delivery of the water from the drainage area.

I wish to make this statement emphatic since the general topographic conditions surrounding the present sand-cut do not point conclusively to this being the place of the last running water from a lake formerly covering the present

swamp area now drained by number 53 which frequently points to the most economical location for a main outlet ditch.

Returning to the first point as to the contractor having done the work in the manner defined in the specifications (a copy of which is here to attached)- While the Engineer who was in personal charge during the work of construction is best qualified to testify on this line of inquiry, the finished structure ordinarily furnishes sufficient proof not only to the Engineer but to any one as to whether the work has been faithfully done or not. A bridge falls or a building collapses- no need to call experts to prove that SOMETHING is wrong. Here we have a line of pipe designed to pass through a sand-cut the wate from about 5.5 square miles. We are warranted in assuming that it was expected that this pipe would care for the water as fast as it would come to it through the system of the ditches of number 53, reducing the flood stage to a normal stage in most cases in a few days- and always in a few weeks at most but it actually does require a few months or half of the summer. No Engineer needed here to convince any tax payer within this drainage area that something here is wrong- just as evident as the failure of a bridge.

Now if we know about what quantity of water ordinarily runs off through a like system of ditches in a given time during the season of high water expressed say, in cubic feet per second- the common units used in this class of problems. Then if we could tell what quantity of water a pipe of this diameter and length would discharge working under the head it would have with the water in the ditch leading to the bulk-head of a depth neces ary to deliver the quantity of water ordinarily coming from 5.5 square miles during the flood season a comparison of these two amounts, that is, the cubic feet per second which the ditch system will bring to the pipe-line and the cubic feet per second

the pipe line can carry away from the ditch system if the two quantities are about equal it would show that the pipe should reduce any flood stage to a harmless normal or even low stage in a few days since it will discharge the water about as fast as it comes to it through the ditch.

Or if the capacity of the pipe expressed in cubic feet per second is considerably greater than the number of cubic feet per second furnished from the drainage area, then the pipe will not only pass the water as fast as it comes, but will not run fu in so doing.

On the other hand, if the number of cubic feet per second which the pipe line can discharge is considerably less than the number of cubic feet per second which any flood season may bring to it then the bulkhead becomes a dam through which the pipe line passes only a part of the water flowing through the system of ditches toward the outlet; that held back remaining in the lower ends of the larger ditches or overflowing the adjoining lands according as the flood is more or less severe or the difference between the pipe and ditch capacity greater or less.

Now the factors involved in this line of problems can be determined in advance with reasonable accuracy. From tables, modified to suit local mean annual rainfall, the drainage engineer can foretell reasonably near what amount of water will run off of any given drainage area whose local conditions he has studied

According to a run-off table recommended by the U.S. Geological Survey for an area resembling very closely that of number 53 with which I am familiar having spent six years on it constructing a system involving about 500 square miles and having practically the same mean annual rain fall this drainage area would bring to its outlet about 75 cubic feet per second and this is the amount which any culvert or pipe line must pass

during a flood stage at this sand-cut or flooding will take place.

Referring to the profile of the Main ditch of number 53, it is learned that the ditch has a grade and cross-sectional area such that it must be 5.0 feet deep to deliver this 75 cubic feet per second to the pipe-line.

Now to the pipe-line side of the problem- From the conditions just determined above, that the water would be 5 feet deep we have a right to assume that the pipe-line will be working under a head measured by the distance from the water surface at the upper bulkhead to the center of the culvert or 54feet plus the drop of the grade in the 1600 feet of pipe or 2 feet which makes a total head of 6 feet. Solving equation 97 page 232 edition of 1914 of Hydraul-

In the matter of the size (internal diameter) of the culverts set in the sand cut will say that I measured all those where such could be measured without uncovering pipes and found them to agree with the size called for in the specifications within two to three hundredths of a foot.

This being well within the allowed limit as to size in COMMAN ~~comm~~ practice with the culvert trade I conclude that the terms of the contract in this particular were substantially complied with.

named above?

Mr. Sublette made a careful determination of the quantity of water which actually passed through the pipes at flood stage last summer and found it to be between 11 and 12 cubic feet per second. From the foregoing I feel warranted therefore in concluding that the present pipe line with its capacity of 15 cubic feet per second falls so sar short of furnishing the capacity needed of 75 cubic feet per second that any contention that something must be wrong with the pipes or with the laying, has no support and falls of its

during a flood stage at this sand-cut or flooding will take place.

Referring to the profile of the Main ditch of number 53, it is learned that the ditch has a grade and cross-sectional area such that it must be 5.0 feet deep to deliver this 75 cubic feet per second to the pipe-line.

Now to the pipe-line side of the problem- From the conditions just determined above, that the water would be 5 feet deep we have a right to assume that the pipe-line will be working under a head measured by the distance from the water surface at the upper bulkhead to the center of the culvert or 4feet plus the drop of the grade in the 1600 feet of pipe or 2 feet which makes a total head of 6 feet. Solving equation 97 page 232 edition of 1914 of Hydraulics by Mansfield Merriman, a recognized authority on hydraulics, we find that, calling this pipe smooth (that is, free from corrugations) and clear from all obstructions it would pass 15.1 cubic feet per second.

That is, we here have a pipe line which if it were capable of discharging as much as a smooth pipe of the same diameter- (which it is not as will appear later)- and allowing that the drop of one-half foot in the grade line at each man-hole does not reduce the flow in the pipe- (and there is no question but that it does reduce it)-if it had these aids it could deliver only a little more than 20% of what it is likely to be called on to deliver at any flood season.

Now with the actual pipe-line with its obstructive feature of corrugations and man-holes we have a right to expect a considerable less t than this. But what did it deliver under substantially the conditions named above?

Mr. Sublette made a careful determination of the quantity of water which actually passed through the pipes at flood stage last summer and found it to be between 11 and 12 cubic feet per second. From the foregoing I feel warranted therefore in concluding that the present pipe line with its capacity of 15 cubic feet per second falls so sar short of furnishing the capacity needed of 75 cubic feet per second that any contention that something must be wrong with the pipes or with the laying, has no support and falls of its

own weight and I further conclude that as it delivers within 15% or 20% of what a smooth pipe would deliver there can be no serious obstruction in the pipe. During its maximum discharge, water was moving in the pipe about 5 feet a second- half this velocity will soon carry away sand, should it accumulate at the time of a low stage of water with its consequent slower velocity.

From an examination of the field records and profile made by Mr. Sublette last summer of the hydraulic gradient present at th this pipe line then working under head, very positive conclutions could be drawn toushing the presence of any considerable obstruction at any point in tne pipe. I learn from him that the uniformity of this hydraulic gradient showed no such obstruction and as it but confirmed what he had shown to be true by his observations for quantity he did not refer to it in his report. His observations in these tin tubes for water level will prove of great value to the engineer who is called upon to determine the required size of a corrugated culvert to meet the requirements of this case. The next opportunity to make these observations will be next spring's flood stage. These are the first and only observations of which I have any knowledge which would enable one to compute definately the coefficient of friction for corrugated pipes, now assumed by culvert companies to be the same as that for smooth iron pipes in the absence of definate knowledge to the contrary.

It is suggested that you have Mr. Sublette add these observations and results to his report and thus save the expense of repeating them as well as making them available at once to the engineer whom you shall select to take charge of this work.

From these considerations I conclude that the pipes were properly laid and that they are now in proper position, at least that they are where the engineer directed they should be placed.

The half foot drop at each man-hole is a radical departure from any practice with which I am familiar and certainly violates all

certain assumptions however relative to rainfall and shape and character of the run-off area which might with fuller knowledge be subject to small yet justifiable corrections- to effect a small saving, if it can be done safely or to provide for a slightly greater run-off if it proved to be needed.

These corrections however large- being at most only a few per cent- could not change my conclusions relative to the number of similar pipes required to carry the water further than to reduce the number to 4 and 1/2 pipes or to increase their required number to 5 and 1/2 and as our conclusion was that a 24 inch pipe was wholly insufficient- a judgement fully sustained by the figures whether the present line is only 18% of the required size, which it would be if the equivalent of 5 and 1/2 pipes were required or whether it is able to carry 22% of the water being the case of 4 and 1/2 pipes.

In what has preceeded I have discussed the question presented to me by your board in the spirit of professional criticism with no reference to persons or a possible long change of circumstances which may be responsible for the present, to say the least,unfortunate result. I have concerned myself very little as to the historical growth of this project up to the present agitation which seems to mark a sort of crisis.

It has been reported that the original glazed pipe-line was intended to care for about 1500 to 1800acres. Its partial sucess may have led a later engineer to lay its inefficiency to the actual breaking down of sections of the pipe he discovered and yielding to a desire to make the cost as small as possible recommended the same size as was used in the first design .

With all of this many of you are more or less familiar and it has doubtless brought you to convictions of your own more or less charitable to all associated with the work including yourself according as you have called into question the engineering knowledge or experience of those in professional charge or the business ability and judgement of your county officials and not least your ouw part as an interested taxpayer since with

drainage projects especially your county officials are to a considerable extent your agents simply carrying out your wishes following the legal advice of the county attorney and entrusting to your chosen engineer the questions of design and installation.

I am not prepared at this time to more than refer in general terms to your remedy, however I do not hesitate to say that upon my present information touching on the factors affecting this situation I am satisfied that you must have either an open cut or a much larger pipe line.

You can make no mistake in halting in this work of further installation since the short piece of glazed pipe-line, until it actually caves in at some point, is as good as the culvert pipes with which you would replace it and will probably pass more water as long as it is in working order which in the end either one must yield to something of greater capacity.

To decide which of these remedies- open cut or pipe-line- should be used involves the consideration of a number of factors affecting the cost of installing, each not yet known to me nor shown by any report made to your board with which I am familiar.

If number 53 area throughout is of the extreme flatness shown by the profile of the lower two miles of the main ditch whose fall is only 1/2 foot to the mile- a some what less sudden run-off would follow than assumed in ~~any~~ my discussion under point one. Coming to the necessary size of a corrugated pipe-line- one having access to the record of field observations made by Mr. Sublette would be able to compute what size can safely be used and I venture that a somewhat smaller pipe will do the work than that recommended in Mr. Sublette's report.

In the matter of the earthwork involved in broadening the present cut and deepening it to make a safe open cut- I took levels and measurements and my reductions show that the open cut, considering the present price of steel, is a promising competitor of the pipe line plan and depends not upon the amount of excava-

tion involved if it were clay or gravel in bringing it to side slopes of even 2 and 1/2 to 1, but upon what will happen when it comes to the last two or three feet in the bottom of the ditch with quick sand action present.

But to compare these two plans as to cost and con tinued efficiency and to be able to say just what the details of the one selected shall be I am in no position at present to speak.

You have already spent say $15000 on this feature of the system whose inability to do its part has greatly reduced the benefit reasonably hoped for from the cash outlay in constructing the whole ditch system. And at this point you have the following on the credit side when you proceed with some sufficient remedy. About $4000 worth of 34 inch pipe and a cut with an average top width of 31.5 feet bottom width 13.2 feet and an average depth of 8.4 and a length of 1600feet which makes about 685 cubic yards per station or about 11,000 yards which at 10¢ a cubic yard gives $1100- the small lower cut would increase this to about $1350 or a total salvage of $5350.

Now the remedy using culverts may cost you say $15000 above what you have in these credits (the open cut may prove to be a somewhat less expensive plan). In any case you have too much at stake in your lands awaiting adequate drainage and the probable cost is so great that I would not venture a professional opinion as to which would be best nor even an approximate estimate of what either would cost. This is where your engineer should begin.

Trusting that the foregoing will be of service to you I close remaining,

Yours truly,

W R Long