U. S. Department of Agriculture
Bureau of Public Roads

Final Report
for the
Construction of the Mount Vernon Memorial Highway

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Final Report for the Construction of the Mount Vernon Memorial Highway

The location of this highway traverses the west bank of the Potomac River. The direction of the river along the line is southerly. In general the right of way extends from along the river front on the east to the higher ground on the west of the roadway. This terrain is indented by tidal estuaries of varying widths. The inclination of the ground surface towards the river varies from level in the tidal flats to about twenty degrees along the higher elevations. The surfaces of these slopes are serrated by innumerable ravines, all of which carry off surface water during storm periods, and some of them are outlets for sub-surface drainage.

The route commences near the south end of the Arlington Memorial Bridge on Columbia Island. From this point onward, like a band of ribbon, it threads its way, deflecting first to the right, then to the left, and so on in long, graceful, serpentine curves as it meanders across tidal inlets and intervening higher ground. Again, we view this lane crowning the hills with long sweeping, undulating grades, reversing themselves over vales as it wends its way, developing attractive and ever-changing vistas.

The located line partly over high ground and tidal marshes, classified the material to be removed. This classification in turn determined the methods of operations.

The results were a decision to let the contracts for grading in two units, the fills across the tidal estuaries to be constructed by hydraulic dredge methods, and the zones of higher ground between to be removed by common excavating equipment.

There were five construction units for which plans were prepared and contracts awarded. In addition thereto contract "A" provided for the construction of a riprap seawall along the river front from the R. F. & P. Railroad to the Boundary Channel Bridge.

Contract "A"

This contract contained three items, namely, riprap seawall Columbia Basin, cofferdam for New Abutment at the 14th Street Highway Bridge, and rubble stone quarried and shaped for rubble masonry bridge facings.

Bids were received September 11, 1929, and the contract was awarded to the Smoot Sand & Gravel Company of Washington, D. C., on September 18, 1929. This contract received the signature of the Secretary of Agriculture on September 28 and the contractor received notice to start work on the same date for Items 1 and 2. The delivery time allowed on Item 3 was the duration of performance on Unit III, the Bridge Contract. The work on Items 1 and 2 was completed on December 30, 1929, with an official time count of 93 calendar days. The delivery on Item 3 was commenced June 11, 1930 and continued until May 11, 1931, with an official time count of 334 calendar days.

The riprap seawall was constructed around Columbia Basin, leaving an opening at the location of the Boundary Channel Bridge. The base of this wall was built six feet below mean low water and the top three feet above. The width of the base equalled twice the height. A derrick dredge equipped with a clam-shell bucket was used to open the channel in the mud bottom for the base of the riprap wall. The location of Columbia Basin is shown as Exhibit No. 1 in the Appendix. During the construction of the wall some of the stone settled by its own weight into the soft mud base below, producing an increase of about 23⅓ per cent. The estimated quantities were 24,000 tons of stone in place at $2.89 per ton, $69,360.00. The final quantities were 29,665 tons at $2.89 per ton, $85,731.85. The cost of engineering and inspection was $4,450.36.

A cofferdam was constructed at the site of the proposed New Abutment of the 14th Street Highway Bridge to protect this location during the hydraulic fill operations in filling in Columbia Basin. The location of this cofferdam and the two spans that were removed under the Unit III contract is shown in the Appendix as Exhibit 2.

Contract "B"

This was an agreement between the Secretary of Agriculture and the Secretary of War, which provided for the construction of hydraulic fills at Columbia Basin, Gravelly Point, Roaches Run, Four Mile Run and Hunting Creek by the U. S. Engineers. Later the hydraulic fill across Little Hunting Creek was included.

This work included dredging from borrow pits located in the bed of the Potomac River and pumping the material through pipe lines laid on pontoons with flexible connections to the site of the fill and thence on a trestle to the discharge end of the pipe.

The dredging plant of the Engineer Corps, U. S. Army, which was employed upon the construction of all hydraulic fills for the Mount Vernon Memorial Highway consisted of the 20-inch dredge "Welatka", the 18-inch dredge "Talcott" and a 20-inch Diesel booster pumping unit which was used in conjunction with both dredges as required. All work was prosecuted under a 24-hour operating basis.

The "Welatka", which is the most powerful 20-inch hydraulic dredge operated by the Engineer Corps, is of steel construction with an overall length of 214 feet and breadth of 40 feet, with provisions for quarters and subsistence of 60 men. The 20-inch dredge pump is driven by a 1500 horsepower triple expansion reciprocating engine, steam being generated by four oil-fired water-tube boilers. The dredging ladder is 75 feet in length and is capable of digging to a depth of 45 feet.

The material deposited was practically 100 per cent sand, gravel and cobbles, and was of an extremely abrasive nature, requiring heavy renewals of all parts coming in contact therewith, such as pumps, piping, cutter, etc. The character of this material was also reflected in the performance of the dredges whose output was reduced below that usually obtained under ordinary dredging conditions, due to the weight and high frictional resistance together with the distance and height to which the material was deposited.

The average output of the "Welatka" at different localities was:

Length of Pipeline	Lift	Cu. Yds. Per Hour
3000 feet	28'	400 (with booster)
3500 feet	15'	200 (without booster)
5400 feet	18'	240 (with booster)

The discharge pressure at the pump under the above conditions varied from 70 to 100 pounds. When the booster was employed, an average of 35 pounds pressure was added to the stream on the discharge side of the booster.

The 18-inch dredge "Talcott" is also of steel construction with an average length of 173 feet and breadth of 32 feet 6 inches, with provisions for quarters and subsistence of 45 men.

The 18-inch dredging pump is driven by a 425 horsepower compound reciprocating engine, steam being supplied by a coal-fired water-tube boiler. The dredging ladder is 55 feet in length and is capable of digging to a depth of 35 feet.

The material handled by the "Talcott" was identical with that handled by the "Welatka" and the average performance was as follows:

Length of Pipeline	Lift	Cu. Yds. Per Hour
1400 feet	14'	180 (without booster)
2500 feet	16'	210 (with booster)

The discharge pressure at the pump under the above conditions varied from 40 to 70 pounds.

The booster plant which was employed when the length of line exceeded the capacity of the dredge, was housed upon a barge 100 feet in length by 30 feet in breadth, upon which was mounted a 650 horsepower six-cylinder, 4-cycle Diesel engine directly connected to a 20-inch dredging pump. The plant was complete with all necessary auxiliaries, such as compressors, pumps, fuel tanks, etc.

In the operation of the plant the booster was placed at such point in the pipe line where approximately 10 pounds pressure from the dredge was delivered on the suction side at which point the discharge pressure was approximately 45 pounds.

There was also a small clam-shell dredge, "Atlas", which was used to open channels to borrow pits. This dredge was also used in unloading sand from barges to build the fill across Gravelly Point Inlet.

A bulldozer was used to shape the hydraulic fills to grade.

In the nature of preparatory work, test borings were made to locate the sand and gravel in the proposed borrow pits. In some cases it was found in the river bed with no overburden to remove. At other places it was necessary to strip mud before suitable material was found. In some instances the stripped material was replaced in the borrow pit after excavation at that point was complete.

Along the located line across these tidal estuaries, mud in various stages of saturation composed the beds on which the fills were made. The elevation of the top of the mud in Four Mile Run varied from zero to three feet below mean tide.

As a practical illustration of the unstable condition of these mud beds, the piles which were driven for testing foundations to determine designing data for bridges penetrated from 8 to 12 feet under their own weight. An additional penetration from 10 to 14 feet was obtained when a hammer weighing 3210 pounds was allowed to rest on top of the pile.

The sand and gravel material used for these hydraulic fills was of greater specific gravity than the mud beds on which the fills were built. It was anticipated that this superimposed weight would penetrate the mud bed until it reached a point of stability. The process of building up this superimposed weight was very gradual. The cross section of the fill under construction was comparable to a triangle with its apex at the high point approximately on the center line of the roadway. The greatest pressure existed underneath this location. During the period of this penetrating movement into the mud it was thought that a lateral movement would occur pushing the mud outwardly beyond the range of the slope lines resulting in a substantial foundation for the fill.

Evidently pockets of mud varying in degree of saturation composed the mud beds of these tidal estuaries. Consequently the underlying materials were more stable at some locations than at others. The resulting comparable effect was that those sections super-saturated, moved more rapidly, causing slides, or when temporarily trapped by the slope of the material pumped thereon, was forced upward along the line of least resistance as the weight increased. This movement continued until the material being pumped in became stabilized and had the effect of producing ridges or cone-shaped mounds on the slopes.

During the process of pumping water with suspended materials flowing from pipe openings, the heavier was deposited nearby while the lighter and yet lighter was deposited by the flow of water further and further away. This process produced a slope that became flatter as the distance increased from the pipe openings. Flashboards were used to accelerate the process of depositing the suspended materials from the flow of the water at desirable locations. The heavier materials were controlled by this method successfully, but the lighter would pass through the flashboards with the water.

The designed roadway section provided for a finished surface level on top and 100 feet wide, that is, fifty feet on each side of the center line with side slopes one on four. This was attained except on the slopes which became variable due to slides and mud boils.

Posts 4 inches by 4 inches were set on the shoulder lines and check levels were taken at intervals and the elevations recorded during the progress of the work. This check was maintained for nine months after the pumping was finished.

The attached chart shows the settlement on Four Mile Run during the year 1930. The data plotted is the average across the roadway for the period indicated on the chart attached in the Appendix as Exhibit 3.

The total combined length of hydraulic fills which were pumped equalled 2.59 miles. The elevation of the finished grade on the hydraulic fills varied from 8.0 to 28.0 feet above mean sea level. Quantities in hydraulic fills are shown on Exhibit 4 in the Appendix.

The foot note on Exhibit 4 contains additional yardage itemized for each hydraulic fill. The total of the additional yardage pumped is 120,068. Included in this volume is 97,774 cubic yards pumped from one to nine feet above the hydraulic fill grade line. The difference between the above volumes is 22,294 cubic yards. The latter quantity represents the volumes obtained from two trapezoidal areas, one on each slope located between elevation +7.7 and the hydraulic fill grade line measured in a vertical line; and between the surface and the theoretical slope measured in a horizontal line. This produced a horizontal plane of sufficient width on which the base of the hydraulic fill section pumped above the hydraulic fill grade line was superimposed.

Soundings were taken to determine the mud line, using mean sea level datum and the located center line as a base for lateral measurements to obtain data for plotting cross sections.

Measurements were taken monthly at these sections and the data was plotted and quantities computed until the required amount of material had been delivered to complete the final hydraulic fill section. The total cost was $1,229,705.15. Engineering and Inspection, $27,526.90.

Contract 3.

The contract for driving test piles and making test borings at bridge sites was let to the Cranford Company of Washington, D. C. The report for this work will be found with that for Bridges, Unit III.

A photographic section is attached at the end of the report showing interesting features of construction on each of the units.

Unit II

This unit included the grading, draining and incidental construction on the high ground located between the tidal estuaries, beginning at Station 116+00 and extending to Mount Vernon, a distance of 10.85 miles.

Bids were received January 23, 1930 and the contract awarded to Vincent Schiavi, of Buffalo, N. Y., February 11, 1930. This contract received the signature of the Secretary of Agriculture, and the contractor was notified to start work on March 17, 1930. The contractor received this notice on March 22, and the official time count commenced March 23, 1930, with a time allowance of 400 calendar days. This time was extended 24 days by reason of extra work that increased the amount of the contract. The contract was completed on May 9, 1931, with an official time count of 412 calendar days consumed.

On March 10, 1930, the contractor commenced clearing the right of way and the removal of buildings at the Mount Vernon Terminus. On March 19 a Lima 101 gasoline power shovel, having a dipper capacity of 1¼ cubic yards commenced grading with three Hug trucks for hauling and a bulldozer for spreading the material.

Another gasoline power shovel commenced grading at Wellington Villa on March 24, using Hug and Mack trucks. At this time Athey trailers were placed at Mount Vernon forhauling the material. Subsequently these shovels operated, the one on the longer hauls using trucks, the other on short hauls using Athey trailers.

On March 27, 1930, a Northwest gasoline power dragline of one cubic yard capacity, commenced excavating and side casting at Station 661. This equipment was quickly moved to Station 653 and commenced cutting down the bluff and filling in swamp to make a roadway to the location of an 8-foot arch. This machine, equipped with 40-foot leads, drove the foundation piling required for structures on this unit. The stripping and storing topsoil was also performed by this dragline.

It was necessary to obtain data of forces and equipment employed to develop a criterion of the performance in work done to determine that the monthly progress made was sufficient to complete the work within the time specified. The daily ratio of progress was computed to be an average of $1,089.73 to complete the work within the 400 calendar day contract time period. A chart was devised showing the required progress by a straight line over the period of the contract in calendar days. This chart is attached in the Appendix as Exhibit 5.

To maintain control, resident engineers were required to furnish the office a daily report of the location of all operations and the number of all forces and equipment at work on the project. To obtain uniformity and systematize the data obtained, a daily report sheet was devised and furnished with instructions to use as many as might be necessary to report all operations. This form is Exhibit 6 in the Appendix. The kind of equipment used was briefed by establishing a code for it. The code letters were used for reporting in the equipment column. (See Exhibit 7 of the Appendix for this code.)

All structures were staked and reports were made, including the time the contractor commenced and finished the work. (See Exhibit 8 of the Appendix.)

Monthly estimates were made to the contractor. The quantities computed were based on careful measurements of all work done to date. The total quantities included in any one item were frequently made up of small components whose locations were diversely scattered over the entire project. To maintain a check and localize these small component quantities, a detailed estimate sheet was devised. This sheet was so arranged that all quantity units that were included in any item could be traced to their respective localities. A total of all quantity units of any item was the total estimate to date. The total quantity items were transferred to a consolidated estimate sheet and multiplied by the un unit bid prices for amounts. The sum of these amounts was the total estimate to date from which a percentage was retained. To the remainder the sum of all extra work orders was added for a final total to date. The previous estimates were then deducted and the remainder represented the current monthly estimate. Estimate forms are attached in the Appendix as Exhibits 9 and 10.

During the period of construction, units of work found to be essential to the finished project and not covered by bid prices are included in the Extra Work Order clauses of the contract. Work was performed by this method only by written work orders signed by the contracting parties. The method of procedure was first to make up an itemized estimate of the work to be done; obtain from the contractor a schedule of wage and equipment rates per hour and write them into the extra work order, including materials and supplies as shown by the original receipted bills.

Resident engineers checked daily with the contractor's time, the man and equipment hours made, to which each vouched for by their signatures. This time was turned in to the office the following day and was tabulated on a detailed extra work order sheet (attached in the Appendix as Exhibit 11). Original receipted bills were obtained and after checking were copied and tabulated.

Topsoil was stripped from the selected ground area between the slope stakes plus five feet on each side. This material was piled on the sides back of the roadway section for future use during the landscape operations.

Common excavation was removed by power shovels and the materials were hauled with trucks and Athey dump trailers. The fills were spread in layers of not more than 12 inches in thickness by means of caterpillar bulldozers. The operations of these machines back and forth shoving and spreading the earth around, and augmented by the movement of three and four cubic yard capacity trucks and Athey trailers, constructed and unusually compact fill.

Reference has been previously made to the crenellated terrain which forms the sloping ground on the west bank of the Potomac River between the tidal estuaries over which the Mount Vernon Memorial Highway is located. Some of the depressions were so low in elevation they were subject to overflow of high tidal waters and while covered with trees and undergrowth the ground was probably made earth. The fills over these partial swamps have had a gradual settlement. Notably among them was the south bank of Little Hunting Creek, where a dry land fill was extended out to the water line. On the left or river side of the roadway a dry land mole extended out nearly parallel. On the right a curve in the creek caused the marshy area to extend closer to the roadway. The superimposed weight as the fill was built out layer by layer, developed a settlement. As the work progressed the marsh land commenced to rise. This was more accentuated on the right of the roadway. Soon the trapped water under the base of the fill commenced to flow through the fill to the surface. The surface at this time had been built about seven feet above the original ground elevation. Attempts were made to release this underground situation by exploding especially constructed cartridges of dynamite. Due to setting up vibrations in the masonry arch under construction about 600 feet away extra heavy loaded charges could not be used. The material under the fill was a saturated peat, and so soft small charges had little effect. Later the construction of this fill was included in the hydraulic dredge work and the material was pumped to an elevation to insure a superimposed weight sufficient to force it to a place of stability. There are other swampy sections along the highway that have settled and this process still continues with a slow movement.

The soils of this region are clays, sand and gravel. A subsoil profile would indicate the soil structure to be stratified, generally with well defined lines of demarcation that do not, as a rule, parallel the ground surface. The soil strata therefore varies in thickness. This soil structure, like the ground surface, tilts towards the river at varying angles of depression. The strata of the more friable soils being porous, allows the circulation of underground water. This water through the action of gravity naturally reached the impermeable soil stratum below, and flowing along a laminated plane to its intersection with the ground surface, reaches an outlet from whence it continues on down the slope as surface water.

In adjusting a grade line whose finished roadway would conform to the demands of modern highway traffic and at the same time fit the topography of the locality, it was an inevitable consequence that the plane of the highway grade line would intersect and cut the soil strata during the process of grading the roadway. The operations of grading and draining the roadway were done during an extraordinary drought period. Notwithstanding the existence of these conditions, subsoil water would seep and run into the excavated sections whenever the friable strata was cut through.

At one place on the roadway the surface as well as the stratified soil topography was so shaped by nature that subsurface water converged to the low point of the soil profile. From 6 to 8 feet below the ground surface an impermeable soil strata was found. During past decades water had percolated through the soil fissures above and deposited a material on the soil stratum below that resembled soft soap in character and consistency. This process developed a liminated plane exceedingly slippery, inclined from the horizontal towards the river at an angle of about 13°. About the time grading was completed at this point, the embankment material together with the ground down to this plane commenced to move towards the river, carrying trees standing upright from 6 to 18 inches in diameter. The trees on the slide gradually inclined uphill from the vertical as the movement continued for a period of several weeks.

Underdrains were installed to intercept this subsurface water and pipe it away. This effectively checked the slide for the time. A sketch showing the location of these underdrains is attached in the Appendix as Exhibit 31.

The construction of underdrains was provided for in the items of the award of the contract. Quantities were estimated wherever the surface indications were of such a nature that underdrains were deemed desirable. However, no knowledge of the soil strata and the subsurface water was available until the work was opened up and consequently

many localities were found that required underdrainage that was not originally contemplated. Further, the conditions found during the construction period could not always be rectified by using the standard design, and to provide for these varying situations special plans were used as the exigencies of the case required.

The quantities that made up the items of the award multiplied by the unit bid prices produced a sum of $435,890.60, which was the amount of the contract.

An extra work order clause was included as a part of the contract. This was done to cover such unforeseen contingencies that would develop during the progress of construction. This included such items as the slide at Station 523; the cement rubble retaining wall at the Holiday House about Station 535; the subway for the use of the pump operator of the R. F. & P. Railroad in crossing under the Mount Vernon Memorial Highway; grading the old electric roadbed from about opposite Station 558 to Station 598 as an access road, and a number of minor miscellaneous features.

The final estimate was made up on items of the contract plus the total of all extra work orders as follows:

Final payments on items of the contract	$432,585.52
Total of all extra work orders	41,145.03
Total final estimate	$473,730.55

The cost of engineering and inspection was 41,291.65

The final estimate contained an increase in quantities on some of the items and a decrease in quantities on other items of the contract. This is defined item by item in Exhibit 18 in the Appendix. These differences are a logical sequence to conditions found after the work was opened up.

The items of the expenditures on the extra work orders were due to developments after the contract was let.

The finishing of the graded roadway was performed as shown by sketch in the Appendix and marked Exhibit 13. During this operation the intersection of the side slope with the ground surface in the excavated sections was curved. The length of arc rounding off this angle varied with a maximum of about 10 feet in the deeper cuts, becoming shorter as the depth of cut decreased.

The final shape of the full slope is shown in the Appendix as Exhibit 18. The lower curved slope section was constructed after the pavements were laid. Likewise the shoulder lines of the fills were curved. The use of varying slope ratios was designed to serve a two-fold purpose, namely to balance excavation and embankment materials, and to enhance the landscape development.

Unit II
Extra Work Orders

Extra Work Order No. 1, dated April 11, 1930, contained authority to widen, scarify, shape and partially surface the old interurban electric railroad grade from a point opposite Station 558+00 to opposite Station 567+00.

Total cost of Extra Work Order No. 1 $498.78

Extra Work Order No. 2, dated May 6, 1930, contained six items, as follows:

1.	Draining cesspool, Sta. 818	$1069.81	
2.	Removing old vitrified pipe lines from the electric railroad grade	109.53	
3.	Clearing, draining, grading and partially surfacing the electric railroad bed from about opposite Station 566 to Station 596	838.95	
4.	Furnishing and laying 4-inch drain tile connection with tree wells	41.50	
5.	Furnishing and placing additional gravel in vitrified underdrain ditch from Station 818+00 to Station 823+00	95.11	
6.	Opening channel at Dyke to deflect tide water from the fill slope	113.52	

Total cost of Extra Work Order No. 2 $2268.42

Extra Work Order No. 3, dated June 16, 1930, provided for the construction of a waterproof pedestrian subway about Station 223+75 for the use of the R. F. & P. Railroad employees in gaining access to the pump house.

Total cost of Extra Work Order No. 3 $11168.29

Extra Work Order No. 4, dated June 16, 1930, provided for the construction of a retaining wall in front of the Girls' Friendly Society property about Station 535+81 to Station 537+45.

Total cost of Extra Work Order No. 4 $5553.13

Extra Work Order No. 5, dated June 16, 1930, provided for restoring embankment caused by slide at about Station 520 to Station 524.

Total cost of Extra Work Order No. 5 $14704.73

Extra Work Order No. 6, dated July 3, 1930, provided for screening, hauling and placing gravel about tree wells at Stations 772 and 825+70; and excavating ditch through embankment near Station 773 to drain water from fill.

Total cost of Extra Work Order No. 6	$355.31

Extra Work Order No. 7, dated September 8, 1930, provided for three items, as follows:

1.	Placing topsoil on slopes at the car and bus parking areas at the Mt. Vernon Terminus	$844.25
2.	Excavating, delivering and placing fine gravel or coarse sand for temporary traffic lanes at the new graded area at Mt. Vernon	48.35
3.	Three-inch pipe conduits at entrance to car and bus parking areas at Mount Vernon	129.44
	Total cost of Extra Work Order No. 7	$1022.04

Extra Work Order No. 8, dated September 18, 1930, provided for special vitrified tile underdrains, Station 525+75 to 527+00 and 571+00 to 577+50.

Total cost of Extra Work Order No. 8	$4985.69

Extra Work Order No. 9, dated December 30, 1930, provided for the construction of crossing over the Mount Vernon Memorial Highway grade at locations of existing roads.

Total Cost of Extra Work Order No. 9	$590.64
Total cost of all Extra Work Orders	$41,145.08

Unit III, Bridges

The Cranford Company of Washington, D. C., was awarded the contract for making test borings and driving test piles.

Foundation Investigation

Cost of Test Borings	$ 825.00
Cost of Driving Test Piles	3,695.00
Subtotal	$4,520.00
Cost of Engineering and Inspection	494.93
Total Cost of Tests	$5,014.93

All bridges built on the highway were included in this unit and contract was awarded in two groups to the Merritt-Chapman & Scott Corpn.

Group 1	Group 2
Boundary Channel Bridge	Airport Overpass
New Abutment, 14th Street Highway Bridge	Four Mile Run Bridge
	Southern Railway Overpass
Underpass, 14th Street Highway Bridge Grade Separation	Hunting Creek Bridge
	Wellington Villa Underpass
Alterations to 14th St. Hwy. Bridge	Fort Hunt Overpass
Roaches Run Bridge	Little Hunting Creek Bridge

Cost of Construction, Group 1	$ 947,836.27
Cost of Engineering & Inspection	37,895.43
Total	$ 985,731.70
Cost of Construction, Group 2	$1,037,461.06
Cost of Engineering & Inspection	34,057.22
Total	$1,071,518.28

All details of supervision and inspection were performed by the personnel from the Division of Bridges & Structures. A detailed report is submitted by them.

Alignment and bench mark elevations were furnished the personnel of the Division of Bridges by the resident engineers stationed on the section including the bridge sites.

Unit IV

Paving and Incidental Construction

The plans for Unit IV were worked up in two sections. Section 1 commenced at Station 10+00 and extended to Station 404+00. The pavements on this section were of different types. Section 2 commenced at Station 404+00 and extended to Mount Vernon. The pavement on this section was of one type, except the access roads.

Section 1

Bids were received February 25, 1931, and the contract was awarded to the MacDougald Construction Co. of Atlanta, Georgia, March 7, 1931. This contract received the signature of the Secretary of Agriculture on March 11, 1931, and the contractor was notified to start work on March 23, 1931. The contractor received notice to start work on March 30, and the official time count began on March 31, 1931, with a contract time allowance of 320 calendar days. This time allowance was increased 30 days by reason of extra work which developed, which increased the amount of the contract. The contract was finally completed and accepted on February 10, 1932, with an official time count of 317 calendar days.

Work was actually started on April 11, 1931, with a Thew-Lorraine gas power shovel excavating south of the Southern Railway Overpass between Station 365 and Station 369. On April 27, excavation commenced with this shovel working north in the City of Alexandria on the west side of Washington Street at the Franklin Street intersection. The excavation consisted of old pavement extending along Washington Street between Franklin and Montgomery Streets. The base pavement was composed of concrete and old macadam. Judging from appearances the old concrete base was laid at different periods, as its texture ranged from indifferent to very good. Its composition of coarse aggregates were poorly graded gravel along certain localities to crushed stone at other points. The wearing surface was a bituminous pavement.

A tentative agreement had been reached with the authorities of the City of Alexandria pertaining to the methods of procedure providing for local traffic during the excavation of the old pavement. The agreement provided that the west half of Washington Street be excavated first and the base pavement laid for use of traffic while the east side was being excavated. On April 30 a request came from the City Council to excavate the entire width from Franklin to Prince Streets, and from Prince to Montgomery the previous agreement to obtain, so the latter procedure was followed.

By May 16 the shovel had excavated the west half of Washington Street between Franklin and Montgomery and the east side from Franklin to Prince. This shovel was then moved to Station 41 on Columbia Island with the intention of doing the necessary excavation there, working north toward Station 21. Little work was accomplished as the shovel soon settled into the soft ground by reason of vibrations set up under its operations. This shovel was dug out and with the use of timber mattresses, moved over the soft ground and was returned to Washington Street, Alexandria. On its arrival it commenced on the east side at Prince Street and completed to Montgomery Street on June 16, 1931.

On the removal of the shovel from Columbia Island, a force was placed at work digging ditches for installing underdrains. This work was done under the inspection of the Division of Tests who supervised subsoil borings and developed grades for laying the drain tile to draw the subsoil water into the river. When these underdrains began to function, the surface commenced to dry slowly, developing contraction cracks.

It was apparent that no roadway could be maintained on such ground and special treatment was decided on to make a base for the highway. In the design for this section the pavement which had been provided was two inches of bituminous concrete surface, a three-inch bituminous concrete base, a four-inch dry choked stone base and a twelve-inch washed gravel base, or a total thickness of one foot and nine inches. It was decided in addition to the above to place a thickness of two feet underneath the above mentioned pavement.

A dragline excavator was obtained and the excavation taken down 3.75 feet below the top of pavement grade. This equipment had the advantage of operating from the ground surface, excavating behind and depositing the material well back of the slope stakes for use later as topsoil. The fill sections were likewise built 3.75 feet below the top of pavement grade and the entire length covered with unwashed gravel obtained from the Potomac River dredges. This material was barged to the bank at a point about opposite Station 35 on Columbia Island and unloaded by a clamshell derrick and deposited in a bin on shore. The unwashed gravel was loaded from the bin into trucks and hauled to points of deposit. This two-foot gravel thickness was spread in layers and rolled. As these layers were spread and rolled situations developed

where the underlying soil was forced through to the surface. This material was carefully removed and new gravel placed and rolled. The entire operation was comparable to constructing the ground on which to locate the highway.

On June 16 the shovel was moved from the north end of Washington Street to Columbia Basin and commenced excavating and making the approach fill on the south side of the Boundary Channel Bridge. This location became the center of operations for this shovel until the grading was completed, moving back and forth from point to point as the urgency in assisting in advancing the excavation ahead of the paving became necessary.

On December 19, 1931 another shovel was rented and placed at work in the Columbia Basin area. The two shovels generally removing deposits of material and hauling and placing it in low places, made a clean up of the area. The grading was entirely completed on January 16, 1932. The final dressing up was completed on January 25, 1932.

The equipment used on Section 1 is listed and will be found in the Appendix as Exhibit 14.

Clay Bound Gravel Base

The material pumped into the hydraulic fills was sand and gravel. An approved type of clay was hauled, spread and mixed to a depth of 12 inches below the base of the bituminous concrete paving, over all the hydraulic fills on Section 1. This class of work extended from Station 52+64.5 to Station 118+50, over Columbia Basin, Gravelly Inlet and Roaches Run; from Station 172+00 to Station 192+50 over Four Mile Run and from Station 370+50 to Station 404+00 over Hunting Creek. On this clay bound gravel base a three-inch bituminous concrete base course was laid, and upon this was superimposed a two-inch bituminous concrete surface course.

Paving

The type of pavement from Station 10+00 to Station 49+88.5 on Columbia Island has been noted. It was sixty feet wide between curbs. From Station 49+88.5 to Station 52+64.5 over Boundary Channel Bridge and the two hinged approach slabs the pavement was a two-inch bituminous concrete laid on the bridge and slab. The two sidewalks over this bridge were constructed of sheet asphalt.

Reinforced Concrete Base

From Station 118+50 to Station 172+00 and from Station 192+50 to Station 281+67.4; also from the latter station around the Memorial Circle to Station 287+31.7 and again from Station 362 34 to 370+50 the type of base pavement is a reinforced concrete, 10-7-10, laid in twenty foot lanes. On this base a two-inch bituminous concrete surface was constructed.

Plain Concrete Base

From Station 227+31.7 to 360+87 through Alexandria, Virginia, on Washington Street, a seven-inch plain concrete base course was laid in lanes twenty feet wide, one of these lanes on each side of the center line of the street. The street varied in width from 56 to 70 feet between curbs in certain of the city blocks. After laying the two twenty-foot lanes an additional lane varying in width adjacent to the gutter on each side of the street was laid. The returns to the property line on cross streets and alley intersections were laid with these outside lanes. On this base a two and one-half inch sheet asphalt surface was laid. This sheet asphalt surface was extended at the south end across the Southern Railway Overpass to Station 362+34.

Work was commenced with a 27-E Koehring paver that had seen much service. It was often in need of repairs or adjustments.

A Blaw-Knox batching plant was set up on Smoot's wharf about the foot of Orinoco Street and approximately 2,000 feet from Washington Street. Aggregates were loaded from barges into the batching plant. The materials were dispatched to the paver in batch-trucks. This plant was used during the time all concrete base pavements were under construction.

Materials for concrete were proportioned by weight and full control was maintained at all times by direction of Mr. Worth D. Ross, the materials engineer who was ever zealous to obtain the best product.

The paver commenced work laying the reinforced concrete base course about 11:00 a.m. May 11, 1931 at Station 211+67, operating south on the left 20-foot lane. After laying 56 lineal feet the work stopped for some minor repairs to the mixer. Before the operations could be resumed a rain prevented further work. A tabulation follows, showing the chronological order in which this paver operated in completing all concrete base pavements on the section.

No.	Sta. Betw. Which Mixer Operated: Begin	Finish	Lane Operating on	Date of Paver Operations: Begin	Finish	Remarks
1.	211+67	226+29	L. 20-ft.	May 11	May 20	Reinforced Concrete Base
2.	360+00	287+31.7	R. 20-ft.	May 25	June 9	Plain Concrete Base
3.	370+50	362+34	R. 20-ft.	June 10	June 11	Reinforced Concrete Base
4.	360+81	287+31.7	L. 20-ft.	June 11	June 22	Plain Concrete Base
5.	192+50	287+31.7	R. 20-ft.	June 26	July 18	Reinforced Concrete Base
6.	360+81	287+31.7	Two Lanes	July 13	July 23	Pl.Conc. Base at Gutter, Wash.St.
7.	287+31.7	192+50	L. 20-ft.	July 23	Aug. 8	Reinforced Concrete Base
8.	Memorial Circle		Ad.Lanes	Aug. 10	Aug. 15	Reinforced Concrete Base
9.	172+00	118+50	L. 20-ft.	Aug. 19	Sept. 9	Reinforced Concrete Base
10.	172+00	118+50	R. 20-ft.	Sept.11	Sept.30	Reinforced Concrete Base
11.	Overlooks & Flares, & Additional Lanes Wash. & Old Dom.			Oct. 1	Oct. 8	Reinforced Concrete Base
12.	Ry. Crossing			Dec. 18	Dec. 18	Reinforced Concrete Base

A switch leading from the main line of the Washington & Old Dominion Railroad into the contractor's asphalt plant caused the delay in finishing the reinforced concrete base pavement until December 18. The switch stand and points were about 8 feet to the right of the highway center line.

The construction of the clay bound gravel base course beginning at Station 52+64.5, including the grade separation roads at the 14th Street Highway Bridge to Station 118+50, and also from 172+00 to 192+50, and again from 370+50 to 404+00, consumed 115 days' time. Considerable difficulty was experienced in getting the surface of the base course parallel to the exact crown and finished pavement grades. This base course was primed with tar conforming to T-C-1-25, United States Government Master Specifications Board No. 279 for tar cold application. This tar was applied at the rate of 1/4 to 1/3 of a gallon per square yard under Extra Work Order No. 4 at an agreement price of $.12 per gallon.

The gravel sub-base course on Columbia Island between Station 10+00 and 50+04.5 was secured from the Columbia Basin hydraulic fill materials. This material was loaded in trucks, hauled, dumped, spread and rolled to a finished surface nine inches below and parallel to the finished crown and grade of the surface pavement.

A dry choked slag base rolled to a thickness of four inches was placed on this gravel sub-base course. The operations of constructing these two sub-bases consumed 44 days.

The asphalt plant was composed of two units, each unit with a rated capacity of twenty tons per hour. This plant was located on a spur track from the Washington & Old Dominion Railroad adjacent to the Mount Vernon Memorial Highway about opposite and to the right of Station 286. The hot asphaltic paving material was hauled in trucks equipped with tight steel dump bodies covered with heavy canvas. The material was dumped on sheet iron dump boards and from there shoveled and spread in place.

The sheet asphalt pavement commenced on July 29 at Station 356+20 and continued north to Station 287+31.7 reaching the latter point on August 29. The bituminous concrete pavement commenced on August 31 and continued until December 21; and the work of constructing curbs commenced June 19 and continued until this item was completed December 18.

The total of the contract as awarded amounted to:	$605,619.25
Extras that developed during the progress of the contract:	64,037.66
	$669,656.91

Final payments on items of the contract:	$648,923.11
Total of Extra Work Orders	64,037.66
Total payment to contractor	$712,960.77
Engineering, supervision and inspection	44,581.07
Total Cost	$757,541.84

There is attached in the Appendix as Exhibit 15, comparative details of all items of the contract. This indicates increases on some items and a decrease on others of the contract. Some of these differences are due to field adjustments found necessary as the work progressed, while others are due to differences developed by the more accurate final measurements, such as excavating below grade on Columbia Island and grading the hydraulic fills down from the hydraulic fill grade line to the elevation of the bottom of the base pavement. Likewise, similar differences in other items could be illustrated.

Similar methods obtained during the construction period for the preparation of estimates and supporting data which were referred to in this report under Unit II.

Unit IV, Sec. 1
Extra Work Orders

Extra Work Order No. 1, dated May 4, 1931, cost a total of $2,677.70 and was distributed over eight items as follows:

Item 1. Removal of trees and stumps from the area to be widened on Washington Street.
Item 2. Removal of granite curbs on the section to be widened on Washington Street.
Item 3. Removal of sidewalks back of the present curb on the widened section of Washington Street.
Item 4. Constructing concrete gutter one foot nine and one-half inches wide on Washington Street.
Item 5. Constructing concrete gutter two feet wide on Washington Street.
Item 6. Changing gate posts and rehanging iron gate at Catholic Cemetery.
Item 7. Removing fuel oil tanks embedded under sidewalks on the widened section of Washington Street.
Item 8. Setting granite curbs on concrete base.

Extra Work Order No. 2, dated June 3, 1931, cost a total of $10,900.35, and provided for subsoil drainage on Columbia Island.

Extra Work Order No. 3, dated June 1, 1931, cost a total of $4,291.99, and was distributed over ten items as follows:

Item 1. Furnishing and placing cold patch material on the concrete base around projecting city service fixtures.
Item 2. Furnishing and placing additional asphalt binder at designated points.
Item 3. Removing concrete pavement about Station 358, jetting and rolling the fill.
Item 4. Excavating and removing wet material from below the base of the concrete pavement on Washington Street and backfill with suitable material.
Item 5. Furnishing and setting granite curbing around Confederate monument, and safety islands.
Item 6. Furnishing and setting special castings for a nine-inch curb and covers for exposed manholes.
Item 7. Furnishing and installing two-inch pipe in the concrete base parallel to the Old Dominion Railroad.
Item 8. Furnishing and placing wire mesh reinforcement in the plain concrete base course at points indicated.
Item 9. Furnishing and placing additional sheet asphalt material at points indicated.
Item 10. Furnishing and placing additional bituminous concrete material at points indicated.

Extra Work Order No. 4, dated July 31, 1931, cost a total of $45,723.58, and was distributed over two items, as follows:

Item 1. Furnishing, placing and rolling gravel embankment on Columbia Island.

Item 2. Furnishing and applying tar prime coat on clay bound gravel base course.

Extra Work Order No. 5, dated November 12, 1931, cost a total of $444.04 and provided for building fences at the 14th Street Highway Grade Separation, and across the Highway at about Station 865.

Unit IV, Section 2

Section 2 of Unit IV, extends from the south bank of Hunting Creek at Station 404+00 to 816+59.5, plus the loop around the oval at Mount Vernon, which measured 1,766.94 feet. The roadway pavement was reinforced concrete 10-8-10, laid in 9, 10 and 11-feet lanes. At highway intersections and the approach of access and border roads, aprons of reinforced concrete pavement were extended out a sufficient distance for cars to come to a stop before crossing the traffic lanes of the Mount Vernon Memorial Highway. At predetermined locations an additional lane was constructed on the outside of the pavement to provide for future bus stops. At certain points along the roadway, additional lanes were provided for parking without blocking the main traffic lanes. The border roads were paved with bituminous macadam.

Bids were received February 25, 1931 and the contract was awarded to the Roberts Paving Co., of Salisbury, Maryland, March 7, 1931.

This contract received the signature of the Secretary of Agriculture March 20 and the contractor was notified to start work on April 2. The contractor received this notice on April 3, and the official time count began on April 4, 1931, for this contract. The time allowance for completing the contract was 320 calendar days. An allowance of two additional calendar days was made due to an increase in the amount of the contract on extra work. The contract was finally completed and accepted on December 23, 1931, with an official time count of 264 calendar days.

Work was commenced on March 18, 1931, excavating a channel from the mouth of Little Hunting Creek to the shore opposite Station 777. A material yard and batching plant was installed on the shore of Little Hunting Creek about 500 feet to the left of Station 777 to which aggregates and cement were delivered by barge. This plant was used during the paving from Station 775+50 to and including the loop at Mount Vernon. Materials were despatched to the paving mixer in batch-trucks.

The excavation required was that of reshaping the subgrade to fit the pavement sections, the roadway having been made approximately to grade under the contract for Unit II. However, this reshaping included the removal of material which had been placed above the required grade line on some of the fills where shrinkage and settlement were anticipated.

The excavation was done by first scarifying the subgrade, then removing the earth with a road blade and rotary fresno, tractor drawn. Excavation was done only in the traffic lane ahead of the paving operations so that much of the earth was moved two or three times before its final disposition. At a few points, where excavation was unusually heavy due to excess material having been placed on fills, the excavation was done with a 3/4-cubic yard crane mounted on a truck, and the material was hauled away by trucks. A list of equipment is attached in the appendix as Exhibit 16.

Paving between Little Hunting Creek and Mount Vernon commenced on April 21 at Station 775+50. The pavement was laid in the following order: beginning with the right 9-foot lane, then the left 9-foot lane, right 11-foot lane, left 11-foot lane. Each lane was commenced at Station 775+50 and continued to Station 816+60; then before returning the paver to begin the next lane a portion of the pavement on the loop around the oval was placed. This procedure was necessitated by the requirement that 10 days elapse between placing adjacent traffic lanes. On the completion of this pavement on June 12, the outfit was moved to the north end of Section 2 at Station 404+00. The batching plant was set up on the bank of the Potomac River about 1,000 feet to the left of Station 425. Paving commenced at Station 404+00 on June 15. On July 1, a second paving outfit, practically identical with this one, was brought in and paving was commenced in the right 11-foot lane. Both outfits worked continuously until October 5. On that date the second paver was removed, leaving the first one with its organization to complete the special and irregular sections which remained at that time. All reinforced concrete paving was completed on October 20, 1931.

The order in which sections of this pavement were laid between Stations 404+00 and 775+50 was as follows: right 9-foot lane to Station 750, right 11-foot lane to Station 750, left 9-foot lane to Station 750, right 9-foot lane across Little Hunting Creek, left 11-foot lane, right 11-foot and left 9-foot lanes on Little Hunting Creek; extra lanes in flares, bus stops, overlooks and turnouts. In this section, as around the loop at the Mount Vernon terminus, the design of the pavement at flares, bus stops and intersections necessitated the placing of the pavement at these places in small sections.

The change in type of pavement from bituminous macadam to reinforced concrete across Little Hunting Creek was made by authority of Change Order No. 1, which was made a part of the contract for this unit on September 8, 1931.

In laying this pavement the subgrade was prepared and forms were set only in the lane which was being constructed. The paver traveled outside the lane with the skip forward. Materials were delivered to the paver from the plant in batch-trucks. Water was supplied through a 2-inch pipe line from three pumps set about equidistant along the job, drawing water from the Potomac River.

Striking off the concrete 2 inches below the top of the forms preparatory to placing wire mesh reinforcing was accomplished by the use of an auxiliary screed attached to the finishing machine, and hinged so that it could be lifted up and fastened out of the way during the final screeding. The reinforcing steel was delivered in flat sheets and distributed along the roadway.

Although it was necessary for the paver to travel back and forth for the length of a sheet of reinforcing between depositing the lower 6-inch and the upper 2 inches of concrete, the operations were so coordinated that no loss of time resulted.

The construction of the pavement through transitions from crown to plane sections was accomplished as follows: for the first lane, auxiliary forms were set three feet outside the regular side forms on each side to grades established every 25 feet. Regular steel side-forms were used for the auxiliary lines. The pavement was first struck off with the finishing machine, using the crown screed. The crown was then removed by screeding with a hand-pulled screed. In the second lane, where the new concrete was placed against a slab already in place, a steel auxiliary form was set as before on only one side and a strip of plank cut in the shape of a wedge was clamped on the existing slab at a distance of three feet from the inner edge, the thickness of the plank being the ordinate necessary to give the top the required elevation to be used as the other auxiliary form. The pavement was then screeded as in the first case.

In the construction of the outside lanes of pavement at turnouts, bus stops and flares, wooden forms were used to secure the proper shape and the location of construction and expansion joints and planes of weakness.

Bituminous Macadam

The bituminous macadam pavement on the access and border roads was subcontracted to the Edgie Russell Co., of Frederick, Maryland. This work commenced on June 2, 1931. The gravel bases were completed on all the access and border roads on July 29, having been done in the following order: east of the Wellington Villa bridge, Access "B", Railroad Access, North Fort Hunt and Fort Hunt to dock accesses. The first asphalt was placed for the bituminous macadam surface July 30, and the surfacing was finished on September 30. The shoulders and cleaning up were completed on October 23, 1931.

The subgrade excavation for these pavements was done with similar equipment and in a manner comparable to that for the concrete pavement. Wooden forms were set at the elevation required for the top of the compacted gravel base. Gravel was distributed on the prepared subgrade by the use of steel spreader boxes. The base was constructed of two layers of equal thickness so that when completed it was 8 inches thick. Gravel was hauled from a pit just west of the Mt. Vernon terminus; it was pit run of acceptable quality.

The first course of slag for the surface was spread with the use of spreader boxes. After this was rolled, bitumen was applied from a pressure distributor, and the binder course and chips were spread by hand. Irregularities in the finished surface were removed by rolling. Shoulders were constructed of the material excavated from the subgrade. After being shaped with a road blade and hand tools, they were thoroughly compacted by rolling.

Curb Construction

Concrete for curbs was mixed on the job in a Jaeger 1-bag mixer. Materials were supplied from the batching plant used for concrete pavement but were proportioned by weight at the mixer, using platform scales. Wooden forms were used in the beginning, but these were soon found to be unsatisfactory, and were replaced by steel forms which were used throughout the rest of the work except on short radii curves around bus stops, turnouts and islands. The curbs were finished to the required cross section by the use of a pressed sheet metal template the shape of the face of the curb and two feet long. After the removal of the forms, earth was backfilled and tamped behind the curbs.

Earth Shoulders

Work commenced shaping the earth shoulders after the construction of the pavement and curbs. The material was distributed wherever necessary to produce uniformity by the use of a crane and trucks and by a tractor and fresnos. The dressing to the required line and shape was done by hand labor, teams and slip-scrapers.

In sections where there was sufficient material suitable for use as topsoil, the shoulders were constructed to the top of the curb line or to the edge of the pavement, instead of the finished lines being constructed six to eight inches below for later distribution of topsoil.

Rustic Guard Rail

The guard rail was constructed of black locust by the Kibbey Engineering Co. of Minneapolis, Minnesota. This material was obtained from western Pennsylvania and Maryland. The posts were set and firmly

tamped. They were then cut, and the rails trimmed and shaped so that all joints were neat and close fitting. During the process of framing and fitting, care was exercised to have the rails laid in place so that all bends would be up or down in a vertical plane. Bent rails laid in adjacent panels would alternate, one with the bend downward, the next upward, so a profile of the finished top would present a serpentine appearance. This provision allowed the straight side of the rails to parallel the curb. After the rails were all fitted, the holes were drilled by machine for the spikes. To obtain a snug fit into the rail the holes were drilled using two different size bits, one for the shank, the other for the countersunk head of the spike. The spikes were driven and the holes plugged. Two coats of thatch brown preservative shingle stain were then applied as a final operation.

The prosecution and progress of the work under this contract and the quality of the work done, indicate that the contractor and his organization were highly efficient and competent. The equipment used was modern, and the methods used were in conformity with accepted practice, and the personnel employed were experienced in their particular work. A spirit of willingness to cooperate with the engineers, and a desire to do work of good quality in an acceptable manner were in evidence at all times.

The sum of the awarded contract amounted to:	$557,298.70
Change Order No. 1	5,902.34
Extras that developed during the progress of construction:	1,706.87
	$562,907.91
Final payments on items of the contract:	$561,803.90
Extra Work Orders No. 1 and 2:	1,706.87
	$563,510.77
Engineering and Inspection:	$ 29,280.09

On the final estimate the items of increase made by Change Order No. 1 was paid for at the unit price.

There is attached in the Appendix as Exhibit 17, comparative details of all items of the contract. This indicates that increases developed during construction on some items, and a decrease on others of the contract. Most of these differences are due to field adjustments found necessary as the work progressed.

Similar methods obtained for the preparation of estimates and supporting data that were referred to in this report under Unit II.

Unit IV, Section 8
Extra Work Orders.

Extra Work Order No. 1, dated April 30, 1931, cost a total of $275.20 and was distributed over three items, as follows:

Item 1. Setting mud jack pipes.

Item 2. Constructing planes of weakness where indicated across each traffic lane.

Item 3. Placing bituminous macadam surface on car parking area at Mount Vernon.

Extra Work Order No. 2, dated October 7, 1931, cost a total of $1,431.67, and provided for furnishing and placing longitudinal expansion joints in reinforced concrete pavement at points indicated.

Unit V, Lighting

This work was advertised and bids received October 15, 1931. The Westchester Electrical Equipment Company of Yonkers, New York, was the low bidder at $73,469.80. The contract was awarded on November 3, and signed by the Acting Secretary of Agriculture, November 6, 1931. The contractor was notified to start work on November 13, and the official time count began November 18, 1931, with an allowance of 150 calendar days to complete the contract.

Incidentally it may be pertinent to state that the Virginia Public Service Company was to furnish the power for the lighting system. On April 14, 1932, they had not made the necessary connections so that the final tests required under the above contract could be made. In fact, some three weeks elapsed before this was done. An official order suspending the work of the Westchester Electrical Equipment Company was issued on April 15, 1932, with 149 calendar days of their contract time consumed. An official order to resume work was issued them on May 6, 1932. The period of time over which the suspended order operated was 22 days.

The contract was completed on May 7, 1932, using the 150 calendar days allowed under the contract. The final payment on the twelve items of this contract was: $73,928.42

Cost of Engineering & Inspection: 6,767.94

$80,696.36

A separate report describing details of construction for the lighting system has been made by Floyd I. Davidson, Jr. Highway Engineer.

Additional Contracts

There were other contracts awarded for the construction of the Mount Vernon Memorial Highway to meet special conditions from time to time. A list of these contracts follows:

Pittsburgh-Des Moines Steel Company,
Erection of Tank & Water Supply Connection at Mt. Vernon Terminus

F. N. Hagmann, Jr.,
Subsurface Investigations Through Hydraulic Fill at Fourmile Run

F. N. Hagmann, Jr.,
Well for Water Supply Source at Mount Vernon Terminal

Leon A. Harris,
Demolition of the Old Concession Building at Mount Vernon

The Chesapeake & Potomac Telephone Company of Virginia,
Placing Telephone Lines Underground at the Mount Vernon Terminus

Industrial Engineering & Construction Co.,
Constructing Police Lodge and Tool House near the Mount Vernon Concession Building

Grier-Lowrance Construction Co., Inc.,
Driving Timber Piles in the Slope at the Slide, Sta. 521 to 524

Merritt-Chapman & Scott Corporation,
Replacing Pavement at the Slide, Station 521 to 524

Mount Vernon, Alexandria & Washington Railway,
Replacing Tracks on the 14th Street Grade Separation over the Mount Vernon Memorial Highway

Washington & Old Dominion Railroad, Bluemont Branch,
Installing Signal with Industrial and Side Tracks Rebuilt

Virginia Public Service Company,
Constructing and Connecting Underground High Power Line with Surface Line.

Richmond, Fredericksburg & Potomac Railroad,
Bypass for Trains during the Construction of the Underpass.
For details see report for Unit III, Bridges.

Incidental Construction

During the protracted rains the latter part of the year 1931 and the early part of 1932, the old slide at Kreuttner's between Stations 521 and 524 commenced to move. By January 11, one section of the 11-foot lane on the left had dropped, breaking the adjacent slab to the south of it.

The gas shovel was moved to Hunting Creek and removed some of the excess material on the slopes of the hydraulic fill north of the bridge. This material was hauled to the slide and the shoulder and slope were rebuilt. However, each morning there were ample indications from a visual inspection that the material had moved during the night. The movements of this slide were more rapid after each rain, gradually becoming less and less until another rain accelerated the movement.

This slide first commenced a movement down the slope towards the river soon after the fill above was completely graded during the month of June, 1930. A plan for sub-drainage was outlined and work commenced under authority of Extra Work Order No. 5 of the Vincent Schiavi contract for Unit II. This system of underdrains is shown in sketch attached in the Appendix as Exhibit No. 31.

When the second movement started the underdrain line D-M apparently broke between K and R. It was decided to drive two double lines of piles parallel to the center line in an attempt to check the movement and hold the embankment material in place. One double line was in the slope of the embankment not far from the shoulder line. A sketch showin the location is attached in the Appendix as Exhibit 32. These piles penetrated well into the underlying impervious soil strata. As the work progressed a check in this outward movement was distinctly noticeable and became less and less as the pile driving continued to completion.

The pile driving was done under contract with the Grier-Lowrance Construction Co., Inc., with an allowance of thirty days to complete the work. The official time count began March 17, 1932 and the contract was completed on March 28, 1932. A total of 5244 lineal feet of piles was driven at a contract price of $0.85 per lineal foot, developing a total cost for this work the sum of $4,457.40.

An additional precaution was taken to maintain the pavement over this slide by driving precast reinforced concrete piles. Two piles were driven for each bent, spaced seven feet nine inches center to center, and the bents were spaced nine feet eleven inches center to center longitudinally with the roadway and under the left eleven-foot traffic lane.

The two piles in each bent were capped with reinforced concrete beams, and the reinforced concrete pavement slabs were constructed thereon with one thickness of tar paper covering the top of the cap. This was provided so if necessary at some future time the pavement could be pumped up to grade with a mud-jack.

This construction was let to contract, the award being made to the Merritt-Chapman & Scott Corporation with a time allowance of thirty days. The official time count began April 15, 1932 and the work was completed on May 7, 1932 with a period of 22 days of the time consumed.

744 lin. ft. reinf. conc. piles at $3.00	$2,232.00
12.7 cu. yds. of Class S concrete at $20.00	254.00
81.8 cu. yds. reinforced concrete pavement at $19.00	1,554.20
20,100 lbs. reinforcing steel at $.04	804.00
Total cost of rebuilding pavement:	$4,844.20

During the progress of the construction of Unit IV, Section 1, an incidental cost of $665.18 was incurred for labor and miscellaneous items, mainly special castings for adjusting street fixtures where Washington Street was widened.

On Unit IV, Section R, an incidental cost of $266.70 was incurred for labor and the cost of miscellaneous items not included in the contract for this unit. Changing the location of fire hydrant and installing water line that was removed during construction cost $ 538.89

Incidental work on bridges	455.65
Drainage on Columbia Island	980.84
Surface and subdrainage	7,887.93
Concession Building at Mount Vernon	74.19
Septic Tank, Mount Vernon	190.57
Telephone Conduits	161.30
Replacing sidewalks removed or damaged in Alexandria during construction	462.32
Signs and signals	2,471.30
Drilling cores in finished pavement and filling open joints	853.20
Water System, Mount Vernon	195.30
Slide, Station 521 to 524 (Kreuttner's)	6,754.03
W. & O. D. Railroad Crossing	99.63
Lighting	129.06
Current for Railroad Signal & Mount Vernon	1,714.26
Guard Rail	50.14
Bus Shelters	6,073.18
Sub-Total	$28,839.17

Brought Forward		$28,829.17
Cleaning Roadway and removing slides		2,600.51
Landscaping, Columbia Island		2,562.82
Brick Sidewalks		2,610.42
Asphaltic Concrete		708.93
Sidewalks, Highway Bridge		1,277.57
Painting Traffic Stripes		754.18
Mud Jack Operations		10,346.70
Replacing Pavement, Stations 521 to 524		7.70
Raising Curb, etc.		249.18
Unit IV, Section 1, Incidentals		665.18
Unit IV, Section 2, Incidentals		266.70
Bridges, Incidentals		453.68
Riprap Wall, Incidentals		14.00
Realoping		2,665.92
Miscellaneous		55.82
	Total	$54,086.45

The topsoil that was stored just outside of the slopes under the grading contract for Unit II was loaded, distributed and spread on the shoulders and slopes of the finished roadway between December 1, 1931 and May 7, 1932.

A government owned gas shovel (Osgood 3/4 cu. yd.) was used for loading, and 1½-ton trucks were rented by the hour for distributing the material. Approximately 35,000 cu. yds. were handled during the period in direct charge of P. H. Stafford, Junior Highway Engineer.

The hauling contract was let to A. G. Boone Co., of Columbia, S. C., for the period December 1 to March 1 at the rate of $1.20 per truck-hour including driver and all expenses. For the period March 1 to May 7, 1932 the contract was held by J. M. Burnley of Clifton Station, Virginia, at the price of $1.10 per truck-hour.

The crew consisted of a foreman (Stafford), a shovel operator, a helper, two watchmen, two or three laborers and for a short time a flagman. This crew distributed the material in piles where it was to be spread by other crews working under the direction of the Landscape Architect. The material was hauled as little as possible, but due to the distribution of the storage piles the average haul was more than a mile. An analysis of cost for this operation follows.

Summary of Cost Analysis

Period	Yardage	Haul (Ft.)	Haul Cost	Cost Per Cu.Y.Mi.	Loading Cost	Load.Cost Per Cu.Yd.	Remarks
1.	6000	5000	$ 442.00	$0.07	$ 614.00	$0.10	
2.	1500	9000	216.00	$0.08	170.00	$0.11	
3.	2000	10000	390.00	$0.10	352.00	$0.18	Very Muddy
4.	4500	16000	1,450.00	$0.11	837.00	$0.20	Very long haul and big repair bill
5.	17000	5000	950.00	$0.06	1550.00	$0.09	
6.	240	34000	140.00	$0.09	100.00	$0.42	Very long haul. Shovel idle 3/4 of time
7.	4500	2000	530.00	$0.29	490.00	$0.11	Trucks often stuck
Totals and Avrgs.	35740	6700	$4,118.00	$0.09	$4113.00	$0.12	

Conclusions

The cost of loading and hauling the soil more than a mile was only $.23. This is a very low figure, perhaps about 1/2 of what it would have cost contracting on a yardage basis. These figures include no charge for depreciation, which would have been an additional three to five cents. However, this work was done in the winter which, though very mild, added much to the cost. The equipment was perfectly suited for the work and the rental price for trucks was fair and reasonable. Mr. Stafford's time for superintending these operations is not included in the above cost.

Mud-Jack Operations

Realizing the likelihood of settlements on embankments across swampy ground, provision was made while paving was in progress for later pumping the pavement back to grade. The preliminary work consisted of cutting 2-inch pipe in lengths equal to the thickness of the pavement. Each of these pieces of pipe was plugged. A steel pin was made and driven into the subgrade at definite locations and the pipe sleeves places over them so that the top of the pipe would be at the elevation of the finished surface of the pavement. After the pavement had hardened 24 to 48 hours the plug was taken out and the pin withdrawn. The plug was then replaced.

Sketches showing the details of the pipe assembly together with the locations in each traffic lane are attached in the Appendix as Exhibit 37. It was later discovered that greater ease in manipulating the mud-jack and raising pavement could be obtained with a $2\frac{1}{2}$-inch diameter hole.

Some difficulty was experienced in pumping the 9-foot pavement lanes with pipe set in the center and equidistances apart, and especially was this true when there were greater frictional resistances along the construction joint on one side when compared to the joint on the other.

On the eleven foot traffic lane the pipes were not spaced so control could be maintained during pumping operations at the expansion joints between adjacent slabs. One pipe would be located five feet away. On the opposite side of the slab the pipe would be twelve feet from the expansion joint. It was necessary to drill holes through the pavement to cope with this situation.

The latter part of November the mud jack was moved to Station 790. No pipe had been placed in this pavement and it was necessary to drill holes for this purpose. Mr. Poulter, the inventor of the mud-jack, was present at the time and was requested to indicate a correct distribution of holes to be drilled in both the nine and eleven foot lanes. After the holed were drilled accurate measurements were taken and a drawing made showing the relative distribution over each slab. This sketch is attached in the Appendix as Exhibit 38.

Traffic Stripes

From Station 10+00 to Station 404+00, excluding the section through Alexandria, a white traffic stripe was painted. From Station 404+00 to Station 816+60 a black stripe was painted.

The white paint was purchased under the following specifications:

> "Ready mixed paint as received, shall be suitable for use with the usual paint brush or a paint machine. It shall be well ground, shall not 'liver', settle badly, cake, or thicken in the container within three (3) months of date of delivery. It shall flow evenly and smoothly, and shall cover solidly in one (1) coat on asphalt. It shall not cause the asphalt to 'bleed' either during application or while it is drying. A single coat shall set within one-half hour (so that there shall be no pick up under traffic) and thoroughly dry within one (1) hour (free from tackiness) to an elastic, opaque, adherent finish. It shall give a brilliantly white finish free from laps or brush marks. It shall not turn gray in sunlight or show appreciable discoloration with age. The color, hiding power and finish, when specified shall be equal to those of a sample mutually agreed upon. The paint shall pass the toughness and elasticity test as given in Federal Specification No. 21b (Bureau of Standards Circular No. 111, 3d Ed., page 6) except that the addition of Kauri solution shall be omitted."

The center stripe was a solid line six inches wide and 28,257 feet long.

241.5 gallons of paint used at $0.93	$224.60
52.0 gallons of turpentine used at $0.62	32.24
4.0 gallons of kerosene used at $0.137	.55
2.0 gallons of gasoline used at $0.117	.23
Total cost of material	$257.62
Labor cost	124.30
Total Cost	$381.92

The painting was done with a disc machine operated by one man pushing it ahead on the center line. To obtain an even distribution two painters followed, filling in with hand brushes. One gallon of paint covered an average distance of 117 lineal feet, and the cost per lineal foot was $0.0135. This application was over the bituminous concrete surface pavement which was rough. To obtain an even distribution of the paint it was necessary to use hand brushes.

The cost of painting the left and right side lanes from Station 85+00 to 281+67 and from Station 360+94 to 404+00 using spots 6 inches by 12 inches spaced 25 feet center to center to indicate the traffic stripe follows.

Date	No. Men	Hours	Rate	Labor	Distance
June 29	1	8	$.30	$ 2.40	8275 ft.
	4	32	.40	12.80	
June 30	1	8	.30	2.40	10075 ft.
	4	32	.40	12.80	
July 1	1	8	.30	2.40	8302 ft.
	4	32	.40	12.80	
July 2	2	16	.30	4.80	4400 ft.
	4	32	.40	12.80	
July 5	2	16	.30	4.80	11273 ft.
	4	32	.40	12.80	
July 7	3	24	.30	7.20	7877 ft.
	3	24	.40	9.60	
Total				$97.60	50200 ft.

Material Cost

12 gal. paint at $0.93	$11.16
2 gal. turpentine at $0.62	1.24
4 gal. gasoline at $0.117	.47
brushes	5.60
templates	.90
Total material cost	$19.37
" labor cost	97.60
Total -	$116.97
Cost per 100 feet	$0.233
Length of traffic lines painted with 6"x12" spots spaced at 25 feet	50,200 ft.
Distance covered per gal. of paint	4,183 ft.

A sketch showing the plan of spacing the spots is attached in the Appendix as Exhibit No. 39.

On the reinforced concrete pavement Headley's emulsified asphalt No. 5 was purchased from the Headley Emulsified Products Co., of Philadelphia, Pennsylvania.

The disc machine used in applying this paint was not entirely satisfactory. When set to cover the width of the stripe with paint it would flood and run down into the construction joint. When set to prevent flooding, more hand brushes were necessary to spread the paint evenly over the surface.

The cost of painting the black traffic stripe follows.

208 gal. paint at $0.33185 per gal.	$ 69.02
20 gal. gasoline at $0.117 per gal.	2.34
Total cost of material	$ 71.36
Labor cost	216.30
Total Cost --	$287.66

The center stripe was a solid line six inches wide and 35,552 feet long. One gallon of paint covered an average distance of 171 lin. ft. and the cost per lineal foot was $0.0081.

Engineering

Under this caption a brief description will outline the methods adopted for field work to control operations during construction.

The work commenced preparatory to beginning construction by referencing points along the center line. This was done by driving hubs on two intersecting lines, approximately at an angle varying from 60° to 120° apart as local conditions would allow. To provide for future landscaping these hubs with tack centers were located along the referenced lines unusual distances away from the roadway. A stake was marked R.-P. on one side. On the other the station of the point referenced was indicated. In the notes a diagram was made and the distances between hubs and the point referenced was recorded on each line. When trees were used as back sights for reference lines a stake was nailed to the tree and a tack driven circumscribed by a circle made with the use of kiel or crayon.

As the located center line was almost entirely curved, compounded into many of varying radii, together with the ends of spirals, numerous points were referenced. As an additional precaution a close inspection of the profile grade line was made to be assured that all referenced points were visible from each other after the grading was completed. At times intermediate points on the curves were referenced.

The alignment and bench marks had been previously checked, using mean sea level datum for elevations. Center line stakes were set uniformly at fifty foot intervals.

The points referenced along the center line follow:

P.T.	Point of tangency
P.O.T.	Point on tangent
P.C.	Point of curve
or P.T.S.	Point of tangent and spiral
P.S.C.	Point of spiral and curve
P.C.C.	Point of compound curve
P.O.C.	Point on Curve
P.C.S.	Point of curve and spiral
P.S.T.	Point of spiral and tangent
P.R.C.	Point of reverse curve

Curves of radii of 5,730 feet or less were spiraled. The sum of all deflection angles to the right were 605°-28'-43.68" and contained 14 spirals and 44 curves within a length of 39321.90 feet. The sum of all deflection angles to the left were 527°-45'-37.80" and contained 8 spirals and 36 curves with a length of 24115.90 feet.

Roadway Measurement

Prior to cross-sectioning and setting slope stakes, pegs were driven in front of the center line stakes so that their tops would be flush with the surface of the ground. Levels were taken along the center line on top of these pegs and their elevations used as the ground at that point. Due to the unusual width of the roadway, this method was deemed desirable for accuracy in taking intermediate sections as well as taking the changes in ground surface from the center line to the slope stake and reference hub. A uniform distance between the slope stakes and reference hubs was fifteen feet. The slope stake was marked on the front with the cut or fill and the distance to the center. The station of the center line was marked on the back.

The guard stakes at the reference hubs were marked as follows: On the back the center line station, and on the front the elevation of the top of the hub and its distance from the center line stake. A sketch is attached in the Appendix as Exhibit 18 and the letters A-B-C-D-E show the finished section on which all cross sections were based. Unusual care was necessary in calculations to provide for the changes from a crown to a superelevated section and changes in ratios per foot on the latter as the work of cross sectioning progressed. On a normal crown section the slope ratio from C. to B. and also to D was four hundredths of a foot (.04') per foot width. The superelevation per foot width was added algebraically to the above four hundredths and multiplied by the distance out to obtain the grade elevations at B and D.

The center line grade was used as an axis of rotation for the superelevated section by elevating the outside edge and depressing the inside resulting in the plus and minus signs for computations.

A tabulation of superelevation for different ratios per foot width of roadway is attached in the Appendix as Exhibit 19.

Grading

During the grading operations center line stakes were set, and grade elevations furnished on the center and shoulders from time to time as the exegencies of the situation demanded to control the symmetrical construction of the roadway and slopes. When the work of finishing and fine dressing commenced, the angle at the intersection of the ground surface and the cut slopes was rounded off, using a leaning wheeled grader and tractor. A hand force followed doing the fine dressing. It was soon found impracticable to set blue tops to grade at the center and shoulder lines as the operation of the tractor and grader would inevitably disturb them to such an extent that they would be useless.

A system was worked outusing a center line stake with the grade marked thereon at that location. The drop and distance was marked on each side of these stakes to the shoulder line and the contractor used a level attached to a cord and measured down to check this work. The field engineering force followed up for a final grade check. The method is illustrated by a sketch attached in the Appendix as Exhibit 20.

Overhaul

During the grading operations twenty per cent was added to the final sections to provide for compaction and future shrinkage. A mass curve was plotted of all excavated materials hauled and deposited in the embankments and from this diagram data was obtained to compute the overhaul.

Drainage Structures

A center line was established for each drainage structure. This line was extended a sufficient distance on each side of the center line ofthe highway to set two reference hubs at definite distances out, and beyond the limits of the grading or foundation excavation operations. This line or axis of the drainage structure was tied in at the intersection with the center line of the highway and recorded. It was a reference line to the center of the highway and a convenient means of locating drop inlet shafts while the grading work was in progress. Levels and cross sections were taken over the ground surface using this axis as a base line. A profile along the center line of the structure was then plotted and the flow line grade established. The length of the structure was then computed and a sketch made showing the plan of the foundation excavation with elevations and distances noted. Another sketch was made for next lines of the structure showing measurements for accurate masonry computations. Several pages in the field note books were allocated for notes and sketches on each drainage structure before work commenced so that all data would be found together in the same section of the book. A full index completed the reference to these notes. These notes were recorded in cross section Field Book 376-A (K. & E. Co.)

Preliminary Work for Paving

As the finishing and fine dressing on the Unit II contract progressed the field engineering forces commenced setting hubs along the center line of the roadway at fifty foot intervals. From these hubs on the center, a hub was set on each side of the roadway and along radial lines offset five feet from the pavement edge for future use in lining for expansion joints and rapidly reproducing the centers by measurements.

At the same time cross sections were taken and plotted on standard size sheets on a distorted scale, that is, five feet to the inch was used for the horizontal scale and one foot to the inch was used for the vertical. Templates were cut for use in drawing the pavement base on the plotted cross sections. An average of three planimeter readings was used for the area of the cross section to be excavated. A number of areas were calculated and compared with the planimetered areas to determine the error between the two methods. This difference was negligible, probably due in a measure to the large scale to which the areas were plotted. For ready comparison a sketch is attached in the Appendix as Exhibit 21, showing the sections of the reinforced concrete pavement design.

Templates were cut for use in plotting the different pavement bases on the cross section sheets. A sketch showing one of these templates superimposed on the finished roadway section indicating its advantages in drawing the excavation lines for the pavement base is attached in the Appendix as Exhibit 22.

The plain and reinforced concrete base pavements were laid in lanes twenty feet in width. The reinforced concrete pavement was laid in lanes nine, ten, and eleven feet in width. At flares to double roadways, overlooks and approach access roads, there were variable shapes of pavement areas between construction and expansion joints. Special designs were drawn for each of these for use during construction to obtain correct locations of joints and avoid the possibility of pouring green concrete in acute angular spaces. Specimen sketches showing the layout of construction and expansion joints, also the planes of weakness for the reinforced concrete pavement are attached in the Appendix as Exhibits No. 23, 24 and 25.

On the first traffic lane constructed two hubs were offset four feet on each side of the edge of the traffic lane at intervals of fifty feet longitudinally along the roadway. One of these hubs located on each side of the traffic lane was driven down so the top was flush with the ground surface and centered with a tack for lining the side forms. The other hubs are on each side of the traffic lane (a sufficient distance away from the above described alignment hubs) were driven so that the tops would be at the elevation of the edge of the traffic lane pavement. These hubs were used for setting the side forms to grade. On the construction of subsequent traffic lanes elevation and alignment hubs were set on one side only.

During the paving construction there were about twenty-three operations in making transitions from the crown section to that of the superelevated. About one-fourth of these were on the reinforced concrete base pavement laid in twenty-foot width lanes with a plane of weakness constructed in the surface parallel to the center and nine feet therefrom. The remainder were distributed along the reinforced concrete pavement.

Referring to the plans for this project, it will be found that the pavement was designed with a crown section for tangents and also for curves ranging in radii from 9,000 to 50,000 feet. Curves of radii less than the above were provided with a plane section that rotated on the center line to obtain the superelevation. The ratio per foot width of this superelevated plane section when referred to a horizontal line at profile grade elevation increases or decreases as the radii of the curves become shorter or longer in length.

A transition was provided to merge the crown section into the superelevated with a uniform smooth surface that would allow motor traffic movement to continue as if no appreciable change had taken place on the pavement. At the same time it would present to the observer an aesthetic treatment of the surface that would be harmonious in appearance.

It has previously been explained how hubs were set for alignment and grades for setting side forms. The same method was used on these transitions except that twenty-five instead of fifty-foot intervals were used. There were also other hubs provided on each side of the traffic lanes, offset beyond the regular hubs for use in lining and setting the auxiliary forms for crown wipe out. The method of constructing this transition is illustrated by sketch attached in the Appendix as Exhibit 26. A specimen sheet showing system of tabulating grade elevations is attached in the Appendix as Exhibit 26-A.

One of the first duties performed before beginning the concrete paving was setting the screed to obtain the correct surface. In anticipation of this duty ordinates were computed for the two different crown sections of the reinforced and plain concrete bases, also for the nine-foot crown traffic lane on the reinforced concrete section. These ordinates are tabulated and are attached in the Appendix as Exhibit 27.

Exhibits No. 28 and 29 were devised for general use during the construction period. They were handy for the inspectors' use during the paving operations in checking the daily plant yield of concrete.

The total length of the pavement, all equations included from Station 10+00 to 816+59.5 plus the length of the loop around the oval at Mount Vernon, is 82,014.68 feet or 15.53 miles. All equations on the center line as constructed are listed and are attached as Exhibit 30.

The rise and fall of the pavement grade from Station 10+00 to Station 816+59.5 follows.

Station	Elevation	Feet	
		Rise	Fall
10+00	26.74		
45	19.12		7.62
51+50	27.20	8.08	
62	7.81		19.39
66	10.79	2.98	
74	7.06		3.73
96	12.22	5.16	
109+50	9.76		2.46
130+50	50.37	40.61	
144+50	31.66		18.71
151+50	42.27	10.61	
184	9.97		32.30
198+50	29.89	19.92	
240+50	8.00		21.89
268+50	45.70	37.70	
281	26.92		18.78
308	46.97	20.05	
328+85	37.35		9.62
353	41.73	4.38	
343+50	20.28		21.45
351	29.50	9.22	
352+39.85 back = 345+94.55 ahead			
349+50	26.77		2.73
360	45.67	18.90	
393	8.13		37.54
402	10.11	1.98	
411+50	6.93		3.18
417+50	8.57	1.64	
428+50	6.00		2.57
435	6.95	0.95	
440+50	6.25		0.70
486	13.88	7.63	
498	10.51		3.37
556+50	75.56	65.05	
578+80	51.01		24.55
584+50	62.21	11.20	
595+00	53.19		9.02
604+50	61.53	8.34	
625	10.30		51.23
629	20.49	10.19	
633+50	10.38		10.11
642	49.53	39.15	
651+50	16.80		32.73
660	35.12	18.32	

Station	Elevation	Feet	
		Rise	Fall
667	22.52		12.60
675+50	37.02	14.50	
692+50	7.43		29.59
701	11.50	4.07	
709	7.57		3.93
715	15.73	8.16	
718	12.91		2.82
723+50	20.87	7.96	
728	13.85		7.02
737+50	29.23	15.38	
748	21.44		7.79
755+50	27.54	6.10	
761+74.80 Back = 772+54.60 Ahead			
774+50	11.91		15.63
781+50	21.36	9.45	
790	8.45		12.91
815	90.86	82.41	
	Total Rise and Fall -	490.09	425.97

Personnel Employed on the Construction of the
Mount Vernon Memorial Highway

Name	Title
Junius W. Johnson	District Engineer
William I. Lee	Assoc. Hwy. Engr.
Worth D. Ross	Assoc. Hwy. Engr.
Edward St. Clair Smith	Assoc. Hwy. Engr.
T. A. Jones	Assoc. Hwy. Engr.
A. C. Spann	Junior Hwy. Engr.
F. W. Cron	Junior Hwy. Engr.
P. H. Stafford	Junior Hwy. Engr.
F. I. Davidson	Junior Hwy. Engr.
S. W. Rixey	Sr. Engr. Insp. Foreman
J. S. Biscoe	Junior Hwy. Engr.
T. E. Ruffin	Sr. Engr. Insp. Foreman
E. C. Paddock	Sr. Topographic Draftsman
C. W. Riesley	Senior Clerk
J. C. Bibb, Jr.	Clerk-Stenographer
J. G. Hanford	Chief Hwy. Draftsman
L. E. Knight	Sr. Topographic Draftsman
Karl Harmeling	Sr. Engr. Insp. Foreman

Inspectors

F. C. Brennecke
J. Paul Felt, Jr.
William B. Green
Reid M. Pierce
W. C. Corson
T. H. Farrington
R. A. Scott
Odie Lynch
F. K. Ditto
George A. Veitch
Clinton V. Stevens
Cortland Ennis Young

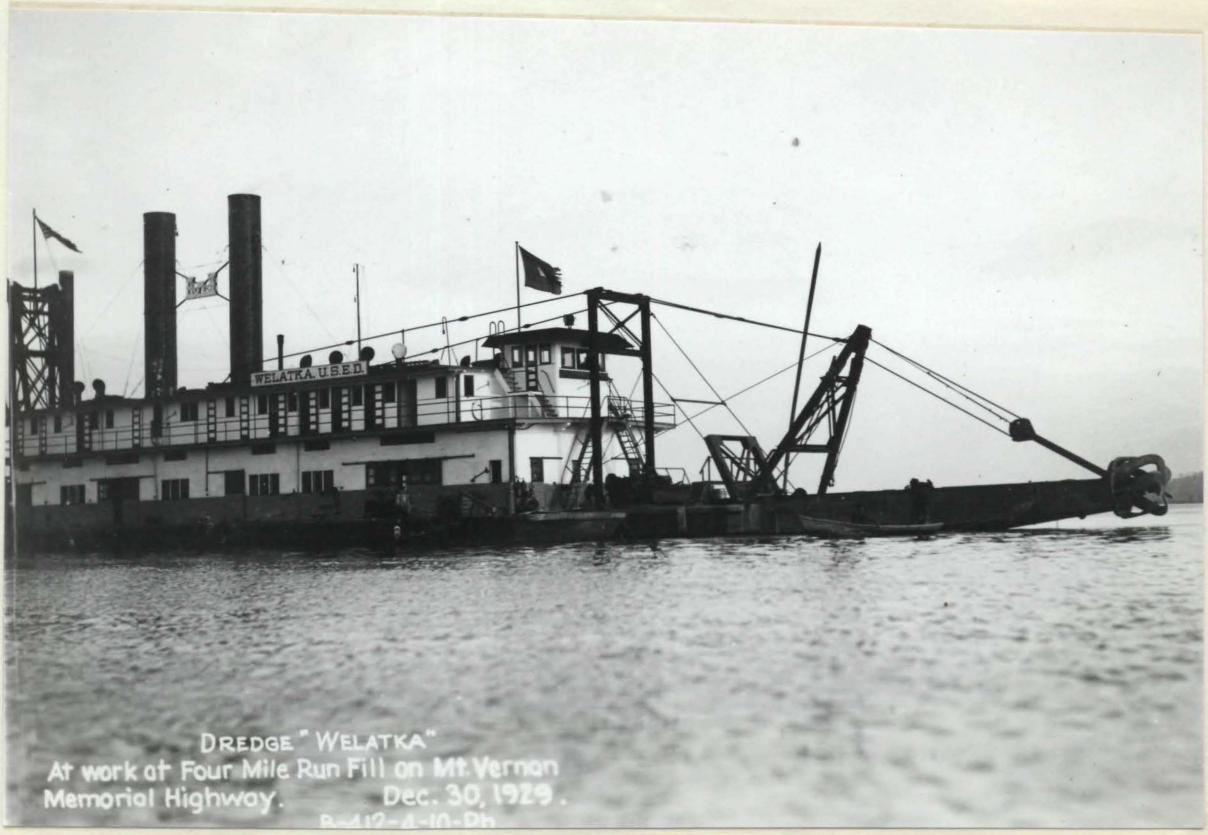
Photographic Section

(No. 126)
Completed Road Showing Alignment and Grades
Station 735 Looking North

No. 1067.
Smoot Sand & Gravel Co. Dredge - Excavating Six Feet Below Mean Low Water for Riprap Sea Wall Foundation.

No. 773.
Constructing Riprap Sea Wall.
Dredge Unloading and Placing Stone south of Columbia Island.

No. 439. Dredge Talcott at Work at Columbia Basin.



Dredge Welatka at Work at Four Mile Run.

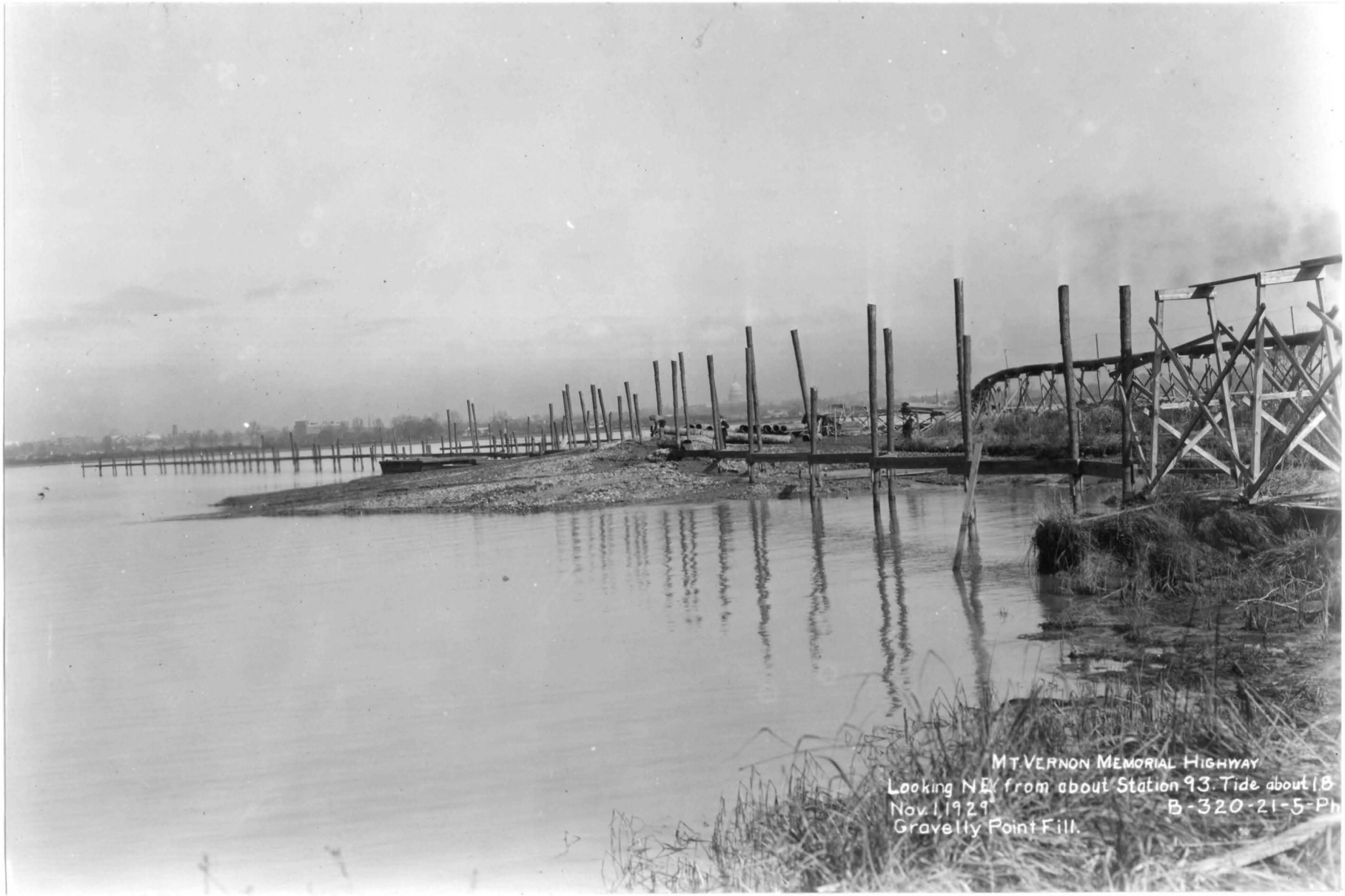
No. 736. Columbia Basin before Filling. The Two Bridge Spans were removed.

No. 548. Columbia Basin showing Pumping Operations.

Hydraulic Fill, End of Discharge Pipe

Hydraulic Fill

Four Mile Run, South Side, End of Discharge Pipe



Gravelly Inlet.

Hydraulic Fill - Four Mile Run.

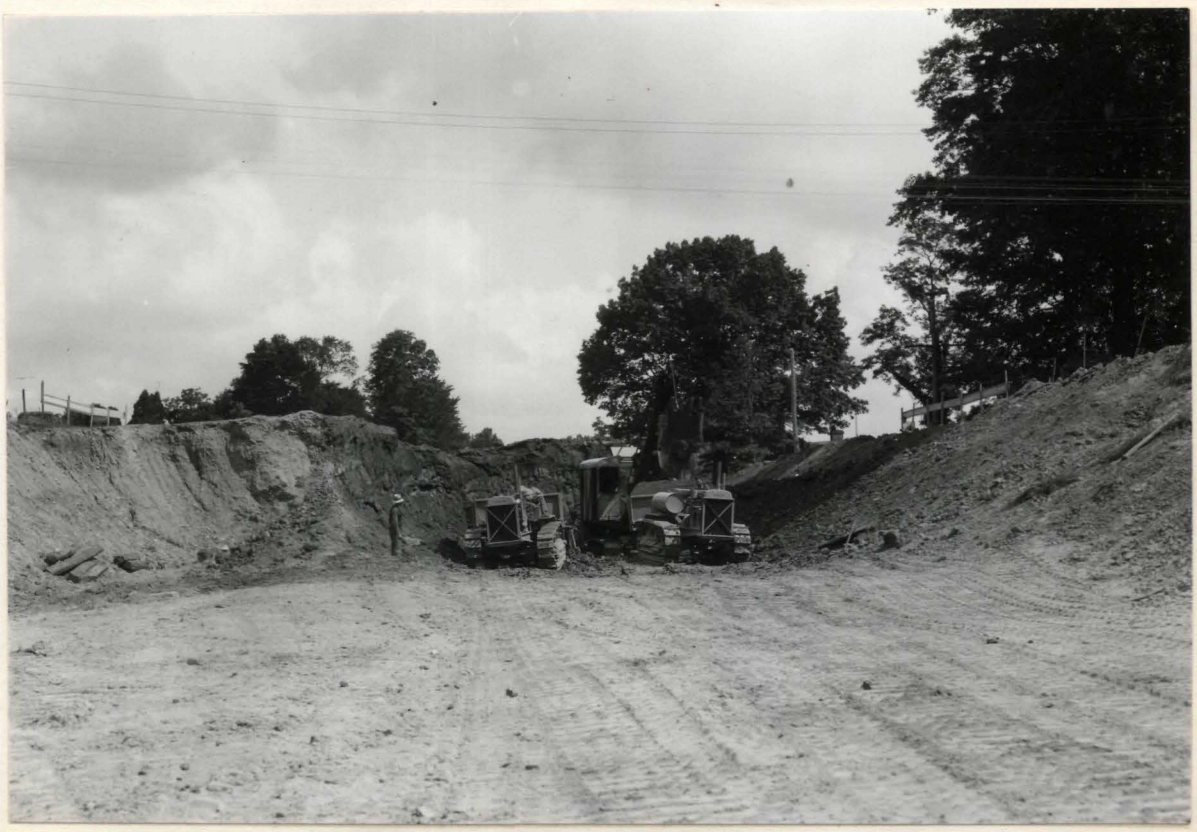
Gravelly Inlet and Columbia Basin.


MOUNT VERNON MEMORIAL HIGHWAY
Little Hunting Creek Fill
Discharge pipe line trestle along center of fill Looking N.W. along eastern side of trestle from about Sta. 751. March 23, 1931.
At about half tide
B-320-21-145-P

Hydraulic Fill - Hunting Creek.


MOUNT VERNON MEMORIAL HIGHWAY
Little Hunting Creek Fill
Pipeline trestle – Dredge to shore "Talcott"
stripping dredging area. March 2, 1931.
Atabout M.L.W. B-320-21-142-Ph.

No. 310. Grading Near Mount Vernon, April, 1930



No. 262. Grading Operations within the Mount Vernon Terminal

No. 528. Finishing Earth Graded Road

No. 554. Finishing Earth Graded Road

No. 826. Grading Operations near Mount Vernon.

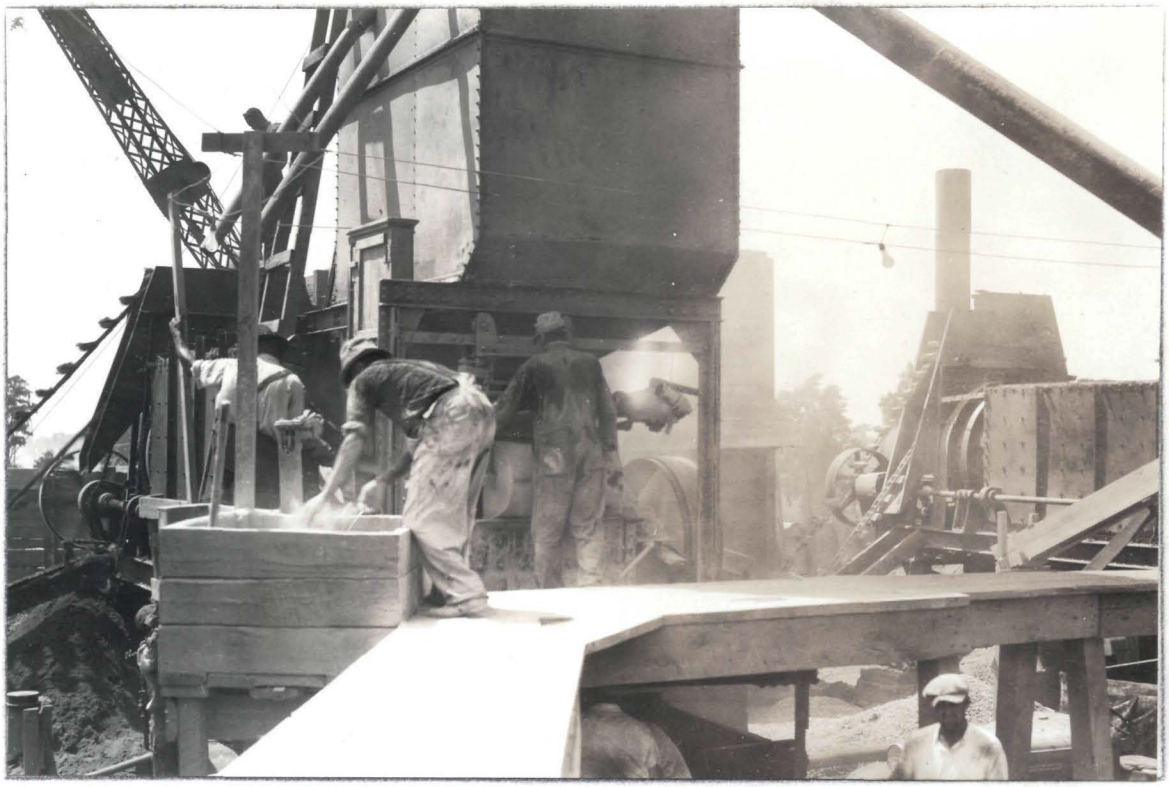
No. 264. Grading Operations.

#46 Building Concrete Curb About Station 250

#12 Finishing Concrete Curb About Station 71

No. 41. Station 216 - Looking Northeast.

No. 25.
Cutting Plane of Weakness Between 9 and 11-foot lanes on 20-foot slab.

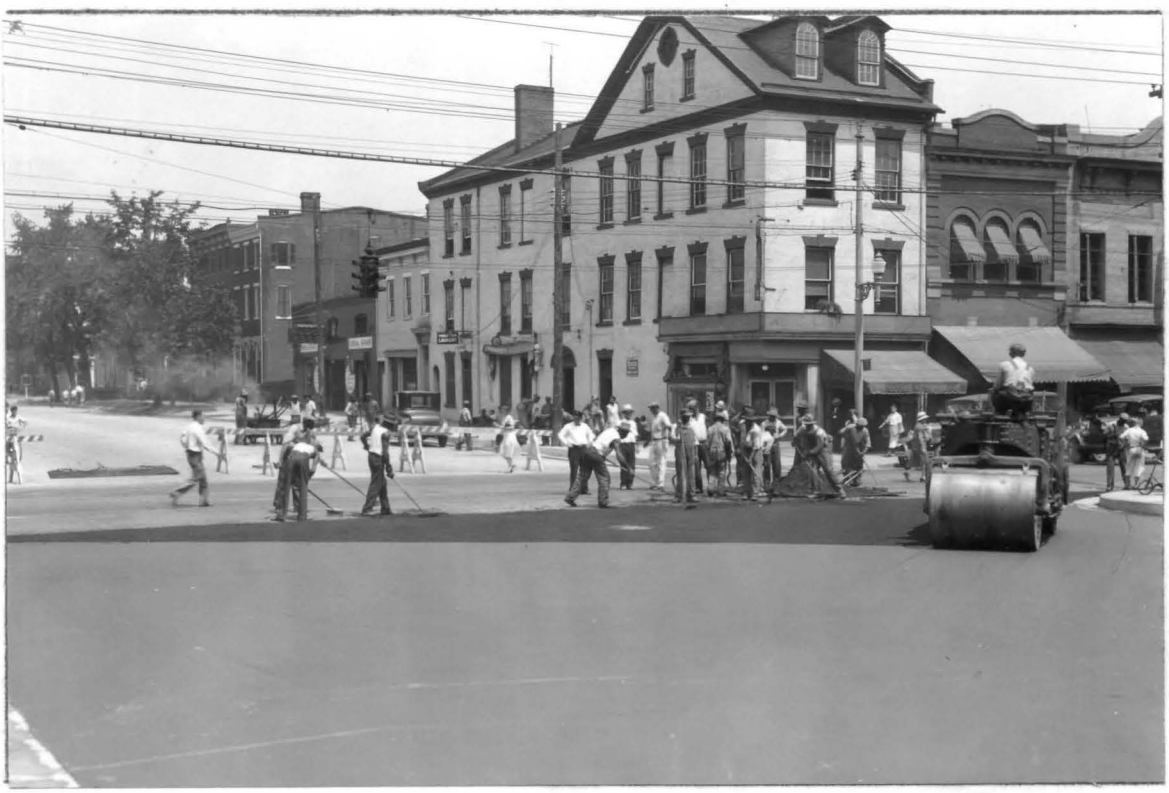


51

#51 Asphalt Plant

54

#54 Plant Layout

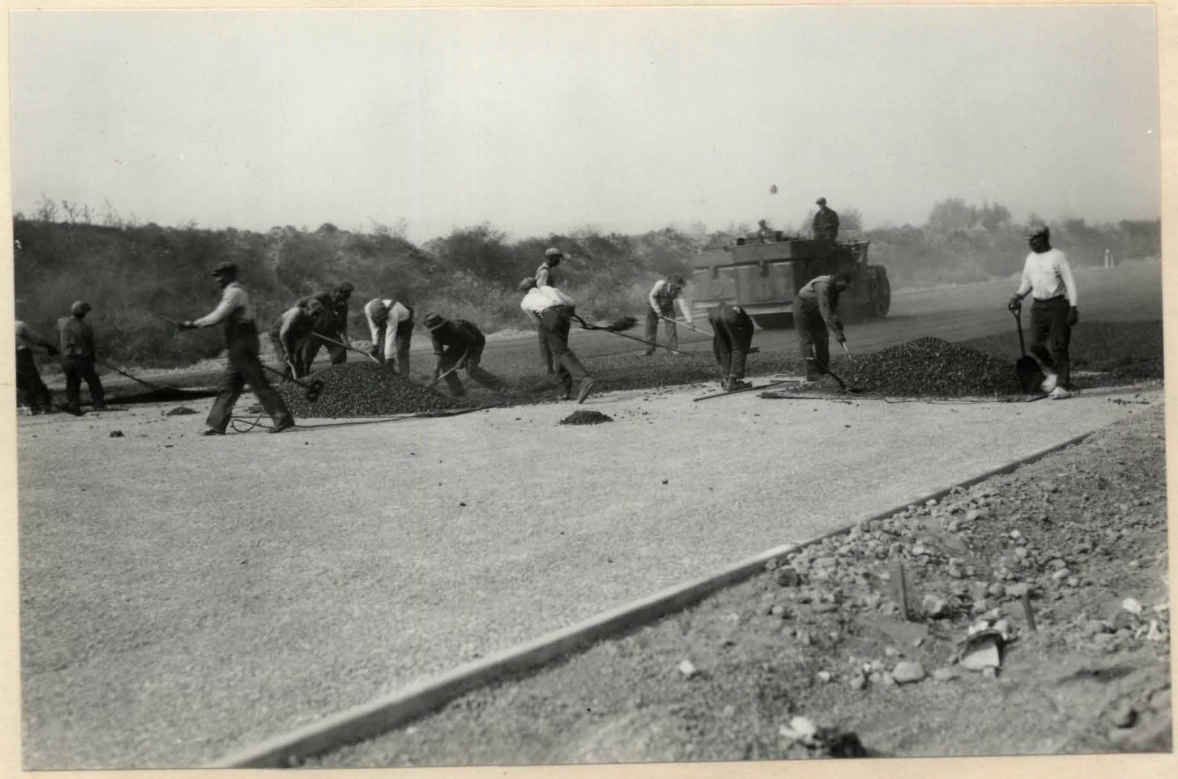


61

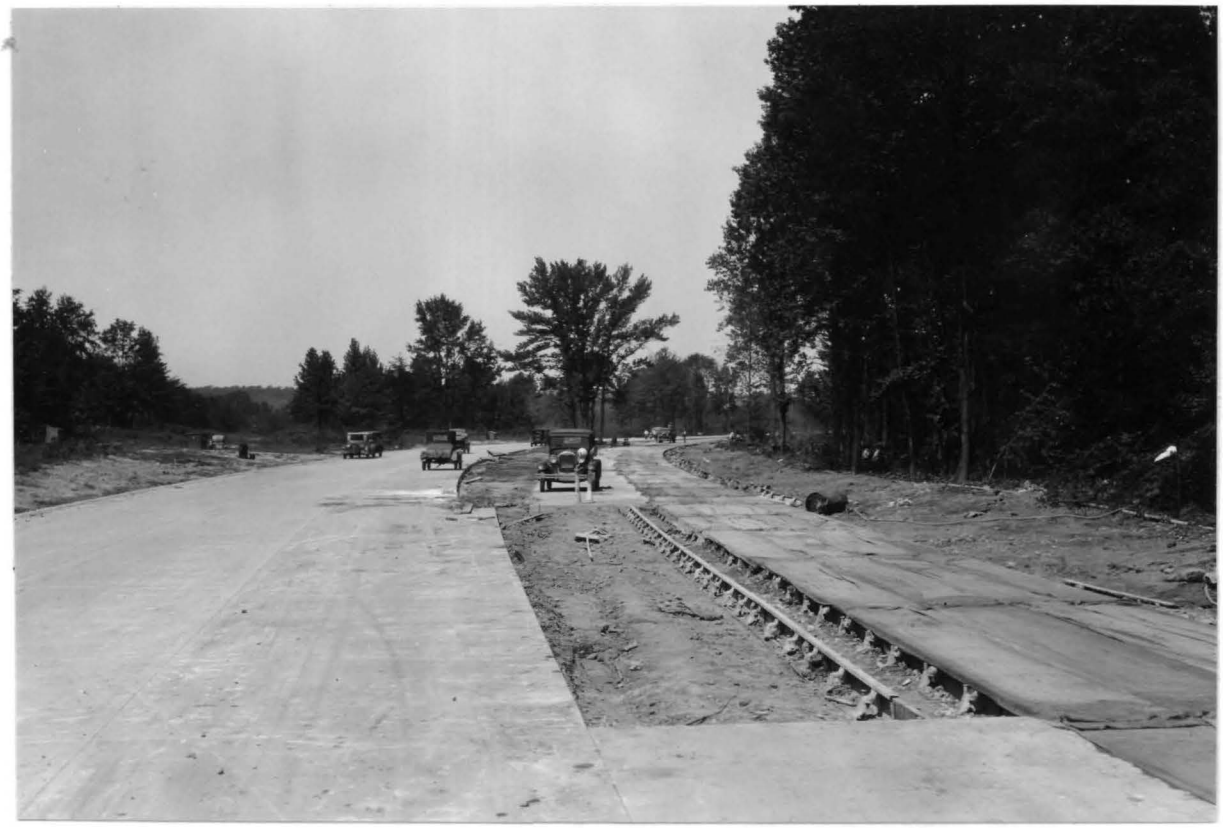
Washington and King Streets Intersection
Spreading and Rolling Asphalt

Spreading Asphalt Binder

No. 20.
Spreading Asphaltic Concrete Surface Course about Station 174.



No. 1.
Spreading Asphaltic Concrete Surface Course about Station 41 - Columbia Island.



No. 82. Station 475+30 Looking North, Bucknell Flare

No. 491. Station 719+00, Price Access and Bus Parking Area

No. 92. 27-E Paver Near Wellington Villa Bridge

No. 94. Same View as Above Taken from Bridge

No. 134. Unloading Barges to Batching Plant, Little Hunting Creek

No. 77. Batching Plant, Little Hunting Creek

No. 115. Rolling Bituminous Macadam, North Access, Fort Hunt

No. 533. Access Road B, Leading from Wellington Villa to Collingwood

No. 556. Access Road "B" Looking Northwest about Station 588.

No. 958. New Alexandria Flare Looking North from Station 622.

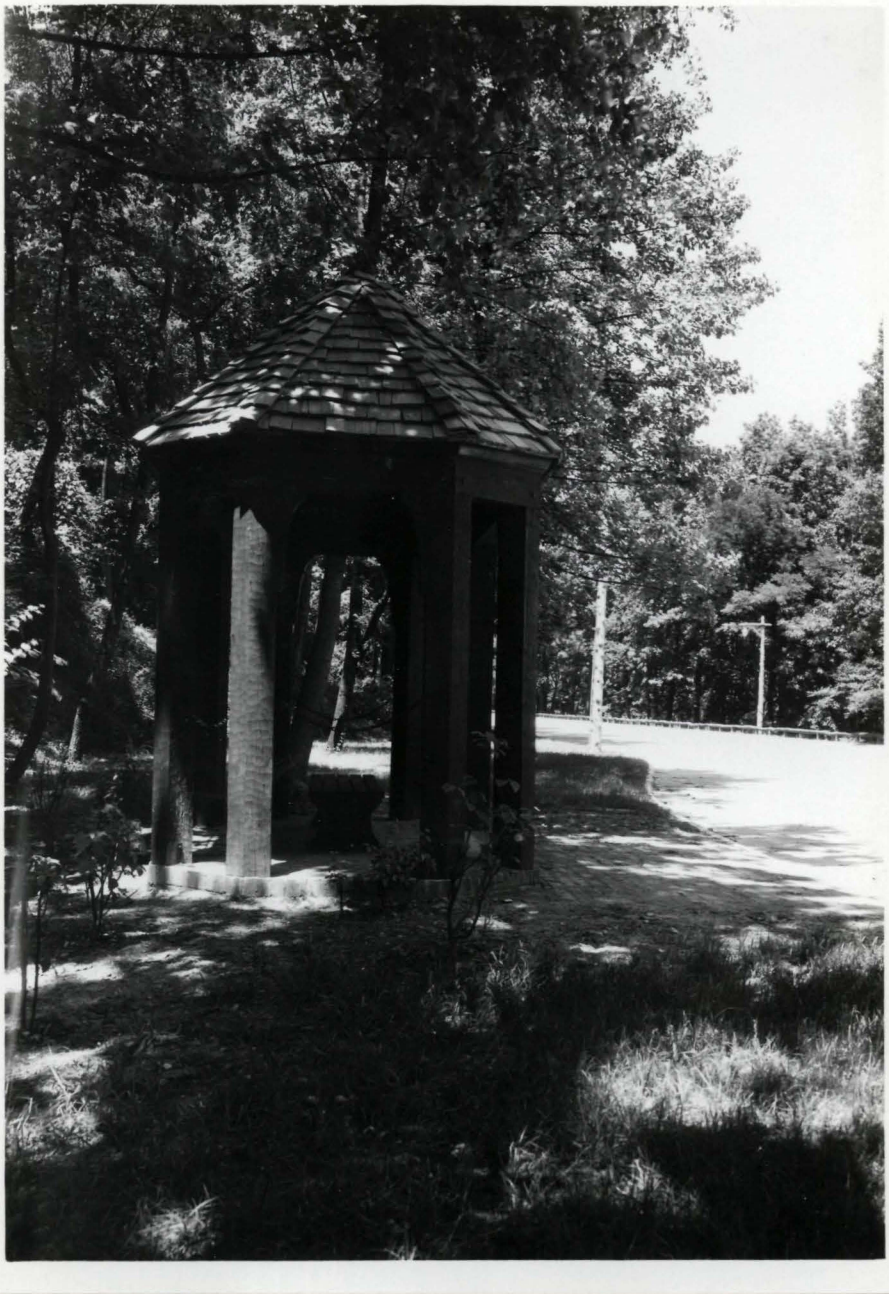
No. 954. Looking North from Station 454.

No. 914. Double Cedar Standard at Unloading Platform
Mount Vernon Terminal.

No. 1088
Single Metal Standard near R. F. & P. R. R. Underpass.

No. 919. Mount Vernon Terminal Unloading Platform and Circulating Lanes

14th Street Highway Bridge Grade Separation. Potomac River on the right, Boundary Channel on the left.

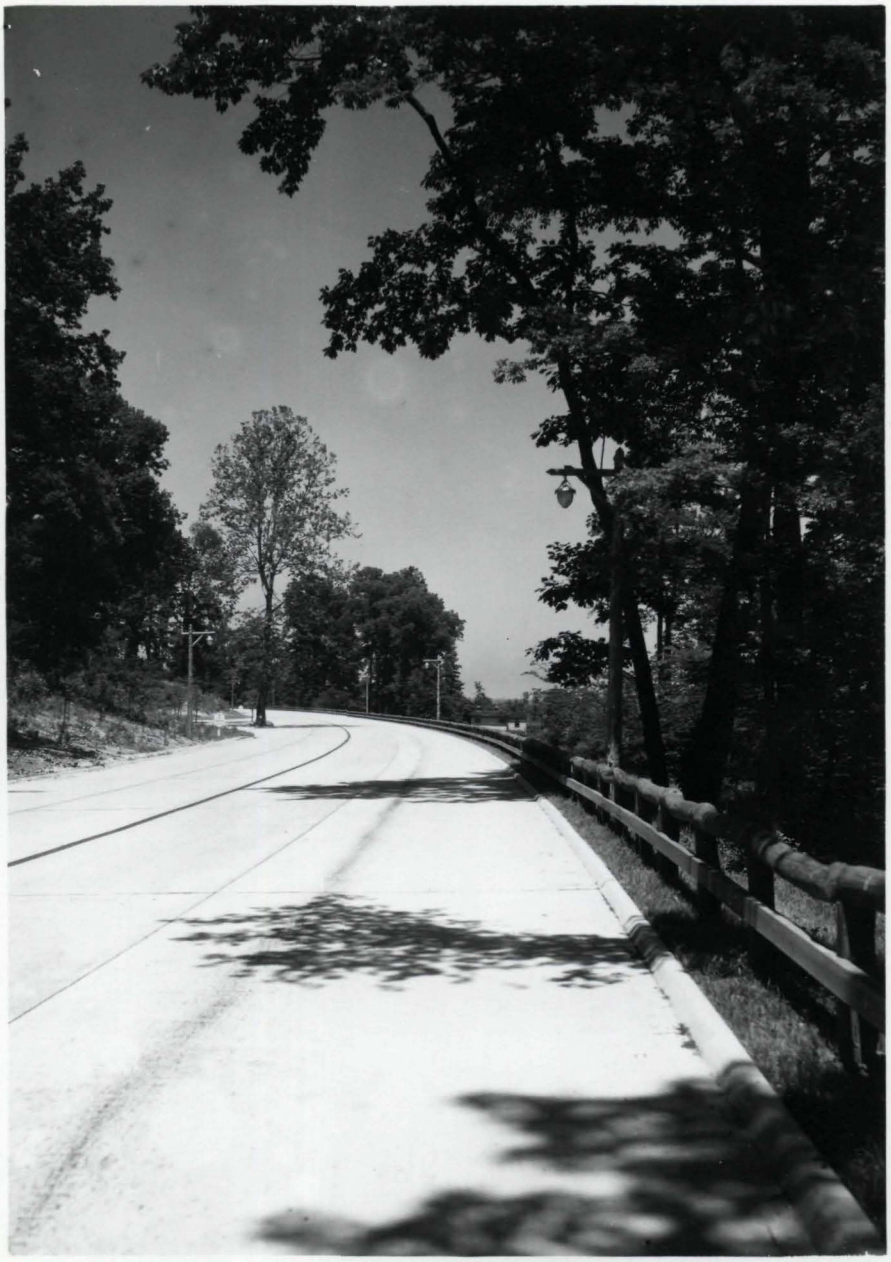


No. 947.
Bus Shelter, about Station 532.

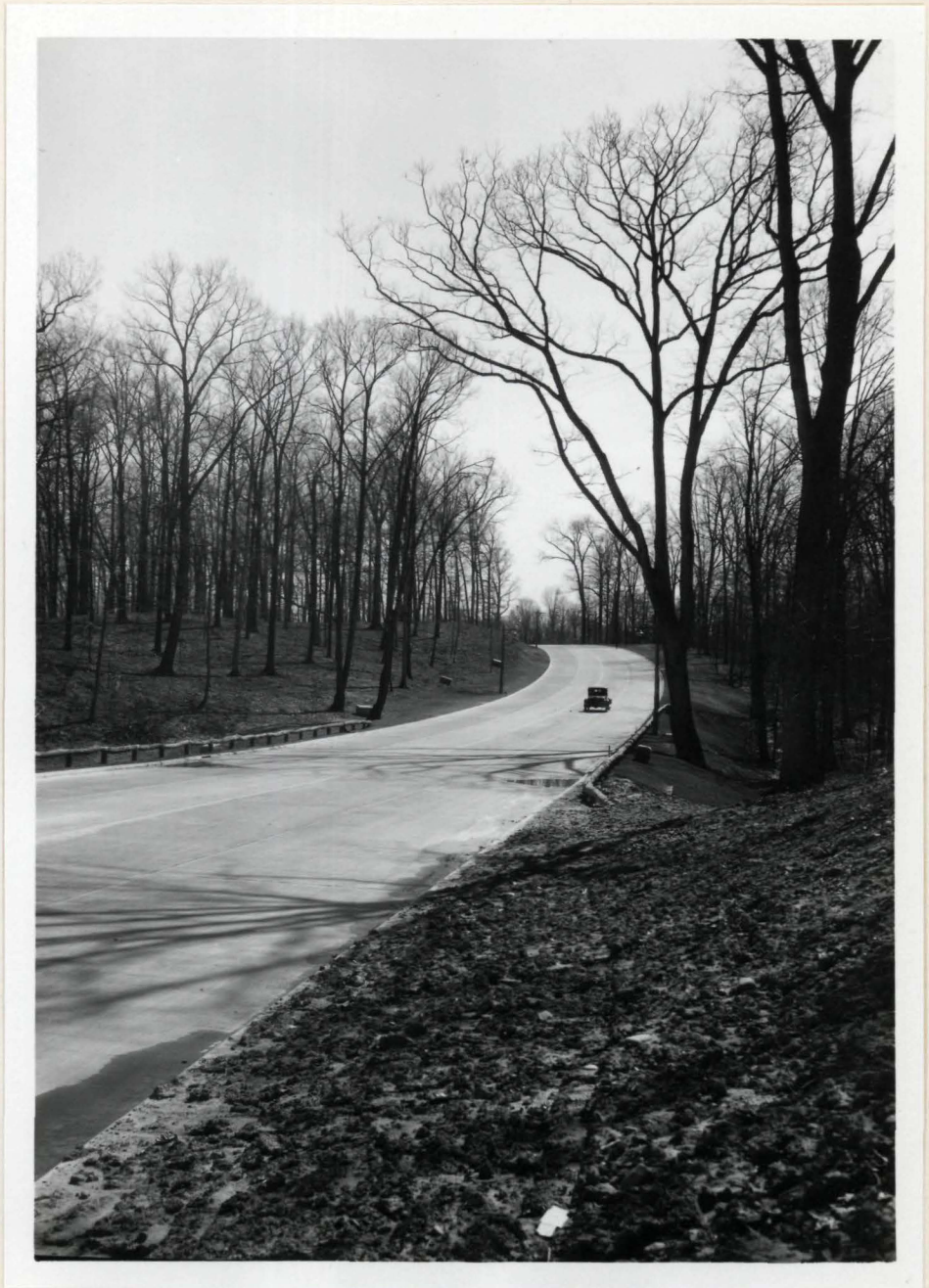
No. 534. Looking South from Station 631.

No. 925. Looking South from Station 650.

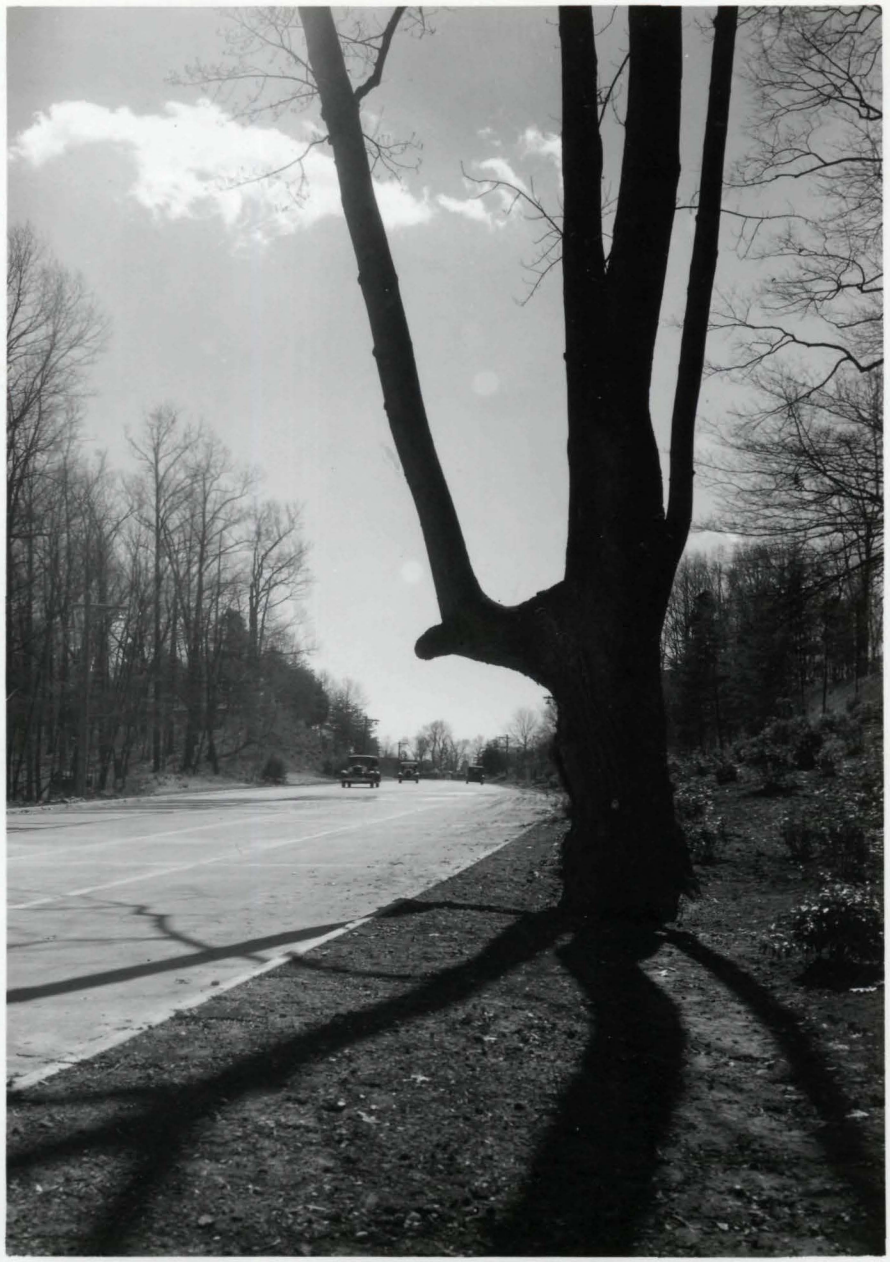
No. 740. Looking South from Station 649.



No. 949. Looking North from Station 501.



No. 935. Looking South from Station 632.



No. 929. Looking South from Station 784.

No. 873. Looking North from Station 793.

No. 874. Looking North from Station 804.

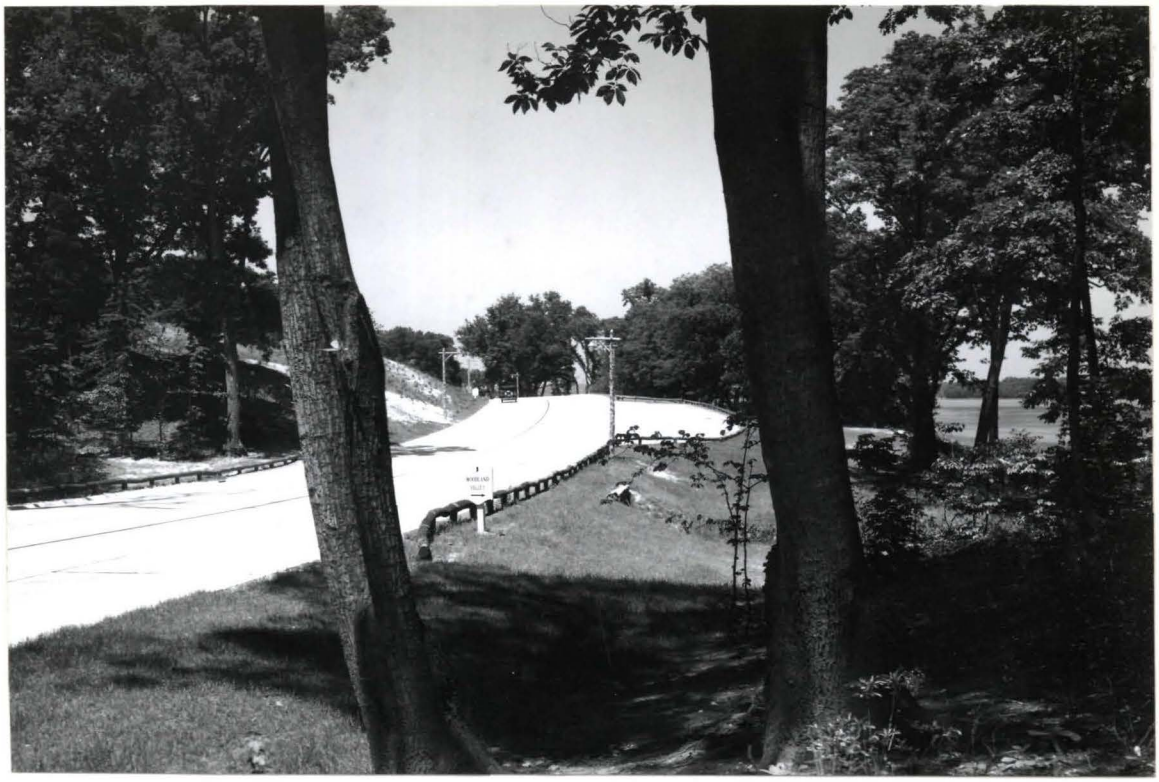
No. 948. Traffic Sign

No. 938. Looking South from Station 645.

No. 946. Looking North from Station 651.

No. 959. Looking North from Station 260. Traffic Stripes.

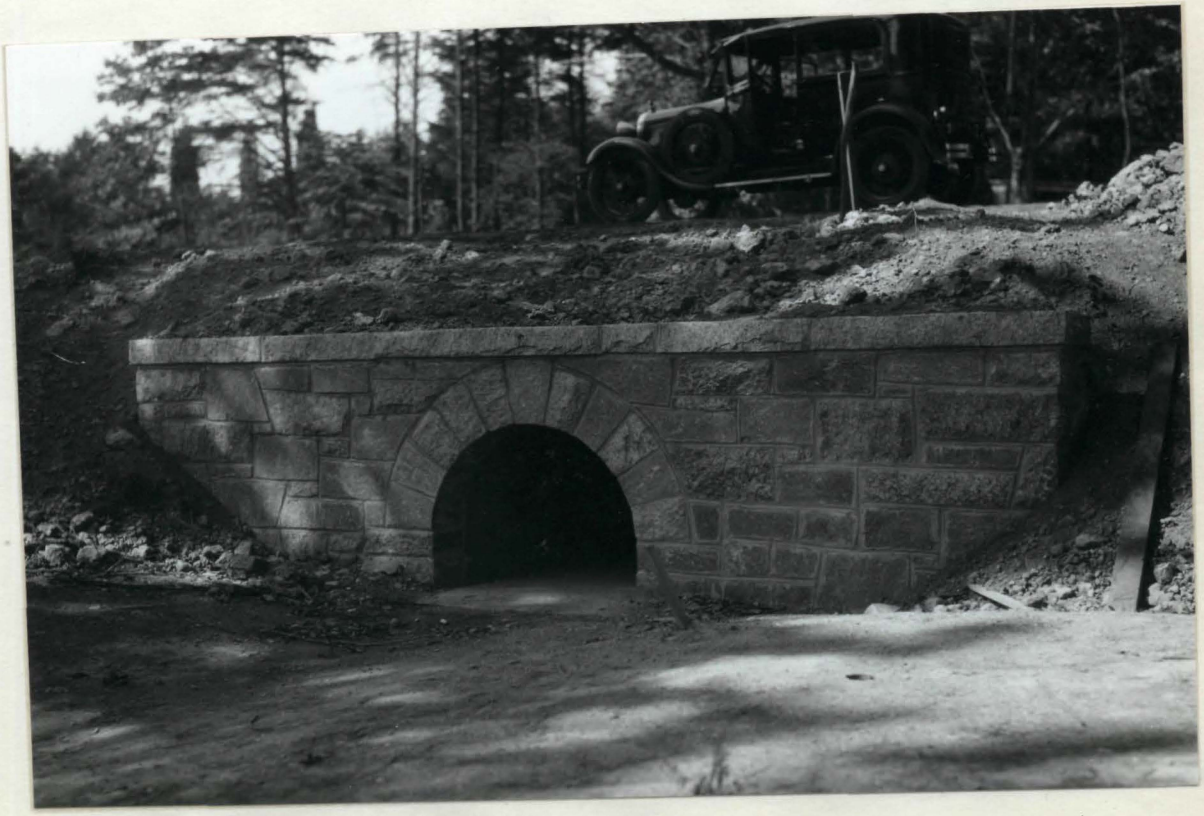
No. 956. Looking North from Station 193.



No. 960. Looking north from Station 634+50

No. 344. Looking North from Station 543.

No. 962. Looking North from Station 718+50.

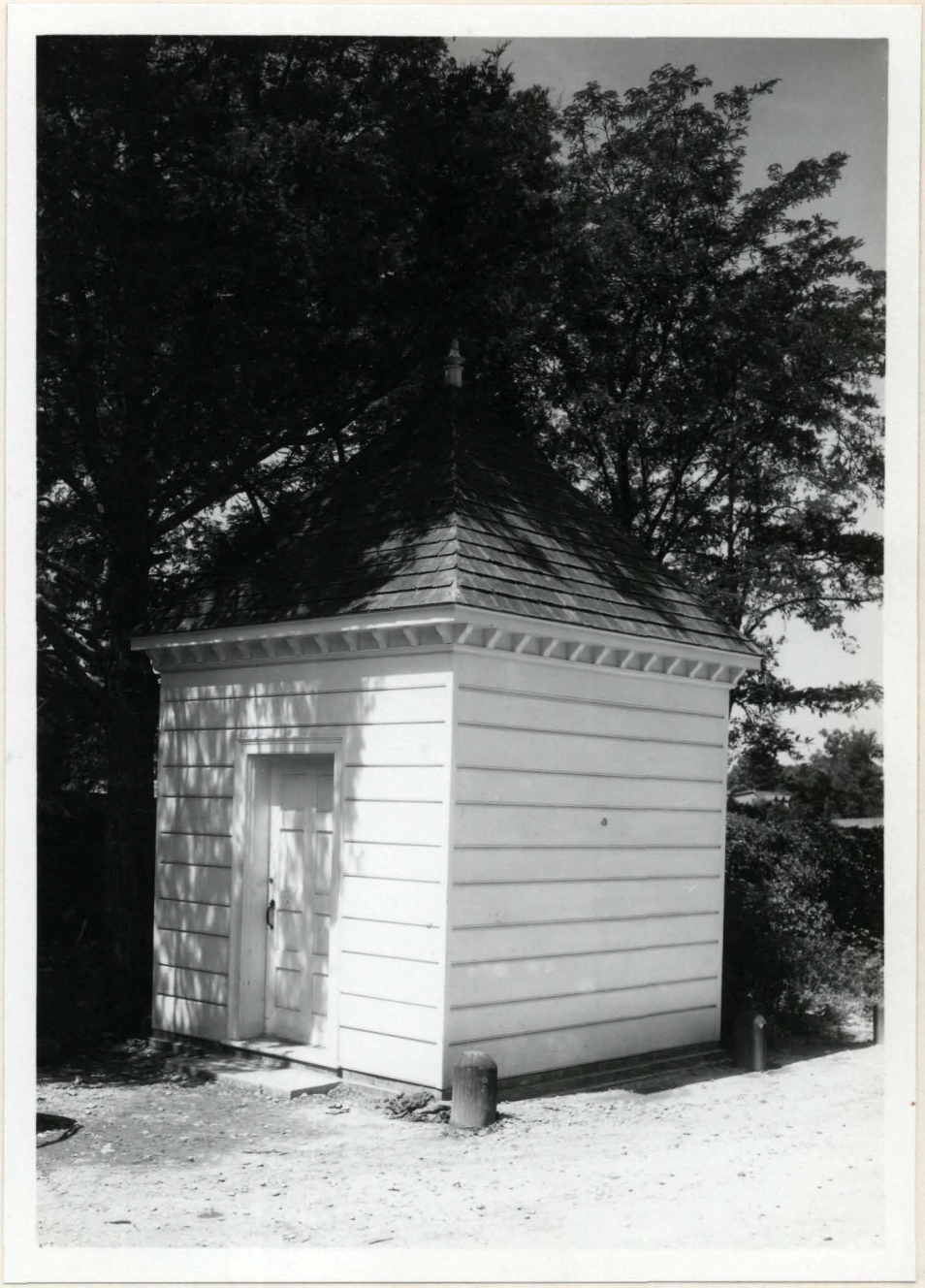


No. 1041. Arch Culvert, Station 718+25.

No. 96. Looking North from Station 544.

No. 695. Looking North from Station 627.

Mount Vernon Terminal showing Circulating Roads with Car Parking Areas on the left, Bus Parking on the right.



No. 980. Tool House, Mount Vernon.

No. 1096. Police Lodge, Mount Vernon.

No. 1095. Looking South - Car Parking Area at Mount Vernon.

No. 1097. Concession Building from entrance of Car Parking Area.

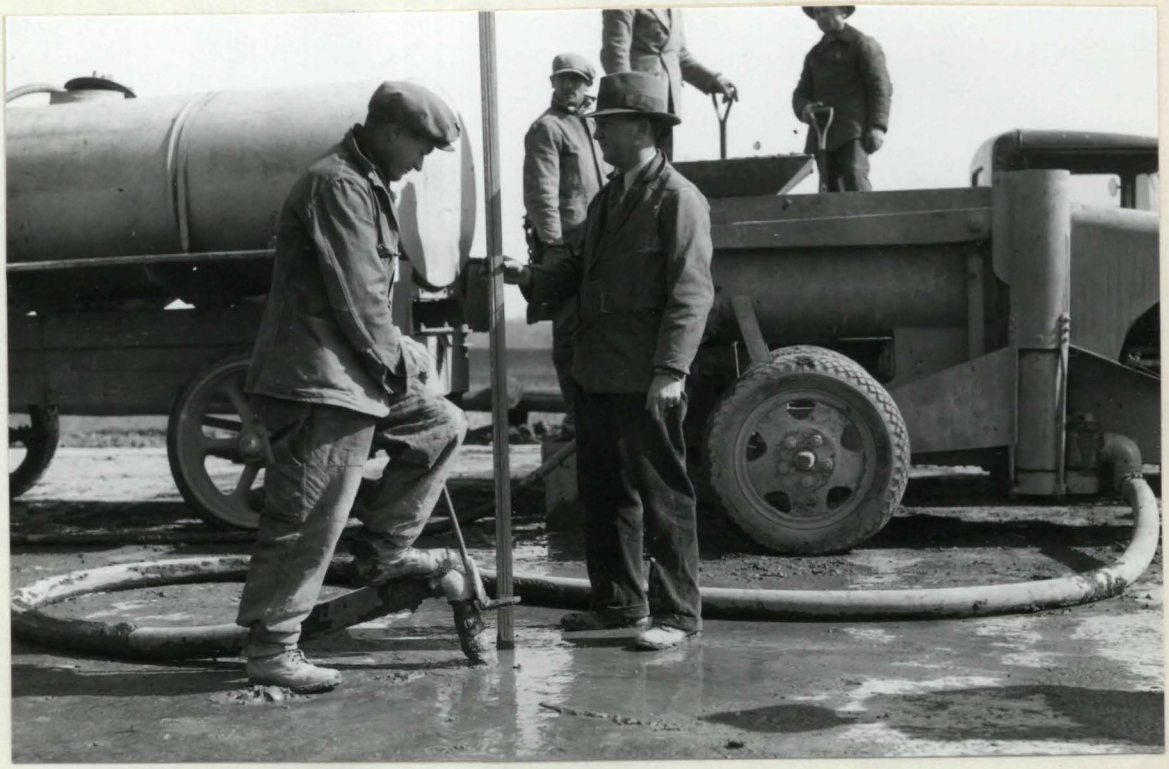
No. 1090. Looking South from Station 475.

No. 1100. Mount Vernon Concession Building from Car Parking Area

No. 1094. Concession Building at Mount Vernon

No. 1099. Circulating Roads & Car Parking Areas at Mount Vernon

No. 653. Raising Pavement, using Mud-Jack.



No. 652. Checking Grade of Pavement with Mud-Jack.

No.715. Checking Grade with Mud Jack in Operation

No.651. Checking Grade with Mud Jack in Operation

Appendix

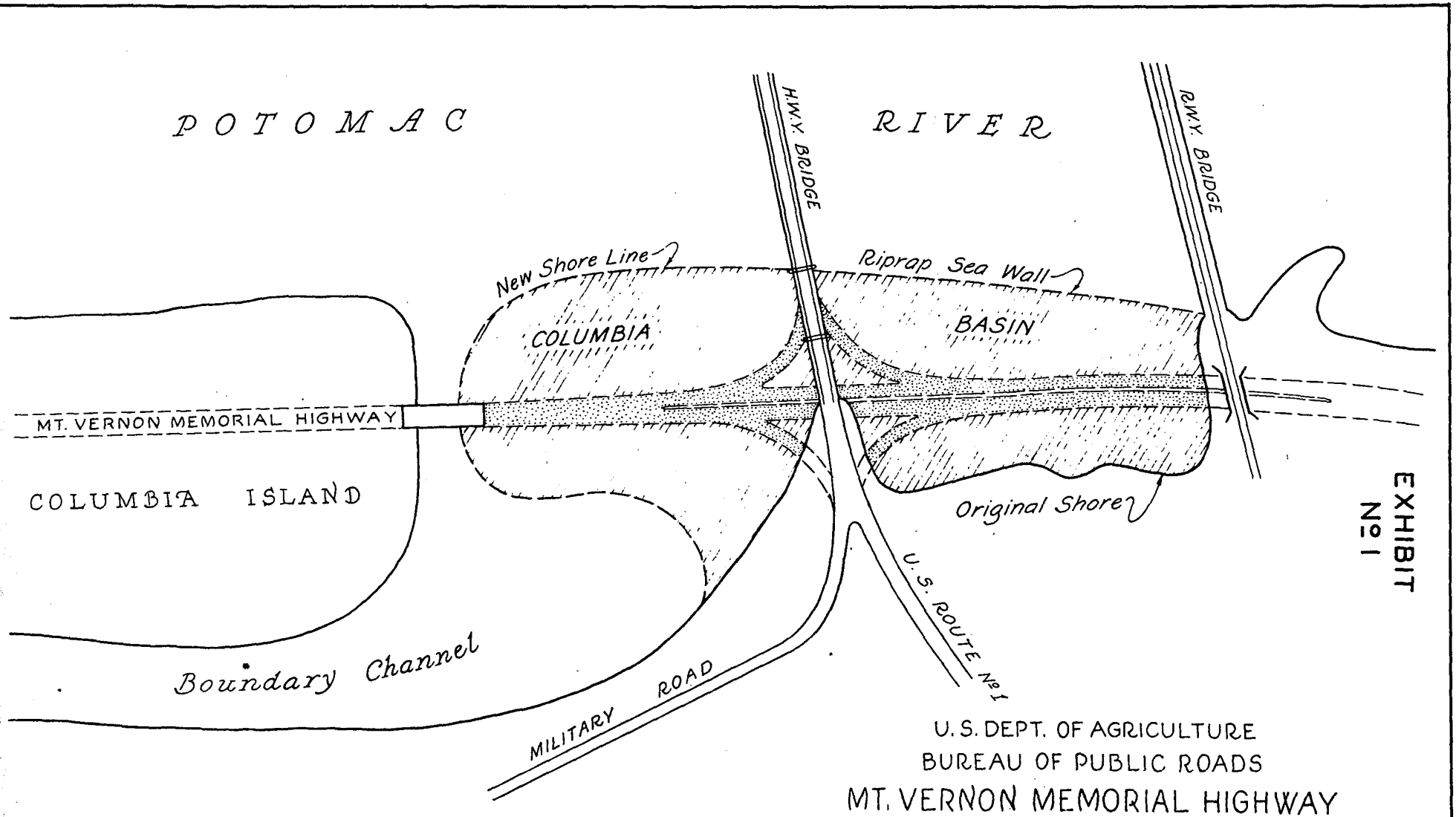


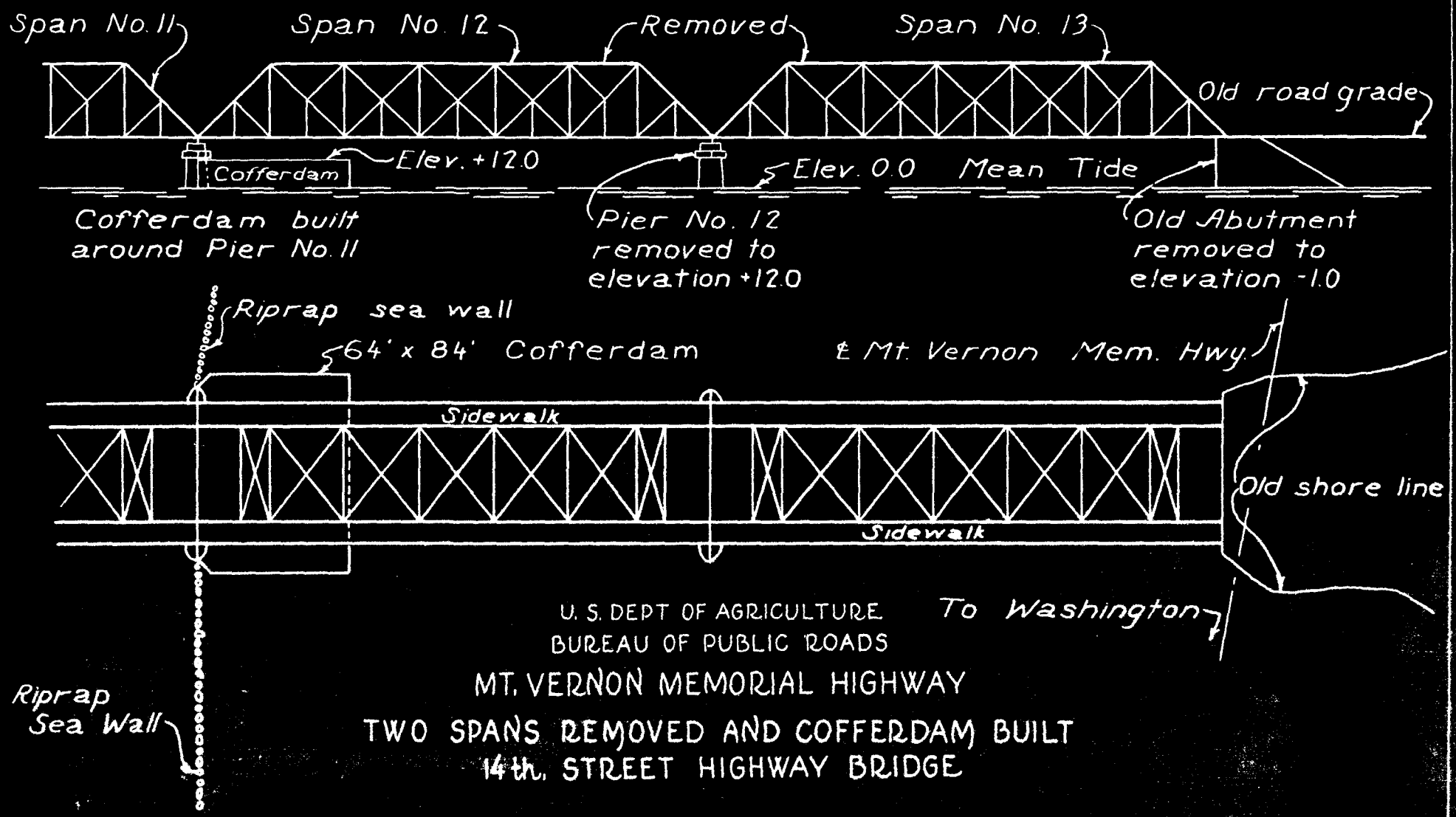
EXHIBIT No 1

U. S. DEPT. OF AGRICULTURE
BUREAU OF PUBLIC ROADS

MT. VERNON MEMORIAL HIGHWAY

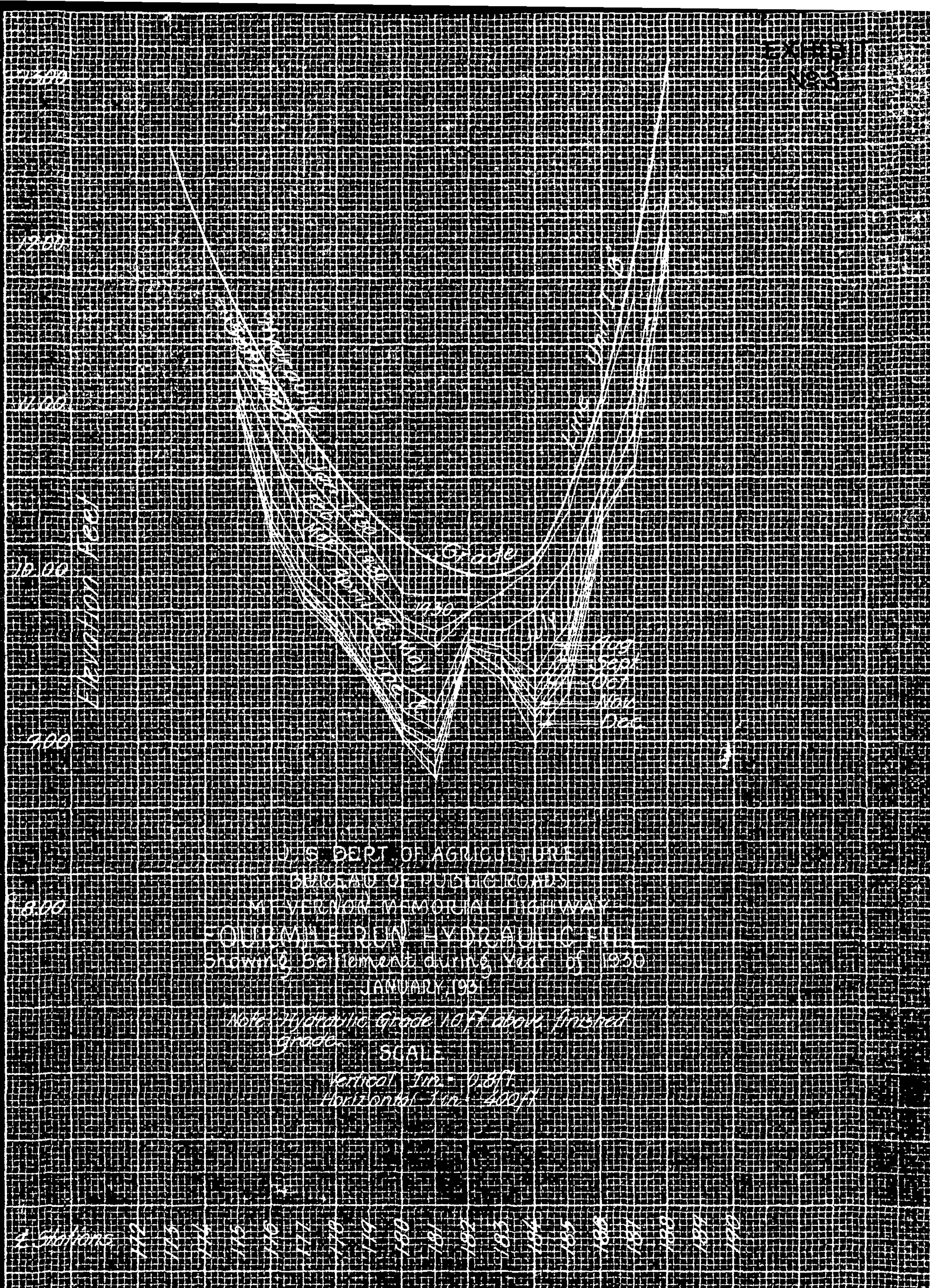
SKETCH SHOWING

COLUMBIA BASIN HYDRAULIC FILL



U. S. DEPT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

MT. VERNON MEMORIAL HIGHWAY
TWO SPANS REMOVED AND COFFERDAM BUILT
14th. STREET HIGHWAY BRIDGE



U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
QUANTITIES HYDRAULIC FILLS UNIT 1-B
MOUNT VERNON MEMORIAL HIGHWAY

Exhibit No 4

Location of Work	Length of fill in feet		Credit Yardage	Gross Yardage	Estimated and Total Cost	Unit Cost Credit Ydge	Unit Cost Gross Ydge
Columbia Basin	2095	Estimated Quantities and Cost	714350	921,000	180,001.44	.252	.195
		Work Performed and Cost	704734	1,070,147	*249,353.94	.354	.233
Grovelly Point	1658	Estimated Quantities and Cost	245893	566000	103,576.12	.421	.182
		Work Performed and Cost	268030	427,280	107,496.92	.401	.252
Rooches Run P	3015	Estimated Quantities and Cost	136011	304,000	61,798.33	.454	.203
		Work Performed and Cost P	131510	277,414	92,971.04	.707	.335
Fourmile Run P_1	2250	Estimated Quantities and Cost	161011	403,000	30,882.94	.824	.329
		Replacement Yardage Cost		537,000	51,799.06		
		Work Performed P_1 and Cost	171976	509,097	198,348.14	1.153	.390
Hunting Creek P_2	3350	Estimated Quantities and Cost	240920	1,157,000	423,644.51	1.758	.366
		Work Performed and Cost P_2	294753	1,039,463	330,322.81	1.121	.318
Little Hunting Creek P_3	1290	Estimated Quantities and Cost	116000	350,000	214,600.00	1.850	.613
		Work Performed and Cost P_3	141676	487,845	215,341.28	1.520	.441
Total of Estimated Quantities and Cost			1,614,185	3,703,000	1,116,303.00	.692	.301
Cost of Extra Work Orders Little Hunting Creek					958.83		
Cost of Extra Work Orders Regular & Special Hydraulic Fills					34,911.59		
Total Cost of Work Performed			1,712,679	3,811,246	1,229,705.15	.718	.323

Note: Dredge daily operating time 24 hours. Three eight hour shifts

P - includes 4731 Credit & 9181 Gross Yardage at a Cost of $5803.00

P_1 - includes 3270 Credit & 9680 Gross Yardage at a Cost of $6694.00

P_2 - includes 47877 Credit & 168141 Gross Yardage at Cost of $87019.00

P_3 - includes 13642 Credit & 46975 Gross Yardage at Cost of $20735.24

* Includes $11000.00 Cost of Pumping 50548 Cu. Yds. above grade.

Period of Time Dredging and Pumping Operations

Location of Work	Dredge	From	To	Dredge Operating Time
Columbia Basin	Talcott	Jan. 21, 1930	Apr. 9, 1930	2 Months 19 days
Columbia Basin	Welotko	Mar. 24, 1930	Aug. 14, 1930	4 Months 21 days
Grovelly Point	Talcott	Oct. 21, 1929	Jan. 20, 1930	3 Months
Rooches Run	Talcott	Apr. 16, 1930	July 11, 1930	2 Months 25 days
Fourmile Run	Welotko	Nov. 7, 1929	Mar. 23, 1930	4 Months 16 days
Hunting Creek	Talcott	July 12, 1930	July 26, 1930	15 days
Hunting Creek	Welotko	Aug. 15, 1930	Nov. 6, 1930	2 Months 22 days
Hunting Creek	Welotko	Dec. 12, 1930	Mar. 18, 1931	3 Months 7 days
Little Hunting Creek	Talcott	Feb. 11, 1931	Mar. 6, 1931	24 days
Little Hunting Creek	Welotko	Mar. 26, 1931	July 6, 1931	3 Months 11 days

PROGRESS CHART UNIT Nº II

AMOUNT EARNED INCLUDING EXTRA WORK ORDERS

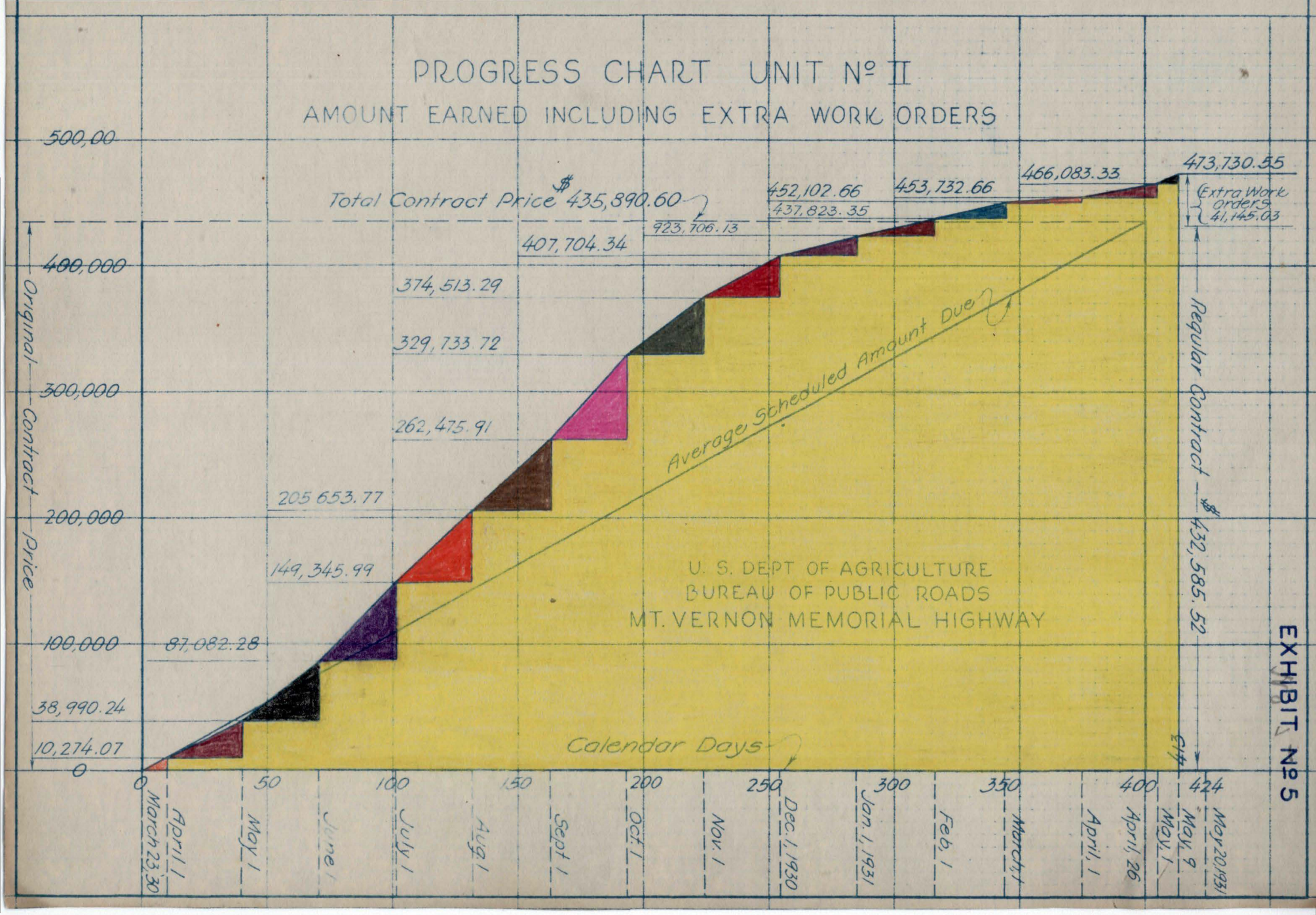


EXHIBIT Nº 5

FORCE REPORT, MT. VERNON MEMORIAL HIGHWAY

Date _____

Item		Station where Work done	Foremen		Asst. Foremen		Shovel Oprs.		Shovel Oilers		Shovel Pitmen		Truck Drivers		Tractor Operators		Carpenters		Carpenter Helpers		Labor Skilled		Labor Unskilled					Equipment	Remarks
Description	No		No	hrs.	No	hrs.	No	hrs.	No	hrs.	No	hrs.	No	hrs.	No	hrs.	No	hrs.	No	hrs.	No	hrs.	No	hrs.					

EXHIBIT No. 6

Weather _____

Signed _____

Resident Engineer

Exhibit No. 9

Equipment Code
Unit II

Desig-nation	Description	No.	Capacity
A	Lima Gas Power Shovel	1	1½ cu. yd.
B	Lima Gas Power Shovel	1	1½ cu. yd.
C	Northwest Gas Power Dragline	1	1 cu. yd.
D	A. C. Mack Trucks	3	4 cu. yd.
E	Hug Trucks	3	3 cu. yd.
F	Athey Trailers and Tractor	2	7 cu. yd. each 28 cu. yd. total
G	Stewart Platform Truck	1	1½ ton
H	Ford Platform Truck	1	1½ ton
I	Blaw-Knox Scrapers with Tractor	2	2 cu. yd. each 4 cu. yd. total
J	Caterpillar tractor with Bulldozer	2	"30"
K	Russel Power Road Grader	1	12 ft. blade
L	Holt Tractor	1	10 ton
M	Caterpillar Tractors	2	"60" - 10 ton
N	Caterpillar Tractors	2	"30" - 5 ton
O	Centrifugal Pump	2	8" x 6"
P	Diaphragm Pump	2	4" x 4"
Q	C. H. & E. Saw Rig (portable)	1	14" cir. blade
R	Ingersol-Rand Air Compressor	1	220 cu. ft.
S	Rex Concrete Mixer	1	2 bag
T	Pile Driving Equipment Consisting of 40 ft. leads, #7 McKiernan-Terry Hammer, Northwest Crane, 1 310 cu.ft. Ing.Rand Air Compressor		
U	Tractor	1	"60"

EXHIBIT
№ 8

MT. VERNON MEMORIAL HIGHWAY

REPORT ON CULVERT CONSTRUCTION

Date _____

Station	Size	Date and by whom			Date Work Started	Date Work Completed	Remark. To fully cover the progress of the work
		Staked	Excavation Figured	Checked			

Signed _____
Resident Engineer

Note: Office force will fill in Colums "Excavation figured", and "Checked" and note below what further actions taken on the above report

Signed _____
Office Engineer

UNIT NO. ________
RESIDENCY STA ________ TO STA ________

UNIT NO. II

U S DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

MOUNT VERNON MEMORIAL HIGHWAY

DETAILED MONTHLY ESTIMATE SHEET

MONTH OF ________ 193__

SHEET ____ OF ____ SHEETS
FOR MONTH ENDING ________ 193__
ESTIMATE NO. ________

	Items 1 Stripping	2 Clearing & Grubbing Regular	2 Clearing & Grubbing Extra	3 Removing Buildings Schedules A	4 B	5 C	6 D	7 Unclassified Excavation	10 Pressure Jetting Fills	11 Borrow Unclassified Exc.	40 Special Borrow	12 Overhaul Distance	12 Overhaul Cu	12 Overhaul Equiv. Cu Yds Hauled 100 Ft	13 Finishing Earth Graded Rd	14 Gravel Base Course 8 inch	15 Gravel Base Course 10 inch	16 Gravel Surface Course 6 inch	17 Gravel Surface Course 8 inch	18 Bit Macadam Surface	34 Grouted Rubble Gutter	35 Concrete Curb	36 Brick Walks	39 Rustic Guard Rails		
Unit of Measure	Cu Yds	Acres	Acres					Cu Yds	Cu Yds	Cu Yds	Cu Yds	Feet	Cu Yd		Miles	Sq Yds	Sq Yds	Sq Yds	Sq Yds	Sq Yds	Sq Yds	Lin Ft	Sq Yds	Lin Ft		
Unit of Payment	.40	220.00		[illegible]	1,000.00	2,000.00	1,000.00	.38	.03	.35	.70		.02		1,000.00	1.40	1.60	1.30	1.35	1.10	3.60	1.00	3.30	1.00		
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Previous Estimate																										
Estimate This Month																										

Drainage Structures

Station	Type of Structure	8 Foundation Excav.	9 Foundation Back Fill	19 Concrete Class A	20 Concrete Class B	21 Concrete Class D	22 Concrete Class S	23 Reinforcing Steel	24 Cement Rubble Masonry	25 Rubble Faced Conc. Masonry	26 Dry Rubble Masonry	32 Timber Piling	27 Pipe 8 inch Diam.	28 Pipe 12 inch Diam	29 Pipe 15 inch Diam	30 Pipe 18 inch Diam	31 Pipe 24 inch Diam	33 Standard Tile Under Drain	Special Tile Under Drain	38 Man Holes	37 Catch Basins	Drop Inlet Left	Drop Inlet Rt.	Open Drop Boxes Left	Open Drop Boxes Right	Head Walls Left	Head Walls Right				Remarks
		Cu Yds	Cu Yds	Cu Yds	Cu Yds	Cu Yds	Cu Yds	Pounds	Cu Yds	Cu Yds	Cu Yds	Lin Ft	Lin Ft	Lin Ft	Lin Ft	Lin Ft	Lin Ft	Lin Ft	Lin Ft	each	each										
		2.50	4.00	18.00	18.00	30.00	30.00	.05	15.00	20.00	10.00	.60						.36		100.00	75.00										
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Note:— Items 3,4,5,6 Removal of Bldgs., Lump Sum per Schedule. Under Drainage Structures, Drop Inlets, Open Drop Boxes, and Headwalls Use check mark to designate their location, Left or Right. In column of "Remarks" note all changes. Use Line for any item constructed and later abandoned. Note authority in column of Remarks.

EXHIBIT Nº 9

U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
[redacted] MT. VERNON MEMORIAL HIGHWAY
MONTHLY ESTIMATE NO. _____

EXHIB
No 10

UNIT II

MONTH OF _____ 193 ____

Item No.	Description	Unit of Measure	Quantities	Unit Price $	Unit Price ¢	Amount ¢
1	Stripping and storing top soil	Sq. Yd.			40	
2	Clearing and Grubbing	Acre		220		
3	Removal Bldgs Schedule "A"	Lump Sum		3,000		
4	Removal Bldgs Schedule "B"	Lump Sum		1,000		
5	Removal Bldgs Schedule "C"	Lump Sum		2,000		
6	Removal Structure " "D"	Lump Sum		1,000		
7	Unclassified Excavation	Cu. Yd.			35	
8	Unclassified Exc. for Structures	Cu. Yd.		2	50	
[redacted]	Foundation Fill	Cu. Yd.		4		
10	Pressure Jetting of Fills	Cu. Yd.			03	
11	Unclassified excavation for borrow	Cu. Yd.			35	
12	Overhaul	Sta.			02	
13	Finishing earth graded road	Mile		1,000		
14	8" Gravel base course	Sq. Yd.		1	40	
15	10" Gravel base Course	Sq. Yd.		1	50	
16	6" Gravel Surface Course	Sq. Yd.		1	30	
17	8" Gravel Surface Course	Sq. Yd.		1	35	
18	Bituminous Macadam Surface Course	Sq. Yd.		1	10	
19	Class "A" Concrete	Cu. Yd.		18		
20	Class "B" Concrete	Cu. Yd.		18		
21	Class "D" Concrete	Cu. Yd.		30		
22	Class "S" Concrete	Cu. Yd.		30		
[redacted]	Reinforcing Steel	Pound			05	
24	Cement Rubble Masonry	Cu. Yd.		15		
25	Rubble Faced Concrete Masonry	Cu. Yd.		20		
26	Dry Rubble Masonry	Cu. Yd.		10		
27AA	8 Inch Concrete Pipe	Lin. Ft.			30	
28AA	12 Inch Concrete Pipe	Lin. Ft.			50	
29AA	15 Inch Concrete Pipe	Lin. Ft.		1		
30AA	18 Inch Concrete Pipe	Lin. Ft.		1	70	
31AA	24 Inch Concrete Pipe	Lin. Ft.		3		
27A	8 Inch Vitrified Pipe	Lin. Ft.			30	
28A	12 Inch Vitrified Pipe	Lin. Ft.			50	
29A	15 Inch Vitrified Pipe	Lin. Ft.		1		
30A	18 Inch Vitrified Pipe	Lin. Ft.		1	70	
31A	24 Inch Vitrified Pipe	Lin. Ft.		3		
32	Untreated timber piling ✓	Lin. Ft.			60	
33	Vitrified tile underdrain	Lin. Ft.			90	
34	Grouted rubble gutter	Sq. Yd.		3	50	
35	Concrete Curb	Lin. Ft.		1		
36	Brick Walks	Sq. Yd.		3	50	
	~~Catch basins and Drop Inlets~~	Each		75		
	Manholes	Each		100		
	Rustic Guard Rail	Lin. Ft.		1		
	Special Borrow	Cu. Yd.				

Estimate to Date
Less 10% Retention
Balance

Add Extra Work Order No. _____ Bill No. _____
Add Extra Work Order No. _____ Bill No. _____
Add Extra Work Order No. _____ Bill No. _____
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Add Extra Work Order No. _____ Bill No. _____

Total Estimate to Date
Less Payments on previous Estimates
Estimate for this Month

Unit No.____
Residency No.____ to____

Sheet____ of____

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
MOUNT VERNON MEMORIAL HIGHWAY

DETAIL SHEET

EXTRA WORK ORDER No.____

FOR MONTH OF____ 193__

LABOR

Name & No.	FOREMEN		SKILLED LABOR		UNSKILLED LABOR		TRUCK DRIVERS		TRACTOR OPERATORS		EQUIPMENT OPERATORS *		OILERS		CARPENTERS		CARPENTER HELP				TOTAL AMT OF LABOR EACH DAY		REMARKS
	Rate per hour		Rate per hour		Rate per hour		Rate per hour		Rate per hour		Rate per hour		Rate per hour		Rate per hour		Rate per hour		Rate per hour		Rate per hour		
	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	Dollars / cts.	
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* Designate type of equipment operator is using. Note.- Use this space or column of remarks for extra details

SUMMARY

	Dollars	cts
Totals of Labor		
Plus Employers Liability Insurance 2.83%		
Total of Labor and Liability Insurance.		
Add cost of materials.		
Total of Ins., Labor & Materials.		
Plus 15% Added.		
Total		
Add rental of equipment.		
Total for extra work order No.__		

MATERIAL

Date	Kind of Material	Unit of Measure	Quantities	Rate Dollars	cts.	Amount Dollars	cts.	REMARKS

EQUIPMENT RENTAL

Name & No.	Lima Gas Power Shovel	1 Bucyrus Erie Dragline Crane Shovel	Kling tractors and trailers	A.C. Mack Trucks	Hug Trucks	Showart Platform Trucks	Rand Platform Trucks	Blaw-Knox Grader & Tractor	Caterpillar Tractor with Bulldozer	Russell Power Road Grader	Hart Tractor	Caterpillar Tractor 60 10 Ton	Caterpillar Tractor 30 2 Ton	Centrifugal Pumps	Diaphragm Pumps	C.H. & E. Saw Rigged Portable	Ing.-Rand Compressor 315 Cu. Ft.	Res Concrete Mixer	Pile Driving Equipment			Total Amount of Equipment Rental each day		REMARKS
	Rate per hr. $8.12	Rate per hr. $8.11	Rate per hr. $7.25	Rate per hr. $2.50	Rate per hr. $2.00	Rate per hr. $1.50	Rate per hr. $1.50	Rate per hr. $4.75	Rate per hr. $2.75	Rate per hr. $2.50	Rate per hr. $3.25	Rate per hr. $8.25	Rate per hr. $2.25	Rate per hr. $1.00	Rate per hr. $1.50	Rate per hr. $3.00	Rate per hr. $3.50	Rate per hr. $1.00	Rate per hr. $15.62			Dollars	Cts.	
	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount	hrs.	Amount			
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REMARKS

EXHIBIT No. 1

* Pile driving equipment includes 40' Leads, #7 McKiernan - Terry Hammer. Northwest Crane, 1-310 cu. ft. Ing. Rand Air Compressor and one 220' Cu. Ft. Ing. Rand Air Compressor

U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
ESTIMATE OF QUANTITIES
MOUNT VERNON MEMORIAL HIGHWAY

EXHIBIT Nº 12

GRADING, DRAINAGE AND INCIDENTAL CONSTRUCTION
UNIT NO. II

Item Nº	Description	Unit of Measure	Unit Cost	Quantities on Approximate Estimate	Quantities on Final Estimate
1	Stripping and Storing Top Soil	Cu.Yds.	.40	43240	36072
2	Clearing and Grubbing	Acre	220.00	106	150.64
3	Buildings to be removed, Schedule "A"	Lump Sum	} See bottom of Page		
4	" " " " Schedule "B"	Lump Sum			
5	" " " " Schedule "C"	Lump Sum			
6	Structures to be removed Schedule "D"	Lump Sum			
7	Unclassified Excavation	Cu.Yds.	.35	383275	366143
8	Unclassified Excav. for Structures	Cu.Yds.	2.50	5020	8742.3
9	Foundation Fill	Cu.Yds.	4.00	150	919.9
10	Pressure Jetting of Fills	Cu.Yds.	.03	131570	---------
11	Unclassified Excav. for Borrow	Cu.Yds.	.35	132365	130970
12	Overhaul	Sta.Yd.	.02	2363770	1771187
13	Finishing Earth Graded Road	Mile	1000.00	12.441	12.59
14	Gravel Base Course 8" Compt. Thickness	Sq.Yds.	1.40	3700	3758.
15	Gravel Base Course 10" " "	Sq.Yds.	1.50	1720	1797
16	Gravel Surface Course 6" " "	Sq.Yds.	1.30	3880	3567
17	Gravel Surface Course 8" " "	Sq.Yds.	1.35	2300	2236
18	Bituminous Macadam Surface Course	Sq.Yds.	1.10	5420	5555
19	Class "A" Concrete	Cu.Yds.	18.00	1950	2238
20	Class "B" Concrete	Cu.Yds.	18.00	10	---------
21	Class "D" Concrete	Cu.Yds.	30.00	10	---------
22	Class "S" Concrete	Cu.Yds.	30.00	10	---------
23	Reinforcing Steel	Lbs.	.05	119900	129911
24	Cement Rubble Masonry	Cu.Yds.	15.00	90	121.5
25	Rubble Faced Concrete Masonry	Cu.Yds.	20.00	400	371.8
26	Dry Rubble Masonry	Cu.Yds.	10 00	50	107.1
27a	Vitrified Pipe 8" Diameter	Lin.Ft.	.30	1680	2118.0
28a	" " 12" "	Lin.Ft.	.50	659	769
29a	" " 15" "	Lin.Ft.	1.00	225	215
30a	" " 18" "	Lin.Ft.	1.70	283	884.3
31a	" " 24" "	Lin.Ft	3.00	4848	4491.2
32	Untreated Timber Piling	Lin.Ft.	.60	44200	34316.
33	Vitrified Tile Underdrain	Lin.Ft	.90	5775	8784.8
34	Grouted Rubble Gutter	Sq.Yds.	3.50	600	639.1
35	Concrete Curb	Lin.Ft.	1.00	1500	1512.3
36	Brick Walks	Sq.Yds.	3.50	860	900.7
37	Catch Basins and Drop Inlets	Each	75.00	12	11
38	Manholes	Each	100.00	6	8
39	Rustic Guard Rail	Lin.Ft.	1.00	1480	2904.
40	Special Borrow (Not mentioned in contract)	Cu.Yds.	.78	186,850	Not Included in this contract.

Item 3 bid in at $3,000.00 — Item 3 Cost Final Estimate $775.20
" 4 " " " $1,000.00 — " 4 " " " $731.80
" 5 " " " $2,000.00 — " 5 " " " ---
" 6 " " " $1,000.00 — " 6 " " " $1000.00

Total ~~Final~~ Estimated $435,890.60

U. S. DEPT. OF AGRICULTURE

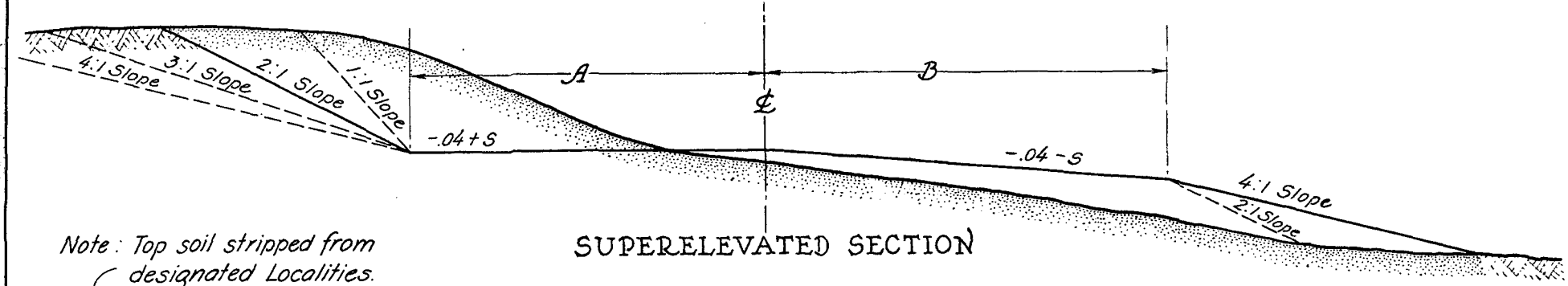
BUREAU OF PUBLIC ROADS

MT. VERNON MEMORIAL HIGHWAY

ROADWAY SECTIONS FOR STAKING, GRADING, and FINISHING

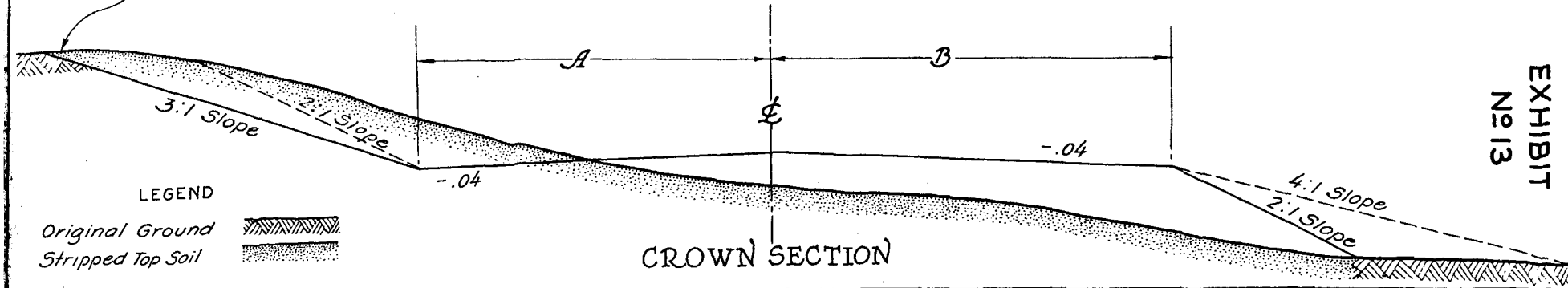
UNIT II

Note: Roadway Width A to Alexandria 33.0 Ft.
Roadway Width B to Alexandria 39.0 and 40.0 Ft.
39.0 Feet with the 2:1 Slope.
Roadway Width A from Alexandria to Mount Vernon 23.0 Ft.
Roadway Width B from Alexandria to Mount Vernon 26.0 Ft.
S = Superelevation per ft.



SUPERELEVATED SECTION

Note: Top soil stripped from designated Localities.



CROWN SECTION

EXHIBIT No 13

Exhibit No. 14

Equipment Code
Unit IV, Section 1

Designation	Description	No.	Capacity
A	Thew Lorraine Gas Power Shovel	1	1-1/4 cu. yd.
B	Caterpillar Tractor	2	"60" - 10 ton
C	Caterpillar Tractor	1	"20"
D	Caterpillar Tractor	1	"15"
E	Russell or Adams Blade Grader	2	12 ft. blade
F	Power Grader	1	8 ft. blade
G	Ball Wagon Graders	3	2 cu. yd.
H	Killifer Revolving Fresno	1	5 cu. ft.
J	Warco Push Grader	1	
K	Hug Trucks	5	3 ton
L	Ford Dump Trucks	15	2 ton
M	Road Rollers	3	10 ton
N	Clyde Derrick, Clamshell	1	1-1/2 cu. yd.
O	Blaw-Knox Batcher Bin	1	150 tons
P	Triplex Gas Pump	1	80 gallons
Q	Water Pipe Lines	2 mi.	2-inch
R	Heltzel Road Forms, 10-inch	3000	lin. ft.
S	Blaw-Knox Road Forms, 7-inch	2500	lin. ft.
T	Lakewood Finishing Machine	1	2 screeds
U	National Steel Fabric Cleft Joint Machine	1	
V	Longitudinal Float Bridge	1	
W	One Man Finishing Bridge	1	
X	27-E Koehring Paving Mixer	1	
Y	Lakewood Sub-Grader		

U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

EXHIBIT
Nº 15

ESTIMATE OF QUANTITIES
MOUNT VERNON MEMORIAL HIGHWAY
PAVING AND INCIDENTAL CONSTRUCTION
UNIT NO. IV SECTION 1

No. of Item	Description	Unit of Measure	Unit Cost	Quantities on Approximate Estimate	Quantities on Final Estimate
1	Unclassified Excavation	Cu. Yds.	.40	125,560	184,024
2	Unclassified Excavation for Structures	Cu. Yds.	.75	3,886	2,434
3	Unclassified Excavation for Borrow	Cu. Yds.	.32	19,200	1,855
4	Overhoul	Sta. Yds.	.01	80,000	226,720
5	Grovel sub-base Course	Cu. Yds.	.55	17,500	15,000
6	Clay bound Grovel Bose Course	Sq. Yds.	.10	93,210	89,686
8	Dry Choked Stone Bose Course	Sq. Yds.	.50	26,700	26,587
9	Bituminous Concrete Base Course	Sq. Yds.	.93	100,840	102,530
10	Reinforced Concrete Bose Course	Sq. Yds.	1.80	75,330	77,752
11	Plain Concrete Base Course	Sq. Yds.	1.55	49,550	51,503
13	Bituminous Concrete Surface Course	Sq. Yds.	.62	178,390	183,764
14	Sheet Asphalt Pavement	Sq. Yds.	.84	49,550	52,332
16	Closs "A" Concrete	Cu. Yds.	$20.00	38	289.9
17	Reinforced Steel	Lbs.	.10	320	25,118
18	Cement Rubble Masonry	Cu. Yds.	$30.00	6.6	5.16
19	Dry Rubble Masonry	Cu. Yds.	$25.00	5.0	5.75
20	Brick Masonry	Cu. Yds.	$30.00	2.1	486
21	Concrete Pipe 8"(inch) Diameter	Lin. Ft.	.50	3091	3,404
22	Concrete Pipe 12"(inch) Diameter	Lin. Ft.	1.45	1045	1,190
23	Concrete Pipe 18"(inch) Diameter	Lin. Ft.	2.50	506	805.2
25	Vitrified Block Gutter	Sq. Yds.	4.40	790	562.5
26	Concrete Curb 20"(inch) Depth	Lin. Ft.	45	19550	25,171
27	Concrete Curb 18"(inch) Depth	Lin. Ft.	41	1480	2,194
29	Concrete Curb 15"(inch) Depth	Lin. Ft.	.33	23,710	24,328
31	Concrete Curb 12"(inch) Depth	Lin. Ft.	.31	8150	8,271
32	Combination Curb & Gutter	Lin. Ft.	1.20	3950	4,951.3
34	Manholes	Each	$100.00	3	3
35	Cast Iron Frames & Gratings Type "A"	Each	28.40	10	10
36	Cast Iron Frames & Gratings Type "B"	Each	29.40	62	64
37	Cast Iron Frames & Gratings Type "C"	Each	29.40	4	9
38	Low Guard Roil	Lin. Ft.	.50	31,000	31,302
39	High Guard Roil	Lin. Ft.	.75	3,920	3,767
40	Adjusting Street Structures	Each	10.00	40	45

Note: Items 7-12-15-24-28-30 and 33 left out above.
They apply to section 2 contract.

Approximate Estimate of Cost $605,619.25
Final Estimate Cost $648,923.11
Extra Work Orders Nos. 1 to 5 ..... 64,037.66
Total Cost of Contract $712,960.77

Exhibit No. 16

Equipment Code
Unit IV, Section 2

Designation	Description	No.	Capacity
A	Tug Boat	1	
B	Caterpillar Tractor	2	"60" - 10 ton
C	Killifer Grade Rooter	1	
D	Lakewood Grade Rooter	1	
E	Adams Road Grader	1	14 ft. blade
F	Adams Road Grader	1	6 ft. blade
G	Adams Fresno	2	2 cu. yd.
H	Rex Centrifugal Pump	1	75 gallon
J	Novo Hoisting Engine	1	15 H.P.
K	Derrick		
L	Single Batch Road Trucks	10	1-1/2 cu. yd.
M	Buffalo Roller	1	10 ton
N	Northwest Crane	1	1-1/2 cu. yd.
O	Northwest Crane	1	1 cu. yd.
P	Rex Triplex Road Pump	1	100 gallon
Q	Galvanized Water Pipe	3 mi.	2-1/2-in. diam.
R	Heltzel Road Forms, 10" x 8"	6000	lin. ft.
S	International Roller	1	5 ton
T	Lakewood Finishing Machine	1	
U	One-bag Mixer	1	
X	Johnson 3-compartment batcher bin	1	110 ton with scales
Y	Worthington Steam Pump	1	50 gallon
Z	Rex 27-E Paver	1	
L^3	International Trucks		

Exhibit No. 17

U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
ESTIMATE OF QUANTITIES
MOUNT VERNON MEMORIAL HIGHWAY
PAVING AND INCIDENTAL CONSTRUCTION
UNIT NO. IV SECTION 2

Item No.	Description	Unit of Measure	Unit Cost	Quantities on Approximate Estimate	Quantities on Final Estimate
1	Unclassified Excavation	Cu. Yds.	.50	25 000	41 361
2	Unclassified Excav. for Structures	Cu. Yds.	1.50	914	837
6	Claybound Gravel Base Course	Sq. Yds.	.50	7550	-------
7	Gravel Base Course	Sq. Yds.	.90	26 000	28 310
12	Bituminous Macadam Surface Course	Sq. Yds.	.95	32 760	27 856
15	Reinforced Concrete Pavement	Sq. Yds.	2.17	203 500	209933.8
16	Class "A" Concrete	Cu. Yds.	30.00	32	142.88
17	Reinforcing Steel	Lbs.	.10	440	15 394.
18	Cement Rubble Masonry	Cu. Yds.	26.00	4.7	13.58
19	Dry Rubble Masonry	Cu. Yds	25.00	10	2.89
20	Brick Masonry	Cu. Yds.	24.00	5	15.2
21a	Vitrified Pipe 8" Diameter	Lin. Ft.	1.10	600	720.2
22a	" " " 12" "	Lin. Ft.	1.40	420	492.
23a	" " " 18" "	Lin. Ft.	1.75	158	297.
24	Grouted Rubble Gutter	Sq. Yds.	5.00	100	522.9
26	Concrete Curb 20" Depth	Lin. Ft	.55	2870	------
28	" " 16" "	Lin. Ft.	.50	737	1083.4
30	" " 13" "	Lin. Ft.	.30	76 840	80 369.4
33	Brick Walks	Sq. Yds.	2.20	360	450.7
35	Cast Iron Frame & Grating Type "A"	Each	22.00	11	18
36	" " " " " " "B"	Each	20.00	57	56
38	Low Guard Rail	Lin. Ft	.40	20 900	22 833
39	High Guard Rail	Lin. Ft.	.45	9960	7 297. 7
	Overhaul	Sta. Yds.	.02	------	78 046

Note: ITEMS 3-5-8-9-10-11-13-14-25-27 29-31-32-34-37 and 40 Left out above; they apply to Section 1 Contract

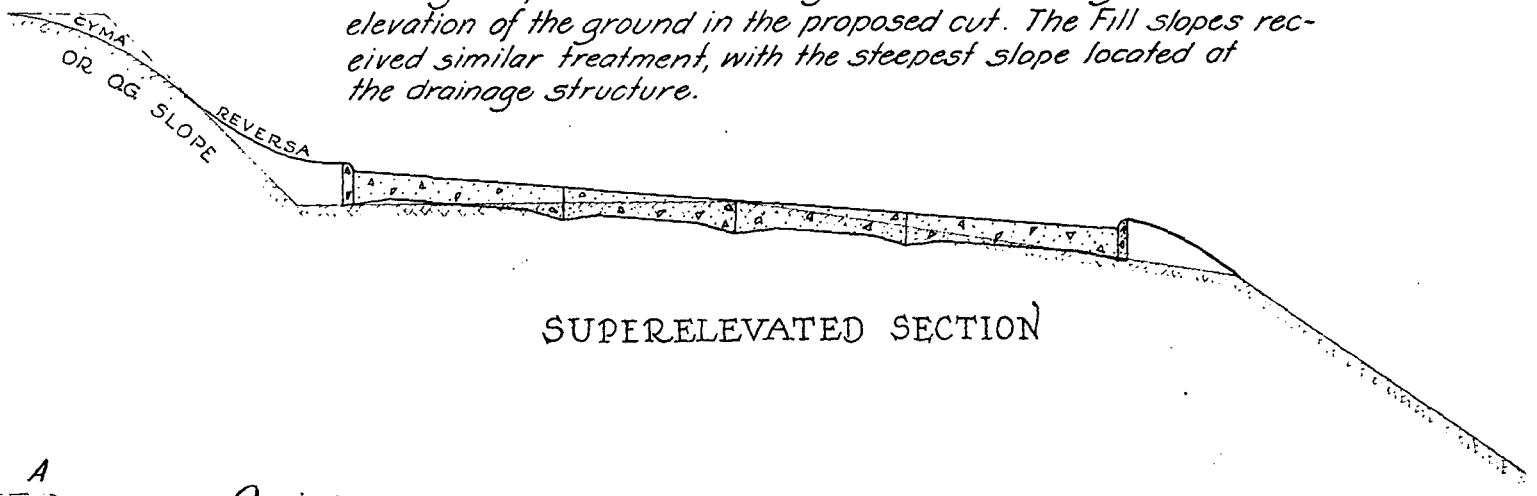
Approximate Estimate of Cost $557, 298. 70
Change Order No. 1 Increases $ 3, 902. 34
$ 561, 201. 04

Final Estimate Cost ..... $ 581, 803. 90
Extra Work Orders Nos 1 & 2 $ 1, 706. 87
Total Cost of Contract $ 583, 510. 77

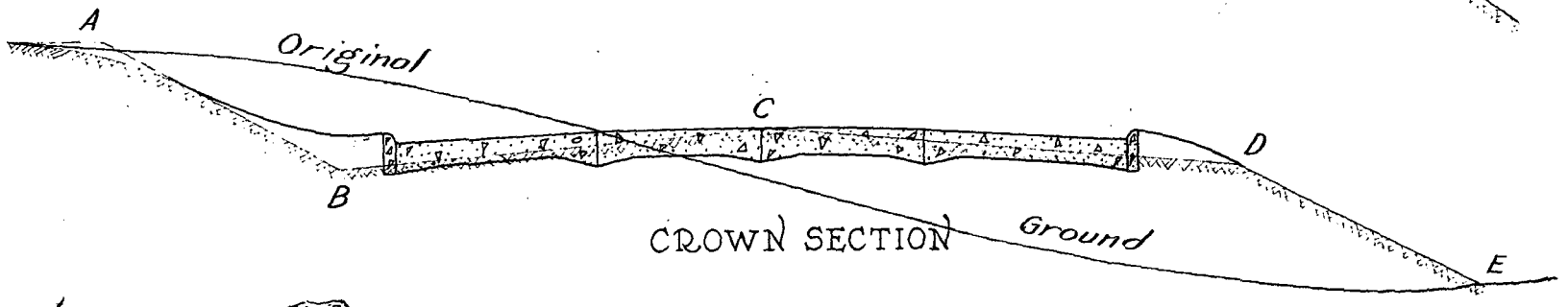
U. S. DEPT. OF AGRICULTURE
BUREAU OF PUBLIC ROADS
MT. VERNON MEMORIAL HIGHWAY

SKETCH SHOWING FINISHED ROADWAY SECTION SUPERIMPOSED UPON THE GRADED ROADWAY SECTION OF UNIT II

Note: The ratio of the slopes varied from 1 on 1 to 1 on 4. A transition was made in the slopes beginning with a flat slope at the grade point and increasing the ratio to the highest elevation of the ground in the proposed cut. The Fill slopes received similar treatment, with the steepest slope located at the drainage structure.



SUPERELEVATED SECTION



CROWN SECTION

Reinforced Concrete

Exhibit No. 18

Exhibit No. 19

U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
MOUNT VERNON MEMORIAL HIGHWAY
SUPER ELEVATION PER FOOT BEGINNING AT ℄ OF ROADWAY

Distance From ℄ Feet	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"	11/16"	3/4"
0												
1	.0052	.0104	.0156	.0208	.026	.0313	.0365	.0417	.0469	.0521	.0573	.0625
2	.0104	.0208	.0312	.0416	.052	.0626	.0730	.0834	.0938	.1042	.1146	.1250
3	.0156	.0312	.0468	.0624	.078	.0939	.1095	.1250	.1406	.1563	.1719	.1875
4	.0208	.0416	.0624	.0832	.104	.1252	.1460	.1667	.1875	.2084	.2292	.2500
5	.0260	.0520	.0780	.1040	.130	.1565	.1825	.2084	.2344	.2605	.2865	.3125
6	.0312	.0624	.0936	.1248	.156	.1878	.2190	.2500	.2812	.3126	.3438	.3750
7	.0364	.0728	.1092	.1456	.182	.2191	.2555	.2917	.3281	.3647	.4011	.4375
8	.0416	.0832	.1248	.1664	.208	.2504	.2920	.3333	.3750	.4168	.4584	.5000
9	.0468	.0936	.1404	.1872	.234	.2817	.3285	.3750	.4219	.4689	.5157	.5625
10	.0520	.1040	.1560	.2080	.260	.3130	.3650	.4167	.4687	.5210	.5730	.6250
11	.0572	.1144	.1716	.2288	.286	.3443	.4015	.4584	.5156	.5731	.6303	.6875
12	.0624	.1248	.1872	.2496	.312	.3756	.4380	.5000	.5625	.6252	.6876	.7500
13	.0676	.1352	.2028	.2704	.338	.4069	.4745	.5417	.6094	.6773	.7449	.8125
14	.0728	.1456	.2184	.2912	.364	.4382	.5110	.5833	.6562	.7294	.8022	.8750
15	.0780	.1560	.2340	.3120	.390	.4695	.5475	.6250	.7031	.7815	.8595	.9375
16	.0832	.1612	.2496	.3328	.416	.5000	.5840	.6667	.7500	.8336	.9168	1.0000
17	.0884	.1768	.2652	.3536	.442	.5313	.6205	.7084	.7969	.8857	.9741	1.0625
18	.0936	.1872	.2808	.3744	.468	.5626	.6570	.7500	.8437	.9378	1.0314	1.1250
19	.0988	.1976	.2964	.3952	.494	.5939	.6935	.7917	.8906	.9899	1.0887	1.1875
20	.1040	.2080	.3120	.4160	.520	.6252	.7300	.8333	.9375	1.0420	1.1460	1.2500
21	.1092	.2184	.3276	.4368	.546	.6565	.7665	.8750	.9844	1.0941	1.2033	1.3125
22	.1144	.2288	.3432	.4576	.572	.6878	.8030	.9167	1.0312	1.1462	1.2606	1.3750
23	.1196	.2392	.3588	.4784	.598	.7191	.8395	.9584	1.0781	1.1983	1.3179	1.4375
24	.1248	.2496	.3744	.4992	.624	.7504	.8760	1.0000	1.1250	1.2504	1.3752	1.5000
25	.1300	.2600	.3900	.5200	.650	.7817	.9125	1.0417	1.1719	1.3025	1.4325	1.5625
26	.1352	.2704	.4056	.5408	.676	.8130	.9490	1.0833	1.2187	1.3546	1.4898	1.6250
27	.1404	.2808	.4212	.5616	.702	.8443	.9895	1.1250	1.2656	1.4067	1.5471	1.6875
28	.1456	.2912	.4368	.5824	.728	.8756	1.0220	1.1667	1.3125	1.4588	1.6044	1.7500
29	.1508	.3016	.4524	.6032	.754	.9069	1.0585	1.2083	1.3594	1.5109	1.6617	1.8125
30	.1560	.3120	.4680	.6240	.780	.9382	1.0950	1.2500	1.4062	1.5630	1.7190	1.8750
31	.1612	.3224	.4836	.6448	.806	.9695	1.1315	1.2917	1.4531	1.6151	1.7763	1.9375
32	.1664	.3328	.4992	.6656	.832	1.0000	1.1680	1.3333	1.5000	1.6672	1.8336	2.0000
33	.1716	.3432	.5148	.6864	.858	1.0313	1.2045	1.3750	1.5469	1.7193	1.8909	2.0625
34	.1768	.3536	.5304	.7072	.884	1.0626	1.2410	1.4167	1.5937	1.7714	1.9482	2.1250
35	.1820	.3640	.5460	.7280	.910	1.0939	1.2775	1.4584	1.6406	1.8235	2.0055	2.1875
36	.1872	.3744	.5616	.7488	.936	1.1252	1.3140	1.5000	1.6875	1.8756	2.0628	2.2500
37	.1924	.3848	.5772	.7696	.962	1.1565	1.3505	1.5417	1.7344	1.9277	2.1201	2.3125
38	.1976	.3952	.5928	.7904	.988	1.1878	1.3870	1.5833	1.7812	1.9798	2.1774	2.3750
39	.2028	.4056	.6084	.8112	1.014	1.2191	1.4235	1.6250	1.8281	2.0319	2.2347	2.4375
40	.2083	.4160	.6240	.8320	1.040	1.2504	1.4600	1.6667	1.8750	2.0840	2.2920	2.5000
41	.2132	.4264	.6396	.8528	1.066	1.2817	1.4965	1.7084	1.9219	2.1361	2.3493	2.5625
42	.2184	.4368	.6552	.8736	1.092	1.3130	1.5330	1.7500	1.9687	2.1882	2.4066	2.6250
43	.2236	.4472	.6708	.8944	1.118	1.3443	1.5695	1.7917	2.0156	2.2403	2.4639	2.6875
44	.2288	.4576	.6864	.9152	1.144	1.3756	1.6060	1.8333	2.0625	2.2924	2.5212	2.7500
45	.2340	.4680	.7020	.9360	1.170	1.4069	1.6425	1.8750	2.1094	2.3445	2.5785	2.8125

SKETCH SHOWING METHOD OF SETTING & MARKING
GRADE STAKES FOR FINISHING EARTH GRADED ROADS

Stake $\frac{3}{4}$" x 2" x 18"
Marked with Sta. No
and drops to shoulder

U. S. DEPT. OF AGRICULTURE
BUREAU OF PUBLIC ROADS

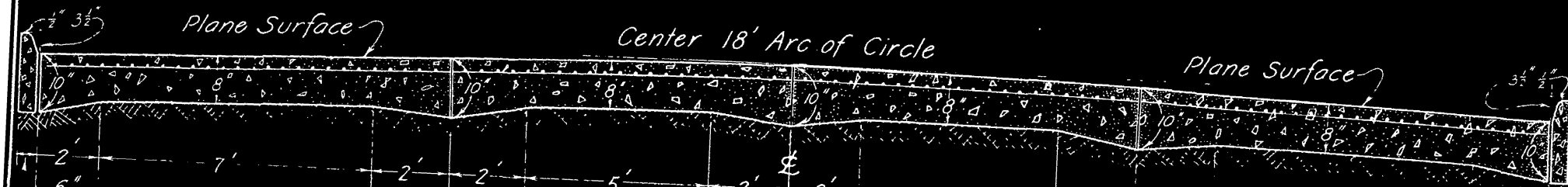
MT. VERNON MEMORIAL HIGHWAY

U.S. DEPT. OF AGRICULTURE
BUREAU OF PUBLIC ROADS

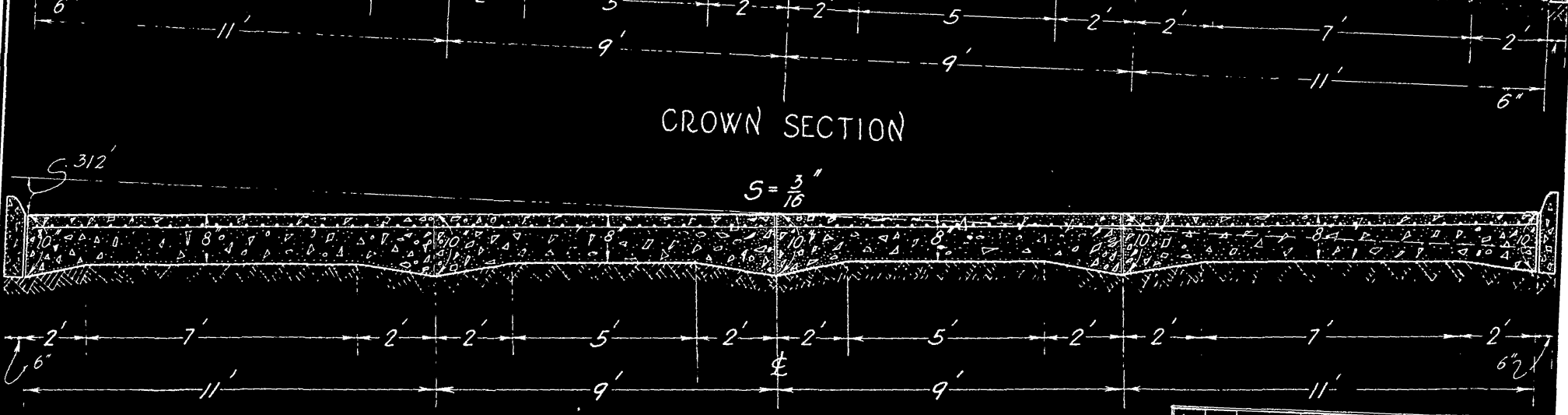
MT. VERNON MEMORIAL HIGHWAY

TYPICAL STANDARD WIDTH CROSS SECTIONS
REINFORCED CONCRETE PAVEMENT

1 Edge of Curb rounded on $\frac{1}{2}$" radius



CROWN SECTION



SUPERELEVATED SECTION

Superelevation Schedule		
℄ of Curve	Elev per Width	
Less than 1°0	None	
1°00'-1°30'	3/16"	= .015'
1°30'-2°15'	1/4"	= .020'
2°15'-2°50'	5/16"	= .026'
2°50'-3°30'	3/8"	= .031'
3°30'-4°20'	1/2"	= .041'
4°20'-5°20'	5/8"	= .052'
5°20'-6°30'	3/4"	= .062'

U. S. DEPT. OF AGRICULTURE

BUREAU OF PUBLIC ROADS

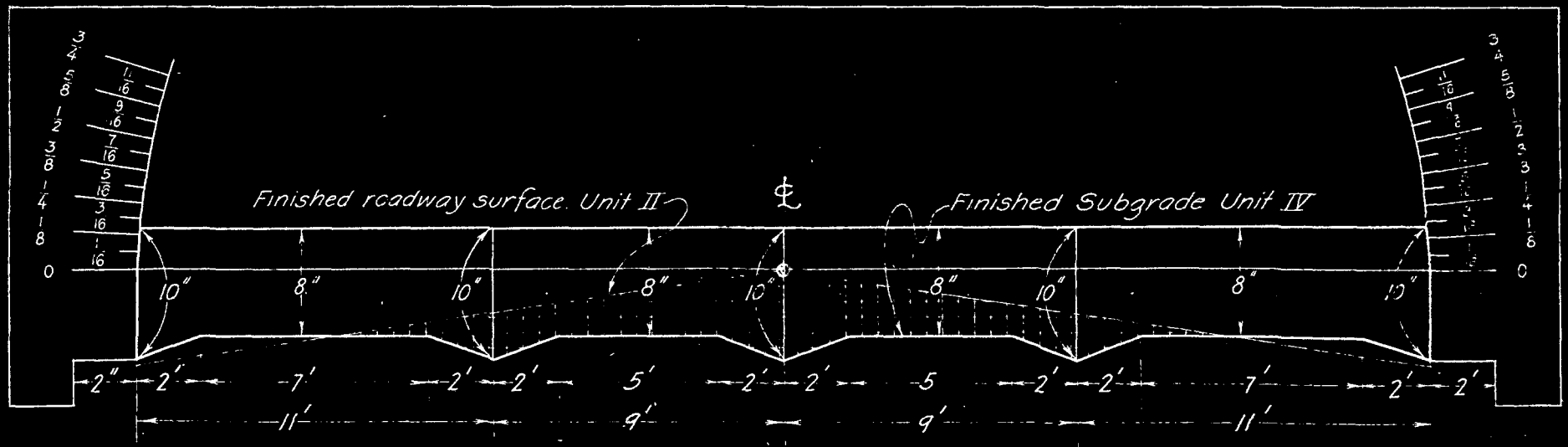
MT. VERNON MEMORIAL HIGHWAY

SKETCH SHOWING TEMPLET

USED FOR PLOTTING CROSS SECTIONS FOR EXCAVATION

SCALE

HORIZ. 1" = 5 VERT. 1" = 1'



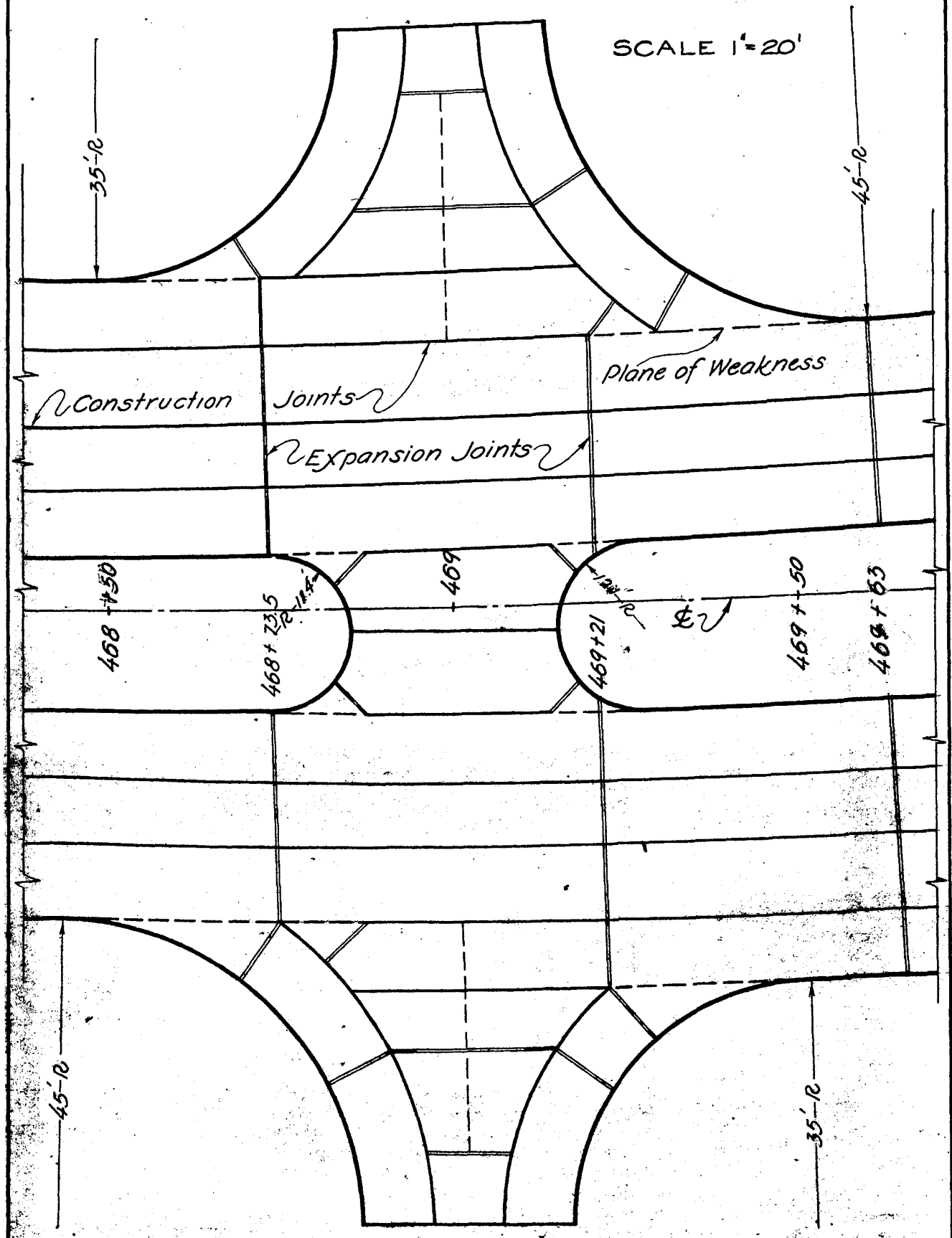
Note: Transparent sheet celluloid $\frac{60}{1000}$ of an inch in thickness used for making Templet

On normal Crown Section, the finished grade was dropped $\frac{1}{2}$" per ft. width from ℄ to Shoulder.
On the Superelevated Section the drop was $\frac{1}{2}$" per ft. plus the algebraic sum of the Superelevation

U.S. DEPT. OF AGRICULTURE
BUREAU OF PUBLIC ROADS

Exhibit
No. 23

MT. VERNON MEMORIAL HIGHWAY
DETAIL OF JOINTS
BUCKNELL UNIVERSITY FLARE



U S DEPT. OF AGRICULTURE
BUREAU OF PUBLIC ROADS

MT. VERNON MEMORIAL HIGHWAY

DETAIL OF JOINTS
END OF SOUTH FLARE, NEW ALEXANDRIA, VA.

SCALE 1" = 20'

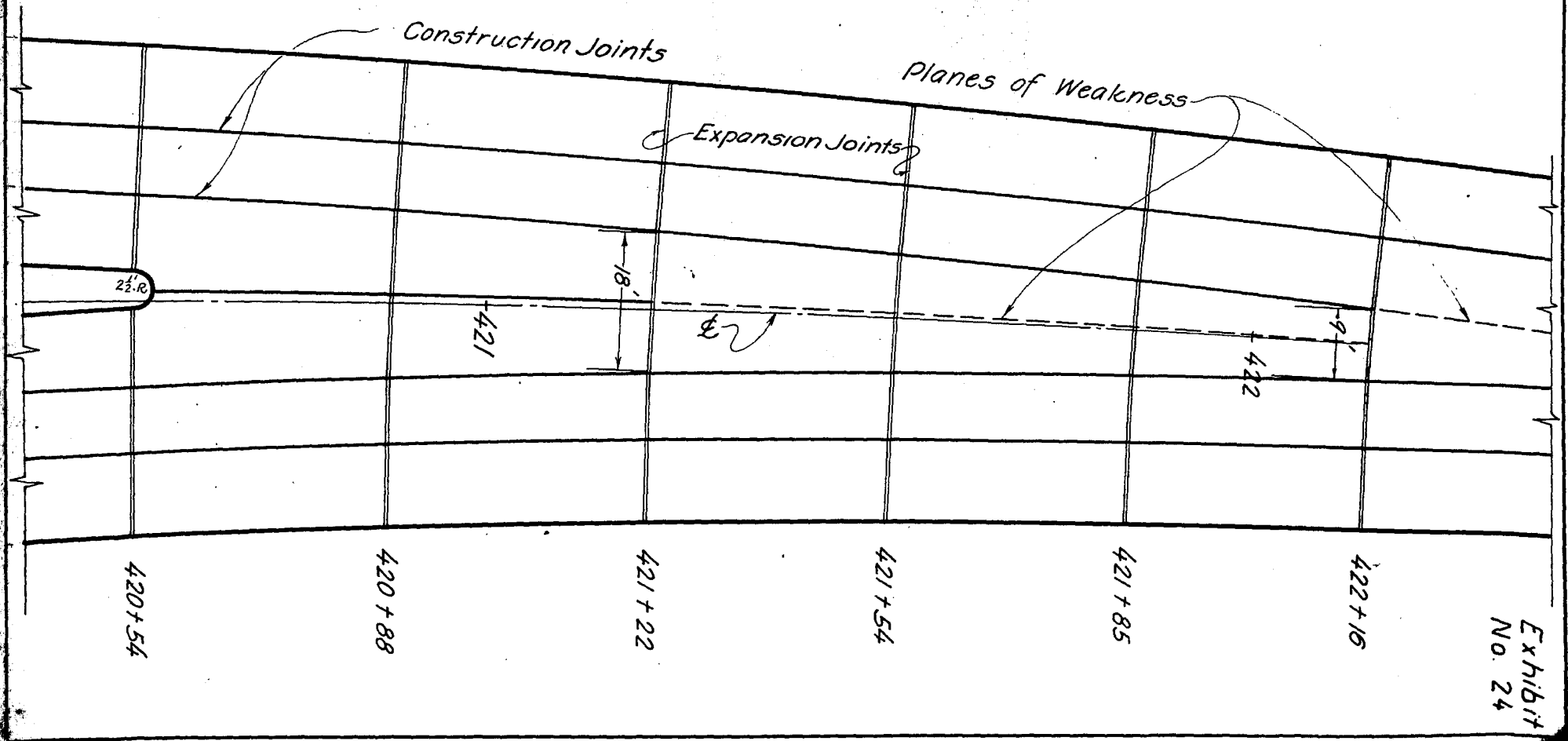


Exhibit No. 24

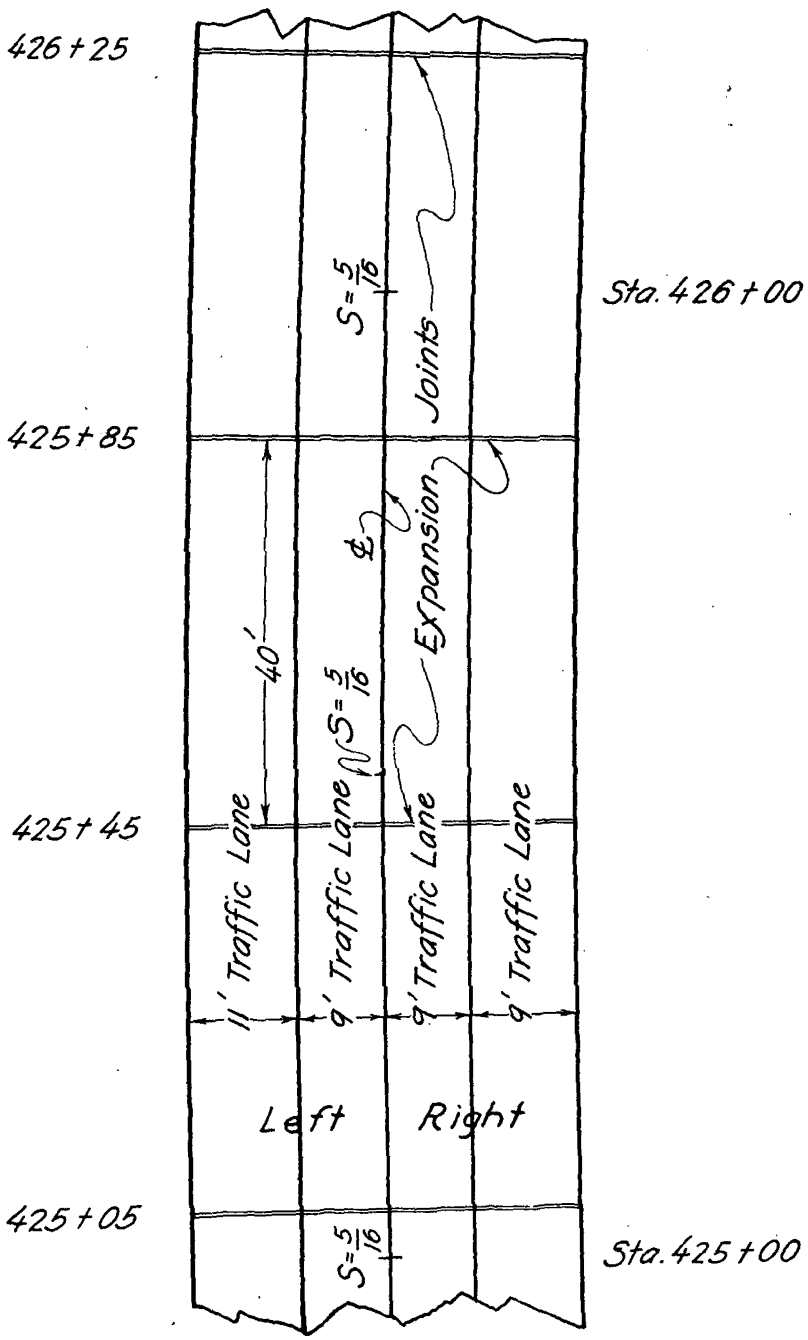
Exhibit
No. 25

U. S. DEPT. OF AGRICULTURE
BUREAU OF PUBLIC ROADS

MT. VERNON MEMORIAL HIGHWAY

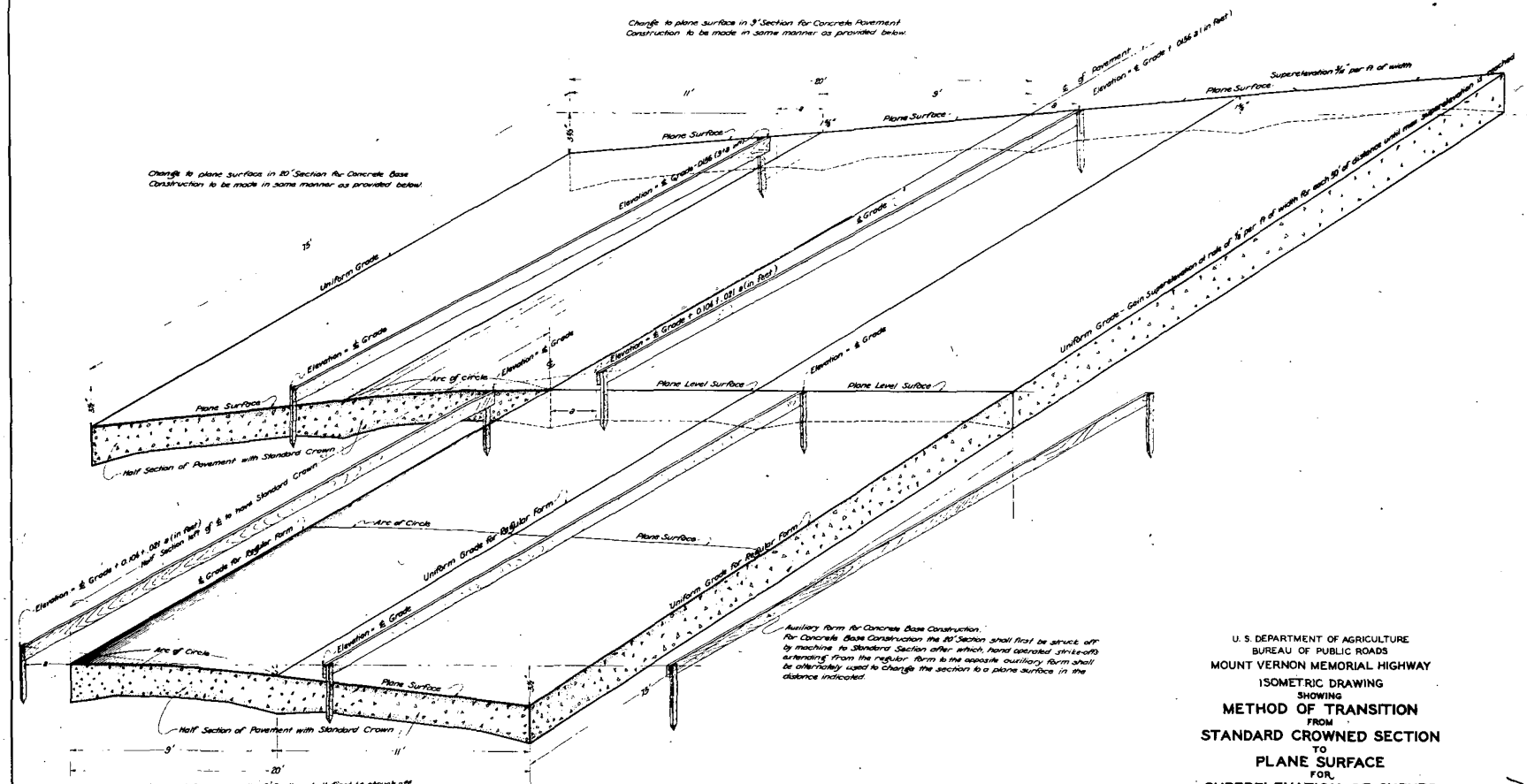
SHOWING 40 FT. ROADWAY OF FOUR TRAFFIC LANES
REINFORCED CONCRETE

SCALE 1" = 20'



UNIT NO. 39

MOUNT VERNON MEMORIAL HIGHWAY				
		DETAIL SHEETS	SHEET NO.	TOTAL SHEETS
		No.	02	03



U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
MOUNT VERNON MEMORIAL HIGHWAY
ISOMETRIC DRAWING
SHOWING
METHOD OF TRANSITION
FROM
STANDARD CROWNED SECTION
TO
PLANE SURFACE
FOR
SUPERELEVATION OF CURVES
APPLICABLE TO
CONCRETE PAVEMENT AND CONCRETE BASE
NOVEMBER, 1930

Exhibit No. 26

Exhibit No. 26-A

U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
GRADE ELEVATIONS AT THE CENTER LINE CONSTRUCTION JOINTS AND EDGES OF REINFORCED CONCRETE PAVEMENT
SPECIMEN SHEET OF COMPUTED ELEVATIONS

Station	Superelevation	Curb	Grade Elevations						Remarks	
			At edge Pav'nt. Lt.	At 3' Const. Joint Lt.	Centerline	At 3' Const. Joint Rt.	At edge Pav'nt. Rt	Curb		
1	2	3	4	5	6	7	8	9	10	
132+00		15" Deep	49.73	49.94	50.02	49.94	49.73	15" Deep		
132+50			49.40	49.61	49.69	49.61	49.40			
133+00			48.97	49.18	49.26	49.18	48.97			
133+50			48.36	48.65	48.73	48.65	48.36			
134+00			47.72	48.01	48.09	48.01	47.72			
134+50			46.98	47.27	47.35	47.27	46.98			
134+84.94 P.R.C.										
135+00			46.13	46.42	46.50	46.42	46.13			
135+50			45.23	45.52	45.60	45.52	45.23			
136+00			44.33	44.62	44.70	44.62	44.33			
136+50			43.43	43.72	43.80	43.72	43.43			
137+00			42.53	42.82	42.90	42.82	42.53			
137+50			41.63	41.92	42.00	41.92	41.63			
138+00			40.73	41.02	41.10	41.02	40.73			
138+50			39.83	40.12	40.20	40.12	39.83			
139+00	Crown Section		38.93	39.22	39.30	39.22	38.93			
139+50			38.03	38.32	38.40	38.32	38.03			
140+00			37.13	37.42	37.50	37.42	37.13			
140+50			36.23	36.52	36.60	36.52	36.23			
141+00			35.33	35.62	35.70	35.62	35.33			
141+50		3" Curb	34.43	34.72	34.80	34.72	34.43	3" Curb		
142+00			33.53	33.82	33.90	33.82	33.53		Auxiliary form Set parallel to and 3 feet from the regular form.	
142+50			32.72	33.01	33.09	33.01	32.72			
143+00			32.17	32.38	32.46	32.38	32.17			
143+50			31.63	31.92	32.00	31.92	31.63			
143+51 P.C.C.									Grades for Auxiliary Forms left traffic Lane.	
144+00			31.37	31.66	31.74	31.66	31.37			
144+50			31.29	31.58	31.66	31.58	31.29			
145+00			31.38	31.67	31.75	31.67	31.38		3' Left	3' Right
145+25	Change from crown to plane section		31.66	31.86	31.87	31.79	31.58		31.87	32.04
145+50			31.95	32.03	32.03	31.95	31.74		32.03	32.14
145+75			32.23	32.23	32.23	32.15	31.94		32.23	32.23
146+00			32.62	32.57	32.48	32.42	32.23		Right traffic Lane Similarly Treated.	
146+25			33.01	32.91	32.78	32.69	32.52			
146+50			33.40	33.25	33.11	32.97	32.82			
147+00	S = 1/16"		34.25	34.08	33.94	33.80	33.63		Located Line Curved to the Right	
147+50			35.25	35.08	34.94	34.80	34.63			
148+00			36.43	36.26	36.12	35.98	35.81			
148+50			37.70	37.53	37.39	37.25	37.08			

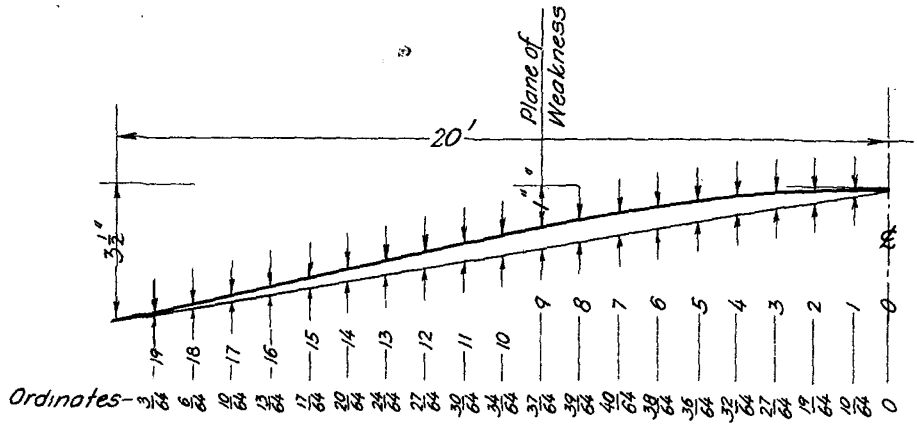
Note: Column 10 shows elevations for setting auxiliary forms for use in wiping out crown section during transition from crown to plane superelevated section.

Exhibit No. 27

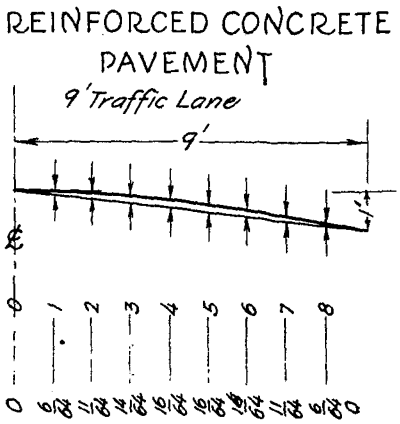
U. S. DEPT. OF AGRICULTURE
BUREAU OF PUBLIC ROADS
MT. VERNON MEMORIAL HIGHWAY

ORDINATES FOR SETTING SCREED FOR FINISHING CONCRETE ROADWAY SURFACE

HALF SECTION REINFORCED CONCRETE BASE

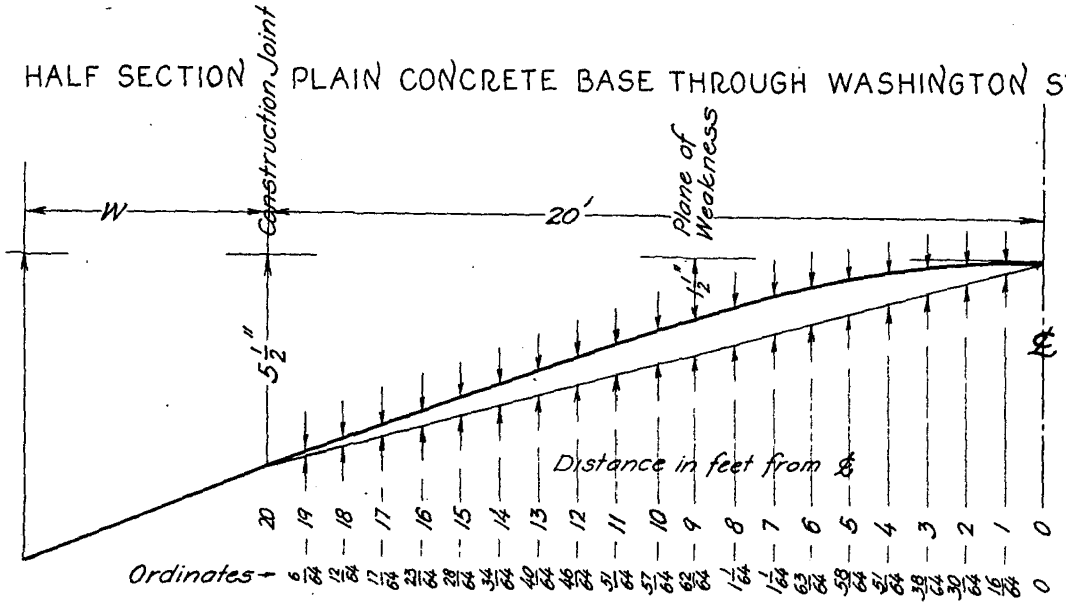


CROWN SECTION REINFORCED CONCRETE PAVEMENT



Note: The above Screed Ordinates are neat measurements. Add to the above ordinates the amount of the slump for green concrete. For reinforced concrete base pavement add $\frac{1}{8}$ inch for slump. For reinforced concrete pavement add $\frac{3}{16}$" for slumps.

HALF SECTION PLAIN CONCRETE BASE THROUGH WASHINGTON ST.

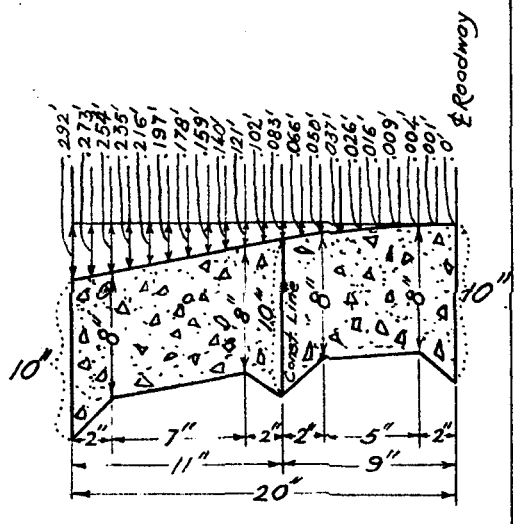


Note: The above Screed Ordinates are Neat Measurements Add to the above ordinates the amount of slump for green concrete For plain concrete base pavement add $\frac{1}{8}$-inch for slump. The Width (W) is the distance from the Construction Joint to the edge of the gutter and varies as the width of the street. The street varies from 56.0 to 70.0 ft. in width.

U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
MOUNT VERNON MEMORIAL HIGHWAY
UNIT NO. IV SECTIONS 1 & 2

Exhibit No. 28

Reinforced Concrete Pavement
Section 2
Scales Hor. 1"=10' Vert 1"=1'



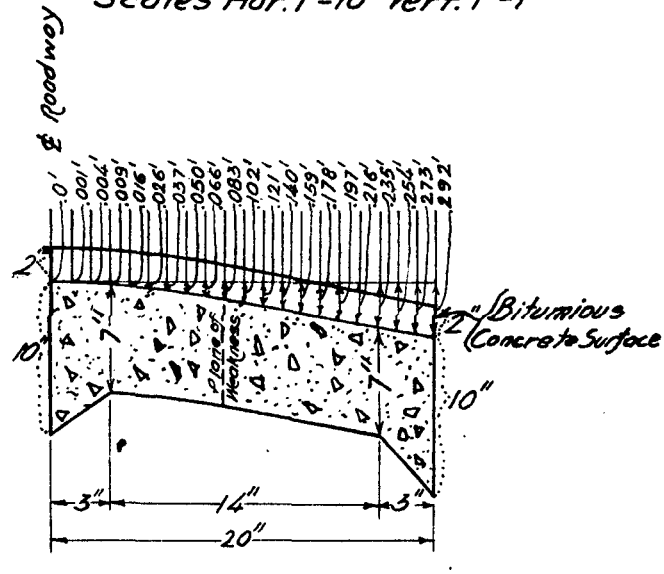
Ordinates from tangent at Crown to surface of pavement at foot intervals for ½ of Roadway. Crown Section

10' Traffic Lane is the same general design as the 9'+11' Lanes - 10-8-10

Areas of 9', 10' and 11' Traffic Lanes
9' Lane Area = 6.33 Sq. Ft.
10' Lane Area = 7.00 Sq Ft.
11' Lane Area = 7.67 Sq Ft.

Quantities				
Lanes	Width	Per Lin. Ft.	Per 40 ft. Sec	Per Mile
		Cu. Yds.	Cu. Yds.	Cu. Yds.
9.0'	9.0 ft.	0.2344	9.376	1237.6
10.0'	10.0 ft.	0.2593	10.370	1368.9
11.0'	11.0 ft.	0.2840	11.358	1499.3
Combinations of Traffic Lanes				
Lanes	Comb. Width	Per Lin. Ft.	Per 40 ft. Sec.	Per Mile
		Cu. Yds.	Cu. Yds.	Cu. Yds.
9.0'+11.0'	20.0 ft.	0.5185	20.74	2737.7
9.0'+10.0'+11.0	30.0 ft.	0.7778	31.11	4106.8
9'+9'+11'+11'	40.0 ft.	1.037	41.48	5475.4

Reinforced Concrete Base - Bit. Conc. Surface
Section 1
Scales Hor. 1"=10' Vert. 1"=1'



Ordinates to top of Reinforced Conc. Base from a tangent at top on ℄ of pavement at Foot intervals for ½ of Roadway. Crown Section.

10' Traffic Lane is the same general design as the Combined 9' and 11' Lanes - 10 - 7 - 10.

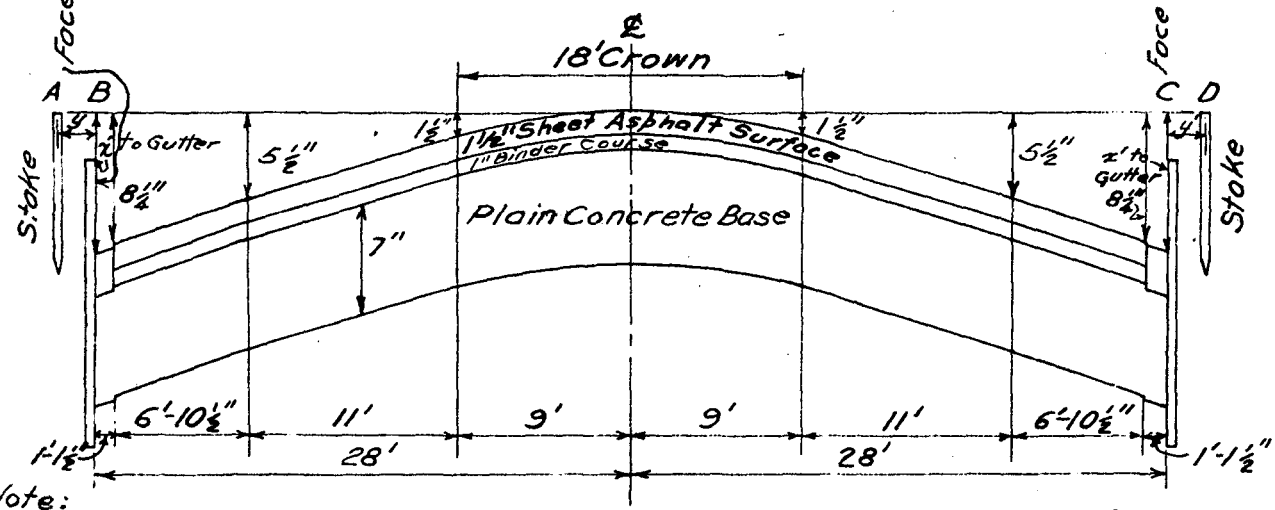
Areas of 9', 10' and 11' Traffic Lanes
Comb. 9'+11' Lane Area 12.416 Sq. Ft. R.C. Base
Comb. 9'+11' Lane Area 3.333 Sq. Ft. B.C. Surface
10' Lane Area 6.208 Sq. Ft. R.C. Base
10' Lane Area 1.667 Sq. Ft. B.C. Surface

Quantities					
Comb. Lane	Width Feet	Material Name	Per Lin. Ft. Cu. Yds.	Per 40' Sec. Cu. Yds.	Per Mile Cu. Yds.
9'+11'	20	B.C. Surface	0.1234	4.94	651.6
9'+11'	20	R.C. Base	0.4598	18.39	2427.7
9'+10'+11'	30	B.C. Surface	0.1851	7.41	977.3
9'+10'+11'	30	R.C. Base	0.6898	27.59	3642.0
9'+9'+11'+11'	40	B.C. Surface	0.2468	9.88	1303.2
9'+9'+11'+11'	40	R.C. Base	0.9197	36.79	4856.0

Note:— The Crown is an arc of a circle. The middle ordinate is one inch for an 18 foot chord.

Exhibit No. 29

56' Pavement
Granite Curb and Vitrified Block Gutter
City of Alexandria, Va.
Scales Hor. 1"=10' Ver. 1"=1'



Note:

A and D are grade stakes driven so top of stake is x feet above elevation at bottom of gutters.

x = 0.75 feet or 9 inches for this type of pavement.

A and D are off-set y-feet back from face of curb.

To find Crown elevation take from plans half the sum of the Left and Right gutter elevations. This sum plus x in feet equals the elevation at the center of street or crown

See table of ordinates at bottom of page.

Quantities			
Description	Areas Sq. Ft.	Per Lin. Ft. Cu. Yds.	Per 100' Sec. Cu. Yds.
9' Plain Con. Base Lane	5.250	0.1944	19.444
20' Plain Con. Base Lane	11.666	0.4321	43.210
7' Plain Con. Base Lane	4.128	0.1529	15.289
1" Binder Course	4.533	0.1679	16.789
1½" Sheet Asphalt Sur.	6.729	0.2492	24.922

Plain Concrete Base Course Computed for 54' width. One foot on each side now existing as base for gutter will be used to complete 56' pavement.

Distance ℄ to Curb Feet	Ordinates Fin. Pav. Feet	Line B-C to Top Con. Bse. Feet	Bit. Con. Bse. Feet
℄	0.0	0.2083	0.7917
1'	0.0015	0.2098	0.7932
2'	0.0062	0.2145	0.7979
3'	0.0137	0.2220	0.8054
4'	0.0247	0.2330	0.8164
5'	0.0358	0.2468	0.8302
6'	0.0555	0.2638	0.8472
7'	0.07555	0.2838	0.8672
8'	0.09875	0.3070	0.8904
9'	0.1250	0.3333	0.9167
10'	0.1550	0.3633	0.9467
11'	0.1856	0.3939	0.9773
12'	0.2159	0.4242	1.0076
13'	0.2462	0.4545	1.0379
14'	0.2765	0.4848	1.0682
15'	0.3068	0.5151	1.0985
16'	0.3371	0.5454	1.1288
17'	0.3674	0.5757	1.1591
18'	0.3977	0.6060	1.1894
19'	0.4280	0.6363	1.2197
20'	0.4583	0.6666	1.2500
21'	0.4916	0.6999	1.2833
22'	0.6250	0.7333	1.3167
23'	0.5583	0.7666	1.3500
24'	0.5916	0.7999	1.3833
25'	0.6250	0.8333	1.4167
26'	0.6583	0.8666	1.4500
26'-10½"	0.6875	0.8958	1.4792
26'-10½"	0.7083		
28	0.7500		

Exhibit No. 30

May 10, 1932

Final Equations
Mount Vernon Memorial Highway

	Plus	Minus
P.C. 67 + 60.20 back = 67 + 58.01 ahead	2.19	
P.T.S. 104 + 06.99 back = 104 + 09.23 ahead		2.24
P.C.C. 128 + 45.65 back = 128 + 46.02 ahead		0.37
P.C.C. 159 + 62.13 back = 159 + 60.43 ahead	1.70	
P.C. 178 + 63.07 back = 178 + 83.30 ahead		20.23
P.S.T. 209 + 85.99 back = 209 + 92.50 ahead		6.51
P.T. 224 + 47.09 back = 224 + 45.62 ahead	1.47	
P.C.T. 352 + 39.85 back = 345 + 94.55 ahead	645.30	
P.C. 378 + 21.70 back = 378 + 17.95 ahead	3.75	
P.C. 414 + 28.61 back = 414 + 22.08 ahead	6.53	
P.C.C. 434 + 92.48 back = 434 + 92.08 ahead	0.40	
P.C.C. 459 + 93.18 back = 459 + 92.34 ahead	0.84	
P.R.C. 512 + 45.24 back = 512 + 46.04 ahead		0.80
P.C.C. 594 + 28.40 back = 594 + 28.13 ahead	0.27	
P.C.C. 620 + 67.34 back = 620 + 21.10 ahead	46.24	
P.C.S. 660 + 35.46 back = 660 + 39.01 ahead		3.55
P.T. 728 + 54.80 back = 728 + 54.91 ahead		0.11
P.C. 761 + 74.80 back = 772 + 54.60 ahead		1079.80
P.S.C. 789 + 33.16 back = 789 + 33.58 ahead		0.42
P.C.C. 797 + 38.28 back = 797 + 41.72 ahead		3.44
P.S.T. 809 + 46.90 back = 809 + 49.88 ahead		2.98
Total plus changes and total minus changes	708.69	1120.45
Net change minus		*411.76*

The length of the pavement from Station 10+00 to Mount Vernon, including the loop around the oval, follows:

Sta. 10+00 to Sta. 816+59.5		80,659.50 ft.
The loop around the oval at Mount Vernon		1,766.94 ft.
	Total	82,426.44 ft.
Net change, minus distance due to equalities		411.76 ft.
Total length in feet		82,014.68 ft.
Total length in miles		15.533 mi.

U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

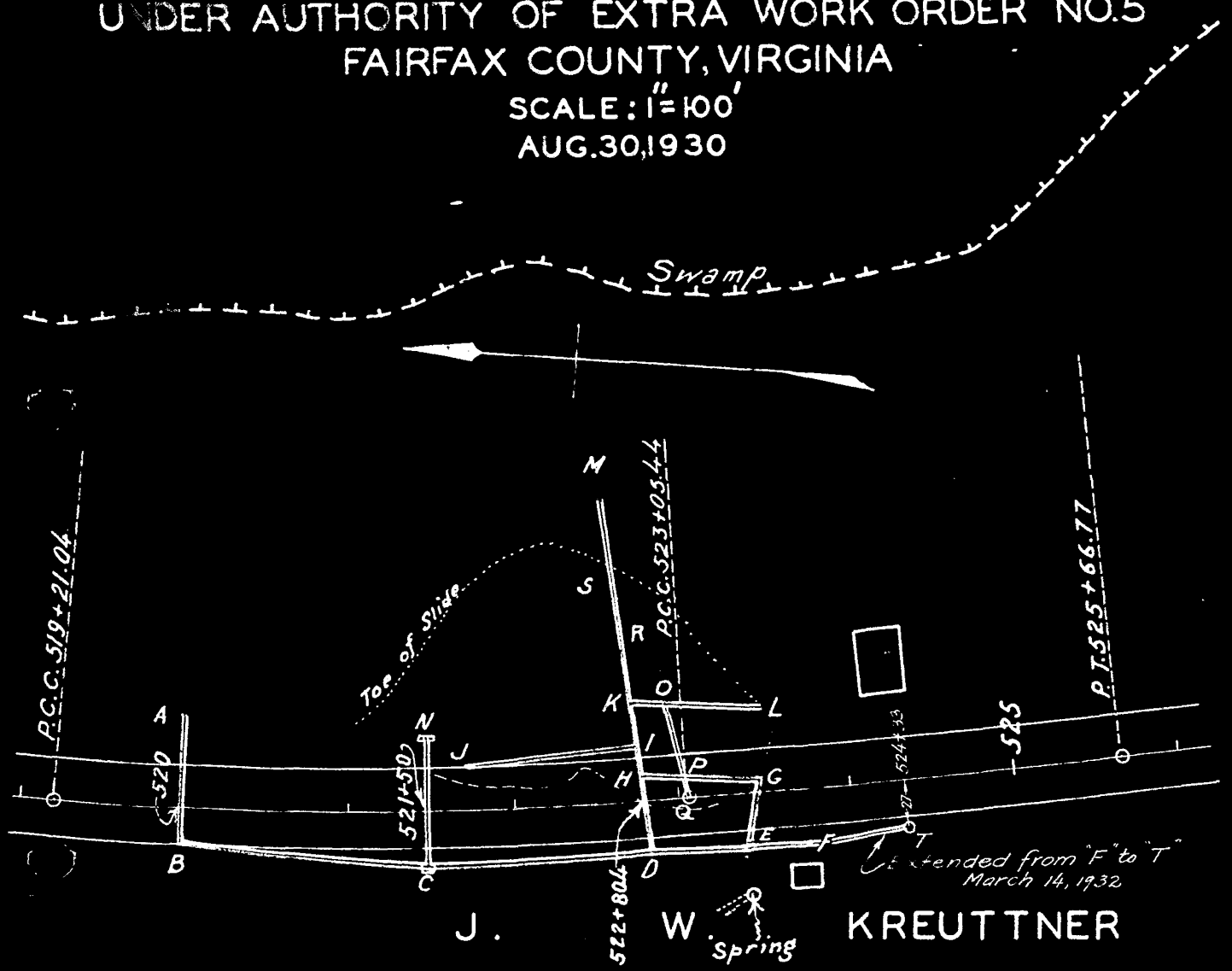
MOUNT VERNON MEMORIAL HIGHWAY

SKETCH SHOWING LOCATION OF SLIDE BEING REPAIRED UNDER AUTHORITY OF EXTRA WORK ORDER NO. 5

FAIRFAX COUNTY, VIRGINIA

SCALE: 1" = 100'

AUG. 30, 1930



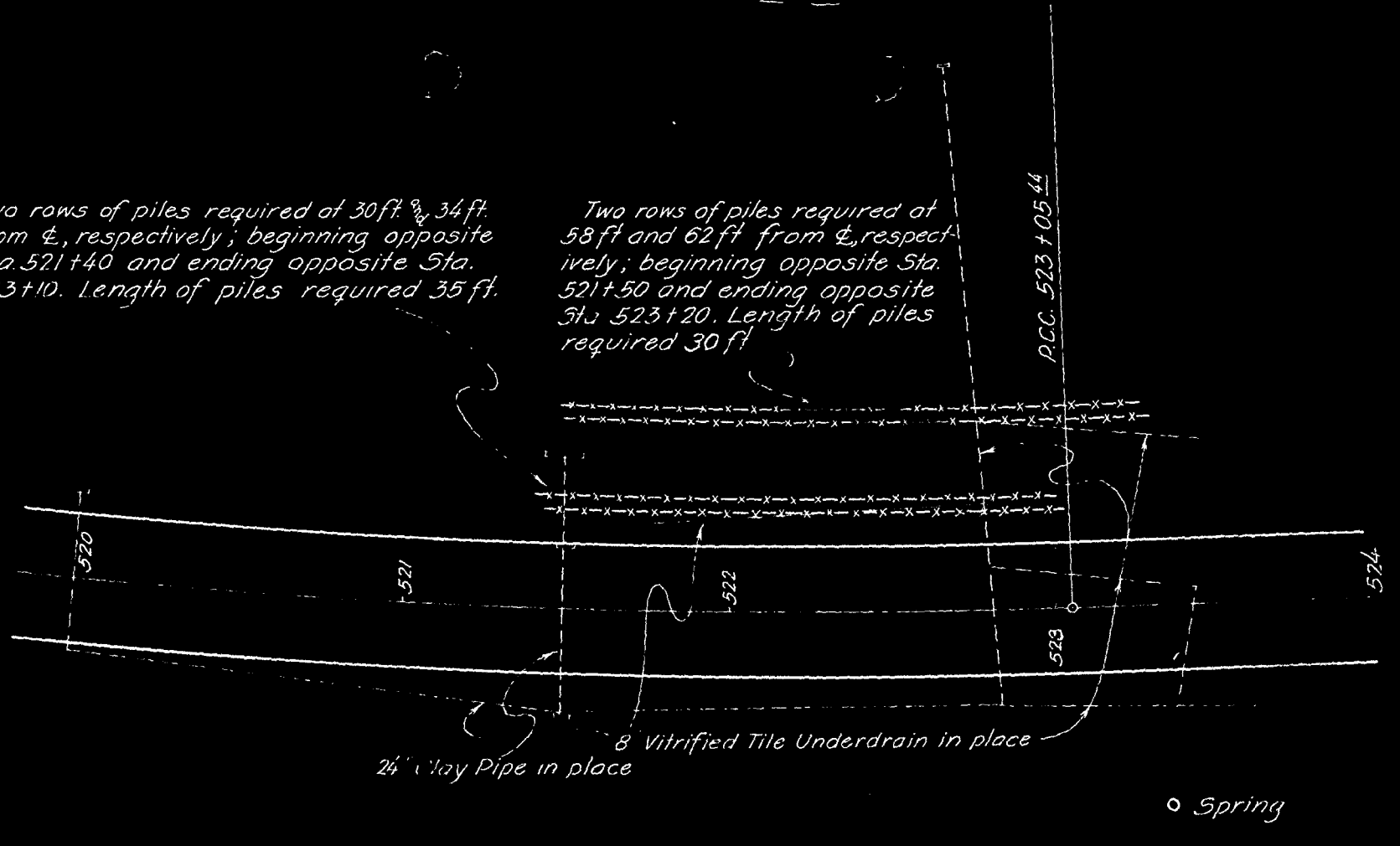
Location	Elev. Flow Line	Elev. Top Gravel	Location	Elev. Flow Line	Elev. Top Gravel
A	48.0		Q	45.67	56.2
B	48.75	50.3	x R	28.93	35.7
C	50.25	57.1	* S	24.39	29.3
D	51.65	59.6	T	53.00	63.0
E	51.30	60.00			
‖ F	52.50	60.6			
G	50.20	58.9			
H	43.40	50.3			
I	39.51	46.9			
J	42.61	50.0			
K	34.89	41.2			
L	41.12	48.4			
M	15.59				
# N					
O	36.24	44.3			
P	43.72	54.2			

x Change in grade

* End of underdrain & beginning of sealed joints

N-C 24" pipe culvert

‖ Vertical pipe top 10' above flow line.



U.S. DEPT. of AGRICULTURE
BUREAU of PUBLIC ROADS

MT. VERNON MEMORIAL HIGHWAY

PLAN OF

PILING TO BE DRIVEN IN SLOPE

Sta. 521 to 524 Left
Scale 1" = 50'

Jan. 1932

Exhibit No. 32

OK. J.W.J.
1-29-32

Exhibit No. 33

Hours of Labor Employed by Vincent Schiavi
Contractor, Unit II

Month	Foremen: Hours	Shovel Operators: Hours	Shovel Helpers: Hours	Tractor Operators: Hours	Truck Drivers: Hours	Carpenters: Hours	Skilled Labor: Hours	Unskilled Labor: Hours
Mar. 1930	440	188	512	1348	232	256		5278
Apr. 1930	1368	684	1166	1385	1385	75	856	12256
May 1930	1819	668	998	1295	1018	668	1041	15998
June 1930	2000	888	1461	1574	1268	1790	1458	14849
July 1930	1998	948	1384	1745	880	1864	916	13621
Aug. 1930	1882	948	1458	1771	1548	1070	784	10875
Sep. 1930	3088	848	1878	1836	1159	1115	1476	6619
Oct. 1930	1109	819	1230	1312	1879	1158	1689	8811
Nov. 1930	1167	505	936	1488	1849	289	969	5019
Dec. 1930	769	385	641	1171	685	854	1035	1885
Jan. 1931	888			352		557	424	2795
Feb. 1931	286			184	274		288	1678
Mar. 1931	818			858	60		56	1508
Apr. 1931	548	56		427	198		188	2928
May 1931	98			198	84		64	800
Totals	18706	6896	11079	14808	13788	8488	10657	102869
Grand Total								184297

Exhibit No. 54

Hours of Labor Employed by MacDougald Construction Co. Contractor, Unit IV, Section 1

Month	Foremen Hours	Shovel Oprtrs Hours	Shovel Helprs Hours	Truck Drvrs Hours	Machine Oprtrs Hours	Form Setters Hours	Finishers Hours	Carpenters Hours	Skilled Labor Hours	Unskilled Labor Hours
Apr. 1931	108	108	216	472	88					264
May, 1931	616	88	144	936	776	392	248	104	120	3986
June 1931	1392	172	172	3152	2840	1160	1184	172	2080	16560
July 1931	1552	184	280	2676	1304	496	808	136	2880	25080
Aug. 1931	1940	136	136	3816	1688	280	240	152	4548	21596
Sep. 1931	2280	140	140	6720	2064	368	968		5764	37588
Oct. 1931	1804	56	56	3218	3290			81	6280	27500
Nov. 1931	840	91	91	1255	866				440	7450
Dec. 1931	1512	208	168	2976	1527				2880	15288
Jan. 1932	448			528				2320		1472
Feb. 1932	88			44				840		44
Totals	12320	1192	1545	25619	14441	2696	3648	3457	25670	149862

Grand Total 238529

Exhibit No. 35

Hours of Labor Employed by Roberts Paving Co.
Contractor, Unit IV, Section E

Month	Foreman: Hrs.	Shovel Oprtrs: Hrs.	Shovel Helprs: Hrs.	Truck Drvrs: Hrs.	Machine Oprtrs: Hrs.	Form Settrs: Hrs.	Finish ers: Hrs.	Carpenters: Hrs.	Skilled Labor: Hrs.	Unskilled Labor: Hrs.
Mar. 1951	96		96		96				96	288
Apr. 1951	816			48	128			8	490	634
May, 1951	1104	24		1516	2856	160	1584	304	1256	9868
June 1951	1128	40	80	3065	2941	165	1526	261	2301	12717
July 1951	1848	116	444	7944	5888	548	2052	800	4618	22499
Aug. 1951	1615			5568	3855	414	1580		3602	18072
Sep. 1951	1959			7407	5540	576	1955		4917	27463
Oct. 1951	1172			2507	1852	152	580		3085	14855
Nov. 1951	625	72		528	856			4309		6968
Dec. 1951	156							1140		728
Totals	9920	252	620	28045	17174	2015	6997	6822	20545	114075

Grand Total 207870

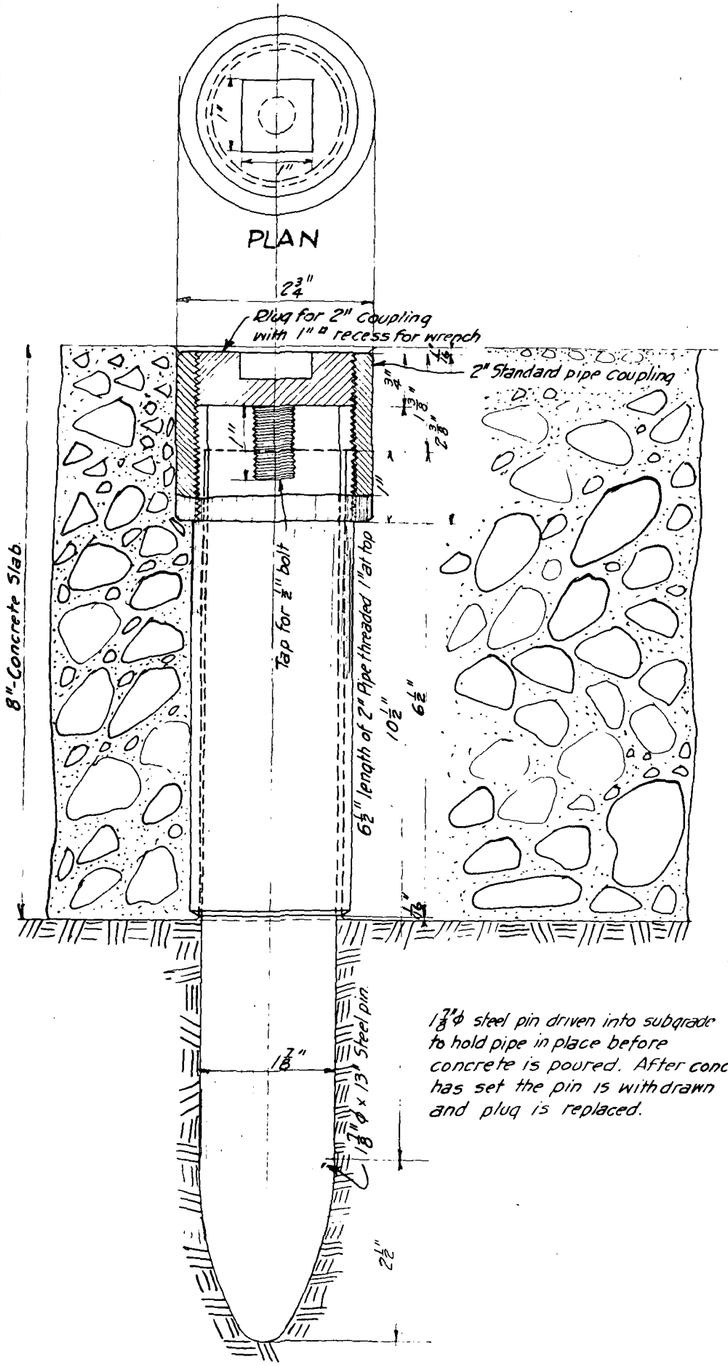
Exhibit No. 36

Hours of Labor Employed by Westchester Electrical Equipment Company
Contractor, Unit V, Lighting

Month	Foremen Hours	Machine Operators Hours	Truck Drivers Hours	Skilled Labor Hours	Unskilled Labor Hours
December, 1931	488	84	118	868	4004
January, 1932	384	112	232	60	4268
February, 1932	478	251	211	514	4486
March, 1932	307	155	218	1708	3689
April, 1932	378		214	698	1548
May, 1932	50		32	6	18
Totals	2181	582	1019	3403	18007

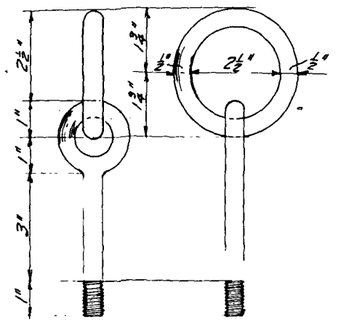
Grand Total 25192

Exhibit
No. 37



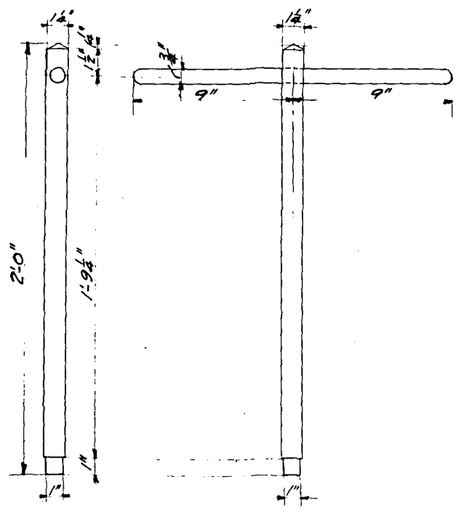
DETAIL OF MUD-JACK PIPE ASSEMBLY

0 ½" ½" ¾" 1" 1½" 2" 2½" 3"
Scale.



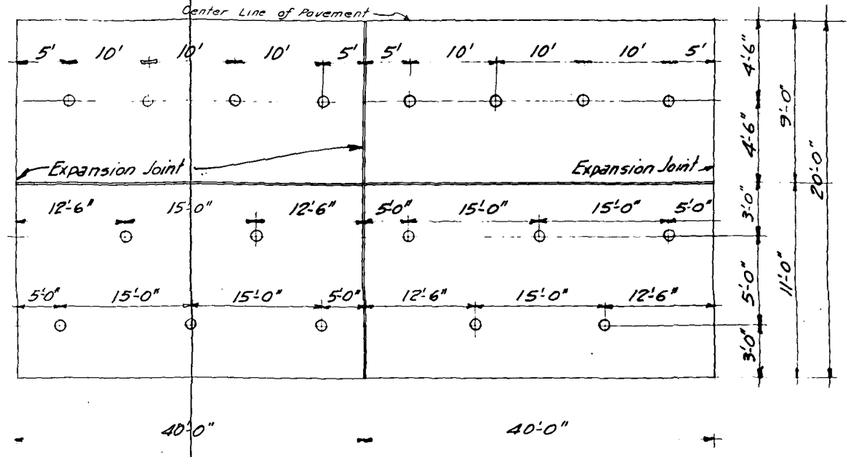
DETAIL OF BOLT FOR PULLING PLUG

0 ½" 1" 2" 3" 4" 5" 6"



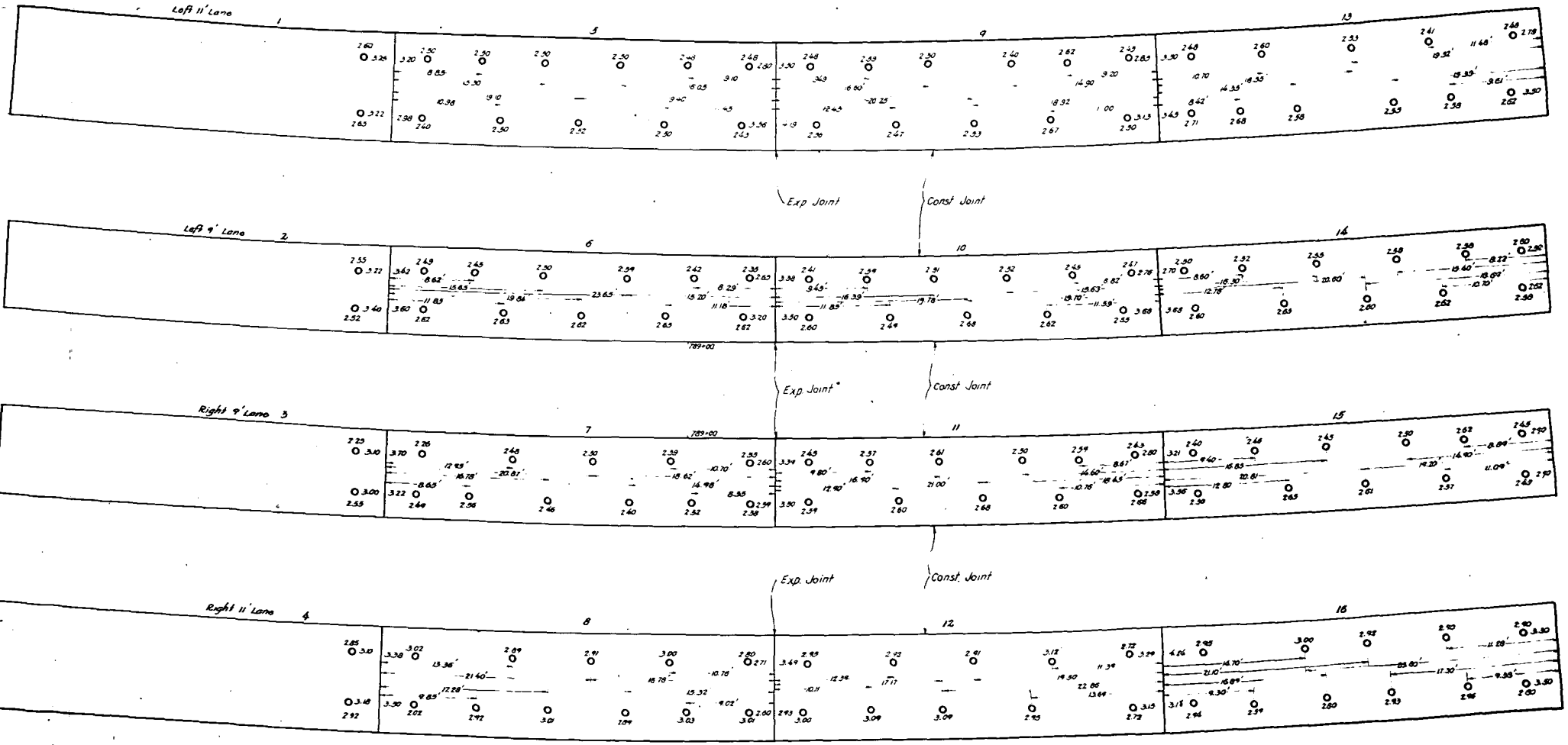
DETAIL OF PLUG WRENCH

Scale as above.



LOCATION OF MUD JACK PIPES IN CONCRETE PAVEMENT.

U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
MOUNT VERNON MEMORIAL HIGHWAY
DETAIL OF MUD-JACK PIPE ASSEMBLY
SEPT. 1931



U. S. DEPT. OF AGRICULTURE
BUREAU OF PUBLIC ROADS
MOUNT VERNON MEMORIAL HIGHWAY
DRILLING REINFORCED CONCRETE PAVEMENT
FOR
MUD JACK OPERATIONS
SCALE 1" = 5'

About Sta. 790+00

Exhibit No. 38

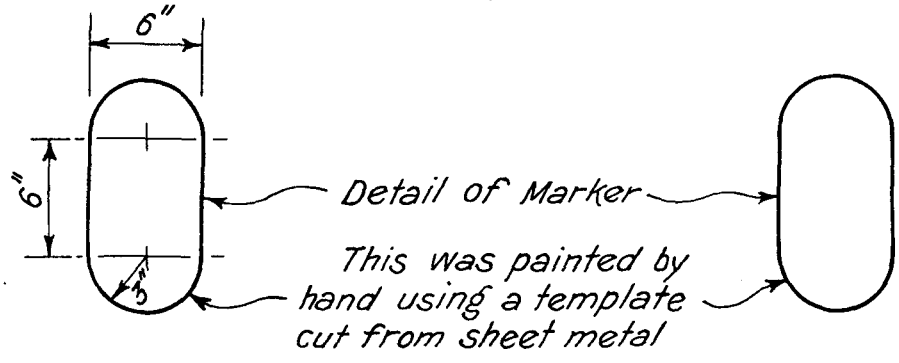
U.S. DEPT. of AGRICULTURE
BUREAU of PUBLIC ROADS

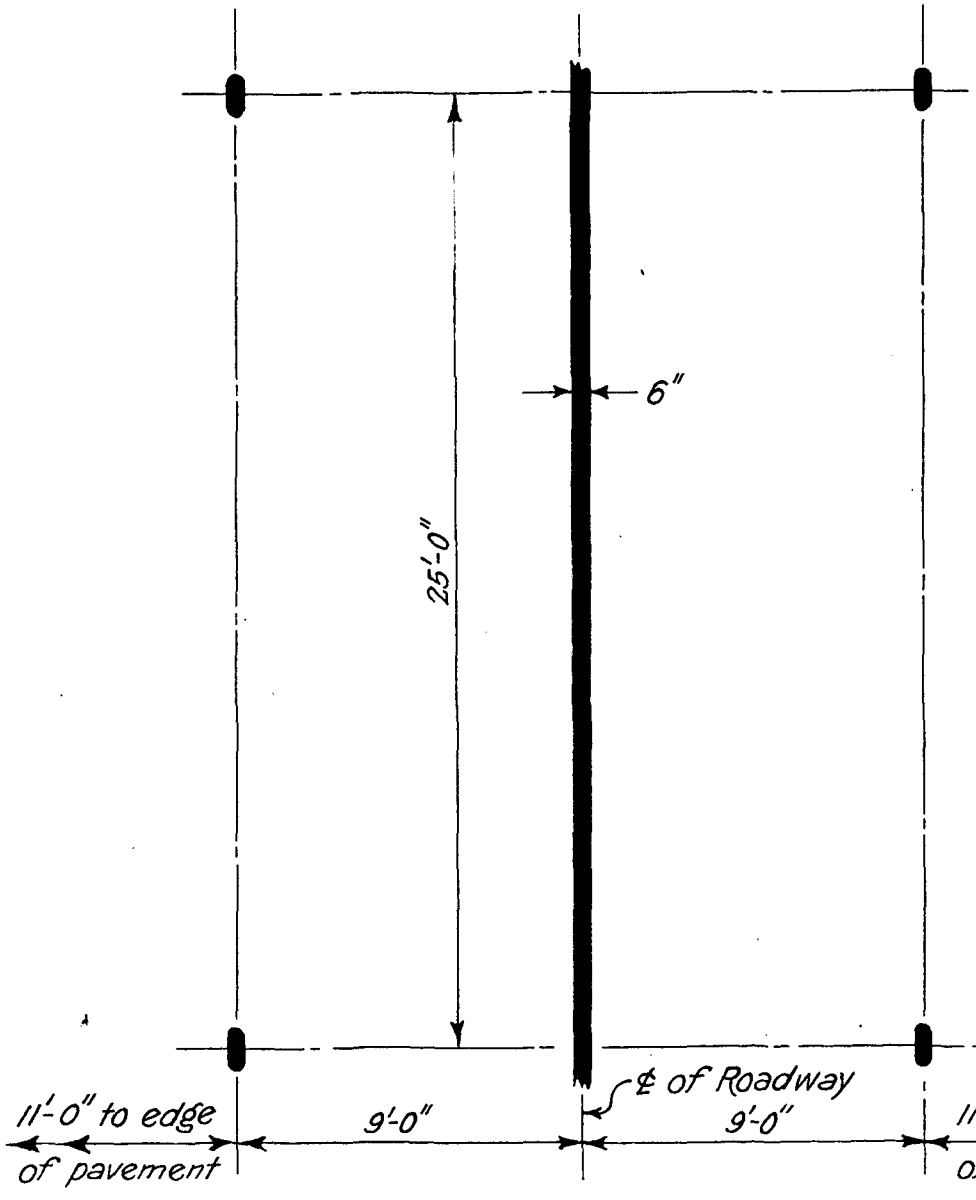
Exhibit No. [redacted] 37

MT. VERNON MEMORIAL HIGHWAY

SKETCH SHOWING
METHOD USED IN MARKING TRAFFIC LANES

JUNE, 1932





The method illustrated extends from Station 80 to 404 on bituminous concrete surface.
From Station 404 to Mount Vernon a center line strip only.