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NEW JERSEY TURNPIKE AUTHORITY

ENGINEERING STUDIES AND ESTIMATES

NEW JERSEY TURNPIKE

South Section

DE LEUW, CATHER & COMPANY
Consulting Engineers

September 1949

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Engineering Studies and Estimates
New Jersey Turnpike
South Section

September 1949

De Leuw, Cather & Company
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DE LEUW, CATHER & COMPANY
ENGINEERS
150 NORTH WACKER DRIVE
CHICAGO 6
FINANCIAL 6-0424

September 12, 1949

New Jersey Turnpike Authority
State House
Trenton, New Jersey

Gentlemen:

Pursuant to our contract, we submit herewith our report on ENGINEERING STUDIES AND ESTIMATES of that portion of the proposed New Jersey Turnpike between Deepwater and Bonhamtown.

During the progress of our assignment we have worked under the direction of your chief engineer, Commander Charles M. Noble, and your general consultants, Howard, Needles, Tammen and Bergendoff. We have collaborated with the firms of Ammann & Whitney, Edwards and Kelcey, Frederic R. Harris, Inc. and O. J. Porter & Company, Associated; engineers for the section of the New Jersey Turnpike between Bonhamtown and the George Washington Bridge; with Coverdale and Colpitts in regard to estimates of traffic and potential revenues; and with Mr. A. Gordon Lorimer, architect for the general consultants. We wish to acknowledge the helpful cooperation throughout this engagement of these individuals and organizations.

We called upon several New Jersey appraisers and engineering firms as sub-contractors to supplement our own forces and to expedite the work. We also retained the firm of Ammann and Whitney as consultants for the Raritan River and Rancocas Creek bridges and the firm of O. J. Porter and Company for borings and consultations in regard to foundation problems at major structures. The assistance of all these men is gratefully acknowledged. A list of the firms and individuals whose services were utilized will be found in Appendix I to this report.

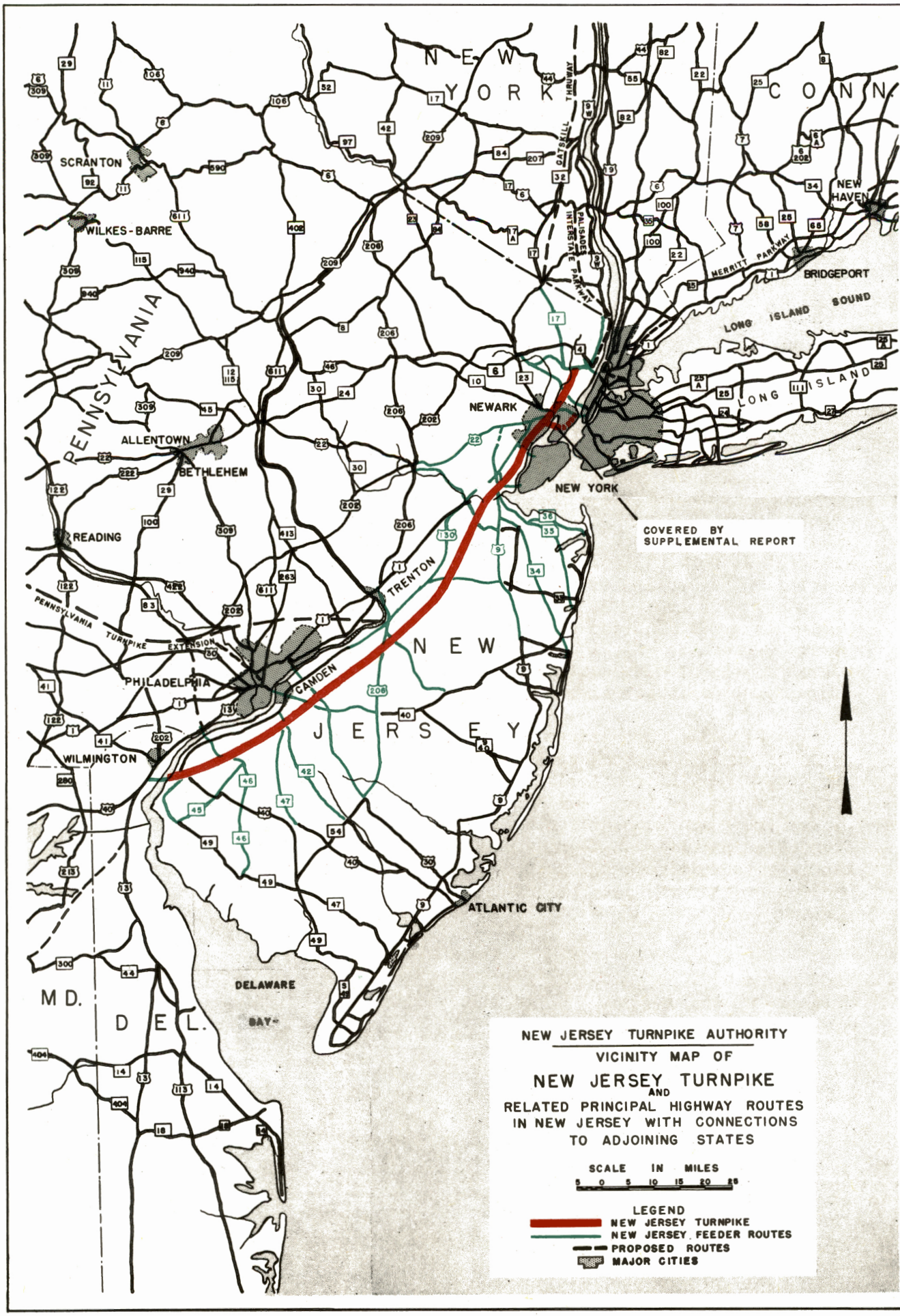
We also wish to acknowledge the very fine cooperation of the many agencies - federal, state and local - who were called on to supply data during the progress of the work. The names of these organizations are also listed in Appendix I.

We wish to take this opportunity to thank you for affording us the privilege of taking part in this interesting assignment.

Very truly yours,

DE LEUW, CATHER & COMPANY

Charles E. De Leuw,
President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PROPOSED ROUTES
MAJOR CITIES

Engineering Studies and Estimates
New Jersey Turnpike
South Section

SUMMARY OF REPORT

The problem of providing adequately for the heavy flow of traffic across the State of New Jersey has led to establishment of the New Jersey Turnpike Authority. The first project of this Authority is the planning and construction of a toll highway from the eastern end of the new Delaware Memorial Bridge at Deepwater to the George Washington Bridge into New York City. This report recommends the location and estimates the cost of the section between Deepwater and Bonhamtown, a distance of 87 miles.

The design standards adopted for this highway will make it outstanding in capacity, safety and driving comfort. The structures will be of pleasing architecture, the right-of-way will be attractively landscaped, and service buildings such as restaurants will be provided for the convenience of the public.

Selection of the recommended location and preliminary design of the highway was based on full use of existing traffic data and on a number of additional studies. Soil conditions, property values, and numerous other factors were also given due consideration.

Connections with existing highways have been planned at appropriate locations to make the proposed turnpike accessible to all major movements of traffic in the area. Toll collection facilities will be provided at these interchanges as well as at the Deepwater terminal.

It is estimated that the right-of-way for the turnpike will cost $4,650,000, including costs incidental to acquisition and consequential damage to adjourning property. The estimated cost of construction is $59,225,000 including all roadways, highway structures, maintenance buildings and facilities for concessions. The total estimated cost of the project in the south section is therefore $63,875,000. These costs do not include engineering, contingencies, or interest during construction, which will be separately estimated in a companion report by Howard, Needles, Tammen and Bergendoff.

Estimates have also been made of operating and maintenance expenses. Costs for maintenance of roadway structures and equipment, for fare collection, and for the operation of the turnpike patrol will be $420,000 in the first full year of operation. This will increase to $525,000 in the tenth year,

it is estimated. General administration costs will be found in a companion report prepared by the engineers for the north section.

A construction program has been proposed herein, with all sections of the highway in the south portion to be built simultaneously, but with the sequence of completion so planned that usable portions could be opened to traffic as revenue-producing units at the earliest possible moment.

INTRODUCTION

The Problem

New Jersey is a corridor state. It lies between New York and Philadelphia, the first and third largest cities in the United States. Automobiles and trucks shuttle between these two cities in vast volumes. There is also a heavy traffic flow between the New England states and Washington, Baltimore, and other southeastern cities. In addition, New Jersey's renowned seashore resorts attract great volumes of tourist traffic and her many and large industries generate large movements of commercial traffic. Furthermore, the agricultural products of her rich farm lands move in large part by truck to the city markets in New Jersey and in the New York and Philadelphia metropolitan areas.

The through-traffic making long trips interferes with purely local travel, and the congestion and accident hazard is a disadvantage to all concerned. The congestion on the highways adds to the cost of doing business, threatens the attractiveness of the resort areas, and taxes the patience of all users of the highways.

It has become clear that the normal sources of revenue for highway purposes are insufficient to furnish adequate highways within a reasonable period of time. The monies likely to be available in the next several years from gasoline taxes and federal aid will be needed for normal maintenance of existing highways and for construction of many, but by no means all, of the new super-roads urgently needed. Other methods of obtaining the modern express type of highway have been sought, therefore, in order that the many benefits to be gained by provision of such highways may be had immediately rather than at some distant date.

Establishment of the Authority

The New Jersey Turnpike Authority was established by the New Jersey State Legislature, Chapter 454, P.L. 1948. The act creating the Authority is similar to legislation establishing successful revenue bond highway facilities in Pennsylvania and Maine. The Authority is given broad powers to con-

struct and operate toll roads in New Jersey and the toll road which is the subject of this report may be only the first in a network covering the state.

The Project

The proposed highway will start at Deepwater, New Jersey, at the eastern end of the Delaware Memorial Bridge now under construction. The turnpike will extend northeasterly entirely across the state to a connection with the George Washington Bridge over the Hudson River into New York City. The route will pass east of Camden, Trenton, and New Brunswick and will go through Elizabeth and Newark. The total length will be approximately 117 miles.

For purposes of engineering studies the route has been divided into two sections, the southern section extending from Deepwater to Bonhamtown just north of the Raritan River, and the northern section extending from Bonhamtown to the George Washington Bridge. It is the south section which is discussed in this report. The north section is covered in a companion report by the firms of Edwards and Kelcey, Frederic R. Harris, Inc., Ammann and Whitney, and O. J. Porter & Company, Associated.

DESIGN STANDARDS

Typical Cross Sections

The design standards adopted for the New Jersey Turnpike will serve to make this by far the best highway in this country, if not in the world. These standards, which have our unqualified endorsement, will add immeasurably to the capacity, attractiveness, and safety of the highway without adding unreasonably to the cost. Typical elevations and cross-sections are shown on Plate 1, which follows Appendix III. The delineation, Plate 2, shows the highway as it would appear at a crossroads bridge from a point slightly above and to the right of the express roadways.

There will be two lanes in each direction in the initial stage with provision for future widening to a six-lane divided highway north of Camden. Each lane will be 12 feet in width, and the two lanes in each direction will be flanked by a 10-foot stabilized shoulder on the right-hand side, and by a 5-foot stabilized shoulder on the left-hand side. The center mall between the two roadways will be 26 feet in width, and future lanes will be added on the outside so as not to reduce the width of this median strip. Side slopes in cuts will be on a slope of two to one, while on low fills not exceeding ten feet in height the slope will be four to one. The two to one ratio will be used

on higher fills with guard rails added as needed. The side slopes and center mall will be planted in grass to enhance the appearance and to prevent erosion.

The right-of-way will be cleared of all brush and trees to the top of the back slopes in cuts and to the toe of slopes on fills. Beyond these limits, the natural woods will be left undisturbed except that large trees within 25 feet of shoulders will be removed. The right-of-way, which will be 300 feet wide, will be fenced throughout.

Because of the level nature of the land over a portion of the route and the proximity to tidewater, special study has been given to drainage.

Structures

There are a total of 148 structures required for the 87-mile section between Deepwater and Bonhamtown. These structures include: underpasses where the intersecting highways and railroads are carried over the turnpike; overpasses where highways and railroads are carried under the turnpike; structures at interchanges; and bridges carrying the turnpike over large waterways.

It will be noted that crossroads are carried over the turnpike in most instances rather than under. This simplifies the drainage problem. These bridges will be of variable widths commensurate with the volume of traffic on the highways they are designed to carry. The grade of the approaches to these bridges will vary from zero to six per cent depending on the importance of the crossroad and on the surrounding topography. It will be noted that the bridges are simple concrete-steel structures with pleasing modern lines and simple construction for low initial cost and ease of maintenance.

At all stream crossings and overpasses, the turnpike will be carried by a single wide bridge rather than by a separate bridge for each direction of travel. The bridge width, except for the Raritan River and Rancocas Creek crossings, will be such as to carry through the normal 26-foot center mall without deviations in alignment. The shoulders on each side of the travelled roadway will also be carried through without reduction in width. In addition there will be a 2-foot emergency walk between the curb and the rail on each side of the bridge. The total width of these structures will be 100 feet, outside of rail to outside of rail. See Plate 3 following the Appendix for the elevation of such a bridge.

The horizontal and vertical clearances of all bridges over streams will comply with the requirements specified by the New Jersey Water Policy Commission and Division of Navigation, and the U. S. Department of the Army.

The Raritan River Bridge is the largest in the south section of the turnpike; it will cross the Raritan River 4600 feet downstream from the present College Bridge (U. S. 1) east of New Brunswick. See Plate 4. The bridge over Rancocas Creek is another major structure. The Raritan River Bridge will provide a channel 150 feet in width with a clearance of 45 feet above mean sea level.

Alignment

The turnpike has been designed with a minimum radius on main roadways of 10,000 feet. With such generous curves and a design speed of 75 miles per hour, transition curves and super-elevation are both unnecessary. Tangent lengths are such as to avoid too frequent curves on one hand and monotonous alignment on the other.

Profile

Grades on the main roadway will be kept to a maximum of three per cent, and for long stretches of highway the maximum grade will be two per cent. The grades employed, for the lengths which will obtain on the turnpike, can be negotiated in high gear by fully loaded trucks without material reduction in speed. These light turnpike grades will result in a gently rolling highway providing an interesting drive for motorists.

Interchanges

The design of interchanges has been based on the high speed characteristic of the highway. Acceleration and deceleration lanes at these points are each 1200 feet in length. Minimum radius on the turns is 200 feet and adequate space has been provided for the approach to the toll booths. Grades on the interchange roadways have been kept to a maximum of four per cent. See Plate 5.

The architectural treatment of all bridges, as well as the toll booths and roadside service facilities, is typified as restrained modern.

TRAFFIC STUDIES

A number of traffic studies previously made by various divisions of the New Jersey State Highway Department were available to guide us in this

work. Substantial help was accorded us by numerous members of the staff of the department in the interpretation and use of these data.

These studies were analyzed and used in preparing our recommendations as to interchange locations, number of lanes to be provided initially, the design of interchanges, and other related matters. Estimates of traffic volumes and revenues are the responsibility of the firm of Coverdale & Colpitts.

Various members of our organization acquainted themselves with the traffic characteristics of the entire area adjacent to the turnpike, and for a considerable distance in all directions from the interchanges. Particular attention was given to large generators of traffic such as resort areas and industrial districts.

Special Studies

Running time studies over the entire area were made by trained crews using the floating car method with calibrated odometers. The results of these studies on existing highways as compared with probable running time on the proposed turnpike show savings in time of as much as one-third for major movements of traffic. We also made 16-hour traffic counts at every highway crossing the route of the turnpike, as finally selected, as a basis for design of crossroad facilities.

ROUTE SELECTION

Knowing the width of right-of-way required to meet design standards as well as the requirements of flat gradients and easy curvature, the next phase of our work was to select an alignment for the highway which would serve the anticipated traffic needs and attract the greatest volume of traffic with a minimum of right-of-way and construction costs.

Criteria

In selecting a highway alignment it was necessary to pass close to the largest generators of traffic and at the same time to provide the shortest feasible route. It was also necessary that consideration be given in the reconnaissance surveys to problems that would be introduced if wide valleys requiring major structures were crossed or if topography would require excessive cuts and fills to keep gradients within the specified standards. Consideration was also given to the type of soil and the drainage throughout the length of the route so that unnecessary cost of providing new sub-base would be avoided. A reconnaissance soil survey of the entire route was made by experienced New Jersey geologists.

We also attempted to select an alignment which would avoid duplicating existing highways of high standard. Acquisition of productive farm lands and destruction of homes or other buildings were avoided to the extent practicable.

Routes Considered

A belt up to 10 miles in width between Deepwater and Bonhamtown was studied in a number of ways. We prepared agronomy maps from previous studies of the agricultural value of the soils in the counties through which our line would pass. Existing aerial photographs were studied intensively and aerial reconnaissance was used to survey areas otherwise somewhat inaccessible. Topographical maps prepared by the United States Geological Survey and others were utilized. Extensive field reconnaissance was undertaken over the same wide area.

Three general routes were considered. These included the one herein recommended, one to the east thereof and one to the west. Numerous alternates in various sections of each of these three routes were also considered in some detail. For each of the three routes, profiles were prepared, preliminary estimates of cost made, and real estate appraisals secured.

It was determined that a route more easterly than the one recommended would entail unnecessary adverse distance for motorists and increased construction costs due to the longer highway without compensating advantages in lessened right-of-way cost as first contemplated. Such a route would also be farther from several important sources of traffic than a route farther to the west.

A route on the west side of the recommended line would pass through Pigeon Swamp and numerous other areas where right-of-way would be inexpensive but the cost of construction, particularly for adequate drainage, would far outweigh the savings in right-of-way costs. The number of structures to be built on each of the three routes was very much the same but the westerly route involved two oblique crossings with Route 25 which would be expensive. This proximity to Route 25 would also furnish unnecessary duplication of highway facilities and impose a competitive burden on the turnpike.

The recommended route is only three and one-half miles longer than the air line distance between Deepwater and Bonhamtown and yet it by-passes all heavily populated areas. Cost of right-of-way, therefore, is not excessive. The route passes close to Swedesboro, Woodbury, Camden, Mt. Holly, Borden-

town, Hightstown and New Brunswick. It goes to the west of Bonhamtown and the Raritan Arsenal. See Plate 6.

The route crosses the counties of Salem, Gloucester, Camden, Burlington, Mercer and Middlesex.

Since structures constitute a large part of the total cost, field surveys were made to determine the profile of each crossroad for a considerable distance each way from the center line of the turnpike and along the center line of the turnpike both directions from the crossroad. The turnpike profile as thus determined by field survey constituted almost one-half of the total length of the turnpike. The balance of the route between surveys was filled in by reference to existing topographical maps and other sources of information. Careful studies were made to establish the character of each structure required for road crossings and to reveal opportunities for relocating and combining crossroads or to close the less important roads.

At major stream crossings, profiles were taken along the center line of the proposed turnpike. Test borings were made by O. J. Porter and Company and the results of these studies used in preliminary designs of the foundations for the structures as well as in the estimates of cost.

Plans and profiles have been prepared at a scale of 1 inch to 400 feet for the entire route. All buildings adjacent to the turnpike have been shown. Property lines indicated are from best available sources. Profiles have also been developed showing the location and grade of proposed highway and railroad crossings of the turnpike. These preliminary location studies are subject to refinements when final field surveys are made but have been completed in sufficient detail to provide an accurate basis for the estimates of right-of-way and construction costs.

Interchanges

The location of interchanges between the turnpike and existing roads was based on available traffic data and examination of field conditions. See Plate 7. We recommend that interchanges be provided as follows:

Name of Interchange	*Connecting Highways*
Deepwater	Route 44 — U. S. 40 & 130 — Delaware Memorial Bridge
Swedesboro	U. S. 322 — County Routes 33 & 95
South Camden	Route 42 — Black Horse Pike
North Camden	Route S41
Mt. Holly-Burlington	County Route 15
Bordentown	Routes 39 & S39 — U. S. 206
Hightstown	Route 33
New Brunswick	Route S28

It is recommended that signs on the highway give notice of the location of these interchanges at five, two, and one miles in advance of the turnoff and at the deceleration lane. The distance to the next interchange should be posted on the leaving side of each interchange.

There will be no lighting on the main highway but the interchanges and the toll plazas will be suitably illuminated.

A topographical map was made at each interchange location and the facility designed so as to take advantage of the contours.

Toll Collection Facilities

Each interchange has been so designed that toll collection can be performed at a single location. Toll booths of appropriate architectural and functional design are recommended as shown by Plate 8. These will provide an adequate number of lanes to accommodate the estimated traffic at each interchange as projected for a considerable period into the future.

Effect on Crossroads

Simple channelization and traffic signal control where necessary is contemplated at the junction of the existing highways and the approach roads to the turnpike interchange. Provision has been made in the design, however, for future underpasses so that left turns may be made without conflict. The cost of property needed for these future developments is included in the cost estimates.

SERVICE FACILITIES

Restaurants

A study was made of the probable number of vehicles going from each interchange to every other interchange as a basis for planning restaurants, service stations and appurtenant facilities for motorists and truckers. It is recommended that two restaurants be constructed initially, one on each side of the highway. The one for southbound traffic will be one-half mile south of the White Horse Pike in Camden County and the one for northbound traffic near Hulse Road in Mercer County. At each location, however, there will be a parking lot on the opposite side of the road from the restaurant and a pedestrian underpass to permit people to reach the restaurant.

Each of these restaurants will contain a main dining room, a lunch counter for the general public and a lunch counter intended primarily for truck drivers. These three rooms will be served from a single kitchen. There will be a dining terrace for summer use. Space will also be provided

at each restaurant for the sale of candy, souvenirs, and other tourist items. See Plate 9.

The restaurants have been located 400 feet from the center line of the highway to provide for parking and permit attractive landscaping. Adequate parking lots will be provided separately for automobiles and trucks and there will be stalls designed especially for inter-city buses. See Plate 10.

Truck Services

A questionnaire survey was made of all over-the-road trucking concerns maintaining an office in New York City and serving the territory between Philadelphia and New York. The list was obtained from Leonards Motor Freight Directory.

This questionnaire attempted to determine what facilities on the highway would be patronized by trucking concerns. Specific questions were asked in regard to lunch counters, bunk houses for drivers, repair facilities, office space for dispatching the trucks of each company, and similar items which might make the highway more attractive to commercial users. The truckers cooperated in this survey fully and a large number of replies were received. General interest in the turnpike was indicated but the anticipated need for other than normal lunch counter and service station facilities was so small that plans for bunk houses or other special services have been kept to a minimum. If the need increases after the truckers have had more experience in using the turnpike, the buildings can be enlarged.

It should be noted that truckers have been slow to take advantage of turnpike facilities and perhaps the lack of interest in special services will be replaced by a demand for more elaborate facilities. On the Maine Turnpike, for example, trucking traffic for the first six months of the second year of operation was 120 per cent greater than in the corresponding period of the first year.

Gasoline Service Stations

Gasoline service stations will be provided for both directions of traffic at the two restaurant locations. In addition there will be six other service stations adjoining which will be snack bars. It is anticipated that these six gasoline stations will each serve one direction of traffic only so that there will be no cross traffic on the turnpike and no need to provide crossing bridges. See Plates 11 and 12.

Buildings

The administration building is to be located in the north section and will be covered in the report of the engineers for that section. This administration building will serve the entire turnpike and no separate building for this function will be required in the south section.

Garages for service, repair and storage of maintenance and police equipment in the south section will be provided at two locations. One of these garages will be located opposite each of the two restaurants.

In addition to these facilities, there will be six maintenance yards so placed that each 11-mile section of the highway will be maintained by a crew having its own central storage yard and garage. These garages should be located in the vicinity of the service stations to simplify the problems of providing power, water, lunch facilities and other necessary appurtenances.

See the accompanying tabulation for the location and description of all service buildings.

ESTIMATES OF CONSTRUCTION COSTS

Care was taken in the preparation of construction costs in view of the method proposed for financing this project. Unit costs used were adopted after conferences of all consultants, together with the chief engineer of the Turnpike Authority. These prices are based on labor and material costs now prevailing, a knowledge of local conditions, bid prices for similar work recently awarded, particularly the easterly extension of the Pennsylvania Turnpike, and discussions with and quotations from local suppliers of building materials.

The unit costs used in the estimates will be found in Appendix II. A summary of the total costs of construction of the project follows.

TABLE 1

New Jersey Turnpike

Estimate of Cost
South Section — 87.2 Miles

Item	*Quantity*	*Unit*	*Unit Cost*	*Total*
Real Estate				$ 4,650,000
Clearing and Grubbing	483	Acres	$300.00	145,000
Earthwork				
Remove Muck Soils and Backfill with Earth	250,000	Cu. Yds.	$ 1.40	$ 350,000
Excavation	7,500,000	Cu. Yds.	0.60	4,500,000
Borrow	5,750,000	Cu. Yds.	0.60	3,450,000
Total—Earthwork				$ 8,300,000
Selected Base Fill	4,150,000	Cu. Yds.	$ 1.00	$ 4,150,000
Pavement				
Approach Slabs on Turnpike and Intersecting Crossroads	47,680	Sq. Yds.	$ 7.00	$ 335,000
Turnpike and Interchange Pavement including Acceleration and Deceleration Lanes	2,600,000	Sq. Yds.	5.00	13,000,000
Pavement at Restaurants, Service Stations and Maintenance Buildings, including Acceleration and Deceleration Lanes	150,000	Sq. Yds.	Variable	610,000
Paving at Access Roads and Intersecting Crossroads	380,000	Sq. Yds.	Variable	930,000
Total—Pavement				$14,875,000
Shoulders				
Turnpike	1,500,000	Sq. Yds.	$ 1.00	$ 1,500,000
Interchange and Intersecting Crossroads	225,000	Sq. Yds.	1.00	225,000
Total—Shoulders				$ 1,725,000
Drainage		Lump Sum		$ 2,700,000
Culverts		Lump Sum		200,000
Topsoil, Fertilizing and Seeding		Lump Sum		2,825,000
Structures				
Raritan River Bridge				$ 1,235,000
Rancocas Creek Bridge				580,000
Other Bridges and Large Stream Crossing Structures				16,485,000
Total—Structures				$18,300,000

TABLE 1

New Jersey Turnpike

Estimate of Cost
South Section — 87.2 Miles (Cont'd)

Item	*Quantity*	*Unit*	*Unit Cost*	*Total*
Utilities—Maintenance and Restoration Thereof				$ 1,350,000
Maintenance of Traffic During Construction		Lump Sum		500,000
Guard Rails	245,000	Lin. Ft.	$2.00	490,000
Right-of-Way Fence	933,300	Lin. Ft.	0.30	280,000
Delineators		Lump Sum		70,000
Signs		Lump Sum		155,000
Snow Fence		Lump Sum		5,000
Monuments		Lump Sum		5,000
Line Striping		Lump Sum		40,000
Toll Booths at Eight Interchanges		Lump Sum		360,000
Lighting at Eight Interchanges		Lump Sum		250,000
Borings		Lump Sum		210,000
Maintenance Buildings		Lump Sum		220,000
Equipment				
Maintenance		Lump Sum		$ 490,000
Shop		Lump Sum		140,000
Police		Lump Sum		20,000
Communications		Lump Sum		100,000
Office		Lump Sum		6,000
Uniforms		Lump Sum		14,000
Total—Equipment				$ 770,000
Concessions				
Two Restaurants, including Four Gas Stations		Lump Sum		$ 1,050,000
Six Gas Stations and Snack Bars		Lump Sum		250,000
Total—Concessions				$ 1,300,000
TOTAL COST				$63,875,000

TABLE 2

Location and Description of Service Facilities

Direction Served	*Approximate Miles from Deepwater*	*Location — County and Nearest Road*	*Facilities Provided*
Northbound	5.5	Salem — County Route 41	Gas Station, Snack Bar and Minor Maintenance Building
Southbound	16.5	Gloucester — County Route 18	Gas Station, Snack Bar and Minor Maintenance Building
Northbound	27.5	Camden — White Horse Pike	Gas Station and Major Maintenance Building
Southbound	27.5	Camden — White Horse Pike	Restaurant, Gas Station and Truckers Bunk House
Southbound	38.5	Burlington — County Route 100	Gas Station, Snack Bar and Minor Maintenance Building
Northbound	49.5	Burlington — Hedding Road	Gas Station, Snack Bar and Minor Maintenance Building
Northbound	60.5	Mercer — Hulse Road	Restaurant, Gas Station and Truckers Bunk House
Southbound	60.5	Mercer — Hulse Road	Gas Station and Major Maintenance Building
Northbound	71.5	Middlesex — County Route 5R6	Gas Station, Snack Bar and Minor Maintenance Building
Southbound	82.5	Middlesex — Washington Avenue	Gas Station, Snack Bar and Minor Maintenance Building

The cost of engineering which covers field surveys, preparation of contract drawings and specifications, inspection during construction and testing of materials, and an allowance for construction contingencies will be found in the report prepared by Howard, Needles, Tammen & Bergendoff. An allowance for interest during construction and other overhead items will also be found in that report.

Construction costs include the provision for proper signing of the approaches to each interchange with highly visible reflectorized signs, four of which will be placed on the turnpike approaching each interchange location. Allowance is also made for signs to inform the patrons of points of interest such as rivers and major crossroads which the turnpike passes over or under. Mile markers to indicate progress along the turnpike are also included. The estimates include ten large illuminated signs to direct potential patrons to the nearest interchange at points of major traffic concentration. We have also included in our estimate an item to cover approximately 2,000 small signs to be located throughout the surrounding territory for a number of miles in all directions from the turnpike. It is believed that this will be a sound investment to promote patronage.

Roadside delineators at 100-foot spacing will be provided at the edge of each outside shoulder and in the center of the median strip. These delineators will consist of reflecting buttons mounted on steel posts. They have been used on other turnpikes as well as on rural highways for a number of years with satisfactory results.

Provision has been made in the estimate for the installation of a modern communication system based on short-wave radio. All patrol cars, maintenance vehicles, supervisors' automobiles, toll booths and the police and administration headquarters will be equipped with two-way radio.

The toll booths at the various interchanges will be supplied with Bell System telephones connecting with the administration building and with each other. The various garages and maintenance buildings will also be in touch with all other turnpike properties and the administrative office through telephone communications.

ESTIMATES OF RIGHT-OF-WAY COST

The estimates of right-of-way cost are based on field surveys. The appraisers were furnished maps indicating boundaries of parcels of property crossed by the turnpike. These property plats were prepared from tax maps where available, supplemented by field surveys and in some instances by title searches.

The estimates of the value of real estate to be taken were prepared by experienced local appraisers working under our direction and under the supervision of Mr. Thomas R. Lowrie, Appraiser-Consultant. All appraisers used were local experts acquainted with prevailing prices and customs of the area involved. It was estimated that the salvage value of structures within the right-of-way will more than offset demolition costs.

Allowances were made in the right-of-way costs not only for the value of the property actually to be taken but also for severance damages where large parcels were divided or so reduced in size as to affect the usefulness of the entire parcel and existing buildings thereon. Damages were also estimated in a number of cases where change of grade at underpasses will adversely affect adjacent property. Right-of-way estimates include the costs of real estate appraisers and negotiation incidental to the acquisition.

An allowance was made for possible damage to the drainage of adjoining lands which might be affected by the compacting of the soil and by the construction of turnpike drains and bridges. It has been the experience of the highway department that such claims are occasionally presented in connection with work of this type.

The total estimated cost of right-of-way is $4,650,000.

OPERATING AND MAINTENANCE COSTS

Toll Collection

Operating expense includes all costs of toll collection. This covers the wages of the superintendent and toll takers. Also included are supplies and uniforms for the toll collection employees, and lamp renewals and power and other similar items.

Police

This includes expenses of all of the turnpike patrol which would include a superintendent and eighteen patrolmen. The cost of operating vehicles used by the turnpike patrol is included, as well as allowances for uniforms and expenses comparable with prevailing practices in New Jersey.

Maintenance

In the estimated cost of maintenance of the south portion of the New Jersey Turnpike, there is included the estimated annual cost of maintenance of the roadway, the median strip and shoulder surfaces, drainage and subsurface structures, bridges and culverts, fences, guard rails and signs, buildings, communication facilities, and power lines. This account also includes the cost of the operation of all equipment.

An important item of cost included in the estimate is snow removal, cindering, erection of snow fences and other winter-time precautions to make the highway safely usable at all seasons of the year and under all conditions.

The itemized estimate of operating and maintenance expenses will be found in Appendix III. These costs are summarized below for the first and tenth year after the opening of the turnpike.

TABLE 3

Annual Maintenance and Operating Expenses

Item	*First Year*	*Tenth Year*
Maintenance of Roadways and Structures	$150,000	$215,000
Fare Collection	135,000	175,000
Turnpike Patrol	135,000	135,000
Total	$420,000	$525,000

CONSTRUCTION PROGRAM

It is important that the construction of the New Jersey Turnpike be coordinated with other major highway construction programs in the vicinity. It is also vital that sections of the turnpike which would be useful and revenue-producing be completed and opened to traffic in stages and at the earliest possible moment after financing of the project has been arranged. See Plate 13.

Estimated dates of completion for various important highways in this area are shown on Plate 14.

With these considerations in mind, a construction program has been prepared which can be completed in two construction seasons.

A program for the assigning of engineering work, the taking of bids and the awarding of construction contracts for the turnpike in general has been prepared by the chief engineer and the general consulting engineer of the Authority. We have examined this program and insofar as the south section is concerned the schedule set forth is entirely workmanlike and attainable.

APPENDICES

APPENDIX I

Acknowledgments

Real Estate Appraisers

Appraisal Consultant:
Mr. T. R. Lowrie
Passaic, New Jersey

Appraiser — Preliminary Route:
Mr. Thomas Stewart
Mr. J. Walklet

Burlington County:
Mr. Walter Lamon, Jr.
Palmyra, New Jersey

Camden County and Gloucester County:
Mr. H. L. Todd
Camden, New Jersey

Mercer County:
George J. Perlman Company
Trenton, New Jersey

Middlesex County:
Mr. J. Joseph Connor
New Brunswick, New Jersey

Salem County:
Mr. George C. Rogers, Jr.
Woodstown, New Jersey

Surveyors and Engineers

Skinner and Compton
Salem, New Jersey
Taylor Engineering Associates
Merchantville, New Jersey
Mr. B. Harold Wills
Mt. Holly, New Jersey

Consultants to DeLeuw, Cather & Company

Soil Exploratory Work and Associated Laboratory Tests:
O. J. Porter & Company
Sacramento, California and Newark, New Jersey

Review of Designs and Cost Estimates for
Rancocas Creek and Raritan River Bridges:
Ammann and Whitney
New York and Milwaukee

Geological and Soil Surveys:
E. A. Henderson
J. R. Schuyler

State Agencies

Department of Conservation and Economic Development
State Highway Department:
Division of Planning and Economics, and
Division of Surveys and Plans

APPENDIX II

Summary of Unit Prices Used in Estimating Construction Costs — South Section

EARTHWORK

Roadway excavation	$ 0.60 per cu. yd.
Borrow excavation	0.60 per cu. yd.
Structural excavation — dry	4.00 per cu. yd.
Structural excavation — wet (requiring cofferdams)	Estimated individually
Sub-base (selected material from nearby excavation)	1.00 per cu. yd.
Topsoiling, 4" thick, plus fertilizing and seeding	0.40 per sq. yd.
Removing muck soils and backfilling	1.40 per cu. yd.

PAVEMENTS

Gravel shoulders and base course	$ 1.00 per sq. yd.
Pavement for parking areas and special roadways	3.50 per sq. yd.
Pavement — complete	5.00 per sq. yd.
Pavement — bridge approaches	7.00 per sq. yd.

STRUCTURES

Class A concrete	
Concrete deck and other various thin sections above piers	$ 65.00 per cu. yd.
Class B concrete	
Piers (dry) above footings	60.00 per cu. yd.
Piers (in water) above footings	70.00 per cu. yd.
Wing walls of abutments	55.00 per cu. yd.
Class C concrete	
Abutments — semi-gravity type	40.00 per cu. yd.
Pier footings	35.00 per cu. yd.
Class D concrete	
Abutments — gravity type	35.00 per cu. yd.
Foundations	35.00 per cu. yd.
Backfill — bank run sand and gravel	3.00 per cu. yd.
Underdrains, 8", back of abutments	4.00 per lin. ft.
Waterproofing — for joints incl. copper seal	3.00 per lin. ft.
Structural steel, simple fabrication	0.12 per lb.
Structural steel, riveted girders and the like	0.14 per lb.
Reinforcing bars	
North of Hightstown	0.12½ per lb.
South of Hightstown	0.11 per lb.
Reinforcing bars in foundations	0.11 per lb.
Steel H piles, 12", 53 #, in place	4.50 per lin. ft.
Steel H piles, 12", 53 #, in place	
Special wet or difficult conditions	6.00 per lin. ft.
Untreated timber piles, ordinary conditions	1.50 per lin. ft.
Steel sheet piling	240.00 per ton
Bridge rails, no galvanizing	8.00 per lin. ft.
Expansion joints	0.30 per lb.

The foregoing unit prices were used for all structure estimates except on the Raritan River and Rancocas Creek structures where the following unit prices were used when applicable.

Silicon steel	$ 0.16½ per lb.
Bearing steel	0.30 per lb.

MISCELLANEOUS STRUCTURES

Underdrains, 6", perforated tile, complete in place	$ 2.50 per lin. ft.
Reinforced concrete pipe, complete in place, 10"	3.50 per lin. ft.
12"	4.00 per lin. ft.
15"	4.75 per lin. ft.
18"	5.50 per lin. ft.
24"	7.00 per lin. ft.
30"	10.00 per lin. ft.
36"	13.50 per lin. ft.
42"	18.00 per lin. ft.
48"	20.00 per lin. ft.
54"	24.00 per lin. ft.
60"	27.00 per lin. ft.
66"	33.00 per lin. ft.
72"	38.00 per lin. ft.
Manholes	270.00 each
Inlets	225.00 each
Concrete curb and gutter	2.00 per lin. ft.
Sidewalks	4.00 per sq. yd.
Property and R-O-W monuments	10.00 each
Guard rails	2.00 per lin. ft.
Right-of-way fence	0.30 per lin. ft.
Delineator markers — 1 directional	4.50 each
Delineator markers — 2 directional	5.50 each
Traffic signs, Non-reflectorized	100.00 each
Reflectorized	150.00 each
Illuminated	250.00 each

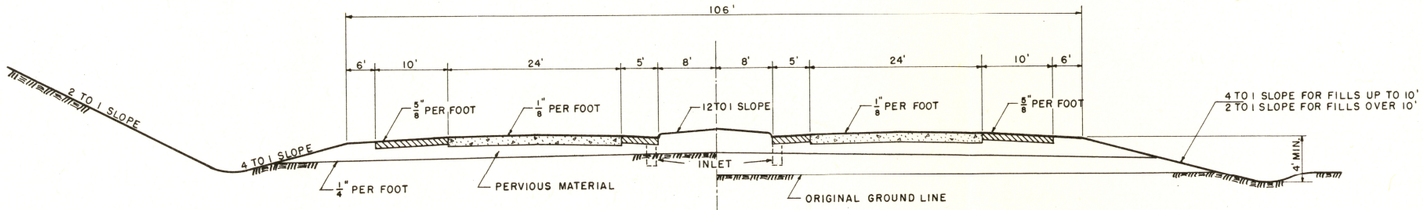
APPENDIX III

Summary of Maintenance and Operating Expenses
South Section

Item	First Year	Tenth Year
I. *General Administration**	$ —	$ —
II. *Maintenance of Roadway, Structures and Equipment*		
A. Superintendence	$ 29,000	$ 29,000
B. Pavement	15,000	33,000
C. Median Strip and Shoulders	12,000	12,000
D. Drainage and Subgrade	5,000	11,000
E. Bridges and Culverts	1,000	10,000
F. Fences, Guard Rails and Signs	1,000	7,000
G. Buildings	3,000	9,000
H. Communications	3,000	5,000
I. Power Lines	—	1,000
J. Maintenance Equipment	40,000	54,000
K. Maintenance Equipment — Purchase	—	3,000
L. Small Tools and Supplies	1,000	1,000
M. Snow Removal and Ice Control	35,000	35,000
N. Other Expenses	5,000	5,000
Total — Maintenance of Roadway, Structures and Equipment	$150,000	$215,000
III. *Fare Collection*		
A. Superintendence	$ 5,000	$ 5,000
B. Toll Collection Expenses	110,000	145,000
C. Lighting and Power	4,000	4,000
D. Supplies and Uniforms	16,000	21,000
Total — Fare Collection	$135,000	$175,000
IV. Turnpike Patrol		
A. Superintendence	$ 5,000	$ 5,000
B. Patrol	120,000	120,000
C. Supplies and Uniforms	10,000	10,000
Total — Turnpike Patrol	$135,000	$135,000
GRAND TOTAL	$420,000	$525,000

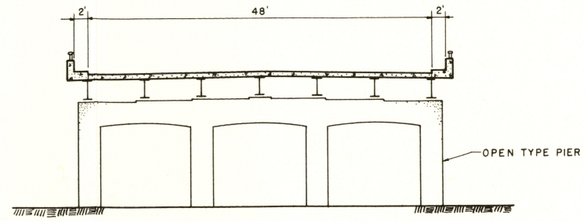
* All General Administration Expenses are included in the report on the North Section.

PLATES



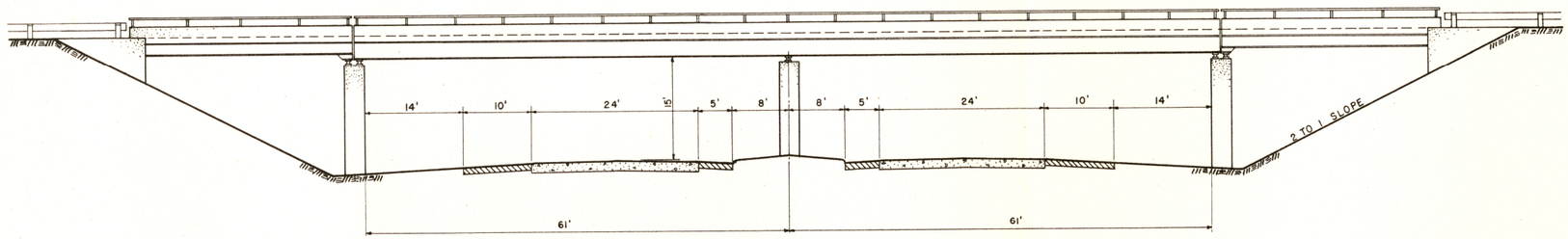
CUT SECTION FILL SECTION

TYPICAL ROADWAY CROSS SECTIONS



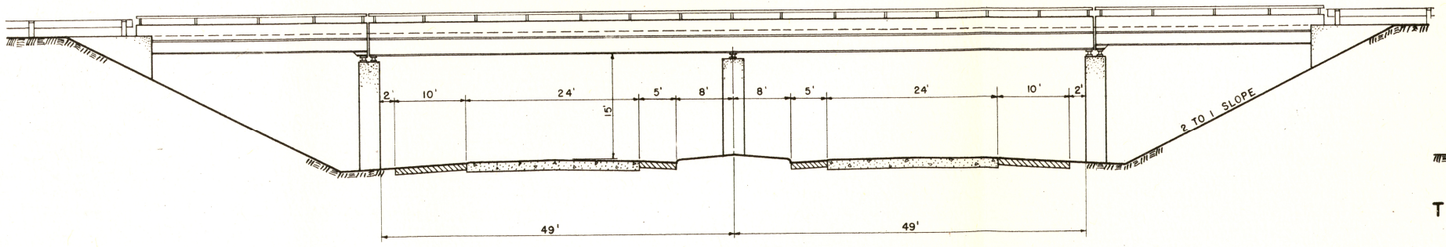
4-LANE UNDIVIDED ROAD OVER TURNPIKE

TRANSVERSE SECTION



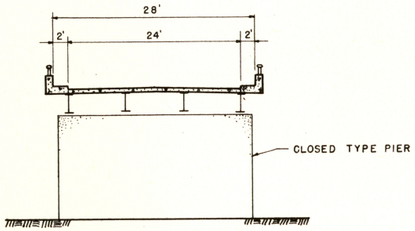
UNDERPASS - NORTH OF NORTH CAMDEN INTERCHANGE

ELEVATION



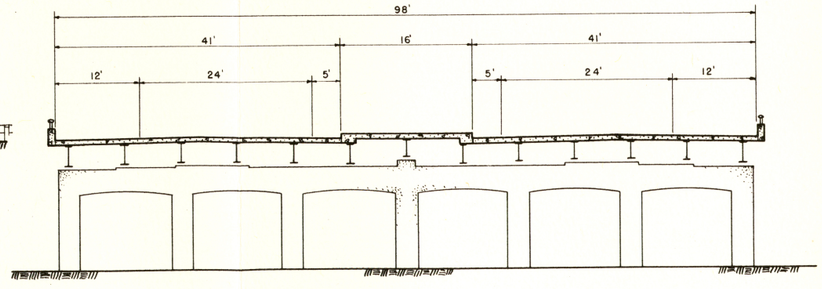
UNDERPASS - SOUTH OF NORTH CAMDEN INTERCHANGE

ELEVATION



2-LANE SECONDARY ROAD OVER TURNPIKE

TRANSVERSE SECTION



TYPICAL TURNPIKE OVERPASS & 4-LANE DIVIDED HIGHWAY OVER TURNPIKE

TRANSVERSE SECTION

NEW JERSEY TURNPIKE AUTHORITY

NEW JERSEY TURNPIKE

TYPICAL ELEVATIONS AND CROSS SECTIONS

SEPTEMBER, 1949

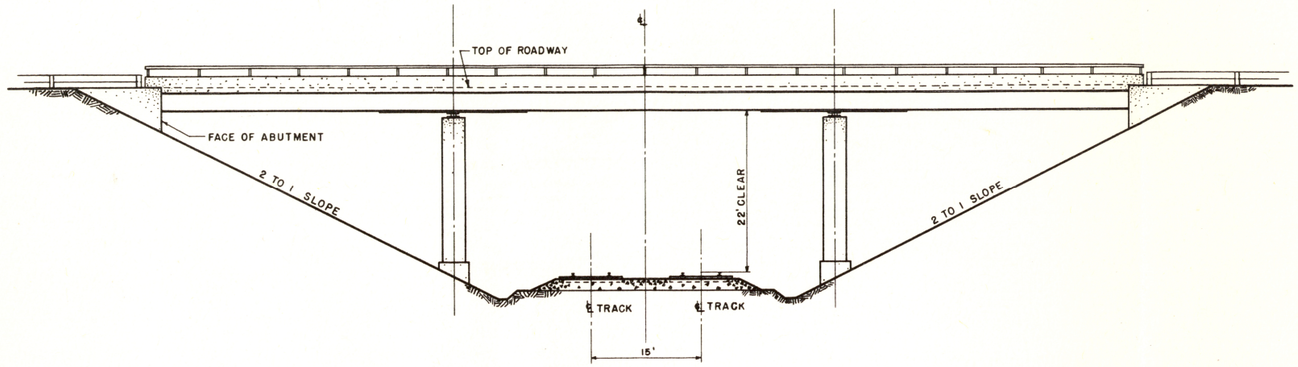
DE LEUW, CATHER & CO.
ENGINEERS

CHICAGO ILLINOIS



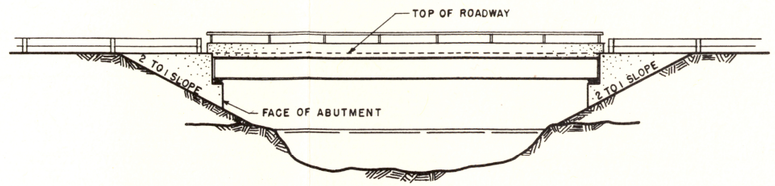
TYPICAL VIEW OF TURNPIKE NORTH OF NORTH CAMDEN INTERCHANGE SHOWING CROSSROAD BRIDGE

PLATE 2



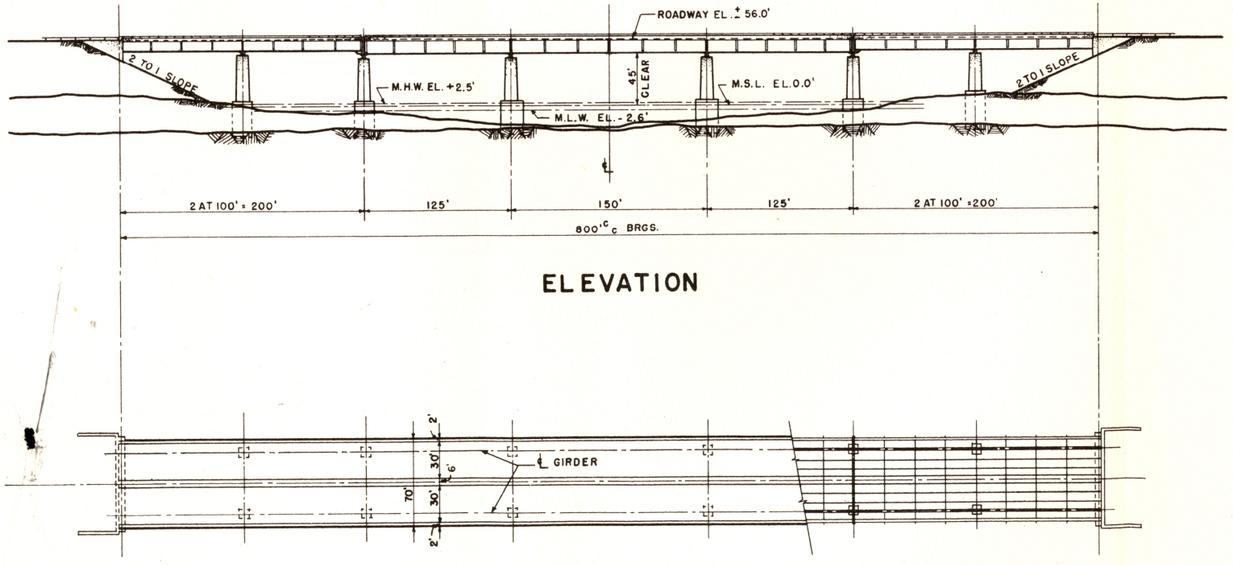
TURNPIKE OVERPASS DOUBLE TRACK RAILROAD BELOW

ELEVATION



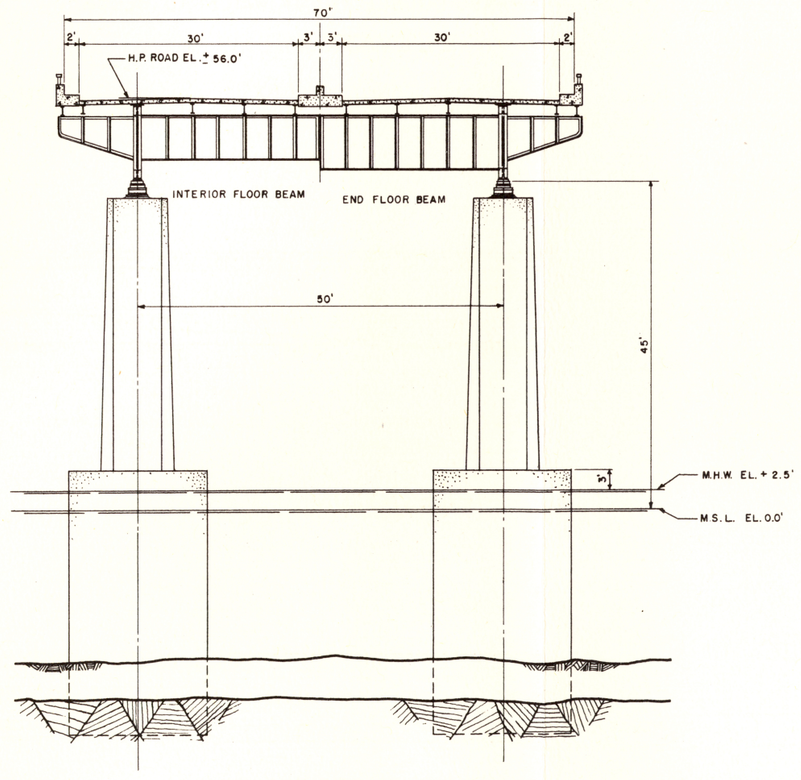
TYPICAL STREAM CROSSING

ELEVATION



ELEVATION

PLAN



TRANSVERSE SECTION

RARITAN RIVER BRIDGE

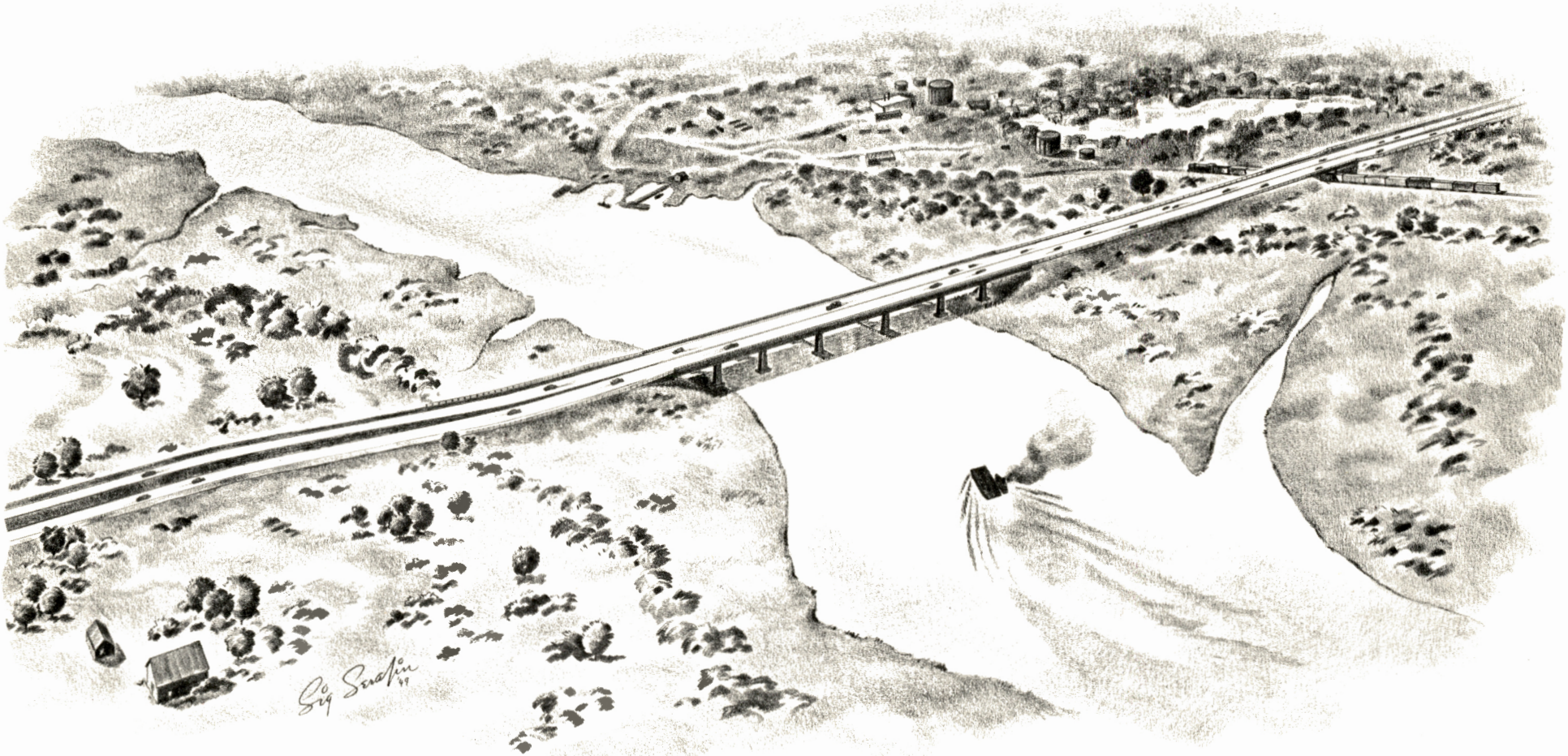
NEW JERSEY TURNPIKE AUTHORITY

NEW JERSEY TURNPIKE

ELEVATION & CROSS SECTIONS STREAM CROSSINGS AND RAILROAD OVERPASS

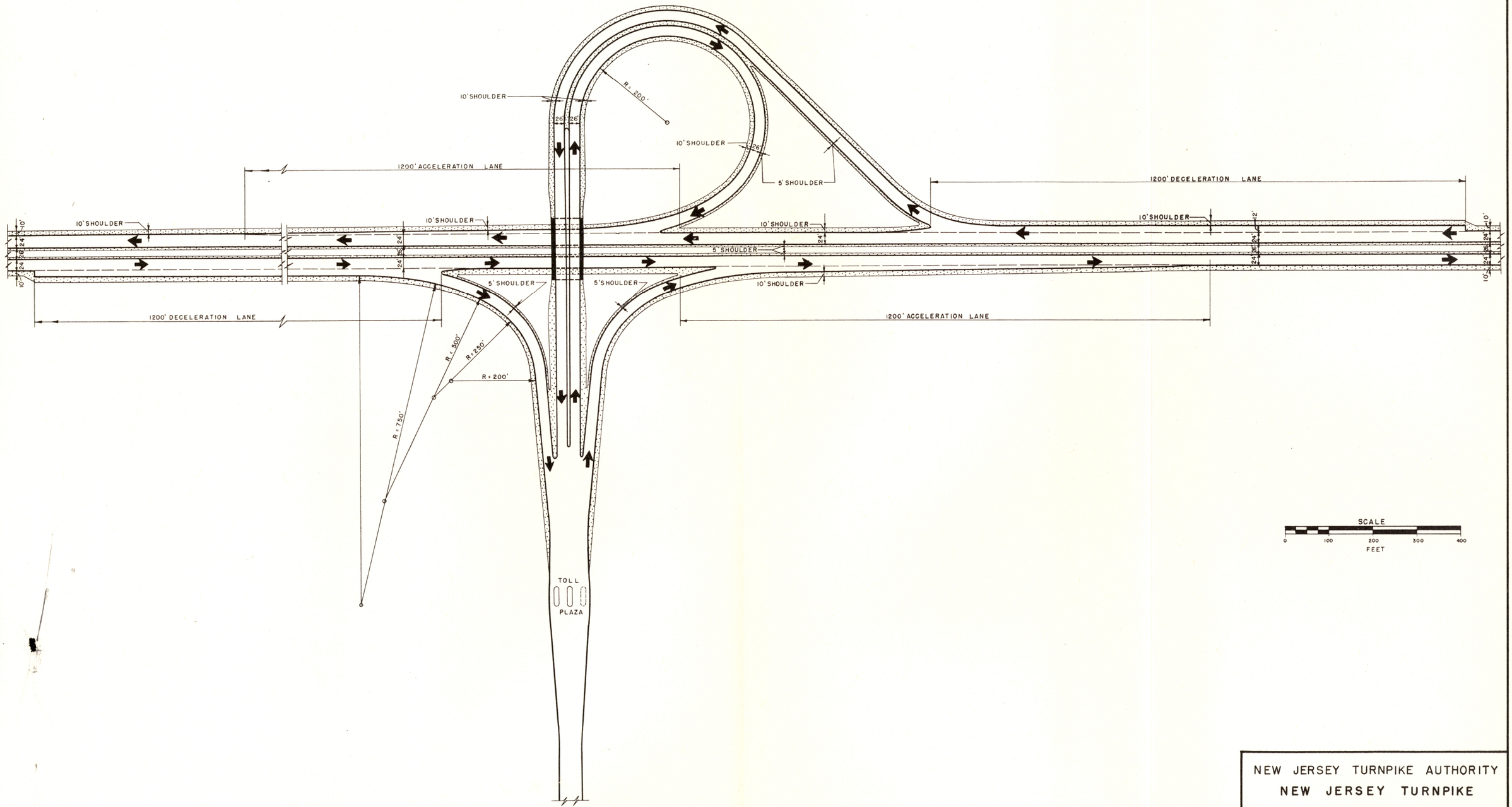
SEPTEMBER, 1949

DE LEUW, CATHER & CO
ENGINEERS
CHICAGO ILLINOIS



NEW JERSEY TURNPIKE AT THE RARITAN RIVER

PLATE 4



NEW JERSEY TURNPIKE AUTHORITY

NEW JERSEY TURNPIKE

TYPICAL INTERCHANGE

SEPTEMBER, 1949

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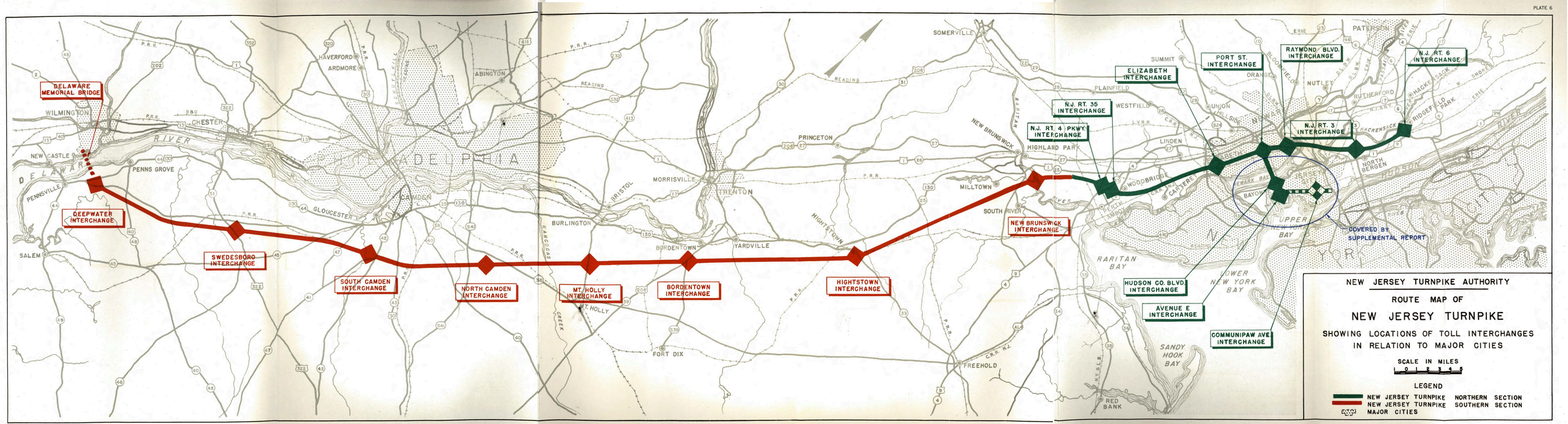
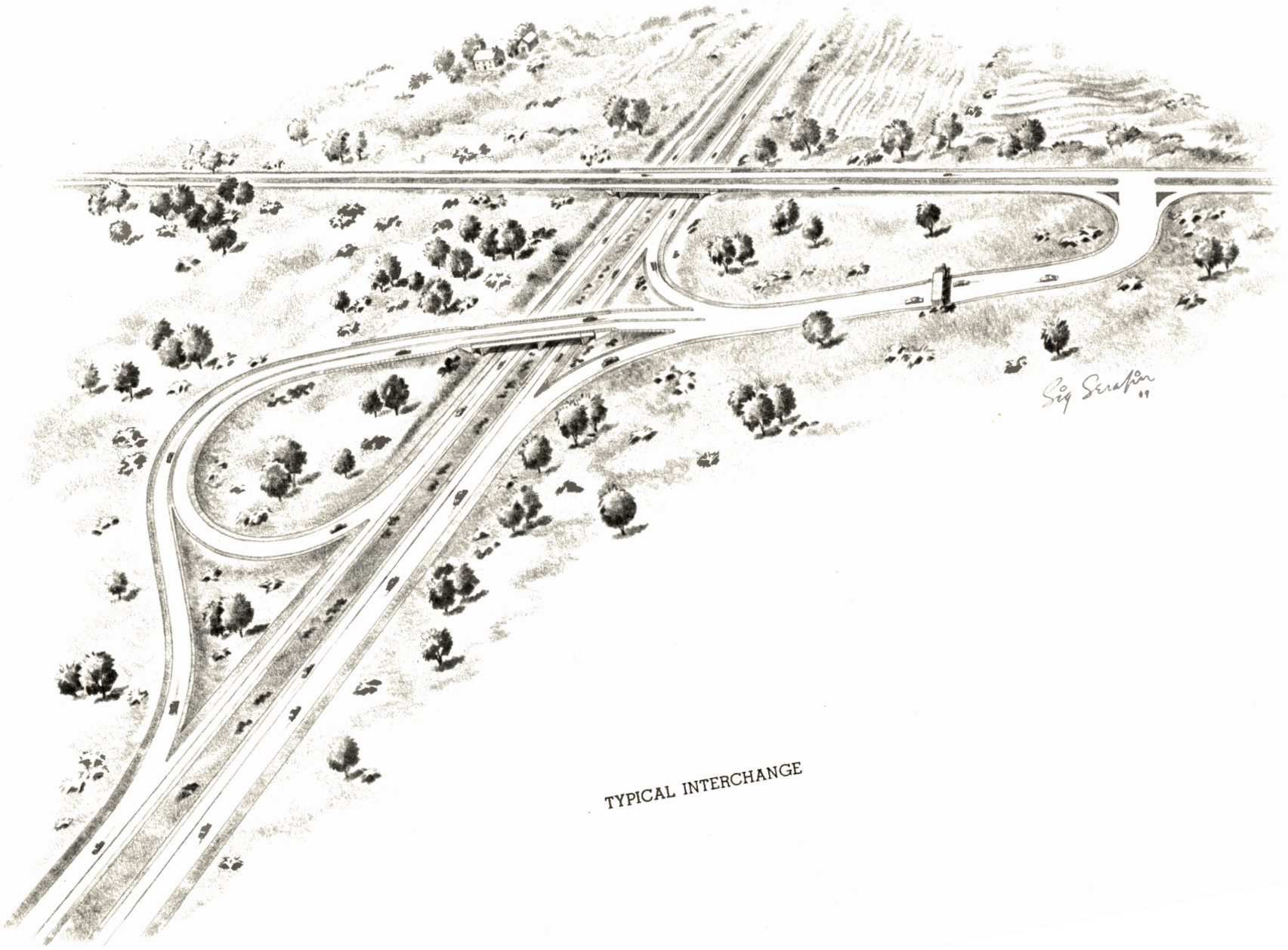
ENGINEERS

CHICAGO ILLINOIS


NEW JERSEY TURNPIKE AUTHORITY
ROUTE MAP OF
NEW JERSEY TURNPIKE
SHOWING LOCATIONS OF TOLL INTERCHANGES
IN RELATION TO MAJOR CITIES
SCALE IN MILES
1 0 1 2 3 4 5
LEGEND
NEW JERSEY TURNPIKE NORTHERN SECTION
NEW JERSEY TURNPIKE SOUTHERN SECTION
MAJOR CITIES
DELAWARE MEMORIAL BRIDGE
DEEPWATER INTERCHANGE
SWEDESBORO INTERCHANGE
SOUTH CAMDEN INTERCHANGE
NORTH CAMDEN INTERCHANGE
MT. HOLLY INTERCHANGE
BORDENTOWN INTERCHANGE
HIGHTSTOWN INTERCHANGE
NEW BRUNSWICK INTERCHANGE
N.J. RT. 4 PKWY. INTERCHANGE
N.J. RT. 35 INTERCHANGE
ELIZABETH INTERCHANGE
PORT ST. INTERCHANGE
RAYMOND BLVD. INTERCHANGE
N.J. RT. 6 INTERCHANGE
N.J. RT. 3 INTERCHANGE
HUDSON CO. BLVD. INTERCHANGE
AVENUE E INTERCHANGE
COMMUNIPAW AVE. INTERCHANGE
COVERED BY SUPPLEMENTAL REPORT
WILMINGTON
CHESTER
NEW CASTLE
PENNS GROVE
PENNSVILLE
SALEM
GLOUCESTER
CAMDEN
HAVERFORD
ARDMORE
ABINGTON
BURLINGTON
BRISTOL
MORRISVILLE
TRENTON
BORDENTOWN
YARDVILLE
PRINCETON
HIGHTSTOWN
MILLTOWN
SOUTH RIVER
NEW BRUNSWICK
HIGHLAND PARK
SOMERVILLE
PLAINFIELD
WESTFIELD
SUMMIT
UNION
LINDEN
WOODBRIDGE
CARTERET
PERTH AMBOY
ORANGE
NUTLEY
RUTHERFORD
HACKENSACK
RIDGEFIELD PARK
NORTH BERGEN
BAYONNE
PATERSON
FREEHOLD
RED BANK
FORT DIX
MT. HOLLY
DELAWARE RIVER
PHILADELPHIA
RARITAN BAY
SANDY HOOK BAY
LOWER NEW YORK BAY
UPPER NEW YORK BAY
HUDSON RIVER
NEW YORK

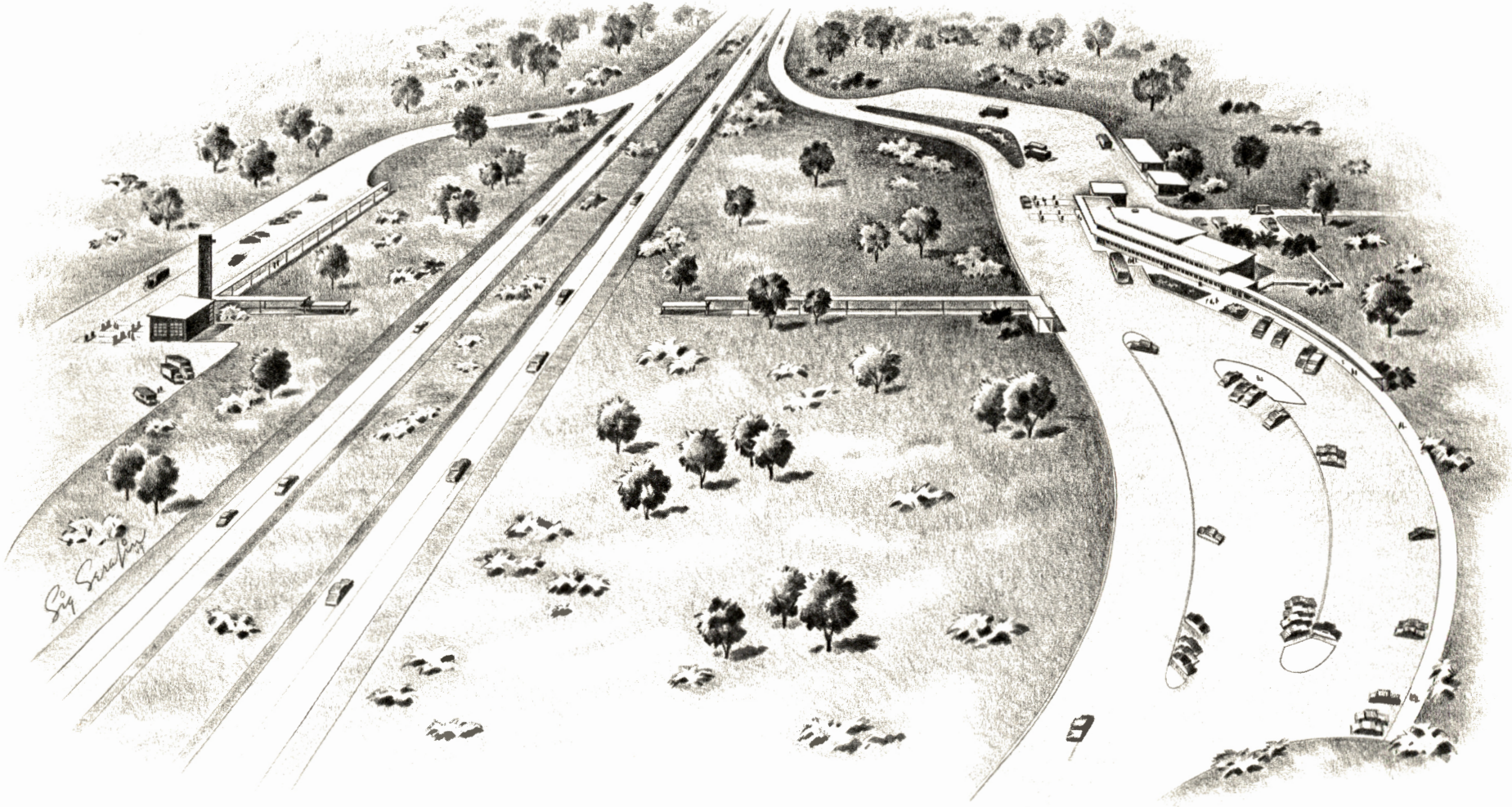


TYPICAL INTERCHANGE

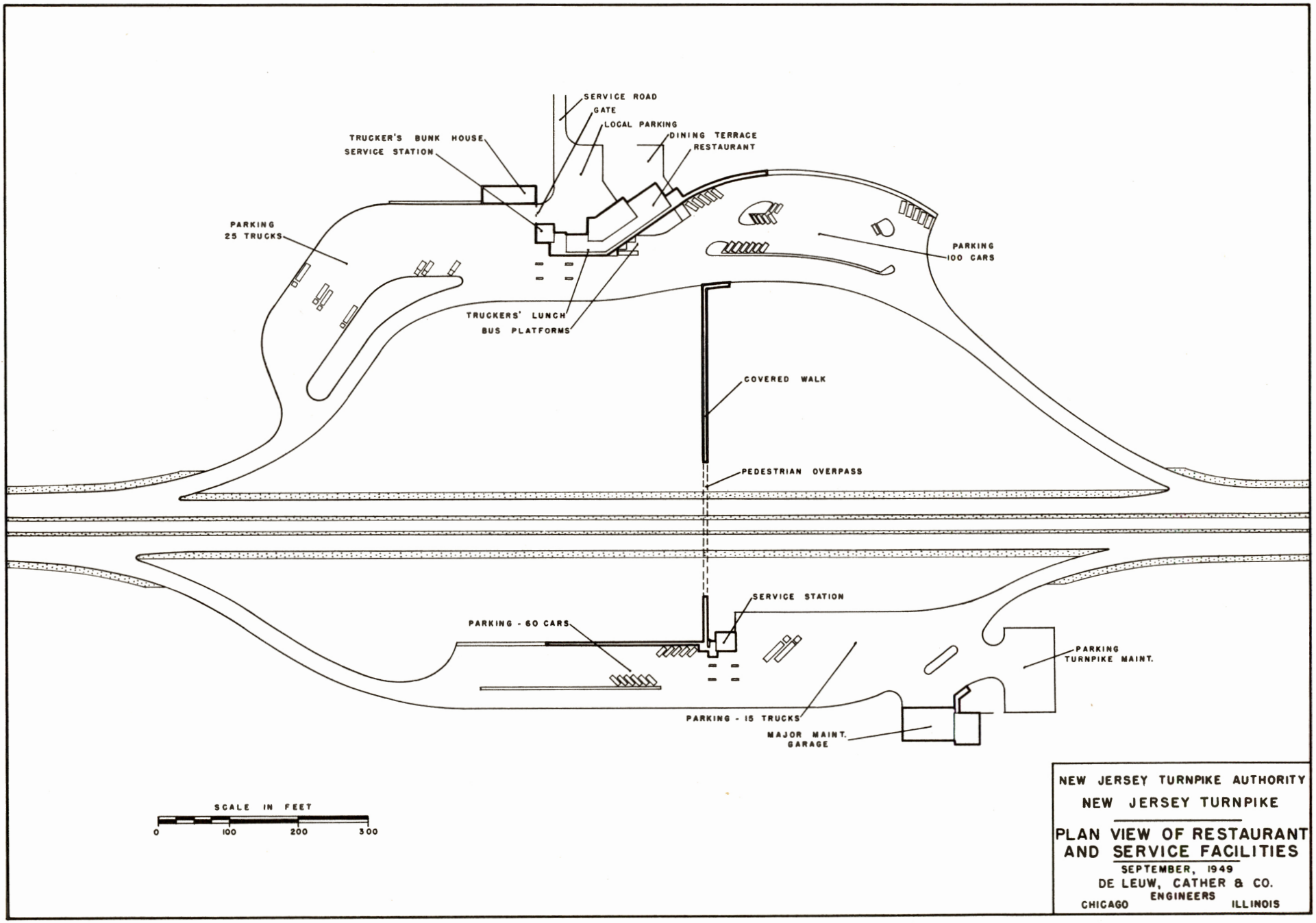


TOLL COLLECTION BOOTHS

PLATE 8



RESTAURANT AND SERVICE STATION AREA



NEW JERSEY TURNPIKE AUTHORITY

NEW JERSEY TURNPIKE

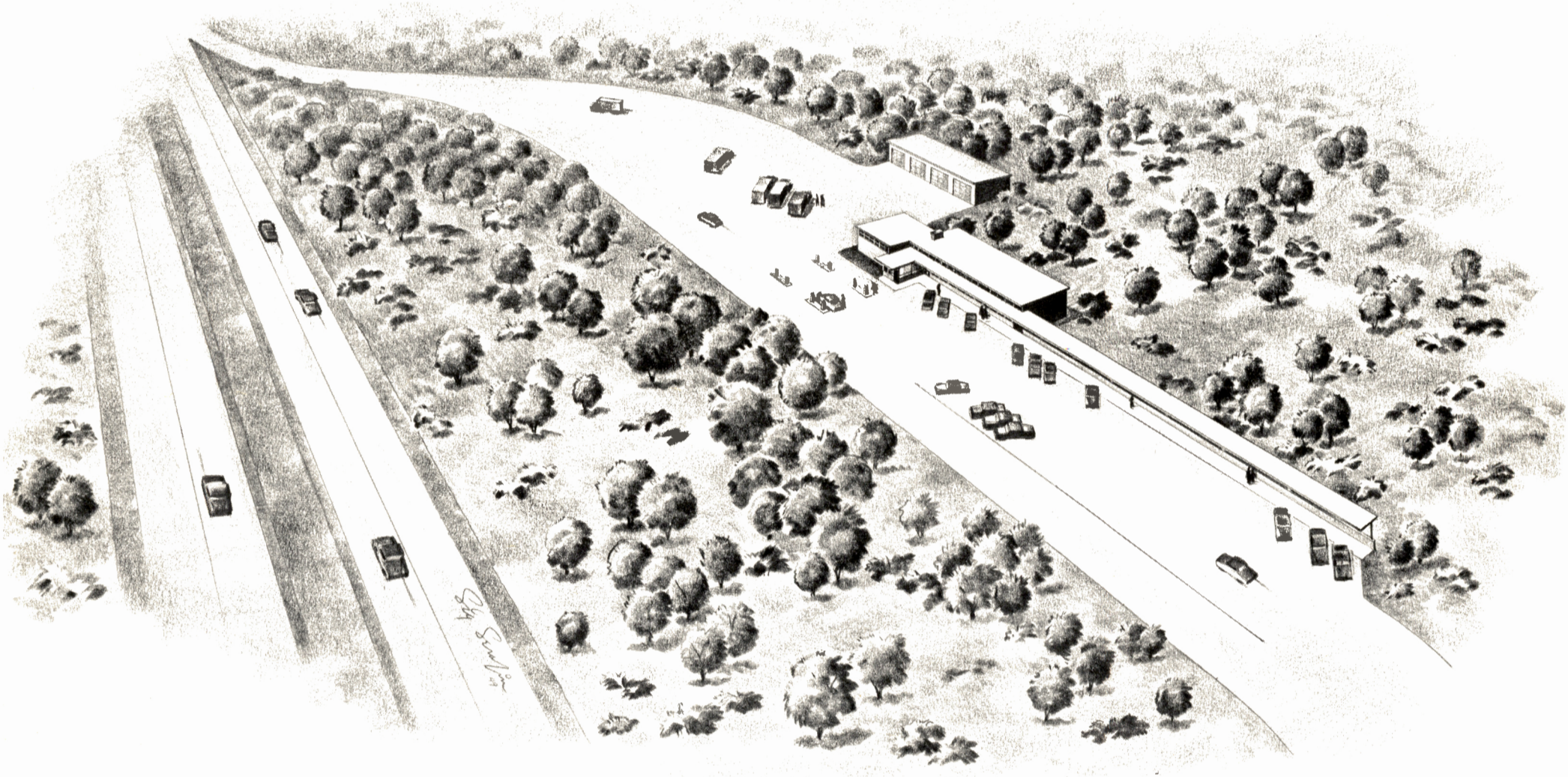
PLAN VIEW OF RESTAURANT AND SERVICE FACILITIES

SEPTEMBER, 1949

DE LEUW, CATHER & CO.
ENGINEERS

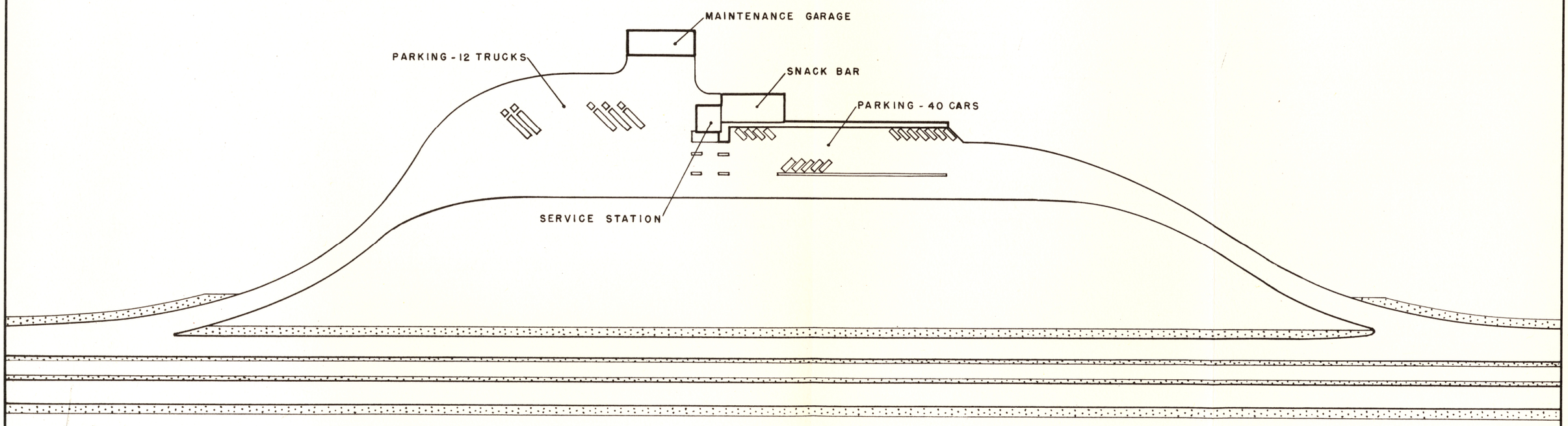
CHICAGO ILLINOIS

PLATE 10



SERVICE STATION AND SNACK BAR AREA

PLATE 11



SCALE IN FEET

0 100 200 300

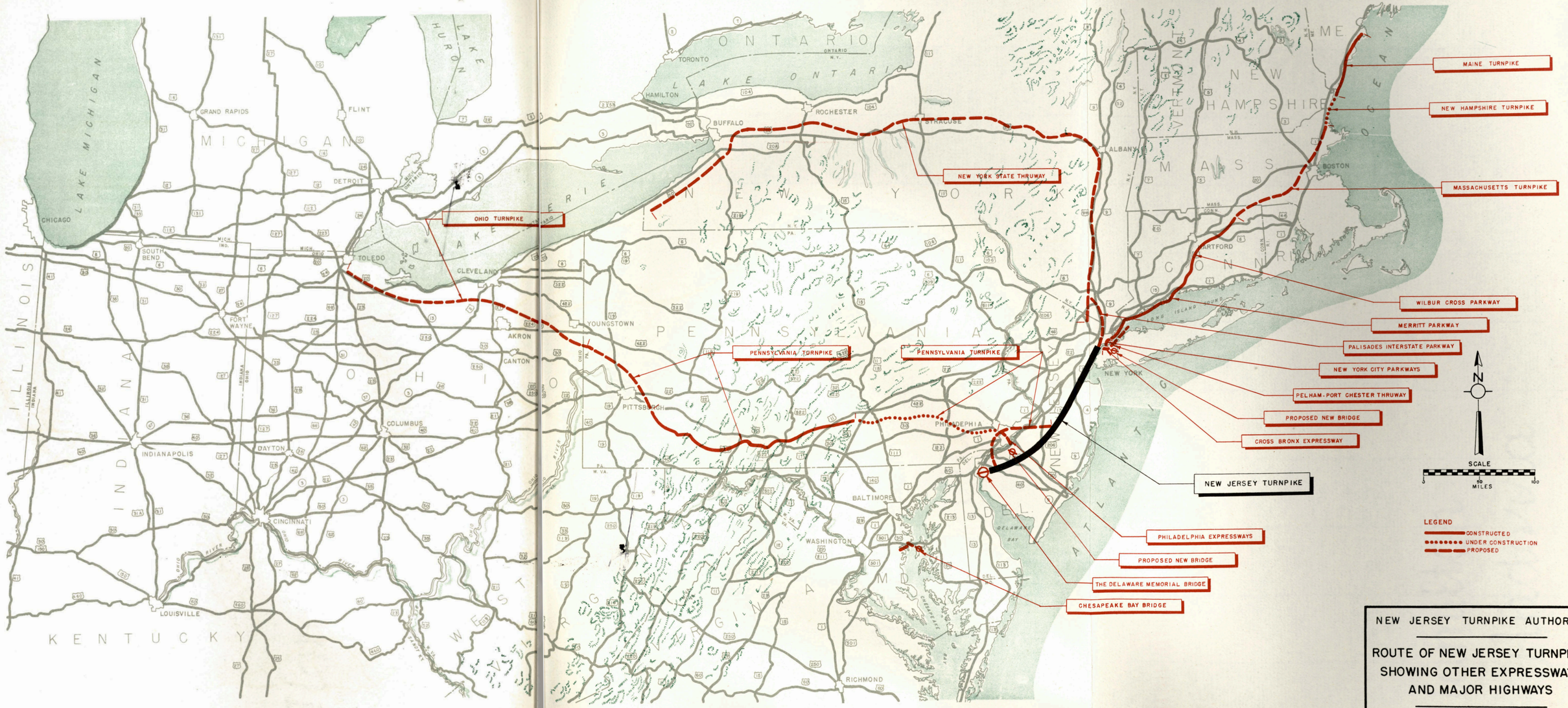
NEW JERSEY TURNPIKE AUTHORITY

NEW JERSEY TURNPIKE

PLAN VIEW OF SERVICE STATION & SNACK BAR

SEPTEMBER, 1949

DE LEUW, CATHER & CO.
ENGINEERS
CHICAGO ILLINOIS

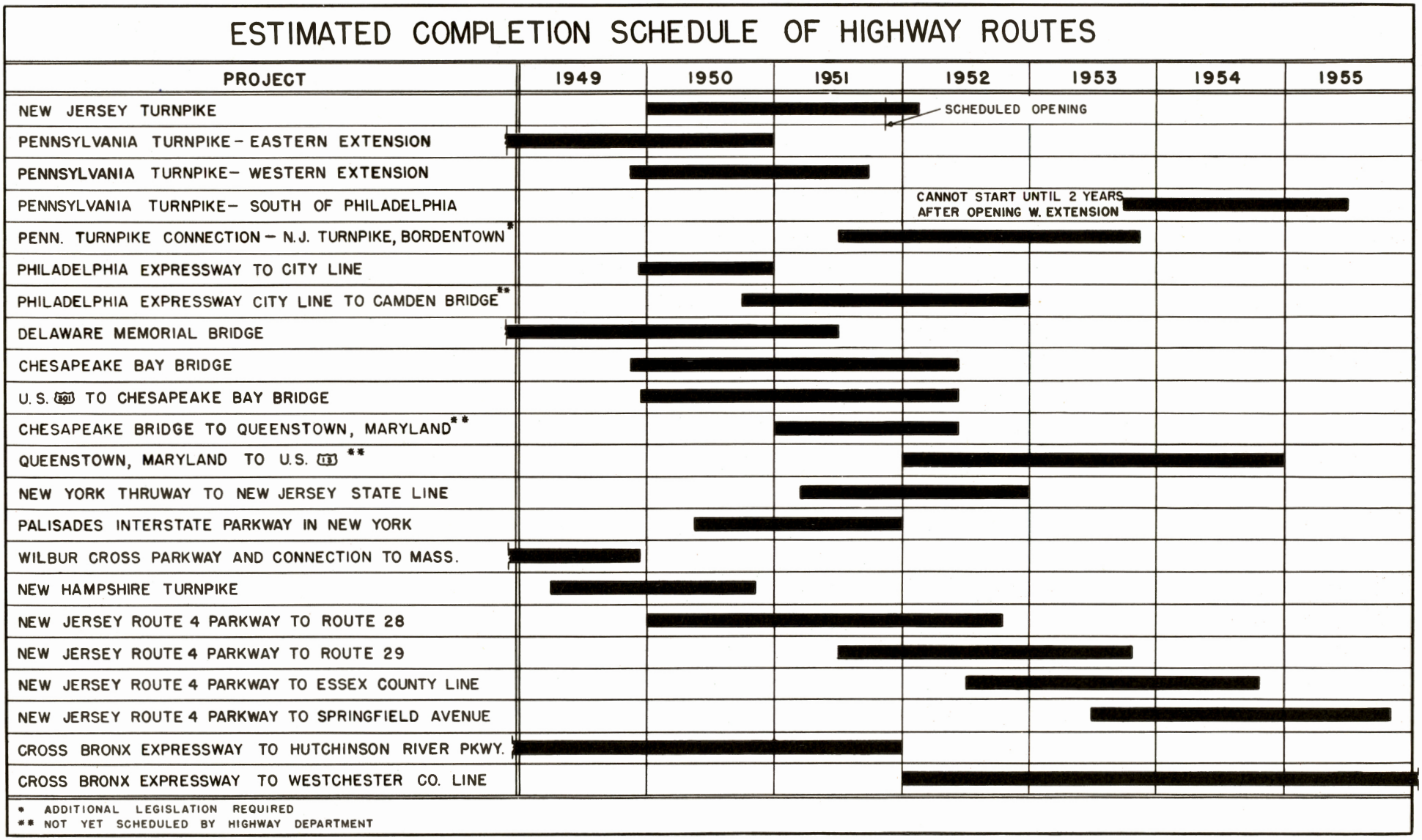


NEW JERSEY TURNPIKE AUTHORITY

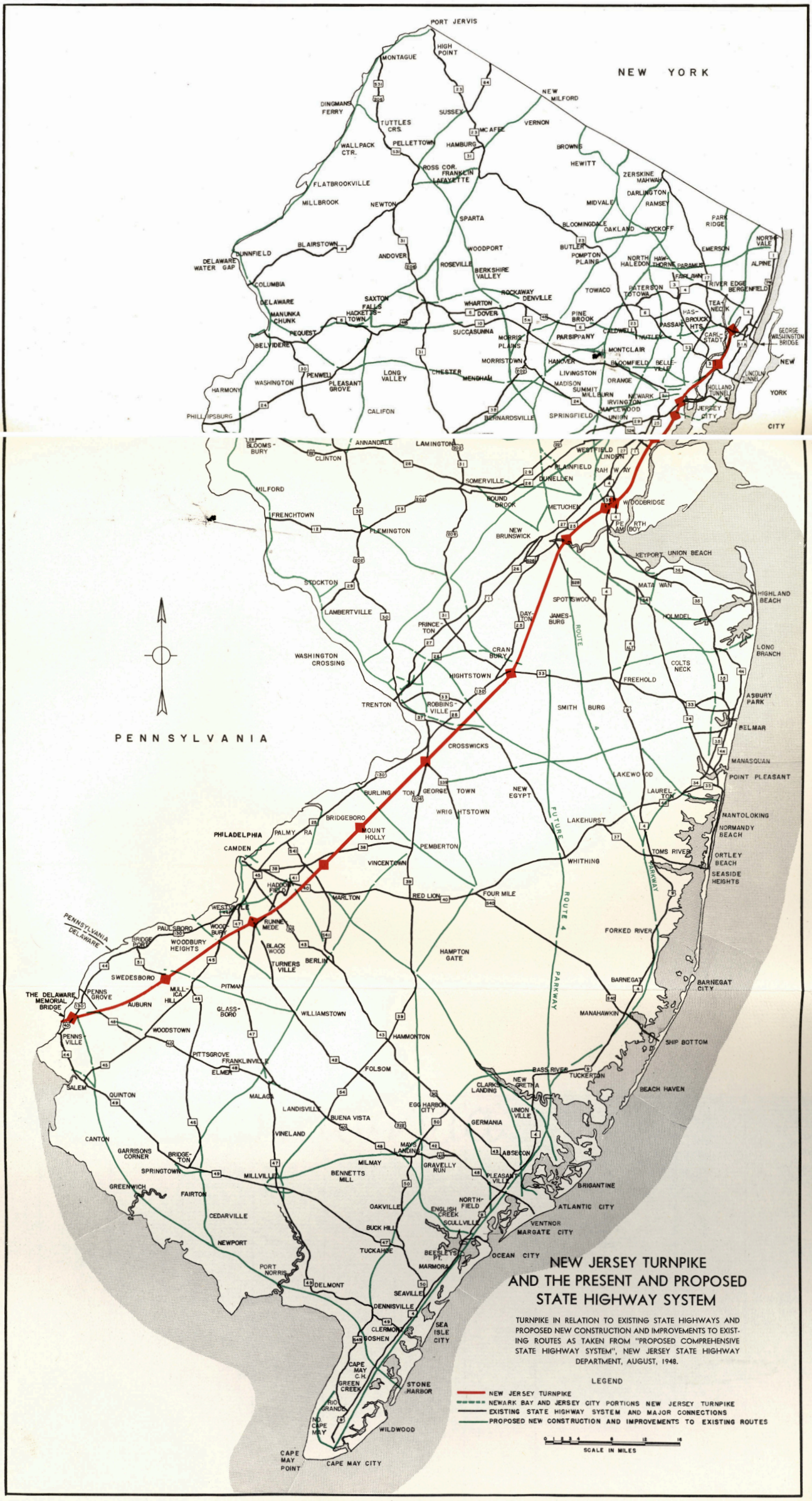
ROUTE OF NEW JERSEY TURNPIKE SHOWING OTHER EXPRESSWAYS AND MAJOR HIGHWAYS

DE LEUW, CATHER & CO.
ENGINEERS
CHICAGO ILLINOIS

ESTIMATED COMPLETION SCHEDULE OF HIGHWAY ROUTES



* ADDITIONAL LEGISLATION REQUIRED
** NOT YET SCHEDULED BY HIGHWAY DEPARTMENT



NEW JERSEY TURNPIKE AND THE PRESENT AND PROPOSED STATE HIGHWAY SYSTEM

TURNPIKE IN RELATION TO EXISTING STATE HIGHWAYS AND PROPOSED NEW CONSTRUCTION AND IMPROVEMENTS TO EXISTING ROUTES AS TAKEN FROM "PROPOSED COMPREHENSIVE STATE HIGHWAY SYSTEM", NEW JERSEY STATE HIGHWAY DEPARTMENT, AUGUST, 1948.

LEGEND

- NEW JERSEY TURNPIKE
- NEWARK BAY AND JERSEY CITY PORTIONS NEW JERSEY TURNPIKE
- EXISTING STATE HIGHWAY SYSTEM AND MAJOR CONNECTIONS
- PROPOSED NEW CONSTRUCTION AND IMPROVEMENTS TO EXISTING ROUTES

SCALE IN MILES

PLATE 15