REPORT

UPON THE

Improvement of the Kankakee River

AND THE

DRAINAGE OF THE MARSH LANDS IN INDIANA.

BY

JOHN L. CAMPBELL,
Chief Engineer.

TO THE GOVERNOR.

INDIANAPOLIS:
WM. B. BURFORD, PRINTER, LITHOGRAPHER AND BINDER.
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STATE OF INDIANA,
EXECUTIVE DEPARTMENT.

Received December 14, 1882, examined by the Governor, and delivered to the Secretary of State to be filed and preserved in his office.

FRANK H. BLACKLEDGE,
Private Secretary.

REPORT OF CHIEF ENGINEER.

To His Excellency, ALBERT G. PORTER,
Governor of Indiana:

SIR—I have the honor herewith to report the results of my surveys of the Kankakee reigon, and of the marsh lands in Allen, Huntington and Knox counties, which were made in accordance with your general instructions, under the act of the General Assembly, approved April 11, 1881.

I had the honor to acknowledge, May 5, 1882, the receipt of my commission from you as Chief Engineer, and I proceeded immediately to make the preliminary examinations and preparations necessary for beginning the field work July 1, 1882.

It was deemed expedient to provide tents and camp equipage for the field corps, and this outlay was more than justified in the actual saving in the cost of subsistence, and in the increased facilities for the prosecution of the work.

The chief instruments needed for the survey were the transit and the level, and these were rented at a small cost. The chain and other minor things required were purchased.

In the organization of the field corps, with your approval, Messrs. Albert B. Anderson, John M. Coulter, and Alfred R. Orton were appointed Assistant Engineers.

In the division of work Mr. Anderson performed the duties of General Assistant Engineer, and took special charge of the reconnoissance in advance of the corps. For this position he had been well fitted by the experience of three years as my Assistant in the United States Geodetic Survey in Indiana.

Prof. John M. Coulter, of Wabash College, was assigned to the position of Surveyor, and in addition to his duties with

the transit, he was specially charged with the examinations of the soil and underlying strata, which you directed to be made along the line of the survey. Prof. Coulter's well-known reputation as one of our most learned botanists and geologists, is the best evidence of his fitness for the part of the work committed to him.

Mr. Orton, an accomplished civil engineer, with a successful experience of fifteen years, was assigned to the most important position of Leveler. The lines of levels run by Mr. Orton on this survey were carefully tested by repetition, and are believed to be accurate in every particular.

The other members of the corps were: Rodmen, Jesse Blair and George W. Benton; Flagmen, Charles B. Landis and Edwin H. Anderson; Chainmen, George W. McConnell and Henry Forsland; Axeman, James M. Simpson; Commissaries, William H. Scott and William H. Shooler; Cook, Wesley Foster.

The faithfulness and efficiency of every member of the corps are cordially acknowledged.

In the many exposures and hardships incident to a survey through the Kankakee marshes, there was no shrinking from duty, and I am glad to add that not a day was lost by any one on account of sickness.

Our tents were pitched on the first of July, near South Bend, and the field work was continued from that date, without interruption, until August 30.

GENERAL TOPOGRAPHY.

The Kankakee region in Indiana lies chiefly in the counties of St. Joseph, Laporte, Starke, Jasper, Porter, Newton and Lake.

The Kankakee river takes its rise in the elevated marsh land near South Bend, in Sec. 16, T. 37 N., R. 2 E.; thence it runs through St. Joseph county to Sec. 14, T. 36 N., R. 1 E., from which point it forms the boundary line between Laporte, Porter, and Lake on the North, and St. Joseph, Starke, Jasper, and Newton counties on the South.

The river leaves the State in Sec. 1, T. 31 N., R. 10 W., and in the State of Illinois, by its junction with the Des Planes, forms the Illinois river.

The Kankakee river is noted for its extreme crookedness. Father Stephan, who made a careful survey of the channel, reports two thousand bends from the source at South Bend to Momence, Illinois. By the same authority the approximate length of the river between these points is two hundred and forty miles.

The water in the stream is remarkably clear and is of excellent quality for domestic purposes. The iron, and possibly other mineral substances held in solution, give the water valuable tonic properties.

The exceptional healthfulness of the Kankakee region as compared with other large swamp districts, may be due in a great measure to these mineral qualities.

The bed of the river generally is sand and fine gravel, and the banks are very low. The chief tributaries of the Kankakee on the North side are Grapevine, Little Kankakee, Vails, Mill, Hog and Crooked creeks; on the South side, Potato and Pine creeks, Yellow river and Bogus creek. Yellow river is the most important tributary and is scarcely inferior to the Kankakee above the junction of the two.

West of Bogus creek on the south side, and of Crooked creek on the north side, the small streams from the uplands lose themselves in the marshes and have no well defined inlets to the river.

The entire area of country drained by the Kankakee and its tributaries in Indiana is over sixteen hundred square miles, or approximately one million of acres.

The country adjacent to the river is a broad plain, varying in width from one to twenty miles, measured by sections north and south, with an average width of about ten miles.

This plain has a declivity westward of a little more than one foot to the mile.

Along the irregular border of the plain, on both sides, are sand ridges, which give to the region the proper designation of the Kankakee Valley.

This valley is for the most part an unreclaimed marsh; and except allong the river banks and on occasional small sand islands, it is destitute of timber.

Coarse prairie grass, wild rice and weeds, grow in the greatest luxuriance in all parts of the marsh, and, in many places, even in the bed ot the river itself.

Frequently the highest water of the year is caused by the rank grass growth in the channel of the river during the summer season.

The soil is a rich vegetable loam and sand, varying in depth from five feet to a few inches. Its general richness may be inferred from the rank growth of grasses, even in the lowest portion of the marshes, where the water remains during the entire year.

In St. Joseph county, and in parts of Laporte, Porter and Lake counties, the adjacent uplands have a plentiful admixture of clay, and the drainage from these uplands for ages has been adding fertility to the marshes, so that, not without reason, it is believed that these lands, when reclaimed, will be of the best quality.

In Starke, Jasper and Newton counties, the uplands are more sandy, and consequently the marshes adjacent have less depth of soil; but there is no part of the valley which is not worth far more than will be the cost of reclamation.

From its source to the mouth of Mill creek, the river runs through the open marsh, but below this point the banks on one or both sides are covered with quite large trees.

In many places the channel is greatly obstructed by fallen timber, which must be removed when the improvement of the river is attempted.

The timber belt rarely exceeds a mile in width, but the area yet uncut is very valuable.

THE SURVEY.

The accompanying map presents the general results of the survey, and includes the general line of the river, the approximate outline of the marsh, the route proposed for the improvement, the wagon bridges and the railway lines which cross the Kankakee. The map is drawn to the scale of one inch to the mile, and the reduced copy which accompanies the printed report is made to the scale of one-quarter inch to the mile.

The line of the river is taken from Father Stephan's original map of the Kankakee, the various large county maps, and from our own notes as made on the survey.

The outline of the marsh shown on the map is only approximate, but represents generally the section to be recovered.

The figures at the principal points on the map give the elevations of these points above the level of the ocean.

The line surveyed begins in St. Joseph county, Indiana, at station marked A on the map, near the S. W. corner of N. E. ¼ of Sec. 16, T. 37 N., R. 2 E., where the small branch which is the source of the Kankakee crosses the Grand Trunk and Chicago railway; thence S. 56¼° W., 12.85 miles, along the general line of the river, to station B, near the middle of the North line of S. W. ¼ sec. 23, T. 36 N., R. 1 W., a point on the bank of the river; thence S. 34¾° W., 3.80 miles through the West part of Mud Lake to station C, near the West Line of S. W. ¼ Sec. 4, T. 35 N., R. 1 W., a point at the middle of the bridge over the Kankakee, on the line of the Indianapolis, Peru and Chicago division of the Wabash, St. Louis and Pacific railway; thence S. 59½° W., 3.45 miles, to station D, near the N. W. corner of S. W. ¼ Sec. 13, T. 35 N., R. 2 W., a point at the middle of the bridge over the Kankakee on the line of the Baltimore and Ohio railway; thence S. 31° W., 3.35 miles, to station E, near the N. E. corner of the S. W. ¼ Sec. 34, T. 35 N., R. 2 W., a point on the bank of the river; thence S. 53½° W., 7.42 miles, to station F, near the S. E. corner ot S. W. ¼ Sec. 22, T. 34 N., R. 3 W., a point in the open marsh on the North side of the river at the head of a gap through "Pup Grove;" thence S. 45¾° W., 1.20 miles, to station G, in N. W. corner of S. E. ¼ Sec. 28, T. 34 N., R. 3 W., a point on the line of the New York, Chicago and St. Louis railway; thence S. 51½° W., 6.43 miles, to Station H, on the South line, near S. W. corner of S. E. ¼ Sec. 15, T. 33 N., R. 4 W., a point on bridge number —, on the line of the Pittsburg, Cincinnati and St. Louis railway; thence S. 63° W., 4.66 miles, to station I, on the middle line of N. ½ Sec. 36, T. 33 N., R. 5 W., a point near the head of "Sand Channel;" thence S. 89° W., 6.9 miles, to station K, East of the middle line of Sec. 35, T. 33 N., R. 6 W., a point in the open marsh on bridge over slough on road leading to Baum's bridge; thence S. 50½° W., 2.05 miles, to station L, near the middle of the East line of S. E. ¼ Sec. 4, T. 32 N., R. 6 W., a point in deep slough in gap through "Long Ridge;" thence S. 66½° W., 0.9 miles, to station M, near the center of N. W. ¼ Sec. 9, T. 32 N., R. 6 W., a point in the open marsh; thence S. 79° W., 5.32 miles, to station N, near the S. E. corner

of N. E. ¼ Sec. 16, T. 32 N., R. 7 W., a point in the open marsh; thence S. 60° W., 3.9 miles, to station O, near the center of Sec. 25, T. 32 N., R. 8 W., a point on the grade of the Indiana, Illinois and Iowa railway; thence by the survey and grade of the Indiana, Illinois and Iowa railway 12.83 miles to the State line; and thence, by the same railway survey, 6.8 miles to Momence, Illinois.

From station N, near the S. E. corner N. E. ¼ Sec. 16, T. 32 N., R. 7 W., the line for the improvement of the river will run S. 66¼° W., 5.45 miles, to station P, near the middle of the east line of S. E. ¼ Sec. 27, T. 32 N., R. 8 W., a point in the Kankakee river; thence S. 53½° W., 1.25 miles, in the general channel of the river to station Q, near the middle of the line which separates sections 33 and 34, T. 32 N., R. 8 W., a point in the river east of the bridge over the Kankakee, on the Chicago and Indianapolis division of the Louisville, New Albany and Chicago railway; thence S. 80° W., 2.75 miles, to station R, near the middle of the north line of N. W. ¼ Sec. 6, T. 31 N., R. 8 W., a point in the river; thence west 2.15 miles, by a new channel, to station S, near the N. E. corner of Sec. 3, T. 31 N., R. 9 W.; thence S. 85° W., 5.20 miles, to station T, on the west line of Sec. 1, T. 31 N., R. 10 W., a point in the river on the State line between Indiana and Illinois.

The Illinois section begins at station T, on the State line; thence N. 82° W., 2.00 miles, by a new channel, to cut off a great bend, to station U, a point in the river; thence S. 70° W., 3.40 miles, in the general channel of the river, to station V; thence N. 60° W., 1.75 miles in the general channel of the river to station W., a point in the river below the mouth of Bull creek; thence S. 74½° W., 1.50 miles, in the channel, to a point in the river below the dam at Momence.

The total distance, as shown by the survey, from the starting point at station A, near South Bend, to the State line, is	75.06 miles.
From the State line to Momence, is	6.80 miles.
Total	81.86 miles.

The distance on the proposed line for the improvement will be measured from the mouth of Grapevine creek, nine miles

from South Bend, and will not differ from the line of the survey, until the line comes to station O, in the river, Sec. 26, T. 32 N., R 8 W. From this station, the proposed line for the improvement will be in the general direction of the river itself, and it will be considerably longer than the straight lines measured in the survey.

THE LEVELS.

The line of levels was run as near as possible with the line of the survey, and care was taken always to select firm ground for the instruments. The levels were carefully tested by repetition and are believed to be accurate. The map shows the elevations above the ocean of every point on the river where it is crossed by either a wagon or railway bridge.

The following tables give the levels which show the general slope of the Kankakee river and marsh.

Ocean level	0.0
Lake Michigan	585.
Starting point, Grand Trunk R. R., Sec. 16, T. 37 N., R. 2 E.	721.6
Crum's Point Bridge, surface of water	709.1
Free Bridge, surface of water	691.9
I., P. & C. R. R. Bridge (Mud Lake) surface of water	689.8
B. & O. R. R. Bridge, surface of water	687.5
Barnes Bridge, surface of water	685.4
P., Ft. W. & Chicago R. R. Bridge, surface of water	682.1
Austen's Bridge, surface of water	676.3
P., C. & St. L. R. R. Bridge (English Lake) surface of water	667.1
L., N. A. & C. R. R. Bridge, surface of water	666.1
Dunn's Bridge, surface of water	663.7
Grand Junction, surface of water	660.5
Baum's Bridge, surface of water	659.4
L., N. A. & C. R. R. Bridge (Chicago Division) surface of water	635.7
Blue Grass Bridge, surface of water	632.2
State line	624.3
Mouth of Bull creek, surface of water	619.1
Below dam at Momence, surface of water	613.5

The following additional levels are in the marsh along the line of the proposed new channel:

Point where line crosses N. Y., C. & St. L. R. R.	681.1
Point where line crosses P., C. & St. L. R. R.	672.4
Point where line crosses L., N. A. & C. R. R.	669.8
Point where line crosses C. & A. R. R.	668.5
Point station I, Sec. 36, T. 33 N., R. 5 W.	668.3
Point Grand Junction	660.5
Point Shaffner's marsh (Sec. 12, T. 32 N., R. 7 W.)	649.6
Point station, Newton county line	642.

The following cross sections furnished me by the chief engineers of the several railways named, show the general outline of the valley and its adjacent ridges:

Baltimore & Ohio Railway:

Walkerton (East)	718.
Kankakee river	687.5
Union Mills (West)	758.

Pittsburg, Ft. Wayne & Chicago Railway:

Hamlet (East)	699.
Kankakee river	682.1
Hanna (West)	709.

New York, Chicago & St. Louis Railway:

Kankakee river	676.3
Chicago & W. Michigan R. R. (West)	686.

Pittsburg, Cincinnati & St. Louis Railway:

North Judson (East)	708.
Kankakee river (English Lake)	667.1
La Crosse (West)	680.

Chicago & Atlantic Railway:

North Judson (East)	708.
Kankakee river	666.3
Kouts	684.

Louisville, New Albany & Chicago Railway:

San Pierre (South)	705.
Kankakee river	666.1
La Crosse (North)	680.
Wanatah (North)	732.

Hebron, on P. C. & St. L. R. R.	676.
Shaffner's marsh	649.6
I., I. & I. R. R, (due south)	677.
Louisville, New Albany & Chicago R. R., Chicago Division:	
Rose Lawn (South)	675.
Kankakee river	635.7
Lowell	665.

The total difference of level from station A, the small rivulet in Sec. 16, T. 37 N., R. 2 E., near South Bend, which is the source of the Kankakee, to the surface of the water below the dam at Momence, is one hundred and eight and one-tenth (108.1) feet. The total distance, as shown by the survey, is eighty-one and eighty-six hundredths (81.86) miles.

The average slope of the marsh is approximately one and three-tenths (1.3) feet to the mile.

There is no part of the line where a slope of one foot to the mile can not be obtained, without any serious variation from an uniform depth for the new channel.

I have made the estimates of capacity for the new channel on this lowest basis of one foot fall to the mile, although in nearly every part the fall will be considerably more.

The mean level of the Kankakee Valley is 674.5 feet above the ocean, from which it is important to notice that, notwithstanding its general marshy character, it is a broad valley which has a mean elevation of ninety (90) feet above Lake Michigan, and of one hundred and sixty (160) feet above the water in the Wabash river at Lafayette.

THE SOIL AND UNDERLYING STRATA.

In accordance with your special instructions, careful examinations were made of the soil and vegetable growth along the marsh, and frequent borings were made for the purpose of determining the underlying strata. These borings were made with a two and one-half inch iron tube, sunk to the depth of from eight to twelve feet, and the strata were examined by using the sand pump.

Reliable sections were obtained near South Bend at Crum's Point bridge, Free bridge, Lemon's bridge, Baltimore & Ohio

railway crossing, Barnes' bridge, Austen's bridge, Huncheon's farm, Stowell's farm, Baum's bridge, Shaffner's marsh, Thayer's station, and the State line.

From these borings the character of the entire valley is properly determined.

Within the depth which will be required in the improvement of the Kankakee, no stone obstruction will be found from its source at South Bend to the limestone ledge near Momence, Illinois. Throughout the State of Indiana the underlying strata are fine sand, increasing downwards to coarse sand and gravel. Occasional thin layers of blue clay are found, but the excavations can be made generally in loose sandy soil and fine gravel.

The soil proper consists of a dark sandy loam, varying in thickness, and sometimes found even to the depth of five or six feet.

Profitable crops of wild hay are annually harvested from a large part of the marsh, and the partially recovered portions are found to be especially adapted to the culture of timothy, clover and blue grass. For stock farms this region will be surpassed by no section of the State.

The cranberry plant is native to the country, and the experiments already made for its culture are most encouraging.

Mr. Lamb has a farm in Starke county, near English Lake Station, on the P., C. & St. L. railway, on which he has a field of cranberry plants, twenty acres in extent, under the most successful cultivation. The yield is enormous, and in 1882 the crop harvested was seventeen hundred bushels. The receipts for this crop this year will be not less than four thousand dollars.

The Beaver Lake region, in Newton county, is a good sample of the reclaimed marsh land along the Kankakee, and the results in this section are so satisfactory that the most earnest efforts should be made to recover all the overflowed lands.

MARSH AREA.

The number of acres in the marshes along the Kankakee and its principal tributaries which may be recovered by judicious drainage, is not less than four hundred thousand.

The acres included in the assessments made by the Kankakee Draining Company were:

St. Joseph county	39,633
Laporte county	124,253
Porter county	75,543
Starke county	153,625
Jasper county	90,459
Newton county	79,854
Lake county	61,438
Total	624,805

These assessments included lands adjacent to the marshes which would be commercially benefited by the improvement of the river, and therefore give an aggregate considerably in excess of the overflowed lands. Owing to the favorable location of the Kankakee region with reference to the great commercial metropolis of the northwest, and the facilities furnished by the numerous railways which pass through it, there will be a rapid increase in the value of the lands as soon as the drainage is effected.

Estimating this increase at twenty dollars per acre, the aggregate addition to the wealth of the State will be eight million dollars ($8,000,000) on the estimated four hundred thousand acres reclaimed.

Or, estimating the general increase in value for the entire section drained by the Kankakee at ten dollars per acre, the added wealth to the State will be ten million dollars ($10,000,000).

Certainly this is a problem worthy of the best efforts of the State.

THE IMPROVEMENT.

The drainage and recovery of the Kankakee marshes will include: First, the construction of a better main channel than now exists, for the flow of the river; second, the straightening and deepening of the beds of the streams which empty into the main stream; and third, the digging of a large number of lateral ditches through the swamps to the improved channels.

The portion of the work which seems properly to belong to State and National supervision, is the improvement of the main channel of the river. The other parts of the work may be left to the owners of the land, to be executed under our general drainage laws.

Two streams, the Kankakee and Grapevine creek, unite near the northwest corner of Sec 4, T. 36 N., R. 1 E., nine miles from South Bend and form the Kankakee river.

This junction seems to be the proper place for the beginning of the improvement under State supervision.

The approximate length of the river in the State from this initial point is two hundred miles, as measured along the crooked channel, and the average fall per mile is less than four inches.

The velocity of the stream is nearly uniform and is about one and a half miles per hour, or one and two-tenths feet per second.

The general declivity of the marsh through which the river flows, is 1.3 feet per mile.

It is proposed to reduce the length of the river by the improvement, so that the distance from the initial point to Momence, Ill., will not exceed eighty-five miles, and the average fall per mile, will be increased to more than twelve inches.

The experiments of Messrs. Richards and Stephans, made in 1871, and reported by Mr. Bennet, civil engineer, show that the Kankakee river, one mile above Momence, Ill., has a sectional area of 1,026 square feet, a mean velocity of 1.424 feet per second, and the volume of discharge of 1,452 cubic feet per second.

At the State line the sectional area is 543 square feet, the mean hydraulic depth is 4.5 feet, the calculated mean velocity is 2.35 feet per second, and the volume of discharge is 1,271 feet per second.

According to the same authority, the dimensions of the new channel proposed by the Kankakee Draining Company were: Width at top 52 feet, width at bottom 42 feet, depth 10 feet, inclination one foot per mile, area of cross-section 470 square feet, calculated velocity 3.32 feet per second, volume of discharge 1,558 cubic feet per second.

In the determination of the dimensions of the new channels

which will be required, I have assumed the correctness of the experiments made to determine the flow at the State line, and that the volume of discharge at ordinary stages of water will not exceed 1,271 cubic feet per second.

To provide sufficient capacity for ordinary floods, I have given the lower end of the new channel, fifteen miles above the State line, an area of cross-section of 500 feet, and the calculated volume of discharge 1,358 cubic feet per second.

It is proper to remark that so much depends on physical features peculiar to each particular case, that hydraulic formulas can serve only as general guides in the solution of any given problem. Absolute results can not be reached, and there is always room for honest differences of opinion among engineers as to the accuracy of conclusions.

The formulas used in the calculations for the velocities and volumes are taken from Fanning's Engineering, and apply primarily to smooth, open and straight channels. (See foot note.)

The side slopes of the new excavations are estimated at one and one-half horizontal to each vertical foot in depth.

For convenience in the detailed descriptions of the improvement the following divisions are made:

Division I. From the initial point at the mouth of Grapevine creek, Sec. 4, T. 36 N., R. 1 E., to the lower end of Mud lake, at Lemon's bridge and the bridge of the Indianapolis, Peru and Chicago railway.

Division II. From the end of Division I, to the mouth of Mill creek, Sec. 7, T. 34 N., R. 2 W.

Division III. From the end of Division II, by a new channel, to the mouth of Crooked creek, Sec. 36, T. 33 N., R. 6. W.

$V=\sqrt{\frac{2gri}{M}}$. Volume of discharge=S×V.

S=Area of cross-section.

v=Mean velocity.

g=Accelerating force of gravity=32.2 feet.

C=Wetted perimeter=sides and bottom of channel.

t=Air perimeter=surface.

r=Mean hydraulic depth=$\frac{S}{C+.1\ t.}$

i=Sine of the angle of inclination.

m=A tabulated coefficient dependent on r.

Divison IV. From the end of Division II, by the old channel, and from the town of Knox, on Yellow river, Sec. 22, T. 33 N., R. 2 W., to the place where Crooked creek, the new channel and old channel, form a grand junction.

Divison V. From Grand Junction, by a new channel, to a point in the river in Sec. 33 T. 32 N., R. 8 W., marked station Q on the map, near the bridge on the line of the Indianapolis & Chicago Air Line railway.

Division VI. From station Q, along the general line of the river, to the State line, Sec. 1, T. 31 N., R. 10 W.

Division VII. Illinois division. From the State line along the general line of the river to Momence, Illinois.

Division I.

From the initial point at the mouth of Grapevine creek, Sec. 4, T. 36 N., R. 1 E., to the lower end of Mud lake, Sec. 4, T. 35 N., R. 1 W.

The river begins in the open marsh and is entirly free from timber to the end of this division. The Crum's Point bridge is near the beginning of this division. "Free Bridge" is in Sec. 26, T. 36 N., R. 1 W., and Lemon's bridge and the bridge of the Indianapolis, Peru & Chicago railway, are at the terminus of the division.

Mud lake is only a widening of the river on account of a slightly less fall than the average. The diminished velocity has caused the deposit of soil, and increased the growth of grasses and weeds in the stream.

The improvement of this division will require the straightening of the channel in the general line of the river. The new channel could be made perfectly straight without any timber obstruction, but, by slight deviations from a straight line, at least ten per cent. of the cost of excavation may be saved, by using as much of the present channel as possible, without material increase in distance.

The length will be 8.5 miles.

The dimensions proposed for the channel in this division are, width at bottom, 27 feet; width at top, 45 feet; depth, 6 feet.

These dimensions would give area of cross-section 216 square feet, mean hydraulic depth 4.26 feet, calculated mean velocity,

with a fall of one foot to the mile, 2.105 feet per second; volume of discharge, 455 cubic feet per second.

The excavations will measure for each linear yard 24 cubic yards, for each mile 42,240 cubic yards, for the entire division, 8.5 miles, 359,040 cubic yards. This aggregate may be reduced ten per cent. for the old channel appropriated in the new, leaving a total for the first division of 323,136 cubic yards.

Division II.

From the terminus of Division I to the mouth of Mill creek, Sec. 7, T. 34 N., R. 2 W.

The river in this division runs through the open marsh, and is free from timber obstruction. The Baltimore & Ohio railway bridge is in this division. The length of the division will be 11.3 miles. The improvement will be along the general line of the river, and the route for the new channel will be nearly a straight line.

The dimensions proposed for the new channel are—width at bottom 27 feet, width at top 48 feet, depth 7 feet. These dimensions will give area of cross-section 262.5 square feet, mean hydraulic depth 4.6 feet, calculated mean velocity 2.187 feet per second, volume of discharge 574 cubic feet per second.

The excavations will measure for each linear yard 29.16 cubic yards, for each mile 51,321 cubic yards, for the division, 11.3 miles, 579,927 cubic yards. This aggregate may be reduced ten per cent. for the old channel appropriated in the new, leaving for the *second division* 521,935 cubic yards.

Division III.

From the terminus of Division II, at the mouth of Mill creek, by a new channel, to the mouth of Crooked creek, Sec. 36, T. 33 N., R. 6 W.

The Kankakee river below the mouth of Mill creek has a belt of timber along its banks, which would make the cost of straightening the river, as in Divisions I and II, very great.

The great deflection of the river from the general direction of the valley makes it important to shorten the distance by a new channel.

The line proposed for the improvement lies in a remarkable part of the valley. The line will be clear from timber obstruc-

tion, except about one and a half miles at the lower end, where it passes through the belt of river-bank timber into the old channel. The line lies for the most part in a series of deep marshes, now impassable, and well known in the neighborhood as a deep slough, sand channel, etc. This division will be crossed by the Pittsburg, Ft. Wayne & Chicago; the New York, Chicago & St. Louis; the Pittsburg, Cincinnati & St. Louis; the Chicago & West Michigan; the Chicago & Atlantic, and the Louisville, New Albany & Chicago railways. The new channel will take the greater part of the water of the improved river above Mill creek, and all the surface drainage on the north side in Laporte and a part of Porter county. The length of the division will be 21.5 miles.

The proposed dimensions for the new channel for this division are at the upper end---width of bottom 27 feet, width at top 51 feet, depth 8 feet, area of cross-section 312 square feet. At the lower end---width at bottom 33 feet, width at top 57 feet, depth 8 feet, area of cross-section 360 square feet. The mean measure will be—width at bottom 30 feet, width at top 54 feet, depth 8 feet, area of cross-section 336 square feet.

These dimensions will give—mean hydraulic depth 5.23 feet, calculated mean velocity 2.405 feet per second, mean volume of discharge 808.4 cubic feet per second. The volume of discharge at the lower end will be 878.4 cubic feet per second.

The mean dimensions will give—for each linear yard 37⅓ cubic yards, for each mile 65,707 cubic yards, for the division, 21.5 miles, 1,412,700 cubic yards.

Division IV.

From the terminus of Division II at the mouth of Mill creek, by the old channel of the river, and from the town of Knox, Sec. 22, T. 33 N., R. 2 W., on Yellow river, to the point where Crooked creek, the new and the old channels, form the grand junction. It is important to preserve and improve the old channel of the river in this division, for the purpose of draining the large territory on the south side, including the Yellow river country.

The new channel of Division III will relieve the present bed of the most of the water above Mill creek, and its relative

carrying capacity will thereby be largely increased; but owing to its extreme crookedness, it will be necessary to expend a liberal amount in dredging and in cutting off the most troublesome bends, in order to increase the velocity of flow, which would otherwise be diminished below its present rate. The English lake region is similar to that above called Mud lake, and is only an enlargement of the river, or rather an extensive widening of the deep marsh border. In this lake the wild rice and grass grow in the greatest luxuriance. Austen's wagon bridge, Sec. 34, T. 34 N., R. 3 W.; Lougee's wagon bridge, Sec. 24, T. 33 N., R. 4 W., and Dunn's wagon bridge, Sec. 15, T. 32 N., R. 5 W., are in this division; and also, bridges on all the railway lines mentioned in Division III, except the Chicago & West Michigan.

For the improvement of this division, I would recommend the expenditure of not less than $80,000.

Division V.

From Grand Junction, Sec. 36, T. 33 N., R. 6 W., by a new channel, to a point in the river in Sec. 33, T. 32 N., R. 8 W., marked on the map as station Q, near the bridge on the line of the Indianapolis & Chicago railway.

At Grand Junction, the new channel or the upper Kankakee, the old channel or the Yellow river section, and Crooked creek, unite their waters and form the enlarged lower river.

From Grand Junction to the State line, and to Momence, Ill., there is plenty of water for the purposes of navigation, and it is desirable that the improvement below Grand Junction should be made with reference both to drainage and navigation. The route proposed for the new channel, as shown by the map, will be through the open marsh, entirely free from timber obstruction, except one mile of river bank timber on the west end, and is admirably located with reference to the drainage of some of the deepest marshes in the entire valley.

Another route may be adopted, nearly if not quite as good as the one proposed, by running the new line more directly west after it enters Newton county, and terminating in the river north of station Q; thence by the straightened river to the terminus at station P. The cost of the two routes will be about equal.

The length of the division will be 16 miles.

The dimensions proposed for the new channel for this division are---at the upper end, width at bottom 36 feet, width at top, 63 feet, depth 9 feet, area of cross-section 445.5 square feet. At the lower end—width at bottom 42 feet, width at top 69 feet, depth 9 feet, area or cross-section 499.5 square feet. Mean measure---width at bottom, 39 feet, width at top, 66 feet, depth 9 feet, area of cross-section 472.5 square feet.

These dimensions will give---mean hydraulic depth 6.06 feet, calculated mean velocity 2.7 feet per second, volume of discharge 1,275.7 cubic feet per second. The volume of discharge at the lower end station will be 1,358.6 cubic feet per second.

The mean dimensions give for each linear yard 52.5 cubic yards, for each mile 92,400 cubic yards, for the division (16 miles) 1,478,400 cubic yards.

The old channel of the river below Grand Junction receives no important creek, and only a small expenditure will be required to keep this channel open for its limited drainage area.

Division VI.

From the terminus of Division V, at station Q, along the general line of the river to the State line.

The increased velocity of the river in this division, owing to its increased slope and the general direction of the stream, make the improvement desirable along the general line of its present flow.

A new channel in Sec. 33, T. 32 N., R. 8 W., one mile in length, and a similar one, chiefly in Sections 1 and 2, T. 31 N., R. 9 W., two and a half miles long, will be required. The dimensions of these new channels are estimated the same as in Division V---per mile 92,400 cubic yards---3½ miles 323,400 cubic yards.

The other improvements in this division will consist in a general straightening of the channel, the removal of timber obstruction and dredging the channel to secure an additional depth of two feet.

The estimated length of the division after the improvement has been made, will be fifteen (15) miles.

Messrs. Cass, Singleton, Williams, Luck & Co. are con-

structing a large ditch, twenty feet wide and six feet deep, on the north side of the Kankakee, which will be an important part of the general improvement.

This ditch is located on the map, and extends from Sec. 29, T. 33 N., R. 7 W., in a general southwesterly direction to the river near the State line.

The marsh is very wide in this region, but when the land is reclaimed, as it doubtless will be when this ditch is completed, it will be as beautiful and as rich as any portion of the State.

The enterprising owners have two steam dredging machines in successful operation, and the construction of the ditch is progressing satisfactorily.

Division VII.—Illinois Division.

From the State line along the general course of the river to Momence, Illinois.

Beyond the jurisdiction of Indiana it will be necessary to continue the improvement of the river to a point below the dam at Momence.

A new channel, beginning a short distance from the State line and running west nearly two miles, will cut off a great bend of the river and effect an important saving in distance.

The dimensions of this channel should be the same as in Division V, and owing to its short length it will readily adjust itself to any required size by the action of the stream itself.

The other improvements of this division will be similar in every particular to those in Division VI, until the rock ledge near Momence is reached.

This obstruction is a limestone ledge which extends about one and a half miles in width, and its removal is a necessity for the proper improvement of the river.

The increased velocity of the straightened channel above will carry down large quantities of soil and sand, for which a free outlet must be provided by opening a way through the rocky ledge.

Even now the improvements in the Beaver lake region have increased the growth of grasses and weeds in the river at Momence and this will be further increased to a very damaging degree, unless this free outlet is provided.

The General Government has ordered a survey of this portion of the river, and the methods for this improvement doubtless will receive proper consideration. A channel forty feet in width and five feet in depth will be large enough to meet the requirements of the new improvement, which will give approximately for the entire length 60,000 cubic yards.

After the completion of the improvement of the river, the estimated distance from the State line to Momence will be 12 miles.

The total distance as shown by the preceding division will be:

Division I	8.5 miles.
Division II	11.3 miles.
Division III	21.5 miles.
Division V	16.0 miles.
Division VI	15.0 miles.
Division VII	12.0 miles.
Total	84.3 miles.

Division IV is not included in this estimate of the length of the new channel.

The entire work may be divided into two general parts, the first including Divisions I, II, III and IV, from the initial point to Grand Junction, Section 36, T. 33 N., R. 6 W., and the second including Divisions V, VI and VII, from Grand Junction to Momence.

The distance from the initial point to Grand Junction will be 41.3 miles, and from Grand Junction to Momence, 43 miles.

It is entirely feasible to begin the improvement of either of these general parts without delaying for the other, and pending the settlement of the proper question of the relation of the General Government to the lower portion as a navigable stream, it is recommended that work be begun as speedily as possible on the upper portion.

METHODS AND COST.

In the construction of the new channel for the Kankakee, it will be necessary to use steam dredging machines.

The best forms of these machines, as now constructed, are made to float in channels of their own making. The Kankakee open marshes and sandy soil, afford the best field for the

economic use of these dredging machines. The two now in use by Messrs. Cass, Singleton, Williams & Co., are constructed after an excellent model, and the work being done by them is satisfactory. Five to six men are required to do the work on each boat, and one machine can excavate thirteen hundred cubic yards per day.

The engine has forty-horse power at sixty pounds of boiler pressure.

All the operatives are comfortably fed and lodged upon the boats.

The special machinery for the excavation consists of a series of scoops attached to an endless chain, which passes over a projecting arm in the forward part of the boat, this arm being adjustable to any point in front, where it is desired that the excavation be made.

The scoops deliver their loads into an elevated chute, which is inclined about 30 degrees, and extends over the side of the boat far enough to deposit the excavated earth at the proper distance from the ditch.

In the Kankakee improvement a number of these machines will be required. For the wide channels it will be more expeditions and economical to use the machines in pairs---one digging half the width and the second following close behind and digging the remaining half.

In addition, it will be found necessary to have small steam tenders to carry supplies to the dredge boats, as in many parts of the marsh it will be impossible to reach the boats by wagons.

The cost of the dredging machines will be from $7,000 to $10,000 each.

I am not able to say what is the lowest possible price at which this work can be done with these dredging machines---or rather the lowest price per cubic yard at which the contract could be made with responsible and capable parties.

The manufacturers of dredging machines claim that the expense of moving earth will be from two to three cents per cubic yard. This amount, however, can not include the use of capital invested, wear of machinery, and necessary losses by breakage and other delays.

Persons with some experience in this kind of work think that five to seven cents would be a fair price, including interest on

capital and all risks incident to the work; while others believe that contracts with responsible parties can not be obtained at less than ten cents per cubic yard.

Herewith I submit the cost of the earth work at both seven and ten cents per cubic yard, and if a less price can be realized it will only be the more satisfactory.

According to the foregoing estimates, the amount of earth work included in the improvement, from the initial point to Grand Junction, will be:

Division I	323,136 cubic yds.
Division II	521,935 cubic yds.
Division III	1,412,700 cubic yds.
Total	2,257,771 cubic yds.

At 7 cents per cubic yard the cost of this excavation would be	$158,043 97
Or at 10 cents per cubic yard	225,777 10
The amount proposed for Division IV is	80,000 00
Making a grand total of	238,043 97
Or of	305,777 10

The amount of earth work included in the improvement from Grand Junction to the State line and to Momence will be:

Division V	1,478,400 cubic yds.
Three and a half miles of Division VI	323,400 cubic yds.
Total	1,801,800 cubic yds.

At 7 cents per yard this will cost	$126,126 00
At 10 cents per yard this will cost	180,180 00
The estimated expenditure for the remaining 11½ miles of Division VI is $6,000 per mile, or for the division, $69,000; making a grand total from Grand Junction to the State line of	195,126 00
Or	249,180 00
The estimated cost for Division VII, Illinois Division, is 10½ miles, at $6,000 per mile	65,000 00
One and a half miles rock excavation at $15,000 per mile	22,500 00
Total	$87,500 00

The total cost from Grand Junction to Momence, on the estimates at 7 cents, will be	$282,626 00
On the estimate at 10 cents, will be	336,680 00
The total cost from the initial point to the State line, at 7 cents, will be	433,169 97
At 10 cents, will be	545,975 10
The entire cost from the initial point to Momence will be, at 7 cents	520,669 97
At 10 cents	642,457 10

GENERAL RESULTS.

Divisions.	Miles Length.	Cubic Yards.	Cost at $0.07.	Cost at $0.10.
I	8.5	323,136	$22,619 52	$32,813 60
II	11.3	521,935	36,535 45	52,193 50
III	21.5	1,412,700	98,889 00	141,270 00
IV	.....	.....	80,000 00	80,000 00
V.	16.	1,478,400	103,488 00	147,840 00
VI	15. $3\frac{1}{2}$	323,400	22,638 00	32,340 00
	$11\frac{1}{2}$	.....	69,000 00	69,000 00
VII.	12.	.....	87,500 00	87,500 00
Totals.	84.3	.....	$520,669 97	$642,457 00

In addition to the cost of construction, the question of maintenance of the new channel requires consideration. The same causes which produced the present crooked river will, in a less degree, affect the straightened stream, and continued care will be required to preserve an unobstructed flow.

The broad valley of the Kankakee marsh is doubtless the result of glacial action. At the close of the glacial period, we may suppose that a shallow river extended from bank to bank of the valley. This stream had a slope of about one foot to the mile, and a consequent velocity rapid enough to take up the particles of fine sand and carry them forward. The retardation along the borders would cause the deposit of the sand, and thereby make the stream more narrow by the formation of

banks. The narrowed and deepened stream would have an increased velocity, and hence, other masses of sand would be taken up by the current and carried forward to form obstructions in the general direction of flow. Following the lines of least resistance, the channel would be diverted from its original direction and would change from straight to crooked, and continue to change so long as the velocity was too great for the stability of the sand bed over which the river flows. By these processes, doubtless, the sinuous Kankakee was formed; and its present length, with its many windings, approximately determines the velocity consistent with permanence in the wide marsh which it now so imperfectly drains.

The formation of the timber line along the river may be explained in like manner.

During freshets the low lands would be overflowed, and the soil and sand brought down by the increased current would be deposited, first along the banks of the river, thereby raising the surface next the stream enough above the level of the marsh to permit the seeds of trees to grow, which would not germinate in the swamp itself.

If we assume that the river now has an approximately stable bed, the result mainly of the free action of natural forces on the sandy soil, it is evident that any increase of velocity will affect this stability and introduce a disturbing element which will require special attention.

The banks of the new channel will likewise deliver quantities of sand into the current until they assume their proper angle of rest and are protected by grass or other vegetable growth.

The lateral ditches, also, will bring down masses of sand which will, if left uncared for, form bars where these ditches empty into the river.

To meet these difficulties it will be necessary to keep at work one or two dredging machines until the new channel has assumed a partially stable condition.

Grass grows most luxuriantly in all parts of the Kankakee valley, and from this cause we may expect that the banks will be covered very rapidly. After the drainage has been once accomplished and the lands brought under cultivation, there will be a great diminution of the volume of water to be carried off.

The absorbent power of the reclaimed land and the evapor-

ating surface will be increased, and the quantity of surplus water will be proportionally diminished.

The diminished volume will give a relative increased capacity with less depth, and thus by degrees the new channel will become stable, while at the same time it fulfills all the requirements for complete drainage.

DIVISION OF EXPENSES.

In this improvement it is proper to consider the relation which the Kankakee sustains to the navigable waters of the Mississippi system, and to what extent the expenses of the work should be borne by the government of the United States.

The Kankakee has always been considered a navigable stream, but the point above which it can not be properly so classed never has been fixed.

Major Jared Smith, of the U. S. Engineers, in charge of the river and harbor improvements in this State, made an examination of the Kankakee in 1879, and reported favorably for its improvement for a distance, by the river, of one hundred and fifty miles. Major Smith's report will be found on pages 1,455–60, Executive Documents, Second Session Forty-sixth Congress 1879–80, Vol, 4, Engineers, No. 1, part 2.

Major Smith's reconnoissance was made by a small steamer from Momence as far up the river as Baum's bridge, and in this entire distance he reports abundance of water for navigation. He says: "The greater portion of the distance of 120 miles, which I thus went over, had a depth of five (5) or more feet, and I found no case where it was less than two feet, and but few as small as three feet."

Baum's bridge is but two miles below the point named in this report as "Grand Junction."

I fully concur in the opinion expressed by Major Smith, and believe that there will be a supply of water sufficient to maintain a reliable depth of two and a half to three feet at the lowest stage, even after the channel has been straightened and improved for general drainage.

The uniform slope of the bed of the Kankakee, and the absence of any rock obstruction in the entire State, will obviate the necessity for the construction of dams for navigation pur-

poses, so that it will be entirely feasible to make the improvement for the double purpose of drainage and navigation.

From Momence to Grand Junction there are but one railway and two wagon bridges. It will not be difficult, therefore, to provide an open way for navigation.

The manifest importance of this improvement, as a part of the general system of water communication through the Mississippi river, will certainly command favorable action.

It is respectfully recommended that the General Government be requested to consider the improvement of the Kankakee for the purposes of navigation, in connection with the State work for drainage, from Momence to Grand Junction.

DRAINAGE TO THE TIPPECANOE.

The short water-shed to the Kankakee on the south side below English lake, has suggested a possible route for the new channel of the Kankakee southward through this dividing ridge to the Monon, and thence to the Tippecanoe and Wabash rivers; and, in accordance with your directions, I made a survey in that section.

The line was run from the mouth of a small creek which empties into the Kankakee in the N. E. ¼ Sec. 35, T. 33 N., R. 4 W., a short distance below the P., C. & St. L. R. R. at English lake; thence up this stream five miles to the dividing ridge near the section line, between Sections 23 and 26, T. 32 N., R. 4 W.; thence down a small tributary of the Monon to the head of the Monon ditch, in Pulaski county, Sec. 6, T. 31 N., R. 3 W.; thence to a point in the same ditch in Sec. 33, T. 30 N., R. 4 W., called Hickory Grove, northeast of Francisville.

The levels on this line show that the summit of the ridge, five miles from the starting point, is 46 feet above the level of the water in English lake, and allowing 6 feet for depth of the river and 1 foot fall per mile, a cut will be required at the summit of 57 feet. At the county line, two miles further south, the cut will be 43 feet in depth. The fall from the head of the Monon ditch to Hickory Grove, a distance of twelve miles, is 40 feet; and, with the same slope as before, the depth of the ditch would be 15 feet at this point.

The impracticability of the route being so manifest, I aban-

doned any further survey at this point. It is important to remark that the fine slope to the marsh along the Monon from its source to Cooper's mill, and the very fertile marsh valley along the river, should prompt immediate and active efforts to complete the drainage already partly accomplished by the "Monon Ditch." To finish this important work will require the enlargement of the ditch, the straightening of the channel in the lower portion, and probably the removal of the dam at Cooper's mill.

ALLEN AND HUNTINGTON COUNTY MARSHES.

During the month of October I made an examination of the extensive swamp lands in Allen and Huntington counties, along the line of the Wabash, St. Louis & Pacific railway. The field leveling was done by Messrs. Anderson & Orton.

The marsh region embraces twenty-five thousand acres, and is nearly equally divided between the two counties. In Allen county the marsh is chiefly prairie, but in Huntington county a considerable portion is in the wood land.

In range twelve, running quite through the county, lies the dividing line between the waters which flow through the Maumee to Lake Erie and those which flow through the Wabash to the Ohio and on to the Gulf of Mexico.

The great marsh begins southwest of the city of Ft. Wayne, and stretches along Little river to the limestone ledge near Huntington.

Little river rises in the south part of Allen county, and runs northward to within a few miles of Ft. Wayne, where it is lost in the marsh, but it reappears again with definite banks and channel in Sec. 25, T. 30 N., R. 11 E.

Through the Richardville Reservation the marsh extends quite to the St. Mary river, and it is both feasible and desirable to direct the upper portion of Little river, by a new channel, through this marsh to the St. Mary. From six to ten feet fall may be found from this marsh to the St. Mary, and there are no stone or timber obstructions in the line of the proposed new channel.

The following table shows the elevations, referred to sea-levels from Ft. Wayne along the general line of the marsh to the surface of the water below the lower dam at Huntington:

P., Ft. W. & C. R. R. depot, Ft. Wayne	784.
Crossing P., Ft. W. & C., and Ft. W. & M. R. R.	792.8
Little river, in Sec. 25, T. 30 N., R. 11 E., at crossing W., St. L. & P. R. R.	757.5
Little river, at crossing R. R., Sec. 26	756.1
Little river, at crossing R. R., Sec. 33	754.7
Little river, at Aboite station	751.3
Little river, at Roanoke station	746.5
Little river, at Mahan	741.1
Little river, at Sec. 4, T. 28 N., R. 10 E	740.4
Little river, at foot of ripple	737.0
Little river, at upper dam at Huntington (top)	732.7
Little river, at surface of water below dam	724.7
Little river, at lower dam at Huntington (top)	723.5
Little river, at surface of water below dam	715.9

The chief obstruction to the drainage of Little river is the ledge of limestone which lies across the channel at Huntington. The entire fall from the starting point, in Allen county, seventeen miles from the upper dam at Huntington, is thirty-two feet, but nearly one-half of this fall is found in the five miles at the lower end. The improvement of the river and the recovery of the marsh lands above will require the removal of the upper dam at Huntington and the opening of a channel through this rock obstruction.

Several years ago a company was formed for the purpose of making this improvement of Little river and the recovery of the marsh prairie. The length of the improved channel of Little river, contemplated by the company, was sixteen and one-half miles from the upper dam at Huntington to a point west of Ft. Wayne, where the river first crosses the line of the Wabash, St. Louis & Pacific Railway.

The rock excavation near Huntington was estimated at sixty-two thousand cubic yards, and the probable cost per yard for removal was seventy cents, giving an aggregate of $44,400. I am not able to give an estimate of the cost of the earth work which will be required without further surveys. It is safe to say, in general terms, that the entire improvement can be made at a cost not exceeding $100,000, an average cost of four dollars per acre for the marsh land recovered.

The nearness of this vast marsh to one of the largest and most flourishing cities in the State, makes its reclamation especially important. These lands are now practically worthless, but when recovered will have a value at least of thirty ($30) dollars per acre, or an aggregate value of $750,000.

KNOX COUNTY SWAMPS.

The extensive area south of Vincennes, in Knox county, known as Cypress Swamp, lies in the belt of territory between Wabash and White rivers, above their junction. The low lands begin near the city of Vincennes, and, interspersed with sand hills or ridges, constitute a series of swamps embracing not less than 15,000 acres. The marshes have but little elevation above the river at ordinary full stage, and during heavy floods they are submerged to the depth of five to ten feet. The soil is very rich and the lands will be valuable when recovered.

The reclamation of this section will require the opening of suitable ditches for drainage and protection from overflows.

A small stream called River Dechee runs through a part of the marsh, and is lost in the marsh itself, but reappears, and, through a fairly defined channel, empties into the Wabash.

A State ditch was once constructed from the Dechee to White river, and by the enlargement of this incomplete work the upper portion of the marsh may be drained. The channel of the Dechee to the Wabash will furnish the proper line for the improvement of another part of the marsh.

In order properly to protect the lands from overflow, it will be necessary to construct levees along the Wabash from the point where the present levee near the city ends, to the rapids, and, also along White river above the junction of the two rivers. Additional surveys will be required to determine the cost of these improvements.

In the eastern part of the county there is another extensive marsh, known as Montour's pond, embracing six to eight thousand acres which is not subject to overflow from the river.

The levels run by the County Surveyor show a fall of two to three feet per mile, from the deepest part of the pond to White river. This section can be readily drained to White river, and when recovered it will be equal in value, for agricultural purposes, to any part of Knox county.

In the conclusion of this report, I deem it proper to acknowledge the invaluable assistance I have received from yourself, in the facilities furnished for the work and in the discussion of methods for its prosecution.

I am specially indebted to the State Geologist for his cordial co-operation, and for the information and assistance which he has given to me.

I desire to express my thanks to the railway companies of the State for favors received, and to the many citizens of the State who have kindly furnished to me valuable information.

The popular interest everywhere expressed in the success of this undertaking, shows how strongly the people will sustain efforts tending to promote the real prosperity of the State.

Respectfully submitted,

JOHN L. CAMPBELL,

Chief Engineer.

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