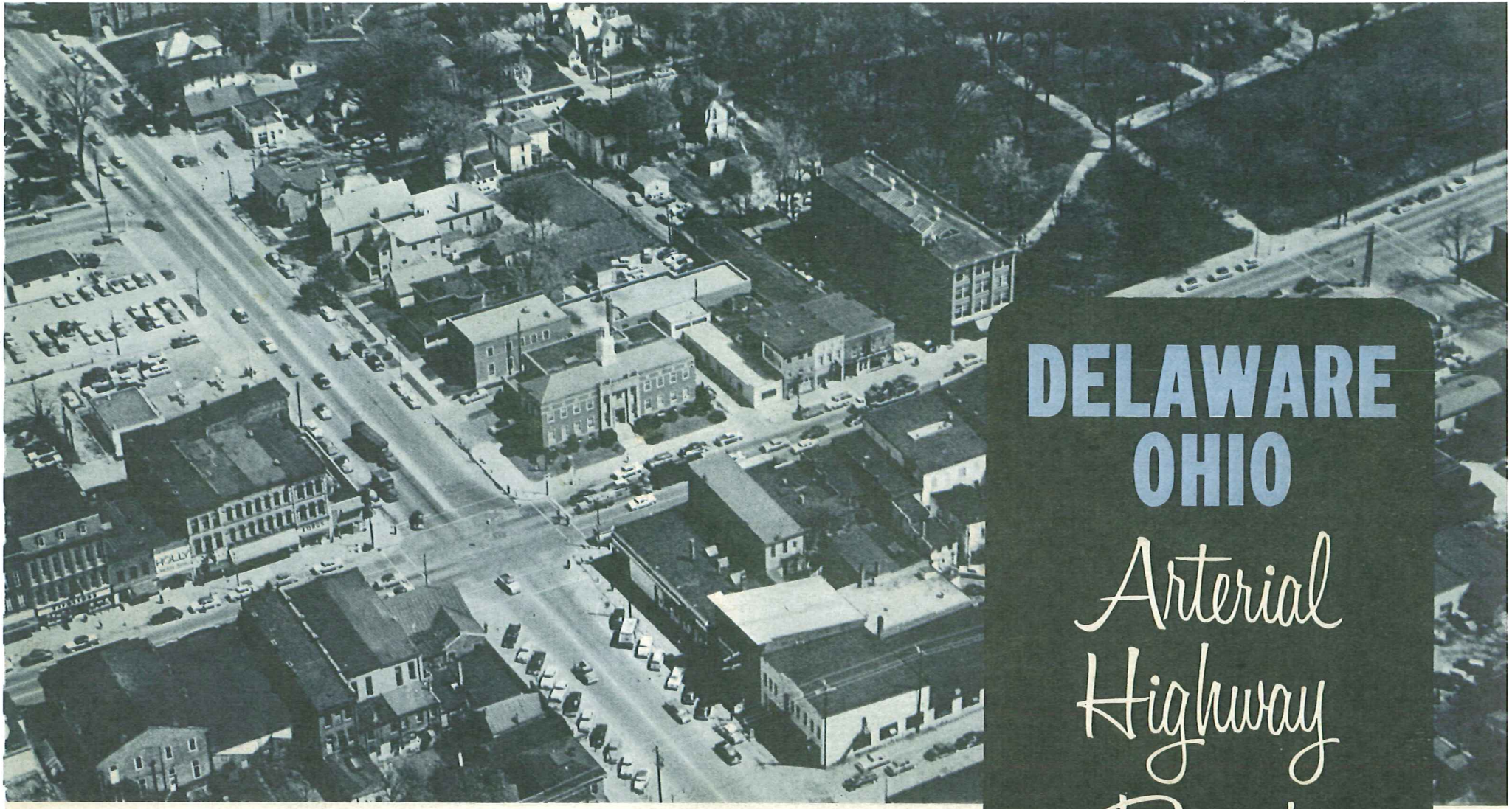


DELAWARE OHIO

Arterial Highway Report

1959

BURGESS & NIPLE CONSULTING ENGINEERS • COLUMBUS, OHIO

FOUNDED 1912 BY
PHILIP BURGESS & CHESTER A. NIPLE
CLAYTON C. BULL, SPECIAL ASSOCIATE

PARTNERS
BEN K. BARE
RAYMOND FULLER
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BURGESS & NIPLE
CIVIL AND SANITARY ENGINEERS
2015 WEST FIFTH AVENUE
COLUMBUS 12, OHIO

WATERWORKS
SEWERAGE
HIGHWAYS
AIRPORTS
INDUSTRIAL WASTES
VALUATIONS
PLANT OPERATION

HUDSON 8-9748

April 1, 1959

Honorable Mayor and Council
City of Delaware
Delaware, Ohio

Gentlemen:

Presented herein is the Arterial Highway Report of Delaware, Ohio. All comments, revisions and additions made subsequent to the submission of the preliminary report of last July have been incorporated in this final form of the report. It is submitted in accordance with the agreement dated April 26, 1958 between the City of Delaware and Burgess & Niple.

The recommended plan was selected after investigation of several probable routes through and around the City of Delaware. It proved to be the most economical of the several routes studied and of all the plans considered provides the best service to both through and local traffic. The City of Delaware is indeed fortunate to have feasible such a centrally located route which will serve both as a through highway and as a business district by-pass.

The relocation of the existing state highways recommended in this report will, by its primary purpose of moving heavy volumes of traffic at moderate speeds through and around the Delaware urban area, remove from your streets a substantial volume of traffic foreign to the economic needs of the city. The central location of the plan will provide excellent access to areas both east and west of the Olentangy River and should stimulate a healthy growth pattern for your city. Any system of arterial highways that will remove the through traffic from the streets of the business district and thus create more road room and more parking space for the shopper will stimulate business within the city. Apparently the increased ease in access to the business district and reduced interference in driving and parking produces greater and more frequent usage of the downtown retail area.

Our traffic studies indicate that in approximately five years time the main intersections of your city will be loaded beyond their possible capacity unless additional facilities to separate the through traffic from the local traffic are provided. The people of the City of Delaware will be obliged to pay for this situation either indirectly through loss of business in the retail area and by increased travel time and accident rates or directly by sharing in the cost of the construction of the new facilities required.

We wish to take this opportunity to express our appreciation to Mayor Paul White and the Members of the City Council, and to Mr. Roger Stilwell, City Manager, and Mr. Donald E. Mackley, Director of Public Works, for their fine assistance and cooperation in the preparation of this report.

Yours very truly,

BURGESS & NIPLE

Ben K. Bare

Ben K. Bare

A Preliminary Engineering Report

ARTERIAL HIGHWAY REPORT OF DELAWARE, OHIO

Prepared for

THE CITY OF DELAWARE, OHIO

by

BURGESS & NIPLE
CONSULTING ENGINEERS
COLUMBUS, OHIO

1959

1959

CITY OF DELAWARE, OHIO
CITY OFFICIALS

Paul B. White	Mayor
Donald Mathews	Vice-Mayor

Members of Council

Paul B. White	Councilman-at-large	Robert W. Meyer	Councilman 1st Ward
Robert E. Holmes	Councilman-at-large	Fred G. Burke	Councilman 2nd Ward
Donald Mathews	Councilman-at-large	Kenneth L. Knight	Councilman 3rd Ward
	Woodrow E. Bargdill	Councilman 4th Ward	

City Staff

Roger W. Stilwell	City Manager
Donald E. Mackley	Director of Public Works
Kenneth R. Bachtel	Director of Finance
Andrew J. Burrows	City Attorney
Russell E. Bayliff	Clerk of Council

OHIO DEPARTMENT OF HIGHWAY OFFICIALS

E. S. Preston
Director of Highways

E. L. Sheley
Deputy Director, Division 6

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DEFINITION OF TERMS

Highway, Street or Road — A general term denoting a public way for vehicular traffic within a designated right-of-way. This classification is divided into two major systems, arterial highways and feeder, or local streets.

Arterial Highways — A general term used for highways or streets carrying through traffic. This system is further classified into major streets and expressways.

Major Street — An arterial street having intersections at grade and direct access to abuting properties, but so designed to give preference to through traffic.

Expressway — Generally a divided arterial highway with full or partial control of access. Further classified into freeways and expressways-at-grade.

Freeway — An expressway with full control of access and all cross streets grade separated or terminated.

Expressway-at-grade — An expressway at or near grade with partial control of access and with at-grade intersections with the principle cross streets.

Interchange — A system of highway ramps connecting an expressway with a cross street, which provides for the interchange of traffic between the expressway and cross street without at-grade crossings on the expressway.

Trip — A one way journey by a motor vehicle between two points.

Through Traffic — Trips through the Delaware corporate area, with both origin and destination outside the area.

GENERAL SECTION

AUTHORIZATION

This report has been prepared in accordance with a contract dated April 26, 1958 between the City of Delaware, Ohio and Burgess & Niple, Consulting Engineers, Columbus, Ohio. The contract is entitled "Agreement for Engineering Services for the Preparation of an Engineering Report for a System of Arterial Highways and Principal Streets for the City of Delaware, Ohio."

SCOPE OF THIS REPORT

This report will present a plan for an arterial highway system for the City of Delaware, Ohio as outlined in the contract. Sections of the contract have been extracted and are reproduced as follows;

WHEREAS, The City desires to have prepared a preliminary engineering report determining an integrated system of arterial highways and principal streets, including any necessary railroad grade crossing eliminations for the metropolitan area of the City of Delaware, Delaware County, Ohio, and,

WHEREAS, The CONSULTANT is willing to provide the said services for the consideration and upon the terms hereinafter mentioned,

SECTION 3. The CONSULTANT in the preparation of the report shall:

(a) Give consideration to:

(1) The physical layout and makeup of the City of Delaware, Ohio and adjacent metropolitan territory, anticipated growth, topography, mass transportation provisions, available traffic records and data, parking conditions and anticipated highway usage over a reasonable period of years, all in accordance with accepted practice for the utilization of such information.

(2) Location, grade and geometrics of a limited access or expressway type of highway for U.S. Rt. 23 and U.S. Rt. 42 through or around the CITY and for other important State highways and principal streets as need may indicate or require.

(b) As a result of such consideration:

(1) Enumerate the possibilities for freeway or limited access types of highways, including railroad-highway grade crossing eliminations, bridge reconstructions, new arterial streets, major street extensions, connections, widenings, bridge construction or reconstruction and other highway changes in and adjacent to the CITY to facilitate the movement of highway traffic in, through or around the CITY.

(2) Make preliminary layouts, approximate profiles and typical cross-sections from available topographic and other maps and from control elevations, for any new streets, expressways, freeways, grade separations both highway and railroad, traffic in-

terchanges and bridges. Such layouts and profiles shall show locations and scale layouts of recommended at-grade street intersections and/or traffic interchanges with profiles indicating approximate grades, including such alternate locations and arrangements of street intersections and traffic interchanges both inside and outside of the CITY, as should receive consideration.

(c) Make recommendations, in order of priority, of need for improvements in the City of Delaware, Ohio with substantiating data of traffic service and cost. Substantiating data shall include traffic analysis, schematic layouts, profiles and typical proposed cross-sections, in sufficient detail to be readily checked for soundness of recommendations and feasibility of construction. Twelve copies of the data set forth in subsections (b) and (c) hereof, as proposed to be included in this report, shall be submitted to the CITY for review.

SECTION 6. The CONSULTANT shall start work on the report within 10 days after written authorization from the CITY to start work.

The CONSULTANT shall complete the work and submissions for the report covered in SECTION 3, subsections (a), (b), and (c) no later than the 10th day of July, 1958.

GENERAL INFORMATION

The City of Delaware is the county seat and the largest city in Delaware County. It is located on the Olentangy River and covers an area of approximately four square miles. The estimated population in 1957 was 14,500 and Delaware County population was estimated at 35,000. Delaware, Ohio is located near the geographical center of the state and is 25 miles north of Columbus, 125 miles southwest of Cleveland, 110 miles south of Toledo and 120 miles northeast of Cincinnati. Three railroads serve the city; they are The New York Central Railroad, The Pennsylvania Railroad, and The Chesapeake and Ohio Railroad. Two motor freight lines maintain terminals in Delaware and several small independent hauling contractors also serve the area.

The Village of Delaware was formed in 1808, and incorporated in 1816. Authorization to form a town council of eight members was granted by the State of Ohio in 1849. The present form of government is the charter system with a council and city manager. There are seven councilmen; three are elected at-large and the others from each of the four wards. The city has a planning commission.

In the past the economy has been primarily agricultural, except for a substantial employment by the railroads in the early part of the present century. There were numerous small factories and business establishments such as tanneries, flour mills, harness making and cigar factories, all generally based on the farm economy of the surrounding area. These have been abandoned in the last thirty years due to improved transportation and the changing economy.

There are presently about twenty manufacturing concerns in and near the city which produce a wide variety of finished materials such as truck bodies, thermostatic controls, precision pumps and valves, cranes, bricks, chemicals, stoves, limestone, iron castings, caskets, canvas products and presses. The agricultural produce amounts to about nine million dollars annually.

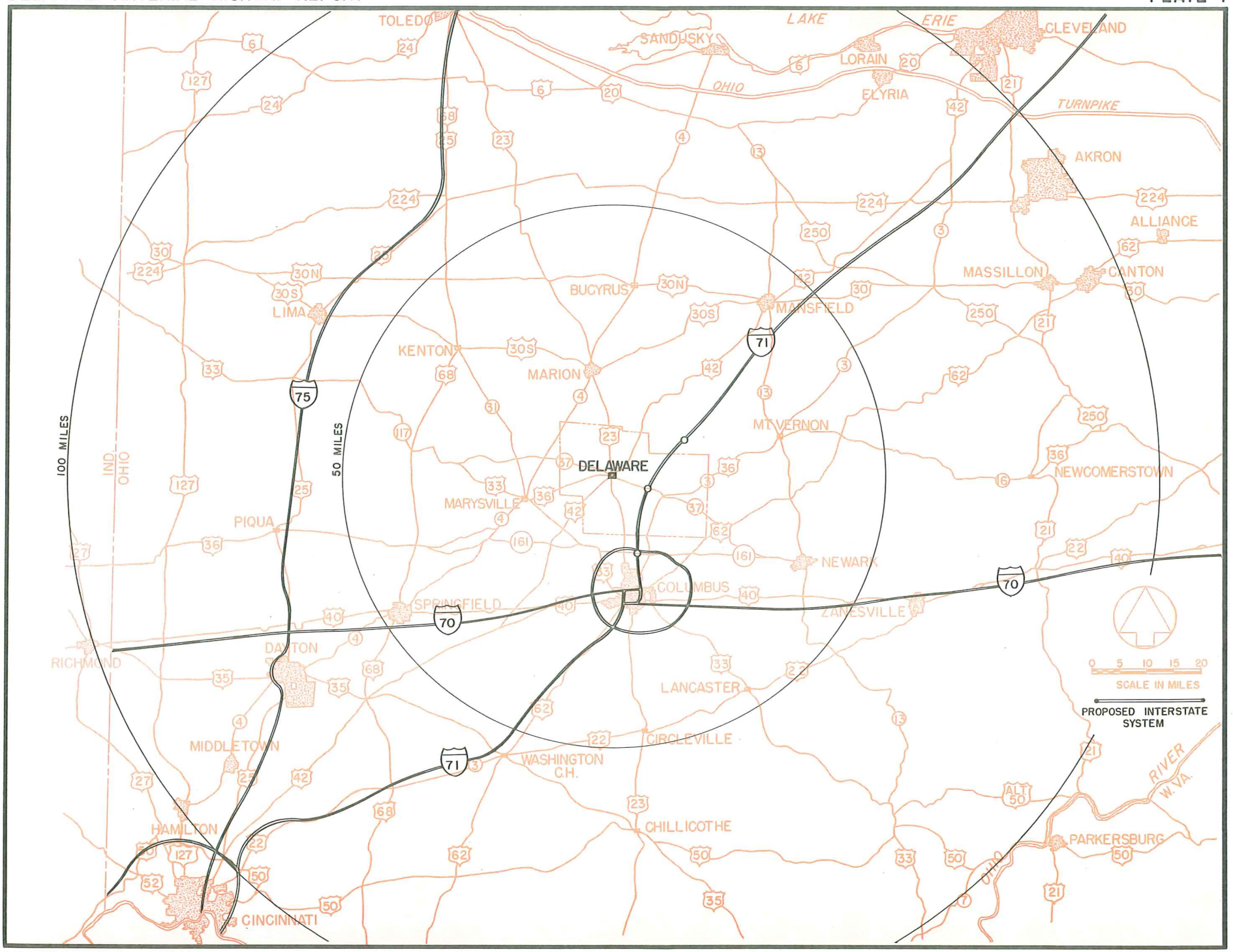
A major factor in the life of the city is Ohio Wesleyan University. It was founded in 1842 and presently has a student enrollment of 2200 and a staff of about 300 people.

There are two hospitals within the city with a total capacity of 105 beds and a million dollar addition to one is now being constructed.

The city owns and operates the municipal water and sewerage systems. Natural gas is supplied by the Ohio Fuel Gas Company through a local distributing company. The Columbus and Southern Ohio Electric Company and The Northern Ohio Telephone Company complete the list of utilities. There are five public schools, including one senior and one junior high school and one parochial school.

DELAWARE ARTERIAL HIGHWAY REPORT

PLATE I



BURGESS AND NIPLE

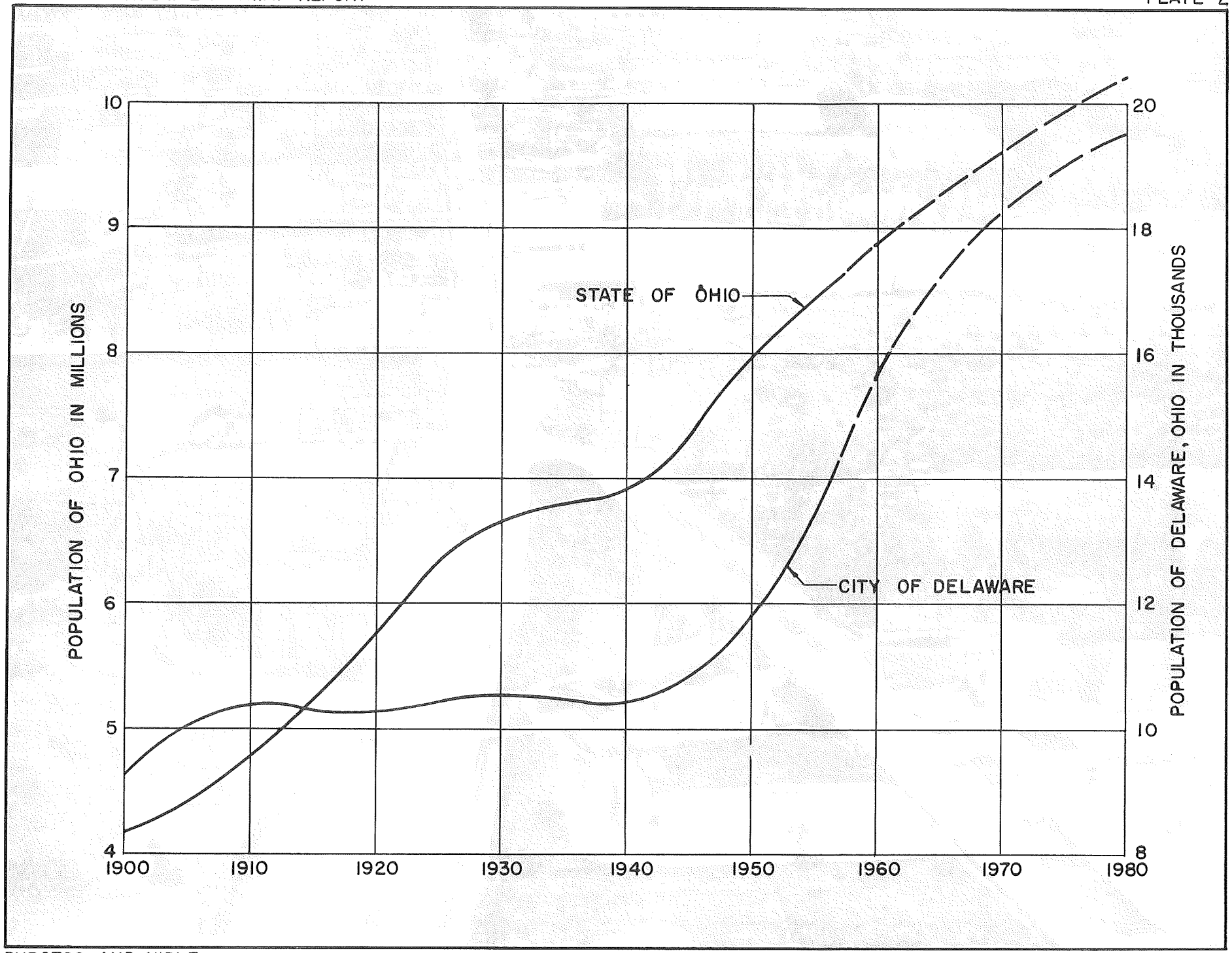
VICINITY MAP

POPULATION GROWTH

The growth of the urban population of Delaware, Ohio will have a marked effect on future traffic within or through the city, and is an important factor in determining traffic for the design year.

The present population of the City of Delaware, Ohio is approximately 14,500 people, including the 2,200 students at Ohio Wesleyan University. During the first four decades of this century, the population of Delaware was almost stationary, but beginning with World War II and to the present time the population has been increasing at a faster rate than the State of Ohio. With the development of an express highway system in nearby Franklin County, the City of Delaware may become a suburban residential community of the Columbus area and a continuous steady growth for the city is predicted.

By 1980, the design year used in this report, it is estimated that the total population of the City of Delaware should be nearly twenty-thousand people.


POPULATION OF OHIO IN MILLIONS
POPULATION OF DELAWARE, OHIO IN THOUSANDS
STATE OF OHIO
CITY OF DELAWARE
10
9
8
7
6
5
4
20
18
16
14
12
10
8
1900
1910
1920
1930
1940
1950
1960
1970
1980

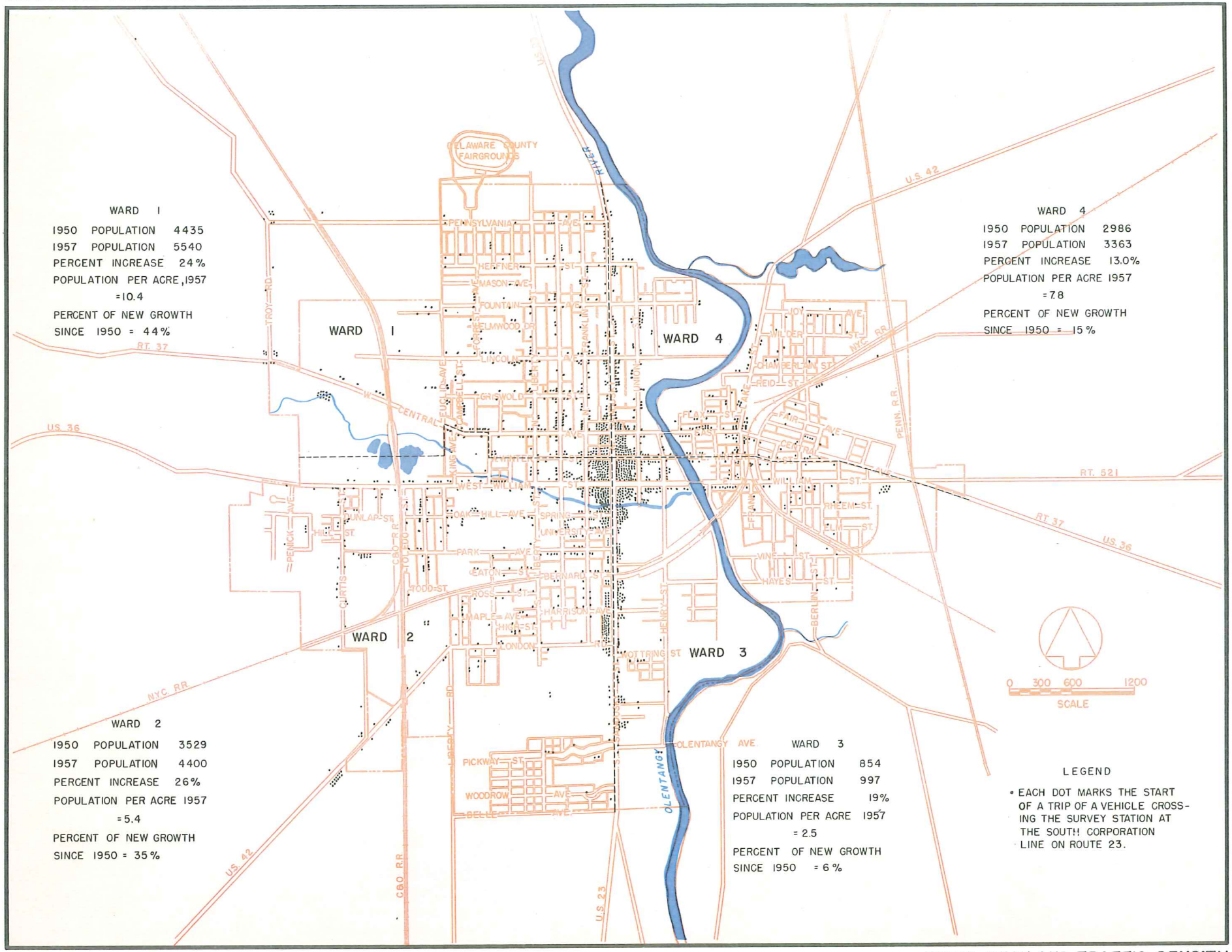
POPULATION DENSITY

In preparing a master plan for future streets and arterial highways for a city, the direction of future growth of the city is an important factor in the determination of the proposed system. The proposed streets and highways should be so located as to encourage and help this growth, rather than act as barriers to it.

Delaware is presently divided into four wards, with each ward forming one quadrant of the city. About eighty per cent of the population growth since 1950 has occurred in the first and second wards, which comprise the western half of the city. There are several topographic features which discourage expansion eastward. The Olentangy River prevents growth in Ward Three, the southeastern quadrant, by preventing easy expansion of the road net and water and sewer facilities. The several railroads in this part of the city further hinder growth and extension of the road net.

In the western wards, the city has now crossed the one north-south railroad in the area and future expansion westward and to the northwest and southwest can be made with no physical obstacles apparent. There are also large areas north and south of the city and west of the Olentangy River that can be easily developed.

With no serious obstacles west of the Olentangy River, it is reasonable to assume that the major portion of the future growth of the city will take place in this area. Consideration will be given to the development of a future arterial street system to assist in the orderly development of this area. It is evident that a need for a north-south arterial street west of the C & O Railroad already exists.

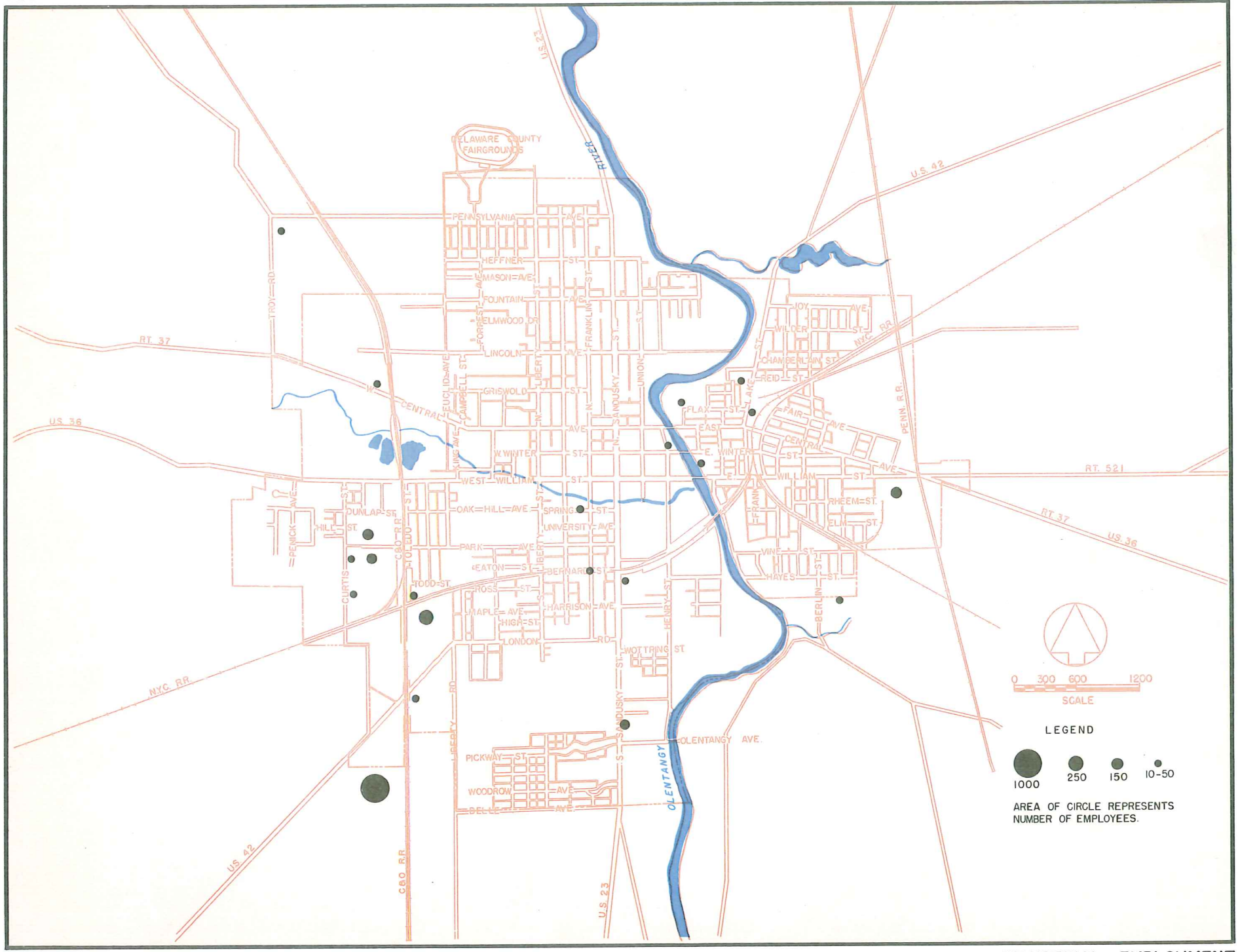

WARD 1
1950 POPULATION 4435
1957 POPULATION 5540
PERCENT INCREASE 24%
POPULATION PER ACRE, 1957 =10.4
PERCENT OF NEW GROWTH SINCE 1950 = 44%
WARD 4
1950 POPULATION 2986
1957 POPULATION 3363
PERCENT INCREASE 13.0%
POPULATION PER ACRE 1957 =7.8
PERCENT OF NEW GROWTH SINCE 1950 = 15%
WARD 2
1950 POPULATION 3529
1957 POPULATION 4400
PERCENT INCREASE 26%
POPULATION PER ACRE 1957 =5.4
PERCENT OF NEW GROWTH SINCE 1950 = 35%
WARD 3
1950 POPULATION 854
1957 POPULATION 997
PERCENT INCREASE 19%
POPULATION PER ACRE 1957 =2.5
PERCENT OF NEW GROWTH SINCE 1950 = 6%
LEGEND
• EACH DOT MARKS THE START OF A TRIP OF A VEHICLE CROSSING THE SURVEY STATION AT THE SOUTH CORPORATION LINE ON ROUTE 23.
0 300 600 1200
SCALE
DELAWARE COUNTY FAIRGROUNDS
WARD 1
WARD 2
WARD 3
WARD 4
OLENTANGY RIVER
OLENTANGY
COLENTANGY AVE
PENNSYLVANIA AVE
HERTNER ST
MASON AVE
FOUNTAIN AVE
HELMWOOD DR
LINCOLN AVE
GRISWOLD ST
EUCLID AVE
WEST PHILLIPPI ST
OAK HILL AVE
SPRING ST
UNION ST
PARK AVE
EATON ST
ROSS ST
MAPLE AVE
HIGH ST
LONDON ST
TODD ST
DUNLAP ST
HILL ST
PENICK AVE
CURTIS ST
HENRY ST
BERLIN ST
MOTTRING ST
PICKWAY ST
WOODROW AVE
BELLE AVE
LIBERTY RD
TROY RD
JOY AVE
WILDER ST
CHAMBERLAIN ST
REID ST
FLAT ST
FAIR AVE
CENTRAL AVE
WILLIAM ST
RHEEM ST
VINE ST
HAYES ST
PENN. R.R.
N.Y.C. RR
C&O. RR
RT. 37
US. 36
US. 42
US. 23
RT. 521

INDUSTRIAL EMPLOYMENT

The majority of trips during peak hours of travel, and those for which most arterial highways and streets must be designed, are home-to-work trips. Plate 4 presents visually the industrial employment concentrations in and near the City of Delaware. The employment plotted represents nearly two thousand employees working at about twenty different locations. The predominate concentration of new firms is in the south-west section of the city. This area is well served by highways, streets, railroads and the necessary utilities. It has clear and level topographic features that can be readily developed as future plant sites.

The present industrial firms located in the city produce a wide variety of products and provide a firm industrial base for future expansion.

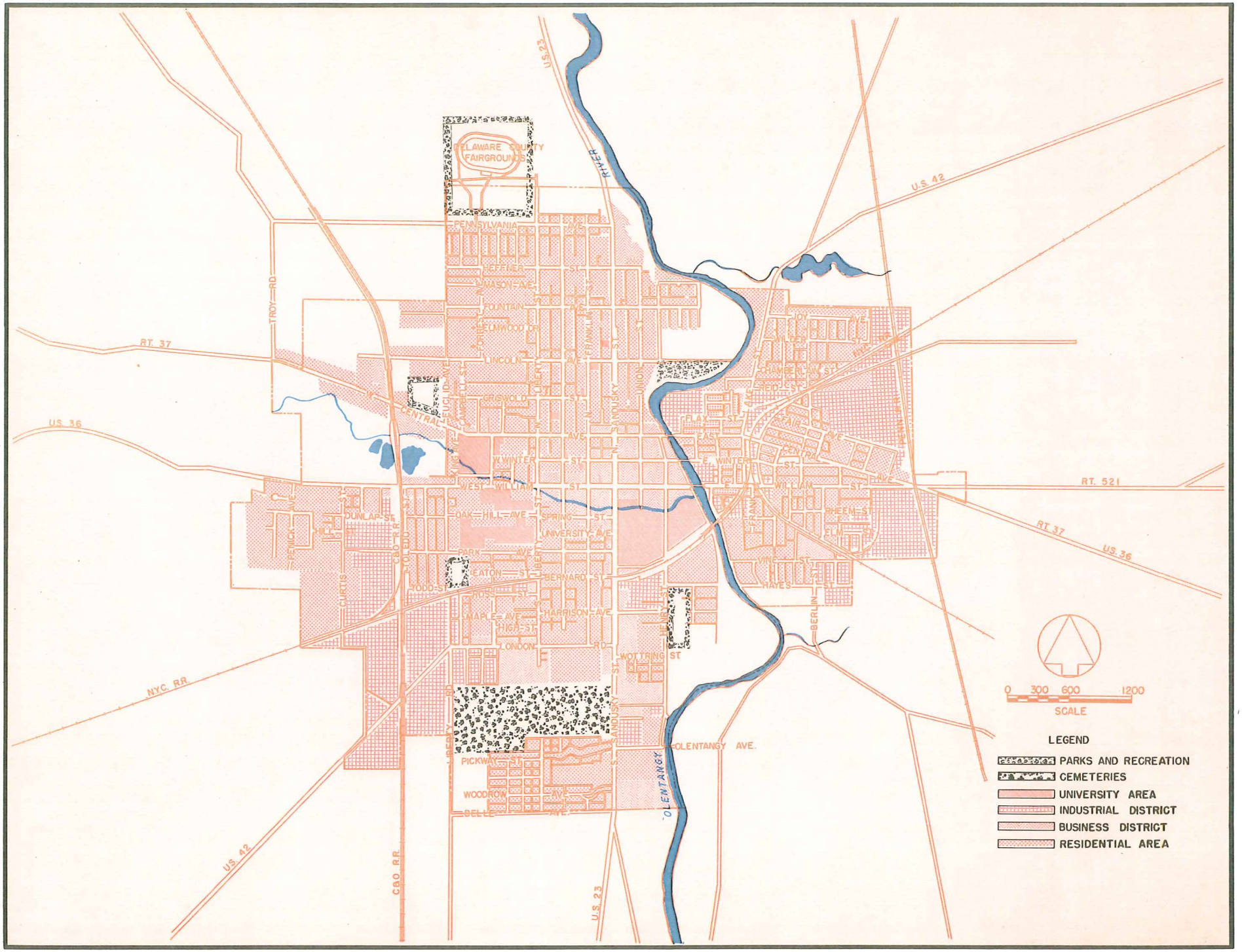
An inspection of the trip origin addresses plotted on Plate 3 reveals a considerable employment at these plants of people living outside the city. It also indicates, by the heavy concentration of trip origins in the downtown business area, that Delaware is serving as the shopping center for the surrounding county. As far as external-internal traffic is concerned, the need is far greater to get people to the shopping area of the city than to the industrial area. Any system of arterial highways that will remove the through traffic from the streets in the business district and make more road room and parking space for the shopper will stimulate business in the city.


DELAWARE COUNTY FAIRGROUNDS
PENNSYLVANIA AVE.
HEFFNER ST.
MASON AVE.
FOUNTAIN AVE.
ELMWOOD DR.
LINCOLN AVE.
GRISWOLD ST.
W. CENTRAL AVE.
W. WINTER ST.
WEST WILLIAM ST.
OAK HILL AVE.
PARK AVE.
EATON ST.
TODD ST.
CROSS ST.
MAPLE AVE.
HIGH ST.
LONDON RD.
SPRING ST.
UNIVERSITY AVE.
BERNARD ST.
HARRISON AVE.
WOTTRING ST.
OLENTANGY AVE.
PICKWAY ST.
WOODROW AVE.
BELLE AVE.
JOY AVE.
WILDER ST.
CHAMBERLAIN ST.
REID ST.
FLAX ST.
EAST FAIR AVE.
CENTRAL AVE.
E. WINTER ST.
WILLIAM ST.
RHEEM ST.
ELM ST.
VINE ST.
HAYES ST.
DUNLAP ST.
HILL ST.
PENWICK AVE.
CURTIS ST.
TROY RD.
RT. 37
US. 36
US. 42
US. 23
RT. 521
N.Y.C. R.R.
PENN. R.R.
C&O R.R.
TOLEDO
LIBERTY RD.
SANDUSKY ST.
HENRY ST.
BERLIN ST.
OLENTANGY RIVER
0 300 600 1200
SCALE
LEGEND
1000
250
150
10-50
AREA OF CIRCLE REPRESENTS NUMBER OF EMPLOYEES.

LAND USE AND ZONING

Plate 5 shows present land use and zoning within the city. The central business district occupies an area of about ten blocks just north of the Ohio Wesleyan University and west of the Olentangy River. The University grounds covers a band through Delaware from the river westward. There are small business areas fronting on Sandusky Street (U.S. 23) and these spot areas will probably increase.

The industrial area in the southwest section is the site for most of the new industries and there are additional large industrial areas along the eastern edge of the city. The residential area in the northern and western sections are not restricted by other zoning that would hinder their further outward growth.


DELAWARE COUNTY FAIRGROUNDS
PENNSYLVANIA AVE.
JEFFERSON AVE.
MASON-AVE.
FOUNTAIN
ELMWOOD DR.
LINCOLN
FRANKLIN ST.
ROBERT ST.
UNION ST.
JOY AVE.
MAIN ST.
FLAX ST.
FAIR AVE.
CENTRAL AVE.
WINTER ST.
WILLIAM ST.
PHEEM ST.
ELM ST.
VINE ST.
HAYES ST.
BERLIN ST.
HENRY ST.
WEST WILLIAM ST.
OAK-HILL-AVE.
SPRING ST.
UNIVERSITY AVE.
PARK AVE.
EATON ST.
BERNARD ST.
TODD ST.
MAPLE AVE.
HIGH ST.
HARRISON AVE.
LONDON RD.
WOTTRING ST.
LINDSEY ST.
SANDUSKY ST.
OLENTANGY AVE.
PICKWAY ST.
WOODROW AVE.
BELLE AVE.
DUNLAP ST.
CURTIS ST.
LIBERTY RD.
TROY-RD.
EUCLID AVE.
CAMBRIDGE ST.
KING AVE.
RT. 37
US. 36
US. 42
US. 23
RT. 521
NYC. RR.
C&O. R.R.
TOLEDO
RIVER
OLENTANGY
0 300 600 1200
SCALE
LEGEND
PARKS AND RECREATION
CEMETERIES
UNIVERSITY AREA
INDUSTRIAL DISTRICT
BUSINESS DISTRICT
RESIDENTIAL AREA

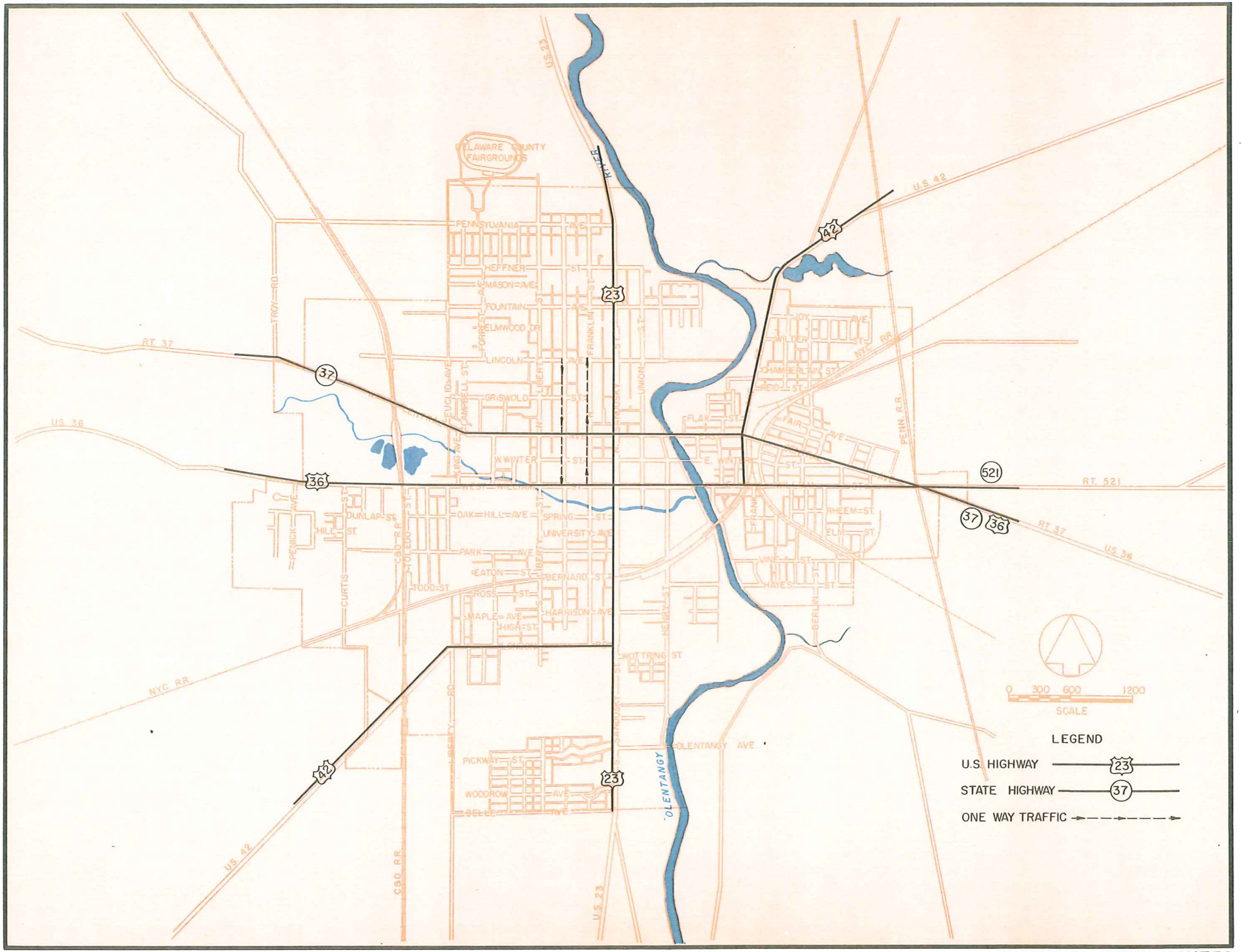
PRESENT HIGHWAYS AND TRAFFIC CONDITIONS

There are presently four numbered state highways routed through Delaware, Ohio. These are U.S. Routes 23, 36 and 42 and State Route 37. Plate 6 shows their location in the city. State Route 521 starts at the east corporation line and extends to the northeast.

Routes 23, 36 and 42 are all parts of the Federal Aid Primary System. Route 23 is presently the main route from Columbus to the Toledo, Sandusky, and Detroit area. Route 42 is one of the principal south-west to north-east routes through the State. Routes 23 and 42 have a common location in Delaware on Sandusky Street from London Road north to William Street. Route 36 is located on William Street throughout. This arrangement causes about 90% of the through traffic and a large percentage of the local traffic to pass through the Sandusky Street – William Street intersection. There is no apparent way of avoiding this routing using the existing street system. William Street has the only four lane bridge crossing the Olentangy River and it must therefore be used by Routes 42 and 36. Both Routes 23 and 42 have been improved at and near this intersection to their full right-of-way widths including reasonable sidewalks for the business area. There are three north-south streets west of Sandusky Street that might be used to carry Route 42 traffic and remove some left-turn movements from the Sandusky-William intersection. However, these streets extend through a residential section and measures such as widening or no parking bans would be necessary if such a re-routing were attempted. The very heavy truck traffic on Route 42 makes any such re-routing very undesirable.

There are some one-way streets west of Sandusky Street and north of William Street which do increase the flow of local traffic. However, this helps through traffic only indirectly.

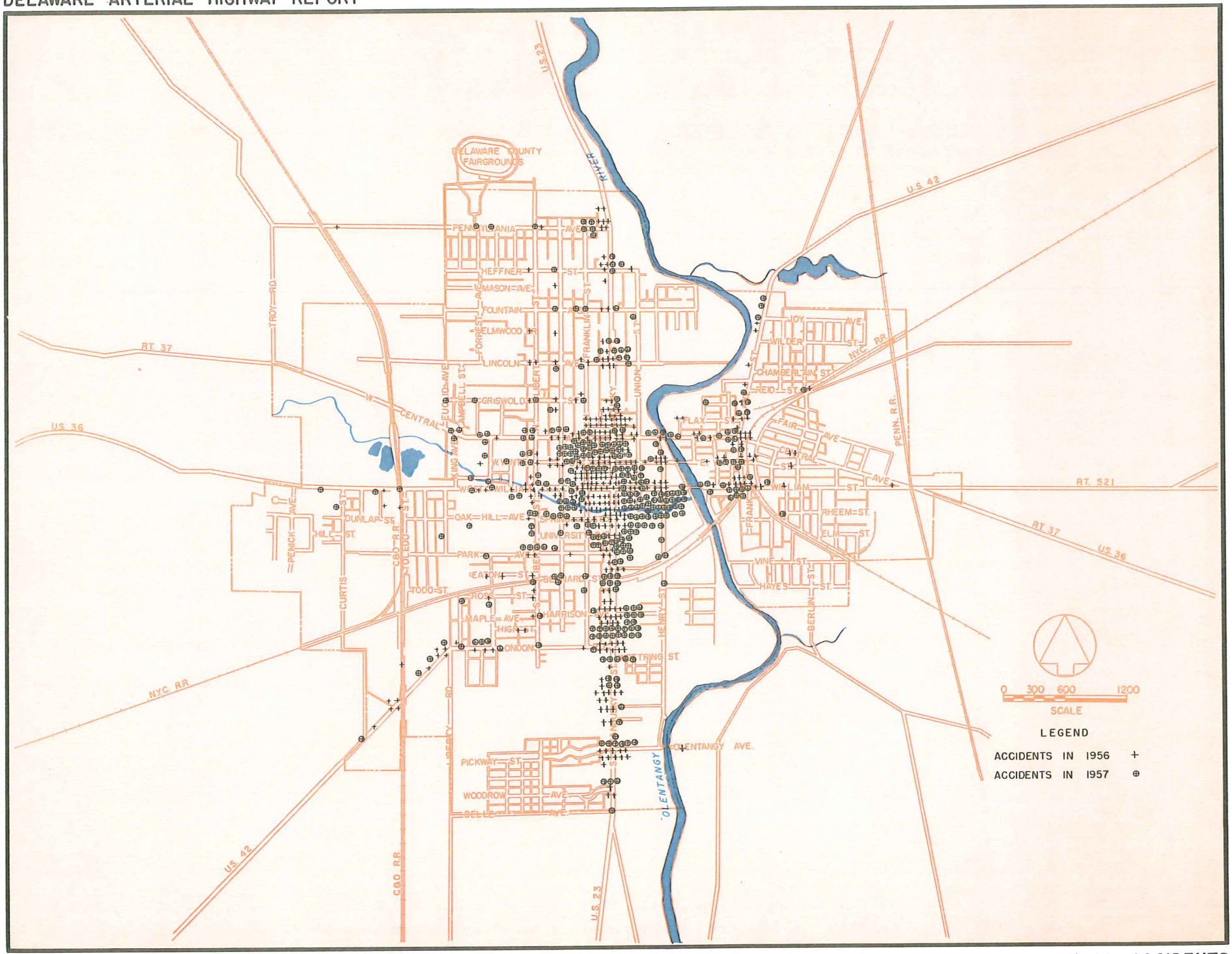
Traffic on Route 23 is and will continue to be predominantly through traffic. This traffic will increase more in proportion to the growth of the Columbus Urban Area than the City of Delaware. Presently the worst traffic congestion occurs during the week end and reaches its peak on Sunday evenings during the summer months when recreational traffic from the Lake Erie area is returning to Columbus. At such times traffic is backed up solidly for several blocks north and east of the Sandusky-William Street intersection.


DELAWARE COUNTY FAIRGROUNDS
U.S. 23
U.S. 42
RT. 37
U.S. 36
RT. 521
NYC RR
C&O RR
PENN. R.R.
OLENTANGY
PENNSYLVANIA AVE
HEFFNER ST
MASON AVE
FOUNTAIN AVE
ELMWOOD DR
LINCOLN AVE
GRISWOLD ST
WINTER ST
WEST WILLIAM ST
OAK HILL AVE
SPRING ST
UNIVERSITY AVE
PARK AVE
EATON ST
BERNARD ST
TODD ST
ROSS ST
MAPLE AVE
HIGH ST
HARRISON AVE
WOOSTER ST
PICKWAY ST
WOODROW AVE
DELLE AVE
COLENTANGY AVE
WOLFRAM ST
RHEEM ST
VINE ST
HAYES ST
FAIR AVE
FLAX ST
REID ST
CHAMBERLAIN ST
WILDER ST
JOY AVE
TROY RD
LIBERTY RD
DUNLAP ST
HILL ST
CURTIS
PENNICK AVE
0 300 600 1200
SCALE
LEGEND
U.S. HIGHWAY
STATE HIGHWAY
ONE WAY TRAFFIC

TRAFFIC ACCIDENTS

The location of all accidents involving motor vehicles occurring in 1956 and 1957 has been plotted on Plate 7. Accidents were so numerous along Sandusky Street (Route 23) that the actual plotted points could not all be plotted along the street and are spread over the adjacent block. The Sandusky Street-William Street intersection is logically the worst site for accidents.

Several causes for all of these accidents are apparent. Among these are numerous access points within blocks discharging large volumes of traffic from business establishments, very heavy traffic at several of the intersections, and an unusually high percentage of truck traffic. The growth of businesses along Sandusky Street which cater to the driving public, such as drive-in restaurants and super markets, have all contributed and will continue to cause accidents along this street.



BURGESS AND NIPLE

VEHICULAR ACCIDENTS

MOTOR VEHICLE REGISTRATION

Plate 8 shows the past, present and projected future motor vehicle registration for Delaware and the State of Ohio. It is estimated that by 1980 there will be approximately eight thousand motor vehicles registered in the city. Future motor vehicle registration will continue to be affected by the presence of Ohio Wesleyan University. University students at present comprise almost twenty per cent of the population of the city but only ten per cent of them have cars. The University will probably continue its present policy on restricting the ownership and use of vehicles by its students, so that the normal ratio of population/vehicles will not be obtained here.

SOIL CONDITIONS

Bed rock underlying the City of Delaware is limestone. The stream bed of the Olentangy River south of William Street lies in this rock. Several quarrying operations, past and present, are visible in and around the city. The high ground on each side of the river valley contains a strata of silt shale above the limestone and there is a surface layer of silty clay overlying these rock formations.

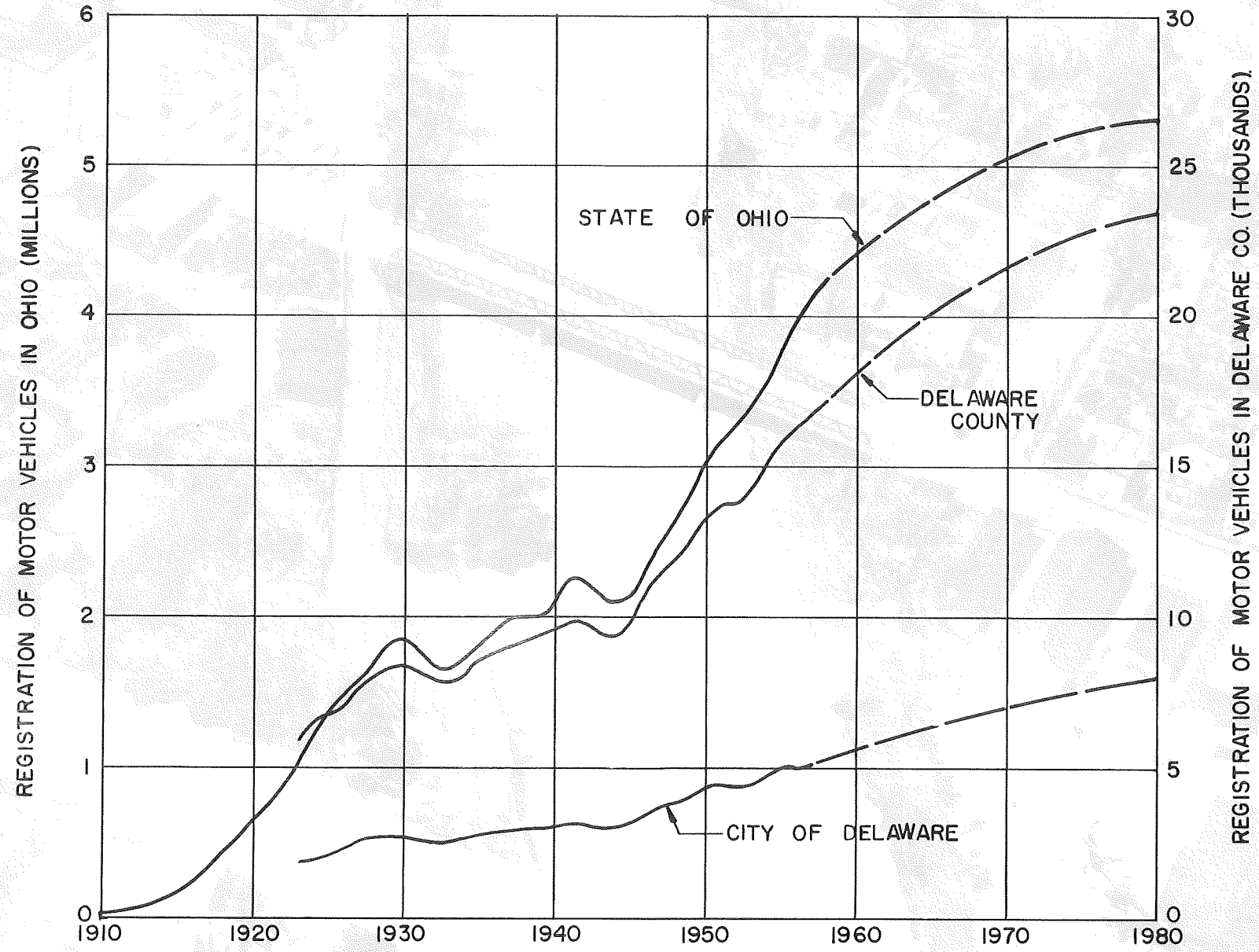
Along the banks of the Olentangy River are some spots where old dykes have caused swampy conditions, but since these spots are man-made they should be easily corrected in any highway construction. Other artificial formations such as trash fills of organic material may be encountered and be a minor cause of foundation trouble.

STREAM FLOW DATA

In 1913 a maximum flood occurred on the Olentangy River. Large sections of the City of Delaware were flooded by the over 40,000 s.f. flow produced at that time. Part of this flooding was caused by constrictions in the river channel existing at the various railroad and highway bridges. All of the bridges were destroyed in this flood. Flood waters reached a maximum elevation of 873.08 at the William Street bridge.

In 1947 the U. S. Corps of Engineers constructed a flood control dam on the Olentangy about four miles above the city. The dam will reduce a 1913 flood to approximately 9200 s.f. flow at William Street with a high water elevation of 858.5. This flow is produced by impounding all the flood waters in the reservoir, but with all control gates open and no free flow over the spillway. The new William Street bridge was designed with a water way opening for a 16,000 s.f. flood with a maximum high water at El. 863.5. This design is based on the Delaware Dam storage of flood waters.

In the design of any new highway along or across the river valley, profile grades should be held above the 16,000 s.f. flood level and any bridges should clear this elevation or its projection up or down the valley.


REGISTRATION OF MOTOR VEHICLES IN OHIO (MILLIONS)
REGISTRATION OF MOTOR VEHICLES IN DELAWARE CO. (THOUSANDS)
STATE OF OHIO
DELAWARE COUNTY
CITY OF DELAWARE
0
1
2
3
4
5
6
0
5
10
15
20
25
30
1910
1920
1930
1940
1950
1960
1970
1980

PROPOSED HIGHWAY IMPROVEMENTS

STATUS OF PLANNING ON STATE AND FEDERAL ROUTES IN THE VICINITY OF DELAWARE, OHIO

Route 23, the north-south route through Delaware, is gradually being improved to a four-lane divided lane highway its entire length across Ohio. From Portsmouth north to Delaware this has already been accomplished except for its length within Columbus and Chillicothe. North of Delaware Route 23 has been rebuilt as four lane divided north towards Waldo. The state has no particular timetable on completion of this improvement but is programming it as money becomes available. Most of the present four-lane construction has been built since 1953.

Route 42 connecting Cincinnati and Cleveland may function as a service road to the new Interstate Route 71 after the new road is completed. At the present time Route 42 is the principle connection between the two largest urban areas of the state. It is heavily overloaded with truck traffic. As various sections of the new Interstate System are completed, through traffic will gradually transfer to it from Route 42. This transition will occur over the next ten years and will not be completed until the Interstate System around and north and west of Columbus is finished. Route 42 may still be expected to carry a substantial amount of traffic and will be gradually improved with minor adjustments in line and grade.

Route 36-37 east of Delaware will become a feeder route to Interstate Route 71, with an interchange located about eight miles east of Delaware.

No new Interstate route will connect the Columbus urban area with Toledo, Detroit and the adjacent Lake Erie recreational area. However, with the completion of Interstate Route 75 between Toledo and Dayton, traffic between Columbus and Toledo will tend to use this route for part of the trip south of Toledo.

DESIGN CRITERIA

The relocation of Route 23 will be designed in accordance with present State of Ohio Standards applicable to the urban expressway. Although not designated part of the Interstate System, Route 23 serves as a principal connecting highway between the third and fourth largest cities in the state and will carry as much traffic as many sections of the Interstate System. Route 42 and any other connections will be constructed to adequate standards as required by the assigned traffic loads.

Design policies by the American Association of State Highway Officials for arterial highways in both rural and urban areas as established in their "Geometric Design Standards" of 1956 and "A Policy on Arterial Highways in Urban Areas" will be followed. Supplementary design criteria developed by The Ohio State Department of Highways for use locally will be incorporated in the highway design.

ACCESS

The relocation of Routes 23 and 42 should be designed as a partially limited access facility within the area of the relocation. Access from adjacent properties will be eliminated except for a few large parcels that would be landlocked. Access will be only at designated interchanges or intersections. There may be at-grade intersections with very minor county or township roads having low traffic counts.

DESIGN SPEED

The design speed for new rural highways is 70 m.p.h., for new urban highways 60 m.p.h. The design speed for the proposed Delaware Arterial Highway will be one or the other of these two design speeds and will depend upon the location used. Design speed for entrance and exit ramps will vary between that of the main highway and the cross street flow conditions.

SIGHT DISTANCE

Minimum stopping sight distance on the new highways will be 475 feet. Sight distance on the ramps will vary with the design speed.

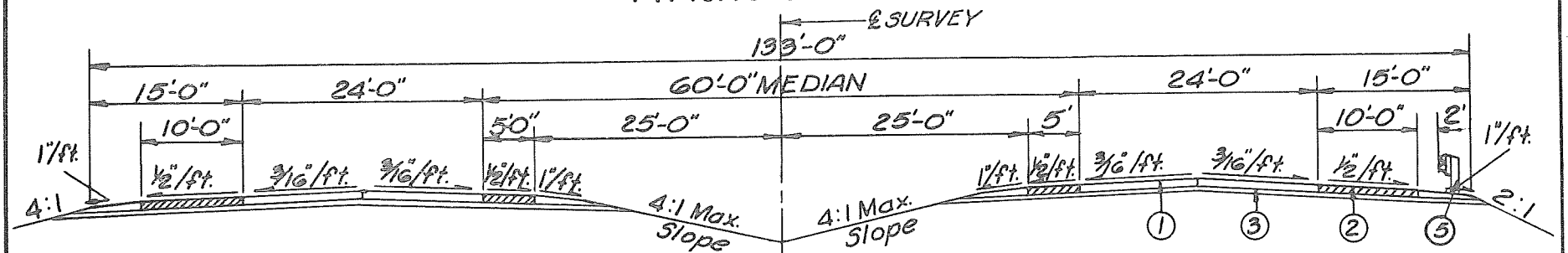
HORIZONTAL ALIGNMENT

The maximum degree of curvature required on the highway relocations in urban areas will be 5 degrees, and 2 degrees for rural areas. Spiral transitions will be used on curves of 1°30' or greater.

SUPERELEVATION

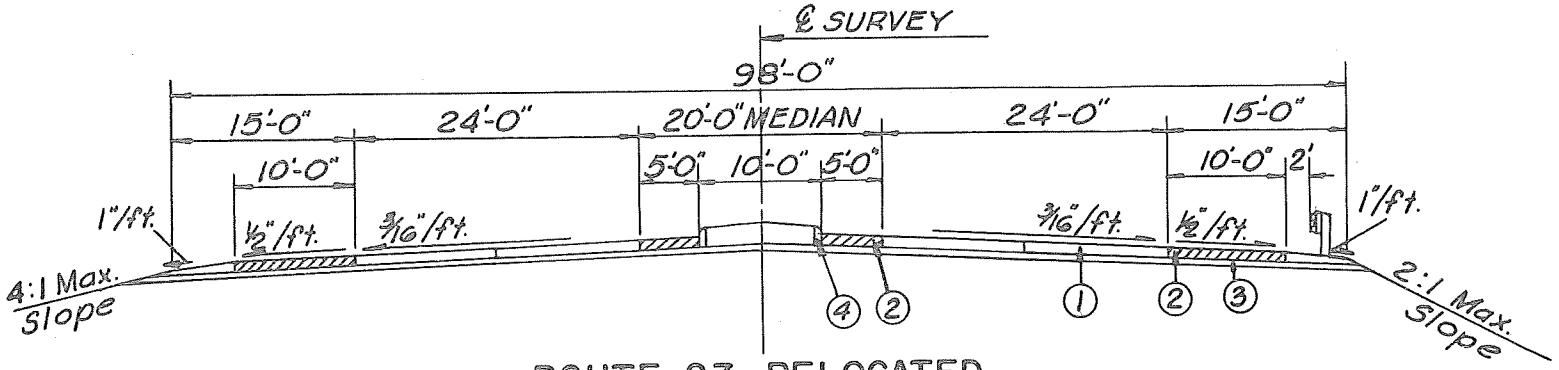
All curves over 1°00' have been superelevated in accordance with the design speed with a maximum rate of one inch per foot.

TYPICAL SECTIONS

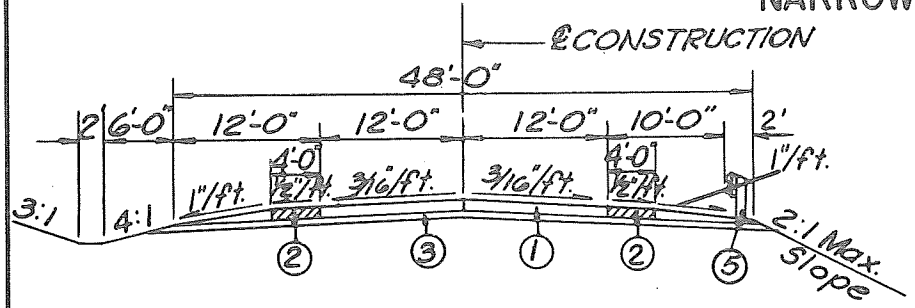


ROUTE 23 RELOCATED
NORMAL SECTION

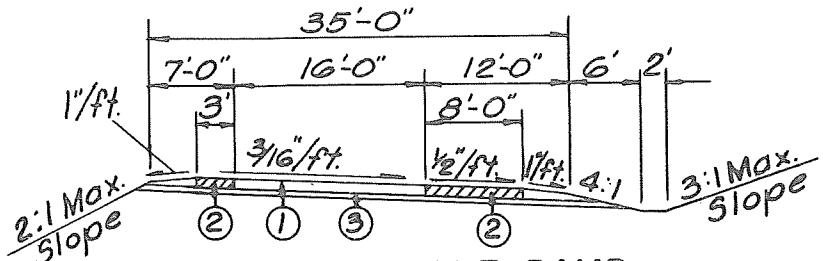
① 9" Rigid Pavement
② 9" Stabilized Berm
③ 6" Granular Subbase
④ Type 6 Curbs
⑤ Guard Rail #2A



ROUTE 23 RELOCATED
NARROW MEDIAN



ROUTE 42 RELOCATED



SINGLE LANE RAMP

VERTICAL ALIGNMENT

The maximum up grade used on the main highway relocation will be 2 per cent. Within interchanges with separate roadways, maximum down grades of 3 per cent are used. Ramp grades will not exceed 5 per cent. Vertical sag curves will be at least 200 feet long. Crest vertical curves will be of sufficient length to provide stopping sight distances appropriate to the design speed used.

CROSS SECTIONS

Plate 9 shows details of the proposed roadways.

The Route 23 relocation will consist of two twelve foot lanes in each direction separated by a median of variable width, but in no case less than 20 feet wide. Stabilized berms 10 feet wide on the right edge of pavement and 5 feet wide on the left edge of pavement will be provided. This typical section is similar to that used on the Interstate System.

Any two-lane two direction new construction required will provide 12 foot lane widths and stabilized berms on both edges.

Ramps will have 16 foot pavement widths with 8 foot and 3 foot stabilized berms right and left. On exit ramps, the ramp terminal area will be widened to 24 foot to provide separate left turn storage space.

Structures carrying Route 23 relocated will be full roadway width.

CLEARANCES

Vertical clearances shall be 15 feet clear height over new construction pavement and 14.5 feet over berms and shoulders. Horizontal clearances will be 12 feet right and 5 feet left from edge of new pavement.

FENCING

New construction in urban areas should be fenced to prevent any access to the roadway by pedestrians or animals. Fencing in rural areas would consist of farm fence along the right-of-way line.

LIGHTING

Some major intersections and interchange ramp terminals may require artificial lighting. In preparing estimates of costs, light standards were assumed to be located at all major intersections and ramp terminals.

DISCUSSION OF ALTERNATE ROUTES STUDIED

Before an investigation of new lines was started, a check of the existing routing of U.S. 23 and U.S. 42 through the city was made to determine if a relocation of these routes was necessary. The use of available north-south streets such as Curtis Street, Liberty Street and Henry Street was investigated as possible carriers of either U.S. 23 or U.S. 42 traffic. In all cases, substantial amounts of money would be required to improve and widen these streets to carry traffic through residential areas and adequate street capacities were still not obtained. In most plans for the use of existing streets, through traffic on the numbered state highways was required to pass through the William Street-Sandusky Street intersection. A capacity analysis of this intersection using design year traffic is shown on Page 18. This intersection would have to be reconstructed with an additional lane width in each direction on Sandusky Street for a block north and south of William Street and with no parking in this area. This would use most of the area now occupied by sidewalks. Such reconstruction would just obtain the possible capacity required for design year traffic and leave no reserve capacity. Additional widening of Sandusky Street, generally south of William Street would be required to provide two lanes of traffic in each direction. Extra widening to provide left turn lanes at several intersections and to numerous business locations would also be required.

An estimate of cost was made of the work necessary to provide the required capacity on the existing routes through the city. This work would consist primarily of widening Sandusky Street beyond its present right-of-way width to provide extra through and turning lanes. Such a program would cost approximately $11,000,000, with about 90 per cent of the cost consisting of right-of-way costs and damages to adjacent properties. All these improvements would leave the through traffic still mixed with local traffic on the main streets of the city and with no proper solution of the traffic problem reached. No satisfactory method of using the existing street system to handle design year traffic could be found. Therefore, a study of various by-pass routes was made.

Plate 10 shows the several principal lines studied. Several variations of each have been considered which have evolved into the alignments shown. Horizontal alignment has been established using 1" = 500' and 1" = 100' scale aerial photographs furnished by the City of Delaware. Vertical alignment was obtained using spot elevations, existing filed highway plans, and other maps and studies available.

Line A is a line extending through the central portion of the city. It follows very closely a previous line established some twenty years ago by the Highway Department for a proposed relocation of Route 23. This old line in turn had followed an abandoned railroad right-of-way along the west bank of the Olentangy River. The old right-of-way width is not adequate for a modern highway, but does provide a strip of vacant land along a substantial portion of the route. Because it follows the river, the access problem is considerably reduced.

CALCULATIONS MADE BY RES
DATE 17 June 58

CAPACITY ANALYSIS SHEET

ROUTE US. 23 & 36.
COUNTY Delaware

INTERSECTION OF Sandusky STREET AND William STREET

1980 DHV TRAFFIC (date)

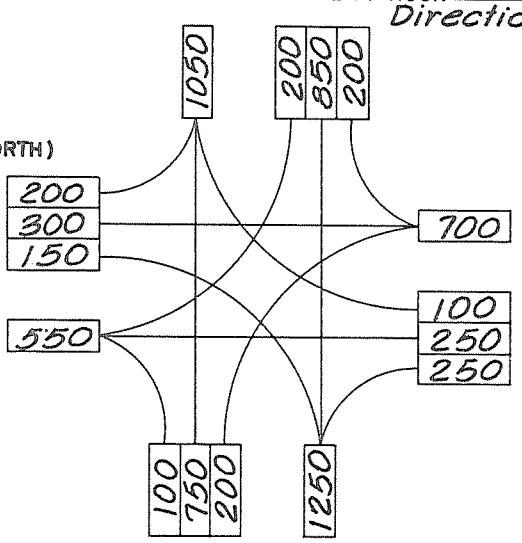
LOCATION Delaware, Ohio

PEAK HOUR 10 % Directional

AREA CLASSIFICATION
✓ DOWNTOWN
____ INTERMEDIATE
____ OUTLYING

N

(INDICATE NORTH)



SIGNAL CALCULATIONS

$\frac{G}{C}$ = $\frac{\text{GREEN INTERVAL (SEC.)}}{\text{TOTAL INTERVAL (SEC.)}}$

SIGNAL TIMING

	GREEN	AMBER	RED	TOTAL
N-S APP.	34.6	3	22.4	60
E-W APP.	19.4	3	37.6	60

	NORTH	SOUTH	EAST	WEST
PARKING REGULATIONS (NP, P-1, P-2)	NP	NP	NP	N.P.
BUS STOPS (NS = NEAR SIDE, FS = FAR SIDE, N = NONE)	N	N	N	N
WIDTH	60	60	75	65
AVERAGE CAP. (FIG. 24, p79 HWY. CAP. MAN.)	2210	2210	2510	2390

19.4 Sec. Green E.W. 32.3 %
34.6 Sec. Green N.S. 57.7%

FACTORS — Amber 10%

	N %	N FACTOR	S %	S FACTOR	E %	E FACTOR	W %	W FACTOR
(a) LEFT TURNS (.10 - %) ÷ 1.00	9.53	1.005	12	.98	28.6	0.8	36.4	0.8
(b) RIGHT TURNS (.10 - %) 1/2 ÷ 1.00	19.1	.96	20	.95	28.6	0.8	18.2	0.8
(c) COMM. VEH. (.10 - %) ÷ 1.00	9	1.01	9	1.01	9	1.01	9	1.01
(d) BUS STOPS		1.05		1.05		1.05		1.05
(e) TOT. FACTOR (a)(b)(c)(d) = (e)		1.024		.988		.85		.85

	N VPH - GREEN	S VPH - GREEN	E VPH - GREEN	W VPH - GREEN
(f) POSS. CAP. = (.90)(e)(AV. CAP.) In vehicles PHOG	2040	1966	1920	1830

	N	S	E	W
(g) PRACT. CAP. = $\frac{G}{C}$ x (f) VEH./HR. In VPH	1180	1135	620	591
(h) DESIGN PK. HR. VOL. VEH./HR.	1050	1250	700	550
(i) VEH. (over, under) CAP. VEH./HR.	+130	- 115	- 80	+41
(j) CAP. INDEX = $(\frac{h}{g})$	0.89	1.10	1.13	.93

This line is the most direct of those studied and closely matches the desire lines of the through traffic. It also gives quick access to the center of the city for external-internal traffic and provides a business area by-pass in addition to carrying through traffic.

It would require some relocation of the river channel north of Central Avenue. There are no structures required by Route 23 relocation for railroad or river crossings. An existing railroad structure over the river has sufficient end span space to accommodate the proposed highway under the railroad without altering the structure. Route 42 extensions would require one railroad structure and one river crossing.

Right-of-way requirements include several residences near Olentangy Avenue in the southern section of the city and some business and residential properties north of William Street.

There would be a grade crossing of this highway to afford access to the city sewage plant, possibly another one to provide access to the land between the highway and the river north of Lincoln Avenue. Olentangy Avenue would have a grade intersection with this line to the east only. All other access points would be limited to regular interchanges or intersections.

Line B has the same termini as Line A with existing Route 23 north and south of the city and a similar extension of Route 42 to the south-west. However, this line is a by-pass route skirting the eastern edges of the city. The alignment generally lies outside the developed sections of the city and requires only minor removal of buildings.

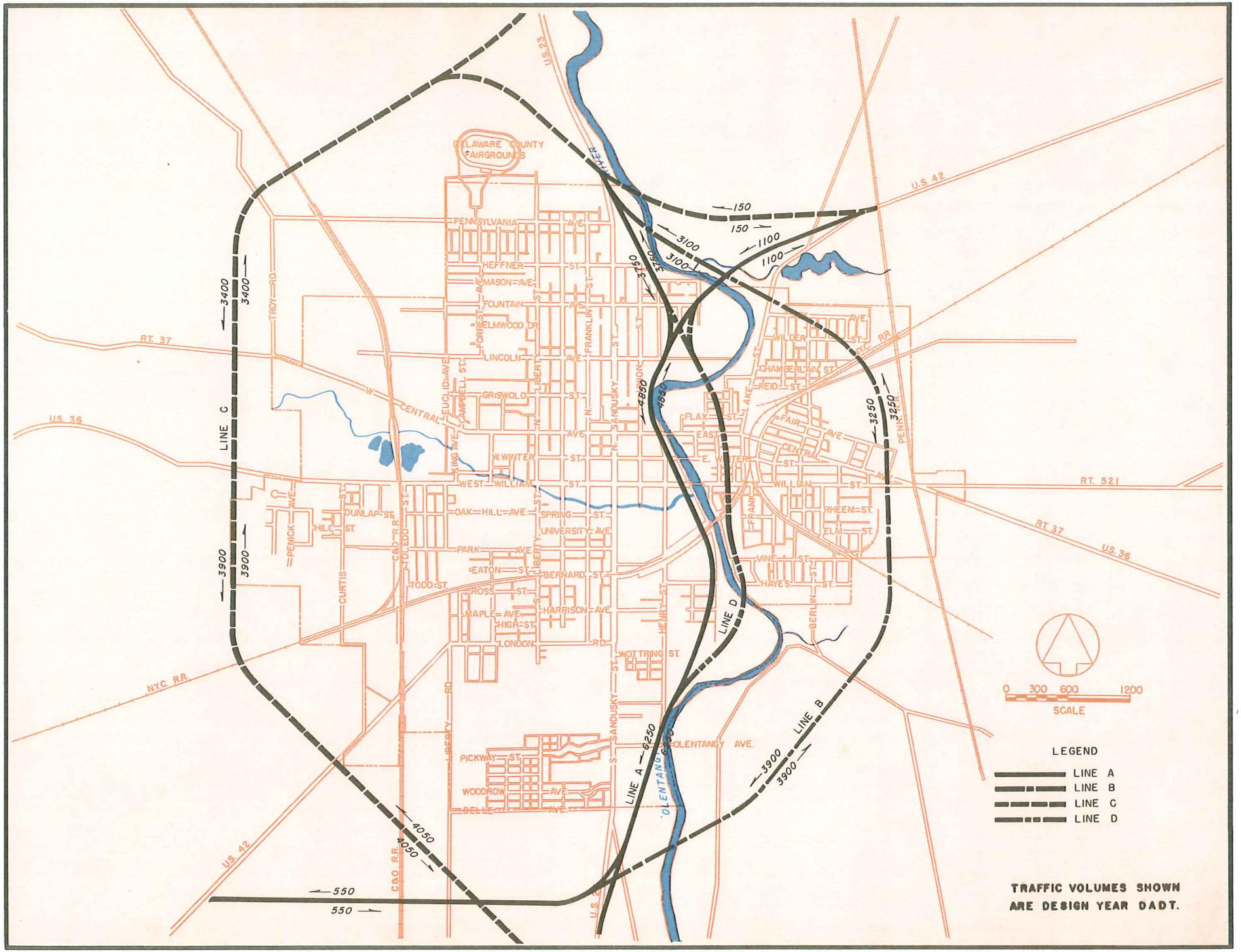
An interchange is provided with Routes 36 and 37 just east of the Highway Department Division Headquarters building. Another interchange with Route 42 in the north-east section of the city is made so that no additional extension of Route 42 is required. Two additional railroad structures are required with this line and an additional river crossing. The county roads south-east of the city would require some rearranging to avoid more than one intersection-at-grade in this area.

Line C is essentially a western by-pass of the city. Three railroad crossings are required and a river crossing of Route 42 connection north. Alignment is almost entirely in open farm land and does by-pass some built-up areas along Route 23 north of the north corporation line. Interchanges are provided with Routes 36 and 37 on the west side of town.

Line D is a variation of Line A, and is a study made to seek a better alignment for a central route. Line A required the use of 5 degree curves, which is not desirable, and should be improved if economically possible. The sharp curves of Line A are caused by the roadway following the bend of the Olentangy River in the down town area. Line D cuts straight across this bend and a better alignment is obtained. It does require two crossings of the river. Interchanges with the three major cross streets would carry the freeway under these streets. This line still retains all the traffic advantages of a central location, and traffic assignments identical to line A have been used.

Preliminary studies were made of the principal alternate routes considered. Alignment and profile was established for each line and traffic assignments made. Estimates of costs and benefit-cost ratios were prepared. For purposes of comparison, all calculations were based on freeway construction being used on all lines studied. The total cost for each line is listed as follows:

	Line A	Line B	Line C	Line D
Total Cost	$6,132,000	$7,678,000	$8,586,000	$6,932,000


DELAWARE COUNTY FAIRGROUNDS
PENNSYLVANIA AVE.
HEFFNER ST.
MASON AVE.
FOUNTAIN AVE.
ELMWOOD DR.
LINCOLN AVE.
GRISWOLD ST.
W. WINTER ST.
WEST WILLIAM ST.
OAK HILL AVE.
SPRING ST.
UNIVERSITY AVE.
PARK AVE.
EATON ST.
BERNARD ST.
TODD ST.
ROSS ST.
MAPLE AVE.
HIGH ST.
HARRISON AVE.
LONDON RD.
WOTTRING ST.
PICKWAY ST.
WOODROW AVE.
BELLE AVE.
OLENTANGY AVE.
FLAX ST.
EAST ST.
E. WATER ST.
WILDER ST.
CHAMBERLAIN ST.
REID ST.
FAIR AVE.
CENTRAL AVE.
WILLIAM ST.
RHEEM ST.
ELM ST.
VINE ST.
HAYES ST.
DUNLAP ST.
HILL ST.
PENICK AVE.
CURTIS ST.
FRANKLIN ST.
LIBERTY ST.
SANDUSKY ST.
UNION ST.
HENRY ST.
BERLIN ST.
LAKE ST.
FRANKLIN ST.
TROY RD.
LIBERTY RD.
EUCLID AVE.
CAMPBELL ST.
KING AVE.
RT. 37
US. 36
US. 42
US. 23
RT. 521
NYC. RR.
C&O. R.R.
TOLEDO
PENN. R.R.
LINE A
LINE B
LINE C
LINE D
150
1100
3100
3750
4850
3250
3400
3900
6250
4050
550
0 300 600 1200
SCALE
LEGEND
LINE A
LINE B
LINE C
LINE D
TRAFFIC VOLUMES SHOWN ARE DESIGN YEAR DADT.

ESTIMATED TRAFFIC USAGE

To evaluate traffic services provided by the various possible routes considered, Burgess and Niple engaged the services of Wilbur Smith and Associates, highway traffic engineering consultants. This chapter of this report is from the report submitted by Wilbur Smith and Associates.

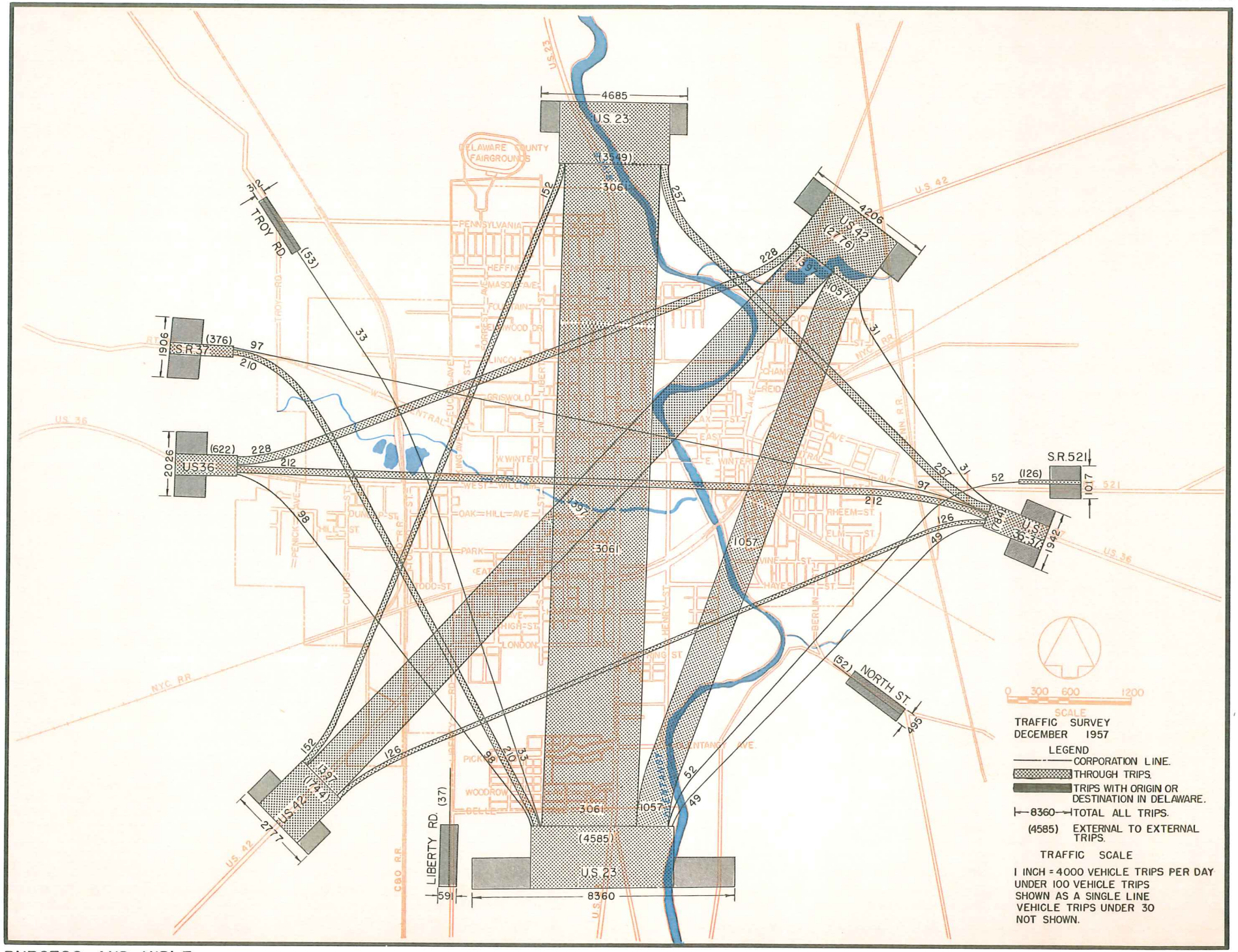
Additional field work such as the supervision of automatic traffic recorders, making manual classified volume counts and speed delay runs, was to be performed by Burgess and Niple. Wilbur Smith and Associates were to assign potential traffic to the three alternate locations, develop growth factors, project present traffic to the design year and determine the relationship of design year annual average daily traffic volumes to design hour volumes. Traffic usage was to be determined along the different sections of the expressways and at all interchange points. By letter dated May 1, 1958, Burgess and Niple authorized the early completion of this study.

Available Data

Considerable traffic data was available from an origin and destination survey made in December of 1957 by the Ohio State Highway Department. Roadside origin and destination interview stations were operated on a typical weekday at a cordon line intercepting all major highways entering the city. Twenty-four hour manual classified vehicle counts were also obtained during the course of the study. To supplement this information, additional field studies were made at our request. These included traffic counts obtained by portable recorders on major state highways entering the city and the three downtown river crossings, manual classified counts, turning movement counts at the principal downtown intersections, and speed-delay runs during peak travel periods along the more heavily used traffic arteries.

The Ohio Department of Highways periodically makes traffic counts on the state highway system. The counts, based upon manual and mechanical traffic counts and adjusted to an estimated annual average 24 hour traffic volume, are summarized in a traffic survey report for the state highway system. The 24 hour traffic density is tabulated by type of vehicle; passenger cars, panel and pick-up trucks, tractor trucks with semi-trailers and trucks with trailers, and single unit trucks are tabulated separately. The "Traffic Survey Report of the State Highway System, 1956" prepared by the Ohio Department of Highways was also available for study.

Planning data prepared by the Chamber of Commerce of the City of Delaware and Burgess and Niple were also made available. This information included trends in motor vehicle registration for the State of Ohio, Delaware County and the City of Delaware for the period 1931 through 1956, population statistics for the period 1900 through 1957 for the State of Ohio and the City of Delaware, motor vehicle registration and population projections made by Burgess and Niple, and data on the local population distribution, industrial, and retail activity in the city.


4685
U.S. 23
(3549)
306
152
257
4206
U.S. 42
(2176)
228
1057
31
TROY RD.
(53)
33
1906
S.R. 37
(376)
97
210
2026
U.S. 36
(622)
228
212
98
212
97
257
31
S.R. 521
52
(126)
1017
126
49
U.S. 35
(744)
1942
3061
1057
NORTH ST.
(52)
495
152
126
98
210
33
397
(744)
U.S. 42
277
LIBERTY RD.
(37)
591
52
49
(4585)
U.S. 23
8360
0 300 600 1200
SCALE
TRAFFIC SURVEY
DECEMBER 1957
LEGEND
CORPORATION LINE.
THROUGH TRIPS.
TRIPS WITH ORIGIN OR DESTINATION IN DELAWARE.
8360 TOTAL ALL TRIPS.
(4585) EXTERNAL TO EXTERNAL TRIPS.
TRAFFIC SCALE
1 INCH = 4000 VEHICLE TRIPS PER DAY
UNDER 100 VEHICLE TRIPS SHOWN AS A SINGLE LINE
VEHICLE TRIPS UNDER 30 NOT SHOWN.

Material prepared by the U. S. Bureau of Public Roads relative to estimates of 1975 population, motor vehicle registration, motor fuel consumption and vehicle miles of travel on the highways of the State of Ohio, the east north central region of the country (Illinois, Indiana, Michigan, Ohio, Wisconsin), and the United States were also available.

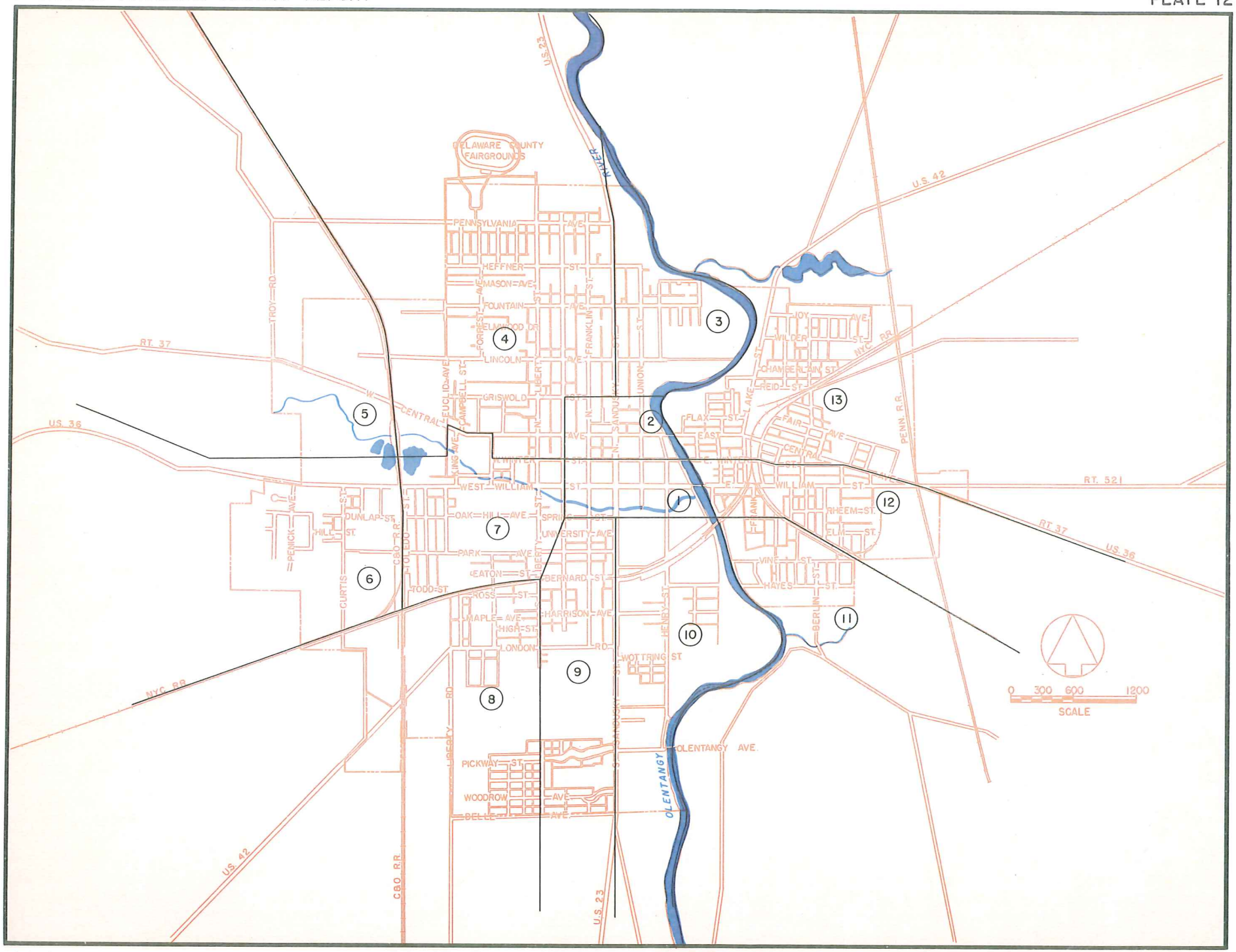
Method of Study

All of the available data was used in determining traffic usage of the proposed alternate locations of the highway improvements under consideration. The origin-destination data obtained from the Ohio Department of Highways were coded to geographic zones delineated specifically for this study. The coded origin and destination data were adjusted to an estimated 1958 traffic level. Present peak hour travel times were determined from the speed delay data and driving distances computed between the internal zones to the external stations via the existing highways and via the proposed alternate expressway locations. Using a universally accepted diversion curve, and the computed ratios of travel time via the alternate expressway locations to travel time via the existing streets, the vehicles assignable to the proposed expressway location were ascertained. The diverted traffic volumes were tabulated by class of vehicle for each section of expressway and summarized. Based upon studies of the planning data relative to population and motor vehicle registration growth, the estimated 1958 diverted traffic was projected to a 1980 traffic level. From the present relationship of peak hour traffic volumes to annual average daily traffic volumes, the design hour traffic was determined for all access ramps and sections of the alternate expressway locations.

Origin-Destination Surveys

In December of 1957, the Division of Planning and Programming of the Ohio State Highway Department made roadside origin and destination surveys of all vehicles entering the City of Delaware. Traffic was intercepted at the 11 major entering highways on a typical weekday. Motorists were questioned as to the origin and destination of their trips. The origin-destination interview data were punched onto statistical business machine cards and tabulated by city of origin and destination. The resultant tabulations were made available to the consultant. To permit an accurate assignment of traffic to the proposed alternate route locations, the City of Delaware, Delaware County, State of Ohio, and neighboring states were delineated into geographic areas or zones.

The Delaware metropolitan area was divided into 13 zones. So that the relationship of population and population growth to trip generation might be established, the zone boundaries were correlated with the existing ward boundaries. Ward 1, the northwestern section of the city, was subdivided into two zones. Ward 2 in the southwestern part of the city was divided into four zones. Ward 3 was divided into three zones, and Ward 4, into two zones. The portions of Wards 1 and 4 in the immediate downtown area were grouped into a zone, and the sections of Wards 2 and 3 in the downtown area into another zone. From the December origin and destination study, the distribution of



BURGESS AND NIPLE

INTERNAL ZONE MAP

trips generated in the various internal zones was determined. The per cent of vehicles intercepted at the cordon line, intersecting all major highways entering the City of Delaware, with origin or destination in the various zones is indicated in Table I.

Table I

TRIP GENERATION
Internal Zones - Delaware, Ohio

Zone Number	Per cent of Internal Trips	Zone Number	Per cent of Internal Trips
1	19.9	8	4.4
2	11.6	9	10.9
3	5.2	10	7.3
4	13.7	11	0.6
5	2.8	12	4.7
6	3.7	13	8.4
7	6.8	Total	100.0

The internal zone map, Plate 12, indicates the boundaries of the 13 internal zones.

Delaware County was divided into 10 zones in addition to the 13 zones in the Delaware metropolitan area. Major cities in Ohio were given separate zone numbers, and the state was subdivided into areas on an external zone map. Separate zones were assigned to Michigan, Indiana, Kentucky, West Virginia, and Pennsylvania. The northeastern states, southern states and western states were grouped into three general classifications for zoning purposes. In general, the further the area or zone of origin or destination is from the study area, the larger is the area encompassed by the zone boundaries.

The coded origin-destination data was tabulated by class of vehicle for the major interview stations. Separate tabulations were prepared for passenger cars, pick-up and panel trucks, semi-trailer vehicles, and other single unit trucks for each interview station. Due to the methods used in obtaining the origin-destination information, there was some duplication of through traffic movements in the tabulations. All duplicate through trips were deleted in the analysis.

Of the motorists interviewed at the roadside station located on U. S. Route 23 at the south corporate limits, 29 per cent had trip termini in Delaware and the City of Columbus. Adjusted to an estimated 1958 traffic level, this indicated almost 3000 vehicles per day travel between Columbus and Delaware. Over 900 trips a day were made between Delaware and the county area immediately to the south which includes Stratford, Lewis, and Powell. Approximately 1750 vehicles a day travel between Marion County and the City of Columbus. Almost 430 motorists travel daily between the Ashland-Mansfield-Mount Gilead area and Columbus. Over 1150 vehicles travel daily between the Toledo-Sandusky-Tiffen area, north of Marion County, and Columbus. Almost 300 motorists travel daily between Michigan and Columbus, and 380 between Cleveland and Columbus.

On U. S. Route 42 southwest of Delaware, over 400 motorists travel daily from Delaware to the southwestern portions of the County, including Bellpoint, Rathbone and Shawnee Hills. Through traffic is particularly heavy on this route. Almost 600 vehicles a day travel between Cincinnati and the northeastern sections of the state including Cleveland, Akron, Canton and Youngstown. Approximately 250 vehicles a day travel between Dayton and the northeastern area of the state. Traffic between Springfield and the northeastern section of the state is much lighter, approximating 175 vehicles a day. Over 165 vehicles a day move between southern Indiana and the northeastern section of the state. Approximately 180 vehicles travel daily between Cleveland and the western and southwestern states.

At 1958 traffic levels, over 920 vehicles move daily between the City of Delaware and Marion County. Over 100 motorists had origins in the northwestern part of Delaware County bordering U. S. Route 23 and the City of Delaware.

At the roadside interview station on U. S. Route 42 northeast of Delaware, the predominant traffic movement was between the City of Delaware and the northeastern area of the county closely bordering U. S. Route 42, approximating 1200 vehicles a day. Almost 400 vehicles were intercepted moving between Delaware and the Ashland-Mansfield-Mount Gilead area daily.

Traffic Volume Counts

Manual vehicle classification counts were taken by the Ohio Department of Highways on all state highways entering the City of Delaware in December, 1957. Vehicles were classified by type for each hourly period in each direction of travel for an entire 24 hour weekday period. Additional manual classification counts were taken by Burgess and Niple early in May, 1958. The supplementary manual counts were taken for a weekday daylight period on U. S. Routes 23, 42, 36 and State Route 37. Vehicles were classified as to type and tabulated by either 15 minute or 30 minute periods in each direction of travel.

In April and May of 1958, Burgess and Niple also obtained volume counts by automatic traffic recording machines on U. S. Route 23 north and south of the city, U. S. Routes 42 and 36, and State Route 37 for a three day period. Additional counts were obtained with the same recorders at the Central Avenue bridge, Winter Street bridge and William Street bridge.

The manual classification counts, machine volume counts and available records of the Ohio Department of Highways provided the necessary data from which to determine annual average daily traffic volumes at each of the roadside interview stations.

Turning movement counts were obtained at the intersections of Sandusky and William Street, London Road and Sandusky Street, and Central Avenue and Sandusky Street from 7 AM to 7 PM by 30 minute intervals. Entering traffic was counted on all four approaches and tabulated as to whether the vehicle travelled straight through the intersection, turned right or left.

Speed Delay Data

To evaluate the quality of travel provided by the present highways through the city and to determine average travel times for the traffic assignment computation, speed delay runs were made during peak travel periods. Runs were made on U. S. Routes 23 and 42 throughout the city. Travel times were recorded in both directions of travel between principal street intersections.

The travel time-distance study indicated that average driving speeds during peak travel periods varied from a low of less than 15 miles per hour to a high of almost 25 miles per hour on U. S. Route 23. On U. S. Route 42, average driving speeds during the afternoon peak travel period vary from a low of 12 miles per hour to a high of almost 23 miles per hour.

Planning Information

As the basis for projecting present traffic volumes at the roadside interview stations to an estimated design year traffic level, studies were made of the growth in population, motor vehicle registration, motor fuel consumption and vehicle miles of travel. The growth in industrial activity and retail sales in the city was also studied. Population statistics for Ohio and the City of Delaware were obtained for the period 1900-1957. Motor vehicle registration data for Ohio, Delaware County, and Delaware City were evaluated for the period 1931-1956. Population distribution within the city and the differential growth in population throughout the city were also evaluated. Projections of the growth anticipated in motor fuel consumption and vehicle miles of travel for Ohio, the east north central region of the country encompassing the states of Illinois, Indiana, Michigan, Ohio and Wisconsin, and the United States were also evaluated.

Estimated 1958 and 1980 Traffic Volumes

Based upon the traffic volume counts and planning information, 1958 and 1980 annual average daily traffic volumes at the location of the roadside interview stations were determined. It is estimated that 1958 annual average daily traffic volumes on U. S. Route 23 at the south corporate limits will approximate 10,300 vehicles and at the north corporate limits 6000 vehicles. On U. S. Route 42 southwest and northeast of Delaware, 1958 annual average daily traffic volumes of 5000 and 5900 vehicles, respectively, are estimated.

It is estimated that by 1980, traffic volumes on U.S. Route 23 at the south corporate limits will approximate 19,100 vehicles per day. At the north corporate limits, a 1980 traffic volume of 11,400 vehicles per day is estimated. There is considerable through traffic presently using U.S. Route 42 that will be diverted to Interstate Highway 71 upon its completion. Almost 3000 of the vehicles presently using U.S. Route 42 through Delaware are potential to Interstate Highway 71 extending from Cincinnati via Columbus and Mansfield to Cleveland. It has been assumed that the Interstate Highway System in Ohio will be completed

prior to the design year, 1980. Therefore, this traffic has been diverted from U.S. Route 42. Consequently, a 1980 annual average daily traffic volume of 3800 vehicles is estimated for U.S. Route 42 southwest of Delaware. A 1980 average daily traffic volume of 5900 vehicles is estimated for U.S. Route 42 northeast of Delaware.

Inadequacy of Existing Routes

An almost 100 per cent increase in the traffic volume presently using the major highways in the Delaware area is forecast in the period 1958-1980. The existing highways are presently loaded to near capacity conditions during peak travel periods. They have little reserve capacity and will become overloaded within the next decade. To indicate the deficiency in the existing highways, a capacity analysis was made of the intersection of Sandusky and William Streets in downtown Delaware. From the extensive traffic information available, present and future peak hour turning movements were evaluated. For 1980, annual average daily traffic on U.S. Route 23 is estimated at approximately 23,000 vehicles per day both north and south of the intersection. At the present time, traffic volumes are heavier south of the intersection due to the large volume of through traffic on U.S. Route 42 which turns east at this intersection. By 1980 it is assumed that this traffic will be using an interstate route located east of Delaware. Correspondingly, while present traffic volumes on William Street east of Sandusky are considerably heavier than those on William Street west of Sandusky Street, the diversion of through traffic from U.S. Route 42 will alter this relationship.

Analysis of present peak hour traffic and its directional distribution indicate that approximately ten per cent of the average daily traffic will flow during the evening peak hour period, 55 per cent in the heavier direction of travel and 45 per cent in the lighter direction of travel. 1980 peak hour volumes of 2300 vehicles are estimated north and south of William Street on Sandusky Street, and peak hour volumes of 1200 and 1300 vehicles are expected on William Street west and east of Sandusky Street, respectively. The turning movements in general are quite heavy. The forecast turning movements from the south to the east have not been increased proportionally due to the diversion of through traffic from U. S. Route 42 by construction of Interstate Route 71.

Even with the diversion of through traffic from U.S. Route 42 and a conservative growth rate of less than 100 per cent, the intersection will be loaded beyond its "possible" capacity. Possible" capacity may be defined as the maximum number of vehicles that can pass a given point on a highway during one hour under the prevailing roadway and traffic conditions. It is the volume of traffic that cannot be exceeded without changing one or more of the conditions that prevail. Assuming the complete elimination of parking on Sandusky Street and William Street, the present streets are not capable of handling forecast traffic volumes. Estimated traffic is over 12 per cent higher than the possible capacity of the intersection. Even

when consideration is given to eliminating all left turns at this location, not a practical consideration, the intersection is overloaded beyond its possible capacity. In determining the capacity of the intersection, the criteria established by the "Highway Capacity Manual" prepared by the U.S. Department of Commerce, Bureau of Public Roads and the design capacity charts for signalized streets and highway intersections as presented in the February, 1951 issue of the "Public Roads Highway Research Journal" were used.

The analyses indicated that the intersection has an approximate 25 per cent reserve capacity for present peak hour demands. Within a period of five years it will be operating beyond its design capacity. Due to the length of time necessary for planning, designing and constructing high type highway improvements, this indicates that immediate steps should be taken to provide a relief route. Before and after studies in many cities indicate that when heavy through traffic volumes are diverted from downtown city streets an immediate and marked increase in retail sales throughout the central business district is noticeable. Apparently the increased ease in access to the central business area and reduced interference in parking maneuvers produces greater and more frequent usage of the downtown retail area.

Traffic Assignment

Traffic was assigned to the proposed alternate locations of relocated U.S. Routes 23-42 premised upon time savings to the motorist. Average driving times via the existing highways and the alternate routings via the proposed expressways were computed. From the ratio of travel time via the expressway routing to travel time via the existing routes, the usage of the proposed expressways were determined. Studies have indicated that there is a high correlation between the travel time ratio and the per cent of vehicles that may be assigned to a major highway improvement. The diversion curve proposed by the American Association of State Highway Officials in their urban geometric highway design policy was used in assigning traffic to the proposed expressway locations.

Travel times via the existing routes were based upon the speed delay studies made by Burgess and Niple in May of 1958. An average operating speed of 35 miles per hour was assumed on the expressways.

Traffic presently using U.S. Route 23 travelling through the City of Delaware will be afforded time savings of 3 minutes by the eastern and western locations of the proposed expressways, and four and one half minutes by the central location due to its shorter length. Through traffic presently using U.S. Route 42 will be afforded time savings of three minutes by the western location and 5 minutes by the central and eastern locations of the proposed expressways.

The proposed westerly location provides little traffic service to vehicles with origin or destination in Delaware. Practically none of the motorists with destination in down-

town Delaware and the area immediately adjacent to downtown would use the proposed westerly location. Usage of the easterly location by vehicles with origin or destination in downtown Delaware would be light. The central location provides good traffic service to the downtown area and would be used by the majority of the vehicles presently using the existing highway. Of the motorists approaching Delaware from the south on U.S. Route 23 with origin or destination in Delaware, approximately 64 per cent would use a portion of the central location of the proposed expressway, slightly over 17 per cent would use a section of the eastern location, and slightly over 15 per cent would use a portion of the western location. Of the traffic approaching Delaware from the southwest on U.S. Route 42 with origin or destination within the city, only 6 per cent would use a section of the western location, slightly over 50 per cent would use a section of the central location, and over 23 per cent would use some portion of the eastern location. Of the vehicles with origin or destination in Delaware approaching the city from the north on U.S. Route 23, slightly over 15 per cent would use some section of the western location, 56 per cent would use a portion of the central location, and almost 25 per cent a section of the eastern location. Of the motorists approaching Delaware from the northeast with origin or destination within the city, only 2.5 per cent would use a section of the western location, 62 per cent would use some sections of the central location, and only 8 per cent would use a portion of the eastern location.

Traffic usage by through traffic is quite high for each of the three alternate locations. However, the largest number of through vehicles would favor the central location. Usage of the eastern and western locations of the proposed expressways by through traffic would be substantially the same, but slightly favoring the western location.

In summary, the central location would provide best traffic service to both through and local traffic movements. The western location would provide the least traffic service to local traffic and rank second in traffic service to through traffic. The eastern location would rank second in local traffic service and provide the poorest service to through traffic.

Estimated 1980 Expressway Traffic

By applying the diversion percentages realized from the diversion curve, the zone to zone traffic movements were assigned to the alternate expressway locations. The interchange to interchange traffic movements were tabulated and summarized. The assigned traffic at 1958 traffic levels was then projected to a 1980 traffic level based upon the growth factors developed from the planning data. It was assumed that through traffic and traffic with origin or destination in the downtown or eastern sections of Delaware would increase 82 per cent in the period 1958-1980. Traffic with origin or destination in the western area of the city, zones 4 through 9 inclusive, was estimated to grow at an approximately 20 per cent higher growth rate.

On Plate 10, the estimated 1980 directional annual average daily traffic volumes are shown for the alternate locations of the proposed expressway system.The analyses of peak hour traffic volumes on the existing highways indicated that approximately 10 per cent of the average daily traffic occurred during the afternoon peak travel period or during the PM peak hour. The directional distribution of traffic in this period was approximately 60 per cent in the heavier direction of travel, 40 per cent in the lighter direction of travel. Therefore, the maximum directional design hourly volume, the number of vehicles traveling in one direction during the peak hour, is 12 per cent of the directional annual average daily traffic volumes indicated for 1980. Trucks (types B & C) are 18 per cent of ADT and 9 per cent of peak hour volumes.

In all cases, the estimated 1980 traffic volumes indicated that a four lane divided facility should be constructed for U.S. 23 relocation. The four lane facility will have adequate reserve capacity for traffic volumes greater than those anticipated for the design year. With the diversion of the long through traffic movements from U.S. Route 42 to Interstate Route 71, the demand for a connection from existing Route 42 to U.S. Route 23 is not great, and a two lane facility will have more than adequate capacity for this anticipated traffic volume.

The central location of the proposed expressway will be much heavier used than either the western or eastern locations. It will provide maximum relief to existing highways. Traffic usage of the central location of the proposed expressway system varies from 12,500 vehicles per day east of the interchange with existing U.S. Route 23 to 7500 vehicles per day between the proposed interchange with William Street and Central Avenue, increasing to 9700 vehicles per day south of the junction with the connection to U.S. Route 42 to the northeast, and decreasing again to 7500 vehicles per day at its northerly terminus.

Estimated 1980 traffic usage of the western location of the proposed expressway system varies from 8100 vehicles per day at its southerly terminus to 7700 vehicles per day between the interchange with U.S. Route 36 and and State Route 37, decreasing to 6500 vehicles per day at its northerly terminus.

Estimated traffic usage of the eastern location of the proposed expressway system varies from 7800 vehicles per day northeast of the interchange with existing U.S. Route 23 to 6000 vehicles per day between the interchanges with U.S. Route 36 and State Route 37 west of Delaware, increasing to 6500 vehicles per day north of the interchange with State Route 37, and decreasing to a low of 6200 vehicles per day at its northerly terminus.

Expressway Peak Hour Traffic Volumes

The directional design hourly volumes for the proposed expressway system are 12 per cent of the directional annual average daily traffic volumes with a directional distribution of 60 per cent in the heavier direction of travel, 40 per cent in the other direction of travel. The two directional peak hour is 10 per cent of the annual average daily traffic volume. Maximum peak hour demand for the central location of the proposed expressway system is 750 vehicles per hour in one direction just northeast of the interchange with existing U.S. Route 23. The minimum peak hour demand is 450 vehicles per hour in the heavier direction of travel.

On the western location of the proposed expressway system, the heaviest peak hour demand is 500 vehicles per hour in the heavier direction of travel just northwest of the interchange with U.S. Route 23 near the south corporate limits. The minimum peak hour demand is 400 vehicles per hour in one direction at its northerly terminus.

Maximum peak hour traffic usage of 475 vehicles in the heavier direction of travel is estimated on the western location just north of its junction with the existing U.S. Route 23. The minimum one directional peak hour demand is approximately 375 vehicles per hour in the heavier direction of travel at its northerly terminus.

U.S. Route 36 and State Route 37

Design year through traffic on U.S. Route 36 and State Route 37 totals approximately 1000 vehicles for the two routes. Except for the present bridge on Route 37 over the Olentangy River, the existing improvements will carry this through traffic plus local traffic with only minor additional improvements. The replacement of the bridge is listed as Stage 4 in the recommended improvements. With this proposed bridge, the present routes will provide adequate lane capacity for the design year traffic.

THE RECOMMENDED PLAN

Line A is recommended as the best route for an Arterial Highway System for the City of Delaware, Ohio. It costs less and attracts more traffic than the other lines studied. The recommended plan includes 6.0 miles of new construction in and around the city. About 2.9 miles of this new construction is actually within the city limits. The plan consists generally of five separate sections:

1. The Olentangy Expressway – a four lane divided expressway that will relocate U.S. Route 23 through the central area of the city and provide a business district by-pass.
2. A two lane relocation of U.S. Route 42 south of the city that will connect to the U.S. Route 23 relocation.
3. A two lane relocation of U.S. Route 42 in the northeast section of the city extending from the new expressway to the existing U.S. Route 42 northeast.
4. A new four lane bridge over the Olentangy River on Central Avenue.
5. A new four lane arterial street running north and south and connecting William Street and Central Avenue near the present west corporation line.

This recommended system will remove through traffic on the two principal state highways from the city streets and will also provide easy and quick access between the business district and outlying areas. The recommended construction will provide adequate capacity for anticipated traffic to 1980.

Plates 13 to 17 show in detail the location and horizontal and vertical alignment recommended for each of the sections. More detailed descriptions of the various sections of the plan are given in the chapter entitled "Description of the Project" and cost estimates are presented for each section in the appropriate chapter of this report.

It is further recommended that the major relocation of the state routes have controlled access to preserve the integrity and capacity of these new facilities.

DESCRIPTION OF THE PROJECT

The Olentangy Expressway

This project, designated Section 1 of the Arterial Highway Plan, is essentially a four-lane divided expressway-at-grade with limited access that will carry U.S. Route 23 through the city on a new location that lies along the west bank of the Olentangy River. The relocation begins approximately 0.4 miles south of the present south corporation line of the city and ends about 0.3 miles north of the north corporation line. One structure is required near the beginning of this section to interchange traffic between the new and the existing highway. This expressway will have at-grade intersections with the three cross streets William Street, Winter Street, and Central Avenue. A median with an adequate width to allow room for left turn lanes for the expressway traffic is included as shown on the drawings of the typical sections on Plate 9. Other access points to this expressway between its terminal points would be at Olentangy Avenue to and from the east only, an at-grade crossing with the drive to the municipal sewage plant, and the municipal playground area near Lincoln Avenue. A pedestrian overpass structure to this playground should also be included in the project plans as a large number of children are attracted to this area.

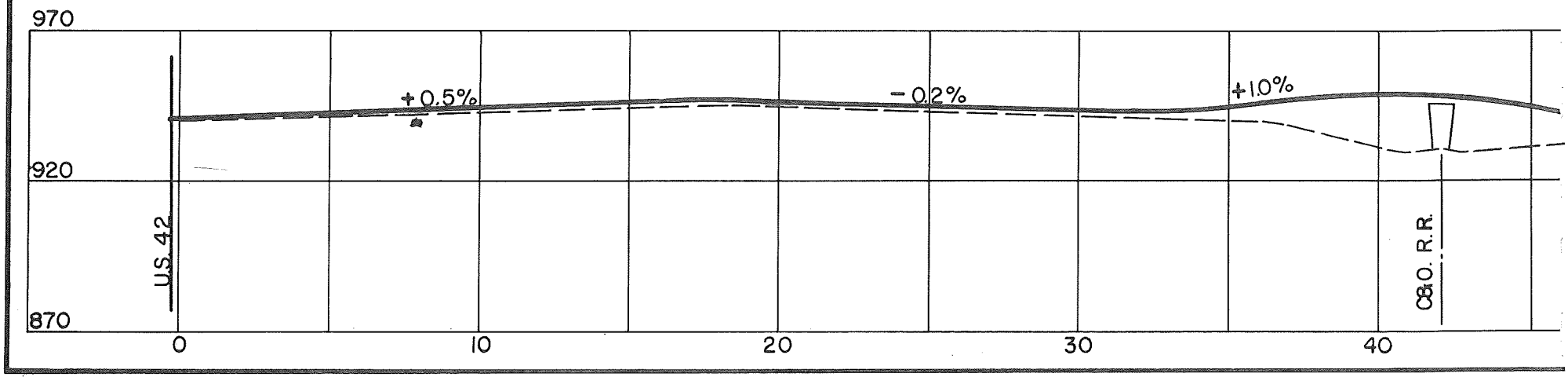
A short length of service road connecting Henry Street and Olentangy Avenue on the west side of the expressway is included to prevent the dead-ending of these two streets. Another service road is required south of the U.S. Route 23 relocation to replace the old highway connection at the south corporation line.

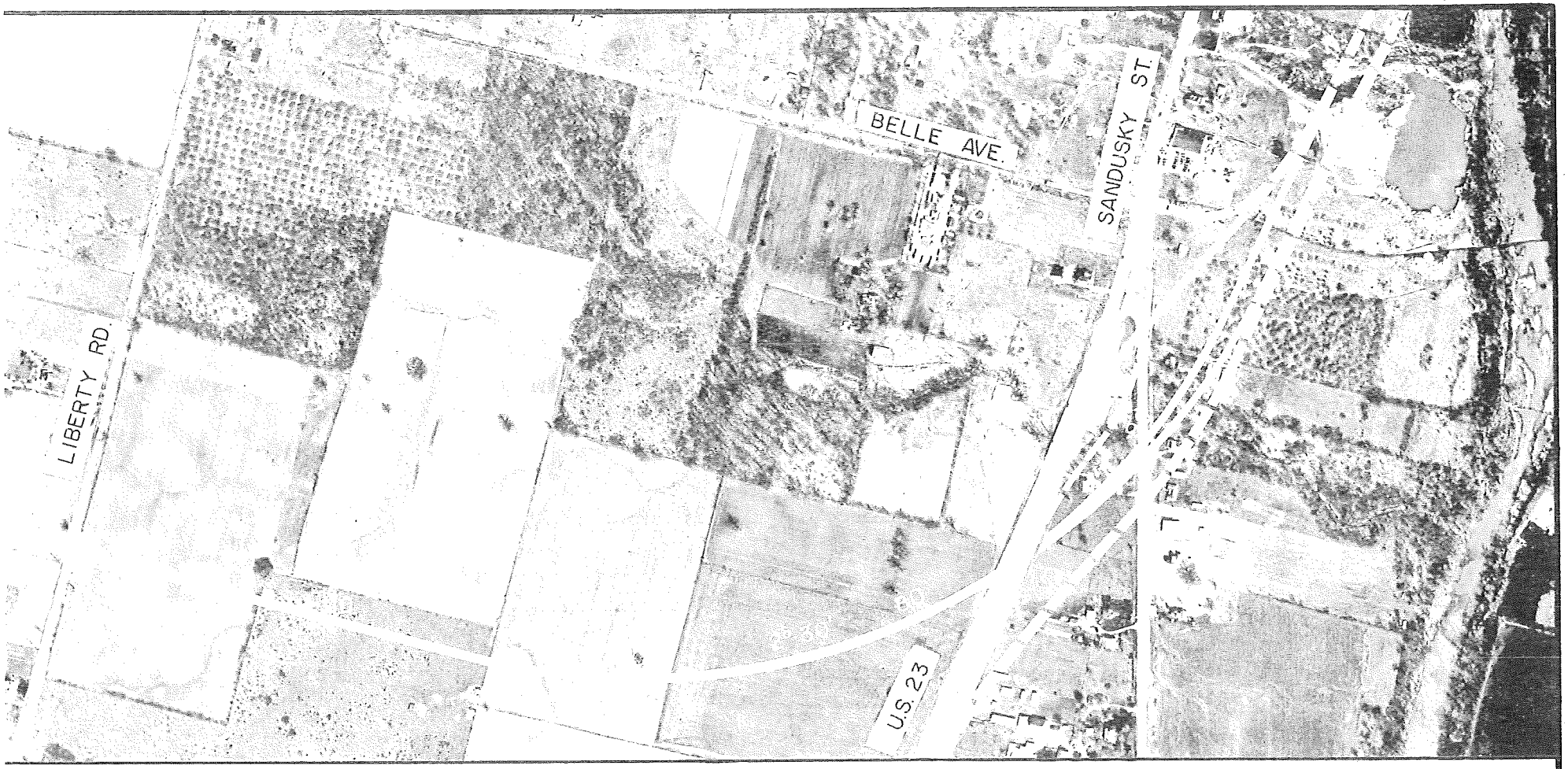
U.S. Route 42 Relocation

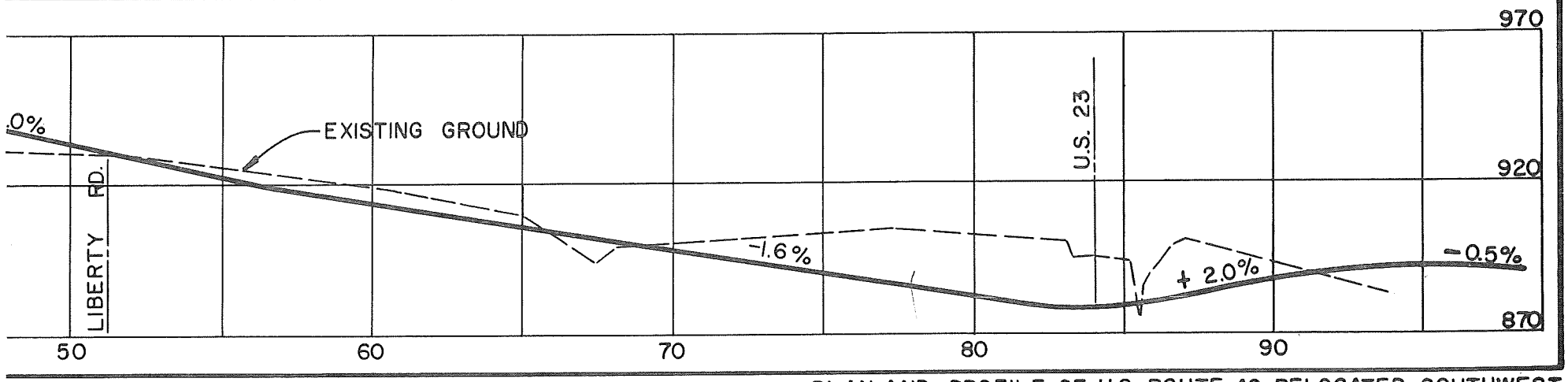
Section 2 of the Arterial Plan is the relocation of U.S. Route 42 south of the present city limits. This section consists of a new two-lane east-west roadway connecting existing U.S. Routes 42 and 23. It is an at-grade highway except for a grade separation structure with the Chesapeake and Ohio Railroad tracks and another structure required to carry this roadway under the existing U.S. Route 23. There would be an at-grade intersection with Liberty Road, which in this area is a minor county road.

Section 3, U.S. Route 42 relocation in the northeast section of the city, is a new two-lane highway that will carry traffic from the Olentangy Expressway to the existing location of this route northeast of the city. A structure over the Olentangy River is required and one other structure is needed to interchange traffic with the expressway.

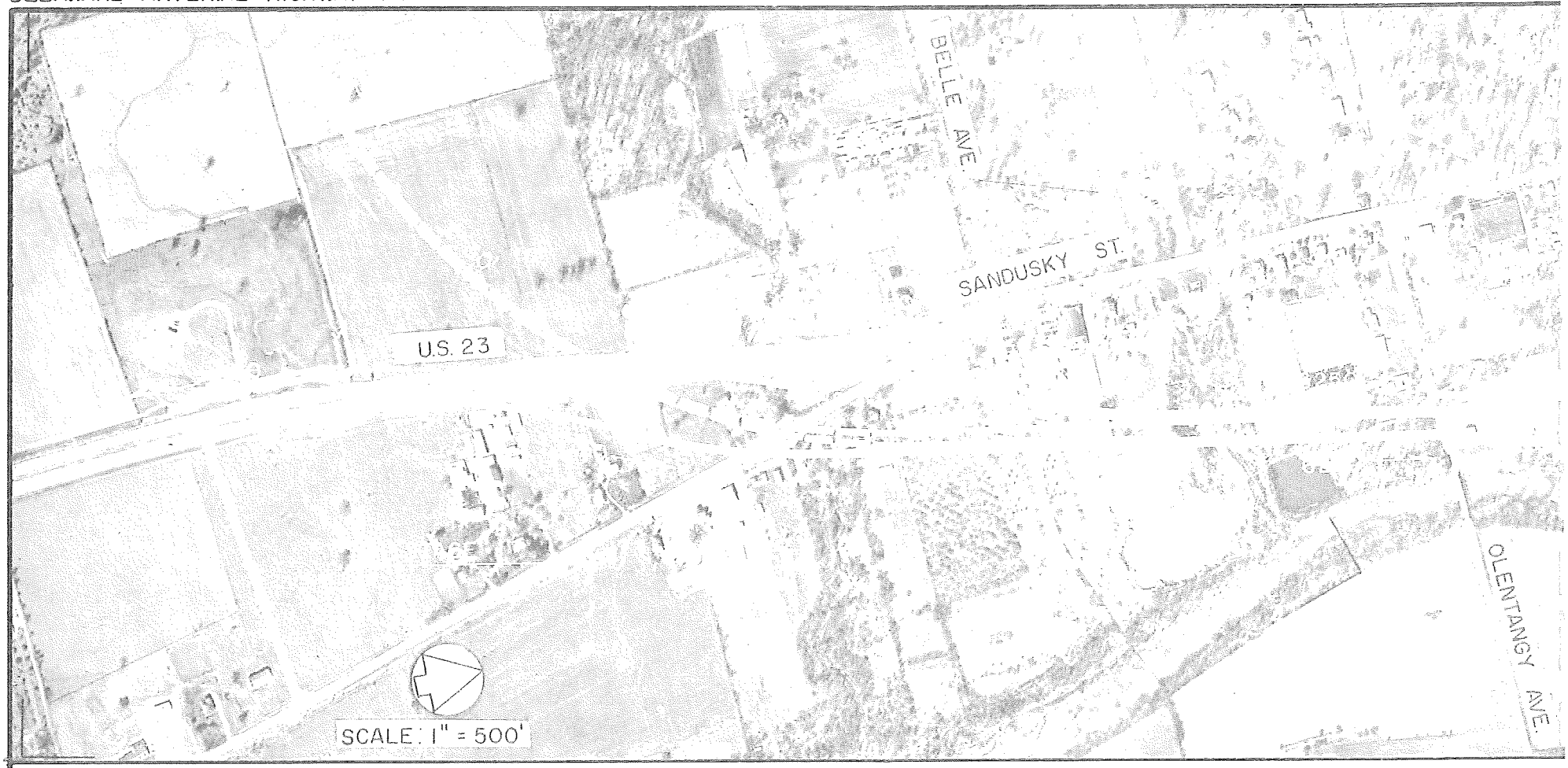

U.S. 42
C.&O. R.R.
SCALE: 1" = 500'

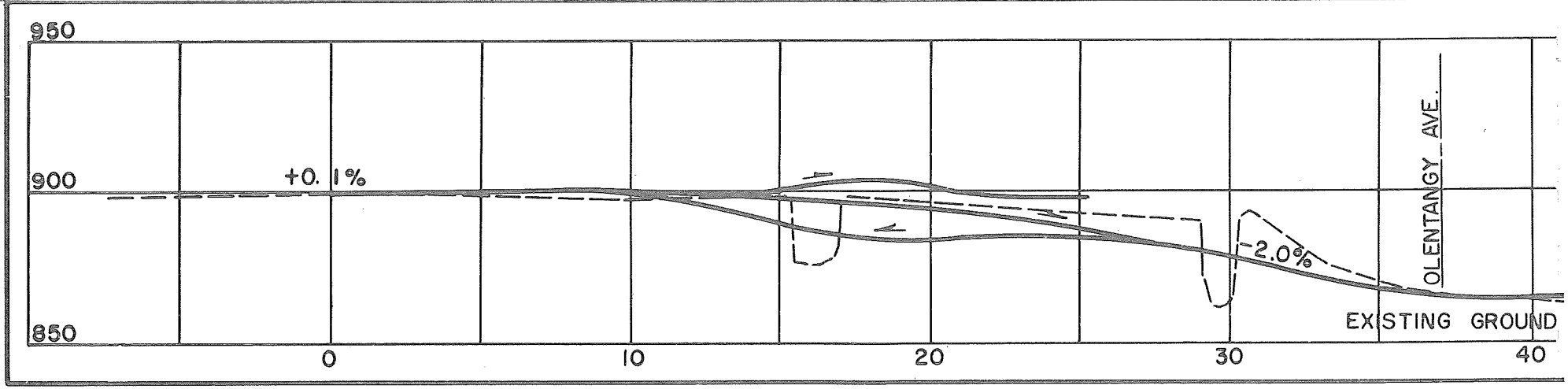

970
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-0.2%
+1.0%
U.S.42
C&O. R.R.
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30
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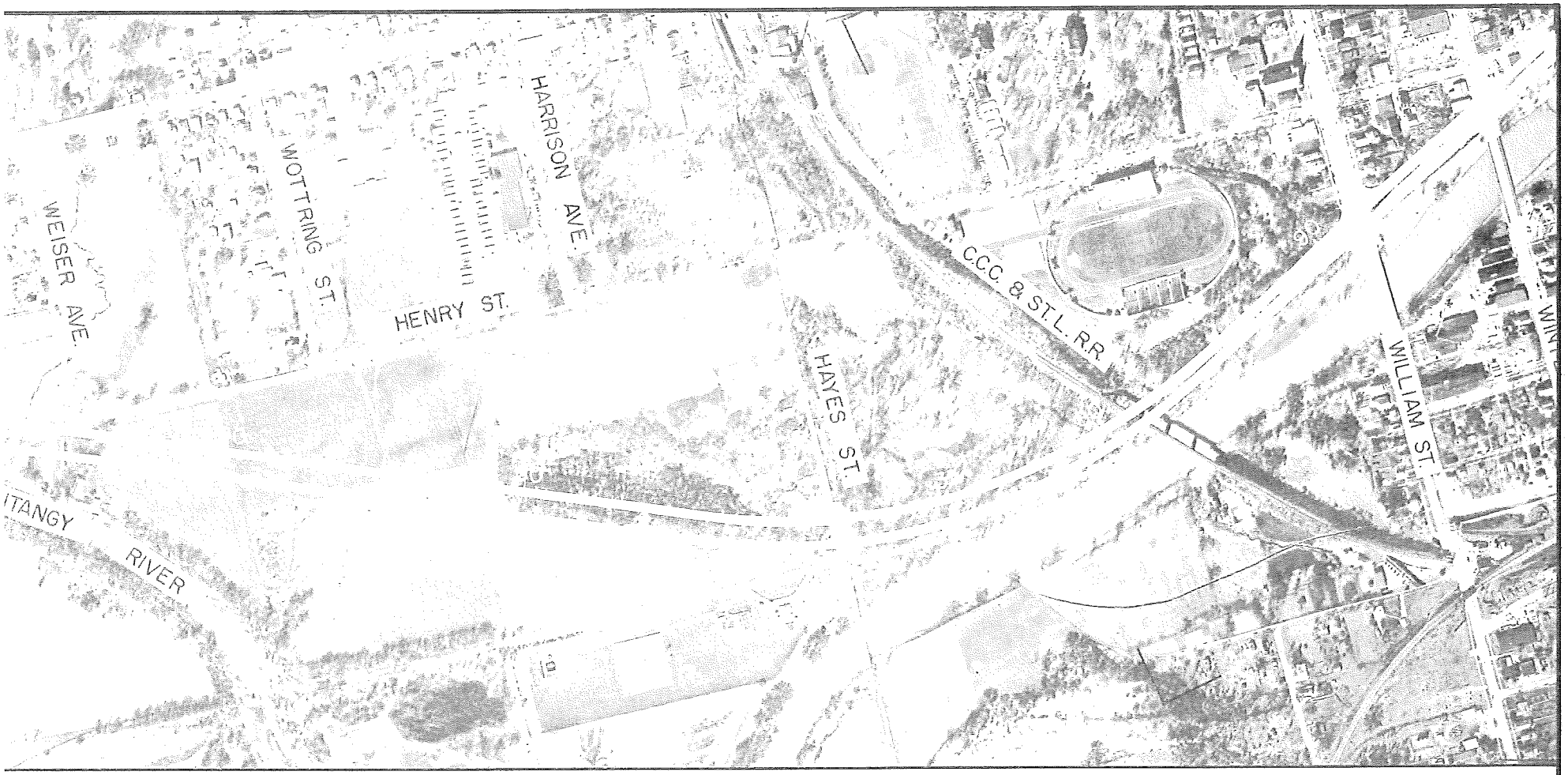


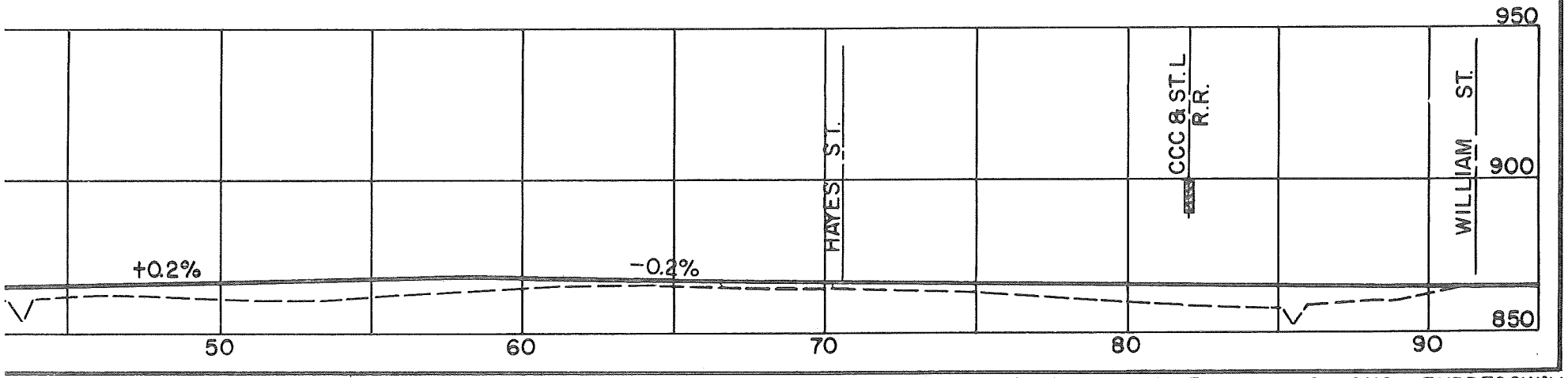


PLAN AND PROFILE OF U.S. ROUTE 42 RELOCATED SOUTHWEST


BELLE AVE.
SANDUSKY ST.
U.S. 23
OLENTANGY AVE.
SCALE: 1" = 500'

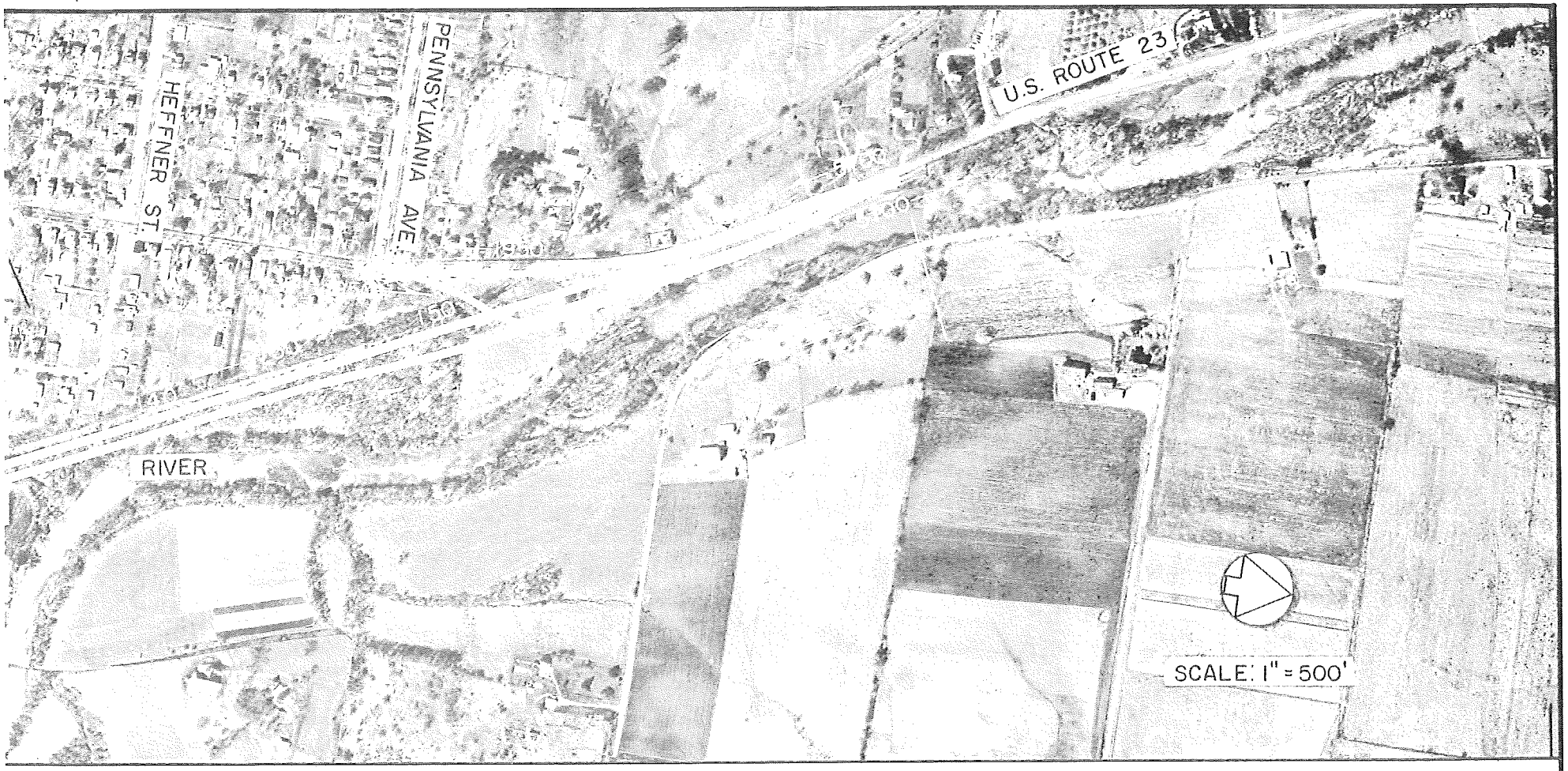

950
900
850
+0.1%
-2.0%
OLENTANGY AVE.
EXISTING GROUND
0
10
20
30
40

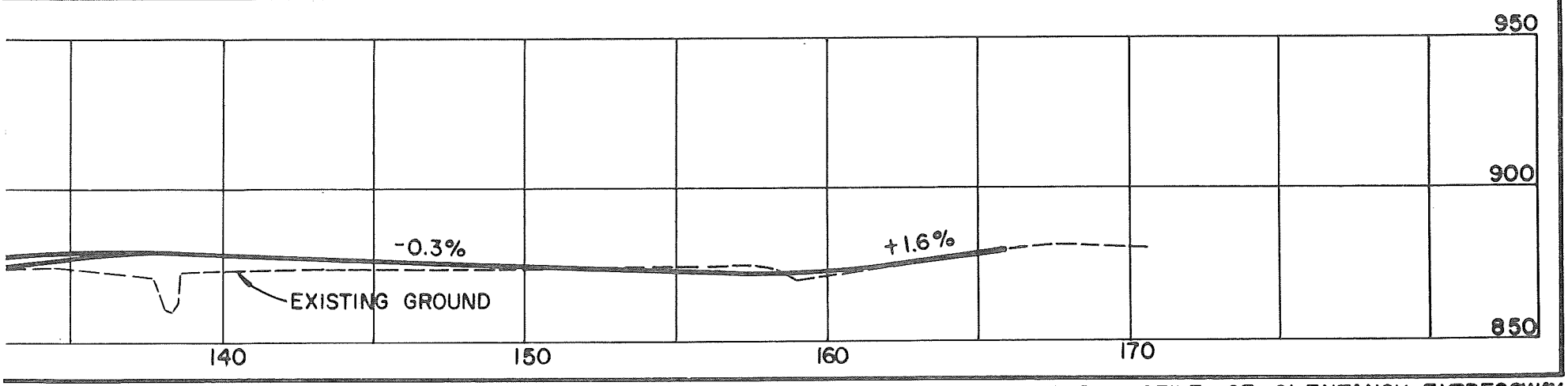




PLAN AND PROFILE OF OLENTANGY EXPRESSWAY

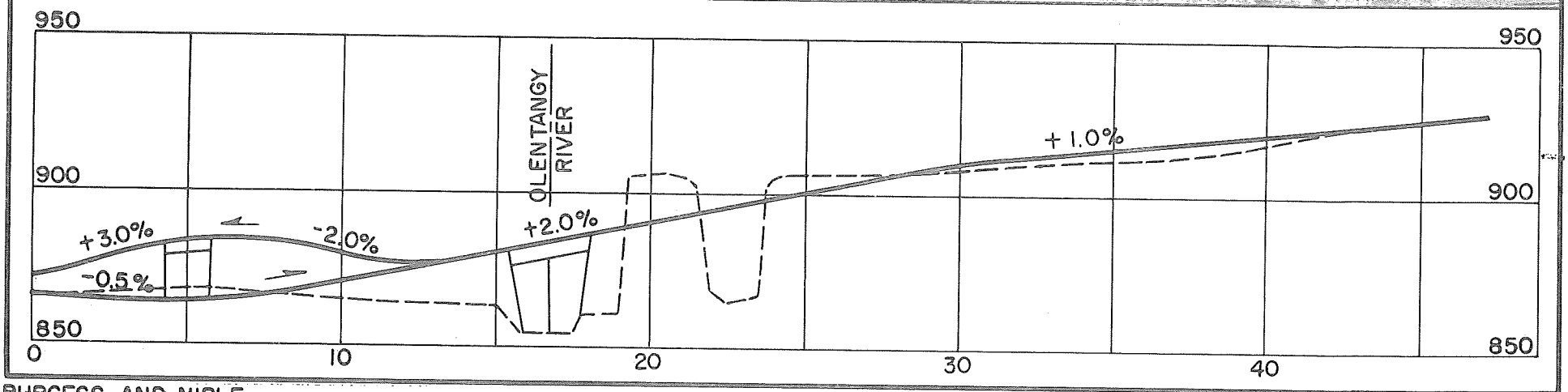

C.C.C. & ST.L. RR.
WILLIAM ST.
WINTER ST.
CENTRAL AVE.
OLENTANGY
LINCOLN AVE.
FOUNTAIN AVE.
SANDUSKY ST.
UNION ST.
BLYMER ST.
STATE
950
900
850
C.C.C.&ST.L. R.R.
-0.2%
+0.2%
-0.2%
+0.6%
+1.2%
80
90
100
110
120
130





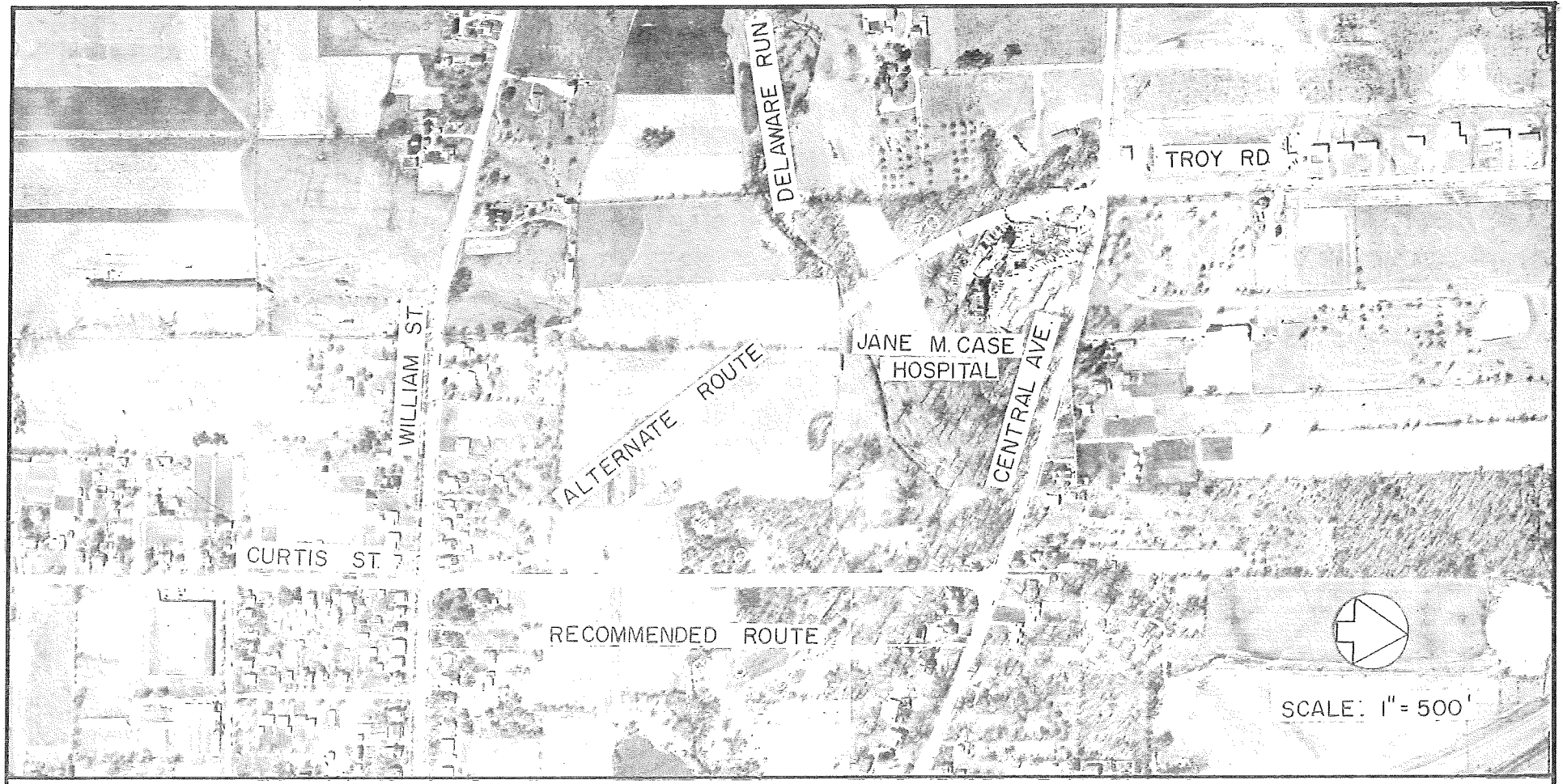
PLAN AND PROFILE OF OLENTANGY EXPRESSWAY

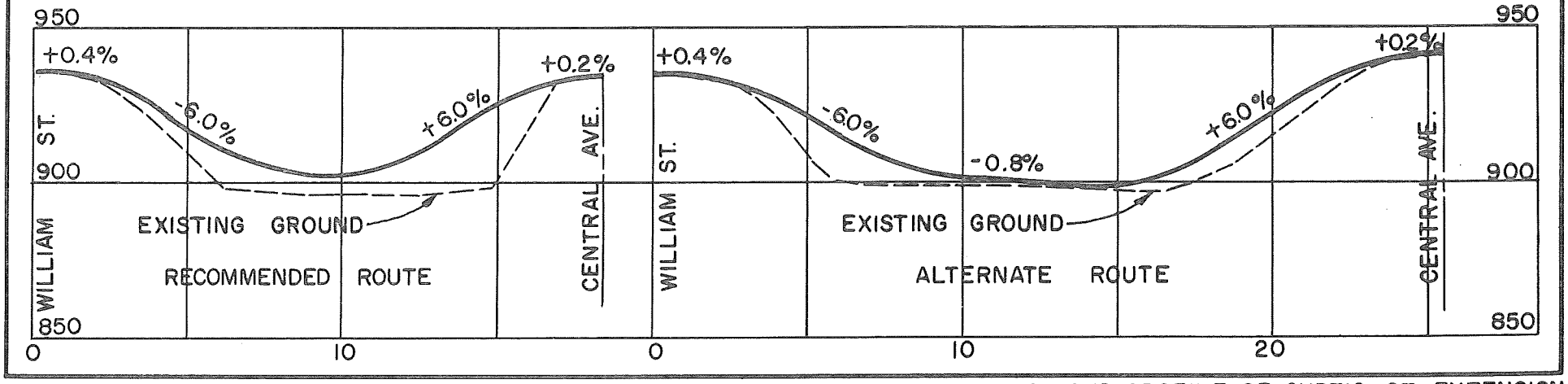




BURGESS AND NIPLE

PLAN AND PROFILE OF U.S. ROUTE 42 RELOCATED NORTHEAST





BURGESS AND NIPLE

PLAN AND PROFILE OF CURTIS ST. EXTENSION

Other Improvements

Section 4 is a new bridge over the Olentangy River at Central Avenue. This new structure should provide four lanes of traffic and sidewalks to replace the existing structure.

Section 5 is an additional arterial city street connecting William Street and Central Avenue in the area west of of the Chesapeake and Ohio Railroad tracks. A line extending Curtis Street north from William Street to Central Avenue would be an excellent location to tie the new residential area north of Central Avenue to the industrial area in the southwest section of the city. An alternate location for this street would be a curving alignment that would connect Troy Road and Curtis Street. A pavement width of forty-eight feet is recommended.

Comments by Approving Agencies

Comments received from State and Federal Agencies on design features of the plan included requests for further information on the economy of providing a frontage road to the large landlocked area between the expressway and the Olentangy River near the south corporation line of the City. The Agencies also questioned the acceptance by the Delaware County Commissioners of the cul-de-sac on the county road just west of the river in this same area.

A triangular tract of land of approximately 25 acres lying between the proposed expressway and the river will be left landlocked by the recommended plan, unless a frontage road is constructed parallel to the expressway through this area. Preliminary estimates, based on tax values of the parcels of property involved, indicate a complete taking of the properties would be the most economical treatment. However, this problem should be re-examined during the detailed plan phase of the project, using actual appraised values for the properties involved and exact right-of-way lines.

The access road, shown on Plate 14, connecting the county road immediately west of the river with U.S. Route 23, will provide equivalent service to all but three properties on the county road. The extra travel distance involved for these three properties, which lie north of the proposed access road, is minor. This arrangement, including the cul-de-sac of the county road, should be approved by the Delaware County Commissioners early in the detailed plan phase of the project.

ALTERNATE FREEWAY CONSTRUCTION

Considerable study and thought was given to a freeway type construction for the recommended route in the William Street to Central Avenue area. Such construction is feasible and provides substantial additional benefits to both local and through traffic when compared to an at-grade facility. Freeway construction would provide for grade-separation structures that would carry the expressway over the three major cross streets; William Street, Winter Street, and Central Avenue. Ramps would be provided south of William Street and north of Central Avenue. Cost estimates and plans for this alternate design have been prepared and are made a part of this report.

A grade separation for the interchange of traffic is the ultimate solution to the intersection at-grade. It promotes safety and develops the maximum traffic capacity of the intersecting roadways. Crossing conflicts are eliminated by the grade separations and turning conflicts are minimized, depending upon the type and degree of development of the interchange.

Numerical warrants for traffic interchanges in urban areas have not been developed for the State of Ohio. For highway design in which the freeway type of construction is not mandatory, logical warrants that would justify grade separated interchanges are those based upon either traffic demands or benefit cost ratios.

Capacity analyses of the three cross street intersections with an at-grade expressway indicate that these intersections would handle the design hourly traffic volumes and retain some fifteen percent reserve capacity. These intersections were based on a four lane width for Central Avenue; the present width of this street is inadequate for either type construction.

One approach in determining the benefits to traffic of an interchange or freeway construction at spot locations is the tabulation of tangible saving accruing to the motoring public by use of the higher type facility. These benefits can be listed as gasoline or fuel savings, reduction in maintenance costs due to the elimination of stop and go driving, accident savings and time savings. Assuming no time savings, it is estimated that motorists will save 0.0113 dollars per vehicle mile for freeway operation. Average annual road user savings of $75,000 per year would be realized by constructing this expressway to full freeway standards. Assuming a four percent interest rate, the benefits to motorists over a twenty year period would amortize an additional $1,020,000 in construction costs.

Another approach might be the evaluation of the additional cost to motorists due to stops and delays at the at-grade intersections with the three cross streets. As-

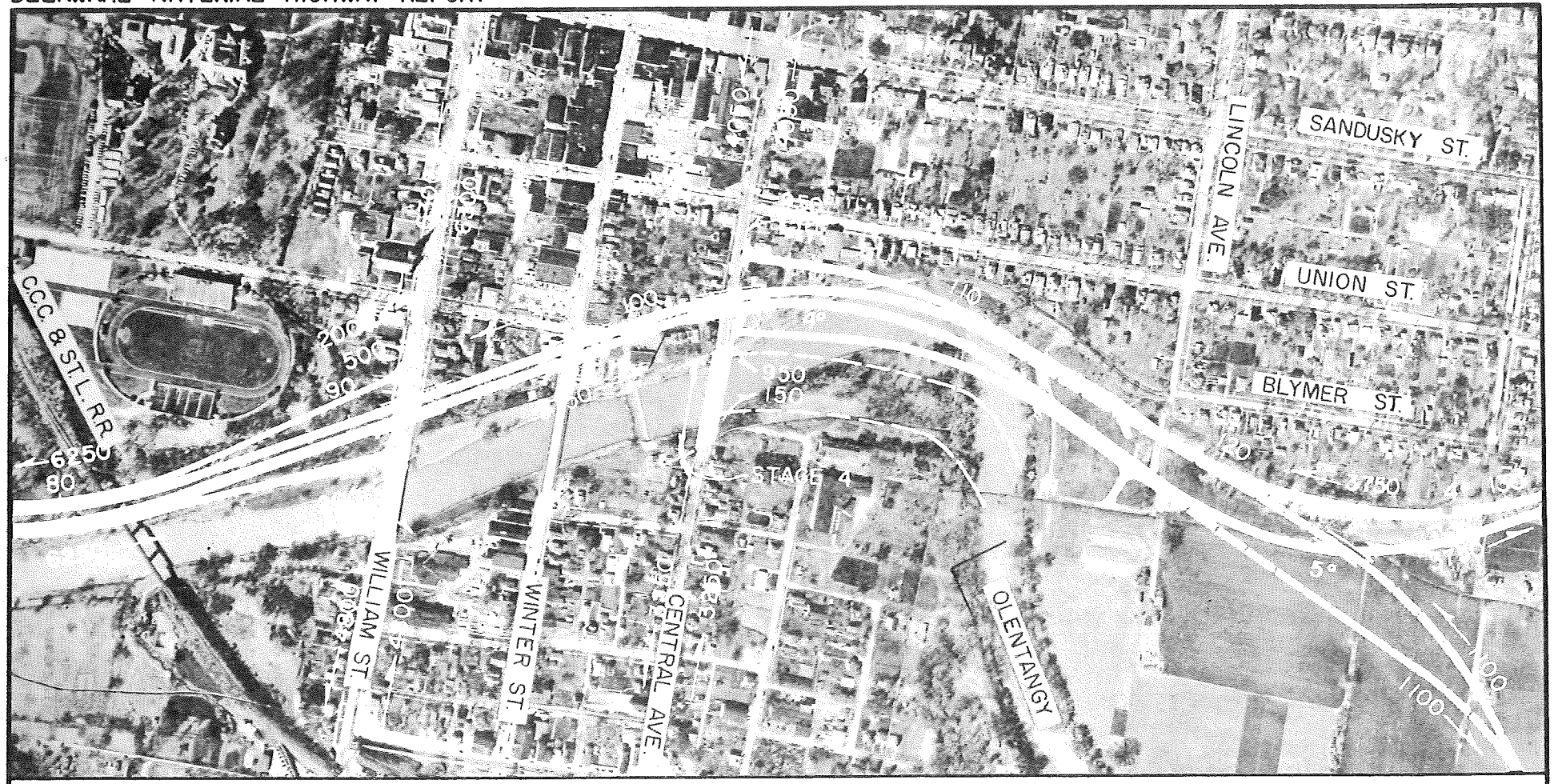
suming an average cost of one and one-half cents per stop the cost of stops and delays to motorists on the expressway and on the three local streets intersecting the expressway would average approximately $56,000 per year. This sum would amortize an additional $760,000 of new construction. To summarize; the economic studies indicate an additional expenditure of $760,000 to $1,020,000 is warranted in order to eliminate at-grade intersections with the major cross streets. These benefits to road users do not include the intangible benefits of uninterrupted traffic flow on the expressway or the value of time savings to the motorist. A grade separation will enable the cross streets and the expressway to handle much higher traffic volumes and therefore provide for traffic growth beyond the design year and for conditions presently unforeseen that may result in much higher usage of the proposed expressway.

The expressway-at-grade would occasionally become loaded to capacity at the intersections during very heavy peak traffic flows occurring a few times a year, such as during long holiday week-ends. Freeway construction would carry these peak loads without interference to local cross street traffic. These unusual and infrequent peak loads are not fully reflected in the design year traffic volumes used.

The design hourly volumes forecast for the cross street intersections of the expressway with William Street and Central Avenue are in a borderline area where either expressway-at-grade or freeway construction may be used. In the early development of this report, Ohio State Highway Department officials urged that freeway construction be used in the William Street to Central Avenue area.

The question of freeway vs. at-grade construction was therefore thoroughly investigated during the preparation of this report, and the advantages and disadvantages of each type discussed with city officials. The decision made by the local officials, favoring the at-grade construction, was based on several factors, and are listed below.

1. The predicted design year traffic can be carried by the at-grade intersections with approximately 15 per cent reserve capacity available. The expressway-at-grade would adequately serve the needs of the community and cost considerably less than freeway construction.
2. The at-grade intersections will provide more direct connections between Routes 36 and 37 and the expressway than the split diamond freeway interchange.
3. The at-grade construction will provide easier access of local traffic to and from the relocation. The three cross streets can all be used for direct access to the new improvement.
4. Existing U.S. Route 23, although now constructed as a four lane divided highway in rural areas from Delaware to the Ohio River, has only one urban freeway section, at Circleville. North of Delaware, present planning does not contemplate any development of U.S. Route 23 to freeway standards.


SANDUSKY ST.
LINCOLN AVE.
UNION ST.
BLYMER ST.
C.C.C. & ST.L. RR.
STAGE 4
WILLIAM ST.
WINTER ST.
CENTRAL AVE.
OLENTANGY

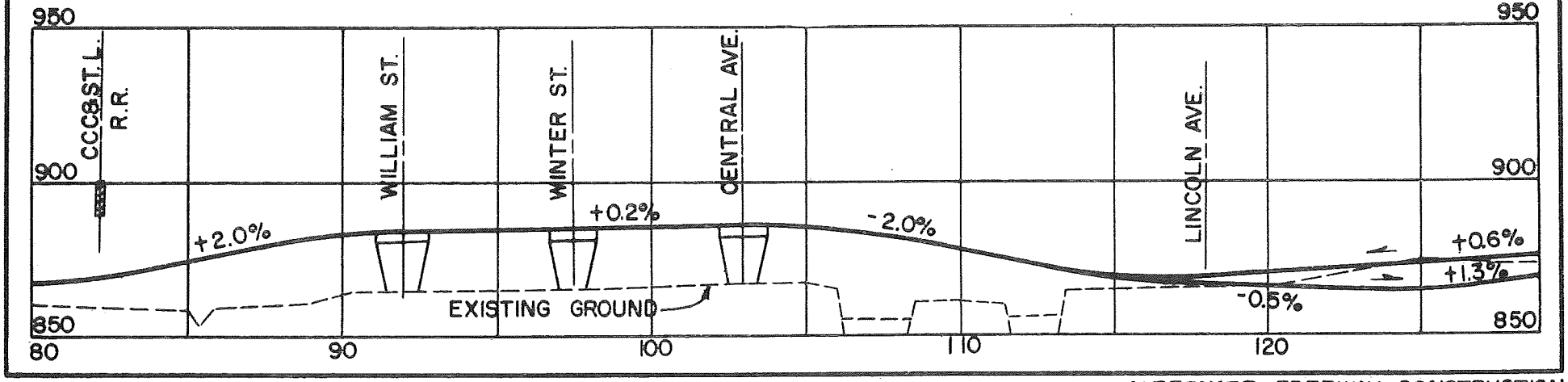
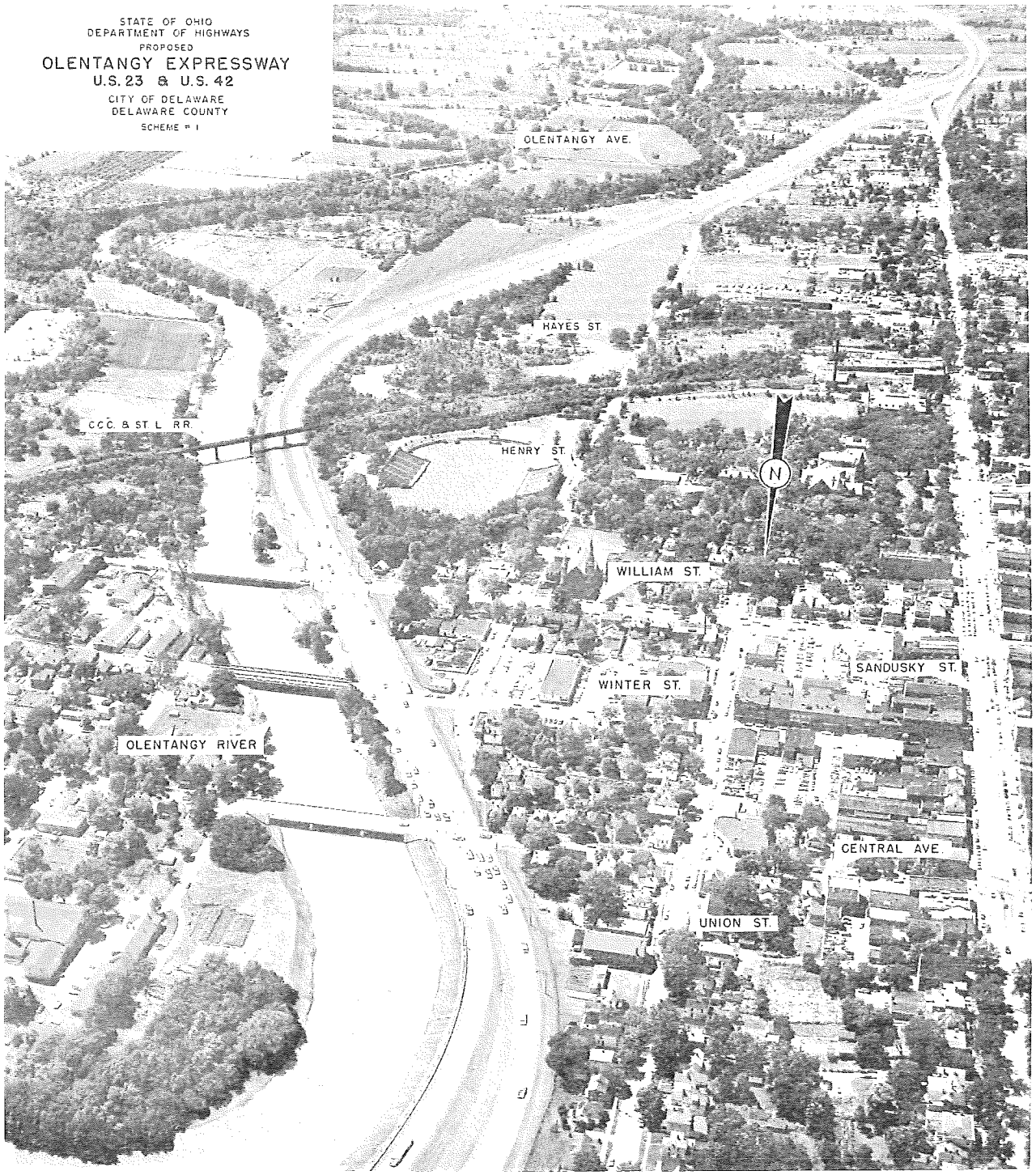

950
900
850
C.C.C.&ST.L. R.R.
WILLIAM ST.
WINTER ST.
CENTRAL AVE.
LINCOLN AVE.
+2.0%
+0.2%
-2.0%
+0.6%
+1.3%
-0.5%
EXISTING GROUND
80
90
100
110
120

PLATE 19

DELAWARE ARTERIAL HIGHWAY REPORT

AERIAL VIEW OF U S ROUTES 23 & 42 RELOCATED AS AN EXPRESS-AT-GRADE



BURGESS AND NIPLE

PLATE 20

DELAWARE ARTERIAL
HIGHWAY REPORT



AERIAL VIEW
OF
U S ROUTES
23 & 42
RELOCATED
AS
FREEWAY

BURGESS AND NIPLE

PRIORITY OF CONSTRUCTION

The complete system as recommended must be constructed to allow traffic to flow properly over the entire system and to obtain the maximum benefits from the improvements. However, to provide for more convenience in programming, financing and construction, and cause less interruption to existing traffic, the system may be divided into stages and the work spread out over several years. The suggested stages are shown on the plan and profile drawings included in this report, are numbered in the order of their recommended priority of construction, and correspond to the sections of the same number.

Stage 1, of first priority, includes the entire Olentangy Expressway or the U.S. Route 23 relocation. Construction of this section of the system can be accomplished with only minor disruption of traffic and will remove a substantial amount of through traffic from the city streets.

Stage 2 consists of the relocation of U.S. Route 42 south of the city. This stage may very conveniently be constructed as a separate contract if so desired, with no inconvenience to traffic during the construction period. With the completion of Stage 1 and Stage 2, U.S. Route 42 traffic will be able to by-pass the main business district.

Stage 3 is the relocation of U.S. Route 42 from the expressway to the northeast. Upon completion of this section, U.S. Route 42 through traffic can be completely removed from the existing city streets. Until this section is completed, a heavy volume of turning movements would occur at the expressway intersections with William Street and Central Avenue. This section of new construction will also enable traffic to avoid hazardous alignment conditions on the existing route.

Stage 4 consists of a new four-lane bridge over the Olentangy River on Central Avenue. It may be deferred until the first three stages are completed, or it could be constructed as part of Stage 1. It is needed to provide the required capacity for Route 37 and the intersection with the expressway.

Stage 5 is a new arterial street in the western section of the city. The final line of the improvement within the area between Troy Road and Curtis Street may depend on agreements with the property owners involved. This street would not be a controlled or limited access facility. It should aid substantially in the development of the western section of the city. Stage 5 is not on any federal or state highway system and would not be eligible for any financial assistance from these agencies. It would be necessary to construct this improvement with local funds.

ESTIMATED COST

The tables included in this chapter of the report present a tabulation of the unit prices of the various items used in the construction cost estimates; total costs of the various sections of the recommended plan, and a division of costs of the various sections into rural and urban costs and the costs chargeable to the City of Delaware. Additional information on Section 1 using freeway type construction is included.

The cost of Section 5 is not included in the total costs with the other sections as it is not an integral part of the relocation of the two state highways.

Estimates of construction costs for the various sections of the recommended plan were based upon the unit prices for the items listed. Quantities were determined from the typical sections shown in this report and from preliminary line and grade established from aerial photographs and existing city maps.

Right-of-way costs within the urban area of the City of Delaware were obtained by factoring the recorded tax values of the individual properties. In the rural areas, right-of-way values were appraised on a potential use basis, and varying values assigned per acre. The values used for rural acreage was made comparable to recent highway right-of-way purchases in Delaware County. Where farms were divided, damages to the larger remaining parcel of land were included in the right-of-way costs.

The table showing the cost of each section of the Arterial Highway Plan chargeable to the City of Delaware is based upon the current policy of the Ohio State Department of Highways for urban projects. This policy states that for cities of less than 38,000 population, the city shall pay 100 percent of utility relocation costs and engineering plan costs and 5 percent of all other costs. The city is required to share in only those costs occurring within its corporate limits.

To summarize, using the figures given in the tables on the estimates of costs, stage 1 construction will cost 2,510,000 dollars with approximately 155,000 dollars of local funds required. This same section, using freeway construction, would cost about 4,267,000 dollars with a local fund share of 295,000 dollars.

Stage 2 will cost 1,000,000 dollars with no local costs involved. Stage 3 will cost 865,000 dollars with a cost to the City of Delaware of 45,000 dollars. Stage 4, with a total cost of 317,000 dollars, requires 30,000 dollars from the city. The total cost to the City of Delaware, for the relocation of the two state highways, U. S. Routes 23 and 42, through the city, would be the sum of stages 1, 2, and 3, or 200,000 dollars.

UNIT PRICES USED FOR ESTIMATION OF COSTS

ITEM	DESCRIPTION	UNIT	UNIT PRICE
	ROADWAY AND DRAINAGE		
E–101	Roadway Excavation	cu. yd.	$ 0.80
E-3	Channel Excavation	cu. yd.	1.50
E–4	Borrow	cu. yd.	0.90
E–11	Water	M. gal.	4.00
I–10	Riprap	sq. yd.	10.00
I–15	Guard Rail, Type 2–A Std.	Lin. ft.	3.00
I–2	18'' Pipe for Storm Sewers	Lin. ft.	7.00
S–27	72'' Pipe for Roadway Culverts	Lin. ft.	50.00
I–4	6''Pipe Underdrains	Lin. ft.	1.50
I–8	Drainage Structures	each	300.00
SS–18	Fence, Type A	Lin. ft.	0.80
SS–18	Fence, Type C	Lin. ft.	3.00
	PAVEMENT		
T–71	9'' R.P.C. Concrete Pavement	sq. yd.	6.50
Spec.	9'' Bituminous Paved Shoulder	sq. yd.	2.75
I–22	6'' Subbase	cu. yd.	2.50
I–12	Concrete Curb, Type 6	Lin. ft.	2.50
S–25	Lighting Unit, Complete	each	600.00
	STRUCTURES		
S–0.02	Concrete Slab Bridges	sq. ft.	15.00
S–0.03	Steel Beam Bridges	sq. ft.	20.00
S–0.03	Railroad Bridges	sq. ft.	100.00

ESTIMATES OF COSTS
THE RECOMMENDED PLAN

STAGE AND SECTION	ROUTE	LENGTH MILES	CONSTRUCTION COST	R/W AND DAMAGES	ENGINEERING AND CONTINGENCIES	TOTAL COST
1	U.S. Route 23	3.14	$1,545,000	$640,000	$325,000	$2,510,000
2	U.S. Route 42, S.W.	1.89	780,000	55,000	165,000	1,000,000
3	U.S. Route 42, N.E.	0.89	615,000	120,000	130,000	865,000
4	Central Avenue Bridge	0.05	262,000	----	55,000	317,000
5	Curtis Street Extension	(0.36)	(150,000)	----	(32,000)	(182,000)
Totals for Sections 1, 2, 3, & 4		5.97	$3,202,000	$815,000	$675,000	$4,692,000

ALTERNATE FREEWAY CONSTRUCTION

1	U.S. Route 23 Freeway	3.14	$2,810,000	$865,000	$592,000	$4,267,000
Totals for Sections 1, 2, 3, & 4 With Freeway Construction		5.97	$4,467,000	$1,040,000	$942,000	$6,449,000

DIVISION OF COSTS
THE RECOMMENDED PLAN

STAGE AND SECTION	ROUTE	LENGTH MILES	URBAN LENGTH	TOTAL COST	RURAL COST	URBAN COST	COST TO CITY OF DELAWARE
1	U.S. Route 23	3.14	2.52	$2,510,000	$ 495,000	$2,015,000	$155,000
2	U.S. Route 42, S.W.	1.89	-----	1,000,000	1,000,000	-----	-----
3	U.S. Route 42, N.E.	0.89	0.32	865,000	365,000	500,000	45,000
4	Central Avenue Bridge	0.05	0.05	317,000	-----	317,000	30,000
5	Curtis Street Extension	(0.36)	(0.36)	(182,000)	-----	(182,000)	(182,000)
Totals for Sections 1, 2, 3, & 4		5.97	2.89	$4,692,000	$1,860,000	$2,832,000	$230,000

ALTERNATE FREEWAY CONSTRUCTION

1	U.S. Route 23 Freeway	3.14	2.52	$4,267,000	$ 495,000	$3,772,000	$295,000
Totals for Sections 1, 2, 3, & 4 With Freeway Construction		5.97	2.89	$6,449,000	$1,860,000	$4,589,000	$370,000

ECONOMIC JUSTIFICATION

The soundness of any business venture can be estimated by comparing derived benefits against costs. In a like manner the economic justification of a highway improvement can be determined. Many tangible and intangible benefits are provided to the expressway user and to the community in general. The intangible benefits such as preservation of the central business district, relief to congested streets and the resulting increase in business, increased property values, reduced accident rates, and a healthier atmosphere along Sandusky Street are difficult to evaluate. Therefore, only the tangible road user benefits of reduced operating costs, time savings and an estimate of the value of driver convenience can be used in the benefit analysis.

Well over 50 percent of the traffic presently using Sandusky Street is through traffic. This traffic is there because it is following a numbered route; it contributes little to the economy of the City of Delaware. On the other hand, this traffic congests the downtown section of the city and discourages many potential shopping trips from being made in this area. Consequently, outlying shopping areas develop and draw business away from downtown merchants. Soon property values in the central business district decline and a major source of tax revenue to the city is seriously threatened. The proposed expressway will carry a large percentage of this through traffic, leaving Sandusky Street and William Street available to serve shoppers and businessmen destined for the business district. Connections have been provided for through traffic on the expressway desiring to stop in Delaware. It is believed that the proposed expressway will maintain the health of the Delaware central business district and result in increased property values.

It is impossible to establish an accident cost per vehicle mile for the alternates being considered. Accident cost studies have been made in several New England states; however, since weather, traffic density and field conditions vary greatly as compared with Delaware, Ohio, assigning these costs to the alternate routes under consideration would not be correct. Accident costs are not compared in the benefit analysis.

An article by Robie Dunman in *Traffic Engineering,* November, 1956, "Economic Costs of Motor Vehicle Accidents," states that the average cost of accidents in one study was $400 per mile on rural roads and $4900 on congested city streets. It further states that approximately 38 percent of costs incurred in fatal accidents were attributed to pedestrians. The proposed expressway has a far greater likeness to a rural road than a city street. It was pointed out that numerous pedestrians and access points are a major cause of accidents on Sandusky Street. Incorporating limitation of access and carefully controlled intersections on the proposed route will make it far less accident prone than the existing route.

The proposed expressway skirting the west bank of the Olentangy River will provide an impressive approach to the City of Delaware, Ohio. A large portion of the noise and fumes associated with automotive traffic will be diverted from the center of the city. This alone will make downtown Delaware a more favorable place to work and shop.

Earlier it was stated that only tangible benefits can be evaluated in the economic analysis. These include the following three benefits accruing to the road users: reduced operating costs, reduced travel time and an assumed value per mile for comfort and convenience. These benefits are derived by an economic comparison, over a twenty year period, of the costs to the users of the expressway against costs to an equal number of vehicles making the same trips on the existing road network. The number of vehicles using the expressway was determined from an analysis of the traffic studies described earlier.

Operating cost and the value of time savings were computed as suggested in the *Informational Report on Road User Benefit Analysis for Highway Improvements* by the AASHO Committee on Planning and Design Policies. Monetary values were adjusted in accordance with current composite prices. The value of comfort and convenience was assumed to be as recommended in the AASHO report. In accordance with usual procedures, aggregate cost of the whole project was amortized at 3 percent over a twenty year period to arrive at the yearly cost of the improvement. This figure includes right-of-way, engineering and contingencies.

The benefit cost ratio of the project is the ratio of the estimated yearly benefits accruing to road users over a twenty year period to the yearly construction costs amortized plus the yearly maintenance cost.

ECONOMIC JUSTIFICATION FOR THE RECOMMENDED PLAN

1.	Yearly Road Users Cost with Expressway	$2,414,000.00
2.	Yearly Road Users Cost without Expressway	$4,151,500.00
3.	Yearly Benefit to Road Users	$1,737,500.00
4.	Yearly Cost of Expressway Amortized for 20 Yrs. @ 3% Interest plus Annual Maintenance Costs	$300,525.00
5.	Yearly Maintenance Cost for Existing Routes	$12,600.00
6.	Benefit Cost Ratio $\frac{3}{4 - 5}$	6.04