TRANS-HUDSON RAPID TRANSIT

A Report to the
PROJECT DIRECTOR OF THE
METROPOLITAN RAPID TRANSIT SURVEY

FEBRUARY 1957

CHARLES E. DE LEUW • CONSULTING ENGINEER

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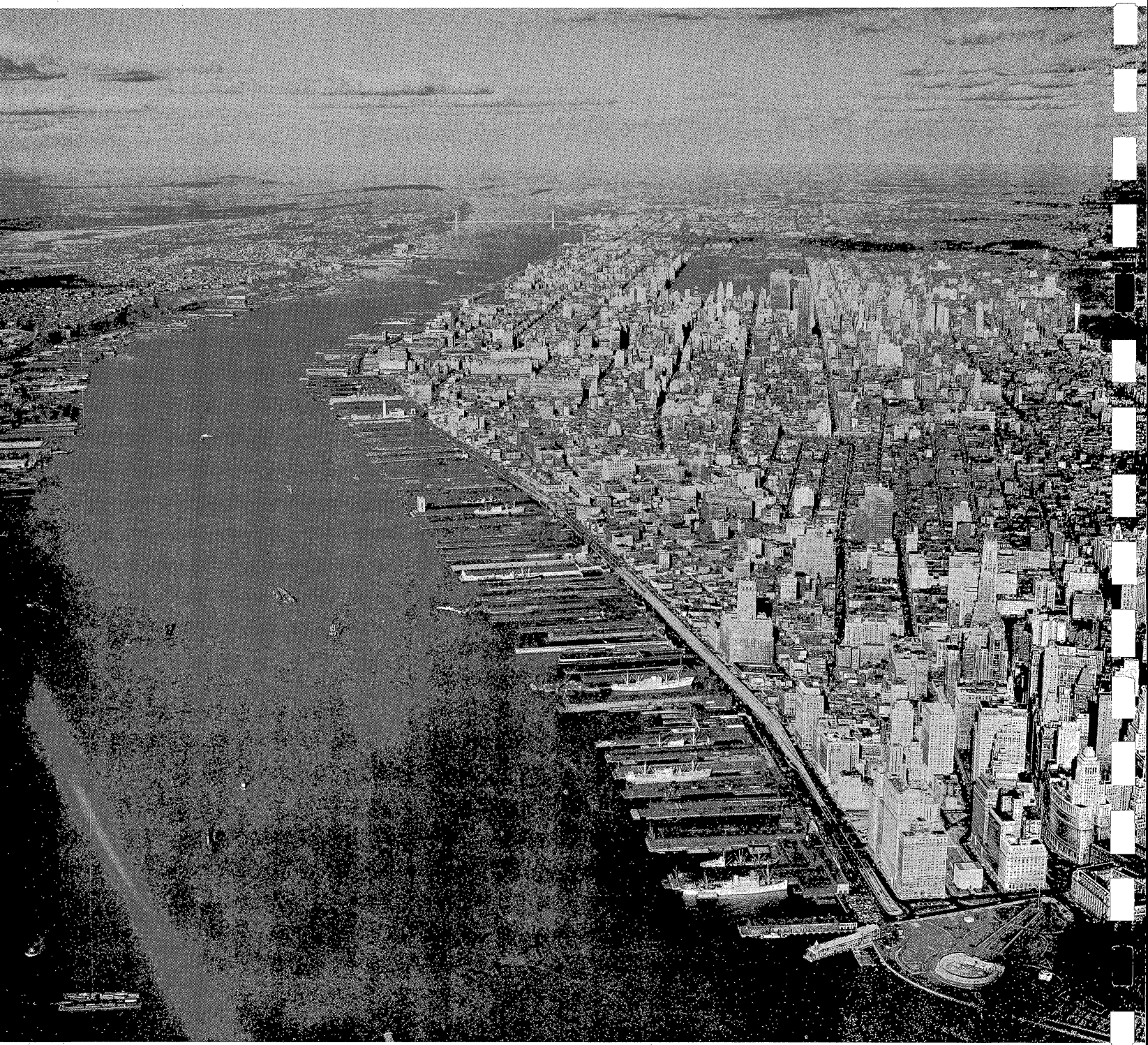

ACKNOWLEDGMENTS

We acknowledge our indebtedness to the many individuals representing both official and quasi-official agencies who gave unstintingly of their time and talents in order that this report could come into being. While it is impossible to list all of these men and women without danger of gross injustice due to omissions, we want each of them to know that they have played an important part in taking constructive steps toward solution of one of the world's most perplexing transportation problems.

Throughout the period of our engagement, we received the full cooperation of members of the staffs of the Metropolitan Rapid Transit Commission, the Metropolitan Rapid Transit Survey and the Port of New York Authority. We called upon the latter in particular for their experience in surveying the movement of people in the metropolitan area as well as for their knowledge of present-day costs of heavy construction.

The many suburban railroads at interest cooperated fully in expediting our surveys of their passengers and in furnishing all requested plans, maps, operating statistics and other records. Officers and staff members made valuable suggestions and offered constructive criticism of schemes reviewed with them.

Members of the New York City Transit Authority and their staff as well as the staff for the Trustee of the Hudson & Manhattan Railroad Company also were most gracious in supplying all requested information. They also discussed at the highest levels the many plans involving coordination with their facilities which were studied during the course of our work.

Finally, the many consulting organizations brought together by the Metropolitan Rapid Transit Commission and the Port of New York Authority for the conduct of this comprehensive study worked with us intimately and with a frank exchange of information which permitted efficient and expeditious performance of our contract. These consultants included Coverdale & Colpitts; Day and Zimmerman; Ford, Bacon & Davis; Dr. William Miller; and the Regional Plan Association.

DE LEUW, CATHER & COMPANY
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February 11, 1957

Mr. Arthur W. Page, Project Director
Metropolitan Rapid Transit Survey
111 Broadway
New York 6, New York

Dear Mr. Page:

Under date of October 25, 1955 we were assigned the task of carrying out certain phases of the project outlined in the Memorandum of Understanding between the Metropolitan Rapid Transit Commission and the Port of New York Authority. We have completed our work and are handing you herewith our report entitled TRANS-HUDSON RAPID TRANSIT.

This report is to be consolidated with the reports of several other consultants covering other sectors of the metropolitan district as well as other phases of the rapid transit problem. A final report will be issued, we understand, by your office. Insofar as this procedure permits, we have come to definitive recommendations on two different plans of providing rapid transit across the Hudson River between New Jersey and Manhattan. The choice between these plans will depend on legal, financial and administrative matters beyond the scope of our studies.

A number of related reports have been submitted to you at various times during the progress of work on our assignment. The principal of these is a report entitled "Basic Data on Commuter Travel Across the Hudson River." This is a compilation of the most important of the underlying data developed from the origin-destination and other surveys of trans-Hudson transit passengers. Sufficient copies of this book have been supplied to permit distribution to all interested public agencies and private transportation companies involved in the problem. Other reports which have been submitted from time to time include one on the rearrangement of facilities of the Central Railroad Company of New Jersey and the Hudson & Manhattan Railroad Company to provide for interchange of passengers between the two at a new transfer station at Communipaw, New Jersey. This plan would permit the cessation of the operation of Jersey Central ferries.

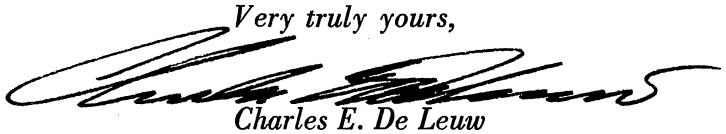
Another report dealt with alternative plans for providing direct rapid transit service to Staten Island via the Bayonne Peninsula. Such a plan would be in lieu of operation of the present Staten Island ferries.

Two other memoranda were filed with you in January. One of these contains data collected through reconnaissance surveys of the several suburban railroad routes in New Jersey. This information was utilized in our consideration of the development of an all-railroad plan. It also served as the basis for approximate figures on improvements in travel time, additional parking stalls and preliminary costs of extensions of direct rapid transit service from Manhattan to the outskirts of the metropolitan area in New Jersey. The second memorandum provided a detailed breakdown of all of the estimates of construction costs which are summarized in this report. These figures, which include unit costs, lengths of the several types of construction and computation of quantities, may be of value when and as engineering studies are undertaken in advance of the preparation of contract plans for the rapid transit project.

The ability of the suburban railroad companies to support indefinitely the deficit operations of trans-Hudson passenger transportation should be a matter of deep concern. Many of these companies have sought and have been granted a measure of relief by regulatory bodies in the matter of curtailment or even abandonment of service. Other actions of this nature are pending and still others are undoubtedly being contemplated by railroad managements. If this trend is allowed to continue, the results would be serious. We believe, therefore, that every thinking person will recognize the urgency of the situation and the need for bold and constructive action.

It has been a sincere pleasure to work with you on this important project. We trust that our efforts, together with those of many others, will lead ultimately under your direction to the fulfillment of the main objective. This goal is to devise an acceptable plan for the provision of adequate transit facilities for the many people in the New York metropolitan area whose activities require frequent trips across the Hudson River.

Very truly yours,



Charles E. De Leuw
Consulting Engineer

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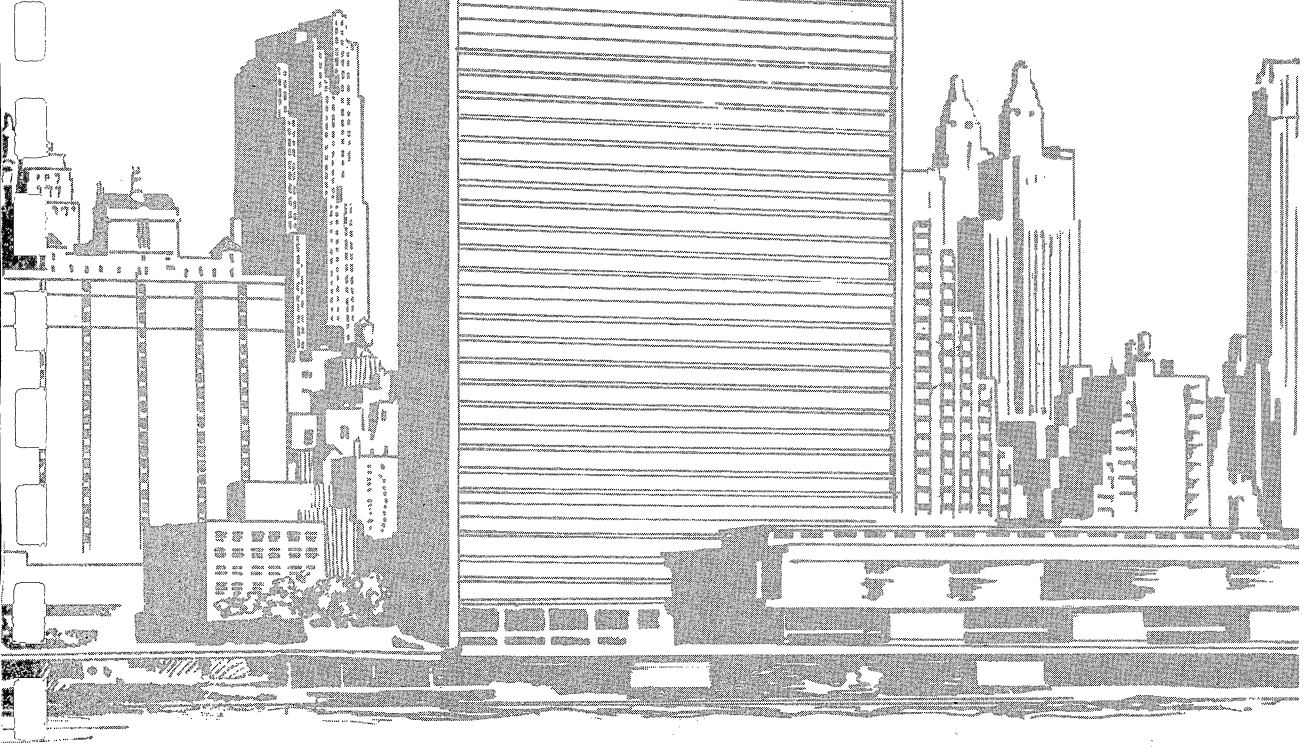
SUMMARY OF REPORT

This report has been occasioned by recognition of the fact that it is in the public interest to study means of providing adequate and attractive transportation for the 220,000 people who now cross the Hudson River in each direction every weekday by public conveyances. Many among the 140,000 crossing each way in private automobiles would also benefit. The report deals principally with the physical facilities that would be required, their estimated cost and the probable financial results of operation. Related problems to be solved by others include those of legislation, finance and administration.

Traffic Volumes and Patterns

In 1930 the number of passengers crossing the Hudson River at New York City by all modes of transportation totaled 262,000,000. A peak was reached in 1946 at 282,000,000. In 1955 the number had decreased only slightly to 279,000,000. Despite this apparent stability in the total, a marked shift from railroads and railroad ferries to buses and private automobiles has occurred. The number of railroad passengers decreased from 171,000,000 in 1930 to 72,000,000 in 1955. Meanwhile, the number via bus in-



creased from less than 9,000,000 in 1930 to more than 67,000,000 in 1955, and the number via automobile increased from 44,000,000 to 136,000,000 during the same period.

Commuter travel is characterized by its extremely high rush hour peaks and its predominant flow in one direction in each rush period. This pattern prevails to an extreme degree on the commuter railroads serving the New Jersey area. Of the total eastbound traffic on the railroad ferries in a 24-hour normal weekday, approximately 77 percent moves in a two-hour period. Further problems were created for the railroads when the five-day week became prevalent and transit riding on week ends all but disappeared.

Basic Studies

Since it was of prime importance that all conclusions be founded on adequate and current information, one of the important parts of the assignment was to gather, summarize and analyze basic data on trans-Hudson travel habits. Studies were made of origins and destinations of transit passengers, their modes of transportation and their opinions as to the elements of a modern transportation system that would be most attractive to them and influential in winning their patronage.

After weighing and interpreting all of the information gathered in these surveys as well as the estimates of population and employment contained in the August 1956 report of the Regional Planning Association, Inc., studies were made to determine the physical feasibility, respective costs and the merits of typical projects in four general classes as follows:

An independent bi-state loop system connecting all or substantially all of the New Jersey railroad commuter lines at appropriate passenger interchange points, with stations in Manhattan south of 59th Street;

Extension of subways of the New York City Transit Authority by means of new Hudson River tunnels, and including appropriate track connections in New Jersey with the various commuter railroads;

A bi-state system of Hudson River tunnels with connecting trackage on both sides of the river of dimensions and operating charac-

teristics suitable for handling standard railroad passenger cars to a destination or destinations in Manhattan without passenger transfer in New Jersey; and

A bi-state grade-separated, high-speed system of the monorail or aerial transit type between the Manhattan and New Jersey sides of the Hudson River.

Engineering Investigations

Preliminary studies indicated that an independent bi-state loop would meet satisfactorily the requirements of a trans-Hudson commuter facility. Further studies were undertaken, therefore, including analyses of engineering and operating problems.

Many alternate plans were considered for use of existing facilities, including both those of the Hudson & Manhattan Railroad and of the New York City Transit Authority. Capacity potentials that could be utilized in connection with other improvements were found and combined into a number of different schemes. Various ones of these were found reasonably feasible and were given further intensive study as to cost, functional adequacy and probable financial results of operation.

Consideration was also given to an independent bi-state loop with direct track connections joining with all the commuter railroads now terminating on the New Jersey side of the Hudson. Trains would operate through new tunnels across the Hudson and in a north-south subway in Manhattan, all of dimensions to accommodate standard railroad equipment. A terminal station for through trains along Third Avenue between 34th and 41st Streets could also be built in connection with such a loop.

A plan was also investigated for a terminal in Manhattan similar to the Pennsylvania Station or the Grand Central Terminal. Such a station would accommodate both the suburban trains and the through trains of all railroads now terminating on the west bank of the Hudson River. Preliminary estimates indicated that such a stub-end terminal would cost in excess of $500,000,000. In the Consultant's opinion, this would be far more than the value of any possible benefits. The railroads would not benefit to a sufficient extent to warrant their sharing any substantial portion of the

cost. The compelling reason for discarding this scheme, however, was that its service to commuters would lack essential elements of convenience.

Preliminary investigations were also made of monorail transit systems and of aerial transit. Both of these types of transit facility were eliminated from further consideration for numerous reasons as set forth in the report.

Plans Studied

The four plans studied in detail were as follows:

PLAN 1

An independent bi-state loop supplemented by modernized Hudson & Manhattan Railroad service to Hudson Terminal;

PLAN 2

Extension of the BMT Broadway subway so as to conform to the pattern of the bi-state loop supplemented by modernized Hudson & Manhattan Railroad service to Hudson Terminal;

PLAN 3

Extension of the BMT Broadway subway: on the north so as to conform with the pattern of Plan 1 to Susquehanna Transfer station with a further extension westerly to a transfer station at the main line of the Erie in Secaucus; and on the south to the Lackawanna Transfer station; supplemented by modernized Hudson & Manhattan Railroad service to Hudson Terminal; and

PLAN 4

Extension of the BMT Broadway subway through a new trans-Hudson tunnel approximately on the line of 60th Street to a transfer station at the main line of the Erie Railroad as in Plan 3. This would be supplemented by the utilization of all of the Hudson & Manhattan Railroad facilities and a new extension to a CNJ Transfer station at Communipaw and an extension easterly to a connection with the local tracks of the IRT Lexington Avenue subway at Brooklyn Bridge station.

Consideration of the relative economics of the several plans should be given great weight in the final determination. A summary of the figures

on total investment as well as revenues and expenses for an assumed base year at 1955 traffic levels on all four plans is shown in the tabulation below:

	Plan 1	Plan 2	Plan 3	Plan 4
Total revenues	$ 22,800,000	$ 18,800,000	$ 18,100,000	$ 18,200,000
Total expenses	8,542,000	7,260,000	7,613,000	9,871,000
Income from operations	$ 14,258,000	$ 11,540,000	$ 10,487,000	$ 8,329,000
Total investment	$474,000,000	$328,000,000	$330,000,000	$246,000,000
Total interest and amortization*	$ 21,672,000	$ 14,889,000	$ 14,929,000	$ 10,940,000
Net income or (deficit)	($7,414,000)	($3,349,000)	($4,442,000)	($2,611,000)

*-Based on four percent interest on entire amount plus amortization over a 50-year period on all items except those requiring replacement within that period. Renewal of the latter is charged as an operating expense.

The details and basic assumptions relative to these figures are developed in Chapters IV and V.

The estimates of income from operations for all four plans have been prepared without any allowance for possible payment to New York City or to the New York City Transit Authority for operating rights or franchises.

It appears that the construction and operation of rapid transit facilities to serve the New Jersey commuters on any plan would require some measure of public support through funds other than those realized from the operation. Accepting this basic fact, the question arises as to whether an inferior plan, such as Plan 4, or a superior but more costly plan, such as Plan 1, should be adopted in view of the comparative benefits described.

Recommended Plan

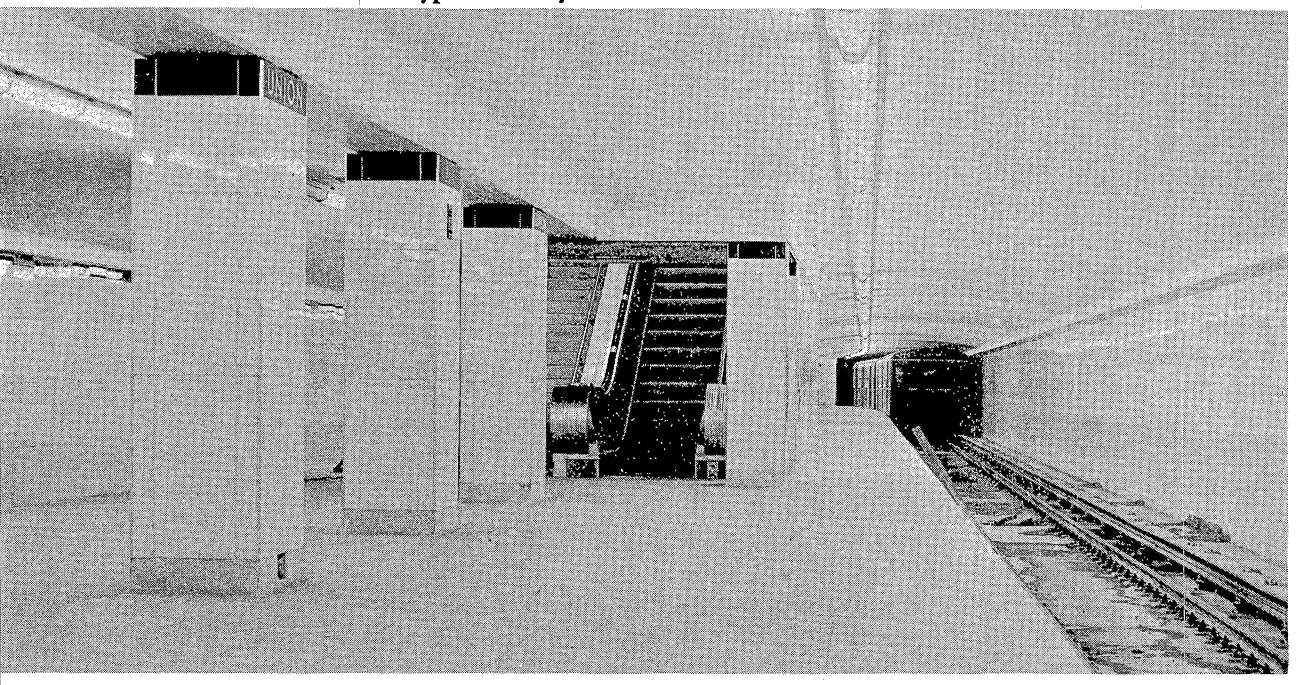
After consideration of all of the facts collected and the analyses made as summarized in Chapters IV, V and VI, we are of the opinion that Plan 1 has so many outstanding advantages that it would have a better chance of acceptance than any other plan. Therefore, we recommend its adoption.

Plan 2 also has merit, however, its principal advantages over Plan 1 being smaller total investment and lower operating deficits. It is our recom-

mendation, therefore, that Plan 2 be considered for adoption in the event that matters of public policy and acceptance by the communities make it the most practicable.

We may eliminate Plan 3 from further consideration in view of the somewhat less attractive service and the slight increases in investment and annual deficit as compared with Plan 2. Plan 4 would offer little improvement over existing service for a large portion of the commuters, offsetting its advantages of lower initial investment and smaller deficits.

Typical Subway Station Platform—Toronto



Development Program

It is assumed that a bi-state public agency would be created for the purpose of developing a logical program to implement these recommendations for trans-Hudson rapid transit. This agency should have powers to plan, finance, construct, operate and maintain (or lease) the required rapid transit facilities. It should also be empowered to enter into contracts with the New York City Transit Authority, any other public transit agency, and the several railroads furnishing suburban passenger service. Such contracts could cover joint operation, track rights, leases, arrangements for transfer facilities, and division of revenues and expenses.

It is estimated that this public transit agency could complete negotiations and enter into operating contracts during the first year of its existence. During this period, it could also carry on engineering, legal and economic studies as required for financing. Progress could also be made concurrently on construction surveys and plans so as to permit the awarding of contracts on the trans-Hudson tunnels as soon as funds became available.

A four-year construction program is envisioned. The tunnels under the Hudson River, the subways in Manhattan, and the rapid transit railroad in New Jersey would require this entire period. During this time, all rolling stock could be acquired and fixed subway equipment could be manufactured and installed.

Ultimate Plan

All plans considered have been developed so as to permit the extension of rapid transit services along the principal radial railroads to the limits of the New Jersey metropolitan area. Perhaps a number of the existing lightly traveled suburban rail lines will eventually be converted to express bus routes operating to the proposed bi-state loop transfer stations.

In view of the great scope and cost of this ultimate development, the Consultant did not prepare specific preliminary operating and physical plans. Reconnaissance surveys were made, however, of the entire railroad suburban network. A preliminary report containing memoranda developed by these reconnaissance surveys and office studies has been filed separately.

For the operator, this ultimate rapid transit program would eliminate the duplication of equipment and crews inherent in any transfer plan. It would provide ideal commuter transportation from the passenger's viewpoint, including such features as marked reductions in travel time and direct service without a transfer from suburban stations to subway stations within easy walking distance of most destinations. The plan would also offer modern air-conditioned equipment.

This magnificent concept of trans-Hudson transportation serving the entire New York-New Jersey suburban area could become a reality during the next generation, provided the initial plan here recommended is considered on the broad lines of immediate and ultimate benefits to the community.



CHAPTER I

THE NEW JERSEY-MANHATTAN TRANSIT PROBLEMS

The economy of the New York-New Jersey metropolitan area depends primarily on the excellent waterways comprising the Port of New York. While these rivers provide handsomely for the movement of ocean-going vessels, they form barriers to the easy flow of wheeled vehicles. The Hudson River in particular impedes the interchange of people between Manhattan, which is the focal point and nerve-center of the entire region, and the areas in New Jersey and portions of New York state west of the river. With better transit service, these latter areas would offer unexcelled residential opportunities for Manhattan workers.

The problem of commuter transportation across the river was met initially by ferry boats. Many are still in operation, in fact, particularly to serve the patrons of the suburban railroads. In 1908 and 1909, however, the Hudson & Manhattan tubes were opened, and these provided the first railroad connection between the two shores. These tubes, which are still in use, serve transit passengers exclusively. The Pennsylvania Railroad tunnels were opened in 1910 to serve both commuter and through passengers.

In 1927 the Holland Tunnel was opened to vehicular traffic. Later the George Washington Bridge (1931) and the Lincoln Tunnel (1937) provided additional facilities for private automobiles, transit buses and commercial vehicles.

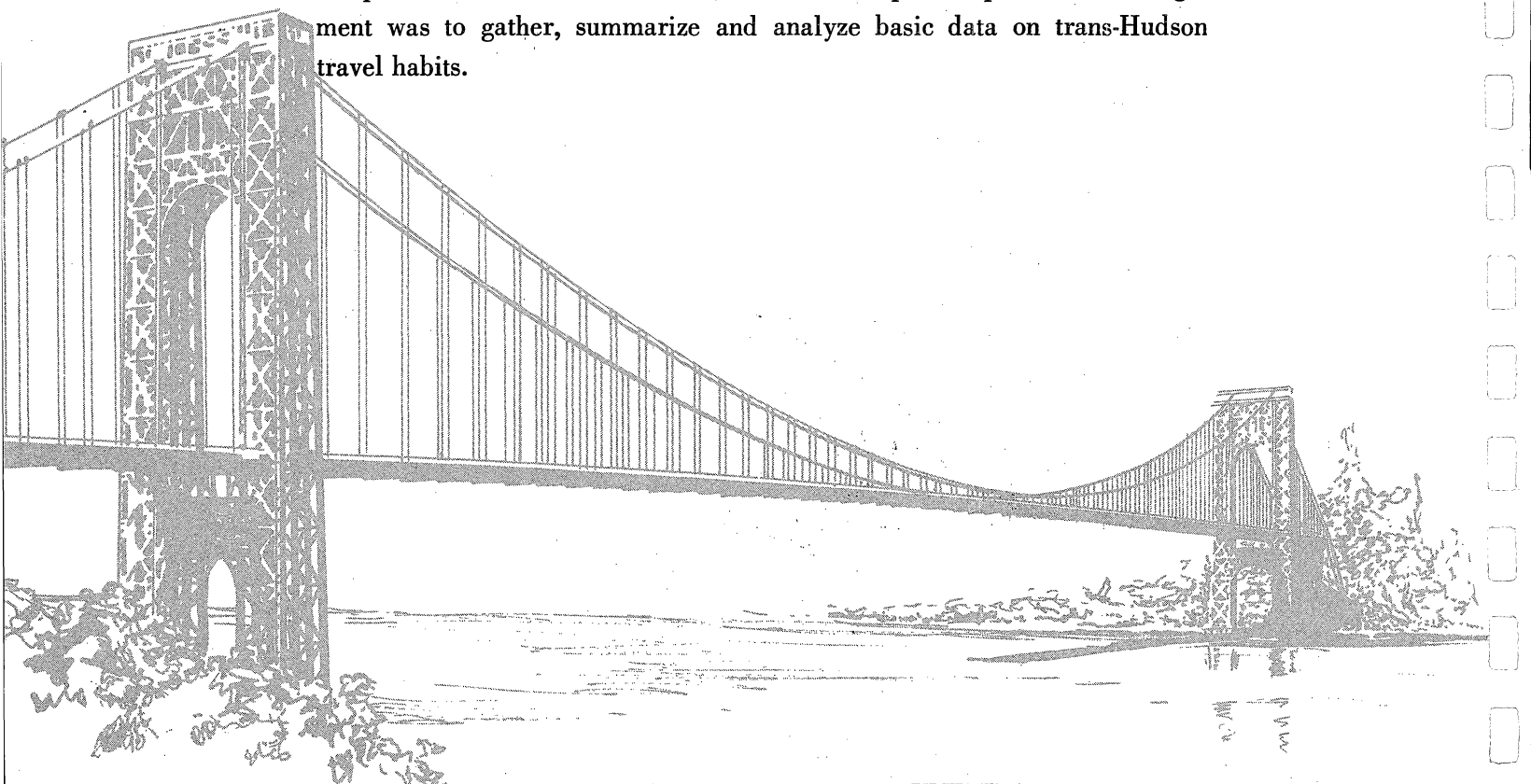
While these new river crossings, all built and operated by the Port of New York Authority, provided vastly superior facilities, they drew seriously from the patronage of the H&M tubes as well as from the ferries and their supporting rail systems. Buses and automobiles through the Lincoln Tunnel, and to a lesser extent across the George Washington Bridge, have especially drawn from the mid-day and weekend flow of people across the river so that the ferries and the railroads have been left most of the unprofitable rush hour traffic, but only a small portion of the flow at other times. This unfavorable pattern has discouraged any capital investment in additional rail transit facilities across the river.

It is becoming increasingly apparent, however, that the problem of trans-Hudson travel will never be solved satisfactorily solely by the provision of additional facilities for road transport. To pursue this policy, it is generally agreed, would be to generate demands for roadway capacity, bus terminals and parking garages on Manhattan which would be prohibitively expensive, if not impossible, to meet.

This study, then, has been occasioned by recognition of the fact that it is in the public interest to study means of providing adequate and attractive transportation for the 220,000 passengers who now cross the Hudson River in each direction every weekday by public transportation. Another 140,000 crossing each way in private automobiles would benefit from the availability of a standby service and one which many would find more advantageous than the use of their own automobiles. The report deals principally with the physical facilities that will be required, their estimated cost and the probable financial results of operation. It remains for others to perform the complementary tasks of solving the equally important problems of legislation, finance and administration.

Compilation of Basic Data

This report forms a part of the most comprehensive study ever made of the rapid transit problem in the New York-New Jersey metropolitan area. Since it was of prime importance that all conclusions be founded on adequate and current information, one of the important parts of the assignment was to gather, summarize and analyze basic data on trans-Hudson travel habits.



This phase of the work included a study of the origins and destinations of passengers traveling across the Hudson River by rail, bus and private automobile. Other studies determined the mode of transportation used by employees between their homes and their working places. Commuters were also questioned as to their opinions on the elements of a modern transportation system that would be most attractive to them as well as influential in winning their patronage. The opinions as thus compiled were compared with actual results of the operation of new transit systems in other metropolitan areas. Finally, the potentials of integration of personal and public transportation were investigated by determining to what extent people in the New York area, as well as in other parts of the country, are using their own automobiles to rail or bus stations and then continuing their trips by public transportation to a major business center.

Numerous field studies of trans-Hudson traffic were made during November and December of 1955. In addition, the results of earlier studies were gathered together and, in some cases, factored to make them comparable with the 1955 survey data. Much of this basic material, together with charts and graphs of the most essential information, will be found in a separate volume entitled *Basic Data on Commuter Travel Across the Hudson River.*

Counts were made of all commuters and others crossing the Hudson River by public carrier for 24 hours on a typical weekday in November and December of 1955. See Tables A-1, A-2 and A-3 in the Appendix. The origins and destinations of trans-Hudson commuters were obtained through postal questionnaire cards. These cards were distributed to the riders on the same days as the above counts.

Journey-to-work questionnaires were distributed to a representative sample of all employees throughout the metropolitan area. The results of this journey-to-work survey provided information pertaining to present modes of transportation as well as conditions that would influence the use of future transit systems.

Recent data were available on the origins and destinations of automobile passengers crossing the Hudson River. This information was gathered originally by the Port of New York Authority during August of 1953. These data were factored from traffic counts to a typical weekday in 1955, and the material was analyzed on the basis of the same geographical units as

used in the 1955 transit survey. See Table A-4. Along with the results of the journey-to-work survey, the automobile origin-destination data were basic in making estimates of diversions to alternate transit systems studied.

The results of numerous counts by the bus operators, railroad companies, the Port of New York Authority and the New York City Transit Authority were used to supplement and verify the results of counts made by the Consultant.

The information gathered in the transit origin-destination survey was recorded on business machine punch-cards and subsequently tabulated in a number of ways. The machine tabulations are described in the data book referred to above. The tabulations themselves have been placed on file with the Project Director of the Metropolitan Rapid Transit Survey.

Interpretation of Data

Certain of the exhibits based on these data make possible easy comprehension of the present pattern of commuter travel. Exhibit 1, for example, shows the 24-hour trans-Hudson transit round trips by sectors west of the Hudson River and by carrier on a typical weekday in 1955. It is readily apparent from this exhibit that the Lincoln Tunnel and the George Washington Bridge have enabled private bus operators to capture a large share of the total traffic in the central and northern portions of the area.

A similar map, Exhibit 2, shows a much larger proportion dependent on rail transportation during the rush hour. Taken together, the two exhibits reveal a picture of the railroads handling the mass movement during rush hours in their large capacity trains, with the buses capturing much of the off-peak business with small and flexible units. While this arrangement favors the passengers and the bus companies, it leaves the railroads with a highly unprofitable load distribution.

Exhibits 3 and 4 show respectively the 24-hour and rush hour trips by districts in Manhattan with an indication of the portion using each carrier. It is readily seen that lower Manhattan plays a major part, considering its size, in generating trans-Hudson transit trips, particularly in rush hours. It will also be seen that buses now serve approximately one-half of the transit riders with origins or destinations north of 34th Street.

These exhibits also show that a relatively minor portion of trans-Hudson transit patrons have origins or destinations north of 59th Street or east of the East River.

The dot maps, Exhibits 5 and 6, show 24-hour and rush hour destinations by zones in Manhattan of trans-Hudson transit patrons. The concentration in lower Manhattan is clearly shown as well as that centering on Fifth Avenue in midtown and uptown.

Exhibit 7 shows by sectors west of the Hudson River the number of motorists using the Holland Tunnel, the Lincoln Tunnel and the George Washington Bridge on a typical weekday in 1955. The data are expanded from a 1953 survey.

The distribution is similar to that of transit patrons and is probably closely proportional to the population of each sector.

The origins and destinations east of the Hudson River of motorists using the three Port of New York Authority facilities are shown by Exhibit 8. It will be seen that the number driving to lower Manhattan is very small, and that the total to all of Manhattan Island south of 59th Street represents only about one-sixth of the total. No bi-state transit system would be attractive to the majority of motorists unless it provided easy transfer to the New York subway system for trips to the boroughs east of the East River as well as to areas north of 59th Street.

The consensus of opinion obtained through the journey-to-work survey has significance in the determination of policy as to the character, type and quality of rapid transit service to be recommended. It is important to know, for instance, that those questioned were much more interested in comfort, convenience and dependability of service than they were in low cost.

Many present motorists replied that they would use a trans-Hudson transit service regularly if it offered sufficient inducements. Others would regard it primarily as a stand-by service, but would use it on occasion.

One of the most statistically interesting results from this survey developed from the answers to the question as to the probable use of parking facilities. About one-quarter said they would use parking space regularly or frequently. The accuracy of this estimate is confirmed by the experience of the Southern Pacific Railroad in connection with its commuter service

in the San Francisco area. Generous parking space is furnished at almost all stations, and the ratio of passengers to parked cars is about four to one.

Those replying to the question in the journey-to-work survey said they would be willing to pay an average of 27 cents per day for convenient parking at outlying railroad stations. There was a surprising uniformity, moreover, in the answers.

THE REGIONAL PLAN ASSOCIATION REPORT

Regional Plan Association, Inc. prepared a special report for the Metropolitan Rapid Transit Survey which was submitted under date of August 1, 1956. This report, entitled *Population, Economic and Land Use Studies of the New Jersey-New York-Connecticut Metropolitan Region,* has been a great help in considering potential changes in population and travel patterns of commuters in the metropolitan area.

Population Growth

The Regional Plan Association report shows that population of the region as a whole is expected to increase approximately one-quarter between 1955 and 1975 from 15,225,000 to 19,100,000. The net increase will be about 3,875,000 of which approximately 2,060,000 or 53 percent will settle in the counties west of the Hudson River, excluding Staten Island. See Appendix A-5.

Labor Force and Employment

The RPA estimates of Labor Force and Employment for 1975 show that, while many of the new jobs and workers in the region will be located in the outer counties of the region, there will probably continue to be a large and increasing demand for commutation. For the New Jersey sector of the region, the estimates show that there were about 260,000 more workers than jobs in 1955. By 1975 there are expected to be 310,000 more workers than jobs. Most of these excess workers are expected to find employment in other parts of the region, principally Manhattan. While this

excess of workers over jobs figure cannot be used to indicate the actual number of commuters there will be in the future, it does indicate that there will continue to be a substantial demand for commutation across the Hudson River and that this demand might increase in the future.

Employment in Manhattan

The magnet for most Jersey commuters historically has been Manhattan below 59th Street. In 1955 about 40 percent of all jobs in the 22-county region were located in Manhattan, and of these about 92 percent were located in the ten square miles of the island below 59th Street. In 1955 about 85 percent of all Jersey commuters were bound for this area.

The RPA report foresees a decrease in employment in Manhattan by 1975, but this area is expected to continue to be the dominant employment center in the region. In this connection the RPA report states "A small though significant employment loss is anticipated in Manhattan. This will be heaviest in manufacturing and those wholesale industries requiring the transportation of bulky raw materials or products. Manhattan's decline should be retarded, however, by steady gains in management and financial activities and related services. Since the latter serve industrial enterprises the world over, their growth should continue for many years into the future. . . . The region is continuing to develop more strongly than ever as the predominant administrative, financial and management center of the nation. Indeed, it is the head office for much of the world's business. . . . Despite the estimated decline in employment in Manhattan, it is likely that commuting to Manhattan, including trans-Hudson commuting, may increase by 1975. This is because there probably will be a considerable increase in Manhattan's relatively high-paying white collar, professional, administrative and executive jobs coupled with a continued tendency of middle and upper income families whose members fill these jobs to move to the environs."

This view is supported by statistics regarding new office building construction since World War II. Since 1947 about 16,000,000 square feet of office space have been added to the large amount of space already existing in Manhattan. With construction now under way and the announced plans of builders, this total should reach 36,000,000 square feet by 1958 and 40,000,000 by 1960. The Real Estate Board estimates that this new space will house about 290,000 employees.

TRANS-HUDSON TRAFFIC

Commuter travel is characterized by its extremely high rush hour peaks and its predominant flow in one direction in each rush period. This pattern prevails to an exceptional degree on the commuter railroads serving the New Jersey area. Of the total eastbound traffic on the railroad ferries in a 24-hour typical weekday, approximately 77 percent moves in a two-hour period between 7:30 A.M. and 9:30 A.M. During this time the reverse direction traffic is about one-fifteenth that in the prevailing direction of flow.

On the Hudson & Manhattan Railroad the imbalance is not quite so marked, the traffic for the heaviest two hours being about 52 percent of the 24-hour total and the rush direction traffic during the maximum period being about four and one-quarter times that in the reverse direction.

The pattern of bus traffic is similar to that on the Hudson & Manhattan. In the rush hours a ratio of traffic in the rush to non-rush direction is about four and one-quarter to one. The tariffs of the bus lines tend to discourage commuter traffic, but the relatively frequent service attracts off-peak patrons.

A heavy flow of automobiles outbound from Manhattan in the morning rush period and inbound in the afternoon has been observed. This would suggest that industrial employment is increasing on the New Jersey side of the river, and that workers are being recruited among people living east of the Hudson. While the reverse direction flow of automobiles through the Lincoln and Holland Tunnels and across the George Washington Bridge is spectacular, the number of people served is comparatively small. The number of automobiles westbound on these three facilities between 7:00 A.M. and 9:00 A.M. on a typical weekday in 1956 amounted to approximately 11,400. At a rate of 1.8 persons per automobile, this would indicate approximately 20,500 people moving westbound across the Hudson River during this period. Assuming that one-half of these people are daily commuters, and further assuming that one-half of this number could be diverted from their automobiles to an attractive rapid transit service, only 5,000 additional people would require transit service during this two-hour period. This is less than five percent of the number of people crossing the Hudson River in an eastbound direction in the two-hour morning rush period.

In 1930 the number of people crossing the Hudson River at New York City by all modes of transportation totaled some 262,000,000. By 1955 this

figure had increased to only 279,000,000, or at an average rate of increase of less than three-tenths of one percent per year on the 1930 base. As a matter of fact, the trend has been slightly downward since 1946, the first full post-war year, when approximately 282,000,000 people crossed the Hudson River at New York City. See Table 1.

While facilities to provide public transportation by railroad ferry and by the Hudson & Manhattan Railroad have been gradually deteriorating since 1930, there have been vast new facilities to serve buses and private automobiles. Despite the rapidly growing population in the New Jersey segment of the metropolitan area, the principal effect of these new facilities has been to cause a shift from railroads and railroad-ferries to buses and private automobiles. The number of railroad passengers, including those crossing the river at New York City by railroad bus (the latter largely through passengers), decreased from 171,000,000 in 1930 to 72,000,000 in 1955. Meanwhile, the number via independent bus was increasing from less than 9,000,000 in 1930 to more than 67,000,000 in 1955, and the number via automobile was increasing from 44,000,000 to 136,000,000 during the same period.



Table I

ANNUAL TRANS-HUDSON PASSENGER TRAFFIC INTO AND OUT OF NEW YORK CITY—1930-1955

Year	Railroad Passengers			Bus Excluding Railroad Bus	Passengers Via Auto	Pedestrians Via Ferry	Total Trans-Hudson Passengers	Total Bus Passengers
	Via Ferry	Via Tunnels	Via Bus	Total Rail	Add 000			
1930	55,197	114,987	477	170,661	8,745	43,747	38,611	261,764	9,222
1931	50,156	103,329	441	153,926	9,552	48,382	35,602	247,462	9,993
1932	45,764	88,977	366	135,107	10,358	52,512	29,696	227,673	10,724
1933	40,860	80,326	320	121,506	13,754	51,403	26,882	213,545	14,074
1934	38,782	81,876	332	120,990	15,203	52,613	27,021	215,827	15,535
1935	37,376	82,019	344	119,739	16,970	54,900	26,436	218,045	17,314
1936	37,628	86,606	395	124,629	18,958	56,817	26,841	227,245	19,353
1937	38,019	88,111	428	126,558	19,602	62,776	27,748	236,684	20,030
1938	38,493	78,147	377	117,017	20,645	64,498	26,945	229,105	21,022
1939	38,452	77,777	526	116,755	26,317	69,144	25,995	238,211	26,843
1940	36,222	77,918	785	114,925	31,884	71,073	22,045	239,927	32,669
1941	35,180	80,216	1,158	116,554	33,538	76,343	21,150	247,585	34,696
1942	35,398	95,985	1,529	132,912	45,699	55,641	17,997	252,249	47,228
1943	34,802	115,677	1,778	152,257	55,698	41,602	14,392	263,949	57,476
1944	32,102	114,470	1,870	148,442	57,989	51,485	13,016	270,932	59,859
1945	30,345	109,057	1,943	141,345	55,845	57,419	12,054	266,663	57,788
1946	32,310	97,589	1,915	131,814	60,313	75,987	13,483	281,597	62,228
1947	28,800	93,784	1,788	124,372	60,158	75,210	9,633	269,373	61,946
1948	26,401	89,390	1,742	117,533	60,061	78,466	8,313	264,373	61,803
1949	25,813	81,102	1,573	108,488	61,541	88,973	6,872	265,874	63,114
1950	25,188	71,419	1,421	98,028	62,078	99,325	6,399	265,830	63,499
1951	23,130	68,418	1,302	92,850	65,214	111,479	4,054	273,597	66,516
1952	22,212	61,010	1,288	84,510	68,025	124,325	3,656	280,516	69,313
1953	21,025	56,770	1,267	79,062	67,106	129,998	3,247	279,413	68,373
1954	18,529	54,373	1,212	74,114	67,485	135,327	2,763	279,689	68,697
1955	17,132	54,130	1,206	72,468	67,332	136,477	2,288	278,565	68,538

The Port of New York Authority
Port Development Department
Planning Division

Problems Caused by Shrinking Commuter Traffic

In the case of the Hudson & Manhattan Railroad Company, the decrease in passenger traffic and revenues has been particularly severe. The peak traffic, attained in 1927, totaled 113,142,000 rides annually. The traffic leveled off in 1954 and 1955 with approximately 37,300,000 rides in each of those years.

Most of the railroads furnishing suburban service have experienced decreases in passenger traffic since the year 1927 generally similar to those experienced by the Hudson & Manhattan Railroad. The adoption of the five-day week, the constantly increasing use of passenger automobiles and buses by commuters, and the concentration of most of the total daily traffic into two rush periods have produced serious financial problems for the carriers. Virtually all of the railroads have attempted to reduce their operating losses through curtailments in service. Most of them have reduced the number of trains and have attempted in one way or another to abandon services. The DL&W, for instance, has been trying to close its Boonton Branch since the year 1949. The New York, Susquehanna & Western Railroad has made application for authority to reduce service. The Erie Railroad has requested approval for abandonment of its ferry service and consolidation of most of its terminal operations with the DL&W. The New York Central has recently received qualified approval for ceasing the ferry service now operated on its West Shore Route. Final action on this matter, however, has been deferred.

Appendix B describes the existing suburban railroad facilities and services in the New Jersey segment of the metropolitan area.

Exhibit 9, a folded map in the back of the report, shows the general region covered in this report.

After weighing and interpreting all of the information gathered from the commuters themselves, studies were conducted under the terms of the contract to determine the physical feasibility of various alternate systems of trans-Hudson rail facilities, their respective costs, and the advantages and disadvantages of each.

CHAPTER II

FEASIBILITY STUDIES

The Memorandum of Understanding required the Consultant to study a typical project in each of several general classifications defined as to area served, physical charactertistics, general alignment, number of tracks, terminal facilities, proposed frequency of service, and rolling stock and other equipment required. Each plan was then to be considered and analyzed as to physical feasibility, potential service to meet commuter needs, and administrative practicality. Those plans meeting all of these various tests were to be fully evaluated from the engineering and economic standpoints.

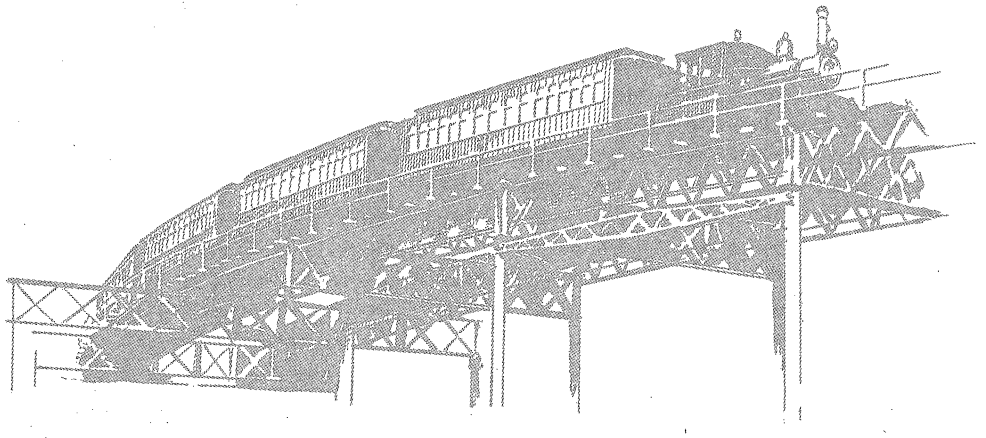
The general classes for which typical projects were chosen for preliminary evaluation in our assignment included the following:

An independent bi-state loop system connecting all or substantially all of the New Jersey railroad commuter lines at appropriate passenger interchange points, with stations in Manhattan south of 59th Street;

Extension of subways of the New York City Transit Authority by means of new Hudson River tunnels, and including appropriate track connections in New Jersey with the various commuter railroads;

A bi-state system of Hudson River tunnels with connecting trackage on both sides of the river of dimensions and operating characteristics suitable for handling standard railroad passenger cars to a destination or destinations in Manhattan without passenger transfer in New Jersey; and

A bi-state grade separated, high-speed system of the monorail or aerial transit type between the Manhattan and New Jersey sides of the Hudson River.



INDEPENDENT BI-STATE LOOP

The term independent bi-state loop has been used to describe a two-track rapid transit facility complete within itself and using no portion of the existing subway system in New York. Several alternate routes were considered, the principal differences being in the location of the north-south leg in Manhattan. All of the routes studied were approximately 18 miles in length with two double-track crossings of the Hudson River, one in the vicinity of 60th Street and the other near the tip of Manhattan Island. Alternate alignments in midtown Manhattan included portions of Third, Fifth and Madison Avenues. Distribution in Manhattan would be by way of appropriate stations, many of which would connect with existing subway stations. See Exhibit 10.

Studies in New Jersey covered routes both east and west of the Palisades. A location east of the Palisades would reduce the distance traveled by some commuters, but operating speeds would be slowed by steep grades and sharp curves. The public would be better served by the recommended alignment, however, the adverse distance being offset by the higher average speed attainable.

Auto and bus traffic in the northern part of New Jersey will continue to grow in importance. Consideration was also given, therefore, to the relative merits of the two alignments as regards opportunities to provide convenient transfer facilities. Potential passengers must be offered adequate bus-to-rail and auto-to-rail transfer stations. The proposed Susquehanna Transfer and West Shore Transfer stations on the recommended alignment could not be duplicated east of the Palisades. A transfer station in the vicinity of the present Weehawken station, furthermore, would involve considerable difference in elevation between the present tracks and those of the proposed bi-state loop.

In addition to the superior service facilities which could be built into the loop west of the Palisades, our preliminary investigations indicated that the total construction cost of a rapid transit facility on an alignment east of the Palisades and north of Jersey City would be higher than on the alignment selected. A rapid transit facility east of the Palisades adjoining the tracks of the New Jersey Junction Railroad would be quite easy to build immediately south of Weehawken. North of Weehawken,

however, there is a densly developed area. The access highways to the Lincoln Tunnel as well as the New York Central yard would require relocation of important freight tracks or possibly extensive tunnel work. Upon reaching the point opposite 60th Street at which the alignment would have to veer easterly towards Manhattan, the cliffs of the Palisades are close to the river. A spiral curve would be required, therefore, to reach the necessary depth below the Hudson River.

There is a possibility of reducing construction costs on the recommended alignment by using the NYC tunnels through the Palisades, rerouting freight service to the tracks of the New York, Susquehanna & Western Railroad. Your Consultant had encouraging conferences with officials of the New York Central System on this subject. The present status of this plan, however, did not justify our excluding the cost of a new tunnel through the Palisades from our estimates of cost.

Description of the Route

A detailed description of one route will indicate the general nature of each of the others. The recommended route for an independent bi-state loop would start in Battery Place near the tip of Manhattan Island. It would then proceed northeasterly and northerly under Bowling Green, private property, Beaver Street, and Hanover Square to a downtown station in Pearl Street extending from Wall Street to Maiden Lane. The route would then continue northerly along Pearl Street and Baxter Street to Canal Street; thence along a reverse curve under private property to Broome Street (at Centre Street); thence west along Broome Street to West Broadway; thence north along West Broadway through Washington Square Park and north along Fifth Avenue to Madison Square Park; thence north along Madison Avenue to 61st Street and under private property to 63rd Street and Fifth Avenue; thence westerly through Central Park to 60th Street and Central Park West; thence west along 60th Street to a new two-track tunnel under the Hudson River.

Stations on the Manhattan portion of the bi-state loop would be located at Bowling Green, Wall Street, Houston Street; at 14th, 23rd, 34th, 42nd, 52nd and 59th Streets; and at Columbus Circle. Platforms 600 in length would be provided with mezzanines at Bowling Green, Wall Street, Houston

Street, 23rd Street, 42nd Street and Columbus Circle. Side platforms would be provided at the other stations conforming generally with those at local stations on the New York subways.

The 60th Street tunnel under the Hudson River would reach the New Jersey shore in the vicinity of the present New York Central ferry terminal. The route of the new facility would then pass through the Palisades in a tunnel paralleling and south of the existing New York Central tunnel. The transfer station to serve the West Shore Railroad would be located west of the Palisades in the vicinity of Tonnele Avenue.

The route would then swing to the south, with grade separations at all existing highways and railroads, along an alignment west of the existing railroad right-of-way. Coach yards as well as shop, terminal and office facilities would be provided just south of the curve in the presently unoccupied area west of the Susquehanna Railroad right-of-way and north of Paterson Plank Road. At the point of crossing the Pennsylvania Railroad tracks, the Susquehanna Transfer station would be built to serve passengers to and from the Erie (Northern Division), the Erie main line and the Susquehanna. This station would be designed to accommodate the Pennsylvania Railroad passengers if such facilities were required in the future. Erie main line trains would reach this station by means of new trackage from a point on the Erie main line just east of the Hackensack River, a distance of approximately three miles.

The Susquehanna Transfer station would also serve motorists using large parking fields nearby as well as passengers transferring from buses. The latter would be routed to the terminal via New Jersey Route 3 or U.S. 1 (also New Jersey Route 1) as well as via the New Jersey Turnpike.

Coach yards would be provided in the meadows just south of Susquehanna Transfer and west of the Susquehanna railroad tracks for the day storage of suburban railroad trains.

The route would continue southerly along private right-of-way to a point about two blocks east of Tonnele Avenue and two blocks north of Manhattan Avenue, at which point it would swing to the east and enter a tunnel under the Palisades. This tunnel would terminate at the east face of the Palisades at the right-of-way of the New York Central system about 1,500 feet north of the existing DL&W tunnels.

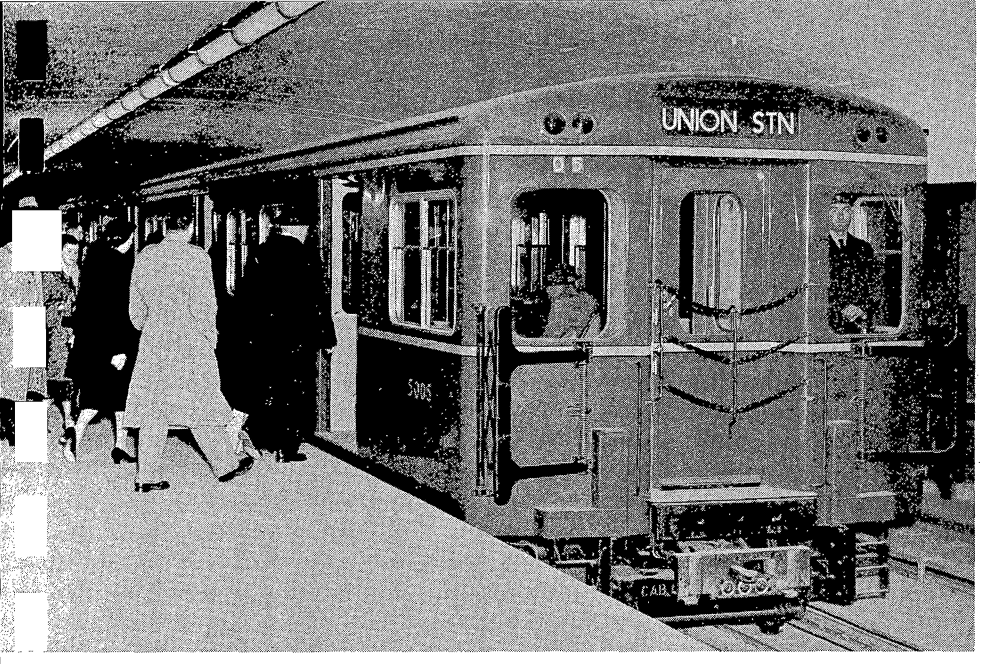
Efforts were made to save the cost of this new two-track tunnel by using the two southerly tracks of the four-track Erie route through the Palisades farther south. These two Erie tracks could be made available for this purpose because of the recent rearrangement and consolidation of terminal operations between the Erie and the DL&W. No feasible plan could be devised, however, which would provide the same high quality of passenger comfort and convenience as would the new and separate facilities described herein.

A transfer station could be built on the west face of the Palisades at the westerly end of the four-track Erie tunnel. The cost of over-passing existing railroad yards and displacing established commercial developments, however, is considered to be excessive for the value of such a location. More important, a station at this point would have to depend on heavily congested Tonnele Avenue for access by bus and automobile. The station would be just north of Tonnele Circle, which is an access point for Pulaski Skyway and one of the most thoroughly congested intersections in the street and highway network serving the New Jersey metropolitan area.

Furthermore, such a station would be on the western edge of the populated area whereas the recommended station east of the Palisades would be centrally located in respect to a potential feeder bus network serving Hoboken, Union City and other nearby communities.

After emerging from the Palisades tunnel, the route of the bi-state loop would swing to the south to a transfer station with the DL&W at the point of intersection. This station would also accommodate trains of the Erie's Greenwood Lake and Newark branches. Any or all of the trains of both railroads could continue on to the present DL&W terminal at Hoboken, thus providing service to this city from the west as well as affording passengers an opportunity to transfer to the Hoboken branch of the H&M. It is proposed to continue operating the latter to provide direct service to the Hudson Terminal in Manhattan.

The route of the bi-state loop would then continue south and southeasterly. At the intersection with the Pennsylvania Railroad tracks, which carry H&M trains at this point, a station would accommodate passengers transferring to and from the latter. The bi-state loop would continue southeasterly and easterly with a transfer station for accommodation of passengers to and from the Central Railroad of New Jersey 4,000 feet west of the



Toronto Subway Car

present Jersey Central terminal. The west portal of the trans-Hudson tunnel would be 2,000 feet east of the transfer station, and the tunnel would extend under the river to Battery Place which is the point of beginning.

All of the transfer stations along this route would be designed to provide maximum convenience for passengers. Cross-platform transfer would be available in some instances, although in all cases it would be necessary for passengers to go through turnstiles, if, as is presumed, an additional fare would be collected for the trip on the bi-state loop. Where cross-platform transfer could not be provided, escalators would be installed where the climb exceeded 15 feet.

Comparison of Routes

Present legislation forbids the use of Fifth Avenue for a rapid transit subway. It is presumed for the purposes of this report, however, that such legislation could be amended if justification were shown. From the viewpoint of convenient delivery for commuters to existing office buildings in the midtown section, the route on West Broadway-Fifth Avenue-Madison Avenue would be superior to any other reasonably available location.

An analysis of the origin-destination survey data indicates that approximately 30 percent more of the potential riders would be within a 10-minute walk of a station on the Madison-Fifth Avenue alignment than on the Third Avenue alignment.

The Third Avenue route would be superior to the other from the viewpoint of alignment and operation. It would lie somewhat to the east of the

present intensive development in the midtown and uptown sections, however. On the other hand, there is indication of an extensive new office building development in the immediate area which would be served by a route on Third Avenue. While this route would be acceptable, we suggest the Madison Avenue route be considered as the preferred location.

Advantages

An independent bi-state loop would have many advantages, one or more of which would be attainable in other schemes discussed herein, but which would be more fully realized with a facility segregated from all other operations. In this group, an independent bi-state loop would:

1. Provide two additional crossings of the Hudson River for rapid transit operation;
2. Provide a north-south transit facility in New Jersey now wholly lacking except for bus service;
3. Offer adaptability for future extension of direct rapid transit service from Manhattan to principal New Jersey communities without need to transfer; and
4. Offer all new passenger equipment of optimum passenger appeal and operating characteristics.

Features of even greater importance, however, would be obtainable exclusively with an independent bi-state loop on one or another of the several available alignments. Such a system, and only a facility of this type, would:

1. Increase the capacity of rapid transit facilities in Manhattan between the financial district and 59th Street, providing relief for the present subway system; and
2. Require a minimum of new legislation, operating agreements, allocation of joint fares, and other time-consuming negotiations and complicated arrangements.

Since preliminary studies indicated that an independent bi-state loop would meet satisfactorily the requirements of a trans-Hudson commuter facility, further studies were undertaken. Engineering and operating analyses of the bi-state loop (Madison Avenue location) will be found in a later chapter.

EXTENSION OF NEW YORK SUBWAYS

Your Consultant was directed to explore the practicality and desirability of extending the subway facilities of the New York City Transit Authority into New Jersey. Preliminary studies have been made to determine the physical and functional feasibility of such possible extensions as well as the added convenience they would offer to the New Jersey commuter.

Inspection of a map of the metropolitan area makes such extension of the New York City subway system appear quite logical. Taking lower Manhattan as the focal point of the metropolitan area, direct single-fare service is provided for 10 to 15 miles to the north and to the east, crossing both the Harlem and East Rivers on numerous routes. To the west, however, the invisible state line in the Hudson River, rather than the river itself, has formed a barrier to subway extensions into New Jersey.

The problems in the development of a single public transit agency to finance, build and operate all public transit in New York City have been many and complicated. Half a century has been consumed in the process, and public funds totaling some two billion dollars have been expended. There have been many difficulties to overcome in maintaining satisfactory service in the rapid transit system and in dealing with the problems resulting from deficit operations in New York City. Those difficulties have undoubtedly discouraged the City government from taking on any responsibility for transit service in those portions of the metropolitan area beyond the city limits. A further consideration could have been the potential complications of taxing benefited areas to meet deficits of a partially tax-supported transit system.

While many of the rapid transit subway tracks in Manhattan are used virtually to the limits of their capacities during the morning and evening rush periods, there is available a large portion of the capacity of certain routes where rush hour traffic to and from New Jersey would be in the reverse direction to the present dominant flow. It would be feasible from a physical viewpoint to increase the length of platforms serving local tracks on certain lines. In some instances this would add a substantial increment to the ability to serve existing heavy rush hour traffic. Through lengthening local platforms in such cases, the equivalent of some ten or twelve trains per hour could be added to the service. The additional trains could be routed to and

from the New Jersey suburban area, if the doubtful assumption is made that there will be no further increases in traffic on the subways in Manhattan. Conferences to establish an understanding of the functional and engineering problems involved have been held with the operating and engineering staffs of the New York City Transit Authority. Investigations of the feasibility of extensions of the New York subway system are described below. See Exhibit 11.

BMT Broadway Subway

Under this plan, a north connection would be made to the existing four-track stub of the BMT Broadway line at 59th Street. A two-track rapid transit facility would be built in subway and tunnel under the Hudson River on the line of 60th Street. A rapid transit line at surface grade would either extend along the meadows to transfer connections with the Erie main line and Northern Division, the Susquehanna, and the West Shore Railroads, or turn south so as to conform to the pattern of the bi-state loop. Convenient passenger transfer stations would be provided in New Jersey. Stations would also be provided for the transfer of passengers from buses to the new rapid transit facility, and parking lots would be developed along the route to the extent practicable.

A south connection would be made to two of the four tracks now terminating at the lower level of the City Hall station on Broadway, thence south along Broadway veering to the west to a connection with the trans-Hudson tunnels to Jersey City, and then to the north along the alignment proposed for the bi-state loop either to the DL&W Transfer station or farther.

The capacity of the new 60th Street tunnel would be approximately 30 trains per hour each way. The present operation of the north portion of the Broadway subway consists of 30 trains passing 42nd Street between 8:16 A.M. and 9:15 A.M., the heaviest hour. In addition to these 30 trains, another 20 trains (10 West End Expresses and 10 Sea Beach Expresses) are now turned back at the stub terminal north of 42nd Street. Thus it appears that there is adequate capacity in the north section of the Broadway subway for the operation of the 30 trains per hour required to utilize the full capacity of the proposed trans-Hudson tunnels.

At the south end of the Broadway subway, however, 30 trains are now routed to the north from the Manhattan Bridge line and 21 trains from the Whitehall Tunnel route, making a total of 51 trains north of the Canal Street junction. To utilize the full 30-train per hour capacity of the proposed Jersey City trans-Hudson tunnels, it would be possible, depending upon service requirements, to operate as many as 15 of the 30 trains from New Jersey north through Canal Street to 59th Street, and through the northern New Jersey trans-Hudson tunnels to the west. The remaining half of the Jersey City service could be turned back at a downtown terminal station in Broadway below Canal Street. This would require re-routing six of the 21 trains now operated from Brooklyn through the Whitehall Tunnel over the Nassau loop, however, an operating change which might be impracticable from the viewpoint of the New York City Transit Authority.

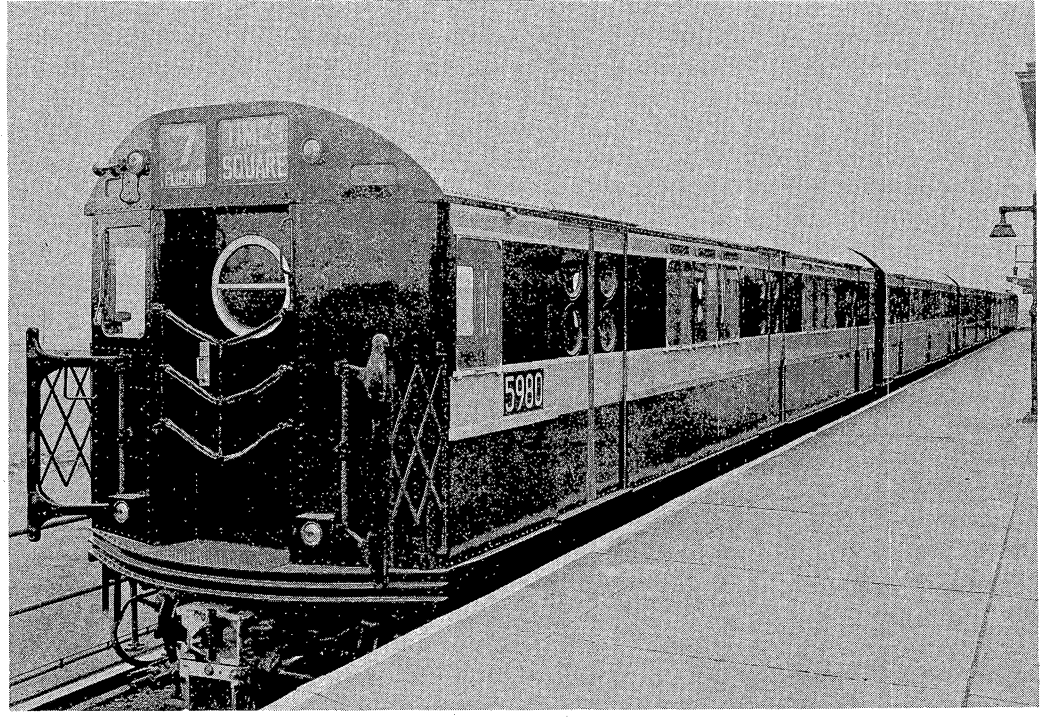
The Broadway subway plan would offer a number of service advantages for New Jersey commuters. The use of 10-foot wide cars would be permitted and first class delivery would be provided for large numbers of New Jersey commuters. In our opinion, this plan should be considered in further detail.

IRT Seventh Avenue Subway

This proposal would also provide a two-track rapid transit facility similar to that described under the Broadway subway scheme. It would connect with a two-track tunnel under the Hudson River, except that the tunnel would be on the line of 63rd Street. The new subway would have connections with the IRT Seventh Avenue subway north of Columbus Circle. Physical conditions would permit such a connection.

Near the tip of Manhattan Island, a connection could be made to the two local tracks now extending south from the Park Place junction to the South Ferry loop at a point just south of the existing Cortlandt Street station. A new subway extension would extend thence south in Greenwich Street to a connection with the southern trans-Hudson tunnels to Jersey City and thence north along the alignment proposed for the bi-state loop either to the DL&W Transfer station or farther.

The IRT Seventh Avenue route has very little excess capacity as presently constituted, but the Transit Authority is currently modernizing this line.



IRT Subway Car New York City Transit Authority

It is proposed to lengthen the local station platforms to accommodate 10-car trains, as the express stations presently do. By providing for 10-car train operation on the local tracks, approximately 12 trains per hour from New Jersey could be absorbed. Service would be operated along Seventh Avenue and West Broadway to a loop terminal in Battery Park as at present or combined with a southern trans-Hudson crossing to form a loop.

This would provide capacity for 13,200 passengers per hour in one direction across the Hudson River. This is substantially less than the rush hour loadings, estimated at 1955 traffic levels, at the standards assumed for the New Jersey commuter service in all studies. This use of the northern portion of the Seventh Avenue subway would provide inadequate service initially. This plan, obviously, makes no provision whatever for future growth.

The southern portion of the Seventh Avenue subway, however, could be operated in such a manner as to utilize the full capacity of the H&M trans-Hudson tunnels to Jersey City. It would require the abandonment of all service between South Ferry, however, or the installation of some type of shuttle service between South Ferry and Rector Street. Aside from this objectionable feature, there seems to be no practical reason for not considering the use of the Seventh Avenue subway, connected to the southern trans-Hudson tunnels, in connection with one of the schemes involving subway extensions to the 60th Street tunnels.

IRT Corona-Flushing Subway

This plan contemplates the extension of the IRT Corona-Flushing line west in 41st Street from its present stub-end terminal in the vicinity of the Port of New York Authority Bus Terminal east of Eighth Avenue. An expensive crossing under the IND Eighth Avenue subway would connect with a new tunnel across the Hudson River. An extension along the meadows would provide transfer facilities with the Erie, Lackawanna, Susquehanna and West Shore railroads as described above.

This extension would provide a desirable terminus for the Corona-Flushing subway and improve that operation. At the same time it would generate a return load in rush hours, balancing the riding in the two directions—always desirable in transit operation.

The 41st Street-42nd Street route would provide New Jersey commuters with direct service to some of the principal destinations on Manhattan Island, namely Times Square, Fifth Avenue at 42nd Street, and Grand Central Station. This would undoubtedly divert a number of passengers from the buses now terminating in the Port of New York Authority bus station, thereby postponing the need for expansion of this terminal as well as relieving the traffic load on the Lincoln Tunnel.

The narrow nine-foot IRT cars on this line are a handicap. This cannot readily be overcome because of the limitations of the Steinway Tunnel under the East River which was originally built to accommodate streetcars. There would have to be a major and extremely costly enlargement and modernization of station entrances and exits, moreover, including stairways and escalators at the Times Square, Fifth Avenue and Grand Central Stations because inbound passengers from Queens would arrive at these stations during the same period as inbound passengers arriving eastbound from New Jersey. In addition, passengers going either uptown or downtown from 42nd Street would have to transfer at these stations to north-south subway routes to reach their ultimate destinations.

The principal disadvanage of this scheme is that it would impose an additional burden on two of the busiest subway stations in the world—Times Square and Grand Central. Not only would the additional New Jersey passengers with destinations in the vicinity of 42nd Street add to the already

uncomfortable concentrations of people in passageways and in stairways, but the large numbers transferring to the north and south subways at these stations would aggravate a situation now almost intolerable. For this reason we would suggest further consideration of the Corona-Flushing subway extension only in the event that no other trans-Hudson facility having greater functional advantages is found feasible.

BMT 14th Street-Canarsie Subway

This plan assumes transfer facilities in New Jersey between a rapid transit extension on the line of 14th Street and existing routes of the Erie and the Lackawanna railroads. A new two-track tube would cross the Hudson River and connect with the BMT 14th Street-Canarsie line in the vicinity of Eighth Avenue and 14th Street.

Since the New Jersey commuters would ride this route in what is now the non-rush direction, essentially the full capacity of the subway would be available for their use. The one-way capacity is estimated at approximately 30 trains, or about 39,000 passengers per hour.

This plan has many disadvantages, the principal one being that 14th Street is the ultimate destination of relatively few New Jersey commuters. Almost everyone using this facility, therefore, would have to transfer to north-south subway routes and travel either uptown or downtown to reach his destination. Another disadvantage of a crossing at this location is that studies of potential trans-Hudson commuter volumes indicate that two double-track facilities will be required. If 14th Street were used as the location of one of these two new crossings, this tunnel would fail to attract its proportionate share of the total passenger volume. Meanwhile, the second new tunnel might well be overloaded and either the financial district or the midtown section would lack direct service.

Moreover, commuters destined for the financial district, which constitutes a very large percentage of the present Erie and DL&W passengers, would have to travel northerly in New Jersey to the line of 14th Street, across the river, and then south more than two miles on heavily loaded subway trains. The Jersey Central passengers would have no direct connection to the 14th Street crossing unless a track were extended southerly to a new

transfer station with the CNJ, possibly at Communipaw. There would be little time saving over existing ferry service or the H&M for present trans-Hudson commuters except for those few passengers destined to the area adjacent to 14th Street.

Passengers coming from the north and destined for the 42nd Street or 59th Street areas would undoubtedly prefer to use Lincoln Tunnel or George Washington Bridge Buses. Those continuing to the financial district would have to use the same crowded subway trains mentioned above whether they used one of these crossings or a new 14th Street subway extension.

For these reasons, we recommend that no further consideration be given to a trans-Hudson extension of the BMT 14th-Canarsie line.

IRT Lexington Avenue Subway

This plan contemplates a new two-track tunnel across the Hudson in the vicinity of Battery Park on the alignment proposed for the independent bi-state loop. Appropriate transfer facilities would be provided in New Jersey with the Erie, Lackawanna and Central of New Jersey railroads. Connections would be made to the local tracks of the IRT subway a short distance north of the Brooklyn Bridge station.

There are four tracks north of this point, but only two tracks to the south. Our investigations indicate that the cost of providing such a connection would be very expensive and would be north of the Wall Street district. There would be no satisfactory north connection. It is the opinion of your Consultant, however, that the extension of this subway might be considered further as an extension of the H&M service.

Independent System

There is an opportunity to connect to the IND subway at the existing two-track stub in Church Street which now terminates just south of Vesey Street. Unfortunately, however, the existing high level subway is at almost the same grade as the high level BMT Broadway subway which enters Church Street north of Fulton Street a short distance to the south. It would be impractical from a physical viewpoint to alter the elevations of either of these

two existing subways so as to provide for the extension of two tracks of the IND subway south along Trinity Place and thence to a connection with trans-Hudson tunnels to the west.

The only other possibility would be to extend the IND tracks through the Hudson Terminal and under private property to a tunnel connection. This, in our opinion, would be utterly impractical unless the operation of the Hudson & Manhattan Railroad were completely abandoned. For these reasons no further study was given to the extension of the Independent system.

Hudson & Manhattan Railroad

Consideration was given to use of the existing Hudson & Manhattan Railroad tubes, either as presently operated, or with track connections for integration with one or another of the New York City subways.

Modern high-speed, high-capacity operation of the 33rd Street-Christopher Street pair of H&M tubes is made difficult by such physical limitations as narrow width, sharp curves and short station platforms. It is generally agreed that it would be almost impossible to straighten the alignment of the present cast iron lined tunnels directly under the river. It would also be extremely costly, if not impossible, to re-align that portion of the tubes from the river to the Ninth Street station for high-speed operation.

It is estimated that the 33rd Street branch would serve only 4,300 to 5,500 rush hour passengers and 11,200 to 13,200 total round trip passengers in 24 hours if this route were retained as an additional feature of Plans 1, 2 or 3. This number of passengers would not justify continued operation, especially on the wide headways required for reasonably economic operation. Gradually, patrons would avail themselves of other services so that the actual number would probably fall even below these estimates. Support of this service, therefore, would become a burden on the balance of the system. Thus, there would be no justification in continuing the 33rd Street branch to serve the comparatively few people who would not have a comparable alternate service available.

For these reasons we recommend under Plans 1, 2 and 3 that service on the 33rd Street branch of the H&M be discontinued upon completion of new bi-state rapid transit facilities.

The H&M service between Hoboken, Newark and Exchange Place on the west and Hudson Terminal on the east requires more careful study. If this facility could be connected with a New York City subway, the direct service and improved distribution might restore this transit artery to a place of importance in any acceptable plan.

The narrow cars required by clearances in the H&M tubes suggests through-routing with IRT subways, rather than with BMT or IND lines. In the case of the IRT it would be possible to operate IRT cars over the H&M tracks through new track construction which would lower the rails. The lower H&M cars could operate with a minimum of track re-alignment on the IRT tracks.

The most practicable extension of the H&M service from Hudson Terminal would be one extending to the local tracks of the IRT Lexington Avenue subway. The two local tracks of this four-track line carry very light traffic northbound in the morning rush hour and southbound in the evening rush hour. Consequently, the morning rush hour traffic inbound from New Jersey over the H&M could be handled and distributed along the Lexington Avenue line in Manhattan if a physical connection were made between the two facilities. Similarly, the evening traffic to New Jersey could be handled on the southbound local track without depriving New York subway patrons of service.



Such a connection would start on the two local tracks a short distance north of the City Hall loop and extend southwesterly under various subways and the Hudson Terminal to a connection with the Hudson tubes at a point near the east bank of the Hudson River.

This connection would include a new station underneath the present Hudson Terminal tracks with platforms to accommodate ten-car trains. It would have passageways, escalators and a mezzanine to connect with the present Hudson Terminal station and the street. The present Hudson Terminal facilities would be rehabilitated but without expensive physical changes. This station could then be used for turning back eight-car trains to balance the service with the pattern of traffic demand making for efficient scheduling.

We considered the substantial improvements in convenience for New Jersey commuters which would thus be afforded. Attention was also given to the fact that the Hudson River tubes are in sound structural condition. Furthermore, there is a large concentration of suburban traffic in the New Jersey area opposite downtown New York. Because of all these factors, we made further detailed studies of the rehabilitation and modernization of the H&M tubes and their extension to a connection with the Lexington Avenue subway as above outlined.

STANDARD RAILROAD EQUIPMENT PLANS

All-Railroad Bi-State Loop

The best system of rail facilities for New Jersey commuters would provide direct, no-transfer service from the various suburban communities to all of the major centers on Manhattan Island. The most feasible plan of this nature would be one incorporating existing railroad facilities in the system. Consequently, consideration was given to development of a facility on essentially the same alignment as the independent bi-state loop together with provision for through service for all passenger trains now operated. The new tunnels under the Hudson as well as all subways and underpasses on the route would be of dimensions required to accommodate standard railroad equipment. The cross-section area of the tunnel portions would be approximately two-thirds greater than that required to accommodate subway cars, while the subway sections would be about one-quarter larger.

Such a plan would offer both through and commuter passengers direct service to Manhattan without a transfer. It would also eliminate the duplication of equipment and crews inherent in any transfer plan. The number of passengers to be transported across the Hudson River, however, together with the limitations on the capacity of the proposed tunnels, would require that all commuter trains carry a standing load of passengers in rush hours. The present schedule of eastbound commuter trains arriving at their respective terminals between 8:00 A.M. and 9:00 A.M. is 81 trains, comprised of the following:

Central of New Jersey	16
Erie	20
Delaware, Lackawanna & Western	25
New York Central	7
New York, Susquehanna and Western	6
New Jersey & New York	4
Northern Railroad of New Jersey	3

We estimate that the all-railroad bi-state loop could handle only 20 trains of this type per hour through each tunnel, a total of 40 trains. As a result, the railroads would have to consolidate trains or cut service and require a large portion of total passengers to stand on the inner section of each route. The type of power required would result in low acceleration and deceleration rates of approximately one mile per hour per second. The subway cars recommended for Plan 1 would have an acceleration rate of 3.5 miles per hour per second.

Furthermore, the congestion and confusion in the Manhattan stations along the route would be appalling in the evening rush hour. Seven different railroads would presumably route their trains through the two-track subway, perhaps three in the clockwise direction and four counterclockwise. Since the railroads render service on various branches and to many short line terminals in rush hours, there might be six to ten different services passing each station platform (twice as many at the center platform stations). Passengers waiting for that number of trains, therefore, would have to accumulate on the platforms. The problem of loading outbound trains expeditiously in the evening rush hour would be great. Thus, the time trains spent in stations would be a governing factor in the capacity of the system.

A central station for long distance trains of all the railroads now terminating on the west bank of the Hudson River could be provided in Manhattan in connection with the bi-state loop if the latter were made large enough to accommodate standard railroad equipment. Preliminary plans were prepared for such a terminal lying along Third Avenue between 36th and 41st Streets. See Exhibit 12. A terminal of this type could provide joint facilities to handle mail, baggage and express, as well as through passengers.

Stations for commuters would be provided at the same locations as under the plan for rapid transit operation on the bi-state loop described in a later section of this report. The through terminal location on Third Avenue between 34th and 41st Streets not only would be convenient with respect to passenger destinations but would have a profound effect on the future development of this section of Manhattan.

The estimated cost of the all-railroad loop, including the through passenger terminal, is shown in the following table:

Table 2

ESTIMATED COST OF ALL-RAILROAD LOOP

Item	Estimated Cost
Manhattan subway construction	$131,000,000
Trans-Hudson tunnels	89,200,000
New Jersey track and structures	54,700,000
Land and easements, fixed equipment and utilities	34,300,000
Through terminal, including land	40,800,000
TOTAL	$350,000,000
Engineering and administrative expense	35,000,000
	$385,000,000
Contingencies	115,000,000
	$500,000,000
Financing and interest during construction	55,000,000
GRAND TOTAL	$555,000,000

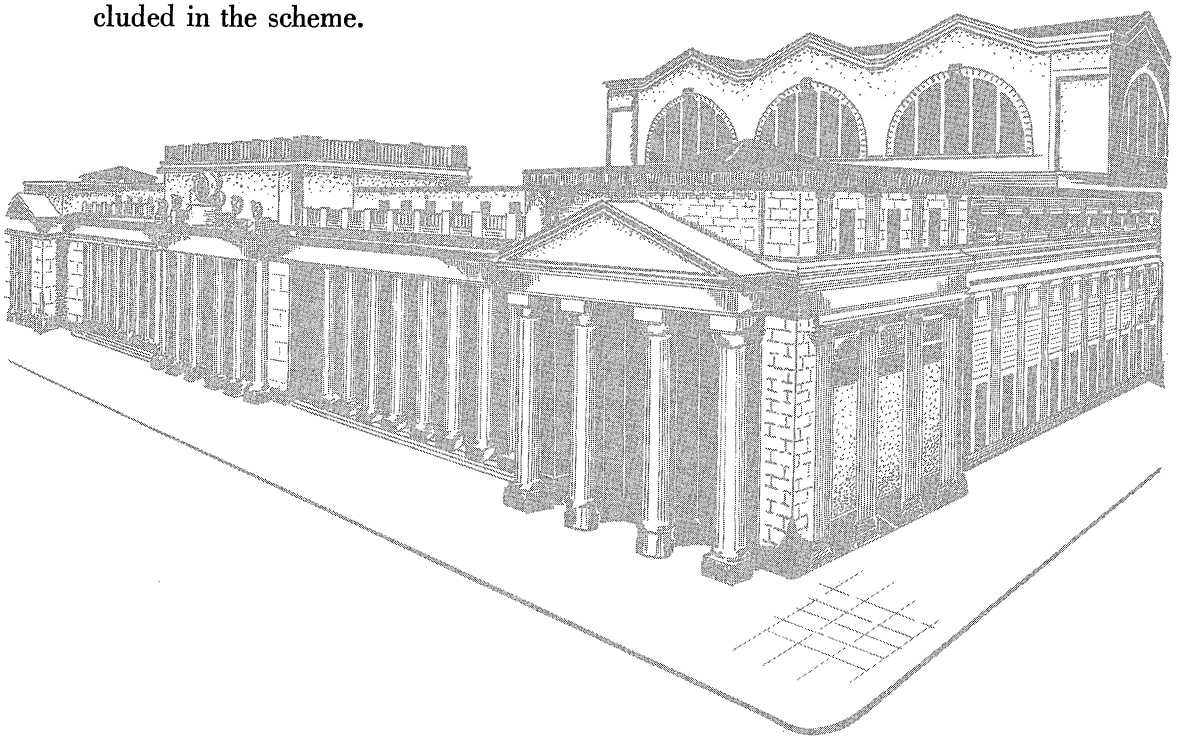
This sum does not include any passenger equipment or locomotives. Electric motive power for all trains would be required in the underground portions of the route. Diesel locomotives are used predominantly by the commuter railroads at the present time. Many alternate schemes for motive power for such an operation were considered without arriving at a wholly

satisfactory plan. The studies were carried sufficiently far, however, to determine that the problem could be solved. The cost of new equipment and motive power required would be on the order of $30,000,000 at present day prices.

Stub Terminal Plan

A plan was investigated for a terminal in Manhattan similar to the Pennsylvania Station or the Grand Central Terminal. Such a station would accommodate both the suburban trains and the through trains of the West Shore route of the New York Central System; the New York, Susquehanna & Western Railroad; the Erie Railroad; the Delaware, Lackawanna & Western Railroad; the Reading Railway System; the Baltimore & Ohio Railroad; and the Central Railroad of New Jersey. The plan developed provided for a two-level, stub-end terminal lying between 46th and 48th Streets and extending from Eighth to Eleventh Avenues. The storage capacity could be made adequate for all present service. The preliminary layout of the terminal is shown in Exhibit 13.

A four-track tunnel across the Hudson River would be required, with three tracks operated in the dominant direction during the rush hours. Two double-track tunnels under the Palisades, as well as electrified tracks and interlocking plants for connections to the several railroads, would be included in the scheme.



Preliminary estimates indicate that a stub-end passenger terminal adequate to accommodate all interstate and suburban trains, including necessary tunnels and connections with existing railroads, would cost about $500,000,000, as itemized in the following table:

Table 3

ESTIMATED COST OF ALL-RAILROAD STUB TERMINAL

Item	Estimated Cost
Terminal building	$111,600,000
Trans-Hudson tunnels	89,200,000
New Jersey—track, tunnels and structures	63,700,000
Track, roadway and signalling	26,400,000
Traction power—substations and distribution	9,100,000
Land and easements	15,000,000
TOTAL	$315,000,000
Engineering and administrative expense	31,000,000
	$346,000,000
Contingencies	104,000,000
	$450,000,000
Financing and interest during construction	50,000,000
GRAND TOTAL	$500,000,000

There is some doubt as to the capacity of the tunnels, but by operating three tracks in the peak direction we estimate that substantially all of the 80 trains could be handled.

Our principal objection to this plan is the fact that the terminal would be within 2,000 feet of the ultimate destinations of only about 7,200 daily commuters from New Jersey. All other passengers arriving at this terminal would have to transfer to other transportation media, principally crowded subways. The Wall Street area (Districts 110 and 111) has 28,000 passengers, the Grand Central area (Districts 133 and 135) has another 9,000 passengers. These two areas alone constitute 49 percent of the total to Manhattan. Furthermore, the great majority of railroad commuters from New Jersey originate south of the site proposed for a stub-end terminal in Manhattan. These people would have to travel north in New Jersey to the line of 47th Street and then south in Manhattan for distances as great as four miles.

We conclude, therefore, that this plan does not warrant further consideration because of the relatively small benefits contrasted with the estimated cost of $500,000,000.

New York Central West Side Freight Connection

A study was made of the possibility of building a freight connection between the north pair of trans-Hudson tunnels and the New York Central freight yards in Manhattan north of 60th Street and west of West End (Eleventh Avenue). The connection could be made by an at-grade double track turnoff on a 2.6 percent grade on a 15 degree curve which would result in a compensated grade of 3.2 percent. While this would not permit long trains, it would be operable. The trains would not reach the surface in New Jersey until they were on the west side of the Palisades. They could be switched back to the west bank of the Hudson, however, through the existing NYC tunnels through the Palisades.

The total cost of making this connection, including the increased cost of the north tunnels, but excluding property damages, would be $53,000,000. The usefulness of this connection would depend upon the amount of freight which could be moved across the Hudson in the four night hours during which passenger service would be suspended. Economic feasibility would be determined by the relative costs of present methods and the costs using the new facilities, including capital charges.

Practicability of All-Railroad Plans

In the Consultant's opinion the great cost of a stub terminal in Manhattan would be substantially in excess of any possible benefits. Not only would the service to commuters lack most of the elements of convenience provided for in other plans developed in this study, but there would be no major benefit either to the interstate passengers or to the railroads which would warrant the latter's participation either directly or indirectly in this large capital outlay.

On the other hand, an efficient midtown through railroad terminal could be developed for long distance passenger trains in an advantageous

location in midtown Manhattan. Certainly the service which would be afforded by operation of an all-railroad bi-state loop would be attractive from the viewpoint of the commuters who would ride from their point of origin to their ultimate destination without transfer. The shortcomings of this plan include limited capacity, congested stations, slow speeds and irregular headways.

The large capital outlay for either plan would not be warranted unless the railroads manifested a willingness to assume responsibility for a substantial share of the cost. We are advised, however, that railroad managements involved have indicated no interest whatsoever in extension of their rail lines into a Manhattan terminal of any character. For these reasons none of the plans providing for operation of standard railroad equipment into Manhattan will be considered further.

MONORAIL TRANSIT

Studies were made of the applicability of the monorail system of transit to serve trans-Hudson commuters. Investigations included review of the following specific proposals presented by officials of the Monorailway Corporation:

1. The Hudson River crossings would consist of tunnels in locations selected by the Consultant under specifications of the Memorandum of Understanding;

2. For the north-south leg in Manhattan, a location for the monorail elevated structure was suggested above the New York Central freight line on the West side or along either Tenth or Ninth Avenues. A location on any north-south thoroughfare east of Ninth Avenue was deemed impractical by the sponsors of monorail;

3. Inclined connections would be provided in suitable locations between the Hudson River tunnels and the aerial portions of an independent bi-state loop both east and west of the Hudson River; and

4. Monorail structures would be installed above all of the suburban railroads in New Jersey finally selected as a part of the recommended rapid transit scheme. Station facilities serving monorail lines would be installed in the vicinity of existing suburban railroad stations.

The route of the monorail system as thus outlined would coincide with the location of the independent bi-state loop with respect to alignment in New Jersey and the crossings of the Hudson River. In Manhattan, one possible monorail route would be in Greenwich Street from a portal just north of Liberty Street to Chambers Street and thence via Greenwich Street, Ninth Avenue, 37th Street and Eleventh Avenue to a portal in Eleventh Avenue at 52nd Street. Subways and tunnels would be constructed from these portals to connections with both two-track tunnels under the Hudson River in the same general locations as proposed for the bi-state loop.

The ultimate development of suburban rapid transit to serve the New Jersey commuting areas would consist of direct rail service from the independent bi-state loop along the principal railroad routes now offering commuter service. Monorail sponsors have suggested that the same pattern be adopted for suburban extensions radiating from junctions on the bi-state loop. Monorail cars and trains eventually would operate from the outer termini of the suburban railroads over the railroad rights-of-way to the bi-state loop and thence to Manhattan.

The officials of Monorailway Corporation also furnished specifications prepared by the Budd Company for a stainless steel rapid transit suburban monorail car. No specific information was furnished with respect to structures. It was assumed, therefore, that the structures might conform generally to those described in a paper presented to the Engineering Institute of Canada by Gibbs & Hill, Inc., consulting engineers, on November 6, 1947.

Physical Feasibility

A monorail rapid transit line has been in operation in Germany for more than fifty years. Many structural, mechanical and electrical engineering problems would have to be overcome, however, before a modern system

of monorail could be built. It is the Consultant's opinion, nevertheless, that from the engineering standpoint this special type of elevated railroad could be developed in time.

The misconception in the public mind that monorail is an ethereal device should be corrected. While the Monorailway Corporation did not submit engineering drawings, spokesmen have frequently used illustrations picturing the structure from which the trains would be suspended. The supporting beam as thus presented would be approximately 3 feet deep and 15 inches wide, presumably with a 60-foot spacing of bents.

Rather detailed studies were made of typical structures for monorail installations by the engineering firm of Gibbs & Hill and described in the 1947 paper mentioned above. The supporting structure for the device which evolved from these studies would consist of a single rail. The track would be suspended between bents by a structure which would replace the ties and roadbed of a standard railroad. The longitudinal girders would be supported by either tee-shaped columns or by arches spanning streets, railroad tracks or other improvements at surface grade below. All stresses generated by the operation of monorail trains would be applied to the supporting structure at such distances from the foundations that the leverage would be about twice that of a conventional elevated railroad. All structures, therefore, would have to be somewhat larger and stronger. The cost of construction for monorail, therefore, would be greater than the cost of a standard elevated railroad to support a train of comparable specifications and operating characteristics. This increased cost for a suspended system over that for a supported system on structure has been estimated at about 12 percent. The greatest cost differential would occur, however, in sections where a conventional elevated train could be operated on standard track at ground level. All portions of a monorail system must be composed of expensive overhead structures, including even the yards and shops.

While the physical problems of building monorail over the streets in Manhattan would be difficult and expensive, even greater problems are envisioned in the future in connection with building monorail over the existing tracks and rights-of-way of the railroads operating suburban service in New Jersey.

The sponsors have suggested a single column tee-shaped type of support for a double-track monorail line. A structure of this type would be im-

practicable on railroad rights-of-way now carrying two or more tracks. While the columns themselves might be only two to three feet in width, the foundations necessarily would extend out on either side from the columns so as to provide a foundation from 15 to 20 feet wide. Such foundations would involve temporary relocation of both tracks for railroad operation during construction—an impractical solution because of stations, industrial sidings, narrow cuts and fills, and bridges and underpasses. The installation over all railroad rights-of-way, therefore, would have to be of the more conventional type of two columns supported by heavy cross girders.

While it would be possible to design and build a structure to permit monorail operation of both the bi-state loop and the all-rail suburban plan, there would be many serious difficulties involved. For example, the bottom of the monorail structure would have to be at least 34 feet above top of rail. Where railroads are now elevated over crossroads, the monorail structure would be some 52 feet above the highways, and the passenger platforms perhaps 42 feet above ground level.

Serious doubts arise, furthermore, as to whether the extensive installation of grade separated monorail structures would be warranted in view of the fact that a very large proportion of the existing suburban railway mileage in New Jersey is of first-class construction, much of it already fully grade separated.

Functional Feasibility

An obvious disadvantage of the suspended car is that any portion of a rapid transit system designed for its use could not be integrated with any other existing system such as the New York subways or the suburban railroads.

Advocates of monorail, duorail and other types of suspended rapid transit operation have claimed as advantages of their vehicles such features as high speed, quiet operation, light weight and air conditioning. None of these features is peculiar to a suspended car, and all could be incorporated in the design of any new rapid transit car. Similarly, the cost of operation would be essentially the same for any type of modern rapid transit car whether it were hung from above or supported from beneath.

The high speed features common to all modern transit equipment, however, could not be used to full advantage on a monorail system. The Budd Company specifications for car equipment for single rail operation provide for maximum sway of individual cars of as much as 20 degrees from the vertical. The greatest horizontal displacement would occur approximately at the floor line. At all stations, therefore, the cars would have to be held at a proper clearance from the edge of platforms. This would require a funneling device in advance of each station to dampen the sway of the cars and guide them into a narrow channel. This operation would either have to be carried on over a distance of several hundred feet in advance of each station or trains would have to slow down to a speed at which impact with the funneling device would not cause injury or excessive discomfort to seated or standing passengers. It is estimated that this slowing down in advance of each station would increase the running time around the 18-mile bi-state loop by about five minutes with a corresponding increase in operating costs and a decrease in attractiveness to the average passenger.

Tunnels under the Hudson River would have to be built to excessive dimensions to provide clearance for free sway of cars traveling at maximum speed. It is contemplated, therefore, that a stabilizing device would have to be developed which would probably be used in combination with a reduction in speed.

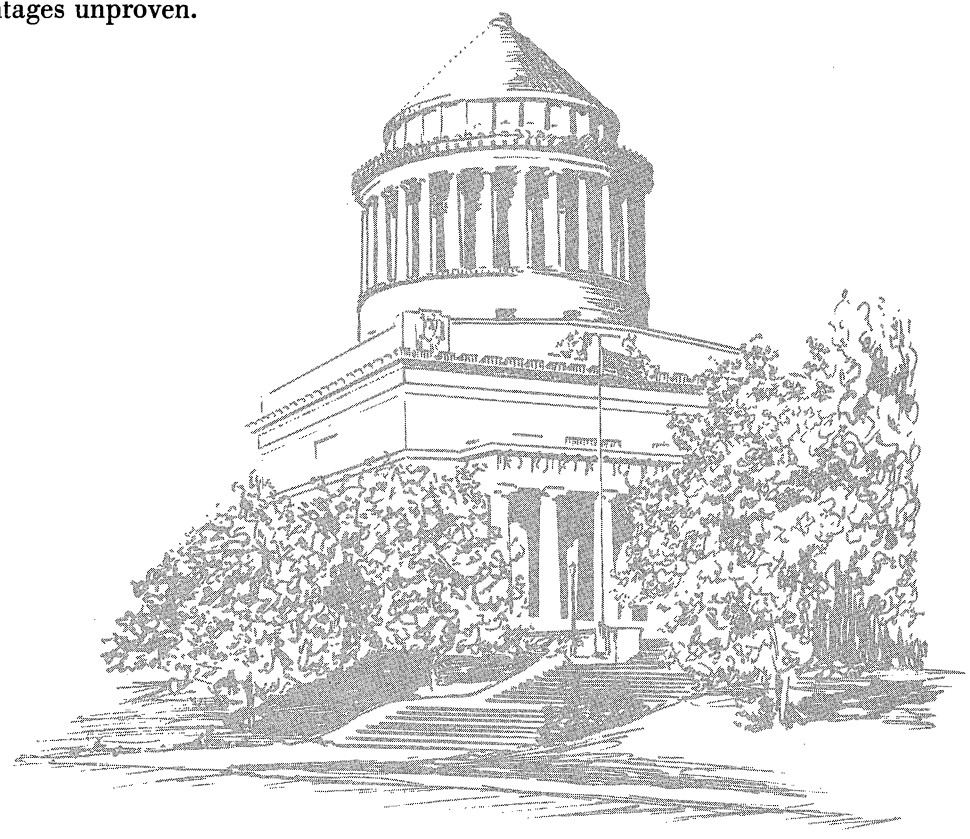
The free sway at curves has been cited as an advantage because it would minimize the sensation of centrifugal force. While this might hold true if cars were operated singly, a car on a curve could not sway freely if held rigidly by cars on tangent track both ahead and behind.

There are additional functional disadvantages in connection with monorail. The cars are presently designed for seated load only. The assumption that there would be no standees is sound in view of the fact that considerable sway would be experienced between stations. This sway would be a source of discomfort as well as a hazard to standing passengers. No transit system can be designed, however, on the assumption that it will never be necessary to carry standees. Neither can it be assumed that all passengers will be in their seats before trains leave the stations and remain there until the trains have come to a full stop.

Station platforms would have to be some 18 to 20 feet above the ground, even on the suburban portions of the routes. Under present operation the station platforms are frequently at the same level as nearby parking lots and adjoining bus loading platforms.

There would be grave problems of switching monorail cars at branch-offs and at terminals. The switching operation to and from the main line would be awkward, time-consuming and expensive as well as seriously restrictive on the capacity of the system. In the event of derailments or other emergencies, which are bound to occur on any busy railroad, there would be staggering problems of disembarking passengers, restoring service without completely disrupting street traffic or railroad operations below, and making temporary and permanent repairs.

There has been no trial on a full scale basis of the practicability of this novel type of rapid transit operation using modern equipment. The relatively low-speed monorail serving a small community in Germany and built more than 50 years ago is of little significance. It is concluded that the functional feasibility of monorail is doubtful and its claimed advantages unproven.



Service to Commuters

As noted above, the monorail sponsors have suggested that the only thoroughfares in Manhattan which might be suitable for monorail installation would be on or to the west of Ninth Avenue. Rapid transit stations could be located on Greenwich Street at Fulton Street; near Canal Street; on Ninth Avenue at 14th, 23rd and 34th Streets; and on Eleventh Avenue at 42nd and 52nd Streets. There would be no direct transfer facilities with any of the New York City subways, although walking transfers, if provided, would permit transfers to the IRT Seventh Avenue subway and the IND Eighth Avenue subway.

Such stations would be remote from most of the destinations of New Jersey commuters and inconvenient with respect to transfer to the network of subway lines in Manhattan. It would provide little improvement, therefore, over the Hudson River ferry and suburban bus services now available to the commuters.

Public acceptance of an elevated railroad on Ninth Avenue is doubtful. It seems probable that the old Ninth Avenue elevated structure (now removed) is fresh in the minds of many citizens of New York. Experience elsewhere has proved that there is a deep-seated prejudice on the part of the average American citizen against elevated railroads of any type. While this antipathy may not be justified in the case of modern streamlined structures, it is still present.

The conclusion is drawn that monorail transit would provide no improvement in convenience; that it would fail to gain public acceptance; and that the substantial capital investment involved in its construction would not be justified from any viewpoint.

AERIAL TRANSIT

A review has been made of a report entitled *Aerial Transit in the New York Metropolitan Area* dated October 1955. This report was prepared through the cooperative efforts of men widely experienced in transit and transportation fields with the assistance of the executives and chief engineers of an impressive list of engineering organizations and equipment manufacturers.

In essence, aerial transit would consist of modern rubber-tired cars, singly or in trains, operating on special roadways. These roadways could be at surface grade in the outer portions of the system. They could be constructed on bridges or through new or existing tunnels. They could be either underground or overhead in the more congested sections of the route.

There are many general areas of agreement between the Consultant and the proponents of aerial transit. There is no room for a difference of opinion, for example, on the importance in modern transportation systems of safety, comfort, convenience, rapidity of movement, quiet operations, attractive design of equipment, and moderate cost to the passenger.

It is also agreed that the car as proposed could be designed and built, and that the estimated cost of such equipment is approximately correct. Most of the features associated with the aerial transit type of vehicle, however, could be incorporated in any modern transportation equipment. Some of the features such as operation on pneumatic tires have been under development and test as long as 15 years. Many other ideas set forth in the report are already under development. One suggestion is that trains be automatically controlled as to starts, stops and speeds. In due time, probably, the necessary devices will be thoroughly tested by the manufacturers, and adopted by transit operators if found practical.

The independent bi-state loop would afford an operation completely separate from all existing facilities. If this plan is adopted, consideration should be given to rubber-tired transit vehicles and possibly to other modern developments which could not be utilized readily except in an all-new facility. In connection with alternative schemes for New Jersey-Manhattan rapid transit, however, aerial transit would have the disadvantage that it could not be readily integrated with any presently existing transit facilities without considerable modification which would necessarily eliminate many of the advantages claimed for aerial transit.

It is agreed that the proposed aerial transit structure could be designed and built. There is no denying the economy of supporting the vehicles by a roadway rather than suspending them from an overhead structure. Some 920 route-miles of new trackage in New York and New Jersey would be required, however, for the system proposed in the 1955 report. The cost would be enormous, obviously, because no existing railroad tracks or operating subways could be incorporated in the plan.

As pointed out in the aerial transit report, it is extremely difficult to estimate the cost of construction of any rapid transit facility from general plans. Portions of the aerial transit scheme could be built at ground surface elevation, but the estimated $300,000 per mile of single track for such construction is considered to be only about one-half of the probable actual cost. Realistic estimates of the cost of overhead structure also would be at least double those indicated in the report, particularly in closely-built-up areas such as any part of Manhattan.

In the entire New Jersey sector of the metropolitan district, there could be no joint use of aerial transit facilities and tracks of the trunk line railroads. Aerial transit, therefore, would require two entirely new tracks on every route throughout this entire suburban zone. This would require complete revamping of the existing railroad plant to permit the continued operation of interstate passenger trains as well as local and through freight services.

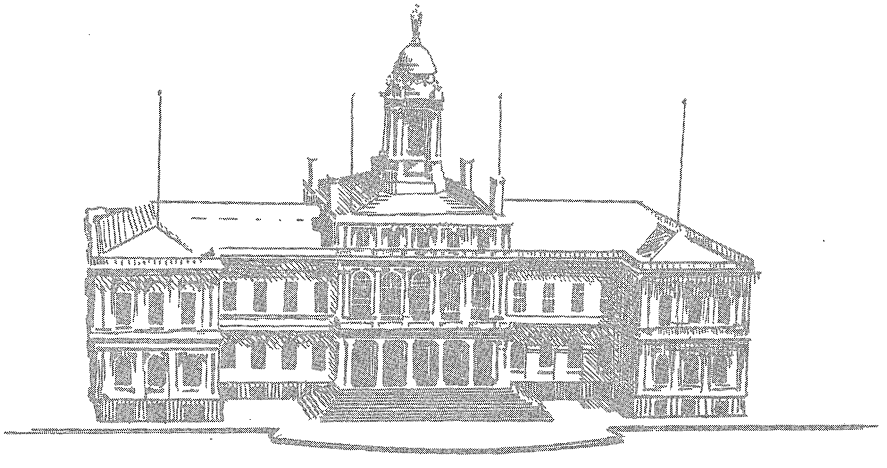
A 13-mile rapid transit line on a right-of-way largely grade separated years ago immediately adjacent to trunk line railroads was completed in 1955 by the Cleveland Transit System at a construction cost alone of some $21,000,000. Based on the Cleveland project, for which the Consultant was the engineer, it is his opinion that the proposed 875 track-miles of aerial transit in New Jersey would cost more than twice the $656,000,000 estimated by the proponents.

Insofar as application of aerial transit to the New York metropolitan area is concerned, interest is confined by terms of the agreement to transportation between Manhattan and the portion of New Jersey within commuting distance. The design capacity of trans-Hudson facilities proposed for aerial transit is within reasonable approximations of actual needs as determined by the recent extensive studies. The operating plan as proposed in the report to develop this capacity, however, requires careful analysis.

The report states that "each train, or at off-peak periods single vehicles, can be run express from the city distribution area direct to and from reach station in the system. A single car or train destined for any station on the suburban route would leave the through line at the proper turnoff and proceed to its designated station. In other words, a community 30 miles distant from the metropolis would be reached in 30 minutes."

A map titled *Aerial Transit in the New York Area* shows a pattern of suburban station development indicating the location of stations to serve virtually all segments of the New Jersey suburban area. The plan shows 11 stations for ten-car trains; 28 stations for six-car trains; and 59 stations for three-car trains; a total of 98 trains providing direct, non-stop service from 98 stations. These 98 stations, according to the plan, would be served by some 455 cars in an unspecified period of time. In the heaviest morning rush hour at present, about 68,000 passengers originate at or near these 98 stations. The number includes present bus passengers, a portion of whom might be attracted to aerial transit. Since 455 cars of the type proposed would have capacity for about 45,000 passengers, a train would depart from each station for direct service to Manhattan on an average of once in 40 minutes. (45,000-passenger capacity divided by 68,000 passengers per hour times 60 minutes.) This infrequency of service would obviously be unsatisfactory. Trains would have to operate on a much closer headway, stopping at a sufficient number of stations to accumulate a full load before starting their express runs to New York. Under this type of operation, the mile-a-minute speed could not be realized and the service would be little different than it could be on existing trackage with any conventional type of modern transit equipment.

Stated another way, the heaviest commuting stations in New Jersey now generate some 500 to 800 passengers in the heaviest morning rush hour. These stations are served by 5 to 10 trains in the maximum 60-minute period. Under the proposed non-stop service, with direct aerial transit from each suburban station to Manhattan, each station would be served by perhaps



two inbound trains in the entire morning rush period and two outbound trains in the evening. This would be wholly unsatisfactory.

Perhaps the proponents contemplated the operation of numerous short trains giving frequent service to each station, these short trains to be coupled into longer trains for the major portion of each trip. While cars might be safely uncoupled on the fly, we consider a flying couple of rapid transit cars to be entirely infeasible. Thus, another time-consuming operation would have to be provided for in the schedule.

Furthermore, the proposed non-stop service for each station would provide no intrastate service. A plan based on this concept would not be acceptable, in the opinion of the Consultant.

The aerial transit report is based on the premise that "subways would be impossible in Manhattan" and, furthermore, that "any effective form of rapid transit must operate above the street level in built up areas" (except for the possibility of going underground in super-congested areas).

The exhibit showing proposed distribution facilities in Manhattan in the aerial transit report has been examined in some detail. It indicates certain assumptions as to the practicability of modern aerial transit structures on various thoroughfares. It also indicates subways in locations where such construction would be difficult and costly if not impossible. These situations are pointed out to indicate the impracticability of the proposal and not in any spirit of petty criticism.

There are several locations where the Consultant considers there is no chance whatsoever of gaining public acceptance or official consent to aerial transit structures, either on the sidewalk or in the center of the thoroughfare. In reviewing this phase of the proposal it was borne in mind that there is public sentiment, or perhaps prejudice, against elevated structures of any type in public thoroughfares in areas of concentrated commercial activity. This, in the opinion of the Consultant, will persist despite the possibility of building reasonably attractive structures over which rubber-tired trains could be operated without objectionable noise. While the structure between stations could be streamlined, the stations with their appurtenant escalators and stairways would take up useful sidewalk space and reduce the natural light in the area directly below the station platforms. Thoroughfares proposed for aerial transit where it would be strongly opposed,

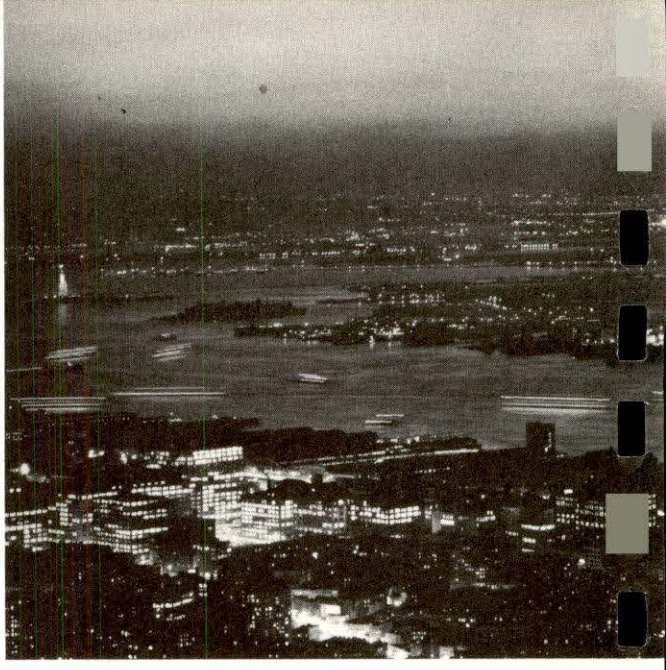
in the opinion of the Consultant, include Rector Street; Wall Street; Broadway and Park Row in the vicinity of City Hall Park; Lafayette Street and the Bowery in the vicinity of the Civic Center; Third, Lexington, Park, Sixth, Seventh, and Eighth Avenues; West 50th and West 58th Streets; and Central Park South.

Certain subway sections indicated in the aerial transit report would present almost insuperable physical difficulties which could be overcome only through an extravagant expenditure of public funds. These include subways in lower Manhattan between both Broadway and West Broadway at Barclay Street and in the vicinity of Pearl and Pine Streets; at an interchange between various aerial transit routes in the vicinity of West Washington Place and Sixth Avenue; a line on 32nd Street, particularly the portion under the Pennsylvania Railroad terminal; and a four-track line on Park Avenue extending under the Grand Central Terminal and the existing New York Central tracks to the north. In the latter instance, proponents of aerial transit anticipate that space occupied by four existing tracks will become available through removal of the New York Central's through-train terminal from Grand Central Terminal to a point north of the Harlem River.

The investment in physical plant and car equipment as estimated by the proponents would amount to the impressive figure of $1,400,000,000. Such a sum would, in the Consultant's judgment, far exceed the amount of capital which could be raised for the construction of improvements in suburban transit. The aerial transit report contains insufficient detail to permit any comment on the estimates of expenses and revenues.

It is believed that any plan, to gain public acceptance and official sanction, must be suitable for development in phases. Each step of the program should provide substantial improvements in convenience when operated as a supplement to existing available railroad facilities. It is for this basic reason that the Consultant recommends the rejection of the aerial transit system or any other totally independent scheme which cannot be blended into existing facilities for a measure of joint operation.

The authors of the aerial transit report have placed the community in their debt, however, for their bold thinking; for proposals for modern rubber-tired rapid transit vehicles; and, finally, for expounding the possibilities of improved electronic control and the principles of automation as applied to railroad operation.



CONCLUSION

None of the plans involving only subway extensions or rehabilitation of the H&M tubes would be complete in itself, but each conceivably could be used in combination with one of the other plans for new facilities to provide service to both the financial district and to the midtown section of Manhattan. On the basis of the foregoing discussion, therefore, we proceeded with the examination in considerable detail of the physical problems, the functional aspects, the relative benefits and the economics of four plans.

PLAN 1

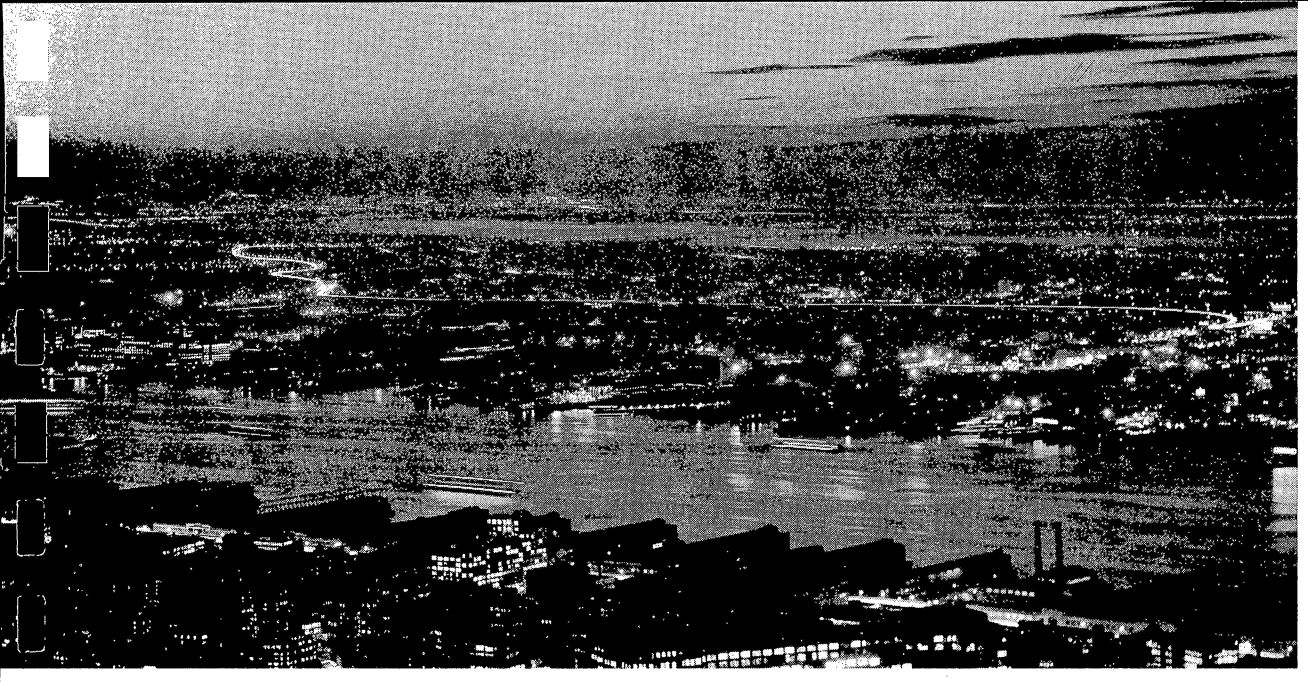
Independent bi-state loop utilizing Madison Avenue for the Manhattan route. This plan includes complete modernization of the Hudson & Manhattan Railroad facilities except the 33rd Street branch which would eventually be abandoned.

PLAN 2

Extension of the New York subways utilizing the BMT Broadway subway for the Manhattan leg of the loop which would conform to the pattern of the independent bi-state loop (Plan 1). Hudson & Manhattan services would be included as in Plan 1.

PLAN 3

Extension of the BMT Broadway subway both north and south to provide a horseshoe operation; the northerly connection to Susquehanna Transfer station with a further extension west to a trans-

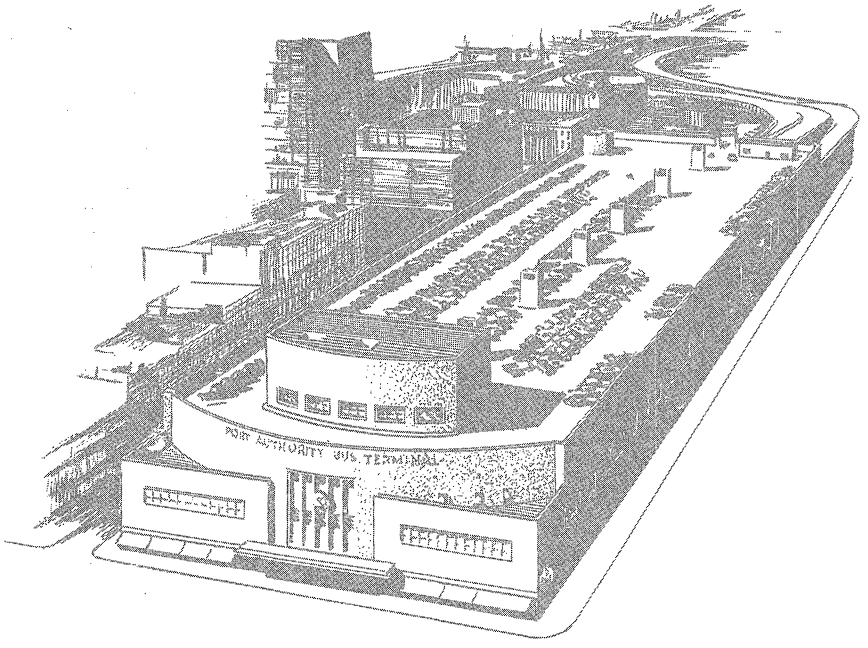


fer station at the Erie main line in Secaucus; and the southerly connection to the Lackawanna Transfer station. The pattern of the scheme in New Jersey would conform to Plan 1 except for the gap between the Lackawanna and the Susquehanna Transfer stations. Included in this scheme would be the continued operation of the Hudson & Manhattan service to the Hudson Terminal but the eventual abandonment of the 33rd Street service as in Plans 1 and 2.

PLAN 4

The north extension of the BMT Broadway subway to the trans-Hudson tunnels at 59th Street and extending west to a transfer station at the main line of the Erie Railroad in Secaucus. Services to the south would be provided by the utilization of all of the Hudson & Manhattan facilities. To provide for Central Railroad of New Jersey commuters this plan includes the extension of the Hudson & Manhattan to a transfer station at Communipaw and an extension east to the IRT Lexington Avenue subway near Brooklyn Bridge station as well as the complete modernization of all of the Hudson & Manhattan Railroad facilities.

The studies also included a detailed examination of the effect on convenience, total investment, revenues and expenses for the first three schemes above outlined as compared with other schemes which would include continued operation of the Hudson & Manhattan's 33rd Street branch.



CHAPTER III

TRAFFIC ANALYSES

The facts developed by the 1955 origin and destination surveys, as well as by the journey-to-work questionnaire survey, described earlier, provided the basic data for estimating the usage of the various schemes considered for rapid transit between northern New Jersey and Manhattan. These data have been supplemented by information on fares, travel time, number of transfers and service rendered on different routes utilized by commuters in traveling from their origins in New Jersey to destinations in Manhattan.

Numerous graphs were plotted comparing present time, fare and transfer differentials for commuters with various origins and destinations. These analyses permitted the development of an allocation curve for trans-Hudson

passengers which agrees closely with actual practices under present conditions. The curve which was thus developed was used to allocate present riders to each new system studied. The percentage allocated varied with the relative total trip cost as computed by taking the passenger's time at two cents per minute plus five cents for each transfer and adding fares at the actual amounts paid.

Table 4 shows the percentage distribution of traffic between two alternative routes for varying cost differentials (estimated in dollars and cents) based on monetary allowances for the passenger's time and his transfers added to the fares paid. The curve derived from these figures was used throughout the studies in measuring the relative attractiveness of alternate routes when a passenger would have a choice between two or more.

Table 4

TRAFFIC ALLOCATION TO TRANS-HUDSON RAPID TRANSIT SCHEMES BETWEEN TWO COMPETITIVE ROUTES FOR VARYING COST DIFFERENTIALS

Differential in Cost	Percent of Traffic to	
	Superior Route	Inferior Route
$1.20	100	0
1.10	100	0
1.00	99	1
0.90	98	2
0.80	97	3
0.70	95	5
0.60	93	7
0.50	89	11
0.40	83	17
0.30	75	25
0.20	68	32
0.10	60	40
0.00	50	50

The term "superior route" refers to that route for which the total of out-of-pocket costs plus the estimated monetary equivalent of travel time, transfers, and other features is less than the total of these items for the next best alternate route, termed the "inferior route".

SCHEMES STUDIED

The four basic schemes as listed in the previous chapter were included in the study. Various combinations of rapid transit operations, however, extended the number of individual studies to more than thirty. These alternatives were concerned mostly with variations in the assumptions made with respect to future use of Hudson & Manhattan Railroad facilities. Allocations were made both on the basis of continuance of the 33rd Street Branch and on the assumption that it would be closed. They contemplated continued H&M service to the Hudson Terminal in all cases, with extension into the Lexington Avenue subway in some alternates. Assumptions made in connection with services to be provided by several suburban railroads and bus operators in New Jersey follow:

Hudson & Manhattan Railroad

It was assumed that all New Jersey stations of the H&M would be retained, and that the routing of trains would be similar to the present except in those schemes in which the 33rd Street leg would be abandoned as well as in those schemes in which the south leg would be extended in the IRT Lexington Avenue subway. It was contemplated that a new station would be built where the proposed bi-state system crossed the H&M for transfer of passengers between those two carriers. The complete modernization of all of the railroad facilities involved in each of the several schemes, as described elsewhere, is assumed. It is also assumed that the H&M facilities would either be owned or controlled by a public agency so as to provide a non-competitive, completely coordinated system of rapid transit, including the proposed new rapid transit railroads as well as the railroad facilities now owned by the H&M.

Central of New Jersey Railroad

It was assumed for all schemes that the Central of New Jersey Railroad ferry would be abandoned. Passengers would transfer to the bi-state system at the proposed CNJ Transfer station on the bi-state loop near the present New Jersey ferry terminal. In the case of Plan 4, the H&M service would be extended to a new transfer station at Communipaw.

Erie Railroad

It is proposed to abandon the Erie Railroad ferries under all schemes. For the loop schemes—Plans 1 and 2—the Erie main line, Bergen County Railroad, and New Jersey and New York Railroad would be routed into the Susquehanna Transfer station of the bi-state loop over a new right-of-way extending from the Erie main line immediately east of the Hackensack River in Secaucus.

For Plans 3 and 4, these lines of the Erie Railroad would continue to operate over the Erie main line tracks into the DL&W Transfer station and the H&M Hoboken Station. The Northern Railroad of New Jersey would terminate at Susquehanna Transfer in all schemes. The Newark Branch, the Greenwood Lake Branch, and the Caldwell Branch would continue to deliver passengers to the Lackawanna Transfer station of the bi-state loop and to the H&M system on all plans.

Lackawanna Railroad

The abandonment of the Lackawanna ferry is assumed in all schemes. Passengers in the future would have the opportunity to transfer to the bi-state loop at the Lackawanna Transfer station or to the H&M system at the Hoboken Station.

New York Central System, West Shore Route

It is assumed that both the Cortlandt Street and 42nd Street ferries of the New York Central would be discontinued. Passengers would transfer to the bi-state system at the West Shore Transfer station.

Pennsylvania Railroad

It is assumed that the Pennsylvania Railroad would continue to operate its trains into the Pennsylvania Station as at present. The Susquehanna Transfer station has been so located and planned, however, that the facilities for transferring Pennsylvania suburban passengers to trans-Hudson rapid transit facilities could be installed at any future date.

Port Authority Bus Terminal

It is proposed that buses would continue to operate into the bus terminal. Service would also be available to the Susquehanna Transfer station, either by discharge from interstate carriers having the right to carry intrastate passengers or by new intrastate service. Buses passing the West Shore station would also stop for the transfer of passengers. The probabilities are that the bus operators would split their service so that a portion of the buses would terminate at either the Susquehanna or West Shore Transfer stations and that the remainder would go directly into the Port Authority Bus Terminal without stopping at these locations.

George Washington Bridge Bus Passengers

It was assumed that the buses would continue to operate into a terminal or terminals in the vicinity of the east end of the George Washington Bridge. Additional bus service would be installed to the West Shore and the Susquehanna Transfer stations for those George Washington Bridge bus passengers who would be better served by such service combined with the use of the proposed bi-state rapid transit facilities.

TRAFFIC ALLOCATIONS

Public Transit Passengers

Table 5 shows the fares and the type of transfer assumed for the purpose of estimates of traffic and revenues for the four basic trans-Hudson rapid transit plans. Because of complications which might result from any modification of the basic 25-cent fare for Plan 1, we have shown the fare for intrastate trips in both Manhattan and New Jersey to be 25 cents. No intrastate New Jersey trips have been estimated for Plan 1 because of this comparatively high fare for service in this area. It is likely, however, that a fare structure could be developed for intra-New Jersey passengers which would produce a modest increase in revenue traffic not now included in our estimates.

Table 5

FARES AND TYPES OF TRANSFERS ASSUMED
FOR VARIOUS TRANS-HUDSON RAPID TRANSIT PLANS

Plan	Service	Trans-Hudson Fare	Intrastate Fare*	Transfer to H&M	Transfer to New York Subways
1	Loop	$0.25	$0.25	Pay	Pay
	H&M	0.20	0.10	—	Pay
2	Loop	0.30	0.15	Free	Free
	H&M	0.30	0.15	—	Free
3	Rapid Transit	0.30	0.15	Free	Free
	H&M	0.30	0.15	—	Free
4	Rapid Transit	0.30	0.15	—	Free
	H&M	0.30	0.15	—	Free

*Excludes joint Pennsylvania-H&M service between Journal Square and Newark.

The assumed fare structures for all plans would represent an increase over present low fares for the trans-Hudson portions of commuters' trips. Nevertheless, the estimated revenues would not be sufficient under any plan to offset all operating costs and fixed charges. Since there would be many who would benefit from the new facilities besides the commuters themselves, we consider it proper that the general public bear a portion of the total cost of providing the service. Final determination of the fare structure should be a matter of administrative policy to be decided by a future bi-state authority. The fare structure would affect the amount of the deficit to be offset from other funds, but any reasonable variation in fares from those assumed herein is not likely to materially change the estimated use of the system.

The 30-cent fare shown for Plans 2, 3 and 4 in the table above is the assumed average fare used in allocating present passengers to the various schemes. Appropriate fare schedules and fare collection systems would presumably be devised at the proper time.

Table 6 shows the trans-Hudson passenger volumes by carrier or service for a typical weekday in 1955. These were the basic volumes used in the allocations.

Future travel time, fares and number of transfers were computed for all rapid transit schemes considered. It may be reasonably assumed that trans-Hudson commuters will continue to place the same values on time,

transfers and costs as they do at present in deciding whether to use the bi-state system or an alternate competing system. The derived curves were used, therefore, to allocate traffic between the various rapid transit plans and the competing service. Time, transfers, fares and the total monetary values were computed for all alternate routes for all districts in Manhattan to transfer stations and other common points west of the Hudson River. Cost differentials were then computed, percentages determined and individual allocations made. The traffic allocations to all four plans are shown on Tables 7, 8, 9 and 10.

Table 6

TRANS-HUDSON PASSENGER VOLUMES BY CARRIER OR SERVICE
TYPICAL WEEKDAY IN 1955

Carrier	Code Number	Typical Weekday—1955 24-Hour Round Trips	Typical Weekday—1955 Peak Hour One-Way Trips
HUDSON & MANHATTAN RAILROAD			
Newark	10	10,713	1,770
Journal Square	12	14,653	5,053
Grove-Henderson	13	7,460	1,899
Exchange Place	14	6,399	2,533
Erie Station	15	6,868	4,552
DL&W Station	16	16,790	7,759
TOTAL		62,883	23,566
RAILROAD FERRIES			
CNJ	20	15,881	9,602
Erie	21	9,183	6,586
DL&W	22	9,868	6,129
NYC-42nd Street	23	5,620	2,080
NYC-Cortlandt Street	24	2,529	2,103
TOTAL		43,081	26,500
BUSES			
George Washington Bridge	30	27,908	6,161
Port Authority Bus Terminal	50	63,191	16,073
TOTAL		91,099	22,234
OTHER			
Pennsylvania Railroad	60	22,619	6,350
Total transit		219,682	78,650
AUTOMOBILE USERS			
Destinations on Manhattan Island south of 59th Street		46,465	4,376
All other destinations		117,238	5,920
Total automobile users		163,703	10,296
GRAND TOTAL		383,385	88,946

Table 7

ALLOCATIONS OF RAIL, BUS AND AUTOMOBILE USERS TO PLAN 1
TYPICAL WEEKDAY — 1955

Present Public Transit Service or Station	1955 Traffic		Allocation to New Rapid Transit			Allocation to H&M	
	24-Hour Round Trip	Peak Hour One Way	Percent	24-Hour Round Trip	Peak Hour One Way	24-Hour Round Trip	Peak Hour One Way
HUDSON & MANHATTAN RAILROAD							
Newark	10,713	1,770	44.7	4,789	791	5,924	979
Journal Square	14,653	5,053	44.7	6,550	2,259	8,103	2,794
Grove-Henderson	7,460	1,899	56.2	4,193	1,067	3,267	832
Exchange Place	6,399	2,533	38.6	2,470	978	3,929	1,555
Erie Station	6,868	4,552	90.7	6,229	4,129	639	423
DL&W Station	16,790	7,759	69.6	11,686	5,400	5,104	2,359
Total	62,883	23,566	—	35,917	14,624	26,966	8,942
RAILROAD FERRIES							
CNJ	15,881	9,602	100.0	15,881	9,602	—	—
Erie	9,183	6,586	90.9	8,347	5,987	836	599
DL&W	9,868	6,129	60.6	5,980	3,714	3,888	2,415
NYC-42nd Street	5,620	2,080	90.1	5,064	1,874	—	—
NYC-Cortlandt Street	2,529	2,103	96.9	2,451	2,038	—	—
Total	43,081	26,500	—	37,723	23,215	4,724	3,014
BUSES							
George Washington Bridge	27,908	6,161	20.1	5,620	1,238	—	—
Lincoln Tunnel	63,191	16,073	49.1	31,027	7,892	—	—
Total	91,099	22,234	—	36,647	9,130	—	—
PENNSYLVANIA RAILROAD	22,619	6,350	4.2	949	267	—	—
Present Transit Users	219,682	78,650	—	111,236	47,236	31,690	11,956
Present Automobile Users	46,465*	4,362*	10.0	4,500	450	—	—
GRAND TOTAL	266,147	83,012	—	115,736	47,686	31,690	11,956

* Only those with destinations on Manhattan Island south of 59th Street.

Table 8

ALLOCATIONS OF RAIL, BUS AND AUTOMOBILE USERS TO PLAN 2

TYPICAL WEEKDAY — 1955

Present Public Transit Service or Station	1955 Traffic		Allocation to New Rapid Transit			Allocation to H&M	
	24-Hour Round Trip	Peak Hour One Way	Percent	24-Hour Round Trip	Peak Hour One Way	24-Hour Round Trip	Peak Hour One Way
HUDSON & MANHATTAN RAILROAD							
Newark	10,713	1,770	49.7	5,324	880	5,389	890
Journal Square	14,653	5,053	49.5	7,253	2,501	7,400	2,552
Grove-Henderson	7,460	1,899	52.6	3,924	999	3,536	900
Exchange Place	6,399	2,533	40.6	2,598	1,028	3,801	1,505
Erie Station	6,868	4,552	90.3	6,202	4,110	666	442
DL&W Station	16,790	7,759	66.0	11,081	5,121	5,709	2,638
Total	62,883	23,566	—	36,382	14,639	26,501	8,927
RAILROAD FERRIES							
CNJ	15,881	9,602	100.0	15,881	9,602	—	—
Erie	9,183	6,586	92.0	8,448	6,059	735	527
DL&W	9,868	6,129	64.9	6,404	3,978	3,464	2,151
NYC-42nd Street	5,620	2,080	90.1	5,064	1,874	—	—
NYC-Cortlandt Street	2,529	2,103	96.9	2,451	2,038	—	—
Total	43,081	26,500	—	38,248	23,551	4,199	2,678
BUSES							
George Washington Bridge	27,908	6,161	18.7	5,219	1,152	—	—
Lincoln Tunnel	63,191	16,073	45.6	28,815	7,329	—	—
Total	91,099	22,234	—	34,034	8,481	—	—
PENNSYLVANIA RAILROAD	22,619	6,350	2.0	452	127	—	—
Present Transit Users	219,682	78,650	—	109,116	46,798	30,700	11,605
Present Automobile Users	46,465*	4,362*	5.0	2,000	200	—	—
GRAND TOTAL	266,147	83,012	—	111,116	46,998	30,700	11,605

*-Only those with destinations on Manhattan Island south of 59th Street.

Table 9

ALLOCATIONS OF RAIL, BUS AND AUTOMOBILE USERS TO PLAN 3

TYPICAL WEEKDAY — 1955

Present Public Transit Service or Station	1955 Traffic		Allocation to New Rapid Transit			Allocation to H&M	
	24-Hour Round Trip	Peak Hour One Way	Percent	24-Hour Round Trip	Peak Hour One Way	24-Hour Round Trip	Peak Hour One Way
HUDSON & MANHATTAN RAILROAD							
Newark	10,713	1,770	47.7	5,110	844	5,603	926
Journal Square	14,653	5,053	48.3	7,077	2,441	7,576	2,612
Grove-Henderson	7,460	1,899	51.3	3,827	974	3,633	925
Exchange Place	6,399	2,533	39.7	2,540	1,006	3,859	1,527
Erie Station	6,868	4,552	66.9	4,595	3,045	2,273	1,507
DL&W Station	16,790	7,759	62.0	10,410	4,811	6,380	2,948
Total	62,883	23,566	—	33,559	13,121	29,324	10,445
RAILROAD FERRIES							
CNJ	15,881	9,602	100.0	15,881	9,602	—	—
Erie	9,183	6,586	60.8	5,583	4,004	3,600	2,582
DL&W	9,868	6,129	63.1	6,227	3,867	3,641	2,262
NYC-42nd Street	5,620	2,080	90.1	5,064	1,874	—	—
NYC-Cortlandt Street	2,529	2,103	96.9	2,451	2,038	—	—
Total	43,081	26,500	—	35,206	21,385	7,241	4,844
BUSES							
George Washington Bridge	27,908	6,161	16.3	4,549	1,004	—	—
Lincoln Tunnel	63,191	16,073	44.6	28,183	7,169	—	—
Total	91,099	22,234	—	32,732	8,173	—	—
PENNSYLVANIA RAILROAD	22,619	6,350	1.6	373	102	—	—
Present Transit Users	219,682	78,650	—	101,870	42,781	36,565	15,289
Present Automobile Users	46,465*	4,362*	5.0	2,000	200	—	—
GRAND TOTAL	266,147	83,012	—	103,870	42,981	36,565	15,289

*-Only those with destinations on Manhattan Island south of 59th Street.

Table 10
ALLOCATIONS OF RAIL, BUS AND AUTOMOBILE USERS TO PLAN 4
TYPICAL WEEKDAY — 1955

Present Public Transit Service or Station	1955 Traffic		Allocation to New Rapid Transit			Allocation to H&M	
	24-Hour Round Trip	Peak Hour One Way	Percent	24-Hour Round Trip	Peak Hour One Way	24-Hour Round Trip	Peak Hour One Way
HUDSON & MANHATTAN RAILROAD							
Newark	10,713	1,770	—	—	—	10,713	1,770
Journal Square	14,653	5,053	—	—	—	14,653	5,053
Grove-Henderson	7,460	1,899	—	—	—	7,460	1,899
Exchange Place	6,399	2,533	—	—	—	6,399	2,533
Erie Station	6,868	4,552	61.5	4,222	2,799	2,646	1,753
DL&W Station	16,790	7,759	—	—	—	16,790	7,759
Total	62,883	23,566	—	4,222	2,799	58,661	20,767
RAILROAD FERRIES							
CNJ	15,881	9,602	—	—	—	15,881	9,602
Erie	9,183	6,586	57.7	5,297	3,800	3,886	2,786
DL&W	9,868	6,129	—	—	—	9,868	6,129
NYC-42nd Street	5,620	2,080	90.1	5,064	1,874	—	—
NYC-Cortlandt Street	2,529	2,103	96.9	2,451	2,038	—	—
Total	43,081	26,500	—	12,812	7,712	29,635	18,517
BUSES							
George Washington Bridge	27,908	6,161	16.3	4,549	1,004	—	—
Lincoln Tunnel	63,191	16,073	44.6	28,183	7,169	—	—
Total	91,099	22,234	—	32,732	8,173	—	—
PENNSYLVANIA RAILROAD	22,619	6,350	—	—	—	—	—
Present Transit Users	219,682	78,650	—	49,766	18,684	88,296	39,284
Present Automobile Users	46,465*	4,362*	2.5	1,000	100	—	—
GRAND TOTAL	266,147	83,012	—	50,766	18,784	88,296	39,284

*-Only those with destinations on Manhattan Island south of 59th Street.

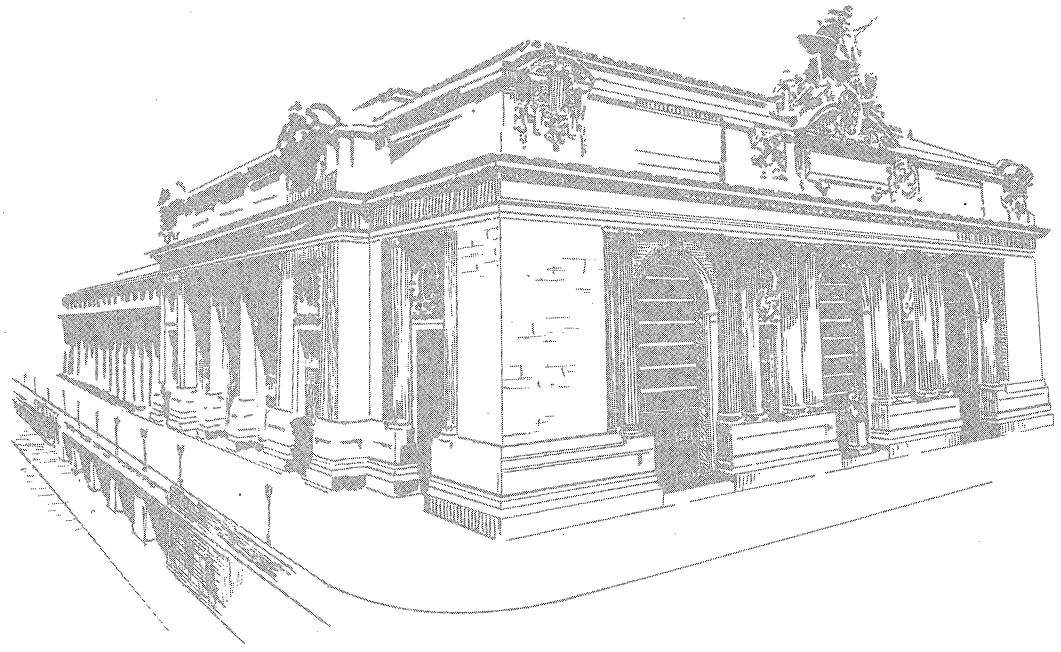
Automobile Passengers

Some 46,000 passengers daily now travel by automobile between origins in the New Jersey sector of the metropolitan area and destinations on Manhattan Island south of 59th Street. It is likely that virtually all of these individuals find greater convenience in automobile travel, but it is also known that most of them incur greater cost than would be involved in the use of public transportation facilities.

The movements of these 46,000 individuals are diverse and complex. It is almost impossible to determine, in a manner comparable with that utilized in making allocations of public transit passengers, the number who would use new public transit facilities. Data are available, however, on the numbers attracted to new superior public transit facilities from those who formerly used automobiles for their daily travel. Bases for estimates may be found in the journey-to-work survey as well as in recent studies of traffic on the Yonge Street subway in Toronto and on the Cleveland Rapid Transit.

The traffic studies in Toronto and in Cleveland indicate that, of the total number of individuals formerly using automobiles, five to ten percent have been attracted to the new rapid transit facility. There are factors present in connection with trans-Hudson commuter travel which are absent in both Toronto and Cleveland. The first is the toll charge of 25 to 50 cents per vehicle for each one-way trip across the Hudson River; the second is the more acute shortage of parking space in Manhattan Island and the higher parking charges (from two to three times those in the other two cities). Thus, the greater cost of automobile use in the New York area will operate to attract a greater portion of passengers to new modern rapid transit service than experienced in Toronto and Cleveland. Considering all factors, we have concluded that at least ten percent of those now driving their own automobiles would be attracted to public transit in the case of an entirely new convenient service as proposed in Plan 1. We estimate, therefore, a total of 4,500 passengers from this source on a typical weekday.

For the other plans, which involve extensions of New York City subways, the added convenience would be less marked and the number of passengers attracted to public transit less. We have estimated a total of 2,000 passengers diverted from automobiles on a typical weekday for Plans 2 and 3 and 1,000 passengers for Plan 4.



Manhattan Passengers

Undoubtedly there would be traffic generated within New York City proper from groups of passengers who would use portions of the new Madison Avenue subway in Plan 1 for travel between 59th Street and Wall Street. Unfortunately, there are no data available covering origins and destinations of passengers on the New York City subway system. We do have available, however, useful statistics covering volumes of traffic on the several subway routes with which we are concerned as well as the number of passengers entering subway stations during a normal 24-hour weekday. In the case of many local stations, we have data covering northbound and southbound passengers separately.

We have assembled and collated the principal facts which bear directly or indirectly on the determination of the number of trips which would be made on the Madison Avenue subway by four groups of Manhattan riders. These pertinent facts will be summarized below together with our approximations of induced traffic at the assumed premium fare of 25 cents (compared with the 15-cent subway fare). In the absence of origin-destination data we must state frankly that these estimates are largely judgment figures.

The groups which should be considered in arriving at an estimate of Manhattan traffic are as follows:

Commuters using Grand Central Terminal;
Other Lexington Avenue subway traffic;
Columbus Circle-to-Madison Avenue subway stations; and
Residents in apartments and employees in office buildings and stores in the Fifth Avenue, Madison Avenue and Park Avenue districts.

Grand Central Commuters

A recent Westchester County origin and destination survey indicates that 11,000 commuters arriving at the Grand Central Terminal have destinations in downtown New York which could be conveniently reached by the proposed Madison Avenue subway. We assume that the 42nd Street station on the Madison Avenue subway (Plan 1) would be provided with a convenient connection at basement level between the Grand Central Terminal proper and the Madison Avenue subway station. An analysis of the diversion of passengers from the Lexington Avenue subway, based on the same allowances for travel time and cost as made in our trans-Hudson traffic allocation studies, indicates that 39 percent of the rush hour riders (30 percent of the total) would use the bi-state loop, or approximately 4,300 round trips daily.

Other Lexington Avenue Subway Traffic

The Lexington Avenue subway carries an estimated 57,000 persons northbound from the Bowling Green, Wall and Fulton stations in 24 hours. Data on passengers entering stations on the Lexington Avenue subway show that those traveling to stations between 14th and 59th Streets comprise approximately 30 percent of the total Lexington Avenue subway system traffic. Applying this percentage to the total of 57,000 passengers who travel to and from the downtown stations, we arrive at a potential of approximately 17,000 passengers on a normal 24-hour weekday. From this number we have deducted the 11,000 commuters mentioned above, which group has already been accounted for, leaving a total of 6,000 passengers to be considered. The number who would pay a premium fare might be appreciable in the case of those who travel during the crowded rush hours but would be small during the other hours of the day. In view of the terrific rush hour conges-

tion on the Lexington Avenue subway platforms and trains between Wall Street and Grand Central stations, we consider an approximation of between 20 and 25 percent would be reasonable—say 1,400 round trips daily.

Columbus Circle to Madison Avenue Subway Stations

The provision of an entirely new subway rapid transit route between Columbus Circle and the Madison Avenue stations between 59th Street and Wall Street would undoubtedly generate a substantial amount of new traffic. No data are available for the preparation of specific estimates for such traffic. Certain available factors, however, are of interest.

The total number of passengers entering the Columbus Circle Station on a normal weekday is approximately 45,000. Information from the New York City Transit Authority indicates that some 5,000 persons utilize the subway in traveling to major events at the new Coliseum. There are major developments in prospect for the Columbus Circle area including the new Metropolitan Opera House, a new Symphony Hall and a major residential development with related facilities in Lincoln Square to the northwest.

It is inconceivable that a new modern subway with direct service between Columbus Circle and such important focal centers on the East Side at 42nd Street, 34th Street and 14th Street would not induce travel on the bi-state loop subway. The subway facilities available now for travel between Columbus Circle and the Grand Central area and other midtown areas tapped by the proposed Madison Avenue subway involve travel north and south on the Lexington Avenue subway to a transfer to the BMT Astoria line at 60th Street; or via the Times Square-Grand Central Terminal shuttle to the IRT Seventh Avenue line. It is our opinion that a figure of 1,300 round trips daily could be estimated conservatively for this new traffic.

Residents and Employees in the Madison Avenue District

There have been spectacular new office building developments along Fifth, Madison, Park and other nearby avenues which would be conveniently served by the proposed Madison Avenue subway. This area is also the site of many high-class apartment buildings providing homes for people employed in downtown New York.

Considering both residents and employees, predominantly in high income groups, we anticipate substantial patronage of the Madison Avenue subway. Our judgment figure is a total of 5,000 round trips daily at the premium 25-cent fare assumed for Plan 1.

Annual Traffic

It was necessary to determine the relation of typical weekday traffic as counted in November 1955 to weekday traffic during the other eleven months of the year. For this analysis we had available numerous records maintained by the staff of the Port of New York Authority for many years. These included summaries of numerous traffic counts of New Jersey suburban transit passengers on both railroad and bus lines, as well as periodical reports made by the suburban carriers giving monthly totals of revenue traffic. Our analysis showed that counts taken on a typical weekday in November are fairly representative of average weekday traffic throughout the year, and consequently no factor was needed to correct these basic figures from our 1955 surveys.

A study was made of the ratio of total annual traffic to typical weekday operations of both the New York City Transit Authority and the Hudson & Manhattan Railroad Company. Annual traffic on both systems was equal to approximately 295 times normal weekday traffic. This figure was utilized in expanding our estimates of weekday traffic on various proposed systems to total annual traffic.

Provision for Future Traffic

The great shifts in the places people will live, work and carry on commercial activities defy exact determination of either the quantity or the pattern of future trans-Hudson commuter traffic. We know, however, that every new transportation facility generates new trips which were not previously made. This is as true of transit systems as it is of highways, bridges and tunnels.

In the past forty years, during which there have been substantial improvement in public transportation equipment and operation, we have had the opportunity to review the results of many improvements in the broad field

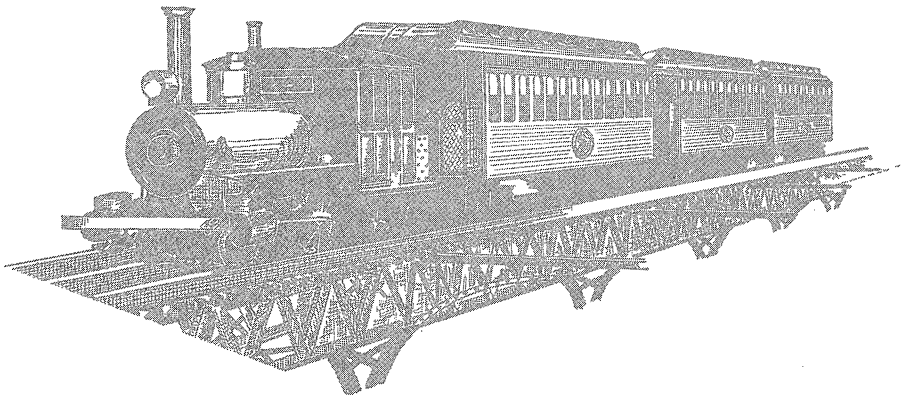
of transportation. We know of no situation where the provision of either a new or improved facility has failed to generate a volume of induced traffic over and above that which could be estimated on the basis of the facts relating to travel habits existing prior to the improvement.

There are examples of such induced traffic in every field of transportation. In the field of public passenger transportation, induced traffic has been experienced as the result of:

Substitution of electric streetcars for horse cars;
Substitution of buses for obsolete electric streetcars;
Substitution of modern (PCC) streetcars for obsolete streetcars;
Installation of express bus services;
Operation of improved rapid transit car equipment with higher speeds and added convenience;
Construction and operation of new rapid transit lines;
Operation of diesel-electric locomotives and modern air-conditioned cars in suburban services;
Operation of modern air-conditioned lightweight cars in trunk line passenger service;
Operation of modern air-conditioned intercity buses; and
Increased speed and convenience of air travel.

Improved trans-Hudson facilities would encourage substantial numbers of people employed in New York City to seek homes in the attractive environment of New Jersey communities. The building of convenient rapid transit, therefore, would have a profound effect on the location and extent of new residential developments. The result would be a gradually increasing number of workers living west of the Hudson River and requiring daily transportation into New York in excess of predictions of RPA. The present office building boom in midtown and downtown Manhattan gives weight to our opinion that New York will employ increasing numbers of white-collar workers of which a goodly portion will be suburban commuters.

Consideration of these factors leads us to the opinion that increased commuter traffic on the bi-state loop is a reasonable expectation during the years following the start of operation on this vastly improved transit facility. Prudent planning, therefore, requires the provision of surplus capacity in the rapid transit system over and above that estimated on the basis of traffic prevailing in the year 1955.



CHAPTER IV

OPERATING STUDIES

Service Standards

Comparable service standards were assumed in all four plans. Preliminary schedules forming the basis of estimates of operating expenses assumed a 20-hour operation, permitting suspension from 1:00 A.M. to 5:00 A.M. This has been found practicable on rapid transit systems elsewhere and results in worthwhile reductions in expenses during the four-hour period. Cleaning and maintenance work can be carried on with maximum efficiency and the labor cost of cashiers and station attendants saved.

Maximum headways of six minutes would be scheduled throughout the 20-hour day, both weekdays and week ends, with seats for all passengers provided during the day base and evening hours. During the rush hours it would be necessary to carry standees, but the standing load would be limited in most cases to relatively short runs between the easternmost transfer station in New Jersey and the first two or three subway stations in Manhattan.

Service standards utilized in planning rush hour services on the several plans are summarized on page 74.

Table 11

RUSH HOUR SERVICE STANDARDS

	Cars	Train Length in Feet	Passengers per Train			Load Factor	Square Feet per Standee
			Seated	Standees	Total		
PLAN 1							
Subway	4*	592	640	860	1,500	2.3	2.80
H&M	6	300	264	396	660	2.5	2.87
PLAN 2							
Subway	8	480	432	868	1,300	3.0	2.95
H&M	6	300	264	396	660	2.5	2.87
PLAN 3							
Subway	8	480	432	868	1,300	3.0	2.95
H&M	6	300	264	396	660	2.5	2.87
PLAN 4							
Subway	8	480	432	868	1,300	3.0	2.95
H&M	10	500	440	660	1,100	2.5	2.87

*Three-car articulated unit.

Proposed Operations and Initial Traffic Volumes

Plan 1—Independent Bi-State Loop Plus Modernized H&M Service to Hudson Terminal

There would be continuous service on the rapid transit loop, both clockwise and counterclockwise. Allocations of traffic to Plan 1 produced a total of 53,300 round trip passengers through the north tunnel and 62,400 round trip passengers through the south tunnel, a total of 115,700 trans-Hudson passengers on a normal weekday (1955 base). The term "round trip passengers" means that there would be 115,700 daily one-way trips eastbound and 115,700 daily one-way trips westbound. The peak hour one-way traffic is estimated at 18,600 passengers through the north tunnel and 29,100 passengers through the south tunnel. The H&M service to the Hudson Terminal would accommodate approximately 31,700 passengers daily with peak hour one-way traffic of some 12,000 passengers.

Plan 2—Bi-State Loop Incorporating BMT Broadway Subway Plus Modernized H&M Service to Hudson Terminal

The service proposed under this plan would be similar to that contemplated in Plan 1. Traffic estimated at 1955 levels would amount to

52,700 round trip passengers daily through the north tunnel and 58,400 through the south tunnel, a total of 111,100 round trip trans-Hudson passengers on the rapid transit loop and 30,700 round trip passengers on the H&M. The peak hour one-way traffic is estimated at 17,900 passengers through the north trans-Hudson rapid transit tunnel, 29,100 passengers through the south trans-Hudson tunnel, and 11,600 passengers through the H&M tubes, a total of 58,600 one-way passengers in the peak hour.

Plan 3—Extension of BMT Broadway Subway to the Erie Main Line at Secaucus and to Lackawanna Transfer Plus Modernized H&M Service to Hudson Terminal

There would be service during 20 hours of each day in both directions on the rapid transit line between the Erie Transfer station in Secaucus on the north and the Lackawanna Transfer station on the south. The H&M service between Hoboken, Exchange Place and Newark on the west and the Hudson Terminal on the east would be continued as at present. Total trans-Hudson passengers on the New Jersey rapid transit operation on a typical weekday is estimated at 49,200 round trip passengers through the north tunnel and 54,700 round trip passengers through the south tunnel, a total of 103,900 passengers. Peak hour one-way traffic through the north trans-Hudson tunnel has been estimated at 17,700 and through the south tunnel at 25,300. The total daily round trip passengers estimated to be handled by the H&M service would be 36,600 with the peak hour one-way traffic of some 15,300.

Plan 4—Extension of BMT Broadway Subway to the Erie Main Line at Secaucus Plus Both Branches of the H&M With an Extension of the H&M to the CNJ at Communipaw

There would be 20-hour per day service on the rapid transit line between the Erie Transfer station in Secaucus on the west and terminals on the BMT system in Brooklyn or at turnback points in downtown Manhattan as required. The H&M service would be operated from existing New Jersey terminals at Hoboken, Journal Square and Newark, and also from a new terminal at Communipaw, through the existing Hudson Terminal tubes. A new connection with the Lexington Avenue subway near the Brooklyn

Table 12

ALLOCATIONS OF PRESENT TRANS-HUDSON PUBLIC TRANSIT AND AUTOMOBILE USERS TO PROPOSED RAPID TRANSIT— PLANS 1, 2, 3 and 4 — TYPICAL WEEKDAY — 1955

Transfer Station on New System	PLAN 1			PLAN 2			PLAN 3			PLAN 4		
	North Tunnel*	South Tunnel†	Total	North Tunnel*	South Tunnel†	Total	North Tunnel*	South Tunnel†	Total	North Tunnel*	South Tunnel†	Total
Round Trip Daily Volumes												
Jersey Central	—	16,830	16,830	—	16,333	16,333	—	16,126	16,126	—	—	—
H&M	1,020	16,610	17,630	4,526	14,200	18,726	—	18,182	18,182	—	—	—
Lackawanna	5,862	14,304	20,166	8,582	11,481	20,063	—	19,284	19,284	—	—	—
Susquehanna	29,155	11,676	40,831	27,219	11,499	38,718	33,254	—	33,254	34,742	—	34,742
West Shore	15,230	549	15,779	11,474	3,802	15,276	15,024	—	15,024	15,024	—	15,024
Total Transit Users	51,267	59,969	111,236	51,801	57,315	109,116	48,278	53,592	101,870	49,766	—	49,766
Total Automobile Users	2,080	2,420	4,500	950	1,050	2,000	950	1,050	2,000	1,000	—	1,000
Total on New System	53,347	62,389	115,736	52,751	58,365	111,116	49,228	54,642	103,870	50,766	—	50,766
Hudson & Manhattan	—	31,690	31,690	—	30,700	30,700	—	36,565	36,565	25,164	63,132	88,296
GRAND TOTAL			147,426			141,816			140,435			139,062
Peak Hour One-Way Volumes												
Jersey Central	—	9,869	9,869	—	9,729	9,729	—	9,669	9,669	—	—	—
H&M	255	4,729	4,984	1,198	4,099	5,297	—	5,147	5,147	—	—	—
Lackawanna	2,945	7,823	10,768	4,262	6,548	10,810	—	10,392	10,392	—	—	—
Susquehanna	9,355	6,304	15,659	8,865	6,263	15,128	11,797	—	11,797	12,908	—	12,908
West Shore	5,830	126	5,956	3,468	2,366	5,834	5,776	—	5,776	5,776	—	5,776
Total Transit Users	18,385	28,851	47,236	17,793	29,005	46,798	17,573	25,208	42,781	18,684	—	18,684
Total Automobile Users	208	242	450	95	105	200	95	105	200	100	—	100
Total on New System	18,593	29,093	47,686	17,888	29,110	46,998	17,668	25,313	42,981	18,784	—	18,784
Hudson & Manhattan	—	11,956	11,956	—	11,605	11,605	—	15,289	15,289	11,196	28,088	39,284
GRAND TOTAL			59,642			58,603			58,270			58,068

*-The North Tunnel refers to the 59th Street crossing for the new system and to the 33rd Street line of the H&M.

†-The South Tunnel refers to the Battery crossing of the new system and to the Hudson Terminal line of the H&M.

Bridge station would permit operation to terminals or turnback points in Manhattan or the Bronx, as required.

The entire system would be modernized, the sharp curves eliminated from the tunnels between Exchange Place and Hudson Terminal, new rapid transit car equipment provided and service accelerated as permitted by better equipment.

Total round trip daily trans-Hudson passengers through the north tunnel is estimated at 50,800, with peak hour one-way traffic of 18,800 passengers. Total round trip daily traffic on the H&M system is estimated at 88,300, of which 63,100 would be carried by the Hudson Terminal branch and 25,200 by the 33rd Street branch. Peak hour one-way traffic is estimated at 28,100 through the Hudson Terminal tubes and 11,200 through the 33rd Street branch tubes, a total of 39,300 one-way peak hour passengers.

Table 12 shows the public transit traffic allocated to each of the four plans by transfer station used together with estimated diversions from present automobile users. Maximum peak hour traffic would occur at Susquehanna Transfer station. Between 15,000 and 16,000 passengers would use this station during the peak hour on Plans 1 and 2, excluding diverted automobile users who could not be assigned to specific transfer stations. This number would decrease to 12,000 and 13,000 on Plans 3 and 4, respectively.

Table 13 shows the capacity of each new or improved trans-Hudson River tunnel proposed to be a part of each plan compared with the estimated number of one-way rush hour passengers.

Table 13

DESIGN CAPACITY OF PROPOSED NEW OR IMPROVED HUDSON RIVER TUNNELS COMPARED WITH ESTIMATED NUMBER OF ONE-WAY RUSH HOUR PASSENGERS

Facility	Plan 1			Plan 2			Plan 3			Plan 4		
	A	B	C	A	B	C	A	B	C	A	B	C
NEW TUNNELS												
North	45,000	18,600	41	39,000	17,900	46	39,000	17,700	45	39,000	18,800	48
South	45,000	29,100	65	39,000	29,100	75	39,000	25,300	65	—	—	—
H&M												
33rd Street Branch	—	—	—	—	—	—	—	—	—	19,800	11,200	57
Hudson Terminal	19,800	12,000	61	19,800	11,600	59	19,800	15,300	77	39,600	28,100	71
TOTAL	109,800	59,700	54	97,800	58,600	60	97,800	58,300	55	98,400	58,100	59

A=Rush hour one-way design capacity.
B=Rush hour one-way passengers, 1955 typical weekday.
C=Estimated use as a percentage of design capacity.

Table 14

ESTIMATED ANNUAL TRAFFIC AND REVENUES
PROPOSED RAPID TRANSIT PLANS 1, 2, 3 AND 4 — 1955

Present Means of Transportation	24-Hour Round Trip	Annual One-Way (Add 000)	Fare: Plan 1	Fare: Plans 2, 3 & 4	PLAN 1: Annual One-Way Traffic: Remaining	PLAN 1: Annual One-Way Traffic: Diverted (Add 000)	PLAN 1: Annual Revenue
New System							
H&M Railroad	62,883	37,100	$0.25	$0.30	15,910	21,190	$ 5,300
Railroad Ferries(1)	43,081	25,420	0.25	0.30	2,790(2)	22,260	5,560
Buses(1)	91,099	53,750	0.25	0.30	32,500(2)	21,620	5,410
Pennsylvania Railroad	22,619	13,340	0.25	0.30	12,780	560	140
Total Transit Users	219,682	129,610			63,980	65,630	$16,410
Automobile	46,465(3)	27,410(3)	0.25	0.30	24,750	2,660	$ 660
Intra-Manhattan	—	—	0.25	—	—	7,080	1,770
Intra-New Jersey	—	—	0.25	0.15	—	0	0
Total						9,740	$ 2,430
H&M							
Trans-Hudson—Newark	(Included in above		0.15(4)	0.25(4)	—	3,480	$ 520
Trans-Hudson—Other	Figures)		0.20	0.30	—	15,220	3,040
Intra-Manhattan	441	260	—	0.10	260(5)	0	0
Intra-New Jersey	2,779	1,640	0.10	0.10	140(6)	1,500	150
Total H&M Users						20,200	$ 3,710
Advertising and Concessions	—	—			—	—	$ 250
GRAND TOTAL						95,570	$22,800
Collected by or paid to New York Transit Authority for joint facility trips							0
TOTAL REVENUES							$22,800

(1) 370,000 annual railroad ferry passengers will use the buses upon the termination of ferry operation.

(2) Passengers from ferries who will use H&M.

(3) Automobile destinations on Manhattan Island south of 59th Street.

(4) Fare is five cents greater, but this amount is retained by the PRR.

(5) To the New York transit system.

(6) To local buses.

	PLAN 2			PLAN 3			PLAN 4		
	Annual One-Way Traffic		Annual Revenue	Annual One-Way Traffic		Annual Revenue	Annual One-Way Traffic		Annual Revenue
	Remaining	Diverted		Remaining	Diverted		Remaining	Diverted	
		Add 000			Add 000			Add 000	
	15,640	21,460	$ 6,440	17,300	19,800	$ 5,940	34,610	2,490	$ 750
	2,480(2)	22,570	6,770	4,280(2)	20,770	6,230	17,490(2)	7,560	2,270
	34,040(2)	20,080	6,020	34,810(2)	19,310	5,790	34,810(2)	19,310	5,790
	13,070	270	80	13,120	220	70	13,340	0	0
	65,230	64,380	$19,310	69,510	60,100	$18,030	100,250	29,360	$ 8,810
	26,230	1,180	$ 350	26,230	1,180	$ 350	26,820	590	$ 180
	—	0	0	—	0	0	—	0	0
	—	0	0	—	0	0	—	0	0
		1,180	$ 350		1,180	$ 350		590	$ 180
	—	3,190	$ 800	—	3,300	$ 830	—	6,320	$ 1,580
	—	14,930	4,480	—	18,280	5,480	—	45,780	13,730
	260(5)	0	0	260(5)	0	0	0	260	30
	140(6)	1,500	150	140(6)	1,500	150	0	1,640	160
		19,620	$ 5,430		23,080	$ 6,460		54,000	$15,500
	—	—	$ 210	—	—	$ 260	—	—	$ 210
		85,180	$25,300		84,360	$25,100		83,950	$24,700
			6,500			7,000			6,500
			$18,800			$18,100			$18,200

REVENUES

Estimates of revenues include all of the fares collected from passengers on the facilities operated, including fares collected from trans-Hudson passengers originating on routes of the Transit Authority, but excluding fares of intra-New Jersey passengers. Estimated revenues also include those derived from advertising and concessions. It has been suggested that there may be potential revenues from handling of freight, mail, express or such other goods as could be accommodated on the proposed transit systems, as well as from parking facilities which are to be provided as auxiliaries to the transit operation.

We have examined the practicability of making a connection between the north trans-Hudson tunnel of a bi-state loop and the New York Central freight tracks on the west side of Manhattan Island as proposed in recent years. While such a connection could be made, the elevation of the trans-Hudson tunnel is 20 to 40 feet below the elevation of the New York Central freight tracks. This connection would involve difficult physical problems which could only be solved at enormous construction cost. The estimate of cost for this connection is shown in Chapter II. As is pointed out in Chapter II, the revenue potential from this operation depends largely upon the amount of freight available and the net difference in the operating costs of the present method as compared with this proposed operation. While we have not studied this economic problem in detail, our preliminary investigation indicated that, because of the moderate lighterage costs in the New York area, we could not justify the expense involved for this connection.

There are, however, real possibilities in connection with the handling of mail and express. The U. S. Post Office Department is currently conducting a comprehensive study in the metropolitan area which could result in a substantial departure from the present arrangements of central stations and distributive facilities. In connection with this study, the New York City Transit Authority is testing the practicability of carrying mail to and from LaGuardia Field. The proposed ultimate abandonment of the 33rd Street branch of the H&M and the suspension of operation of the entire rapid transit system for four early morning hours suggest interesting possibilities. It is impossible at this time, however, to estimate potential revenues which could

be derived from mail, freight and express with any exactness. We, therefore, have not included net revenues from these sources.

While parking facilities which might be operated at a moderate profit are included in the several plans, we have assumed that a sound policy would be to charge fees which would provide for operation on a break-even basis and have estimated no net revenues from this source.

All estimates of revenues are based on allocations of traffic for the first year of operation at 1955 traffic levels. Estimates for all four plans are shown in Table 14.

Plan 1

Estimates of revenues for Plan 1 are based on a 25-cent one-way fare for loop rapid transit service with no free transfer to the New York subways. Continuation of the present fares on the H&M is assumed with no free transfer to the New York subways. Fare collection procedures on the H&M are assumed to continue as at present.

Plan 2

Estimates of revenues for Plan 2 are based on a 30-cent fare for trans-Hudson subway service including the fares of those who would transfer to the New York subways; a 15-cent fare for rides between New Jersey stations; and a 15-cent fare for Manhattan trips. In estimating total passenger revenues, it is assumed that the New York City Transit Authority would retain all revenues collected for trips originating on its system and in addition would be compensated in an amount equal to 15 cents for each New Jersey passenger whose trip included any use whatever of the existing Broadway subway.

It should be noted, however, that approximately one-half of the passengers now coming from New Jersey pay a fare to the Transit Authority. The payments to the Authority of $6,500,000 to $7,000,000 shown under the various plans, therefore, would, in effect, be reduced by the amounts already being paid by such two-fare riders. The exact amount to which the Transit Authority would be entitled in the proposed transfer arrangements could be exactly determined only after operations have been carried on for some time.

On Plans 2 and 3, additional trains would have to operate in the section of subway north of City Hall to serve the anticipated increase in traffic as well as to supply service for the north tunnel. It is assumed that the cost of such service would be included in the payments made for New Jersey passengers riding through on existing Transit Authority tracks.

Similarly, a fare averaging 30 cents is contemplated for H&M passengers traveling to or from New Jersey including a portion who would also use the New York subway system. A 15-cent fare on the H&M for trips in New Jersey is assumed.

Plan 3

Estimates of revenues for Plan 3 are based on the same fare schedules and assumptions with respect to compensation to the New York City Transit Authority as in the case of Plan 2.

Plan 4

Estimates of revenues for Plan 4 are based on the same fare schedules and assumptions with respect to compensation to the New York City Transit Authority as in the case of Plan 2.

OPERATING EXPENSES

All estimates of operating expenses are based on traffic during the initial year of operation as estimated in the preceding chapter. The total estimated number of car-miles operated in the several plans is shown in the following tabulation:

	Annual Car-Miles	
Plan	Trans-Hudson Service	Hudson & Manhattan Service
1	4,694,000*	2,241,000‡
2	6,900,000†	2,200,000‡
3	6,474,000†	2,460,000‡
4	3,834,000†	6,860,000‡

*-148-foot, three-car articulated units
†-Does not include mileage on New York City Transit Authority tracks.
‡-50-foot by 9-foot car.

The cost estimates are based on labor and material costs prevailing in the year 1956. They apply to a normal year, sometime after the operation of the new facilities has reached the point where full maintenance is in effect. It is likely that the maintenance expenses, both for way and structures and for car equipment, would be somewhat less during an initial two- or three-year period.

Maintenance of way and structures expenses on the proposed trans-Hudson rapid transit railroad were estimated on a per-mile basis for the several types of structures in all four plans, including subways, tunnels, elevated structures, and conventional open-type track. These figures were determined after an analysis of the way and structures expenses in New York, Philadelphia, Chicago and Toronto. They give effect to the reductions in maintenance expense resulting from the installation of welded rail modern track assembly with no ties in tunnels and subways, and modern structural glass station finish with stainless steel railings, doors and fittings. This item alo includes maintenance of signal and interlocking systems, communication system, D.C. and A.C. feeder and distribution systems, and all buildings and structures.

Estimates of maintenance of way and structures expense are based on costs now experienced on the H&M operation except for track maintenance, which has been reduced in view of the reduced cost of maintenance of modern welded rail throughout, the installation of which has been provided for in our estimates of cost.

Maintenance of equipment was estimated after review of these expenses for New York, Philadelphia, Chicago and Toronto, giving consideration to the probable effect on maintenance cost of the operation of an entirely new fleet of modern rapid transit cars.

Power costs were based on graphs supplied by the manufacturers for the high acceleration rapid transit cars contemplated on the system. An average rate of two cents per kilowatt hour was estimated, which makes allowance for additional power required for modern station lighting, as well as for the operation of substations. All substation operation, however, was assumed to be completely automatic, with modern centralized control. The power cost as thus estimated is somewhat higher than that now ex-

perienced on the New York subways due largely to the increased motive power and the higher lighting intensities proposed in subway stations.

The expense item for conducting transportation includes the cost of all motormen, conductors, trainmen, supervisors, signal tower operators, miscellaneous car service employees, and all transportation supervision. These expenses were developed on a car-mile basis from schedules prepared for the new trans-Hudson rapid transit service and using hourly scales and working rules currently effective on the New York City Transit Authority system.

Transportation expenses on the H&M operation were estimated on the basis of present wages and working agreements, modified, however, to give effect to the somewhat higher speeds made possible through the operation of cars with increased motive power. Station expenses were presumed to remain at their present level.

Injuries and damages expenses as well as general and miscellaneous expenses presently experienced on the New York City Transit Authority and the Hudson & Manhattan Railroad Company operations have been utilized in the estimates of expenses based on the number of passengers carried. In the case of the H&M, an additional item covering track rentals, amounting to $40,000 per year, has been included.

In estimating the amounts required for payments into a depreciation reserve, it was assumed that it would be necessary to set up reserves sufficient to replace all equipment and structures subject to renewal within a 50-year period. Payments into a depreciation reserve were established for each classification of equipment, such as cars, track, signals and electrical equipment based on the estimated useful life of each, on a three percent sinking fund basis.

Estimate of Operating Expenses

The following table shows the estimate of annual operating expenses on all four plans.

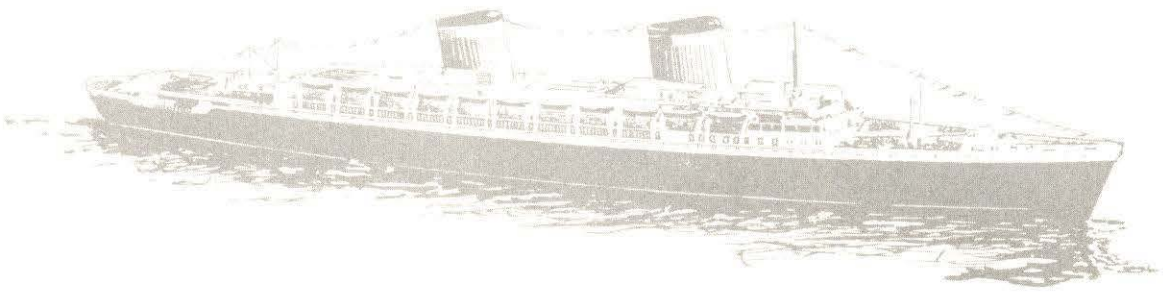


Table 15

ESTIMATES OF ANNUAL OPERATING EXPENSES

	PLAN 1		PLAN 2		PLAN 3		PLAN 4	
	Rapid Transit	Hudson & Manhattan	Rapid Transit*	Hudson & Manhattan	Rapid Transit*	Hudson & Manhattan	Rapid Transit*	Hudson & Manhattan*
Maintenance of Way and Structures	$ 778,000	$ 458,000	$ 540,000	$ 458,000	$ 515,000	$ 458,000	$ 280,000	$ 800,000
Maintenance of Equipment	657,000	157,000	483,000	154,000	453,000	172,000	268,000	480,000
Power	845,000	314,000	690,000	308,000	647,000	344,000	383,000	960,000
Conducting Transportation	1,647,000	1,205,000	1,175,000	1,195,000	1,371,000	1,260,000	809,000	3,175,000
Injuries and Damages	75,000	21,000	72,000	20,000	67,000	24,000	33,000	57,000
General and Miscellaneous	704,000	219,000	552,000	216,000	518,000	237,000	307,000	589,000
Depreciation	1,106,000	356,000	1,041,000	356,000	1,191,000	356,000	684,000	1,046,000
TOTAL—EACH SYSTEM	$5,812,000	$2,730,000	$4,553,000	$2,707,000	$4,762,000	$2,851,000	$2,764,000	$7,107,000
TOTAL—ENTIRE PLAN	$8,542,000		$7,260,000		$7,613,000		$9,871,000	

*-These expenses do not include cost of car-miles operated between the 57th Street and Wall Street area on New York City Transit Authority tracks.

CHAPTER V

FOUR RAPID TRANSIT PLANS

The engineering and operating studies of the four plans selected for detailed examination are summarized in the following description of each plan together with those estimates of construction cost and operating results required for final selection of a recommended plan.

PLAN 1

This plan is composed of a new and entirely independent bi-state rapid transit railroad loop providing transfer connections with all of the northern New Jersey suburban railroads. It would include two pairs of new trans-Hudson tunnels and a north-south subway in Manhattan. It would be supplemented by the Hudson Terminal operations of the Hudson & Manhattan Railroad, the latter modernized and re-equipped. See Exhibits 14 and 15.

Construction

The proposed subway in Manhattan would start at a permanent shaft of the southern Hudson River crossing in Battery Park and proceed easterly in two single-track tunnels under the Battery Park underpass, the Brooklyn-Battery tunnel, and the IRT Seventh Avenue and IRT Lexington Avenue subways to the Bowling Green subway station. The two single-track tunnels would continue in an easterly direction along Beaver Street and partially under private property, passing under the BMT Broadway subway, the BMT Nassau subway, and the IRT Seventh Avenue subway in William Street to the rapid transit subway station at Wall Street. From Wall Street the route would extend northerly as a double-track cut-and-cover subway under Pearl Street to the vicinity of Park Row. The bi-state subway would go over the IND Fulton Street subway. See Exhibit 16.

From Park Row, two shield-driven cast iron single-track tunnels would be constructed northerly along Baxter Street, thence westerly along Broome Street to West Broadway and northerly to the Houston Street subway station. In this section the proposed route would go under the BMT subways at

Walker Street, Canal Street, Centre Street and Broadway; also the IRT Lexington Avenue subway at Lafayette Street. The Houston Street station would be located under the IND subway to Brooklyn.

Two single-track shield-driven tunnels would extend northerly along West Broadway from Houston Street to Washington Square at which point the construction would be changed to a double-track cut-and-cover subway. This cut-and-cover construction would be extended under Fifth Avenue to the 14th Street subway station, which would be constructed over the BMT 14th-Canarsie subway. The double-track cut-and-cover subway would continue under Fifth Avenue and under the BMT Broadway subway at 23rd Street to the Madison Square station. From this station the same type of cut-and-cover construction would extend along Madison Avenue to 34th Street, passing over the Pennsylvania Railroad-Long Island tunnels located in 32nd and 33rd Streets. Between 34th Street and 46th Street there would be two single-track tunnels in rock under Madison Avenue. The 42nd Street station would be located above the Queensboro subway and under the Times Square-Grand Central shuttle.

Cut-and-cover construction is contemplated from 46th Street along Madison Avenue to 62nd Street and along a curve largely on new right-of-way to the intersection of 63rd Street and Fifth Avenue. The new subway would pass over the IND tunnels in 53rd Street and the BMT Broadway-Queensboro subway in 60th Street.

The rapid transit route would then extend westerly across Central Park in two single-track tunnels in rock to Columbus Circle, where it would pass under the IND Eighth Avenue and the IRT Seventh Avenue subways. The route would extend west in two single-track tunnels in rock under West 60th Street, passing under the NYC freight tracks, to the eastern permanent shaft for the northern Hudson River crossing.

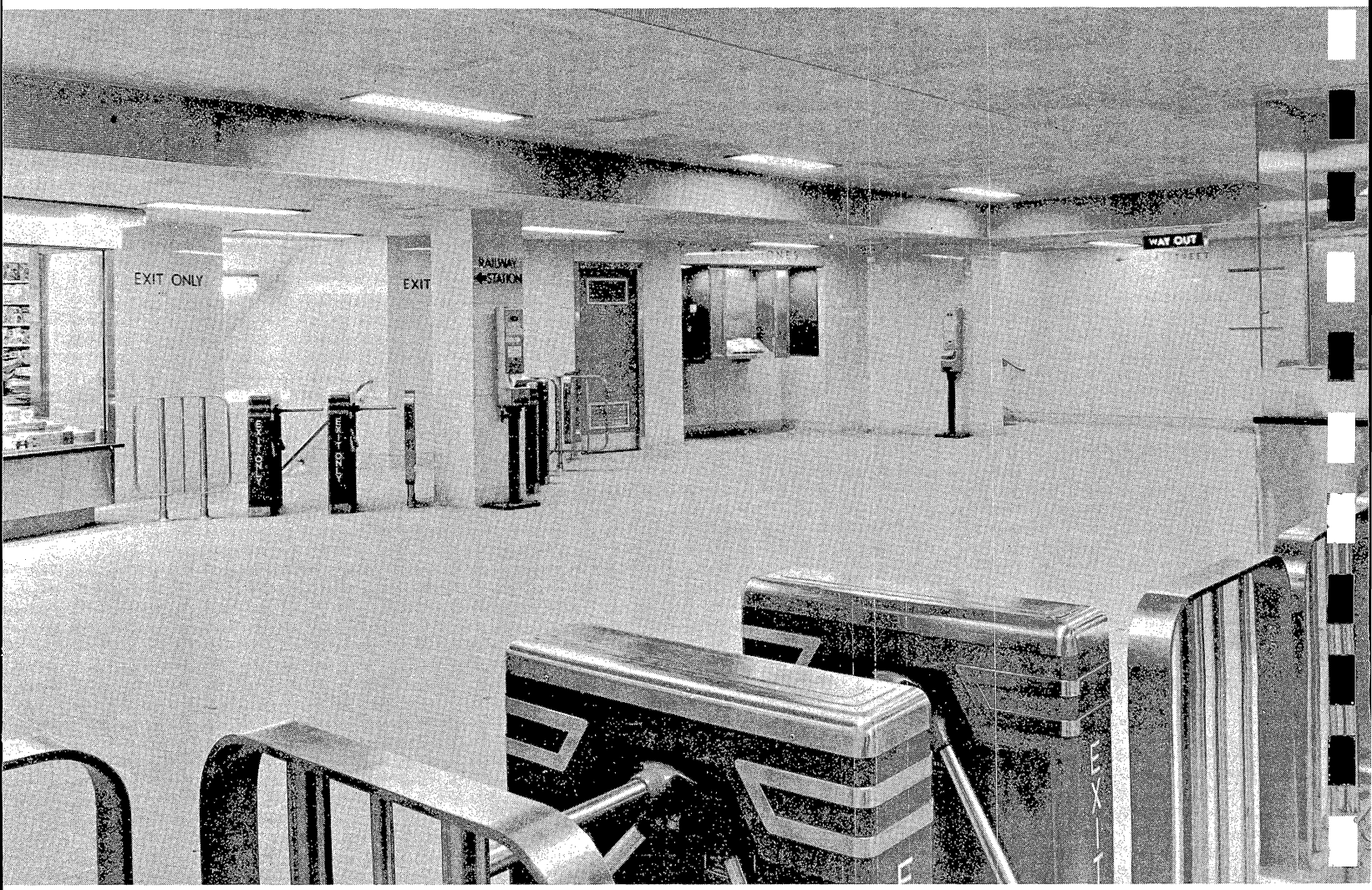
The northern Hudson River crossing would consist of a pair of single-track tunnels each 5,745 feet long, shield-driven between the Manhattan permanent shaft and the New Jersey permanent shaft.

From the New Jersey permanent shaft the rapid transit route would continue as a single double-track tunnel in rock for 2,200 feet and as a pair of single-track tunnels for an additional 2,100 feet, emerging from the west face of the Palisades at a point about 800 feet east of the West

Shore Transfer station. The bi-state rapid transit would then extend southerly passing under Tonnele Avenue, over relocated Railroad Avenue and over the Northern Railroad of New Jersey and the New York, Susquehanna and Western Railroad tracks to a terminal yard located on private right-of-way just west of the New York, Susquehanna and Western Railroad right-of-way.

The yards would have capacity for approximately 100 cars as well as maintenance facilities for inspecting, washing and repairing the rolling stock. Plans include a general office building with offices for the operating

Mezzanine Level of Modern Subway Station—Union Station, Toronto



and mechanical departments, and an employee parking lot. The storage facilities planned for the initial installation include some 18,000 feet of track, approximately 10 percent more than required to accommodate the 82 three-car articulated 148-foot units required for the initial operation described elsewhere.

The proposed bi-state rapid transit would then follow an alignment extending southerly, paralleling the New York, Susquehanna and Western Railroad, passing over Paterson Plank Road, under the Lincoln Tunnel approach, and under State Highway Route 3 to the Susquehanna Transfer station located under the main line of the Pennsylvania Railroad. The rapid transit route would extend southeasterly over Secaucus Road, the New York, Susquehanna and Western Railroad track, and over Tonnele Avenue, where it would enter two single-track rock tunnels under the Palisades. The east portal of these tunnels would be near the Lackawanna Transfer station.

From Lackawanna Transfer, the route would extend southerly over the New Jersey Junction Railroad tracks, under the new Jersey Turnpike, under 12th Street, under Newark Avenue, under the Pennsylvania Railroad tracks to the H&M Transfer station located under the Pennsylvania Railroad yard, and thence through a pair of single-track tunnels under Wayne, Mercer and Montgomery Streets. The rapid transit route would continue southerly under Bright Street and over Colden, Grand, Pacific and Canal Streets. The route would veer to the east and pass under the New Jersey Junction Railroad, the Hudson County spur of the New Jersey Turnpike, Johnston Avenue, and through the Central of New Jersey Transfer station to a portal 1,800 feet west of the west bulkhead line of the Hudson River.

The southerly Hudson River crossing would consist of two single-track shield-driven tunnels each 5,500 feet long, and two single-track rock tunnels each 1,425 feet long with light cast iron lining to Battery Park on Manhattan Island.

Typical sections of the several subway and tunnel portions are shown on Exhibits 17, 18 and 19. The alignment has been planned with curves of minimum radii ranging from 400 feet on the Manhattan subway to 1,000 feet on the rapid transit line in New Jersey. Preliminary plans have been prepared for underpinning all subways and tunnels underpassed by the new subway as well as all adjacent buildings along the route. The temporary support of all underground utilities along the route has also been planned.

Subway Stations

A complex station is planned at Bowling Green where the new subway would be well below the existing subways in this area. Platforms would be approximately 70 feet below the street. This station would have a 24-foot center platform and a commodious mezzanine with one 12-foot stairway and two escalators between platform and mezzanine. Passageways and stairways would provide connections to the IRT Lexington Avenue subway, the BMT Broadway subway, and to building lobbies, one at Broadway and one at New Street. A total of six escalators would be provided in this station for the convenience of passengers.

The Wall Street subway station would serve a heavy volume of New Jersey traffic. It would be located under Pearl Street and extend from the north side of Wall Street to the south side of Maiden Lane. Side platforms would be 15 feet in width and 600 feet in length. Mezzanines would be provided at each end of the station with escalators leading from the platform to the mezzanine and from the mezzanine to the street for the inbound passengers. There would be stairways and street entrances on all four corners of the Maiden Lane-Pearl Street intersection and on all but the southeast corner of the Wall-Pearl intersection.

The Houston Street subway station would have a 22-foot wide center platform served by a single mezzanine located under West Broadway. The platforms at this station would be almost 50 feet below the street surface so that two escalators would be provided for movements between platform and mezzanine and two additional escalators between the mezzanine and street. Exhibit 20 illustrates the arrangement of this station.

Platforms at 23rd Street would be 44 feet below the street surface. Two mezzanines are planned. Escalators, stairways and passageways would provide connections from the northbound and southbound BMT Broadway subway platforms to the street level on both the north and south sides of Madison Square. Four escalators would add to the convenience of the passengers using this station.

Conventional side platform stations would be provided at 34th, 51st and 59th Streets of the type built at most of the local stations on the New York subways. See Exhibit 21. Two mezzanines would be provided on each

side of the 42nd Street station. Connections are planned to the building on the northwest corner, to the Grand Central Terminal, to the 42nd Street shuttle, and to the building on the southwest corner. Four escalators are planned at this station.

Another elaborate station is planned for Columbus Circle. The new new subway would pass under the IND Eighth Avenue subway at this location. There would be a 30-foot wide center island platform served by a mezzanine. Connections would be provided to the IND Eighth Avenue subway, to the IRT Seventh Avenue subway, to the sidewalks, and to the new Coliseum. Six escalator installations are planned for this subway station.

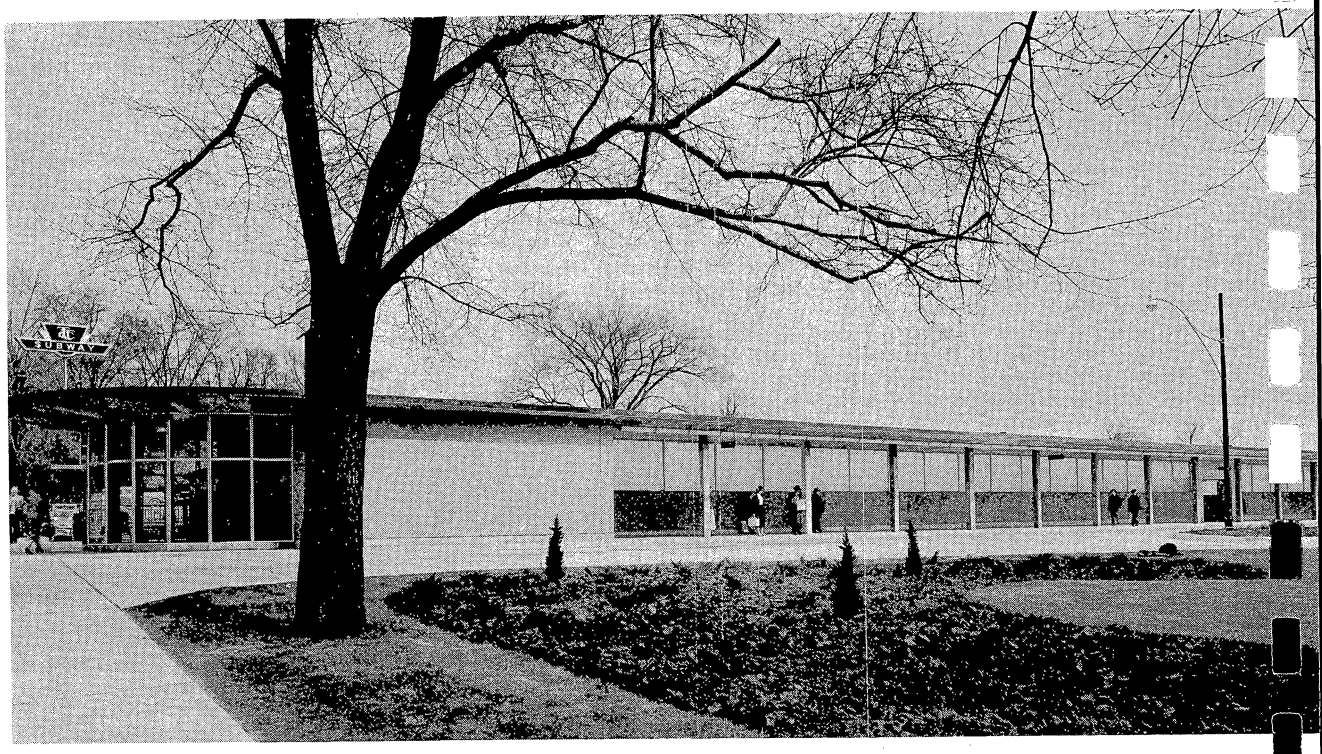
New Jersey Transfer Stations

These facilities would be tailored to provide maximum convenience for passengers transferring from suburban trains to rapid transit. With two exceptions they would provide equal convenience for feeder buses and bus services which may be substituted for light suburban train operations in the future. Parking facilities are also planned. Canopies and heated enclosures would be built to shelter all passengers awaiting trains.

West Shore Transfer Station

One platform 800 feet in length and 22 feet in width would provide for convenient across-platform transfer between rapid transit eastbound and West Shore eastbound trains with a similar platform for transfer between rapid transit westbound and New York Central westbound trains. The New York Central eastbound and the rapid transit westbound tracks would be flexed 400 feet east of the station. Adequate provision would be made immediately south of the rail transfer platforms for separate facilities to serve feeder buses and automobiles. Two parking lots would be provided. Both bus and automobile platforms would be about 25 feet above the top of rail. They would be connected with the transfer platforms by passageways with stairways and escalators extending from the transfer platforms to the passageway above. The plans for the station development include the construction of a grade separation for southbound buses and automobiles under Tonnele Avenue as part of a loop connecting into Madison Street opposite

Typical Modern
Rail-to-bus Transfer Station
Rosedale Station, Toronto



the main entrance to the parking lot and bus roadway. The installation of four escalators would add to the convenience of this station. Exhibit 22 shows the general plan of this facility.

Susquehanna Transfer Station

An even more complete transfer station is planned to serve passengers transferring between the new bi-state rapid transit facility and New York, Susquehanna and Western Railroad and Erie main line trains. There would be two platforms each 1,200 feet in length and 22 feet wide to serve four tracks of the Erie suburban trains. An additional platform 650 feet in length would serve the Susquehanna suburban trains and a single platform

25 feet in width and 650 feet long would serve the rapid transit railroad. These platforms would be connected with each other and with the bus platforms to the west by three underground passageways. Passengers arriving by private automobile and feeder buses would be accommodated by platforms directly connected to the underground passageway. The bus platform would be 1,150 feet long and the automobile platform 780 feet in length. Parking space would be provided to the west of the transfer terminal for 1,500 cars. Efficient access facilities would be provided to the transfer station from highways in the vicinity. The layout of this station is shown on Exhibit 23.

This station would be so laid out as to permit transfer platforms, stairways and connections from the Pennsylvania Railroad at any time in the future when public convenience might require installation of such transfer facilities.

Lackawanna Transfer Station

There would be a heavy concentration of suburban railroad traffic at this transfer station which would accommodate all of the present Lackawanna suburban service and a large portion of the Erie suburban service. For this reason this station would be provided with two platforms 1,200 feet in length and 22 feet wide to serve the suburban railways. Provision would be made for the addition of a third such platform should fifth and sixth tracks be required for suburban and other railroad service in the future.

The rapid transit railroad would be served initially by a single platform 600 feet in length and 22 feet wide. This layout is planned so that a second platform could be installed in the future when and if necessary. A mezzanine would be interposed between the suburban and the rapid transit platforms. Four escalators and supplemental stairways would extend from the suburban railroad platforms to the mezzanine and two escalators and stairways from the mezzanine to the rapid transit platform. Provision would also be made for entrances and exits to the local streets leading directly to the suburban platforms. Parking space for 300 cars would be provided northeast of the station. Escalators and stairways would be provided for this purpose. Eight escalators in all are planned at this location. See Exhibit 24.

Hudson & Manhattan Transfer Station

This would be a relatively simple transfer station located in the vicinity of Waldo Avenue and Second Street in Jersey City. There would be two platforms provided for Hudson & Manhattan service, each 600 feet in length and 18 feet in width. The layout permits the future extension of these platforms to a length of 1,200 feet to provide for transfer from Pennsylvania trains on the adjacent tracks when and as required. Rapid transit tracks would pass under the Hudson & Manhattan tracks at this point. The rapid transit platform—a center island platform 600 feet in length and from 20 to 32 feet in width—would be connected with a mezzanine above and the mezzanine with the H&M platform. A liberal installation of six escalators is planned. See Exhibit 25.

CNJ Transfer Station

This station would be located in Johnston Avenue, Jersey City, about 4,000 feet west of the existing terminal station of the Central Railroad of New Jersey. It would have two 1,200-foot platforms 22 feet in width to accommodate CNJ suburban trains. Rapid transit tracks would be served by two platforms 600 feet in length and 18 feet in width. Buses feeding into this station would be accommodated along the northerly side of the space occupied by the suburban trains and rapid transit trains. The bus platform would be connected to the rapid transit platforms by underground passageways. This layout would involve a minor relocation of Johnston Avenue, a shift to the north of about 60 feet for a length of about a quarter of a mile. This station layout is illustrated in Exhibit 26.

Parking facilities should also be provided at this station. These could probably best be provided by private enterprise, possibly on air rights above nearby railroad yards.

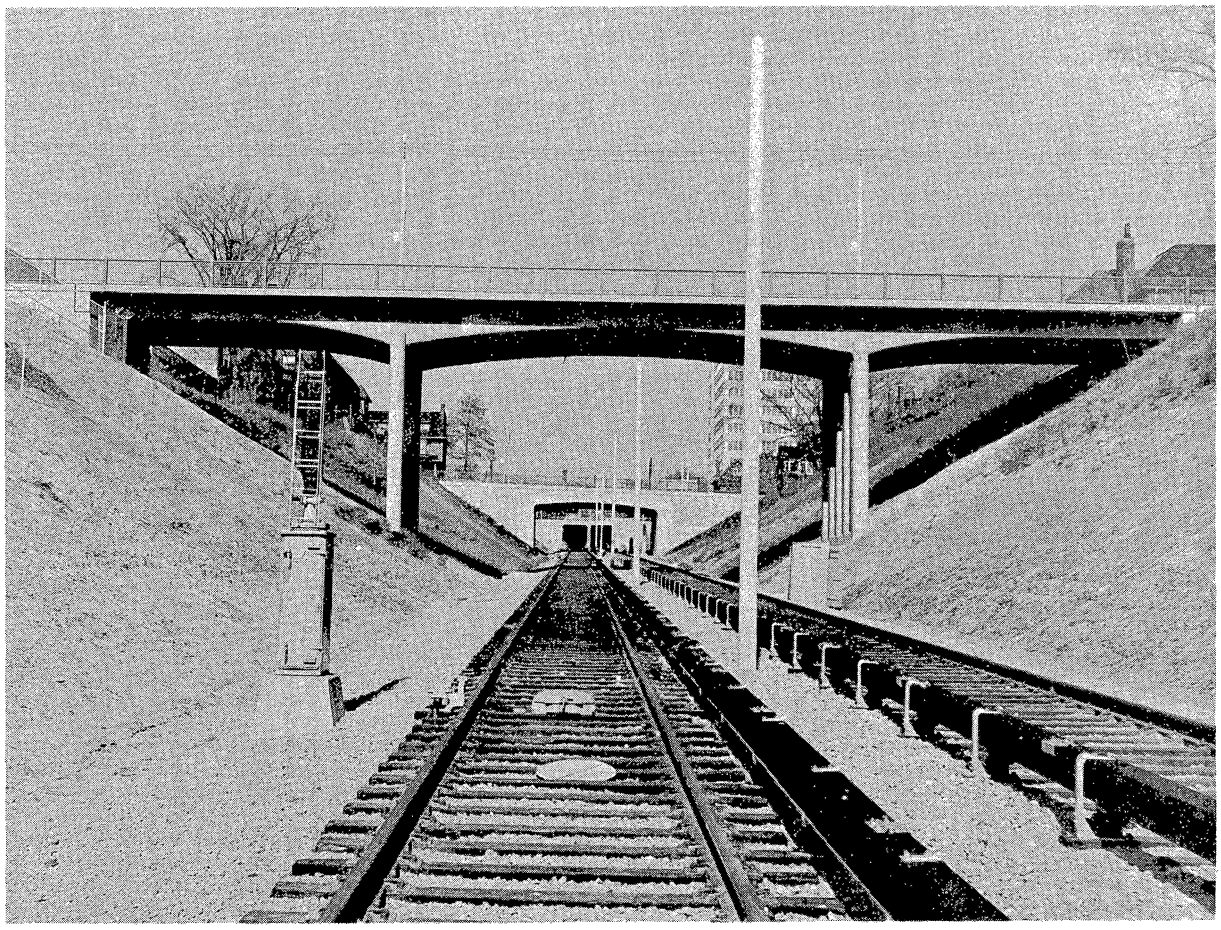
Fixed Equipment

The fixed equipment planned for the rapid transit subways and railroad would incorporate all of the developments essential to modern and convenient rapid transit.

Equipment planned for installation in this rapid transit facility would be limited to those installations which have been thoroughly tested by rapid transit operators in New York and elsewhere.

There have been recent proposals for the installation of ultra-modern electronic controls in rapid transit railroad operation. They would permit complete automatic operation of rapid transit trains on frequent headways without manual control, thus dispensing with motormen, guards, and other operating personnel on the trains. It is sensible for us to look forward with keen anticipation to such improvements, which if actually developed would accomplish great reductions in operating expenses. It is our opinion that the day when such operation becomes practicable is so far in the future, however, as to warrant no immediate consideration for this project.

Open-cut Section of the Toronto Subway



The signal and interlocking system proposed, therefore, would be the conventional three-color signals operated from a single control, with full provision for emergency stops on the line and calculated to secure maximum speeds with frequencies up to 40 trains per hour.

Other fixed equipment would include traction power transmission and distribution including substations, circuit breakers and third rail; communication and emergency alarm systems; and station equipment including railings, turnstiles, cashiers' booths, token vending equipment, and other similar items.

Rapid strides are being made in development of equipment to permit A.C. distribution of traction power which would be converted to D.C. by units on the cars. Availability of such equipment should be investigated at the time the system is being designed and rolling stock is being ordered.

Tunnel and subway track would conform to modern practices in which wooden ties are completely eliminated and the rails laid on tie plates supported by rubber pads resting directly on the concrete invert of the tunnel and subway structures. This accomplishes a reduction of about 12 inches in total height of the subway and tunnel structures. It also reduces labor in maintenance of tracks. One hundred pound welded rails would be used throughout the subways and tunnels as well as on the open sections of the rapid transit railroad.

Modern fluorescent lighting would be installed at all stations. Fixtures would be mounted in the ceilings in continuous rows located about three feet back from the edge of the platforms so as to provide the greatest intensities in the most needed areas. Recent installations in other subways have indicated that lighting intensities of about 10-foot candles on platforms, increasing to as much as 15-foot candles on stairways and passageways and in other critical areas is desirable for the convenience and safety of passengers.

Acoustical treatment is proposed throughout the subway and tunnels. This would take the form of strips of acoustical material about three feet in height affixed to one wall of single-track sections and both walls of double-track sections. This treatment would be continued through the station areas with the strips fixed to the platform walls just above the tracks. Acoustical tile also would be installed in ceilings of stairways and mezzanines.

High standards of ventilation are proposed through the installation of powerful fans in the permanent shafts at both ends of the Hudson River tunnels and at suitable emergency ventilating stations throughout the Manhattan subway. Large ventilating shafts at each end of subway stations would provide for the effiicient development of natural ventilation through the high speed movement of trains in comparatively small-bore subway and tunnel sections. Sumps and pumps with automatic controls would be installed both in the Hudson River tunnels and at low points in the grade line in the Manhattan subway.

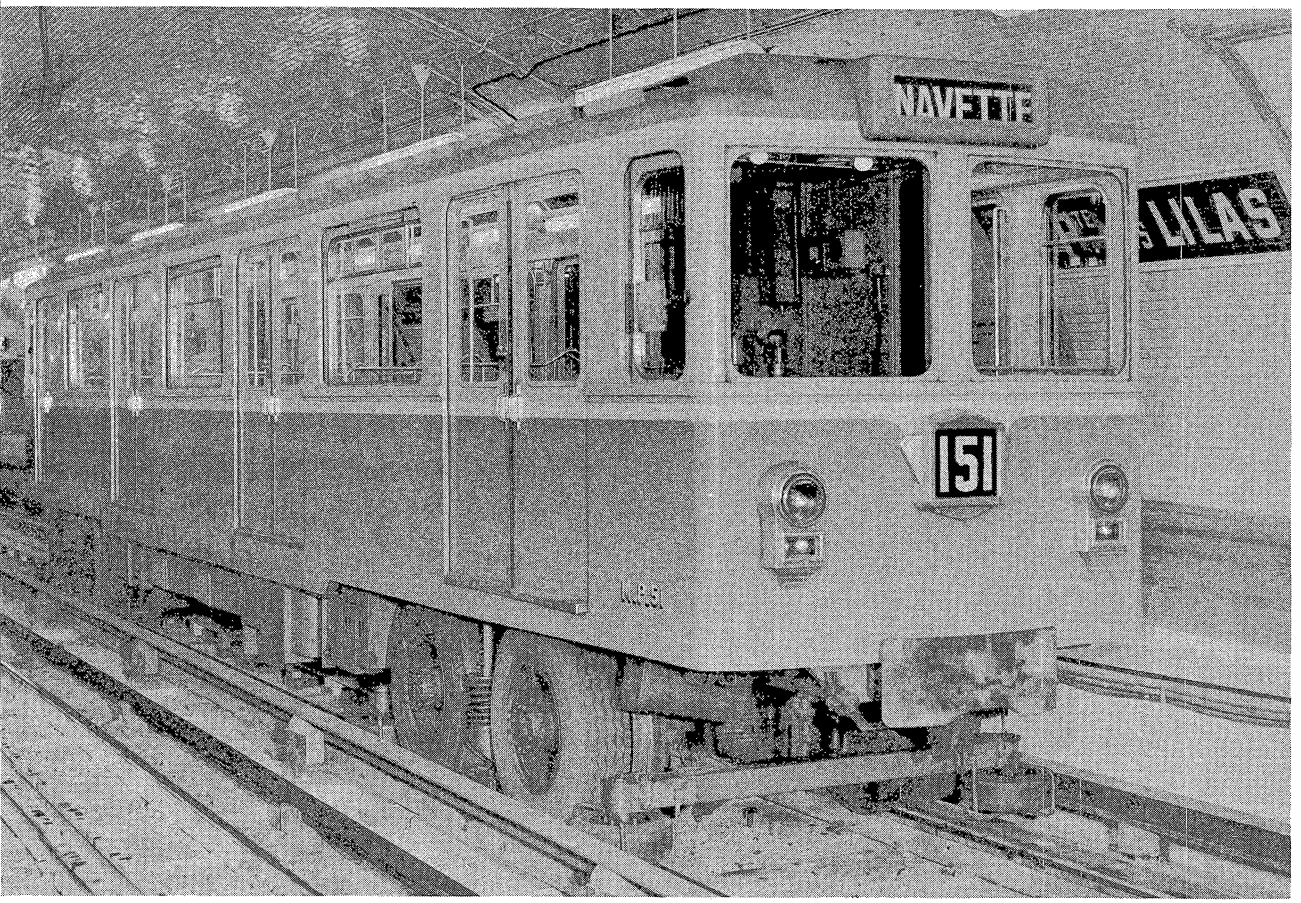
Car Equipment

The rolling stock recommended for use on the independent bi-state loop would be a three-car articulated unit which could be operated in one-to four-unit trains 148 to 592 feet in length. The floor plan and side view are shown on Exhibit 27. One unit would seat 160 passengers. The unit would consist of three separate bodies, permanently connected and mounted on four trucks. This unit empty would weigh approximately 125,000 pounds, and the cost is estimated at about $180,000.

The use of a three-car articulated unit would achieve the best overall ratio of weight to capacity without jeopardizing riding quality. This would result in a much lower overall investment with no loss in convenience or service standards. All axles would be motored, the motors transom hung, and the cars equipped with dynamic braking. The body would be an all-welded structure using low alloy, high tensile steels. This steel has a good corrosion characteristic and does not present any welding or painting difficulties.

We suggest the use of stainless steel on the exterior of the car bodies. The interior finish of the cars would make full use of anodized aluminum and plastics developed for such use so that the interior of the car would never require repainting. The flooring in the car would be vinyl asbestos tile laid over a flexible underlay. The seats would undoubtedly be of moulded fiberglas which would be highly resistant to vandalism and wear. The cars would be equipped with fluorescent lighting throughout. All doors would be outside-hung and controlled from the cab of the car. In addition, there would

be a separate switch which would enable the door operator to open selected doors and also permit him to place the controls in a position where a passenger could press a button to open the door. This feature would be of great value in the winter in saving on heat, particularly at the open transfer stations in New Jersey, where doors would be opened only in case passengers were entering or leaving.



Paris Pneumatic-tired Subway Car

The use of eight 100 H.P. motors for powering the cars would result in an average speed on the rapid transit railroad of approximately 31 miles per hour including stops. These cars would have a balancing speed in the neighborhood of 65 miles per hour. The cars would be capable of extending the initial acceleration rate of 3.0 miles per hour per second considerably

beyond the present point of fall-off to a new point reached at a speed of about 35 miles per hour.

For about 25 years the Michelin Rubber Company of France, in cooperation with the operators of the Paris subways, have been engaged in the development of a rubber-tired vehicle for rail rapid transit operation. Their joint efforts resulted in the building of several rubber-tired rail coaches about six years ago which have been the subject of intensive experimentation and development since. This rail coach consists of a body about 50 feet long resting on two two-axle trucks. Each axle is fitted with heavy duty rubber tires running on wooden tracks about 10 inches in width. Side by side with each carrier wheel is a safety steel flanged wheel which comes into use when switching or in the event of a puncture or other tire failure, thus insuring safety and continuity of operation. Horizontal wheels fitted with pneumatic tires bear on lateral bars just above the track, and are said to insure frictionless and noiseless guiding without wear. These guide bars also serve as conductors to feed electric energy to the rail coaches. Several of these cars have been in almost continuous operation over one of the lightly traveled Paris subways for the last three years. Individual units have now been operated as much as 100,000 miles.

The French engineers claim a number of definite advantages, as follows:

This vehicle is less noisy than the conventional type of car operated over steel rails.

The jolts due to rail joints are completely eliminated;

Starting and braking speeds are increased by the adhesion of the tires to the track (limited only by the effects of sudden shocks on standing passengers);

The metal-reinforced heavy duty tires can operate a minimum of 125,000 miles without retread, and such tires can be retreaded several times;

Mechanical resistance on curves as well as on tangents is minimized;

Cost of track installation is reduced; and

Improved adhesion permits the use of steeper gradients, thus effecting an overall reduction in construction costs.

Two of our engineers have visited Paris recently and have made detailed inspection of the rubber-tired equipment now in operation. One of them was permitted to operate the cars. They both reported an astounding improvement in the ease of ride and reduction of noise. They also had the opportunity to review records of numerous tests and experiments and from their examinations seem to concur generally in the foregoing advantages. This unit could also be articulated to reduce weight and cost.

This development has now proceeded to the point where the Paris subway operators are installing such trains on one entire route of the Paris subway system. It would be advisable, therefore, to give careful consideration to this type of equipment on Plan 1. Before its adoption, however, the difficult problems of snow and ice removal on open sections of the track in New Jersey must be solved.

Hudson & Manhattan Railroad Modernization

Plan 1 also includes the operation of the Hudson & Manhattan Railroad facilities. It is contemplated that the 33rd Street Branch would be maintained in operation during the initial period required for the completion of the new rapid transit subway and then abandoned or put to other uses. The remainder of the system would be modernized immediately.

The modernization would include elimination of the existing sharp curves in the vicinity of track junctions in New Jersey, new welded rails throughout, renewal of traction power feeders and sub-stations, improvements to stations and platforms and installation of escalators, and, finally, improvements to shops and yards.

Fifty new rapid transit cars are now on order, 20 to be owned by the H&M and 30 by the PRR. The program would include purchase of additional car equipment which would provide new car equipment on all routes operated into the Hudson Terminal. The cars would be the most modern available and would conform generally with the new car equipment recently ordered. The new cars will be 49 feet 6 inches in length and 8 feet 10 inches in width, a portion of them semi-permanently coupled into double units. Each car is to be equipped with four 100 H.P. motors.

Estimates of Cost

Estimates of construction costs are based on labor, material and equipment costs prevailing in the fall of 1956. Preliminary plans were developed for subways, tunnels, rapid transit railroad structures, and subway and transfer stations; underpinning of buildings and subway structures intersected in Manhattan; maintenance and restoration of underground utilities; and decking and repaving of all cut-and-cover subway sections. Preliminary plans for this construction were advanced to the point where a take-off of approximate quantities was permitted. Cost of private property, easements and right-of-way takings in Manhattan was estimated on the basis of 1955-56 assessed valuations. In New Jersey where right-of-way required was mostly vacant acreage, values were estimated on the basis of recent sales.

Estimates of fixed subway equipment include track; traction power transmission and distribution systems, including substations, circuit breakers and third rail; signals and interlocking plants; communication and emergency alarm systems; and station equipment including railings, turnstiles, cashiers' booths, token vending equipment and other similar items. Most of these items have been estimated largely on the basis of experience on similar projects.

A complete detailed estimate showing unit prices utilized and quantities computed from the preliminary plans has been prepared. Three copies will be transmitted for the permanent files of the Commission.

Engineering and administrative expenses have been estimated at 10 percent of the total cost of construction, right-of-way, fixed equipment and car equipment. To this sub-total there has been added an allowance of 30 percent for contingencies. About two-thirds of this allowance is calculated to provide for anticipated increase in the cost of labor and materials in the period from the start of the project until all contracts have been awarded. In the case of the Hudson & Manhattan Railroad modernization, which is programmed for immediate construction, this contingency allowance has been reduced to 20 percent.

We have also added a further allowance for interest during construction and financing of approximately 11 percent. The figure for interest was developed from a fund requirement curve based on the normal four-year

subway construction period for an assumed rate of interest of four percent per annum, to which about 2.5 percent was added for financing.

The estimated cost for Plan 1, shown in Table 16, covers the cost of the independent bi-state loop in its entirety. Also included is the cost of the connection between the main line of the Erie Railroad near the Hackensack River and the Susquehanna Transfer as well as the cost of modernizing the railroad properties of the Hudson & Manhattan Railroad Company except for the 33rd Street Branch.

We have given careful consideration to the estimated cost—if any—of acquiring the railway properties of the Hudson & Manhattan Railroad Company. Far outweighing any academic figures based on cost to reproduce less accrued depreciation of the physical properties is the fact that substantial deficits have resulted from the operation of these railway properties for a considerable period with no real prospect for eliminating such losses under continued private ownership. This, coupled with the fact that the company realizes a substantial income from its real estate holdings and that the owners would benefit materially from the disposal of their unprofitable railway properties, led us to the conclusion that no allowance should be made for their acquisition in the estimated costs of any of the plans considered.

Financial Results

Estimates of annual revenues and expenses previously developed are summarized as follows:

Total Revenues	$22,800,000
Total Expenses	8,542,000
Operating Revenues	$14,258,000

An interest rate of four percent per annum has been assumed on a 50-year bond issue as a basis for estimating fixed charges. Of the $474,000,000 initial investment required for Plan 1, the cost of the items subject to renewal within 50 years is estimated at $60,000,000 on which annual charges would consist of interest plus depreciation, the latter charged as an item of operating expense. On the remainder of the initial investment of $414,000,000, charges have been computed for interest and also amortization in

Table 16

ESTIMATED COSTS FOR PLAN 1

TRANS-HUDSON RAPID TRANSIT SYSTEM		
Manhattan Subway		
Construction	$130,972,000	
Right-of-Way	4,856,000	
Restoration of Utilities	7,862,000	$143,690,000
Trans-Hudson Tunnels		54,776,000
New Jersey Rapid Transit		
Construction	$ 51,278,000	
Right-of-Way	660,000	51,938,000
Erie Railroad Connection		2,900,000
Cost of Construction and Right-of-Way		$253,304,000
Fixed Subway Equipment		22,246,000
Rolling Stock (82 Cars*)		14,800,000
		$290,350,000
Engineering and Administrative Expense		29,150,000
		$319,500,000
Contingencies		95,500,000
		$415,000,000
Financing and Interest during Construction		45,500,000
		$460,500,000
HUDSON & MANHATTAN RAILROAD		
Renewals and Modernization	$ 5,675,000	
Rolling Stock (20 cars on order plus 36 additional cars)	4,600,000	
	$10,275,000	
Engineering and Administrative Expense	600,000	
	$10,875,000	
Contingencies	2,025,000	
	$12,900,000	
Financing and Interest	600,000	13,500,000
GRAND TOTAL		$474,000,000

*-Three-car articulated units.

the 50-year period. The total fixed charges as thus calculated are $21,-672,000.

On these assumptions there would be an annual deficit after all fixed charges during the initial few years of the operation amounting to $7,414,-000. In other words, estimated operating income would cover almost two-thirds of the total fixed charges.

PLAN 2

This plan covers a bi-state loop rapid transit railroad similar in all respects to Plan 1 except that the BMT Broadway subway would be utilized in lieu of the new Madison Avenue subway proposed in Plan 1. The route is shown on Exhibits 28 and 29.

Construction

The southern subway connection in Manhattan would start at the permanent shaft of the south Hudson River crossing in Battery Park and extend easterly, veering to the north to Bowling Green and thence north along Broadway to a connection with the existing third and fourth tracks of the BMT Broadway subway at the north end of the City Hall Park station at Reade Street. See Exhibit 30. Two single-track shield-driven tunnels would extend from the permanent shaft to a point just north of Exchange Place; between this point and John Street the construction would be by cut-and-cover methods. Two single-track shield-driven tunnels would be constructed between John Street and Warren Street with cut-and-cover construction between Warren Street and Reade Street, the connecting point.

The new tunnels and subway would pass under the Brooklyn Battery tunnel, the IRT Seventh Avenue subway, the BMT Broadway subway at Bowling Green, the IND Eighth Avenue Subway at Fulton Street, and the IRT Seventh Avenue subway at Park Place.

This construction would involve some extremely difficult and very costly subway construction in Broadway from Battery Park on the south to Vesey Street on the north, where the new subway would be located immediately under the existing IRT Lexington Avenue subway structure. Prior to

the start of construction work, it would be necessary to underpin and provide permanent support for the IRT Lexington Avenue subway (including the existing side platform stations at Wall Street and at Fulton Street) for a length of almost 3,000 feet. It would be necessary to carry on the same construction procedure in connection with the support of the two-track BMT Broadway subway from a point near Chambers Street to Vesey Street.

No special construction problems would be involved in the northern connection at 59th Street due to the fact that the original construction of the BMT Broadway subway provided, in addition to the two-track extension to Queens, now in operation, a two-track stub connection to the west at this junction. A minor re-arrangement of structures and tracks only would be required at this junction. See Exhibit 31. The subway connection to the east shaft of the northern Hudson River tunnels would extend along 60th Street in two single-track tunnels in rock as in Plan 1.

Subway Stations

Physical limitations would not permit the construction of a subway station in Bowling Green as in Plan 1, so a new station is planned from the north side of Wall Street to the north side of Liberty Street. There would be a heavy concentration of traffic at this station and, therefore, three tracks and two island platforms are proposed. Platforms would be 500 feet in length, conforming to the prevailing platform lengths on the BMT Broadway subway. This platform and track plan would permit the operation of two tracks for incoming passengers during the morning rush hours and two tracks for the outgoing passengers in the evening rush period. Approximately half of the New Jersey-Manhattan trains would be turned back at this station during the morning and evening rush hours.

Two mezzanine platforms are planned—one serving Rector and Wall Streets to the south and one serving Cedar and Liberty Streets to the north. Connections are planned from these mezzanines through passageways and stairways to sidewalks both at the north and south end of the station platforms, and transfer connections would also be provided to the IRT Lexington Avenue subway Wall Street station immediately south of the new subway station. Two escalators would be installed at this station.

Table 17

ESTIMATED COSTS FOR PLAN 2

TRANS-HUDSON RAPID TRANSIT SYSTEM		
BMT Broadway Subway Connections		
Construction		
North Connection	$18,355,000	
South Connection	27,933,000	
	$46,288,000	
Right-of-Way	50,000	
Restoration of Utilities	621,000	$ 46,959,000
Trans-Hudson Tunnels		61,604,000
New Jersey Rapid Transit Construction	$51,278,000	
Right-of-Way	660,000	51,938,000
Erie Railroad Connection		2,900,000
Cost of Construction and Right-of-Way		$163,401,000
Fixed Subway Equipment		17,117,000
Rolling Stock (124 Cars)		17,700,000
		$198,218,000
Engineering and Administrative Expense		19,782,000
		$218,000,000
Contingencies		65,500,000
		$283,500,000
Financing and Interest during Construction		31,000,000
		$314,500,000
HUDSON & MANHATTAN RAILROAD		
Renewals and Modernization	$ 5,675,000	
Rolling Stock (20 cars on order plus 36 additional cars)	4,600,000	
	$10,275,000	
Engineering and Administrative Expense	600,000	
	$10,875,000	
Contingencies	2,025,000	
	$12,900,000	
Financing and Interest	600,000	13,500,000
GRAND TOTAL		$328,000,000

Fixed Equipment

Fixed equipment planned for this project, except for the portion covered by the BMT Broadway subway, would conform in all respects with that described under Plan 1.

Car Equipment

The rolling stock recommended for use on the proposed rapid transit line would conform with the present dimensions of cars operated on the BMT and IND systems of the New York City Transit Authority—approximately 60 feet in length and 10 feet in width. Rush hour operation would be with eight-car trains having a total length of 480 feet. The rapid transit car now contemplated is similar to the R16 purchased by the New York City Transit Authority in 1955. This unit empty weighs approximately 85,000 pounds and the cost is estimated at about $143,000. The initial capital cost would be reduced below that shown, however, by use of the three-car articulated units recommended under Plan 1.

The use of four 100 H.P. motors for powering the cars would result in an average speed on the entire rapid transit railroad loop of approximately 25 miles per hour including stops. These cars would have a balancing speed in the neighborhood of 52 miles per hour. The purchase of a sufficient number of cars (124) is included in Plan 2 to provide for the operation of all of the loop service except that on the BMT Broadway subway.

Hudson & Manhattan Railroad Modernization

Hudson & Manhattan Railroad facilities would be incorporated in Plan 2 in a manner similar in all details to that described for Plan 1.

Estimates of Cost

Estimates of construction costs, fixed equipment, car equipment, engineering and administrative expenses, contingencies and financing have been prepared in precisely the same manner as that described for Plan 1. No part of the cost of rehabilitating the BMT Broadway line is included in this estimate. See Table 17 for estimates of cost for Plan 2.

Financial Results

Estimates of annual revenues and expenses previously developed are summarized as follows:

Total Revenues	$18,800,000
Total Expenses	7,260,000
Operating Revenues	$11,540,000

An interest rate of four percent per annum has been assumed on a 50-year bond issue as a basis for estimating fixed charges. Of the $328,000,000 initial investment required for Plan 2, the cost of the items subject to renewal within 50 years is estimated at $58,000,000 on which annual charges would consist of interest plus depreciation, the latter charged as an item of operating expense. On the remainder of the initial investment—$270,000,000—charges have been computed for interest and also amortization in the 50-year period. The total fixed charges as thus calculated are $14,899,000.

On these assumptions there would be an annual deficit after all fixed charges during the initial few years of the operation amounting to $3,349,000. In other words, estimated operating income would cover almost three-quarters of the total fixed charges.

PLAN 3

This plan is similar to Plan 2 except that the New Jersey portion of the loop between the Lackawanna Transfer station and the Susquehanna Transfer station is omitted, and the northerly terminal is extended west from the Susquehanna station to a new terminal and transfer station at the Erie Railroad main line. The Hudson Terminal operations of the Hudson & Manhattan Railroad would be modernized and re-equipped to conform with those described for Plans 1 and 2. The route is shown on Exhibits 29 and 32.

Construction

The rapid transit railroad construction from Susquehanna Transfer to the Erie main line transfer station would be an addition to the construction in Plans 1 and 2. The division terminal including storage, maintenance, repair and administrative facilities would be built there.

At the southwest terminal it would be necessary to extend tracks to the north through the Lackawanna Transfer station to a new storage yard beween Marshall and Harrison Streets and between Paterson Plank Road and Second Street to accommodate about half of the rapid transit cars utilized in the operation. These tracks would be on a structural deck approximately 60 feet above the street level. The space underneath this deck would be utilized for parking when and as required by consideration of public convenience, but no allowance has been made in the estimates of cost in Plan 3 for such parking facilities.

Equipment

The fixed equipment planned for the rapid transit subway and railroad would conform in all respects with the fixed equipment and car equipment described for Plan 2. The number of cars required for Plan 3, however, would be increased from 124 to 167 as a result of the somewhat less flexible operation.

Hudson & Manhattan Railroad Modernization

Hudson & Manhattan Railroad facilities would be incorporated in Plan 3 in a manner similar in all details to that described for Plan 1.

Estimates of Cost

Estimates of construction cost, fixed equipment, car equipment, engineering and administrative expenses, contingencies and financing have been prepared in precisely the same manner as that described for Plan 1. Table 18 shows estimated costs for Plan 3.

Financial Results

Estimates of annual revenues and expenses previously developed are summarized as follows:

Total Revenues	$18,100,000
Total Expenses	7,613,000
Operating Revenues	$10,487,000

Table 18

ESTIMATED COSTS FOR PLAN 3

TRANS-HUDSON RAPID TRANSIT SYSTEM		
BMT Broadway Subway Constructions		
Construction		
North Connection	$18,355,000	
South Connection	27,933,000	
	$46,288,000	
Right-of-Way	50,000	
Restoration of Utilities	621,000	$ 46,959,000
Trans-Hudson Tunnels		61,604,000
New Jersey Rapid Transit Construction	$48,642,000	
Right-of-Way	1,327,000	49,969,000
Cost of Construction and Right-of-Way		$158,532,000
Fixed Subway Equipment		16,952,000
Rolling Stock (167 Cars)		23,900,000
		$199,384,000
Engineering and Administrative Expense		19,616,000
		$219,000,000
Contingencies		66,000,000
		$285,000,000
Financing and Interest during Construction		31,500,000
		$316,500,000
HUDSON & MANHATTAN RAILROAD		
Renewals and Modernization	$ 5,675,000	
Rolling Stock (20 cars on order plus 36 additional cars)	4,600,000	
	$10,275,000	
Engineering and Administrative Expense	600,000	
	$10,875,000	
Contingencies	2,025,000	
	$12,900,000	
Financing and Interest	600,000	13,500,000
GRAND TOTAL		$330,000,000

An interest rate of four percent per annum has been assumed on a 50-year bond issue as a basis for estimating fixed charges. Of the $330,000,000 initial investment required for Plan 3, the cost of the items subject to renewal within 50 years is estimated at $66,000,000 on which annual charges would consist of interest plus depreciation, the latter charged as an item of operating expense. On the remainder of the initial investment—$264,000,000—charges have been computed for interest and also amortization in the 50-year period. The total fixed charges as thus calculated are $14,929,000.

On these assumptions there would be an annual deficit after all fixed charges during the initial few years of the operation amounting to $4,442,000. In other words, estimated operating income would cover almost two-thirds of the total fixed charges.

PLAN 4

This plan contemplates the same northern subway connection to the BMT Broadway subway at 59th Street as in Plans 2 and 3. From Susquehanna Transfer the route would extend to a terminal and transfer station at the Erie main line as in Plan 3. This route is shown on Exhibits 33 and 34. Trains from this terminal would operate to the connection with the BMT Broadway subway at 59th Street and thence through the BMT Broadway subway to Brooklyn or intermediate turnback points as may be determined by the New York City Transit Authority. Service to downtown Manhattan would be furnished by making full use of all of the existing facilities of the Hudson & Manhattan Railroad including the 33rd Street Branch with an extension from the portal in the vicinity of National Junction to Communipaw, where a new transfer station would be constructed to accommodate the suburban passengers from the Central Railroad of New Jersey.

The H&M operation through Hudson Terminal would extend through a new subway to a connection with the local tracks of the IRT Lexington Avenue subway just north of the Brooklyn Bridge express station. This operation would be carried north to terminals in the Bronx or to intermediate turnback points as may be determined by the operators. See Exhibit 35. All but five of the IRT Lexington Avenue subway local stations have been lengthened to accommodate 10-car trains and the remainder are scheduled for lengthening in the near future. New platforms constructed under the

Hudson Terminal and adjacent to the Brooklyn Bridge station will also be 500 feet in length, thus permitting the operation of 10-car trains from New Jersey terminals on the west to IRT Lexington Avenue terminals in northern Manhattan or the Bronx. Supplemental service to the existing platforms of the Hudson Terminal station could be operated by trains up to seven cars in length as required for rush hour traffic. It is estimated that through trains to IRT Lexington Avenue terminals could be operated on two-minute headways and that the additional service could be provided when required to carry the rush hour traffic up to ten trains per hour, making a total maximum operation of forty trains per hour.

The extension to Communipaw was covered in a separate report on the *Proposed Integration of Commuter Services of the Hudson & Manhattan Railroad Company and the Central Railroad of New Jersey, October 1956.* The estimated cost of this extension including additional rolling stock was $13,360,000. We have shown the station layout on Exhibit 36.

Construction

The construction features of the rapid transit line as well as the equipment would conform in all respects with those proposed under Plans 2 and 3 as described above. Plan 4 also contemplates the extension of the Hudson & Manhattan tracks in tunnels and subways in Manhattan from the Hudson Terminal to a connection with the IRT Lexington Avenue subway. The H&M tracks would be directly connected with the IRT local tracks a short distance north of the Brooklyn Bridge station. These tracks now terminate in a loop to the south of the Brooklyn Bridge station adjacent to City Hall Park.

The connection to the existing H&M tubes would be made a short distance west of the bulkhead line. From this connection they would extend at almost level grade to a location below the existing Hudson Terminal platforms and related facilities. A wide center platform, 510 feet in length, is planned to accommodate the operation of 10-car trains. The tracks would then be extended in tunnel under the BMT Broadway subway, the IND Eighth Avenue subway, the IRT Lexington Avenue subway in Beekman Street and the existing loop tracks in City Hall Park to the connection with the local IRT Lexington Avenue tracks as noted above.

Table 19

ESTIMATED COSTS FOR PLAN 4

TRANS-HUDSON RAPID TRANSIT SYSTEM			
BMT Broadway Subway Connections			
Construction		$18,355,000	
Right-of-Way		50,000	
Restoration of Utilities		65,000	$ 18,470,000
Trans-Hudson Tunnels			26,695,000
New Jersey Rapid Transit			
Construction		$20,451,000	
Right-of-Way		367,000	20,818,000
Cost of Construction and Right-of-Way			$ 65,983,000
Fixed Subway Equipment			11,702,000
Rolling Stock (88 Cars)			12,600,000
			$ 90,285,000
Engineering and Administrative Expense			8,715,000
			$ 99,000,000
Contingencies			30,000,000
			$129,000,000
Financing and Interest during Construction			14,000,000
			$143,000,000
HUDSON & MANHATTAN RAILROAD			
Renewals and Modernization		$ 9,975,000	
Extension to Communipaw-CNJ Tranfer			
Construction	$ 5,103,000		
Right-of-Way	100,000	5,203,000	
Hudson Terminal Connection to IRT Lexington Avenue Subway			
Construction	$24,645,000		
Right-of-Way	2,252,000		
Restoration of Utilities	200,000	27,097,000	
Fixed Subway Equipment		2,709,000	
Rolling Stock (20 cars on order plus 274 additional cars)		29,600,000	
		$74,584,000	
Engineering and Administrative Expense		7,416,000	
		$82,000,000	
Contingencies		16,000,000	
		$98,000,000	
Financing and Interest during Construction		5,000,000	103,000,000
GRAND TOTAL			$246,000,000

Subway Stations

There would be a rather complex subway station developed under the Hudson Terminal with ample connections to the existing mezzanine, the IRT Seventh Avenue subway and the street. Seven escalators would be installed in this station.

The second station would likewise be a center-platform station located partially in City Hall Park and partially in private property between Chambers and Reade Streets. Transfer facilities would be provided at this point to and from the Brooklyn Bridge express station of the IRT Lexington Avenue subway.

Equipment

The fixed equipment and the car equipment required for rapid transit railroad operation included in Plan 4 would conform to that described in Plans 2 and 3.

Hudson & Manhattan Railroad Modernization

The modernization of H&M properties as outlined in Plan 1 would be included in this plan. In addition, installation of fixed equipment would be extended to cover the entire 33rd Street Branch including the northern H&M tubes. A substantial number of additional new cars would be required because of the extraordinary duty imposed on the H&M system by the operating features of this plan. It would also be necessary to purchase cars similar to the New York Transit Authority's latest IRT cars.

Estimates of Cost

Estimates of construction cost, fixed equipment, car equipment, engineering and administrative expenses, contingencies and financing have been prepared in precisely the same manner as that described for Plan 1. See Table 19 for estimated costs for Plan 4.

Financial Results

Estimates of annual revenues and expenses previously developed are summarized as follows:

Total Revenues	$18,200,000
Total Expenses	9,871,000
Operating Revenues	$ 8,329,000

An interest rate of four percent per annum has been assumed on a 50-year bond issue as a basis for estimating fixed charges. Of the $246,000,000 initial investment required for Plan 4, the cost of the items subject to renewal within 50 years is estimated at $78,000,000 on which annual charges would consist of interest plus depreciation, the latter charged as an item of operating expense. On the remainder of the initial investment—$168,000,000—charges have been computed for interest and also amortization in the 50-year period. The total fixed charges as thus calculated are $10,940,000.

On these assumptions there would be an annual deficit after all fixed charges during the initial few years of the operation amounting to $2,611,-000. In other words, estimated operating income would cover three-quarters of the total fixed charges.



CHAPTER VI

RELATIVE ECONOMICS AND BENEFITS OF THE FOUR PLANS

The final determination of the best scheme for rapid transit service between northern New Jersey and Manhattan cannot be made solely on the basis of initial capital outlay. Neither can the decision be limited to the single factor of earning power. Before a final recommendation can be made, these two important factors must be weighed together with answers to numerous other questions on each of the four plans, such as:

Does it provide improved service?

Does it offer capacity sufficient to handle future growth of trans-Hudson rapid transit traffic?

Would the proposed transit facilities provide the dramatic betterments in service required to insure acceptance by the commuters?

Is the improved convenience sufficient to stop or even reverse the trend of increasing use of private automobiles?

Does the initial plan permit logical future extensions of direct rapid transit rail services?

What weight should be given to comparative initial investment, financial results and public benefits?

What difficulties may develop in negotiating agreements with the New York City Transit Authority and with railroads furnishing suburban service?

These and related questions will be discussed and the comparative benefits and costs considered for each of the four rapid transit plans.

Plan 1

This plan is composed of a new and entirely independent bi-state rapid transit railroad loop providing transfer connections with all of the northern New Jersey suburban railroads. It would include two pairs of new trans-Hudson tunnels and a north-south subway in

Manhattan. It would be supplemented by the Hudson Terminal operations of the Hudson & Manhattan Railroad, the latter modernized and re-equipped.

The capital outlay required for this plan would total $474,000,000. Estimated net operating income would fail to meet annual fixed charges by $7,414,000 at 1955 traffic levels under the fare schedule assumed herein.

This plan, while it would involve the largest initial capital outlay, has outstanding advantages and presents the greatest appeal both to the commuters and from the standpoint of constructive development of the New York metropolitan area.

One of the principal advantages of this plan from the viewpoint of commuters is the substantial potential reduction in daily travel times. Plan 1 would provide an entire fleet of new cars of optimum passenger appeal and operating characteristics. Convenience would be further enhanced by the use of modern, attractive subway stations in Manhattan where architectural design, acoustical treatment, and increased lighting intensities would provide a dramatic improvement in contrast to older subway stations. Time savings would be enjoyed by commuters from the entire northern New Jersey metropolitan area because of the average speed of more than 30 miles per hour, the two-minute headways operated in both directions during rush hours, and the six-minute maximum headways during the non-rush and evening hours. Table 20 shows typical round trip time savings from various representative suburban communities to the Wall Street, 34th Street and 42nd Street areas. These areas are Districts 111, 124 and 133 respectively on Exhibit 3.

The weighted average time saving for the 59,900 New Jersey commuters now utilizing public transit services in traveling to three of the principal focal centers (Wall Street, 34th Street and 42nd Street areas) in Manhattan would amount to more than 24 minutes. See Table 21. Savings on trips to other parts of New York City, while not estimated in detail, would be comparable.

The proposed running time between the New Jersey Transfer stations and stations in Manhattan is shown in Table 22.

Under Plan 1, most commuters would find their daily trips slightly more expensive, but a fair portion would enjoy modest savings. The total cost of a New Jersey commuter's daily trip includes the fare paid for suburban train service (calculated on the basis of monthly commutation tickets)

or suburban bus service; the cost of the trans-Hudson portion of his ride; and the additional fare, if any, paid for a ride on New York City subways.

Plan 1 would provide the superior transportation facilities required to insure acceptance by the commuters themselves, in our opinion, and would also be acceptable to the administrative officials of public agencies involved in implementing the recommendations of this report.

Evidence from rapid transit installations in New York and elsewhere indicate that improved public transit facilities would speed the growth of the many attractive suburban communities in New Jersey. This in turn would generate increased commuter traffic to Manhattan. The post-war boom in construction of office buildings in both midtown and downtown areas of Manhattan, commented on elsewhere, has been accelerated during the past two years. This would seem likely to give new impetus to commuter traffic into Manhattan. Any plan for rapid transit to serve New Jersey suburban areas, therefore, should provide surplus capacity to accommodate reasonable expectations for future increases in rush hour traffic.

The total number of potential inbound passengers during the maximum hour of the morning rush period at 1955 traffic levels is estimated at 18,600 passengers in the case of the 60th Street trans-Hudson tunnel and 29,100 passengers in the south tunnel. This would absorb, on the assumptions previously discussed for service standards, 41 percent of the capacity of the north tunnel and 65 percent of the capacity of the south tunnel. The maximum rush hour flow through the Hudson & Manhattan tubes under Plan 1 would be 12,000 or 61 percent of the capacity of these existing facilities. It appears, therefore, that Plan 1 would have sufficient potential capacity to handle predictable future increases in traffic.

There is another major factor in the selection of a rapid transit plan. That is the practicability of future rapid transit railroad extensions from a bi-state system to provide direct service to Manhattan from the more important suburban communities. The bi-state rapid transit loop has been so planned as to permit feasible extensions along all of the principal suburban rail routes. These extensions could be built in the future as traffic develops and as the need for service to the commuters warrants the additional investment.

Such potential future developments will be discussed in more detail. It is our opinion that Plan 1 has maximum flexibility, however, and is capable

of future expansion as required. We conclude that Plan 1 has unique adaptability for future extension of direct rapid transit service to the principal New Jersey communities.

There would also be direct benefits to all of the present patrons of north-south subways in Manhattan in the area between 59th Street and the Wall Street area. This would result from building the Madison Avenue subway which would provide additional rush hour transportation between such important centers as Columbus Circle, Grand Central Terminal, 34th Street and Wall Street. The shift of passengers to the new Madison Avenue subway would serve to relieve some of the heavy rush hour loadings on the now over-taxed north-south subways.

There would be additional benefits in Manhattan through a decrease in the number of passenger automobiles stored on the over-crowded New York streets and in off-street parking facilities. Traffic volumes would be reduced to a degree, effecting modest relief in traffic congestion in the area of concentrated activity.

Finally, the construction of a rapid transit system would reduce the current losses of suburban railroad operators. It is reasonable to assume, consequently, that railroad managements would discontinue their almost constant pleas for permission to curtail or abandon service.

Plan 2

> This plan covers a bi-state loop rapid transit railroad similar in all respects to Plan 1 except that the BMT Broadway subway would be utilized in lieu of the new Madison Avenue subway proposed in Plan 1.

The capital outlay required for this plan—$328,000,000—compares with $474,000,000 involved in Plan 1. Further, estimated net operating income would fail to meet total fixed charges by $3,349,000 under the fare schedule assumed herein as contrasted with the substantially larger figure of $7,414,000 on Plan 1.

Many of the benefits discussed in connection with Plan 1 would be inherent in Plan 2. For instance, a fleet of new modern cars would be provided. Plan 2 would be inferior to Plan 1, however, in respect to flexibility and rider appeal.

Scheduled running time in Plan 2 would be somewhat greater than in Plan 1 since the average speed would be only 25 miles per hour as contrasted with 31 miles per hour in the first plan. Consequently average travel time savings for New Jersey commuters would be slightly less. Travel time would be substantially reduced, however, for those passengers with destinations conveniently reached by the BMT Broadway subway, such as the Times Square and the Pennsylvania Station areas. This would be more than balanced by the greater travel time required by those with destinations east of Fifth Avenue served directly by the Madison Avenue subway proposed under Plan 1. Table 20 shows typical round trip time savings from various suburban communities.

The weighted average time savings for the 59,900 New Jersey commuters now utilizing public transit services in traveling to three of the principal focal centers in Manhattan would amount to more than 21 minutes, compared with 24 minutes for Plan 1. See Table 21. Savings on trips to other parts of New York City, while not estimated in detail, would be comparable.

Running time between New Jersey Transfer stations and stations in Manhattan is presented in Table 23.

As discussed in connection with Plan 1, improved public transit facilities providing for delivery of New Jersey commuters between 59th Street and the Wall Street area would generate increased commuter traffic.

The estimated rush hour traffic through the north trans-Hudson pair of tunnels would be 17,900 passengers; through the south trans-Hudson pair of tunnels, 29,100 passengers; and through the H&M tubes to Hudson Terminal, 11,600 passengers. This would absorb, on the assumed service standards, 46 percent of the capacity of the north tunnels, 75 percent of the capacity of the south tunnels, and 59 percent of the capacity of the Hudson & Manhattan tubes. It appears, therefore, that Plan 2 has sufficient potential capacity to handle predictable future increases in traffic.

The new rapid transit railroad facilities in New Jersey would be similar in all respects to those provided in Plan 1. Plan 2 would provide as efficiently as Plan 1, therefore, for future extensions of direct railroad service to the principal suburban communities. There would also be similar benefits through a decrease in the number of passenger automobiles stored in Man-

hattan and in the reduction of the current losses now experienced by suburban railroad operators. The benefits to passengers now utilizing north-south subways in Manhattan, however, would be lacking.

Plan 3

This plan is similar in most respects to Plan 2. The BMT Broadway subway would be utilized for the Manhattan leg, but on the New Jersey side there would be a gap in the rapid transit railroad between the Lackawanna and the Susquehanna Transfer stations. Furthermore, the northerly route would be extended from the Susquehanna Transfer station to a new transfer station in Secaucus on the Erie main line. The modernized H&M would operate to Hudson Terminal.

This plan would eliminate the rock tunnels under the Palisades west of Lackawanna Transfer, and would accomplish a reduction in construction cost. Such saving would be more than offset by the construction cost of the two new terminals, both of which would have to be in somewhat constricted areas, thus adding slightly to the overall cost of the project.

The capital outlay for Plan 3, therefore, would amount to $330,000,000, or $2,000,000 more than involved in Plan 2. The estimated net operating income would fail to meet total fixed charges by $4,442,000, as compared with $3,349,000 in Plan 2 under the assumed fare schedules. This follows from the lack of flexibility involved in any plan which operates from two fixed terminals as compared with operation on a continuous loop.

Most of the benefits discussed in connection with Plan 2 would also be gained through the adoption of Plan 3. Plan 3 would benefit especially those commuters originating on the Erie main line who would have the option of transferring to the north trans-Hudson tunnels at the new Secaucus Terminal, or continuing their trips to the Lackawanna Transfer station.

Except for those originating on the Erie main line, however, most passengers from the north with destinations in the financial district would have to be transported north-and-south in Manhattan. Similarly, Lackawanna and Central of New Jersey passengers destined for the uptown district would all have to be transported in New York subways.

Since this plan would be ruled out in favor of Plans 1 or 2 by other considerations, a discussion of scheduled running time and time savings has been omitted.

Plan 4

This plan contemplates the same northern subway connection to the BMT Broadway subway at 59th Street as in Plans 2 and 3. From Susquehanna Transfer the route would extend to a terminal and transfer station at the Erie main line as in Plan 3. Trains from this terminal would operate to the connection with the BMT Broadway subway at 59th Street and thence through the BMT Broadway subway to Brooklyn or intermediate turnback points as determined by the New York City Transit Authority. Service to Manhattan would be furnished by making full use of all of the existing facilities of the Hudson & Manhattan Railroad with an extension from the portal in the vicinity of National Junction to Communipaw, where a new transfer station would be constructed to accommodate the suburban passengers from the Central Railroad of New Jersey. The Hudson Terminal branch of the H&M would be extended easterly to a connection with the local tracks of the IRT Lexington Avenue subway.

The capital outlay required for this plan would total $246,000,000. Even with this reduced investment as compared with the other plans, the estimated net operating income would fail to meet fixed charges by $2,611,000 under the assumed fare schedule.

Plan 4 would lack almost all of the benefits discussed in connection with the other plans. The principal advantage would accrue to commuters originating in the north and northwestern portions of the New Jersey suburban area who could use the extension of the BMT Broadway subway service through the north trans-Hudson tunnels. This group of commuters would, as a matter of fact, gain many of the advantages enumerated for Plans 2 and 3. For the great majority of commuters, however, including the entire group delivered by the several suburban railroads to the Hudson & Manhattan Railroad and its extension to the IRT Lexington Avenue subway there would be lesser improvements in the service.

Table 20 shows typical round trip time savings from various suburban communities.

The weighted average time savings for the 59,900 New Jersey commuters now utilizing public transit services in traveling to three principal focal centers in Manhattan would amount to more than 15 minutes. See Table 21.

Total travel costs would be approximately the same for Plan 4 as for Plan 2.

The proposed running time between New Jersey transfer stations and stations along the BMT Broadway subway is shown in Table 24A. Table 24B shows the running time on the modernized H&M service to Manhattan.

The total number of potential inbound passengers during the maximum hour is estimated at 18,800 through the 60th Street trans-Hudson tunnels; 11,200 passengers through the H&M tubes to the 33rd Street Terminal; and 28,100 passengers through the H&M tubes to the Hudson Terminal. There would be potential capacity under Plan 4 to handle future increases in traffic based on service standards previously assumed so long as the present latent capacity of the BMT Broadway and IRT Lexington subways remains available. This reserve capacity would accommodate 30 additional trains per hour southbound in the morning rush hour and northbound in the evening rush hour on the BMT Broadway subway and 30 ten-car trains from New Jersey on the IRT Lexington Avenue subway north-bound in the morning rush hour and southbound in the evening rush hour. The estimated traffic flows at 1955 levels would absorb 48 percent of the capacity of the north trans-Hudson tunnel; 57 percent of the capacity of the uptown Hudson & Manhattan tubes; and 71 percent of the capacity of the Hudson Terminal tubes in the maximum rush hour.

There is a substantial weakness in Plan 4 from the viewpoint of providing rapid transit service between New Jersey and Manhattan. It lacks flexibility. Many difficulties would be experienced in the future construction of rapid transit railroad extensions to provide direct service between Manhattan and outlying suburban communities. While the plan would permit abandonment of existing railroad ferries, the improvements would be insufficient, in our judgment, to attract any substantial number of additional passengers, or to stem the increasing flow of trans-Hudson automobile traffic.

For these reasons, we do not recommend consideration of Plan 4 as a complete plan for rapid transit between New Jersey and Manhattan. Should there be reluctance or inability to commit the capital sums required for Plans 1 or 2, however, Plan 4 could logically be considered as an initial step in the development of satisfactory rapid transit as proposed in the more costly schemes.

Conclusions

Consideration of the relative economics of the several plans should necessarily be given great weight in the final determination. A summary of the figures on total investment as well as revenues and expenses for an assumed base year at 1955 traffic levels on all four plans is shown in the following tabulation:

	Plan 1	Plan 2	Plan 3	Plan 4
Total Revenues	$ 22,800,000	$ 18,800,000	$ 18,100,000	$ 18,200,000
Total Expenses	8,542,000	7,260,000	7,613,000	9,871,000
Income from Operations	$ 14,258,000	$ 11,540,000	$ 10,487,000	$ 8,329,000
Total Investment	$474,000,000	$328,000,000	$330,000,000	$246,000,000
Total Interest and Amortization*	$ 21,672,000	$ 14,889,000	$ 14,929,000	$ 10,940,000
Net Income or (Deficit)	($ 7,414,000)	($ 3,349,000)	($ 4,442,000)	($ 2,611,000)
Deficit per Round Trip	$0.17	$0.08	$0.11	$0.06

*-Based on four percent interest on entire amount plus amortization over a 50-year period on all items except those requiring replacement within that period. Renewal of the latter is charged as an operating expense.

Our estimates indicate that the construction and operation of rapid transit facilities to serve the New Jersey commuters on any plan would require some measure of public support through funds other than those realized from the operation or else a fare schedule substantially higher than we deem reasonable and proper. Accepting this basic fact, the question arises as to

whether an inferior plan, such as Plan 4, or a superior plan, such as Plans 1 or 2, should be adopted in view of the comparative benefits described above. We may eliminate Plan 3 from further consideration in view of the somewhat less attractive service and the slight increases in investment and annual deficit as compared with Plan 2.

After consideration of all the facts collected and the analyses made and summarized in the foregoing discussions, we are of the opinion that Plan 1 has so many outstanding advantages that it would have a better chance for acceptance by the commuters and by the public agencies involved than any other plan. Therefore, we recommend its adoption.

Plan 2 also has merit, however, its principal advantages being reduction in total investment and deficits. It is our recommendation, therefore, that Plan 2 be considered for adoption in the event that considerations of public policy and acceptance by the communities make it the most acceptable.

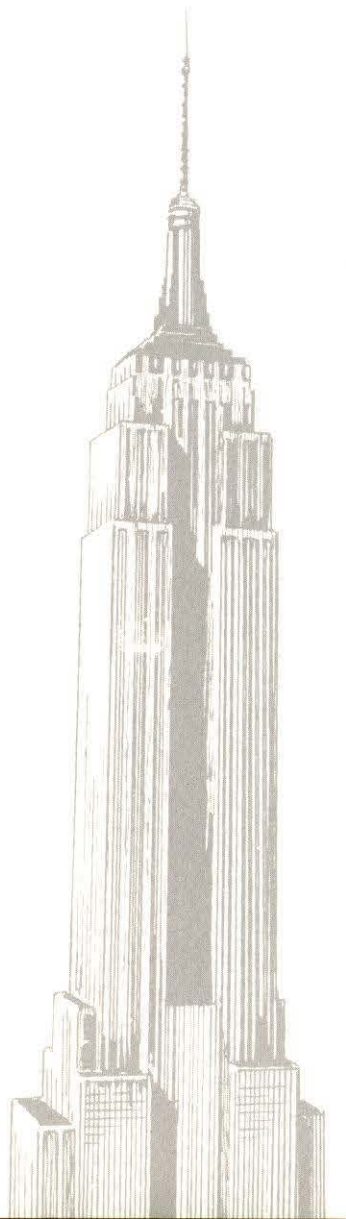


Table 20

REDUCTIONS IN ROUND TRIP TRAVEL TIME — PLANS 1, 2 and 4

Origin	Present Carrier	Destination	District*	Time in Minutes: Total — Present Carrier	Total — Plan 1	Total — Plan 2	Total — Plan 4	Savings — Plan 1	Savings — Plan 2	Savings — Plan 4
Bayonne	CNJ	Wall Street area	111	78	56	58	74	22	20	4
		34th Street area	124	96	78	80	86	18	16	10
		42nd Street area	133	106	74	86	96	32	20	10
Plainfield	CNJ	Wall Street area	111	130	108	110	126	22	20	4
		34th Street area	124	148	130	132	138	18	16	10
		42nd Street area	133	158	126	138	148	32	20	10
Jersey City**	H&M	Wall Street area	111	50	40	42	42	10	8	8
		34th Street area	124	56	60	60	54	–4	–4	2
		42nd Street area	133	68	58	66	64	10	2	4
Newark	H&M	Wall Street area	111	70	60	62	62	10	8	8
		34th Street area	124	76	80	80	74	–4	–4	2
		42nd Street area	133	88	78	86	84	10	2	4
Orange	DL&W (via Ferry)	Wall Street area	111	112	80	82	94	32	30	18
		34th Street area	124	124	100	96	94	24	28	30
		42nd Street area	133	134	92	100	116	42	34	18
Summit	DL&W (via Ferry)	Wall Street area	111	136	104	106	118	32	30	18
		34th Street area	124	148	124	120	118	24	28	30
		42nd Street area	133	158	116	124	140	42	34	18
Orange	DL&W (via H&M)	Wall Street area	111	102	80	82	94	22	20	8
		34th Street area	124	96	100	96	94	–4	0	2
		42nd Street area	133	120	92	100	116	28	20	4
Summit	DL&W (via H&M)	Wall Street area	111	126	104	106	118	22	20	8
		34th Street area	124	120	124	120	118	–4	0	2
		42nd Street area	133	144	116	124	140	28	20	4
Ridgewood	Erie (via Ferry)	Wall Street area	111	144	116	118	126	28	26	18
		34th Street area	124	156	116	112	112	40	44	44
		42nd Street area	133	166	108	116	116	58	50	50
Montclair	Erie (via Ferry)	Wall Street area	111	126	94	96	108	32	30	18
		34th Street area	124	138	114	110	108	24	28	30
		42nd Street area	133	148	106	114	130	42	34	18

Table 20—Continued

REDUCTIONS IN ROUND TRIP TRAVEL TIME—PLANS 1, 2 and 4

Origin	Present Carrier	Destination	District*	Time in Minutes: Total — Present Carrier	Total — Plan 1	Total — Plan 2	Total — Plan 4	Savings — Plan 1	Savings — Plan 2	Savings — Plan 4
Ridgewood	Erie (via H&M)	Wall Street area	111	134	116	118	126	18	16	8
		34th Street area	124	128	116	112	112	12	16	16
		42nd Street area	133	152	108	116	116	44	36	36
Montclair	Erie (via H&M)	Wall Street area	111	116	94	96	108	22	20	8
		34th Street area	124	110	114	110	108	–4	0	2
		42nd Street area	133	134	106	114	130	28	20	4
Teaneck	NYC	Wall Street area	111	132	84	92	92	48	40	40
		34th Street area	124	120	78	74	74	42	46	46
		42nd Street area	133	124	70	78	78	54	46	46
West Nyack	NYC	Wall Street area	111	192	144	152	152	48	40	40
		34th Street area	124	180	138	134	134	42	46	46
		42nd Street area	133	184	130	138	138	54	46	46
Teaneck	PABT Bus	Wall Street area	111	136	90	92	112	46	44	24
		34th Street area	124	122	90	86	86	32	36	36
		42nd Street area	133	122	82	90	90	40	32	32
Paterson	PABT Bus	Wall Street area	111	156	122	124	144	34	32	12
		34th Street area	124	142	122	118	118	20	24	24
		42nd Street area	133	142	114	122	122	28	20	20
Newark	PABT Bus	Wall Street area	111	116	82	84	104	34	32	12
		34th Street area	124	102	82	78	78	20	24	24
		42nd Street area	133	102	74	82	82	28	20	20
Englewood	GWB Bus	Wall Street area	111	120	92	94	114	28	26	6
		34th Street area	124	104	92	88	88	12	16	16
		42nd Street area	133	106	84	92	92	22	14	14
Teaneck	GWB Bus	Wall Street area	111	122	90	92	112	32	30	10
		34th Street area	124	106	90	86	86	16	20	20
		42nd Street area	133	108	82	90	90	26	18	18
Fairlawn	GWB Bus	Wall Street area	111	146	104	106	126	42	40	20
		34th Street area	124	130	104	100	100	26	30	30
		42nd Street area	133	132	96	104	104	36	28	28

*Districts shown on Exhibit 3.
**Journal Square Station.

Table 21

WEIGHTED AVERAGE ROUND TRIP TIME SAVINGS FOR NEW JERSEY TRANSIT COMMUTERS TRAVELING TO THREE PRINCIPAL AREAS IN MANHATTAN FOR RAPID TRANSIT PLANS 1, 2 AND 4

Principal Manhattan Area	District	24-Hour Round Trip Passengers	Weighted Average Time Savings in Minutes		
			Plan 1	Plan 2	Plan 4
Wall Street	111	30,400	25.2	22.6	12.2
34th Street	124	12,600	11.2	13.8	15.6
42nd Street	133	16,900	31.8	23.6	21.8
TOTAL PASSENGERS		59,900			
Weighted average time saving for the three areas			24.2	21.2	15.6

Table 22

PROPOSED RUNNING TIME ON NEW RAPID TRANSIT SYSTEM—PLAN 1

	Time in Minutes	
	Clockwise	Counter-Clockwise
NEW JERSEY TRANSFER STATIONS		
Jersey Central	0	34
H&M	3	31
Lackawanna	5	29
Susquehanna	11	23
West Shore	14	20
MANHATTAN STATIONS ON NEW MADISON AVENUE ROUTE		
Columbus Circle	17	17
59th Street	19	15
51st Street	21	13
42nd Street	22	12
34th Street	23	11
23rd Street	25	9
14th Street	26	8
Houston Street	28	6
Wall Street	31	3
Bowling Green	32	2
JERSEY CENTRAL TRANSFER STATION	34	0

Table 23

PROPOSED RUNNING TIME ON NEW RAPID TRANSIT SYSTEM—PLAN 2

	Time in Minutes	
	Clockwise	Counter-Clockwise
NEW JERSEY TRANSFER STATIONS		
Jersey Central	0	41
H&M	3	38
Lackawanna	5	36
Susquehanna	11	30
West Shore	15	26
MANHATTAN STATIONS ON BMT BROADWAY ROUTE		
Columbus Circle	19	22
57th Street	21	20
49th Street	23	18
42nd Street	24	17
34th Street	25	16
28th Street	27	14
23rd Street	29	12
14th Street	30	11
8th Street	31	10
Prince Street	33	8
Canal Street	34	7
City Hall	37*	—
Cortlandt Street	38*	—
Rector Street	39*	—
Cedar Street	37	4
Whitehall Street	41*	—
JERSEY CENTRAL TRANSFER STATION	41	0

*-Running time is based on using train destined to Brooklyn via Montague tunnel.

Table 24A

PROPOSED RUNNING TIME
ON NEW RAPID TRANSIT SYSTEM—PLAN 4

	Time in Minutes	
	Clockwise	Counter-Clockwise
NEW JERSEY TRANSFER STATION		
Erie	0	32
Susquehanna	4	28
West Shore	8	24
MANHATTAN STATIONS ON BMT BROADWAY ROUTE		
Columbus Circle	12	20
57th Street	14	18
49th Street	16	16
42nd Street	17	15
34th Street	18	14
28th Street	20	12
23rd Street	22	10
14th Street	23	9
8th Street	24	8
Prince Street	26	6
Canal Street	27	5
City Hall	28	4
Cortlandt Street	29	3
Rector Street	30	2
Whitehall Street*	32	0

*Trains would continue in the BMT Broadway subway to its terminus.

Table 24B

PROPOSED RUNNING TIME ON MODERNIZED H&M—PLAN 4

Newark to Brooklyn Bridge*	Time in Minutes
NEW JERSEY STATIONS	
Newark	0
Harrison	2
Journal Square	10
Grove-Henderson	14
Exchange Place	16
MANHATTAN STATIONS	
Hudson Terminal	19
Brooklyn Bridge	21

Communipaw to Brooklyn Bridge*	Time in Minutes
NEW JERSEY STATIONS	
Communipaw	0
Grove-Henderson	6
Exchange Place	8
MANHATTAN STATIONS	
Hudson Terminal	11
Brooklyn Bridge	13

Newark to 33rd Street	
NEW JERSEY STATIONS	
Newark	0
Harrison	2
Journal Square	10
Grove-Henderson	14
Erie Station	17
MANHATTAN STATIONS	
Christopher Street	21
9th Street	23
14th Street	25
23rd Street	27
33rd Street	29

Communipaw to 33rd Street	
NEW JERSEY STATIONS	
Communipaw	0
Grove-Henderson	6
Erie Station	9
MANHATTAN STATIONS	
Christopher Street	13
9th Street	15
14th Street	17
23rd Street	19
33rd Street	21

*Trains would continue in the IRT Lexington Avenue subway to its terminus.

Note: Additional service would be provided from the DL&W station in Hoboken. The times from Hoboken would be approximately 11 minutes to Brooklyn Bridge and 14 minutes to 33rd Street.



CHAPTER VII

DEVELOPMENT PROGRAM

The logical first step to implement the recommendations for trans-Hudson rapid transit would be to create a new bi-state public agency. It should be granted powers to plan, finance, construct, operate and maintain (or lease) the required rapid transit facilities. The agency would also be empowered to enter into contracts with the New York City Transit Authority or any other public transit agency, as well as with the several railroads furnishing suburban passenger service. Such contracts could cover joint operation, track rights, leases, arrangements for transfer facilities, and division of revenues and expenses.

The Program During the First Year

During its first year the public transit agency could expect to complete negotiations and contracts with all transit operators, both public and private. Within this period the engineering, legal and economic studies and reports should be carried on as required for the completion of financing.

It is suggested that work on construction surveys and plans be advanced concurrently with the above activities so as to permit prompt awarding of contracts and starting work on the trans-Hudson tunnels. Work on general plans for subways and subway connections in Manhattan should also be advanced to the point where basic subway construction contracts could be awarded and work started within three months after completion of financing.

In the first year, land surveys should be made of all private property required, both in New York and New Jersey. Title searches and appraisals should also be completed within this period so as to place the new public agency in position to start proceedings to acquire land and easements as soon as money becomes available.

Four-Year Construction Program

Immediately upon completion of financing, the railway properties of the Hudson & Manhattan Railroad Company should be acquired, and the new public agency should take over its operation and maintenance. Work should be started on modernization of the Hudson Terminal route, including renewals of fixed equipment and purchase of new rapid transit cars as described previously. This modernization program would require an estimated two years.

Assuming that the engineering plans have been advanced and contracts with the several carriers negotiated prior to financing, we estimate that a total of four years would be needed to build the entire rapid transit system ready for operation. The basic subway contracts in Manhattan would require a construction period of approximately two years. During this time contracts for the rapid transit railroad construction in New Jersey could be gotten under way. Plans would be developed and contracts awarded for station finish, all fixed subway equipment and all rolling stock.

Hudson & Manhattan 33rd Street Branch

It has been recommended that, unless Plan 4 is adopted, the Hudson & Manhattan Railroad service to the 33rd Street and Sixth Avenue terminal be abandoned upon the start of operations of the trans-Hudson rapid transit system. Such suspension would involve a measure of inconvenience to a

relatively small group of commuters. The determination on this policy question should be made shortly after start of operation of the new rapid transit facilities, at which time any possible loss of convenience could be weighed against the additional financial burden imposed through the continuation of this unprofitable service.

Ultimate Development

All of the plans considered have been developed so as to permit the extension of rapid transit services along radial lines to the outskirts of the New Jersey metropolitan area. It is improbable that such rapid transit extensions would ever be made on all of the existing suburban lines. Studies of the several existing suburban operations are being made by other consultants, and it seems likely that they will recommend the conversion of a number of the existing lightly traveled suburban rail lines to express bus lines operating to the proposed bi-state loop transfer stations.

The routes which might logically be considered for extension of direct rapid transit service to Manhattan would include the main line of the Central of New Jersey; the main line of the Lackawanna; the Montclair Branch of the Lackawanna with an extension along the Erie Greenwood Lake Branch; the Erie and Susquehanna main lines forming a loop serving Passaic, Paterson and Hackensack; the Erie Bergen County Branch and nothren portion of the Erie main line; and the NYC West Shore Route.

In view of the great scope of this ultimate development, it was not deemed advisable to prepare specific preliminary operating and physical plans. Careful reconnaissance surveys were made, however, of the entire railroad suburban network. These were in sufficient detail to permit preliminary determination of the number of railroad-highway grade separations required, the scope of work involved in reconstruction of existing suburban railroad stations, and the tentative location of new and additional parking facilities. A tentative plan was prepared for modernization of suburban station layouts involving the elimination of a number of existing unimportant station stops as well as the provision of new transfer stations favorably located with respect to accommodating feeder buses and providing substantial additional day storage for private automobiles. A preliminary report

containing memoranda developed by these reconnaissance surveys and office studies has been filed separately.

Such extensions, when financially feasible, would provide three additional important improvements in service. First, there would be substantial savings in travel time through the substitution of rapid transit cars for the equipment now used in railroad suburban service. These savings would be added to the travel time savings described earlier in the report which would result from the completion of the initial bi-state rapid transit system.

Second, there would be additional parking facilities to accommodate the increasing number of commuters who prefer to drive to suburban stations and utilize public transit to reach their ultimate destinations. Our preliminary canvass indicated that the facilities on nearby streets, off-street parking lots and railroad property provide for the day storage of approximately 10,000 automobiles. The full program of future extensions outlined herein would provide an additional 15,000 parking stalls.

Third, modern transfer facilities are proposed to provide the maximum of convenience for rubber-to-rail transfer between numerous feeder bus routes and rapid transit. The layout of the feeder routes extending from all of the outer transfer points and strategic intermediate stations could be such as to make the facilities of the rapid transit railroad network available to the entire New Jersey metropolitan area.

This full development would involve a total capital outlay estimated at approximately one-third of a billion dollars. It is not recommended for consideration in the initial plan. In the meantime, many improvements such as those suggested by the Monmouth County Board could be effected by the railroads.

London Suburban Rapid Transit

Such a direct service with rapid transit-type equipment between the central subways and many suburbs has been developed in the London metropolitan area since the formation in 1933 of the London Passenger Transport Board (now the London Transport Executive). The successful example presented by this Board merits some discussion.

The London Transport Executive is the world's outstanding example of the many advantages of unified operation of all transit service in a metropolitan center. The Executive operates and controls all transit in the entire metropolitan area by subways, local buses, suburban buses and rapid transit rail extensions from the city subways through the suburban areas along main line railways. The unified system serves an area of nearly 2,000 square miles with a population of nearly 10 million. This large and capable organization has about 87,000 employees and serves approximately 12 million riders every weekday.

The suburban rail system is gradually being electrified and extensions are made as required to serve new suburban communities. An example of the gradual development of electric rail extensions was a ten million dollar reconstruction and electrification plan announced in July 1956. The announcement stated that the project is being undertaken to increase the efficiency of the line and to give better running, faster speeds and more trains.

Conclusion

The splendid London rapid transit program suggests the practicability of the ultimate development here proposed. Ideal commuter transportation from the passenger's viewpoint would provide, among other features, direct service without a transfer from his suburban station to a station within easy walking distance of his destination. For the operator, such a plan would eliminate the duplication of equipment and crews inherent in any transfer plan.

This magnificent concept of trans-Hudson transportation serving the entire New York-New Jersey suburban area could become a reality during the next generation, provided the initial plan here recommended is considered on the broad lines of immediate and ultimate benefits to the community.

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METROPOLITAN RAPID TRANSIT SURVEY

SUMMARY OF TRANS-HUDSON FERRY EASTBOUND PASSENGER COUNTS

Typical Weekday in 1955

Time Period	CNJ Station 20	Erie Susquehanna Station 21	DL&W Station 22	NYC 42nd Street Station 23	NYC Cortlandt Station 24	Total Ferry Stations
12:00 P.M. - 1:00 A.M.	54	19	13	—	—	86
1:00 A.M. - 2:00	16	0	10	—	—	26
2:00 - 3:00	2	0	5	—	—	7
3:00 - 4:00	13	0	7	—	—	20
4:00 - 5:00	30	0	9	—	—	39
5:00 - 6:00	54	14	15	—	—	83
6:00 - 7:00	217	234	120	310	—	881
7:00 - 7:30	1,043	490	314	366	—	2,213
7:30 - 7:40	278	0	73	280	247	878
7:40 - 7:50	25	135	442	73	0	675
7:50 - 8:00	763	0	810	527	0	2,100
8:00 - 8:10	1,595	1,484	887	261	551	4,778
8:10 - 8:20	1,210	1,218	566	758	826	4,578
8:20 - 8:30	2,969	1,403	1,130	254	0	5,756
8:30 - 8:40	1,584	791	1,028	641	726	4,770
8:40 - 8:50	2,027	1,226	660	76	0	3,989
8:50 - 9:00	217	464	1,048	90	0	1,819
9:00 - 9:10	514	632	360	149	0	1,655
9:10 - 9:20	230	94	570	127	131	1,152
9:20 - 9:30	563	251	126	42	—	982
9:30 - 10:00	47	54	289	101	—	491
10:00 - 11:00	271	87	221	193	—	772
11:00 - 12:00 M.	207	43	95	70	—	415
12:00 M. - 1:00 P.M.	139	91	112	84	—	426
1:00 P.M. - 2:00	152	38	108	96	—	394
2:00 - 3:00	100	25	97	69	—	291
3:00 - 4:00	135	74	112	141	14	476
4:00 - 5:00	498	104	179	280	21	1,082
5:00 - 6:00	540	75	205	260	7	1,087
6:00 - 7:00	116	84	109	218	—	527
7:00 - 8:00	70	24	56	49	—	199
8:00 - 9:00	37	20	32	19	—	108
9:00 - 10:00	30	14	13	23	—	80
10:00 - 11:00	79	3	28	71	—	181
11:00 - 12:00 P.M.	46	3	20	—	—	69
TOTAL	15,871	9,194	9,869	5,628	2,523	43,085

METROPOLITAN RAPID TRANSIT SURVEY

SUMMARY OF HUDSON & MANHATTAN RAILROAD COMPANY EASTBOUND PASSENGER COUNTS

Typical Weekday in 1955

Time Period	Newark Station 10	Journal Square Station 12	Grove Station 13	Exchange Place Station 14	Erie Station 15	DL&W Station 16	All Stations
12:00 P.M. - 1:00 A.M.	198	88	47	66	0	33	432
1:00 A.M. - 2:00	55	36	18	28	13	22	172
2:00 - 3:00	38	5	19	6	16	17	101
3:00 - 4:00	26	27	23	1	3	11	91
4:00 - 5.00	24	44	46	7	1	16	138
5:00 - 6:00	73	176	132	32	15	104	532
6:00 - 7:00	367	608	408	156	108	418	2,065
7:00 - 7:30	477	828	525	56	325	690	2,901
7:30 - 7:40	168	383	193	92	57	467	1,360
7:40 - 7:50	344	529	242	55	202	390	1,762
7:50 - 8:00	260	734	286	106	548	784	2,718
8:00 - 8:10	272	888	346	264	548	910	3,228
8:10 - 8:20	456	988	320	429	1,201	1,449	4,843
8:20 - 8:30	266	1,044	468	391	722	1,914	4,805
8:30 - 8:40	327	1,094	384	394	930	1,486	4,615
8:40 - 8:50	266	641	227	648	603	1,253	3,638
8:50 - 9:00	183	398	154	407	456	747	2,345
9:00 - 9:10	232	315	118	210	194	503	1,572
9:10 - 9:20	115	193	81	263	108	389	1,149
9:20 - 9:30	101	195	86	101	46	234	763
9:30 - 10:00	309	343	122	76	7	493	1,350
10:00 - 11:00	391	707	220	114	74	566	2,072
11:00 - 12:00	353	431	141	124	74	409	1,532
12:00 M. - 1:00 P.M.	349	297	207	144	51	374	1,422
1:00 P.M. - 2:00	297	307	176	107	83	332	1,302
2:00 - 3:00	312	499	176	161	71	224	1,443
3:00 - 4:00	423	403	258	186	36	263	1,569
4:00 - 5:00	780	644	632	707	136	486	3,385
5:00 - 6:00	1,677	727	483	538	71	941	4,437
6:00 - 7:00	498	293	355	194	31	321	1,692
7:00 - 8:00	331	173	185	104	63	99	955
8:00 - 9:00	162	151	121	69	8	59	570
9:00 - 10:00	230	133	87	31	8	181	670
10:00 - 11:00	181	184	47	37	51	43	543
11:00 - 12:00 P.M.	172	148	125	97	0	153	695
TOTAL	10,713	14,654	7,458	6,401	6,860	16,781	62,867

METROPOLITAN RAPID TRANSIT SURVEY

NUMBER OF AUTOMOBILE USERS (DRIVERS PLUS PASSENGERS) USING PORT OF NEW YORK AUTHORITY HUDSON RIVER CROSSINGS BY HOUR AND BY DIRECTION

Typical Weekday in 1955

Hour Period	George Washington Bridge		Lincoln Tunnel		Holland Tunnel		Total	
	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound
6:00 - 7:00 A.M.	5,077	6,561	2,306	3,274	1,535	2,936	8,918	12,771
7:00 - 8:00	6,573	4,540	2,463	2,827	1,260	2,312	10,296	9,679
8:00 - 9:00	5,129	4,500	3,089	1,964	1,350	1,909	9,568	8,373
9:00 - 10:00	3,473	3,772	2,353	1,765	1,502	1,647	7,328	7,184
10:00 - 11:00	3,816	4,263	2,254	1,601	1,227	1,717	7,297	7,581
11:00 - 12:00 M.	2,969	3,676	1,963	2,135	1,675	1,217	6,607	7,028
12:00 - 1:00 P.M.	3,498	3,663	2,014	1,564	1,358	1,604	6,870	6,831
1:00 - 2:00	4,238	4,279	2,295	2,206	1,593	1,506	8,126	7,991
2:00 - 3:00	3,952	5,075	2,241	2,433	2,061	1,659	8,254	9,167
3:00 - 4:00	6,235	6,612	3,247	2,557	1,881	1,575	11,363	10,744
4:00 - 5:00	6,826	7,651	3,010	1,650	2,961	1,792	12,797	11,093
5:00 - 6:00	7,215	7,173	3,127	2,788	3,153	1,296	13,495	11,257
6:00 - 7:00	4,266	5,102	2,746	1,919	1,939	1,528	8,951	8,549
7:00 - 8:00	4,567	3,431	2,020	2,083	832	1,381	7,419	6,895
8:00 - 9:00	3,328	3,947	1,628	1,857	1,222	1,168	6,178	6,972
9:00 - 10:00	3,842	2,985	1,359	2,022	1,180	984	6,381	5,991
10:00 - 11:00	1,849	3,150	1,301	1,780	902	934	4,052	5,864
11:00 - 12:00 P.M.	2,180	2,582	1,071	1,455	674	999	3,925	5,036
18-HOUR TOTALS	79,033	82,962	40,487	37,880	28,305	28,164	147,825	149,006

COMPARISON OF 1955 AND ANTICIPATED 1975 POPULATION, EMPLOYED LABOR FORCE AND EMPLOYMENT BY COUNTIES AND BY SURVEY SEGMENTS IN THE NEW JERSEY-NEW YORK-CONNECTICUT METROPOLITAN REGION

Counties	Population		Employed Labor Force		Employment	
	1955	1975	1955	1975	1955	1975
	add 000					
Counties West of the Hudson						
Orange, New York	170	260	60	95	50	85
Rockland, New York	100	250	35	95	30	60
Total	270	510	95	190	80	145
Essex, New Jersey	950	1,100	405	455	365	415
Morris, New Jersey	200	400	75	160	55	120
Passaic, New Jersey	375	460	170	200	150	165
Total	1,525	1,960	650	815	570	700
Hudson, New Jersey	645	600	275	250	245	270
Bergen, New Jersey	655	1,100	270	445	200	400
Union, New Jersey	450	640	190	270	180	300
Total	1,750	2,340	735	965	625	970
Somerset, New Jersey	115	225	45	85	35	60
Middlesex, New Jersey	335	700	140	280	115	235
Monmouth, New Jersey	280	600	95	220	70	135
Total	730	1,525	280	585	220	430
Richmond (Staten Island) New York	210	500	80	185	35	100
Total West of the Hudson	4,485	6,835	1,840	2,740	1,530	2,345
New York City (except Staten Island)						
New York (Manhattan) New York	1,875	1,825	860	790	2,520	2,280
Kings, New York	2,725	2,675	1,095	1,055	665	740
Queens, New York	1,750	1,900	740	800	390	530
Total	4,475	4,575	1,835	1,855	1,055	1,270
Bronx, New York	1,490	1,500	610	600	230	280
Total New York City (except Staten Island)	7,840	7,900	3,305	3,245	3,805	3,830
Northeast Counties						
Dutchess-Putnam, New York	190	320	70	125	60	115
Westchester, New York	735	1,000	310	415	240	350
Fairfield, Connecticut	555	800	230	315	235	320
Total Northeast Counties	1,480	2,120	610	855	535	785
Long Island (excluding New York City)						
Nassau, New York	975	1,400	375	550	295	475
Suffolk, New York	445	845	155	310	110	265
Total Long Island (excluding New York City)	1,420	2,245	530	860	405	740
TOTAL EAST OF HUDSON	10,740	12,265	4,445	4,960	4,745	5,355
TOTAL WEST OF HUDSON	4,485	6,835	1,840	2,740	1,530	2,345
TOTAL REGION	15,225	19,100	6,285	7,700	6,275	7,700

Data from Population, Economic and Land Use Studies of the New Jersey-New York-Connecticut Metropolitan Region for the Metropolitan Rapid Transit Survey by the Regional Plan Association, Inc.—August 1, 1956.

Change—1955 to 1975						Net Excess or Deficit (—) of Workers in Relation to Jobs		
Population		Labor Force		Employment				
Absolute	Percent	Absolute	Percent	Absolute	Percent	1955	1975	Change
Add 000								
90	53	35	58	35	70	10	10	0
150	150	60	171	30	100	5	35	30
240	89	95	100	65	81	15	45	30
150	16	50	12	50	14	35	40	5
200	100	85	113	65	118	20	40	20
85	23	30	18	15	10	20	35	15
435	29	165	25	130	23	75	115	40
—45	—7	—25	—9	25	10	30	—20	—50
445	68	175	65	200	100	70	45	—25
190	42	80	42	120	67	10	—30	—40
590	34	230	31	345	55	110	—5	—115
110	96	40	89	25	71	10	25	15
365	109	140	100	120	104	25	45	20
320	114	125	132	65	93	25	85	60
795	109	305	109	210	95	60	155	95
290	138	105	131	65	186	45	85	40
2,350	52	900	49	815	53	305	395	90
—50	—3	—70	—8	—240	—10	—1,660	—1,490	170
—50	—2	—40	—4	75	11	430	315	—115
150	9	60	8	140	36	345	270	—75
100	2	20	1	215	20	775	585	—190
10	1	—10	—2	50	22	380	320	—60
60	1	—60	—2	25	1	—505	—585	—80
130	164	55	79	55	92	10	10	0
265	36	105	34	110	46	70	65	—5
245	44	85	37	85	36	—5	—5	0
640	43	245	40	250	47	75	70	—5
425	44	175	47	180	61	80	75	—5
400	90	155	100	155	141	45	45	0
825	58	330	62	335	83	125	120	—5
1,525	14	515	12	610	13	—305	—395	—90
2,350	52	900	49	815	53	305	395	90
3,875	25	1,415	23	1,425	23	0	0	0

METROPOLITAN RAPID TRANSIT SURVEY
SUMMARY OF BUS AND PENNSYLVANIA RAILROAD
WESTBOUND PASSENGER COUNTS
Typical Weekday in 1955

Time Period	Buses George Washington Bridge Station 30*	Buses PABT** Station 50	Pennsylvania Railroad Station 60
12:00 P.M. - 1:00 A.M.	—	1,249	266
1:00 A.M. - 2:00	—	588	48
2:00 - 3:00	—	192	0
3:00 - 4:00	—	62	26
4:00 - 5:00	—	61	0
5:00 - 6:00	—	209	31
6:00 - 7:00	—	1,781	588
7:00 - 8:00	707	3,819	1,315
8:00 - 9:00	1,467	2,093	1,938
9:00 - 10:00	525	968	743
10:00 - 11:00	401	963	983
11:00 - 12:00 M.	399	1,100	510
12:00 M. - 1:00 P.M.	512	1,136	666
1:00 P.M. - 2:00	484	1,508	778
2:00 - 3:00	841	2,086	504
3:00 - 4:00	1,503	3,467	1,164
4:00 - 5:00	2,379	5,923	2,122
5:00 - 6:00	5,451	16,073	6,350
6:00 - 7:00	6,161	6,599	1,848
7:00 - 8:00	2,303	3,512	1,015
8:00 - 9:00	1,597	2,689	615
9:00 - 10:00	1,780	2,654	602
10:00 - 11:00	1,396	2,094	500
11:00 - 12:00 A.M.	—	2,357	0
TOTAL	27,906	63,183	22,612

*This count was taken between 7:00 A.M. and 11:00 P.M. only.

**PABT=Port Authority Bus Terminal at 41st Street and Eighth Avenue, Manhattan.

APPENDIX B

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Existing Suburban Railroad Facilities and Services

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APPENDIX B

EXISTING SUBURBAN RAILROAD FACILITIES AND SERVICES

Commuters from the New Jersey segment of the metropolitan area are served by private automobiles, by the bus lines of a number of independent operators and by six railroad companies which, together with their subsidiaries, provide commuter service. In addition, the Hudson & Manhattan Railroad operates an electrified service through two pairs of tunnels across the Hudson River. This report is concerned primarily with the services of the seven railroads, including the H&M.

The corporate names of the various railroads furnishing through or commuter passenger service in the area are shown below. Abbreviations in common use are employed throughout this report.

The Baltimore & Ohio Railroad Company
The Central Railroad Company of New Jersey
The Delaware, Lackawanna and Western Railroad Company
Erie Railroad
    Bergen County Railroad
    Greenwood Lake Division
        Caldwell Branch (New York-Essex Fells-Wanaque-Midvale)
        Orange Branch (New York-Forest Hill-West Orange)
    Main Line (New York-Goshen-Middletown)
    Main Line (New York-Suffern)
    Newark Branch
    The New Jersey and New York Railroad Company
    Northern Branch
Hudson & Manhattan Railroad Company
Lehigh Valley Railroad Company
New York Central System
    West Shore Route
The New York & Long Branch Railroad Company
New York, Susquehanna & Western Railroad Company

The Pennsylvania Railroad Company
- Main Line
- Woodbridge Branch (New York-Point Pleasant-Bay Head Junction)

Reading Railway System

The following description of the commuter railroads and their services places them in counterclockwise order.

West Shore

The West Shore Route of the New York Central System consists of 142 miles of road between Weehawken, New Jersey and Albany, New York. Railroad passengers between Weekawken and Manhattan use either the West 42nd Street ferry or the Cortlandt Street ferry, both of which are owned and operated by the NYC-West Shore Route. The NYC recently applied to the Interstate Commerce Commission and other regulatory bodies for permission to abandon these ferries. Authority to do so has been granted, contingent on the provisions of satisfactory substitute service across the Hudson. No final plans have been announced. One plan being considered, however, is to route West Shore trains via the Erie-Susquehanna tracks to the Erie Terminal at Jersey City, with a stop at Susquehanna Transfer to permit use of the shuttle buses to the PNYA Bus Terminal.

The West Shore's present Weehawken passenger terminal, located on the west bank of the Hudson River, has 18 stub tracks for passengers, mail and express. A double track extends westerly from the terminal in a tunnel through the Palisades. There are four tracks from the west end of the tunnel to Dumont, 13 miles from Weehawken. From Dumont to West Haverstraw, a distance of 21 miles, the railroad has two main tracks. Most of the suburban trains terminate at West Haverstraw.

All operation is powered by diesel locomotives, 20 of which are used in the commuter service. The railroad has 91 coaches seating 83 to 96 passengers. Most of the coaches were built between 1906 and 1926 but they have been well maintained and 26 of them have air-conditioning. Light repairs to coaches are made at Weehawken. Heavy repairs to coaches and locomotives are made at shops beyond the commuter area. Storage yards are provided at both Dumont and West Haverstraw.

This railroad serves a total of 20 stations including Weehawken and West Haverstraw. The total number of passengers arriving at Weehawken each business day is approximately 6,000 of which about 70 percent are daily commuters. The area between Weehawken and Bogota is partly industrial and partly old residential. From Bogota to Dumont, the area is almost completely filled with good quality homes. Beyond Dumont there are small communities, largely centered on the railroad stations, with large undeveloped areas between stations.

The NYC owns seven Hudson River passenger ferry boats. Three of these are operated in the 42nd Street ferry service and three in the Cortlandt Street ferry service, while one is kept in reserve or is in drydock for repairs. All of the ferries are in good operating condition. The passenger limit of each is approximately 2,000.

The annual cost of operating the ferries in accordance with NYC accounting systems is approximately $1,800,000, while revenue credited to this service is approximately $600,000, indicating an annual operating deficit of $1,200,000.

Susquehanna

The New York, Susquehanna and Western Railroad owns 118 road-miles of track and has trackage rights over 145 road-miles. Its eastern terminus for passengers on its own tracks is Croxton, New Jersey. Here it connects with the Erie Railroad over which it has trackage rights into the Jersey City station. The station is jointly used by the Erie and the Susquehanna. Passengers continue their trips to Manhattan either by the Erie's Chambers Street ferry or by the Hudson & Manhattan Railroad.

From Croxton to Susquehanna Transfer and thence west to Granton Junction, a single track owned by the Susquehanna parallels a single track of the Erie's Northern Division. These two tracks are operated jointly as a double-track line by the two railroads.

All trains on both railroads stop at Susquehanna Transfer to serve passengers, most of whom transfer to or from shuttle buses operating between Susquehanna Transfer and the Port of New York Authority Bus Terminal, Manhattan, via the Lincoln Tunnel. All Erie trains operate to

and from the Jersey City station, but a large number of Susquehanna trains terminate at Susquehanna Transfer.

At Granton Junction, the Susquehanna branches off to the northwest with two main tracks to Paterson. At Paterson Broadway station there is a 0.7-mile spur to Paterson City station. From Paterson Broadway there is a single track to Butler, 37 miles from Jersey City station.

The passenger service consists of a through service between Jersey City and Butler, an intermediate service between Susquehanna Transfer and Paterson City station and a few trains daily between Jersey City and North Hawthorne, 1.5 miles north of Paterson.

All operation is by diesel locomotives or rail-diesel cars. Equipment consists of 16 coaches and four rail-diesel cars less than five years old, six coaches from 30 to 40 years old, and three combination cars over 40 years old. Six diesel locomotives are used in passenger service. All passenger operation on the railroad is suburban in character. On a normal business day, six trains deliver passengers to Jersey City or Susquehanna Transfer between 8:00 A.M. and 9:00 A.M. There are five earlier eastbound trains and 18 eastbound trains after 9:00 A.M. during the entire balance of the day. A comparable service is operated in the westbound direction. Approximately 60 percent of all passengers are handled in one morning and one evening rush hour.

Coach yards are provided at Jersey City station for day storage and at North Hawthorne and Butler for night storage. Light repairs to coaches are made at Jersey City and at Butler. Heavy repairs to coaches, rail-diesel cars and diesel locomotives are made at Little Ferry.

The railroad serves approximately 3,000 round trip passengers per day who originate at some 27 stations on the line beyond Susquehanna Transfer. Of these stations, 13 are in the section to and including Paterson Broadway, and 14 in the section beyond, the latter all minor in importance. Paterson (population 139,000) contributes the greatest number of passengers, while other stations immediately to the east contribute a large proportion of the balance. The area between Hackensack and North Hawthorne lies from 14 to 23 miles from Manhattan and is generally thickly settled with good quality homes. Running time from this area to Manhattan via Susquehanna Transfer or Jersey City varies from 40 minutes to one hour.

The Susquehanna neither owns nor leases any Hudson River ferries. Its passengers use the Erie's Chambers Street ferry for which the Susquehanna pays the Erie on the basis of number of passengers accommodated.

Erie Railroad—Northern Branch

The Northern Railroad of New Jersey is operated as the Northern Branch of the Erie Railroad. It consists of 26 miles of road between Croxton, New Jersey and Nyack, New York. East of Croxton, its trains operate over the main line Erie tracks to Jersey City, a distance of 2.2 miles; thus the operation extends over a total of about 28 miles. Railroad passengers to or from Manhattan use the Chambers Street ferry, which is owned and operated by the Erie Railroad, or transfer to the Hudson & Manhattan at Jersey City station.

The Jersey City passenger terminal of the Erie is located on the west bank of the Hudson River. It has 12 stub tracks for passengers, mail and express. From the terminal west of Croxton, the Erie has four main passenger tracks. From Croxton to Granton Junction, the Northern Branch of the Erie operates jointly with the Susquehanna as heretofore described. From Granton Junction to Leonia (4.3 miles) there are two main tracks, and from Leonia to Nyack (16.7 miles) there is a single track only.

Passenger service on the Northern Branch is limited to commuter trains, all of which operate the full distance between Jersey City and Nyack. On a normal business day, there are three eastbound trains in the morning rush period and three westbound trains during the evening period. No mid-day or evening service is operated. There are only two trains each way on Saturdays and no service is operated on Sundays or holidays. The service is used by approximately 1,000 round trip passengers per day. A small number of these use the Susquehanna Transfer station, the balance transferring at Jersey City station to the Erie ferries.

Operation is powered entirely by diesel-electric locomotives. Equipment consists of 16 coaches and three locomotives, all owned by the Erie Railroad. Coaches seat from 80 to 92 passengers and vary in age from 20 to 40 years. The locomotives are fairly new and in good condition.

Coaches and locomotives are stored at Jersey City during the day and at Nyack during the night. Light repairs are made at Jersey City while

heavy repairs are made at one of the Erie main line shops. There are 14 stations along this route beyond Susquehanna Transfer serving an area of good quality homes, particularly in the outer sections. Approximately 60 percent of all passengers originate in the south end of Bergen County in an area which is 12 to 18 miles from Manhattan. The running time from this area is from 40 to 55 minutes. Bus competition in this area is quite severe, with routes serving Manhattan via both the George Washington Bridge and the Lincoln Tunnel.

The Northern Railroad of New Jersey does not own or operate any ferries. Passengers use the ferry service of the Erie Railroad which is described later.

New Jersey & New York Railroad

The New Jersey & New York Railroad, which is owned and operated by the Erie Railroad, consists of 30.6 miles of road extending from NJ&NY Junction on the Erie to Thiells, New York. Easterly of the junction it operates on the Erie main line to Jersey City terminal, a distance of 7.5 miles.

All commuter trains operate the full distance between Jersey City and Woodbine, New York. NJ&NY passengers to and from Manhattan use the Erie Railroad's Chambers Street ferry or transfer to the Hudson & Manhattan tubes at Jersey City station.

The passenger service is limited to four eastbound trains during the morning rush hour and two eastbound trains at other times of the day. Comparable westbound service is operated. There is even less service on Saturday and none on Sundays and holidays. There are approximately 2,000 round trip passengers carried each normal business day.

Operation is powered entirely by diesel-electric locomotives. Equipment consists of 27 coaches, one combination passenger-baggage car and six locomotives, all leased from the Erie Railroad. The coaches are from 20 to 30 years old and are in fair condition.

Coaches are stored at Jersey City in the daytime and at Woodbine during the night. Light repairs are made at Jersey City and heavy repairs at one of the Erie Railroad main line shops.

The NJ&NY serves 18 stations. The principal ones are in the south

end of Bergen County, 13 to 22 miles from Manhattan. Running time is 40 to 65 minutes. While the area from Hackensack to Hillsdale is almost solidly built up with good quality homes, it is served by a network of bus lines which enter Manhattan via both the George Washington Bridge and the Lincoln Tunnel.

Erie Main Line and Branches

The Erie Railroad operates passenger service over the New York Division main line from Jersey City, New Jersey to Port Jervis, New York (87.3 miles) together with various branches in the New York metropolitan area as follows:

1. Bergen County Railroad (9.9 miles) from Rutherford Junction to Ridgewood Junction—both on the main line;
2. Greenwood Lake Division (29.1 miles) from Croxton on the main line to Wanaque (end of line);
3. Newark Branch (14.5 miles) from NY&GL Junction on the Greenwood Lake Division to XW Tower on the main line in Paterson, New Jersey; and
4. Caldwell Branch (5.7 miles) from Great Notch station on the Greenwood Lake Division to Essex Fells.

Erie passengers to and from Manhattan use the Chambers Street ferry, or transfer to the Hudson & Manhattan tubes at Jersey City station.

The Jersey City passenger terminal, located on the west bank of the Hudson River, has 12 stub tracks for passengers, mail and express. Westerly from Jersey City, there are five main line tracks in three two-track tunnels under the Palisades to Croxton (2.2 miles). From Croxton to Rutherford Junction (6.8 miles) there are four passenger tracks. At Rutherford Junction, two of the four tracks continue on the main line and two branch off to the Bergen County Railroad. At Ridgewood Junction, the four tracks rejoin and continue to Suffern which is 31.9 miles from Manhattan. The commuter service ends at Suffern.

The Greenwood Lake Division branches off of the main line at Croxton and continues with two main line tracks to Great Notch (14.3 miles). From there a single track extends 14.8 miles to the end of the line.

The Newark Branch extends from the Greenwood Lake Division at NY&GL Junction with two tracks to Newark Station (3.8 miles) and then continues as a single track to a junction with the main line at XW Tower at Paterson (10.7 miles). The Caldwell Branch is all single-track to Essex Fells which is the limit of commuter service. The main line passenger service consists of through service between Jersey City and Port Jervis and a commuter service between Jersey City and Suffern. There is also an intermediate commuter service between Jersey City and Waldwick. A limited number of main line trains operate over the Bergen County Railroad.

On the Greenwood Lake Division, all trains operate between Jersey City and Wanaque except four trains in each direction which operate between Jersey City and Great Notch via the Greenwood Lake Division and from Great Notch to Essex Fells over the Caldwell Branch. Most trains on the Newark Branch operate between Jersey City and Paterson only.

Equipment consists of 206 coaches in fair condition. They were built between 1915 and 1934. Most of the coaches seat from 86 to 92 passengers. Motive power consists of 41 diesel-electric locomotives, all in good condition.

Service on the main line and its branches is substantial, consisting of 57 eastbound and 58 westbound trains per day, of which approximately one-third in each direction operate in the heaviest hour. Coaches are stored at Jersey City during the day and at Suffern or Waldwick on the main line or at the outer ends of the branches during the night. There are about 60 stations served by the Erie main line and its branches.

Approximately 13,000 round trip passengers are served on a normal business day. About 80 percent of these passengers are commuters. The heaviest commuter traffic is generated by Glen Rock and Ridgewood on the main line. These stations are 20 and 22 miles from Manhattan. The second heaviest commuter area on the main line is in the vicinity of Rutherford, 9 to 10 miles from Manhattan. On the Greenwood Lake Division, the heaviest commuter traffic is from the Montclair area, 12 to 15 miles from Manhattan.

Running time between Manhattan and the Montclair area is approximately 55 minutes. Running time from Manhattan to Rutherford is approximately 25 minutes, to Ridgewood 45 minutes, and to Waldwick 50 minutes.

On the Newark Branch, the development is largely industrial. On the Greenwood Lake Division, the area as far as Great Notch is thickly settled with good quality homes. West of Great Notch, including the Caldwell Branch to Essex Fells, development is largely in the vicinity of stations with considerable open country between.

The area served by the Erie main line and its branches is also served in part by the Susquehanna, particularly at Paterson, and by the Boonton line and the Montclair Branch of the Lackawanna. Bus competition is heavy in all of the thickly settled areas.

The Erie Railroad owns four Hudson River passenger ferry boats. These will gradually be taken out of service during 1957, however, and the passengers accommodated either by the H&M Railroad or the Lackawanna ferries. Under this plan, all Erie trains on the main line and its branches will terminate at the Lackawanna's Hoboken station. The Erie's Northern Division and its tenant, the Susquehanna, will then use a modified Jersey City terminal of the Erie, providing transfer connections with the H&M. One of the Erie ferry boats will be added to the Lackawanna service. The annual loss due to the present Erie ferry operation has been estimated by the railroad at some $760,000.

Lackawanna

The Delaware, Lackawanna & Western Railroad operates passenger service over the Morris & Essex Division of the main line from Hoboken, New Jersey to Dover, New Jersey (38.1 miles) together with various branches in the New York metropolitan area as follows:

1. Montclair Branch (4.1 miles) from Roseville Junction on the main line to Montclair, New Jersey;
2. Gladstone Branch (22.2 miles) from Summit on the main line to Gladstone, New Jersey;
3. Boonton line (64.6 miles) from Bergen Junction on the main line to Netcong, Hackettsville and Washington, New Jersey; and
4. Sussex Branch (21.5 miles) from Netcong on the Boonton line to Branchville, New Jersey.

DL&W passengers to and from Manhattan use the Barclay Street ferry, owned and operated by the DL&W, or transfer to Hudson & Manhattan tubes at Hoboken station.

The Hoboken passenger station, located on the west bank of the Hudson River, has 15 stub tracks for passengers, mail and express. Westerly from Hoboken, four tracks pass through two two-track tunnels under the Palisades. The four main line tracks continue to Bergen Junction. From this point, the main line consists of two or three tracks in various sections to Dover, a distance of 39.1 miles from Manhattan at which point most commuter service terminates. There is a limited amount of commuting on the Boonton line trains which operate west of Dover to Netcong and Washington.

The Montclair Branch leaves the main line at Roseville Junction with two tracks to Montclair where there is a six-track stub-terminal. The Gladstone Branch leaves the main line at Summit with a single track to Gladstone. The passenger service on the main line and on these two branches is all electrified.

The Boonton line leaves the main line at Bergen Junction with two or three tracks via Dover to Netcong. The Sussex Branch is a single track line. All of the passenger service on these two branches is operated with diesel locomotives.

Service on this railroad is particularly intense, there being 131 eastbound and 128 westbound trains daily. A small portion of these are through trains which also carry commuters.

There are coach yards for day storage at Hoboken and for night storage at Dover, Granton and Montclair. Light repairs to coaches and motor cars are made at various storage terminals. Heavy repairs are made at Scranton, Pennsylvania.

More than 50 communities are served by the Lackawanna main line and its branches. These stations generate approximately 20,000 round trip passengers per day, about 90 percent of whom are commuters. Not all of the commuters go to Manhattan, however, there being many who work in Hoboken and live in the service area of the Lackawanna.

The heaviest area for commuters on the main line is between East Orange and Madison, which is 11.0 to 26.5 miles from Manhattan. Running time between Manhattan and this area varies from 35 to 55 minutes. The

heaviest commuter area on the Montclair Branch is Montclair at the end of the line which is 14.1 miles from Manhattan. Running time is approximately 45 minutes.

In addition to numerous areas of high quality homes along this railroad, there are many good apartment buildings in the vicinity of the outlying stations. There is bus competition in the more thickly populated areas.

Equipment consists of 336 coaches and motor cars together with eight diesel locomotives. All coaches and motor cars are in very good condition, while the diesel locomotives are practically new.

The Lackawanna owns and operates five Hudson River passenger ferry boats which accommodate approximately 2,000 passengers each. These boats carry pedestrains and vehicles as well as train passengers. Based on the accounting system of the Lackawanna, the annual deficit from this operation has been approximately $670,000. This deficit should be substantially reduced by the recently authorized joint operation with the Erie Railroad which will add to the number of passengers served by Lackawanna ferries without any great increase in operating expenses.

Pennsylvania

The Pennsylvania Railroad operates passenger service over its New York District between Manhattan and Holmes, Pennsylvania (78.2 miles) and over its Philadelphia Terminal Division between Holmes and 30th Street, Philadelphia (12.2 miles) together with various branches in the New York metropolitan area as follows:

1. Jersey City Branch from Hudson on the main line to Jersey City (6.2 miles);
2. Princeton Branch from Princeton Junction on the main line to Princeton, New Jersey (2.7 miles); and
3. Perth Amboy and Woodbridge Branch from Union on the main line to a junction with the New York & Long Branch Railroad at WC Tower (5.8 miles) thence to South Amboy over the latter's tracks (2.3 miles). From South Amboy to Bay Head Junction, passenger service is operated over the NY&LB Railroad (36.6 miles) by the Pennsylvania Railroad

as well as by the Central Railroad of New Jersey. The NY&LB Railroad is owned by the Pennsylvania Railroad and the Central Railroad of New Jersey on a 50-50 basis.

The Pennsylvania Railroad also operates a passenger service between Newark and Journal Square, Jersey City, over its own main line and between Journal Square and Hudson Terminal (approximately 3.0 miles) over the H&M Railroad. The cars for this operation are jointly owned by the Pennsylvania and the H&M.

The Pennsylvania Station at 32nd Street and Seventh Avenue, Manhattan, serves the main line. Main line passengers are transferred to the Hudson Terminal service at Newark. A few main line trains operate over the Jersey City Branch between Kearny Junction on the main line and Jersey City. Transfer facilities are available in Jersey City at the Exchange Place station of the H&M.

The Pennsylvania Station has 21 standing tracks and 11 passenger platforms. At the west end of the station, the tracks coverge into two tracks going underneath the Hudson River and continuing to a junction with the Jersey City Branch at Kearny Junction. From Kearny Junction to Newark and through to Trenton, there are four main line tracks.

The Jersey City Branch has two main line tracks. The Princeton Branch is single track and the Perth Amboy and Woodbridge Branch is a double-track railroad. The NY&LB is a double-track railroad from Perth Amboy to Bay Head Junction.

Trains between Manhattan and Trenton (58.1 miles) carry both commuters and through passengers. Shuttle service is provided on the Princeton Branch, trains making connections with the main line at Princeton Junction.

Regular commuter service is provided between Manhattan and County (34.2 miles) just south of New Brunswick, New Jersey and between Manhattan and Bay Head Junction (66.5 miles). This latter operation is by electric locomotive to South Amboy and by steam locomotive from South Amboy to Bay Head Junction. Main line trains are partly electric locomotive with standard coaches and partly multiple-unit motor cars and trailers.

Equipment required to meet weekday schedules includes 108 coaches, 114 A.C. multiple-unit cars, 54 D.C. multiple-unit cars (owned jointly with

the H&M), 10 steam locomotives, and 17 electric locomotives. In addition, there are a sufficient number of spare units in each classification to permit routine maintenance activities. All of this equipment is old but is well maintained.

Coaches and motor cars, when not in use, are stored at Sunnyside yard, Brooklyn; Pennsylvania Station, New York; Jersey City, New Jersey; and at the outer terminals of all the branches. Light repairs are made at the storage terminals. Heavy repairs are made at various main car shops.

Weekday service is quite heavy consisting of 146 eastbound and 148 westbound trains, approximately one-third of which are in through service. In addition, 26 trains operate each way daily between Princeton Junction and Princeton, New Jersey.

The Pennsylvania Railroad serves more than 50 commuter stations to and including Trenton, New Jersey. The railroad serves approximately 23,000 round trip passengers per day of which about 70 percent are commuters to and from Manhattan.

The heaviest area for commuters on the main line is Newark (population 500,000). Running time to Newark is about 15 minutes. From Newark to New Brunswick (10.0 to 32.7 miles from Manhattan), the territory is practically all fully developed along the railroad with residential, business and industrial improvements. Running time to New Brunswick is 40 to 45 minutes.

The heaviest area for commuters on the Perth Amboy and Woodbridge Branch lies between Woodbridge and South Amboy. This is from 24.5 to 30.0 miles from Manhattan with running times of 45 to 50 minutes. The area from South Amboy to Bay Head Junction consists mostly of small developments near stations except for Matawan, Red Bank, Long Branch and Asbury Park which are fairly large communities.

The joint service with the Hudson & Manhattan between Newark and Hudson Terminal serves a large number of Pennsylvania Railroad commuters. These people transfer to and from the main line to Pennsylvania trains at Newark to gain the convenience of direct delivery to lower Manhattan.

There is minor rail competition in Newark from both the DL&W and the Erie. There is also rail competition from the Jersey Central at Elizabeth.

The rest of the main line area has no rail competition. On the Perth Amboy and Woodbridge Branch, there is rail competition by the Jersey Central only between Perth Amboy and Bay Head Junction. Both railroads operate over the same line (NY&LB RR) and the commuter's preference is largely governed by his destination in Manhattan.

There is bus competition in the main line area. Local and long distance buses operate parallel to the railroad all the way from Trenton to Manhattan. The New Jersey Turnpike parallels the main line and the Garden State Parkway serves the NY&LB area. Both highways encourage competition by private automobile with the Pennsylvania service.

Jersey Central

The Central Railroad of New Jersey operates passenger service over its Central Division between Jersey City and Phillipsburg (72.1 miles) including several branches in the New York metropolitan area as follows:

1. Newark and New York Branch between Newark Broad Street station and Brills Junction on the Newark and Elizabeth Branch (1.78 miles);
2. Newark and Elizabeth Branch between Brills Junction and Elizabethport on the main line (5.03 miles);
3. Perth Amboy Branch between Elizabethport on the main line and Perth Amboy Junction with the NY&LB RR (10.43 miles);
4. Sound Shore Branch between Elizabeth Avenue station on the Perth Amboy Branch and Chrome, the end of the line (5.83 miles); and
5. The Seashore Branch of the Southern Division between Matawan station on the NY&LB and Highlands, the end of the line (14.35 miles).

The Central Railroad of New Jersey also operates passenger service over the New York & Long Branch Railroad from Woodbridge Junction on the Perth Amboy Branch to Bay Head Junction (38.0 miles). The NY&LB is owned jointly by the Central Railroad of New Jersey and the Pennsylvania Railroad which also operates trains over the NY&LB tracks to Bay Head Junction.

CNJ passengers to and from Manhattan use the Liberty Street ferry service owned and operated by the CNJ.

The Baltimore & Ohio Railroad operates over CNJ tracks from Bound Brook Junction to Jersey City (31.76 miles). There are seven B&O through trains per day in each direction, but they handle very few commuters. Passengers to and from Manhattan are mainly carried by B&O-owned buses using the CNJ ferries.

The Reading Railway System also operates over CNJ tracks from Bound Brook Junction to Jersey City. The Reading has six through trains per day in each direction and serves only a few commuters. Passengers to and from Manhattan use CNJ passenger ferries.

The Jersey City passenger station has 16 stub tracks for passenger service and two for mail and express. Westerly from Jersey City there are four main line tracks to Raritan (35.8 miles) and two tracks beyond. The line from Newark to Elizabethport and through to Perth Amboy, Matawan and Bay Head Junction is a two-track railroad. The Sound Shore and the Seashore Branches are single-track lines. The CNJ operates commuter trains on its main line as far west as Raritan as well as on all of its branches described above. In addition, there are seven through trains per normal business day in each direction to and from points west of Raritan which also carry commuters to and from points between Raritan and Jersey City.

The CNJ operates 80 eastbound trains of which 14 arrive at Jersey City and three arrive at Newark between 8:00 A.M. and 9:00 A.M. A corresponding number of westbound trains are operated.

Equipment consists of 329 coaches, most of which are in good condition. Motive power is furnished by 56 diesel-electric locomotives, most of which are in the power pool and used for both passenger and freight service as required. All locomotives are fairly new and in good condition.

Coach yards are maintained at Jersey City, Newark, and at the outer terminals of all services listed above. Light repairs are made at all terminals. Heavy repairs to coaches are made at Elizabethport shops while locomotives are maintained at the Communipaw shops.

The CNJ serves some 50 stations and approximately 15,000 daily round trip passengers. About 70 percent of the passengers are commuters.

The heaviest area for commuters on the main line is in the Westfield-Plainfield section which is from 20 to 24 miles from Manhattan. Running time to this area is 45 to 55 minutes.

The heaviest area for commuters for the NY&LB RR is the Middletown-Long Branch section which is 35 to 45 miles from Manhattan. Running time from this area to Manhattan is 70 to 80 minutes. The heaviest station on the Seashore Branch is Keansburg.

The main line of the CNJ is thickly developed in the Bayonne Peninsula area with medium quality homes. From Elizabeth to Bound Brook, the area served by the main line is developed with good quality houses. West of Bound Brook, residences are largely confined to the vicinity of stations together with country estates.

On the NY&LB RR and the Seashore Branch, development is also limited to the vicinity of stations together with country estates. There is a practically continuous strip of summer cottages and homes on the Jersey shore from Long Branch to Bay Head Junction. The area along the Sound Shore Branch is largely industrial.

There is practically no rail competition in CNJ territory except for the Pennsylvania Railroad operation over the NY&LB RR between Perth Amboy and Bay Head Junction. Bus competition with the main line is fairly heavy. On the branches, bus competition is relatively light.

Hudson & Manhattan Railroad Company

The H&M operates service between Manhattan and Newark. It has two terminals in Manhattan, one called the Hudson Terminal located at 30-50 Church Street, and the other called the 33rd Street Terminal at 33rd Street and Avenue of the Americas (Sixth Avenue).

The H&M owns approximately 7.9 miles of double-track main line railroad, all of which consists of underground or under-river tunnels. It also leases from the Pennsylvania Railroad approximately 0.6 miles of double-track line from Journal Square station, Jersey City, to the west end of the H&M tunnels.

Transfer connections are provided with the Pennsylvania Railroad and the Erie Railroad in Jersey City, with the DL&W Railroad in Hoboken,

and with the New York subway system at Hudson Terminal as well as along Avenue of the Americas at 14th Street, 23rd Street and 33rd Street. There are also stations at Christopher and Greenwich Streets and at 9th Street and Greenwich Avenue on the 33rd Street Branch.

The H&M has four single-track tubes under the Hudson River, each approximately 6,000 feet long. Two tubes cross the river from Exchange Place in Jersey City, connecting with the Hudson Terminal on the east and extending to Journal Square station on the west. The other two tubes cross the river at Hoboken to Christopher Street, Manhattan, connecting with tunnels northeasterly and northerly to 33rd Street and Avenue of the Americas (Sixth Avenue).

The H&M connects at Journal Square in Jersey City with the Pennsylvania Railroad branch to Jersey City from the Pennsylvania main line near Newark. The H&M and the PRR operate a joint passenger service between Newark and Jersey City over its own track. At the Pennsylvania Railroad Hudson Terminal. The cars used in this service are jointly owned by the two railroads.

The Pennsylvania Railroad also operates its own service between Newark and Jersey City over its own track. At the Pennsylvania Railroad Jersey City terminal, PRR passengers can transfer to and from the H&M at Exchange Place station.

The H&M owns 254 multiple-unit cars operating on 600 volts D.C. These cars vary in length from 48 feet to 51 feet and seat 44 passengers. The Pennsylvania and the H&M jointly own 54 multiple-unit cars 48 feet long which seat 44 passengers. The present schedule calls for 188 cars in local service and 54 cars in joint service. This leaves 66 cars available for spares. The cars are only 8 feet-10-1/2 inches wide because of the restricted clearances in the H&M tubes.

Commuter Fares

Average suburban railroad fares based on monthly commutation ticket rates have been computed for all of the trunk line railroads furnishing suburban service. Table B-1 shows the present average rates of fare between selected suburban stations on each route and its terminal.

Table B-1

AVERAGE SUBURBAN RAILROAD FARES FROM SELECTED SUBURBAN STATIONS TO MANHATTAN BASED ON MONTHLY COMMUTATION TICKETS*

Railroad	Station	Trip to Manhattan Terminals: Miles	Trip to Manhattan Terminals: Fare in Cents per Mile	Route and Manhattan Terminal
New York Central West Shore Route	Little Ferry	7.0	3.60	To 42nd Street Terminal
	Bogota	8.9	3.25	
	Dumont	13.9	2.65	
	West Nyack	25.2	1.95	
Susquehanna	Little Ferry	11.1	2.90	Via Jersey City to Chambers Street Terminal
	Hackensack	13.9	2.60	
	North Hawthorne	23.4	1.75	
	Butler	37.9	1.35	
Erie—Northern Branch	Ridgefield	10.2	3.25	Via Jersey City to Chambers Street Terminal
	Leonia	12.5	3.20	
	Cresskill	18.2	2.60	
	Nyack	29.0	2.00	
Erie—New Jersey & New York	Carlstadt	9.8	3.45	Via Jersey City to Chambers Street Terminal
	Essex Street, Hackensack	13.5	3.10	
	Hillsdale	22.5	2.35	
	Spring Valley	31.7	1.90	
Erie—Main Line	Rutherford	9.5	3.60	Via Jersey City to Chambers Street Terminal
	Glen Rock	20.5	2.35	
	Ridgewood	22.0	2.30	
	Suffern	31.6	1.90	
Lackawanna—Main Line	Harrison	8.1	3.60	Via Hoboken to Barclay Street Terminal
	East Orange	11.0	3.20	
	Madison	26.5	2.10	
	Dover	39.1	1.70	
Pennsylvania—Main Line	Newark	10.0	4.00	To Pennsylvania Station
	New Brunswick	32.7	1.90	
	Trenton	58.1	1.20	
Jersey Central—Main Line	East 33rd Street, Bayonne	6.0	3.75	Via Jersey City to Cortlandt Street Terminal
	Westfield	19.5	2.55	
	Plainfield	24.0	2.20	
	Hampton	57.6	1.25	

***-Based on tariffs in effect on December 1, 1956, and assuming all rides on each ticket are used.**

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4 Trans-Hudson Transit One-Way Trips by Districts in Manhattan—Rush Hour—Typical Weekday in 1955

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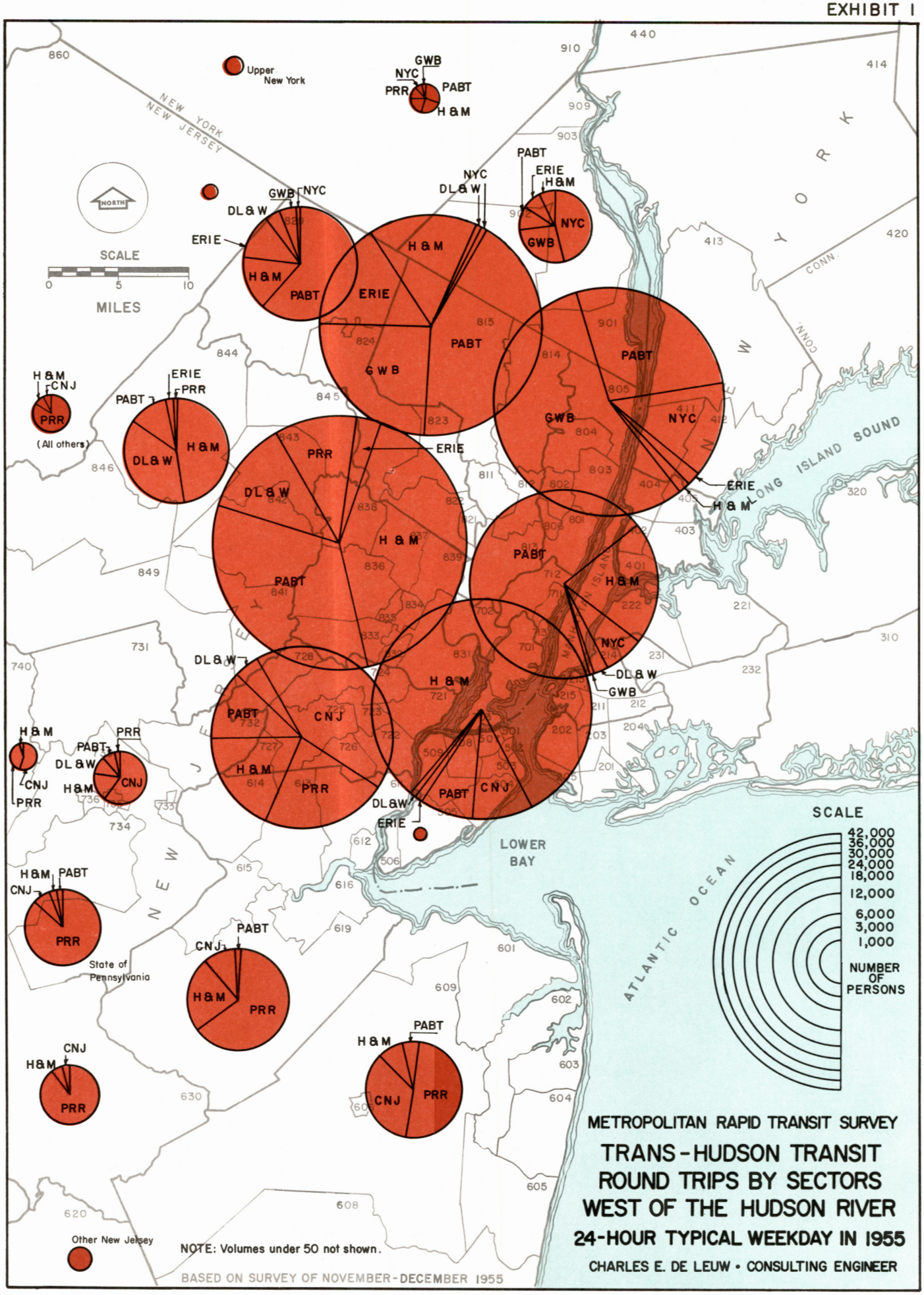
EXHIBIT I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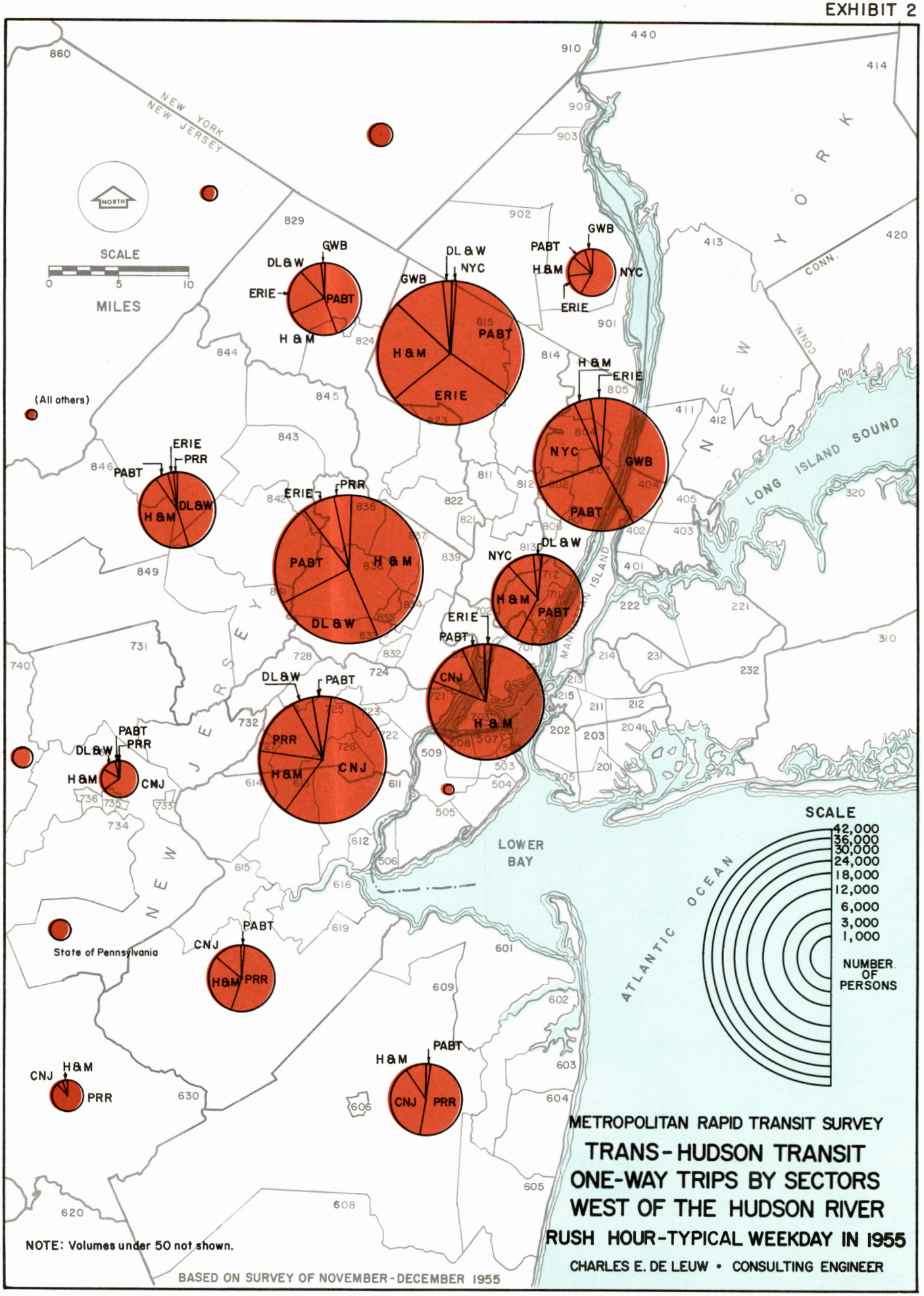
DL & W
CNJ
(All others)
LONG ISLAND SOUND
CONN.
LOWER BAY
ATLANTIC OCEAN
State of Pennsylvania
Other New Jersey
NOTE: Volumes under 50 not shown.
BASED ON SURVEY OF NOVEMBER-DECEMBER 1955
SCALE
42,000
36,000
30,000
24,000
18,000
12,000
6,000
3,000
1,000
NUMBER OF PERSONS
METROPOLITAN RAPID TRANSIT SURVEY
TRANS-HUDSON TRANSIT
ROUND TRIPS BY SECTORS
WEST OF THE HUDSON RIVER
24-HOUR TYPICAL WEEKDAY IN 1955
CHARLES E. DE LEUW • CONSULTING ENGINEER

EXHIBIT 2



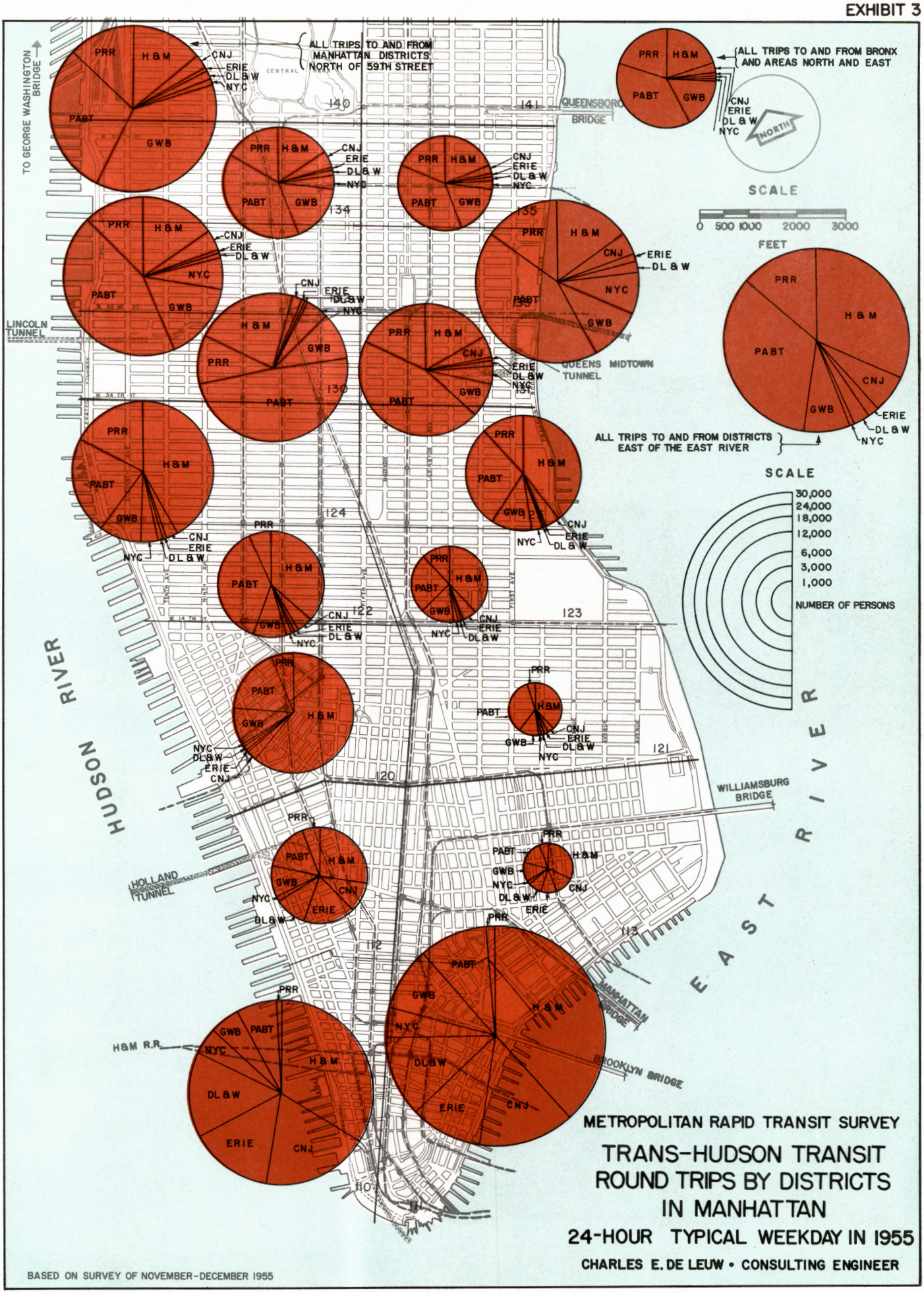
METROPOLITAN RAPID TRANSIT SURVEY

TRANS-HUDSON TRANSIT ONE-WAY TRIPS BY SECTORS WEST OF THE HUDSON RIVER

RUSH HOUR-TYPICAL WEEKDAY IN 1955

CHARLES E. DE LEUW • CONSULTING ENGINEER

EXHIBIT 3



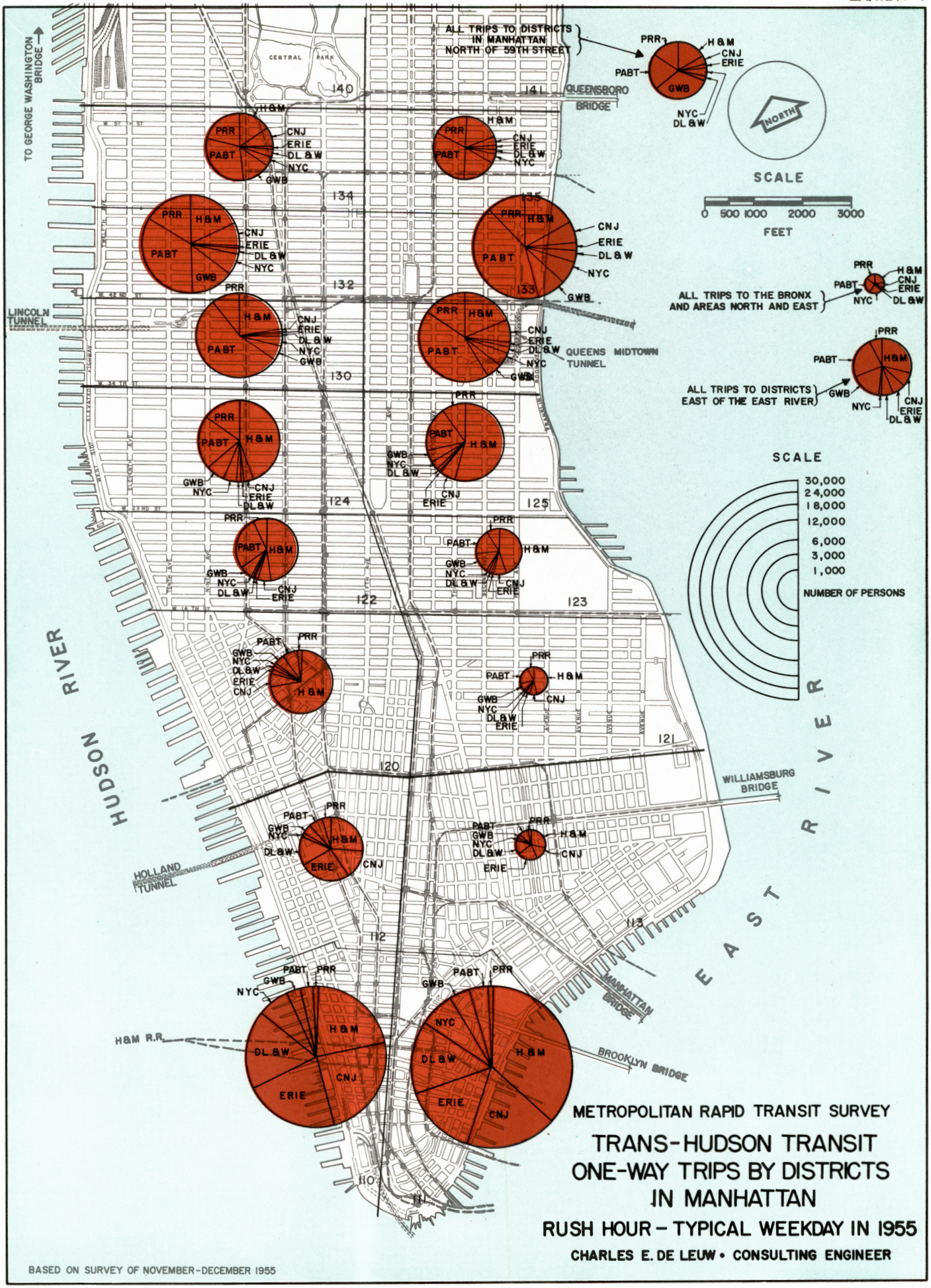
METROPOLITAN RAPID TRANSIT SURVEY

TRANS-HUDSON TRANSIT ROUND TRIPS BY DISTRICTS IN MANHATTAN

24-HOUR TYPICAL WEEKDAY IN 1955

CHARLES E. DE LEUW • CONSULTING ENGINEER

BASED ON SURVEY OF NOVEMBER-DECEMBER 1955



METROPOLITAN RAPID TRANSIT SURVEY

TRANS-HUDSON TRANSIT ONE-WAY TRIPS BY DISTRICTS IN MANHATTAN

RUSH HOUR – TYPICAL WEEKDAY IN 1955

CHARLES E. DE LEUW • CONSULTING ENGINEER

BASED ON SURVEY OF NOVEMBER-DECEMBER 1955

EXHIBIT 5

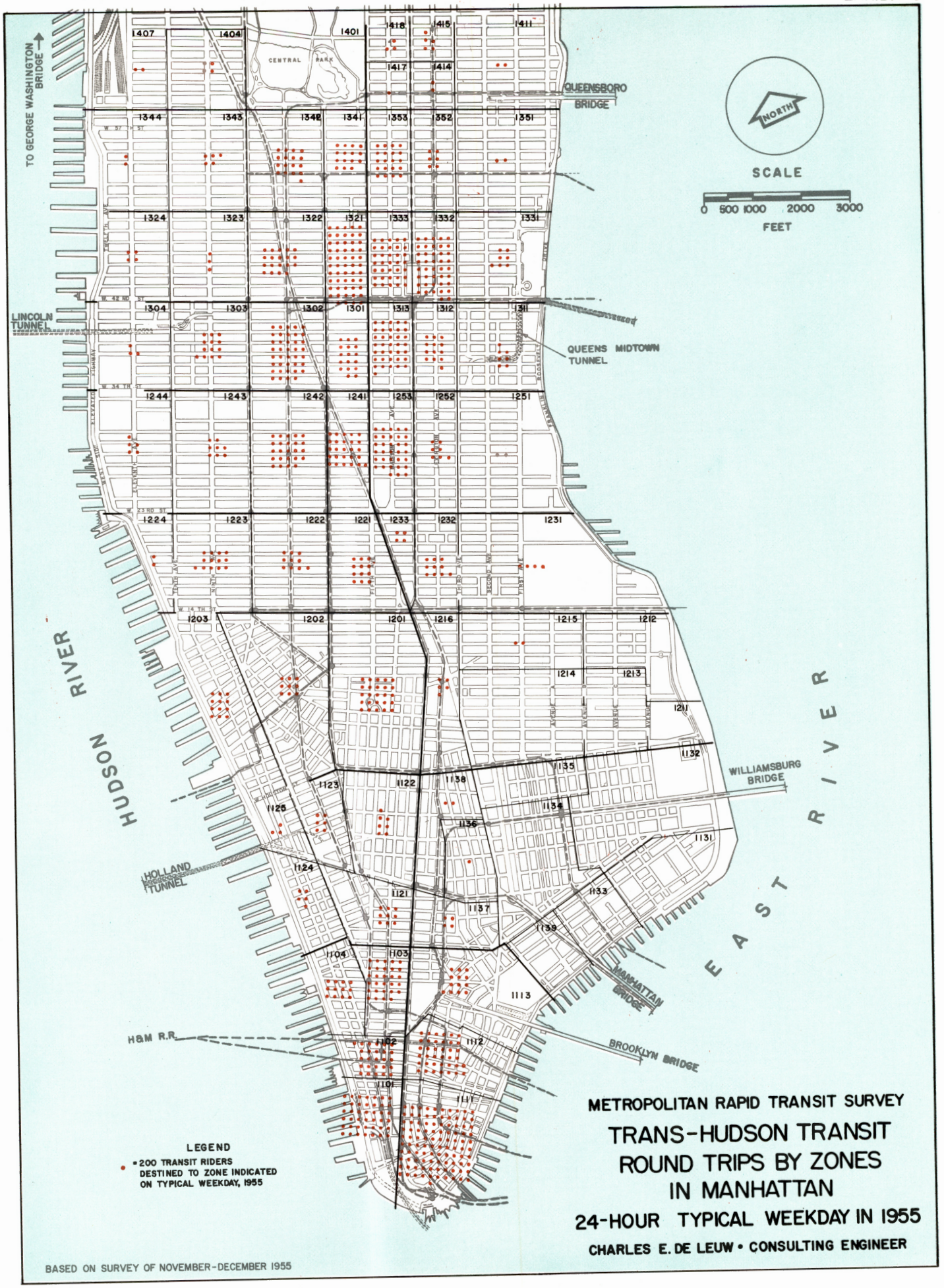
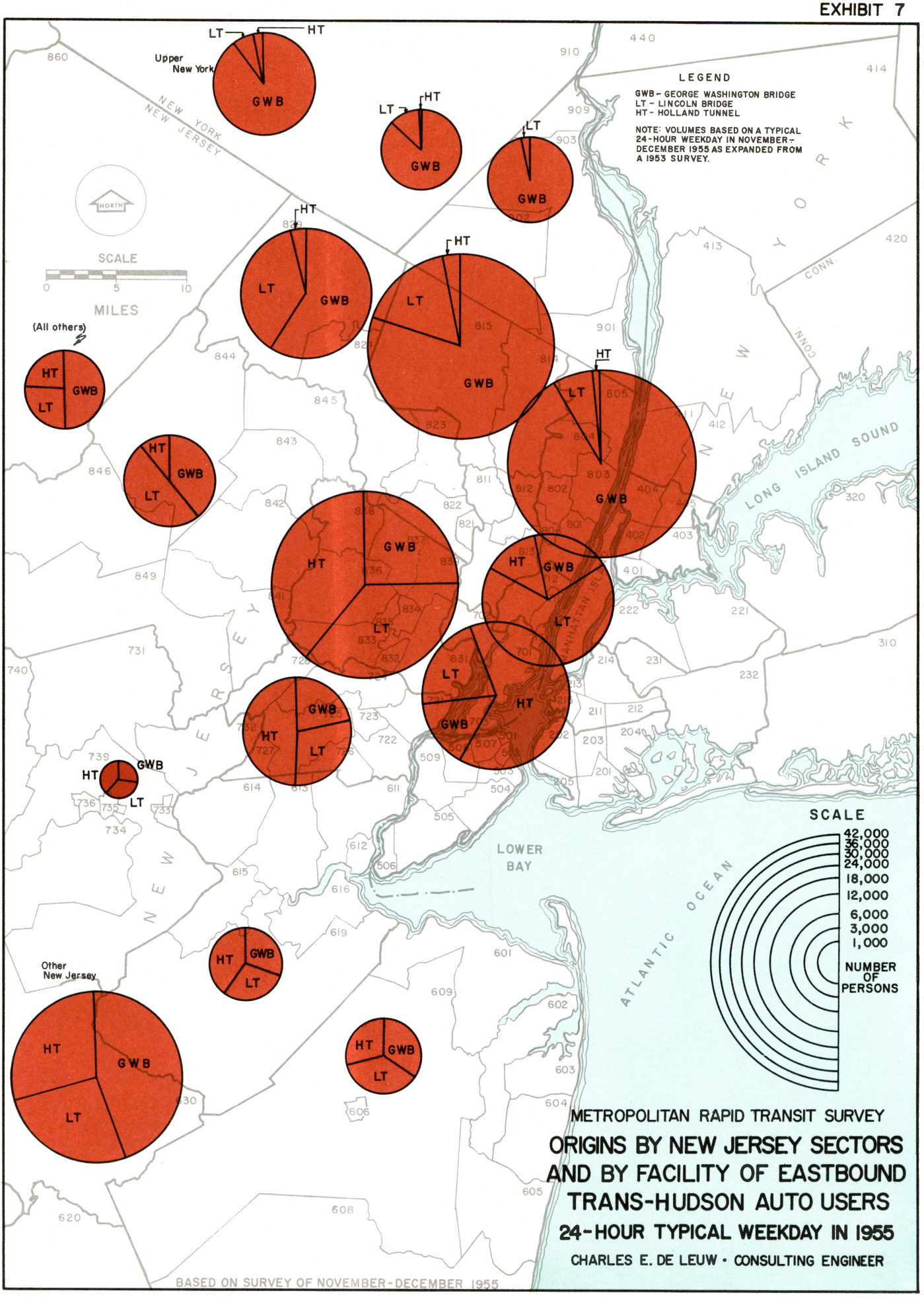
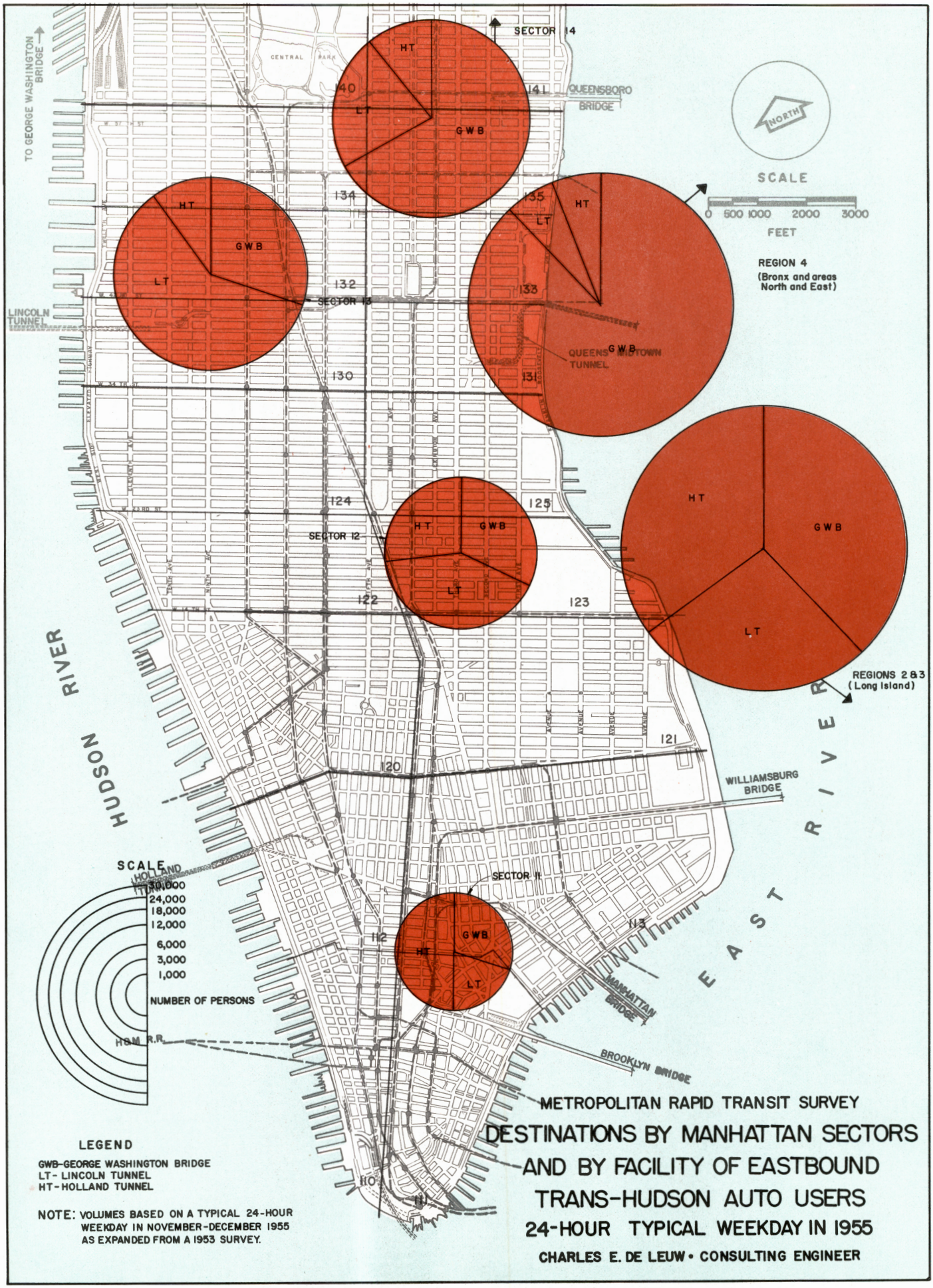

TO GEORGE WASHINGTON BRIDGE
CENTRAL PARK
QUEENSBORO BRIDGE
NORTH
SCALE
0 500 1000 2000 3000
FEET
LINCOLN TUNNEL
QUEENS MIDTOWN TUNNEL
HUDSON RIVER
EAST RIVER
HOLLAND TUNNEL
WILLIAMSBURG BRIDGE
MANHATTAN BRIDGE
BROOKLYN BRIDGE
H&M R.R.
LEGEND
• = 200 TRANSIT RIDERS DESTINED TO ZONE INDICATED ON TYPICAL WEEKDAY, 1955
METROPOLITAN RAPID TRANSIT SURVEY
TRANS-HUDSON TRANSIT
ROUND TRIPS BY ZONES
IN MANHATTAN
24-HOUR TYPICAL WEEKDAY IN 1955
CHARLES E. DE LEUW • CONSULTING ENGINEER
BASED ON SURVEY OF NOVEMBER-DECEMBER 1955

EXHIBIT 6


TO GEORGE WASHINGTON BRIDGE
CENTRAL PARK
QUEENSBORO BRIDGE
NORTH
SCALE
0 500 1000 2000 3000
FEET
LINCOLN TUNNEL
QUEENS MIDTOWN TUNNEL
HUDSON RIVER
EAST RIVER
WILLIAMSBURG BRIDGE
HOLLAND TUNNEL
MANHATTAN BRIDGE
H&M R.R.
BROOKLYN BRIDGE
LEGEND
• =200 TRANSIT RIDERS DESTINED TO ZONE INDICATED ON TYPICAL WEEKDAY, 1955
METROPOLITAN RAPID TRANSIT SURVEY
TRANS-HUDSON TRANSIT
ONE-WAY TRIPS BY ZONES
IN MANHATTAN
RUSH HOUR - TYPICAL WEEKDAY IN 1955
CHARLES E. DE LEUW • CONSULTING ENGINEER
BASED ON SURVEY OF NOVEMBER-DECEMBER 1955

EXHIBIT 7


LEGEND
GWB - GEORGE WASHINGTON BRIDGE
LT - LINCOLN BRIDGE
HT - HOLLAND TUNNEL
NOTE: VOLUMES BASED ON A TYPICAL 24-HOUR WEEKDAY IN NOVEMBER-DECEMBER 1955 AS EXPANDED FROM A 1953 SURVEY.
NORTH
SCALE
0 5 10
MILES
Upper New York
(All others)
Other New Jersey
NEW YORK
NEW JERSEY
CONN.
LONG ISLAND SOUND
LOWER BAY
ATLANTIC OCEAN
MANHATTAN IS.
SCALE
42,000
36,000
30,000
24,000
18,000
12,000
6,000
3,000
1,000
NUMBER OF PERSONS
METROPOLITAN RAPID TRANSIT SURVEY
ORIGINS BY NEW JERSEY SECTORS AND BY FACILITY OF EASTBOUND TRANS-HUDSON AUTO USERS
24-HOUR TYPICAL WEEKDAY IN 1955
CHARLES E. DE LEUW • CONSULTING ENGINEER
BASED ON SURVEY OF NOVEMBER-DECEMBER 1955



METROPOLITAN RAPID TRANSIT SURVEY

DESTINATIONS BY MANHATTAN SECTORS AND BY FACILITY OF EASTBOUND TRANS-HUDSON AUTO USERS

24-HOUR TYPICAL WEEKDAY IN 1955

CHARLES E. DE LEUW • CONSULTING ENGINEER

LEGEND

GWB-GEORGE WASHINGTON BRIDGE
LT- LINCOLN TUNNEL
HT-HOLLAND TUNNEL

NOTE: VOLUMES BASED ON A TYPICAL 24-HOUR WEEKDAY IN NOVEMBER-DECEMBER 1955 AS EXPANDED FROM A 1953 SURVEY.

EXHIBIT 10

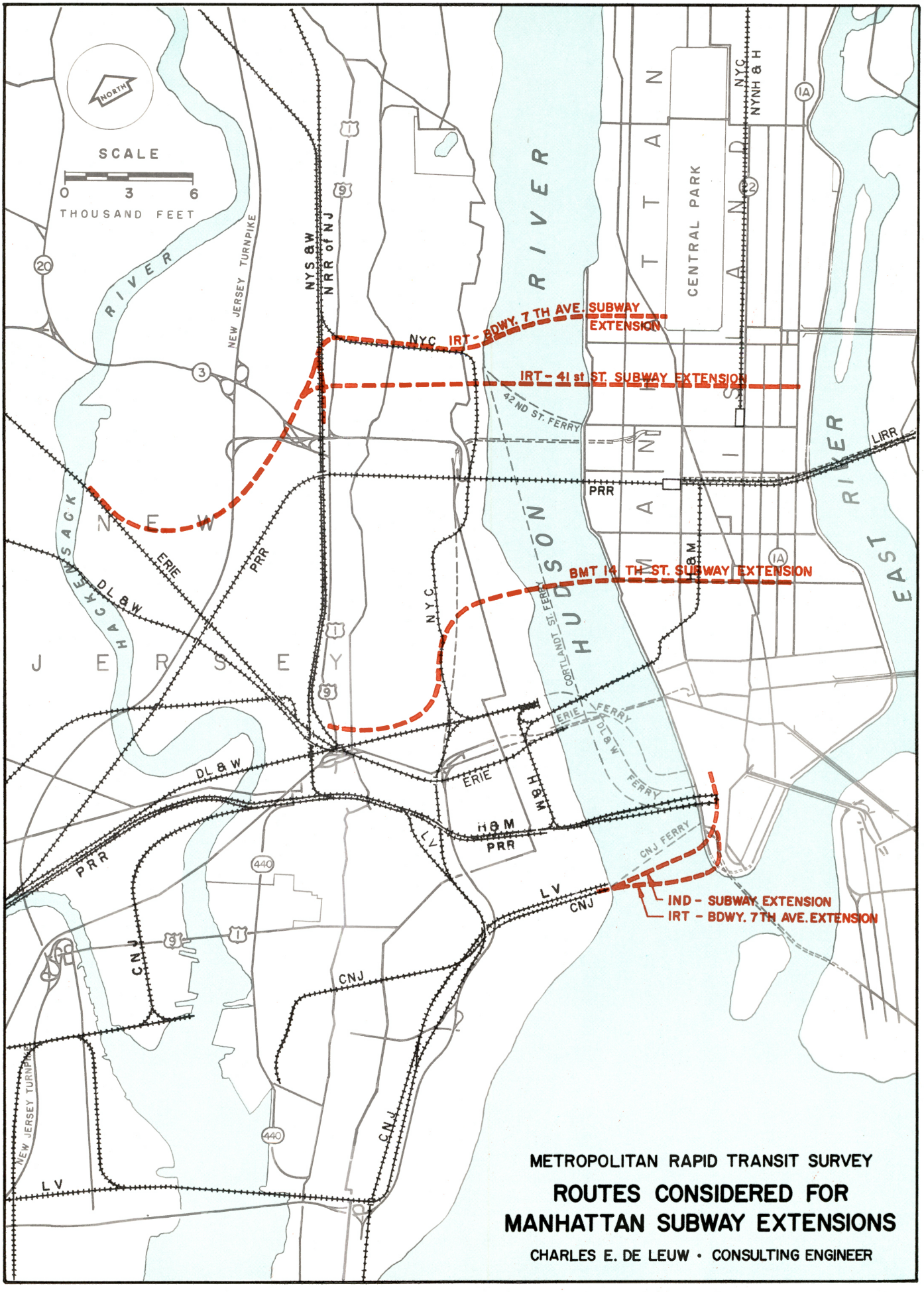


METROPOLITAN RAPID TRANSIT SURVEY

ROUTES CONSIDERED FOR NEW RAPID TRANSIT SYSTEMS

CHARLES E. DE LEUW • CONSULTING ENGINEER

EXHIBIT II

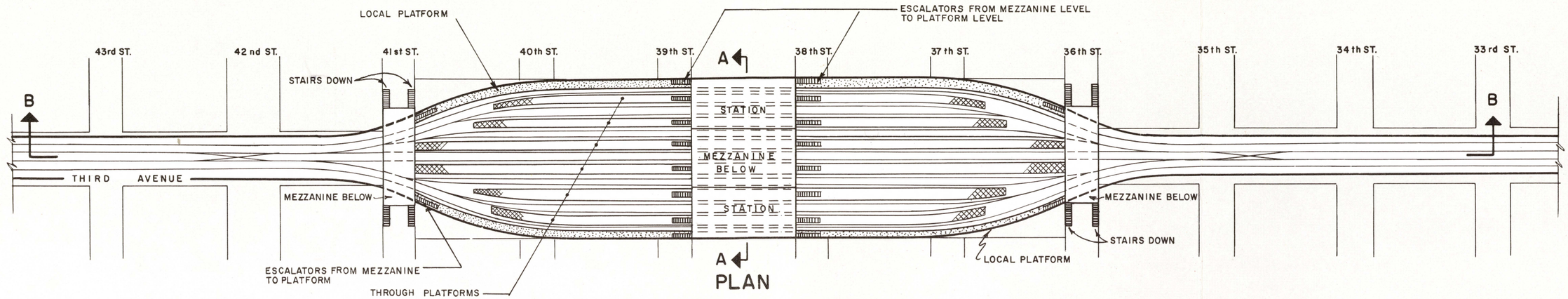


METROPOLITAN RAPID TRANSIT SURVEY

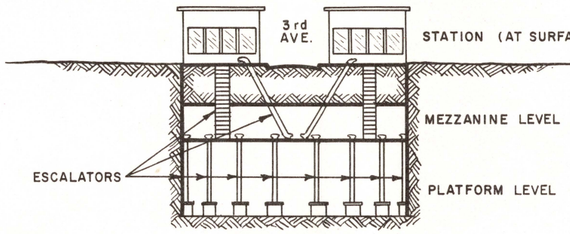
ROUTES CONSIDERED FOR MANHATTAN SUBWAY EXTENSIONS

CHARLES E. DE LEUW • CONSULTING ENGINEER

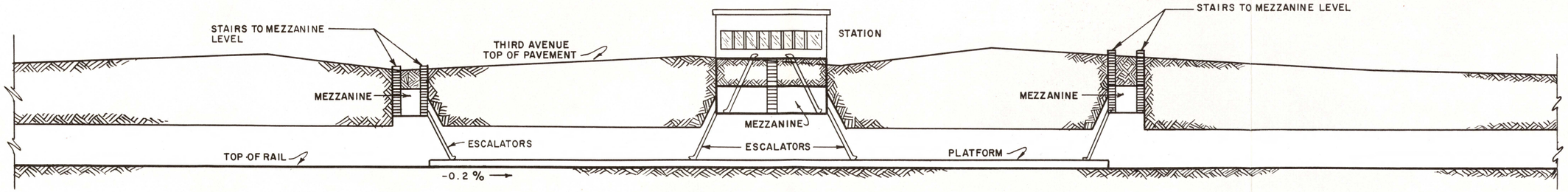
EXHIBIT 12



PLAN



SECTION A-A



SECTION B-B

SCALE

HORIZONTAL 0 80 160 320 FEET

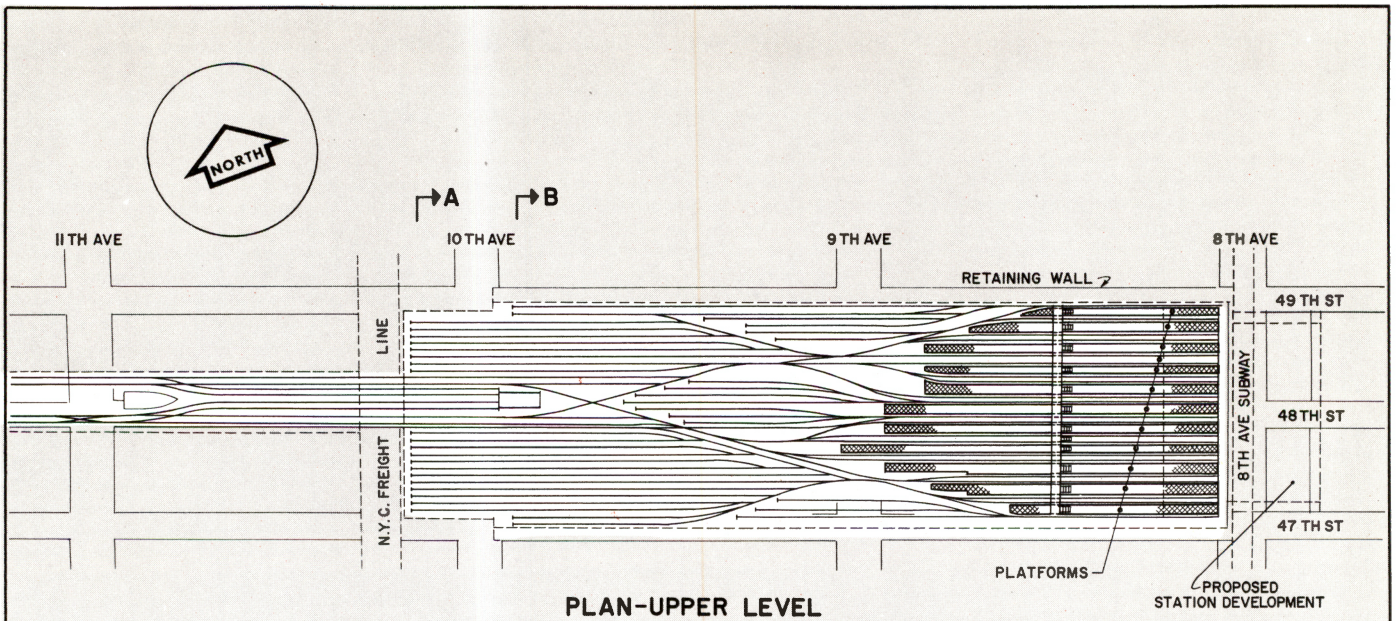
VERTICAL 0 20 40 80 FEET

METROPOLITAN RAPID TRANSIT SURVEY

ALL-RAILROAD THROUGH TERMINAL ON THE INDEPENDENT BI-STATE RAPID TRANSIT SYSTEM

PLAN AND CROSS SECTIONS

CHARLES E. DE LEUW CONSULTING ENGINEER

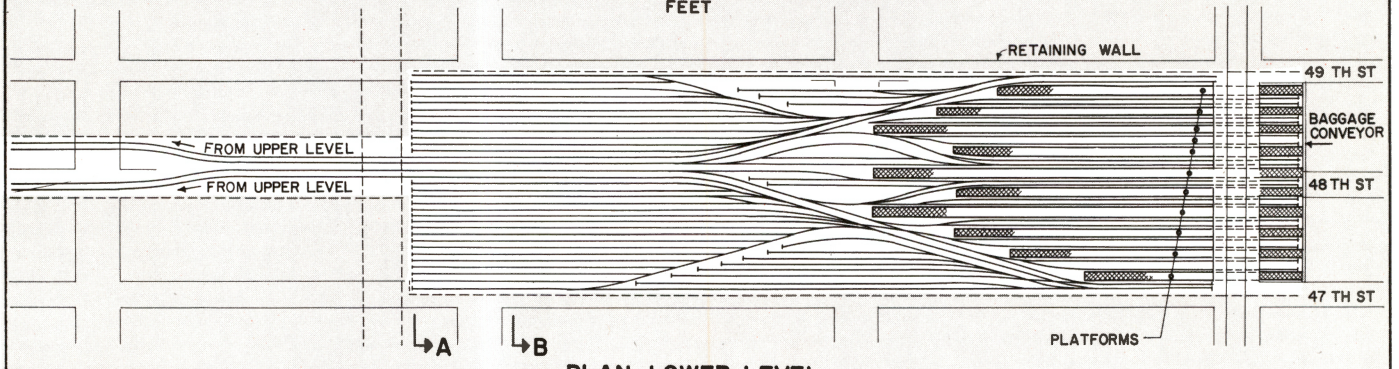


PLAN-UPPER LEVEL

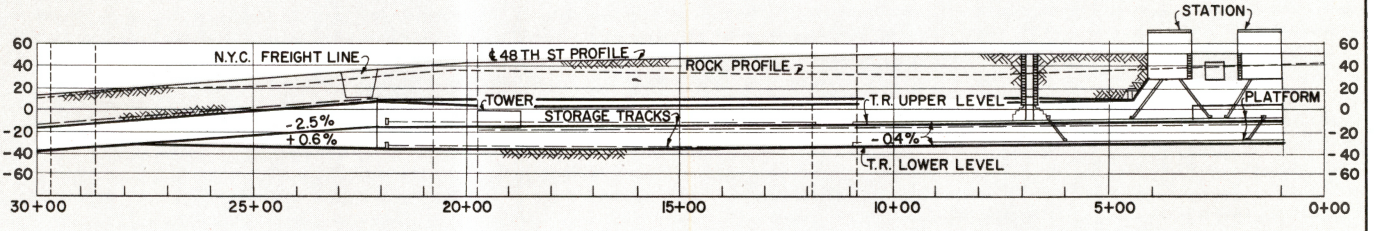
SCALE

0 20 40 60 80

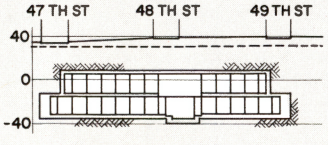
FEET



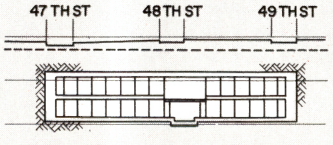
PLAN-LOWER LEVEL



PROFILE



SECTION A-A



SECTION B-B

METROPOLITAN RAPID TRANSIT SURVEY

ALL-RAILROAD STUB-END TERMINAL IN MANHATTAN

PLANS AND CROSS SECTIONS

CHARLES E. DE LEUW • CONSULTING ENGINEER

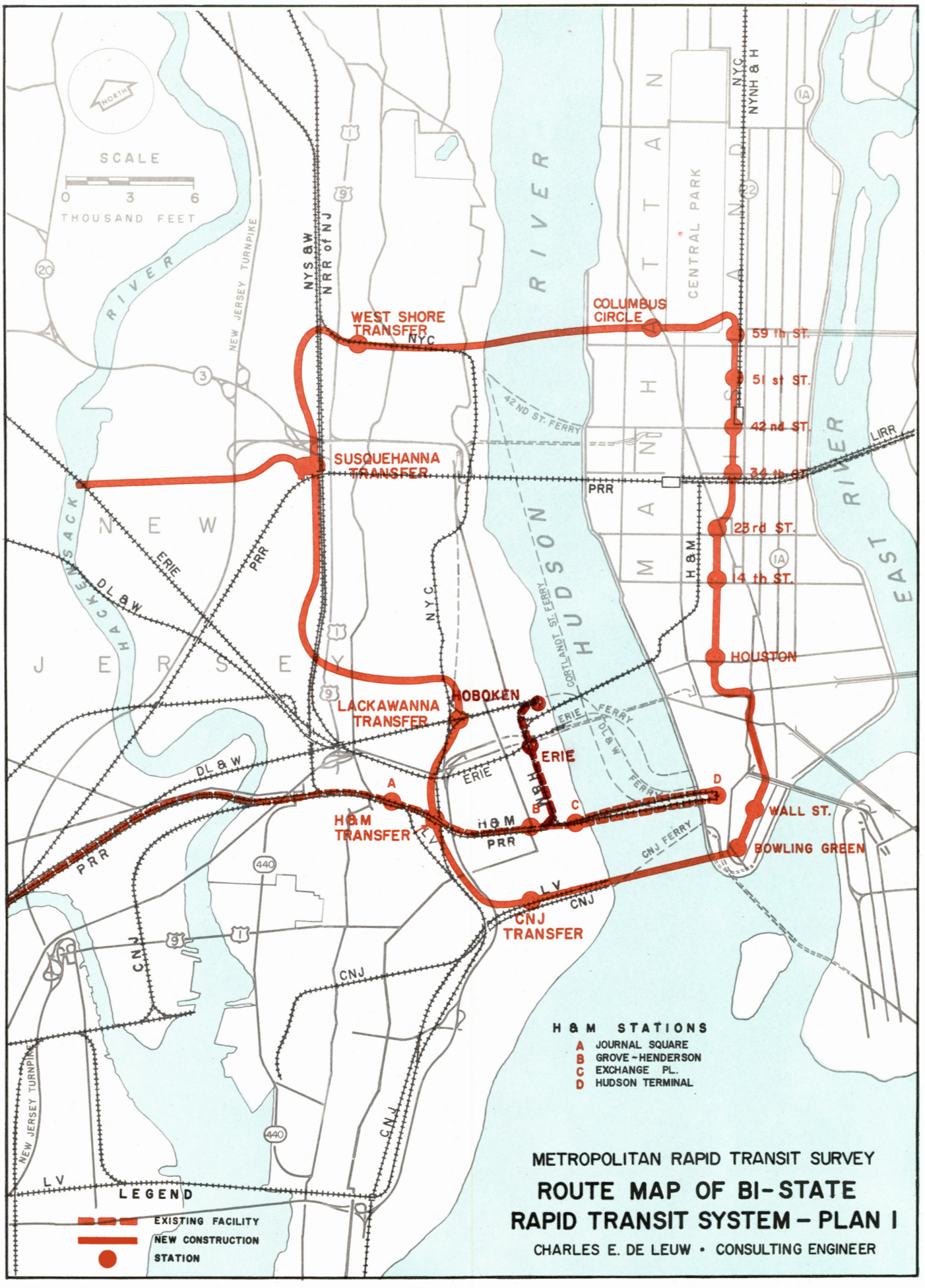

NORTH
SCALE
0 3 6
THOUSAND FEET
NEW JERSEY TURNPIKE
HACKENSACK RIVER
NYS&W
NRR of NJ
WEST SHORE TRANSFER
NYC
SUSQUEHANNA TRANSFER
LACKAWANNA TRANSFER
HOBOKEN
H&M TRANSFER
CNJ TRANSFER
COLUMBUS CIRCLE
59 th ST.
51 st ST.
42 nd ST.
34 th ST.
23rd ST.
14 th ST.
HOUSTON
WALL ST.
BOWLING GREEN
CENTRAL PARK
NYNH & H
HUDSON RIVER
EAST RIVER
42ND ST. FERRY
CORTLANDT ST. FERRY
ERIE FERRY
DL&W FERRY
CNJ FERRY
LIRR
PRR
ERIE
DL&W
NYC
H&M
CNJ
LV
NEW JERSEY
MANHATTAN
H & M STATIONS
A JOURNAL SQUARE
B GROVE-HENDERSON
C EXCHANGE PL.
D HUDSON TERMINAL
LEGEND
EXISTING FACILITY
NEW CONSTRUCTION
STATION
METROPOLITAN RAPID TRANSIT SURVEY
ROUTE MAP OF BI-STATE
RAPID TRANSIT SYSTEM – PLAN I
CHARLES E. DE LEUW • CONSULTING ENGINEER

EXHIBIT 15



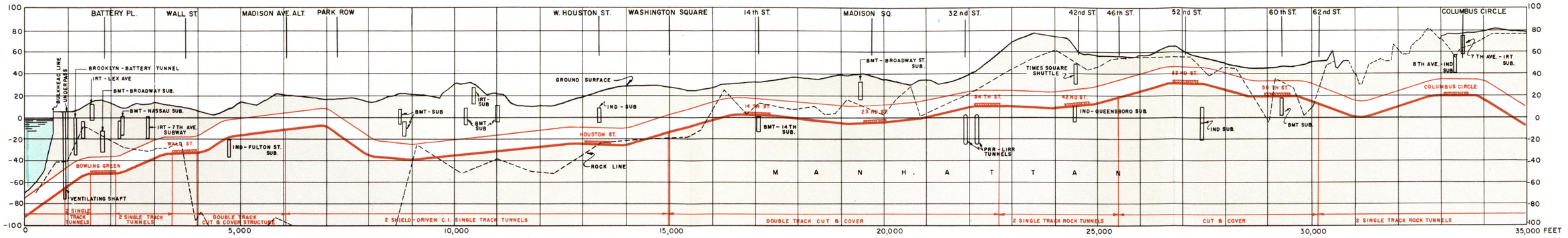
METROPOLITAN RAPID TRANSIT SURVEY

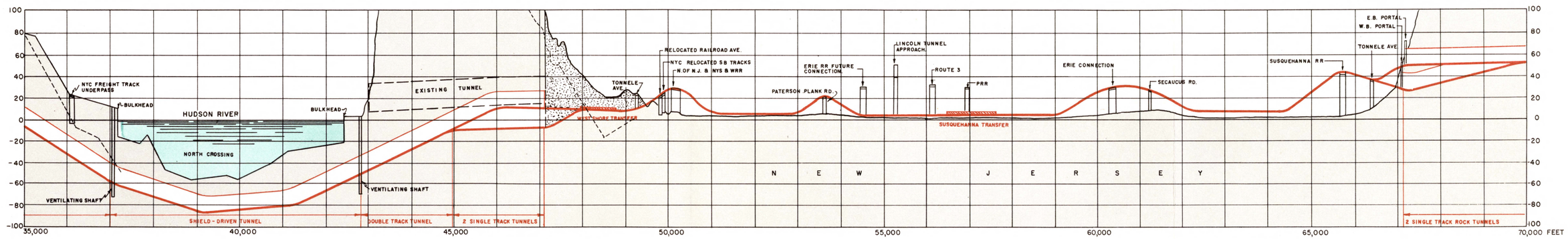
MANHATTAN

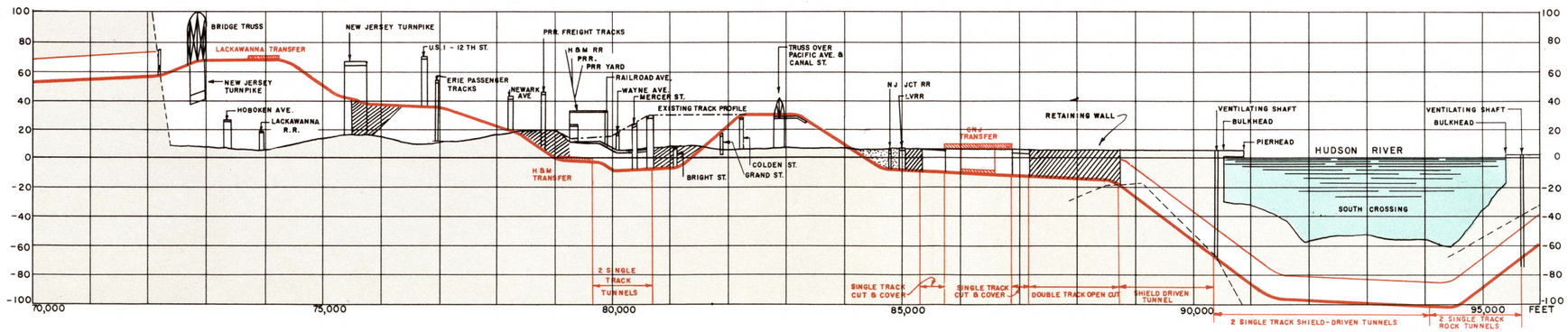
ROUTE AND STATION LOCATIONS OF BI-STATE RAPID TRANSIT SYSTEM

PLAN I

CHARLES E. DE LEUW • CONSULTING ENGINEER



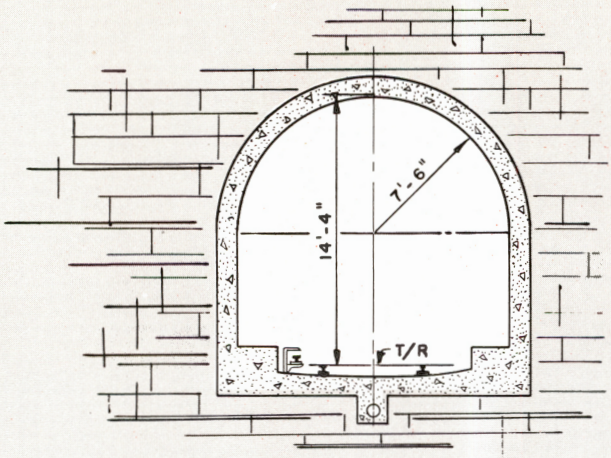




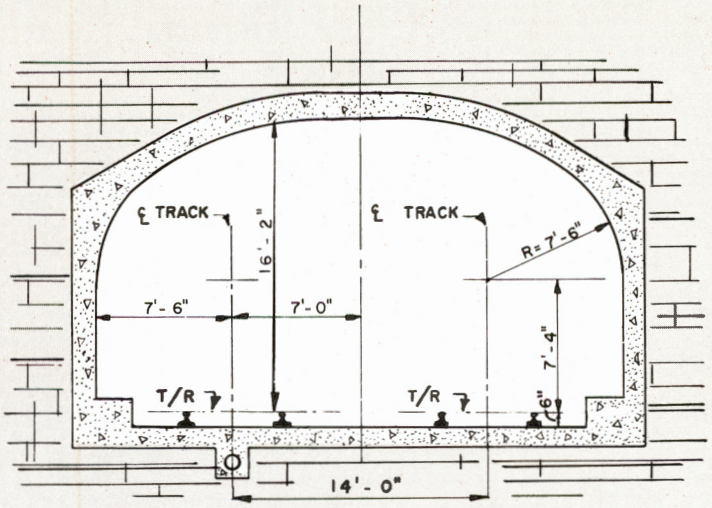
METROPOLITAN RAPID TRANSIT SURVEY

PROFILE OF BI-STATE RAPID TRANSIT SYSTEM

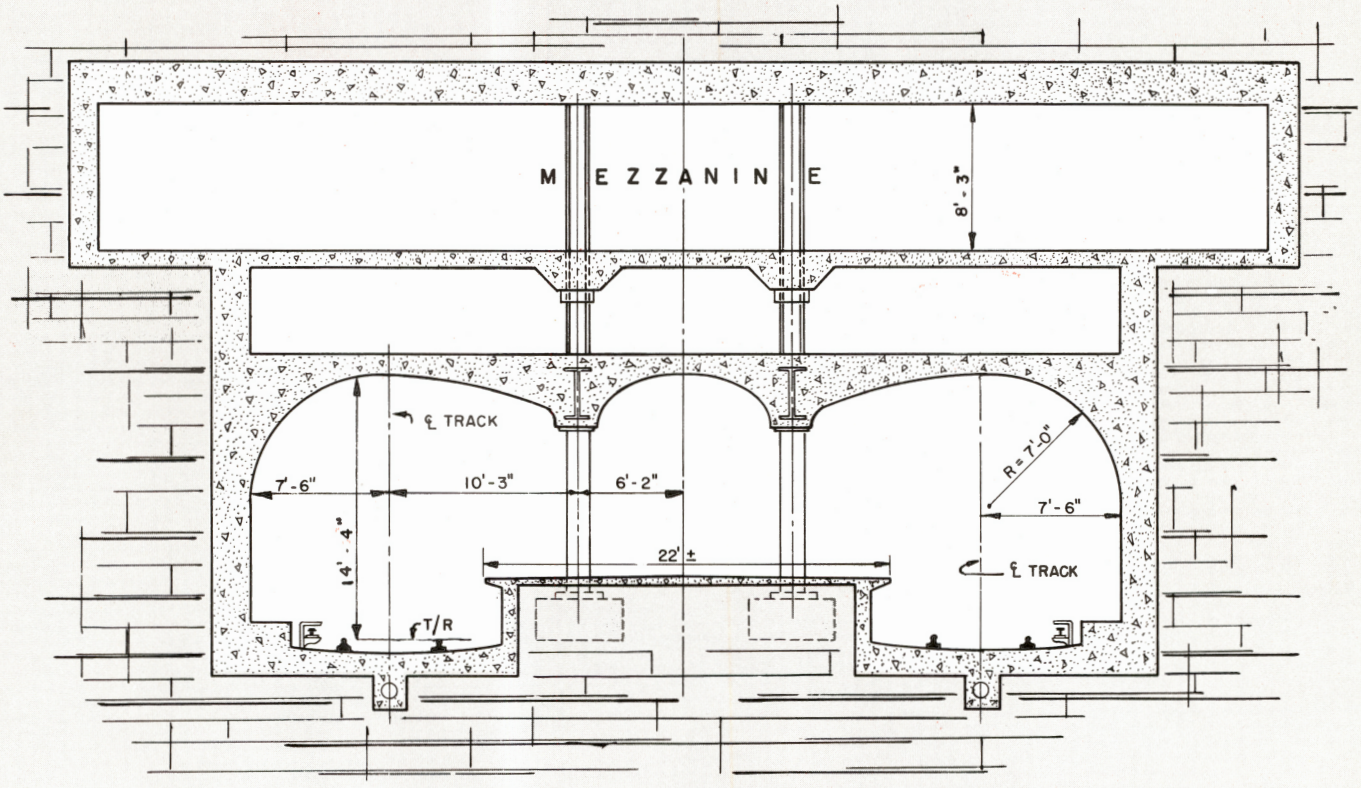
CHARLES E. DE LEUW · CONSULTING ENGINEER



SINGLE TRACK TUNNEL IN ROCK



DOUBLE TRACK TUNNEL IN ROCK

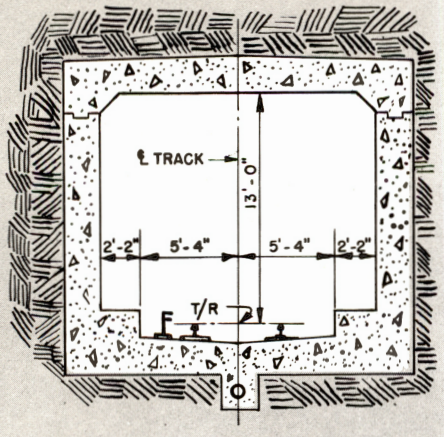


STATION STRUCTURE WITH MEZZANINE IN ROCK

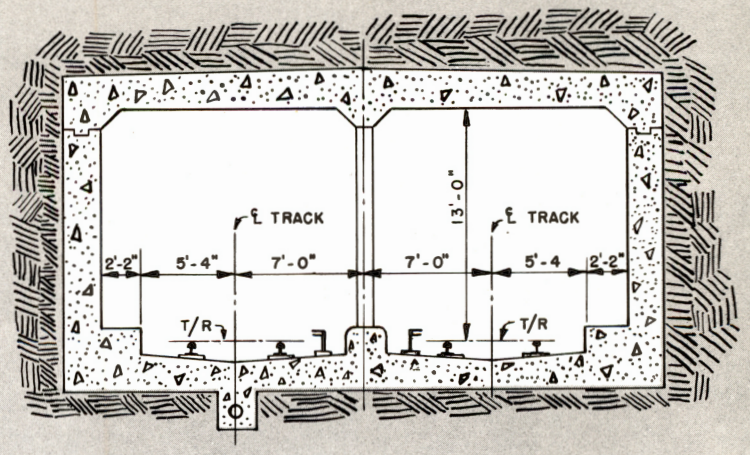
METROPOLITAN RAPID TRANSIT SURVEY

TYPICAL CROSS SECTIONS OF ROCK TUNNELS BETWEEN AND AT STATIONS

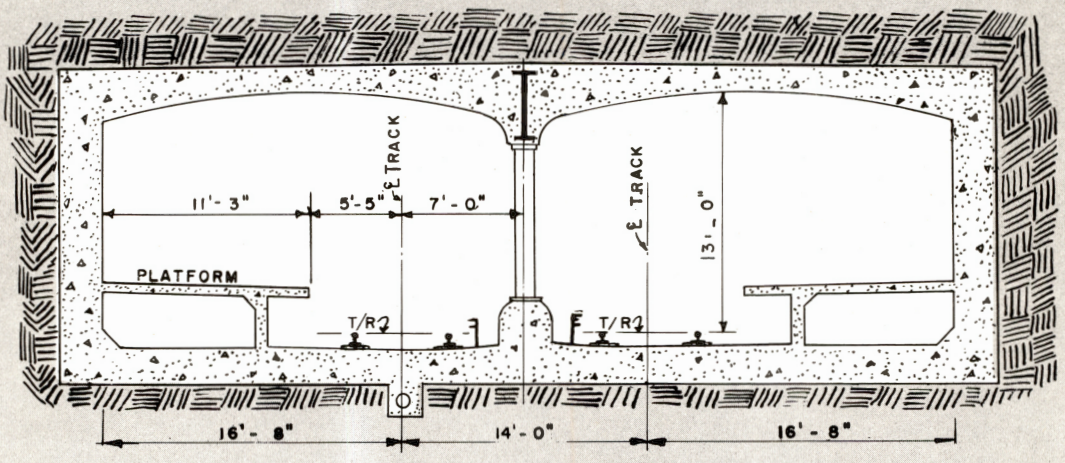
CHARLES E. DE LEUW · CONSULTING ENGINEER



SINGLE TRACK TUNNEL
CUT AND COVER



DOUBLE TRACK TUNNEL
CUT AND COVER

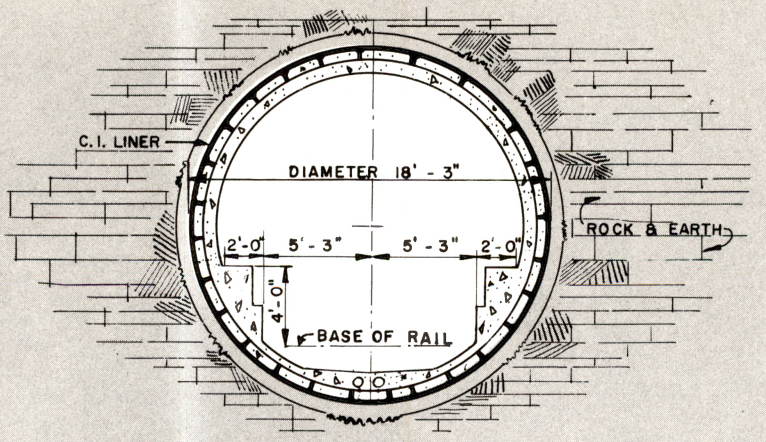


STATION STRUCTURE—CUT AND COVER

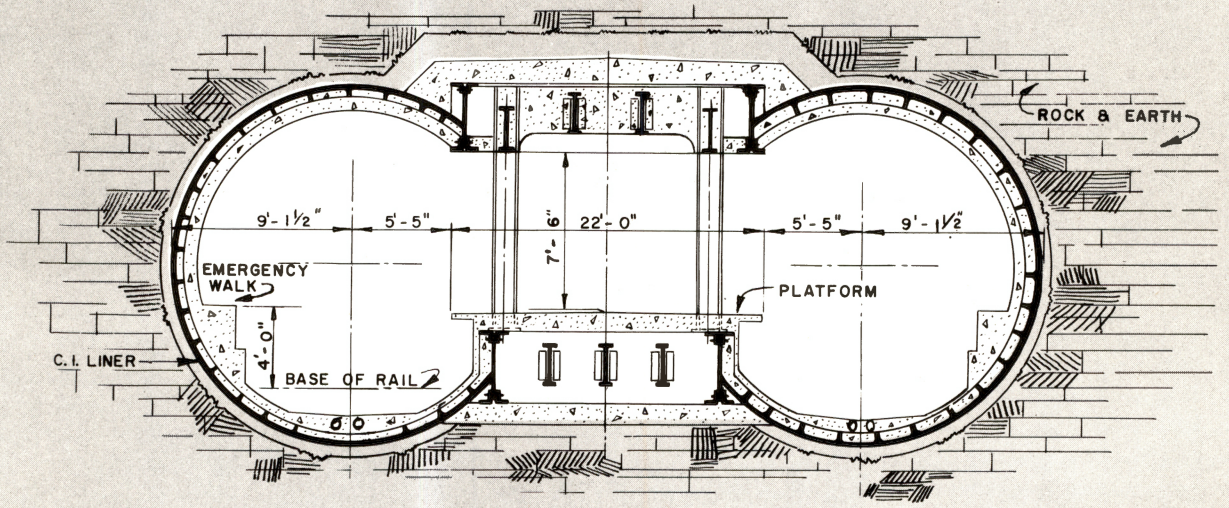
METROPOLITAN RAPID TRANSIT SURVEY

TYPICAL CROSS SECTIONS OF CUT AND COVER CONSTRUCTION BETWEEN AND AT STATIONS

CHARLES E. DE LEUW · CONSULTING ENGINEER



SINGLE TRACK TUNNEL
CAST IRON LINED



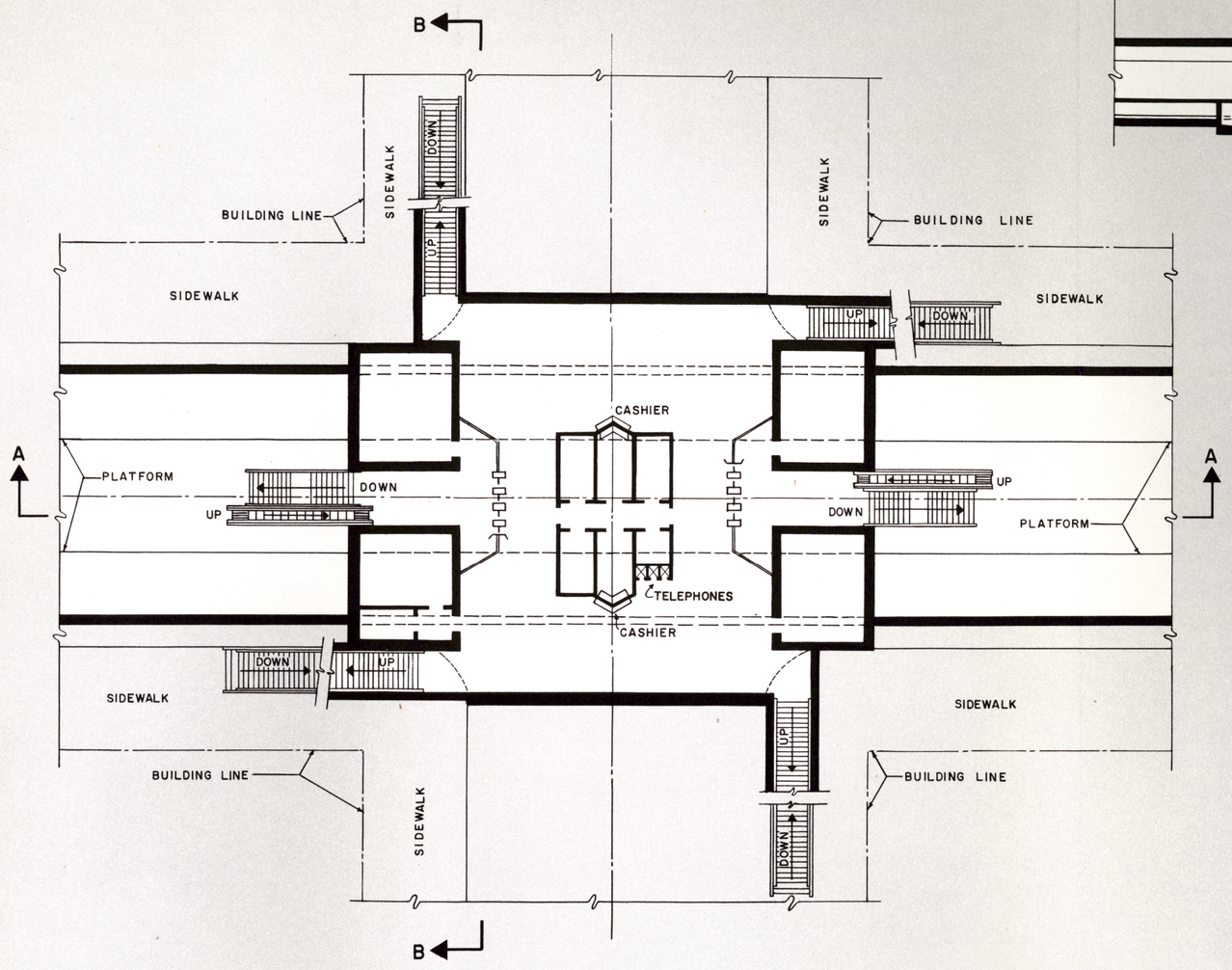
STATION STRUCTURE - CAST IRON LINED

METROPOLITAN RAPID TRANSIT SURVEY

TYPICAL CROSS SECTIONS OF CAST IRON LINED TUNNELS

CHARLES E. DE LEUW · CONSULTING ENGINEER

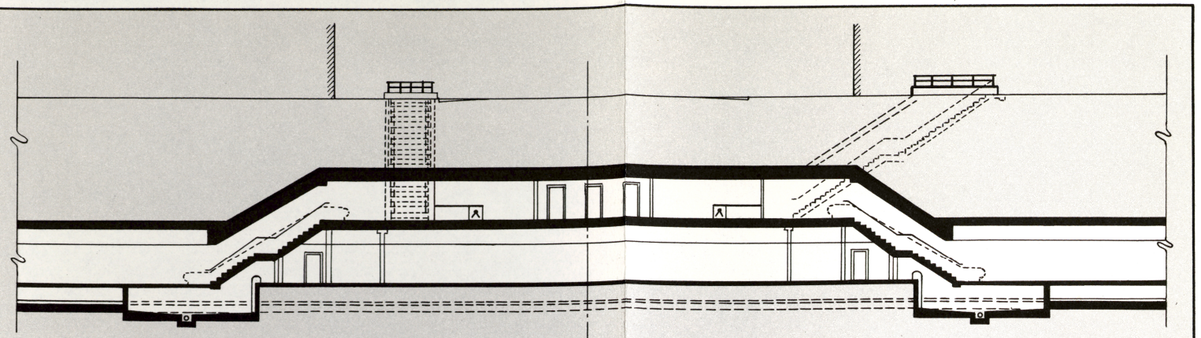
EXHIBIT 20



PLAN

SCALE

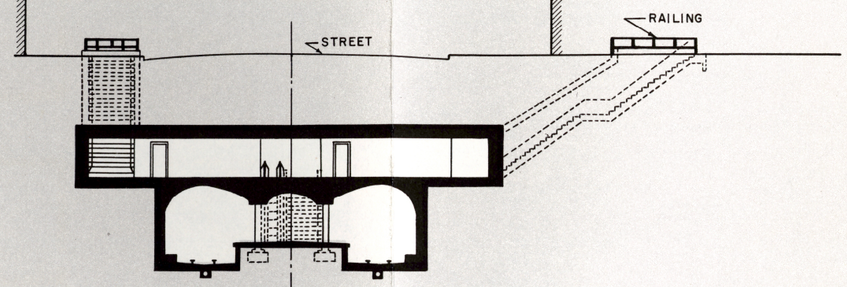
0 5 10 20 30
FEET



SECTION A-A

SCALE

0 5 10 20 30
FEET



SECTION B-B

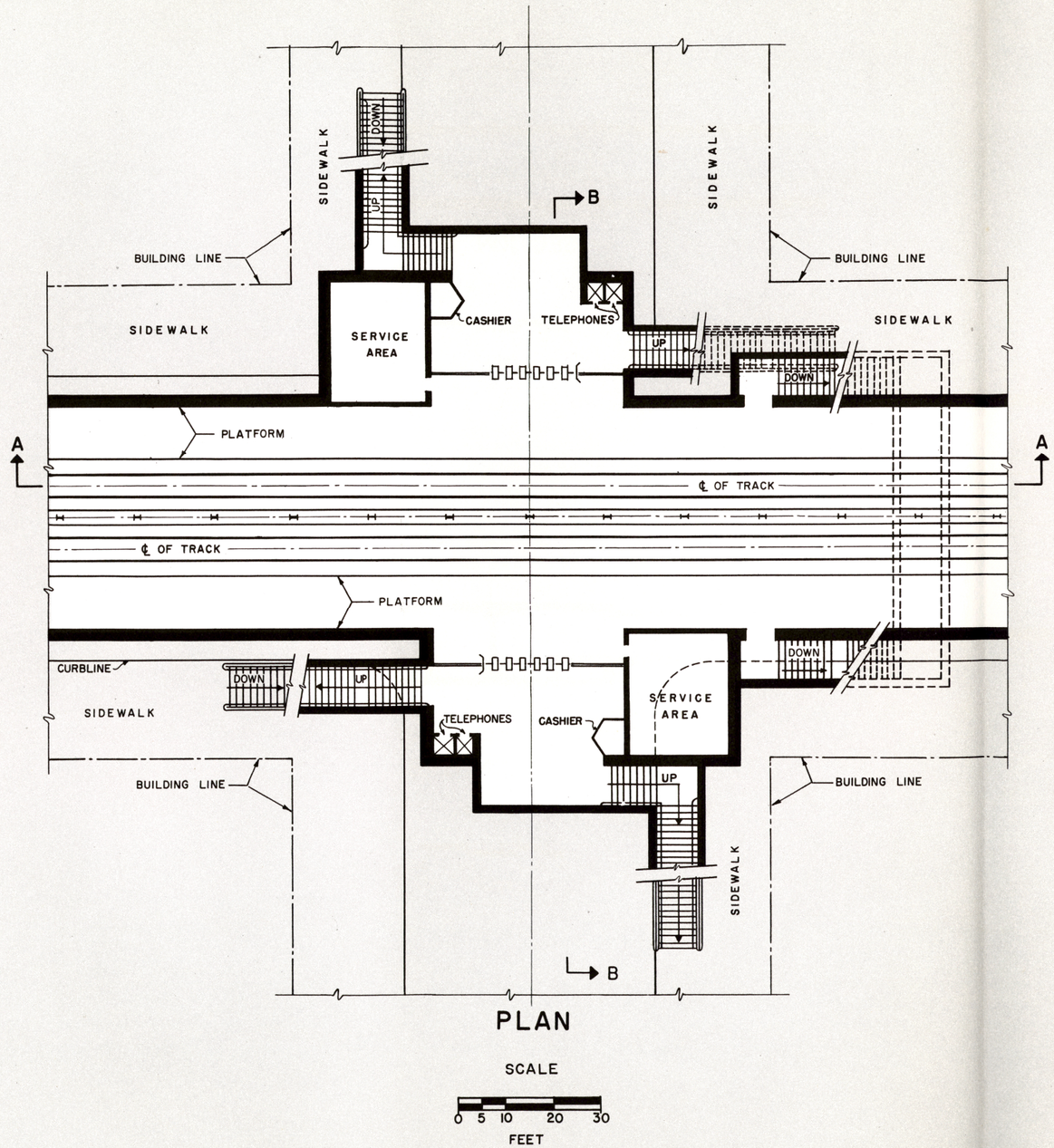
SCALE

0 5 10 20 30
FEET

METROPOLITAN RAPID TRANSIT SURVEY

TYPICAL CENTER PLATFORM SUBWAY STATION

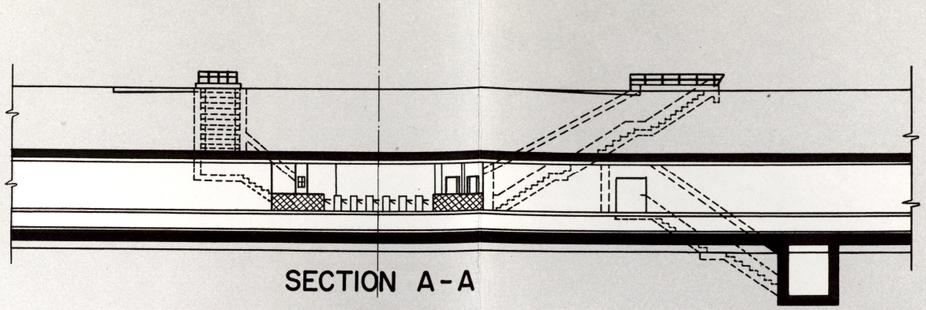
CHARLES E. DE LEUW · CONSULTING ENGINEER



PLAN

SCALE

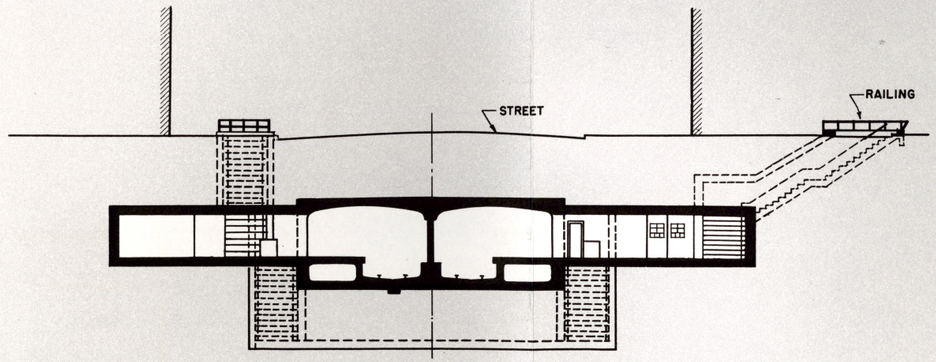
0 5 10 20 30
FEET



SECTION A-A

SCALE

0 5 10 20 30
FEET



SECTION B-B

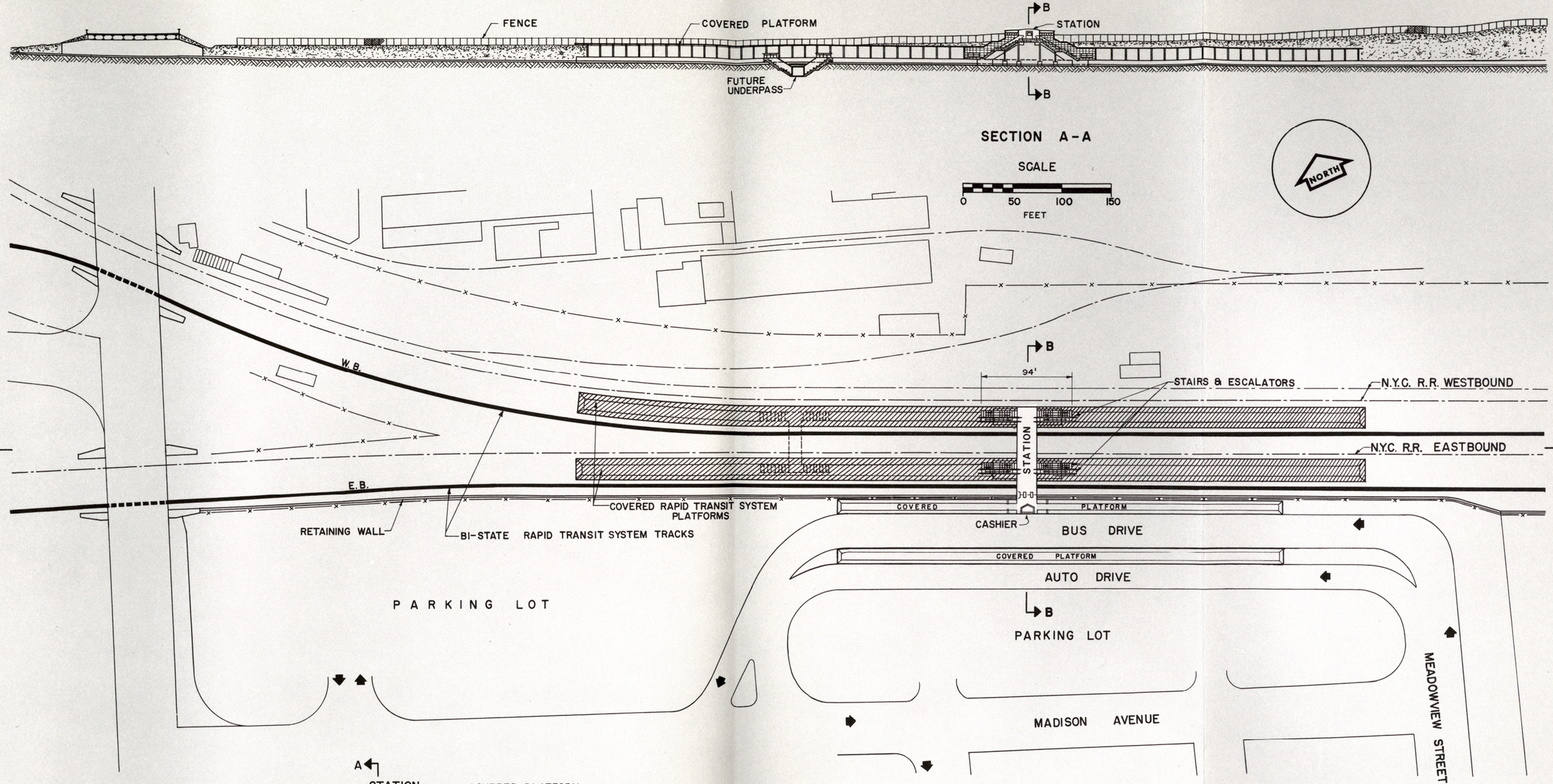
SCALE

0 5 10 20 30
FEET

METROPOLITAN RAPID TRANSIT SURVEY

TYPICAL SIDE PLATFORM SUBWAY STATION

CHARLES E. DE LEUW · CONSULTING ENGINEER

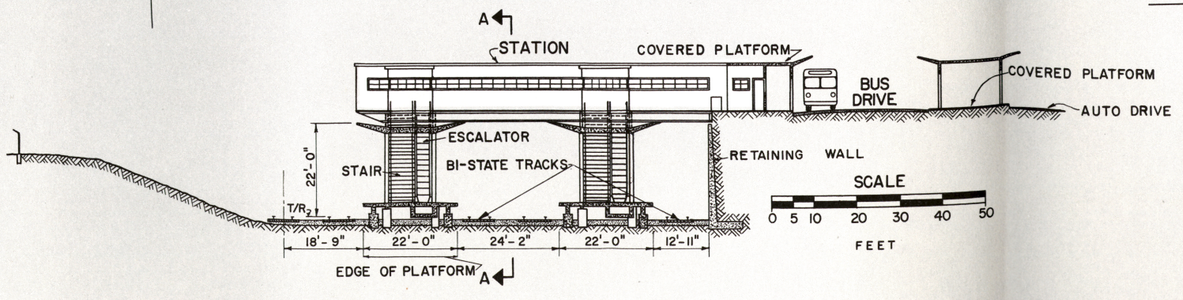


SECTION A-A

SCALE

0 50 100 150

FEET



SECTION B-B

PLAN

SCALE

0 50 100 150

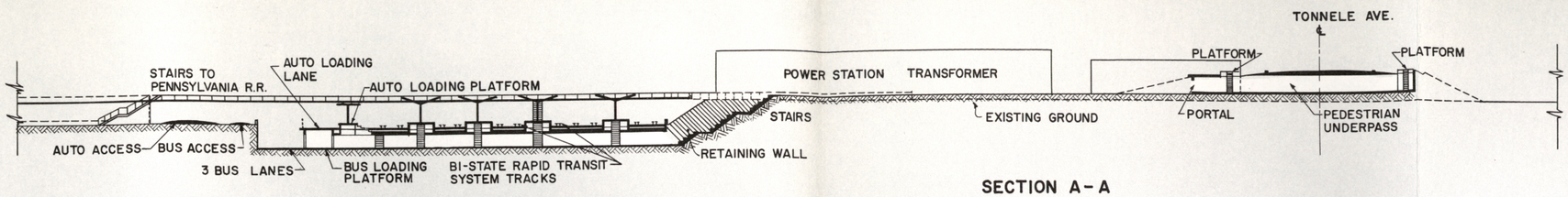
FEET

METROPOLITAN RAPID TRANSIT SURVEY

WEST SHORE TRANSFER STATION ON BI-STATE RAPID TRANSIT SYSTEM

PLAN AND CROSS SECTIONS

CHARLES E. DE LEUW · CONSULTING ENGINEER

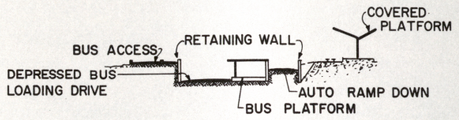


SECTION A-A

SCALE

0 20 40 60

FEET



SECTION B-B

PLAN

SCALE

0 50 100 150

FEET

NORTH

METROPOLITAN RAPID TRANSIT SURVEY

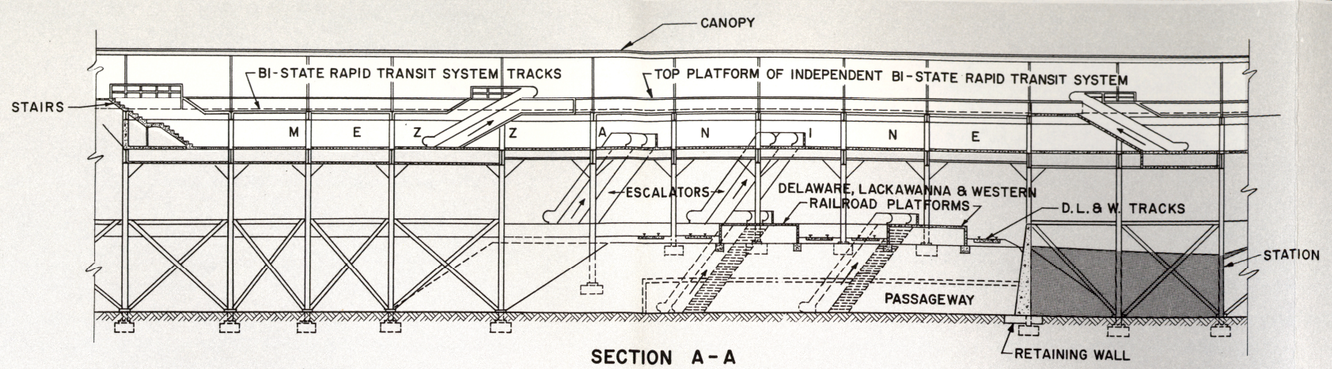
SUSQUEHANNA TRANSFER STATION ON BI-STATE RAPID TRANSIT SYSTEM

PLAN AND CROSS SECTIONS

CHARLES E. DE LEUW · CONSULTING ENGINEER

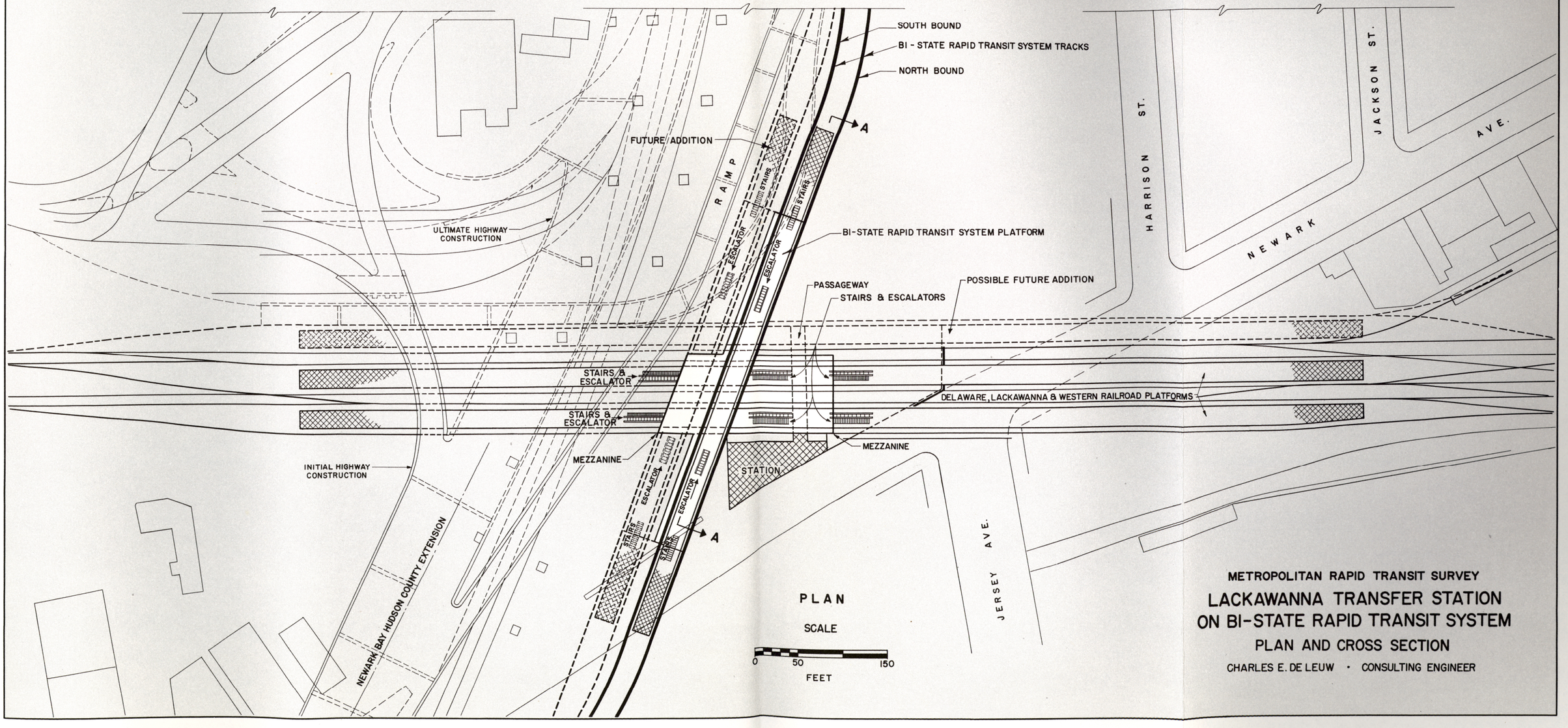
EXHIBIT 24

SCALE
FOR SECTION A-A
0 20 40 60
FEET



SECTION A-A

NORTH



PLAN

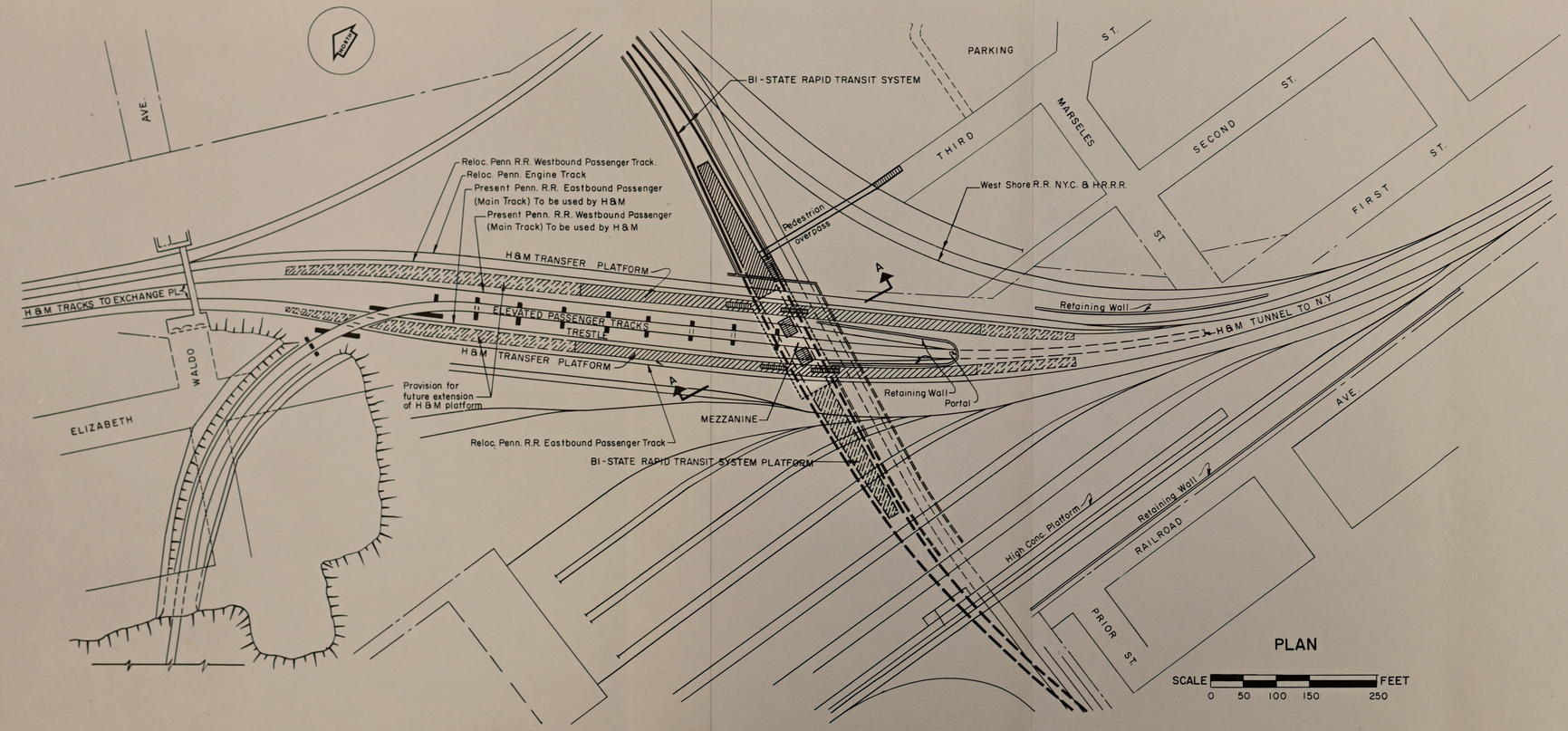
SCALE
0 50 150
FEET

METROPOLITAN RAPID TRANSIT SURVEY

LACKAWANNA TRANSFER STATION ON BI-STATE RAPID TRANSIT SYSTEM

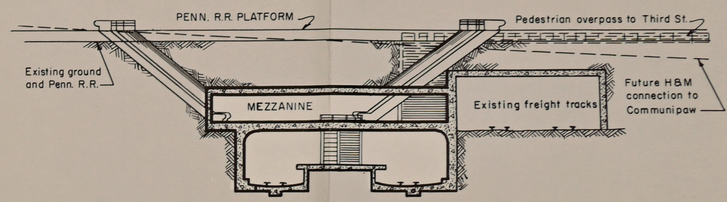
PLAN AND CROSS SECTION

CHARLES E. DE LEUW • CONSULTING ENGINEER



PLAN

SCALE 0 50 100 150 250 FEET



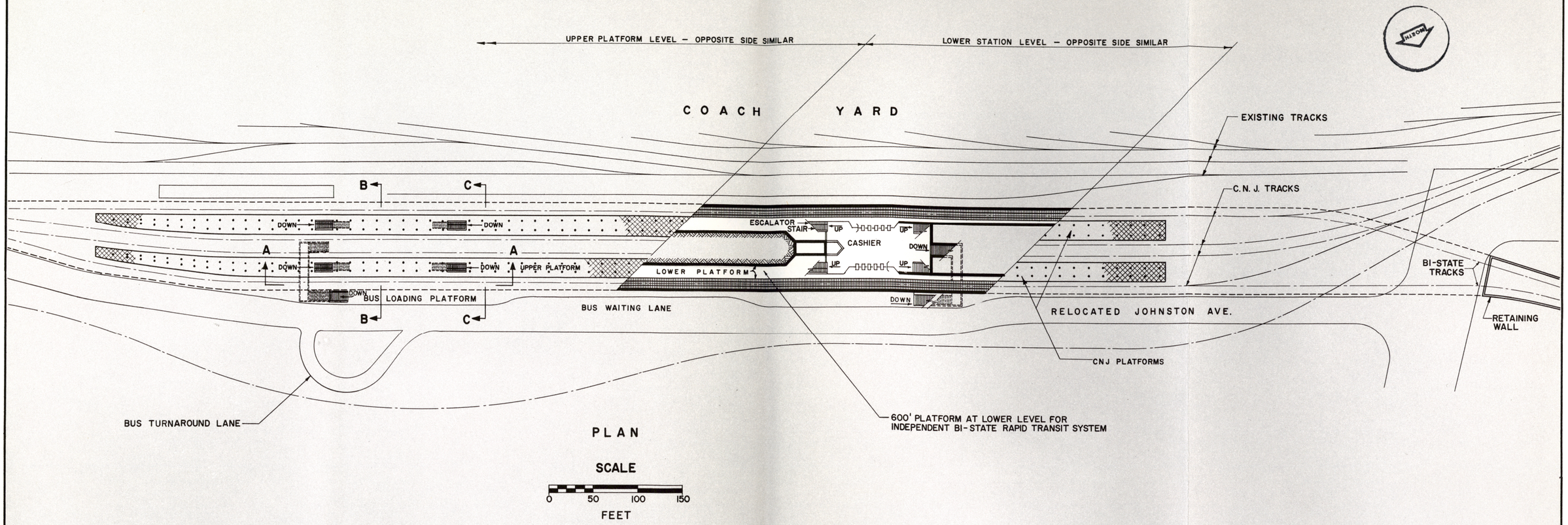
SECTION A-A

SCALE 0 10 20 40 FEET

METROPOLITAN RAPID TRANSIT SURVEY

HUDSON & MANHATTAN TRANSFER STATION ON BI-STATE RAPID TRANSIT SYSTEM PLAN AND CROSS SECTION

CHARLES E. DE LEUW · CONSULTING ENGINEER

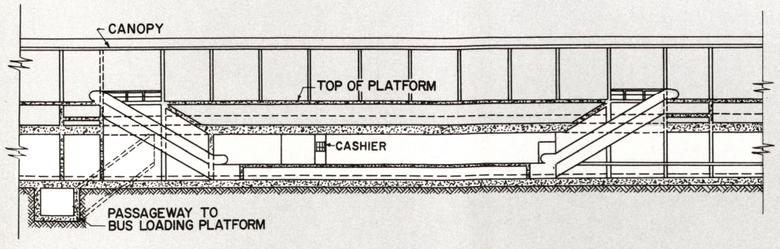


PLAN

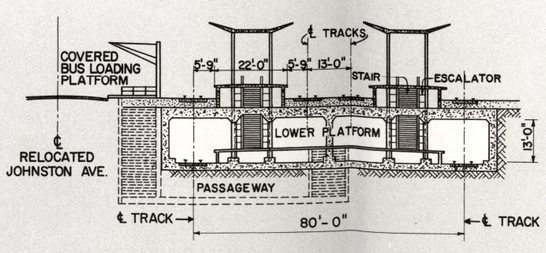
SCALE

0 50 100 150

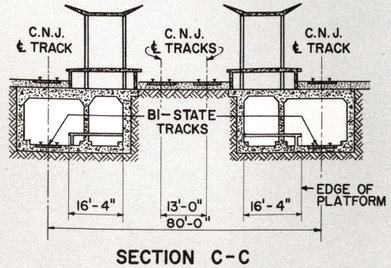
FEET



SECTION A-A



SECTION B-B



SECTION C-C

SCALE

0 20 40 60

FEET

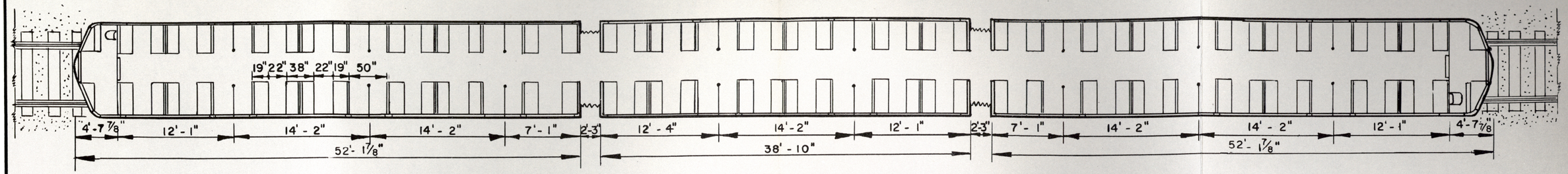
METROPOLITAN RAPID TRANSIT SURVEY

CNJ TRANSFER STATION ON BI-STATE RAPID TRANSIT SYSTEM

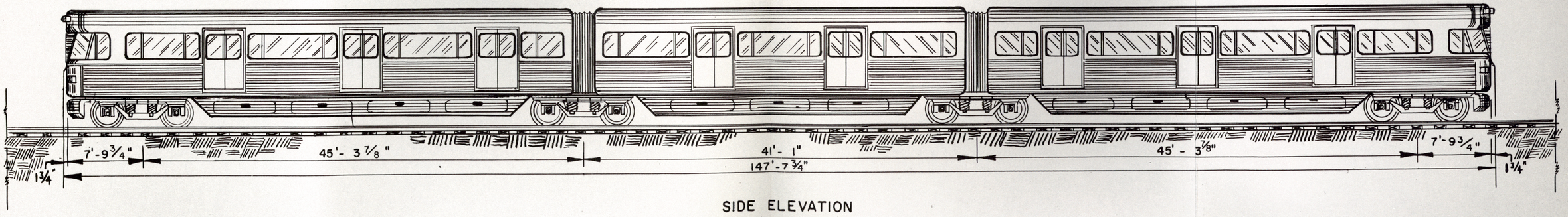
PLAN AND CROSS SECTIONS

CHARLES E. DE LEUW • CONSULTING ENGINEER

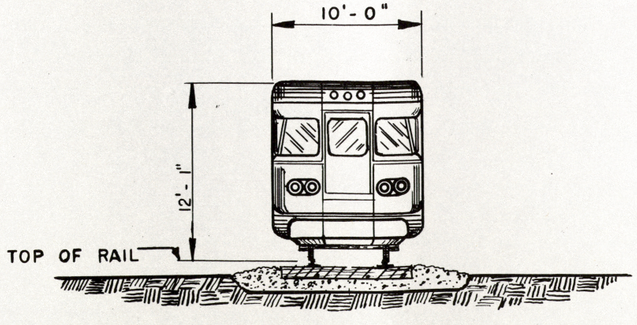
EXHIBIT 27



PLAN



SIDE ELEVATION



FRONT ELEVATION

CAPACITY

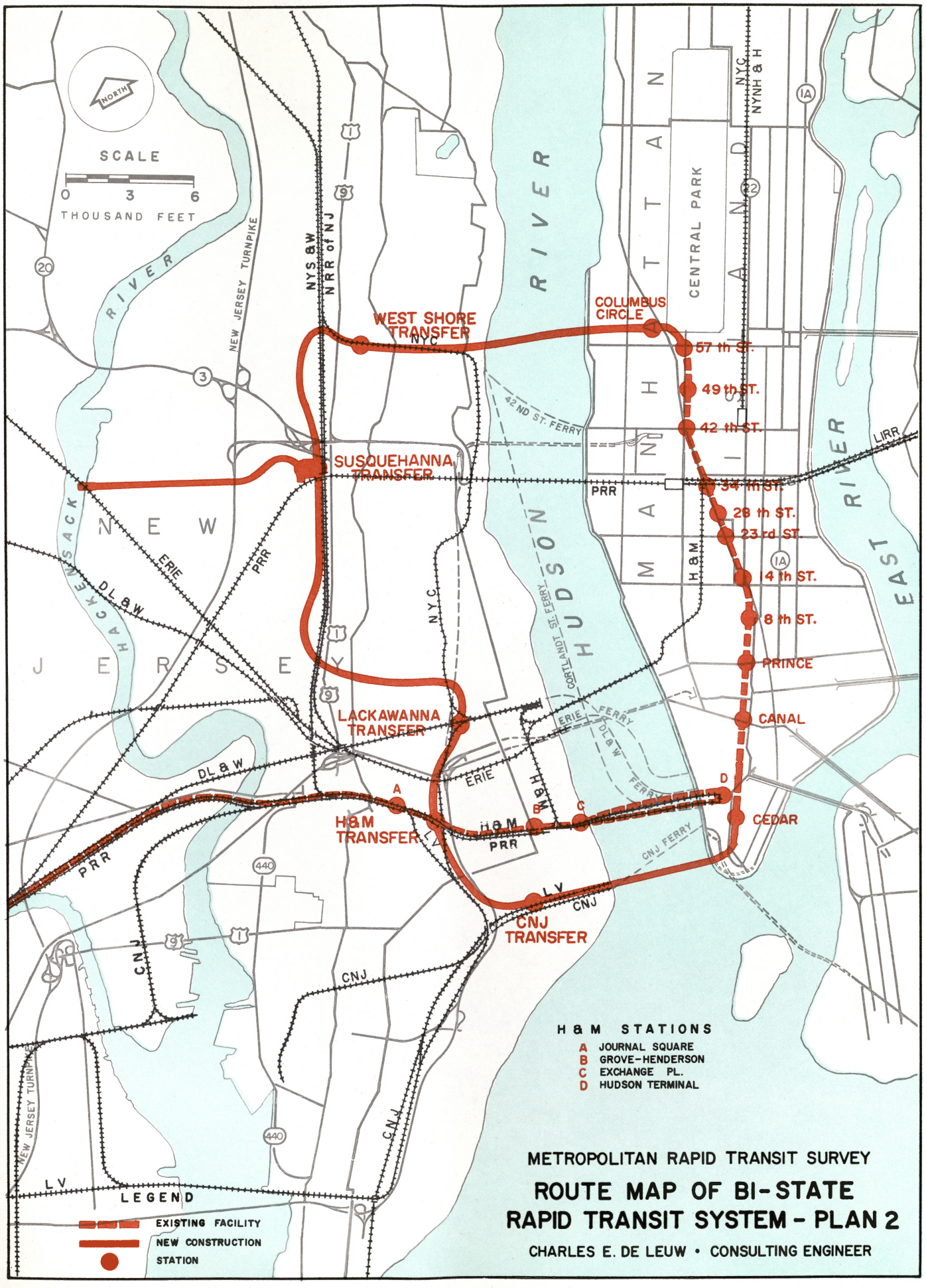
SEATED	160 PERSONS
STANDING	215 PERSONS
TOTAL	375 PERSONS

METROPOLITAN RAPID TRANSIT SURVEY

THREE - CAR ARTICULATED RAPID TRANSIT UNIT

CHARLES E. DE LEUW • CONSULTING ENGINEER

EXHIBIT 28



METROPOLITAN RAPID TRANSIT SURVEY

ROUTE MAP OF BI-STATE RAPID TRANSIT SYSTEM - PLAN 2

CHARLES E. DE LEUW • CONSULTING ENGINEER

EXHIBIT 29



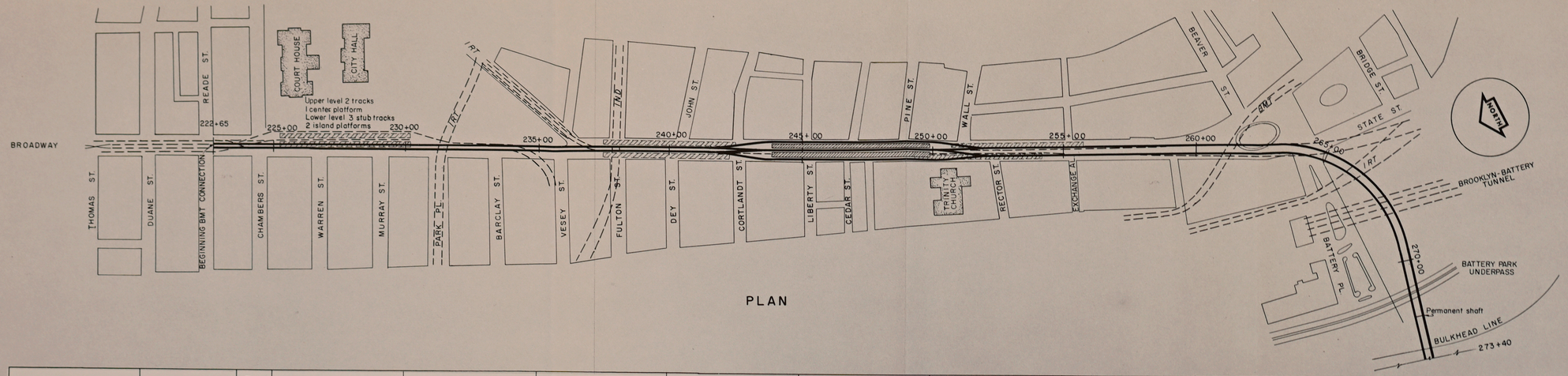
METROPOLITAN RAPID TRANSIT SURVEY

MANHATTAN

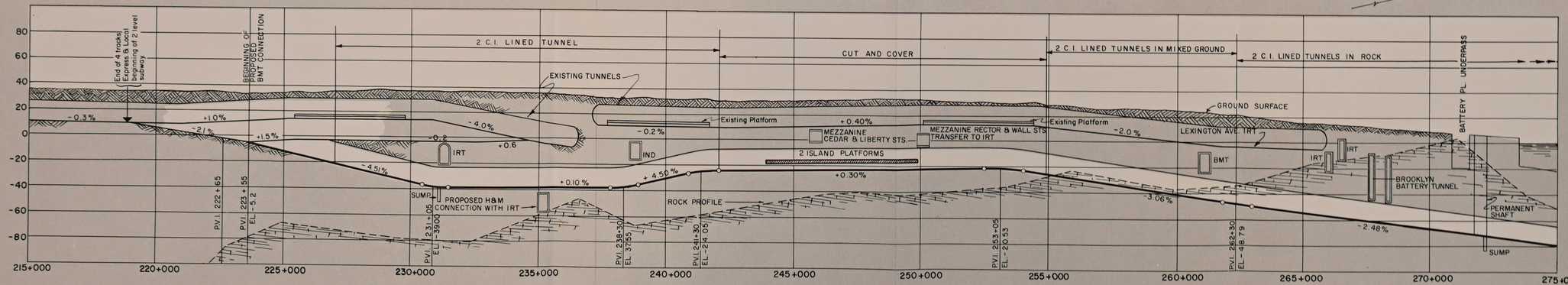
ROUTE AND STATION LOCATIONS OF BI-STATE RAPID TRANSIT SYSTEM PLAN 2 AND 3

CHARLES E. DE LEUW • CONSULTING ENGINEER

EXHIBIT 30



PLAN



PROFILE

SCALE

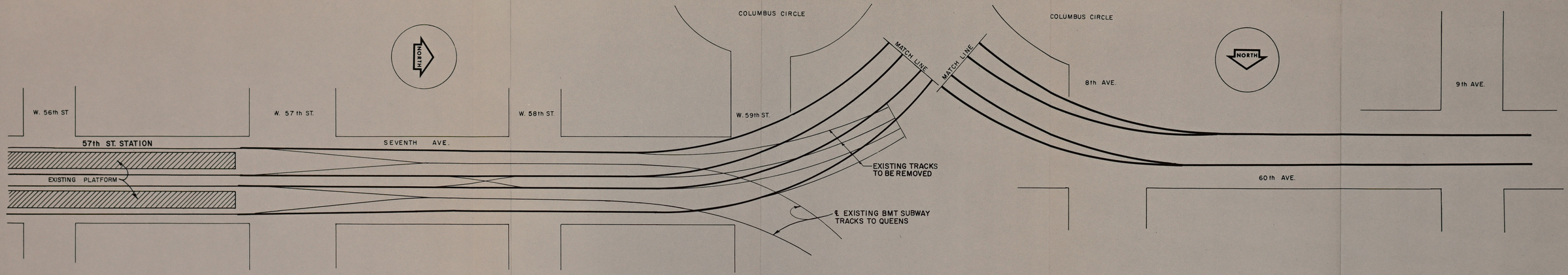
VERTICAL 0 20 40 80 120 FEET

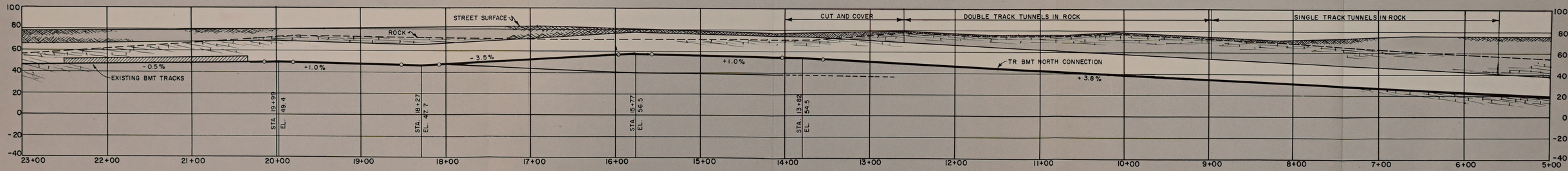
HORIZONTAL 0 100 200 400 600 FEET

METROPOLITAN RAPID TRANSIT SURVEY

SOUTH CONNECTION TO BMT BROADWAY SUBWAY PLAN AND PROFILE

CHARLES E. DE LEUW · CONSULTING ENGINEER





SCALE

HORIZONTAL 0 25 50 100 150 FEET

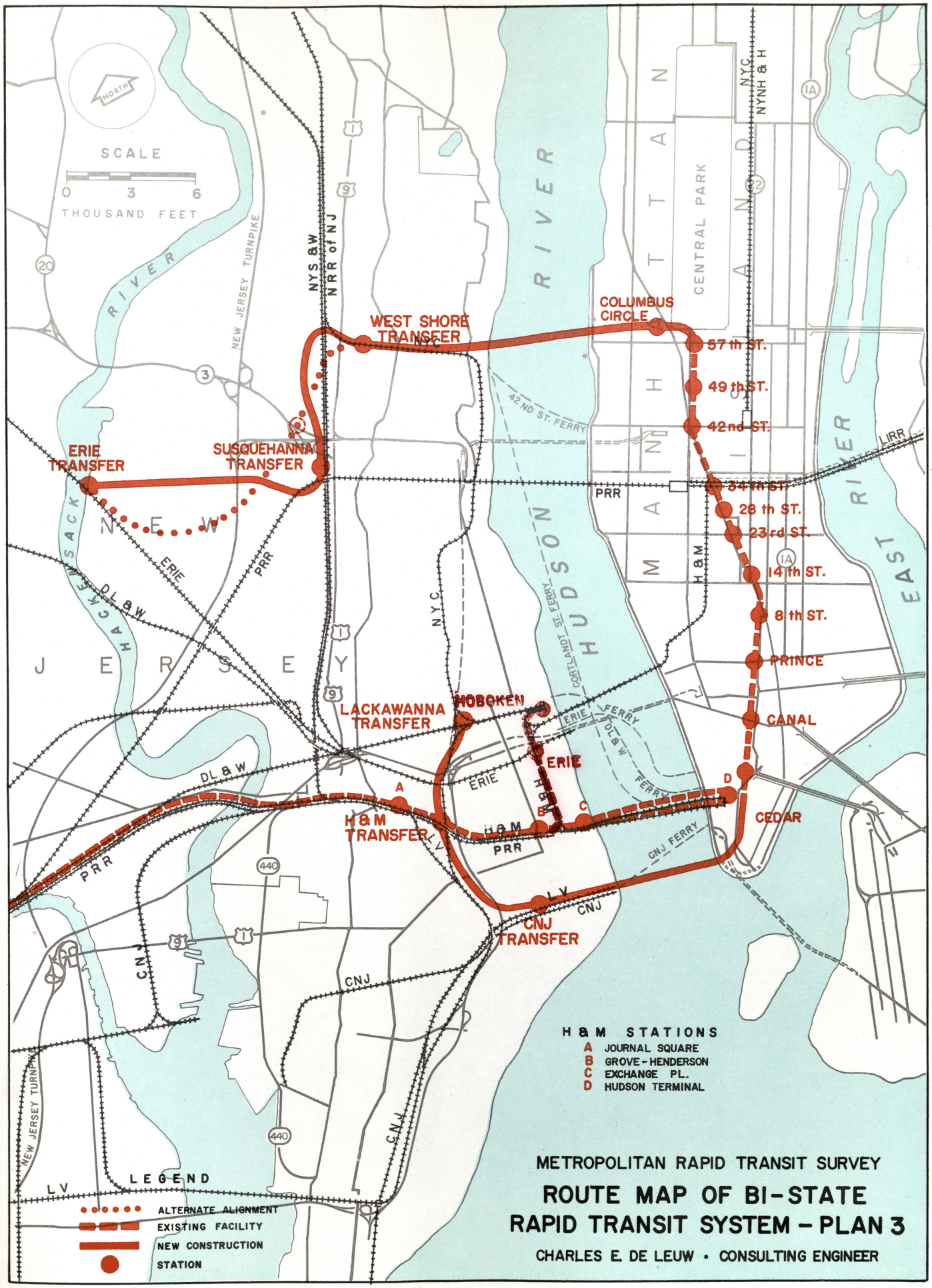
VERTICAL 0 20 40 80 120 FEET

METROPOLITAN RAPID TRANSIT SURVEY

NORTH CONNECTION TO BMT BROADWAY SUBWAY PLAN AND PROFILE

CHARLES E. DE LEUW · CONSULTING ENGINEER

EXHIBIT 32



METROPOLITAN RAPID TRANSIT SURVEY

ROUTE MAP OF BI-STATE RAPID TRANSIT SYSTEM – PLAN 3

CHARLES E. DE LEUW • CONSULTING ENGINEER

EXHIBIT 33

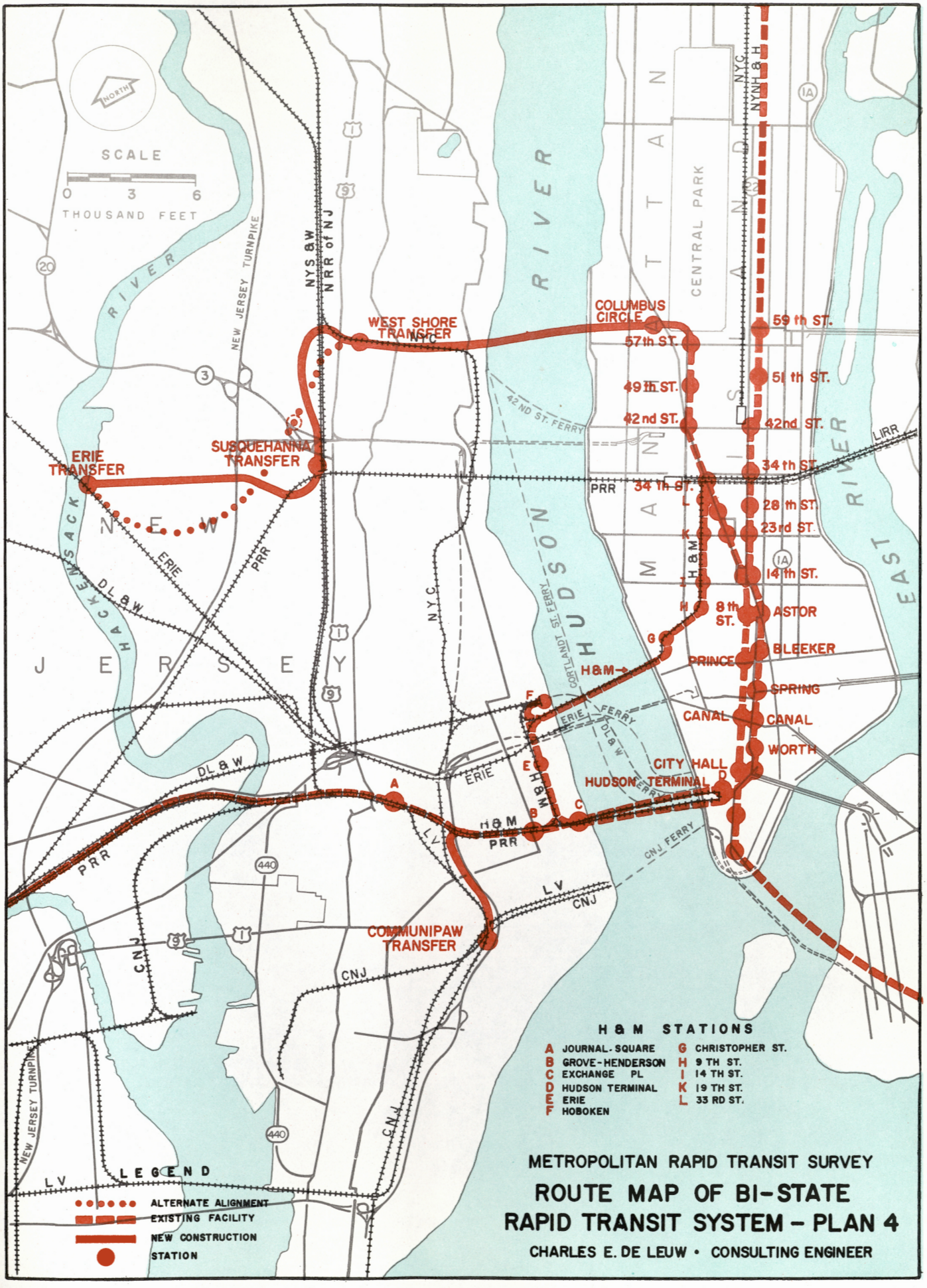

NORTH
SCALE
0 3 6
THOUSAND FEET
HUDSON RIVER
EAST RIVER
MANHATTAN
CENTRAL PARK
JERSEY
HACKENSACK RIVER
NEW JERSEY TURNPIKE
NYS&W
NRR of NJ
NYC
NYNH&H
LIRR
PRR
ERIE
DL&W
CNJ
LV
H&M
COLUMBUS CIRCLE
59th ST.
57th ST.
51st ST.
49th ST.
42nd ST.
42nd ST. FERRY
WEST SHORE TRANSFER
SUSQUEHANNA TRANSFER
ERIE TRANSFER
34th ST.
28th ST.
23rd ST.
14th ST.
8th ST.
ASTOR
BLEEKER
PRINCE
SPRING
CANAL
CANAL
WORTH
CITY HALL
HUDSON TERMINAL
CORTLANDT ST. FERRY
ERIE FERRY
DL&W FERRY
CNJ FERRY
COMMUNIPAW TRANSFER
A
B
C
D
E
F
G
H
I
K
L
H & M STATIONS
A JOURNAL-SQUARE
B GROVE-HENDERSON
C EXCHANGE PL
D HUDSON TERMINAL
E ERIE
F HOBOKEN
G CHRISTOPHER ST.
H 9 TH ST.
I 14 TH ST.
K 19 TH ST.
L 33 RD ST.
LEGEND
ALTERNATE ALIGNMENT
EXISTING FACILITY
NEW CONSTRUCTION
STATION
METROPOLITAN RAPID TRANSIT SURVEY
ROUTE MAP OF BI-STATE RAPID TRANSIT SYSTEM – PLAN 4
CHARLES E. DE LEUW • CONSULTING ENGINEER

EXHIBIT 34



METROPOLITAN RAPID TRANSIT SURVEY

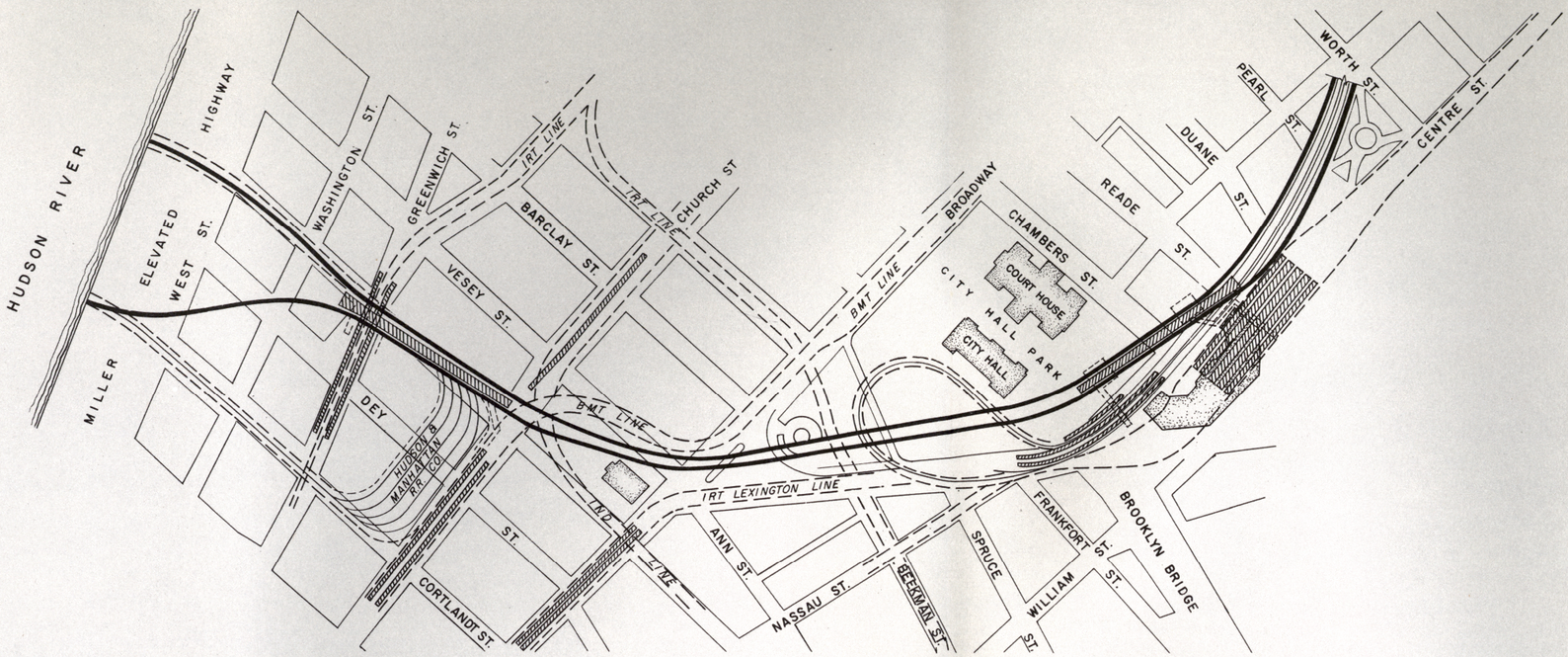
MANHATTAN

ROUTE AND STATION LOCATIONS OF BI-STATE RAPID TRANSIT SYSTEM

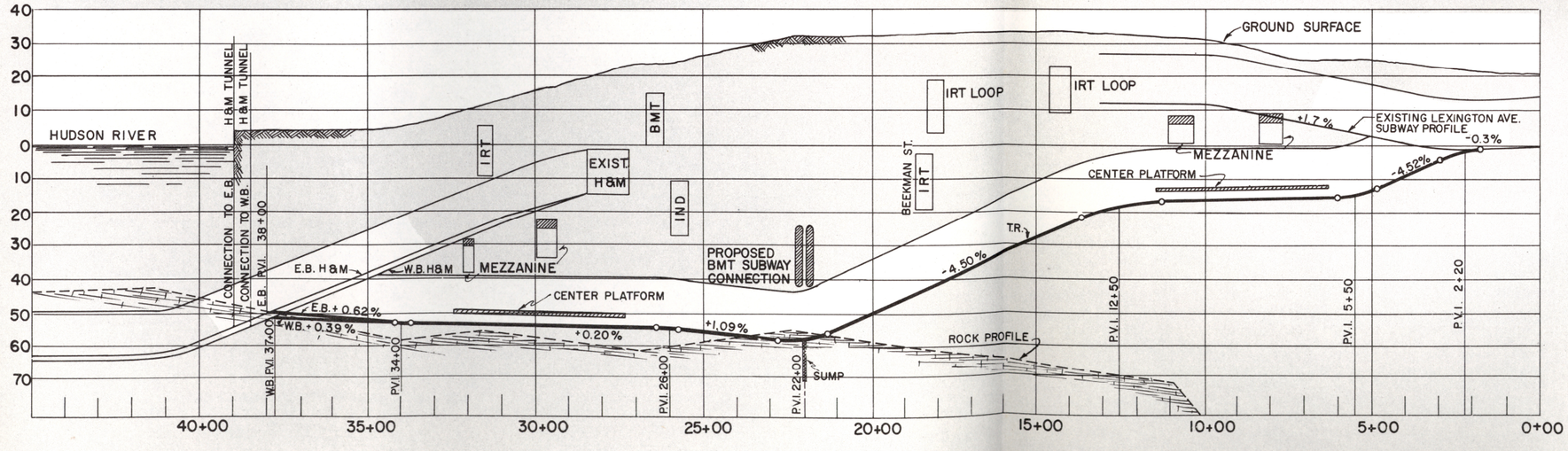
PLAN 4

CHARLES E. DE LEUW • CONSULTING ENGINEER

EXHIBIT 35



PLAN



PROFILE



SCALE

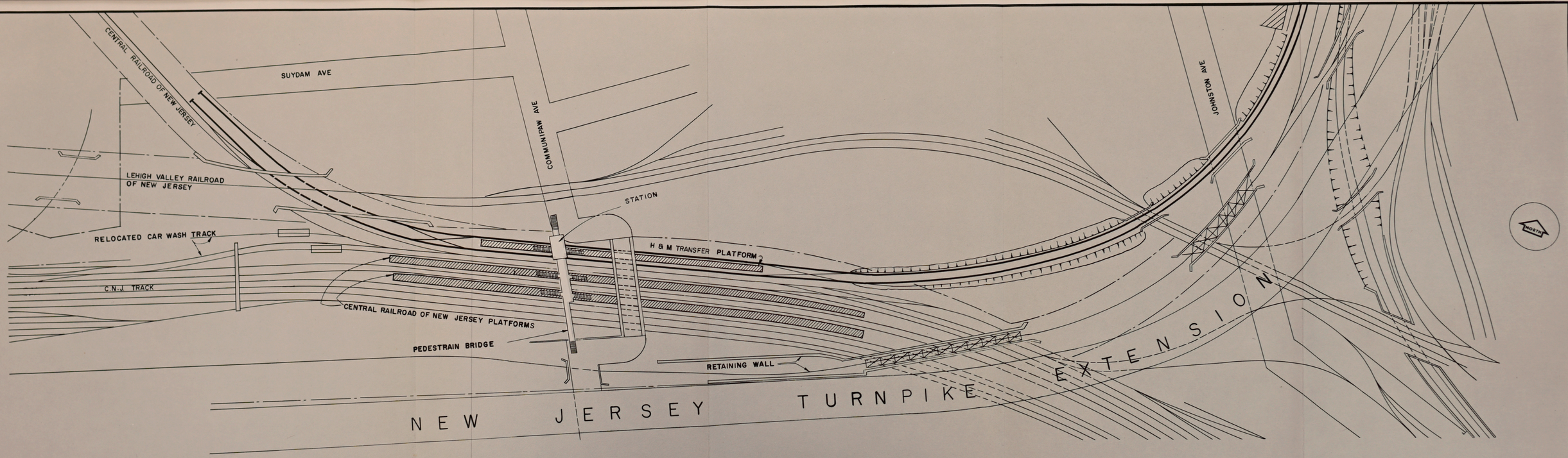
VERTICAL 0 10 20 40 60 FEET

HORIZONTAL 0 100 200 400 600 FEET

METROPOLITAN RAPID TRANSIT SURVEY

EXTENSION OF H&M TUBES TO IRT LEXINGTON AVENUE SUBWAY PLAN AND PROFILE

CHARLES E. DE LEUW · CONSULTING ENGINEER



PLAN

SCALE

0 50 100 200 300

FEET

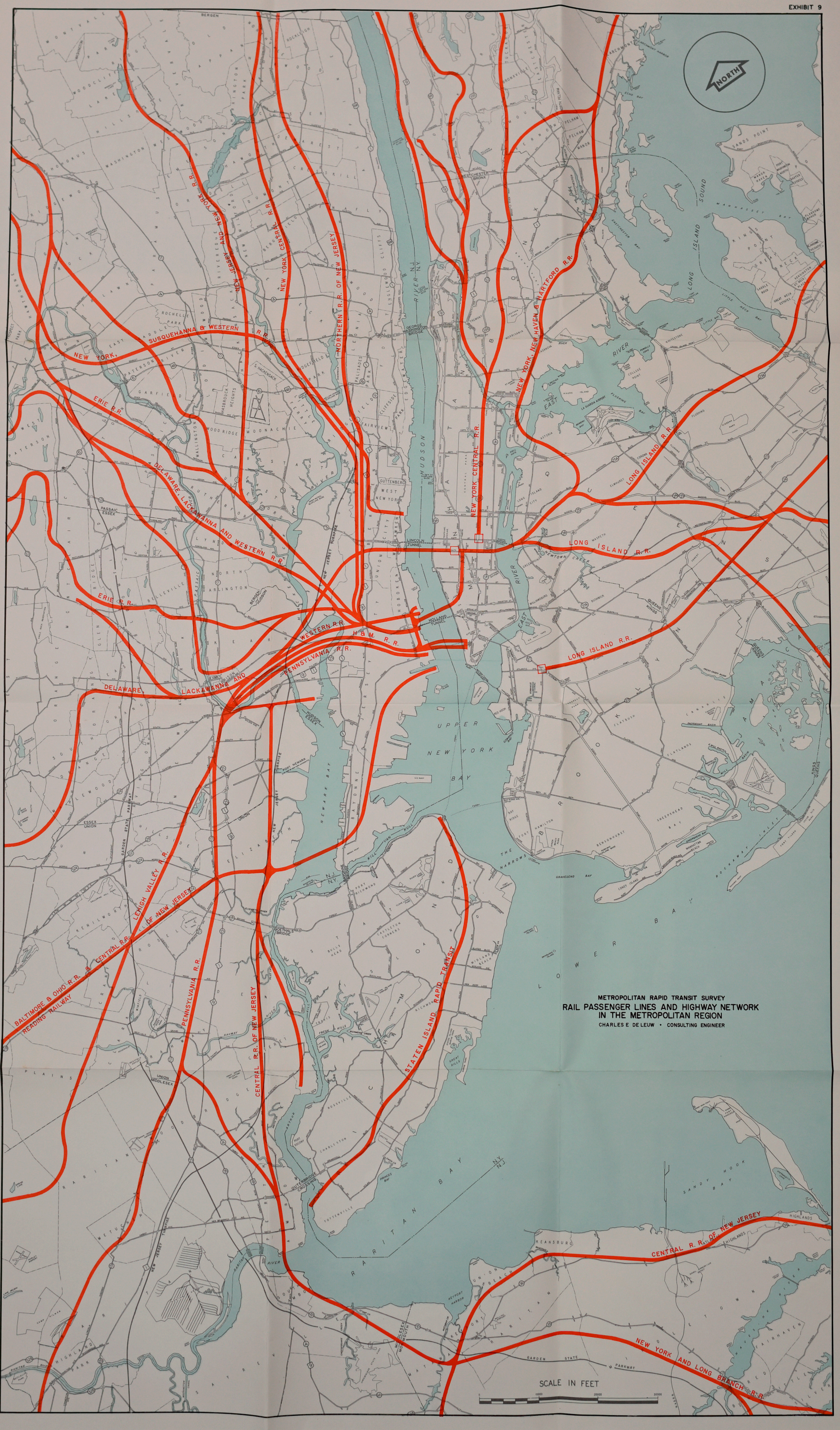
METROPOLITAN RAPID TRANSIT SURVEY

H & M - CNJ TRANSFER STATION AT COMMUNIPAW

PLAN VIEW

CHARLES E. DE LEUW - CONSULTING ENGINEER

EXHIBIT 9



METROPOLITAN RAPID TRANSIT SURVEY
RAIL PASSENGER LINES AND HIGHWAY NETWORK
IN THE METROPOLITAN REGION
CHARLES E DE LEUW • CONSULTING ENGINEER