Essex County. Laying Durax pavement on Morris Avenue.

Twenty-third Annual Report

OF THE

Commissioner of Public Roads

For the Year Ending October 31st

1916

TRENTON, N. J.
MacCrellish & Quigley Co., State Printers.
1916.

OFFICE OF COMMISSIONER OF PUBLIC ROADS,

TRENTON, NEW JERSEY, December 1, 1916.

To the Honorable James F. Fielder, Governor, and the Legislature of New Jersey:

I have the honor to submit the Twenty-third Annual Report of the Commissioner of Public Roads for the fiscal year ending October 31, 1916, with such comments and suggestions as existing circumstances seem to require.

E. A. STEVENS,

Commissioner of Public Roads.

FINANCIAL STATEMENT.

Statement of Appropriations—November 1, 1915, to October 31, 1916.

Public Road Funds.	Carried Forward on Contracts.	Annual Appropriation.	Total Amount Available.	Expended.	Outstanding on Requisitions.	Balance Forward on Contracts.	Lapsed to State Treasury.
Appropriation Public Roads, 1909–10,	$1,203 63	.....	$1,203 63	.....	.....	$1,203 63	.....
State Road Fund, 1913–14,	113,163 67	.....	113,163 67	$71,818 70	.....	41,160 91	$184 06†
State Road Fund, 1914–15,	374,936 03	.....	374,936 03	234,031 67	.....	128,071 45	12,832 91†
State Road Fund, 1915–16,	.....	$500,000 00	500,000 00	93,988 41	$4,889 95	396,273 95	4,847 69*
	$489,303 33	$500,000 00	$989,303 33	$399,838 78	$4,889 95	$566,709 94	$17,864 66
General Appropriations.							
Salary of Commissioner,		$5,000 00	$5,000 00	$5,000 00	.....	.....	.....
Salary of State Highway Engineer,		4,000 00	4,000 00	4,000 00	.....	.....	.....
Salary of Division Engineers (Annual and Supplemental),		7,300 00	7,300 00	6,750 00	.....	.....	$550 00
Clerical and Office Expenses,		17,500 00	17,500 00	12,795 67	$3,547 13	.....	1,157 20*
Expenses of Surveying Corps (Appropriation and Earnings),		7,026 14	7,026 14	6,389 11	607 70	.....	29 33*
Administration of Township Roads Act,		3,000 00	3,000 00	2,011 16	986 39	.....	2 45*
Survey of State Highway System,		519 43	519 43	519 43	.....	.....	.....
Purchase of Automobile,		400 00	400 00	394 98	.....	.....	5 02
Convict Labor (Annual and Supplemental),		90,000 00	90,000 00	69,866 82	20,060 80	.....	72 38*
		$134,745 57	$134,745 57	$107,727 17	$25,202 02	.....	$1,816 38

Motor Vehicle Account.	Balance Forward.	Receipts.	Total Amount Available.	Expended.	Carried Forward.
Motor Vehicle Fund,	$522,385 22	$1,350,549 16	$1,872,934 38	.....	$1,040,547 69
Paid on Allotments,	.....	.....	.....	$716,361 69	.....
Appropr ated for Expenses Assistant Supervisors,	.....	.....	.....	3,000 00	.....
Appropriated for Expenses Motor Vehicle Department,	.....	.....	.....	113,025 00	.....
	$522,385 22	$1,350,549 16	$1,872,934 38	$832,386 69	$1,040,547 69

CASH STATEMENT.

For Fiscal Year 1915–16.

PUBLIC ROAD FUNDS.

Paid on Contracts,		$316,439 29
Paid on Extras,		14,462 04
Paid for Engineering (final),		11,153 07
Paid for Inspection (final),		5,562 77
		$347,617 17
Paid in advance for Inspection on 40% roads, 1916,		13,658 52
Paid in advance for Inspection on 40% roads, 1915,		4,471 80
Paid for Inspection not charged to any given roads:		
Salary Regular Inspectors,	$3,250 00	
Expenses of Inspectors,	1,047 66	
Salary of Foremen,	14,847 50	
Wages of Seasonal Inspectors,	14,946 13	
		34,091 29
		$399,838 78

MOTOR VEHICLE FUNDS.

Paid on allotments for maintenance and repair of roads,		$716,361 69
Paid for Expenses of Assistant Supervisors,	$2,015 36	
Outstanding on requisitions,	682 28*	
Lapsed to State Treasury,	302 36	
		3,000 00
Appropriated for Expenses of Motor Vehicle Department,		113,025 00
		$832,386 69

Balance Sheet—October 31, 1916.

PUBLIC ROAD FUNDS.

ASSETS.

Cash Balance, Appropriation for Public Roads, 1909–10,	$1,203 63
Cash Balance, State Road Fund, 1913–14,	41,160 91
Cash Balance, State Road Fund, 1914–15,	128,071 45
Cash Balance, State Road Fund, 1915–16,	401,163 90
	$571,599 89

LIABILITIES.

Approved contracts for new construction outstanding,	$495,378 90
Approved extras outstanding,	7,708 04
Reserve for extras, engineering and inspection,	63,623 00
Outstanding on requisitions,	4,889 95
	$571,599 89

MOTOR VEHICLE FUNDS.

ASSETS.

Cash Balance, Motor Vehicle Fund,	$1,040,547 69

LIABILITIES.

Allotments for maintenance outstanding,	854,233 31
Balance available,	$186,314 38

* Amounts as apparent; these may be changed through entire amount outstanding on requisitions not being used.

† Amounts lapsing to State Treasury on account of savings on contracts on which final payments have been made.

STATEMENT.

Item.	*1910–11.*	*1911–12.*	*1912–13.*	*1913–14.*	*1914–15.*	*1915–16.***
Salaries,	$11,600 00	$11,600 00	$15,100 00	$15,600 00	$16,300 00	$16,549 84
Office Expenses,	10,994 85	15,960 00	15,500 00	19,092 91	14,916 01	17,500 00
Auto Purchases,	3,925 00	.....	4,999 80	.....	2,500 00	400 00
Sundries,	.....	.....	585 26	.....	.....	2,500 00
Administration Expense,	$26,519 85	$27,560 00	$36,185 06	$34,692 91	$33,716 01	$36,949 84
Per Cent.,	4.85%	4.11%	3.38%	2.88%	3.04%	2.25%
Road Construction,	$299,816 08	$282,739 46	$521,575 37	$497,412 71	$255,866 27	$555,000 00
Road Repair,	232,184 03	367,717 35	495,902 49	590,226 28	751,277 39	1,000,000 00
Surveys, etc.,	8,533 90	13,274 53	9,142 37	15,866 80	4,831 06	519 43
Experimental Work,	6,057 76	5,978 38	.....	.....	.....	.....
Convict Labor,	.....	.....	44,683 24	99,980 15	98,494 50	90,000 00
Work Performed,	$546,591 77	$669,709 72	$1,071,303 47	$1,203,485 94	$1,110,469 22	$1,640,519 43
Inspection Cost,	$25,996 20	$27,663 10	$28,269 16	$44,747 34	$44,958 25	$57,000 00
Per Cent.,	4.75%	4.13%	2.64%	3.71%	4.05%	3.47%
Total Per Cent. of Administration and Inspection,	9.6 %	8.24%	6.02%	6.59%	7.09%	5.72%

** The figures below indicate liabilities incurred; all bills not having been presented as yet.

Payments on Roads and Bridges, 1916.

PAYMENTS FROM 1916 APPROPRIATION.

In compliance with chapter 395, laws of 1912, and all supplements thereto and amendments thereof, the following statement of cost of roads and bridges is submitted.

The following payments have been made during the fiscal year 1916 and were made from the appropriation for 1916:

GLOUCESTER COUNTY—Mullica Hill-Woodbury turnpike, 6.770 miles; purchase price allowed, $25,000; State's share, $12,500.

MIDDLESEX COUNTY—Perth Amboy-South Amboy drawbridge. Cost of maintenance and repairs, $14,979.03; State's share, in accordance with chapter 413, laws of 1912, $4,993.01.

MORRIS COUNTY—Sussex turnpike, section two, 1.063 miles; cost allowed, $24,903.20; State's share, $9,569.13.

OCEAN COUNTY—Barnegat-Buddtown road, first section, cost allowed on partial payment, $7,845.85; State's share on partial payment, $3,138.34.

SUSSEX COUNTY—Newton-Sparta road, cost allowed on partial payment, $24,948.05; State's share on partial payment, $9,979.22. Ross's Corner-Sussex road, cost allowed on partial payment, $12,097.70; State's share on partial payment, $4,839.08. Total for county, $37,045.75; State's share, $14,818.30.

WARREN COUNTY—Fish Hatchery road, 0.150 mile; cost allowed, $1,219.82; State's share, $1,219.82.

Total mileage paid for from 1916 appropriation, 7.983; total cost allowed on contracts paid for from 1916 appropriation, $110,993.65; total State's share paid on contracts from 1916 appropriation, $46,238.60; payment for general inspection of roads, $47,749.81; total payments from 1916 appropriation, $93,988.41.

PAYMENTS FROM 1915 APPROPRIATION.

The following payments have been made during the fiscal year 1916, but paid from the appropriation for 1915:

ATLANTIC COUNTY—Bass Harbor bridge, cost allowed, $16,957.25; State's share, $1,355.23. Broad Thorofare bridge, cost allowed, $78,725.80; State's share, $7,025.08. Hospitality Creek bridge, cost allowed, $23,480.84; State's share, $1,929.83. Northfield road, 0.112 mile; cost allowed, $1,886.95; State's share, $683.28. Northfield bridge, cost allowed, $2,164.55; State's share, $116.45. Patcong Creek bridge, cost allowed, $42,326.88; State's share, $7,170.48. Risley's Channel bridge, cost allowed, $77,558.45; State's share, $6,544.36. Somers Point-Longport boulevard, cost allowed on partial payment, $100,168.10; State's share on partial payment, $40,067.24. Bridges on Somers Point-Longport boulevard, cost allowed on partial payment, $28,563.30; State's share on partial payment, $2,856.33. Wheat road and Twelfth street, 13.787 miles; cost allowed, $73,258.39; State's share, $27,612.55. Total for county, 13.899 miles; cost allowed, $445,090.51; State's share, $95,360.83.

BERGEN COUNTY—Kinderkamack road, sixth section, 2.108 miles; cost allowed, $51,746.77; State's share, $19,695.47.

BURLINGTON COUNTY—Chesterfield-Jacobstown road, cost allowed on partial payment, $11,172.95; State's share on partial payment, $4,469.18. Hartford-Fairview road, 1.133 miles; cost allowed, $9,787.94; State's share, $3,702.18. Total for county, 1.133 miles; cost allowed, $20,960.89; State's share, $8,171.36.

CAMDEN COUNTY—Main street, Haddonfield, 1.350 miles; cost allowed, $36,062.19; State's share, $13,677.88.

CUMBERLAND COUNTY—Landis avenue, sections one, two and three, 9.742 miles; cost allowed, $29,659.14; State's share, $11,245.65. Millville-Maurice River road, 7.450 miles; cost allowed, $41,390.82; State's share, $16,034.32. Total for county, 17.192 miles; cost allowed, $71,049.96; State's share, $27,279.97.

HUNTERDON COUNTY—Frenchtown Borough road, .340 mile; cost allowed, $3,504.92; State's share, $1,207.97. Lebanon-Clinton road, .161 mile; cost allowed, $2,299.15; State's share, $760.76. Total for county, .501 mile; cost allowed, $5,804.07; State's share, $1,968.73.

MIDDLESEX COUNTY—Roosevelt-Woodbridge road, section three, 1.977 miles; cost allowed, $35,014.18; State's share, $13.555.67. Schalk's Station road, 2.295 miles; cost allowed, $17,518.86; State's share, $6,354.04. Total for county, 4.272 miles; cost allowed, $52,533.04; State's share, $19,909.71.

MONMOUTH COUNTY—Riverside drive, cost allowed on partial payment, $11,893.25; State's share on partial payment, $4,757.30.

OCEAN COUNTY—Toms River-Lakehurst road, east section, .947 mile; cost allowed, $13,299.36; State's share, $4,675.74.

SOMERSET COUNTY—Finderne avenue, 1.041 miles; cost allowed, $11,905.68; State's share, $4,315.27.

UNION COUNTY—Shunpike road, middle section, paving only, mileage added in 1915; cost allowed, $3,430.00; State's share, $1,291.00. Wood avenue, Linden, 1.135 miles; cost allowed, $30,796.90; State's share, $12,237.16. Total for county, 1.135 miles; cost allowed, $34,226.90; State's share, $13,528.16.

WARREN COUNTY—Bloomsbury-Still Valley road, 2.915 miles; cost allowed on road, $38,527.20; State's share on road, $14,531.25; cost allowed on bridge, $8,441; State's share on bridge, $1,688.20. Total for county, 2.915 miles; cost allowed, $46,968.20; State's share, $16,219.45.

Total mileage paid from 1915 appropriation, 46.493 miles; total cost allowed on contracts paid from 1915 appropriation, $801,540.82; total State's share paid from 1915 appropriation, including inspection, $234,031.67.

PAYMENTS FROM 1914 APPROPRIATION.

The following payments have been made during the fiscal year 1916, but paid from the appropriation for 1914:

ATLANTIC COUNTY—English Creek bridge, cost allowed, $5,991.20; State's share, $807.74. Lake's Creek bridge, cost allowed, $4,875.44; State's share, $791.09. Oyster Creek road, 3.466 miles; cost allowed, $21,274.85; State's share, $7,660.94. Somers Point-Mays Landing road, cost allowed on partial payment, $54,004.65; State's share on partial payment, $21,601.86. Total for county, 3.466 miles; cost allowed, $86,146.14; State's share, $30,861.63.

BERGEN COUNTY—Market street, 2.871 miles; cost allowed, $75,253.81; State's share, $29,355.82.

MERCER COUNTY—Bridges on Windsor-Newtown-Yardville road, cost allowed on bridges at sta. 223 + 36 and sta. 278 + 58, $2,716.30; State's share, $543.26. Cost allowed on bridges over Miry Run and Assunpink Creek, $1,820.00; State's share, $364.00. Total for county, $4,536.30; State's share, $907.26.

SUSSEX COUNTY—Newton-Branchville road, section one, 4.487 miles; cost allowed on final partial payment, $26,734.98; State's share on final partial payment, $10,693.99.

Total mileage paid for from 1914 appropriation, 10.824; total cost allowed on contracts paid from 1914 appropriation, $192,671.23; total State's share on contracts paid from 1914 appropriation, $71,818.70.

Total length of improved roads added to mileage during fiscal year ending October 31, 1916, and total amount of money allowed and expended by State on contracts during same period:

	Miles.	*Cost Allowed.*	*State's Share.*
Paid from 1916 appropriation,	7.983	$110,993 65	$93,988 41
Paid from 1915 appropriation,	46.493	801,540 82	234,031 67
Paid from 1914 appropriation,	10.824	192,671 23	71,818 70
	65.300	$1,105,205 70	$399,838 78

The following roads are approaching completion:

County.	*Name of Road.*	*Miles.*	*Cost Approximate.*
Atlantic,	Main avenue and Broadway, Somers Point,	.394	$6,487 80
	Somers Point-Longport boulevard,	4.114	182,211 91
Bergen,	Anderson avenue, second section,	1.595	34,337 89
Burlington,	Chesterfield-Jacobstown,	2.192	18,442 50
	Vincentown-Buddtown,	2.515	5,710 40
	Vincentown-Eayrestown,	2.015	4,578 85
Camden,	Kresson,	3.036	19,871 15
Essex,	Gregory avenue,	1.675	14,000 00
Hunterdon,	Hoffman's-Lower Valley,	1.670	14,578 44
Monmouth,	Riverside drive,	1.667	16,667 48
Ocean,	Bay Head-Point Pleasant,	.565	3,359 50
Somerset,	Greater Cross roads, second section,	2.710	53,714 72
Sussex,	Newton-Branchville, second section,	3.320	28,089 22
Union,	Mountain avenue, first section,	3.637	80,000 00
Warren,	Buttzville-Danville,	5.790	66,000 00
	Total,	36.895	$548,049 86

Number of Miles of Road Built in Each County with State Aid in Each Year and Total

COUNTY.	1893. No. Miles.	1894. No. Miles.	1895. No. Miles.	1896. No. Miles.	1897. No. Miles.	1898. No. Miles.	1899. No. Miles.	1900. No. Miles.	1901. No. Miles.	1902. No. Miles.	1903. No. Miles.	1904. No. Miles.
Atlantic, ...	.....	.....	.....	12.00	10.00	6.84	4.03	.....	7.03	20.10	13.00	1.00
Bergen, ...	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.02	.....	9.375
Burlington, ..	10.54	20.46	9.75	11.02	10.48	15.03	18.36	8.93	17.36	19.131	27.98	2.48
Camden, ...	13.62	.....	8.25	.....	4.125	12.79	2.23	1.00	4.48	8.80	9.50	5.985
Cape May, ...	.....	.....	.....	.....	.....	.....	.....	.....	6.00	5.394	6.20	0.15
Cumberland, .	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.22	.....
Essex, ...	.....	.....	6.5	6.00	4.91	6.67	12.07	9.60	9.36	8.723	5.79	8.545
Gloucester, ..	.....	.....	7.75	6.00	5.5	7.59	11.40	6.04	17.44	6.875	7.73	.....
Hudson, ...	.....	.....	.....	.....	.....	.....	.....	2.44	.....	.....	.....	.....
Hunterdon, ..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mercer, ...	.....	9.46	6.40	10.95	4.75	2.704	10.83	9.16	10.37	15.89	12.3	7.55
*Middlesex, ..	3.18	2.36	7.68	8.43	4.75	6.164	13.10	9.01	6.12	14.95	9.52	12.42
Monmouth, ..	.....	.....	.....	3.75	5.00	5.1	14.46	5.64	6.67	13.25	17.67	5.21
Morris, ...	.....	.....	.....	.....	6.13	6.3	10.46	6.53	4.306	10.079	7.13	5.98
Ocean, ...	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.9	9.97	11.83
Passaic, ...	.....	.....	.....	.....	4.79	5.48	8.67	6.73	3.987	6.57	6.09	1.54
Salem, ...	.....	.....	.....	2.67	.....	.....	2.17	2.05	.....	2.51	4.61	7.477
Somerset, ...	.....	.....	.....	.....	6.22	7.27	6.6	6.65	7.93	5.88	6.24	10.68
Sussex, ...	.....	.....	.....	.....	.....	.....	.....	.....	0.893	.....	4.03	1.695
Union, ...	.....	.....	.....	.....	.....	.....	.....	3.432	.....	2.141	.....	0.63
Warren, ...	.....	.....	.....	.....	.....	.....	0.08	.....	7.43	8.792	3.94	13.09
Totals,.....	27.34	32.28	46.33	60.82	66.655	81.938	114.46	77.212	09.376	154.005	152.92	105.637

* In 1892, Middlesex, 10.55 miles.

Each Year Since Passage of State Aid Law, Also Total Number Built Number in Each County.

1905. No. Miles.	1906. No. Miles.	1907. No. Miles.	1908. No. Miles.	1909. No. Miles.	1910. No. Miles.	1911. No. Miles.	1912. No. Miles.	1913. No. Miles.	1914. No. Miles.	1915. No. Miles.	1916. No. Miles.	*Totals. No. Miles.
1.51	.....	6.408	13.94	7.24	8.077	.....	.....	11.016	11.867	.....	17.365	151.423
2.22	0.42	1.14	9.595	10.533	.....	.....	3.607	8.776	2.704	1.760	4.979	56.129
.....	2.51	3.11	7.55	0.132	.....	2.9	8.095	14.244	11.595	.....	1.133	222.790
1.40	.....	20.51	2.33	2.43	5.113	4.987	.....	2.924	8.070	1.402	1.350	121.296
2.63	.....	4.00	3.399	11.87	3.042	.....	16.809	10.797	6.161	.....	.....	76.452
.....	.....	.....	.....	.....	.....	.....	19.141	5.595	1.458	.....	17.192	44.606
8.24	.....	7.115	12.623	.....	.....	8.157	1.414	3.355	2.831	6.409	.....	128.312
.....	.....	.....	5.74	.....	.....	3.594	2.169	3.503	.....	4.079	6.770	102.180
.....	2.32	.....	.....	.....	.....	.....	0.785	.....	.....	.....	.....	5.545
.....	5.55	5.37	6.478	5.867	1.000	9.207	4.394	5.839	9.940	13.185	.501	67.331
16.18	.....	5.85	7.85	2.25	.....	5.308	5.506	.....	.....	7.057	.....	150.365
8.335	4.981	5.13	17.674	13.613	1.685	5.158	3.470	10.354	4.958	1.784	4.272	189.648
7.47	3.36	2.18	11.54	7.085	8.226	9.607	1.173	2.781	2.310	2.150	.....	134.632
3.59	5.94	0.69	.....	.....	6.585	2.938	.....	4.524	.....	.....	1.063	82.245
7.16	.....	6.91	11.006	2.867	.....	5.379	19.675	22.168	5.420	6.420	.947	113.652
5.38	3.88	4.132	4.99	.....	0.789	2.786	0.528	2.969	7.802	0.632	.....	77.745
.....	.....	.....	2.906	7.78	3.31	1.779	5.049	14.540	6.753	2.955	.....	66.559
2.685	5.6	7.284	4.37	5.365	1.268	5.155	10.343	5.038	.....	3.029	1.041	108.648
0.98	.....	.....	.....	.....	3.455	3.278	.....	12.628	5.476	.....	4.487	36.922
.....	4.01	2.336	4.232	7.757	.....	4.427	3.520	7.916	4.038	2.067	1.135	47.641
.....	.....	.....	7.95	1.92	.....	12.265	.....	.....	10.663	.....	3.065	69.195
67.78	38.571	82.165	134.173	86.709	42.550	86.925	105.678	148.967	102.046	52.929	65.300	2,053.316

Description and Statement of Cost of Roads Improved in 1916.

ATLANTIC COUNTY.

Northfield Road, .112 Mile Long.

For description of Northfield Road see Northfield Road and Bridge.

Wheat Road and Twelfth Street, 13.787 Miles Long.

This improvement begins at the Pennsylvania railroad crossing in Hammonton and extends southerly through Hammonton, and thence to Buena Vista. From the Hammonton line south it is known as the Wheat road. At Buena Vista the road bears toward the east, passing through Wheat Station and ending at the Cumberland county line, about one mile north of Vineland.

The great value of this road lies in the fact that it forms a north and south line of communication through the southern central portion of the State, thus connecting and making available the many improved roads of this section which have been built in a general easterly and westerly direction. The improvement of this road opens up to traffic and development a section of the State which has, for a long time, lain dormant. It is, therefore, of both State and local value.

The road is graded to a width of 30 to 34 feet and paved with gravel and macadam for a width of 20 to 30 feet to a depth of 8 inches in the center and 5½ inches at the sides. This road is built through a comparatively level section of the country, and therefore the change in maximum grade was not very great, being reduced from 3.5 to 2.716 per cent.

A great deal of fill was necessary to be made in order to bring the road above the surrounding surface water, and thus what was formerly only a wood road through the Pines has been converted into a firm, smooth and

Foundation, type macadam, 3,418.1 square yards, at 42 cents; total,	$1,435 60
Surface, type macadam, 3,418.1 square yards, at 44 cents; total,	1,503 96
Surface, type gravel, 165,647 square yards, at 22½ cents; total,	37,270 57
Earth excavation 50,978 cubic yards, at 35 cents; total,	17,842 30
Special fill, 1,135 cubic yards, at 42½ cents; total,	482 37
Cross drain, 340 lineal feet, 12-inch galvanized pipe, at $1.50; total,	510 00
Cross drain, 40 lineal feet, 18-inch galvanized pipe, at $2.00; total,	80 00
Cross drain, 192 lineal feet, 24-inch cast-iron pipe, at $3.15; total,	604 80
Cross drain, 254 lineal feet, 36-inch cast-iron pipe, at $5.86; total,	1,488 44
Cross drain, 156 lineal feet, 48-inch cast-iron pipe, at $10.12; total,	1,578 72
Cross drain, 36 lineal feet, 12-inch cast pipe, at $2.00; total,	72 00
Gutter type concrete, 269 7/9 square yards, at 90 cents; total,	242 80
Gutter type concrete, 236 8/9 square yards, at $1.35; total,	319 80
Catch basins, 6 at $35.00; total,	210 00
Guard rail, 14,562.5 lineal feet, at 25 cents; total,	3,640 62
Drainage trenches, 3,630 lineal feet, at 20 cents; total,	726 00
Drainage ditch, 450 cubic yards, at 35 cents; total,	157 50
Lowering pipe, station 611, $17.62; interchanging pipe, stations 67 and 201, $8.50; total,	26 12
	$68,191 60
Inspection,	1,690 81
Engineering,	3,375 98
Total cost of road,	$73,258 39
Lump sum, contract price,	$67,519 58
Amount allowed by State,	73,258 39
Forty per cent. of above, State's share,	$29,303 36
Less credit by cost of inspection already paid by State, $1,690.81 (part payment, $14,707.86),	16,398 67
Amount due by State,	$12,904 69
Maximum grade before,	3.5 per cent.
Maximum grade after,	2.716 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

A. H. NELSON,
Engineer.
C. BODINE SOMERS,
Inspector.

July 12th, 1916.

Oyster Creek Road, 3.466 Miles Long.

This road begins at the county road at Oceanville and extends northeasterly to the bulkhead eight feet south of the bank of Oyster creek. It is graded to a width of 26 feet and gravelled 20 feet wide. This gravel, after compaction, was 8 inches deep in the center and 6 inches on either side.

The road is the principal thoroughfare of the oyster men who land their schooners at the pier at Oyster creek, and from thence all the oysters and fish are transported inland to Absecon, Pleasantville and the other settlements of the interior.

The maximum grade was reduced from 5 per cent. to 3 per cent.

Detailed statement of the cost of the Oyster Creek road, township of Galloway, county of Atlantic. Total length, 18,300 feet, or 3.466 miles.

Kind of pavement, gravel.
Width of paved way, 20 feet.
Length of paved way, 18,300 feet.
Depth, 6 inches to 8 inches.
Width between slopes or curbs, 26 feet.

Gravel, 8,343 cubic yards, at 90 cents; total,	$7,508 70
Earth excavation, 7,761 cubic yards, at 32 cents; total,	2,483 52
Extra embankment, 16,406 cubic yards, at 39 cents; total,	6,398 34
Under drain, type galvanized pipe, 36-inch, 48 lineal feet, at $4.50; total,	216 00
Fence, 8,886 lineal feet, at 32 cents; total,	2,843 52
Approaches to road—	
115 cubic yards fill, at 39 cents; total,	44 85
55 cubic yards gravel, at 90 cents; total,	49 50
	$19,544 43
Amount paid entirely by county,	136 83
	$19,407 60
Inspection,	849 00
Engineering (5% on $20,365.00),	1,018 25
Extras paid entirely by county,	136 83
Total cost of road,	$21,411 68
Lump sum, contract price,	$19,407 60
Amount allowed by State,	21,274 85
Forty per cent. of above, State's share,	$8,509 94
Less credit by cost of inspection already paid by State,	849 00
Amount due by State,	$7,660 94
Maximum grade before,	5 per cent.
Maximum grade after,	3 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

A. H. NELSON,
Engineer.
C. BODINE SOMERS,
Inspector.

June 9th, 1915.

BERGEN COUNTY.

Kinderkamack Road, Sixth Section, 2.108 Miles Long.

This road begins at the end of the improved road at the north line of Woodcliff Lake borough and extends through Montvale northerly to the New York State line.

The completion of this improvement gives us a finished modern pavement from Hackensack north to the New York State line. It is graded from 30 to 32 feet in width, and is paved for a width of 16 feet and to a depth of

7 inches, the upper 2 inches of which consists of cold mixed bituminous concrete.

Owing to the many crooks and angles in the old road, as laid out in the open, it was necessary to acquire considerable right of way and thus furnish us with a modern, improved road, with good alignment, in place of the old roadway, which formerly existed at this point.

The maximum grade was reduced from 9 per cent. to 5 per cent.

Detailed statement of the cost of Kinderkamack road, sixth section, boroughs of Park Ridge and Montvale, county of Bergen. Total length, 11,128 feet, or 2.108 miles.

Kind of pavement, B. C. (Amiesite).
Width of paved way, 16 feet.
Length of paved way, 11,128 feet.
Depth, 7 inches.
Width between slopes or curbs, 30 feet.

Crushed stone, 8,363 tons, at $2.20; total,	$18,398 60
Surface, type B. C. (Amiesite), 21,751 square yards, at 92 cents; total,	20,010 92
Macadam shoulders, 1,056 square yards, at 60 cents; total,	633 60
Excavation, 8,136 cubic yards, at 44 cents; total,	3,579 84
Extra embankment, 897 cubic yards, at 44 cents; total,	394 68
Under drain, type 4-inch tile, 11,735 lineal feet, at 24 cents; total,	2,816 40
Under drain type 8-inch vitrified pipe, 16 lineal feet, at 40 cents;	6 40
Under drain. type 12-inch vitrified pipe, 85 lineal feet, at 80 cents; total,	68 00
Cast-iron pipe, 12-inch, 144 lineal feet, at $1.80; total,	259 20
Standard catch basin, 4, at $40.00; total,	160 00
Cobble gutters, 1,222, at 72 cents; total,	879 84
Trees removed, 80, at $5.60; total,	448 00
	$47,655 48
Inspection,	1,003 24
Engineering,	3,088 05
Extras paid entirely by county, drainage, pavement, retaining walls, walks, curbs and entrances,	10,014 32
Total cost of road,	$61,761 09
Lump sum, contract price,	$45,999 72
Amount allowed by State,	51,746 77
Forty per cent. of above, State's share,	$20,698 71
Less credit by cost of inspection already paid by State,	1,003 24
Amount due by State,	$19,695 47
Maximum grade before,	9 per cent.
Maximum grade after,	5 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

HENRY WELLES DURHAM,
Engineer.
PAUL F. RANDOLPH,
Inspector.

August 23d, 1916.

Market Street, 2.871 Miles Long.

This improvement begins on the west side of the Saddle river bridge, just across the stream from Essex street, of which it is really a continuation. It runs thence westerly to the Passaic river bridge at Paterson, completing the improved paved highway between the two county seats of Bergen and Passaic counties, namely, Hackensack and Paterson. It forms part of the through line from the Hudson river ferries across Bergen and Passaic counties to northern New Jersey.

The road was graded to a width of 30 feet, paved with bituminous concrete 16 feet wide and 7 inches thick. This bituminous concrete was laid upon a macadam base.

As the road had been partially graded, there was no material change in either line or grade.

Detailed statement of the cost of Market street, from Saddle River Bridge road, township of Saddle River, county of Bergen, to Passaic River bridge. Total length, 15,158.85 feet, or 2.871 miles.

Kind of pavement, asphalt concrete.
Width of paved way, 16 feet.
Length of paved way, 15,158.85 feet.
Depth, 7 inches.
Width between slopes or curbs, 30 feet.

Foundation, type "C," 28,346 square yards, at 55 cents; total,	$15,590 30
Surface, type "A," 1,397 square yards, at 35 cents; total,	488 95
Surface, type "G," 26,949 square yards, at $1.15; total,	30,991 35
Earth excavation, inside, 16,239 cubic yards, at 65 cents; total,	10,555 35
Earth excavation, outside, 741 cubic yards, at 65 cents; total,	481 65
Under drain, type 4-inch tile, 14,400 lineal feet, at 40 cents; total,	5,760 00
Gutter, type second-hand stone block, 3,135 square yards, at $1.50; total,	4,702 50
Extra embankment in place, 3,600 cubic yards, at 65 cents; total,	2,340 00
Removing trees, five, at $5.00; total,	25 00
Catch basins, one, at $25.00; total,	25 00
	$70,960 10
Inspection,	745 70
Engineering, 5 per cent.,	3,548 01
	$75,253 81
Extras paid entirly by county, $9,499.25 + 5 per cent., engineering,	9,974 21
Total cost of road,	$85,228 02
Lump sum, contract price,	$72,015 10
Amount allowed by State,	75,253 81
Forty per cent. of above, State's share,	$30,101 52
Less credit by cost of inspection already paid by State,	745 70
Amount due by State,	$29,355 82
Maximum grade before,	4.37 per cent.
Maximum grade after,	4.37 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

RALPH D. EARLE, JR.,
Engineer.
WM. H. CADMUS,
Inspector.

November 30th, 1914.

BURLINGTON COUNTY.

Hartford-Fairview Road, 1.133 Miles Long.

This improvement begins at the end of the present macadam at the Page road and extends thence northwesterly to the Garwood road. It is an extension of the improvement commenced in 1912.

The work consisted in grading the roadway to a width of 30 feet and placing thereon a water-bound macadam pavement, 16 feet wide and 6 inches deep, after ultimate compression.

Owing to the fact that some very wet ground was encountered, it was found necessary to add nearly 900 feet of French drain to properly protect the road from the subsurface water.

The chief advantage of this road lies in the fact that it gives the farmers of Chester township a good, hard, smooth outlet to the Mauricetown and Mount Holly road at Hartford and to the Westfield and Camden turnpike at Bridgeboro. This road was made necessary by the increased demand for transportation of the farm produce in Chester township.

There was no change in alignment and but little change in grade, the maximum percentage being reduced from 2 per cent. to 1.4 per cent.

Detailed statement of the cost of the Hartford-Fairview road, township of Chester, county of Burlington. Total length, 5,985.5 feet, or 1.133 miles.

Kind of pavement, water-bound macadam.
Width of paved way, 16 feet.
Length of paved way, 5,985.5 feet.
Depth, 6 inches.
Width between slopes or curbs, 30 feet.

Foundation, type M, 10,641 square yards, at 34 cents; total,	$3,617 94
Surface, type M. W. B., 10,641 square yards, at 36 cents; total,	3,830 76
Earth excavation, 3,422.68 cubic yards, at 30 cents; total,	1,026 80
Earth excavation, for foreign material, 855 cubic yards, at 30 cents; total,	256 50
Under drain, type French extra, 894 lineal feet, at 45 cents; total,	402 30
Paving entrances, type M. W. B., 396.47 square yards, at 36 cents; total,	142 73
Note.—100 lineal feet tile included in lump sum bid, at $0.15 per lineal foot, not used.	
	$9,277 03
Less extra for foreign material not allowed by State,	256 50
	$9,020 53
Inspection,	213 00
Engineering,	554 41
	$9,787 94
Extras paid entirely by county,	256 50
Total cost of road,	$10,044 44

Lump sum, contract price,	$8,633 23
Amount allowed by State,	9,787 94
Forty per cent. of above, State's share,	3,915 18
Less credit by cost of inspection already paid by State,	213 00
Amount due by State,	$3,702 18
Maximum grade before,	2 per cent.
Maximum grade after,	1.4 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

EARL THOMSON,
Engineer.
BERNARD F. FEENEY,
Inspector.

September 21st, 1915.

CAMDEN COUNTY.

Main Street, Haddonfield, 1.35 Miles Long.

This road begins at the center of the arch bridge over Cooper river, Delaware township line, and extends to the old line of the borough of Haddonfield.

The foundation of this road or street is of concrete. From the beginning point to the business center of Haddonfield the pavement is of Amiesite. Through the business section it is of brick up to within a point two hundred feet east of the railroad. Beyond the railroad the pavement is of Amiesite to the end. The section on either side of the railroad was not paved for the reason that the question of the elimination of the grade crossing at this point is still in abeyance.

The road is not only of local but also of State importance, inasmuch as it is a very necessary link in the improvement of the King's Highway, one of the oldest roads in the State.

The greatest improvement in grade was made at the beginning where the maximum grade was reduced from 8.3 per cent. to 5 per cent. This reduction was made by elevating the bridge as well as by cutting down the top of the knoll.

Detailed statement of the cost of Main street, Haddonfield, borough of Haddonfield, county of Camden. Total length, 7,128.5 feet, or 1.35 miles.

Kind of pavement, brick and amiesite on concrete base.
Width of paved way, varying.
Length of paved way, 6,132.4 feet.
Depth, brick, 9 inches; amiesite, 8½ inches.
Width between slopes or curbs, varying.

Foundation, type C., 495.35 square yards, at $4.81; total,	$2,382 63
Foundation, type C. I. S., 1,982.49 square yards, at $5.04; total,	9,991 75
Surface, type brick, 4,458.13 suqare yards, at $1.498; total,	6,678 29
Surface, type amiesite, 11,894.93 square yards, at 88.3 cents; total,	10,503 22
Earth excavation, 11,454 cubic yards, at 35.6 cents; total,	4,077 62

Quantities given are only for a strip 24 feet wide in the paving of which the State participated. Outside of this the borough paid in entirety. Total of contract was $47,834.01.

Paid entirely by borough—		
Contract,	$14,200 50	
Engineering,	710 03	
Total paid entirely by borough,	$14,910 53	
		$33,633 51
Inspection,		747 00
Engineering,		1,681 68
		$36,062 19
Paid entirely by borough,		14,910 53
Total cost of road,		$50,972 72
Lump sum, contract price,		$45,833 59
Amount allowed by State,		36,062 19
Forty per cent. of above, State's share,		$14,424 88
Less credit by cost of inspection already paid by State,	$747 00	
Less partial payment,	10,061 19	
		10,808 19
Amount due by State,		$3,616 69
Maximum grade before,		8.3 per cent.
Maximum grade after,		5.0 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

J. J. ALBERTSON,
Engineer.
J. A. WILLIAMS,
Inspector.

July 12th, 1916.

CUMBERLAND COUNTY.

Landis Avenue, Sections 1, 2 and 3, 9.742 Miles Long.

This road was advertised for and let in three different sections, but it happened that one man was the low bidder on all three. The improvement completed under this contract was part of the through line from Bridgeton to the Atlantic seaside resorts. It begins at Carll's Corner, on the Bridgeton and Deerfield road, which was improved with State aid some time since, and extends thence easterly to the Salem county line. This comprises the first and second sections. The third section begins at the Salem county line, two and one-half miles from the end of the second section, and thence extends easterly through Vineland to the Atlantic county line.

It is the intention of Atlantic county to extend this improvement to connect with the Mays Landing and Downstown road, thereby furnishing a smooth,

hard and convenient road for the travel from Bridgeton, through Vineland, to Atlantic City.

The road is graded to a width of 30 and 32 feet, and is paved 22 and 30 feet with gravel having a depth, after ultimate compression, of 8 inches in the center and 5 inches on either side. Owing to the comparatively level nature of the country, the maximum grade was reduced from 3 to 2.25 per cent.

The road is of value not only to the tourist and traveler across the State but is also a very important aid to the farmers and truck raisers along its line, as it affords them a good and commodious highway to the markets of Vineland.

Detailed statement of the cost of Landis avenue, Sections one, two and three, townships of Deerfield and Landis, county of Cumberland. Total length, 51,439 feet, or 9.742 miles.

Kind of pavement, gravel.
Width of paved way, 22 and 30 feet.
Length of paved way, 51,439 feet.
Depth, 5 and 8 inches.
Width between slopes or curbs, 30 and 32 feet.

Brick and slab cross drains, 6 lineal feet, at $2.00; total,		$12 00
Surface, type gravel entrances, 706 cubic yards, at 80 cents; total,		564 80
Surface, type gravel road, 21,512 cubic yards, at 80 cents; total,		17,209 60
Surface, type gravel extra, 562.5 cubic yards, at 80 cents; total,		450 00
Earth excavation, 20,897 cubic yards, at 24 cents; total,		5,015 28
Cross drain, type cor.-iron pipe, 427 lineal feet, at $1.00; total,		427 00
Cross drain, type cor.-iron pipe, 135 lineal feet, at $1.00; total,		135 00
Cross drain, type cor.-iron pipe, 6 lineal feet, at $1.10; total,		6 60
Extra embankment, 9,623 cubic yards, at 30 cents; total		2,886 90
Grubbing, 1.5 acres, at $100; total,		150 00
Slope protection, 50 square yards, at $1.00; total,		50 00
Little Robin culvert,		399 45
Maurice River channel,		297 18
		$27,603 81
Inspection,		618 00
Engineering,		1,437 33
		$29,659 14
Extras paid entirely by county,		1,142 82
Total cost of road,		$30,801 96
Lump sum, contract price,		$26,363 68
Amount allowed by State,		29,659 14
Forty per cent. of above, State's share,		$11,863 65
Less credit by cost of inspection already paid by State,	$618 00	
Less partial payment,	5,418 38	
		6,036 38
Amount due by State,		$5,827 27
Maximum grade before,	3	per cent.
Maximum grade after,	2.25	per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

WALTER M. SHARP,
Engineer.
JOHN D. SCHADE,
Inspector.

June 7th, 1916.

Millville–Maurice River Road, 7.45 Miles Long.

This improvement begins at Plum street, in the city of Millville, and extends southerly along the easterly side of the Maurice river to the Mauricetown road.

The road is graded to a width of 32 feet and is covered with gravel for a width of 22 feet, having a depth of 8 inches in the center and decreasing to 5 inches on either edge.

The country through which this road is built is very flat; consequently, there was very little change in the grade.

This improvement is of great importance to the country lying south of Millville, as the original road was very heavy and sandy, and it was impossible to transport loads over it of any considerable weight. In many sections it was almost as much as a horse could do to pull a light wagon through the sand. Now this is all changed, and we have a smooth, hard, wide road, extending from the city of Millville to Mauricetown, which will eventually form a portion of the proposed through line, extending southerly and southeasterly to the Cape May county line; from thence the road is already improved to the extreme southerly end of the State—Cape May Point.

Detailed statement of the cost of the Millville-Maurice River road, townships of Millville and Maurice River, county of Cumberland. Total length, 39,350 feet, or 7.45 miles.

Kind of pavement, gravel.
Width of paved way, 22 feet.
Depth, 5 and 8 inches.
Width between slopes or curbs, 32 feet.

Six-inch pipe, 24 lineal feet, at 40 cents; total,	$9 60
Ten-inch pipe, 28 lineal feet, at 60 cents; total,	16 80
Twelve-inch pipe, 68 lineal feet, at 80 cents; total,	54 40
Eighteen-inch pipe, 42 lineal feet, at $1.00; total,	42 00
Gravel shoulders, 4,641 cubic yards, at 75 cents; total,	3,480 75
Gravel entrances, 209 cubic yards, at $1.27; total,	265 43
Gravel in road, 18,193 cubic yards, at $1.22; total,	22,195 46
Earth excavation, 16,710 cubic yards, at 28 cents; total,	4,678 80
Grubbing, 4.5 acres, at $70.00; total,	315 00
Extra embankment, 15,212 cubic yards, at 40 cents; total,	6,084 80
Guard rail, 217 lineal feet, at $1.00; total,	217 00
Guard rail repairs, 392 lineal feet, at 20 cents; total,	78 40
Slope protection, 541 square yards, at 25 cents; total,	135 25
Bulkhead, 199.83⅓ feet, at $6.00; total,	1,199 00
Catch basin and pipe,	150 00
	$38,922 69
Inspection,	522 00
Engineering, 5 per cent. of $38,922.69,	1,946 13
Total cost of road,	$41,390 82

Lump sum, contract price,	$37,153 00
Amount allowed by State,	41,390 82
Forty per cent. of above, State's share,	$16,556 32
Less credit by cost of inspection already paid by State, $522.00 + $11,641.22,	12,163 22
Amount due by State,	$4,393 10

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

WALTER M. SHARP,
Engineer.
ROBERT ELDRIDGE,
Inspector.

May 26th, 1916.

GLOUCESTER COUNTY.

Mullica Hill–Woodbury Turnpike, 6.770 Miles Long.

This turnpike was purchased by the State in 1916.

The purchase price was $25,000, of which the State paid one-half, or $12,500.

HUNTERDON COUNTY.

Frenchtown Borough Road, .34 Mile Long.

This improvement begins at the end of the old macadam on the Milford–Frenchtown road, and extends the pavement through the suburbs to the macadamized streets of the thickly-settled portion of the borough of Frenchtown, thus really completing the line of improved roads from Spring Mills through Milford and Frenchtown to the county seat at Flemington. Thus the value of this road is far greater than its length would lead one to suppose.

The road was graded to a width of 30 feet; on the 16 feet in its center was placed a macadam road, 6 inches deep after final consideration.

The road was not properly drained. To accomplish this object a hill was cut down and the hollow filled up, thus reducing the maximum grade from 2 per cent. to .75 per cent.

Detailed statement of the cost of the Frenchtown Borough road, borough of Frenchtown, county of Hunterdon. Total length, 1,796 feet, or 0.340 mile.

Kind of pavement, water-bound macadam.
Width of paved way, 16 feet.
Length of paved way, 1,796 feet.
Depth, 6 inches.
Width between slopes or curbs, 30 feet.

Foundation, type M, 3,527 square yards, at 30 cents; total,	$1,058 10
Surface, type M. W. B., 3,527 square yards, at 36 cents; total,	1,269 72
Entrances, 116 square yards, at 40 cents; total,	46 40
Earth excavation, 395 cubic yards at 50 cents; total,	197 50
Extra embankment, 97 cubic yards, at 60 cents; total,	58 20
Under drain, type French, 1,000 lineal feet, at 30 cents; total,	300 00
Cross drains, 12-inch C. I. pipe, 108 lineal feet, at $2.00; total,	216 00
Maintenance materials, 15 tons, at $2.00; total,	30 00
	$3,175 92
Inspection,	194 00
Engineering,	135 00
	$3,504 92
Extras paid entirely by county rebuilding cross drain at station 7; cost plus 10 per cent.,	205 37
Total cost of road,	$3,710 29
Lump sum, contract price,	$3,175 92
Amount allowed by State,	3,504 92
Forty per cent. of above, State's share,	$1,401 97
Less credit by cost of inspection already paid by State,	194 00
Amount due by State,	$1,207 97
Maximum grade before,	2 per cent.
Maximum grade after,	0.75 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

GRANT DAVIS,
Engineer.
I. H. HIGGINS,
Inspector.

January 20th, 1916.

Lebanon–Clinton Road Extension, .161 Mile Long.

This road is the extension of the Jersey turnpike which leads across the State and through the county of Hunterdon to the borough of Clinton. The piece just improved formed a very serious obstruction to travel, owing to the fact that it consisted of a rock ledge, crossing the road diagonally. As it was more than the borough felt like undertaking, the county and State took up and completed this improvement, for the purpose of connecting the county roads of Hunterdon with the borough streets of Clinton, thus completing the through line across the State to this point and making a smooth, hard and convenient highway for travel.

This road was graded 30 feet and paved 16 feet in width and 6 and 9 inches in depth. The pavement consists of water-bound macadam.

The maximum grade was reduced from 8 per cent. to 4.5 per cent.

Detailed statement of the cost of the Lebanon-Clinton road extension, township of Clinton, county of Hunterdon. Total length, 848 feet, or 0.161 mile.

Kind of pavement, water-bound macadam.
Width of paved way, 16 feet.
Length of paved way, 848 feet.
Depth, 6 inches macadam, 9 inches rock bottom.
Width between slopes or curbs, 30 feet.

Foundation, type M., 754 square yards, at 35 cents; total,	$263 90
Foundation, type R. B., 754 square yards, at 40 cents; total,	301 60
Surface, type M. W. B., 1,508 square yards, at 35 cents; total,	527 80
Surface, type entrances, 115 square yards, at 60 cents; total,	69 00
Excavation outside road, 87 cubic yards, at $1.25; total,	108 75
Earth excavation, 568 cubic yards, at 65 cents; total,	369 20
Rock excavation, 215 cubic yards, at $2.00; total,	430 00
	$2,070 25
Inspection,	158 90
Engineering,	70 00
Total cost of road,	$2,299 15
Lump sum, contract price,	$1,915 00
Amount allowed by State,	2,299 15
Forty per cent. of above, State's share,	$919 66
Less credit by cost of inspection already paid by State,	158 90
Amount due by State,	$760 76
Maximum grade before,	8 per cent.
Maximum grade after,	4.5 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

GRANT DAVIS,
Engineer.
LYMAN L. LISTER,
Inspector.

January 6th, 1916.

MIDDLESEX COUNTY.

Roosevelt–Woodbridge Road, Section Three, 1.977 Miles Long.

This road begins at the end of section two and extends to the Woodbridge turnpike in front of the Baron Library in Woodbridge.

The road is graded to a width of 30 feet and paved with concrete for a width of 16 feet, which is protected by a macadam wing 2 feet wide on either side, making a paved width of 20 feet.

The concrete is laid on a level foundation and has a depth of 8 inches in the center, reducing gradually to 6 inches at either edge.

This road traverses a very wet, flat and marshy section, consequently the change in grade was comparatively small, the maximum grade being reduced from 2 to 1.82 per cent.

Concrete was used in the construction of this road, with the hope that it would form a satisfactory pavement over this very insecure base. The road furnishes an outlet from the large manufacturing plants of Roosevelt to

Woodbridge, and thence over improved roads to Perth Amboy. The chief object of this road is to furnish an outlet for the inhabitants of Roosevelt to Woodbridge, Perth Amboy and the county seat of New Brunswick.

Detailed statement of the cost of the Roosevelt-Woodbridge road, section three, township of Woodbridge, county of Middlesex. Total length, 10,438.2 feet, or 1.977 miles.

Kind of pavement, concrete, type C.
Width of paved way, 16 feet concrete and 4 feet macadam (2 feet on each side of concrete).
Length of paved way, 10,393.2 feet.
Depth, 8 inches at center and 6 inches at edges.
Width between slopes or curbs, 30 feet.

Pavement, type C (concrete), 20,846 square yards, at $1.07; total,	$22,305 22
Pavement, type M. W. B., 4,280 square yards, at 72 cents; total,	3,081 60
Earth excavation, 7,686.5 cubic yards, at 77 cents; total,	5,918 60
Embankment, 1,110 cubic yards, at 85 cents; total,	943 50
Under drain, type 4-inch round, 1,000 lineal feet, at 19 cents; total,	190 00
Under drain, type French, 1,200 lineal feet, at 58 cents; total,	696 00
Retaining walls, 7.06 cubic yards, at $22.00; total,	155 32
Foreign materials, slag, 17.5 cubic yards, at $1.70; total,	29 75
Cross drains, 36-inch C. I. pipe, 12 lineal feet, at $6.50; total,	78 00
Cross drains, 15-inch T. C. pipe, 130 lineal feet, at $1.12; total,	145 60
Cross drains, 10-inch T. C. pipe, 18 lineal feet, at 68 cents; total,	12 24
	$33,555 83
Inspection,	450 00
Engineering,	1,008 35
	$35,014 18
Extras paid entirely by county, 30 lineal feet, 15-inch T. C. pipe, at $1.12,	33 60
Total cost of road,	$35,047 78
Lump sum, contract price,	$33,358 02
Amount allowed by State,	35,014 18
Forty per cent. of above, State's share,	$14,005 67
Less credit by cost of inspection already paid by State, $450 00	
Less previous payment on account, 12,563 99	
	13,013 99
Amount due by State,	$991 68
Maximum grade before,	2 per cent.
Maximum grade after,	1.82 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

ALVIN B. FOX,
Engineer.
WILLIAM IRVINE,
R. J. DELANEY,
Inspectors.

July 19th, 1916.

Schalk's Station Road, 2.295 Miles Long.

This road is of importance to the local farmers. It runs from the Plainsboro road to the Kingston–Monmouth Junction road. The construction is gravel with a lignin dressing. The depth of the gravel is 8 inches at the center and 6 inches at the sides. The paved width is 18 feet and the total graded width is 24 feet.

This road was built as an experiment to determine whether a good road could be obtained by using the local gravel and treating it with lignin binder.

The maximum grade was reduced from 3 per cent. to 1.435 per cent.

Detailed statement of the cost of the Schalk's Station road, township of South Brunswick, county of Middlesex. Total length, 12,116 feet, or 2.295 miles.

Kind of pavement, gravel, lignin binder.
Width of paved way, 18 feet.
Length of paved way, 12,116 feet.
Depth, 8 inches at center and 6 inches at edges.
Width between slopes or curbs, 24 feet.

Surface, type G. L. D., 24,190 square yards, at 36 cents; total,	$8,708 40
Surface, type entrances, G. L. D., 135 square yards at 25 cents; total,	33 75
Earth excavation, 14,260 cubic yards, at 35 cents; total,	4,991 00
Cross drain, type 24-inch T. C., 42 lineal feet, at $2.00; total,	84 00
Cross drain, type 12-inch T. C., 66 lineal feet, at 60 cents; total,	39 60
Cross drain, type 12-inch C. I., 24 lineal feet, at $2.00; total,	48 00
Concrete and timber guard rail, 1,750 lineal feet, at 70 cents; total,	1,225 00
Removing stumps, 10, at $10.00; total,	100 00
Concrete culvert, complete,	1,400 00
	$16,629 75
Inspection,	373 50
Engineering,	515 61
Cost of road and culvert, allowed by State,	$17,518 86
Extras paid entirely by county,	229 00
Total cost of road and culvert,	$17,747 86
Lump sum, contract price,	$17,191 55
Amount allowed by State on road work, $16,118.86; on culvert, $1,400.00,	17,518 86
Forty per cent. of road work, $6,447.54; 20 per cent. culvert, $280.00; total State's share,	$6,727 54
Less credit by cost of inspection already paid by State,	373 50
Amount due by State,	$6,354 04
Maximum grade before,	3. per cent.
Maximum grade after,	1.435 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

ALVIN B. FOX,
Engineer.
LYMAN L. LISTER,
Inspector.

November 16th, 1915.

MORRIS COUNTY.

Sussex Turnpike, Section Two, 1.063 Miles Long.

This improvement begins at the base of Mine Hill, on the old Sussex turnpike, and extends across the flat to Kenville. The improvement consisted in making a fill varying in depth from two to four feet across this low, wet stretch, and laying on top of this fill, after the same was thoroughly consolidated, a bituminous concrete pavement, 18 feet in width and a total depth, including the foundation, of 9 inches. The road was graded to a width of 33 feet.

This road forms an important improvement of a very bad section of road which leads from the Powder Works to Dover, and is not only of great value to the through traffic, but also to the people of the locality, owing to the constant and continuous motor vehicle and motor bus traffic between Dover and the Powder Works.

The grade was practically unchanged, the principal alteration being the raising of the roadbed above the surrounding wet country in order to insure a durable and satisfactory pavement, which has not existed in years over that stretch.

Detailed statement of the cost of the Sussex turnpike, section two, townships of Randolph and Roxbury, county of Morris. Total length, 5,615.57 feet, or 1.063 miles.

Kind of pavement, bituminous concrete, amiesite, on macadam foundation.
Width of paved way, 18 feet.
Length of paved way, 5,615.57 feet.
Depth, 9 inches.
Width between slopes or curbs, 33 feet.

Foundation, type M. W. B., 11,427.14 square yards, at 48 cents; total, ...	$5,485 02
Foundation, type M., 831 square yards, at 30 cents; total, ...	249 30
Surface, type B. C. Grade A, 11,427.14 square yards, at $1.04; total, ...	11,884 22
Surface, type M. W. B., 831 square yards, at 35 cents; total, ...	290 85
Earth excavation, 1,008.01 cubic yards, at 60 cents; total, ...	604 81
Earth fill, 7,320.66 cubic yards, at 60 cents; total, ...	4,392 39
Under drain, type F., 900 lineal feet, at 30 cents; total, ...	270 00
One concrete catch basin and grating, ...	25 00
Fifteen W. I. pipe, 352 feet, at $1.50; total, ...	528 00
Eight-inch vitrified tile, 68 feet, at $0.463; total, ...	31 46
	$23,761 05
Inspection, ...	392 15
Engineering, ...	750 00
	$24,903 20
Extras paid entirely by county, ...	270 49
Total cost of road, ...	$25,173 69
Lump sum, contract price, ...	$23,467 03
Amount allowed by State, ...	24,903 20

Forty per cent. of above, State's share,	$9,961 28
Less credit by cost of inspection already paid by State,	392 15
Amount due by State,	$9,569 13

Maximum grade before,	2.60 per cent.
Maximum grade after,	2.50 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

FREDERICK S. SMITH,
Engineer.
EDWARD W. KILPATRICK,
Inspector.

October 17th, 1916.

OCEAN COUNTY.

Toms River—Lakehurst Road, East Section, .947 Mile Long.

This road begins at Main street, Toms River, north of North Bridge, and extends northwesterly toward Lakehurst. This improvement connects the improved portion of the Lakehurst-Toms River road with Toms River. One of the most marked changes was at the northwesterly end where a very sharp curve was eliminated and a new bridge constructed by the county, on a new line.

The Toms River section was very low and wet, hence a great deal of draining was made necessary. The work, as completed, consists of a road with a clear graded width of 30 feet, paved with gravel 24 feet wide and having a depth of 8 inches in the center and 4 inches at the outer edges.

The completion of this work furnishes the traveling public with a fine, smooth, well-graded road, from Lakehurst to Toms River, and converts what was a narrow, crooked by-road into a fine, smooth highway.

The maximum grade was reduced from 3.46 per cent. to 1.44 per cent. This was accomplished by the heavy cut at the upper end and a fill, nearly 20 feet in height, up to and beyond the bridge in the new line.

Detailed statement of the cost of the Toms River-Lakehurst road, east section, township of Dover, county of Ocean. Total length, 5,000 feet, or .947 mile.

Kind of pavement, gravel.
Width of paved way, 24 feet.
Length of paved way, 5,000 feet.
Depth, 8 inches to 4 inches.
Width between slopes or curbs, 30 feet.

Grubbing, 1.8 acres, at $60.00; total,	$108 00
Foreign material, 50 cubic yards, at 33 cents; total,	16 50
Gravel, 2,432 cubic yards, at $1.00; total,	2,432 00
Earth excavation, 1,821 cubic yards, at 33 cents; total,	600 93
Extra embankment, 22,426 cubic yards, at 33 cents; total,	7,400 58
Under drain, type C. I., 6-inch, 60 lineal feet, at $1.25; total,	75 00
Cross drain, type "C.," concrete, 15 cubic yards, at $8.00; total,	120 00

Round iron rods, ¾-inch, 613 lineal feet, at 2 cents; total,	$12 26
Retaining wall, sod, 188 cubic yards, at 55 cents; total,	103 40
Protection of slopes, turf, 4,749 square yards, at 15 cents; total,	712 35
Maintenance, gravel, type A., 100 cubic yards, at $1.00; total,	100 00
Plus difference between sum of items and lump sum,	371 70
	$12,052 72
Inspection,	644 00
Engineering,	602 64
Total cost of road,	$13,299 36
Lump sum, contract price,	$12,052 72
Amount allowed by State,	13,299 36
Forty per cent. of above, State's share,	$5,319 74
Less credit by cost of inspection already paid by State,	644 00
Amount due by State,	$4,675 74
Maximum grade before,	3.46 per cent.
Maximum grade after,	1.44 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

I. H. CRAMER,
Engineer.
WM. PITTIS,
Inspector.

September 6th, 1916.

SOMERSET COUNTY.

Finderne Avenue, 1.041 Miles Long.

This work marks the completion of the Blackwell's Mills–Millstone road, commenced several years ago, and follows the westerly bank of the Millstone river from Blackwell's Mills through Millstone, Weston, Manville, crossing the Raritan river and the Central Railroad of New Jersey to Union avenue.

The present work begins at the bridge over the Raritan river, and extends thence to Union avenue, a distance of 1.041 miles. The pavement is a water-bound macadam, 16 feet wide and 8 inches thick. The road is graded between slopes or curbs to a width of from 30 to 33 feet.

The maximum grade of 5 per cent. is that of the approaches to the overhead bridge above the tracks of the Central Railroad of New Jersey, and does not represent the improvements made in the grades of the old road. These were materially bettered at the bridge approach over the Raritan river by a heavy fill, and at the northern end by an extensive cut through a hill just south of the terminus of the road at Union avenue.

The road is of great value locally, and particularly to the large plant of the Johns–Manville people at Manville—as it enables them to bring in their local supplies, such as lumber, building materials and crushed stone, over a smooth, hard road, thus facilitating very much the construction work which,

necessarily, is going on at all times around a large plant. It also furnishes a good and convenient means of ingress and egress to the plant for the hundreds of employees who live north of it. It is also of great value to all of the residents of Somerset county, south of the Raritan river, for the reason that it is the only means of reaching Somerville from the southern portion of the county during seasons of high water in the Raritan river.

Detailed statement of the cost of Finderne avenue, township of Bridgewater, county of Somerset. Total length, 5,497 feet, or 1.041 miles.

Kind of pavement, water-bound macadam, M., M. W. B.
Width of paved way, 16 feet.
Length of paved way, 5,400 feet.
Depth, 8 inches.
Width between slopes or curbs, 30 to 33 feet.

Foundation, type M., 10,086 square yards, at 40 cents; total,	$4,034 40
Surface, type M. W. B., 10,086 square yards, at 29 cents; total,	2,924 94
Surface, type M. drives, 119 square yards, at 50 cents; total,	59 50
Earth excavation, 9,562 cubic yards, at 42 cents; total,	4,016 04
Under drain, type P. T., 650 lineal feet, at 15 cents; total,	97 50
Cross drain, type C. I. P., 12 lineal feet, at $1.50; total,	18 00
Concrete walls, 12 7/10 cubic yards, at $7.50; total,	95 25
	$11,245 63
Inspection,	447 00
Engineering,	213 05
	$11,905 68
Extras paid entirely by county,	8 28
Total cost of road,	$11,913 96
Lump sum, contract price,	$11,448 13
Amount allowed by State,	11,905 68
Forty per cent. of above, State's share,	$4,762 27
Less credit by cost of inspection already paid by State,	447 00
Amount due by State,	$4,315 27
Maximum grade before,	5 per cent.
Maximum grade after,	5 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

JOSHUA DOUGHTY, JR.,
Engineer.

C. A. WYCKOFF,
Inspector.

July 11th, 1916.

SUSSEX COUNTY.

Newton-Branchville Road, Section One and Y, 4.487 Miles Long.

This improvement begins at the borough line of Newton and extends northeasterly in the direction of the town of Sussex for a distance of four and one-half miles to the cross-roads, commonly known as Ross's Corner.

The second section of the same road is already extended westerly from this point to Branchville. It is also proposed later to build a road connecting with this and extending from Ross's Corner to Sussex.

In a number of stretches the road departed several hundred feet from the former line of travel in order to straighten the line, and many grades were reduced, some on the old road being as steep as fourteen per cent.

The graded width of the roadway is 30 feet, with a 16-foot macadam pavement, 7 inches in depth.

A few hundred feet of the road was paved 14 feet in width. This section connects with the present township road leading toward Lafayette.

The maximum grade was reduced from 14 per cent. to 6 per cent.

Detailed statement of the cost of the Newton-Branchville road, sections one and Y, townships of Hampton, Lafayette and Frankford, county of Sussex.

Total length, 23,691 feet, or 4.487 miles.
Kind of pavement, broken stone.
Width of paved way, 16 feet; 1,115 feet 14 feet wide.
Length of paved way, 23,691 feet.
Depth, 7 inches.
Width between slopes or curbs, 30 feet; 1,115 feet 24 feet wide.

Foundation, type field stone, 41,939 square yards, at 20 cents; total,	$8,387 80
Surface, type A., 41,939 square yards, at 31 cents; total,	13,001 09
Earth excavation, outside, 399.8 cubic yards, at 60 cents; total,	239 88
Earth excavation, 39,734 cubic yards, at 30 cents; total,	11,920 20
Rock excavation, 8,926.1 cubic yards, at $1.50; total,	13,389 15
Under drain, type 4-inch tile, 2,335 lineal feet, at 25 cents; total,	583 75
Under drain, type stone, 818 lineal feet, at $1.00; total,	818 00
Drainage ditches, 764.35 cubic yards, at 60 cents; total,	458 61
Clearing stone fences, 116 cubic yards, at $1.50; total,	174 00
Extra work as per statement,	759 17
Cross drains, 12-inch pipe, 612 feet, at 80 cents; total,	489 60
Cross drains, 18-inch pipe, 98 feet, at $1.40; total,	137 20
Cross drains, 24-inch pipe, 129.1 feet, at $2.00; total,	258 20
Cross drains, 30-inch pipe, 126 feet, at $3.00; total,	378 00
Cross drains, 36-inch pipe, 40 feet, at $3.30; total,	132 00
Cross drains, 42-inch pipe, 64 feet, at $4.00; total,	256 00
Cross drains, 48-inch pipe, 122 feet, at $5.25; total,	640 50
Repairing stone drain as per statement,	26 66
	$52,049 81
Inspection,	1,700 75
Engineering,	1,985 00
	$55,735 56
Extras paid entirely by county,	17 80
Total cost of road,	$55,753 36

Lump sum, contract price,	$44,102 31
Amount allowed by State,	55,735 56
Forty per cent. of above, State's share,	$22,294 22
Less credit by cost of inspection already paid by State,	1,700 75
Amount due by State,	$20,593 47
Maximum grade before,	14 per cent.
Maximum grade after,	6 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

HARVEY SNOOK,
Engineer.
MERRITT P. STRADER,
Inspector.

November 1st, 1915.

UNION COUNTY.

Shunpike Road, Middle Section, Paving.

This road was described in the 1915 report, and mileage added.

Detailed statement of the cost of the Shunpike road, middle section, paving, township of Springfield, county of Union (Contract No. 2). Total length, 1,468 feet, or 0.278 mile.

Kind of pavement, macadam.
Width of paved way, 16 feet.
Length of paved way, 1,468 feet.
Depth, 8 inches.

Foundation, type C., 2,610; Surface, type A., 2,610; Macadam complete, 2,610 square yards, at 90 cents; total,	$2,349 00
82 lineal feet of underdrain trench, with two 6-inch pipes laid therein, at $2.10; total,	172 20
18 square yards of 8-inch macadam pavement on the new Briant Brook bridge, at 90 cents; total,	16 20
Application of Tarvia B,	261 00
126 lineal feet of trench in earth, with two 6-inch pipes laid therein, at $1.00; total,	126 00
181 lineal feet of branch-line trenches through rock, with one 6-inch pipe laid therein, at $1.60; total,	289 60
	$3,214 00
Inspection,	81 00
Engineering,	135 00
	$3,430 00
Extras paid entirely by county, underdrains,	940 80
Total cost of road,	$4,370 80
Lump sum, contract price,	$2,869 20
Amount allowed by State,	3,430 00

Forty per cent. of above, State's share,	$1,372 00
Less credit by cost of inspection already paid by State,	81 00
Amount due by State,	$1,291 00
Maximum grade before,	5 per cent.
Maximum grade after,	5 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

J. L. BAUER,
Engineer.
WILMER F. SICKEY,
Inspector.

September 25th, 1916.

Wood Avenue, Linden, 1.135 Miles Long.

Wood avenue is a connection which has long been sought by the people of Linden. Starting from St. George avenue on the northwest, the pavement is bituminous concrete, two and one-half inches thick, cold mix, on a crushed stone foundation, for a distance of 3,812 feet, where it connects with the present brick pavement in the borough of Linden.

South of this point, 1,046 feet, the work is again taken up and extends in the same direction nearly 2,200 feet farther, until it intersects the Edgar road. This last portion, however, is Portland cement concrete with a bituminous dressing. The concrete is 7 inches deep. After the work started there were so many recent pipe trenches found in the street that the county decided to add reinforcing metal at 18½ cents per square yard. The cost of this was borne entirely by the county.

The pavement is in all cases 20 feet in width, but for most of the distance the local authorities have extended the work to the curbs, which makes a 42-foot pavement, including the concrete gutters, and connects St. George and Edgar roads, the two important county routes leading from Rahway to Elizabeth.

Detailed statement of the cost of Wood avenue, Linden, township of Linden, borough of Linden, county of Union. Total length, 5,992.6 feet, or 1.135 miles.

Kind of pavement, cement concrete and bit. concrete.
Width of paved way, 20 feet.
Length of paved way, 5,992.6 feet.
Depth, 7 inches and 10 inches.
Width between slopes or curbs, 42 feet.

Foundation, type C., 5,664 square yards, at $1.27 cents; total,	$7,193 28
Foundation, type M. W. B., relaid, 200 tons, at 1 cent; total,	2 00
Foundation, type M. W. B., new, 3,473.15 tons, at $1.80; total,	6,251 67
Surface, type B.-C. (grade A.), 9,393 square yards, at $1.02; total,	9,580 86
Surface, type B.-D., 5,664 square yards, at 12 cents; total,	679 68
Excavation, 9,665 cubic yards, at 42 cents; total,	4,059 30
Under drain, crushed stone, 5,131 lineal feet, at 15 cents; total,	769 65
Crosswalks relaid, 314 lineal feet, at 1 cent; total,	3 14
Manholes reset, 22, at 1 cent; total,	22
Cross drain, Gibbon street,	180 00
Cross drain, Blancke street,	190 00
Basin connections at Henry street, 2, at $10.00; total,	20 00

Basin connections at Elm street, 4, at $12.50; total,	50 00
Basin connections at Edgar road, 2, at $27.50; total,	55 00
Cross drain, Morris avenue,	65 00
Cross drain, Munsell avenue,	65 00
	$29,164 80
Inspection,	461 60
Engineering,	1,170 50
	$30,796 90
Extras paid entirely by county,	3,797 58
Total cost of road,	$34,594 48
Lump sum, contract price, $27,956.20, less $1,900.00 bridge,	$26,056 20
Amount allowed by State,	30,796 90
Forty per cent. of above, State's share,	$12,318 76
Less credit by cost of inspection already paid by State,	461 60
Amount due by State,	$11,857 16
Twenty per cent. being State's share of $1,900.00 bridge,	380 00
	$12,237 16
Maximum grade before,	3.8 per cent.
Maximum grade after,	3.8 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

J. L. BAUER,
Engineer.
JOHN J. MacKENZIE,
Inspector.

November 27th, 1915.

WARREN COUNTY.

Fish Hatchery Road, .150 Mile Long.

This is an institutional road.

Bloomsbury–Still Valley Road, 2.915 Miles Long.

This road begins at the bridge over the Musconetcong river in Bloomsbury and extends thence westerly, following the line of the old Jersey turnpike to Still Valley, at which point it meets the macadamized road leading to Phillipsburg.

This improvement completes the work on the western end of the Jersey turnpike from Phillipsburg to West End. Owing to the very hilly nature of the land over which it was built, a great deal of grading was required. One-third of the entire amount spent in this improvement was for grading. In addition thereto a decided change of alignment was made at the stone mill on Pohatcong creek. The improvement made in grading and alignment on this section is among the most marked of any made during the past

year. The maximum grade was reduced from 10 per cent. to 6 per cent., and this maximum was for only a short section leading up from the Musconetcong river at Bloomsbury.

The road was graded for a width of 30 feet and macadamized for a width of 16 feet and to a depth of 6 inches.

This improvement is of great value to all of the country lying west of Phillipsburg for a distance of eight miles, as it permits the farmers and dairymen living along it to reach the markets of Phillipsburg at all seasons of the year. Its further value lies in the fact that it is an important section of the old Jersey turnpike leading across the State from New Brunswick to Phillipsburg, and, when the missing section between Clinton and West End is completed, will form a very important addition to the through lines of the State.

Detailed statement of the cost of the Bloomsbury-Still Valley road, township of Greenwich, county of Warren. Total length, 15,393.41 feet, or 2.915 miles.

Kind of pavement, water-bound macadam.
Width of paved way, 16 feet.
Length of paved way, 15,393.41 feet.
Depth, 6 inches.
Width between slopes or curbs, 30 feet.

Foundation, type M., 27,469 square yards, at 40 cents; total,	$10,987 60
Excavation at entrances, 800 cubic yards, at 50 cents; total,	400 00
Surface, type M. W. B., 27,469 square yards, at 22 cents; total,	6,043 18
Entrances, surface, type M. W. B., 284.8 square yards, at 22 cents; total,	62 66
Extra embankment, 85.7 cubic yards, at 50 cents; total,	42 85
Cast-iron pipe taken up and relaid, 72 lineal feet, at 20 cents; total,	14 40
Earth excavation, 31,712.2 cubic yards, at 33 cents; total,	10,465 03
Rock excavation, 1,776.5 cubic yards, at $1.50; total,	2,664 75
Under drain, type French, 2,560 lineal feet, at 30 cents; total,	768 00
Vit. drain, type 6-inch, 100 lineal feet, at 30 cents; total,	30 00
Gutter, type cobble, 3,858.2 square yards, at 50 cents; total,	1,929 10
Concrete retaining walls, 66 cubic yards, at $6.00; total,	396 00
Concrete culverts and end walls, 151.6 cubic yards, at $6.00; total,	909 60
Rubble masonry retaining walls, 122.4 cubic yards, at $6.00; total,	734 40
Bridge No. 2, complete,	8,300 00
Piles, 99, at $1.00,	99 00
Extra concrete in foundation, 7 cubic yards, at $6.00; total,	42 00
	$43,888 57
Inspection,	879 63
Engineering,	2,200 00
Total road work,	$46,968 20
Bridge work let in same contract,	8,441 00
Total cost of road and bridge,	$46,968 20
Lump sum, contract price, road, $34,674.87; bridge, $8,456.00,	$43,130 87
Amount allowed by State road work,	38,527 20
Amount allowed by State, bridge work,	8,441 00

Forty per cent. of road work, State's share,	$15,410 88
Twenty per cent. of bridge work as per same contract, $8,441.00,	1,688 20
	$17,099 08
Less credit by cost of inspection already paid by State,	879 63
Amount due by State,	$16,219 45
Maximum grade before,	10 per cent.
Maximum grade after,	6 per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

F. W. SALMON,
Engineer.
F. KINSEY METZGER,
Inspector.

January 13th 1916.

Description and Statement of Cost of Bridges Constructed in 1916.

ATLANTIC COUNTY.

Bass Harbor Bridge, on the Somers Point-Longport Boulevard.

The new bridge over Bass Harbor is entirely of creosoted timber. Wood block, carefully laid on creosoted plank, forms the wearing surface. The bents are composed of eight piles with a heavy cap timber. The total length of the bridge is 245 feet and the clear width of roadway 40 feet.

A substantial wooden guard-rail extends along the entire length of the bridge.

DETAILED STATEMENT OF COST OF BRIDGE.

County—Atlantic.
Township—Egg Harbor.
Name of bridge—Bass Harbor.
Name of road—Somers Point-Longport Boulevard.
Type of bridge—Creosoted wooden trestle, wood block floor.
Total length—245 feet, c/c of end bents.
Number of spans—20 panels.
Span length—12 feet 3 inches.
Clear width of roadway—40 feet

Original contract price,	$16,906 00	
April 29th, 1915, original length of bridge reduced 73 feet 6 inches, at $45.00 per foot,	3,307 50	
Contract price (as changed),		$13,598 50
Engineering,		422 65
Inspection,		340 50
Extras paid entirely by county,		12 90
Extras paid by State and county (covered by orders),		2,595 60
Total cost of bridge,		$16,970 15
Amount allowed by State,		$16,957 25
Ten per cent. of above, State's share,		$1,695 73
Less credit by cost of inspection already paid by State,	$340 50	
Less credit by payment on account,	597 83	
		938 33
Amount due by State,		$757 40

We hereby certify that the above bridge is finished in all respects in strict compliance with the plans and specifications.

A. H. NELSON,
Engineer.
JONAS H. CAMP,
Inspector.

February 11th, 1916.

Note.—Order of February 20th, 1916, increasing length of piles, applies only to 20 bents, as constructed, instead of to 27 bents, as orginally ordered.

Broad Thorofare Bridge, Somers Point–Longport Boulevard.

The bridge over Broad Thorofare consists of a creosoted piling trestle, with a steel bascule draw-span, having a clear opening of 50 feet. The entire length of this bridge is 1,400 feet, with a width of 30 feet.

The bascule span consists of a two-leaf draw of Strauss design. This bridge is operated by electric motor from the operator's house located at the one side of the trestle approach. At either end of the trestle approach are substantial bulkheads of creosoted timber to hold the sand and gravel of the roadway.

DETAILED STATEMENT OF COST OF BRIDGE.

County—Atlantic.
Township—Egg Harbor.
Name of bridge—Broad Thorofare.
Name of road—Somers Point-Longport Boulevard.
Type of bridge—Strauss bascule, creosoted timber approaches, wood block floor.
Total length—1,400 feet, including bulkhead.
Number of spans—70 panels at 12 feet, bascule span 100 feet over all, 460 feet bulkhead.
Span length—Bascule, 60 feet clear between piers.
Clear width—30 feet.

Original contract price,	$77,932 00	
Deduction for length of piling,	2,002 00	
Contract price (less piling),		$75,930 00
Engineering,		1,948 30
Inspection,		847 50
Extras paid entirely by county,		45 90
Total cost of bridge,		$78,771 70
Amount allowed by State,		$78,725 80
Ten per cent. of above, State's share,		$7,872 58
Less credit by cost of inspection, already paid by State,	$847 50	
Less credit by payment on account,	3,899 19	
		4,746 69
Amount due by State,		$3,125 89

We hereby certify that the above bridge is finished in all respects in strict compliance with the plans and specifications.

A. H. NELSON,
Engineer.
JONAS H. CAMP,
Inspector.

August 7th, 1916.

Hospitality Creek Bridge, on the Somers Point–Longport Boulevard.

The new timber trestle bridge over Hospitality creek has a total length of 448′ 6¾″. The clear width of roadway is 40 feet. Creosoted wood blocks laid on creosoted flooring form the pavement. The entire bridge is of creosoted timber.

DETAILED STATEMENT OF COST OF BRIDGE.

County—Atlantic.
Township—Egg Harbor.
Name of bridge—Hospitality Creek.
Name of road—Somers Point-Longport Boulevard.
Type of bridge—Creosoted timber trestle.
Total length—448 feet, 6¾ inches.
Number of spans—33 bays.
Span length—11 feet, 9¼ inches.
Clear width—40 feet.

Contract price,		$22,900 00
Engineering,		701 59
Inspection,		418 25
		$24,019 84
Deduction by State and county, covered by order,		539 00
Total cost of bridge,		$23,480 84
Amount allowed by State,		$23,480 84
Ten per cent. of above, State's share,		$2,348 08
Less credit by cost of inspection already paid by State,	$418 25	
Less credit by payment on account,	1,810 18	
		2,228 43
Amount due by State,		$119 65

We hereby certify that the above bridge is finished in all respects in strict compliance with the plans and specifications.

A. H. NELSON,
Engineer.
B. F. FEENEY,
Inspector.

May 6th, 1916.

Northfield Road and Bridge, .112 Mile Long.

This construction, consisting of an extension to the Northfield road, eliminates a dangerous curve and replaces a narrow bridge with a modern concrete one of thirty feet in width. The gravel road portion is 579.4 feet in length, with a graded width of 30 feet.

The bridge is a reinforced concrete slab, with encased I-beams of 18 feet span, resting on heavy concrete abutments supported by a pile and platform foundation. A heavy wooden guard-railing extends along the sides of the road at both ends of the bridge.

Detailed statement of the cost of the Northfield road and bridge, township of Egg Harbor, county of Atlantic. Total length, 579.4 feet, or .112 mile.

Kind of pavement, gravel.
Width of paved way, 20 feet.
Length of paved way, 579.4 feet.
Depth, 8 inches.
Width between slopes or curbs, 30 feet.

Note.—Contract includes a bridge of which the total cost, including engineering and inspection, etc. (see attached sheet), all of which was allowed by the State, amounts to,		$2,164 55
Ten per cent., or State's share,		$216 45
Less inspection already paid,		100 00
Amount due by State on bridge,		$116 45
Contract price, bridge,		$2,000 00
Contract price, road,		1,729 00
Total contract price,		$3,729 00
Contract price, road,		$1,729 00
Inspection,		71 50
Engineering,		86 45
Total cost of road,		$1,886 95
Lump sum, contract price,		$1,729 00
Amount allowed by State,		1,886 95
Forty per cent. of above, State's share,		$754 78
Less credit by cost of inspection already paid by State,		71 50
Amount due by State on bridge,	$116 45	
Amount due by State on road,	683 28	
		$799 73
Maximum grade before, about	4.5	per cent.
Maximum grade after,	2.05	per cent.

We hereby certify that the above road is finished in all respects in strict compliance with the plans and specifications.

A. H. NELSON.
Engineer.
EDWIN WOOLBERT,
Inspector.

November 13th, 1915.

Patcong Creek Bridge on the Somers Point–Mays Landing Road.

The new bridge over Patcong creek, on the new road leading from Mays Landing to Somers Point, consists of a center-bearing draw-span of 116′ ½″ in length, with approaches of creosoted timber. The piling approach on the east end of the draw-span is 279′ 0″ in length and the west approach 59′ 0″.

The draw-span, consisting of riveted trusses 10 feet in height, is supported by a cylindrical concrete pier 26 feet in diameter, resting on piling. The end-rest piers are two cylinders filled with concrete, each 6 feet in diameter, connected by steel bracing. The flooring in both the approaches and the steel span is of wood block on creosoted plank flooring.

Adequate turning machinery is provided for hand operation, and provision has been made for the addition of electric motors in the future. When in open position, the bridge provides two waterways, each 35 feet in width.

DETAILED STATEMENT OF COST OF BRIDGE.

County—Atlantic.
Township—Egg Harbor.
Name of bridge—Patcong Creek.
Name of road—Somers Point-Mays Landing.
Type of bridge—Steel center-bearing draw, creosoted timber trestle approaches.
Total length—496 feet, including 42 feet of bulkheads.
Number of spans—28 bays, one draw span.
Span length—116 feet, ½ inch C. to C.; bays 12 feet C. to C.
Clear width—24 feet.

Contract price,	$37,570 00
Engineering,	1,214 95
Inspection,	1,294 90
Extras paid entirely by county,	158 30
Extras paid by State and county, covered by orders,	2,247 03
Total cost of bridge,	$42,485 18
Amount allowed by State,	$42,326 88
Twenty per cent. of above, State's share,	$8,465 38
Less credit by cost of inspection already paid by State,	1,294 90
Amount due by State,	$7,170 48

We hereby certify that the above bridge is finished in all respects in strict compliance with the plans and specifications.

A. H. NELSON,
Engineer.
R. C. ROBBINS,
Inspector.

May 6th, 1916.

Risley's Channel Bridge on the Somers Point–Longport Boulevard.

Risley's Channel bridge has a total of 1,130 feet. This bridge consists of 798 feet of creosoted timber trestle in the Longport side of the two-leaf bascule bridge, and 228 feet of trestle on the Somers Point end.

The bascule bridge provides a clear waterway of 50 feet when in the open position. The flooring, both of the bascule spans and of the creosoted trestle, is of wood block.

The clear roadway of the entire bridge is 30 feet.

The operation is by electric power controlled from an operator's home on the bridge.

DETAILED STATEMENT OF COST OF BRIDGE.

County—Atlantic.
Township—Egg Harbor.
Name of bridge—Risley's Channel.
Name of road—Somers Point-Longport Boulevard.

Type of bridge—Scherzer two-leaf bascule, creosoted timber trestle approaches.
Total length—1,130 feet, including 54 feet bulkheads.
Number of spans—One draw, 83 bays at 12 feet.
Span length—90 feet C. to C.
Cear width—30 feet.

Contract price,		$73,243 00
Engineering,		2,563 51
Inspection,		1,211 49
Extras paid entirely by county,		53 40
Extras paid by State and county, covered by orders,		540 45
Total cost of bridge,		$77,611 85
Amount allowed by State,		$77,558 45
Ten per cent. of above, State's share,		$7,755 85
Less credit by cost of inspection already paid by State,	$1,211 49	
Less credit by payment on account,	3,794 34	
		5,005 83
Amount due by State,		$2,759 02

We hereby certify that the above bridge is finished in all respects in strict compliance with the plans and specifications.

A. H. NELSON,
Engineer.
LEVI D. COLES,
Inspector.

May 6th, 1916.

English Creek Bridge on the Somers Point–Mays Landing Road.

This bridge over English creek is built on the new line of the road and eliminates an abrupt grade and curve. It is a steel pony truss with a clear span of 50 feet and a roadway of 30 feet.

The floor is of creosoted wood block. The heavy abutments and wing-walls are of concrete and are supported by a heavy pile and platform foundation.

Detailed Statement of Cost of Bridge.

County—Atlantic.
Township—Egg Harbor.
Name of bridge—English Creek.
Name of road—Mays Landing-Somers Point Road.
Type of bridge—Steel truss, concrete abutments.
Total length—74 feet, about.
Number of span—One.
Span length—52 feet (out to out).
Clear width—30 feet.

Contract price,	$5,334 00
Engineering,	266 70
Inspection,	390 50
Total cost of bridge,	$5,991 20

Amount allowed by State,	$5,991 20
Twenty per cent. of above, State's share,	$1,198 24
Less credit by cost of inspection already paid by State,	390 50
Amount due by State,	$807 74

We hereby certify that the above bridge is finished in all respects in strict compliance with the plans and specifications.

A. H. NELSON,
County Engineer.
JONAS H. CAMP,
Inspector.

August 12th, 1915.

Lake's Creek Bridge on the Somers Point–Mays Landing Road.

The new bridge over Lake's creek consists of a reinforced concrete slab floor resting on encased I-beams. The abutments and new wing-walls are supported on a substantial wooden platform resting on piles. Portions of the heavy stone wing-wall of the old bridge on the down-stream side were repaired and made to serve as the wing-wall for the new construction.

The clear span is 28 feet and the width of roadway is 30 feet. A heavy galvanized pipe railing protects the sides of the bridge and extends the full length of the wing-walls. The wearing surface of the bridge floor is of gravel, the same as that of the road.

DETAILED STATEMENT OF COST OF BRIDGE.

County—Atlantic.
Township—Egg Harbor.
Name of bridge—Lake's Creek.
Name of road—Mays Landing-Somers Point.
Type of bridge—Steel girders encased in concrete, stone abutments on piles.
Total length—78 feet, including wing-walls.
Number of spans—One.
Span length—28 feet.
Clear width—30 feet.

Contract price,	$4,458 00
Engineering,	222 90
Inspection,	184 00
Extras paid by State and County,	10 54
Total cost of bridge,	$4,875 44
Amount allowed by State,	$4,875 44
Twenty per cent. of above, State's share,	$975 09
Less credit by cost of inspection already paid by State,	184 00
Amount due by State,	$791 09

We hereby certify that the above bridge is finished in all respects in strict compliance with the plans and specifications, except as noted.

Note.—Allowed for extra work on old wings,		$47 20
Deducted for piles cut off,	$21 30	
Deducted for sheet piling omitted,	15 36	
		36 66
Net additional cost,		$10 54

A. H. NELSON,
County Engineer.
JOHN R. TILTON,
Inspector.

July 2d, 1915.

MERCER COUNTY.

Back Creek Bridges at Station 223 + 36 and Station 278 + 58 on the Windsor-Newtown-Yardville Road.

Both of these new bridges over Back creek are of reinforced concrete. The floor consists of a concrete slab with encased I-beams resting on concrete abutments. The wing-walls and parapets are also of concrete. The larger bridge, at station 278+58, has a span of 20 feet and the one at station 223+36 a span of 15 feet. Both bridges have a clear width of 30 feet.

DETAILED STATEMENT OF COST OF BRIDGES.

County—Mercer.
Township—Hamilton.
Name of road—Windsor-Newtown-Yardville.
Name of bridges—Back creek at sta. 223 + 36 and 278 + 58.
Type of bridges—Steel I-beam and concrete.
Total length—40 feet, including wing-wall (sta. 223 + 36); 60 feet, including wing-wall (sta. 278 + 58).
Number of spans—One.
Span length—20 feet for bridge at sta. 278 + 58; 15 feet for bridge at sta. 223 + 36.
Clear width—30 feet.

Contract price for both bridges, including bridges at sta. 278 + 58 and 223 + 36,	$2,641 30
Engineering,	75 00
Inspection,	300 00
Total cost of bridges,	$3,016 30

Lump sum contract price,	$2,641 30
Amount allowed by State,	2,716 30
Twenty per cent. of above, State's share,	543 26
Amount due by State,	543 26

We hereby certify that the above bridges are finished in all respects in strict compliance with the plans and specifications.

THEODORE TOBISH,
Engineer.
E. W. CROFS,
Inspector.

October 12th, 1915.

Miry Run Bridge and Assunpink Creek Culvert, on the Windsor–Newtown–Yardville Road.

The new bridge over Miry Run is of the concrete slab type with encased I-beams. The span is 15 feet. The concrete culvert over Assunpink creek is of reinforced concrete with a short span of 6 feet.

Both the bridge and culvert have a clear width of 30 feet. The full pavement of the macadam roadway extends over both structures.

DETAILED STATEMENT OF COST OF BRIDGE.

County—Mercer.
Township—Washington.
Name of road—Windsor-Newtown-Yardville road.
Name of bridge—Miry Run, at sta. 117 + 43.
Type of bridge—Steel I-beam and concrete.
Total length—45 feet, including length of wing-walls.
Number of spans—One.
Span length—15 feet.
Clear width—30 feet.

Contract price, including bridge at sta. 17 + 85,	$1,745 00
Engineering, including bridge at sta. 17 + 85,	75 00
Inspection, including bridge at sta. 17 + 85,	225 00
Total cost of bridge,	$2,045 00
Amount allowed by State,	$1,820 00
Twenty per cent. of above, State's share,	364 00
Amount due by State,	364 00

We hereby certify that the above bridge is finished in all respects in strict compliance with the plans and specifications.

THEODORE TOBISH,
Engineer.
R. D. PERRINE,
Mercer County Inspector.

October 12th, 1916.

DETAILED STATEMENT OF COST OF BRIDGE.

County—Mercer.
Township—Washington.
Name of road—Windsor-Newton-Yardville Road.
Name of bridge—Assunpink Creek, Culvert at Sta. 17 + 85.
Type of bridge—Reinforced concrete box culvert.
Total length—22 feet, including length of wing-walls.
Number of spans—One.
Span length—6 feet.
Clear width—30 feet.

Contract price, including bridge at sta. 117 + 43,	$1,745 00
Engineering, including bridge at sta. 117 + 43,	75 00
Inspection, including bridge at sta. 117 + 43,	225 00
Total cost of bridge,	$2,045 00
Amount allowed by State,	$1,820 00

Twenty per cent. of above, State's share,	$364 00
Amount due by State,	364 00

We hereby certify that the above bridge is finished in all respects in strict compliance with the plans and specifications.

THEODORE TOBISH,
Engineer.
R. D. PERRINE,
Inspector.

October 12th, 1915.

MIDDLESEX COUNTY.

Perth Amboy–South Amboy Drawbridge.

State pays one-third of repairs and maintenance from State Road Fund (Chapter 413, P. L. 1912).

Total cost of repairs and maintenance, May 1st, 1912, to October 1st, 1913,..	$22,366 79
State's share,	7,455 59
Total cost of repairs and maintenance, October 1st, 1913, to October 31st, 1914,	$20,892 78
State's share,	6,964 26
Total cost of repairs and maintenance, November 1st, 1914, to October 31st, 1915,	$26,396 01
State's share,	8,798 67
Total cost of repairs and maintenance, November 1st, 1915, to October 31st, 1916,	$16,029 54
State's share,	5,343 18
Total cost of repairs and maintenance of portion of bridge within the city of Perth Amboy, November 1st, 1915, to August 5th, 1916,	$910 16
State's share,	303 39

Devil's Run Bridge, on the Schalk's Station Road.

This new bridge, which replaces an old wooden one, has a span of 20 feet. The floor slab is of reinforced concrete with a gravel pavement about 8 to 4 inches in depth.

The total cost of the bridge was $1,400, of which the State's share was 20 per cent., or $280.

(The cost of this bridge is included in the statement of cost of the above road.)

UNION COUNTY.

West Brook Bridge, Wood Avenue, Linden.

The small reinforced concrete span over West creek has been constructed to the full width of Wood avenue. The floor slab of concrete rests on encased I-beams.

Ample sidewalks are provided on both sides of the bridge.

The total cost of the bridge was $1,900, of which the State's share was 20 per cent., or $380.

(The cost of this bridge is included in the statement of cost of the above road.)

WARREN COUNTY.

Pohatcong Creek Bridge, on Bloomsbury–Still Valley Road.

The new reinforced concrete arch over Pohatcong creek has been built on a new line, which eliminates a dangerous old steel bridge and two steep approach grades. The new skew arch has a span of sixty feet with a rise of 18 feet. Heavy concrete wing-walls hold the high fill forming the road approaches.

The clear width of roadway is 32 feet, of which 16 feet is a standard macadam pavement.

The total cost of the bridge was $8,441, of which the State's share was 20 per cent., or $1,688.20.

(The cost of this bridge is included in the detailed statement of cost of the above road.)

Cost of Repairs.

In compliance with Chapter 113, P. L. 1906, amended Chapter 235, P. L. 1909, amended Chapter 225, P. L. 1910, also amended Chapter 395, P. L. 1912, further amended Chapter 317, P. L. 1913, money from the motor vehicle fund, during the fiscal year from November 1, 1915, to October 31, 1916, has been sent to the various authorities for repairs on the following roads:

Name of Road.	*County.*	*Amount.*
Ackerman, Clifton and Highland avenues,	Passaic,	$5,000 00
Adelphia-Farmingdale road,	Monmouth,	2,310 60
Alloway-Quinton road,	Salem,	1,500 00
Amboy-Keyport road, first section,	Monmouth,	4,620 28
Amboy-Keyport road, second section,	Monmouth,	2,976 00
Approaches to overhead crossing at Midvale,	Passaic,	4,149 92
Ballinger's Mills-Pole Tavern road,	Salem,	780 25
Ballinger's Mills-Pole Tavern road,	Salem,	1,500 00
Ballinger's Mills-Pole Tavern road,	Salem,	904 80
Basking Ridge-Millington road,	Somerset,	1,000 00
Beach road,	Ocean,	5,000 00
Beach and Shore roads,	Ocean,	3,000 00
Bellevue avenue, Hammonton,	Atlantic,	3,600 00
Belmont avenue and High Mountain road,	Passaic,	2,500 00
Blackwell's Mills-Finderne road,	Somerset,	500 00
Bloomfield and Van Houten avenues,	Passaic,	3,700 00
Bordentown and Crosswicks Creek road,	Burlington,	1,200 00
Bowne's Corner-Columbus road,	Burlington,	601 30
Branchville-Layton road,	Sussex,	500 00
Bridgeport-Nortonville road,	Gloucester,	400 00
Bridgeport-Nortonville road,	Gloucester,	500 00
Broad street and Maple avenue,	Salem,	3,600 00
Broad street, Keyport,	Monmouth,	8,000 00
Broad street, Keyport,	Monmouth,	12,398 22
Brown's Mills-Lakehurst road,	Burlington,	1,000 00
Brown's Mills-Pemberton road,	Burlington,	3,000 00
Brunswick pike,	Mercer,	10,000 00
Brunswick pike,	Mercer,	10,000 00
Burlington-Bridgeboro road,	Burlington,	8,994 45
Cape May Point boulevard,	Cape May,	12,500 00
Central avenue or Glenbrook road,	Morris,	7,000 00
Central avenue or Glenbrook road,	Morris,	900 00
Central Avenue, Norwood,	Bergen,	5,000 00
Clinton-Hampton road,	Hunterdon,	1,000 00
County road, Cresskill,	Bergen,	1,000 00
County road, Tenafly,	Bergen,	1,500 00
Crown Point road,	Gloucester,	1,100 00
Crown Point road,	Gloucester,	6,226 05
East Allendale avenue, Saddle River,	Bergen,	1,000 00
East Saddle River road and East Allendale road, Saddle River borough,	Bergen,	1,000 00

Name of Road.	*County.*	*Amount.*
East Saddle River road, Saddle River township,	Bergen,	1,500 00
Elmer-Alloway road,	Salem,	297 27
Franklin avenue,	Passaic,	1,500 00
Franklin Furnace-Stockholm road,	Sussex,	150 00
Franklin-Stockholm road,	Sussex,	1,000 00
Freehold-Adelphia road,	Monmouth,	2,500 00
Freehold-Adelphia road,	Monmouth,	6,825 00
General Repairs,	Bergen,	900 00
General Repairs,	Cape May,	5,000 00
General Repairs,	Cumberland,	1,600 00
General Repairs,	Cumberland,	5,000 00
General Repairs,	Cumberland,	5,000 00
General Repairs,	Cumberland,	2,000 00
General Repairs,	Morris,	20,000 00
General Repairs, Patrol System,	Essex,	25,000 00
General Repairs,	Union,	5,140 00
Glassboro-Hardingville-Clayton roads,	Gloucester,	1,000 00
Glen Gardner Sanatorium road,	Hunterdon,	79 87
Hancock's Bridge-Canton road,	Salem,	4,285 66
Holmdel-Matawan road,	Monmouth,	2,500 00
Hurffville-Cross Keys road,	Gloucester,	1,000 00
Interlaken-Oakhurst road,	Monmouth,	5,000 00
Jamesburg-Englishtown road,	Middlesex,	1,500 00
Jamesburg-Helmetta-Spotswood road,	Middlesex,	500 00
Jobstown pike,	Burlington,	1,368 00
Kaighn's Avenue,	Camden,	12,000 00
Kaighn's Avenue and Extension on Browning road,	Camden,	1,783 10
Lakeside avenue,	Passaic,	1,900 00
Lambertville-Flemington road,	Hunterdon,	1,700 00
Landis avenue,	Cumberland,	1,600 00
Lebanon-Clinton road,	Hunterdon,	1,000 00
Little Falls turnpike,	Passaic,	20,000 00
Locust and Lodi avenues, Wallington,	Bergen,	1,000 00
Lodi avenue, Little Ferry,	Bergen,	330 10
Long Hill and Cedar Cliff road,	Passaic,	2,500 00
Long Hill Extension,	Morris,	1,000 00
Lumberton-Medford road,	Burlington,	639 11
Madison Avenue,	Morris,	5,000 00
Madison avenue, Dumont,	Bergen,	1,000 00
Madison avenue, Dumont,	Bergen,	1,750 00
Main and Passaic avenues,	Passaic,	6,000 00
Matawan-Freehold road,	Monmouth,	2,430 00
Meadow boulevard,	Atlantic,	15,000 00
Meadow boulevard,	Atlantic,	6,000 00
Meadow and Shore road,	Burlington,	985 89
Medford-Ballinger's Mill road,	Burlington,	59 34
Metuchen-Menlo Park-Iselin road,	Middlesex,	2,000 00
Metuchen-Perth Amboy road,	Middlesex,	3,000 00
Millstone-New Brunswick road,	Somerset,	1,000 00
Mine Brook road (realignment),	Somerset,	5,000 00
Mercerville-Edinburg road,	Mercer,	4,000 00
Metlar's lane, Piscataway township,	Middlesex,	150 00
Midvale-Greenwood Lake road,	Passaic,	7,500 00
Moonachie avenue, Moonachie,	Bergen,	500 00
Morris and Springfield avenues,	Union,	8,000 00
Morris Plains-Denville road,	Morris,	2,000 00
Morristown-Bernardsville road,	Morris,	500 00
Morris turnpike,	Union,	2,860 00
Mt. Holly-Brown's Mills road,	Burlington,	5,000 00

Name of Road.	*County.*	*Amount.*
Mullica Hill-Harrisonville road,	Gloucester,	2,000 00
Neshanic road,	Somerset,	1,000 00
New Brunswick-Franklin Park road,	Middlesex,	1,500 00
New Brunswick-Franklin Park road,	Middlesex,	900 00
Newton-Stanhope road,	Sussex,	825 22
North Main street, Lodi,	Bergen,	1,500 00
Norwood avenue,	Monmouth,	10,000 00
Norwood avenue,	Monmouth,	9,400 00
Ocean boulevard, at Galilee,	Monmouth,	4,400 00
Ocean highway, through Ocean county,	Ocean,	8,167 22
Orchard Hill road,	Monmouth,	1,500 00
Palisades avenue-Gorge road,	Bergen,	8,000 00
Park avenue,	Middlesex,	1,500 00
Passaic avenue,	Passaic,	22,000 00
Passaic avenue,	Hudson,	5,000 00
Passaic avenue, Lodi,	Bergen,	1,500 00
Paterson-Hamburg turnpike,	Morris,	500 00
Paterson-Hamburg turnpike,	Passaic,	7,500 00
Paterson-Hamburg turnpike, section one,	Passaic,	25,000 00
Paterson Plank road,	Hudson,	34,500 00
Paterson Plank road,	Hudson,	480 00
Paulsboro-Swedesboro road,	Gloucester,	500 00
Paulsboro-Swedesboro-Auburn road,	Gloucester,	2,000 00
Pedricktown-Nortonville road,	Salem,	299 92
Pedricktown-Nortonville road,	Salem,	252 27
Pedricktown-Pennsgrove road,	Salem,	1,000 00
Pennsgrove Borough road,	Salem,	2,179 83
Pennsgrove-Salem road,	Salem,	7,000 00
Pennsgrove-Salem road,	Salem,	715 18
Pinckney road,	Monmouth,	3,220 00
Pine Brook road,	Morris,	1,000 00
Prospect street, Glen Rock,	Bergen,	500 00
Prospect street, Glen Rock,	Bergen,	400 00
Prospect street, Glen Rock,	Bergen,	1,500 00
Ratzer road,	Passaic,	1,000 00
Red Bank-Oceanic road,	Monmouth,	8,422 00
Repair of roads,	Sussex,	5,498 38
Repair of roads,	Sussex,	500 00
Repair of roads,	Cumberland,	300 00
Repair of roads,	Essex,	40,000 00
Repair of roads,	Hudson,	11,500 00
Repair of roads,	Passaic,	1,300 00
Richmond avenue, Point Pleasant Beach,	Ocean,	1,000 00
River road,	Middlesex,	300 00
River road,	Middlesex,	1,000 00
River road, Yardville-Crosswicks, Yardville-Allentown roads,	Mercer,	9,433 40
Saddle River avenue, Saddle River,	Bergen,	700 00
Saddle River avenue, Saddle River township,	Bergen,	3,000 00
Scobeyville-Tinton Falls road,	Monmouth,	1,000 00
Sea Bright-Long Branch road,	Monmouth,	10,000 00
Seashore road,	Cape May,	10,000 00
Seashore road,	Cape May,	11,500 00
Shore road,	Burlington,	2,611 15
Shore road,	Ocean,	5,000 00
South River-Old Bridge-Matawan road,	Middlesex,	2,000 00
Spotswood-Jamesburg road,	Middlesex,	600 00
Spring street, town of Newton,	Sussex,	2,000 00
Spruce Run turnpike, Hampton borough,	Hunterdon,	300 00

Name of Road.	*County.*	*Amount.*
Squaw Brook road,	Passaic,	1,100 00
St. George's avenue,	Union,	6,000 00
Stelton-New Market-Dunellen road,	Middlesex,	1,000 00
Stone House Plains road,	Passaic,	2,000 00
Tappan road, Norwood,	Bergen,	500 00
Terrace avenue,	Bergen,	294 00
Trenton-Pennington-Hopewell road,	Mercer,	4,000 00
Tuttle's Corner-Layton and Branch road,	Sussex,	100 00
Union avenue,	Middlesex,	700 00
Union avenue,	Passaic,	1,000 00
Wallington avenue, Westwood,	Bergen,	500 00
Westville-Glassboro road,	Gloucester,	7,000 00
White Horse pike,	Atlantic,	1,000 00
White Horse pike,	Camden,	4,000 00
White Horse pike,	Camden,	6,000 00
White Horse pike,	Camden,	6,632 63
Woodbury-Knight's Run road,	Gloucester,	549 60
Wyckoff and Airmont road,	Bergen,	732 25
Wyckoff road, Hohokus township,	Bergen,	2,499 96
Wyckoff road, Hohokus township,	Bergen,	108 91
Wyckoff road, borough of Ramsey,	Bergen,	147 50
Wyckoff road, Hohokus township,	Bergen,	1,500 00
Wyckoff road, Hohokus township,	Bergen,	59 90
Wyckoff road, Hohokus township,	Bergen,	500 00
Special Allotments—		
Advertising for bids, Newark turnpike,		28 95
Lincoln Highway signs,		240 00
Ocean Highway survey,		526 14
Tags for Motor Vehicle Department,		3,642 07
Total,		$716,361 69

REPAIRS AND RESURFACING FROM COUNTY FUNDS DURING THE YEAR 1916.

In some cases it is difficult to secure accurate returns; consequently, the figures in this table are approximate only:

County.	*Amount.*
Atlantic,	$38,787 57
Bergen,	61,106 00
Burlington,	75,000 00
Camden,	40,687 98
Cape May,	44,000 00
Cumberland,	20,526 93
Essex,	271,004 94
Gloucester,	24,143 95
Hudson,	253,851 54
Hunterdon,	40,218 74
Mercer,	95,256 26
Middlesex,	189,237 65
Monmouth,	122,030 49

Morris,	27,374 23
Ocean,	10,000 00
Passaic,	212,259 52
Salem,	32,909 11
Somerset,	46,048 32
Sussex,	9,099 33
Union,	40,090 27
Warren,	65,866 20
Total,	$1,719,499 03

Report of the Commissioner.

The demands on the Department for State aid in new work keep on increasing. Two years ago those requests on roads of sufficient importance to justify favorable consideration could have been met by a supplemental appropriation of $175,000, in addition to the then available appropriation of $500,000. A year ago, with the same amount available, the excess of requests for roads, deemed of enough importance, was $250,000. This year, in view of the terms and evident intent of the Budget Act of 1916, all road authorities were notified to send in requests for all State aid needed to October 31, 1918. For new work these amount to $1,642,121 for 1916–17, and to $1,331,012 for 1917–18. The department is prepared to approve of work calling for $1,234,849 of State aid in 1916 and $996,212 in 1917–18, if funds be available, and if the present road policy and the system of disbursing State road moneys is to be maintained. This system is based on appropriating from general resources a fund to be used for new work only, and on devoting the Motor Vehicle Fund to repair and, since last spring, to work on certain minor roads. Such a policy involves a continuous increase in mileage of improved roads.

To-day, however, the preservation of our roads has become the matter of paramount importance. Until, by satisfactory methods of maintenance, we have provided for the conservation of our present great investment, it seems unwise to increase the amount at risk and add to the size and difficulties of the task. The extent of these can be judged from the totals of requests for aid in maintenance. For 1916–17 this is $3,299,253, and for 1917–18, $2,322,936. The amounts to be expected from the Motor Vehicle receipts are, of course, uncertain. For present purposes they may be assumed at $1,660,000 and $1,930,000 respectively. After deducting 8 per cent. for ad-

ministration of the Motor Vehicle Department, and $210,000 for two years' work under the Township Road Act (Chapter 217, P. L. 1916), there would remain about $3,100,000 to meet the said requests amounting to over $5,600,000.**

It is well to recall, first, that six years ago practically all reasonable requests for aid in repair work could be met; second, that the growth in receipts entails a corresponding growth in traffic and a growth in cost of repair that, in the case of overloaded roads, is proportionately greater than the growth in traffic; third, that, on the average, every vehicle licensed inflicts on the roads wear, to make good the expense of which, under our present system, costs more than the amount of the license fee paid, and, fourth, that the requests for 1917–18 are probably much below the amount that will be needed if work is to go on as in the past. This is largely due to the difficulty of estimating needs so far ahead and to the inexperience of our county road authorities in making such forecasts.

Our State road law is based on the principle that all control and responsibility are devolved solely on the local authority in charge, except for work in whose cost the State shares. The powers of the Road Department to protect the State's investment are limited and ineffective, and their exercise is, therefore, seldom, if ever, of advantage.

Whatever may have been the case twenty years ago, the problem has outgrown our methods. The unforeseen growth in the volume and industrial importance of our traffic, and change in the methods of propulsion, have completely changed the conditions to meet which our present policy was devised.

I have no desire to criticise individuals or governing bodies now charged with the care of our roads. Their task has grown to be an impossible one. It is becoming daily more and more clear that for our main roads the county is too small a unit to

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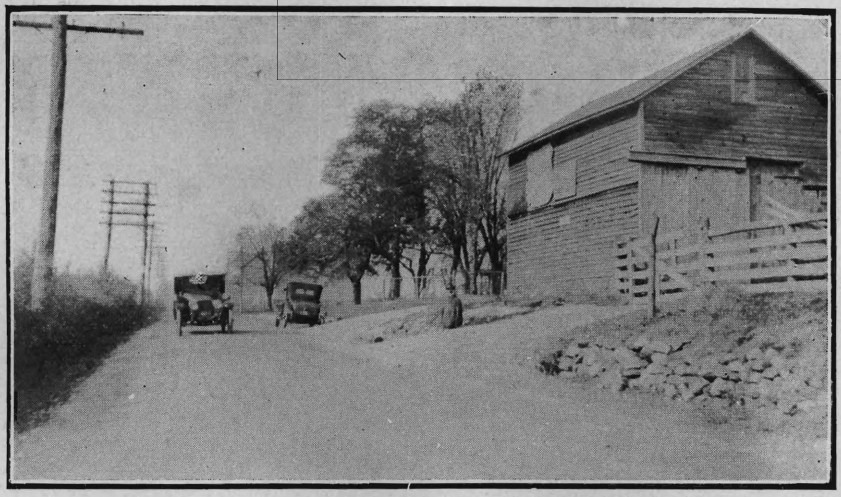
** Note—This was written before the adoption of the Egan Act. The amount available will be reduced each year by that law at least $500,000 for principal in addition to the interest on outstanding bonds; it is even questioned whether the whole of the motor vehicle receipts will not have to be set aside. In any event, the repairs of the Egan Act routes for a time will absorb all the balance in the motor vehicle fund.

Traffic post with permanent base 4 feet wide placed at intersection of roads. This post may cause accidents or loss of life, for which local officials will be responsible, as it is an illegal obstruction to traffic.



Private entrances reduce width of roadway over five feet.

provide satisfactory service excepting as a subdivision of a larger organization. The same is, of course, even more true of townships or municipalities.

The commercial value and the necessarily great expense of good road service in this State render it necessary to organize and handle the work on a scale commensurate with its importance. The Commission appointed to consider this subject will report at an early date. It is, therefore, fitting to leave the formulation of definite measures to that body, but I feel it necessary to draw attention to the necessity of action.

I deem it not improper, however, to express at this time my views as to the salaries paid the administrative and engineering staff of this Department. The Commissioner was solely responsible for the expenditure of about $1,800,000 last year; this total, this year, will be over $2,000,000. His compensation is $5,000. This would be inadequate in any business of similar difficulties and responsibilities. As, however, changes in the organization are desirable, this item may be passed over. The engineering staff is underpaid. The State Highway Engineer receives $4,000. He is held responsible to the Commissioner for all engineering details. Whether the present system of centering all legal responsibility on the Commissioner or other Department head be continued, or whether the engineering responsibility be placed by law on the State Highway Engineer does not affect the duties nor the real responsibilities of his office. His salary should be $7,500. Of the Division Engineers two have left the service of the Department within the last four years to take better paid jobs; the other two have received offers that, as far as salaries are concerned, were more attractive than their present positions. These men have acquired valuable experience in the service. Their successors must be trained, and for some time are not worth as much as when fully trained. Their maximum pay to-day is $2,000 a year. I recommend that this be raised to $4,000. It is my thought that they should be appointed at about $2,000 a year and raised $250 a year until they attain the maximum. These salaries are on the same scale as paid in Massachusetts, New York, Pennsylvania and Maryland.

Our accounting is not carried out on a scale commensurate with the work. It is of prime importance that we have full and accurate accounts of all moneys spent on roads in this State. These accounts must include cost data and should also include traffic figures. With our lack of any uniform system for keeping the accounts of public bodies, it would be misleading to make any general compilation of the road accounts of all the bodies charged with the care of roads in this State, as these accounts are now kept. It would, moreover, be well nigh impossible to secure reports from most of the townships and minor municipalities. Under these circumstances, all that can be done at this time is to compile the best available data as to State and county work. Previous to this year the funds at the disposal of the Department have not even allowed of anything more than a compilation of reports as made by the counties; on account of differences in the fiscal year among the counties themselves, and the State as well, figures as reported are unsatisfactory. Besides this, there are other causes for differences. It was found possible, during the past year, to take this work up seriously by using part of the time of the forces provided for bridge work and for township roads. While the facts gathered are not as trustworthy as they must be if the thoroughness which the work demands is to be attained, it has been possible to differentiate between betterment work on old roads and repairs, to make more satisfactory allowance for difference in periods covered, and to largely eliminate the errors due to mixing liabilities incurred with payments made. These figures give information as to the principal roads of the State in a more satisfactory form and with less error than heretofore. (See table.)

The Budget Act makes it necessary for the Department to determine at this time the program of State road work until October 31, 1918. Requests have been made on the counties for statements of their needs. It may be admitted that such a course is open to objection. The present boards cannot commit their successors, and the same is true as to myself. Nevertheless, in no other way does it seem possible to comply with the spirit of the law and to meet the needs of the local governing bodies intelligently.

It will readily be seen that the preparation of the tables of repair costs and of future needs call for a large increase in the clerical work of the Department, not only in quantity, but in the skill and experience needed.

The accounting force proper consists of one man. It is manifestly impossible for him to keep up the requisition and ordinary bookkeeping work and the statistical work above outlined. Recourse has been had to the engineering staff for help as to the latter. This is undesirable. There is plenty of work for all our engineers in the line of their profession. A satisfactory system of accounting for costs and analyzing data calls for a man of no mean ability or experience. He must have a sufficient staff to relieve him of mere detail, so that he can devote himself to the more important work of generalization and analysis. Such a man cannot be secured and held at the salary we are now paying. When familiarized with the work he should be well worth a salary of $3,000.

In closing this report, I feel it my duty to draw special attention to the subject of convict labor on roads. Our experience of about four years thoroughly persuades me of three things—first, that work can be done by this means at the same, or less, cost than by contract; second, that this class of work is a specially promising method of preparing convicts for a law-abiding and useful career; and, third, that we are by no means availing ourselves of either of the above opportunities. Requests for amendment of the law governing this work have been made every year since its enactment, without satisfactory result. Under present legislation the division of responsibility and control works havoc with efficiency. The work is often delayed for considerable periods on this account. This defect must be cured if better results are to be obtained. The moral improvement of the inmates of our camps is not committed to my department, and I therefore do not comment thereon or on the changes desirable for that purpose. I may, however, be pardoned for expressing the belief that the benefits to the men fully justify a continuance of the work even if the return in work performed is a little more costly and is longer delayed than in the case of contracts.

State Highway Engineer's Report.

Hon. E. A. Stevens, Commissioner of Public Roads, Trenton, New Jersey:

DEAR SIR—I have the honor to submit to you a report of the work done under the supervision of this department during the past year. The reports of the several divisions, accompanying this, describe in detail the work accomplished.

You will note that only one road, approved by you during the fiscal year ending October 31, 1916, was finished, accepted and paid for in time to be reported this year. This most strikingly illustrates the labor shortage plus the car shortage that has so seriously retarded our work throughout the State. New and greater demands are being laid on our roads every month. The weight and number of vehicles is increasing beyond all the calculations of ten or even five years ago. In fact, we are now passing through the same stages that our railroads have encountered, and to meet which they were compelled to increase the weight of their rails from 60 pounds to 72 pounds, to 80 pounds, to 90 pounds, to 100 pounds per square yard, and our method of accounting will have to follow theirs; that is, we will have to divide our old repair account into maintenance and betterments.

The difference between repairs and betterments is frequently lost sight of in discussing road improvements. One might, with equal justice, say that all of the money spent in building automobiles ten or even five years ago was wasted as that the money spent on roads ten years ago was wasted. The roads built then served their purpose, but are no more adequate to meet the demands of the present than the old one-cylinder auto is to meet requirements of the tourist of to-day. Roads and bridges that were amply strong enough to carry loads of five tons will not support those of twenty or more tons. Hence, our former standards are being raised with a corresponding increase of cost.

In 1910, ten thousand dollars per mile was the cost of a first-class road; to-day, twenty-five thousand dollars per mile is required, and, on some heavy traffic roads, this cost exceeds thirty thousand dollars. With the increase in cost, more time and thought must be given to the planning and execution of the work. A fuller and more complete set of details must be prepared; the drainage, both transversely and longitudinally, must be provided for; culverts, bridges, road intersections and approaches to dwellings must all be carefully studied and made to conform to and constitute a part of the original plan.

To meet this demand, our engineering force should be doubled at least. This also applies to those of the County Engineers who are sixteen-hour rather than eight-hour men. The grade of engineering work done by the County Engineers of New Jersey is equalled by few and surpassed by none

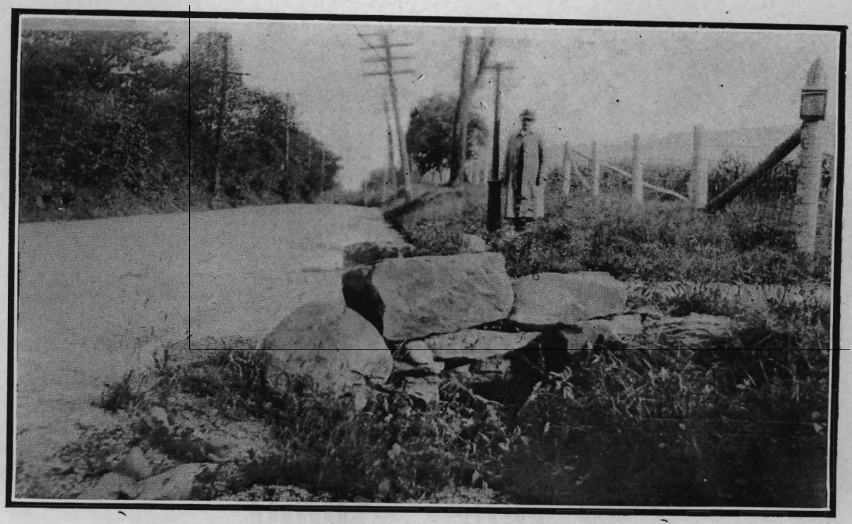
in our country. I am glad to note that in many counties their value is being more fully recognized. It has been frequently proven that $1,000 spent in planning work has saved the public $10,000 in money, and weeks or months of delay and consequent inconvenience.

There is another very important class that is often overlooked, namely, the contractors. We have in our State contractors whose tenders are sought by engineers of neighboring States because, as one of them expressed it, "We have not in our State enough trained contractors capable of doing the work as designed, therefore, we come to New Jersey and ask your contractors to bid on our work." Design without execution is like faith without works. There is an interdependence between engineers and contractors that must be fully recognized before we can obtain the most satisfactory results. This is fully realized by our engineers and most of our contractors, and the result is that both are working in harmony instead of at cross purposes, as often happened in years gone by. Better and more finished work is the outcome of this team work, and our roads show a more finished surface, not only of the pavement but also of the shoulders and slopes, both in excavation and embankment, thereby forming a harmonious and complete whole.

Respectfully submitted,

R. A. MEEKER,
Engineer.

Roadway narrowed by deep ditches and guard rails.



Undesirable private entrance on back road.

Report from Northern Division.

Mr. R. A. Meeker, State Highway Engineer, Trenton, New Jersey:

DEAR SIR—The road work in the eight counties which constitute the Northern Division of New Jersey is steadily advancing to meet the ever-changing conditions. Quite naturally, the minor details of the work are dependent upon local conditions as well as upon the personnel of the officials representing the different localities. At the same time, the State plans and specifications, which standardize materials and the manner of their use in road work, have brought about a better understanding of the problems involved, resulting in the saving of time and more uniformity in the work. The results obtained have been materially aided by developing a better class of inspectors, due to increased pay, which has made the position more sought after.

On a few of the roads in North Jersey vehicular traffic has been counted by both county and State men, but thus far the results obtained have been of relatively small value for selecting new types of pavement because the traffic increases out of all expectation as soon as the roads are put in good condition. These counts, however, will be continued whenever men are available for the purpose, because they form a valuable comparison of existing conditions in the various sections and serve to show what changes in the line of travel occur when road conditions are improved on parallel routes.

The patrol system of maintenance is now being freely discussed, and its use has spread to three or four of the northern counties, the men working singly and in pairs; some with horse and wagon or cart; others merely with wheelbarrow. It is, of course, understood that these men do only the maintenance work, and act as caretakers for their sections between visits of the main repair gangs.

There is less opposition than formerly to expenditures for underdrainage, while in many sections gutters and shoulders are thoroughly cleaned and reshaped at regular intervals. A marked increase is noticeable in the attention paid to the trimming of trees, especially on the inside of curves.

While the details of the pavement occupy an important place in the engineers' designs, there are matters of greater importance, especially in cases where funds available for improving roads are insufficient. Thus it is of great importance to establish the best possible line and grade since an expensive pavement may be installed later; whereas a change of established line, width or grade, causes greater hardships the longer it is postponed. A failure to provide proper lines, grades and widths of roadway may lessen the cost of engineering and, perhaps, right of way, but the results of such neglect are far from pleasing, or even economical.

A phase of road building which has occasioned no little trouble arises from erecting guard rails in places where a slightly greater cost would produce a more permanent improvement by increasing a cut at the top of a hill or the inside of a curve and using the excavated material to widen the fill where the guard rail would otherwise have been erected. Guard rail contractors, unless carefully watched, will set posts within instead of beyond the required line, which is usually at least fifteen feet from the center of the road.

Some delays in road work have been occasioned by lack of co-operation on the part of street car companies and owners of pipe lines; other very considerable delays have resulted from a scarcity of labor.

In some roads culverts, laid lengthwise of gutters and open at their ends, constitute obstructions which at times have caused serious mishaps and, in many cases, at the present time, remain as menaces to travel. To obviate these drawbacks, several designs for side intakes, carrying the culverts outside the graded width of road, have been brought into use.

Many of the back roads which have been in use for years were originally partially graded dirt roads with a high crown. The addition of layer after layer of stone and gravel has brought up the center, and the gutters have been deepened from time to time until it has become necessary to build bridges at crossing points. In some of the more progressive districts these ditches have been filled and shoulders constructed with a properly formed cross section to carry the drainage in a broad, flat gutter, so that scour is light and attended with but little wash.

In front of private residences, a convenient entrance is provided by concreting or cobbling the gutter wide and flat. Gutter work of this kind not only makes a more beautiful street, but also provides a broader carriageway, and serves to prevent accidents, which sometimes occur, due to skidding or turning abruptly in places where the gutters are not clear of obstructions.

Photographs of some of our bad gutter conditions are inserted herewith in the hope that more consideration will be given to these matters in the future. The results obtained will be found to far outweigh the cost involved. On narrow roadways in outlying districts, it may be wise to dig open gutters beyond the fence line, or, in other words, within the fields adjoining the roadway. In this connection, the following considerations are pertinent:

The minimum width advised by the State for carriageway on trunk lines is forty (40) feet, and for ordinary county roads thirty (30) feet in the clear. Many of the old turnpikes which were purchased and later turned over to the county and State have a right of way of sixty-six (66) feet between fence lines. At times when traffic was light on these roads, the local authorities allowed fences and even buildings to be placed temporarily within these rights of way, but have never released the title of the land. In most cases this can only be done by a special act of the Legislature. As traffic increases and the full width of roadway is required for public use, these obstructions must be removed by the owners. Many of the properties have changed hands and the new owners do not appear to realize that the squatter possession thus obtained is illegal and they must move off as soon as requested. Even Boards of Freeholders and borough officials frequently

lose sight of the law in this matter, and instead of collecting rental for the use of the ground, which would be fair and possible, even go so far as to listen to requests for imaginary damages from persons who have been occupying public lands without paying rent. As soon as the law is better understood, these conditions will automatically adjust themselves.

These photographs and suggestions for betterments may lead to the belief that New Jersey is losing her place at the head of the list of good road States. This is by no means the case, but if we expect to maintain this position we must know our weak spots in order that we may know how to obtain the best results.

Respectfully submitted,

E. M. VAIL,

Division Engineer.

Report from Central Division.

Mr. R. A. Meeker, State Highway Engineer, Trenton, New Jersey:

DEAR SIR—New road construction or reconstruction has been carried on in each of the counties of the Central Division during the past year. This work consisted of the following types of construction: water-bound macadam, gravel, bituminous concrete, hot mix and cold mix, Portland cement concrete, water-bound macadam with bituminous dressing.

The custom of having a county apply a bituminous dressing to a new macadam road, after the contractor's maintenance period has expired, has not been satisfactory for the reason that the county does not always do it. The water-bound macadam roads constructed by State aid carry a traffic that makes it absolutely necessary that they be given a surface treatment to prevent destruction. There are few exceptions to this statement.

I would, therefore, recommend that when specifications are prepared for water-bound macadam construction, they include the application of a surface dressing. If the road be finished too late in the fall for applying the bituminous material, the road should be accepted and the surfacing applied the following year, the contractor's maintenance period to end one year from the date of acceptance of the macadam work.

During the construction there is more or less dissatisfaction among the users of the road on account of detours not being properly designated, and also on account of the condition of the road that is being used while still unfinished. The contractor, under the direction of the Board of Freeholders, should erect and maintain suitable signs showing the detours, not only at the points where the detour leaves the road being built, but wherever it be found necessary to direct the traffic to an improved road. Where it is not advisable to divert the traffic the contractor should grade the shoulders so that they would be convenient for travel.

The repair work during the past year has been very unsatisfactory. Some of the counties are doing work now that should have been started in May. Many of the main roads are not properly maintained, and it is impossible to locate the responsibility. The important roads, of course, should be under a central control, but until this is brought about I think that the counties should be notified during the winter that work on the main roads should be started early in the season, and done in accordance with instructions from the department, and, also, to be constantly maintained in good condition. Any county failing to comply with these conditions will receive no money from the motor vehicle fund.

The method of granting State aid to boroughs and small cities is a question that deserves serious thought. It does not seem just that the smaller municipalities should be compelled to maintain roads subjected to heavy through traffic, but, on the other hand, there is not enough money to put the

county roads in good condition. It would seem to me that in view of the present status of the road situation and the condition of the county roads that the public interest would be best conserved by withholding State aid from such municipalities and increasing State aid to the counties.

Respectfully submitted,

EDWARD E. REED,
Division Engineer.

CONVICT LABOR WORK.

Following is a report of the work done during the fiscal year by convict labor in the Central Division.

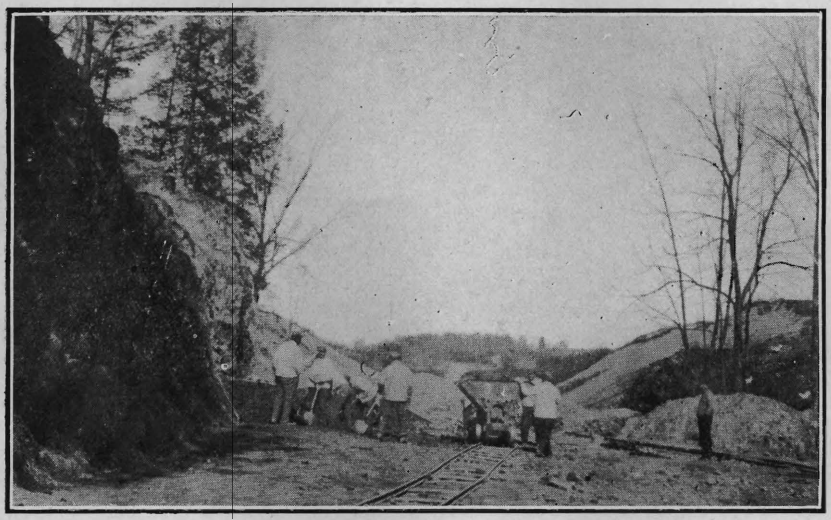
Report on Convict Labor—Camp No. 2.

All the road work being prosecuted in connection with convict labor at State Road Camp No. 2, near Princeton, is approaching completion. The original preparations for the establishment of Road Camp No. 2 began in June, 1913, and, commencing with September of that year, the first gang of men was taken to the camp site to begin the work of constructing the housing quarters. The materials for construction and the necessary tools and equipment had previously been carted to the grounds. During the construction period the men were conveyed each day by motor truck from the New Jersey State Prison to the camp site and return. The men were permanently located at the camp upon completion of the frame buildings early in November, 1913, and the road construction was at once undertaken.

It was at first intended to build only the Princeton-Bolmer's Corner road, which extends from the trolley tracks at Bayard Lane, in Princeton, to the Somerville road at Bolmer's Corner, near Rocky Hill. The new line runs over private right of way donated to the State for road purposes in Mercer county, from which point the improvement was continued along a former roadway in Somerset county, thus forming a more direct route from Princeton to Somerville and North Jersey. Later, however, it was decided to repair the road from Bolmer's Corner to Blawenburg, and also the road from Mount Rose to Rocky Hill. Considerable work was performed on all these roads, as the construction reports show. In addition to the road work, a new stone quarry was opened and operated to provide the trap rock needed in connection with the road construction.

The stone quarry, which was privately owned property, was recently stripped, and all the quarrying machinery and equipment were removed from the site. Upon the completion of the remainder of road work near Princeton, and new housing quarters near Monmouth Junction, the buildings and equipment of Camp No. 2 will soon be removed to Camp No. 2A, and the old camp abandoned.

A complete and final statement on the costs and operation of Camp No. 2 will likely be made next year. The following is the report for the fiscal year 1916:



New road being built by Prison labor near Layton in North Jersey.

Gravel road built near Elmer in South Jersey by Prison labor.

Camp No. 2—Convict Labor.

Value of road work performed by Camp No. 2, at prevailing contract prices for similar work, from November 1, 1915, to October 31, 1916, inclusive.

Princeton–Bolmer's Corner Road.

4,092	cubic yards excavation, earth, at $0.70,	$2,864 40
363	cubic yards excavation, rock, at $2.50,	907 50
12,237	square yards foundation, coarse macadam, 4-inch compacted, at $0.46,	5,629 02
26,574	square yards surface, coarse macadam, 4-inch compacted, at $0.50,	13,287 00
72	lineal feet 14-inch C. I. P. placed, at $1.95,	140 40
36	lineal feet 12-inch C. I. P. placed, at $1.75,	63 00
600	lineal feet ditching, at $0.05,	30 00
160	lineal feet stone underdrain, at $0.50,	80 00
98	cubic yards reinforced concrete bridge, at $10.00,	980 00
25½	cubic yards concrete culvert, at $8.00,	204 00
200	lineal feet fence, removed and reset, at $0.01,	2 00
.035	acres heavy grubbing, at $50.00,	1 75
		$24,189 07

Blawenburg-Bolmer's Corner Road.

2,588	cubic yards excavation, earth, at $0.70,	$1,811 60
4,153	square yards surface, at $0.50,	2,076 50
12,080	lineal feet ditching, at $0.05,	604 00
		$4,492 10

Mount Rose-Rocky Hill Road.

200	cubic yards excavation, earth, at $0.70,	$140 00
63,360	lineal feet ditching, at $0.05,	3,068 00
1.194	acres heavy grubbing, at $50.00,	59 70
3	miles roadway scraped, at $264.00,	792 00
		$4,059 70

Totals.

Value of road work done at prevailing contract prices for similar work on—		
Princeton-Bolmer's Corner road,		$24,189 07
Blawenburg-Bolmer's Corner road,		4,492 10
Mt. Rose-Rocky Hill road,		4,059 70
		$32,740 87
Value of road materials purchased and unused to date,		1,543 00
Value of work done and materials on hand,		$34,283 87
Operating expense,	$23,655 49	
Depreciation on machinery and equipment, 1916,	2,704 00	
Depreciation on buildings and equipment,	481 00	
Total operating expense and depreciation, 1916,		$26,840 49

EXPENDITURES OF STATE ROAD CAMP NO. 2 DURING FISCAL YEAR 1916.

Expended for equipment—		
Tools,		$243 72
House-building materials,		33 61
Plumbing,		53 02
Total,		$330 35
Expended for operation—		
Machinery repairs,	$934 51	
Tool repairs,	20 52	
Hardware and supplies,	186 36	
Paint,	6 55	
Gasoline, etc.,	989 56	
Soft coal,	617 00	
Explosives,	1,232 47	
Road-building material,	236 84	
Advertising,	20 58	
Supervision,	3,407 00	
Team hire,	5,021 01	
Convict hire,	10,329 14	
Rent,	120 00	
'Phone,	43 95	
Liability and insurance,	490 00	
Total,		23,655 49
Grand total expended,		$23,985 84
Value of materials on hand on October 31, 1916—		
Dynamite,		$75 00
Cast-iron pipe,		100 00
Terra cotta pipe,		75 00
Crushed stone,		30 00
Cement,		15 00
Bridge reinforcing,		80 00
Road binder,		1,168 00
Total,		$1,543 00

NOTE.—No report is included herewith of either expenditures or value received in connection with contract for applying road tar and screenings to surface of Princeton-Bolmer's Corner road. Although funds are taken from 1916 appropriation, the contract has not progressed sufficiently to permit reporting this year.

REPORT ON CONVICT LABOR CAMP No. 2-A.

The establishment of the new Camp No. 2-A, near Monmouth Junction, is rapidly progressing, and, upon completion of the housing quarters, the men, as well as all buildings, furnishings, machinery and equipment, will be removed to the new site from Camp No. 2, near Princeton.

Beginning with September, 1916, a force of men was conveyed each day by motor truck from Camp No. 2 to the new Camp site, where the work of

erecting the new portable housing quarters was begun, as well as tests made for potable water supply, telephone line provided, tests made for quarry location, and some road work performed, as the below report will show.

The work of the new Camp will be to proceed with the construction of the unimproved section of the Trenton-New Brunswick turnpike, in Middlesex county, beginning at the Kingston-Monmouth Junction road and extending to a point of former improvement near New Brunswick. This will result in complete improvement of the entire direct-line turnpike from Trenton to New Brunswick.

A nearby stone quarry will be opened in connection with the operation of the Camp, to provide the trap rock needed for the road construction. The following is a report for the fiscal year 1916:

TRENTON–NEW BRUNSWICK TURNPIKE.

Value of road work performed at prevailing contract prices for similar work:

5.289 acres heavy grubbing, at $50.00,	$264 45
Value of camp buildings,	2,300 00
Value of camp and work performed,	$2,564 45
Operating expense,	$1,926 75

Expenditures of State Road Camp No. 2-A.

Expended for equipment—		
Tools,		$0 95
Lumber,		676 45
House-building materials,		459 44
Total,		$1,136 84
Expended for operation—		
Hardware and supplies,	$3 53	
Paint,	32 33	
Supervision,	338 00	
Supervisor's expense,	20 07	
Team hire,	178 20	
Convict hire,	1,354 62	
Total,		1,926 75
Grand total expended,		$3,063 59

REPORT ON CONVICT LABOR.

Camp No. 4.

The construction of Woodbridge avenue, Section Three, otherwise known as the Woodbridge-Reformatory road, Middlesex county, was begun in July, 1915, and is rapidly approaching completion. Young men from the Rahway Reformatory have been used on this work, and, as the job is located near that institution, the men walk to and from the work, which eliminates the necessity of temporary housing quarters.

A complete and final statement on the costs and operation of Camp No. 4 will likely be made next year. The following is the report for the fiscal year 1916:

Camp No. 4.

CONVICT LABOR ON WOODBRIDGE AVENUE, SECTION THREE
(Woodbridge–Reformatory Road.)

Work performed from November 1, 1915, to October 31, 1916.

705 cubic yards excavation, at $0.70,	$493 50
8,200 square yards macadam foundation, at $0.45,	3,690 00
2,657 square yards foundation replaced, at $0.45,	1,195 65
2,943 lineal feet French drains, at $0.50,	1,471 50
36 lineal feet C. I. P., 12-inch, at $2.00,	72 00
36 lineal feet C. I. P., 36-inch, at $8.00,	288 00
100 lineal feet ditching, at $0.10,	10 00
723 lineal feet ditching, at $0.10,	72 30
9,400 square yards surface, at $0.45,	4,230 00
775 square yards foundation and intersection surfaces, at $0.90,	697 50
Concrete culvert,	1,000 00
	$13,220 45
Value of road materials on hand,	2,575 12
Total value of road work done at prevailing contract prices for similar work,	$15,795 57
Operating expense,	$15,176 93

EXPENDITURES OF STATE ROAD CAMP NO. 4, 1916.

Expended for equipment—		
Tools,		$47 44
Lumber,		77 15
Total,		$124 59
Expended for operation—		
Machine repairs,	$115 03	
Hardware and supplies,	6 28	
Kerosene,	15 05	
Soft coal,	112 63	
Road-building materials,	5,254 81	
Supervision,	1,250 00	
Supervisor's expense,	181 41	
Advertising,	10 40	
Team hire,	3,407 67	
Convict hire,	4,699 06	
Total,		15,052 34
Grand total expended,		$15,176 93

NOTE.—The foregoing report includes only the amount expended under first estimate of $3,078.22 and the value of road work performed under same, in connection with the contract for furnishing crushed trap rock for this job. Although funds are taken from 1916 appropriation, the contract has not progressed sufficiently to permit reporting this year.

Report from Southern Division.

Mr. R. A. Meeker, State Highway Engineer, Trenton, New Jersey:

DEAR SIR—A normal amount of road work has been undertaken in all of the counties of the Southern Division during the year just closed in spite of the high cost of materials and scarcity of labor. Nearly all of the contracts and a good deal of the force account work are, however, several months behind; one road that was reported nearing completion a year ago will appear under the same heading in this year's report. Most of the delay has been due to conditions unforeseen at the time the work was laid out, but in several instances a little more respect for the penalty clause would have hastened the completion of contracts.

Atlantic county has taken care of all its road repairs and resurfaced the Meadow boulevard with county funds. The Somers Point–Longport boulevard is ready for use and the Absecon–Atlantic City boulevard is under way, both with State aid.

Burlington county, following a policy of some years standing, has built no new roads, but has devoted all the county money and State allotments to repairs and resurfacing. Although most of the work has been macadam with bituminous dressing, a comprehensive system of reconstruction is being laid out, which, if adhered to for a few years, should put the roads of the county in first-class condition. The types in view consist of sheet asphalt, Portland cement and bituminous concrete.

Camden county has added several miles to its bituminous concrete roads, all of the new work and reconstruction being of this material.

Cape May county has reconstructed a short section of the Ocean highway with bituminous concrete, and intends to extend this type of pavement, as finances permit, until a hard surfaced road is completed the entire length of the county. The gravel roads of Cape May have been in almost perfect condition during the entire summer and fall, in spite of the dense travel, but the increasing cost of maintenance and the necessity of a winter road make a hard surface advisable for the main arteries.

Cumberland county has built one new gravel road and has used State allotment money for general repairs on the old gravel roads. The roads of the county have been maintained in a fair state during the year, but a higher class pavement will soon be demanded on the two main north and south routes. Gravel occurs in widespread abundance throughout the county, and this is the only material used up to the present time in Cumberland county improvements.

In Gloucester county considerable money has been spent for widening and for the construction of concrete gutters, both of which are in the nature of permanent improvements. A fruitless effort has been made to keep the macadam roads in repair, but it has been a hopeless task, and the

county will soon be forced to adopt a system of reconstruction with a higher class pavement. The gravel roads in Gloucester county have, with the exception of one section, been kept in good condition throughout the season. The Mullica Hill and Woodbury turnpike has been purchased by the State and county since the last report, leaving only three toll roads in existence in this division.

The sudden increase in travel over the roads in the vicinity of Pennsgrove, due to activity at the powder mills, has imposed a great burden upon Salem county. Construction of the main street in Pennsgrove has been started and reconstruction of the Pennsville–Pennsgrove road is under way, both with State aid. The county has had a gang of prisoners from the county jail at work on roads all summer with State money, and this department has nearly finished the Salem county section of Landis avenue, employing convicts from the State Prison, thus completing the road between Vineland and Bridgeton.

Wherever gravel roads predominate they have been well maintained, and for the most part show no material depreciation. They are practically impassable during January, February and March, but are restored to normal condition and kept in shape with small expense after the frost is out of the ground. Except upon the main routes to the seashore resorts, these are the most economical roads that we have. The main routes have reached the point where a better surface would be more economical. The bituminous concrete pavements constitute our best roads in the Southern Division; they wear well and are easily repaired and maintained, and, where properly laid, there is no doubt but that they are a good investment. Under conditions of travel in Southern New Jersey, macadam roads, either water or bituminous bound, are out of date and are a liability rather than an asset. Burlington county is "road poor," having nearly two hundred miles of macadam road that has been resurfaced, while bonds for the original construction are still outstanding. With the exception of a few miles of poorly constructed roads of other types, the poor roads of this division are macadam.

We have not had enough experience with Portland cement concrete to form an opinion as to its suitability for this section of the State, but it is being favorably considered, and short sections will be constructed in several counties during the coming year. Owing to the small appropriation for convict labor, there have been only twenty-two men at work at Camp No. 3A during the summer. The convicts have appeared more contented and have done more and better work than free labor for the past several months. Work has been plenty for free men, and they have been independent to the point of insolence on nearly all jobs.

My experience and observations lead me to believe that the general policy of construction and maintenance should be changed in several respects. It is a fact that our road surfaces are wearing out faster than they are being replaced, and, in the majority of cases, the maintenance is only a temporary expedient; the best that financial conditions permit, it is true, but highly uneconomical. While from a theoretical standpoint it would be impossible to have enough improved roads as long as any remained unimproved, from a practical standpoint we already have a great enough mileage, and, with the exception of a few connecting links that should be constructed to com-

plete a comprehensive system, it would be to the interest of the traveling public to have the available money from all sources expended in reconstruction and maintenance, and not for increase of mileage.

In the second place, State funds can be used to much better advantage in the reconstruction of through routes than in the improvement of borough streets and approaches to cities. Under the present law the initiative is with the local bodies, and it is to their interest to continue the present methods, but the law might well be amended to allow the State Department to distribute funds in the interest of the State as a whole. In four out of the seven counties in this division the majority of State money is being expended in built-up communities or in immediate approaches to them, while main-traveled roads are in a state of deterioration.

A third revision of policy is recommended in connection with convict labor. Under the present system, the only one possible under the law, the work is prosecuted under a verbal agreement between the State Department and the county authorities with the result that there is constant misunderstanding and disagreement between the officials and employees who are charged with deciding minor details in connection with construction. As long as the State Department must work in conjunction with the counties on convict labor roads, it is essential that an agreement be made in writing between the two parties setting forth, in detail, the duties and privileges of each. In this way heads of both departments would be spared much petty annoyance.

With respect to the employees of the Department in this division, I would recommend that promotion examinations be held and that a part of the rating be based on observation of the men at their work. There are drones who are able to present a good paper and make a good appearance at a written and oral examination, and there are active, well-meaning men who, because of unfortunate temperament or physical or mental incapacity, are unfitted for the positions that they hold. There are, on the other hand, capable, deserving men in the Department working for small pay because examinations do not take these intangible qualifications and disqualifications into consideration. I am under Civil Service, and fully appreciate its benefits, and I realize that this Department, fully as much as its employees, needs the protection of Civil Service. A rating based on observation of the men at work by an examiner from the Civil Service Commission would be fair to the men and a protection to the Department.

The relation between this division office and the county authorities and members of other State departments with whom it has dealing, continues amiable, and the pleasure of contact with these gentlemen constitutes no small part of the recompense of the position.

Very respectfully submitted,

ROY MULLINS,

Division Engineer.

Report on State Aid Bridges.

Mr. R. A. Meeker, State Highway Engineer, Trenton, New Jersey:

DEAR SIR—The most important and largest bridges completed during the past year were the three drawbridges constructed over Risley's Channel, Broad Thorofare and Patcong Creek, in Atlantic county, and a concrete arch span, in Warren county, over Pohatcong Creek, on the Bloomsbury–Still Valley Road.

The contract price for the Broad Thorofare bridge was $77,922.00, and for the bridge over Risley's Channel $73,243.00. Both of these drawbridges are of the two-leaf bascule type, with a clear waterway of fifty feet. The Patcong Creek bridge cost $42,485.18, which includes the center bearing steel draw span and the creosoted wooden approaches. The sixty-foot arch over Pohatcong Creek, in Warren county, cost $8,300.00. This improvement straightened the line of the old road and eliminated a dangerous old steel bridge and two steep approach grades.

The careful inspection and prompt repair of highway bridges is doubtless of equal importance with the patrol system for roads. The need of repair, however, is not always as self-evident in the case of a bridge as in that of the road. Often the greatest need is other than the actual bridge pavement, and is not so readily seen by the traveling public.

In many cases in the past it has required an accident such as an auto or motor truck breaking through the bridge to bring to the attention of the local governing bodies that one of the bridges under their supervision needed repair.

A thorough inspection of each bridge structure at least twice during the year, followed by such repairs as are necessary, would do much toward eliminating the numerous bridge accidents. It is not infrequent to find in the small pony truss bridges, erected some twenty years ago, that they are often without sections of the lower chord and, in some cases, floor-beam webs and stringer sections are partially rusted away.

It often happens, however, that by constant repair to the plank or wood-block deck the more serious defects are hidden until total failure occurs. The substitution of a concrete slab deck for a wooden floor in old steel structures has become quite common and doubtless is done as a step toward the elimination of a large portion of the yearly repair bills. That this is not always the safest method is particularly true in pin connected bridges where carelessness in placing the concrete, and, in a few cases, the actual boxing of the pin connections with concrete, causes overload and produces stresses which the original bridge was not designed to carry.

In the southern counties it seems to be poor economy to construct heavy concrete abutments on piling to hold heavy fills of the road approaches. A better method would be to lengthen the bridge by constructing small approach spans and thus decreasing the danger from overturning and wash

due to tide or stream current. The additional bridge length can easily be made in case of piling approach spans, and pays where the bridge is being built on a new line with sand fill forming the road approaches.

Little attention in the past has been given to the area of the drainage basin when designing the bridge with sufficient waterway to adequately provide for the flood of the stream. A study of the run-off, surface conditions of drained land, and drainage basin area is most essential to proper design.

An effort has been made to revise the bridge data collected several years ago, and to bring up to date the information in regard to new bridges erected on the principal highways of the State. Most of the locations of the important bridges have been shown on a map with a scale of one inch to the mile. The numbering and reference data has been made to conform, as far as possible, with the various county records. The Department has, however, not had a sufficient force to properly collect all of the new data for the main roads.

The following tables show the bridges accepted by the State during the past year and also the amount of work under construction at the present time.

Respectfully submitted,

L. McENTIRE,

Division Engineer in Charge of Bridges.

STATE AID BRIDGES.	Completed Bridges, 1912–1913.	Completed Bridges, 1913–1914.	Completed Bridges, 1914–1915.	Completed Bridges, 1915–1916.	Bridges Under Construction.	Total.
Atlantic,	.....	.....	4	8	16	28
Burlington,	1	.....	.....	.....	.....	1
Camden,	.....	.....	2	.....	.....	2
Cape May,	.....	.....	1	.....	.....	1
Cumberland,	4	.....	.....	.....	4	8
Hunterdon,	.....	1	.....	.....	.....	1
Mercer,	.....	.....	.....	4	.....	4
Middlesex,	1	1	.....	1	.....	3
Monmouth,	1	.....	.....	.....	.....	1
Ocean,	.....	1	.....	.....	.....	1
Somerset,	.....	1	1	.....	4	6
Union,	3	.....	.....	1	1	5
Warren,	.....	5	.....	2	3	10
Total,	10	9	8	16	28	71

County.	Bridge.	Road.	Type.	Total Cost.	Allowed by State.	State's Share.
Atlantic,	Lake's Creek,	Somers Point-Mays Landing,	Concrete Slab,	$4,875 44	$4,875 44	$975 09
Atlantic,	English Creek,	Somers Point-Mays Landing,	Steel Truss,	5,991 20	5,991 20	1,198 24
Atlantic,	Patcong Creek,	Somers Point-Mays Landing,	Draw Bridge,	42,485 18	42,326 88	8,465 38
Atlantic,	English Creek,	Northfield Road,	Concrete Slab,	2,164 55	2,164 55	216 45
Atlantic,	Bass Harbor,	Somers Point-Longport,	Wood Trestle,	16,970 15	16,957 25	1,695 73
Atlantic,	Risley's Channel,	Somers Point-Longport,	Draw Bridge,	77,611 85	77,558 45	7,755 85
Atlantic,	Broad Thorofare,	Somers Point-Longport,	Draw Bridge,	78,771 70	78,725 80	7,872 58
Atlantic,	Hospitality Creek,	Somers Point-Longport,	Wood Trestle,	23,480 84	23,480 84	2,348 08
Mercer,	Miry Run,	Windsor-Newtown-Yardville,	Concrete Slab,	2,045 00	1,820 00	364 00
Mercer,	Assunpink Creek,	Windsor-Newtown-Yardville,	Concrete Slab,			
Mercer,	Bridge at Sta. 223 + 51,	Windsor-Newtown-Yardville,	Concrete Slab,	3,016 30	2,716 30	543 26
Mercer,	Bridge at Sta. 278 + 78,	Windsor-Newtown-Yardville,	Concrete Slab,			
Middlesex,	Devil's Run,	Schalk's Station,	Concrete Slab,	1,400 00	1,400 00	280 00
Union,	West Brook,	Wood Ave., Linden,	Concrete Slab,	1,900 00	1,900 00	380 00
Warren,	Bridge No. 1,	Bloomsbury-Still Valley,	Concrete Slab,	8,441 00	8,441 00	1,688 20
Warren,	Bridge No. 2, Pohatcong Ck.,	Bloomsbury-Still Valley,	Concrete Slab,	595 80	595 80	119 16

BRIDGES UNDER CONSTRUCTION AND CONTRACT PRICES.

County.	*Bridge.*	*Contract Price.*
Atlantic,	Bridge No. 1, Absecon boulevard,	$6,000 00
"	Bridge No. 2, Absecon boulevard,	3,675 00
"	Bridge No. 3, Absecon boulevard,	4,600 00
"	Bridge No. 4, Absecon boulevard,	6,500 00
"	Bridge No. 5, Absecon boulevard,	3,500 00
"	Bridge No. 6, Absecon boulevard,	4,900 00
"	Bridge No. 7, Absecon boulevard,	10,500 00
"	Bridge No. 8, Absecon boulevard,	19,152 00
"	Bridge No. 9, Absecon boulevard,	25,500 00
"	Bridge No. 10, Absecon boulevard,	65,000 00
"	Bridges Nos. 2, 3, 4, 6, 7, and 8, Longport boulevard,	27,000 00
"	Culverts, Longport boulevard,	12,000 00
Cumberland,	Bear Creek,	491 00
"	Cedar Creek,	847 00
"	West Branch Panther Creek,	455 00
"	East Branch Panther Creek,	975 00
Somerset,	Dunham's Bridge,	1,680 00
"	Extension to arch at Sta. 131,	1,530 00
"	Bridge east of Worman's, Bridge west of Worman's,	2,300 00
Union,	South Branch, Rahway,	7,875 00
Warren,	Bridge No. 1, Buttzville-Danville road,	1,300 00
"	Bridge No. 2, Buttzville-Danville road,	850 00
"	Bridge No. 3, Buttzville-Danville road,	850 00
	Total,	$207,480 00

Township Roads.

Mr. R. A. Meeker, State Highway Engineer, Trenton, New Jersey:

DEAR SIR—Since July 1, 1916, this Department has taken up the administration of the Township Aid Law—Chapter 217, Laws of 1916—which provides State aid for the proper construction, grading and drainage of the unimproved township roads. About sixty-five applications were received from eleven counties. In many cases the requests could not be granted because the road for which applications were made had already received some form of State aid, and could not be considered under the provisions of the Township Law.

The failure of the townships in some of the counties to apply for the full amount apportioned to each county made it possible for the Commissioner, in accordance with the statute, to reapportion the funds after the first day of July to the applications first received.

As the act required the work of surveying and planning to be done by the Department, a great deal of time was required to do the necessary field work and prepare the plans and specifications before the work could be advertised.

The following table shows the applications and roads approved by the Commissioner.

Respectfully submitted,

L. McENTIRE,
Field Accountant.

Township Roads. Chapter 217, P. L. 1916.

	County.	*No. of Applications.*	*Total Applied For.*
1.	Burlington,	1	$5,000 00
2.	Gloucester,	1	3,271 28
3.	Hunterdon,	4	7,000 00
4.	Mercer,	2	5,500 00
5.	Middlesex,	1	600 00
6.	Monmouth,	2	3,750 00
7.	Morris,	1	2,500 00
8.	Somerset,	3	6,450 00
9.	Sussex,	5	12,250 00
10.	Warren,	15	32,500 00
	Total,	35	$78,821 28

Township.	*Name of Road.*	*Length Miles.*	*Amount Applied For.*
BURLINGTON COUNTY.			
Chesterfield,	Crosswicks-Chesterfield,	1.00	$5,000 00
GLOUCESTER COUNTY.			
Franklin,	Newfield Boulevard,	....	3,271 28
HUNTERON COUNTY.			
Clinton,	Annandale-Allerton,	3.00	3,000 00
Raritan,	Flemington-Stockton,	2.6	3,000 00
Readington,	Pleasant Run-Stanton,	1.3	500 00
Readington,	Dreahook Corner-Wyckoff Corner,	.69	500 00
MERCER COUNTY.			
Hamilton,	White Horse-Mercerville,	1.4	2,500 00
Hopewell,	Hopewell-Woodsville,	3.2	3,000 00
MIDDLESEX COUNTY.			
Piscataway,	New Market-New Brunswick,	1.3	600 00
MONMOUTH COUNTY.			
Wall,	Hamilton-Glendola,	1.00	2,500 00
Ocean,	Larchwood Avenue,	0.33	1,250 00
MORRIS COUNTY.			
Mt. Olive,	Budd's Lake-Mt. Olive,	....	2,500 00
SOMERSET COUNTY.			
Hillsboro,	Flagtown-South Branch,	2.0	3,000 00
Franklin,	Weston Canal,	3.00	2,250 00
Franklin,	Middle Lane,	1.75	1,200 00
SUSSEX COUNTY.			
Lafayette,	Lafayette,	1.5	1,500 00
Hampton,	Newton-Baleville,	3.0	2,750 00
Green,	Springdale-Schoolhouse-Tranquility,	3.00	1,500 00
Wallpack,	Ennis Bridge-Flatbrookville (1),	9.0	5,000 00
Sandyston,	Ennis Bridge-Flatbrookville (2),	2.0	1,500 00
WARREN COUNTY.			
Greenwich,	Stewartsville-Bloomsbury,	2.49	5,000 00
Mansfield,	Anderson Schoolhouse-Port Murray,	1.2	2,000 00
Oxford,	Belvidere Avenue,	0.81	1,000 00
Oxford,	Washington Avenue,	0.80	1,000 00
Pohatcong,	Forge-Springtown,	1.18	2,000 00
Hope,	Hope-Mt. Herman,	2.1	1,000 00
Knowlton,	Warrington-Delaware,	2.2	2,000 00
Hope,	Hope-Great Meadows,	2.5	1,000 00
Frelinghuysen,	Johnsonburg-Allamuchy,	2.3	2,000 00
Frelinghuysen,	Blairstown-Newton,	3.8	2,000 00
Allamuchy,	Johnsonburg-Allamuchy,	2.8	2,000 00
Mansfield,	Hackettstown-Rock Port,	1.8	2,000 00
Blairstown,	Hackettstown-Rockport,	1.8	2,000 00
Blairstown,	Paulina Rd.,	1.1	2,000 00
Independence,	Great Meadows-Allamuchy Twp. Line,	2.9	1,500 00

Township Aid Law.

CHAPTER 217, P. L. 1916.

AN ACT to provide for the proper construction, grading and drainage of the unimproved township roads of the State and to provide State aid therefor.

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey:*

1. There shall be set aside annually from the net receipts of the motor vehicle fund the sum of one hundred and five thousand dollars, which shall be used to meet the State's share of the cost of the work hereinafter prescribed. Payments from this fund shall be made in the same way as other payments from the motor vehicle fund. The State Commissioner of Public Roads shall reserve each year a sum of five thousand dollars to meet the said State's share in each county until the first day of July. Any amount thus reserved that has not been applied for on said date shall be distributed among other applicants, in the discretion of said Commissioner, for the work contemplated by this act.

2. Any township committee may on its own motion apply to the said Commissioner for aid under this act. Such application may be passed by resolution of said township committee at any meeting. It shall set forth the road or roads on which it is proposed that the work shall be done and the beginning and ending points of such work, and the amount of money the said committee may be authorized to spend on the work, including any contributions thereto.

3. The State Commissioner of Public Roads shall decide which applications in any county will best serve the interests of the township, county and State. He shall notify the township committee of his approval of such applications and shall thereupon enter with them into a written agreement for the necessary planning and surveying and for the doing of the actual work and for the inspection thereof. Said work may be performed, in whole or in part, by the labor of prisoners, by contract, either with or without advertisement, but advertisement shall in every case be made upon the demand of said Commissioner.

4. The work contemplated under this act will include, in addition to constructing said road, the survey and preparation of plans, profiles and cross-sections, the grading and drainage of the road and the construction of the necessary culverts and bridges whose construction and maintenance is by law now imposed upon the township authorities.

5. The share of the cost of the work to be assumed by the State shall not exceed fifty per centum of the cost of the actual work. In addition the State shall pay the cost of the survey and preparation of plans. Said work of survey and planning shall in all cases be done by said Commissioner and shall be paid for out of said fund.

6. Township committees are hereby authorized to raise the funds necessary for the work contemplated in this act, by including the same in the tax levy or by temporary loans, the amount of which said temporary loans and the interest thereon until time of payment shall be included in the tax levy of the next year following that in which the indebtedness is incurred. Any township committee is hereby authorized to accept contributions from any person or corporation toward meeting its share of the cost of this work. The financial officer of the township is hereby directed to receive such contributions and to properly credit the same.

7. Any township committee may acquire any land necessary for straightening or relocation of any road on which work is to be done under this act by gift, grant, demise, by purchase, or by the exercise of eminent domain, in the manner now provided by law. All roads on which work may be done under this act shall have a right of way not less than thirty-three feet wide.

8. It shall be the duty of any township committee, accepting State aid under this act, to maintain the roads on which State aid has been received in a condition satisfactory to the State Commissioner of Public Roads. The State Commissioner of Public Roads may agree in any year to assume a share, not exceeding one-half of the cost of said maintenance, and to pay the same out of the receipts of the motor vehicle fund.

9. The State Commissioner of Public Roads is hereby authorized to employ such assistants, either temporary or permanent, as may be necessary for the discharge of the duties imposed upon him by this act.

10. All acts and parts of acts inconsistent with this act are hereby repealed, but this repealer shall not work to revive any statute or part thereof heretofore repealed.

11. This act shall take effect immediately.

Approved March 20, 1916.

Road Accounts.

Mr. R. A. Meeker, State Highway Engineer, Trenton, N. J.:

DEAR SIR—In order to establish a uniform system of road accounts the Department has prepared a set of record sheets, which have been forwarded to the Supervisor of Roads of each county. It is the intent of these record sheets to supply the information necessary to the proper apportionment of the motor vehicle receipts, and also to record the maintenance costs per square yard, for the different types of pavement.

The old records, giving the maintenance per mile for the different types of roads, were of little value, owing to the various widths and conditions of travel. It has been deemed advisable to reduce all the maintenance charges to a square yard basis, in order to be better able to compare various pavements.

One series of blanks forwarded to the counties, known as an Equipment Record, gives the following information:

EQUIPMENT RECORD.

.....County, N. J.

1, Description, equipment, replacements and repairs. 2, Make, date of purchase, inventory, replacement, repair. 3, Number. 4, Original value. 5, Cost of replacement and repair. 6, Total amount for year. 7, Percentage of depreciation. 8, Amount of depreciation. 9, Present net value. 10, Operation days. 11, Average daily cost of operation.

The annual report of Maintenace and Betterment shows the following:

Name of road; Miles; Width; Total Square Yards; Type of Pavement; Cost of Maintenance per square yard; Amount Received from Motor Vehicle Fund.
Force Account Work.—Asphalt; Tar; Lignin Binder; Stone; Gravel; All other Materials; Labor; Teams and Equipment; Patrol System; Maintenance Gang System.
Work Done By Contract or Agreement.
Sundries.
Supervision and Inspection.
Depreciation of Equipment.
Total Maintenance.
Total Betterment.

Detailed report for each road shows the following:

MAINTENANCE AND BETTERMENT ACCOUNT.

Road—Cost per square yard for Maintenance for Year 19 . $
Notes.
Date, 1916.
M. (Maintenance), B. (Betterment).
Force Account Work.—Asphant; Tar; Lignin Binder; Stone; Gravel; All other Materials; Labor; Teams and Equipment; Patrol System; Maintenance Gang System.
Work Done By Contract or Agreement.
Sundries.
Supervision and Inspection.
Total Maintenance.
Total Betterment.
Grand Total.
Remarks.
Amount Received From Motor Vehicle Fund.

This annual report is supplemented by a similar report in detail for each road, and gives the cost per square yard for maintenance for the year.

A distinction has been made between the items for maintenance and betterment. Roughly the division is as follows: Maintenance charges are those necessary to put the road in the same condition as when first constructed. This is purely a repair charge. The betterment charges are those costs due to widening, changing the grade, or constructing an entirely different type of road.

Respectfully submitted,

L. McENTIRE,

Field Accountant.

Report of Surveying Corps, 1916.

Mr. R. A. Meeker, State Highway Engineer, Trenton, New Jersey:

DEAR SIR—The past year marks the establishment of a Surveying Corps as a distinct part of the organization of the Department of Public Roads. Heretofore there had not been such an organization, nor had there been any equipment, and the Department was compelled to employ outside engineers to make all needed surveys.

The legislative appropriation of 1915 for the Department of Public Roads carried a certain sum to organize and equip a Surveying Corps, and in November of 1915 I was appointed to administer the same.

The organization, at first, consisted of one field party of three men, with the necessary equipment, but for the past two months, during the time of the township road surveys, it has been increased to two parties of three each and one office man, making a total of eight men on the present force. This organization has been augmented furthermore with three other parties outside of the Department, employed on special surveys.

I have ascertained that the cost of work which was done by my men has averaged, in most cases, about eighty per cent. of the cost of similar work done by outside parties, notwithstanding the fact that the latter were more familiar with the local conditions. Thus it would seem that the Surveying Corps is not only a great convenience for doing the work expeditiously, but it is also an economical branch of the Department.

A yet further saving could be accomplished by supplying one or more small cars for the use of the Corps, because much time is lost in traveling to and from the various jobs, due to the fact that conveyances are rarely conveniently near at hand.

The following is a brief resumé of the various surveys and other work done during the year:

A new State road map, on the scale of two miles to one inch, has been started, and was about one-half completed when more pressing work caused it to be laid aside temporarily.

Surveys have been made for the division engineers of the central and southern divisions to assist their foreman on the prison labor work in camps numbers two and three.

The Legislature of 1916 provided for a survey of an extension of the ocean boulevard from Atlantic Highlands to Keyport. This survey will probably be resumed in the very near future.

I have made a reconnaissance survey to determine the probable cost of a system of roads which would comply with the routes as laid out in Chapter 285, P. L. 1916, commonly known as the Egan Bill. The complete results of this survey have been made the subject of a detailed report already submitted to you in the month of September, 1916.

The following is a description of the several routes:

Route No. 1. Elizabeth to Trenton.—Beginning at St. George's avenue (Rahway avenue) at the south city line of Elizabeth and following it to the Pennsylvania Railroad in Rahway; thence along the north side of the railroad along the Essex and Middlesex turnpike to the grade crossing between Colonia and Iselin; thence along a new right of way to the beginning of Middlesex avenue in Menlo Park; thence along Middlesex avenue to Metuchen, detouring at Lake street to avoid a grade crossing, and passing the Lehigh Valley Railroad station, and thence back on Middlesex avenue; thence along Middlesex avenue to the Albany street bridge over the Raritan river to the New Brunswick city line; beginning again at the Cranbury turnpike at the south city line of New Brunswick and along the said turnpike to Hightstown; thence through Windsor, Robbinsville, Hamilton Square and Mercerville to Greenwood avenue, and thence along Greenwood avenue to the Trenton city line.

Route No. 2. Trenton to Camden.—From Trenton city line, along the White Horse road, White Horse road extension, and Trenton road to Park street and Farnsworth avenue, Bordentown; thence along Florence road to Burlington; thence through Burlington to and along the Camden-Burlington pike to the Camden city line.

Route No. 3. Camden to Absecon.—Beginning at the White Horse pike, Camden city line, and following the present line through to Absecon, with the exception of a realignment around Hammonton.

Route No. 4. Rahway to Absecon.—Beginning at the intersection of the Essex and Middlesex turnpike and St. George's avenue in Rahway, at junction with Route No. 1; thence along St. George's road to Perth Amboy avenue, Woodbridge; thence along Perth Amboy avenue to Perth Amboy city line; then beginning at the north end of the Perth Amboy-South Amboy bridge crossing the Raritan river; thence along Stephens avenue, with some changes in line, to the Keyport road, and through Keyport, following the Keyport road to Middletown; thence along the Middletown-Red Bank road to Red Bank; thence along the Red Bank-Eatontown road to Eatontown; thence along the Eatontown-Long Branch road to the Monmouth road, and thence along same to Cedar avenue, to Norwood avenue and thence southerly along Norwood avenue, crossing Deal lake to Asbury Park; thence along Main street, through Asbury Park, Neptune township, Bradley Beach and Avon, crossing the Shark river bridge to Belmar; thence along the Belmar and Manasquan river road to Point Pleasant, from Point Pleasant through Burrsville to Lakewood; thence along the Lakewood-Toms River road to Toms River; thence along the Main Shore road to New Gretna, with a detour in Lacy and Ocean townships to eliminate two grade crossings; thence along the Chestnut Neck road to Absecon, to junction with Route No. 3.

Route No. 5. Newark to Delaware river.—Along Springfield avenue from Newark city line to Morris avenue, Springfield; thence westerly along Morris avenue to Madison avenue to Morristown; thence along Speedwell street through Morris Plains, Mount Tabor to Denville; thence through Rockaway to Dickinson's bridge; thence along Blackwell street through

Dover to the Sussex turnpike and along the same to Ledgewood and to the culvert under the canal; thence along the Sussex–Newton turnpike to Netcong borough line; thence to avoid railroad grade crossings on a new line to Budd's Lake road; thence southerly along Budd's Lake road and a new road to be built along the easterly shore of Budd's Lake to Hackettstown; leaving Hackettstown by the Denville road through Denville to the Buttzville road and the Buttzville-Belvidere road to the Delaware road; thence along the Delaware road and new line to Delaware and extending to the bridge over the Delaware river, ending at the New Jersey–Pennsylvania State line.

Route No. 6. Camden to Bridgeton.—Beginning at Broadway, southerly from the Camden city line, through Gloucester to the Gloucester–Woodbury turnpike (toll road) to Woodbury; thence along the Mantua turnpike to Mullica Hill; thence along the Mullica Hill road to Oldman's creek; thence to Shirley and along the Shirley–Deerfield road and the Deerfield–Bridgeton road to Bridgeton.

Route No. 7. Hightstown to Asbury Park.—Beginning at the junction with Route No. 1 at Hightstown along the Manalapan road to Manalapan, along the Manalapan–Freehold road to Freehold; thence along the Freehold–Jerseyville road to Jerseyville, and along the Jerseyville–Hamilton road to Corlies avenue to Main street, Neptune township, where it joins Route No. 4, and a short distance along same to Asbury Park.

Route No. 8. Montclair to near Unionville, New York State.—Beginning in Montclair and following the Pompton turnpike to the junction with the Paterson–Hamburg turnpike at Riverdale; thence along the Paterson–Hamburg turnpike to Stockholm; thence along the Stockholm–Franklin Furnace road to Franklin Furnace; thence through Hardinstonville and Hamburg to Sussex; thence northerly from Sussex borough, on the road east of the D., L. & W. R. R. to the State line near Unionville.

Route No. 9. Elizabeth to Phillipsburg.—Westfield avenue westerly from Elizabeth city line to Westfield; thence along South avenue to the Plainfield city line; thence westerly from Plainfield city line on Front street and Lincoln road to Union avenue, through Bound Brook to Gaston avenue and Main street, Somerville; thence along Brunswick pike to the White House–Lebanon road; thence along the Clinton–West Portal road through Bloomsbury and Still Valley to Phillipsburg.

Route No. 10. Paterson to Fort Lee Ferry.—From Market street bridge over the Passaic river in Paterson easterly along Essex street to Hackensack, through Hackensack and along Fort Lee turnpike to River road, with an improved connection; thence along River road to Fort Lee ferry.

Route No. 11. Paterson to Newark.—Beginning at the southerly city line of Paterson on Main street and continuing along the same to the northerly city line of Passaic; thence continuing from the southerly city line of Passaic on Passaic avenue to the end of the same in Nutley; thence by a new line to Franklin avenue and along the same, and by a new line through Soho Park to Harrison street, through Bloomfield and Belleville to Franklin street and along the same to the Newark city line, near the northerly end of Branch Brook Park.

Route No. 12. Paterson to Phillipsburg.—From the Paterson city line southerly along the Little Falls road through Little Falls and Singac; thence along Fairfield road to Bloomfield avenue at the Passaic river bridge; thence along the Pine Brook–Denville road to Denville, where this Route joins with Route No. 5 and continues over the same to Hackettstown; thence continuing from Hackettstown along the Morris turnpike, as now built, through Washington borough to Phillipsburg.

Route No. 13. New Brunswick to Trenton.—From the westerly city line of New Brunswick along Somerset street to Franklin Park; thence continuing to Ten Mile run, to Kingston and across the canal and Millstone river to and through Princeton borough; thence to Lawrenceville and along the Lawrenceville–Trenton road and Princeton avenue to the Trenton city line.

The tabulated summaries covering the foregoing routes, from the detailed report, follow:

EGAN ACT ROUTES.

MILEAGE OF PRESENT TYPES BY ROUTES—WITH COST OF IMPROVING.

Route.	Up to Standard.	Under Contract.		Standard (Narrow).		Macadam, Telford, Surface Dressing.		Shell and Gravel.		Dirt and New Road.		Bridges (Long).	Turnpike, Purchase and Improvement.	
No.	Miles.	Miles.	Cost.	Miles.	Cost.	Miles.	Cost.	Miles.	Cost.	Miles.	Cost.	Miles.	Miles.	Cost.
1	1.60	24.65	$493,570	.....	.....	16.03	$298,340	.....	.....	3.27	$126,740	0.15	.....	.....
2	.....	.....	.....	3.85	$23,100	17.61	479,310	.....	.....	8.00	276,000	.....	.....	.....
3	.....	.....	.....	.....	.....	12.85	306,900	34.72	$851,810	0.30	15,300	.....	.....	.....
4	5.11	2.08	31,950	.....	.....	19.03	371,290	81.66	2,252,820	2.85	120,300	2.10	.....	.....
5	1.83	5.85	83,040	.....	.....	48.91	1,195,060	.....	.....	10.15	551,700	.....	.....	.....
6	.....	.....	.....	.....	.....	5.92	117,360	8.71	251,890	17.15	580,200	0.05	3.50	$174,200
7	.....	.....	.....	.....	.....	16.36	424,400	12.70	412,360	.....	.....	.....	.....	.....
8	6.53	.....	.....	.....	.....	34.72	1,024,350	.....	.....	6.50	263,500	.....	.....	.....
9	.....	1.76	21,000	.....	.....	43.21	857,300	.....	.....	5.24	182,040	.....	.....	.....
10	7.85	0.54	26,630	.....	.....	1.22	33,480	.....	.....	2.23	254,800	.....	.....	.....
11	.....	.....	.....	.....	.....	5.77	136,560	.....	.....	0.80	72,280	.....	.....	.....
12	1.80	.....	.....	1.00	13,000	37.30	985,650	.....	.....	0.55	19,500	.....	.....	.....
13	.....	5.71	81,200	.....	.....	20.97	433,820	.....	.....	.....	.....	.....	.....	.....
Totals,	24.72	40.59	$737,390	4.85	$36,100	279.90	$6,663,820	137.79	$3,768,880	57.04	$2,462,360	2.30	3.50	$174,200

TABLE No. 2.—SUMMARY BY ROUTES.

Route.	Miles.	Right of Way.	Grading.	Paving and Drainage.	Total Cost.	Cost Per Mile.
No. 1, ...	45.70	$35,000	$61,510	$822,140	$918,650	$20,102
No. 2, ...	29.46	33,000	197,350	548,060	778,410	26,423
No. 3, ...	47.87	6,000	150,790	1,017,220	1,174,010	24,525
No. 4, ...	112.83	111,500	380,580	2,284,280	2,776,360	24,607
No. 5, ...	66.74	83,000	472,960	1,273,840	1,829,800	27,417
No. 6, ...	35.33	107,000	224,440	792,210	1,123,650	31,804
No. 7, ...	29.06	33,500	163,800	639,460	836,760	28,794
No. 8, ...	47.75	35,000	455,610	797,240	1,287,850	26,971
No. 9, ...	50.21	61,000	131,820	867,520	1,060,340	21,118
No. 10, ...	11.84	35,000	169,200	110,710	314,910	26,597
No. 11, ...	6.57	45,000	22,120	141,720	208,840	31,787
No. 12, ...	40.65	6,000	171,600	840,550	1,018,150	25,047
No. 13, ...	26.68	3,000	81,420	430,600	515,020	19,303
Totals, ...	550.69	$594,000	$2,683,200	$10,565,550	$13,842,750	$25,137

TABLE No. 3.—COUNTY CONTRACTS TO BE REPAID.

Route.	Miles.	Total Contract Price.	State Aid.	County's Share.	Cost Per Mile, Total Contract.	Cost Per Mile, County's Share.
No. 1, ...	24.65	$523,570	$30,000	$493,570	$21,240	$20,023
No. 4, ...	2.08	70,400	38,450	31,950	33,846	15,361
No. 5, ...	5.85	155,100	72,060	83,040	26,513	14,195
No. 9, ...	1.76	41,000	20,000	21,000	23,295	11,932
No. 10, ...	0.54	26,630	.....	26,630	49,315	49,315
No. 13, ...	5.71	146,200	65,000	81,200	25,604	14,221
Totals, ...	40.59	$962,900	$225,510	$737,390	$23,723	$18,167

TABLE No. 4.—GRAND SUMMARY.

Kind of Work.	Miles.	Right of Way.	Grading.	Paving and Drainage.	Total Cost.	Cost Per Mile.
Rebuilding, ...	426.04	$344,500	$1,777,270	$8,521,230	$10,643,000	$24,981
New work	57.04	249,500	905,930	1,306,930	2,462,360	43,169
Contract (State Aid),..	30.49	.....	.....	574,590	574,590	18,845
Contract (County Unaided), ...	10.10	.....	.....	162,800	162,800	16,119
No work needed, ...	24.72	.....	.....	.....	.....	.....
Bridges (Long), ...	2.30	.....	.....	.....	.....	.....
Totals of Routes 1–13,	550.69	$594,000	$2,683,200	$10,565,550	$13,842,750	$25,137

The following correction should be noted: The Lawrenceville–Princeton road on Route 13, on which it was proposed to give aid for repairs to the extent of $55,000, has not been constructed; therefore, the work done under County Contracts To Be Repaid should be reduced by five miles and $55,000; and there should then be added to Reconstruction of Macadam, Telford, etc., five miles and $110,000, increasing the grand total by $55,000; bringing the sum up to $13,897,750.

The foregoing tables were arrived at on the following assumptions: that the present requirements of a six-degree curve and a five-per-cent. grade would be adhered to whenever practicable.

The unit prices of grading and drainage used were:

Excavation—Earth, ...	$0.60	per cubic yard.
Rock, ...	3.00	per cubic yard.
Extra Embankment, ...	0.80	per cubic yard.
Drainage—French Underdrains, ...	$0.60	per lineal feet.
Cross Drains, ...	1.25	per lineal feet.
Catch Basins, ...	25.00	each.
Gutters, ...	1.25	per square yard.

Guards Rails,	$0.80 per lineal foot.
Paving,	$1.60 per square yard.

Average Quantities and Cost Per Mile—

6,400 cubic yards earth, at $0.60,	$3,840 00
180 cubic yards rock, at $3.00,	540 00
1,400 cubic yards fill, at $0.80,	1,120 00
Total,	$5,500 00

Cost of paving and drainage averaging 23′ 0″ wide, under not unfavorable conditions.

12,000 square yards paving, at $1.60,	$19,200 00
1,500 lineal feet underdrain, at $0.60,	900 00
Cross drains and catch basins,	330 00
600 square yards gutters, at $1.25,	750 00
1,000 lineal feet guard rail, at $0.80,	800 00
Signs,	20 00
Total,	$22,000 00

This estimate does not include any amounts for reconstructing bridges, nor for railroad grade-crossing elimination.

Surveys have been made for road work at two State institutions to carry out the provisions of the law providing that all such work must be approved by the State Commissioner of Public Roads.

The latest and most extensive work has been the making of surveys and plans for the township roads for State aid, as provided for in Chapter 217, P. L. 1916. These had to be done very rapidly, and, while the close of the fiscal year witnessed all the field work completed, the plans have not yet all been entirely finished. They are, however, being rapidly pushed to completion.

Under the above-mentioned act precisely 68.06 miles of roads have been surveyed. In addition to the township road work, about 6.50 miles of other roads have been surveyed, making a total of 74.56 miles of road surveys accounted for.

Respectfully submitted,

F. WESTERVELT TOOKER,

Engineer of Surveys.

Report on Laboratory and Experimental Work.

Mr. R. A. Meeker, State Highway Engineer, Trenton, New Jersey:

DEAR SIR—The value of specifying under each item of construction the type, size, grade and character of materials that should be used therein becomes more pronounced each season. The chances for the use of cheap and inferior grades of materials, or of disputes arising as to just what is required, are very much reduced thereby. Bids based on the use or substitution of cheap or inferior grades of materials for those specified are becoming more rare each year.

The requirements governing the quantity and quality of the various materials used in the different types of road construction are practically the same as those used in 1915. Additional materials, such as culverts, expansion joints, asphalt blocks, bricks, stone blocks, etc., have been defined. It is very doubtful if the quality of the materials in general, as now defined, would be improved sufficiently by further modifying the requirements therefor to justify such changes. These usually increase the cost of the materials affected. All such changes should be discouraged unless a marked improvement in quality will be secured thereby.

It has now been over four years since we introduced the system of determining the properties and merits of the various road-building materials by the use of an "Approved List of Road Materials." I desire to call your attention in particular to the labor, trouble, time and expense that has been saved by the use of this method. The contractors are not only saved the trouble of securing and submitting with their bids samples of the materials they intend to use, but the chances of having their bids thrown out by submitting an unsuitable sample is avoided. The time consumed and expense incurred in determining the quality of samples thus submitted is also eliminated. With a list of the firms who can supply any material specified, contractors are often able to secure lower prices than otherwise, and can reduce their bids accordingly.

By our present method of procedure, most of the materials used in road construction are tested in the laboratory maintained by the Department of Conservation and Development before using. It is to be desired that all materials used during the 1917 season be tested, but it will be impossible to do any greater quantity or variety of work than is now being done until a more adequate and better equipped laboratory is secured. As stated in our 1915 report, we expected to be in our new laboratory building before this date; an appropriation was made to the Department of Conservation and Development for this purpose. However, on account of the rapid advance in the price of building materials, this appropriation was not sufficient for the purpose, and a larger one was secured. Unfortunately, the latter

appropriation was not available until after November 1, 1916. It may be possible to rush the new laboratory building to completion in time so that it can be used during part of the 1917 season. When this building is completed we will have ample facilities for testing all the materials to be used.

Samples of all materials to be used in the construction of all bituminous pavements are now forwarded to the laboratory and tested before construction is begun. During construction samples are forwarded as the materials are received. A pavement sample is also cut daily by the inspector and a sample forwarded, together with his daily laboratory report. By this procedure a very close check is kept on the materials being used and the quality of the pavement produced therefrom. When bad materials are received, or errors in constructing the pavement occur, they can be quickly corrected or eliminated.

During the season of 1916 no experimental pavements were constructed. While the value of a pavement can generally be roughly determined by such an experiment, a better average estimate of its value is secured by the actual construction of a mile or two under normal conditions. You have, no doubt, noticed that some pavements constructed by contractors of average ability have not given the results the laboratory tests and experimental stretches, previously constructed, indicate should be secured. In some cases, however, just the reverse is true. This is not surprising, for the value of any type of construction depends upon the proper control of the various factors entering into its construction. In certain cases these factors can be much better controlled when the quantity of the work is quite limited, while, on the other hand, the same equipment must be installed and initial expense incurred to prepare and lay ten square yards of any bituminous concrete as is required for ten thousand square yards.

Again, laboratory and experimental pavements are usually constructed during favorable weather conditions and on well-drained bases. This is not true of pavements in general. Neglect to properly protect pavements against either or both of these adverse factors could easily produce the variations above cited, and is, no doubt, one, if not the chief, cause of the various premature pavement failures, especially in bituminous and block pavements.

As the mileage of the so-called "permanent" surface is rapidly increasing, the number of premature failures naturally becomes greater year after year. This is particularly true of bituminous concrete surfaces that are three or more years old, and further confirms the conclusions given in previous reports regarding the conditions which vitally affect the life of these high-priced pavement surfaces. On account of the damage done by not proceeding in the proper manner or neglecting some of these vital factors, it is, no doubt, advisable to again enumerate them.

First, it is absurd to assume that any novice who can get a bond can properly construct a high-priced pavement. It is even more foolish to assume that the State's interests are protected by such a bond. If skill along any line could be secured in such a manner, it would be needless to spend large sums of money and years of time in training to secure such an attainment.

Second, an expensive equipment is generally required to properly construct these types of surfaces, and unless a contractor has such an equipment it is impossible for him to do a satisfactory job, regardless of how skilled he may be. A good inspector cannot cure or always detect the defects produced by incompetent workmen or a bad equipment.

Third, it is of vital importance that the successful bidder should be skilled in the work to be done, have the required equipment and the necessary finances to properly prosecute the work, and these factors should have equally as much weight in the awarding of contracts as a few dollars difference in the price bid therefor. If contracts cannot now be legally awarded in this way, the present statutes should be so modified as to permit of that practice. It is impossible to draw a specification that will describe that essential "good workmanship." There is a vast amount of difference between merely complying with a specification and producing a good job. No amount of inspection will absolutely insure that result.

Fourth, the damage done bituminous pavements by being laid on an improperly drained base is greatly underestimated. This is particularly true of old macadam roads which have been resurfaced with a bituminous pavement. Before being thus resurfaced any water that got into the bases of these roads quickly evaporated. When the surface is covered with a bituminous pavement the avenues of evaporation are thus closed and the water is held in the base. It is very seldom that they are dry, even in midsummer, when thus used as a base. Since all bitumens are affected by water, particularly surface waters which are charged with oxygen and carbon dioxide, the life of any bituminous pavement naturally depends on the rate the bitumen is decomposed by these adverse agencies. The rate of attack also depends upon the temperature of the water and character of the bitumen, for some bitumens are decomposed more quickly and easily than others. The action, in general, therefore, is greatest during warm and hot weather, and maybe nearly negligible during cold or freezing weather. Drains should be so located that water will be prevented from passing through the shoulders into the base of the road, for it is more important to keep water out of the base of the road than to remove it after it gets there. For this reason drains located adjacent to or under the edge of the pavement, under a header or curb when the pavement extends the full width of the street, will perform a double function. Drains of this type constructed parallel to street car tracks are of vital importance, for the latter will invariably force water into the base of a road.

Fifth, all pavements are injured by a movement in the foundation. Some are injured more than others. The bond in a grouted block pavement is usually destroyed and a premature failure started by any movement in the base. For this reason this type of pavement should always be laid on a concrete foundation with a mortar cushion. Macadam bases seldom possess the stability required for this type of pavement. Of the bituminous pavements those that are the most elastic are the ones least affected by movements in the base, yet, on the other hand, since the lack of stability is usually caused by the presence of water in the sub-base, the denser the mixture the slower the attack will be from this water. However, if the pavement is brittle or

so deficient in ductility or elasticity that cracks are formed therein by slight movements of the base, water is then admitted into the pavement, which is thus soon ruined. It is safe to assume that the life of any pavement is shortened by movements in the base thereof and that bituminous pavements are soon ruined by such conditions or the factors producing them.

Very respectfully yours,

R. B. GAGE,

Chemist to Division of Geology,

Department of Conservation and Development.

Appendix A.

CONTRACT FOR STATE AID
for the Bridge over the
.....
IN THE.....ROAD
Between the
STATE COMMISSIONER OF PUBLIC ROADS
and the
BOARD OF CHOSEN FREEHOLDERS,
COUNTY OF
.....

WHEREAS, The State Commissioner of Public Roads, under authority conferred on him by section 4, chapter 395, laws of 1912, deems the following bridge in the .....
a road to be improved, namely, ...
.....
to be.....
and the cost of the structure yet unbuilt to replace the said bridge as too great for the public body charged with its construction;

AND WHEREAS, The Board of Chosen Freeholders, the body so charged, desires to replace the said structure with.....
.....

Now, THEREFORE, It is agreed between the said parties, the Board of Chosen Freeholders of.....county and the State Commissioner of Public Roads, that the said Board will erect, or cause to be erected, the structure above described at a location to be approved by said State Commissioner of Public Roads and in strict compliance with plans and specifications likewise to be approved by the said Commissioner.

The said Board further agrees that the contract for the erection of said structure shall specify that payments on account shall be not more than 80 per cent. of the cost of the work, at the prices named in the contract, and that the final payment shall not be made until the structure has been accepted by the Commissioner of Public Roads as complying in all respects with the plans and specifications therefor.

The said Board further agrees to advertise for and receive bids as required in section 3, chapter 395, laws of 1912, in the case of roads.

The said Board further agrees that all of the provisions as to the contract and bond and its approval and as to the approval of the plans and specifications, as provided in section 2 of said act, shall be enforced as to the planning and letting of the contract for the structure aforesaid.

In consideration of the construction by the said Board of the structure under the conditions above set forth, the said State Commissioner of Public Roads agrees, on behalf of the State, to pay to said Board, on completion of the work and its acceptance by said Commissioner, a sum equal to.....per cent. of the contract price therefor.

IN WITNESS WHEREOF, The said Commissioner has signed and sealed these presents, and the said Board has caused the same to be signed by their Director and their corporate seal to be attached thereto and attested by its Clerk this.....
day of....., 191....

.....
State Commissioner of Public Roads.

.....
Director Board of Chosen Freeholders,
County of.....

Attest:
.....
[SEAL.] *Clerk.*

Appendix B.

NUMBER OF TONS OF STONE PER MILE REQUIRED TO BUILD THE FOLLOWING DEPTHS AND WIDTHS.

For the information of intending road builders, we have compiled the following tables, which approximate the number of tons of thoroughly rolled stone necessary to construct each mile at the designated depths and widths.

The basis is 3,000 tons of loose stone or 3,500 tons of compressed stone for a road one mile long, sixteen feet wide and eight inches deep. A road eight inches deep, when finished, will have required at least ten inches of stone. It should be placed in two layers of five inches each, and each layer rolled down to four inches. Then the application of the three-quarter inch and screenings will bring the road to the prescribed depth; for other thickness the stone should be placed in proportion to the intended finished depths.

An observance of this rule will insure the contract thickness for the roadbed, and save the sometimes necessary expense of resurfacing before acceptance from the contractor.

A road	8	feet	wide	and	4	inches	deep	will require	875	tons of stone per mile.
"	8	"	"		6	"	"		1,312½	" " "
"	8	"	"		8	"	"		1,750	" " "
"	8	"	"		10	"	"		2,187½	" " "
"	8	"	"		12	"	"		2,625	" " "
"	9	"	"		4	"	"		984⅜	" " "
"	9	"	"		6	"	"		1,476 9/16	" " "
"	9	"	"		8	"	"		1,968¾	" " "
"	9	"	"		10	"	"		2,460 15/16	" " "
"	9	"	"		12	"	"		2,953⅛	" " "
"	10	"	"		4	"	"		1,093¾	" " "
"	10	"	"		6	"	"		1,640⅝	" " "
"	10	"	"		8	"	"		2,187½	" " "
"	10	"	"		10	"	"		2,734⅜	" " "
"	10	"	"		12	"	"		3,281¼	" " "
"	11	"	"		4	"	"		1,203⅛	" " "
"	11	"	"		6	"	"		1,804 11/16	" " "
"	11	"	"		8	"	"		2,406¼	" " "
"	11	"	"		10	"	"		3,007 13/16	" " "
"	11	"	"		12	"	"		3,609⅜	" " "
"	12	"	"		4	"	"		1,312½	" " "
"	12	"	"		6	"	"		1,968¾	" " "
"	12	"	"		8	"	"		2,625	" " "
"	12	"	"		10	"	"		3,281¼	" " "
"	12	"	"		12	"	"		3,937½	" " "

A road	13	feet	wide	and	4	inches	deep	will require	1,421⅞ tons of stone per mile.
"	13	"	"		6	"	"		2,132$^{13}/_{16}$ " " "
"	13	"	"		8	"	"		2,843¾ " " "
"	13	"	"		10	"	"		3,554$^{11}/_{16}$ " " "
"	13	"	"		12	"	"		4,265⅝ " " "
"	14	"	"		4	"	"		1,531¼ " " "
"	14	"	"		6	"	"		2,296⅞ " " "
"	14	"	"		8	"	"		3,062½ " " "
"	14	"	"		10	"	"		3,828⅛ " " "
"	14	"	"		12	"	"		4,593¾ " " "
"	15	"	"		4	"	"		1,640⅝ " " "
"	15	"	"		6	"	"		2,460$^{15}/_{16}$ " " "
"	15	"	"		8	"	"		3,281¼ " " "
"	15	"	"		10	"	"		4,101$^{9}/_{16}$ " " "
"	15	"	"		12	"	"		4,921⅞ " " "
"	16	"	"		4	"	"		1,750 " " "
"	16	"	"		6	"	"		2,625 " " "
"	16	"	"		8	"	"		3,500 " " "
"	16	"	"		10	"	"		4,375 " " "
"	16	"	"		12	"	"		5,250 " " "
"	17	"	"		4	"	"		1,859⅜ " " "
"	17	"	"		6	"	"		2,789$^{1}/_{16}$ " " "
"	17	"	"		8	"	"		3,718¾ " " "
"	17	"	"		10	"	"		4,648$^{7}/_{16}$ " " "
"	17	"	"		12	"	"		5,578⅛ " " "
"	18	"	"		4	"	"		1,968¾ " " "
"	18	"	"		6	"	"		2,953⅛ " " "
"	18	"	"		8	"	"		3,937½ " " "
"	18	"	"		10	"	"		4,921⅞ " " "
"	18	"	"		12	"	"		5,906¼ " " "
"	19	"	"		4	"	"		2,078⅛ " " "
"	19	"	"		6	"	"		3,117$^{3}/_{16}$ " " "
"	19	"	"		8	"	"		4,156¼ " " "
"	19	"	"		10	"	"		5,195$^{5}/_{16}$ " " "
"	19	"	"		12	"	"		6,234⅜ " " "
"	20	"	"		4	"	"		2,187½ " " "
"	20	"	"		6	"	"		3,281¼ " " "
"	20	"	"		8	"	"		4,375 " " "
"	20	"	"		10	"	"		5,468¾ " " "
"	20	"	"		12	"	"		6,562½ " " "

TABLES.

As many persons interested in the construction of stone roads are asking questions about their cost, we enclose a table to show at a glance the number of square yards at different widths in a mile of road; also the cost at different widths, and various prices per square yard. Any variations from these prices can be quickly ascertained by adding, subtracting, multiplying and dividing for a less or greater width. For example, a road eight feet wide has 4,693⅓ square yards in one mile. To obtain the

number of square yards in a road having a width of nine feet, add one-eighth to the foregoing figures, and in one having a width of seven feet, subtract one-eighth; in one of twice the width given in the table, multiply by two.

SQUARE YARDS IN ONE MILE OF

8 feet in width,	4,693⅓	square yards.
10 "	5,866⅔	"
12 "	7,040	"
14 "	8,213⅓	"
16 "	9,386⅔	"
18 "	10,560	"

8 feet wide, or	4,693⅓	square yards, at	25c.	per square yard,	.....	$1,173 33⅓
10 "	5,866⅔	"	25c.	"	.....	1,466 66⅔
12 "	7,040	"	25c.	"	.....	1,760 00
14 "	8,213⅓	"	25c.	"	.....	2,053 33⅓
16 "	9,386⅔	"	25c.	"	.....	2,346 66⅔
18 "	10,560	"	25c.	"	.....	2,640 00
8 "	4,693⅓	"	30c.	"	.....	1,408 00
10 "	5,866⅔	"	30c.	"	.....	1,760 00
12 "	7,040	"	30c.	"	.....	2,112 00
14 "	8,213⅓	"	30c.	"	.....	2,464 00
16 "	9,386⅔	"	30c.	"	.....	2,816 00
18 "	10,560	"	30c.	"	.....	3,168 00
8 "	4,693⅓	"	35c.	"	.....	1,642 66⅔
10 "	5,866⅔	"	35c.	"	.....	2,053 33⅓
12 "	7,040	"	35c.	"	.....	2,464 00
14 "	8,213⅓	"	35c.	"	.....	2,874 66⅔
16 "	9,386⅔	"	35c.	"	.....	3,285 33⅓
18 "	10,560	"	35c.	"	.....	3,696 00
8 "	4,693⅓	"	40c.	"	.....	1,877 33⅓
10 "	5,866⅔	"	40c.	"	.....	2,346 66⅔
12 "	7,040	"	40c.	"	.....	2,816 00
14 "	8,213⅓	"	40c.	"	.....	3,285 33⅓
16 "	9,386⅔	"	40c.	"	.....	3,754 66⅔
18 "	10,560	"	40c.	"	.....	4,224 00
8 "	4,693⅓	"	45c.	"	.....	2,112 00
10 "	5,866⅔	"	45c.	"	.....	2,640 00
12 "	7,040	"	45c.	"	.....	3,168 00
14 "	8,213⅓	"	45c.	"	.....	3,696 00
16 "	9,386⅔	"	45c.	"	.....	4,224 00
18 "	10,560	"	45c.	"	.....	4,752 00
8 "	4,693⅓	"	50c.	"	.....	2,346 66⅔
10 "	5,866⅔	"	50c.	"	.....	2,933 33⅓
12 "	7,040	"	50c.	"	.....	3,520 00
14 "	8,213⅓	"	50c.	"	.....	4,106 66⅔
16 "	9,386⅔	"	50c.	"	.....	4,693 33⅓
18 "	10,560	"	50c.	"	.....	5,280 00
8 "	4,693⅓	"	55c.	"	.....	2,581 33⅓
10 "	5,866⅔	"	55c.	"	.....	3,226 66⅔
12 "	7,040	"	55c.	"	.....	3,872 00
14 "	8,213⅓	"	55c.	"	.....	4,517 33⅓
16 "	9,386⅔	"	55c.	"	.....	5,162 66⅔
18 "	10,560	"	55c.	"	.....	5,808 00

8	feet wide, or	4,693⅓	square yards, at	60c.	per square yard,	.....	$2,816 00
10	"	5,866⅔	"	60c.	"	.....	3,520 00
12	"	7,040	"	60c.	"	.....	4,224 00
14	"	8,213⅓	"	60c.	"	.....	4,928 00
16	"	9,386⅔	"	60c.	"	.....	5,632 00
18	"	10,560	"	60c.	"	.....	6,336 00
8	"	4,693⅓	"	65c.	"	.....	3,050 66⅔
10	"	5,866⅔	"	65c.	"	.....	3,813 33⅓
12	"	7,040	"	65c.	"	.....	4,576 00
14	"	8,213⅓	"	65c.	"	.....	5,338 66⅔
16	"	9,386⅔	"	65c.	"	.....	6,101 33⅓
18	"	10,560	"	65c.	"	.....	6,864 00
8	"	4,693⅓	"	70c.	"	.....	3,285 33⅓
10	"	5,866⅔	"	70c.	"	.....	4,106 66⅔
12	"	7,040	"	70c.	"	.....	4,928 00
14	"	8,213⅓	"	70c.	"	.....	5,749 33⅓
16	"	9,386⅔	"	70c.	"	.....	6,570 66⅔
18	"	10,560	"	70c.	"	.....	7,392 00
8	"	4,693⅓	"	75c.	"	.....	3,520 00
10	"	5,866⅔	"	75c.	"	.....	4,400 00
12	"	7,040	"	75c.	"	.....	5,280 00
14	"	8,213⅓	"	75c.	"	.....	6,160 00
16	"	9,386⅔	"	75c.	"	.....	7,040 00
18	"	10,560	"	75c.	"	.....	7,920 00
8	"	4,693⅓	"	80c.	"	.....	3,754 66⅔
10	"	5,866⅔	"	80c.	"	.....	4,693 33⅓
12	"	7,040	"	80c.	"	.....	5,632 00
14	"	8,213⅓	"	80c.	"	.....	6,570 66⅔
16	"	9,386⅔	"	80c.	"	.....	7,509 33⅓
18	"	10,560	"	80c.	"	.....	8,448 00
8	"	4,693⅓	"	85c.	"	.....	3,989 33⅓
10	"	5,866⅔	"	85c.	"	.....	4,986 66⅔
12	"	7,040	"	85c.	"	.....	5,984 00
14	"	8,213⅓	"	85c.	"	.....	6,981 33⅓
16	"	9,386⅔	"	85c.	"	.....	7,978 66⅔
18	"	10,560	"	85c.	"	.....	8,976 00
8	"	4,693⅓	"	90c.	"	.....	4,224 00
10	"	5,866⅔	"	90c.	"	.....	5,280 00
12	"	7,040	"	90c.	"	.....	6,336 00
14	"	8,213⅓	"	90c.	"	.....	7,392 00
16	"	9,386⅔	"	90c.	"	.....	8,448 00
18	"	10,560	"	90c.	"	.....	9,504 00
8	"	4,693⅓	"	95c.	"	.....	4,458 66⅔
10	"	5,866⅔	"	95c.	"	.....	5,573 33⅓
12	"	7,040	"	95c.	"	.....	6,688 00
14	"	8,213⅓	"	95c.	"	.....	7,802 66⅔
16	"	9,386⅔	"	95c.	"	.....	8,917 33⅓
18	"	10,560	"	95c.	"	.....	10,032 00
8	"	4,693⅓	"	$1.00	"	.....	4,693 33⅓
10	"	5,866⅔	"	1.00	"	.....	5,866 66⅔
12	"	7,040	"	1.00	"	.....	7,040 00
14	"	8,213⅓	"	1.00	"	.....	8,213 33⅓
16	"	9,386⅔	"	1.00	"	.....	9,386 66⅔
18	"	10,560	"	1.00	"	.....	10,560 00

TABLE FOR GRAVEL.

Table showing number of cubic yards of gravel required in the construction of one mile of gravel road, of widths varying from 6 feet to 20 feet, and depths from 6 to 12 inches. The within quantities should be multiplied by 1½ to give the number of cubic yards of loose gravel required to make the within depths of compact gravel.

One Mile in Length.	Number of feet in width.	Number of cubic yards in road 6 inches deep.	Number of cubic yards in road 7 inches deep.	Number of cubic yards in road 8 inches deep.	Number of cubic yards in road 9 inches deep.	Number of cubic yards in road 10 inches deep.	Number of cubic yards in road 11 inches deep.	Number of cubic yards in road 12 inches deep.
One mile, ...	6 feet wide, ...	586$^{2}/_{3}$	684$^{4}/_{9}$	782$^{2}/_{9}$	880	977$^{7}/_{9}$	1,075$^{5}/_{9}$	1,173$^{1}/_{3}$
One mile, ...	7 feet wide, ...	684$^{4}/_{9}$	798$^{14}/_{27}$	912$^{16}/_{27}$	1,026$^{2}/_{3}$	1,140$^{20}/_{27}$	1,254$^{22}/_{27}$	1,368$^{8}/_{9}$
One mile, ...	8 feet wide, ...	782$^{2}/_{9}$	912$^{16}/_{27}$	1,042$^{25}/_{27}$	1,173$^{1}/_{3}$	1,303$^{10}/_{27}$	1,434$^{2}/_{27}$	1,564$^{4}/_{9}$
One mile, ...	9 feet wide, ...	880	1,026$^{2}/_{3}$	1,173$^{1}/_{3}$	1,320	1,466$^{2}/_{3}$	1,613$^{1}/_{3}$	1,760
One mile, ...	10 feet wide, ...	977$^{7}/_{9}$	1,140$^{20}/_{27}$	1,303$^{19}/_{27}$	1,466$^{2}/_{3}$	1,629$^{17}/_{27}$	1,792$^{16}/_{27}$	1,955$^{5}/_{9}$
One mile, ...	11 feet wide, ...	1,075$^{5}/_{9}$	1,254$^{22}/_{27}$	1,434$^{2}/_{27}$	1,613$^{1}/_{3}$	1,792$^{16}/_{27}$	1,971$^{23}/_{27}$	2,151$^{1}/_{9}$
One mile, ...	12 feet wide, ...	1,173$^{1}/_{3}$	1,368$^{8}/_{9}$	1,564$^{4}/_{9}$	1,760	1,955$^{5}/_{9}$	2,151$^{1}/_{9}$	2,346$^{2}/_{3}$
One mile, ...	13 feet wide, ...	1,271$^{1}/_{9}$	1,482$^{26}/_{27}$	1,694$^{22}/_{27}$	1,906$^{2}/_{3}$	2,118$^{14}/_{27}$	2,330$^{10}/_{27}$	2,542$^{2}/_{9}$
One mile, ...	14 feet wide, ...	1,368$^{8}/_{9}$	1,597$^{1}/_{27}$	1,825$^{5}/_{27}$	2,053$^{1}/_{3}$	2,281$^{13}/_{27}$	2,509$^{17}/_{27}$	2,737$^{7}/_{9}$
One mile, ...	15 feet wide, ...	1,466$^{2}/_{3}$	1,711$^{1}/_{9}$	1,955$^{5}/_{9}$	2,200	2,444$^{4}/_{9}$	2,688$^{8}/_{9}$	2,933$^{1}/_{3}$
One mile, ...	16 feet wide, ...	1,564$^{4}/_{9}$	1,825$^{5}/_{27}$	2,085$^{25}/_{27}$	2,346$^{2}/_{3}$	2,607$^{11}/_{27}$	2,868$^{4}/_{27}$	3,128$^{8}/_{9}$
One mile, ...	17 feet wide, ...	1,662$^{2}/_{9}$	1,919$^{7}/_{27}$	2,216$^{8}/_{27}$	2,493$^{1}/_{3}$	2,770$^{10}/_{27}$	3,047$^{11}/_{27}$	3,324$^{4}/_{9}$
One mile, ...	18 feet wide, ...	1,760	2,053$^{1}/_{3}$	2,346$^{2}/_{3}$	2,640	2,933$^{1}/_{3}$	3,226$^{2}/_{3}$	3,520
One mile, ...	19 feet wide, ...	1,857$^{7}/_{9}$	2,167$^{11}/_{27}$	2,477$^{1}/_{27}$	2,786$^{2}/_{3}$	3,096$^{8}/_{27}$	3,405$^{26}/_{27}$	3,715$^{5}/_{9}$
One mile, ...	20 feet wide, ...	1,955$^{5}/_{9}$	2,281$^{13}/_{27}$	2,607$^{17}/_{27}$	2,933$^{1}/_{3}$	3,259$^{7}/_{27}$	3,585$^{5}/_{27}$	3,911$^{1}/_{9}$

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ILLUSTRATIONS.