DRAFT ENVIRONMENTAL STATEMENT AND LOCATION STUDY REPORT

500 FACILITY POLK COUNTY

PROJECT NO. RF-500-1

IOWA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

DECEMBER 1976

FHWA - IOWA - EIS - 77 - 02 - D
FEDERAL HIGHWAY ADMINISTRATION
REGION 7

ARTERIAL HIGHWAY
500
IN POLK COUNTY
FROM
IOWA 5 TO INTERSTATE 80
ADMINISTRATIVE ACTION
DRAFT
ENVIRONMENTAL IMPACT STATEMENT

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
and
IOWA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

SUBMITTED PURSUANT TO 42 U.S.C. 4332 (2) (C) 23 U.S.C. 128 (a)

1-7-77
DATE

FOR THE DIVISION ADMINISTRATOR
FEDERAL HIGHWAY ADMINISTRATION

PREFACE

This Draft Environmental Statement/Location Study report is presented in two parts. The main body of the report contains information required for both environmental statement and location study purposes, and is organized in environmental statement format. Included is a section which discusses comparative analyses of economic and environmental costs and benefits which provides a basis for selection among the alternatives considered.

The Appendix contains the detailed studies which support the analyses and impact assessments presented in the main report.

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ADMINISTRATIVE ACTION
DRAFT ENVIRONMENTAL STATEMENT

ARTERIAL HIGHWAY 500
IN POLK COUNTY

DECEMBER, 1976

SECTION I

SUMMARY OF STATEMENT

SUMMARY SHEET - FHWA-IOWA-EIS-76-01-D
State Project No. RF-500-1

A. FEDERAL HIGHWAY ADMINISTRATION ADMINISTRATIVE ACTION FOR:

(x) Draft ( ) Final

(x) Environmental Statement

(x) Location Study Report

Additional information concerning this proposed project and environmental statement can be obtained from:

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Project Planning Engineer
Office of Project Planning
Highway Division
Iowa Department of Transportation
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B. DESCRIPTION

The proposed project involves the consideration of providing additional traffic capacity with a high mobility facility in a north-south corridor east of Des Moines. Upgrading of existing roadways to major arterial standards or constructing a major arterial highway on a new alignment will be examined as possible means of accomplishing this goal. The proposed highway would provide approximately 10.7 miles of additional traffic capacity, beginning in the vicinity of the junction of Iowa 5 and Iowa 46 near Avon, and would extend northward to Interstate 80 in the vicinity of Altoona.

Within a general corridor of approximately four to six miles in width, several possible route locations are being studied. An analysis and assessment of alternatives is presented in this statement in order to aid in the selection of the location and type of facility that will be functional, physically feasible, will coincide with area socio-economic and environmental concerns and will be consistent with statewide and Des Moines Urban Area transportation planning.

C. SUMMARY OF ENVIRONMENTAL IMPACTS AND ADVERSE ENVIRONMENTAL EFFECTS

The proposed project would:

- Provide a safer, more efficient north-south transportation facility on the east side of the Des Moines metropolitan area than presently exists.

- Connect with proposed Arterial Highway 592 to provide more efficient transportation service between the eastern and southern Des Moines metropolitan areas, and between Des Moines and the cities of Knoxville, Oskaloosa and Ottumwa to the southeast.

- Provide accessibility to the eastern Des Moines metropolitan area consistent with regional "balanced growth" planning objectives.

- Displace existing homes, farmsteads and commercial buildings.

- Divert 248 to 657 acres (depending upon alternative selected) of quality farmland to highway right-of-way, and precipitate the conversion of additional farmland to developed uses.

- Cause increased noise levels near the "Build" alternatives. Applicable noise standards are expected to be exceeded at several sensitive locations near the highway. Noise levels within the corridor will increase even if nothing is done.

- Cross the Des Moines River and other area streams and will cause soil erosion and sedimentary-type water pollution of these waterways during the construction period.

- Produce changes in the landscape, surface drainage, vegetation and wildlife habitat of the study corridor.

- Have roadways (for Alternatives 4 and 5) passing through a proposed private recreation area - the White's Lake area - located near the Des Moines River west of the Iowa Power and Light Company generating plant. These two alternatives would also take land from proposed open space corridors along the Des Moines River and in the Four Mile Creek valley. Alternative 5 would pass immediately adjacent to a proposed county park near Woodland Hills. None of the alternatives will take land from any publicly owned park, recreation area, wildlife or waterfowl refuge, or historic site having national, state or local significance wherein 4(f) land is involved.

- Intrude on the natural setting of the corridor and (for Alternatives 2, 3, 4) would intrude on existing residential areas.

D. ALTERNATIVES

Five alternatives are being considered for this project. Alternative 1, the "No-build" Alternative, involves a study of the corridor area to determine if building no major highway improvement would meet the future traffic, safety, and service needs of the area.

The other four alternatives, referred to as "Build" alternatives, involve the construction of a high-mobility highway within the corridor. All of the "Build" alternatives would begin at the terminal point of the proposed southern 592 Beltway, in the vicinity of the intersection of Iowa 5 and Iowa 46 and would proceed generally northward to Interstate 80 in the vicinity of Altoona.

Alternative 2 consists of the upgrading of a section of Iowa 46 and N.E. 56th Street to Class III arterial highway standards, with a Class II arterial highway connection between them. Alternative 3, the "Inner Freeway-East", which parallels Alternative 2, provides a freeway type facility close to the major developed areas of Pleasant Hill and Altoona. Alternative 4, the "Inner Freeway-West", provides a freeway type facility approximately along the east corporate limits of Des Moines. Alternative 5, the "Outer Freeway", provides a freeway-type facility bypassing east of the developed areas of Pleasant Hill and Altoona.

E. STATE GOVERNMENT AND MULTI-STATE RESPONSIBILITY

- o This action will have no effect on adjacent states or on any multi-state responsibility.

F. REVIEWING AGENCIES

Copies of this Draft Statement were sent to the following reviewing agencies for their comments:

Federal Agencies:

Department of Transportation
Department of Housing and Urban Development
Department of Agriculture
Department of Interior
Department of Health, Education and Welfare
Environmental Protection Agency
Army Corps of Engineers
Federal Aviation Administration
Federal Railroad Administration
Urban Mass Transportation Administration
Coast Guard

The statement was circulated through the State Clearinghouse, Office for Planning and Programming, to the following state agencies:

Iowa Development Commission
Department of Soil Conservation
Iowa Conservation Commission

Iowa Natural Resources Council
Department of Environmental Quality
State Historical Society
State Historic Preservation Officer
Office of the State Archaeologist
Iowa Department of Agriculture

Local Agencies:

Polk County Board of Supervisors
Warren County Board of Supervisors
Polk County Conservation Board
Central Iowa Regional Association of Local Governments
Warren County Regional Planning Commission
Southeast Iowa Regional Planning Commission
Mayor, City of Pleasant Hill
Mayor, City of Altoona
Mayor, City of Carlisle
Mayor, City of Des Moines
Mayor, City of Bondurant

Private Organizations:

Iowa Confederation of Environmental Organizations

This statement was made available to the Council on Environmental Quality on February 1, 1977.

SECTION II

DESCRIPTION OF PROPOSED ACTION, AND ALTERNATIVES CONSIDERED

A. OBJECTIVES AND PURPOSE OF PROPOSED ACTION

The proposed action is to provide a high mobility north-south highway facility along the eastern edge of the Des Moines Metropolitan area. The facility is intended to serve the growth that is expected to take place within the area, and to provide internal relief to the existing street and roadway system.

The highway - designated Arterial Highway 500 - was one element in the proposed statewide system of freeways and expressways which was adopted by the Iowa State Highway Commission in 1968, was included in the Revised Initial 1990 Des Moines Urbanized Area Transportation Plan, and is included in the Initial Iowa Transportation Plan (TransPlan '76) as part of the State Arterial Highway System.

There is at present no continuous highway route that can adequately and safely provide the service which will be provided by the proposed facility. Present north-south travel in the eastern Des Moines urban fringe area is circuitous, and is possible only on roads intended primarily for local traffic. Travel from northern Warren County to Eastern Polk County, and to Interstate 80 and 35 to the north, must be accomplished by using the existing Iowa 46 Des Moines river bridge crossing. The existing thru-truss bridge has a limited vertical clearance of 13'-9". Travel from the river north must follow either a combination of Iowa 46, University Avenue, N.E. 29th Street and Hubbell Avenue through the city of Des Moines, or one of the north-south county routes farther to the east. Springtime load restrictions on the county roads force truck traffic to and from the industrial area in south Pleasant Hill and Southeast Des Moines to use Des Moines city streets to reach Interstate 80, 35 and other routes north and east. Accident rates on the segments of Iowa 46, University Avenue (Iowa 163) and Hubbell Avenue (U.S. 65), within Des Moines, which are used for through north-south travel, are significantly higher than the statewide average rates for similar roadways, as noted in Section III D3 of this report.

In July, 1974, the Highway Division, Iowa Department of Transportation, undertook a Route Location Study and the preparation of a Draft Environmental Statement for the proposed Arterial Highway 500, within a corridor extending from the vicinity of the junction of Iowa 5 and Iowa 46 near Avon northward to Interstate 80 (Figure II-1). The study is based on projected residential, commercial and industrial development and traffic volume levels for the year 2000 and considers four alternatives for the location of the new highway facility in addition to the "No-Build" alternative. The Draft Environmental Statement examines a number of major factors that affect or will be affected by the alternatives considered; included are socio-economic, traffic service, engineering and environmental factors.

B. HISTORICAL BACKGROUND

A complete review of highway needs on Iowa's road and street system and related finances was performed in 1960. The highway needs and fiscal studies were called for in 1959 by the 58th General Assembly of Iowa in the passage of House Joint Resolution 12. Persuant to the resolution, the Iowa Highway Study Committee entered into an agreement with the Automotive Safety Foundation of Washington, D.C., to direct the necessary engineering studies required to determine highway needs. The needs study covered the years 1960 - 1980 and was compiled by the Automotive Safety Foundation in cooperation with the Iowa State Highway Commission, the 99 County Engineer offices, and the 51 municipalities of 5,000 or greater population. One of the significant recommendations of the study report was the statewide system of Freeways and Expressways to supplement the Interstate System.

After the 1960 study, the Highway Commission proceeded with origin and destination studies to pinpoint more closely proper freeway corridor locations, and to develop a segment-by-segment plan which included traffic and cost estimates. In 1967, the Highway Commission performed another series of traffic assignment studies on a Freeway-Expressway system to decide on final corridor locations, and to determine which routes would be freeway facilities in the final system, and which would be expressways. In February, 1968, the Commission adopted the revised Freeway-Expressway system which reflected facility changes in adjacent states and changes in socio-economic development in Iowa. This revised system contained the corridor location for proposed Arterial Highway 500. This highway is to be one of the links connecting I-80 with Arterial Highway 592 now in the "Final Design and Right-of-Way Acquisition" phase in Marion and Mahaska Counties.

In March, 1976, the Iowa Department of Transportation published the Initial Iowa Transportation Plan (TransPlan '76). Arterial Highways 500 and 592 are designated as four-lane components of the proposed State Arterial Highway System in the Roads and Streets Section of the Initial Plan (Figure II-2).

The sections of proposed Arterial Highways 500 and 592 east and south of Des Moines have become known as the Southeast Beltway. Interstate 35 and Interstate 80 presently comprise the west and north links in the Des Moines Beltway System. The Southeast Beltway was included in the Initial Des Moines Urbanized Area Transportation Plan (Initial DMUAT Plan) prepared as part of the Initial Metropolitan Plan Concept by the Central Iowa Regional Planning Commission (CIRPC) in 1972. The Initial DMUAT Plan was revised (Figure II-3) by CIRPC's successor agency, the Central Iowa Regional Association of Local Governments (CIRALG) in May, 1974, to reflect deletion of the proposed North-South Freeway through the City of Des Moines. The need for the south and east sections of the Beltway was outlined in a 1971 study (1) conducted during the preparation of the

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(1) Proposed Corridor for a Southeast Beltway in Conjunction with the Urban Transportation Plan, Staff Report to the Central Iowa Regional Planning Commission and Local Officials and Residents, CIRPC, November, 1971.

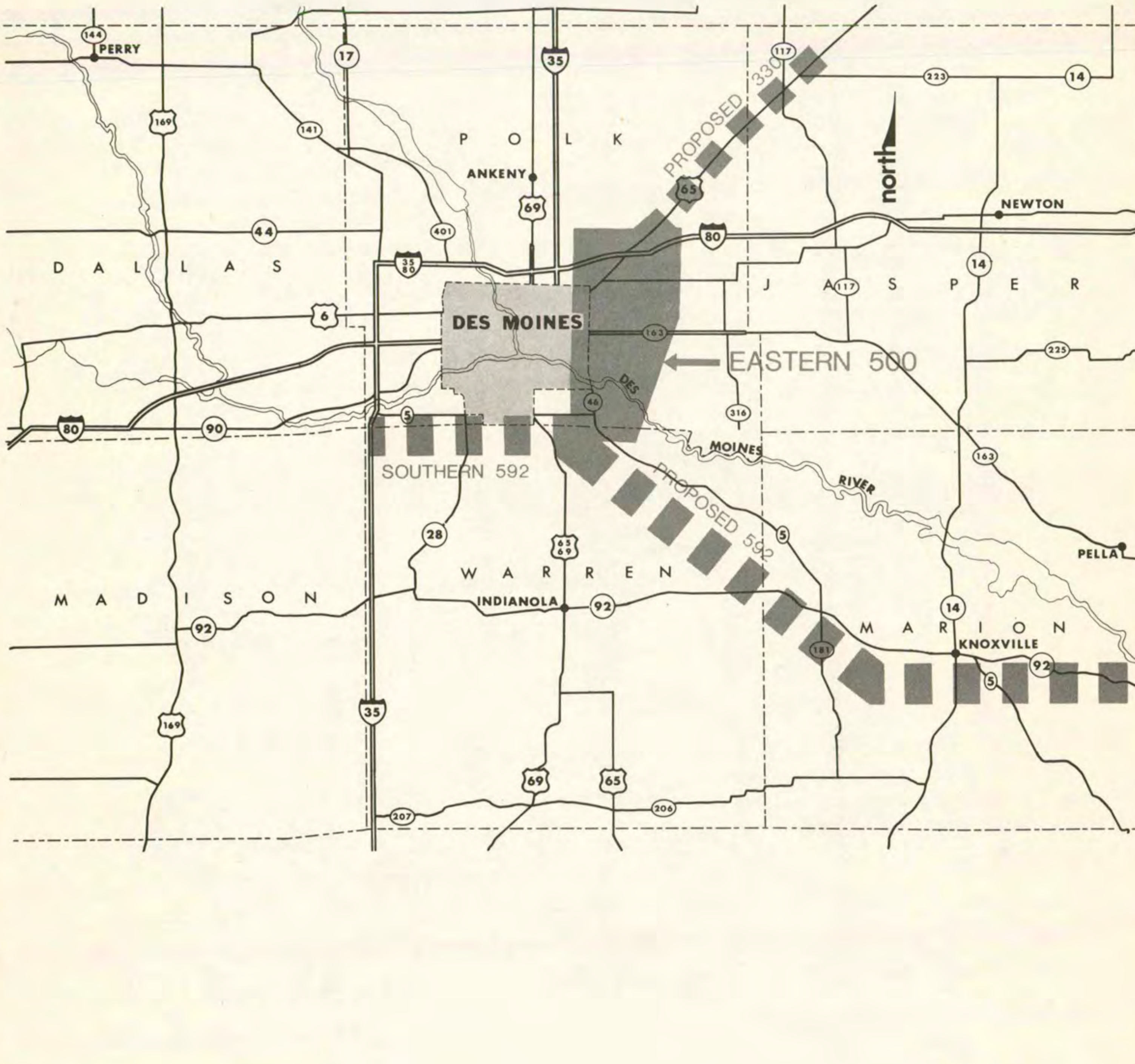
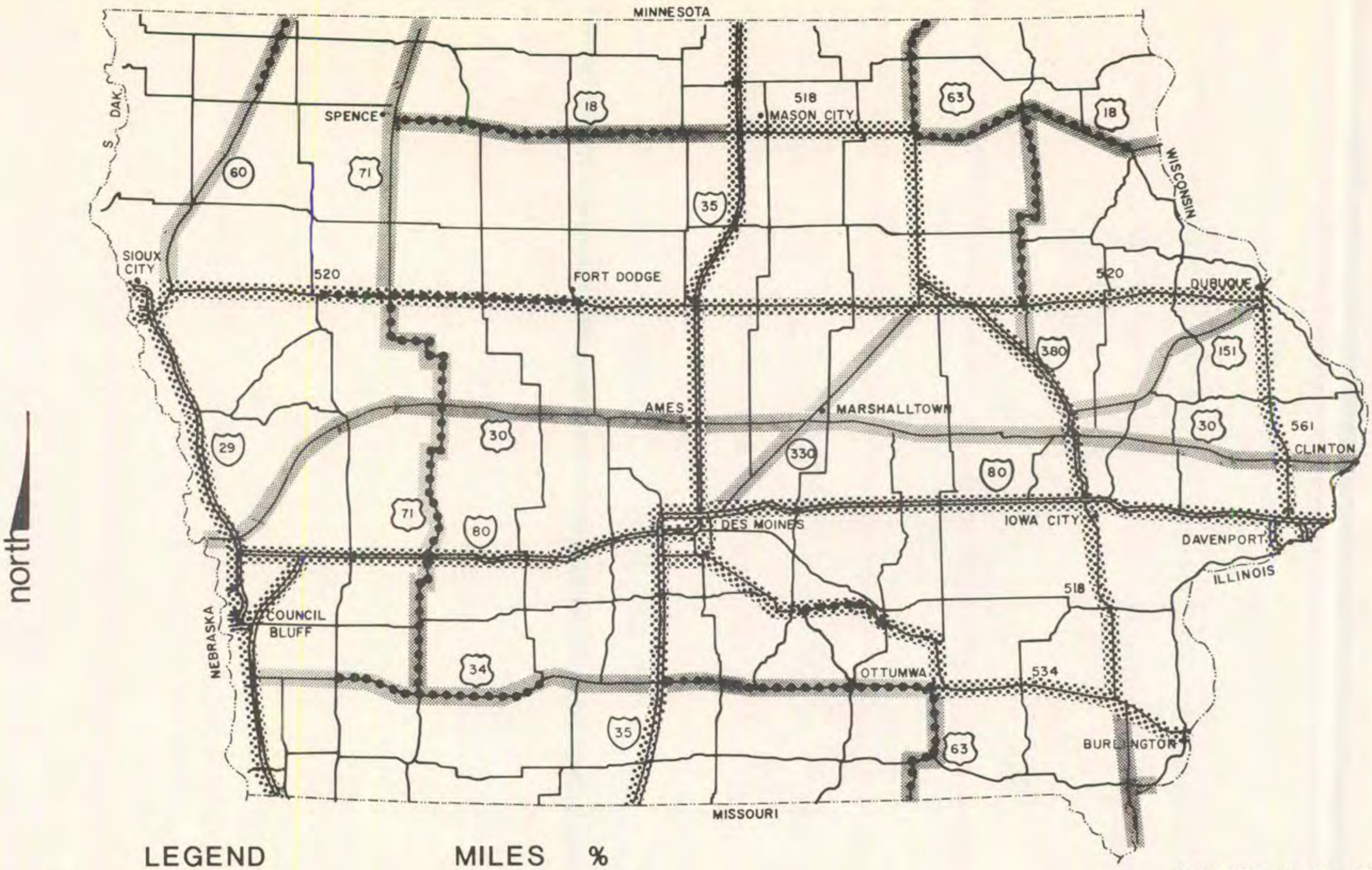


FIGURE II-1

LOCATION MAP

EDWARDS AND KELCEY, INC.



LEGEND

		MILES	%
STATE ARTERIALS	4-LANE	1486	15
	2/4-LANE	1238	13
	OTHER ARTERIALS	3506	36
	(NOT SHOWN) OTHER PRIMARY	3564	36
	TOTAL	9794	100

●●●●●● POST 2000

SOURCE: IOWA DEPARTMENT OF TRANSPORTATION

FIGURE II-2

PROPOSED STATE ARTERIAL HIGHWAY SYSTEM

EDWARDS AND KELCEY, INC.

Initial DMUAT Plan. The study indicated that the facility would:

1. Serve the substantial growth which is expected to occur in eastern Polk and northern Warren Counties over the next 20 to 30 years.

2. Improve east-west access across northern Warren County, improve north-south access across eastern Polk County and allow travel from northern Warren County to eastern Polk County without having to go through the City of Des Moines.

In July, 1973, the Iowa State Highway Commission moved to initiate studies towards the completion of the Southeast Beltway as part of the statewide Arterial Highway system. Arterial Highway 592, extending from Interstate 35 eastward to the vicinity of Iowa 5 and Iowa 46 near Avon, when completed, will serve as the southern link. Arterial Highway 500 will serve as the eastern link in the Beltway system. The relationship of the 500 facility to the other arterials in the area is shown in Figure II-2.

The section of Interstate 80 (the northern terminus of the study) between U.S. 69 north of Des Moines and U.S. 6 west of Newton was completed and opened to traffic in November, 1960.

The proposed Arterial Highway 500 also connects with proposed Arterial Highway 330 in the vicinity of Altoona. Arterial Highway 330 was included as part of the state Freeway-Expressway system in 1968. It extends northeasterly from Interstate 80, passing just to the north of Marshalltown, and terminates at Arterial Highways 518 and 520 just south of Cedar Falls. Highway 330 generally follows the present alignment of U.S. 65 and Iowa 330, a diagonal alignment extending between Des Moines and Marshalltown that was constructed in 1934.

C. STATUS OF PROPOSED ACTION AND CONSTRUCTION SCHEDULE

While this study deals only with the Eastern 500 link in the Beltway System, the completion of some type of high-mobility facility for the Southern 592 link (Figure II-1) was a necessary assumption in this study. An Interim Route Location Study Report and Draft Environmental Statement for the Southern 592 segment of the Beltway System were completed in June, 1974, and the Corridor Public Hearing for this segment was held in February, 1975. A decision on the Southern 592 facility was made by the D.O.T. Commission in October, 1976, with Alternative 4A, a four lane controlled access highway extending from I-35 in the west to the vicinity of Iowa 5 and Iowa 46 near Avon in the east, was approved for further development.

In the event that one of the Beltway 500 "Build" alternatives is selected for construction, the new 500 facility is expected to be opened to traffic in the middle 1980's.

D. DESCRIPTION OF THE STUDY CORRIDOR

The study corridor lies in southeastern Polk County, along the eastern edge of the Des Moines metropolitan area. The corridor extends generally from S.E.

72nd Avenue near Avon in the south, to Interstate 80 near Altoona in the north. Corridor width varies from approximately four miles in the south to six miles in the north, with E. 36th Street in Des Moines forming the western boundary.

The western and northern portion of the study corridor, which includes the eastern edge of the City of Des Moines and the communities of Altoona and Pleasant Hill, is quite heavily developed, with residential land use predominating. The eastern and southern areas, and the areas between the developed communities, are largely agricultural. Industrial development is confined largely to the southeastern corner of the City of Des Moines and south Pleasant Hill, along Iowa 46 and Vandalia Drive, while commercial activity is concentrated along N.E. Hubbell Road and U.S. 6 near Altoona.

Terrain in the study corridor is relatively flat in the central and northeast areas, and in the Des Moines river flood plain. The bluff lines along both the north and southwest edges of the Des Moines river valley and along the lower reaches of Four Mile Creek in Pleasant Hill are quite steep.

E. DESCRIPTION OF ALTERNATIVES CONSIDERED

1. General

The three general alternatives considered for this study are: (1) making no major highway improvements within the corridor, the "No-Build" alternative; (2) upgrading a portion of existing Iowa 46 and N.E. 56 Street with a segment of new controlled access highway joining them; and (3) construction of a major arterial on a new alignment. These alternatives represent a range of options in terms of geographic location, traffic service, socio-economic and environmental implications, and costs. All alternatives would connect with the proposed Southern 592 Beltway, and with proposed Arterial Highway 592 to the southeast.

The locations of the alternatives were developed in consideration of existing and proposed land use and transportation facilities, and of the social and environmental characteristics of the Des Moines metropolitan area and the "500" study corridor. The alternative routes are shown in Figure II-4. All alignments were developed according to accepted American Association of State Highway and Transportation Officials (AASHTO) criteria, and Iowa design standards for Class I, Class II or Class III highways. A Class I fully controlled access facility is designed to provide access only through interchanges at designated public roads. A Class II controlled access facility provides access at interchanges, but also allows at grade ingress and egress at designated public road intersections. A Class III controlled access facility provides for at grade access at other approved points in addition to public road intersections.

Alternatives 3, 4 and 5 are Class I highways. Alternative 2 has Class III access control on the upgraded segments and Class II access control on the new alignment segments. Typical cross sections for major arterial facilities are shown in Figures II-5 and II-6.

SOURCE: CENTRAL IOWA REGIONAL ASSOCIATION OF LOCAL GOVERNMENTS.

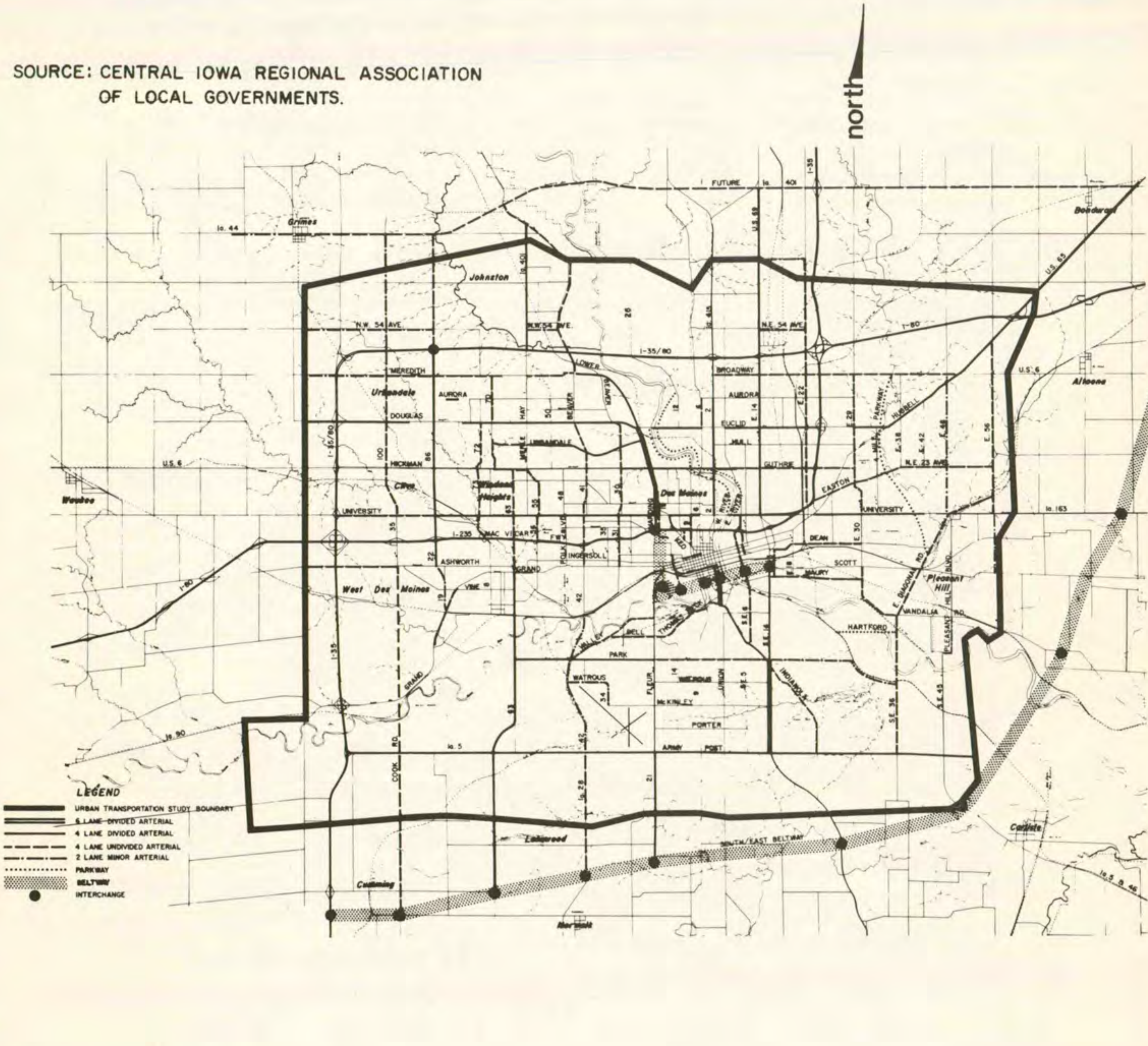


FIGURE II-3

REVISED INITIAL 1990 DES MOINES URBANIZED AREA TRANSPORTATION PLAN (MAY 1974)

2. *Alternative 1 – "No Build"*

An alternative that must be considered in the development of any project is the possibility of doing nothing. Alternative 1, the "No-Build" alternative, assumes no major new highway improvement equivalent to the proposed 500 facility within the study corridor. The upgrading of east-west and north-south roads within the corridor as proposed in the Initial Des Moines Urbanized Area Transportation Plan (Figure II-3) is assumed.

3. *Alternative 2 – "Major Upgrading"*

Alternative 2 will provide for major north-south travel within the study corridor by upgrading existing roadways. As an upgrading alternative, it utilizes existing right-of-way wherever possible, and provides appropriate connections to the existing street and roadway network.

This alternative is a four-lane divided arterial with a 40 foot median. It is approximately 9.1 miles in length. Traditional local access would be maintained wherever possible along the upgraded segments. Combined driveways would be used wherever feasible. A right-of-way width of up to 230 feet would be required in the developed areas. Additional right-of-way would be required in the undeveloped areas.

Starting at Iowa 5 (Army Post Road) on the south, Alternative 2 follows the present Iowa 46 alignment north, and crosses over the Chicago, Rock Island and Pacific Railroad south of the Des Moines River. Just south of the river the alignment swings east away from existing Iowa 46 and crosses the river just downstream from the existing bridge.

The alignment continues north-northeastward bypassing east of the gas and petroleum storage facilities of Hydrocarbon Transportation, Inc. and Williams Brothers Pipeline Company, crosses Four Mile Creek and interchanges with Vandalia Drive. A grade separation over Vandalia and the Norfolk and Western Railroad is proposed for this location. Relocation of a section of power transmission line will be required in this area. The alignment continues north-northeastward paralleling the power transmission lines, turns northeast through Carbondale and then turns north to align with N.E. 56th Street at Iowa 163. At-grade intersections are provided at S.E. 6th Avenue and Rising Sun Drive, and S.E. Shadyview Boulevard near S.E. 6th Avenue will be realigned to facilitate an at-grade intersection.

North of Iowa 163 the alignment follows existing N.E. 56th Street. A grade separation is provided over the Chicago, Rock Island and Pacific Railroad. At-grade intersections are provided at N.E. 27th Avenue and Douglas Avenue. North of Douglas Avenue the alignment turns northwest and terminates at an interchange with N.E. Hubbell Avenue (U.S. 65) with access to Interstate 80 via Hubbell Avenue. An at-grade intersection is provided at U.S. 6.

4. *Alternative 3 – "Inner Freeway – East"*

Alternative 3 is a Class I major arterial designed to freeway standards.

Its right-of-way varies from 300 feet to 350 feet depending on the depth of cut and fill. It is approximately 10.7 miles in length.

Its southern origin is at an interchange at the eastern terminal point of proposed Beltway 592 located near the intersection of Iowa 5 and Iowa 46, in the vicinity of Avon. From that point, Alternative 3 turns north and crosses over the Chicago, Rock Island and Pacific Railroad, under S.E. 40th Avenue and over the Des Moines River, just downstream from the existing Iowa 46 bridge. North of the river Alternative 3 has the same alignment as Alternative 2. Like Alternative 2, an interchange at Vandalia Drive provides a grade separation over the roadway and the Norfolk and Western Railroad tracks. The alignment through this area will require relocation of some sections of transmission lines.

Alternative 3 follows the alignment of Alternative 2 through the Carbondale area and then turns northward to interchange with Iowa 163 approximately one quarter mile east of N.E. 56th Street. Grade separations are provided at S.E. Shadyview Boulevard, S.E. 6th Avenue and Rising Sun Drive.

North of Iowa 163, Alternative 3 parallels N.E. 56th Street, crossing over the Chicago, Rock Island and Pacific Railroad, East Four Mile Creek, and N.E. 27th Avenue. The alignment turns northwestward passing under N.E. 56th Street near Douglas Avenue then turns north again, just south of U.S. 6. The alignment terminates at an interchange with I-80. Partial interchanges are provided at U.S. 6 and at N.E. Hubbell Avenue (U.S. 65). The interchange at I-80 will cause relocation of the existing weigh station.

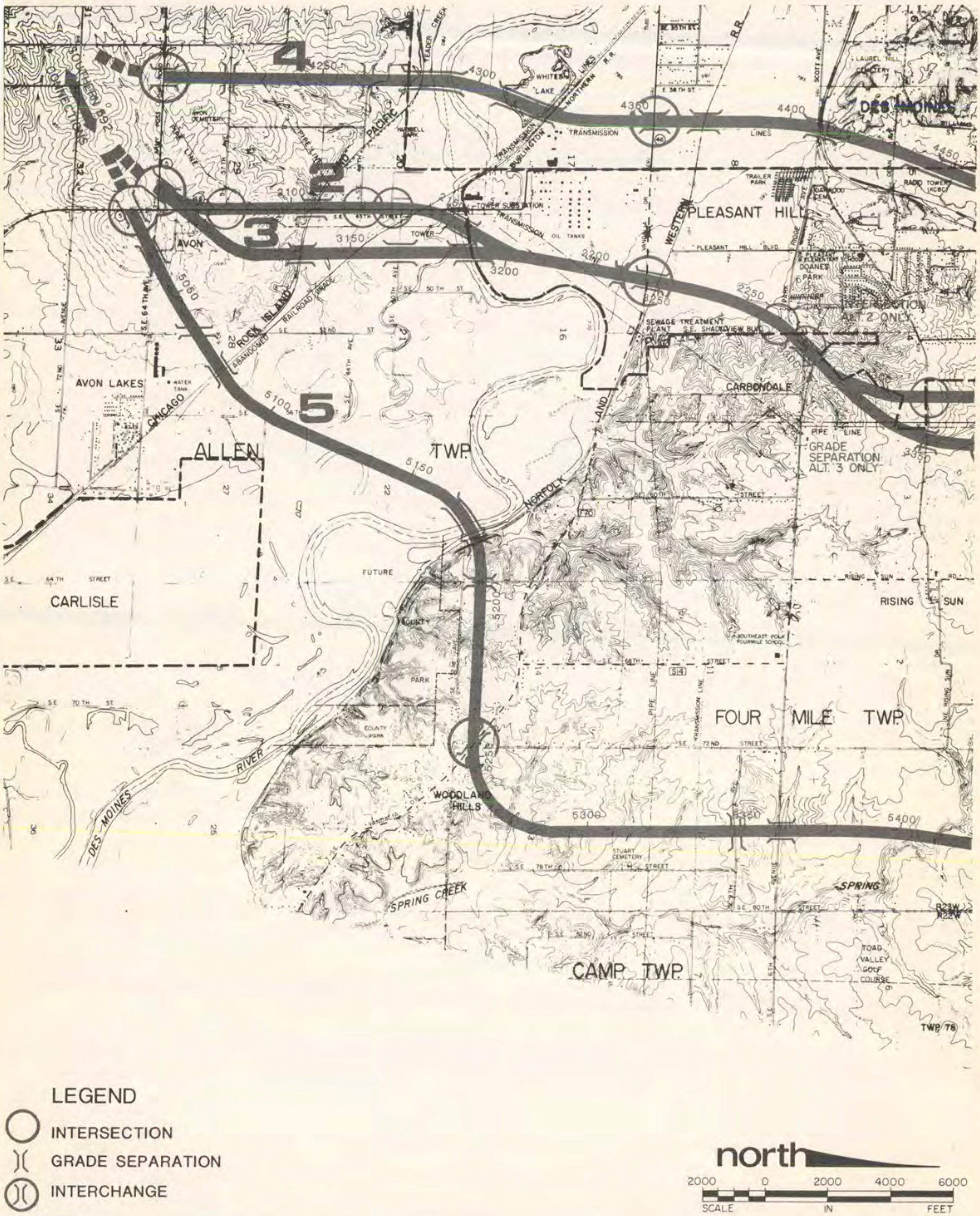
5. *Alternative 4 – "Inner Freeway – West"*

Alternative 4 is also a Class I major arterial designed to freeway standards. Its right-of-way varies from 300 feet to 450 feet depending on the depth of cut and fill. It is approximately 10.4 miles in length.

Alternative 4 originates in the south at an interchange with the eastern terminal point of the proposed 592 facility. The interchange is located near Avon approximately one mile west of the intersection of Iowa 5 and Iowa 46. From that point, the alignment crosses under S.E. 57th and S.E. 44th Avenues, and then passes over the Chicago, Rock Island and Pacific Railroad, and the Des Moines River. North of the river, Alternative 4 turns slightly northeastward passing between the industrial area of Pleasant Hill on the east, and the proposed White's Lake Recreational Area on the west.

Proceeding northward, Alternative 4 crosses over a spur of the Burlington Northern Railroad, S.E. Vandalia Drive, (Iowa 46), and the Norfolk and Western Railroad. An interchange is provided at Vandalia Drive. The alignment then turns northeastward, and passes over Scott Avenue and the Chicago, Rock Island and Pacific Railroad tracks as it enters the Four Mile Creek valley. It then follows the valley northward to an interchange with Iowa 163.

North of Iowa 163, Alternative 4 proceeds northward to an interchange with Hubbell Avenue (U.S. 65); grade separations are provided at N.E. 23rd Avenue


4
2
3
5
1
PLEASANT HILL
DES MOINES
AVON
AVON LAKES
CARBONDALE
ALLEN TWP.
FOUR MILE TWP.
CAMP TWP.
CARLISLE
RISING SUN
WOODLAND HILLS
INTERSECTION ALT. 2 ONLY
GRADE SEPARATION ALT. 3 ONLY
SEWAGE TREATMENT PLANT
TOAD VALLEY GOLF COURSE
DES MOINES RIVER
SPRING CREEK
STUART CEMETERY
TRANSMISSION LINES
PIPE LINE
ROCK ISLAND
CHICAGO
NORFOLK AND WESTERN R.R.
BURLINGTON NORTHERN R.R.
WHITES LAKE
TRAILER PARK
LAUREL HILL CEMETERY
COUNTY PARK
FUTURE
4250
4300
4350
4400
4450
2100
3150
3200
2200
2250
2300
3350
5050
5100
5150
5200
5250
5300
5350
5400
LEGEND
INTERSECTION
GRADE SEPARATION
INTERCHANGE
north
2000
0
2000
4000
6000
SCALE IN FEET

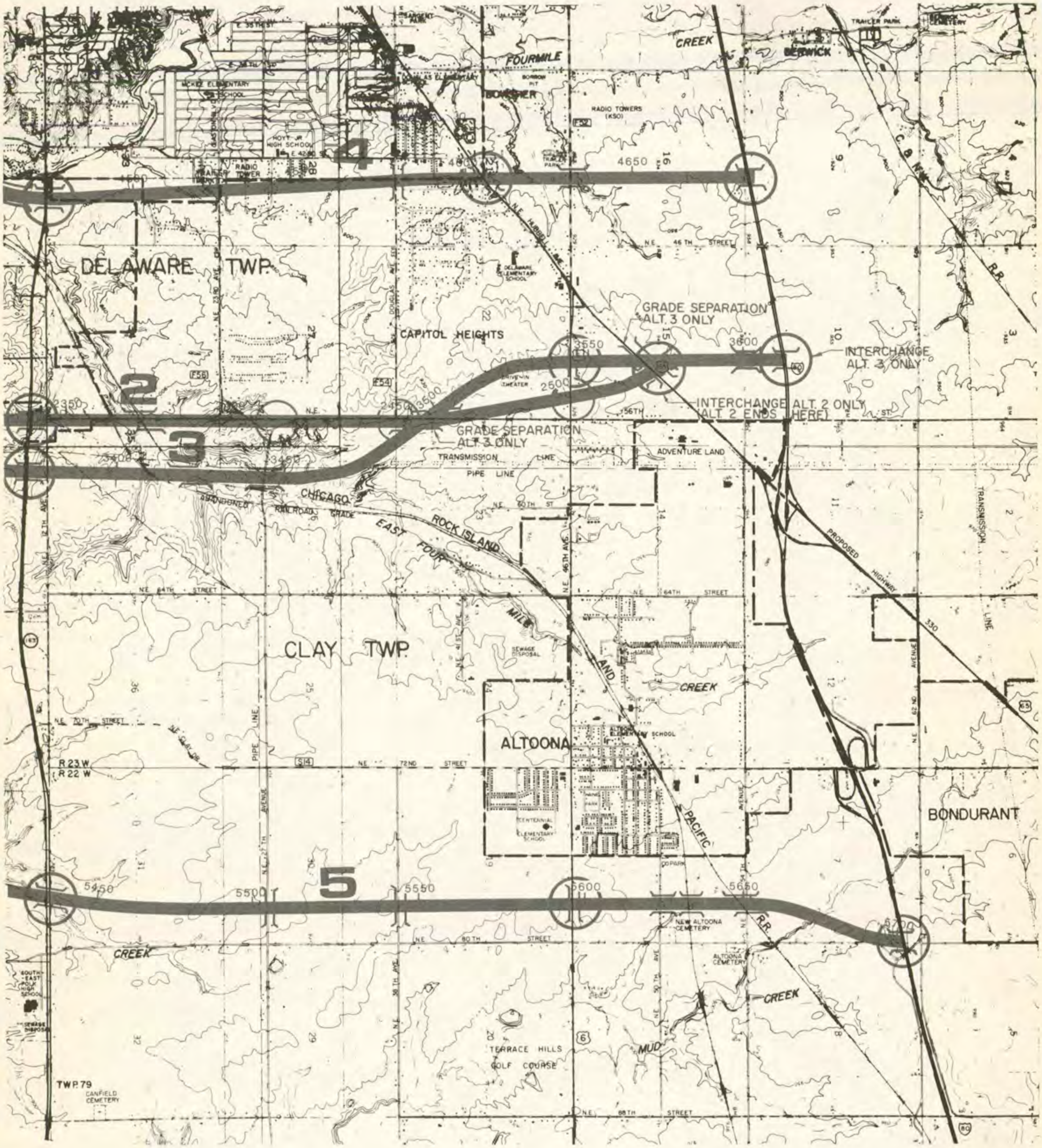


FIGURE II-4

ALTERNATIVE ROUTES SELECTED FOR DETAILED STUDY

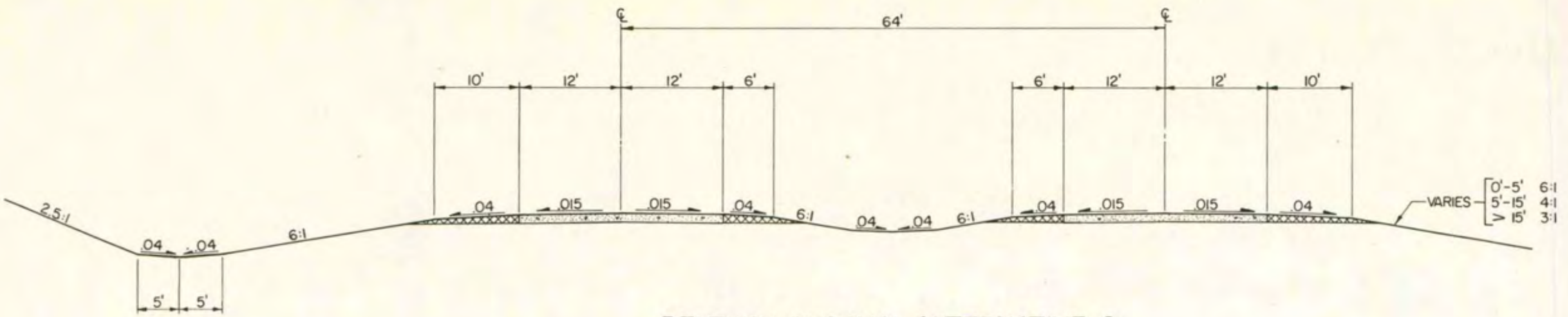
and Douglas Avenue. The alignment then continues north over N.E. 46th Avenue and terminates at an interchange with I-80.

6. *Alternative 5 - "Outer Freeway"*

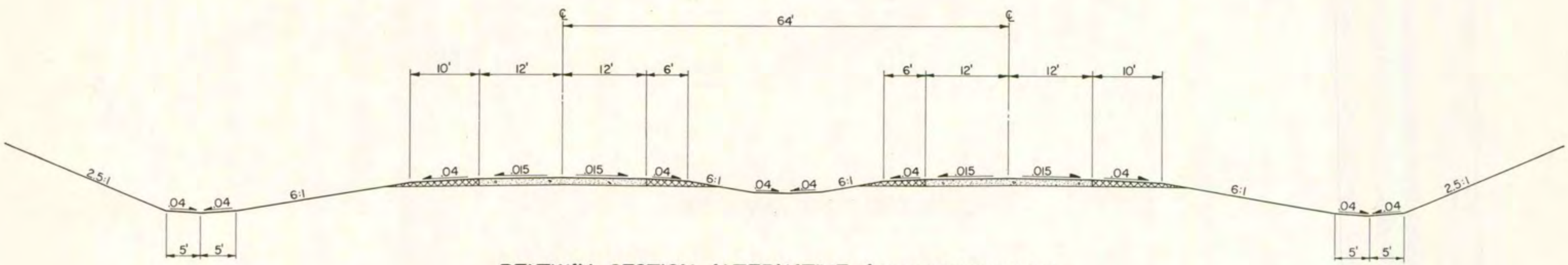
Alternative 5 is also a Class I major arterial designed to freeway standards. Its right-of-way varies from 300 feet to 400 feet depending on the depth of cut and fill. Its length is approximately 12.6 miles.

Alternative 5 originates at an interchange with the proposed 592 facility near the intersection of Iowa 5 and Iowa 46 at Avon. From that point it proceeds northeastward crossing over S.E. 64th Avenue (Army Post Road extended) and the Chicago, Rock Island and Pacific Railroad. It then traverses the Des Moines River flood plain in a northeasterly direction crossing the river west of a proposed County Park. North of the river the roadway ascends the bluffline, crossing over the Norfolk and Western Railroad and turns east, passing under Rising Sun Road (S.E. 64th Street), to an interchange with S.E. Vandalia Drive. From that point, Alternative 5 turns and proceeds straight north to an interchange with I-80.

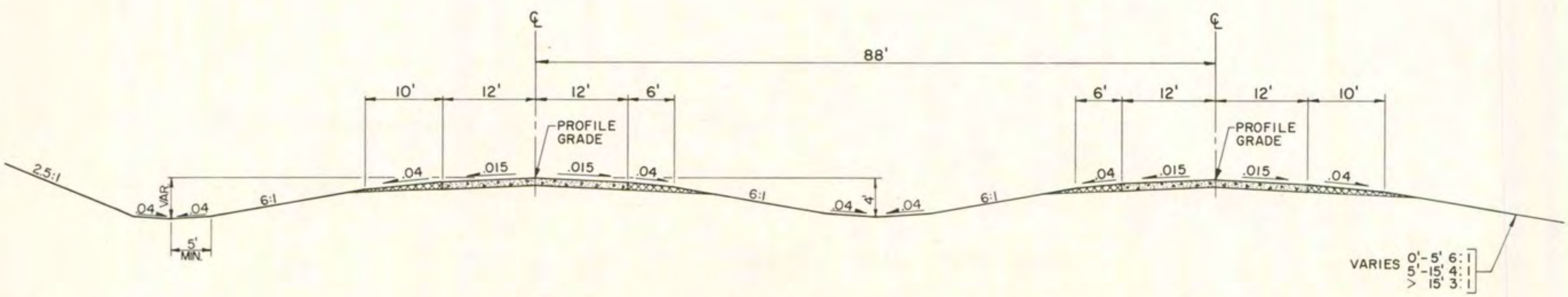
Intermediate interchanges are provided at Iowa 163, and at U.S. 6 east of Altoona, and grade separations are provided at S.E. 9th Avenue, S.E. 6th Avenue, N.E. 27th Avenue, N.E. 38th Avenue, N.E. 50th Avenue and at the Chicago, Rock Island and Pacific Railroad. Within this section, Alternate 5 crosses over two streams - Spring Creek and Mud Creek. At Interstate 80, the proposed interchange provides for a future connection to Highway 330 northeast of Bondurant.



BELTWAY SECTION ALTERNATIVE 2



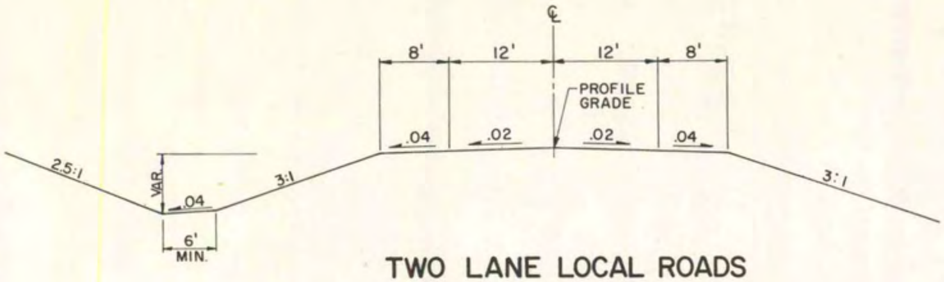
BELTWAY SECTION ALTERNATIVE 4 (NORTH OF IOWA 163)
(DEPRESSED ROADWAY)



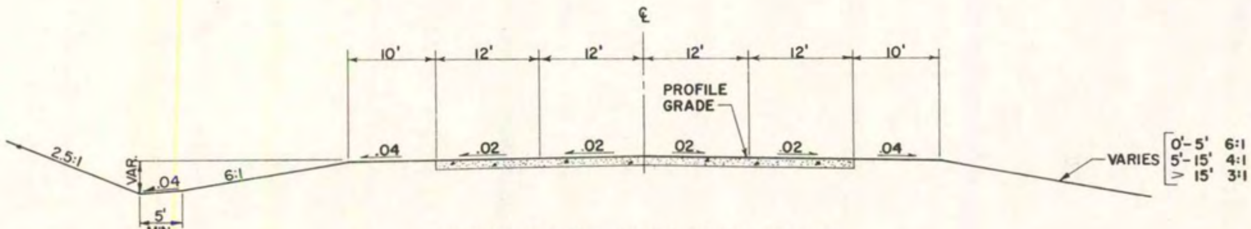
BELTWAY SECTION ALTERNATIVES 3, 4 (SOUTH OF IOWA 163), & 5

FIGURE II-5

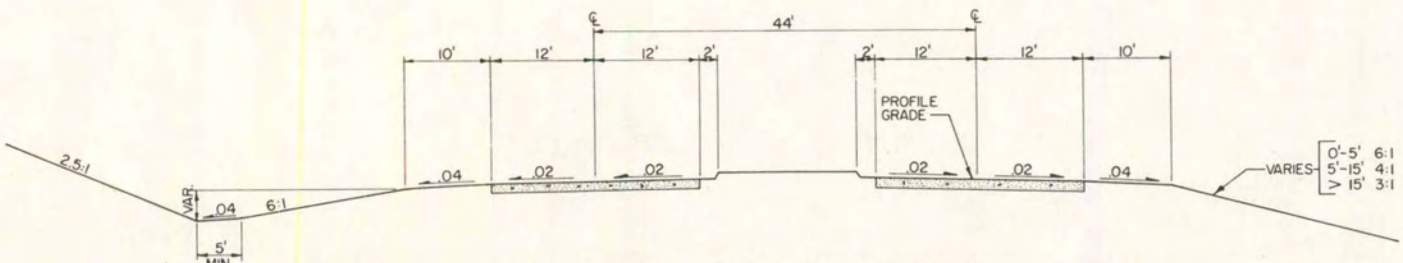
TYPICAL ROADWAY SECTIONS



TWO LANE LOCAL ROADS



FOUR LANE UNDIVIDED ROAD



FOUR LANE DIVIDED ROAD

FIGURE II-6

TYPICAL ROADWAY SECTIONS

SECTION III

ENVIRONMENTAL SETTING

A. LAND USE PLANNING

1. *Areawide Planning*

The Central Iowa Regional Association of Local Governments (CIRALG) serves as the designated agency for areawide planning in the Des Moines region, including land use planning functions under the Urban Area Transportation planning program, U.S. Department of Housing and Urban Development "701" metropolitan and non-metropolitan planning programs, and Environmental Protection Agency "208" Areawide Waste Treatment Management Planning Program. CIRALG's combined responsibilities provide a consistent and coordinated land use planning approach among these various federally supported programs and with local planning in the area.

Between 1965 and 1972, the Central Iowa Regional Planning Commission (CIRPC), CIRALG's predecessor agency, prepared a conceptual metropolitan area land use plan as part of an overall program of urban and regional land use and transportation planning. This Initial Metro Plan Balanced Growth Concept for "Future Population and Employment Patterns 1990 - 2000" is shown in Figure III-1. It served as the basis for both CIRPC's Initial Des Moines Urbanized Area Transportation Plan and CIRALG's current Revised Urbanized Area Transportation Plan which, as previously discussed, include the provision of a Southeast Beltway. Metropolitan growth patterns, past and projected, are discussed in further detail in Appendix I of this report.

In the 500 study corridor, urban uses under the conceptual plan are shown as extending to cover nearly 20,000 gross acres or slightly over 40% of the corridor -- approximately 35% in residential and 5% in commercial-industrial uses. These acres represent generalized locations suitable for development purposes and include large sections of low and sparse residential use.

Under the current 208 Waste Treatment Management Planning Program, land use objectives identified to support water quality goals include:

a) To preserve and maintain predominantly forested, naturally vegetated and agricultural land as a natural resource.

b) To preserve and revitalize the central residential and commercial areas of local communities according to ongoing land use planning.

c) To encourage development within existing incorporated land areas or needed annexed areas in order to promote orderly, contiguous and economical development.

TABLE III-1

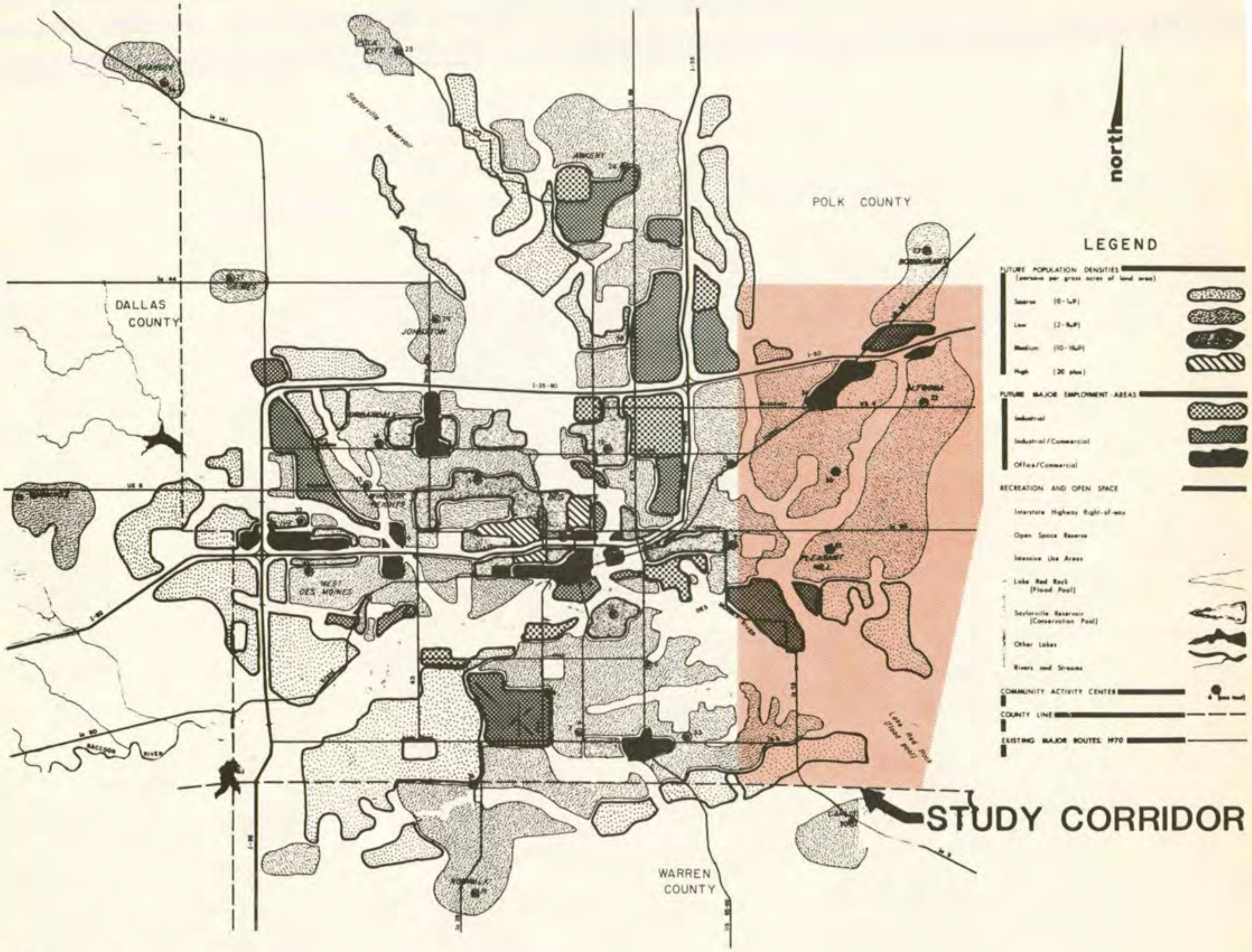
FUTURE POPULATION

ALTERNATE INTENSITY DEVELOPMENT PLANS*

208 Waste Treatment Management Study

		Alternate A: Adjusted Composite Plan		Alternate B: Minimum Public Expenditure Plan		Alternate C: Minimum Environmental Effect Plan	
	Estimated Population	Total 2000 Population	Change 1975-2000	Total 2000 Population	Change 1975-2000	Total 2000 Population	Change 1975-2000
Altoona	4,150	11,000	+6,850	4,500	+ 350	4,500	+ 350
Pleasant Hill	2,550	5,000	+2,450	3,550	+1,000	4,300	+1,750
Delaware Township	2,300	3,300	+1,000	4,300	+2,000	2,500	+ 200

* Preliminary 208 Intensity Development Considerations, Central Iowa Regional Association of Local Governments, 1975.



SOURCE:
CENTRAL IOWA REGIONAL PLANNING COMMISSION, FEBRUARY 1972.

FIGURE III-1

FUTURE POPULATION AND EMPLOYMENT PATTERNS 1990-2000

EDWARDS AND KELCEY, INC.

As part of the 208 Program, CIRALG is presently updating its areawide land use plans, including evaluation of alternative intensity development patterns for the metropolitan area. Three alternate intensity patterns have been formulated reflecting broad areawide options for the location and intensity for future growth, as follows:

a) Alternate Plan "A" or "Adjusted Composite Plan," which reflects a pattern with comprehensive development plans for individual governmental units carried out to the year 2000;

b) Alternate Plan "B" or "Minimal Public Expenditure Plan", which maximizes utilization of existing sanitary sewer facilities in order to reduce capital expenditures;

c) Alternate Plan "C" or "Minimal Environmental Effect Plan", which reflects development on land having the least impact in terms of general land capability-environmental sensitivity criteria.

Table III-1 shows the effect, as projected by CIRALG, that each of these alternate intensity patterns would have on population growth for three of the communities in the study corridor. Future development in the corridor under Alternates "B" or "C" would be extremely limited, particularly in Altoona. Even under Alternate "A", which is based on local comprehensive plan forecasts, projected 2000 populations are significantly lower than levels which could be accommodated under the land use patterns shown in the same comprehensive plan reports. For example, residential use areas delineated in the Altoona and Pleasant Hill Comprehensive Plans (see Section III.A.3 below) could accommodate some 20,000 to 24,000 and 9,000 to 11,000 persons, respectively, or approximately twice the projections shown for the year 2000.

2. *Existing Land Use*

The existing land use distribution within the study corridor is shown in Figure III-2. Urban type development, including residential, commercial and industrial uses, comprises only about nine percent of corridor land at the present time. An additional three percent is in public and institutional use including, in part, open space areas such as parks and golf courses. The remaining 88 percent of corridor land is in agricultural use or is otherwise undeveloped.

Residential use occupies some 3,300 acres, or about 76 percent of the developed land within the study corridor. The remaining developed land, about 1,050 acres, is in commercial and industrial use. As can be seen from Figure III-2, the major commercial centers are located in the northern portion of the corridor, while industrial operations are found primarily along the Des Moines River in the southern portion of the corridor.

3. *Proposed Land Use*

Future land use patterns from a more definitive perspective than the areawide concepts are reflected in (1) local zoning ordinances and (2) comprehensive development (master) plans for the corridor.

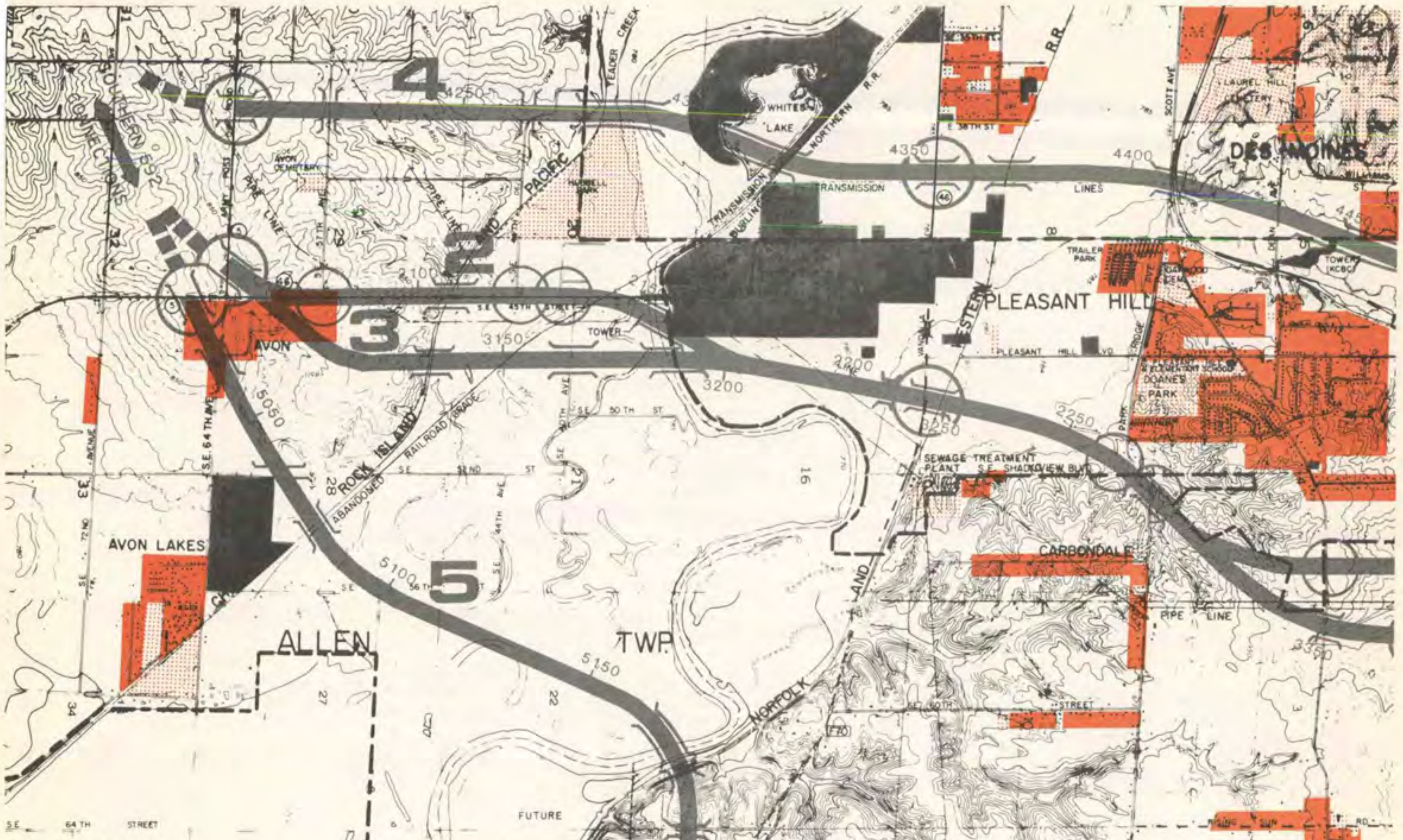
Zoning - Land uses permitted in the zoning ordinances are, for the most part, extensions of present land development patterns. As shown in Figure III-3, approximately 32% of the corridor is zoned for urban uses, with 8% unclassified (primarily flood plain) and the remaining 60 percent zoned agricultural, the latter also permitting rural residential use. Residential activity accounts, as under existing land use, for the majority of the area zoned for urban uses. Proportionately, however, industrial zoned land allows for the most significant expansion over present use. Residential zoning (all classifications) covers about 18 percent of the study corridor, or nearly twice the total area presently in urban use. Nearly all of the residential area is zoned for one or one and two-family units on minimum lot sizes varying generally from one-sixth to one acre. In addition, the 60 percent of the corridor zoned for agricultural uses can, under present regulations, be developed for residential use on a minimum lot size of one acre. Recent attempts to increase the minimum residential lot requirement for the agricultural zone to five acres have been rejected by the Polk County Board of Supervisors.

Approximately two percent of the corridor is zoned for commercial use; the commercial districts are located along Hubbell Avenue and U.S. 6 in Des Moines and unincorporated Delaware Township, along Hubbell Avenue near I-80, along U.S. 6 in Altoona, and along Iowa 163 in Pleasant Hill. Industrial zoning covers 12 percent of the corridor, with large tracts located along the Chicago, Rock Island and Pacific Railroad in Altoona and along both sides of the Des Moines River in Des Moines, Pleasant Hill and Allen Township. U-1 flood plain zoning includes the Des Moines River and Four Mile Creek flood plain areas within the City of Des Moines. "Unclassified" zones include the I-80 right-of-way, and Four Mile Creek flood plain in Pleasant Hill, and portions of the Red Rock flood pool in unincorporated Allen and Four Mile Townships.

The recently annexed areas of Bondurant and Carlisle have been zoned for agricultural use. Land uses other than agricultural are permitted only after an exemption is passed by the respective City Council.

Comprehensive Plans - Altoona (in 1974) and Pleasant Hill (in 1972) have both adopted comprehensive land use plans, each covering a planning area beyond present municipal boundaries as permitted under State law. Des Moines is presently developing a Preliminary 1990/2000 Land Use Plan to update a 1980 Plan which was prepared back in 1963.

Bondurant (in 1968) and Carlisle (in 1969) have also adopted land use plans; however, the plans do not cover the portions of these cities within the study corridor which have only recently been annexed. Current "plans" for these areas are thus reflected by their present zoning, as discussed above. Polk County, through CIRALG, has undertaken recent planning studies for the remaining unincorporated sections of the corridor. A concept of "controlled growth" was proposed in which development would be limited outside of cities, towns, and other areas presently experiencing growth. The plan was rejected by the Polk County Board of Supervisors in December, 1974. Instead, it was



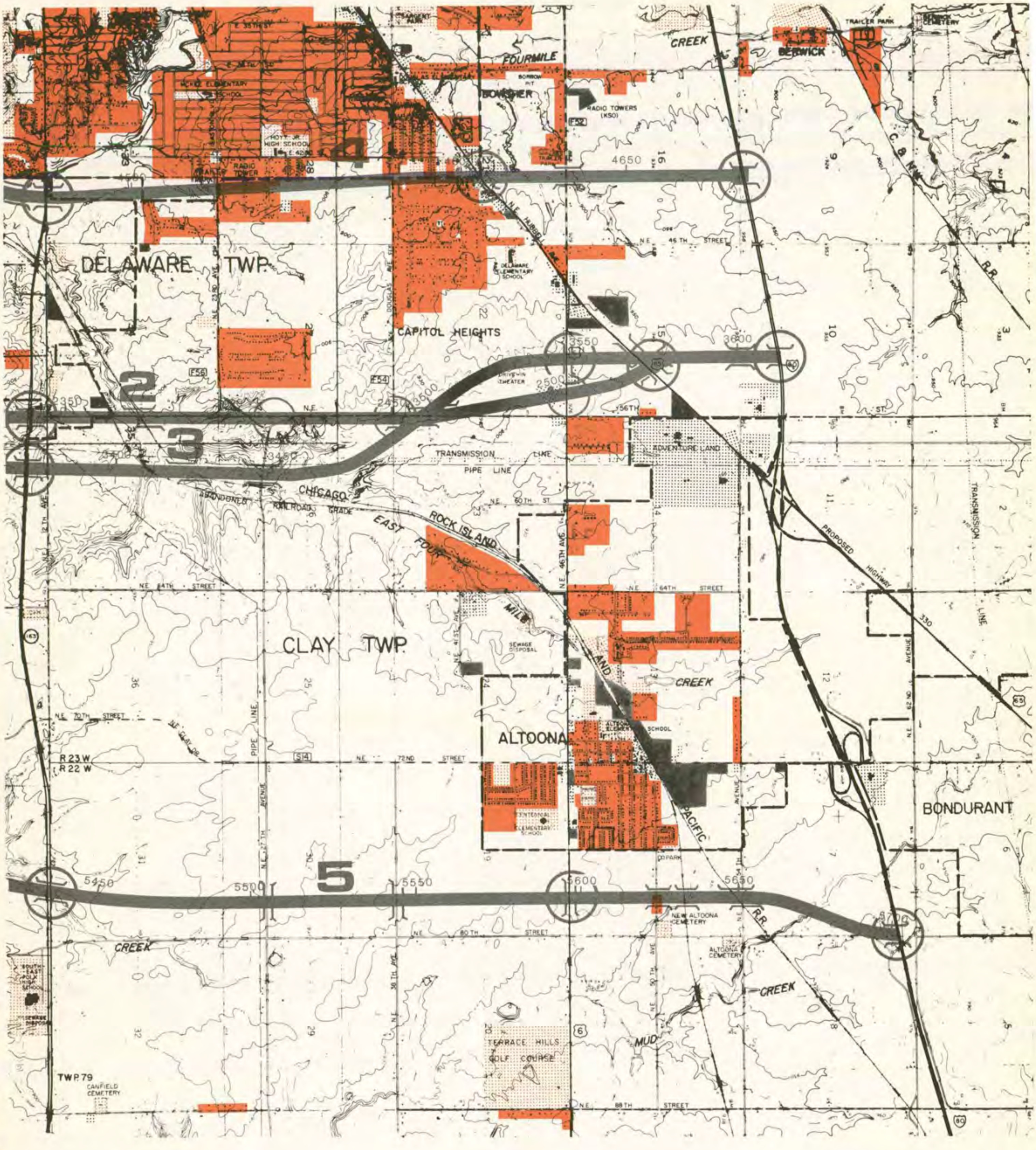
Study Corridor Land Use

(Gross Acres)

Comprehensive Planning Area	Agricultural and Undeveloped	Residential	Commercial	Industrial	Public and Institutional(1)	Total
ALTOONA	11,355	716	225	84	248	12,628
PLEASANT HILL	5,805	485	10	284	109	6,693
DES MOINES	1,745	1,096	42	235	666	3,784
RURAL POLK COUNTY(2)	22,690	981	57	107	468	24,303
CORRIDOR TOTAL	41,595	3,278	334	710	1,491	47,408
% CORRIDOR	87.7	6.9	0.7	1.5	3.2	100.0

(1) Includes also privately owned golf courses

(2) Includes unincorporated areas within corridor but outside comprehensive planning boundries



LEGEND

AGRICULTURAL AND OPEN SPACE

RESIDENTIAL

PUBLIC AND INSTITUTIONAL

COMMERCIAL

INDUSTRIAL

EDWARDS AND KELCEY, INC.

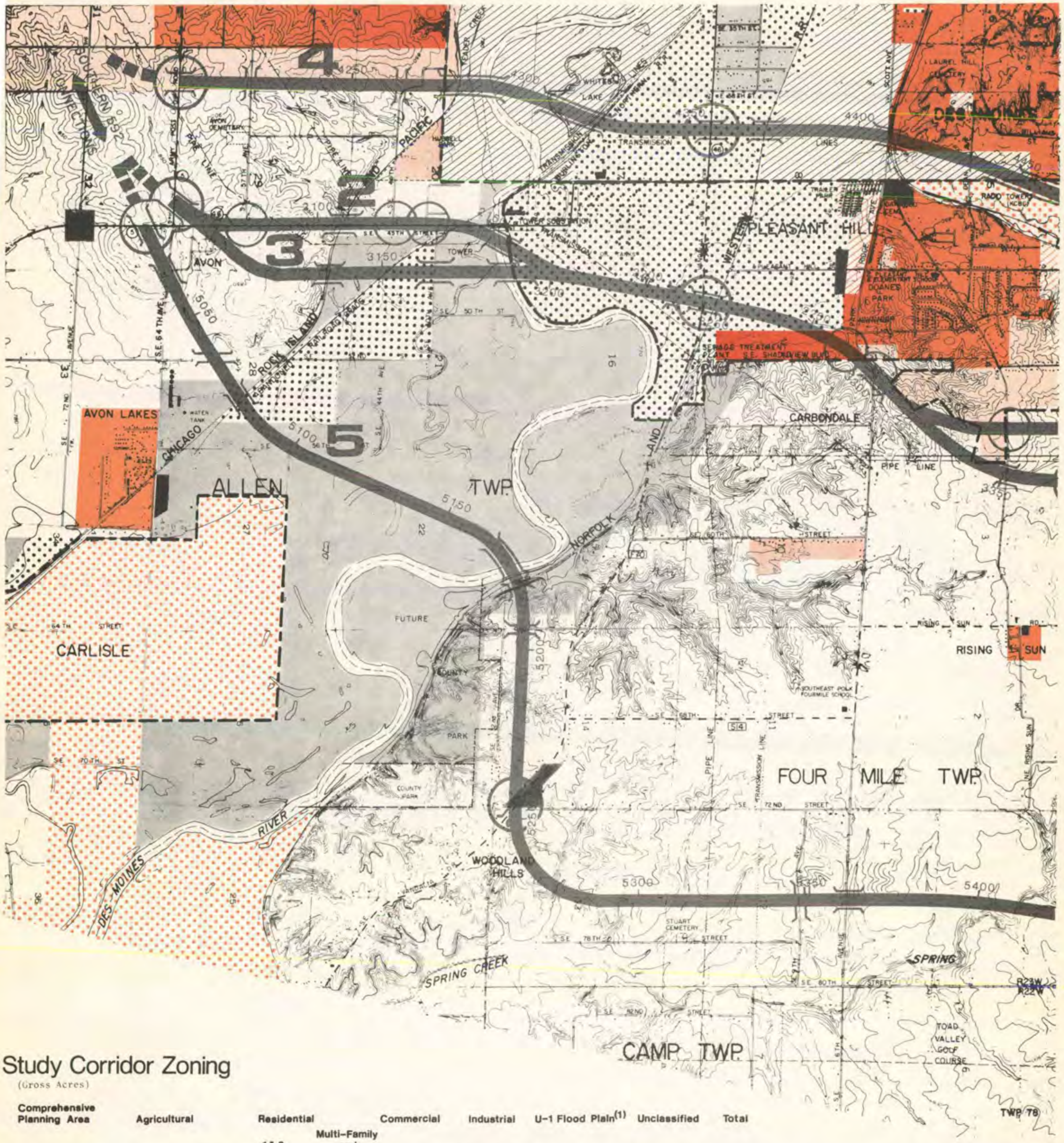
north

2000 0 2000 4000 6000

SCALE IN FEET

FIGURE III-2

EXISTING LAND USE



Study Corridor Zoning

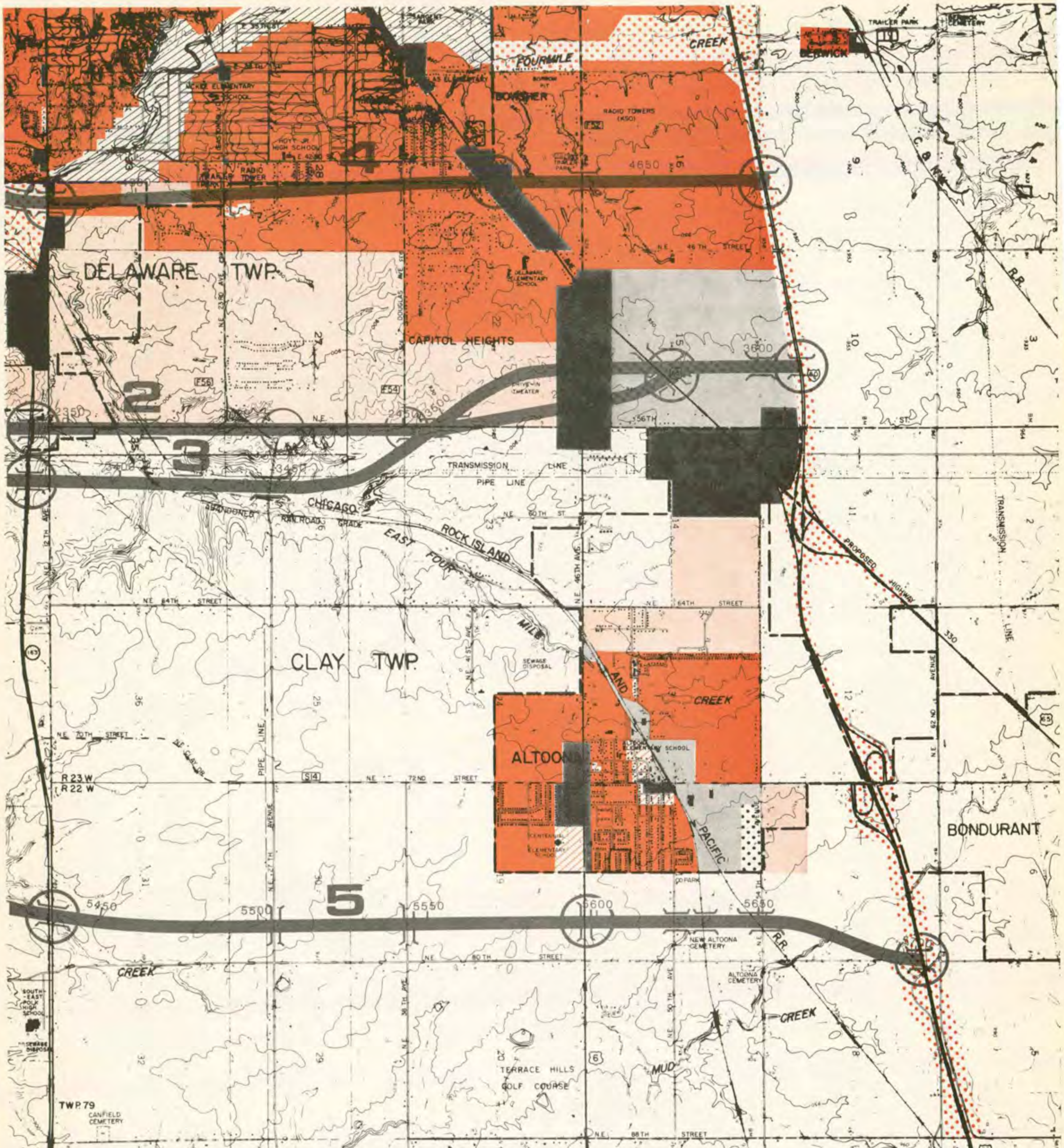
(Gross Acres)

Comprehensive Planning Area	Agricultural	Residential 1-Family	Residential 1& 2 Family	Residential Multi-Family and Mobile Home	Commercial	Industrial Light	Industrial Heavy	U-1 Flood Plain(1)	Unclassified	Total
ALTOONA	10,484	393	804	59	315	256	26	-	291	12,628
PLEASANT HILL	3,255	1,019	510	100	111	431	1,089	-	178	6,693
DES MOINES	0	18	1,821	3	75	100	444	1,323	-	3,784
RURAL POLK COUNTY(2)	14,527	1,534	2,196	0	367	3,085	319	-	2,275	24,303
CORRIDOR TOTAL	28,266	2,964	5,331	162	868	3,872	1,878	1,323	2,744	47,408
% CORRIDOR	59.6	6.3	11.2	0.3	1.8	8.2	4.0	2.8	5.8	100.0

(1) Flood plain area in City of Des Moines
(2) Includes unicorporated areas within corridor but outside comprehensive planning boundries
(3) Town of Carlisle ordinance permits limited mult-family dwellings in R-2

LEGEND

- AGRICULTURAL
- COMMERCIAL
- LIGHT INDUSTRIAL
- HEAVY INDUSTRIAL
- U1 FLOOD PLAIN



LEGEND

RESIDENTIAL-ONE FAMILY

RESIDENTIAL-ONE & TWO FAMILY

MULTIPLE FAMILY & MOBILE HOMES

UNCLASSIFIED

EDWARDS AND KELCEY, INC.

north

2000 0 2000 4000 6000

SCALE IN FEET

FIGURE III-3

EXISTING ZONING

decided that zoning decisions in the unincorporated areas would be reviewed on an individual basis, with consideration being given to such factors as soil characteristics, topography, utility provision and conservation areas. Figure III-4 provides a composite illustration of the land use plans and, for areas outside planning boundaries, of significant limitations to development.

Neither the Pleasant Hill or Altoona Future Land Use Plans are based on a Southeast Beltway in any specific location. The Pleasant Hill Plan does show a schematic location east of the eastern planning area boundary, but is not directly reflected in the land use plan. Comprehensive plan studies for both communities point to the importance of a Southeast Beltway in attracting proposed commercial and industrial development. Altoona officials have expressed a preference for the route to pass east of Altoona in order not to "divide" the town and its utility services, and so as not to restrict anticipated growth. Pleasant Hill officials have expressed concern that a new route, whether passing to the east or west of Pleasant Hill be situated so as to minimize problems in supplying utilities. In particular, concern has been expressed that a route passing considerably east of Rising Sun would encourage eastward extension of growth into the Spring Creek drainage basin.

Growth in this area is not provided for in the present comprehensive plan. Sanitary sewer service within the Spring Creek basin would require a new treatment plant or a lift station, since the existing treatment facilities lie within the Four Mile Creek drainage Basin.

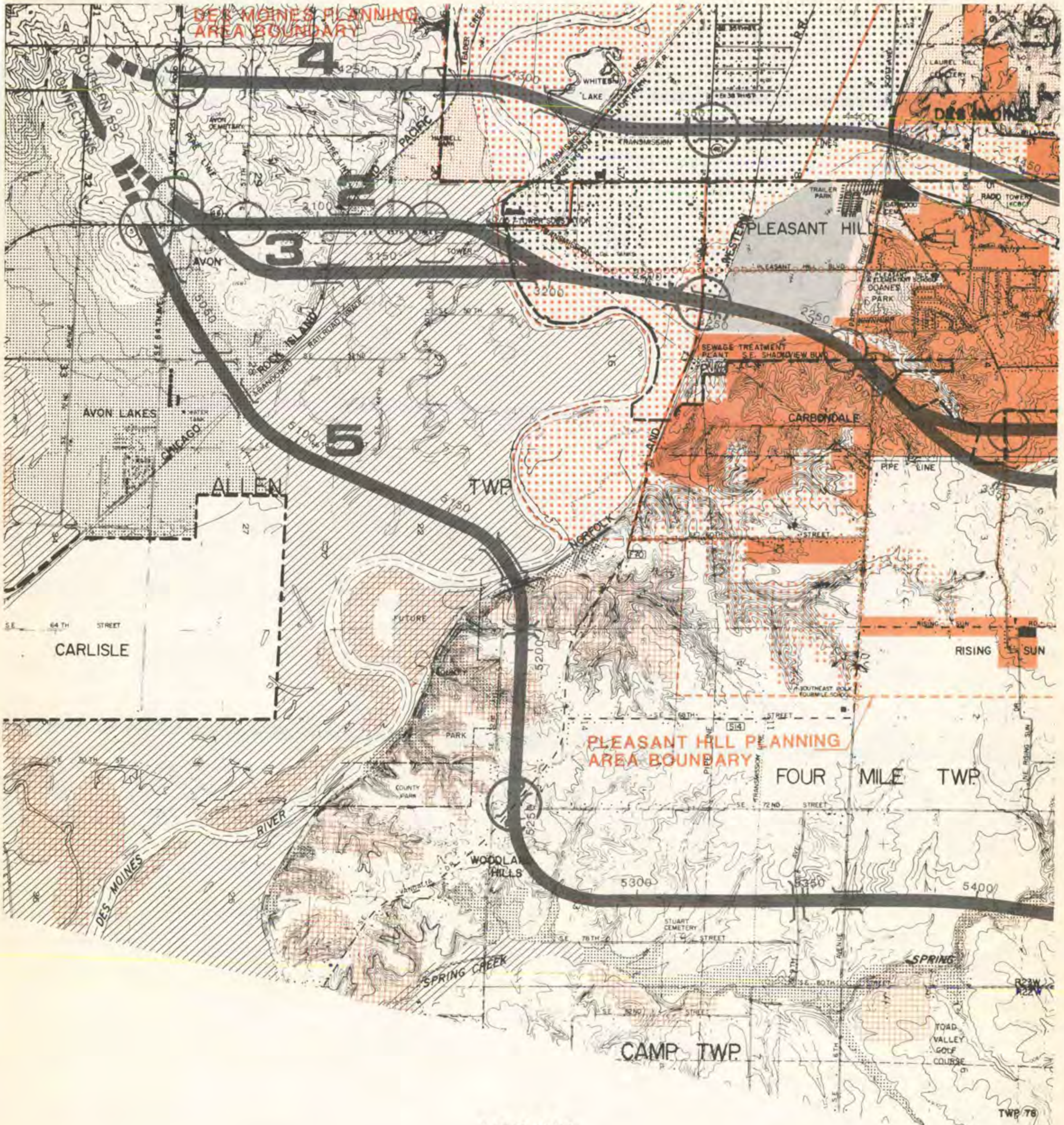
The Des Moines portion of the corridor is primarily developed, with no major changes envisioned under the Preliminary 1990/2000 Plan. Since the discussion of any plan has not yet been translated to map form, land uses shown on Figure III-4 are based primarily on present generalized uses. Exceptions are an expanded industrial zone in the Vandalia area and linear park development along the Des Moines River for which development plans are being prepared by the City. The latter is further described in Section III B 4.

As was the case for Altoona and Pleasant Hill, the Preliminary Des Moines Plan does not directly provide for a Southeast Beltway location. However, City officials have indicated a preference for an Inner alignment near the Des Moines border to better serve north-south movements in the eastern portion of the City.

B. COMMUNITY ENVIRONMENT

The study corridor is located in southeastern Polk County. In addition to Des Moines, there are four incorporated communities within or adjacent to the corridor. Three of these - Bondurant, Altoona, and Pleasant Hill - are in Polk County. The fourth - Carlisle - is in Warren County, although a recently annexed portion of the city lies in Polk County.

Bondurant is basically an agricultural community which has experienced relatively slow population growth in recent years. There are few industries, retail trade establishments or service and professional businesses in Bondurant.



LEGEND

- AGRICULTURE
- COMMERCIAL
- LIGHT INDUSTRIAL
- HEAVY INDUSTRIAL
- FLOOD-PRONE AREAS
- SEVERE SOIL LIMITATIONS
- LOW/MEDIUM DENSITY RESIDENTIAL
- HIGH DENSITY RESIDENTIAL
- PUBLIC & INSTITUTIONAL
- CONSERVATION-OPEN SPACE
- FORESTED (CONSERVANCY AREAS)
- ARTERIAL ROADWAYS
- COLLECTOR ROADWAYS

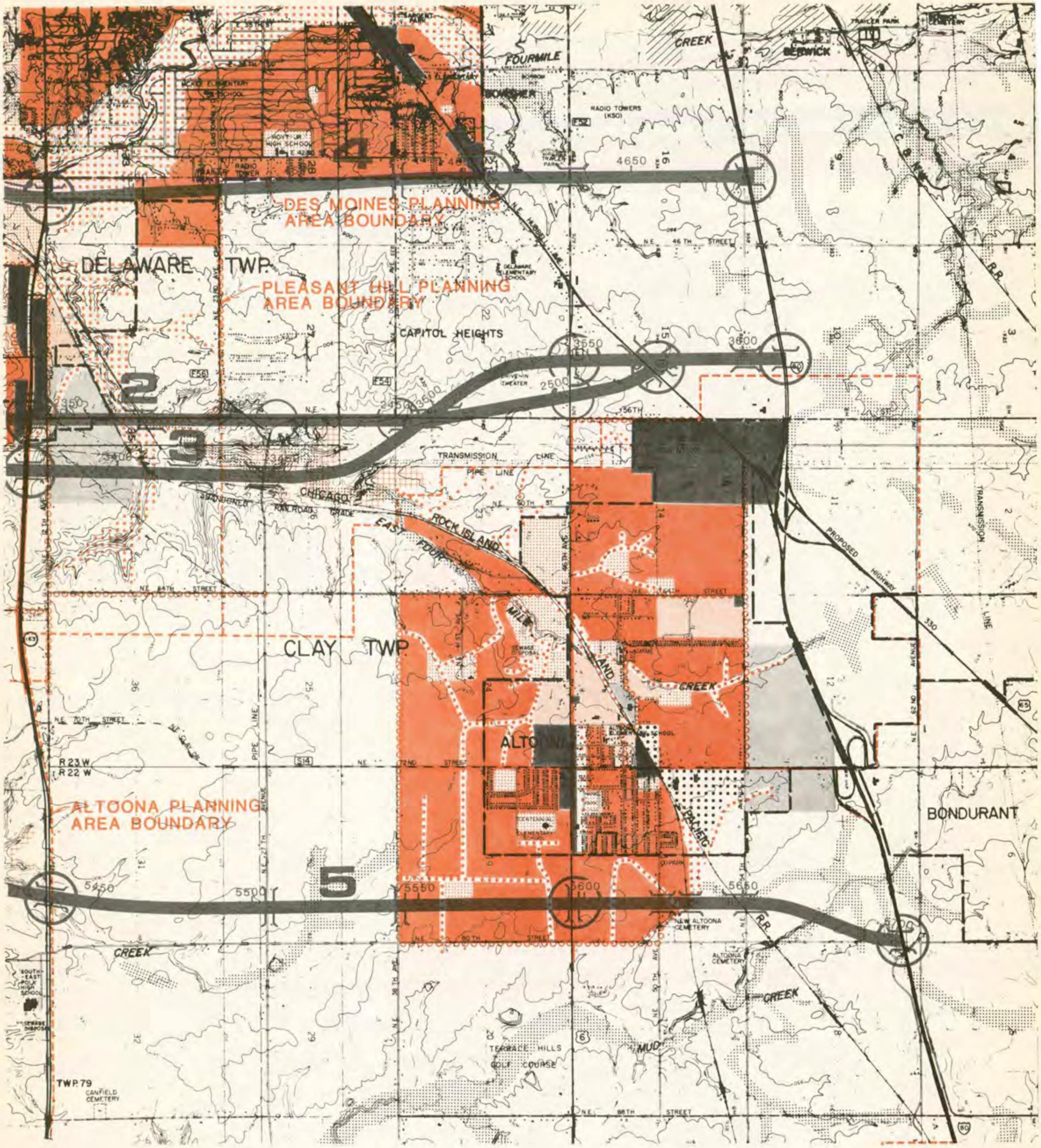


FIGURE III-4

EDWARDS AND KELCEY, INC.

north

2000 0 2000 4000 6000
SCALE IN FEET

PROPOSED LAND USE BY COMPREHENSIVE PLANNING AREAS

The majority of the employed population works outside of the city.

Altoona, which is a free standing satellite community economically integrated with Des Moines, is located about nine miles northeast of the Des Moines Central Business District (CBD). The city had a 1960 population of 1,458 and a 1970 population of 2,854, an increase of 96%. Virtually all recent development in Altoona has been residential.

Adventureland, located in northwestern Altoona at the intersection of U.S. 65 and Interstate 80, is a privately owned commercial-recreational complex opened in 1974. The facility presents a variety of recreational opportunities and will have economic impacts upon the community as it will attract visitors from all over the midwest and other areas of the United States.

Pleasant Hill is located adjacent to the City of Des Moines, about six miles east of the Des Moines CBD. The city had a population of 397 in 1960 and 1,535 in 1970, indicating a growth of 287% during the last decade. Pleasant Hill, like Altoona, is primarily a residential suburb although there is some industrial development in the southern part of the city.

Carlisle, which lies about 10 miles southeast of the Des Moines CBD, is 20th on the Iowa Development Commission's list of "Iowa's Fastest Growing Places" with a 70.5% population increase for 1960 - 1970. Like Bondurant, Pleasant Hill, and Altoona, Carlisle is principally a residential city. Although the city has five industries, the largest, General Mills, employs only 51-100 persons.

The predominantly agricultural and residential character of the study corridor communities does not enable them to provide full employment for area residents. The economy of the area is largely dependent upon employment available in Des Moines. Overall, present development within the study corridor provides only about 2.0% of total metropolitan area employment.

1. Population and Housing Characteristics

The population of the study corridor comprises nearly 8 percent of the total Des Moines metropolitan area, which includes most of Polk County and adjoining portions of northern Warren and Eastern Dallas Counties. Except for Des Moines, each city has noted a significant population increase between the years 1960 and 1970. This growth trend is typical of satellite communities in metropolitan areas in Iowa and throughout the United States, as increasing numbers of people prefer to live in the smaller cities that are conveniently near the employment and social-cultural resources of a metropolitan center.

A review of 1970 Census Tract data reveals some pronounced differences between study corridor residents and residents living elsewhere in the Des Moines metropolitan region (See Figure III-5 and Table III-2). Referring to these illustrations, we note that the study area residents are primarily white, and were born in America. The City of Des Moines, and surrounding Polk County, has an older population with fewer children and more elderly citizens than the study

TABLE III-2

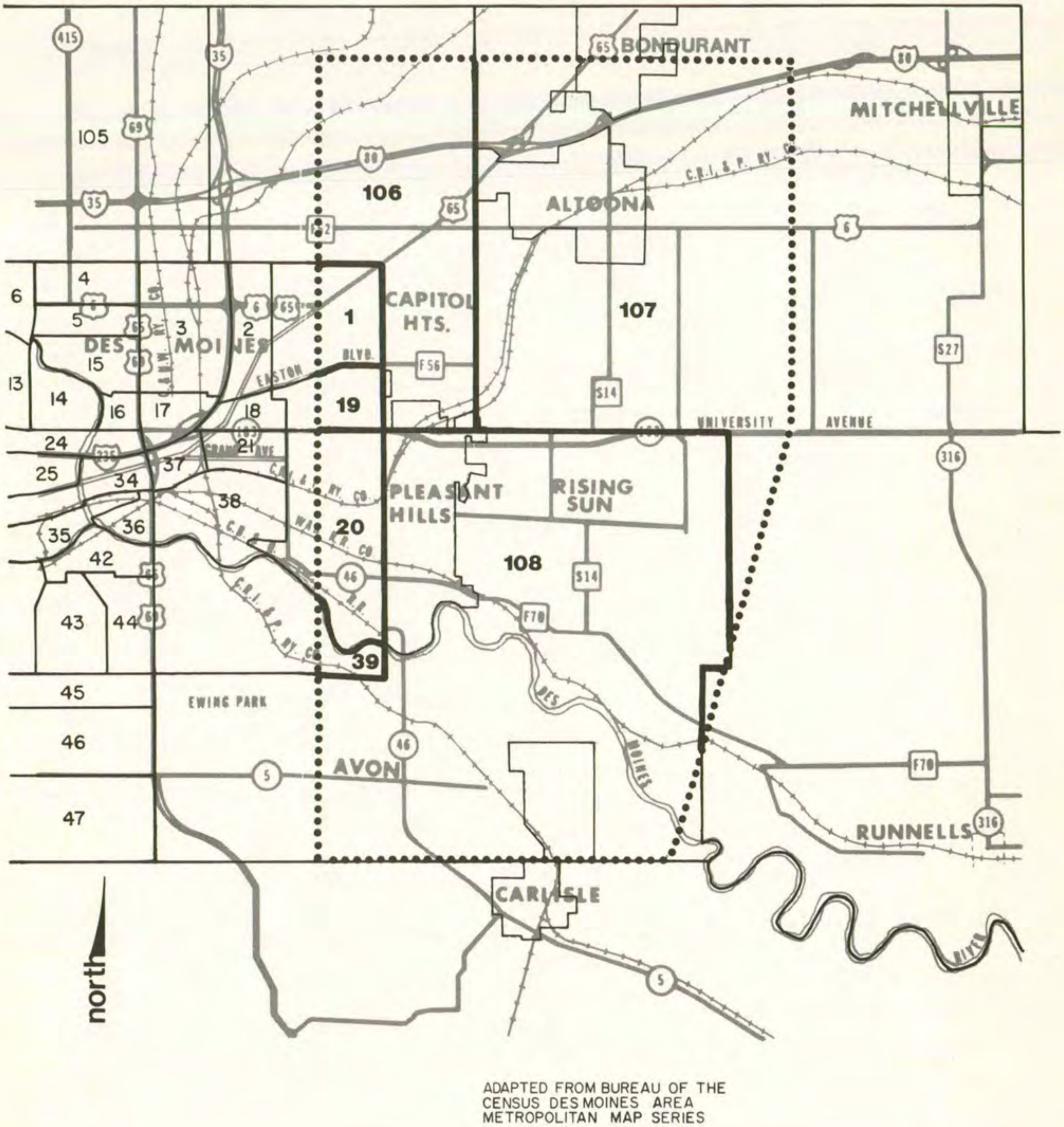
1970 CENSUS TRACTS DATA

	Des Moines 500 Beltway Corridor								Regional Data Base		
	Des Moines Area				East-Suburban Polk County Area						
	1	19	20	Average	106	107	108	Average	Des Moines	Polk County	Polk County Outside Des Moines
AGE											
% age 65 and over of total population	4.5	8.1	8.3	6.0	6.2	7.8	5.6	6.7	11.4	9.8	6.0
% ages 14 and under of total population	37.4	29.3	30.5	34.2	32.9	33.2	34.4	33.4	26.7	28.5	32.9
RACE											
% non-white of total persons	0.7	0.1	0.4	0.5	0.5	0.2	0.4	0.4	6.2	4.6	0.8
NATIVITY											
% foreign stock of total population	6.0	9.0	6.8	7.0	6.5	7.1	4.6	6.2	9.8	9.2	7.9
EDUCATION											
Median school years completed	12.3	12.0	11.1	12.1	11.5	12.4	12.3	12.1	12.4	12.4	12.6
% high school graduates of persons age 25 and over	65.0	51.9	41.8	58.1	45.0	70.1	62.1	59.9	65.3	68.0	74.9
TRANSPORTATION											
% workers using private autos (driver & passengers) of all workers	93.0	93.2	95.1	93.3	96.3	88.6	90.6	91.5	84.5	85.9	89.2
% workers using bus of all workers	2.7	4.2	1.8	3.0	0.5	-	1.0	0.4	5.7	4.4	1.2
% workers using other means; of all workers*	4.3	2.6	3.1	3.7	3.2	11.3	8.4	8.0	9.8	9.7	9.6
AUTO AVAILABILITY											
% households with no auto available of all occupied housing units	5.2	10.1	16.7	8.2	8.5	6.6	4.2	6.6	16.1	13.1	4.9
% households with 2 or more autos available of all occupied housing units	54.0	37.0	53.4	44.2	48.4	41.5	50.7	46.3	35.6	40.6	54.2
OCCUPATION											
% white collar workers of total employed**	50.5	45.1	38.0	47.6	32.6	51.6	48.2	44.8	57.1	58.2	60.9
% blue collar workers of total employed***	49.5	54.9	62.0	52.4	67.4	48.4	51.8	55.2	42.9	41.8	39.1
PLACE OF WORK											
% working in Des Moines Central business district; of all workers	18.1	16.2	11.5	16.9	13.9	12.1	17.2	14.1	22.6	20.7	16.0
% working in the remainder of Des Moines; of all workers	51.7	55.8	72.0	54.8	58.5	34.4	50.5	46.4	59.0	54.4	43.1
% working in Polk County outside Des Moines; of all workers	10.6	10.3	12.4	10.7	19.8	45.6	17.4	29.7	8.4	15.3	32.0
% working outside Polk County; of all workers	8.2	1.5	-	5.5	2.0	4.4	7.2	4.5	2.7	2.9	3.5
% not reported; of all workers	11.4	16.2	4.0	12.1	5.8	3.4	7.6	5.3	7.2	6.7	5.4
INCOME - 1969											
Median Family Income ($)	$11,160	$ 9,366	$ 9,471	$10,412	$ 9,387	$10,152	$10,556	$10,025	$10,239	$10,682	$11,692
% of all families with income less than $4000/year	6.9	14.7	13.1	10.1	12.0	11.1	6.7	10.2	11.8	10.5	7.5
% of all families with income more than $15,000/year	20.6	13.4	19.4	18.2	4.6	17.8	19.3	16.4	21.0	23.5	29.1
OWNER OCCUPIED HOUSING											
Median persons/dwelling unit of all occupied units	3.6	2.8	3.0	3.3	3.1	3.1	3.4	3.2	2.4	2.5	3.2
% owner occupied of all year around housing units	87.7	84.3	72.4	84.8	82.1	76.0	82.7	79.7	62.8	66.1	75.5
Median value of all specified owner occupied units ($)	$16,100	$11,300	$10,000	$14,100	$10,100	$16,900	$17,800	$14,900	$14,700	$16,100	$20,600
% less than $15,000 value of all specified owner occupied units	36.9	73.6	67.7	52.5	79.1	39.8	37.8	52.1	51.8	44.7	26.9
% more than $35,000 value of all specified owner occupied units	1.0	0.4	1.4	0.8	0.6	1.6	2.5	1.5	3.6	5.3	9.5
RENTER OCCUPIED HOUSING											
Median rent of all specified renter occupied units (in dollars)	$ 97	$ 84	$ 75	$ 88	$ 72	$ 99	$ 87	$ 88	$ 94	$ 98	$ 125
% less than $100/month rent of all specified renter occupied units	47.0	62.7	71.0	57.5	68.1	47.8	52.8	55.0	53.1	49.5	31.8
% more than $200/month rent of all specified renter occupied units	0.4	-	-	0.2	0.5	0.7	1.3	0.8	3.3	3.4	3.7
AGE OF HOUSING UNIT											
% structures built since 1960 of all year around housing units	49.7	10.0	21.8	33.2	20.0	40.7	38.6	33.4	15.5	22.5	41.9
% structures built before 1940 of all year around housing units	20.8	41.2	52.4	31.2	28.7	42.6	27.4	33.9	54.4	46.6	25.0
YEAR MOVED INTO UNIT											
% moved into unit since 1960 of all occupied housing units	78.4	62.8	58.7	71.0	67.9	74.1	68.6	70.6	66.2	68.0	73.1
% moved into unit before 1950 of all occupied housing units	9.2	18.9	19.7	13.6	9.6	13.3	12.7	12.0	15.8	14.3	10.2
RESIDENTIAL STABILITY											
% residence in 1965 same as residence in 1970, total of all persons 5 years and over in 1970	61.2	64.8	65.0	62.7	56.1	47.5	52.4	51.6	53.7	51.8	47.2
% residence in 1965 elsewhere in Polk County than residence in 1970, total of all persons 5 years and over in 1970	25.2	22.3	22.3	24.0	30.8	31.0	32.1	31.2	26.2	26.4	27.0
% residence in 1965 outside Polk County residence in 1970; total of all persons 5 years and over in 1970	9.9	5.1	10.6	8.4	10.2	16.5	10.0	12.7	15.5	17.6	22.4

* Other means includes categories: subway, etc.; walked to work; worked at home; and others.

** Professionals, managers and administrators, sales, clerical.

*** Craftsmen, operators, transport, laborers, farm & service workers, private household workers.



LEGEND

•••••••• LIMITS OF STUDY CORRIDOR

—— CENSUS TRACT BOUNDARY

106 CENSUS TRACT NUMBER

FIGURE III-5

CENSUS TRACTS

EDWARDS AND KELCEY, INC.

corridor, and most of the neighborhoods outside the corridor have some residents who are of minority races, foreign stock or are direct descendants of immigrants.

The average level of educational attainment of corridor residents is somewhat lower than the entire City of Des Moines and lower than the average Polk County resident living beyond the limits of the corridor. There is also a significant variation in educational levels within the corridor; the residents of northeastern Des Moines and Altoona have completed more formal schooling than have residents in Southeastern Des Moines and in Delaware township. Study corridor workers are primarily employed in blue collar jobs, although northeastern Des Moines and Altoona are statistically white collar communities.

The median family income (year 1970) of study area families is $10,212 which is slightly less than the median income in Des Moines or within Polk County beyond corridor limits. There is some intra-corridor variation; the median income varies from $9,387 in east and southeastern Des Moines to $11,160 in northeastern Des Moines. The percentage of families whose income is below $4,000 per year in the study corridor is higher than in the rest of Des Moines metropolitan area. The distribution of incomes below poverty level within the corridor varies between 14.7% of all families in eastern and southeastern Des Moines to about 6.8% in northeastern Des Moines and in the Pleasant Hill area.

About 93% of study area families have at least one automobile and 45% have two or more. In the metro area on the whole, the percentages are 87% and 41% respectively. The variation of auto availability within the corridor is consistent with previous findings in that eastern and southeastern Des Moines have fewer available autos (83%) than do the northeastern Des Moines, Altoona, and Pleasant Hill areas (95%). This compares with a figure of 86% for the City of Des Moines. Over 92% of study area workers use the automobile for transportation to and from work. The metropolitan area average is about 86%.

Eighty percent of the housing units within the corridor are owned and occupied by single families. In addition, there are more people residing in these single family dwellings than in the average single family home elsewhere in the metropolitan area.

The age of housing varies throughout the corridor. Pleasant Hill, Altoona, and northeastern Des Moines have relatively new housing development, with 46% of all occupied housing in those areas built since 1960, and 64% constructed since 1950. The areas of Delaware Township and eastern and southeastern Des Moines are somewhat older. 60% were built before 1950, and 39% were built prior to 1940. 71% of all corridor residents moved into their present housing since 1960, while 13% moved prior to 1950.

Multi-family residential housing units are primarily located along University and Hubbell Avenues; over 50 percent of all corridor multi-family housing is located in census tract 1, and an additional 20 percent is located in tracts 19 and 20. The remainder of corridor multi-family housing is located mainly within Altoona with several rental units in Pleasant Hill. Median gross rents for Des Moines, Altoona and Pleasant Hill in 1970 were $88 per month, $99 per month and $88 per month, respectively.

TABLE III-3

LARGEST 20 PRIVATE SECTOR EMPLOYERS IN CORRIDOR

Company	Location	Type of Business	Number of Permanent Employees	Number of Temporary Employees
Adventure Land	N.E. 56th and N.W. 9th Street, Altoona	Motel, Restaurant, Convention Center and Amusement Park	350	150
Diamond Laboratories	2538 S.E. 43rd St., Des Moines	Veterinary Biological Preparations	150-200	0
Iowa Power and Light	310 5th St. Pl. S.E., Pleasant Hill	Generating Plant No. 1	125	0
Mid-Iowa I-80 Truck Plaza	I-80 and Altoona Exch., Altoona	Truck Stop	80	20
Ace Alkire Line, Inc.	4143 E. 43rd, Capitol Heights	Commodity Trucking	50 (175 Drivers)	0
General Mills, Inc.	Avon Lake, Iowa	Grain Elevator, Mill and Packaging Plant	50	0
Helena Chemical Co.	3525 Vandalia Rd., Des Moines	Manufacturer of Agricultural Chemicals	40	40 (Seasonal)
Townsend Industries	R.R. #1, Altoona	Printing Press and Printing Rollers	40	1
Artistic Manufacturing Co.	602 3rd St., S.W. Altoona	Plastics and Aluminum Forming	35	4
Williams Bros. Pipeline	2503 S.E. 43rd St. Pleasant Hill	Petroleum Transmission Pipeline	35	0
Hydrocarbon Transportation Co.	4401 Vandalia Rd., Pleasant Hill	Liquid Propane Storage & Transport	34	0
Kent Feed, Inc.	203 1st Ave. No., Altoona	Animal Feeds	25	0
Vitalis Truck Lines	1200 S. Pleasant Hill Blvd., Pleasant Hill	Special Commodity Trucking	21 (42 Drivers)	0

TABLE III-3 (CONT.)

Company	Location	Type of Business	Number of Permanent Employees	Number of Temporary Employees
Northwestern Bell Telephone Company	305 9th St., S.E. Altoona	Telephone Service	18	0
Farmers Grain Dealers Association of Iowa	Avon Lake, Iowa	Grain Storage and Shipping Facilities	15	0
Prestressed Concrete Operation - Wheeler Division, St. Regis Paper Company	3312 S.E. Granger, Des Moines	Manufactures Hollow Cored Flat Slabs	13	+2 (Summer)
Hy-Vee Food Store	629 8th St., S.E. Altoona	Grocery Store	12	24
Campbell Industries, Inc.	3201 Dean Ave., Des Moines	Crop Dryers, Commercial and Industrial Warm Air Heating Equipment	12	
Des Moines Ford Tractor	N.E. 56th & University Ave. Pleasant Hill	Sales and Service	12	3
Park Sheet Metal, Inc.	203 1st St., E. Altoona	Sheet Metal Working	11	0

* Public and institutional employment (local governments, state facilities in corridor, schools, etc.) are not included in this tabulation.

In summary, the corridor residents are generally younger, have more children, and move more often than their neighbors in other parts of Polk County. Southeastern and eastern Des Moines residents are more blue collar, have lower educational and income levels, move less frequently than in other areas of the corridor and tend to develop more traditional neighborhood bonds. In the developing residential areas of northeastern Des Moines, Altoona and Pleasant Hill, residents are better educated, more mobile, have higher incomes, and move more often than residents in the study corridor as a whole. Residents of these areas tend to have less affinity to their immediate surroundings than residents of more traditional neighborhoods.

When study corridor residents (or would be residents) purchase a home, neighborhoods as such are probably not an important factor. The residential districts, many of which are currently undergoing development, would have little traditional neighborhood characteristics to offer. Rather, the essential buying factors are likely cost and required minimum space, taxes, schools, distance and access to work, shopping centers, health facilities and places of entertainment.

2. *Economic Characteristics*

Employment - Corridor residents are typically employed in manufacturing, services, wholesale and retail firms; this is characteristic of the Des Moines metropolitan area. Most study area workers are employed within the City of Des Moines; about 15 percent work in the Central Business District and about 50 percent work elsewhere in the city. Only 20 percent of corridor workers are employed in Polk County outside the City of Des Moines. Non-farming employment opportunities within the corridor are principally blue collar and are located in four general areas; the City of Altoona, the commercial-industrial "strip" along Hubbell Avenue, the industrial areas along Vandalia Drive in Pleasant Hill and Des Moines, and in the industrial area northwest of Carlisle. Corridor firms are primarily engaged in providing traffic services, serving the needs of local population for convenience items, transporting of materials, the storage, conversion and distribution of energy forms, and producing agriculturally related products such as fertilizers and seed. A summary of the 20 largest private sector employers is shown on Table III-3. Total corridor employment levels and employment projections are discussed in Section III B 1.

Retail Trade - The location of purchase of goods and services is generally governed by convenience, price and selection. Corridor residents, primarily due to the lack of local retail outlets, shop in the City of Des Moines for clothing, furniture, professional services, large appliances, automobiles, gasoline and auto service. The purchase of groceries, household items and convenience goods is dependent on the residents location within the corridor; residents living in or near Altoona typically shop for food stuffs and convenience items at locations in the city. Residents living some distance (south of Iowa 163) from commercial establishments in Altoona typically frequent shopping areas in Des Moines for these items.[1]

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(1) Altoona & Pleasant Hill Comprehensive Plans

TABLE III-4

PER CAPITA SALES: 1970 & 1975

COMMUNITY	PER CAPITA SALES - 1970			PER CAPITA SALES - 1975			
	1970 [1] Population	1970 Taxable [2] Sales-Fiscal Year Ending June 30, 1970	1970 Per Capita Sales	1975 [3] Population (Estimated)	1975 Taxable [2] Sales-Fiscal Year Ending June 30, 1975	1975 Per Capita Sales	Percent Change
Altoona	2,854	$ 5,857,551	$2052	4,150	$ 10,074,547	$2428	+18.3
Ankeny	9,151	14,832,006	1621	13,000	27,427,107	2110	+30.2
Des Moines	201,404	877,744,973	4358	199,000	1,134,853,546	5703	+30.9
Grimes	834	2,142,987	2570	900	2,487,423	2764	+ 7.5
Polk City	715	540,237	756	850	682,651	803	+ 6.2
Urbandale	14,434	3,626,559	251	17,000	13,733,356	808	+221.9
West Des Moines	16,441	22,770,505	1385	22,000	44,068,732	2003	+44.6
Polk County	286,101	$954,545,257	$3336	301,000 [4]	$1,261,210,621	4190	+25.6
Iowa (State)	2,824,376	$6,086,850,799	$2155	2,879,000 [4]	$8,040,975,377	2793	+29.6

(1) U.S. Department of Commerce, Bureau of the Census

(2) State of Iowa, Department of Revenue, Research and Statistics Division

(3) CIRALG, Preliminary 208 Intensity Development Considerations

(4) State of Iowa, Office of Planning and Programming, Projected Estimates

TABLE III-5

TAXABLE RETAIL SALES: DES MOINES METROPOLITAN AREA 1965 - 1975

	1965 (x1000 Dollars)	1970 (x1000 Dollars)	1975 (x1000 Dollars)	Percent Change 1965-1975	Percent Change 1970-1975
Ankeny	7,267	14,832	27,427	+277.4	+84.9
Altoona	3,533	5,858	10,075	+185.2	+72.0
Des Moines	510,147	877,745	1,134,854	+122.5	+29.3
Grimes	1,013	2,143	2,487	+145.5	+16.1
Mitchellville	712	1,226	1,004	+ 41.0	-18.1
Polk City	362	540	683	+ 88.7	+26.5
Urbandale	398	3,627	13,733	+3350.5	+278.6
West Des Moines	16,061	22,771	44,069	+174.4	+93.5
Towns Under 500	2,805	2,185	2,956	+ 5.4	+35.3
Rural	14,879	19,223	14,824	- 0.4	-22.9
Non-Permit	1,744	3,237	6,188	+254.8	+91.2
Total Polk County	558,921	954,545	1,261,211	+125.7	+32.1
Total State	3,806,090	6,086,851	8,040,975	+111.3	+32.1

Per capita sales, shown in Table III-4, give an indication of overall retail strength in Polk County Communities. Des Moines clearly dominates retail trade in Polk County, and per capita sales for Polk County are 55 percent higher than the State of Iowa as a whole, indicating the strength of Des Moines as a statewide center of retail trade. While per capita retail sales have increased generally in the last five years, Altoona's segment of total market sales has decreased relative to the City of Des Moines. Although retail outlets in Altoona (and the other commercial establishments in the corridor) cannot compete directly with Des Moines at this time, economic growth has taken place in the area of convenience goods and services.

Data for commercial establishments in other areas of the corridor have not been released by the State Department of Revenue for reasons of confidentiality. The trends identified for Altoona can be extended to other areas in the corridor, however. The preparation of Table III-5 was based on total taxable sales as an indicator of corridor economic vitality in accordance with recommendations of the Iowa State Department of Revenue.

Property Values - The owner specified median value (1970 census) of single family housing units (house and lot) within the corridor is $14,500 and varies between median values $10,000 and $17,800 in southeastern Des Moines and Pleasant Hill, respectively. The median value for a single family home in the metropolitan area as a whole (Polk County) is $16,100. The median property value for Capitol Heights, east and southeast Des Moines is $10,700 while the median value for remaining areas of the corridor (Pleasant Hill, Altoona, Unincorporated Polk County) is $16,900. Therefore, while the aggregate corridor property values are somewhat less than those elsewhere in the metropolitan area, the median residential property values of areas in northeast Des Moines, Pleasant Hill, Altoona and sections of unincorporated Polk County exceed the median value determined by considering Polk County (including Des Moines) as a whole. This, in turn, implies that property values in the Capitol Heights area of Delaware Township and in east and southeast Des Moines are depressed relative to the rest of the corridor area.

Property Taxes - Prior to the assessment year beginning January 1, 1975, and the fiscal year beginning July 1, 1976, property taxes were levied against 27 percent of the fair market value of land and structures, as multiplied by the applicable millage rate. For assessment years beginning January 1, 1975, and thereafter (fiscal years beginning July 1, 1976, and thereafter) property taxes will be levied against 100 percent of the fair market value of land and structures. Rates will be expressed in dollars per $1,000 of taxable value, rather than as a millage rate. In all cases, however, a reduction in taxes paid is allowed for homestead credits and as a property tax exemption for eligible World War II vaterans.

Table III-6 shows the millage rates for the fiscal year ending June 30, 1976, for various corridor municipalities. Also shown are the total assessed value of the municipalities (27 percent of fair market value), the total tax burden of that municipality, and the total taxes owed on a $20,000 home ($23,000 in Polk County outside the Des Moines city limits) for the fiscal year ending June 30, 1976. Tax rates per $1,000 of fair market value, applicable for the fiscal year

TABLE III-6

1974 TAX LEVIES

(PAYABLE FISCAL YEAR JULY 1, 1975 - JUNE 30, 1976)

	MILLAGE RATES											
	Board of Education	County	Area XI College	General School	School House	Corporation	Township	City	Total Millage Rate	Fair Market Value x 27% = Assessed Valuation (1000's)	Estimated Total Tax Burden (1000's)	Taxes Payable On A Typical $20,000 Home (House & Lot)** 7-1-75 to 6-30-76
CITIES												
Altoona (S.E. Polk Community)	.333	28.563	1.572	52.181	10.077	-	-	27.828	120.554	$ 12,810	$ 1,544	$749
Bondurant (Bond-Farr)	.333	28.563	1.572	54.157	11.153	-	-	28.768	124.546	3,797	473	773
Carlisle* (Carlisle Community)	None	28.563	1.572	55.041	10.080	-	-	33.906	129.162	115	15	802
Des Moines (Des Moines Ind.)	.333	27.588	1.572	49.269	11.059	45.309	-	.912	136.042	574,892	78,209	735
Pleasant Hill (S.E. Polk Com.)	.333	28.563	1.572	52.181	10.077	-	-	13.700	106.426	21,973	2,300	661
Pleasant Hill (Des Moines Ind.)	.333	28.563	1.572	49.269	11.059	-	-	13.700	104.496			649
TOWNSHIPS												
Allen (Carlisle Community)	None	41.181	1.572	55.041	10.080	-	1.500	-	109.374	4,344	475	679
Beaver (S.E. Polk Community)	.333	41.181	1.572	52.181	10.077	-	1.650	-	106.994	3,954	423	664
Camp (S.E. Polk Community)	.333	41.181	1.572	52.181	10.077	-	2.405	-	107.749	4,555	491	669
Clay (S.E. Polk Community)	.333	41.181	1.572	52.181	10.077	-	2.119	-	107.463	4,310	463	667
Delaware (S.E. Polk Community)	.333	41.181	1.572	52.181	10.077	-	2.969	-	108.313	10,936	1,185	673
Four Mile (S.E. Polk Community)	.333	41.181	1.572	52.181	10.077	-	2.487	-	107.831	6,106	658	670

* Within Polk County

** A $23,000 home in Polk County outside the city of Des Moines, due to a 15 percent valuation increase. The total taxes owed may be reduced by homestead and veterans exemptions.

From information supplied by Polk County Assessor's Office and Greater Des Moines Chamber of Commerce Federation.

beginning July 1, 1976, have not been established at this time.

3. Service and Facilities

The level of Community Services available to the inhabitants of an area is one of the factors determining the attainable level of human activity and physical growth. Comfort, safety and enjoyment to be found in the area depend upon the level of police and fire protection, the quality of medical care and educational institutions and the diversity of religious and cultural experiences offered.

The function of any transportation network is service. The transportation network should provide for efficient and convenient accessibility to public facilities and services. Anticipation of the impact that a proposed highway facility will have on community services is an essential, integral aspect in not only determining the need for a transportation improvement but also in selecting the alternative that best serves the area. Community Services and facilities located within the study corridor are shown in Figure III-6.

Public Safety - Police departments are maintained by each municipality within the study corridor; jurisdiction extends to the respective corporate limits. The Polk County Sheriff's office serves the unincorporated areas. Reciprocity exists between the municipal law enforcement agencies and the Sheriff's office, and all after hours calls are handled by the County. The Pleasant Hill police service originates at the City Hall, 4450 Oakwood Drive. The Altoona police station is located at 203 3rd Street S.W., while the Carlisle police station is at 115 School Street. The Polk County Sheriff's office is in the Courthouse Building, 500 Mulberry Street, Des Moines.

Due to the predominantly rural nature of the study corridor, fire protection districts have developed on a township basis. Fire stations are located in incorporated or developed areas, and serve the township in which they are located. The Altoona Station, 201 S.E. 3rd Street, serves Clay Township; the Carlisle station, 135 2nd Street, serves Allen Township; the Mitchellville Station, 108 N.E. 2nd Street, serves Beaver Township; the Pleasant Hill Station, 4450 E. Oakwood Drive, serves Four Mile Township and the incorporated area in southern Delaware Township; the Runnels Station, 106 Brown Street, serves Camp Township. Delaware Township is served by a fire station in the Capitol Heights community. This station is located at 4951 N.E. 38th Avenue. Only the Altoona, Pleasant Hill and Delaware Township stations are located within the study corridor. The fire districts have a reciprocal agreement whereby response to an alarm will generate the equipment necessary to provide adequate services.

Schools - The study corridor includes portions of four school districts: Bondurant-Farrar, Carlisle, Des Moines and Southeast Polk. The school district boundaries, schools and school attendance boundaries are shown on Figure III-6. For the Bondurant-Farrar and Carlisle school districts, only the district boundaries are shown. Students living within the study corridor attending these school systems are bussed to locations outside the corridor.

All Pleasant Hill High School students are bussed to secondary schools in the Des Moines school system. These schools lie outside the study corridor. All Pleasant Hill grade school students within walking distance walk to Pleasant Hill Elementary School, 4801 Oakwood Drive.

There are four southeast Polk district elementary schools within the study corridor. Four Mile Elementary School, 670 S.E. 68th Street, serves Four Mile Township with the exception of Pleasant Hill. Delaware Elementary School, 4401 E. 46th Street, is attended by students living in Delaware Township south of I-80. Students living north of U.S. 6 in Altoona and all students living in unincorporated Clay Township attend Altoona Elementary School, 301 S.W. 6th Avenue. Students living within the Altoona corporate limits and south of U.S. 6 attend Centennial Elementary School, 910 S.E. 7th Avenue. All students attending Four Mile and Delaware schools are bussed. Altoona elementary school students living in unincorporated Clay Township are bussed while those living in Altoona walk. All students attending Centennial Elementary School walk.

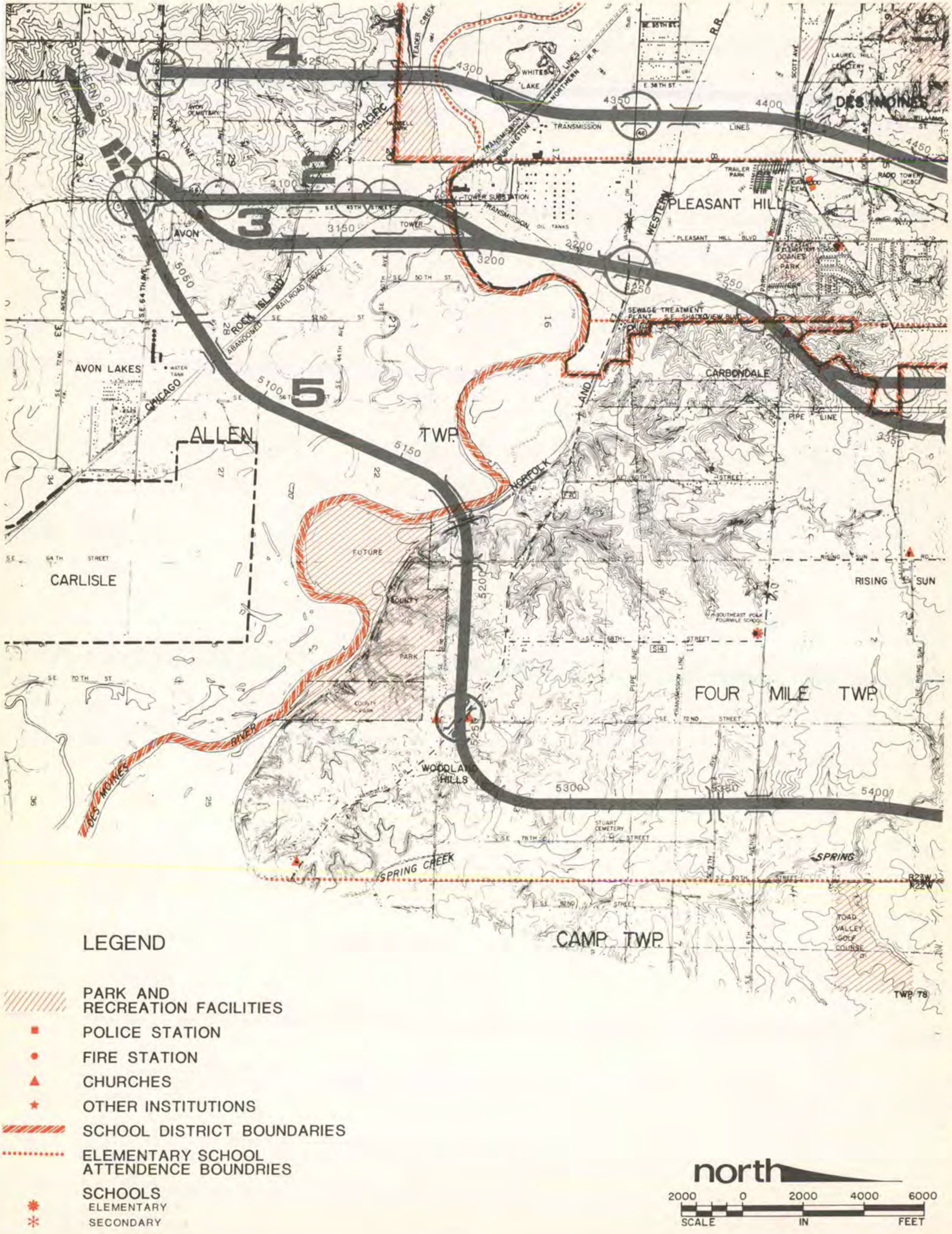
Southeast Polk Junior-Senior High School, 8325 N.E. University, provides secondary education for the Southeast Polk School District. Practically all Southeast Polk students are bussed.

Health Care - There are no hospitals or medical clinics located within the study corridor. Des Moines General Hospital, 603 E. 12th, and Iowa Lutheran Hospital, 700 E. University, provide emergency medical care for the area. These hospitals are located approximately two miles west of the Des Moines corporate limits, and are fairly convenient to the corridor population. The Altoona Manor Care Center, 200 7th Avenue S.W., provides nursing home care. A new nursing home is presently under construction in Pleasant Hill. The facility is located near the intersection of Pleasant Hill Boulevard and Parkridge Avenue.

Other Facilities - There are 13 churches of varying denominations located within the study corridor. They are shown on Figure III-6. These include: Altoona Christian Church, 206 2nd Avenue S.E.; Altoona Regular Baptist Church, 801 3rd Avenue S.W.; Altoona United Methodist Church, 602 5th Avenue S.W.; Adelphi Calvary Baptist Church, 7925 S.E. Vandalia Drive; Avon Community Church, 5975 S.E. 46th Street; Capitol Heights United Methodist Church, 4040 N.E. 45th Drive; Carbondale Evangelical Free Church, Rural Route 5, Pleasant Hill; Church of Christ, 3857 E. 42nd Street; Lighthouse Temple (Pentecostal), 107 6th Street S.W.; Rising Sun Church of Christ, 6390 Rising Sun Drive; Woodland Hills Church of Christ, 7200 S.E. Vandalia Drive.

The City of Altoona maintains a library at 700 1st Avenue South. The East Branch of the Des Moines Public Library System, 2559 Hubbell Avenue, serves the remainder of the study corridor.

The Four Mile Community Center, 3711 Easton Boulevard, is maintained by the City of Des Moines for the use of neighborhood residents. The facilities include a gym, game room, meeting rooms, Senior Citizens Lounge and a kitchen. Programs administrated by the Center are geared to all ages and include dance programs and Arts and Crafts workshops. In addition, the Four Mile Neighborhood Priority Board Meetings and Central Advisory Board meetings are held at the facility at regular intervals. Use of the facility is primarily geared to



4
2
3
5
DES MOINES
PLEASANT HILL
CARBONDALE
AVON
AVON LAKES
ALLEN TWP.
CARLISLE
FOUR MILE TWP.
RISING SUN
WOODLAND HILLS
CAMP TWP.
DES MOINES RIVER
SPRING CREEK
FUTURE COUNTY PARK
TOAD VALLEY GOLF COURSE
LEGEND
PARK AND RECREATION FACILITIES
POLICE STATION
FIRE STATION
CHURCHES
OTHER INSTITUTIONS
SCHOOL DISTRICT BOUNDARIES
ELEMENTARY SCHOOL ATTENDENCE BOUNDRIES
SCHOOLS
ELEMENTARY
SECONDARY
north
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SCALE IN FEET

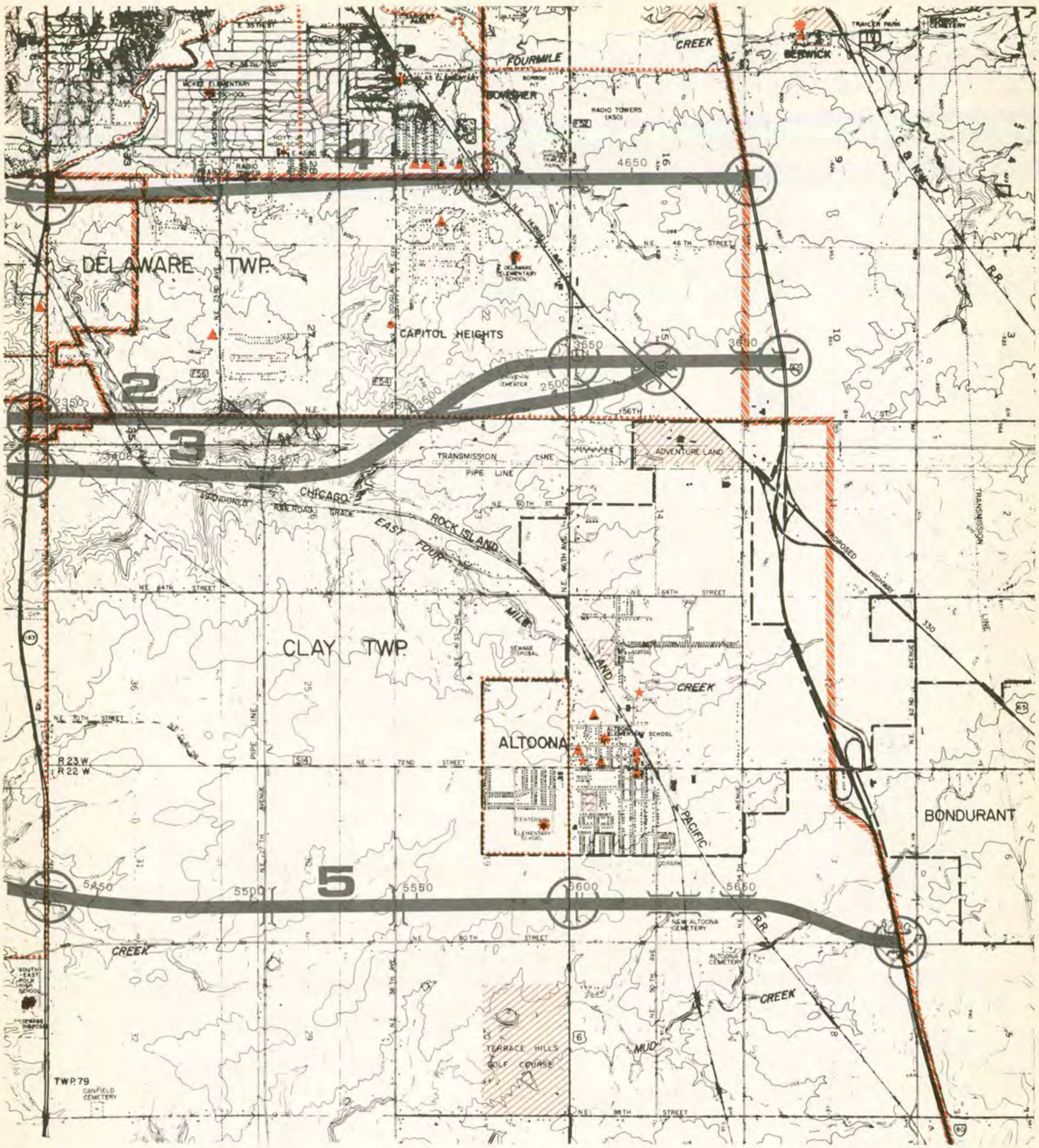

FIGURE III-6

PUBLIC AND INSTITUTIONAL FACILITIES

local Des Moines residents, although city residence is not required. The Center is primarily used by neighborhood residents, many of whom walk to the facility.

Public Transportation - At the present time, there is no public transportation within the study corridor. The Metropolitan Transit Authority operates a bus system within the Des Moines metropolitan area. Bus service presently terminates at the eastern Des Moines city limits.

There are two privately owned cab companies which serve the outlying Des Moines metropolitan area. Service for study corridor residents generally requires about one-half hour lead time. No cabs are regularly stationed within the study corridor.

4 Recreational, Historical and Cultural Features

Parks - There are two major public parks located within the study corridor (see Figure III-6). These are Hubbell Park, which is administered by the City of Des Moines, and is located just south of the Des Moines River, west of Iowa 46, and Doane's Park, which is a municipal park located at Parkridge Avenue and Pleasant Hill Boulevard in Pleasant Hill. In addition, Polk County owns a 103 acre tract known as the Johnson Property, which is located on the bluffs overlooking the Des Moines River at Woodland Hills. The park has recently been expanded by an additional 300 acres. Future plans for this park include camping, picnicking and hiking facilities.

Yeader Creek Park, a major County park, and Ewing Park, a Des Moines City park, are located just west of the study corridor south of the Des Moines River. The City of Des Moines has prepared a riverfront development plan which includes the preservation of natural areas along both banks of the Des Moines River within the city. In the southeast area, the plan envisions the development of a private water-oriented recreation area at Whites Lake, which is located on the north side of the river northwest of Hubbell Park, in addition to the preservation of the natural area along both sides of the river itself.

Recreational Facilities - In addition to parks, there are a number of other recreational facilities located within or close to the study corridor. Terrace Hills Golf Course near Altoona and Toad Valley Golf Course south of Iowa 163 are located near the east limit of the study corridor. The Pleasant Hill Comprehensive Development Plan recommends the development of a nine-hole public golf course within the Four Mile Creek Valley south of Iowa 163.

The Iowa State Fairgrounds is located within the City of Des Moines near the west corridor limits just south of Iowa 163. Adventureland, a privately owned recreational complex, is located in Altoona at the intersection of U.S. 65 and Interstate 80.

The Lake Red Rock Recreation Area, being developed by the Corps of Engineers in conjunction with the Red Rock Dam flood control project on the Des Moines River, is expected to become one of Iowa's major recreation areas. The Area is located about twenty-five miles southeast of Des Moines.

The Regional Open Space System (ROSS), the major concept of the 1972 CIRPC Central Iowa Outdoor Recreation Plan consists of "...a network of river and stream corridors which link the region's major park facilities to each other and to the major cities and towns".(1) The Des Moines River and Four Mile Creek are two of 14 river corridors designated for inclusion in ROSS. Along the Des Moines River, an open space corridor one mile wide has been recommended. The corridor along Four Mile Creek extends at a width of 200 feet from Interstate 80 south to the confluence with the Des Moines River. The Plan recommends that major transportation routes should not be located within these open space corridors. The Plan further recommends that an urban trail be developed along the Four Mile Creek corridor from the Des Moines River north to Ankeny, and assigns a high priority to such development.

The Polk County Conservation Board has also recognized the need to preserve river and stream valleys from encroachment, and has designated Four Mile Creek as one of eight Polk County streams to be protected.(2)

Historical and Archaeological Features - A number of historical and archaeological features of varying significance have been identified within the study corridor. A preliminary survey of historic sites was conducted by the Iowa Division of Historic Preservation, State Historical Department, during the summer of 1975. These sites are listed in Table III-7, and are located on Figure III-7. None of these sites is included in the National Register.

A field survey was also conducted by the office of the State Archaeologist during the summer of 1975 and areas of potential archaeological significance were identified. As can be seen from Figure III-7, the Des Moines River flood plain and the bluff areas immediately north and south of the river valley have the greatest archaeological potential.

C. AGRICULTURAL LANDS AND PRODUCTIVITY

Historically, agriculture has been economically important to Iowa, and as the world market for American agricultural products expands, the demand for the state's farm production should increase in the future. The agricultural productivity of Polk County is higher than that of Iowa as a whole, equalling or exceeding the average state yield in corn, soybeans, sorghum, wheat and red

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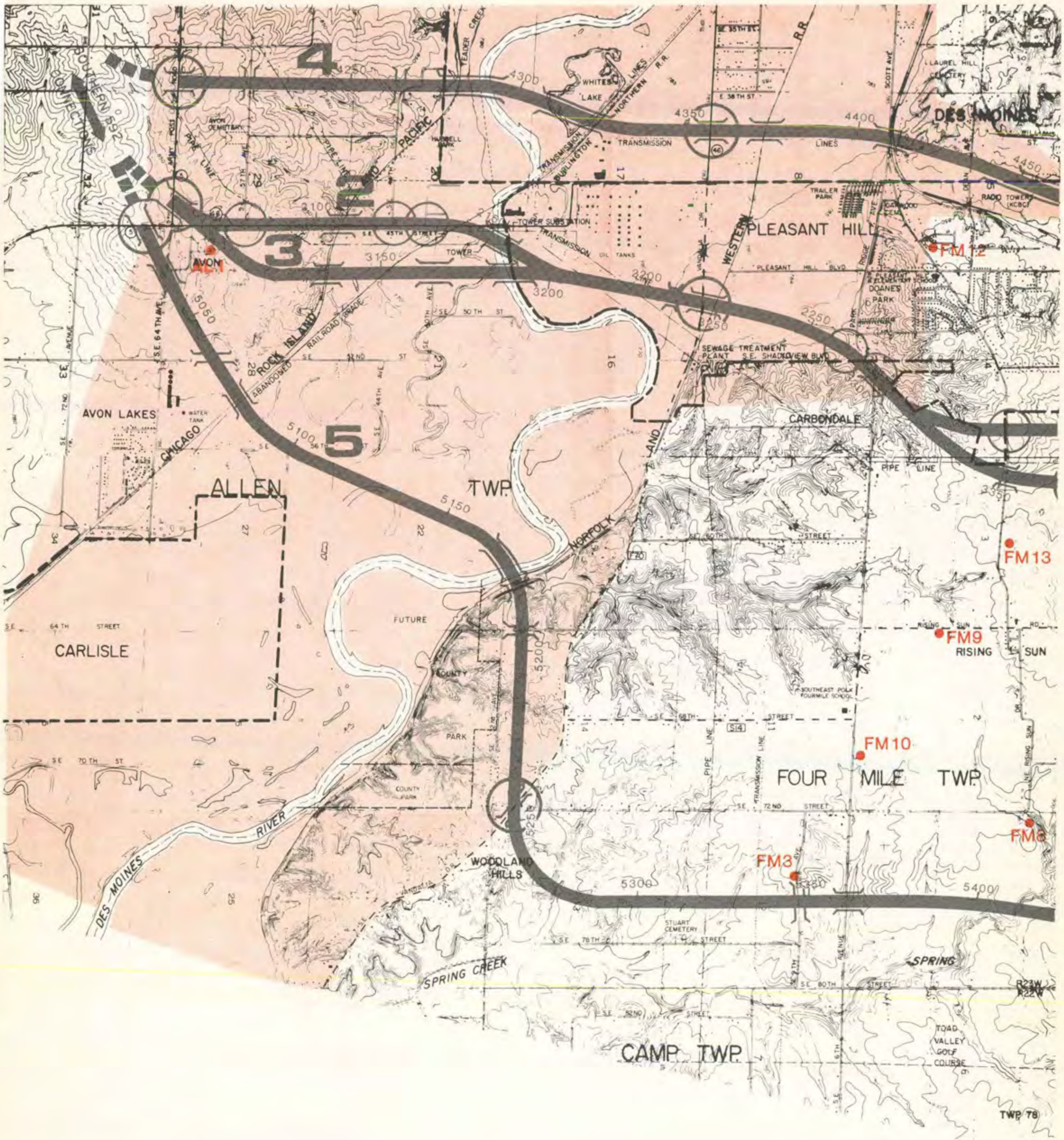
(1) Initial Central Iowa Outdoor Recreation Plan, Central Iowa Regional Planning Commission, 1972

(2) Comprehensive Planning Resume 1974-1979 Polk County Conservation Board



LEGEND

APPROXIMATE AREA OF HIGHEST ARCHAEOLOGICAL POTENTIAL

• FM8 NATIONAL REGISTER POTENTIAL/ HISTORIC - ARCHITECTURAL SITES

north

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SCALE IN FEET

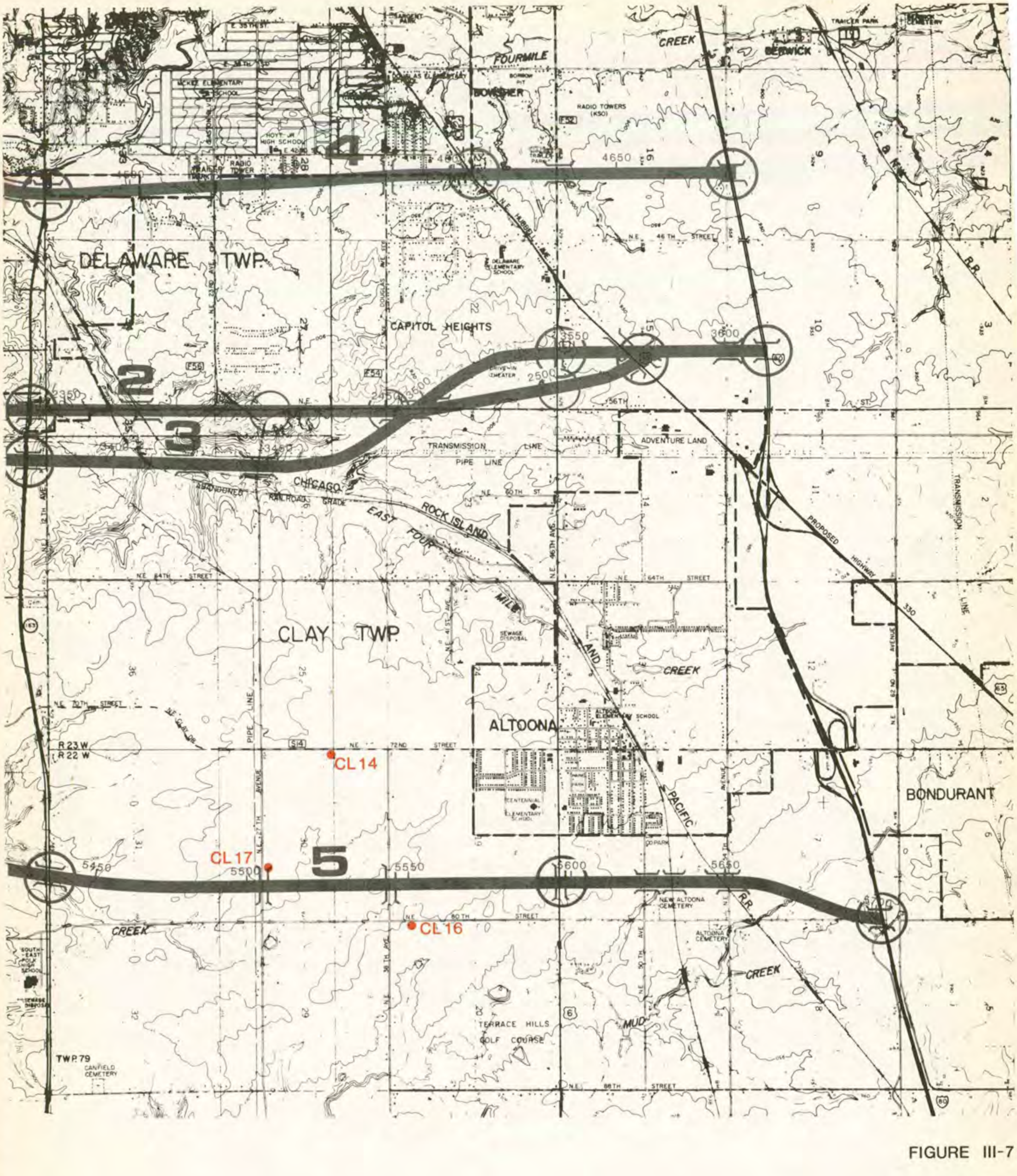

FIGURE III-7

ARCHAEOLOGICAL AND HISTORIC SITES

TABLE III-7

INVENTORY OF HISTORIC - ARCHITECTURAL SITES

Site No.	Description
FM12:	Two story brick house with segmental arched openings, circa late 19th century.
CL14:	Corn crib with unusual decorative motifs.
CL16:	Gable roof barn, stone foundation, and an example of early glazing.
CL17:	Two story early example of concrete block construction of a house.
FM3:	Two story frame house, Greek Revival motif.
FM8:	Two-and-a-half story brick house with dormers in the Georgian Revival motif.
FM9:	Two story frame house, Italianate style.
FM10:	Gambrel roofed barn.
FM13:	Two-and-a-half story brick, decorative lintels, porch and bargeboard.
AL1:	Early frame schoolhouse.

clover (104%, 100%, 100%, 137% and 141% respectively).[1] The county's farmland is devoted primarily to corn and soybeans, with a smaller percentage of agricultural land in pasture, hay and oats.

The majority of land within the study corridor is utilized for agricultural production. Productivity has been above average compared to other areas in Polk County, with approximately 80% of the land presently farmed producing yields greater than 100 bushels of corn per acre.[2]

Although productivity depends on many factors, good soil is a prerequisite for successful farming. In this regard, the U.S. Soil Conservation Service (S.C.S.) has established a Soils Classification System indicating the general suitability of each type of soil for various purposes; of these, Classes I, II and III are deemed suitable for farming without requiring extensive preparation or major precautionary measures. Class I is considered most desirable for agricultural uses, while Class III is regarded as least desirable. 91% of the land in the study corridor is rated as S.C.S. Class I, II, or III (25.5%, 45.6% and 20.2%, respectively). However, 16% of the Class III land lies within the Des Moines River flood plain and is subject to periodic flooding.

The better soils are generally found in the uplands area of the corridor north of the Des Moines River, while land in the bluffs region and in areas immediately adjacent to rivers and streams is marginal.

D. EXISTING TRAFFIC CONDITIONS

1. *General*

The 500 Beltway study corridor lies along the eastern edge of the Des Moines urban area and includes all of the suburbanized areas east of Des Moines, as well as several small towns which have only, within recent years, been drawn into the metropolitan area by the expansion of suburban Des Moines. The roadway system which serves the corridor reflects the past character of the area in that all major routes serve travel demand to and from Des Moines. (See Figure III-8). The major routes which serve the study corridor - U.S. 65, I-80, U.S. 6 and Iowa 163 - are all primarily inter-city routes, designed to connect Des Moines with other nearby towns. These highways are all radial to the City of Des Moines and primarily serve east-west travel demand. The only other state route which serves the study area is Iowa 46. This road connects Iowa 5 with Iowa 163 along the western edge of the corridor, and, although oriented in a north-south direction, does not serve any significant north-south travel demand.

There are many other roads in the study corridor; these are county roads which lie, for the most part, along the one-mile grid system prevalent in most rural sections of the Midwest. The primary function of these roads is to provide access to the farmland which constitutes the major land use in the study corridor.

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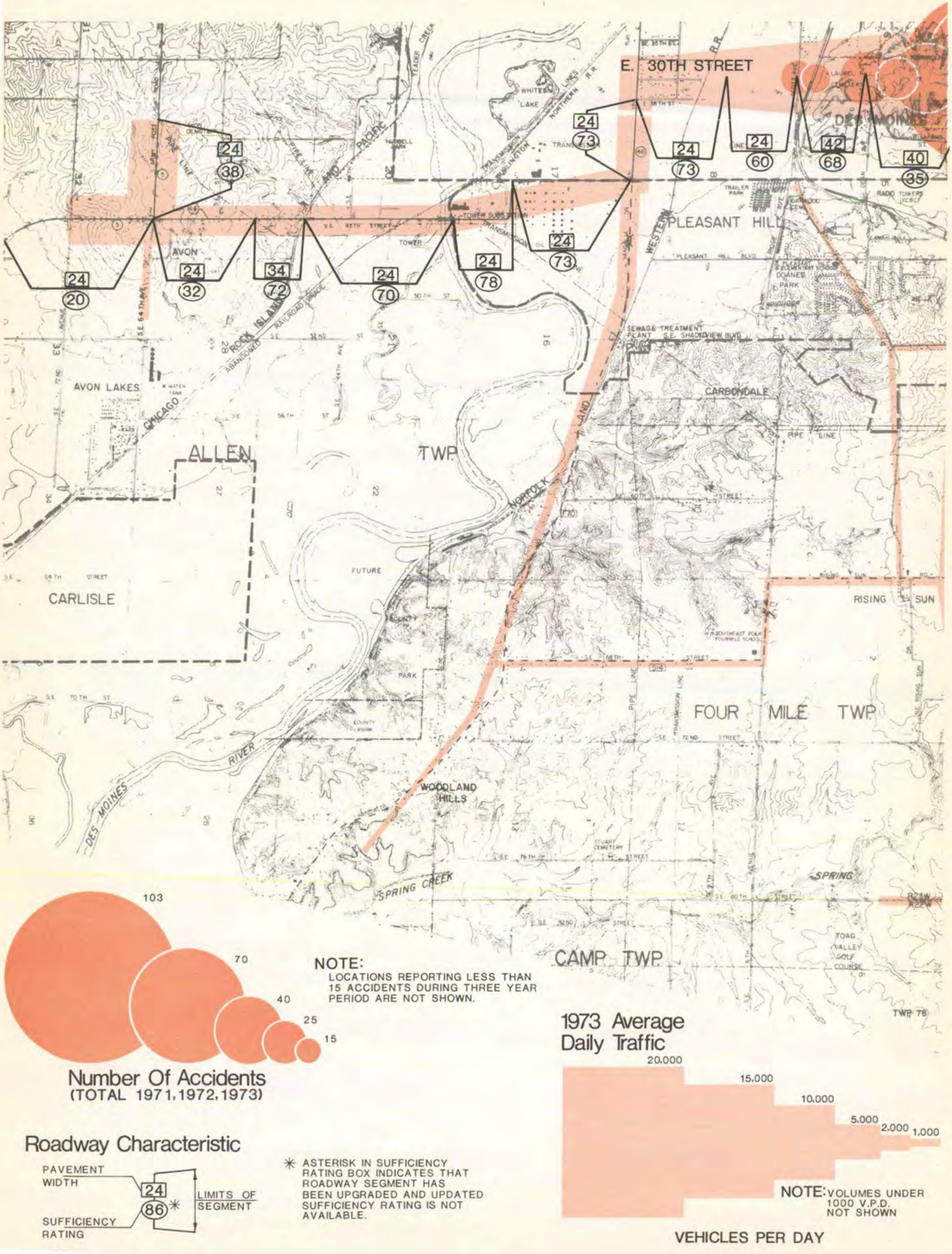
(1) 1973 FARM CENSUS, Iowa Department of Agriculture

(2) Agricultural Stabilization and Conservation Service, (Iowa Department of Agriculture)


E. 30TH STREET
DES MOINES
PLEASANT HILL
AVON
AVON LAKES
ALLEN TWP.
CARLISLE
CARBONDALE
RISING SUN
FOUR MILE TWP.
CAMP TWP.
WOODLAND HILLS
DES MOINES RIVER
SPRING CREEK
ROCK ISLAND
CHICAGO
NORFOLK
24
20
24
32
34
72
24
70
24
78
24
73
24
38
24
73
24
73
24
60
42
68
40
35
103
70
40
25
15
Number Of Accidents
(TOTAL 1971, 1972, 1973)
NOTE:
LOCATIONS REPORTING LESS THAN 15 ACCIDENTS DURING THREE YEAR PERIOD ARE NOT SHOWN.
1973 Average Daily Traffic
20,000
15,000
10,000
5,000
2,000
1,000
NOTE: VOLUMES UNDER 1000 V.P.D. NOT SHOWN
VEHICLES PER DAY
Roadway Characteristic
PAVEMENT WIDTH
SUFFICIENCY RATING
LIMITS OF SEGMENT
24
86
* ASTERISK IN SUFFICIENCY RATING BOX INDICATES THAT ROADWAY SEGMENT HAS BEEN UPGRADED AND UPDATED SUFFICIENCY RATING IS NOT AVAILABLE.

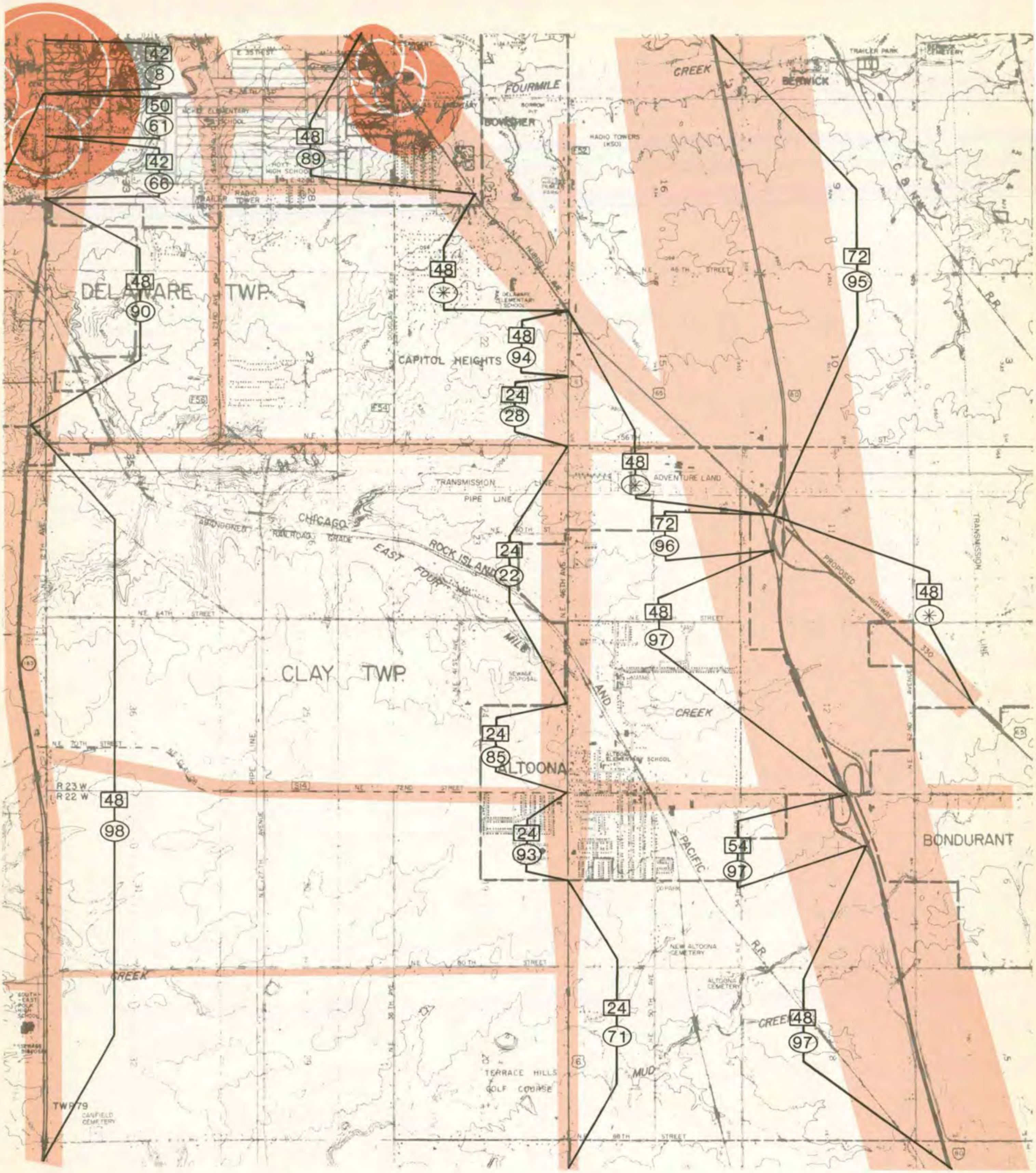


FIGURE III-8

AVERAGE DAILY TRAFFIC SOURCE:
IOWA D.O.T. - HIGHWAY DIVISION TRAFFIC COUNTS

ACCIDENT DATA SOURCE:
WITHIN DES MOINES CORPORATE LIMITS - CITY OF DES MOINES - DEPARTMENT OF TRAFFIC AND TRANSPORTATION
ALL OTHER AREAS - IOWA D.O.T. - HIGHWAY DIVISION

ROADWAY CHARACTERISTICS SOURCE:
IOWA D.O.T. - HIGHWAY DIVISION (SEE TEXT FOR DISCUSSION OF SUFFICIENCY RATING)

EDWARDS AND KELCEY, INC.

north

2000 0 2000 4000 6000
SCALE IN FEET

EXISTING TRAFFIC CONDITIONS

The design of roads in the study corridor varies. Iowa 163, east of the Des Moines corporate limits, and U.S. 65, north of Broadway Avenue, are four-lane median separated roadways. U.S. 65 (Hubbell Avenue) south of Broadway, is a four-lane, undivided urban arterial which has lost capacity over the years due to the buildup of strip development along the roadway. U.S. 6, east of Hubbell Avenue, is a two-lane rural roadway. Iowa 46, south of the Des Moines River, is of the same design type as U.S. 6; however, north of the river to the Des Moines corporate limits, Iowa 46 is narrow, with narrow shoulder construction, and several curves of low design speed. Pavement width varies from 24 feet to 42 feet. Within the City of Des Moines, Iowa 46 is marked and driven as a four-lane roadway with 10 foot lanes, and there are several signalized intersections which further reduce capacity. Interstate 80 has three lanes in each direction west of the U.S. 65 interchange and two lanes in each direction east of the U.S. 65 interchange. The only interchange other than at U.S. 65 within the study corridor is on I-80 at County Road S-14, and is known as the Altoona interchange.

County roads in the study area include both paved surface roadways, (N.E. 56th Street, County Road S-14, N.E. 80th Street, N.E. 96th Street, N.E. 23rd Avenue, University Avenue, S.E. 6th Avenue and Vandalia Drive) and granular surfaced roadways (most other roadways). These roadways nearly always follow section lines, with profiles which follow the existing topography very closely, and with many driveways and field entrances provided to allow access to adjacent lands. Vandalia Drive, which lies along the north side of the Des Moines River, is a narrow two-lane paved county road which serves several small towns southeast of Des Moines as well as a limited amount of residential development within the study corridor.

In the examination of the study corridor roadway system, it has become evident that there is no through route by which corridor length north-south trips can be made. At the present time, trips which would be expected to use a north-south facility in the study corridor, were it available, are probably using either U.S. 65 or, if they are familiar with the local roads, Iowa 46 in combination with one of the roads which connect Iowa 163 with U.S. 65. In either case, these trips must use routes which are designed to serve principally a land access function rather than a through travel function. None of the available routes are continuous, and all have the potential to become overloaded if traffic volumes continue to increase as expected.

Figure III-9 illustrates the variation in traffic flow during a typical weekday for several locations in the study corridor. Each location exhibits the morning and evening rush hour peaking characteristics typical of routes used by commuters. The magnitude and duration of the peak volumes give an indication of the type of travel which occurs on the routes. The higher peak volumes of short duration indicate that the route carries a substantial volume of commuter traffic. If the peaks are lower and more spread out during the day, it indicates that midday travel, with trip purposes other than work, is a more important component of travel.

The study corridor is, at the present time, primarily agricultural in nature, and traffic occurring there reflects that situation. There are indications, however, that the study corridor is attracting an increasing amount of residential development, both in the form of subdivisions of all sizes and in the form of scattered single homes on comparatively large lots. Since employment opportunities exist primarily in the City of Des Moines, it is reasonable to expect that traffic on study corridor roads, especially those leading into Des Moines, will exhibit, to an increasing degree, the characteristics of commuter routes.

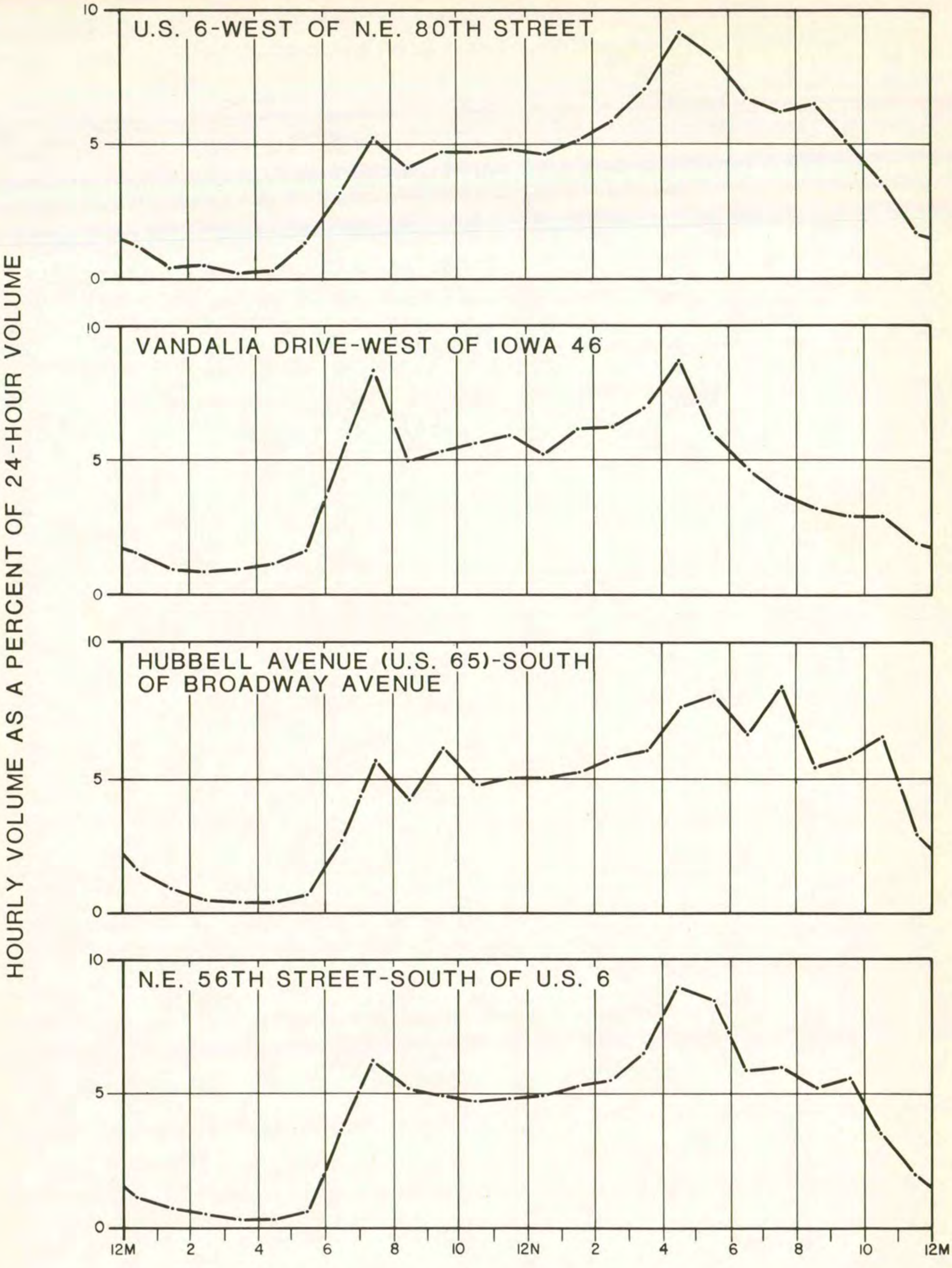
It is difficult to identify specific trip generators within the study corridor because of its rural nature. Altoona is an area which has a concentration of residential development, and is experiencing a continuation of such development. Adventureland Park, located in Altoona, is a combined convention center and amusement park. The developer reports that Adventureland attracted 585,000 visitors during 1975, and expects about 750,000 visitors in the year 1976. This type of development can be expected to precipitate the development of supporting businesses such as additional transient housing and food service facilities.

Other potential trip generators which may come into existence in the future are indicated by zoning plans developed for Polk County and by the comprehensive plans developed for each of the municipalities within the study corridor. (See Section III A 4). The City of Pleasant Hill has planned a combined office-commercial-residential area south of Iowa 163 near Pleasant Hill Boulevard, as well as some industrial development near Vandalia Drive. The latter would occur near the present industrial development at the south limit of Pleasant Hill, which includes the Iowa Power and Light Company power generating plant as well as an oil and natural gas storage facility. The Polk County zoning plan indicates three areas of potential industrial development within the unincorporated portions of the study corridor. These occur, 1) along the Des Moines River north and northwest of Carlisle, 2) north of Iowa 163 between N.E. 56th and N.E. 64th Streets, and 3) along Hubbell Avenue and U.S. 6 west of Altoona. Residential development is expected to take place primarily in the area west of E. 56th Street, between Iowa 163 and U.S. 6. Zoning plans certainly do not indicate that development will occur, but do offer an indication of where specific types of development are likely to occur.

2. *Volume/Capacity*

A roadway analysis network has been selected by which the impact of the study alternatives will be measured. Portions of this analysis network which are currently in existence have been examined to determine current operating conditions and the level of service provided. Volume to capacity ratios were determined. The volume to capacity ratio expresses actual traffic volume as a percentage of the capacity of the roadway when traffic on the roadway is operating at Level of Service "C". Level of Service "C" is defined as a condition of stable traffic flow, with speeds and maneuverability more closely controlled by higher volumes. Under such conditions drivers are restricted in their freedom to select their speed, change lanes, or pass, but they are able to maintain generally acceptable operating speeds. Level of Service "C" is considered an acceptable level of operating conditions in an urbanized area.

For the purposes of analyses based on traffic volumes, the roadway analysis network was expanded beyond the west limit of the study corridor in order to



SOURCE: IOWA DEPARTMENT OF TRANSPORTATION TRAFFIC COUNTS

FIGURE III-9

HOURLY TRAFFIC VARIATION

EDWARDS AND KELCEY, INC.

include East 30th and East 29th Streets. It is expected that traffic will be diverted from this route to the 500 Beltway.

The analysis network was analyzed and field observations were made to assess the current level of operating conditions. It appears that, at the present time, no roadway link or intersection operates at a level of service worse than Level of Service "C". Existing (1973) traffic volumes on network roadways are shown in Figure III-8.

3. Accidents

The Highway Division, Iowa Department of Transportation and the Department of Traffic and Transportation, City of Des Moines, provided information concerning traffic accidents which have occurred during 1971, 1972 and 1973 on the following roadway segments:

- I-80 from N.E. 38th Street to N.E. 96th Street
- U.S. 6 from Hubbell Avenue to N.E. 96th Street
- Hubbell Avenue from N.E. 29th Street to N.E. 64th Street
- Iowa 163 from N.E. 29th Street to N.E. 96th Street
- Iowa 46 from Iowa 5 to Iowa 163
- E. 29th Street, from Iowa 163 to Hubbell Avenue

During the three year period, a total of 1,297 accidents, occurring on these roadway segments, were reported to the Iowa Department of Transportation and the City of Des Moines. Figure III-8 shows the particular locations which have experienced the most accidents. Basically, high occurrence locations have been along more heavily traveled routes in more heavily developed areas. Because this is a typical pattern, accident rates for specific roadway segments have been calculated and compared to Iowa statewide rates for comparable roadways (Table III-8).

There are seven segments which, during the reporting years, have experienced higher than average accident rates:

- U.S. 6 between N.E. 56th Street and County Road S-14 (N.E. 72nd Street)
- Iowa 163 between N.E. 29th Street and the Des Moines corporate limits
- Iowa 163 between N.E. 56th Street and County Road S-14
- Iowa 46 between Vandalia Drive and the C.R.I. & P. Railroad tracks
- Iowa 46 between the C.R.I. & P Railroad tracks and Iowa 163
- N.E. 29th Street between Iowa 163 and Hubbell Avenue

TABLE III-8

TRAFFIC ACCIDENT EXPERIENCE

Location		Number of Accidents				Accidents Per 100 Million Vehicle Miles			
Route	Between	71	72	73	3 Yr. Ave.	71	72	73	3 Yr. Ave.
I-80	N.E. 38th St./U.S.65	7	13	11	10	33	62	52	49
	U.S. 65/Co.Rd. S-14	29	27	38	31	237	221	311	256
	Co.Rd. S-14/E.96th St.	11	14	23	16	52	66	104	74
U.S. 6	Hubbell Ave./N.E. 56th St.	3	10	3	5	189	629	189	336
	N.E.56th St./Co.Rd.S-14	12	11	13	12	274	251	297	274
	Co.Rd. S-14/E.96th St.	0	2	4	2	-0-	83	166	83
Ia. 163	E.29th St./Four Mile Creek	82	98	118	99	1002	1198	1443	1214
	Four Mile Creek/E. 56th Street	2	5	3	3	34	85	51	57
	E.56th St./Co.R. S-14	8	13	7	9	222	360	194	259
	Co.Rd. S-14/E.96th St.	5	9	15	10	90	162	271	174
Ia. 46	Army Post Rd./Vandalia	9	6	4	6	197	132	88	139
	Vandalia/CRIP R.R.	23	23	19	22	358	358	297	338
	CRIP R.R./Ia. 163	82	80	80	81	2343	2286	2286	2305
E. 29th St.	Ia.163/Hubbell			21				1475	
Hubbell Ave.	E.29th St./Euclid	21	30	38	30	847	1210	1532	1196
	Euclid/D.M.Corp.Lim.	37	61	72	57	923	1521	1796	1413
	D.M.Corp.Lim./U.S.6	9	1	3	4	308	34	103	148
	U.S.6/I-80	12	6	10	9	460	230	383	358
	I-80/N.E.64th St.	3	5	4	4	261	435	348	348
	Statewide Accident Rates								
	Road System - Rural								
	Interstate					77	78	92	
	Primary					175	201	195	
	Secondary					306	337	340	
	- Municipal								
	Interstate					203	215	243	
	Primary					768	871	883	
	Secondary					1071	900	956	

Source: Within Des Moines Corporate Limits: City of Des Moines, Department of Traffic and Transportation
Remainder of Study Area: Iowa Department of Transportation

- Hubbell Avenue between N.E. 29th Street and the Des Moines Corporate limits

The higher than average accident rates experienced on the portions of Iowa 163 and Iowa 46 listed above may well be due to high traffic volumes and a mix of through and local traffic which these roadways were not meant to serve. This would be particularly true of Iowa 46. As mentioned above, many trips which would use a facility by-passing the built up area, if it were available, are currently forced to use Iowa 46. The combination of local trips which must use E. 30th Street and through trips which use Iowa 46 because there is no available by-pass, fosters conflict situations which could easily result in traffic accidents. The conflict situations include cases where through traffic must cope with the generally lower speeds and more frequent stops and turning movements characteristic of local traffic.

4. *Sufficiency Study*

There is another means of evaluating existing highway facilities and deficiencies in the 500 corridor. In Iowa, a numerical system of rating the adequacy of primary roads has been developed. This numerical system is called a Sufficiency Rating Study. The purpose of the study is to measure the adequacy of a particular primary road section in its proper perspective with all other primary road sections in the State. Data on pavements, bridges, curves and other features of the highways are recorded and analyzed. Three basic factors enter into the establishment of a sufficiency rating on a section of road: structural adequacy, safety and service. Structural adequacy measures the ability of the road section to stand up under traffic and climatic conditions. Safety measures the ability of the road section to offer the motorist reasonable assurance of safe movement. Service measures the capability of the road to transport vehicular traffic with a minimum of conflict.

The basic rating is then adjusted for intolerability, if necessary, based on the tolerable standards approach, thereby arriving at a tolerability adjusted rating. A tolerable standard is defined as the minimum prudent condition, geometric or structural, which can exist without being in critical need of upgrading. An adjustment is then applied to the tolerability adjusted rating to determine the volume to capacity adjusted rating based on the volume to capacity ratio of a road. The volume to capacity ratio is the ratio of the volume of traffic that is using a road to the volume of traffic that it could be expected to carry at a given level of service. An adjustment is then applied to the volume to capacity adjusted rating to determine the continuity adjusted rating. The purpose of this adjustment is to reflect poor individual road sections interspersed between long sections of appreciably better road sections. This is the last adjustment and the result is the final sufficiency rating. A rating of 100 is used to represent the maximum sufficiency rating obtainable on any road section. The numerical sufficiency rating classification is as follows:

SUFFICIENCY RATING SCALE

Points	Rating
100 to 90	Excellent
89 to 80	Good

79 to 65	Fair
64 to 50	Tolerable
49 to 0	Critical

The sufficiency rating of roadways within the study corridor is shown in Figure III-8.

5. Summary

From a traffic operations viewpoint, the existing roadway network operates in a satisfactory manner at all points except along the portion of Iowa 46, Iowa 163, U.S. 6 and Hubbell Avenue, which have above average accident rates. From a systems viewpoint, however, the existing roadway network lacks a direct north-south route which would tie together all parts of the study corridor and provide a faster and safer route for through traffic.

E. NOISE ENVIRONMENT

The existing noise environment of the study corridor was characterized through a field survey conducted by the consultant in July, 1975. Ambient noise levels determined during this survey and the location of survey sites are shown in Figure IV-5.

The study corridor is primarily rural in character with ambient noise levels of 40 dBA L_{10} common in agricultural areas. Departures from this typical rural noise environment occur adjacent to major transportation corridors including Iowa 46, Iowa 163, N.E. 56th Street, U.S.6, U.S. 65, and I-80, and within the built-up residential/commercial areas of Des Moines, Pleasant Hill and Altoona.

The single largest source of noise generation within the corridor is the industrial area in south Pleasant Hill comprised of the Iowa Power and Light Company power generation plant and the adjacent petroleum and gas storage and distribution areas.

There are no sites within the study corridor that qualify for land use Category A classification [1]. Category B Noise Sensitive land uses consist primarily of residential tracts within Des Moines, Pleasant Hill, Altoona, Woodland Hills and Capitol Heights and other residences scattered throughout the remainder of the corridor. A new Polk County Park, located near Woodland Hills, also qualifies as a Category B noise sensitive site along with Hubbell Park, located near the southwest corner of the study corridor. The Toad Valley Golf Course, located near the eastern edge of the study corridor south of Iowa 163 and Terrace Hills Golf Course east of Altoona, are also Category B sites.

Noise sensitive land use throughout the study corridor is shown on Figure IV-5.

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(1) Category "A" and "B" land uses and the allowable noise levels associated therewith are specified in Federal Highway Administration, Federal-Aid Highway Program Manual, Section 773. For a detailed discussion, see Appendix VI, Section B 3 of this report.

F. AIR QUALITY

1. Background

Beginning in 1963, the United States, recognizing the threat of air pollution to the health and welfare of the Country, has addressed the air quality issue with increasing intensity. An amendment to the Clean Air Act passed by Congress in 1967, provided for a system designed to insure the abatement, prevention and control of air pollution on a regional basis. This system coordinates the efforts of Federal, State and local governments. Regional programs were initiated in geographical areas (air quality control regions) that endure common air pollution problems without regard for state boundary lines, while the abatement, prevention and control of air pollution at the source was made the primary responsibility of the State and local government.

Federal Legislation, passed in 1970, required the Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS). Primary and Secondary Air Quality Standards were established for several of the more common pollutants. Primary standards provide protection for public health, and secondary standards define levels of air quality to protect the public welfare. The pollutants include sulfur oxides, (SO_x), particulate matter, carbon monoxide (CO), hydrocarbons (HC) and nitrogen oxides (NO_x). A description of the pollutants and their effect on public health is included in Appendix VII of this report.

The 1970 Clean Air Act also required each state to adopt and submit to EPA a plan which provides for the implementation, maintenance and enforcement of the NAAQS. The State Implementation Plans (SIP) describe how the standards will be met in each air quality control region in the state. Generally, each plan sets forth a "control strategy" for attainment and maintenance of the NAAQS; legally enforceable regulations and compliance schedules for implementation of the control strategy; establishment of air quality monitoring stations; and procedures to assure that the construction or modification of air pollutant emitters will not interfere with the attainment or maintenance of the national standards.

Environmental Protection Agency guidelines published in July, 1974, required all states to identify areas having the potential for exceeding any National Ambient Air Quality Standard as a result of existing pollutant sources, or projected growth over the ten year period 1975 - 1985. Such areas are called Air Quality Maintenance Areas (AQMA), and may be identical with counties, urban areas, standard metropolitan statistical areas (SMSA), or other boundaries. The control strategy for the maintenance of air quality for each pollutant in each AQMA is incorporated in the SIP and is to be reviewed at five-year intervals to insure than any growth and development will be compatible with maintenance of the national standards throughout the ten year period.

In April, 1974, the Iowa Department of Environmental Quality (DEQ), acting as the state's air pollution control agency, recommended the designation of Polk and Warren Counties as Air Quality Maintenance Areas for the pollutants carbon monoxide and particulates. EPA acted on this recommendation in April, 1975, designating "South-Central" Iowa (the Des Moines Metropolitan Region) as an AQMA for carbon monoxide.

2. *Existing Air Quality*

Carbon monoxide and suspended particulates are the only two pollutants in the Des Moines metropolitan area whose measured levels have exceeded the applicable standards in the past. To date, carbon monoxide monitoring has been limited to one fixed location in the Des Moines central business district (CBD). Initial air quality investigations conducted as part of the overall Urbanized Area Transportation Plan studies indicated that the CBD is the only area where it has been established that air quality does not meet established Federal standards for CO.[1] The State DEQ was not satisfied with the conclusions of the Transportation Plan air quality report in regard to existing CO concentrations in the metropolitan area outside the Des Moines CBD. As a result, a cooperative effort is presently underway between CIRALG and the Iowa Department of Transportation to determine areawide CO concentrations by diffusion modeling.[2]

Suspended particulate matter in the Des Moines area is emitted primarily from area-wide (non-point) sources. Primary particulate sources include combustion products, industrial processes, agricultural activities and unpaved roads. The major particulate point source in the corridor is the Iowa Power and Light power generating station. It is not yet in complete compliance with DEQ and Des Moines/Polk County Health Department emission standards. Improvement of particulate levels in the Des Moines area is, however, proceeding faster than the rate originally projected.

The results of recent modeling indicate that SO_X levels are not currently a problem in the Des Moines area. Based on the results of point source modeling of large sources by DEQ, however, it is possible that monitoring may eventually result in the designation of South-Central Iowa as an AQMA for SO_X.

Recent calculations by DEQ indicate that 1985 concentrations of photochemical oxidants, which are formed from HC and NO_X in the presence of sunlight, are expected to fall well below maximum levels.

The internal combustion engine is a major source of CO, HC and NO_X pollutants, but only a minor source of SO_X and particulates.

G. GEOLOGY AND SOILS

1. *Geologic Setting*

The study area is located in the central lowlands' geomorphic province. It is astride the boundary between two sub-sections, the old dissected till plains

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(1) Summary of the Revised Initial 1990 Des Moines Urbanized Area Transportation Plan, Central Iowa Regional Association of Local Governments, May, 1974.

(2) The Des Moines Urbanized Area Transportation Air Quality Report for 1974, Central Iowa Regional Association of Local Governments, March, 1975.

and the young glacial drift section. The rocks of the central lowlands which underlie the entire study area are flat lying sedimentary rocks, alternating layers of shale, coal, limestone, and sandstone.

The flat lying bedrock has little effect on the surface topography of the study area. The land forms are more directly controlled by the glacial deposits on the surface. The boundary between the young and old glacial deposits, as shown on Figure III-11, reflects the two most recent glacial events. A brief summary of glacial history will illustrate the distinction.

The Kansan glaciation was the next to last to occur in the study area. The Kansan ice sheet reached almost to St. Louis. In passing through the Des Moines area, the ice laid down a thick layer of glacial till (a dense mixture of gravel, sand, silt, clay and boulders). The Kansan till gave the area a plain-like topography of low relief and uniform elevation. As soon as the Kansan ice sheet retreated, streams began to dissect the till plain. This process continues today.

Following an interglacial period, the final glaciation of the Pleistocene Epoch occurred. This was the Wisconsin glaciation which ended 16 to 20 thousand years ago. A lobe of the Wisconsin continental ice sheet extended southward to the present location of the City of Des Moines. The Wisconsin ice laid down another blanket of glacial till covering the Kansan till and leaving a new, fresh till plain surface. The southern limit of the Des Moines lobe, shown on Figure III-11 is the demarkation between the old dissected Kansan till plains to the south, and the young Wisconsin glacial drift section to the north.

The Wisconsin glaciation affected the Kansan till area south of the Des Moines lobe with proglacial deposits. During Wisconsin time, glacial outwash was carried from the face of the glacier by major streams such as the Racoon and Des Moines Rivers. Materials ranging from clay to boulders were churned up by the erosive force of the glacier. As the meltwaters flooded the channels, sand and gravel formed outwash terraces which exist today in the Racoon and Des Moines Valleys.

Fine sands, silts, clays, and rock flour were windblown over south central Iowa. These windblown fine soils, or loess, were deposited as a thick blanket over the Kansan tills. The loess is found over most of the uplands south of the Des Moines lobe limits. On the slopes of some steeper stream valleys, the loess has been eroded and the underlying Kansan glacial till is exposed.

Topographic, drainage, and soil conditions differ between the two glacial areas. The northern half of the study area, the young Wisconsin drift section, is an area of uniform elevation and low relief. Broad flat topped divides separate the streams. Drainage on the Wisconsin till surface is poorly developed. Only a few major streams have well defined channels. These streams were well established south of the Wisconsin limit and worked into the young till area by headward erosion. Degradation by the streams is at a youthful stage, resulting in broad shallow valleys and narrow flood depressions with no exterior drainage. These form boggy areas and small ponds.

In the Kansan dissected till plains, stream erosion has cut the surface to a land of narrow flat top divides. The divides are seldom more than one-half mile wide. The major streams flow in wide-bottomed valleys filled with alluvium. The valley walls have moderate to gentle slopes in most places. Where the streams approach the level of the Des Moines River, they have cut deeply into the surrounding plain area.

A third major geologic feature of the study area is the Des Moines River flood plain. This two-mile wide band of bottomland occupies a fifth of the study area and bisects the dissected till plains at the south end of the corridor.

The flood plain is an area of recent alluvial deposits with numerous abandoned river meander channels. At the mouths of major tributaries, like North River and Spring Creek, glacial terraces of sand and gravel were deposited by high volume meltwaters during retreat of the Wisconsin ice. The flood plain overlies a deep bedrock channel that was cut during preglacial time and has since been filled with alluvium and glacial debris.

2. *Soils Characteristics*

The generalized soil sequence for the three geologic areas in the study area is as follows:

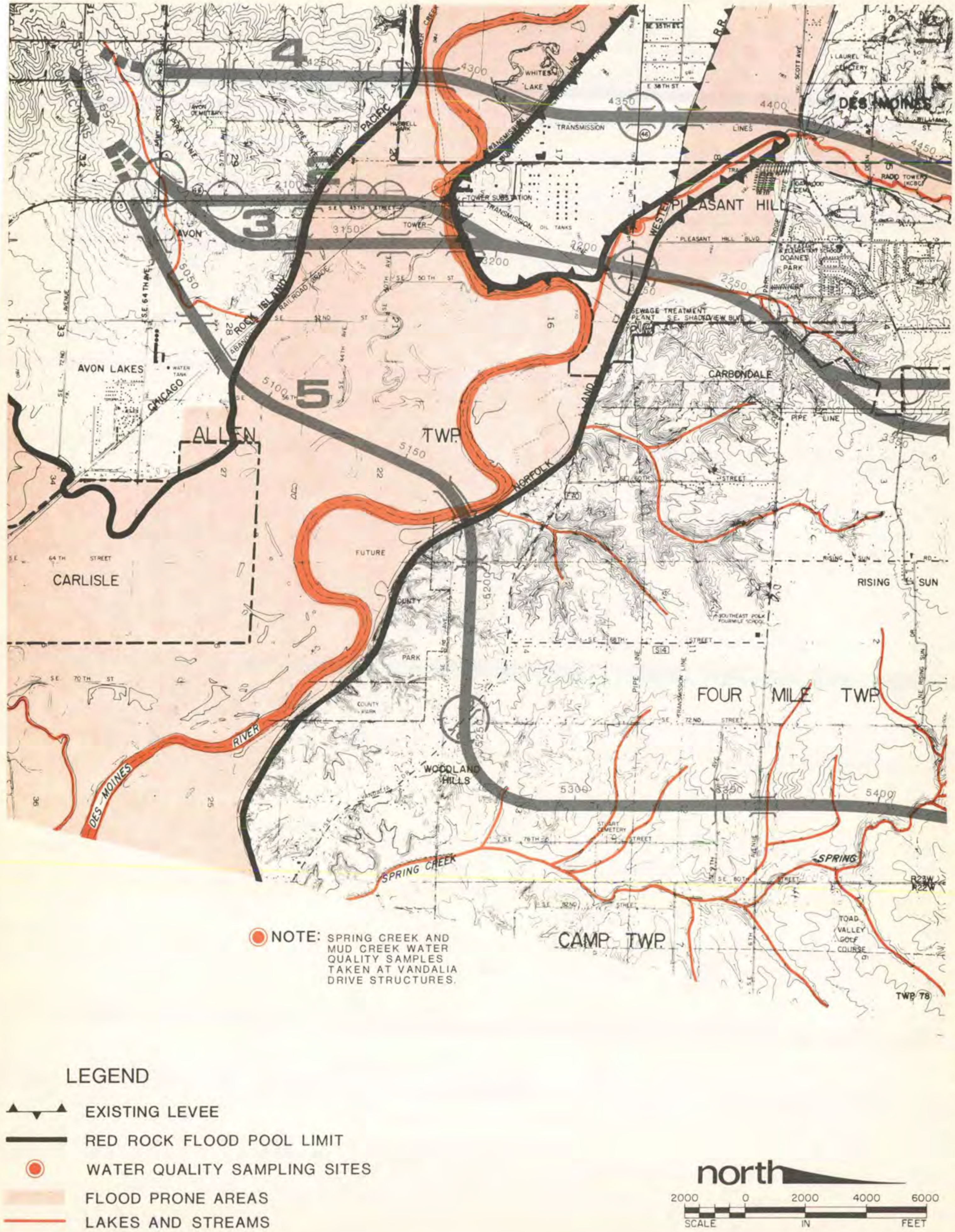
Wisconsin Young Drift Area - (Generally north of Iowa 163) Dense, somewhat sandy Wisconsin glacial till overlies Kansan till. A combined till thickness is 60 to 100 feet. In many areas the loess that covered the Kansan till was preserved and buried under the Wisconsin till. The loess is seldom greater than 10 feet thick. The bedrock underlying the glacial sediments is shale of the Pennsylvanian system.

Dissected Till Plains Section - (Generally south of Iowa 163) Ten feet of loess covers 15 to 30 feet of Kansan till. The Kansan till commonly has a clayey layer at the surface, called gumbotill, as a result of weathering. The Kansan till overlies the flat lying shale of the Pennsylvanian system.

Des Moines River Flood Plain - The highest sediments in the flood plain are the coarse sands and gravels of the glacial outwash terraces. These are located at the mouths of major streams and stand several feet higher than the flood plain. The outwash is commonly 75 percent or more sand and gravel, and is often a good source of construction material. The sequence in the remaining flood plain is sand and silt from river deposits more than 90 feet thick lying in a deep bedrock channel cut in shale.

Loess covers about 20 percent of the study area. It is generally composed of 60 percent silt, 30 to 40 percent clay, with varying amounts of fine sand. The loess is homogeneous, of low density, high capillarity, high porosity, and quite permeable. On unprotected slopes, it is erodible. Loess averages 10 feet thick across the study area; however, deposits of up to 100 feet have been reported outside the area. The seasonal high water table is generally 5 feet or more below the surface.

The Kansan glacial till which underlies the dissected till plain is exposed only where erosion at the head and side walls of streams has removed the loess. The typical composition of the till is 40 percent sand, 30 percent silt, 20



NOTE: SPRING CREEK AND MUD CREEK WATER QUALITY SAMPLES TAKEN AT VANDALIA DRIVE STRUCTURES.
DES MOINES
PLEASANT HILL
CARBONDALE
AVON LAKES
AVON
ALLEN TWP.
CARLISLE
RISING SUN
FOUR MILE TWP.
CAMP TWP.
WOODLAND HILLS
DES MOINES RIVER
SPRING CREEK
SEWAGE TREATMENT PLANT
TOAD VALLEY GOLF COURSE
LEGEND
EXISTING LEVEE
RED ROCK FLOOD POOL LIMIT
WATER QUALITY SAMPLING SITES
FLOOD PRONE AREAS
LAKES AND STREAMS
north
2000 0 2000 4000 6000
SCALE IN FEET

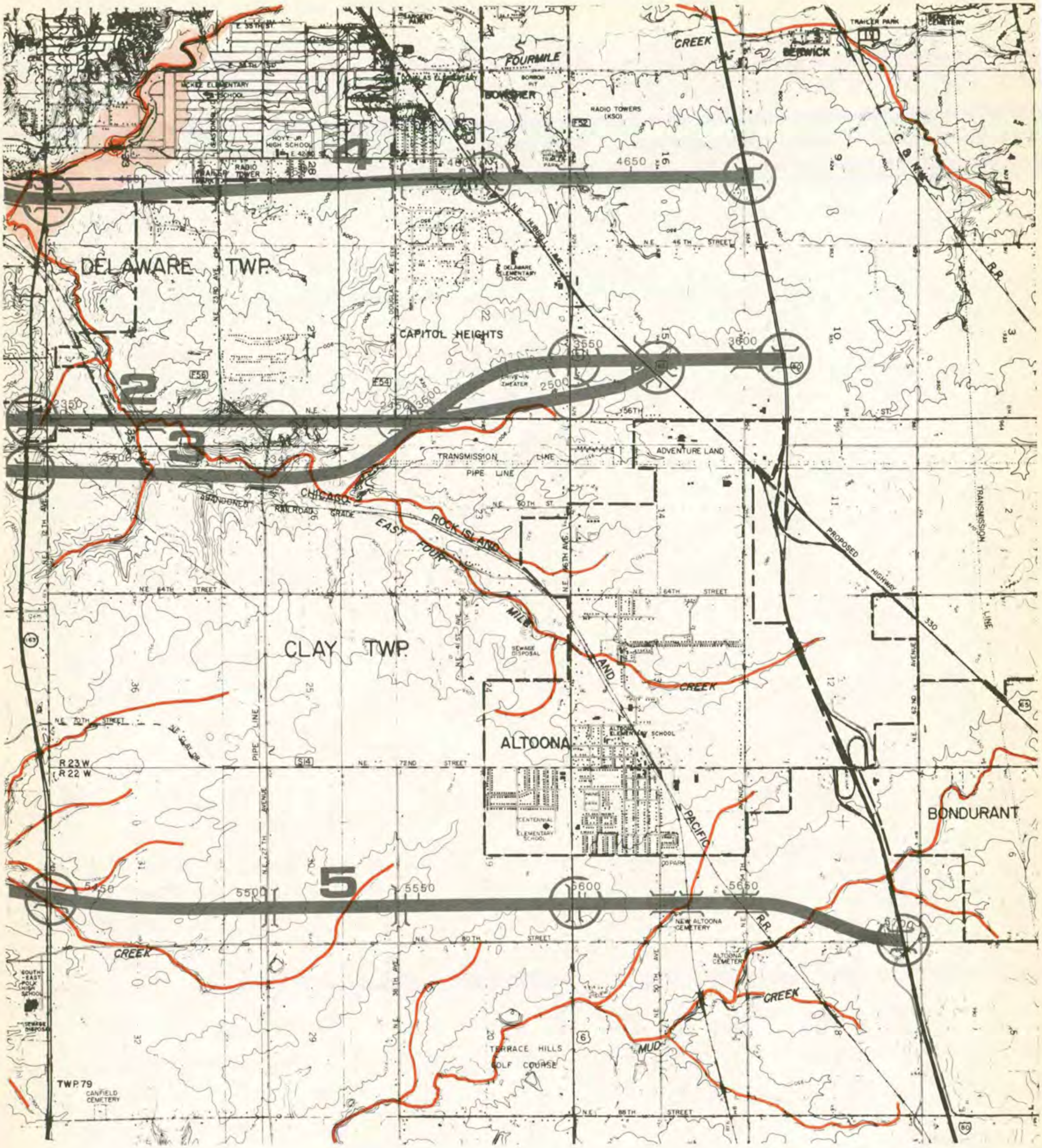


FIGURE III-10

WATER RESOURCES

percent clay, and 10 percent gravel and cobbles. The till is quite dense and its low permeability commonly supports the water table. The till is heterogeneous and lenses, or pockets, of a single constituent, such as sand or clay, occur. The till cover ranges from 15 to 30 feet thick. On slopes it may be absent or only several feet thick. On unprotected slopes this till is quite erodible. The Wisconsin till is quite similar to Kansan till, except that it is more sandy. It is classified as less clayey and commonly has pockets of well sorted sand and gravel which contain free water. Together the two till deposits compose 52 percent of the area. In a few of the deeper stream cuts in the young drift area, the Wisconsin till has been stripped away, exposing the Kansan till.

Alluvium occupies the broad bottom lands of the streams. Because of its location this soil is commonly flooded. The water table is seasonably variable, but is generally shallow. The alluvium is principally fine sands and silts. It is low density material with a high moisture content. Frost susceptibility is high when the water table is near the surface.

Aolian sand is wind blown, well sorted, fine sand picked up from river bottom lands. It has been deposited as spotty caps over the glacial till. These sand deposits are often good sources of highway construction material and the water table is usually deeper than 5 feet.

There is little variation in the erodibility of the soils throughout the study area. Most soils are of moderate erodibility except 5 percent of the area with highly erodible soils. The erodibility of the soils was compared using the Soil Conservation Service erodibility factor K. There is a narrow belt of highly erodible soils along the west side of the Des Moines River channel extending approximately one-half mile downstream from the Iowa 46 bridge. These are recently deposited silts and clays.

3. Groundwater

Groundwater is the principal water source for public and private supply in the study corridor. Water is drawn from two aquifer systems, bedrock and surficial. The top of bedrock is less than 100 feet below surface, but the top of the shallowest bedrock aquifer is at a depth of 250 to 300 feet. There are two additional bedrock aquifers below the top one. These aquifers provide the most dependable large yield sources of water in the area.

The surficial aquifer, as its name implies, is near the surface and consists of unconsolidated sand and gravels of alluvial and glacial deposits. The alluvial aquifers are located in the flood plain deposit of major streams such as Des Moines River and the lower reaches of Four Mile Creek. In the upland areas away from the streams, groundwater is available from the glacial drift or till that covers most of the study area. The till is irregular in composition and pockets of high sand or gravel content can yield water sufficient for domestic use. The drift aquifers are widely scattered and are not continuous. They support single local wells, but are shallow and susceptible to drought and surface pollution.

H. WATER QUALITY

1. Introduction

The Des Moines River with its tributaries is the largest river in the State of Iowa, and the most westerly of the major rivers within the State which are directly tributary to the Mississippi River. Watersheds bordering the basin on the west drain into the Missouri River.

The Des Moines River rises in Murray and Pipestone Counties, Minnesota, at an elevation of about 1900 feet. It flows generally southeasterly for about 535 miles and joins the Mississippi River just south of Keokuk, Iowa. The total area drained is 14,540 square miles, of which 1,525 are in Minnesota; 12,925 in Iowa and 90 in Missouri. The area drained in Iowa comprises 23% of the total area of the state.

The major tributaries of the Des Moines River include the Raccoon River, Boone River, Lizard Creek, North River, Middle River, South River, and Whitebreast Creek.

The portion of the river basin of interest in this study is that which lies between the confluence of the Raccoon River and North River in the eastern part of Polk County which is drained by Four Mile Creek, Mud Creek and Spring Creek. (See Figure III-10)

2. Existing Conditions

Investigations by educational institutions and state agencies have generated modest understanding of the water quality of the Des Moines River in this region. Sampling conducted as part of this study* (Figure III-10), gives some indication of the existing water quality of Four Mile, Spring and Mud Creeks. All four of these waterways are potentially affected by the Arterial Highway 500 study alternatives.

The primary effects on surface water quality from a major highway construction project are caused by erosion and sedimentation during the construction period, by erosion and sedimentation due to streambed adjustment subsequent to construction, and by runoff contaminated by deicing or other chemical compounds applied to or spilled on the roadway surface.

The major physical characteristic of the Des Moines River and its tributaries is turbidity or the presence of suspended solids. Wide fluctuations in turbidity occur depending on runoff conditions, and tend to show highest values during the spring. While existing levels are below concentrations found in some Iowa streams, concentrations approaching observed maximums can have deleterious effects on aquatic life as the suspended solids can destroy certain habitats, foul gills, interfere with feeding mechanisms, and have an abrasive effect on the softer tissue of aquatic organisms.

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* Water quality investigations were carried out by Dr. Wayne B. Merkley, Associate Professor of Biology, Drake University.

Measured chloride concentrations in study corridor streams indicate that prevailing levels, even during the deicing season, are well below critical levels.

Other indicators of water quality within the study corridor are measured concentrations of heavy metals, pesticides, herbicides, nitrogen and phosphorous compounds, dissolved solids, coliform bacteria and alkalinity. The level of dissolved oxygen, biochemical oxygen demand (BOD) and variations in water temperature provide a further indication. In general, concentrations of lead, the compound DDE (a first-stage degradation of the pesticide DDT), the nitrogen compound ammonia and coliform bacteria in study area streams are frequently in excess of prescribed state or federal standards. The other indicators have normally been satisfactory.

I. VEGETATION AND WILDLIFE

1. Vegetative Communities

A field inventory of the study corridor was conducted during July, 1975, under the direction of Dr. Roger Q. Landers, Department of Botany and Plant Pathology, Iowa State University.

A number of different vegetative communities were identified within the study corridor. These have been grouped into generalized categories, which are depicted in Figure III-11. The vegetative categories shown include mature upland forest, immature upland forest (including open woods), stringer, bottomland forest, prairie and agricultural (the latter category including rowcrops and pasture, as well as residential and industrial areas).

Agricultural uses predominate on the major portion of study corridor land. Acreage on rowcrops occupies about 90% of the land in the northern third of the corridor, and the small groves of trees associated with farm buildings occur on an average of about five per section. This pattern changes significantly as upland sites become more dissected and hilly near the bluffs north of the Des Moines River with remnants of upland forest occupying more than half of the area. In the southern and western portion of the corridor north of the river, residential development is more pronounced with small pastures and pastured open forest the usual condition.

In the Des Moines River flood plain, agriculture predominates on higher ground, but extensive young forests of willow, cottonwood, boxelder, and soft maple occupy areas close to the main waterway. As a result of periodic inundation by flood water from the Red Rock Dam Flood Control project (See Figure III-10), these modified flood plain forests are rapidly changing.

Small streams (East and West Four Mile Creek, Spring Creek, and Mud Creek) course southerly through the study corridor into the Des Moines River. The stringers that follow these watercourses consist primarily of boxelder, mulberry, cottonwood, bur oak, willow and elm. Small farm ponds are present in almost every section in the upland areas.

2. *Wildlife Habitat*

Wildlife habitat in the southwestern half of the study corridor is generally fair, while that in the northeastern half is generally poor.

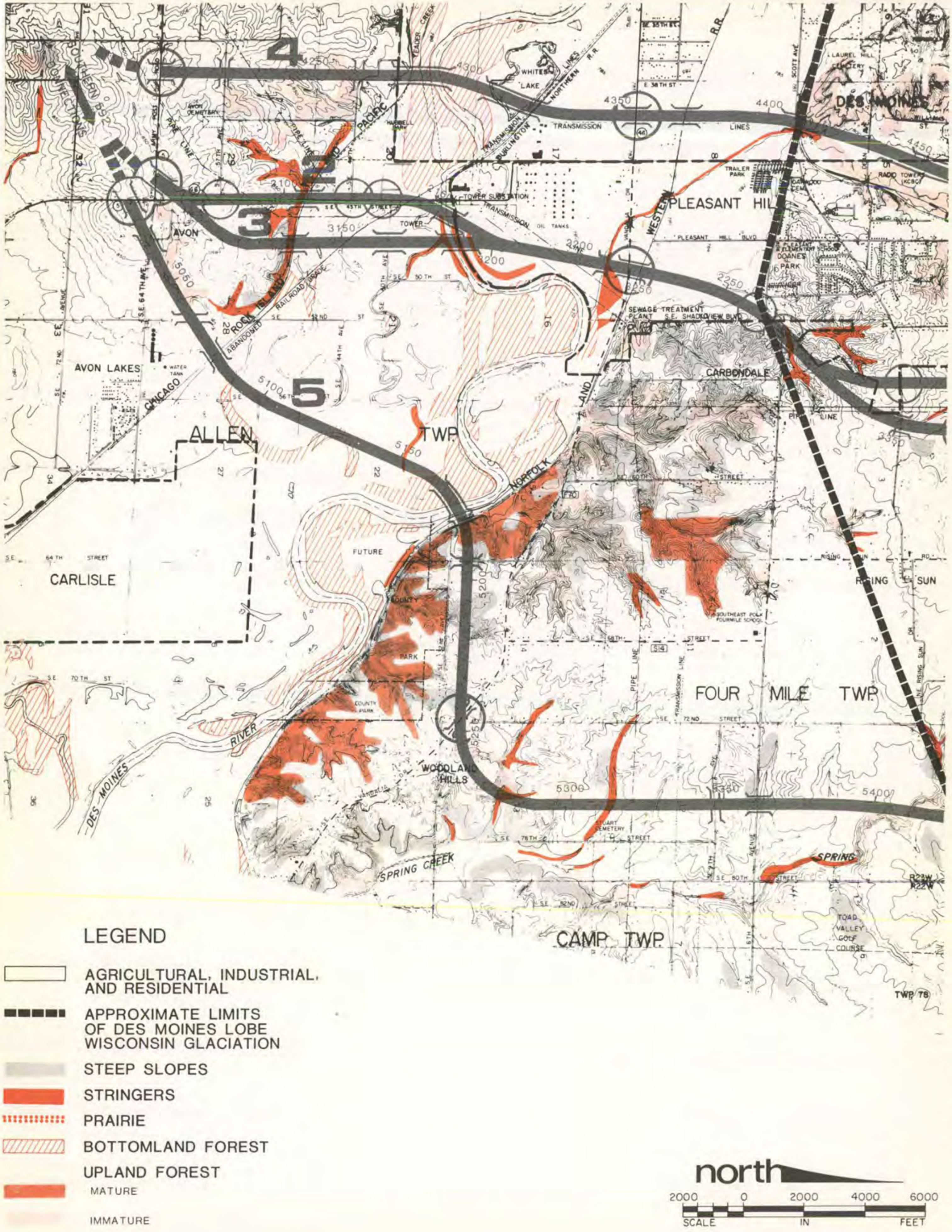
Characteristic of the intensively cultivated land, especially in the northern half of the study corridor are small farm groves in approximately every quarter section, scattered young trees along some fence rows and small creeks, and open forest pastures with scattered old oak, ash, elm and cottonwood trees. Although fair to good for the ring-necked pheasant, these habitats are poor to fair for other wildlife species such as white-tail deer, cottontail rabbit, raccoon, fox squirrel, and fox because of the lack of continuity of cover. Where forested and brushy pasturelands are more extensive such as along Four Mile Creek in the west, Mud Creek in the east, and Vandalia Drive in the south, the number of residences is also generally much higher. These residences are located on relatively small parcels of land and many have outbuildings and domestic animals such as horses, cows and dogs associated with them. The presence of these animals reduces the value of adjacent forest habitats for wildlife. Grazing in these areas tends to be moderate to heavy which further reduces wildlife cover.

Forest and shrub cover along railroad tracks and stream edges is regularly interrupted by heavily used east-west roadways. Exceptions to this general condition include the timbered portions of Four Mile Creek and the Rock Island and Pacific Railroad which pass under Iowa 163, and the timbered upland above the Des Moines River along the Norfolk and Western Railroad. Interstate 80, U.S. 65, Iowa 163, Vandalia Drive, and Iowa 46 are significant barriers to the safe movement of wildlife.

A narrow strip of native prairie vegetation extends along the Rock Island and Pacific Railroad east of Altoona for two or more miles and along N.E. Casebeer Drive for less than one-quarter mile. This habitat appears too interrupted and strongly modified to support many of the characteristic prairie wildlife species.

By far the larger amount of area designated as forest is cut over forest with a few large trees remaining, with various amounts of regrowth occurring. Bur oak is common as the major tree component accompanied by extensive honey locust, elm, cottonwood, boxelder, mulberry, and other shrubby tree growth. Abundant food and cover is provided by this vegetative category because of the extensive "edge" growth associated with it.

The suitability of the bottomland forest for wildlife is only fair despite the large expanse that it covers. Because of the fluctuating water level due to the Red Rock flood control reservoir, all of the bottomland forest below elevation 780 could be inundated during high flood conditions. As a temporary habitat for deer, it is good to excellent. Bobwhite quail might be expected to do well in the weedy conditions of the bottomland agriculture and forest edge. As a stopover habitat for migratory waterfowl the habitat is good to excellent; however, there is much more attractive habitat for waterfowl at a point further downstream. There is no permanent wetlands vegetation or wildlife found within the study corridor.


LEGEND
AGRICULTURAL, INDUSTRIAL, AND RESIDENTIAL
APPROXIMATE LIMITS OF DES MOINES LOBE WISCONSIN GLACIATION
STEEP SLOPES
STRINGERS
PRAIRIE
BOTTOMLAND FOREST
UPLAND FOREST
MATURE
IMMATURE
north
2000 0 2000 4000 6000
SCALE IN FEET
4
3
5
DES MOINES
PLEASANT HILL
AVON
AVON LAKES
ALLEN TWP.
CARLISLE
CARBONDALE
FOUR MILE TWP.
RISING SUN
WOODLAND HILLS
CAMP TWP.
DES MOINES RIVER
SPRING CREEK
TOAD VALLEY GOLF COURSE

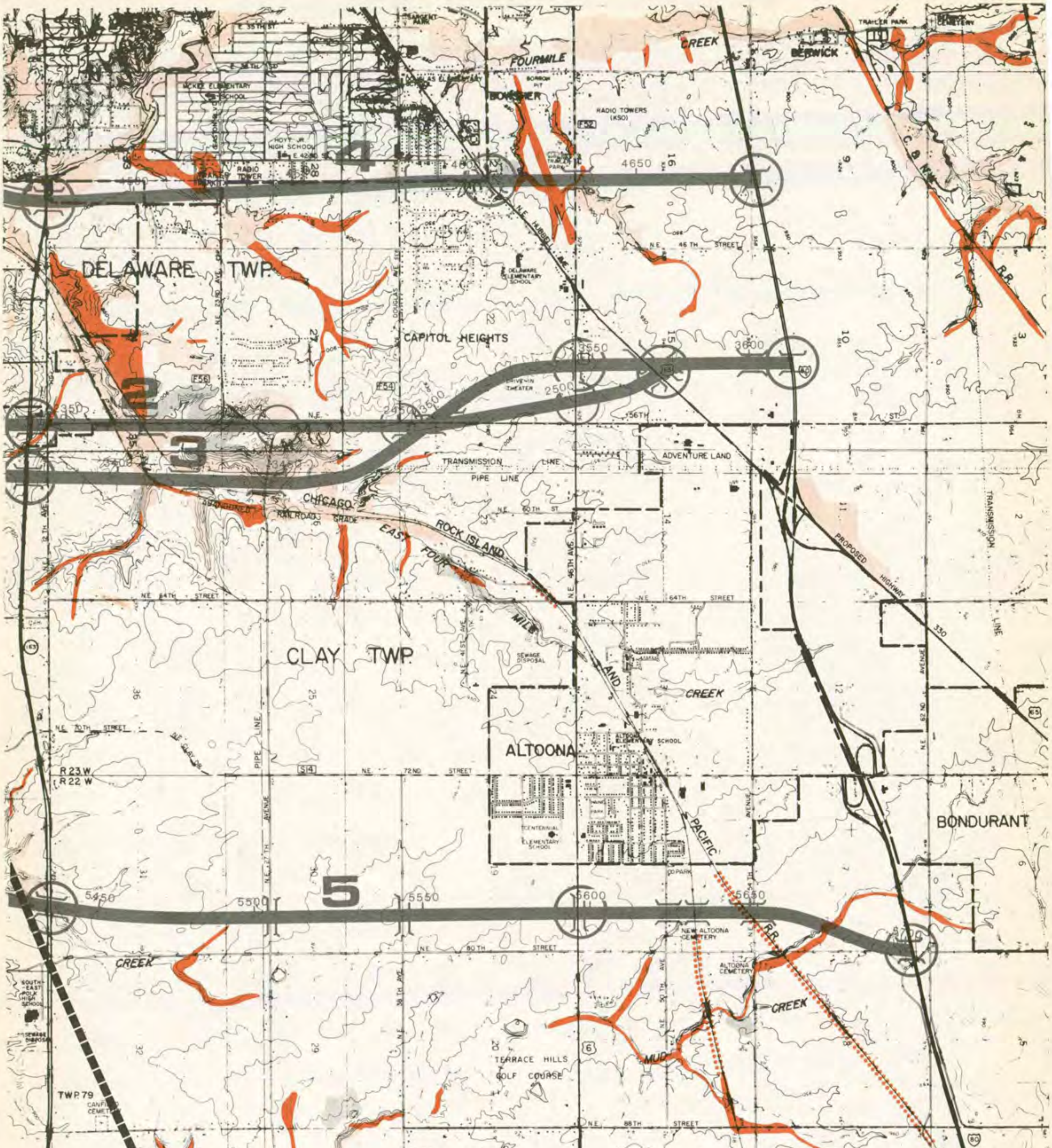


FIGURE III-11

VEGETATION

3. *Unique or Endangered Species*

No plant species which have been designated as endangered are known to occur in the study corridor. Of the four plant species on the U.S. endangered list (Aconitum noveboracense, Monkshood; Sullivantia renifolia, Sullivantia; Primula mistassinica, Bird's-eye primrose; Saxifraga forbesii, Forbe's saxifrage) which are known to have occurred in Iowa, none has been collected in the study area nor is any expected to be found there. No unique habitats were encountered which should be preserved for scientific purposes.

No wildlife species which is on the U.S. endangered list is native to the study corridor.

SECTION IV

PROBABLE IMPACTS OF THE PROPOSED ACTION

A. SOCIAL AND ECONOMIC IMPACTS

1. Relationship of the Alternatives to Existing Land Use Plans, Policies and Controls

Accessibility and the traffic service characteristics of the corridor roadways are among a number of factors influencing land use patterns. Congested roadways with poor accessibility will likely constrain natural and often desirable growth patterns. Conversely, new highways with improved accessibilities may accelerate the timing and extent of development, particularly in the vicinity of interchange locations. New highway development is generally a necessary, though alone not a sufficient factor to produce major changes. While a new highway will allow for new or expanded development, such development will also depend on a number of additional factors. These include local and areawide policies on planning, zoning and the provision of utilities, and, more importantly, the availability of equal or more desirable locations for development elsewhere in the region.

Alternative 1 - "No-Build" - While a no-build decision would not encourage additional growth, development of the corridor would continue due to prevailing social and economic forces. Thus, corridor growth under the "No-build" option would proceed, but likely at a slower pace than under the "Build" alternatives, particularly in later years as traffic congestion develops in the corridor.

On a metropolitan area basis, a no-build decision would act against the policy of a balanced growth pattern, as the present disproportionate accessibility attraction of the northern and western suburban areas would continue, thus adding to the problems and costs of providing urban services to the latter areas.

Within the corridor, the potential of a Beltway facility as a means for structuring desired land use patterns would be lost. In particular, ability to use the facility to attract and accommodate industrial and commercial development as proposed in the local land use plans would be hindered. Increasing north-south travel congestion would also likely act against the policy of encouraging growth within and adjacent to presently developed areas. Studies of fringe area growth between 1950 and 1970 in beltway and non-beltway metropolitan areas have shown that while fringe area population densities have generally decreased, the average decrease in beltway areas has been only 15 percent. Decrease in non-beltway areas has, by contrast, averaged over 30 percent, reflecting a greater degree of dispersion. When developed in conjunction with compatible land use policies and controls, beltways can provide an incentive for concentrating and structuring growth at desired locations to conserve fringe area land resources. The above impacts of a "No-build" alternative would be least felt if areawide development is pursued under 208 Planning Program Alternate Intensity Development Plans "B" or "C" (see Section III A 1). Under these 208 study options, future development in the corridor would be minimal, particularly in the Altoona area. Such conditions would, however, require a substantial departure from present local land use planning and controls both in the corridor and throughout the metropolitan area.

"Build" Alternatives - General - On a metropolitan basis, a "Build" decision would extend the geographic limits of the existing labor market. Experience with beltways in other areas of the country suggests, however, that few adverse economic effects were experienced by either the Central City or the Central Business District (CBD) as a result of beltway construction. Studies of CBD growth between 1950 and 1970 in beltway and non-beltway areas has shown that while development density in the Central City of beltway areas did decrease, the reduction was less than in non-beltway areas. Moreover, while beltway cities gained more retail establishments outside the Central City faster than did non-beltway areas, both beltway and non-beltway areas lost CBD establishments at about the same rate. Beltway cities not only experienced a more rapid overall growth in retail sales than did non-beltway areas, but beltway areas also experienced a higher rate of sales increases within the Central City and CBD than non-beltway areas. Thus, beltway construction should strengthen the economic position of the City of Des Moines and its CBD as well as that of the study corridor communities.

Accessibility and service characteristics of the various "Build" alternatives will affect corridor land use most significantly in terms of their effect on distribution of growth within the corridor (i.e. secondary effects). While overall development levels would likely be somewhat higher than under the "No-build" options, the greatest land use impact of the "Build" options is in their varying ability to influence and accommodate growth in a manner consistent with corridor land use plans and goals.

Adoption of areawide growth policies and controls pursuant to 208 Study Alternate Plans "B" or "C" would, of course, reduce overall development and corresponding traffic growth and service needs under any of the alternatives. Improved access to the Altoona area afforded by any of the "Build" alternatives, including the "Outer Beltway" in particular, would appear inconsistent with the virtual "no growth" policy for Altoona reflected in CIRALG's Plan "B" and "C" projections.

Table IV-1 and IV-2 show estimated variations, by alternative, in residential and commercial-industrial development potentials among eight development assessment areas covering parts of six metrosectors as shown in Figure IV-1. The relative development potentials are not intended to indicate how development should occur, but to reasonably reflect the relative extent and distribution of new development likely to occur (i.e. secondary impacts) given the varying accessibilities and traffic service afforded by each of the study alternatives within the context of local land use planning efforts and land suitabilities. Assessment methods and translations of these relative growth potentials into numerical population and employment growth projections for adjusting traffic assignments can be found in Appendix I of this report.

Alternatives 2 and 3 - Following generally the same alignments, these alternatives provide convenient access to each of the major planned commercial-industrial areas in the corridor. The "Inner Freeway East", Alternative 3, would most strongly support these planned activities by encouraging clustered development in the vicinity of its interchanges, each of which are at locations planned for commercial-

TABLE IV-1

RESIDENTIAL DEVELOPMENT POTENTIAL

METROSECTOR	SUBAREA	Alternative 1 No Build	Alternative 2 Major Upgrading	Alternative 3 Inner Beltway East	Alternative 4 Inner Beltway West	Alternative 5 Outer Beltway
East and N.E. Des Moines	Vandalia-Four Mile	low	low	low	low to moderate	low
Delaware	Capitol Heights	moderate to high	high	high	high	high
	Altoona	moderate to high	moderate to high	high	moderate to high	moderate to high
Altoona	Eastern	low	low	low to moderate	low	moderate to high
	Southwestern	low to moderate	moderate	moderate	low to moderate	moderate
Pleasant Hill	Pleasant Hill-Carbondale	moderate	moderate to high	high	high	moderate to high
	Four Mile	low	low	low to moderate	low	moderate
Carlisle	Avon	low	low	low to moderate	low to moderate	low to moderate
OVERALL		moderate	moderate	moderate to high	moderate to high	moderate to high

TABLE IV-2

COMMERCIAL - INDUSTRIAL DEVELOPMENT POTENTIAL

METROSECTOR	SUBAREA	Alternative 1 No Build	Alternative 2 Major Upgrading	Alternative 3 Inner Beltway East	Alternative 4 Inner Beltway West	Alternative 5 Outer Beltway
East to N.E. Des Moines	Vandalia-Four Mile	low to moderate	moderate	moderate to high	high	moderate
Deleware	Capitol Heights	moderate	moderate to high	high	high	moderate
	Altoona	moderate	moderate to high	moderate to high	moderate to high	moderate to high
Altoona	Eastern	negligible	negligible	low	negligible	moderate
	Southwestern	low	low to moderate	low to moderate	low	low
Pleasant Hill	Pleasant Hill-Carbondale	low to moderate	moderate to high	high	moderate	low to moderate
	Four Mile	negligible	negligible	negligible	negligible	low
Carlisle	Avon	negligible	low	low	low	low
OVERALL		low to moderate	moderate	moderate to high	moderate	moderate

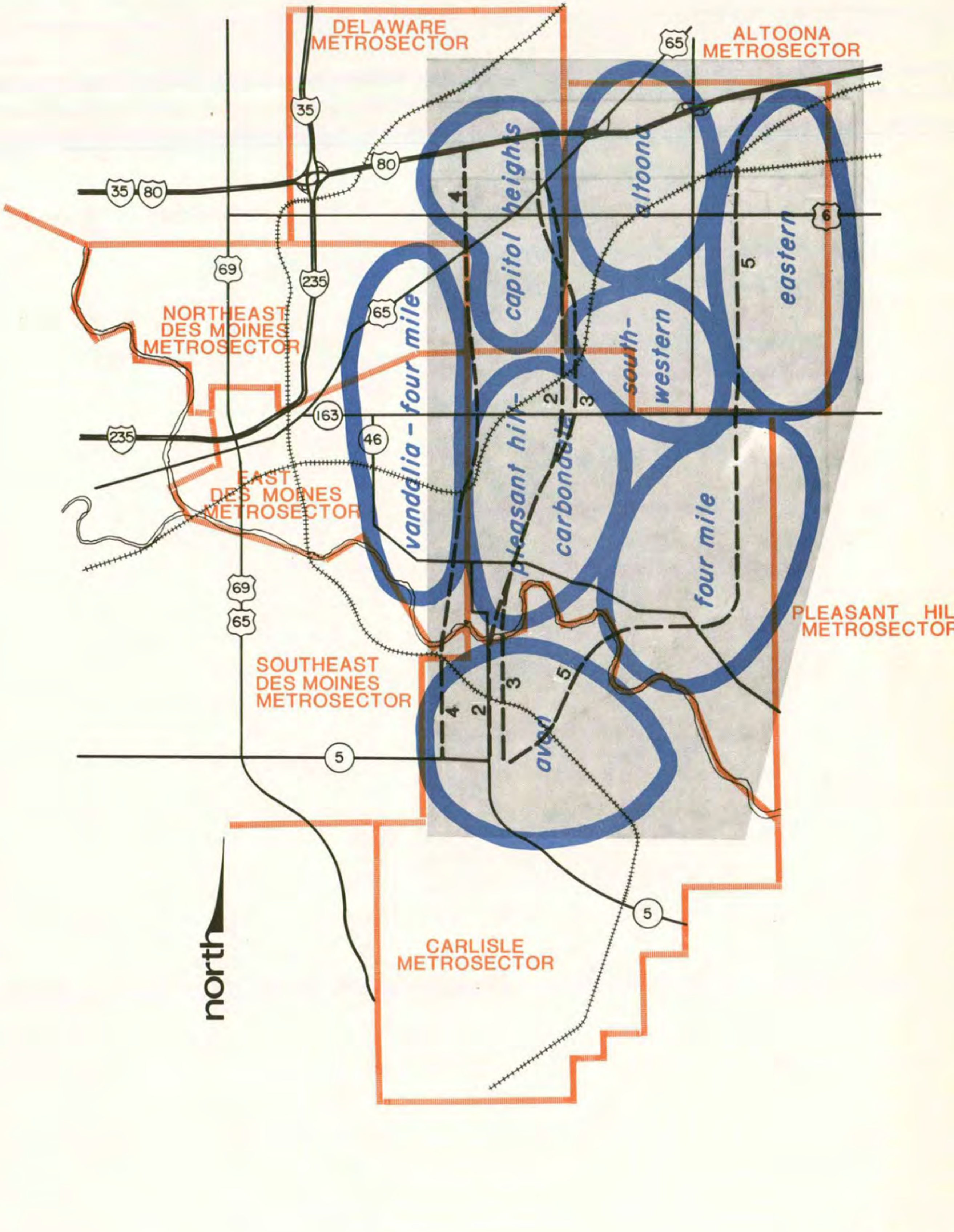


FIGURE IV-1

DEVELOPMENT ASSESSMENT AREAS

industrial development. Overall corridor commercial-industrial development potential, reflecting potential for increased employment, is considered highest for Alternative 3, as shown in Table IV-2. While the "Upgrading" Alternative would also serve these areas, ability to control strip-type development along the route would be reduced. Limited-access interchanges of a freeway allow high density development in the interchange area. Such development can be readily planned for, however, and once it occurs, it is relatively stable. Development along an uncontrolled or only partially-controlled access route is subject to greater change and is more difficult to control.

Under the Pleasant Hill Comprehensive Plan, N.E. 56th Street is proposed as a "municipal arterial" route to connect principal traffic generators in the community to the primary road system. The "Upgrading" Alternative would require that N.E. 56th Street also accommodate regional through traffic.

Both the "Upgrading" and "Inner Freeway-East" Alternatives separate the existing developed area of Pleasant Hill from the largely undeveloped planned residential area of Carbondale to the southeast, as shown in Figure III-4. The "crossing" however, follows an existing transmission line through a depression along the present eastern Pleasant Hill boundary. With careful joint planning of the adjacent residential lands, a new highway need not act as a visual or functional barrier between the present and proposed residential sections. Rather, the highway could be incorporated into the proposed "green belt" which follows the depression. Joint-use planning potential could also be realized where the alignments follow the existing rail corridor and the east branch of Four Mile Creek north of Iowa 163. Such joint development potentials are further discussed in Section IV B. In view of the projections of regional and local land use needs, it does not appear that Altoona's growth would be restricted by alternative routes passing to the west of the city, a concern expressed by local officials (see Section III A 3). Alternatives 2 and 3, as proposed, would not divide existing or planned development areas or utilities of Altoona.

Alternative 4 "Inner Freeway-West" - Overall, the accessibility and resultant development potential afforded to the eastern and central portions of the study corridor would not differ significantly from those provided by Alternative 3, the "Inner Freeway-East".

The "Inner Freeway-West" Alternative would, however, most directly serve the presently developed area of western Des Moines and the proposed Vandalia industrial area. At the same time, it would likely increase pressures for higher levels of development in Delaware Township, a factor not reflected in current zoning and planning considerations for these areas.

Of particular concern would be development pressures on lands adjoining Four Mile Creek in the vicinity of the interchange of Alternative 4 with Iowa 163. Parts of these lands are planned for public and semi-public use (including a golf course) under the Pleasant Hill Comprehensive Plan (see Section III A 3, Figure III-4). The Iowa 163 interchange on this alignment is not as desirably located with respect to the planned commercial-light industry zones of Pleasant Hill as its counterpart interchange under the "Inner Freeway-East" alignment. One potential remedial measure would be to acquire adjoining lands for recreational use as part of the highway development.

Alternative 5 "Outer Freeway" - The "Outer Freeway" Alternative would tend to encourage increased spread of corridor development. In particular, the undeveloped agricultural lands in the eastern portion of the corridor would be "opened" to increased land speculation and development, likely years in advance of actual opening of the highway. This potential for premature and greater overall spread of development would increase the cost of providing public utilities and services in the corridor and is inconsistent with the regional objective "to encourage development within existing incorporated land areas or needed annexed areas in order to promote orderly, contiguous and economical development".(1) In addition, probable development pressures for commercial-office or industrial development in the vicinity of interchanges with Iowa 163 and U.S. 6 would compete with present and proposed Altoona and Pleasant Hill business and industrial districts, and could compete with office space gains anticipated in the CBD. Such pressures would thus conflict with regional land use objective "to preserve and revitalize the central ... commercial areas of local communities according to ongoing land use planning,"(1) as reflected in the local comprehensive plans of Pleasant Hill and Altoona and the Des Moines 1980 General Plan.

2. *Community Character & Cohesion*

Des Moines - The principal effect of the "No-build" Alternative on the city of Des Moines would be to continue existing trends. The natural population growth will increase demands on the existing housing supply somewhat, and as the average family size continues to decrease, additional residential development would likely occur as single-family housing in the northeast and southeast sections of the city and as multiple-family housing located along University Avenue and Hubbell Avenue. There would be little or no pressure to convert the undeveloped areas south and east of the Fairgrounds to residential land use, and property values in this area will likely remain depressed relative to surrounding corridor communities.

"Strip" type commercial development would continue to occur along the University Avenue - Hubbell Avenue corridors. There would be little, if any impetus generated to develop community or regional commercial centers in the area. Lack of regional access would continue to hinder development of the proposed industrial park along Vandalia Drive in southeast Des Moines. The present residential-industrial land use amalgamation, and the attendant undesirable automobile-truck traffic mix, would likely continue in that section of the city.

The service orientation of Des Moines "neighborhoods"(2) adjacent to the study corridor would continue to be to the west and north. Shopping trips would be destined to the commercial establishments along University Avenue and Hubbell

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(1) Preliminary 208 Intensity Development Considerations, Central Iowa Regional Association of Local Governments, 1975.

(2) For planning purposes, the Des Moines Plan and Zoning Commission had divided the City into twelve somewhat arbitrary "neighborhoods". The Eastern portion of the Goodrell and Willard neighborhoods fall within the immediate study corridor. The Goodrell neighborhood corresponds generally to census tracts 1 and 19 (see Figure III-5) and the Willard neighborhood to census tract 20.

Avenue, the Central Business District and to other locations within the City of Des Moines. The lack of new jobs in the eastern portion of the City would continue the established westward work-trip orientation. Dependence on the automobile and the rate of auto ownership would likely remain at the present, high levels.

Under Alternative 2, as for the "No-build" Alternative, the potential for increased population would remain low. In fact, Alternative 2 may draw some of the anticipated new residential development away from the Des Moines neighborhoods and into Pleasant Hill and the Capitol Heights area of unincorporated Delaware Township. The spatial distribution of anticipated residential development would be similar to that of the "No-build" Alternative. While Alternative 2 would only marginally increase the regional accessibility of the residential areas in the eastern Des Moines neighborhoods, no physical disruption of these communities would result.

The primary effect of Alternative 2 on the eastern Des Moines community would be to encourage moderate development of the Vandalia industrial area. As the eastern Des Moines "neighborhoods" are predominantly blue collar in nature (the average income is $1600 per year lower than the metro area as a whole, and the residential turnover rate is very high), the creation of additional industrial jobs could have the beneficial effect of stabilizing the population base and raising the mean income within the neighborhoods. Increased industrial development in the Vandalia Drive area and the City of Des Moines' Voluntary Relocation Program scheduled for the area should reduce the amount of mixed residential-industrial land uses presently occurring in the area and anticipated to continue under Alternative 1. Access to these new jobs from the eastern Des Moines "neighborhoods" would be along residential streets, however, and could possibly result in increased pedestrian-auto conflicts and an undesirably high level of automobile traffic on the local street network.

Alternative 2 could change the present orientation of shopping trips within the Willard and Goodrell "neighborhoods". Pressures for commercial development near the proposed interchange of Alternative 2 at Iowa 163 and in the U.S. 6 - Hubbell Avenue area may provide the impetus needed to develop a regional or sub-regional commercial center at those locations. This would benefit eastern Des Moines residents by providing a choice in shopping facilities and by providing a possible increase in competition among area businesses. This type of development will, however, cause an increased reliance on the automobile by residents of the eastern Des Moines communities.

Alternative 3, the "Inner Freeway-East", will have much the same effect on the Goodrell and Willard residential areas as Alternative 2, and differences in impacts between the two alternatives are related to the resulting intensity of commercial-industrial development pressure. Although the magnitude and spatial distribution of residential development and open space conversion in the eastern Des Moines "neighborhoods" expected under Alternative 3 would approximately equal the impacts anticipated under the "Upgrading" Alternative, the "Inner Freeway-East" can be expected to encourage a moderate to high level of industrial development in the Vandalia Industrial Park area. This may well encourage additional residential development in the vicinity of the Fairgrounds, possibly resulting in increased property values and an expanded tax base. Although much of the additional truck and automobile traffic generated by the increased industrialization of this area will be channeled along Vandalia Drive to the 500 Beltway rather than utilizing existing local roads, some increase in local traffic can be expected. In addition, auto dependence of the eastern Des Moines "neighborhoods" can be expected to increase under this alternative.

Alternative 4, the "Inner Freeway-West", would have moderate effect on residential development in the Goodrell and Willard "neighborhoods". Residential development would likely occur as single-family housing in the undeveloped areas along the eastern corporate limits, as multi-family development along Hubbell and University Avenues and there will likely be some additional residential development near the Fairgrounds.

Commercial and industrial development pressures on the eastern Des Moines "neighborhoods" would increase upon completion of Alternative 4. Commercial development pressure would be highest near the interchange locations at University and Hubbell Avenues, while industrial developmental pressure would be strongest in the Vandalia Industrial Park area.

Experience with other Beltway-type facilities has shown that Beltway interchanges become a focal point for intensive multi-family and commercial development. Since they have maximum accessibility, they are natural growth areas and are emerging, in many areas, as major multi-purpose centers.[1] Thus, the Hubbell Avenue interchange with Alternative 4 may stimulate further development of apartment complexes and "strip" type commercial development. The University Avenue interchange is located in the Four Mile Creek Flood Plain and is therefore unsuitable for most urban development forms. In addition, the area along Four Mile Creek has been included in the ROSS plan as a desirable open space corridor that should be preserved for future generations. Further mixed commercial and multi-family residential land use development along University Avenue, west of Four Mile Creek, is likely under Alternative 4, however.

Alternative 5 would result in a population increase of the same magnitude as that projected for Alternatives 2 & 3, and the character of the resulting residential development would be similar to that of Alternative 2. Anticipated commercial and industrial development would be similar to that expected under the "No-build" option.

Pleasant Hill - Carbondale - The primary benefit accruing to the Pleasant Hill - Carbondale development assessment area under the "No-build" Alternative would be the avoidance of physical displacements. The town would remain an isolated residential community, dependent upon Des Moines for job opportunities, shopping, medical care and other urban services. The geographic barriers presented by the Des Moines River and Four Mile Creek would continue to limit Pleasant Hill's socio-economic integration into the surrounding region.

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(1) U.S. Department of Transportation, "Social and Economic Effects of Highways". Federal Highway Administration, Office of Program and Policy Planning, Socio-Economic Studies Division, Washington, D.C. 20590, 1974.

The Pleasant Hill - Carbondale area, whose most extensive socio-economic linkages have been with Des Moines in the past, would remain a desirable suburban destination for out-migrating Des Moines households. At the present time, land values and apartment rents are somewhat lower than in the other areas of the Des Moines metropolitan region, although future development pressures, even under Alternative 1, should cause land values and housing costs to increase within a range characteristic of the existing population makeup.

Under Alternative 1, new employment opportunities within Pleasant Hill are likely to be service jobs demanded by the population growth rather than an extensive increase in blue collar industrial jobs. The slower rate of growth anticipated under the "No-build" Alternative, relative to the "Build" Alternatives, will assist in maintaining the occupational distribution (white collar, blue collar, service sector) now evident in Pleasant Hill.

Due to its geographic location, Pleasant Hill's industrially zoned land, especially the area south of Parkridge Avenue, would remain relatively isolated (lacking regional access), and the potential for additional industrial development would remain limited. Thus, a "No-build" decision would create an adverse impact on Pleasant Hill's industrial base potential.

The population of the Pleasant Hill - Carbondale area is expected to increase regardless of the alternative chosen; however, the magnitude of that population increase will vary with the alternative. Alternative 1 and 5 would provide a moderate potential for residential development, while the potential would be high under Alternatives 2, 3 & 4. There is an adequate amount of residential land incorporated into the Pleasant Hill Comprehensive Plan (see Figure III-4) to assimilate the maximum population increase anticipated under any of the alternatives at the population densities presently allowed by zoning ordinances. The primary impact of this development would be to increase demands on existing municipal services (see Section IV A 3).

Relocation of several streets and roadways in the Pleasant Hill - Carbondale area will be required under Alternatives 2 & 3. Vandalia Drive and Pleasant Hill Boulevard will be relocated near the Norfolk and Western Railroad tracks to provide for an interchange in that area. S.E. Shadyview Boulevard will be relocated at S.E. 6th Avenue to provide the proper geometrics for the at-grade intersection or grade separation structure required by Alternatives 2 and 3, respectively. No existing roadways will be closed in Pleasant Hill - Carbondale, however, and traditional access to all properties will be maintained.

Both Alternatives 2 and 3 will be on fill in the industrially zoned lowlands area of Pleasant Hill (see Figure A IV-1) and will become at-grade or below grade north of Parkridge Avenue, isolating the future residential area of Carbondale (located south and east of the Parkridge Avenue - S.E. Shadyview Boulevard intersection) from the existing residential development of Pleasant Hill proper. There are several factors that minimize this separation.

First, access will be maintained on all existing roadways, and given the reliance on the automobile characteristic of the eastern suburbs, development of this area should not be inhibited by construction of the Beltway. In fact, the increase in regional accessibility under Alternatives 2 and 3 may well encourage growth and development in the area.

Second, due to the fact that it is within the southeast Polk County School district (rather than the Des Moines School district), the area may well become a neighborhood unto itself. The area would likely utilize the municipal services, recreational and commercial opportunities provided by Pleasant Hill, but as a neighborhood it would likely be oriented along school district boundaries. As such, neighborhood ties would be structured by construction of Alternatives 2 and 3.

Alternative 2, due to its at-grade design, would create a somewhat different access situation in the Carbondale area. At-grade intersections are planned for S.E. Shadyview, Parkridge Avenue and Rising Sun Drive. Inherent in this design is the potential for pedestrian-vehicular and vehicular-vehicular conflicts. This is mitigated somewhat by the alignment of Alternative 2, which is located at or near school district boundaries; consequently few students will be required to cross the high mobility facility as pedestrians. The intersection of Alternative 2 and S.E. Shadyview Boulevard holds the highest potential for auto-pedestrian conflicts; a pedestrian bridge constructed at this location would minimize the possibility of injury.

There are two areas shown on the Pleasant Hill Comprehensive Plan as being suitable for industrial development (see Figure III-4). Both areas would be served directly by Alternatives 2 or 3, and indirectly by Alternative 4. Alternative 3 will provide the greatest potential growth stimulus on the Pleasant Hill - Carbondale area of any alternative considered. Alternative 2 would have a similar, but lesser, impact. Alternative 4 will have a moderate developmental influence, while Alternative 5 will have a marginal potential for influencing industrial development of these areas.

Construction of Alternatives 3 or 4, and Alternative 2 to a lesser extent, will increase accessibility to the employment areas in the north suburbs, particularly to the John Deere Plant in Ankeny. In addition, increased accessibility to the Pleasant Hill industrial areas will allow residents of other suburban areas of Polk County high mobility access to those potential employment centers.

The Pleasant Hill Comprehensive Plan (Figure III-4) shows a proposed general commercial area south of Iowa 163 near N.E. 56th Street. This area will be served directly under Alternatives 2 and 3 at interchange with Iowa 163. Either alternative will have a strong positive influence on commercial developmental potential, although Alternative 2 may encourage "strip" development south of the interchange area. Alternative 4 would provide moderate influence on these commercial areas; development under this alternative would likely be in response to increased residential growth of Pleasant Hill - Carbondale. Alternative 5 would have minimal impact on commercial development. Commercialization of the area would likely result in increased traffic and the possibility of an undesirable land-use mix if secondary development is not controlled, however.

In summary, the primary effect of the "Build" alternatives on the Pleasant Hill - Carbondale area would be to accelerate the existing rate of growth and the total magnitude of development expected to occur. These effects would result from improved regional accessibility provided by a Beltway. Furthermore, expanded socio-economic ties to suburban and exurban areas to the south and north, particularly in terms of industrial linkages, employment and commuting patterns, would likely result. In any case, changes in the rate and character of urbanization are more likely to be generated by the construction of Alternatives 2, 3 or 4 than would occur under Alternatives 1 or 5.

Capitol Heights - The Capitol Heights development assessment area includes that portion of Delaware Township north of Pleasant Hill, west of N.E. 56th Street, north and east of the Des Moines city limits and south of I-80. (See Figure IV-1)

The "No build" Alternative will offer little incentive to bring about a change in the uncontrolled transition from agricultural to urban land use characteristic of the area. This could result in a continued undesirable mixing of land uses, a scattered and inefficient provision of municipal services and the potential for pollution of the ground water resources in the area.

Pressure for residential development in Capitol Heights has been increasing in recent years, and is expected to increase still further in the future, regardless of the alternative chosen. Lack of sanitary service to the area will likely maintain the trend toward lower cost housing developments under the "No-build" Alternative, and the area would likely remain economically depressed, relative to the surrounding communities.

The Capitol Heights area is predominantly oriented toward the City of Des Moines for both consumer goods and job opportunities. In contrast with surrounding incorporated communities, fewer employment trips end within the CBD. In the absence of any short term expansion of municipal services, this service orientation is expected to continue under Alternative 1. As residential development continues, however, some additional commercial development should occur in Capitol Heights, especially along Hubbell Avenue. Other commercial areas (specifically in Altoona and along University Avenue in Pleasant Hill) will likely develop and be available to serve the Capitol Heights community.

The primary effect of the "Build" alternatives will likely be to influence and structure the magnitude and physical orientation of future development in Capitol Heights.

Pressure for conversion of agricultural land to residential use would be highest under Alternatives 3 and 4. Residential development will likely first occur near areas presently in urban uses, primarily due to access to the existing water distribution system. As area development continues, however, the area of Capitol Heights south of Hubbell Avenue and north of Pleasant Hill will likely experience extensive residential land conversions, especially under Alternatives 3 and 4. The potential for residential development under Alternative 2 is somewhat less than for the above alternatives, but is nevertheless quite high; the spatial and temporal distribution of residential development would be similar to that anticipated under Alternatives 3 and 4. Alternative 5 would tend to draw potential population increases from the Capitol Heights area to areas further east; consequently the potential for residential development would be less than for any other alternative considered, including "No-build".

Alternative 4 is the only alternative to physically divide an existing residential neighborhood. It crosses Sheridan and Arthur Avenues in Capitol Heights at about mid-block, necessitating the closing of both roadways. Beyond direct takings, the presence of the highway will impact residents remaining in neighborhoods divided by Alternative 4. Noise, air pollution and pedestrian safety appear to be the proximity effects cited most often as adversely impacting residences. Noise and air pollution are discussed in separate sections of this report, and, as Alternative 4 is a depressed, controlled-access highway, pedestrian safety is not expected to be a problem in the Capitol Heights area.

The social impact of highway construction varies greatly from one neighborhood to another. Much of this variation can be traced to the type and quality of local activity patterns, the neighborhood stability and the neighborhood dependence on pedestrian transportation. An analysis of housing occupancy indicated Capitol Heights exhibits greater residential stability than the City of Des Moines or other areas of Polk County. Further, analysis of transportation characteristics of Capitol Heights shows the area to be dependent on the automobile for access to relatively wide-spread activity centers. Therefore, this relatively stable, auto oriented community should be better able to adapt to the effects of major highway construction than are those that are less stable. Also, while east-west access through the community will be interrupted at Arthur and Sheridan Avenues, perhaps causing inconvenience to some residents, the major east-west routes along Easton Boulevard, Douglas Avenue and Hubbell Avenue will remain open. Beyond the physical displacements required, Alternative 4 will have a minor effect on the character and cohesion on the traversed neighborhoods.

Alternatives 3 and 4 would provide the greatest potential for commercial-industrial development in the Capitol Heights assessment area of all alignments considered. The area between Hubbell Avenue and I-80 is zoned for commercial-light industrial usage, and construction of either alternative would result in vacant (agricultural) land conversion near the interchange locations. While the area around the Hubbell Avenue interchange with Alternative 4 would be supportive of multi-family and local service establishments, the interchange at U.S. 6 and Hubbell Avenue proposed under Alternative 3 would most likely foster a regional or sub-regional commercial center and industrial development such as truck terminals, warehouses and auto sales and service organizations. Although the potential for commercial-industrial development under Alternative 2 is somewhat less than that anticipated under Alternative 3 and 4, the resulting character and location of that development would be similar to Alternative 3. Alternative 5 would have an effect on the commercial-industrial development potential of the area similar to that of Alternative 1; that is, development would be in response to the residential growth of the area and the service area of resulting development would be limited to the local communities and the immediately surrounding areas.

While all the alternatives will tend to structure future development, the lack of total access control inherent in the "at-grade" design of Alternative 2 through the Capitol Heights assessment area could promote rapid, unrestricted growth along the length of the Alternative utilizing existing right-of-way along N.E. 56th Street. Each property or groups of properties would require access to the Beltway. Strip commercial development would be fostered, and an undesirable mix of land uses could result. This could have an adverse impact not only on the desirability of the area for residential development, but also on the service characteristics of the "Upgrading" Alternative itself. If development occurs along Alternative 2 requiring access to individual properties, a highly undesirable mixing of through-traffic and local access traffic would result.

Altoona - The City of Altoona is a fast growing, free standing satellite community that has benefited in the past from its proximity to the industrial and commercial areas of Des Moines, and its location relative to I-80, I-35, and the Chicago, Rock Island and Pacific Railroad. Recent growth in the area has been accelerated by the construction of Adventureland Theme Park, and an increase in population is anticipated regardless of the alternative chosen.

None of the alternatives will affect Altoona directly, and any impacts on the City will be due to secondary growth generated by accessibility effects. As the potential for residential, commercial and industrial development in the City is about the same under any of the alternatives considered, the primary difference in Beltway generated impacts comes not so much from the quantity of secondary development but in its spatial orientation. Commercial and residential development under Alternatives 1, 2, 3 & 4 would be expected to occur in the western portion of Altoona. This is an extension of present trands, as new residential development is currently taking place both north and west of the City. Alternatives 1, 2, 3 & 4 will thus have little or no impact on the character or cohesion of the community. Alternative 5, on the other hand, will tend to promote residential and commercial growth on the east side of the City, an area described in the Cities' Comprehensive Plan as being presently "as fully developed as desired".

Eastern and South-Western Development Assessment Areas - These areas comprise Clay and Beaver Townships south and east of the City of Altoona. While all the alternatives including the "No-build" Alternative, will result in an increased amount of agricultural land conversions, Alternative 5 will result in the highest residential and commercial development pressures on the Eastern and Southwestern development areas, supporting significantly more residential development in these agricultural areas than any other alternative. New residential development is expected to be on large lots, resulting in decreased availability of good quality farm land, higher land prices and a random spread of urban and exurban land uses. A relatively small increase in population will require a significant amount of productive agricultural land conversion.

The spatial distribution of residential development in the east and southeast development sectors would also be affected by the choice of alternative. Under Alternatives 1, 2, 3 & 4, much of the agricultural land conversions would likely occur in the western portion of the assessment area, with a decrease in population density toward the eastern portion of the corridor. Alternative 5, on the other hand, would tend to promote both commercial and residential growth along the length of its alignment, with concentrations at or near interchange locations. Thus, the effect of Alternative 5 would be to promote widely scattered development of the Eastern and Southwestern development assessment areas.

Bridges will be provided at Beltway/local road crossings to maintain traditional access in the area.

Four Mile Development Assessment Area - The effects of Alternatives 1, 2, 3 & 4 on the Four Mile area would be to maintain the developmental status quo. Pressures for residential development would follow existing growth patterns, and there would be some development along Vandalia Drive and the north-south roadways in the corridor. Commercial growth potential would be negligible under these Alternatives. Alternative 5, on the other hand, would result in much higher levels of residential development and a small amount of commercialization. Residential development pressure would likely be highest near the Vandalia Drive interchange (near Woodland Hills), possibly altering the rural nature of existing development. Alternative 5, including the secondary growth effects, would be supportive of some local land service commercial establishments near Vandalia Drive and traffic service business at the interchange with Iowa 163.

Grade separations will be provided at Beltway/local road crossings to maintain traditional access to the area.

Avon - The "No-build" Alternative can be expected to maintain the developmental status quo of the area. Additional residential and commercial development would be limited and the area would remain primarily agricultural. The trend toward scattered, uncoordinated development would likely continue in the absence of additional public utilities and improved access.

Construction of Alternatives 3, 4 or 5 would result in increased residential pressure on the existing residential areas of Avon and Avon Lakes and would foster additional vacant land conversion in those areas. Alternative 2 would result in lesser residential demands; the spatial orientation of land conversions would be similar to the other "Build" Alternatives.

A negligible increase in commercial-industrial development is projected under the "No-build" Alternative, while employment projections under the "Build" alternatives indicate a moderate level of growth. Some commercial pressures will be generated by the interchange of the "Build" alternatives with Army Post Road and Iowa 46. Future commercial development would likely consist of neighborhood stores and highway service establishments.

Although the "Build" alternative alignments were located to minimize disruption of the area, the presence of a high mobility facility will affect the area to some degree. Alternatives 2, 3 & 4 would pass to the west of the major residential concentrations, parallel to existing Iowa 46, and the effect on these areas would be minimized. Alternative 5, on the other hand, would split the communities of Avon and Avon Lakes. Access between communities would be maintained via a grade separation structure at S.E. 64th Avenue (Army Post Road). All roadways outside the Des Moines River flood plain would remain open. Access to the agricultural areas within the flood plain would be provided by at-grade intersections along Alternative 2, by a grade separation structure at S.E. 40th Avenue for Alternative 3 and by a grade separation of S.E. 52nd Street for Alternative 5.

3. Public Facilities and Services

This section considers the effect that the alternatives would likely have on such public and institutional facilities as schools, churches, libraries, hospitals, community activity centers, the airport, fire and police districts and major public utilities. Possible adverse effects on such facilities could result from direct takings, proximity effects or the severance of traditional linkages within the community. In addition, the effect of anticipated secondary growth on individual community plans for public services is also considered.

Des Moines - Increased residential development, particularly of the medium density multi-family type presently found along Hubbell and University Avenues, will increase demand for municipal services (sanitary, water supply, police, fire, schools).

Sewage collection and treatment service demands will likely increase due to secondary residential, commercial, industrial and related developmental increases. The present sewage treatment facility, located at S.E. 30th and Vandalia Drive is presently overloaded. A new, regional facility is currently in the planning stages. In the area south of University Avenue and east of the Fairgrounds, sanitary interceptors have been constructed, although lateral connections (land service) have not been provided. The anticipated secondary development pressures may increase land values sufficiently to provide pressure needed for construction of these facilities.

As noted in Section III B, the Eastern Des Moines schools are presently experiencing a decrease in enrollment, primarily due to out-migration and the trend toward smaller average family sizes. As the residential growth potential of the Eastern Des Moines neighborhoods is moderate at best (a maximum anticipated increase of 1700 persons), construction of any of the alternatives should not result in overcrowding in any of the area's schools. In fact, a stabilization in attendance may be considered beneficial by permitting the continuation of programs that may otherwise be discontinued due to insufficient enrollment or tax base.

Traffic congestion along University Avenue under Alternative 4 could have an adverse effect on fire and police protection in the adjacent areas. Regional access to the State Fairgrounds would be improved under all of the "Build" Alternatives, although congestion on University Avenue under Alternative 4 could cause local access difficulties. No public buildings in Des Moines will be directly affected by any of the alternatives.

Pleasant Hill - Carbondale - Pleasant Hill recently (1970-71) constructed a sewage treatment plant near Vandalia Drive, replacing a sewage lagoon located south of the new facility. The present sewage treatment plant was designed to accommodate an ultimate population of 3700 people. It is evident, however, that plant capacity will be outstripped by growth expected to occur under all alternatives, including the "No-build" Alternative, and that future expansion of treatment facilities will be required regardless of which alternative is chosen.

Alternatives 1 through 4 would tend to encourage future growth within the geographical area presently served by the existing system. City officials have expressed concern that development east of Rising Sun (such as could be expected to occur under Alternative 5) is outside of present city limits, but within the

Cities' Comprehensive Planning Area, and could not be served economically within the present collection system.

Pleasant Hill maintains its own water distribution system. Water is obtained from the City of Des Moines. None of the alternatives is expected to have any significant impact on water distribution within the City, and demand should not exceed foreseeable supplies.

School enrollment in Pleasant Hill has been keeping pace with the city's rapid population growth. Pleasant Hill is part of the Des Moines school district, while Carbondale students attend Southeast Polk County schools. The slower growth rate anticipated under Alternative 1 will allow some opportunity to assimilate new students into the present facilities. Pleasant Hill Elementary School is presently nearing capacity, however, and expansion of existing facilities is currently under consideration. Thus, an addition to the existing facilities is anticipated regardless of Beltway construction. The rate of residential development in the Carbondale area (served by Southeast Polk County School District) can be controlled to some extent by local land use controls and the timing of utility expansion. The need for an additional school, as shown in the Pleasant Hill Comprehensive Plan,[1] or expansion of the existing Southeast Polk Four Mile Elementary School can probably be postponed until the area is fiscally prepared to handle the increased burden.

In instances of multiple alarms, inter-municipal police and fire service would be enhanced under Alternatives 2, 3 and, to a somewhat lesser extent, under Alternative 4. Although Alternatives 2 and 3 pass through Pleasant Hill, dividing the community, traditional access will be maintained and no adverse effect on police and fire service is anticipated.

Due to its location, Alternative 5 would have little, if any, effect on police and fire service in the Pleasant Hill - Carbondale area. No public buildings in Pleasant Hill will be directly affected by any of the alternatives.

Alternatives 2 and 3 will require the relocation of a section of Iowa Power and Light Company 161 kv transmission line in south Pleasant Hill.

Capitol Heights - As a result of topographic limitations, development in the Capitol Heights area is not served by a sanitary sewer system; rather, individual septic fields are used. Further development which is forced to rely on septic fields for sewage disposal could result in contamination of the relatively shallow (200-300 feet) local alluvial aquifers. As noted in the "Preliminary 208 Intensity Development Considerations", there is considerable movement of water along these aquifers and they may feed into buried channel (deep) aquifers. In addition, contamination of the ground water supply increases the potential of further contamination of surface waters in the area. Alternatives 3 and 4, which would be accompanied by a 300 percent population increase within the Capitol Heights assessment area, would have the greatest potential for ground water pollution.

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(1) Pleasant Hill, Iowa Comprehensive Development Plan, Veenstra & Kimm. Engineers and Planners, September 11, 1972

The "No-build" Alternative, with a 260 percent population increase, the least of any alternative, would also have a significant effect.

Capitol Heights is served by the Des Moines water system. Alternative 4, which is depressed through the area, would require the relocation of trunk watermains along Easton Boulevard, Douglas Avenue and Hubbell Avenue.

The Delaware Elementary School is presently at about 70 percent of capacity. Expanded facilities will be needed in the future regardless of which alternative is selected. None of the alternatives will significantly affect the accessibility of the school to area students. Police and fire protection within the Capitol Heights area will not be significantly affected by the alternatives, although inter-municipal service would be somewhat improved under Alternatives 2, 3 and 4.

Alternative 3 will require the relocation of the state-owned weigh station on I-80.

Altoona - Existing population growth in the Altoona area has begun to outpace supporting services. The two existing local elementary schools are approaching capacity (in fact, some Altoona students attend Delaware Elementary School in Capitol Heights) and a second expansion of the municipal sewage treatment plant is presently in the development stage. The west side of Altoona, which would be expected to experience the largest share of projected growth under Alternatives 2, 3 and 4, is presently served by the existing sanitary sewer system. Sewer service beyond the present eastern city limits will be difficult and costly to provide. Service to this area would require a new treatment plant or a lift and pumping station since the area falls within the Mud Creek Watershed Basin, as opposed to the East Four Mile Creek Basin within which the remainder of the community lies. Alternative 5, which would encourage growth to the east of Altoona, would require the provision of municipal services in an area not scheduled for service under the existing Comprehensive Plan.

Police and fire protection in Altoona will not be directly affected by any of the alternatives, although inter-municipal service will be somewhat improved under all of the "Build" Alternatives.

Eastern, South-Western and Four Mile Areas - Elementary students in the Eastern and South-Western areas attend Altoona Elementary School. The school is presently approaching capacity, and the increase in the grade school population of Clay and Beaver Townships likely to occur under all alternatives could result in overcrowding of these facilities. However, the natural growth of the City of Altoona has already increased demand on the educational facilities to the point where construction of a third elementary school is under consideration.

In the Four Mile area, the population increase projected for Alternative 5 will likely force expansion of Southeast Polk Four Mile School or construction of an additional facility in the Carbondale area. This is mitigated somewhat by the fact that increased student capacity of the school will be required by the anticipated growth of the Carbondale area. Southeast Polk County High School provides secondary education for area pupils, and is adequate for the existing enrollment. Future population growth in Altoona and the Eastern, South-Western and Four Mile assessment areas will probably require expansion of the school, regardless of the alternative selected.

Police and fire protection to the area will likely be unaffected by any of the alternatives considered, although inter-municipal service would be improved under Alternative 5. As no roadways in the area will be closed due to the Beltway, traditional land access will be maintained. Some disruption of local traffic patterns will occur during the construction period, however.

The major concern in the Eastern, South-Western and Four Mile areas is the provision of municipal services. Present development in these areas relies on individual wells and septic fields for water supply and sewage disposal. Future development in the eastern portion of the study corridor, as anticipated to occur under Alternative 5, would be difficult and costly to serve with municipal water and sewer because of distance to existing treatment facilities, and area topography. Residents of the Woodland Hills area along Vandalia Drive have already inquired about the possibility of obtaining sewer service from the City of Pleasant Hill. Further development in this area will no doubt bring about increased pressure for municipal services.

Avon - Like the Eastern, South-Western and Four Mile areas, the Avon assessment area is without municipal services and residents must rely on individual wells and septic fields. The area could not conveniently be provided with municipal services at the present time. The feasibility of providing such services in the future is largely dependent on the decisions reached on the basis of the ongoing 208 Wastewater Study.

Area students attend Carlisle Schools. Alternatives 3, 4 and 5, which would be accompanied by the greatest population gains, would have the greatest effect on existing facilities. Significant population gains are also projected under the "No-build" Alternative and Alternative 2 as well, however.

Traditional access will be maintained and fire and police service should be unaffected. Inter-municipal service to the Avon area should be improved by all of the "Build" alternatives.

4. Social Impacts on Special Groups

Neighborhoods in this study corridor are not characterized by the traditional, pedestrian-oriented activities often found in older, closer-knit, traditional ethnic neighborhoods common to more central city locations (see Section III B). The 1970 Census of Population has reported that only a very small percentage of the population in the corridor area is composed of non-white races (see Table III-2), and as none of the alternatives would sever a neighborhood of an established cultural, racial or religious identity, no minority groups would be adversely affected by the proposed project.

The proposed Arterial Highway 500 alternatives would not isolate any communities or residential and commercial areas, although Alternative 4 will traverse an existing residential neighborhood. As residents in the 500 corridor are auto-oriented, and activities frequently take place outside the immediate neighborhood area, the automobile provides the chief means of transportation.

Although a door-to-door canvass was not possible, field observations made during the course of the study indicates that no minority groups or individuals or any particular sector of the population would be directly affected by the right-of-way acquisition and displacement accompanying the location and design of any of the proposed alternatives, nor are the alternatives in conflict with provisions of Title VI of the Civil Rights Act of 1964.

The handicapped would be neither adversely nor beneficially affected by the proposed highway.

Bicycle traffic in the study corridor, particularly that on north-south county or township roads north of Iowa 163, would benefit from the reduction in through traffic frequently using those roads which would be diverted to the new highway.

5. *Takings and Relocation*

One of the major considerations in assessing each alternative was the extent of immediate impact on study corridor properties and residents in the form of takings and relocations. Taking refers to the direct taking of land, homes or other buildings within the right-of-way limits, while relocation refers to the necessary relocation of people or businesses as a result of direct property taking. While the exact number of displacements and location of affected parcels cannot be determined until final design plans are completed, a preliminary summary of takings for all "Build" alternatives is shown in Table IV-3.

Residential Takings - Alternative 1, the "No-build" Alternative, would require right-of-way acquisition for the proposed S.E. 36th Street/East Diagonal Road south of Iowa 163. No direct takings or displacements are anticipated for this improvement.

Alternatives 2, 3 and 5 would require essentially the same total number of residential takings, and would displace similar numbers of farmsteads. While most residential displacements result from the taking of isolated properties distributed throughout the length of the alignments, displacements in the Avon area vary between four residential dwellings and one farmstead under Alternatives 2 and 3, and seven dwellings under Alternative 5.

Analysis of 1970 Census block data for the Avon area (census tract 108, blocks 207, 210, 910) reveals a population predominately consisting of husband/wife/family units. In terms of age, 36 percent of the impacted (i.e. traversed) area of Avon is below 18 years of age, while only three percent are 62 years or older. No minority groups were identified by the census in this vicinity. Information concerning average 1970 housing values, rentals and the average number of rooms for the impacted blocks was withheld from public disclosure for reasons of confidentiality by the Bureau of the Census.

Alternative 4 would have the greatest impact on corridor properties, requiring sixty-five residential displacements. Of these, thirty-nine single family and twenty-five mobile home displacements (total of 64 dwelling units) occur in residential areas of Capitol Heights.

TABLE IV-3

TAKINGS

	Alt. 2	Alt. 3	Alt. 4	Alt. 5
RESIDENTIAL				
Homes *	15	14	40	16
Mobile Homes	0	0	25	0
Farmsteads	3	4	0	3
COMMERCIAL/INDUSTRIAL				
	3	2	19	0
PUBLIC/INSTITUTIONAL				
	0	2 **	0	0

* Includes homes from farmsteads
** Weigh Stations on I-80

TABLE IV-4

SUMMARY OF ESTIMATED EMPLOYEE DISPLACEMENTS RESULTING FROM COMMERCIAL - INDUSTRIAL TAKINGS

ALTERNATIVE	NUMBER OF COMMERCIAL/INDUSTRIAL TAKINGS	ESTIMATE OF EMPLOYEES DISPLACED
1	0	0
2	3	19 + 13 Seasonal
3	2	8
4	19	82
5	0	0

Analysis of 1970 Census block data for the impacted areas of Capitol Heights (census tract 106, blocks 209, 304, 910 and 911) reveals a population consisting primarily of husband/wife/family units. About eighteen percent of the occupied housing units were one person households or were headed by females. In terms of age, thirty-four percent of the impacted blocks' population is under 18 years old, while seven percent were 62 or older. No minority groups were identified by the census in this area. Housing values for the traversed blocks are summarized below:

CENSUS TRACT	BLOCK NUMBER	STREET NAME	AVERAGE ESTIMATED VALUE OWNER OCCUPIED UNITS	AVERAGE ROOMS PER UNIT
108	209	N.E. 43rd Ct.	$18,000	4.5
	304	Hubbell Avenue	$16,800	4.8
	910	Sheridan Avenue	$ 9,600	5.2
	911	Arthur Avenue	Suppressed*	Suppressed*

* Withheld from disclosure by U.S. Census.

Figure IV-2 illustrates typical properties displaced by the various alternatives.

Commercial - Industrial Takings - As Alternative 1 would require no displacements, no corridor commercial or industrial properties would be affected. Alternatives 2 and 3 would require the taking and relocation of 3 and 4 businesses, respectively, while Alternative 5 would not affect any commercial establishments. Alternative 3 would require the relocation of the state owned weigh station on I-80 west of Altoona, however. Alternative 4 would require the displacement and relocation of 19 commercial establishments, most of which are located at the proposed interchange with Hubbell Avenue. Commercial - Industrial takings and estimates of the number of employees affected are shown in Table IV-4.

A study of the availability of replacement housing was conducted by the Iowa D.O.T. Relocation Office in October, 1976. Results of this study indicate that there is an adequate supply of single-family housing available in a variety of locations within and near the study corridor to accommodate those homeowners displaced by the proposed projects (see Table IV-5) although average prices have increased sharply within the past year. In addition, the construction of new homes in the corridor would also offer those displaced a variety of dwelling unit types, price ranges and locations from which to choose replacement housing. The supply of rental single-family homes and mobile home sites is very limited at present, however, and the relocation of displaced tenants and mobile home owners may pose somewhat of a problem. Inquiries made during the relocation study indicate that the unavailability of natural gas and the high cost of LP gas is the major factor responsible for the shortage of mobile home sites in the Des Moines area. This situation is most serious for Alternative 4 where 25 mobile homes would be displaced.

TABLE IV-5

SUMMARY OF HOUSING AVAILABILITY AS OF OCTOBER 1976

COMMUNITY	PRICE RANGE 1000's DOLLARS	NUMBER OF AVAILABLE UNITS	DESCRIPTION OF UNITS AVAILABLE
North East Des Moines (includes area of city north of University, east of Des Moines River)	7 - 16	12	2 Bedroon S.F.R.
	16 - 25	19	2 Bedroom S.F.R.
	25 - 30	23	3 Bedroom S.F.R.
	30 - 40	36	3, 4 Bedroom S.F.R.
	40 - 50	11	3, 4, 5 Bedroom S.F.R.
	60	1	4 Bedroom S.F.R.
Eastern Des Moines (includes Pleasant Hill)	10 - 16	11	2 Bedroom S.F.R.
	16 - 30	9	3 Bedroom S.F.R.
	30 - 40	24	3, 4 Bedroom S.F.R.
	40 - 56	14	3, 4, 5 Bedroom S.F.R.
Altoona	21 - 38	10	3 Bedroom S.F.R.
	41 - 45	6	3, 4, 5 Bedroom S.F.R.
	47 - 54	9	4, 5 Bedroom S.F.R.
Carlisle	12	1	2 Bedroom S.F.R.
	29 - 39	3	3 Bedroom S.F.R.
	39 - 52	9	3, 4, 5 Bedroom S.F.R.
	82	1	4 Bedroom S.F.R.

AVON LAKES AREA:
IOWA 46 NORTH OF IOWA 5

ALTERNATIVES 2 AND 3

CAPITOL HEIGHTS:
SHERIDAN-ARTHUR AVE. AREA

ALTERNATIVE 4

CAPITOL HEIGHTS: N.E. 43RD CT.
NORTH OF DOUGLAS AVE.

ALTERNATIVE 4

CAPITOL HEIGHTS:
HUBBELL AVE. NEAR N.E. 42ND ST.

ALTERNATIVE 4

CAPITOL HEIGHTS:
HUBBELL AVE. NEAR N.E. 43RD CT.

ALTERNATIVE 4

TYPICAL RURAL RESIDENCE

ALL ALTERNATIVES

FIGURE IV-2

TYPICAL STRUCTURES DISPLACED BY RIGHT OF WAY

EDWARDS AND KELCEY INC.

There appears to be an adequate supply of commercial property and rental space available within the corridor, although prices are somewhat inflated in the Altoona area, probably as a result of the influence of Adventureland Park. Commercial operations displaced by Alternative 4, most of which are located at the interchange of Hubbell Avenue, would be most seriously affected by this situation.

A comprehensive program of relocation assistance operates in Iowa under State and Federal legislation. The intent of this program is to insure that those persons being displaced do not suffer disproportionate injuries as a result of highway programs designed for the benefit of the public as a whole. The program assists displaced persons, both owners and tenants, in finding decent, safe and sanitary housing. It offers payment to landowners, tenants, businesses and farm operations for vaious moving expenses. It also offers certain additional payments to landowners, tenants and businesses, where necessary, to make it possible for them to obtain suitable replacement housing or to relocate their business.

Relocation payments and advisory assistance are provided in addition to the State's offer for the purchase of property required for highway purposes. Full-time field agents are made available to the public to assist with relocation problems and to ensure full benefits of the program to the parties involved.

6. Effect on Tax Base and Property Values

An analysis was performed to determine the effect that the proposed action will have on the tax base and property values within the affected communities. This analysis included consideration of short-term, long-term, direct and indirect effects. The bulk of information utilized in the anlaysis of tax loss was obtained from assessors records in Polk County. This involved a calculation of the tax value of land and buildings taken for right-of-way using a figure of 100 percent as the determinant of assessed value according to current assessment practice. In preparing the estimate, it was necessary to make certain judgements and assumptions as outlined below:

1. Mobile homes were assumed to be relocated with no loss of building value/assessment.

2. Where adjoining parcels are assigned to a single owner, judgement was exercised as to the appropriate land value selected for improved and unimproved parcels involved in the possible acquisition. Values were pro-rated on a per acre value equivalent basis.

A summary of the initial tax base loss for all alternatives as a result of right-of-way acquisition is shown in Table IV-6. Values shown for Alternatives 1 and 5 include the effect of right-of-way required for the construction of S.E. 36th Street/East Diagonal Road.

Alternative 4 produces the greatest initial tax base loss followed by Alternatives 5, 3, 2 and 1, in that order. Polk County tax rolls would be most heavily affected, with a maximum loss of .17 percent of the total tax base occurring under

TABLE IV-6

INITIAL TAX BASE LOSS FOR

HIGHWAY RIGHT - OF - WAY

(Thousands of Dollars)

	Des Moines	Pleasant Hill	Polk Co. (unincorporated)	Total
Total Assessed Value *	$2,129,229	$81,381	$452,465	$2,663,075
Tax base removed by:				
Alternative 1	48.0	-	13.0	61.0
% Total	.002		.003	.002
Alternative 2	-	73.4	332.8	406.2
% Total		.090	.074	.015
Alternative 3	-	36.8	403.3	440.1
$ Total		.045	.089	.016
Alternative 4	96.1	7.9	782.7	886.7
% Total	.004	.010	.173	.033
Alternative 5	48.0	-	590.9	638.9
% Total	.002		.131	.024

* Based on 1975-1976 tax base, at 100% of market value per current assessment practice.

Alternative 4. Initial tax base losses would likely be more than offset by new development and property value increases under all "Build" alternatives, possibly beginning even before completion of the new highway.

As suggested above, the total tax base within the study corridor will be affected by other factors in addition to the initial loss caused by right-of-way acquisition. A major new highway will result in a faster rate of appreciation and higher values for most corridor land, particularly in the vicinity of interchanges and along major connecting roads. Since commercial-industrial lands tend to appreciate more than residential land under similar circumstances, Alternative 3, which provides the greatest commercial-industrial development potential, would produce greatest overall gains in property value. (See Table IV-2)

Alternatives 2 and 4 could be expected to produce similar, though somewhat lower, gains in property values, followed by Alternative 5 which has the lowest potential for bringing about value increases within the corridor of all the "Build" alternatives.

The "No-build" Alternative, while producing the lowest tax base loss, would also cause the least gain in property values of all alternatives considered.

Residential property values are also generally benefited by new highway construction with the exception of properties in direct proximity to the highway. Economic disbenefits of highway proximity have been analyzed in a number of studies; these have shown that only residential properties directly abutting the highway right-of-way suffer property value loss, primarily as the result of noise impacts. One summarization of study effects concluded that proximity effects lower market values of abutting properties in the range of 0 to -10 percent, an effect sometimes offset by accessibility increases.(1) An Ohio study concluded that contiguous residential properties decreased in value in locations up to fifty feet from the right-of-way, and increased in value over fifty feet away.(2) In general, studies have shown that land values in nearby, but non-contiguous, areas have increased by approximately four to ten percent per year.(3)

Since the new alignments traverse primarily undeveloped land, proximity effects of noise will be minimal and future use of abutting lands can be planned and relocated to avoid substantial noise impacts. As a result, most residential properties in the corridor will show an increase in value due to improved accessibility and mobility offered by a new facility. An exception to this general condition occurs along Alternative 4 in the Capitol Heights area where the highway penetrates an established residential area. Some decrease in property values for homes immediately adjacent to the right-of-way can be expected in this location.

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(1) Social and Economic Effects of Highways, U.S. Department of Transportation, Federal Highway Administration, Washington, D.C., 1974, p.15.

(2) David C. Colony, Study of the Effect, if any, of an Urban Freeway upon Residential Properties Contiguous to the Right-of-Way, (University of Toledo, 1967).

(3) Ref. (1) p. 69-70

TABLE IV-7

RIGHT-OF-WAY ACREAGE BY

SOIL CLASS BY ALTERNATIVE

SCS SOIL CLASS	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Class I	47	71	138	164	209
Class II	47	98	180	161	315
Class III	20	79	168	68	133
Class IV	-	9	10	4	41
Class V & VI	-	1	-	-	-
Class VII	-	2	1	-	16
Class I, II, III	107	248	486	393	657
Total Acreage	107	260	497	397	714

Note: Figures above include only new acreage required for right-of-way. This acreage is not necessarily being farmed at the present time.

7. Agricultural Production

The construction of a major new highway within the study corridor would have both direct and indirect impacts on the corridor agricultural lands.

Direct impacts result from the taking of agriculturally suitable land for right-of-way. The total acreage, and the acreage of Class I, II and III agricultural soils, required for right-of-way by each alternative is shown in Table IV-7. Alternative 5 takes the greatest amount of agricultural land, followed by Alternatives 2, 3 and 4 of the "Build" alternatives. Alternative 1, requiring right-of-way for the S.E. 36th Street/East Diagonal alignment, would take the least. It can also be seen from the table that practically all of the land required for right-of-way for all alternatives is rated as Class I, II or III, a fact which attests to the quality of land within the study corridor.

Additional direct impacts can occur as the result of the disruption of individual farms by a new highway. While such disruption does not usually increase the amount of land taken, it can have an effect on the efficiency of farming operations, and hence on the overall productivity of study corridor farmlands. Table IV-8 shows the number and type of farm severances caused by each alternative. Alternative 5 would clearly cause the greatest disruption of farming operations, followed by Alternative 3, 4, 2 and 1, in that order.

Indirect impacts can result from the taking of agricultural lands for development which is associated with, or is affected by, a new highway. Alternatives 2, 3 and 4, would serve and structure anticipated growth in areas immediately adjacent to existing development, and would likely speed up conversion of agricult-tural land to urban uses in those areas. It is likely that portions of those same areas, particularly those in Delaware Township between Pleasant Hill and Altoona, will be converted to developed use in the future even under the "No-build" Alternative, though at a slower rate than would occur under Alternatives 2, 3 or 4.

Alternative 5, on the other hand, would support growth in the prime agricultural areas in the eastern and northeastern portions of the corridor. Conversion of agricultural land could be expected to occur not only in the immediate vicinity of beltway interchanges, but in the areas between existing development and the beltway as well. The resultant "sprawl" would likely cause the utlimate conversion of more land from agricultural to other uses than would be cause by the other "Build" Alternatives. Therefore, the total amount of land taken out of agricultural production depends not only on land required for highway construction but also on the amount and distribution of land conversions caused by secondary development.

In order to evaluate the potential secondary effects of increased corridor growth on agricultural production, estimates were made of the total amount of land that would be required by the projected population increases under each of the alternatives. An estimated 3.0 persons per dwelling unit was assumed applicable for new development through the year 2000. In view of corridor zoning and recent development trends, the additional units will likely be developed at an average density of between 1.2 and 1.5 units per gross acres of land; an average value of 1.35 was assumed applicable for the developing corridor areas. The magnitude and distribution of resulting land conversions is shown in Table IV-9.

TABLE IV-8

FARM SEVERANCES

ALTERNATIVE	NO. OF FARMS AFFECTED	ACCESS TO SEVERED PARCELS: Circuitous No.*	Circuitous Acres	None No.*	None Acres
1	2	-	-	2	30
2	3	1	60	3	18
3	8	3	75	6	72
4	6	1	119	5	37
5	9	4	89	6	188

* Number of parcels may not equal number of farms affected as some farms have both parcels with circuitous access and parcels with no access.

TABLE IV-9

POTENTIAL SECONDARY LAND CONVERSIONS

BY ALTERNATIVE BY ASSESSMENT AREA

Development Assessment Area	Land Required by Potential Population Increases* (Acres) Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Des Moines	200	200	200	420	200
Pleasant Hill-Carbondale	610	1010	1010	1010	920
Capitol Heights	915	1010	1110	1110	1010
Altoona	920	915	1000	920	870
Eastern & Southeastern	510	715	900	610	1250
Four Mile	205	200	300	200	510
Avon	100	200	420	420	420
Totals	3460	4250	4940	4690	5180

* 3.0 persons per dwelling unit, 1.35 dwelling units/gross acre; based on population estimates from Table A I-4.

B. JOINT DEVELOPMENT

To reduce the adverse social and economic effects of a highway on the local environment as well as to protect the highway investment by restricting adverse traffic induced development, the Federal Highway Administration has advocated joint development planning on new highway facilities within urbanized areas. Joint development refers to actions taken in concert by a state highway department, other government agencies, private organizations, and individuals in preparing for the construction of a new highway. Such actions might include activities to develop, redevelop or adjust land uses and the local service network which are to be affected by the highway, or to provide for multiple use of highway right-of-way.

Joint development activities can include the public acquisition of property beyond that normally required for highway right-of-way to ensure compatible development. While the Iowa Department of Transportation does not itself have the authority to purchase such additional properties, it can cooperate with another state or local agency during the highway right-of-way negotiation process, to purchase property for that agency.

Public acquisition of additional land can reduce or eliminate adjacent land uses deemed to be incompatible with local development objectives or uses that interfere with the functioning of the highway itself. It also allows for the establishment of parks or other open space areas that provide a shielding effect against intrusion from highway sights, sounds and smells, and can also provide recreational areas benefiting the community and surrounding region.

Acquisition of property beyond the normal right-of-way has several advantages and limitations. While the acquired property may be costly, any "windfall" gains in property values will be deferred to the public rather than profiting a single owner or developer. The property thus acquired will take land from the tax rolls and require a maintenance investment. On the other hand, such action will share any losses in property values (due to proximity effects, etc.) rather than penalizing individual property owners. In addition, it assures land uses compatible with community needs and desires.

Figure IV-3 shows the potential for linking the proposed conservation areas along the Des Moines River and Four Mile Creek with the proposed medium and low density residential districts in Pleasant Hill. Through acquisition of additional land in conjunction with the construction of Alternative 3, a significant amount of open space could be obtained that would have a positive impact on the future development of the area.

The Pleasant Hill Comprehensive Plan shows a green belt along the waterway separating the city residential areas from Carbondale. The illustration shows how the integrity of the Plan could be retained. The additional land obtained would be flat or slightly rolling, with clumps of trees along the watercourses. The resulting open space would be a perfect complement to the adjacent residential areas. Playgrounds and ballfields could be built within the parks at convenient locations. To the south, the highway provides a buffer between residential areas and the light industrial area to the west. Parkland adjacent to the proposed commercial areas near Iowa 163 would present an interesting opportunity to insure public access to these vanishing natural resources. The interchange at Vandalia Drive and Iowa 163 are so located as to prevent industrial and commercial traffic from filtering through residential areas. Extensive planting of appropriate trees and shrubs along the right-of-way would reduce noise and visual impacts.

Figure IV-4 shows the section of the Four Mile Creek valley in the vicinity of Iowa 163. This area of wooded slopes, open fields and a swift running stream could be adversely affected by highway construction. The illustration shows how such impact could be minimized, and how the highway could serve as a positive influence in development of the valley. Through acquisition of additional land, a great deal of property could be obtained for parks to serve the local area. This land is part of the ROSS system (see Section III B 4) and purchase of it could stimulate further protection and acquisition of the Four Mile Creek flood plain. There are large areas of woods, especially along the banks of the creek, that would be suitable for trails and picnic tables. A golf course, as suggested in the Pleasant Hill Comprehensive Plan, or playing fields and playgrounds could be built in the open areas. Automobile and pedestrian access would be quite simple and efficient using the existing street network.

The development of bikeways paralleling the proposed highway should be considered. These would be an asset to the local communities and would be compatible with the ROSS Plan proposals for the Four Mile Creek valley, and with local comprehensive plans.

The above examples are illustrative of the types of joint development potential available at various locations throughout the study corridor. The locations of these and other joint development opportunities are shown on Figure IV-10 and Figures V-1 through V-5.

C. TRAFFIC SERVICE

1. Regional and Interstate Service

Regional and interstate service considers how quickly long distance trips can be made through the study corridor, and how well the proposed facility fits into the areawide and statewide transportation network. Alternatives are compared on the basis of travel time for corridor length trips, and on functional continuity.

At the present time, long distance through trips which pass through the Des Moines area do so primarily on the Interstate System. Interstate 80, which passes around the north side of Des Moines, serves east-west travel demand, while Interstate 35, which passes around the west edge of the Des Moines metropolitan area, serves north-south travel demand. A roadway facility passing through the study corridor would serve two functions: First, it would serve as the east leg of a circumferential route around the Des Moines metropolitan area, and second, it would make the north and east parts of Des Moines more accessible to the southeastern portions of Iowa via the proposed 592 facility extending northwestward from Ottumwa and Knoxville.

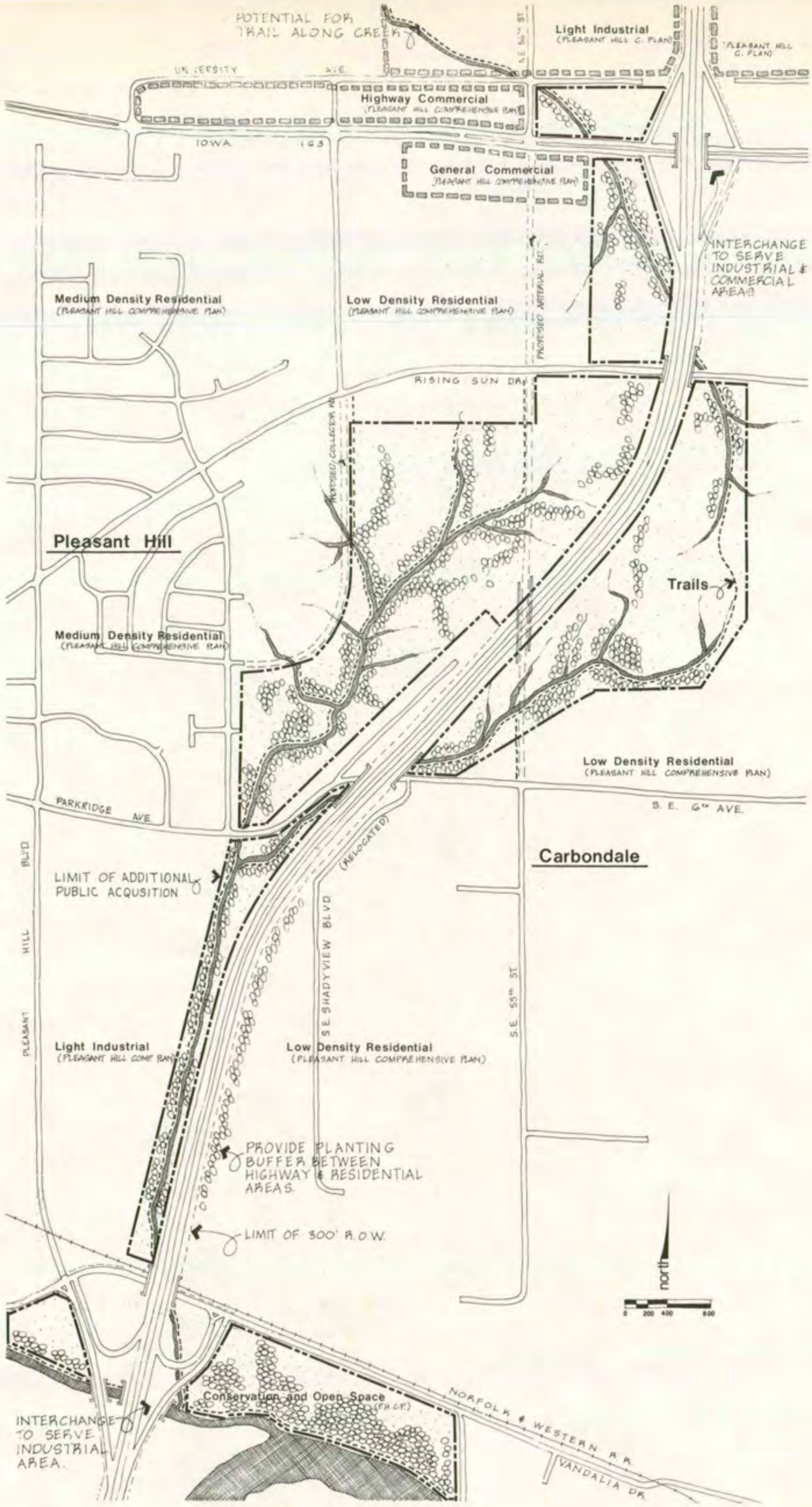

FIGURE IV-3

JOINT DEVELOPMENT ALTERNATIVE 3

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FIGURE IV-4

JOINT DEVELOPMENT ALTERNATIVE 4

Table V-10 shows calculated travel times for various trips within the study corridor. The first entry in the table is of particular interest, since the trip between Army Post Road and the north end of the corridor is the one that simulates through trips using the study corridor.

At the present, there is no through route available for corridor length, north-south trips. Only drivers who are familiar with the local street system in the study area are able to make this trip, while those who are unfamiliar with the area probably pass through the heart of the City of Des Moines, using either U.S. 65 or U.S. 69.

Under Alternative 1, a small improvement is provided by the new S.E. 36th Street/Diagonal Boulevard facility. However, a significant improvement in travel time for corridor length trips would be provided by Alternatives 2 - 5.

Long distance trips should ideally be made on a continuous freeway type facility, which provides the fastest, safest and most efficient service for that type of trip. Alternative 1 and 2 do not provide this functional continuity, and result in a reduction of the level of efficiency and safety with which through trips can be made.

Predicted traffic volumes on the study corridor roadway network for all alternatives are shown on Figures V-1 through V-5.

2. Community Service

This factor measures the efficiency of the roadway system, but at a more detailed level than Regional and Interstate Service. For long distance through trips, one or two overloaded sections of roadway would be a minor annoyance and would not add appreciably to the total travel time. However, for local trips which take place nearly every working day, those same overloaded sections of roadway cause delays which add significantly to the total travel time.

Community service also relates to the way in which the proposed roadway network serves the existing and planned development in the corridor. Items considered are the travel times between combinations of points both within and on the edge of the study area, and the effect on trip length of road closings or realignments proposed as part of a particular alternative.

The alternative which allows the greatest degree of freedom to move about within the community is the best alternative from the standpoint of community service. To measure the degree of mobility, volume to capacity ratios for peak hour conditions were calculated for all links in the traffic analysis network developed for each alternative. Under each of the alternatives, there would be certain roadway segments which will be overloaded by design year, peak hour traffic flows. These segments are identified on the maps (Figures V-1 through V-5) in Section V. There are, however, three situations which are of special interest.

- An upgrading of E. 29th St. is planned which includes a realignment such that E. 30th and E. 29th Streets would be continuous between Vandalia Drive and Hubbell Ave. The section between Iowa 163 and Hubbell Ave. would

TABLE IV-10

YEAR 2000 DESIGN HOUR TRAVEL TIME

Trips Between	Via	Existing Conditions	Travel Time In Minutes Alternative 1	2	3	4	5
• Intersection APR and Ia. 46/ I-80 East	• E. 30th St. and Hubbell Road	25.3					
	• E. 36th St. and Diagonal Blvd.		24.3				
	• 500 Beltway			15.9	16.8	17.2	15.1
• Carlisle (Ia.5)/Intersection E. 30th St. and Ia. 163	• Ia. 46	11.4	10.1		11.9	13.3	14.1
	• E. 36th St. and Ia. 46		9.3				13.4
	• 500 Beltway and Ia. 46			13.3	11.4	10.3	
• Intersection APR and Ia. 46/ Ia. 163 East	• Ia. 46	20.3					
	• E. 36th St. and Diagonal Blvd.		12.9				
	• 500 Beltway			10.3	10.0	12.1	9.3
• Intersection E. 29th St. and Hubbell Road/Altoona	• Hubbell Road	8.9	11.1	11.1	12.4	16.6	11.2
• Pleasant Hill/U.S.65 North	• E. 56th Street	7.4	8.0		8.7	8.0	8.0
	• 500 Beltway			7.4	8.5	8.3	
• Pleasant Hill/I-80 East	• E. 56th Street	10.8	11.9				
	• 500 Beltway			11.3	12.4	13.3	11.5

operate at a level of service which is worse than Level of Service "C" during the design hour regardless of which alternative is selected. This segment will experience Level of Service "F" flow conditions (forced flow, stop-and-go traffic) under Alternative 1, 2, 3 and 5. Only Alternative 4 offers an alternative to this route. This roadway segment would still operate at Level of Service "E" (severe traffic congestion and intolerable delays) under Alternative 4.

- Alternative 4 provides substantial relief to north-south routes along the west side of the study area. At the same time, however, construction of Alternative 4 would tend to confine development to the west edge of the corridor, and the resultant traffic would overload several other portions of the corridor roadway system. For example, note the substantial increase in travel time (Table IV-10) between E. 29th Street and Altoona on Hubbell Avenue.

- Alternative 5, while attracting the greatest amount of corridor development and distributing the development most evenly throughout the corridor, does not directly serve that development to the same degree as Alternatives 2, 3 and 4. The result is relatively low volumes on Highway 500, and relatively high volumes and low levels of service on roadways in the western part of the study area.

The capacity analysis of the five alternative roadway networks indicates then that the roadway networks associated with Alternatives 1, 2 and 3 perform reasonably well in serving the traffic expected to occur under those alternatives. Alternative 1, while it does include construction of the S.E. 36th Street/East Diagonal Road facility, still does not provide the clearly identifiable, through, north-south route which is lacking in the study area. There are serious deficiencies in the way in which the roadway networks associated with Alternatives 4 and 5 serve the traffic expected to occur under those alternatives.

Operating conditions are also an important indication of the relative ease with which trips can be made within the corridor. Another consideration is whether it would be necessary to close, realign, or in any other way limit or deny access to areas served by the present roadway system. The indicator used to assess the combined effect of these two factors is peak hour travel time between pairs of typical origins and destinations which represent commonly made trips within the study corridor. Table IV-10 lists peak hour travel time for several of these typical trips. Except for corridor length trips, none of the alternatives offer any significant advantage in making trips in the corridor when compared to other alternatives or existing conditions.

Another consideration is the amount of traffic disruption and motorist inconvenience caused by the actual construction of the Beltway. Alternative 1, with no Beltway construction, would cause no disruption or inconvenience. Alternatives 3 and 5, which would be constructed on entirely new alignment through relatively undeveloped areas, would cause only minimal disruption and inconvenience to existing traffic flow while grade separations for the Beltway are constructed.

Construction of Alternative 2 may cause considerable disruption and inconvenience to traffic using Iowa 46 and N.E. 56th Street during construction of those segments of Alternative 2. These impacts may be mitigated somewhat by proper staging of construction. Alternative 4 has probably the most potential to cause disruption and inconvenience during construction due to its location in the more intensely developed portion of the corridor. The construction of grade separations and interchange ramps at Iowa 163 and Hubbell Road may be particularly troublesome to the many drivers using those routes.

3. Service Flexibility

During this portion of the analysis, each alternative was examined relative to possible changes in the predicted patterns of future development. The types of development considered include residential, commercial, industrial, highway and mass transit.

The Central Iowa Regional Association of Local Governments, in its Revised Initial Des Moines Urbanized Area Transportation Plan, proposes certain land use and development patterns to be followed in the future. Many decisions concerning future development in the study corridor, however, have yet to be made.

These decisions may significantly alter the nature of travel demand within and through the study area. Roadway improvement plans may not materialize as anticipated or may be revised. The chosen alternative, therefore, should have the flexibility to be adaptable to altered development patterns. Of the "build" alternatives, Alternative 2 and 4 would have the least flexibility to adapt to changes in development patterns. The alignments of Alternatives 2 and 4 pass through areas which are now developed or developing and which will continue to be developed in the near future. These two alternatives will become even more inflexible in the future as the development in the west portion of the study corridor intensifies. Alternatives 3 and 5, with alignments lying generally east of Alternatives 2 and 4, are better suited to serve new development expected to occur in the eastern portion of the study area. These alternatives are generally more flexible in terms of adjustments in alignment and interchange location and layout because of their location on relatively undeveloped land.

One consideration about which there is, at present, a great deal of uncertainty, is the nature of future transportation and transportation systems. Mass transit seems destined to become a more widely used form of transportation in high travel demend corridors in the future. As it applies to the Des Moines metropolitan area, this principally refers to the demand for transportation service to downtown Des Moines. For circulation within less intensely developed areas such as the study corridor, it is generally conceded that some sort of personal vehicle is the only practical means of transportation. The proposed Beltway, with the high degree of north-south mobility it would provide, would be a logical line along which to locate "park-and-ride" type facilities, at which people destined for downtown Des Moines could transfer from their personal vehicles to either buses or some other type of mass transit for the remainder of their trip. The ability of the alternatives to serve this function relates directly to their position relative to the source of travel demand and the availability of land adjacent to the Beltway for the construction of the necessary facilities. Alternatives 2, 3 and 5 would likely have sufficient land available for terminal facilities. Alternatives 2 and 3, however, would be more centrally located within the demand area. Alternative 4 would be much less likely to have adjacent land available for terminal facilities.

4. Safety

Since there is a wide variation in accident rates for various types of roadways, traffic safety is a valid concern in the selection of an alternative in this study. Two criteria are used to estimate future accident potential. The first is the roadway type. Lower accident rates would be expected on roadways of higher design, such as expressways and freeways. The second consideration is the character of the traffic expected to occur on a given roadway. A mix of high speed, through traffic with low speed local traffic creates conflicts which add considerably to accident potential.

The number of accidents for each alternative was forecast based on both statewide average accident rates supplied by the Iowa Department of Transportation and recent accident experience as reported to the Iowa Department of Transportation and the City of Des Moines. Inasmuch as accident rates vary greatly from location to location in a way which cannot be accounted for in a table of average rates, the numbers arrived at during this analysis were considered on a comparative basis only.

The rate and number of accidents for segments of the traffic analysis network have been estimated for the forecast year (2000) for each alternative. Since accident rates are based on vehicle mileage, and since total vehicle mileage varies between alternatives, the best basis for comparison between alternatives is the combined accident rate shown in Table IV-11. Alternative 3 has the lowest combined accident rate. This is due to a combination of the relatively high amount of travel on the Beltway compared to Alternative 5, and the relatively low accident rate on the Beltway compared to Alternative 4.

Alternatives 3, 4 and 5 have significantly lower accident rates than Alternatives 1 and 2 because of the greater amount of travel taking place on a limited access highway. This type of facility has, historically, had considerably lower accident rates than facilities of a lower design type. This lower rate is considered to be a direct result of the elimination of most of the vehicle conflicts which are present on lower type facilities. The conflicts between faster moving, through trips, and slower, local trips is likely a major factor in a number of the accidents currently occurring on some roadway segments in the study area. An alternative which succeeds in separating local and through trips can be expected to have a better safety record than an alternative which does not separate them.

D. NOISE IMPACTS

An analysis of the existing and projected noise environment of the study corridor was undertaken to provide an indication of the impact of transportation noise for each alternative. A summary of the results of this analysis are presented herein. Details of the analysis methodology and results are included

TABLE IV-11

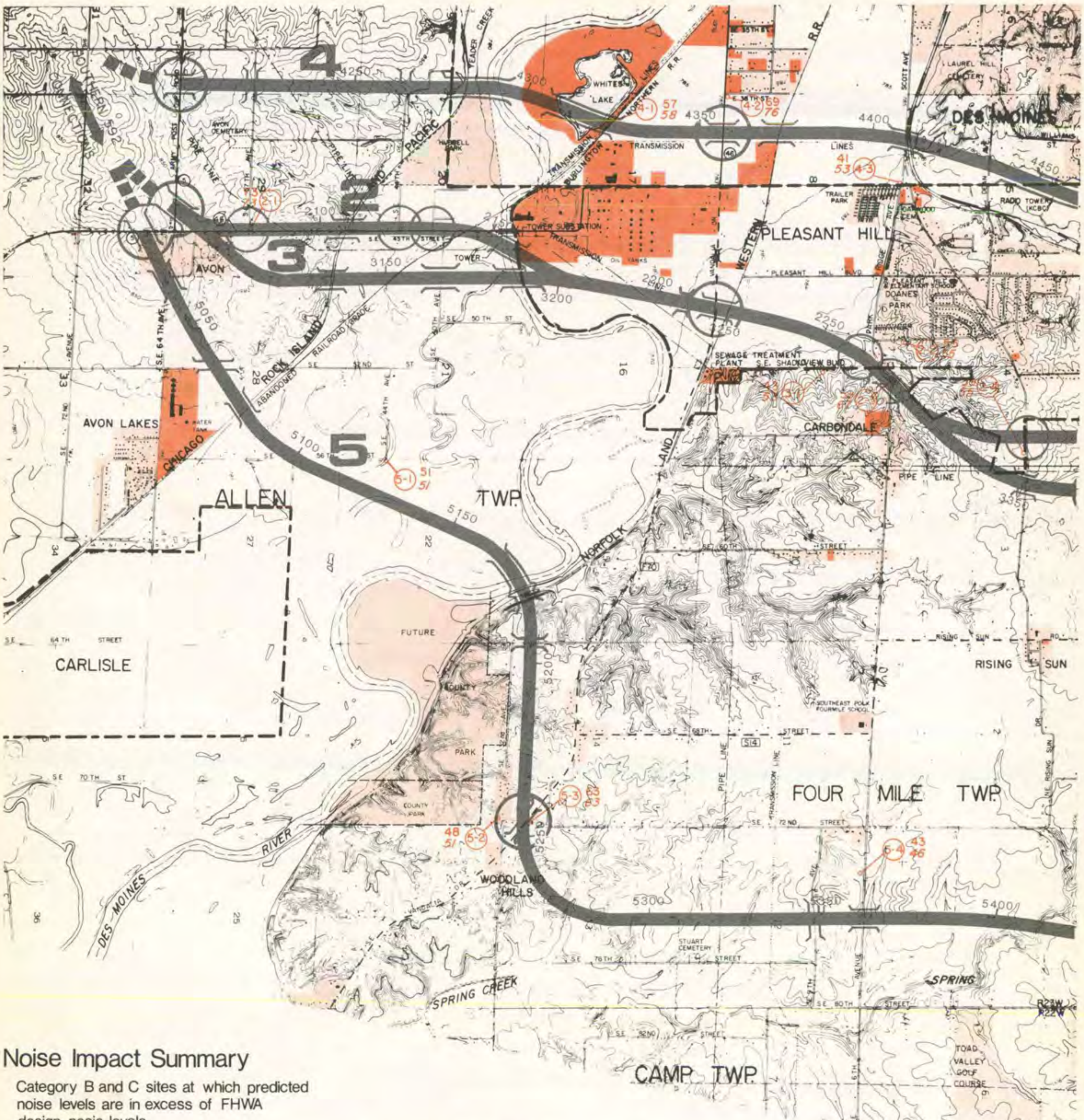
YEAR 2000 ACCIDENT OCCURRENCE FORECAST

Alternative	Vehicle Miles Of Travel Per Year (Vehicle Miles In Millions) Beltway	Other(1)	Non-Corridor(2)	Total	Projected Number Of Accidents Beltway	Other(1)	Non-Corridor(2)	Total	Accident Rate (Accidents Per Million Vehicle Miles) Beltway	Other(1)	Non-Corridor(2)	Combined
1	-	257	41	298	-	1562	363	1925	-	6.08	8.85	6.46
2	43	247	22	312	266	1320	197	1783	6.19	5.34	8.95	5.71
3	64	264	6	334	80	1391	52	1523	1.25	5.27	8.67	4.56
4	105	282	12	399	255	1573	104	1932	2.43	5.58	8.67	4.84
5	46	283	-	329	42	1579	-	1621	0.91	5.58	-	4.93

(1) Includes roadway segments, other than Beltway, on Traffic Analysis Network.

(2) For description of non-corridor travel, see Section B-II.

Note: Accident rates for individual roadway segments drawn from Iowa Department of Transportation records for statewide system and from recent accident experience as reported to the Iowa Department of Transportation and the City of Des Moines.



Noise Impact Summary

Category B and C sites at which predicted noise levels are in excess of FHWA design nosie levels.

	Beltway				Other Roadway				
	B		C		B		C		
Alternative	Residential	Other	Commercial	Other	Residential	Other	Commercial	Other	Total
Present	0	0	0	0	38	9	25	1	73
Alternative 1	0	0	0	0	155	16	45	3	219
Alternative 2	1	0	0	0	147	18	45	4	215
Alternative 3	0	0	0	0	161	19	48	4	232
Alternative 4	5	0	0	0	149	14	35	6	209
Alternative 5	0	0	0	0	163	18	46	3	230

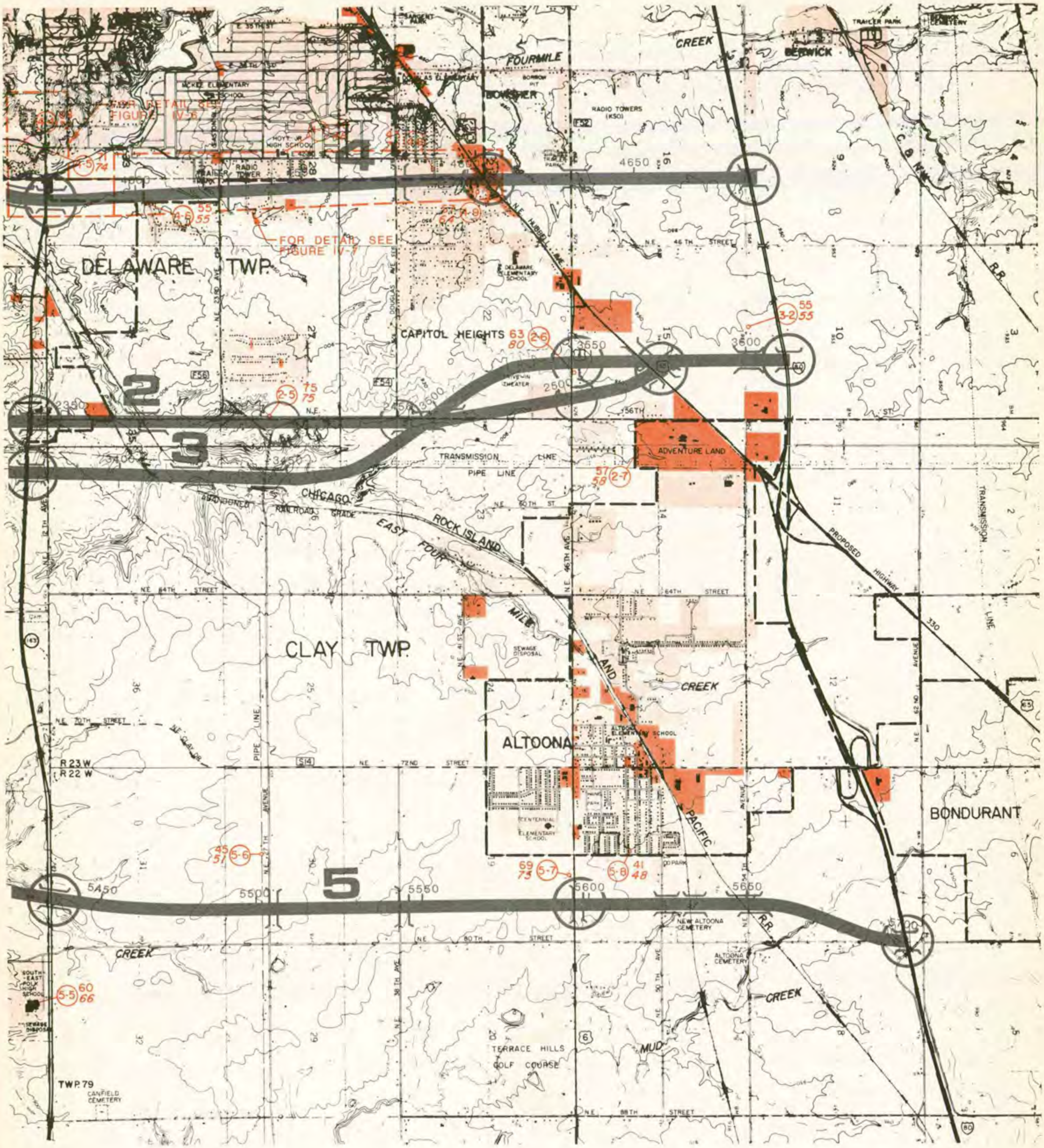
LEGEND

EXISTING NOISE SURVEY SITE (5-3)

DESIGN NOISE LEVEL LAND USE CATEGORY

B

C



LEGEND

56 MEASURED L_{10} NORMALIZED TO PEAK CONDITION

45 MAXIMUM L_{10} PREDICTED FOR SITE

EDWARDS AND KELCEY, INC.

north

2000 0 2000 4000 6000
SCALE IN FEET

FIGURE IV-5

1975 EXISTING NOISE SURVEY

in Appendix VI.

The existing noise environment of the study corridor was characterized through a field survey conducted by the Consultant on July 21-24, 1975. Existing noise levels determined during this survey are shown in Table A VI-4, and are depicted by location in Figure IV-5.

Noise projections were made for each alternative on the basis of procedures described in NCHRP Report 117, HIGHWAY NOISE: A Design Guide for Highway Engineers. Projections for each alternative included noise levels along segments of the existing roadway network as well as along segments of the proposed Beltway alternatives.

Two criteria were used to assess the impact of projected noise levels. 1) maximum allowable, or Design Noise Levels for a particular category of activity as specified by the FHWA and as described in Table A VI-3. 2) future noise levels which are projected to exceed existing noise levels but which do not necessarily exceed the FHWA Design Noise Levels are considered to produce the impact shown in Table A VI-2.

There will be no impact on category A activities within the study corridor. Predicted noise impact on category B and C sites from each alternative are tabulated on Figure IV-5. Specific impacts and mitigative measures are discussed in the following paragraphs.

1. Beltway Impacts

An assessment was made of the noise impacts within the study area caused by traffic on the Beltway itself. Only Alternatives 2 and 4 cause noise impacts which are in excess of FHWA Design Noise Levels. Under Alternative 2, there is one residential structure (category B) which would experience an L_{10} noise level in excess of 70 dBA. This residence is located on the east side of Alternative 2 just south of N.E. 23rd Avenue at alignment station 2393. The predicted noise level at the site is 73 dBA.

Under Alternative 4 there are five residences that would be exposed to noise levels in excess of FHWA category B criteria. All of these residences are located within the developed area between Iowa 163 and Hubbell Road as shown on Figures IV-6 and IV-7. There is one affected home at Arthur Avenue and two each at Sheridan and Madison Avenues. Noise levels at the Arthur and Sheridan sites are predicted to be 72 dBA while the predicted noise level at the Madison site is 71 dBA.

2. Other Roadway Impacts

In order to assess the relative noise impact of each alternative on the entire study area, an analysis was made of noise levels along each link in the Traffic Analysis Network (Figure A II-1). The comparison of the number of impacted sites was made between existing conditions and future (year 2000) conditions, and between alternatives under future conditions.

As would be expected, the general increase in traffic which will occur in the study area between the present time and the year 2000 will cause a general increase in the noise level along study area roadways, and a corresponding increase in the number of sites which will be subjected to noise levels in excess of FHWA criteria. As shown in the table on Figure IV-5, any of the alternatives, including the "No-build" Alternative, will cause an approximately 200 percent increase in the number of impacted sites. (This does not take into account any new development within noise impacted areas). Due to the intensity of development, and the proximity of the development to heavily traveled roadways, certain parts of the study area will be disproportionately impacted. These are the areas along Hubbell Avenue between E. 40th Street and U.S. 6; E. 46th Street south of Hubbell Avenue; U.S. 6 between Hubbell Avenue and Altoona; E. 72nd Street in Altoona; Iowa 163 between E. 38th Street and E. 56th Street; and Vandalia Drive near the intersection with Iowa 46.

The comparison, for year 2000 conditions, of the five alternatives to each other, shows that there is not a large difference between alternatives in the total number of sites impacted. However, in comparing alternatives to each other on a roadway segment basis, certain relative differences are apparent.

- On U.S. 6, between N.E. 56th Street and Altoona, 26 structures would be impacted under Alternative 3, while only 14 structures would be impacted under any of the other alternatives.

- On Iowa 163, between E. 38th Street and Four Mile Creek, 53 structures would be impacted under both Alternative 4 and Alternative 5; under Alternatives 1, 2 and 3, 46, 48 and 48 structures, respectively, would be impacted. (See Figure IV-6)

- On N.E. 56th Street, between U.S. 6 and Hubbell Avenue, six structures would be impacted under Alternative 1; under the other alternatives, no structures would be impacted.

- On Iowa 163, between E. 46th Street and E. 56th Street, Alternatives 1 and 4 would cause impacts on five and four structures, respectively; the other alternatives would cause impacts on eight structures.

- On Hubbell Avenue between E. 40th Street and E. 46th Street, Alternative 4 would cause impacts on only 12 structures, while all other alternatives would cause impacts on 28-30 structures.

Another means of comparison is the assessment of the differences in general noise levels along study area roadways. While impacts in some areas may not exceed FHWA criteria, the change from present conditions may be noticeable. The comparison was made using the "No-build" Alternative as a base, and the L_{50} noise level at 100 feet from the roadway as a measure. Under Alternatives 2, 3 and 4, there is one roadway segment along which noise levels change such that there is "some negative impact" (+6 to +10 dBA change). In each case, the impacted areas are along Vandalia Drive near the interchange with the Beltway. Since these areas are either industrial or agricultural, it is felt that the predicted increases in noise levels would not have a significant impact.

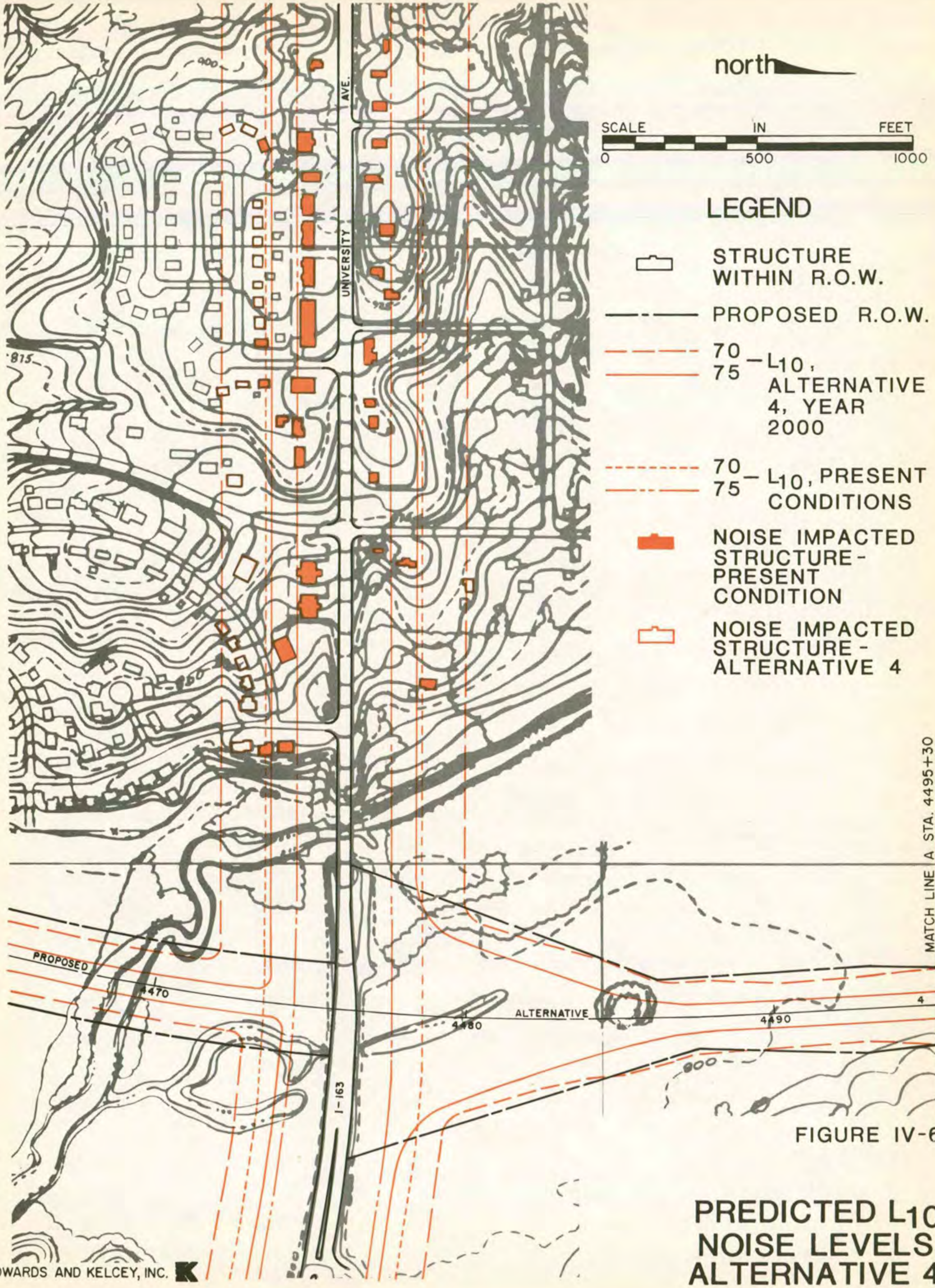
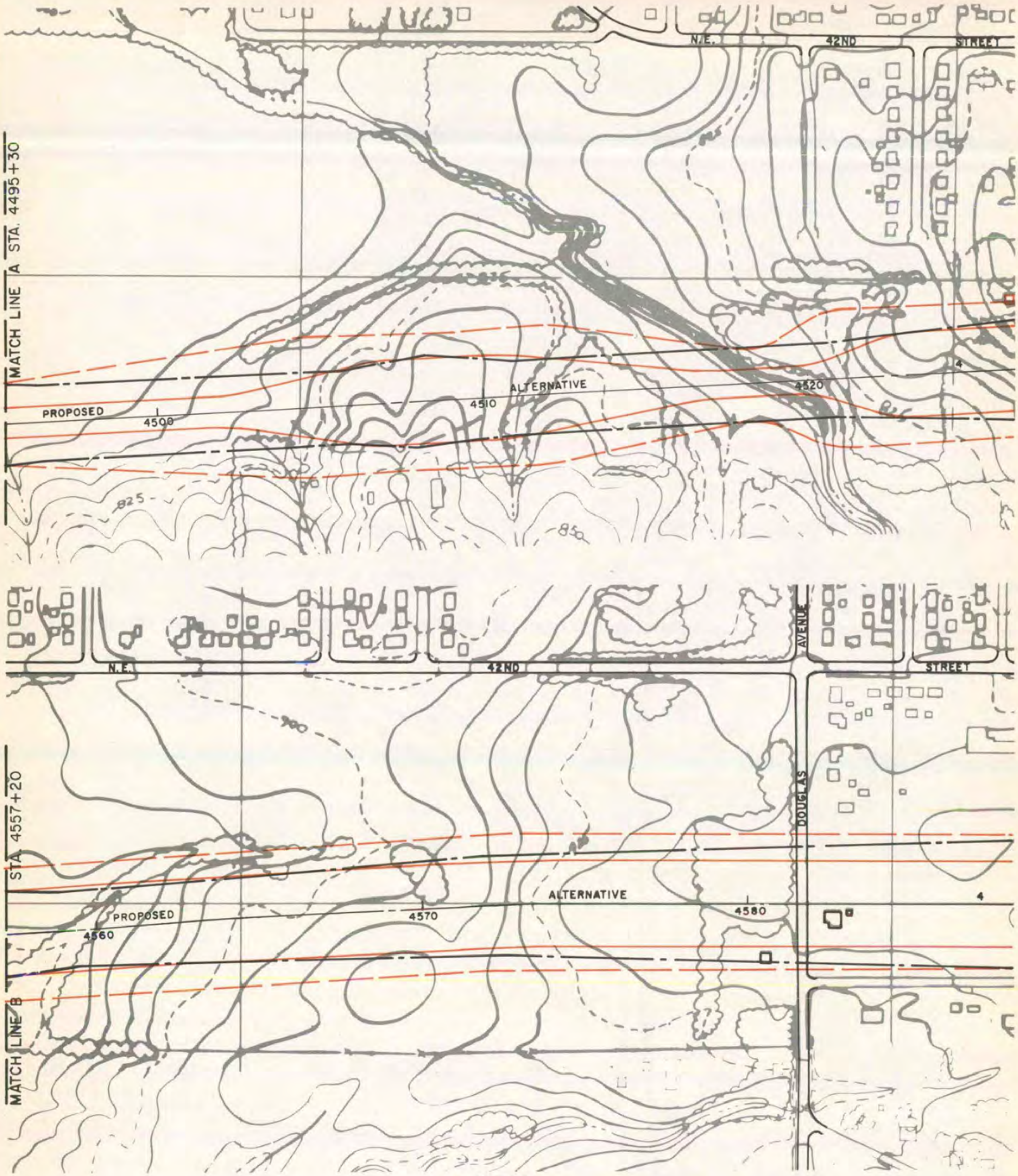


FIGURE IV-6

PREDICTED L_{10} NOISE LEVELS, ALTERNATIVE 4

EDWARDS AND KELCEY, INC.



LEGEND

- PROPOSED R.O.W.
- 70/75 – L_{10}, ALTERNATIVE 4, YEAR 2000
- STRUCTURE WITHIN R.O.W.
- 70/75 – L_{10}, PRESENT CONDITIONS
- NOISE IMPACTED STRUCTURE -PRESENT CONDITION
- NOISE IMPACTED STRUCTURE -ALTERNATIVE 4

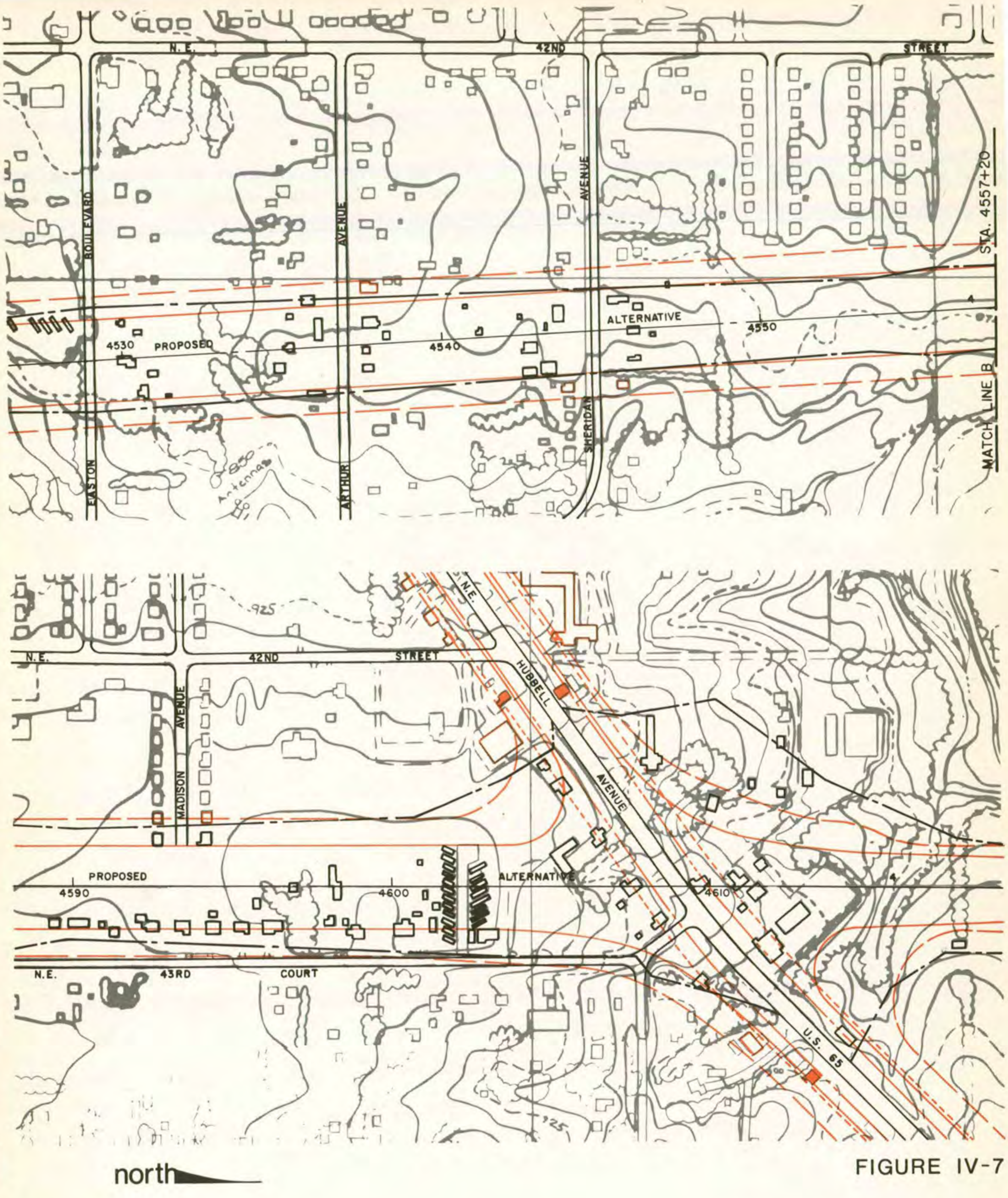


FIGURE IV-7

PREDICTED L_{10} NOISE LEVELS, ALTERNATIVE 4

EDWARDS AND KELCEY, INC.

Under Alternatives 2, 3, 4 and 5, there are some roadway segments along which noise levels would be reduced such that there would be "some positive impact" (-10 to -6 dBA change). The areas adjacent to these roadway segments contain a certain amount of noise sensitive development, and will probably be subject to further development in the future. These roadway segments are:

- Under Alternative 2 - N.E. 56th Street, between U.S. 6 and Hubbell Avenue.
- Under Alternative 3 - N.E. 56th Street, between Easton Boulevard and U.S. 6.
- Under Alternative 4 - N.E. 56th Street, between Easton Boulevard and U.S. 6, and Iowa 46, between Army Post Road and the Des Moines River.
- Under Alternative 5 - N.E. 56th Street, between Easton Boulevard and U.S. 6.

3. *Mitigative Measures*

The anlaysis indicates that the vast majority of noise impact will occur along local streets and roadways and not along the proposed Beltway. This impact will occur in the future whether or not a new Beltway type facility is constructed.

Noise attenuation along local streets and roadways is all but impossible to achieve by presently available means. Any barriers provided would necessarily have numerous openings to allow access to adjacent properties and cross streets. Such openings would render the barrier ineffective as a noise attenuator. It is anticipated that exceptions to FHWA design noise levels will be granted in these areas.

Under Alternatives 2 and 4, as described above, there are cases where sites adjacent to the Beltway itself would be subjected to Design Noise Level impacts. In each of these cases, indications are that an earth berm placed along the right-of-way line for noise attenuation purposes would require removal of the structure from the site.

A preliminary analysis of the required height and length of wall type noise barriers was also made for each of the four impacted sites. For the site impacted under Alternative 2, a 15 foot high wall about 700 feet long would be required to reduce the impact on the single residential site at an estimated cost of $49,000. To reduce impacts under Alternative 4, three separate 5' high walls of 1100', 1200' and 1500' would be required to protect sites with one, two and two residences respectively, at an estimated cost of $114,000 for the three barriers. It is felt that the cost of these noise barriers is very high in relation to the potential benefits.

In view of the above facts, it is anticipated that exceptions to the applicable design noise levels will be granted if either of these alternatives is selected for construction.

E. AIR QUALITY IMPACTS

The Federal Highway Administration, recognizing the interdependency of land use, transportation planning and air quality, has issued guidelines to assure that the planning, location and construction of Federally funded highways are consistent with the approved State Implementation Plan (SIP). These guidelines require the State highway agency responsible for the planning, location and construction of Federal-aid highways to establish a continuing review procedure with that state's air pollution control agency. This review procedure requires, among other things, an assessment of the consistency of transportation plans and programs with the approved State Implementation Plan.

To assist the Iowa Department of Transportation in implementing the FHWA regulations, the Iowa Department of Environmental Quality (DEQ) established "Guidelines of the Department of Environmental Quality for Review of Federally-Funded Highway Projects". These were developed in consultation with the Iowa D.O.T., and were adopted as revised, December 12, 1974, by the Iowa Air Quality Commission. The "Guidelines" contain the procedures to be used by DEQ in evaluating the air quality impact of any project under consideration, including transportation programs, highway plans and construction specifications.

The DEQ guidelines for the review of Urban Transportation Plans and Programs recommend a mathematical air quality analysis be performed for those metropolitan areas within Standard Metropolitan Statistical Areas (SMSA). In 1975, the Iowa D.O.T., Highway Division, completed modeling the Revised Initial 1990 Des Moines Urban Area Transportation Plan (which includes the 500 Beltway), using the APRAC-1A Urban Diffusion Model, and submitted the results to DEQ for evaluation of the plan's consistency with the SIP. Inconsistency of the Des Moines transportation plan could be judged to occur if it increases carbon monoxide concentrations to a level jeopardizing the National Ambient Air Quality Standard for CO. In this case, DEQ, after consultation with the appropriate planning agencies, may suggest additional transportation controls. DEQ has completed its analysis and has concluded that the Transportation Plan is probably consistent with the SIP.

The DEQ quidelines for the review of highway projects include a series of tables showing maximum traffic volumes allowable for different roadway types (2 lane, 4 lane-undivided, 4 lane-divided, etc.) at different average operating speeds. If the traffic volumes anticipated on the proposed projects are below the 1-hour and 8-hour cut-off volumes for the speed anticipated during those averaging periods, the project is considered consistent with the SIP and no further action is required. If the anticipated traffic volumes exceed the guideline volumes, DEQ requires prediction of the air quality impact via mathematical analysis and submittal of a Draft Environmental Impact Statement for their analysis.

To fulfill the DEQ guidelines, all segments of the Traffic Analysis Network for this study (Figure A II-1) were evaluated relative to the DEQ maximums. The traffic volumes for each segments, corresponding to 1-hour and 8-hour averaging periods, were matched with the roadway type and an average operating speed anticipated during those peak periods. The data was then compared to the maximum guideline values for that roadway type and speed (see Table IV-12). The only network segment to equal or exceed the allowable maximums occurs under Alternative

TABLE IV-12

CONSISTENCY OF ALTERNATIVES WITH DEQ AIR QUALITY GUIDELINES

Alternative	Transportation Analysis Network Segment	Roadway Section	YEAR 2000 PEAK VOLUMES 1-Hour Average Operating Speed	1-Hour Vehicles	8-Hour Average Operating Speed	8-Hour Vehicles	DEQ MAXIMUM* 1-Hour Vehicles	DEQ MAXIMUM* 8-Hour Vehicles
1 - "No-build"	I-80, West of Hubbell Road	6 Lane, Divided	50	3,580	50	22,930	5,700	33,170
	I-80, East of Hubbell Road	4 Lane, Divided	50	3,190	50	20,400	5,170	30,060
	U.S. 6, Hubbell to N.E. 56th Street	4 Lane, Divided	30	1,580	30	10,110	3,490	20,320
	IA 163, N.E. 30th Street to N.E. 46th Street	4 Lane, Divided	25	1,940	35	12,420	2,970	17,280
	Army Post Rd., West of IA 46	4 Lane, Divided	50	1,330	50	8,510	5,170	30,060
	Hubbell Road, N.E. 29th to N.E. 46th Street	4 Lane, Divided	30	1,860	35	11,900	3,490	22,690
2 - "Up-grade"	I-80, West of Hubbell Road	6 Lane, Divided	50	3,960	50	25,340	5,700	33,170
	I-80, East of Hubbell Road	4 Lane, Divided	50	3,430	50	21,950	5,170	30,060
	U.S. 6, Hubbell Road to Beltway	4 Lane, Divided	30	1,170	30	10,940	3,490	20,320
	IA 163, N.E. 30th Street to N.E. 46th Street	4 Lane, Divided	25	2,300	35	14,720	2,970	22,690
	Vandalia Drive, IA 46 to Beltway	4 Lane, Undivided	40	1,020	40	6,530	3,960	23,040
	Army Post Road, West of IA 46	4 Lane, Divided	50	1,780	50	11,390	5,170	30,060
	N.E. 46th Street, Douglas Ave. to Hubbell Road	2 Lane	15	1,090	25	6,980	1,520	13,890
	Hubbell Road, N.E. 29th St. to N.E. 46th St.	4 Lane, Divided	30	2,020	35	12,930	3,490	22,690
	Beltway, Rising Sun Drive to IA 163	4 Lane, Divided	50	1,570	50	10,040	5,170	30,060
3 - "Inner Freeway East"	I-80, West of Beltway	6 Lane, Divided	50	4,760	50	30,460	5,700	33,170
	I-80, East of Hubbell Road	4 Lane, Divided	50	4,000	50	25,600	5,170	30,060
	U.S. 6, Hubbell Road to Beltway	4 Lane, Divided	25	2,050	30	13,120	2,970	20,320
	IA 163, N.E. 30th Street to N.E. 46th Street	4 Lane, Divided	25	2,220	35	14,210	2,970	22,690
	Vandalia Dr., West of IA 46	4 Lane, Undivided	30	1,050	35	6,720	3,200	20,780

TABLE IV-12 (CONT.)

Alternative	Transportation Analysis Network Segment	Roadway Section	YEAR 2000 PEAK VOLUMES: 1-Hour Average Operating Speed	1-Hour Vehicles	8-Hour Average Operating Speed	8-Hour Vehicles	DEQ MAXIMUM* 1-Hour Vehicles	DEQ MAXIMUM* 8-Hour Vehicles
	Army Post Road, N.E. 29th Street to N.E. 46th Street	4 Lane, Divided	50	1,210	50	7,740	5,170	30,060
	N.E. 46th Street, Douglas Ave. to Hubbell Road	2 Lane	15	1,210	25	7,170	1,520	13,890
	Hubbell Road, N.E. 29th St. to N.E. 46th St.	4 Lane, Divided	25	2,100	35	13,440	2,970	22,690
	Beltway, IA 163 to Hubbell Road	4 Lane, Divided	50	1,770	50	11,330	5,170	30,060
4 - Inner Freeway West	I-80, Beltway to Hubbell Rd.	6 Lane, Divided	50	4,470	50	28,610	5,700	33,170
	I-80, East of Hubbell Road	4 Lane, Divided	50	3,940	50	25,220	5,170	30,060
	U.S. 6, Hubbell Road to N.E. 56th Street	4 Lane, Divided	25	2,390	30	15,300	2,970	20,320
	IA 163, N.E. 30th St. to Beltway	4 Lane, Divided	10	3,300	20	21,120	1,370	14,170
	Vandalia Dr., West of Beltway	4 Lane, Undivided	30	1,570	35	10,050	3,200	20,780
	Army Post Rd. W. of Beltway	4 Lane, Divided	45	2,070	50	13,250	4,740	30,060
	N.E. 46th St., Douglas Ave. to Hubbell Road	2 Lane	20	920	25	5,890	1,960	13,890
	Hubbell Road, Beltway to N.E. 46th Street	4 Lane, Divided	25	2,950	30	18,880	2,970	20,320
	Beltway, IA 163 to Hubbell Road	4 Lane, Divided	50	2,870	50	18,370	5,170	30,060
5 - Outer Freeway	I-80, West of Hubbell Road	6 Lane, Divided	50	4,180	50	26,750	5,700	33,170
	I-80, East of Beltway	4 Lane, Divided	50	3,580	50	22,910	5,170	30,060
	U.S. 6, Hubbell Road to N.E. 56th Street	4 Lane, Divided	20	1,630	25	10,430	2,440	17,280
	IA 163, N.E. 30th Street to N.E. 46th Street	4 Lane, Divided	20	2,410	25	15,420	2,440	17,280
	Vandalia Drive, N.E. 36th Street to IA 46	4 Lane, Undivided	30	840	35	5,380	3,200	20,780
	Army Post Rd., West of IA 46	4 Lane, Divided	45	1,860	50	11,900	4,740	30,060
	N.E. 46th Street, Douglas Ave. to Hubbell Road	2 Lane	10	1,240	20	7,940	1,100	11,390
	IA 46, Beltway to Army Post Road	4 Lane, Divided	35	1,810	40	11,580	3,900	25,160
	Hubbell Road, N.E. 29th St. to N.E. 46th St.	4 Lane, Divided	30	1,990	35	12,740	3,490	22,690

TABLE IV-12 (CONT.)

			YEAR 2000 PEAK VOLUMES				DEQ MAXIMUM*	
			1-Hour		8-Hour			
Alternative	Transportation Analysis Network Segment	Roadway Section	Average Operating Speed	Vehicles	Average Operating Speed	Vehicles	1-Hour Vehicles	8-Hour Vehicles
	N.E. 36th St., Army Post Road to Vandalia Drive	4 Lane, Undivided	50	890	50	5,696	4,730	27,540
	Beltway, IA 163 to U.S. 6	4 Lane, Divided	50	1,330	50	8,510	5,170	30,060

* Tables I - IV, Guidelines of the Department of Environmental Quality for Review of Federally Funded Highway Projects, revised December 12, 1974.

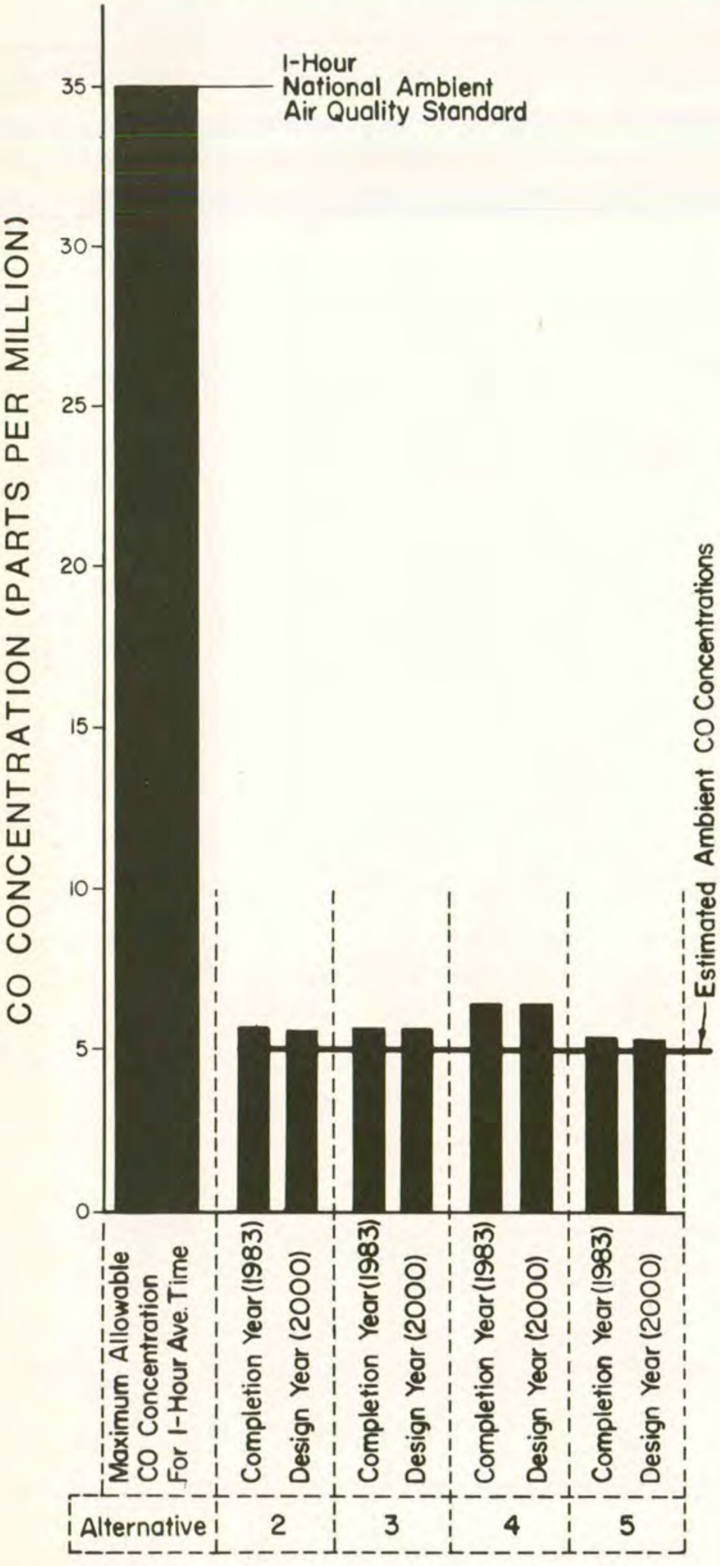
4, and is that section of Iowa 163 (University Avenue)) between E. 30th Street and the Beltway. This segment exceeded DEQ guidelines for both the 1-hour and 8-hour averaging periods. A mathematical analysis for both the 1-hour and 8-hour periods was performed using the "California Line Source Model" at distances of zero (mixing cell), 50, 100 and 150 feet from the roadway. Worst probable meteorological conditions (stability Class F, a wind speed of 2 m.p.h. and a 12.5 degree wind angle) were assumed. The total (ambient plus vehicular emissions) CO concentrations predicted fall below EPA Standards for carbon monoxide during the 1-hour and 8-hour averaging periods at all distances from the roadway, including the mixing cell. The computed CO concentrations for the 1-hour period in the year 2000 range from 25.5 ppm at the roadway to 14.9 ppm at a distance of 150 feet. The 1-hour standard is 35 ppm. The year 2000 8-hour CO concentrations range from 8.3 ppm in the mixing cell to 5.0 ppm at a distance of 150 feet. The 8-hour standard is 9 ppm. The standards (Table B VII-1) and the predicted CO concentrations (Figure IV-8) for the years 1983 and 2000 are discussed in Appendix VII of this report.

For comparative purposes carbon monoxide concentrations were also estimated using the California Line Source model for all alternatives. Worst probable meteorological conditions were assumed. The results are summarized in Figure IV-8 and show the most severe CO concentration computed for any segments of the alternative indicated. The highest predicted concentration (Alternative 4, 6.5 ppm, 1-hour and 3.4 ppm, 8-hour, in the design year) fall far below allowable maximums, and are only slightly higher than the assumed ambient concentrations. (See Appendix VIII, Section D 3)

A meso-scale, or burden, analysis for carbon monoxide (CO), Hydrocarbon (HC) and Nitrogen Oxides (NO_x) is also required. Estimated Carbon Monoxide, Hydrocarbon and Nitrogen Oxide pollutant burdens for the estimated year of completion (1983) and for the design year (2000) traffic levels on the study corridor major street network under each of the alternatives are shown in Table IV-13. Burden estimates are shown separately for Beltway traffic and for travel on other roads in the Traffic Analysis Network. Total pollutant burdens for Alternative 1 - 4 also include a non-corridor adjustment for a lower overall tripmaking level in the study corridor which would be off-set by added trips and resultant pollution burden elsewhere in the metropolitan area. (See Appendix II, Section C) Thus, the adjusted burden total reflects the equalized or overall impact of each alternative on the metropolitan air basin. Estimated existing (1975) burdens are also shown for comparison. A description of the pollutants, their effect on public health and welfare and the procedures used to calculate the concentrations and burden levels are included in Appendix VII of this report.

As shown in Table IV-13, the emission burden summary reveals only minor differences between the years 1983 and 2000. By the year 2000, emission control standards and an increase in overall travel speed in the corridor will reduce CO emissions 55 to 60 percent relative to existing conditions despite the significant growth in corridor traffic under any of the alternatives. The estimated carbon monoxide burden for all "Build" alternatives are greater than Alternative 1, the "No-build" alternative. This is primarily due to the higher traffic volumes under the "Build" alternatives and the resulting increase in traffic and congestion on the existing connecting roadways. The increase in

CARBON MONOXIDE CONCENTRATIONS
"BUILD" ALTERNATIVES 2,3,4 AND 5



Carbon monoxide concentrations were predicted for each segment of the Transportation Analysis Network. The values shown are the highest carbon monoxide concentrations predicted for each Alternative under the worst probable meteorological conditions. Peak 1-hour and 8-hour predicted concentrations for each alternative were contributed by vehicles using that roadway, and include estimated ambient concentrations within the study corridor.

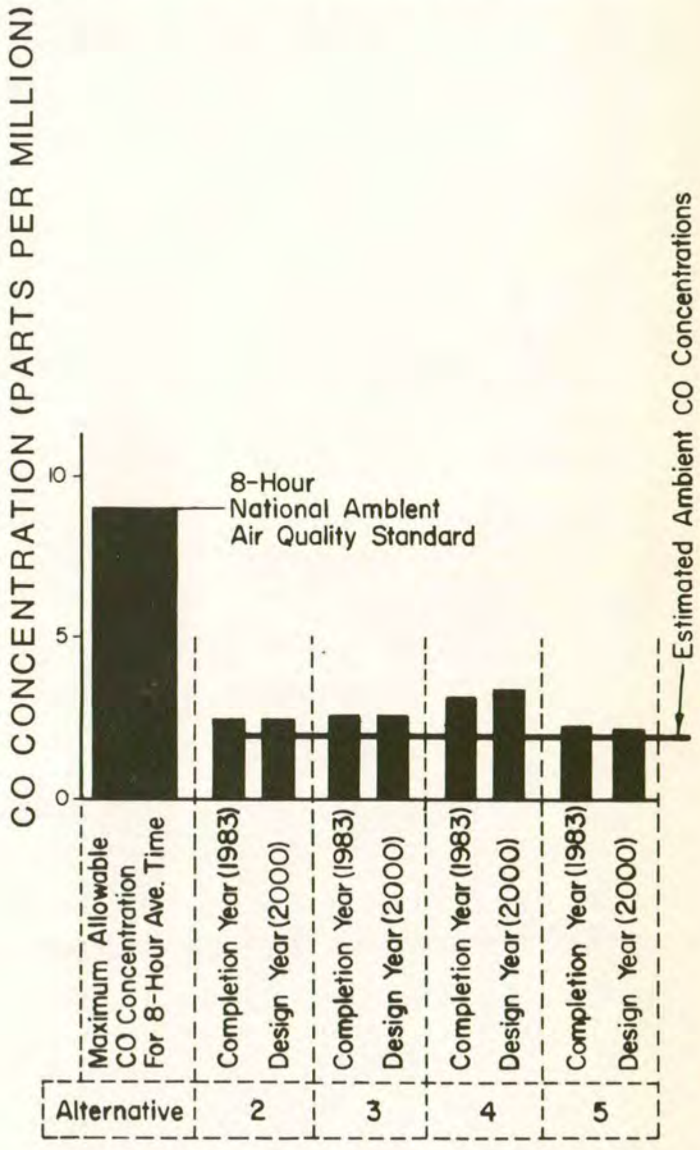


FIGURE IV-8

MICRO-SCALE PREDICTED AIR ANALYSIS: YEAR 1983 AND 2000

TABLE IV-13

AREA WIDE (MESO SCALE)

AIR POLLUTANT BURDEN ANALYSIS

ALTERNATIVE	1983 CO (TON/YR)	1983 HC (TON/YR)	1983 NO_X (TON/YR)	2000 CO (TON/YR)	2000 HC (TON/YR)	2000 NO_X (TON/YR)
1. NO BUILD						
Other	1658.2	391.8	588.4	1755.7	448.8	787.4
Non-corridor Adj.	276.7	63.0	77.8	244.0	51.8	97.6
TOTAL	1934.9	454.8	666.2	1999.7	500.6	885.0
2. UPGRADING						
Beltway	195.6	59.5	99.3	175.0	48.6	124.7
Other	1670.6	436.1	579.5	1783.8	344.1	769.0
SUBTOTAL	1866.2	495.6	678.8	1958.8	392.7	893.7
Non-Corridor Adj.	150.2	34.2	42.2	132.4	28.1	53.0
TOTAL	2016.4	529.8	721.0	2091.2	420.8	946.7
3. INNER FREEWAY EAST						
Beltway	275.5	86.4	145.2	259.7	72.9	188.2
Other	1728.7	401.6	610.0	1833.5	361.2	816.9
SUBTOTAL	2004.2	488.0	755.2	2093.2	434.1	1005.1
Non-Corridor	39.5	9.0	11.1	34.9	7.4	14.0
TOTAL	2043.7	497.0	766.3	2128.1	441.5	1019.1
4. INNER FREEWAY WEST						
Beltway	496.0	145.2	260.0	435.0	127.2	352.1
Other	1711.5	400.4	608.1	1833.7	359.1	818.8
SUBTOTAL	2077.5	545.6	868.1	2268.7	486.3	1170.9
Non-Corridor	79.1	18.0	22.2	69.7	14.8	27.9
TOTAL	2286.6	563.6	890.3	2338.4	501.1	1198.8
5. OUTER FREEWAY						
Beltway	160.6	60.2	79.1	114.4	44.7	66.9
Other	1845.8	432.2	653.8	1965.3	387.0	876.9
SUBTOTAL	2006.4	492.4	732.9	2079.7	431.7	943.8
Non-Corridor	-	-	-	-	-	-
TOTAL	2006.4	492.4	732.9	2079.7	431.7	943.8

ALTERNATIVE	1975 CO (TON/YR)	1975 HC (TON/YR)	1975 NO_X (TON/YR)
1. EXISTING	4981.3	909.3	907.0

CO burden due to non-corridor traffic is highest under the "No-build" alternative, varying from twice to almost seven times that found under the "Build" alternatives. Thus, CO concentrations elsewhere in the metropolitan area would tend to be higher under Alternative 1 than under any of the "Build" alternatives.

In the design year, the emission control standards and increase in overall corridor travel speed will result in a 45-55 percent reduction in the overall hydrocarbon burden, relative to existing conditions. Alternative 2, the "Upgrading" alternative, has the lowest HC burden, due chiefly to lower traffic volumes. Alternative 4 produces the highest burden, again due to the higher traffic volumes and resulting congestion on the connecting roadway network. The non-corridor adjustment is highest under the "No-build" alternative, indicating higher HC levels occurring elsewhere in the Des Moines area. The total HC burden varies only slightly between alternatives; the difference in burden levels for all alternatives is about three percent.

Unlike carbon monoxide and hydrocarbon emissions which decrease with increasing speed, oxides of nitrogen (NO_x) emissions increase with increasing speed. Thus, all of the alternatives result in an increase in overall NO_x burdens over existing conditions ranging from 4 to 32 percent. Alternative 4 produces the highest NO_x burden, due to the high volume of high speed traffic forecast, while Alternatives 2 and 5 produce the lowest burden of the "Build" alternatives. Alternative 1 again produces the highest burden increase due to non-corridor traffic.

In summary, Alternative 1, the "No-build" alternative, results in the lowest overall pollutants burden, although a higher percentage of that burden will occur elsewhere in the Des Moines metropolitan area and may cause locally high pollutant concentrations in areas of high congestion. Alternative 5, the "Outer Freeway" has the lowest pollutant emissions from the Beltway itself, although it also has the highest burden due to travel on local streets within the corridor. Alternative 4, the "Inner Freeway-West", produces the highest burdens computed for the Beltway portion of the traffic analysis network. This is due to the high forecast traffic volumes and resulting congestion. The impact of Alternatives 2 and 3, "Upgrading" and "Inner Freeway-East", respectively, are similar. Alternative 2 produces lower pollutant levels on the Beltway and existing corridor street network, while Alternative 3 results in a lower non-corridor adjustment. All alternatives are consistent with all Federal and State Air Quality requirements for highways, and none of the alignments will result in a significant degredation of existing air quality within the study corridor air basin.

F. WATER QUALITY AND AQUATIC LIFE

This section of the report summarizes the impact of the proposed alternatives on water quality and aquatic life. A detailed discussion of impact upon water quality is contained in Appendix VIII of this report.

1. *Impact of the Proposed Action*

The impacts of the proposed action are discussed in three parts:

- Stream Modification and Flood Hazard Evaluation.

- Effects of Filling Within the Des Moines River Flood Plain.

- Impact on Water Quality and Aquatic Life.

Stream Modification and Flood Hazard Evaluation - Impacts due to stream modification may occur on East Four Mile Creek under Alternative 3. As Alternative 3 passes through the area of N.E. 27th Avenue, the alignment crosses East Four Mile Creek twice. The proposed alternative to these crossings involves realignment of East Four Mile Creek along the west side of the Beltway. The realignment would reduce a 1500 foot reach of the existing channel to 900 feet (a reduction of 40 percent). At this point, East Four Mile Creek drains an area of 8.23 square miles. Approval of the stream relocation by the Iowa Natural Resources Council would not be required because the area drained is less than 10 square miles. (1)

Flood hazards have been considered in the design studies for each alternative. A description of the findings is contained in Appendix IV, Section D of this report. All bridge configurations were designed to pass the Intermediate Regional Flood within the backwater limitations specified by the Iowa Natural Resources Council.

Effects of Filling Within the Des Moines River Flood Plain - A special construction impact could result from the large embankment that is required to cross the Des Moines River flood plain. Alternatives 2 and 3 will require a 15,000 foot crossing. The crossings for Alternative 4 and 5 will be 12,000 and 10,000 feet long, respectively. The embankments will average 15 to 25 feet high with a short section nearly 70 feet high in the bluff area at the north side of the flood plain on Alternative 5. Elsewhere on the alignments, eroded soil from embankments has not been considered a major pollutant, since vegetative buffer strips will trap most of the soil before it reaches streams. On the flood plain, any soil that is trapped at the base of an embankment could be swept into the river during a flood. If a flood occurred during construction, additional soil could be eroded from the embankment where armoring or stabilization is not complete.

Impact on Water Quality and Aquatic Life - The primary impacts of the proposed project will originate from two sources: (1) the temporary increase in sediment load due to the effect of rain on bare soil exposed during construction and the long-term increase in sediment load due to drainage modification and the resultant channel scour, and (2) from the dispersion of traffic-related chemicals and deicing chemicals employed in the maintenance of ice-free roads during the winter season.

- Sedimentation - The creeks in the study corridor and the Des Moines River carry a heavy sediment load during times of heavy runoff; in spite of this, aquatic life continues to exist and survive in these conditions. The impact of increased sediment on aquatic life in the Des Moines River will be minimal because of the dilution effect provided by the large river flows, and because the aquatic organisms which exist there have adapted themselves over a period of many hundreds of years to survive in sediment-laden prairie streams.

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(1) Iowa Natural Resources Council Rules, Chapter 4.2(2), July 20, 1973.

The problems encountered by aquatic organisms in Mud Creek and Spring Creek are somewhat different. The drainage basin of each of these two creeks is less than 100 square miles; this means that they are intermittent streams and will occasionally run dry. During storm events, when increasing volumes of water are carrying the shock load of sediment, these organisms are only slightly affected because they are not active. Most of the organisms in intermittent stream beds will not respond until well after a storm has been initiated. Thus the sediment shock load may have passed before the organisms return to a vulnerable form. Only Alternative 5 will have an effect on Spring and Mud Creeks.

Four Mile Creek is the stream most likely to be adversely affected by the increased sediment movement and resultant turbidity. This is because the drainage basin is large enough that it is unlikely to run completely dry, and the flora and fauna that would persist from season to season would be a typical stream biota. A typical stream biota is more susceptible to the effects of turbidity than the biota of an intermittent stream for the reasons stated previously. On the other hand, the basin is much smaller than the Des Moines River basin, and the dilution effect will not be as great as found in the larger river.

Alternative 4 would cause the greatest impact on Four Mile Creek while Alternatives 2 and 3 would have a similar, but lesser, impact.

The impact resulting from the increased turbidity due to the proposed project is expected to be temporary. No permanent alteration of benthic fauna is anticipated as a result of the proposed project, nor is it expected that temporary increased sediment loads will have any adverse effect on fishes, amphibians and reptiles indigenous to the creeks and the Des Moines River.

- Traffic Related Chemicals - The second most significant impact that the proposed project could have on water quality will result from deicing practices. The deicing chemicals, principally sodium chloride, applied to winter road surfaces to maintain ice-free roadways, are not only significant pollutants in water but serve as significant contributors to highway and vehicle deterioration as well. Salt is readily dissolved in the precipitation that falls during the months when it is applied and this salt solution is either splashed onto the shoulders and penetrates into the soil, or it finds its way into a nearby surface water course. Calculations indicate that the chloride concentration of roadway runoff which enters directly into the streams adjacent to the proposed alternatives will range from 350 to 500 mg/l. While many small crustacea and other fish-food organisms, as well as fish fry, are immobilized by chloride concentrations above 3,100 mg/l (McKee and Wolf, 1963), it appears that most fresh water organisms can survive in water with a chloride concentration of 2,000 mg/l or less. Thus, the expected chloride concentrations from deicing practices of the Iowa Department of Transportation on the proposed alternatives will have little or no ecological impact on the aquatic organisms of the creeks or the Des Moines River.

Groundwater is a resource of some importance in the study corridor. It is the primary source of water for both individual and municipal/industrial systems. The greatest groundwater resources are from several hundred to several thousand feet below the surface, and are too deep to be impacted by the proposed action. However, there may be shallow wells serving individual homes near all of the alternatives. Though near-surface groundwater is not a widespread resource of great importance, it will be vulnerable to impacts from the highway. Highway salts or spill pollutants could contaminate a nearby aquifer, making the water unusable. This would be a long-term impact and might be unnoticed for many years. Highway cuts that intersect the water table can drain away groundwater and have a drastic effect on small local aquifers.

The potential for localized groundwater contamination and water table alteration exist on all of the "Build" alternatives.

A comparison of anticipated impacts from all alternatives is shown in Table IV-14.

2. Measures to Mitigate Impacts

Standard erosion control practices can reduce potential turbidity and sedimentation impacts by up to 90 percent. If an extra effort is made, it should be possible to increase the efficiency of erosion control. A five percent increase in effectiveness would reduce impact quantities by one-half.

Several control measures can be used in tandem to eliminate construction sediment impacts from road cuts. For example, erosion at a road cut can be retarded by the use of fiber or asphalt mulch which is about 90 percent effective. The runoff from the cut can then be routed through a sediment basin which, as a practical matter of design, will be about 70 percent effective. This combination would result in a drastic reduction in sediment impact on area streams.

Construction within the flood plain of the Des Moines River and Four Mile Creek poses a special problem. Every effort should be made to complete embankment construction and slope protection during periods of low flood potential. Any construction or excavation below the water line in the river should be done within sediment containment structures.

The impacts of highway drainage on local stream flow can be reduced in a number of ways. Often the discharge for a long cut section can be daylighted to several small tributaries instead of to a single point in a stream. This allows the tributaries to fulfill their natural role of storage and to delay concentration time. The drainage from some cut sections can be made to pass over infiltration beds of crushed stone, reducing the flow to the receiving stream. At the sites of major runoff concentrations, retarding basins can be built.

There is little that can be done to mitigate impacts from highway deicing salts. Economics and the national commitment to bare surface roads leave no alternatives to road salting. Stringent controls on salting to ensure the minimum application necessary is the best effort to reduce salting impacts. At

TABLE IV-14

COMPARATIVE

WATER QUALITY IMPACTS

Alternative	Total Potential (Tons) Sediment Release (Annual) Tons/Year	Potential Sediment (Tons) Release Per Acre (Annual) Ton/Yr./Acre	Potential Annual Sediment Release Compared To Stream Size (Q5) Ton/Year/cfs	Average Sediment Increase In Receiving Streams From Selected Cut Sections 5 Year Event mg/l	Drainage Length From Cut Sections Compared To Stream Size (Q5) ft/cfs	Runoff From Selected Cut Sections Compared to Q5 Of Receiving Stream 5 Year Event cfs/cfs	Total Annual Salt Discharge From Entire Roadway Tons/Season	Average Salt Discharge From Cuts Compared To Receiving Stream Sz.(Q5) Tons/Year/cfs
1				NONE				
2	1606	3.50	.65	8532	23.5	.523	146.9	.072
3	3434	6.95	2.43	11415	35.4	.448	171.2	.102
4	3957	9.97	5.69	11239	51.1	.446	166.4	.152
5	4376	7.20	2.09	9963	28.9	.426	201.0	.091

specific sites there may be local environmental resources which must be protected. Examples would be a nearby shallow well, farm pond, or small stream. The highway runoff can be released at some point down gradient from the well or pond, or directed to a larger stream where dilution will reduce the impact to stream life.

G. VEGETATION AND WILDLIFE

The vegetation within the study corridor has been highly modified by human activity during the past 150 years. Remnants of the original tall grass prairie which once covered most of the level and gently rolling land prior to settlement, are to be found today only in two or three narrow strips in railroad rights-of-way. Bottomland forest is gone except for recent establishment of young trees along protected loops of the Des Moines River above severe flooding levels of the Red Rock flood pool. Upland forests of young trees have probably expanded since settlement into sloping land which might have been prairie at one time. Today these upland forests are the predominant feature of the natural landscape especially in the upland slopes north of the Des Moines River; however, they are often heavily grazed by cattle and horses, distracting from their value as wildlife habitat. Agricultural uses prevail on most of the remaining land.

Expanding residential development has a kind of "uniformity" effect on this contrasting forest-agricultural landscape. Where there are dense trees, clearing is done to provide room for buildings, gardens, lawns, etc., and where there are cultivated fields, planting of trees and shrubs is done to provide shade, windbreaks and beauty. The chopping up of the forest in small pieces and the establishing of trees in former pastures and fields would continue whether or not any of the five alternatives are chosen. However, with development of the proposed Beltway 500, the pace of residential and industrial construction in the area would undoubtedly increase.

Alternatives 2 and 3 are similar in their impact on vegetation and wildlife habitat over much of their length. From Avon northward, both interrupt vegetation corridors (see Figure III-11) along the Chicago Rock Island and Pacific Railroad, but since Alternative 2 follows the existing Iowa 46, its effect at this point would be less disruptive. Crossing the Des Moines River flood plain near the power generation plant, Alternative 2 again is less disruptive through this young flood plain vegetation. Proceeding northward through Carbondale both routes cross open agricultural land until the forested residential land along the Chicago, Rock Island and Pacific Railroad north of Iowa 163 is encountered. Here again Alternative 2 follows an already established roadway (N.E. 56th Street) while Alternative 3 crosses three forest corridors, limiting the movement of deer and other wildlife between the agricultural fields and stringers to the east, and the more mature upland forest to the west along the railroad rights-of-way. Of the two, Alternative 2 would have less impact on vegetation and the movement of wildlife than Alternative 3.

Alternative 4 skirts immature upland forest as it proceeds northward from Army Post Road. It crosses recent flood plain forest near Hubbell Park, with little consequence as far as the loss of valuable vegetation and wildlife habitat is concerned. Continuing northward, Alternative 4 intercepts vegetation corridors at the point where Four Mile Creek passes under (1) the Chicago, Rock Island and Pacific Railroad and Scott Avenue, (2) Iowa 163 (3) at a stringer along N.E. 23rd Avenue, and (4) at stringers along N.E. 46th Avenue (U.S. 6). These four crossings could effectively close access for deer and other wildlife from the wooded areas which follow East and West Four Mile Creek, and the wooded areas north and west of Pleasant Hill to the large areas of agricultural and young bottomland forest along the Des Moines River. Adverse environmental effects could be reduced by providing adequate underpasses for the movement of deer and other wildlife species at these critical points. It appears that adequate provision for wildlife movement can probably be made at all locations mentioned except where Alternative 4 crosses the stringer in the vicinity of N.E. 23rd Avenue. Here, the proposed freeway would be in deep cut and an underpass would not be feasible.

Alternative 5 passes through immature upland forest east of Avon. Proceeding northeastward, the alignment encounters agricultural areas and the immature bottomland forest of the Des Moines River. North of Vandalia Drive, Alternative 5 intersects stringers along Spring Creek and Mud Creek, and one strip of prairie along the Chicago, Rock Island and Pacific Railroad near Altoona. With the exception of the crossings of Mud Creek and the railroad right-of-way east of Altoona, the consequence of cutting through wildlife habitat corridors appears minimal.

The S.E. 36th Street/East Diagonal Road alignment proposed under Alternative 1 and 5 would have impacts similar to those described for Alternative 4.

Alternative 4 crosses more critical corridors of vegetation than either Alternative 2 or 5 and possibly Alternative 3. Because of its position further downstream than any of the others, Alternative 5 would interfere more with management of waterfowl habitat in the Army Corps of Engineers easement land in the Des Moines River flood plain. All alternatives would have minor impact on vegetation, as compared to the previous impacts of land use and construction. Based on vegetation considerations alone, Alternative 2 would have less impact than Alternative 3, 4, or 5, mainly because it follows existing roadways more closely. The Iowa Conservation Commission has indicated a preference for Alternative 2 because it minimizes the loss of wildlife habitat.

The impact on unique, endangered or otherwise important plant and animal species is minimal. Streams, forests, prairies, and river flood plains have been greatly altered over the past 150 years of human activity in this area. Endangered species are not known to occur in the area nor are there habitats in which they would be expected to be found. None of the alternatives, therefore, would be favored above another as far as unique or endangered species are concerned.

H. PARKS, RECREATIONAL FACILITIES, HISTORICAL AND CULTURAL FEATURES

None of the alternatives will take land from any publicly owned park, recreation area, wildlife or waterfowl refuge or historic site having national, state, or local significance wherein 4(f) land is involved. All alternatives, however, will have some effect on recreational, historical or cultural features of the corridor (see Figures III-6 and III-7).

1. Parks

None of the alternatives will have direct impact on existing or planned parks. Alternative 4 will abut the west end of Hubbell Park south of the Des Moines River. Hubbell Park is designated for use by recreational vehicles. In view of the type of use for which the park is intended, impact from the proposed freeway can be expected to be minimal.

Alternative 5 will pass close to the newly acquired county park at Woodland Hills. This park is designated for hiking, picnicking and nature study. Some visual impact can be expected. A general increase in noise levels can be expected but levels in excess of FHWA criteria are not anticipated.

All of the "Build" Alternatives would provide improved regional access to the major parks within and adjacent to the study corridor and, with the proposed Freeway 592 from Knoxville, to the Lake Red Rock Recreational Area to the southeast.

2. Recreational Facilities

Of all the alternatives, Alternative 4 will have the greatest impact upon study corridor recreational facilities. Alternative 4 infringes upon lands designated for "natural preservation" in the Des Moines Southeast Riverfront Development Plan. A new Des Moines river crossing, at the approximate site of the proposed Alternative 4 crossing, is, however, provided for in the Plan. The highway would also cross the east end of White's Lake in the proposed private recreational area located just north of the river.

Further to the north, Alternative 4 passes through the Four Mile Creek valley corridor designated for preservation in the 1972 ROSS plan (see Section III B 4). Noise and visual impacts from the highway can be expected. On the other hand, construction of the highway could serve as a vehicle for assisting local jurisdictions in acquiring adjacent open space for preservation and recreational development. (See Section IV B) Careful attention to proper landscaping and other aesthetic treatments during design can minimize visual impact.

The proposed S.E. 36th Street/East Diagonal Road alignment which is included in Alternatives 1 and 5, would have an impact similar to that described in Alternative 4 in the area between the Des Moines River and Iowa 163.

Joint development of adjacent natural areas for recreational purposes is also possible under Alternative 2 and 3 as was explained in greater detail in Section IV B.

All of the alternatives would provide improved regional access to the Iowa State Fairgrounds, and to the privately owned Adventureland Park near Altoona.

3. Historic/Archaelogical and Cultural Features

None of the alternatives will have any direct impact upon identified historic/archaeological or major cultural features. Preliminary field surveys indicate the possible existence of archaeological sites on the river bluffs in the vicinity of Alternative 5. Provision should be made in the construction contract to provide for professional excavation of these sites if any are encountered during construction.

Historic sites FM3 and CL17 (see Figures III-7 and IV-9) are located adjacent to Alternative 5. Site AL1 is adjacent to Alternatives 2 and 3. If any of these alternatives are selected for construction, provision should be made, in cooperation with the State Historical Department, to preclude disturbance of these sites during construction.

A number of churches lie close to the proposed alignments for Alternative 2, 3, 4 and 5. The Avon Community Church, near the intersection of Iowa 5 and Iowa 6 (Alt. 3), the Carbondale Evangelical Church (Alt. 2 & 3) and the Hope Lutheran Church, the Calvary Lutheran Church for the Deaf, the Foursquare Evangelical Church and the Eastside Evangelical Free Church, all located along E. 42nd Street just south of Hubbell Avenue (Alt. 4) will be subjected to an increase in ambient noise levels. Noise levels at these sites, however, will be below FHWA prescribed levels for category B land use (see Section IV D).

I. AESTHETICS AND VISUAL QUALITY

1. General Considerations

The consideration of aesthetics and the visual effects that a highway might create is an integral part of any location study and environmental assessment. The evaluation of aesthetic value is complicated by the fact that aesthetic judgements are largely subjective. What is visually pleasing to one individual may not be so to another. While reaction to specific features might vary, recent studies(1) have shown that in general, motorists prefer trees, plantings and a park-like appearance along highways, and that attitudes toward farmland as roadside scenery are favorable.

In evaluating aesthetic quality there are two levels which must be examined. One level involves the treatment of the roadway itself and the design of roadway appurtenances and landscaping. Since similar treatments of roadway elements and close-in roadside details can be applied to all alternatives, this level of aesthetic quality was not considered in the evaluation.

The second level, and the one upon which an evaluation can be based, deals with the larger scale consideration of how well the highway blends with the terrain and to what extent its location takes advantage of and complements the natural scenic amenities and planned open space areas of the corridor. The view from the road, the view of the road and the compatibility of the highway with local comprehensive open space planning were considered.

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(1) Economic Analysis of Roadside Beautification and Recreational Development. M. Baker, A.P. Reiners, and L.M. Hammer. Department of Agricultural Economics, University of Nebraska (Lincoln, N.E. 68503), Res. Study 66-5, July, 1973.

STRUCTURE AL1:

EARLY FRAME SCHOOL HOUSE

STRUCTURE FM3:

TWO STORY FRAME HOUSE, GREEK REVIVAL MOTIF

STRUCTURE CL17:

EARLY EXAMPLE OF TWO STORY CONCRETE BLOCK HOME CONSTRUCTION

FIGURE IV-9

SOURCE: DIVISION OF HISTORIC PRESERVATION, STATE HISTORICAL DEPARTMENT OF IOWA

SELECTED NATIONAL REGISTER POTENTIAL HISTORIC-ARCHITECTURAL SITES

EDWARDS AND KELCEY INC.

POTENTIAL REST AREA WITH URBAN VIEW OF DES MOINES
4
HIGHWAY BRIDGE OVER WHITES LAKE WILL IMPAIR VIEWS OF LAKE FROM PROPOSED RECREATION AREA.
HIGHWAY THROUGH PROPOSED CONSERVATION AREA. NOISE, REMOVAL OF VALUABLE TREE COVER. HIGHWAY BRIDGE OVER RIVER COULD IMPAIR VIEWS FROM CONSERVATION AREA.
PROPOSED RECREATION - CONSERVATION AREA
ARMY POST ROAD
HUBBELL PARK
BRIDGE CROSSING IN INDUSTRIAL AREA WOULD NOT DESTROY EXISTING WOODS NOR RUIN VIEWS OF RIVER
POTENTIAL REST AREA WITH URBAN VIEW OF DES MOINES.
2
VIEW OF TRANSMISSION LINES MIGHT BE OFFENSIVE.
IOWA 46
HIGHWAY THROUGH FOUR MILE CREEK FLOOD PLAIN WILL REDUCE IT'S RECREATION POTENTIAL WITH NOISE AND VISUAL POLLUTION.
3
PLEASANT HILL BLVD
POTENTIAL REST AREA WITH URBAN VIEW OF DES MOINES.
BRIDGE CROSSING IN INDUSTRIAL AREA WOULD NOT DESTROY EXISTING WOODS NOR RUIN VIEWS OF RIVER.
GRAIN ELEVATOR ACTS AS FOCAL POINT IN FLOOD PLAIN CROSSING.
VANDALIA DR.
5
STRONG POTENTIAL FOR JOINT OPEN SPACE DEVELOPMENT.
SUN DR.
HIGHWAY THROUGH STEEP SLOPES WOULD REMOVE TREE COVER AND WOULD INFRINGE UPON NATURAL AREA SUITABLE FOR RECREATION.
RISING
POTENTIAL REST AREA WITH VIEWS OF RIVER VALLEY
FUTURE
COUNTY
PARK
S.E. 6TH AVE.
COUNTY
PARK
72ND ST.
LEGEND
NEGATIVE IMPACT
POSITIVE IMPACT
north
2000
0
2000
4000
6000
SCALE
IN
FEET

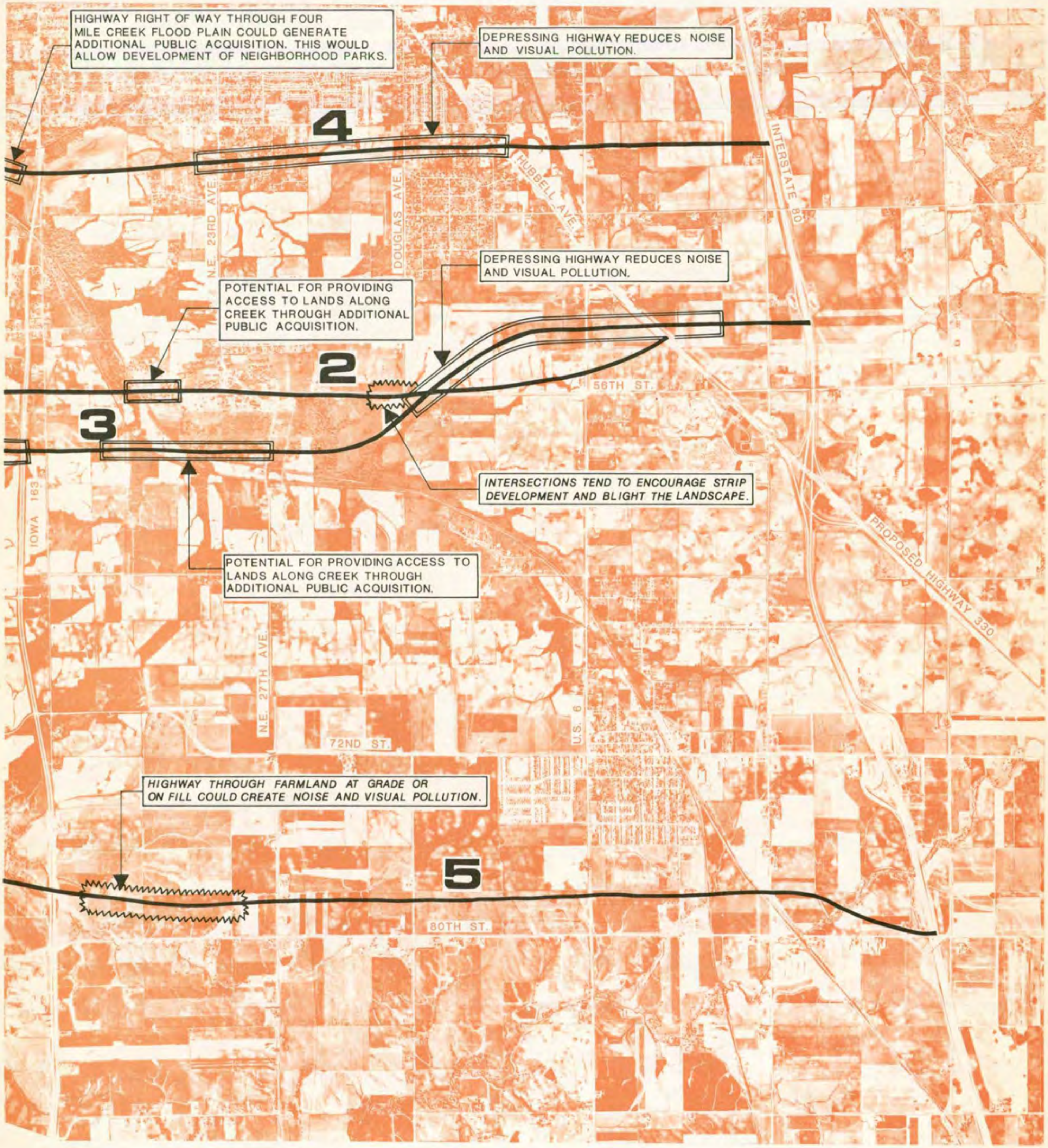


FIGURE IV-10

AESTHETIC IMPACTS

2. Overall Impact

The major natural features of the study corridor consist of scattered woodlands, the Des Moines River and Four Mile Creek and the relatively steep bluff lines adjacent to those waterways. (Figure III-10 and III-11). The remainder of the rural portion of the corridor consists primarily of flat to gently rolling farmlands. Numerous manmade features such as residential, industrial and commercial developments, golf courses and farm ponds provide variety and contrast within the natural scene. The majority of these large scale corridor features are objects or groups of objects which are best viewed at a distance and which are compatible with the high-speed, high-mobility highway from which they would be viewed.

In general, Alternatives 2, 3 and 4 traverse more varied terrain and would provide a greater variety of viewing opportunities to the motorist than would Alternative 5. Conversely, the presence of a high mobility highway within the developed areas of Pleasant Hill and Capitol Heights (Alternatives 2, 3 and 4) and immediately adjacent to the proposed Whites Lake recreation area (Alternative 4) would likely be less desirable to the off-road viewer than would the presence of Alternative 5 in the open farmlands to the east.

Opportunities for views and for the development of rest or overlook areas occur on all Alternatives. Potential aesthetic impacts are shown in Figure IV-10.

3. Special Consideration

The adverse effects of a highway within a developed area can be significantly reduced through proper coordination with local open space planning. Opportunities for joint development occur at several locations along the alignments as shown in Figure IV-10. Two examples, one on Alternative 3 and one on Alternative 4, were discussed in Section IV B of this report.

4. Evaluation of Scenic Features

An analysis of aesthetics and visual quality for each alternative was done using a technique developed by Edwards and Kelcey in a 1972 study - Highway Planning Studies - Upper Great Lakes Region - for the Upper Great Lakes Regional Commission. The technique is explained in detail in Report Volume 4 "General Findings and Applications."

The technique involves the evaluation of scenic features using a composite rating system which considers the number of objects in a scene, the visual quality of the objects, the directions of travel from which the scene is viewable, the angle of viewing from the direction of travel, and the viewing time.

A "score" was calculated for each alternative using this method of analysis, and a comparative rating was derived directly from these "scores" for purposes of comparison.

The results of the rating process are discussed in Section V C of this report.

SECTION V

COMPARATIVE ANALYSIS OF ECONOMIC AND ENVIRONMENTAL COSTS AND BENEFITS

A. ENGINEERING ECONOMICS

All study alternatives have been designed to conform to accepted engineering standards. There are, however, significant differences between design speeds and applicable standards for the "Upgrading" alternative, (Alternative 2) and the Freeway type alternatives. (Alternative 3, 4 and 5) The effect of these differences is felt primarily in the level of traffic service and the level of safety which is provided on each type of roadway and, therefore, these differences have been considered under Traffic Service.

Differences in the engineering characteristics of alternatives are reflected primarily in the capital costs of constructing each, and in operating costs and benefits to highway users.

1. Capital Costs

The total capital cost of construction includes the cost of right-of-way acquisition as well as the actual cost of construction itself. A detailed estimate of construction and right-of-way costs for each alternative is shown in Table V-1.

Construction costs were computed on the basis of estimating work item quantities and applying unit prices supplied by the Highway Division, Iowa Department of Transportation. Costs shown are based on 1976 price levels. Bridge and drainage structures were estimated separately. Construction costs shown for all alternatives include the cost of upgrading or extending local roadways as called for in the Revised Initial Des Moines Urbanized Area Transportation Plan (Figure II-3) and as shown on Figures V-1 through V-5. This includes the cost of the S.W. 36th Street/East Diagonal Road alignment under Alternatives 1 and 5. Right-of-way cost estimates include the cost of takings, severances, relocation assistance, and administrative overhead.

2. Engineering Economy

Engineering economy is a measure of the relative economy of the alternatives over the life of the project. It is calculated in terms of the average annual costs and benefits associated with each alternative, which are a function of (1) the amortized annual capital cost of the project over its expected lifetime, (2) the annual maintenance cost and (3) the annual road user, or operating cost. Equivalent uniform annual project costs, which are the summation of these costs, are shown in Table V-2. Also shown are the annual savings expected from each "Build" alternative and the "No-build" alternative, relative to Alternative 4, the most costly alternative.

TABLE V-1

CONSTRUCTION COST ESTIMATE

Alt.	Roadway	Grading & Drainage	Base & Surface	Miscellaneous	Structures	10% Eng. & Contingencies	Subtotal	R.O.W.	Total
1	Beltway	-	-	-	-	-	-	-	-
	Other State Respon.	-	-	-	-	-	-	-	-
	Other Respon.	671,000	3,955,000	-	13,531,400	1,815,600	19,973,000	612,000	20,585,000
	Total	671,000	3,955,000	-	13,531,400	1,815,600	19,973,000	612,000	20,585,000
2	Beltway	3,726,000	6,119,000	1,000	5,766,000	1,561,000	17,173,000	3,261,000	20,434,000
	Other State Respon.	22,000	274,000	-	-	30,000	326,000	19,000	345,000
	Other Respon.	12,000	147,000	-	-	16,000	175,000	10,000	185,000
	Total	3,760,000	6,540,000	1,000	5,766,000	1,607,000	17,674,000	3,290,000	20,964,000
3	Beltway	8,453,000	7,024,000	152,000	11,408,000	2,704,000	29,741,000	5,133,000	34,874,000
	Other State Respon.	22,000	274,000	-	-	30,000	326,000	19,000	345,000
	Other Respon.	80,000	293,000	-	-	37,000	410,000	69,000	479,000
	Total	8,555,000	7,591,000	152,000	11,408,000	2,771,000	30,477,000	5,221,000	35,698,000
4	Beltway	7,170,000	5,909,000	502,000	16,790,000	3,037,000	33,408,000	8,071,000	41,479,000
	Other State Respon.	16,000	200,000	-	-	22,000	238,000	29,000	267,000
	Other Respon.	287,000	1,640,000	-	-	193,000	2,120,000	207,000	2,327,000
	Total	7,473,000	7,749,000	502,000	16,790,000	3,252,000	35,766,000	8,307,000	44,073,000
5	Beltway	8,023,000	8,601,000	204,000	10,231,000	2,706,000	29,765,000	3,597,000	33,362,000
	Other State Respon.	13,000	160,000	-	-	17,000	190,000	11,000	201,000
	Other Respon.	671,000	3,955,000	-	13,531,400	1,815,600	19,973,000	612,000	20,585,000
	Total	8,707,000	12,716,000	204,000	23,852,400	4,538,600	49,928,000	4,220,000	54,148,000

TABLE V-2

EQUIVALENT UNIFORM ANNUAL PROJECT COSTS

Alternative	Annual Road User Cost	Annual Construction and Maintenance Cost	Equivalent Uniform Annual Cost	Annual Savings Over Alternative 4
1	73,426,000	1,484,000	74,910,000	13,906,000
2	76,800,000	1,573,000	78,373,000	10,443,000
3	76,926,000	2,582,000	79,508,000	9,308,000
4	85,686,000	3,130,000	88,816,000	0
5	73,829,000	3,974,000	77,803,000	11,013,000

Road user costs were calculated for total travel on the corridor traffic analysis network as represented in Figure A II-1. The total trip level used in the analysis reflects adjustments made to the corridor trip level for Alternatives 1, 2, 3 and 4 to account for trips within the metropolitan area outside of the corridor which were diverted from the corridor as a result of the lower development levels associated with those alternatives (see Appendix II). User costs are for year 1991 travel in terms of 1976 dollars.

The road user cost analysis was based on data and procedures set forth in the American Association of State Highway Officials Manual, Road User Analyses for Highway Improvements, 1960. Unit costs from the manual were updated to 1976 levels.

B. COMPARATIVE SUMMARIES

Following are summaries of study findings relating to each alternative. The written summaries of relevant findings are accompanied by maps (Figures V-1 through V-5) showing each alternative separately along with notes indicating specific impacts, potential problem and opportunity areas, and representative traffic volumes, as they apply to the alternative under consideration.

A comparative discussion and ranking of all alternatives follows the summaries.

SUMMARY - ALTERNATIVE 1

Socio-Economics

- The "No-build" Alternative would likely hinder achievement of a balanced growth pattern in the metropolitan area. Moreover, the "No-build" Alternative would likely foster a relatively dispersed growth pattern in the corridor, increasing the cost of providing urban services as well as the potential for encroachment on valuable agricultural land.

- Corridor commercial development would probably occur along major highways such as U.S. 65, U.S. 6 and Iowa 163. Long term increases in traffic volumes would adversely affect accessibility to these businesses. Little flexibility would be available for structuring future development in the study corridor.

- No takings, relocations or severance of property are required for a Beltway under this alternative. Right-of-way would be required for the S.E. 36th Street/East Diagonal Road improvement, however.

- No public facilities or services would be directly disrupted. Congestion which will occur in the future may, however, effect the operation of emergency vehicles in the western portion of the study corridor.

- Reduced accessibility and the proximity effects of higher levels of traffic and traffic congestion, particularly in the Des Moines portion of the study corridor, would tend to have a gradual deteriorating effect on the character of adjacent developed areas.

- No property would be removed from the tax rolls for construction of a Beltway; however, tax revenue benefits from increased development intensity would not be gained, and the appreciation of corridor land values would be suppressed in the long run. Some immediate tax loss would occur as a result of takings required for S.E. 36th Street/East Diagonal Road.

- No direct taking of agricultural land for a Beltway would be required, although S.E. 36th Street/East Diagonal Road would remove 107 acres of good agricultural land. Two parcels on two farms would be severed from the farmstead.

Traffic Service

- Corridor length, north-south trips would have no well defined route available to them.

- Eastern portions of the corridor would not have ready access to office, industrial and commercial facilities in other suburban Des Moines areas.

- Through and local trips would probably experience some difficulty in traveling through areas where expected strip development will cause local interference with traffic flow.

- The pattern of development which would occur under the "No-build" Alternative would probably preclude the efficient use of any alternative means of transportation.

- Confining all corridor travel to lower-level roadway facilities would result in higher traffic accident rates as well as a higher number of accidents.

Engineering Economics

- The use of public funds for the construction of a Beltway would not be required. Construction of S.E. 36th Street/East Diagonal Road would cost $20,585,000.

- Total equivalent uniform annual cost for this alternative would be $74,910,000, or 16 percent less than the most expensive alternative.

Environmental

- FHWA design noise levels would be exceeded at 219 sites, primarily in areas of existing development.

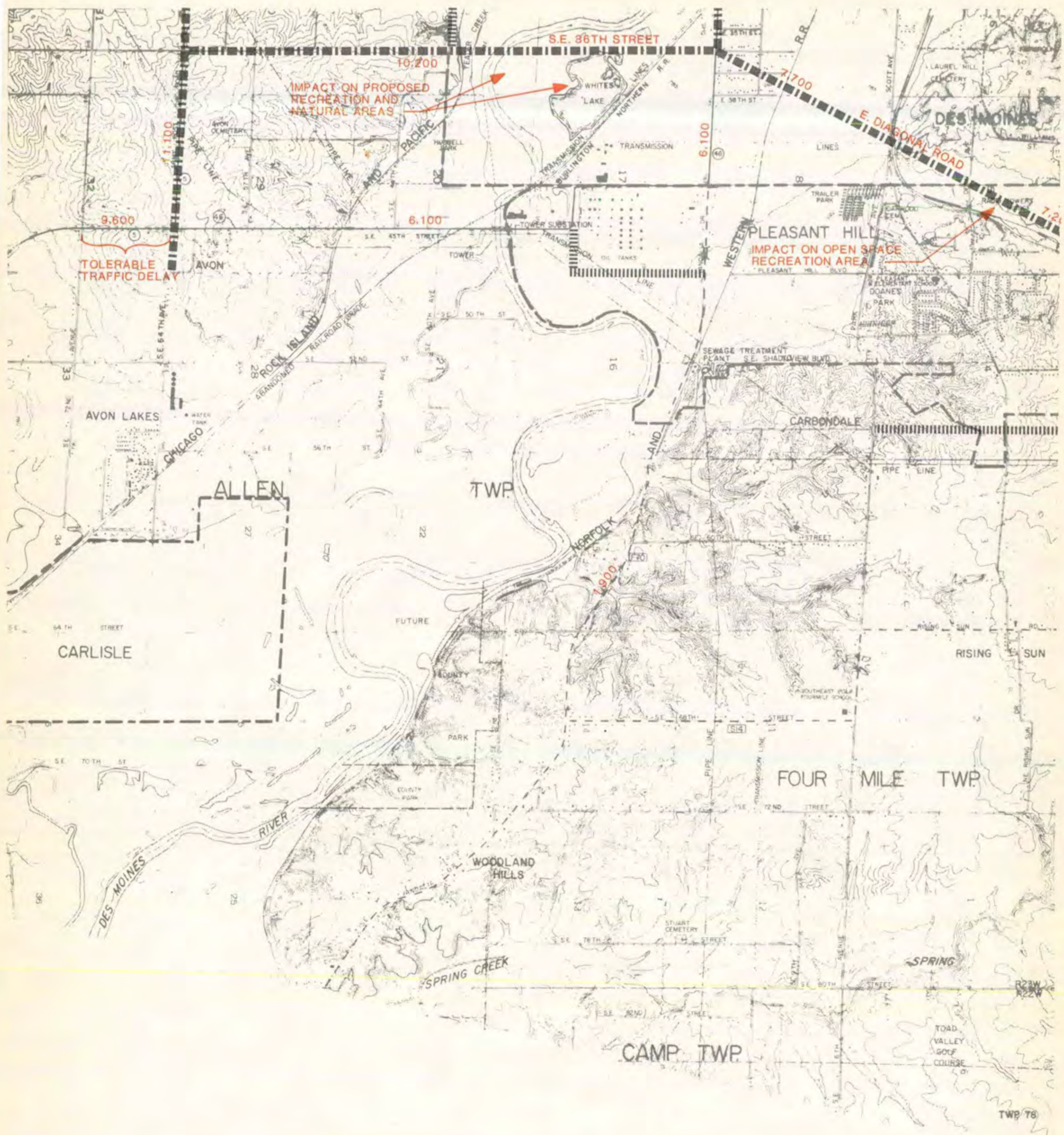
- The total air pollutant burden is lower than for any other alternative. However, localized congestion, particularly in the Des Moines portion of the study corridor, would increase the potential for exceeding ambient carbon monoxide concentration standards.

- Construction of S.E. 36th Street/East Diagonal Road within the Four Mile Creek Valley will increase the potential for degradation of water quality in the creek.

- Natural features and wildlife habitat in the corridor will be affected by construction within the Four Mile Creek Valley.

- No existing parks, recreational facilities, historic or archaeological sites would be directly affected. The S.E. 36th Street/East Diagonal Road will affect the proposed Whites Lake recreation area and the ROSS corridor along Four Mile Creek.

- Little opportunity is provided for taking advantage of corridor scenic amenities. Long term deterioration foreseen for certain corridor areas would be aesthetically displeasing and potentially distracting to the through motorist.



LEGEND

44,000 YEAR 2000 AADT VOLUME

TRANSPORTATION PLAN PROPOSED IMPROVEMENTS

2 LANES

4 LANES

north

2000 0 2000 4000 6000

SCALE IN FEET

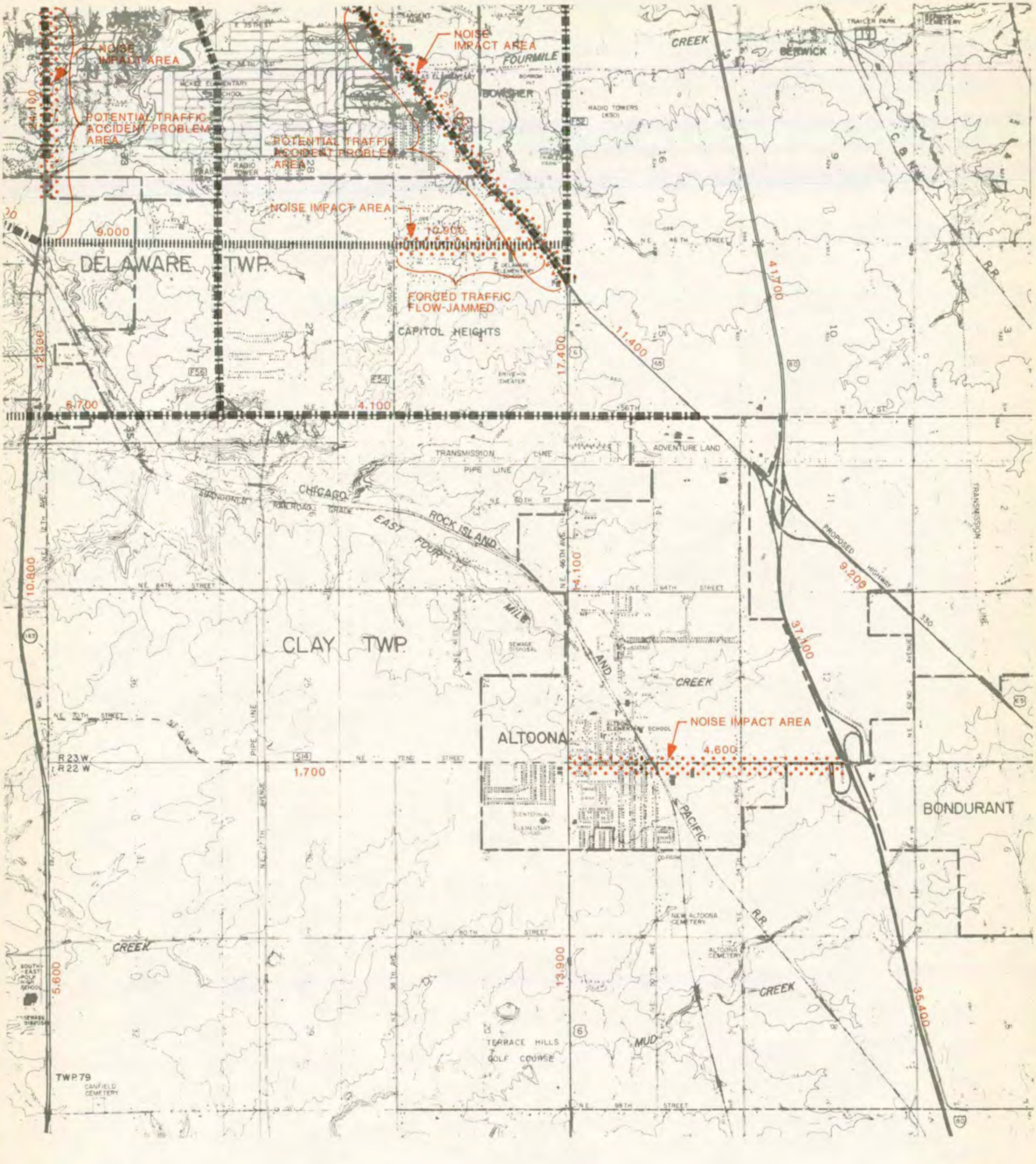


FIGURE V-1

ALTERNATIVE 1

SUMMARY - ALTERNATIVE 2

Socio-Economics

- The "Upgrading" Alternative provides increased accessibility to the corridor and thus improves the area's potential to accommodate a balanced share of metropolitan area growth.

- Lack of total access control could allow some strip development to occur. Control of development adjacent to the Beltway will be more difficult than under the other "Build" alternatives.

- The amount of right-of-way required is less than for other "Build" alternatives. Fifteen homes, including three farmsteads, and three businesses will be taken.

- There would be some inconvenience during construction to users of East 56th Street and Iowa 46 between Army Post Road and the Des Moines River.

- There would be an immediate loss to the corridor tax base of about $406,000 as a result of right-of-way acquisition. Increase in property values due to the Beltway should cover this loss.

- Approximately 250 acres of good agricultural land would be required for Beltway right-of-way. Four parcels on three farms would be severed from the farmstead.

Traffic Service

- The mix of local and through traffic which would be present and the strip development which could occur along portions of this route would tend to make through travel less efficient.

- Local traffic would have good access to this through, north-south route via at-grade intersections and private drives.

- No serious congestion problems would be expected to occur along the Beltway through the year 2000.

- The strip development which could occur along portions of this facility would limit opportunities to adapt this alternative to other types of transportation systems or to development patterns different from those presently planned for.

- The "Upgrading" Alternative would result in an accident rate which is lower than the "No-build" Alternative, but higher than the other "Build" alternatives.

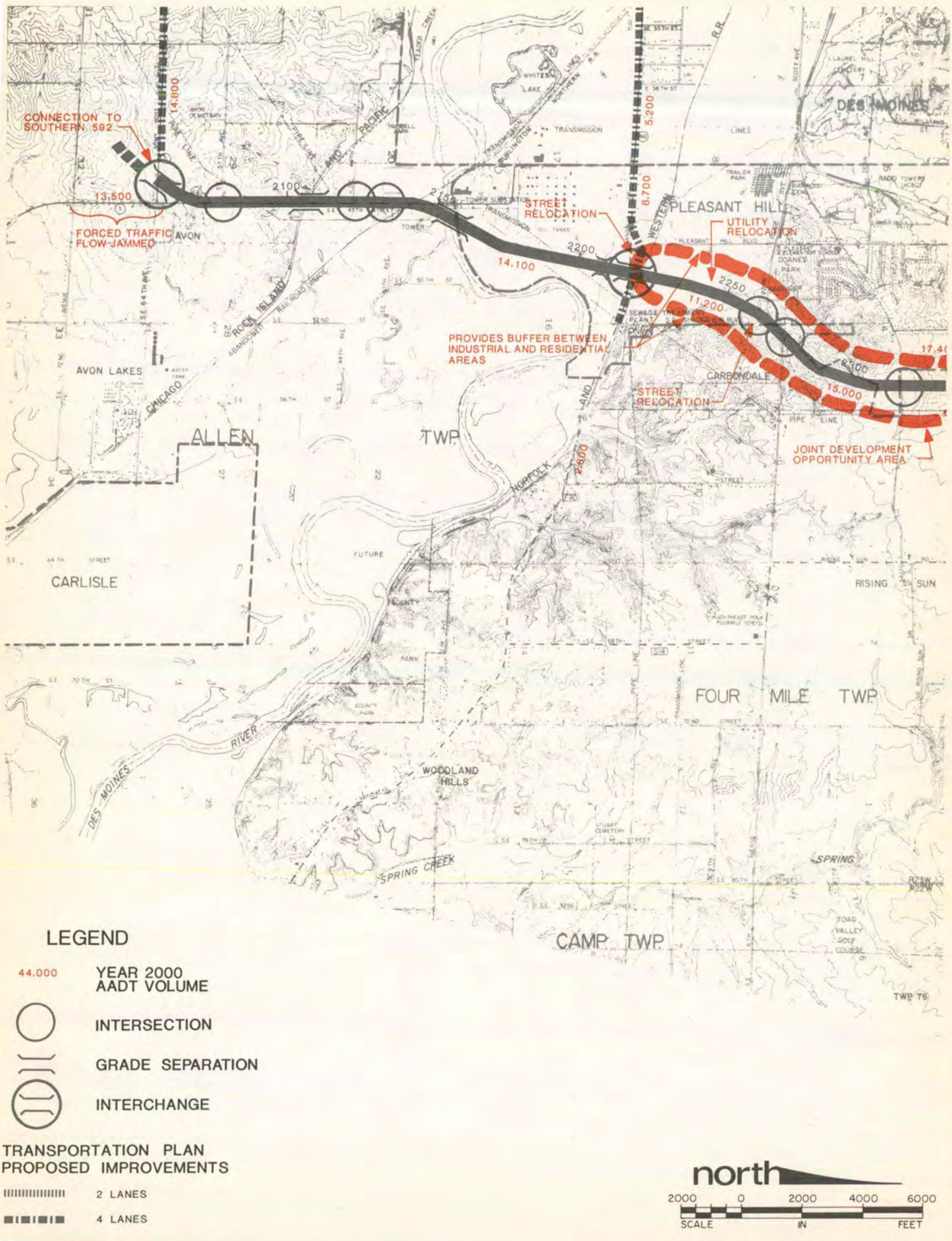
Engineering Economics

- The combined construction and right-of-way cost for this alternative is estimated to be $20,964,000.

- Total equivalent uniform annual cost for this alternative would be $78,373,000, or 12 percent less than the most expensive alternative.

Environmental

- FHWA design noise levels would be exceeded at 214 sites, mainly along University Avenue, Hubbell Avenue and East 46th Street. The Beltway itself would impact one site near N.E. 27th Avenue.
- The total air pollutant burden would be about 7 percent higher than for the "No-build" Alternative in 1983, and about 2 percent higher in the year 2000.
- The potential for sediment release during construction of this alternative is less than one-half the potential of the other "Build" alternatives.
- There would be no significant changes in drainage patterns or water quality as a result of implementation of this alternative.
- There would be no significant impacts on wildlife habitat or other natural features in the corridor.
- No park, recreational facility, archaeological or historic site would be directly affected. The Beltway would provide somewhat easier access into and within the corridor.
- This alternative would provide varied viewing opportunities including the Des Moines River Valley and its bluffs, attractive residential areas and rolling farmland.
- The presence of the highway within the built-up area of Pleasant Hill/ Carbondale may be visually objectionable to area residents.



TRANSPORTATION PLAN
PROPOSED IMPROVEMENTS

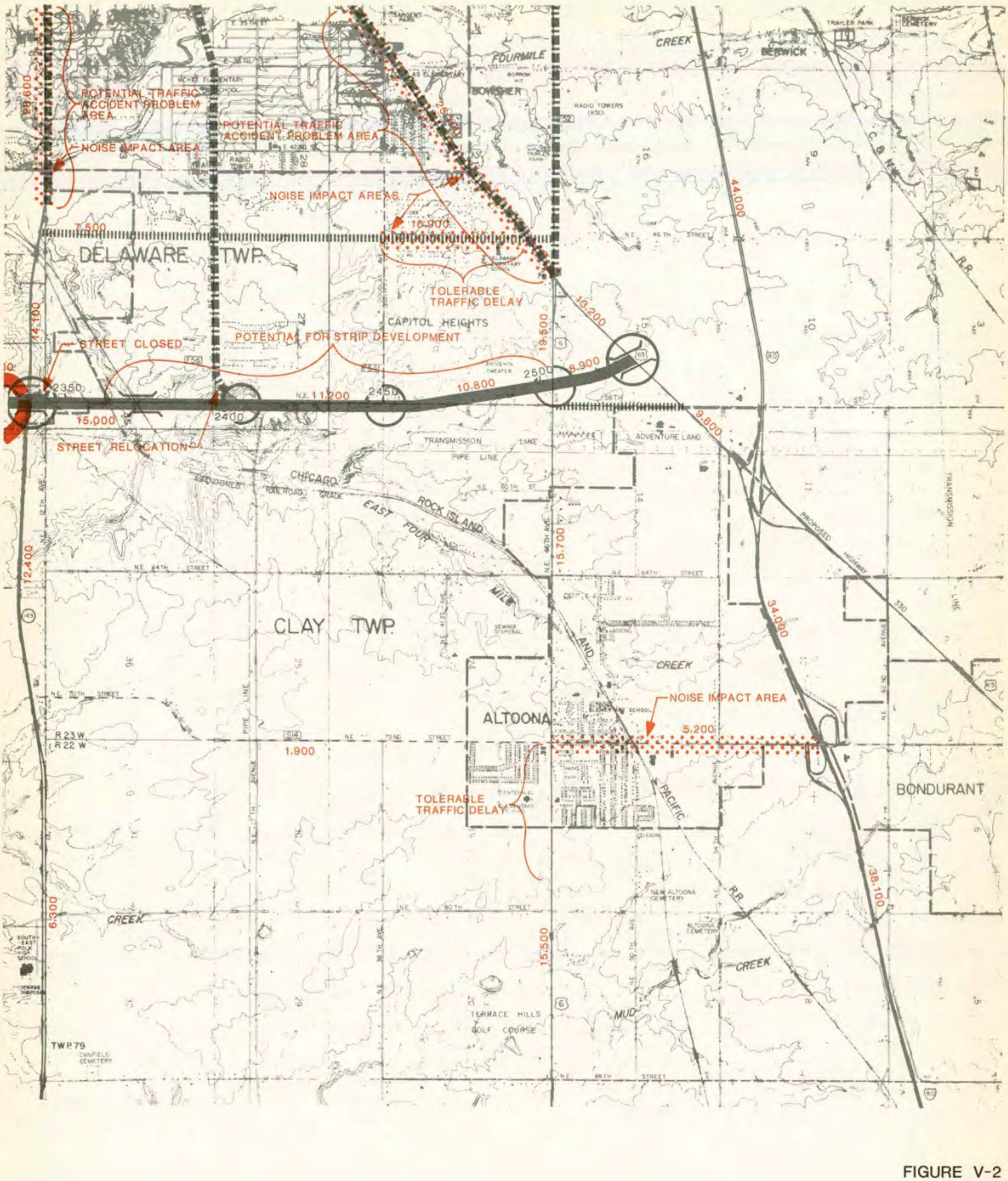


FIGURE V-2

ALTERNATIVE 2

SUMMARY - ALTERNATIVE 3

Socio-Economics

- The construction of this alternative would allow for and encourage the concentration of growth within and adjacent to presently developed areas. This would reduce the cost of providing public services to developing areas, minimize development encroachment on agricultural lands, and, at the same time, accommodate a balanced share of metropolitan area growth.
- There are opportunities available for the joint development of lands adjacent to the proposed Beltway which could contribute to existing plans for open space, as well as provide additional open space as a contribution to the aesthetic appeal of the corridor.
- Fourteen homes, including four farmsteads, and two businesses would be taken for right-of-way purposes.
- No negative impacts on public facilities or services would occur as a result of construction of this alternative. Positive impacts would occur in the form of improved public accessibility and improved response times for emergency vehicles.
- There would be an immediate loss to the corridor's tax base of about $440,000 as a result of right-of-way acquisition. This loss should be recovered in a relatively short time as a result of increases in property value and new development due to the Beltway.
- About 500 acres of land would be required for right-of-way under this alternative. Nearly all of this land is good agricultural land. Nine parcels on eight farms would be severed from the farmstead.
- The existing weigh-station on I-80 would have to be relocated if this alternative is selected.

Traffic Service

- This alternative would provide an easily identified, controlled-access, through north-south route through the study corridor. In terms of long-distance travel, the primary benificiaries of this type of facility would be those travelers approaching the area from the north, east and south with destinations on the east side of the metropolitan area.
- The effects of this alternative on local traffic would be to provide better accessibility within the corridor, and to reduce the likelihood of local traffic congestion due to conflicts between local and through traffic.
- The disruption of local traffic flow during construction would be minimal due to the proposed Beltway's location on new right-of-way.
- This alternative would be the most flexible of the five considered in terms of adapting to an altered pattern of development or to a need for a complementary transportation facility. The central location (in the

corridor) and its location on new right-of-way would facilitate the construction of an additional interchange, if required, or of an intermodal transfer facility, if such transportation development occurs in the Des Moines area.

- In terms of traffic safety, this alternative would result in the lowest number and rate of accidents, among the alternatives considered, for equivalent traffic flow.

Engineering Economics

- The combined construction and right-of-way cost for this alternative is estimated to be $35,698,000.

- Total equivalent uniform annual cost for this alternative would be $79,508,000, or 10 percent less than the most expensive alternative.

Environmental

- FHWA design noise levels would be exceeded at 232 sites in the study area. Particular problem areas include University Avenue, Hubbell Avenue and East 46th Street. Traffic on the Beltway itself would not result in any design noise level impacts.

- The total air pollutant burden would be about eight percent higher than under Alternative 1 in 1983, and about six percent higher in the year 2000.

- This alternative would require realignment of a portion of East Four Mile Creek, reducing a 1,500 foot reach to 900 feet.

- The potential sediment release during construction is over twice the amount estimated for Alternative 2.

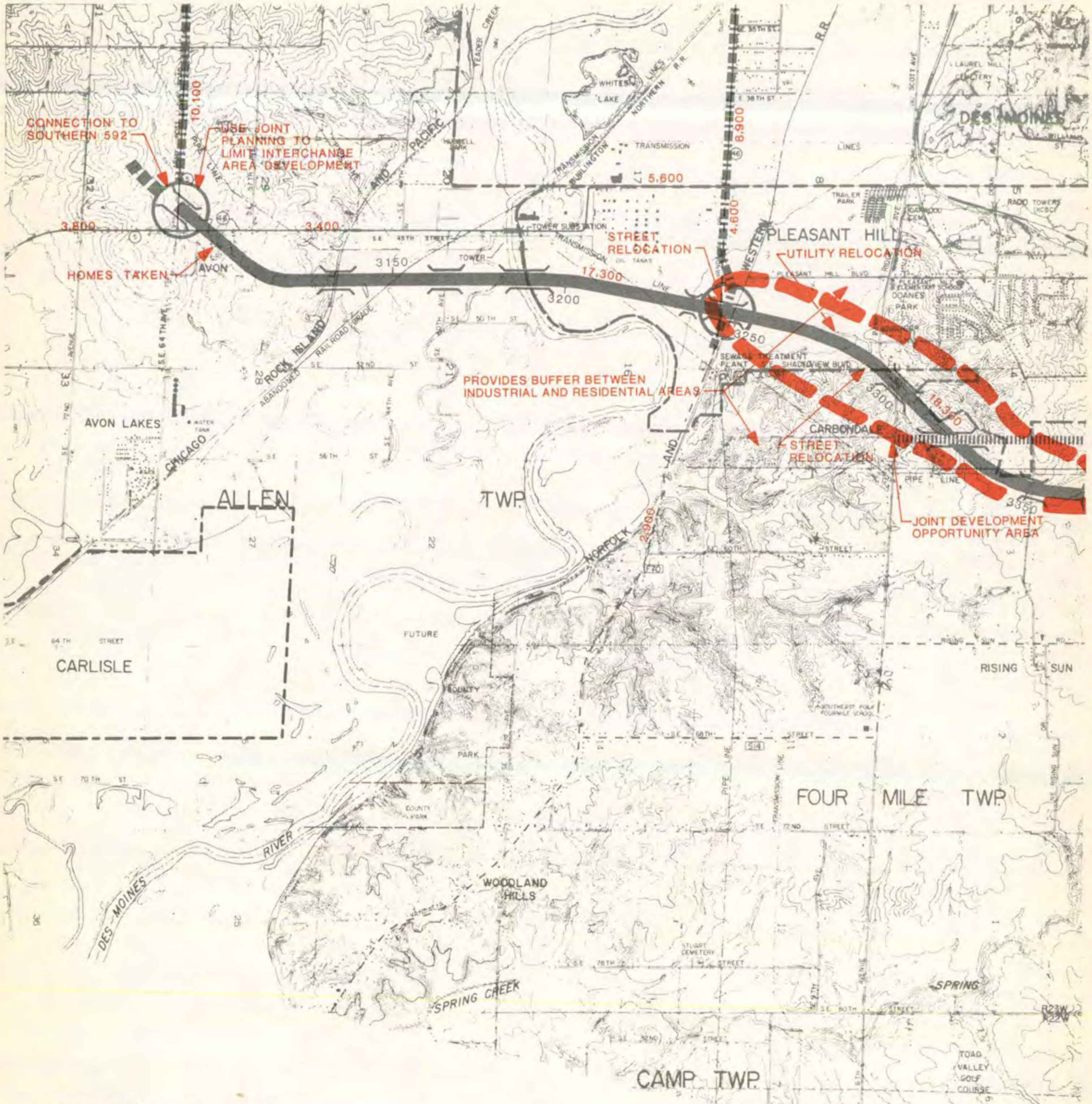
- No significant long-term impacts on water quality are foreseen as a result of implementation of this alternative.

- This alternative would limit, to some degree, movement of wildlife between habitat areas on either side of the Beltway between University Avenue and N.E. 27th Avenue. This alternative would also eliminate a small amount of wildlife habitat near the C.R.I. & P. Railroad, south of the Des Moines River.

- No park, recreational facility, archaeological or historical site would be directly affected. The Beltway would provide easier access into and within the study corridor.

- This alternative would provide viewing opportunities similar to Alternative 2, with additional viewing opportunities in the East Four Mile Creek area.

- The presence of the highway within the built-up area of Pleasant Hill/ Carbondale may be visually objectionable to area residents.



LEGEND

44,000 — YEAR 2000 AADT VOLUME

GRADE SEPARATION

INTERCHANGE

TRANSPORTATION PLAN
PROPOSED IMPROVEMENTS

2 LANES

4 LANES

north

2000 0 2000 4000 6000
SCALE IN FEET

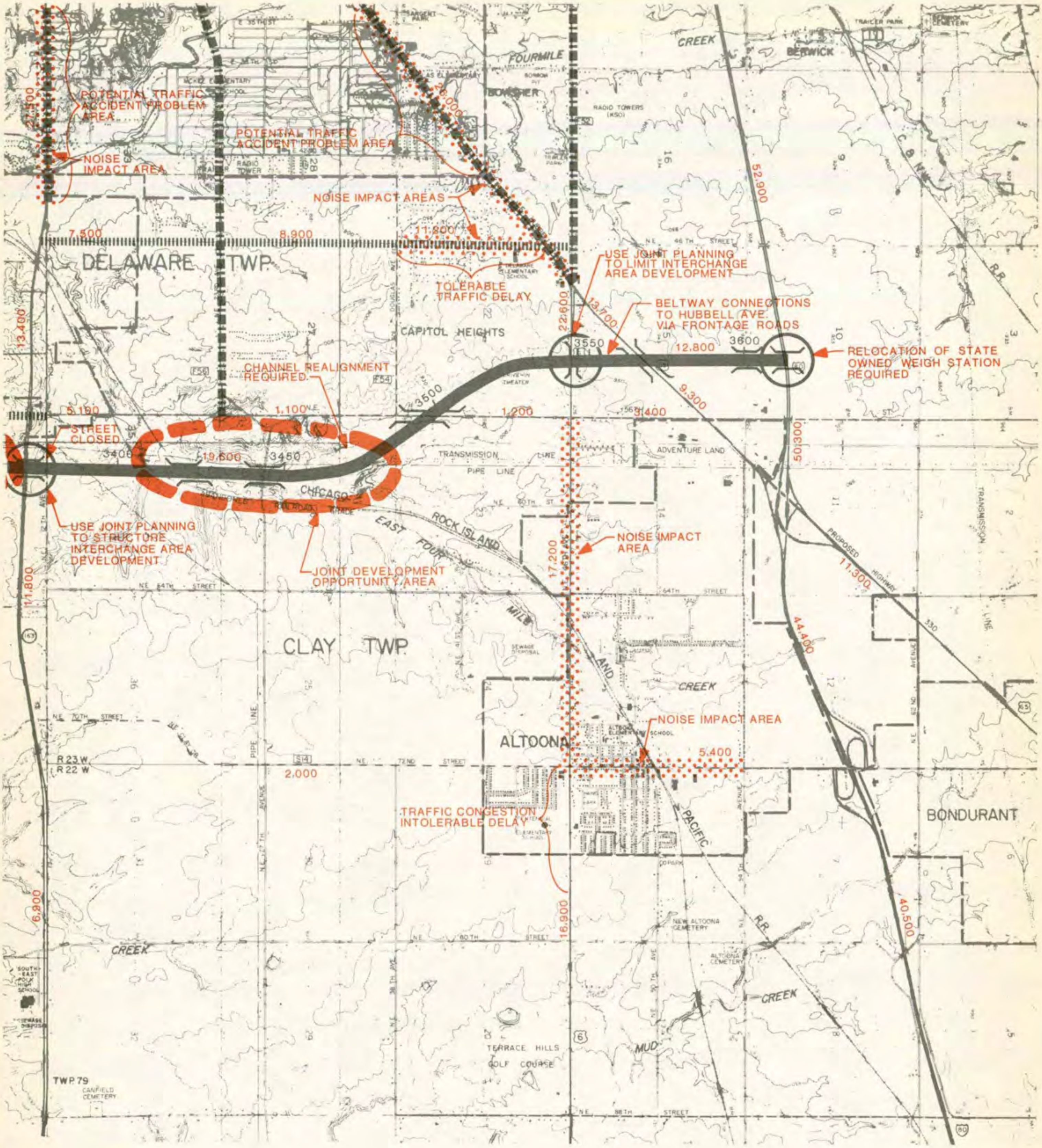


FIGURE V-3

ALTERNATIVE 3

SUMMARY - ALTERNATIVE 4

Socio-Economics

- This alternative improves the accessibility of the study corridor and thus improves the areas potential for accommodating a balanced share of metropolitan area growth.

- A facility in this location would tend to draw development into areas which are not planned for intense development.

- Development of portions of the corridor, which are planned for development, would not be as readily structured with a Beltway in this location.

- Opportunities for joint development occur, particularly near the interchange of the Beltway with Iowa 163.

- This alternative would require the taking of 65 homes and 19 commercial or industrial establishments; this is about four times the number of relocations required by any other alternative.

- Impacts on public facilities and services would be generally favorable. Improved public accessibility and emergency vehicle mobility could be expected, primarily in the western portions of the corridor.

- Purchase of right-of-way required for the Beltway would remove about $887,000 in assessed valuation from the tax base. This loss would likely soon be offset by property value increases and new development.

- Right-of-way required for the Beltway amounts to about 400 acres, almost all of which is good agricultural land. Six parcels on six farms would be severed from the farmstead.

Traffic Service

- This alternative would have the highest Beltway traffic volumes of any of the "Build" alternatives, due to its location near the most intensely developed areas of the corridor. In spite of the higher traffic levels, the Beltway would operate at a satisfactory level of service at all times through the year 2000.

- Local traffic will experience benefits in terms of accessibility via the Beltway, but the attractiveness of the Beltway draws much more traffic to nearby streets than would be present under other alternatives.

- If development should occur in a pattern different from that anticipated, this alternative would provide little in the way of alignment flexibility or potential additional interchange locations. There would be little space available for support facilities for complementary travel modes.

- Under this alternative the accident rate based on vehicle miles of travel would be comparable to rates expected under Alternatives 3 and 5.

Engineering Economics

- Combined right-of-way and construction cost for this alternative is estimated to be $44,073,000.

- Total equivalent uniform annual cost for this alternative would be $88,816,000, the highest of any alternative considered.

Environmental

- FHWA design noise levels would be exceeded at 204 sites in the study area. Traffic on the Beltway itself would result in design noise level impacts at four sites in three separate locations. On other study area roadways, particular noise problems would occur along University Avenue, Hubbell Avenue, E. 46th Street and E. 72nd Street in Altoona.

- The total air pollutant burden would be about 22 percent higher than under Alternative 1 in 1983, and about 19 percent higher in the year 2000.

- The potential sediment release during construction would be about 2.5 times the potential sediment release under Alternative 2. This alternative would have a substantially greater negative impact on water quality than any of the other alternatives during construction.

- There would be no serious, long-term negative impacts on water quality as a result of construction of this alternative.

- This alternative would sever wildlife access between woodlands and nearby agricultural and river bottom lands at four locations. Wildlife underpasses could be provided at three of these locations.

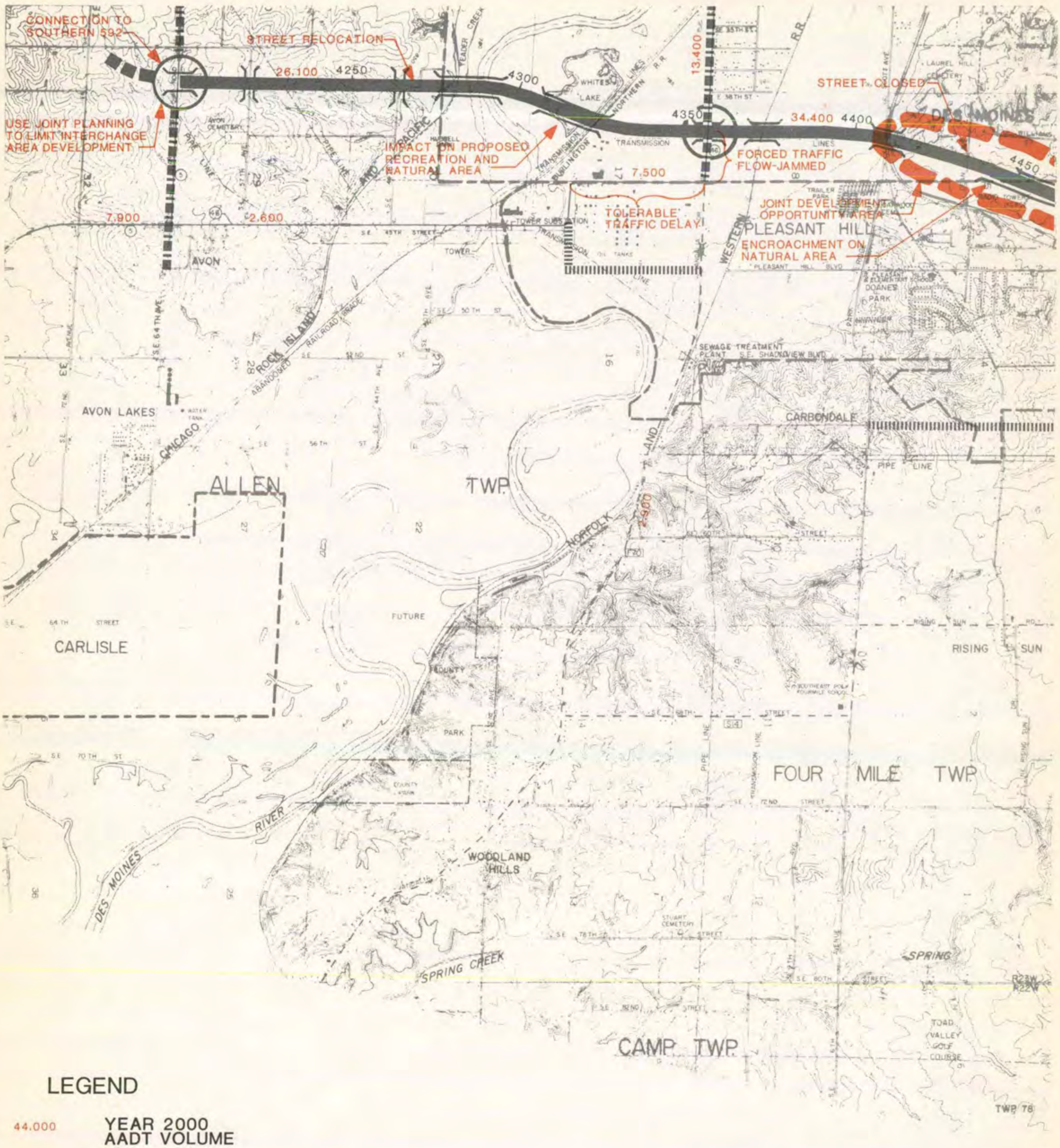
- This alternative would pass close to Hubbell Park, but impact would be minor due to the designation of the park for use by recreational vehicles.

- The White's Lake area and the Four Mile Creek valley designated for preservation in their natural state would be infringed upon by this alternative, with resultant noise and visual impacts.

- No known historical or achaeological sites would be directly affected by this alternative.

- The southern portion of this alignment would provide aesthetically pleasing views of agricultural land and the natural areas near the Des Moines River and Four Mile Creek. The northern end, in deep cut much of the way, would not present significant viewing opportunities.

- The highway will require deep cuts in the riverbluff south of the Des Moines River, in the end of the ridge line near Four Mile Creek north of Scott Avenue, and north of Iowa 163. These cuts and the presence of the highway in the residential areas of Capitol Heights may be visually objectionable to area residents.



LEGEND

44,000	YEAR 2000 AADT VOLUME
	GRADE SEPARATION
	INTERCHANGE

TRANSPORTATION PLAN PROPOSED IMPROVEMENTS

	2 LANES
	4 LANES

north

2000 0 2000 4000 6000
SCALE IN FEET

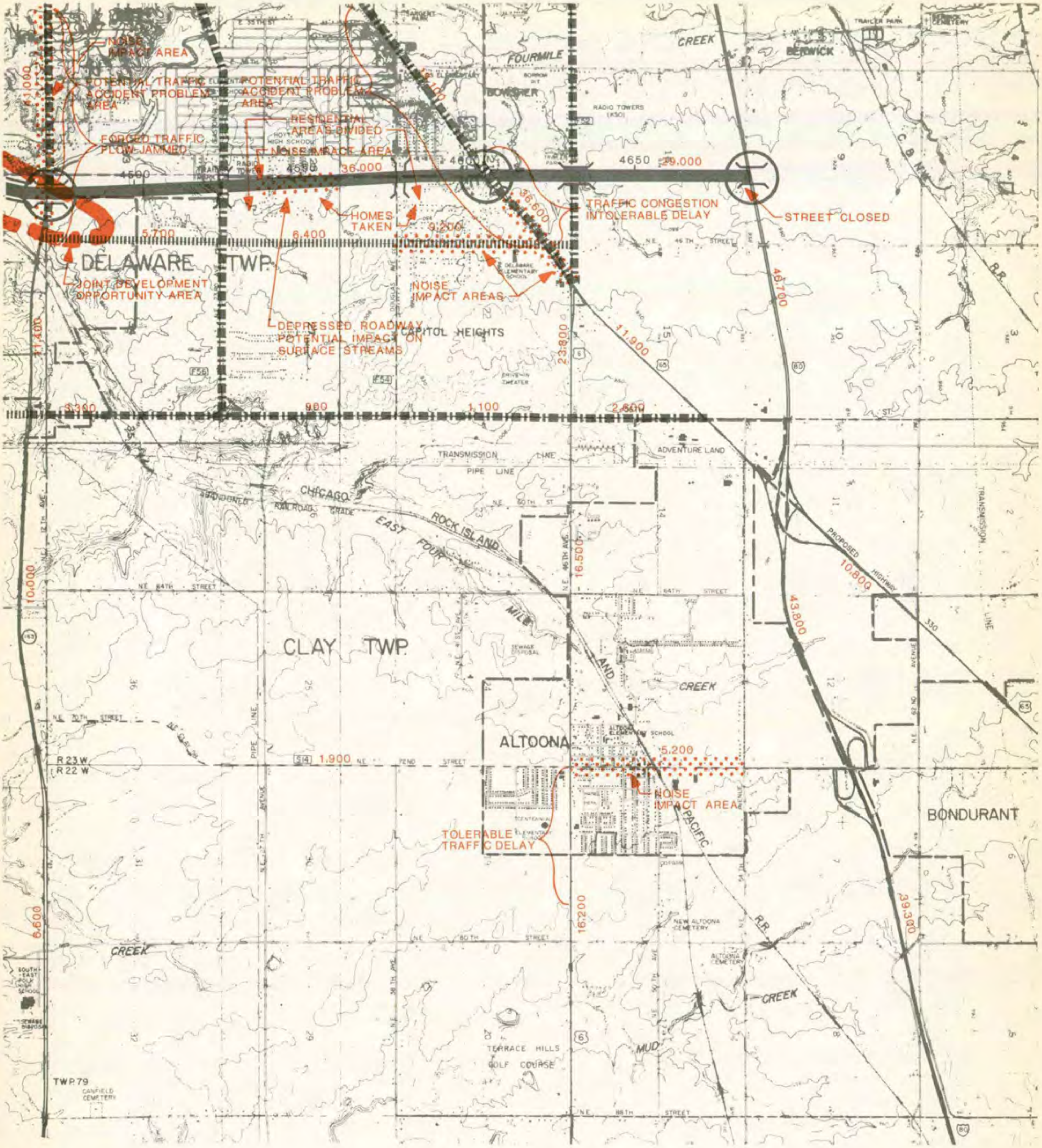


FIGURE V-4

ALTERNATIVE 4

SUMMARY - ALTERNATIVE 5

Socio-Economics

- This alternative would increase the corridor's accessibility sufficiently to improve its potential for accommodating a balanced share of metropolitan area growth.

- There would be pressure for development of isolated Beltway interchange areas, and prime agricultural land between the Beltway and existing development along the Des Moines corporate limits would be made more attractive for residential development. The resultant "sprawl" would significantly increase the cost of providing public services.

- Opportunities for joint development associated with this alternative are limited by its far eastern location in the corridor.

- A total of sixteen residences, including three farmsteads, would be taken for construction of the Beltway, and S.E. 36th Street/East Diagonal Road.

- There would be a short term loss to the area's tax base of approximately $640,000. Precipitous increases in property values near Beltway interchanges, and lesser increases in the area between the Beltway and existing development would eventually make up for the initial loss.

- Right-of-way required for construction of the Beltway and S.E. 36th Street/East Diagonal Road would amount to over 700 acres; 660 acres of the required area are good agricultural lands. Ten parcels on nine farms would be severed from the farmstead.

Traffic Service

- Long-distance, through travelers would find little traffic on the Beltway under this alternative. These through trips could be made easily, and with little interference from traffic with more local origins and destinations.

- Local traffic would benefit to some extent by the construction of S.E. 36th Street/East Diagonal Road. Local traffic would remain, for the most part, however, on the local street system, resulting in higher volumes and congestion on some study area streets.

- The overall accident rate expected under this alternative would be slightly higher than for the other freeway type alternatives.

Engineering Economics

- Combined right-of-way and construction cost of this alternative is estimated to be $54,148,000.

- Total equivalent uniform annual cost for this alternative would be $77,803,000, or 12 percent less than the most expensive alternative.

Environmental

- FHWA design noise levels would be exceeded at 230 sites in the study area. No sites along the Beltway itself would experience design noise level impacts. Particular noise problems would occur along all of E. 46th Street, along University Avenue and Hubbell Avenue and along N.E. 72nd Street in Altoona.

- The total air pollutant burden would be about six percent higher than for Alternative 1 in 1983, and about two percent higher in the year 2000.

- During construction of this alternative, there would exist a relatively high potential for soil erosion and subsequent sedimentation. No long term negative impacts on water quality would be expected however.

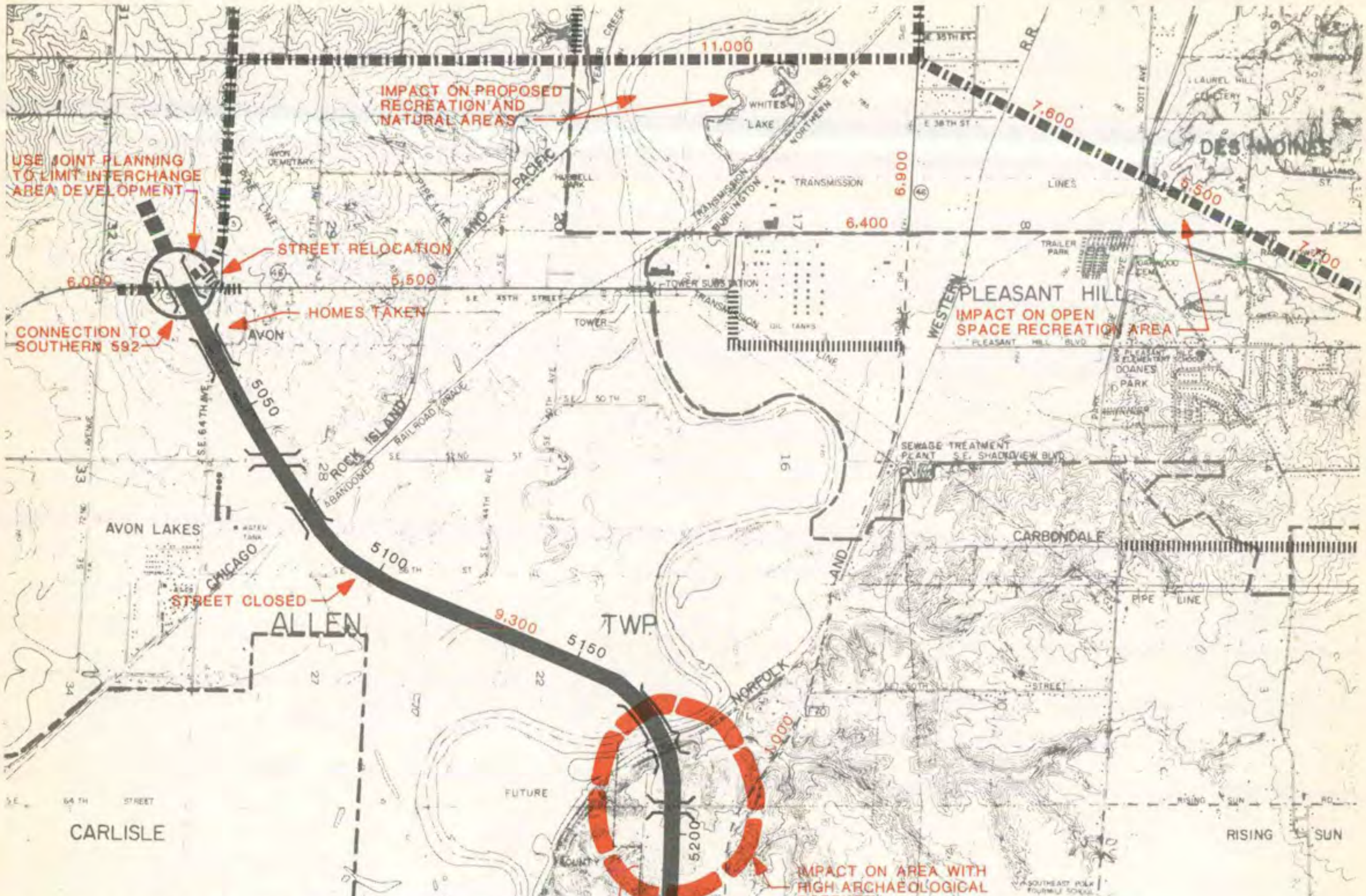
- Some minor negative impact on wildlife habitat can be expected as a result of the passage through vegetative corridors along the railroad east of Altoona and Mud Creek. Other impacts on study area wildlife habitat are considered minimal.

- This alternative passes through an area of high archaeological potential on the bluff north of the Des Moines River. No historic sites will be directly affected.

- This alternative would provide excellent access to the Polk County Park along the north side of the Des Moines River near S.E. 68th Street.

- Some interesting viewing opportunities would be available in the Des Moines River area. North of the Des Moines River, only typical agricultural scenes would be available.

- The highway will pass through deep cuts as it ascends the bluffs north of the Des Moines River. These cuts may be visually objectionable to local residents.



LEGEND

44,000 — YEAR 2000 AADT VOLUME

GRADE SEPARATION

INTERCHANGE

TRANSPORTATION PLAN PROPOSED IMPROVEMENTS

2 LANES

4 LANES

north

2000 0 2000 4000 6000

SCALE IN FEET

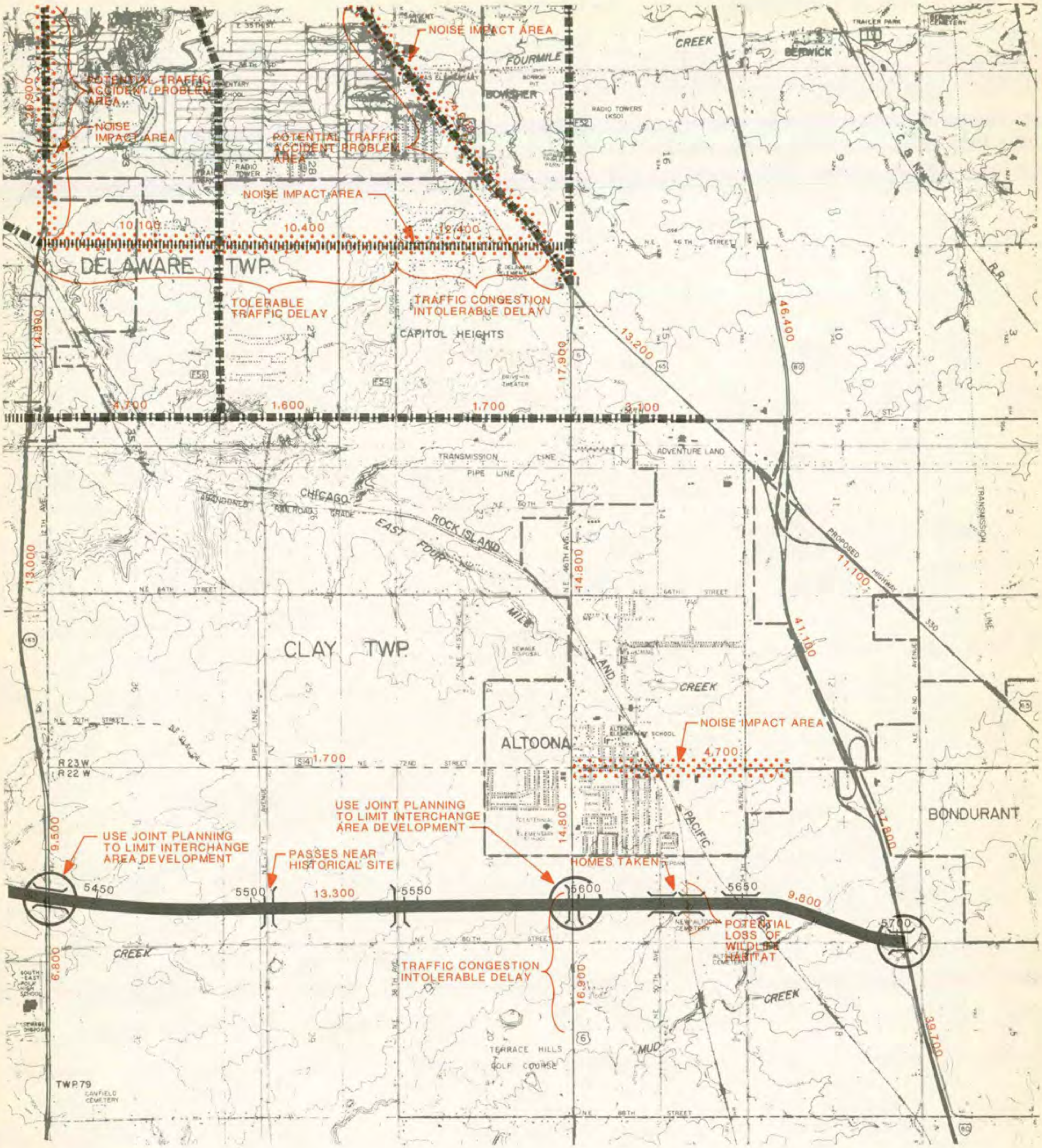


FIGURE V-5

ALTERNATIVE 5

C. COMPARISON AND RANKING OF ALTERNATIVES

1. Methodology

If all of the effects analyzed during the assessment of probable impacts of the alternatives could have been measured in terms of a single common denominator, such as dollars, the rating of alternatives could have been done on a common basis such as overall least cost. Since it is presently not possible to place dollar values or costs on such items as aesthetics, historic preservation, wildlife habitat, etc., a procedure was used in which each alternative was ranked on the basis of its positive or negative effects as determined during the assessment process. To accomplish this, the effect of each alternative on each major factor (Socio-Economics, Traffic Service, Engineering Economics, and Environmental) was rated, the major factors were weighted relative to one another, and a numerical "score" was developed signifying the relative overall worth or rank of the alternatives. In the event that similar scores should evolve for two or more alternatives, it would be necessary to base a recommendation on subjective considerations not directly measurable through the rating process.

While the above procedure cannot be expected to give exact results which should be exclusively relied upon, it does provide a good indication of relative value and is considered an adequate tool for use at the location stage of project development.

The general procedures for development of the rating system used in this study are as follows:

1. Select major factors to be compared.
2. Include in the rating system only those factors for which there are differences among alternatives.
3. Select subfactors where applicable.
4. Establish a rating scale. For this study the following rating system was used:

Magnitude	Value	Effect
Heavy	+3	
Moderate	+2	Favorable
Slight	+1	
Negligible	0	
Slight	-1	
Moderate	-2	Unfavorable
Heavy	-3	

5. Rate each alternative by subfactor in accordance with the established rating scale.

6. Weight each subfactor as a percentage of the major factor.

7. Weight each major factor so that the total of their weights equal 100.

8. Establish a tabular format as shown in Table V-3a through V-3d for recording the results of the rating process.

9. Perform the calculations specified in the column headings in the Evaluation Table.

10. Total the weighted ratings for each subfactor to determine a total "score" for each alternative. The best alternative will have the highest score.

2. *Comparative Rating By Factor*

It was determined during the assessment analysis that there was sufficient difference among alternatives with respect to each major factor considered to warrant including all in the rating process.

Socio-Economics - The impact of the proposed alternatives was assessed through seven principal subfactors as discussed in preceeding Section IV.

Regional and Community Growth
Development of Adjacent Lands
Community Character and Cohesion
Public Facilities and Services
Takings and Relocations
Local Tax Base and Property Values
Agricultural Production

These subfactors are listed in Table V-3 and the effects upon them from each alternative are summarized below.

• Regional and Community Growth - The alternatives were rated on the basis of the effect they would likely have on the metropolitan areawide balanced growth policy. The alternatives which would have the effect of supporting the policy of balanced growth consistent with regional and community comprehensive plans are rated favorable, while the alternatives which would encourage less structured growth are rated unfavorable. Also, those alternatives that would minimize the cost of extending public services and the amount of agricultural land conversion are rated favorable.

Alternative 1 has been rated moderately unfavorable because community and regional plans to attract development to the area would be seriously hindered by the lack of accessibility into and within the corridor. Alternative 2 is considered to have slightly favorable effect. It provides accessibility to planned commercial-industrial areas within the corridor but lack of full access control would tend to encourage spread rather than clustered development. Alternatives 3 and 4 have been rated moderately and slightly favorable, respectively. These two alternatives provide similar regional accessibility but Alternative 3 serves planned growth areas more directly than does Alternative 4. Alternative 4 would place developmental pressures on some areas not planned for development. Alternative 5 would provide regional accessibility, but would disperse secondary growth over a greater portion of the study corridor and would result in increased conversion of prime agricultural lands and increased service costs; it is rated moderately unfavorable.

- Development of Adjacent Lands - Each alternative was rated on the basis of its potential for permitting joint planning and the structuring of growth in adjacent areas.

Alternative 1 is rated moderately unfavorable. It provides little opportunity for structuring growth within the corridor. The present pattern of strip type development along major roadways would likely continue. Alternative 2 is considered to have a slightly unfavorable effect, in that while the "at-grade" design could result in strip development, local governments can exercise some control over that roadside development. Alternative 3 is rated moderately favorable because it provides the best opportunity for structuring future development in a manner consistent with community planning, and because of the opportunities present for joint development. Alternative 4 is considered to have a negligible effect. While it serves the Vandalia industrial area well, it also would place undesirable development pressure on portions of the Four Mile Creek Valley. Although Alternative 5 would offer opportunities for structuring development, such development would occur in areas inconsistent with local and regional planning objectives. Alternative 5 is rated slightly favorable.

- Community Character and Cohesion - The alternatives have different effects on both the character and integrity of the neighborhoods through which they pass.

Alternative 1 is rated slightly unfavorable in that the construction of S.E. 36th Street/Diagonal Road and the extension of N.E. 46th Street to Iowa 163 will increase traffic on the local street network in Capitol Heights. Alternatives 2 and 3 are also rated slightly unfavorable because they would tend to isolate the proposed Carbondale residential development from the City of Pleasant Hill. Alternative 4 is rated moderately unfavorable due to the fact that it penetrates existing neighborhoods along the Des Moines corporate limits. Alternative 5 will have a negligible effect in this regard and is so rated.

- Public Facilities and Services - The alternatives were rated according to the effect that they would have on public facilities and services.

Alternatives 1 through 4 were judged to have generally balanced positive and negative effects and were rated negligible. Alternative 5, which would encourage growth in areas not readily served by public services was rated moderately unfavorable.

• Takings and Relocations - Consideration was given to the direct effect that each alternative would have on corridor properties.

Alternative 1 would require a small amount of agricultural and industrial land for the S.E. 36th Street/East Diagonal Road connection and is rated slightly unfavorable. While Alternatives 2, 3 and 5 will displace an equivalent number of homes, farmsteads and businesses, differencies in the amount of right-of-way acreage required and the productivity of agricultural lands taken results in a slightly unfavorable rating for Alternatives 2 and 3, and a moderately unfavorable rating the Alternative 5. Alternative 4 required a large number of residential and commercial displacements; it is therefore rated heavily unfavorable.

• Local Tax Base and Property Values - Also considered was the effect that each alternative alignment would have on the corridor tax base and property values.

Alternative 1, with little tax base lost due to right-of-way acquisition, is considered to have a slightly unfavorable effect, primarily due to the lack of potential gains in property value. Alternative 2, which results in the smallest loss of tax base and which would probably precipitate some increase in property values, is rated as slightly favorable. Alternative 3 has been rated moderately favorable because of a relatively low loss of tax base and relatively high potential for an increase in property values. The potential for an increase in property values due to construction of Alternative 4 is relatively low because the Beltway traverses areas that are generally not developable or are already developed; this, combined with a relatively high loss of tax base, results in a rating of slightly unfavorable. Alternative 5 would result in a loss of tax base, although not as large a loss as Alternative 4. The eastern location, however, is not as attractive as the others in terms of increasing property values; Alternative 5 is rated as having a negligible effect.

• Agricultural Production - This factor measures the extent to which each alternative would affect corridor agricultural production, primarily through the taking of prime agricultural lands.

Alternative 1, which required no right-of-way for a Beltway, and only minor takings of agricultural lands for the S.E. 36th Street/East Diagonal Road alignment is considered to have negligible effect. Alternatives 2 and 4, which require the taking of equivalent amounts of agricultural land, were rated slightly unfavorable. Alternatives 3 and 5, which require the taking of the largest amounts of agricultural land, were rated moderately unfavorable.

• Subfactor Weighting - On the basis of the major concern for the effect that a new highway will have on metropolitan growth patterns and the structuring of future development, the first two Socio-Economic subfactors were weighted a total of 35% with the largest share, or 20 percent, being assigned to regional and community growth. The importance of agriculture to the study corridor was also recognized by assigning a weight of 20 percent to Agricultural Production. A weight of 15 percent was assigned to Takings and Relocations. The remaining three subfactors were each assigned weights of 10 percent, primarily on the basis of the relatively minor differences that existed among alternatives. (See Table V-3)

Traffic Service - The effect on the study corridor in terms of traffic service of each of the proposed alternatives was assessed considering four principal subfactors as discussed in Section IV; these subfactors include:

Regional and Interstate Service
Community Service
Service Flexibility
Safety

• Regional and Interstate Service - This subfactor assesses each alternative in terms of the service provided to through trips. The assessment is based on the availability of a through, north-south route in the corridor, and on estimated travel times for corridor length trips.

All alternatives provide a better means of north-south travel than is currently available. However, a freeway type facility such as Alternatives 3, 4 and 5, would provide the most direct and identifiable improvement in north-south travel. An expressway type facility, such as Alternative 2, would provide much better service than now exists, but through travel would conflict, to some extent, with local traffic. Under Alternative 1, improved north-south travel would be provided by the proposed S.E. 36th Street/Diagonal Road facility; although this is a better means of north-south access than is currently available, it is not as good as the other alternatives.

The travel time for corridor length trips is not significantly improved under Alternative 1. Under Alternatives 2, 3, 4 and 5, corridor length trips can be made in about 60 to 70 percent of the time currently required for that trip. Corridor length travel time shown in Table IV-10 is for trips from southern to northern terminous or vice versa. Trips to or from points west on I-80 would take 3 to 4 minutes longer on Alternative 5 than on Alternatives 2, 3 or 4. Conversely, trips to or from points east on I-80 would take 3 to 4 minutes longer on Alternatives 2, 3 and 4 than on Alternative 5.

Based on these comparisons Alternative 1 has been rated as having a negligible effect on Regional and Interstate Service. Due to the slightly better service provided to through trips, and the significantly lower travel time for corridor length trips, Alternative 2 has been rated as moderately favorable. Alternatives 3, 4 and 5 have all been rated as heavily favorable because of significantly lower travel time for corridor length trips and because much better service is provided to through trips.

• Community Service - This factor considers the effect of each alternative on traffic service within the community. Measures used for this assessment were travel times between various points within the study area, and the level of traffic congestion expected to occur in the design year.

No significant differences were apparent when travel times for each alternative were compared to each other or to travel times under existing conditions. Differences between alternatives were apparent, however, when the roadway segments with worse than Level of Service "C" conditions under design hour traffic flows were examined. Considering both the number of roadway segments with worse than Level of Service "C" flow conditions, and the severity of traffic congestion expected on those roadway segments, Alternatives 4 and 5 were rated moderately unfavorable. Alternative 2 was rated slightly unfavorable because the expected congestion would be less widespread than under Alternatives 4 and 5. Under Alternatives 1 and 3, congestion on study area roadways will not be severe; these alternatives will have negligible effect on community service.

• Service Flexibility - This factor measures the ability of each alternative to adapt to changes in development and travel patterns. Alternatives 1 and 4 are considered least flexible in this respect and have been rated slightly unfavorable. Alternative 2 would be slightly more flexible and has been rated as having negligible effect. Alternatives 3 and 5 have been rated moderately favorable in terms of service flexibility, because their alignments would be adaptable to changes in future development and travel patterns.

• Safety - Alternatives 1 and 2, which do not provide a freeway type facility in the corridor, are judged to have higher accident potential than the other alternatives. Alternative 2, which does provide an expressway facility, should have a lower accident rate than Alternative 1; Alternatives 1 and 2 have been rated slightly unfavorable and of negligible effect, respectively. Alternatives 3, 4 and 5, which allow much travel to take place on a freeway type facility, which has, historically, experienced lower accident rates than lower type facilities, should have lower overall accident rates than Alternatives 1 and 2. Alternatives 3, 4 and 5 have been rated as having a slightly favorable effect on the study area in terms of traffic safety.

• Subfactor Weighting - In the assignment of weighting to the subfactors of the major factor of traffic service, consideration was given to the major function of a 500 Beltway facility. Since most through-travel desire can be accommodated by other facilities, the importance of the subfactor Regional and Interstate Service has been de-emphasized; it has been assigned a weighting of 10 percent. This allows a fairly heavy weighting of the subfactors related to service to the study area community. Community Service and Safety have each been assigned weightings of 35 percent, and Service Flexibility has been assigned a weighting of 20 percent. (See Table V-3)

Engineering Economy - This factor is a measure of the relative expensiveness of the alternatives. Ratings were assigned on the basis of the annual savings shown for each alternative with respect to the most expensive alternative (Table V-2).

On this basis, Alternative 4, the most expensive alternative, was considered to have negligible effect. Alternatives 1, 2, 3 and 5 were rated slightly favorable.

Environmental - Environmental effects were assessed on the basis of six subfactors, as discussed in Section IV. These subfactors are:

Noise
Air Quality
Water Quality and Aquatic Life
Vegetation and Wildlife
Parks, Recreational Facilities, Historical and Cultural Features
Aesthetics and Visual Quality

These subfactors are listed in Table V-3 and the effects upon them from each alternative are described below.

• Noise - Alternatives were rated on the basis of whether they would favorably or adversely affect the future noise environment of the study corridor. Analysis indicates that there are no significant differences between any of the alternatives in the number of impacted sites. At the present time, about 70 sites in the study corridor experience design noise level impacts. In the future, under any alternative, including the "No-build" Alternative, about three times as many sites will experience design noise level impacts.

Since the study corridor, under any of the alternatives, will experience approximately the same level of increased noise impact, each has been rated slightly unfavorable.

• Air Quality - The general air quality in the study corridor is expected to improve in the future, largely as the result of the imposition of nationwide emission control standards. In the microscale analysis, it was found that all predicted carbon monoxide concentrations fall far below allowable maximums. In the microscale or air pollutant burden analysis, it was found that for all alternatives, air pollutant burdens in 1983 will all fall below the present air pollutant burdens and that, in the year 2000 all but the nitrous oxides air pollutant burdens will be below existing levels.

Based on these analyses, Alternative 1 has been rated slightly favorable, Alternatives 2, 3 and 5 are considered to have negligible effect, and Alternative 4 has been rated slightly unfavorable.

• Water Quality and Aquatic Life - The major impact on water Quality is a result of soil erosion both during and after construction and traffic related chemicals which are washed from the roadway surface into nearby streams. No permanent long-term degradation of water quality or aquatic life is expected as a result of the proposed project. The alternatives are, however, expected to have slightly different short-term effects.

Alternative 1, is considered to have negligible effect. Alternatives 2, 3 and 5 are expected to produce some impact and are rated slightly unfavorable. Alternative 4, which has the greatest direct effect on Four Mile Creek is rated moderately unfavorable.

• Vegetation and Wildlife - All alternatives would impose only minimal impacts on corridor vegetation and wildlife when compared to other human activities. However, when comparing alternatives to each other, some differences appear. Alternative 1, with no right-of-way required for the Beltway, does not cause any disturbance of habitat areas, and is rated to have negligible effect. Alternative 2, which requires the least right-of-way of the "Build" alternatives, also is rated to have a negligible effect. Alternatives 3 and 5 cause some disruption of wildlife habitat, and were considered slightly unfavorable. Alternative 4, which reduces wildlife access to the East and West Four Mile Creeks, has been rated as moderately unfavorable.

• Parks, Recreational Facilities, Historical and Cultural Features - No publicly held park, recreation facility, historic or cultural facility would be physically disrupted by any of the alternatives. Each of the "Build" alternatives, however, would result in either direct or indirect impact to the study area's recreational and cultural resources. Positive impacts caused by all the "Build" alternatives take the form of improved accessibility and opportunities for acquisition and expansion of public lands adjacent to the highway.

Alternative 4 requires the taking of land proposed for recreational purposes both near the Des Moines River and near Four Mile Creek; Alternative 4 is rated moderately unfavorable. Alternative 5 passes very near two historic sites and through an area of known archaeological significance; Alternative 5 has been rated slightly unfavorable. Alternatives 2 and 3 pass near one historic site, but impact on the site is avoidable; Alternatives 2 and 3 will have negligible effect. Alternative 1 is also considered to have negligible effect.

• Aesthetics and Visual Quality - This factor is a measure of how well the alternatives take advantage of the corridor's scenic amenities and to what extent the roadways themselves would detract from or contribute to the visual environment. Alternative 1, with no construction, was considered to have negligible impact. Alternatives 2 and 3 while traversing varied terrain, also pass through developed areas of less visual interest; these alternatives have been rated slightly favorable. Alternative 5 has been rated moderately favorable because, although the terrain is less variable, there are no areas with negative visual impacts. Alternative 4, which passes through areas of visual interest near the Des Moines River and in the Four Mile Creek valley, was rated moderately favorable.

• Subfactor Weighting - Noise was the single most significant environmental factor of concern in this study. Considerable noise impact is expected under all alternatives. For this reason noise was assigned a weight of 30 percent. Air Quality, Water and Aquatic Life; Vegetation and Wildlife; and Parks, Recreational Facilities, Historical or Cultural Features each received 15 percent weight. As a result of the absence of any major high quality scenic features within the study corridor, this element was assigned the lowest weight of 10 percent. (See Tabel V-3)

3. *Weighting of Major Factors*

Major factors considered in this study were:

Socio-Economics
Traffic Service
Engineering Economics
Environmental

As with the establishment of subfactor weights, major factor weights were also set by comparing the entire range of impact or importance of each factor to the range of impact or importance of the other factors.

In order to assess the effect of varying the weighting, or level of importance, assigned to each of the major factors considered in this study, four

TABLE V-3A

EVALUATION TABLE

MAJOR FACTOR Weight (a)	MAJOR FACTOR Title	SUBFACTOR Title	Percentage of Major Factor (b)	Percentage of Total (a)x(b)/100 = (c)	ALT. 1 - "NO-BUILD" Rating (d)	ALT. 1 - "NO-BUILD" Weighted Rating (c)x(d)	ALT. 2 - "UPGRADING" Rating (d)	ALT. 2 - "UPGRADING" Weighted Rating (c)x(d)	ALT. 3 - INNER FWY.E. Rating (d)	ALT. 3 - INNER FWY.E. Weighted Rating (c)x(d)	ALT. 4 - INNER FWY.W. Rating (d)	ALT. 4 - INNER FWY.W. Weighted Rating (c)x(d)	ALT. 5 - OUTER FWY. Rating (d)	ALT. 5 - OUTER FWY. Weighted Rating (c)x(d)
35	Socio-Economics	Regional & Community Growth	20	7.00	-2	-14.00	+1	+ 7.00	+2	+14.00	+1	+ 7.00	-2	-14.00
		Development of Adjacent Lands	15	5.25	-2	-10.50	-1	- 5.25	+2	+10.50	0	0	+1	+ 5.25
		Takings & Relocations	15	5.25	-1	- 5.25	-1	- 5.25	-1	- 5.25	-3	-15.75	-2	-10.50
		Public Facilities & Services	10	3.50	0	0	0	0	0	0	0	0	-2	- 7.00
		Community Character & Cohesion	10	3.50	-1	- 3.50	-1	- 3.50	-1	- 3.50	-2	- 7.00	0	0
		Local Tax Base & Property Values	10	3.50	-1	- 3.50	+1	+ 3.50	+2	+ 7.00	-1	- 3.50	0	0
		Agricultural Production	20	7.00	0	0	-1	- 7.00	-2	-14.00	-1	- 7.00	-2	-14.00
			100			-36.75		-10.50		+ 8.75		-26.25		-40.25
25	Traffic Service	Regional & Interstate	10	2.50	0	0	+2	+ 5.00	+3	+ 7.50	+3	+ 7.50	+3	+ 7.50
		Community	35	8.75	0	0	-1	- 8.75	0	0	-2	-17.50	-2	-17.50
		Service Flexibility	20	5.00	-1	- 5.00	0	0	+1	+ 5.00	-1	- 5.00	+1	+ 5.00
		Safety	35	8.75	-1	- 8.75	0	0	+1	+ 8.75	+1	+ 8.75	+1	+ 8.75
			100			-13.75		- 3.75		+21.25		- 6.25		+ 3.75
20	Engineering Economics	Engineering Economy	100	20.00	+1	+20.00	+1	+20.00	+1	+20.00	0	0	+1	+20.00
20	Environmental	Noise	30	6.00	-1	- 6.00	-1	- 6.00	-1	- 6.00	-1	- 6.00	-1	- 6.00
		Air Quality	15	3.00	+1	+ 3.00	0	0	0	0	-1	- 3.00	0	0
		Water Quality & Aquatic Life	15	3.00	0	0	-1	- 3.00	-1	- 3.00	-2	- 6.00	-1	- 3.00
		Vegetation & Wildlife	15	3.00	0	0	0	0	-1	- 3.00	-2	- 6.00	-1	- 3.00
		Parks, Recreation, Historic, Cultural	15	3.00	0	0	0	0	0	0	-2	- 6.00	-1	- 3.00
		Aesthetics & Visual Quality	10	2.00	0	0	+1	+ 2.00	+1	+2.00	+2	+ 4.00	+2	+ 4.00
			100			- 3.00		- 7.00		-10.00		-23.00		-11.00
					Total	-33.50		- 1.25		+40.00		-55.50		-27.50
					RANK	4		2		1		5		3

TABLE V-3B

EVALUATION TABLE

MAJOR FACTOR Weight (a)	MAJOR FACTOR Title	SUBFACTOR Title	Percentage of Major Factor (b)	Percentage of Total (a)x(b)/100 = (c)	ALT. 1 - "NO-BUILD" Rating (d)	ALT. 1 - "NO-BUILD" Weighted Rating (c)x(d)	ALT. 2 - "UPGRADING" Rating (d)	ALT. 2 - "UPGRADING" Weighted Rating (c)x(d)	ALT. 3 - INNER FWY.E. Rating (d)	ALT. 3 - INNER FWY.E. Weighted Rating (c)x(d)	ALT. 4 - INNER FWY.W. Rating (d)	ALT. 4 - INNER FWY.W. Weighted Rating (c)x(d)	ALT. 5 - OUTER FWY. Rating (d)	ALT. 5 - OUTER FWY. Weighted Rating (c)x(d)
20	Socio-Economics	Regional & Community Growth	20	4.00	-2	- 8.00	+1	+ 4.00	+2	+ 8.00	+1	+ 4.00	-2	- 8.00
		Development of Adjacent Lands	15	3.00	-2	- 6.00	-1	- 3.00	+2	+ 6.00	0	0	+1	+ 3.00
		Takings & Relocations	15	3.00	-1	- 3.00	-1	- 3.00	-1	- 3.00	-3	- 9.00	-2	- 6.00
		Public Facilities & Services	10	2.00	0	0	0	0	0	0	0	0	-2	- 4.00
		Community Character & Cohesion	10	2.00	-1	- 2.00	-1	- 2.00	-1	- 2.00	-2	- 4.00	0	0
		Local Tax Base & Property Values	10	2.00	-1	- 2.00	+1	+ 2.00	+2	+ 4.00	-1	- 2.00	0	0
		Agricultural Production	20	4.00	0	0	-1	- 4.00	-2	- 8.00	-1	- 4.00	-2	- 8.00
			100			-21.00		- 6.00		+ 5.00		-15.00		-23.00
50	Traffic Service	Regional & Interstate	10	5.00	0	0	+2	+10.00	+3	+15.00	+3	+15.00	+3	+15.00
		Community	35	17.50	0	0	-1	-17.50	0	0	-2	-35.00	-2	-35.00
		Service Flexibility	20	10.00	-1	-10.00	0	0	+1	+10.00	-1	-10.00	+1	+10.00
		Safety	35	17.50	-1	-17.50	0	0	+1	+17.50	+1	+17.50	+1	+17.50
			100			-27.50		- 7.50		+42.50		-12.50		+ 7.50
15	Engineering Economics	Engineering Economy	100	15.00	+1	+15.00	+1	+15.00	+1	+15.00	0	0	+1	+15.00
15	Environmental	Noise	30	4.50	-1	- 4.50	-1	- 4.50	-1	- 4.50	-1	- 4.50	-1	- 4.50
		Air Quality	15	2.25	+1	+ 2.25	0	0	0	0	-1	- 2.25	0	0
		Water Quality & Aquatic Life	15	2.25	0	0	-1	- 2.25	-1	- 2.25	-2	- 4.50	-1	- 2.25
		Vegetation & Wildlife	15	2.25	0	0	0	0	-1	- 2.25	-2	- 4.50	-1	- 2.25
		Parks, Recreation, Historic, Cultural	15	2.25	0	0	0	0	0	0	-2	- 4.50	-1	- 2.25
		Aesthetics & Visual Quality	10	1.50	0	0	+1	+ 1.50	+1	+ 1.50	-2	+ 3.00	+2	+ 3.00
			100			- 2.25		- 5.25		- 7.50		-17.25		- 8.25
					Total	-35.75		- 3.75		+55.00		-44.75		- 8.75
					RANK	4		2		1		5		3

TABLE V-3C

EVALUATION TABLE

MAJOR FACTOR		SUBFACTOR			ALT. 1 - "NO-BUILD"		ALT. 2 - "UPGRADING"		ALT. 3 - INNER FWY.E.		ALT. 4 - INNER FWY.W.		ALT. 5 - OUTER FWY.	
Weight (a)	Title	Title	Percentage of Major Factor (b)	Percentage of Total (a)x(b)/100 = (c)	Rating (d)	Weighted Rating (c)x(d)	Rating (d)	Weighted Rating (c)x(d)	Rating (d)	Weighted Rating (c)x(d)	Rating (d)	Weighted Rating (c)x(d)	Rating (d)	Weighted Rating (c)x(d)
25	Socio-Economics	Regional & Community Growth	20	5.00	-2	-10.00	+1	+ 5.00	+2	+10.00	+1	+ 5.00	-2	-10.00
		Development of Adjacent Lands	15	3.75	-2	- 7.50	-1	- 3.75	+2	+ 7.50	0	0	+1	+ 3.75
		Takings & Relocations	15	3.75	-1	- 3.75	-1	- 3.75	-1	- 3.75	-3	-11.25	-2	- 7.50
		Public Facilities & Services	10	2.50	0	0	0	0	0	0	0	0	-2	- 5.00
		Community Character & Cohesion	10	2.50	-1	- 2.50	-1	- 2.50	-1	- 2.50	-2	- 5.00	0	0
		Local Tax Base & Property Values	10	2.50	-1	- 2.50	+1	+ 2.50	+2	+ 5.00	-1	- 2.50	0	0
		Agricultural Production	20	5.00	0	0	-1	- 5.00	-2	-10.00	-1	- 5.00	-2	-10.00
			100			-26.25		- 7.50		+ 6.25		-18.75		-28.75
15	Traffic Service	Regional & Interstate	10	1.50	0	0	+2	+ 3.00	+3	+ 4.50	+3	+ 4.50	+3	+ 4.50
		Community	35	5.25	0	0	-1	- 5.25	0	0	-2	-10.50	-2	-10.50
		Service Flexibility	20	3.00	-1	- 3.00	0	0	+1	+ 3.00	-1	- 3.00	+1	+ 3.00
		Safety	35	5.25	-1	- 5.25	0	0	+1	+ 5.25	+1	+ 5.25	+1	+ 5.25
			100			- 8.25		- 2.25		+12.75		- 3.75		+ 2.25
50	Engineering Economics	Engineering Economy	100	50	+1	+50.00	+1	+50.00	+1	+50.00	0	0	+1	+50.00
10	Environmental	Noise	30	3.00	-1	- 3.00	-1	- 3.00	-1	- 3.00	-1	- 3.00	-1	- 3.00
		Air Quality	15	1.50	+1	+ 1.50	0	0	0	0	-1	- 1.50	0	0
		Water Quality & Aquatic Life	15	1.50	0	0	-1	- 1.50	-1	- 1.50	-2	- 3.00	-1	- 1.50
		Vegetation & Wildlife	15	1.50	0	0	0	0	-1	- 1.50	-2	- 3.00	-1	- 1.50
		Parks, Recreation, Historic, Cultural	15	1.50	0	0	0	0	0	0	-2	- 3.00	-1	- 1.50
		Aesthetics & Visual Quality	10	1.00	0	0	+1	+ 1.00	+1	+ 1.00	+2	+ 2.00	+2	+ 2.00
			100			- 1.50		- 3.50		- 5.00		-11.50		- 5.50
					Total	+14.00		+36.75		+64.00		-34.00		+18.00
					RANK	4		2		1		5		3

TABLE V-3D

EVALUATION TABLE

MAJOR FACTOR		SUBFACTOR			ALT. 1 - "NO-BUILD"		ALT. 2 - "UPGRADING"		ALT. 3 - INNER FWY.E.		ALT. 4 - INNER FWY.W.		ALT. 5 - OUTER FWY.	
Weight (a)	Title	Title	Percentage of Major Factor (b)	Percentage of Total (a)x(b)/100 = (c)	Rating (d)	Weighted Rating (c)x(d)	Rating (d)	Weighted Rating (c)x(d)	Rating (d)	Weighted Rating (c)x(d)	Rating (d)	Weighted Rating (c)x(d)	Rating (d)	Weighted Rating (c)x(d)
25	Socio-Economics	Regional & Community Growth	20	5.00	-2	-10.00	+1	+ 5.00	+2	+10.00	+1	+ 5.00	-2	-10.00
		Development of Adjacent Lands	15	3.75	-2	- 7.50	-1	- 3.75	+2	+ 7.50	0	0	+1	+ 3.75
		Takings & Relocations	15	3.75	-1	- 3.75	-1	- 3.75	-1	- 3.75	-3	-11.25	-2	- 7.50
		Public Facilities & Services	10	2.50	0	0	0	0	0	0	0	0	-2	- 5.00
		Community Character & Cohesion	10	2.50	-1	- 2.50	-1	- 2.50	-1	- 2.50	-2	- 5.00	0	0
		Local Tax Base & Property Values	10	2.50	-1	- 2.50	+1	+ 2.50	+2	+ 5.00	-1	- 2.50	0	0
		Agricultural Production	20	5.00	0	0	-1	- 5.00	-2	-10.00	-1	- 5.00	-2	-10.00
			100			-26.25		- 7.50		+ 6.25		-18.75		-28.75
15	Traffic Service	Regional & Interstate	10	1.50	0	0	+2	+ 3.00	+3	+ 4.50	+3	+ 4.50	+3	+ 4.50
		Community	35	5.25	0	0	-1	- 5.25	0	0	-2	-10.50	-2	-10.50
		Service Flexibility	20	3.00	-1	- 3.00	0	0	+1	+ 3.00	-1	- 3.00	+1	+ 3.00
		Safety	35	5.25	-1	- 5.25	0	0	+1	+ 5.25	+1	+ 5.25	+1	+ 5.25
			100			- 8.25		- 2.25		+12.75		- 3.75		+ 2.25
10	Engineering Economics	Engineering Economy	100	10.00	+1	+10.00	+1	+10.00	+1	+10.00	0	0	+1	+10.00
50	Environmental	Noise	30	15.00	-1	-15.00	-1	-15.00	-1	-15.00	-1	-15.00	-1	-15.00
		Air Quality	15	7.50	+1	7.50	0	0	0	0	-1	- 7.50	0	0
		Water Quality & Aquatic Life	15	7.50	0	0	-1	- 7.50	-1	- 7.50	-2	-15.00	-1	- 7.50
		Vegetation & Wildlife	15	7.50	0	0	0	0	-1	- 7.50	-2	-15.00	-1	- 7.50
		Parks, Recreation, Historic, Cultural	15	7.50	0	0	0	0	0	0	-2	-15.00	-1	- 7.50
		Aesthetics & Visual Quality	10	5.00	0	0	+1	+ 5.00	+1	+ 5.00	+2	+10.00	+2	+10.00
			100			- 7.50		-17.50		-25.00		-57.50		-27.50
					Total	-32.00		-17.25		+ 4.00		-80.00		-44.00
					RANK	3		2		1		5		4

evaluation tables were prepared. In each of these tables, primary emphasis was assigned to one of the major factors.

Initially (Table V-3a) it was considered that of the four major factors being compared, Socio-Economics and Traffic Service were of major significance on this project. In view of the effect that a major highway improvement would likely have in support of the adopted policy of balancing metropolitan area growth, socio-economics was weighted 35%. Since improved traffic service would increase the attractiveness of the eastern area, traffic service was weighted 25 percent. Engineering Economics and Environmental considerations were assigned a lesser but equal weighting of 20 percent each.

In the succeeding Tables (V-3b through V-3d) a 50 percent weight was assigned to Traffic Service, Engineering Economics, and Environmental Factors in turn. The weights of the remaining factors were assigned to maintain the relationship between them shown in Table V-3a.

The final steps in the ranking procedure are the performance of the mathematical operations in the Evaluation Table to arrive at a total "score" for each alternative. The highest "score" indicates the most desirable alternative with respect to the ratings and weighting assigned. The alternatives were then ranked from 1 to 5 (most desirable to least desirable) for each of the four weighting schemes used. The results of this ranking are shown following:

RANKING *

	Weighting Scheme (Table V-3)			
	a	b	c	d
Alternative 1	4	4	4	3
Alternative 2	2	2	2	2
Alternative 3	1	1	1	1
Alternative 4	5	5	5	5
Alternative 5	3	3	3	4

* 1 = Most Desirable

5 = Least Desirable

As can be seen, Alternative 3 is ranked "most desirable" regardless of which weighting scheme is used while Alternative 4 is "least desirable".

SECTION VI

PROBABLE, UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Section IV of this report provided a detailed description of the probable environmental effects - both adverse and beneficial - of the proposed action and the alternatives considered. This section summarizes the probable adverse effects that are deemed unavoidable, even though, in some cases, steps may be taken to minimize harm.

A. DISLOCATION AND RELOCATION

An expanding highway network means, for some people, giving up especially valuable possessions - their homes, businesses or farms - in order that the entire public might benefit. To reduce the displacement hardships caused by highway land acquisition, eligible families and businesses will receive compensation through acquisition payments and through relocation assistance.

Acquisition payments are based on the property's fair market value as determined through an appraisal guided by current sales and prices. The payments are made specifically for the home, farm or business buildings, and for property such as land, fences, wells and trees. In cases of partial acquisition, payment is based on a comparison of the fair market value before and after acquisition.

The relocation assistance program supplements these acquisition payments in order to mitigate the economic stress involved in the process of moving and finding replacement housing. Supplemental housing payments are offered in the amount necessary which, when added to the acquisition payment, will enable the resident to acquire a decent, safe and sanitary replacement dwelling. This supplemental payment can amount to a maximum of $15,000 for owner-occupied residences or $4,000 for dwellings occupied by tenants. If a home is vacant, the owner would not qualify for relocation payments as this program applies to occupants.

Supplemental payments include a compensation for various moving expenses which is offered to any individual, family, business, farm operation or non-profit organization that is required to move as a result of the highway project. Also available are other services and relocation information as provided for in the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and House File 182, 64th General Assembly, State of Iowa.

Programmed replacement housing as a "last resort" is provided for under Section 206 of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. This Act stipulates that if the local agency determines it is in the public interest to proceed with the construction of the Federal-aid project and it cannot do so because of an inadequate supply of comparable replacement housing, then it may, as a last resort, provide the necessary housing by use of funds authorized for the highway projects.

The physical displacement of homes and businesses, despite the relocation process, must be viewed as an unavoidable adverse impact.

Preliminary surveys indicate that the location, design and construction of any of the proposed Beltway 500 alternatives would not be in conflict with the provision of Title VI of the Civil Rights Act of 1964 which states: "The State shall not locate, design or construct a highway in such a manner to require, on the basis of race, color, or national origin, the relocation of any persons." The number of homes, businesses and farmsteads that would be dislocated by each of the alternates is discussed in Section IV A of this report.

B. PROPERTY VALUES

A reduction in the value of residences located immediately adjacent to the new Beltway is likely. This effect will be most severe in the Capitol Heights area of Delaware Township adjacent to Alternative 4.

C. UTILITY IMPACTS

Although the locations of existing storm sewer, water distribution, electrical distribution and pipe lines were known and taken into account during the route location process, it was impossible to avoid impacting them to some extent with construction of the Beltway. The impacts were minimized by locating the alignments on the periphery of existing service districts and parallel to major transmission facilities. Alternatives 2, 3 & 4 are located near the Iowa Power and Light electric generating station and will require some relocation of existing transmission lines in the area south of Parkridge Avenue and Scott Avenue. In addition, Alternative 4 will cross watermains at Easton Boulevard, Douglas Avenue and Hubbell Avenue. Proper construction staging will insure continued service from all utilities during the relocation process, and service is not expected to be interrupted by Beltway construction regardless of the alternative chosen.

D. AGRICULTURAL PRODUCTIVITY

Construction of Arterial Highway 500 will result in the acquisition of about 250 to 650 acres of good quality farm land for right-of-way, depending on the alternative chosen. A more significant impact will result from the conversion of farmland to other land uses as a result of secondary development. While the total magnitude and spatial distribution of secondary development varies depending upon the alternative chosen, local governments can have a major influence in shaping the resulting development through application and interpretation of zoning ordinances. In any event, land in the western areas of the study corridor is less desirable for agricultural uses than land in the eastern sections, and the choice of any of the western alternatives (2, 3 & 4) would tend to minimize the impact of direct and secondary land conversion on agricultural production in the corridor.

E. NOISE ENVIRONMENT

Noise levels higher than the FHWA Design Noise levels for Category B activities will occur at several locations along Alternative 4 and at one location along Alternative 2.

Design Noise Level impacts will also occur along sections of existing streets and roadways within the study corridor, regardless of which alternative is selected, including the "No-build" Alternative. It appears that abatement measures to reduce the noise to acceptable levels at the affected sites is either not economically or technically feasible. Significant increases in the ambient noise environment will occur along certain Beltway segments and along major local streets and roadways regardless of which alternative is selected, although the resultant noise levels will not be higher than the FHWA Design Noise Level criteria.

In locations where noise abatement is not feasible. vegetative screening can be used to reduce the psychological effect of increased noise levels. Judicious land use planning and application of controls can assure compatible development of presently undeveloped areas immediately adjacent to the proposed Beltway.

F. WATER QUALITY

Construction of any of the Beltway alternatives will result in erosion, turbidity and sedimentation during the construction period and until complete stabilization of cut slopes occurs. The presence of a new highway will also increase the amount of highway related chemicals that find their way into area streams.

Alternative 4 will result in increased sediment loads in Four Mile Creek during construction. Alternatives 2 and 3 will have a similar but lesser effect. Alternative 5 will result in increased sediment loads in Mud and Spring Creeks. No long-term adverse effects are expected due to erosion from any of the alternatives.

The greatest potential for degradation of water quality in local streams lies in the use of deicing chemicals.

Current maintenance policies of the Iowa Department of Transportation incorporate practices to guard against the adverse effects caused by deicing salts. Improved salt spreaders and calibration methods insure that only the amount needed to do the job will be applied to the pavement. Maintenance foremen are charged with the responsibility of exercising good judgement in determining where to salt and how much to salt in order to fulfill the obligation of keeping the traffic moving safely. The aim of snow and ice removal operations is to return the driving surface to normal conditions as soon as possible.

The Iowa Department of Transportation has been a leader in the development of calibration for salt spreaders and it presently uses the most sophisticated ground-oriented calibrated spreaders ever developed to assure efficient and economical application. An application technique utilizing salt solutions is also being developed by the maintenance department. This technique allows a reduction in the amount of salt necessary for deicing purposes. It also reduces the incidence of salt scattering onto roadside vegetation during application. This recent development has been put to use on Iowa'a Interstate highways and will be expanded to all primary roads in future years.

Salt stored by the Iowa Department of Transportation is stockpiled in permanent buildings or covered to protect it from wind and rain. When outside storage is necessitated, the salt is covered and is stored for a very short time period to assure minimum exposure to the elements.

G. VEGETATION AND WILDLIFE

There will be a direct loss of some vegetated areas, and associated wildlife habitat, as a result of constructing any of the Beltway alternatives.

Alternative 4 would have the greatest impact on vegetation of all the alternatives considered. It penetrates areas planned for natural preservation along both the Des Moines River and Four Mile Creek. Removal of wildlife habitat is somewhat offset by the introduction of edge cover along highway rights-of-way which provides habitat for certain species. Alternative 4 also effectively blocks wildlife movement from the wooded areas along N.E. 56th Street to Four Mile Creek north of Iowa 163. Common to all alternatives would be a loss of vegetation and associated wildlife as a result of increased development within the study corridor.

The Iowa Department of Transportation has adopted a practive of limited mowing and spraying to encourage wildlife nesting in right-of-way areas. Rights-of-way are not mowed until after July 1st, the end of the peak nesting period. Then, only medians and a single swath along the foreslopes are mowed so motorists can distinguish the edges of the shoulders. Bridge berms and similar areas are planted with low-growing ground cover plantings such as crown vetch, thus eliminating the need for mowing.

The Iowa Department of Transportation does not practice blanket spraying of highway rights-of-way. Rather, the Department cooperates with the respective County Weed Commissioner to determine the herbicide to use in controlling noxious weeds. The growth of such weeds is discouraged by the dominating cover of the roadside vegetation. When spraying is necessitated, the herbicide is applied in an emulsion form to minimize drift.

The acquisition of additional property along the highway during acquisition of right-of-way, as discussed in greater detail elsewhere in this report, can help to preserve existing open space areas in their natural state.

H. RECREATION / OPEN SPACE

Alternative 4 passes through a part of the Des Moines southeast riverfront area designated for open space use and through the proposed Whites Lake private recreation area. Visual and noise impacts in this area are unavoidable.

Alternative 4 also passes through the Four Mile Creek valley which is designated in the ROSS plan for open space preservation and trail development. The highway will be above grade either on fill or structure, through both of these areas.

Alternative 5 passes close to a proposed Polk County park near Woodland Hills. Visual impact at this site would be unavoidable.

Impacts upon open space lands can be reduced by providing extensive landscaping to help the highway blend in with the surrounding terrain.

I. AESTHETICS

All of the Beltway alternatives will visually disturb the natural setting of the study corridor. Two distinct areas in which this visual impact will be most pronounced are 1) the wooded river bluffs and 2) developing residential neighborhoods.

1. River Bluffs - The wooded river bluffs of the Des Moines River and Four Mile Creek valleys are recognized as being a desirable and irreplaceable regional resource. The transition between wooded slopes and the valley floor is very pronounced, particularly in the vicinity of Alternative 4 south of the river, and near Alternative 5 north of the river. In these areas, the proposed highway will descend into the valley passing through the bluff line and resulting in large, local cuts and fills. This will interrupt the visual and physical continuity of the valley and the dramatic transition between the bluff and the river valley floor will be diminished.

The impact on the wooded areas can be minimized by limiting the number of trees taken, rounding back the slopes into the surroundings and revegetating the cut areas as quickly as possible. The visual impact on the valley/bluff interface can be minimized through the use of variable slopes and plantings to blend the Beltway into the existing terrain. These measures will improve the scenic quality of the road for the motorist, minimize potential erosion and reduce the visual intrusion of the Beltway.

2. Residential Neighborhoods - Several of the alternatives (2, 3 & 4) under consideration will pass through existing or developing residential communities. This will interrupt the physical and visual character of the existing neighborhoods, and affect the orientation and development of the emerging areas.

The negative effects of the Beltway's impact on these neighborhoods will be reduced by:

- depressing the Beltway in existing or potential residential neighborhoods,
- providing grade separation structures to minimize the isolating effects of the Beltway,
- including landscape plantings to minimize the harshness of the transportation facility and help it become an integral part of the area,
- assisting state or local agencies in acquiring open space areas adjacent to the right-of-way consistent with local comprehensive plans.
- encouraging local officials to control land uses adjacent to the Beltway so that they conform to the characteristics of the surrounding community.

SECTION VII

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

A primary objective of planned development is to ensure that short-term uses of the environment do not conflict with long-term productivity. Due to the large and often irreversible commitments of resources in a highway project such as the 500 "Build" alternatives, this relationship must be carefully evaluated.

During the construction phase of the Beltway, many noticeable short-term disruptions of the environment would occur. These include the noise, dust, and exhaust emissions from the operation of heavy equipment, an increased potential for soil erosion from denuded ground surfaces, and in some cases, the temporary disruption of local traffic patterns. Such adverse effects limit the short-term utilization and enjoyment of the environment. The construction period would also result in short-term economic gains. The demand for construction personnel and the need for service facilities for both men and machines should increase, resulting in regional fiscal benefits.

On a broader scale, the existing environment would be altered by the re-shaping of the landscape to obtain a smooth grade line and by the removal of natural features such as vegetation. As a result, some wildlife habitat would be removed, and some woodland areas impacted. The long-term effect of the Belt-way on wildlife and vegetation is expected to be minimal as the corridor is already under the influence of extensive agricultural and urban land uses. Once construction is complete, revegetation of the right-of-way will help provide an effective cover for small wildlife species in the area.

Highway construction will result in the displacement of families, the re-moval of urban and farm dwellings and, consequently, a reduction in local tax base. The relocation assistance program will reduce the financial impact on those displaced, while increased accessibility afforded by the "Build" alterna-tives should induce enough area growth and development to not only offset the local tax base losses, but also provide long-term economic gains to the corridor communities.

The majority of land in the vicinity of the proposed improvement is used for agricultural purposes. This land is of prime importance in meeting present as well as future food needs. While the amount of good quality farmland directly taken for the right-of-way for the "Build" alternatives varies from about 250 to 660 acres, the principal conversion of agricultural land to urban type uses will be caused by secondary (induced) development. The magnitude and spatial distri-bution of this development is dependent on the alternative selected.

The direct conversion of agricultural lands to a transportation facility would also yield important benefits. These long-term benefits include the added safety of an improved expressway or freeway type facility, a reduction of traffic congestion and increased convenience for the individual and commercial highway traveler. In addition to the traffic considerations, a wide range of public benefits would be derived from the improved accessibility provided by these alternative alignments. The reduction in travel time and distance inherent in the "Build" alternatives could provide access to a wider array of cultural, social, economic and employment opportunities for residents of eastern Des Moines and surrounding areas. For example, improved north-south access to recreation areas such as Hubbell Park, the Polk County Park near Woodland Hills, the proposed White's Lake recreation area and the Adventureland Theme Park would provide additional recreational opportunities for Des Moines area residents. Access to the industrial areas of Des Moines, Pleasant Hill and Altoona would also be improved.

Generally, improved accessibility would increase the attractiveness of the project area to prospective residents and employers; and thus the proposed 500 "Build" alternatives would coincide with the Central Iowa Regional Association of Local Governments' promotion of areawide policies and programs that facilitate the implementation of balanced metropolitan growth. CIRPC's (now CIRALG) "Initial Metro-Plan Concept 1900-2000" emphasized that the productivity of the metropolitan area will benefit more from a redirection of the dominant westward expansion toward increased growth to the south and east of Des Moines than by allowing the existing development patterns to continue. CIRALG's Des Moines Urban Area Transportation Plan proposed a "Beltway" bordering the metropolitan area as one means of facilitating this balanced growth. The "Build" alternatives under consideration in the 500 project would serve as the eastern segment of this Beltway. As such, the utilization of the environment for a 500 facility would be an integral part of this comprehensive plan for the metro area and would serve the traffic needs of the anticipated development.

SECTION VIII

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

An irreversible commitment of resources involves the consignment of those resources in such a fashion as to initiate an event or chain of events that cannot be prevented from occurring.

An irretrievable commitment of resources involves the consignment of resources to an action in such a fashion as to ensure that those resources are no longer available for any other present or future use.

Investment in a highway project such as the 500 facility would involve a long-term and, in some instances, irreversible and irretrievable commitment of resources. Accelerated development will likely be stimulated within the corridor as a result of the improved accessibility provided by the "Build" alternatives. The pressure for development may be an irreversible trend, but does not necessarily result in irreversible or irretrievable commitments of resources. Control by local planning and zoning agencies must allow for, or even promote, development that is deemed favorable.

Agricultural crop land is the main resource that will be lost if a Beltway is constructed within the corridor. From 250 to 660 acres of good agricultural land could be required for right-of-way for the "Build" alternatives. This constitutes about 0.8 to 2.2 percent of undeveloped corridor land suitable for agriculture. By contrast, from 7700 to 9500 acres of good agricultural land could be converted to developed use by the year 2000 because of new development following construction of the "Build" alternatives. Even under the "No-build" alternative it is expected that about 6300 acres could be lost from agricultural use as a result of new development. While the land committed to highway use could be reconverted to other uses in the future, and is thus not an irretrievable commitment, the land which will undergo developmental conversion, while not totally irretrievable, would be extremely expensive to reclaim.

In regional context, however, it must be kept in mind that future development which does not take place within the study corridor, such as under the "No-build" Alternative, would take place elsewhere in the metropolitan area, likely in the north and west. Similar conversions could be expected in this area of equally good or better agricultural land. Thus, while a decision on the 500 Beltway will affect the regional distribution of agricultural land loss, it will likely not affect the total amount of land ultimately lost to developed use.

Regional planning objectives include a balancing of growth within the metropolitan area in order to minimize costs and commitment of resources to provide urban services to developed areas. The 500 Beltway will contribute to this goal.

In central Iowa, remaining forest and woodland areas are considered a valuable natural resource that should be preserved. The main concentration of woodlands in the study corridor is along the north bluff of the Des Moines River, and immediately adjacent to other corridor streams. It will be impossible to construct a major highway without damaging some of the forest land. Where it becomes necessary to route the facility through a wooded area, the highway right-of-way will be revegetated with native grasses, shrubs and trees. The loss of natural wooded areas does, however, represent an irretrievable commitment of resources.

On Alternative 4, the conversion of open-space areas designated for natural preservation along both the Des Moines River and Four Mile Creek to highway use does represent an irretrievable commitment. While these areas could be returned to other than highway use in the future, if desired, it is unlikely that they could be returned to their present natural state.

Materials (e.g. cement, sand, gravel, asphalt, steel and aluminum) which will be required for Beltway construction could be recycled in the future, depending on the needs and economics prevailing at that time. Motor fuels and lubricants used during construction are a truly irretrievable commitment of these resources, especially when the quantities of these products currently being expended on a project of this scale are becoming more significant relative to national use and declining availability. Finally, human resources will be invested in this project. The Beltway will be the direct result of all the irretrievable staff hours spent in programming, planning, design and construction.

SECTION IX

COMMUNITY INVOLVEMENT AND AGENCY COMMENTS

This study was conducted in coordination with the affected local governments, appropriate regional, state and federal agencies and the citizens of the eastern Des Moines metropolitan area.

A. COMMUNITY INVOLVEMENT

Study corridor residents were kept informed of the progress of the study through 1) informational meetings and 2) newsletters. Informational meetings were scheduled three times during the course of the study, both to inform the public and to obtain public input. Meetings were held a) at the beginning of the study b) following the selection of alternative alignments for detailed study and c) prior to the public hearing. The public was notified of meetings through the local media and the study newsletter.

Newsletters were mailed to study corridor residents four times during the course of the study to keep them abreast of study progress.

In addition, a local informational office was maintained in Des Moines. Residents were encouraged to visit the office to view study maps and other displays and to comment on the study.

B. AGENCY COMMENTS

The following agencies were contacted during the course of the study, either by formal letter, phone call or personal visit:

City of Altoona
City of Bondurant
City of Carlisle
City of Des Moines
City of Hartford
City of Indianola
City of Norwalk
City of Pleasant Hill
Polk County Board of Supervisors
Warren County Board of Supervisors
Warren County Regional Planning Commission
Central Iowa Regional Association of Local Governments
Des Moines Plan and Zoning Commission
Des Moines Department of Traffic and Transportation
Polk County Conservation Board
Iowa Conservation Commission
Iowa Natural Resources Council
Iowa Department of Environmental Quality
Iowa State Historical Department
State Archaeologist of Iowa

Iowa Office for Planning and Programming
Iowa Department of Agriculture
Iowa Geological Survey
Iowa Development Commission
Iowa Employment Security Commission
U.S. Environmental Protection Agency
U.S. Department of the Interior
U.S. Soil Conservation Service
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Agricultural Stabilization and Conservation Service
Iowa Civil Rights Commission
Mission Center, Inc.

The approximate date and type of contact made with each agency, a summary of information exchanged and the report sections in which the information was used are outlined below.

City of Altoona

December 1974	- Meeting with city officials to introduce study.
March 1975	- Meeting with city officials to present alternative alignments. (Altoona prefers an alignment east of the city.)
April 1975	- Meeting to present status report to council.
July 1975	- Letter seeking comment on alternative alignments. (No response)

City of Des Moines

July 1975	- Letters seeking comment on alternative alignments. (Indicated preference for Alternative 4)

Cities of Hartford, Indianola and Norwalk

July 1975	- Letter seeking comment on alternative alignments (No response)

City of Bondurant

April 1975	- Meeting with mayor concerning status of study.
July 1975	- Letter seeking comment on alternative alignments. (No response)

City of Carlisle

March 1975	- Meeting with mayor concerning status of study (Carlisle would prefer an alignment lying close to Des Moines.)
July 1975	- Letter seeking comment on alternative alignments. (No response)

City of Pleasant Hill

December 1974	- Meeting with city officials to introduce study.
March 1975	- Meeting with city officials to present alternative alignments (Pleasant Hill does not like either Alternative 2 or 3 which divide the city. Would prefer a line somewhat east of Alternative 3. Alternative 4 would be acceptable.)
April 1975	- Meeting to present status report to council.
July 1975	- Letter seeking comment on alternative alignments. (No response)

Polk County Board of Supervisors

December 1974	- Attended Polk County land use hearing.
March 1975	- Meeting with County Engineer to present alternative alignments.
April 1975	- Meeting with county officials to present study status.
July 1975	- Letter seeking comment on alternative alignments. (No response)

Warren County Board of Supervisors

July 1975	- Letter seeking comment on alternative alignments. (No response)

Warren County Regional Planning Commission

July 1975	- Letter seeking comment on alternative alignments. (No response)

Central Iowa Regional Association of Local Governments

March 1975	- Letter concerning status of 208 Wastewater Study. (Report Section III A and Appendix I)
March 1975	- Meeting to present alternative alignments.
April 1975	- Meeting to present study status.
July 1975	- Letter seeking comment on alternative alignments. (No response)
October 1975	- Attended meeting of Transportation Technical Committee to present alternative alignments.

Des Moines Plan and Zoning Commission

April 1975	- Letter requesting information on riverfront planning. (Report Section IV H and VI H)
April 1975	- Meeting with staff to present alternative alignments.
March 1975	- Meeting with staff to present study status.
May 1975	- Attended neighborhood planning meeting. (Report Section IV A)
July 1975	- Meeting with staff to discuss study.
July 1975	- Letter seeking comments on alternative alignments. (No response)

Des Moines Department of Traffic and Transportation

March 1975	- Meeting with staff to present alternative alignments.
April 1975	- Letter concerning accident data. (Report Section III D)
April 1975	- Meeting with staff to present study status.
July 1975	- Letter seeking comment on alternative alignments. (Indicated preference for Alternative 4)

Polk County Conservation Board

June 1975	- Visit to obtain Comprehensive Planning Resume. (Report Sections III B and IV H)
August 1975	- Letter seeking comment on alternative alignments. (No response)
January 1976	- Letter from the Board indicating a proposed addition to the County Park at Woodland Hills. As a result of this contact, a significant revision in the alignment of Alternative 5 was made to bypass the proposed park addition. (Report Section III B and Figure V-5)

Iowa Conservation Commission

July 1974	- Letter from Commission concerning wildlife. (Report Sections III I and IV G)
October 1974	- Meeting with staff to discuss study.
January 1975	- Letter from Commission with general comments on study. (Report Section IV G)
July 1975	- Letter seeking comments on alternative alignments. (Indicated preference for Alternative 2 to minimize loss of habitat)

Iowa Natural Resources Council

December 1975	- Phone contact concerning stream and river crossing regulations. (Report Appendix IV D)

Iowa Department of Environmental Quality

December 1975	- Phone contact concerning air quality and drainage criteria. (Report Sections III F & H, and IV E & F)

Iowa State Historical Department

State Archaeologist of Iowa

October 1974	- Letter seeking general information about study corridor. (No response)
March 1975	- Letter requesting detailed inventory. (Report Section III B)
August 1975	- Letter seeking comment on alternative alignments. (No response)

Iowa Office for Planning and Programming

September 1974 - Letter from office concerning Altoona water supply.

Iowa Development Commission

Iowa Employment Security Commission

March 1975 - Visit to gather employment data. (Report Section III B)

U.S. Department of the Interior

August 1975 - Letter seeking comment on alternative alignments. (No response)

U.S. Soil Conservation Service

January 1975 - Visit to collect areawide soils data. (Report Appendix IV C)

U.S. Army Corps of Engineers

October 1974 - Meeting with staff in Rock Island, Illinois, to discuss study. (Report Appendix IV D)

August 1975 - Letter seeking comment on alternative alignments. (Received general reply concerning effect of alternative alignments on Red Rock flood pool and offer to supply additional information)

U.S. Coast Guard

April 1975 - Phone contact concerning permit requirements.

U.S. Agricultural Stabilization and Conservation Service

October 1974 - Visit to collect crop yield and other data. (Report Section III C and Appendix III)

Iowa Civil Rights Commission

Mission Center, Inc.

August 1975 - Letter seeking comment on alternative alignments. (No response)

Iowa Department of Agriculture

Iowa Geological Survey

U.S. Environmental Protection Agency

Contacts were made at different times during the study and/or published data was used in the conduct of the study.

In addition to the specific contacts listed above, numerous additional contacts by phone or personal visit were made with a number of the agencies mentioned throughout the course of the study. These contacts were for the purpose of gathering data, soliciting comment and for keeping abreast of the status of areawide planning within the Des Moines metropolitan area. Agencies most frequently contacted included the cities of Altoona and Pleasant Hill, the Central Iowa Regional Association of Local Governments and the Des Moines Plan and Zoning Commission.

This report will be circulated to the proper governmental agencies for review. Copies will also be made available to the public. After sufficient time has been allowed for review, a corridor public hearing will be held. Interested persons and agencies will be given an opportunity at that time to further express their views on the proposed project.

APPENDIX I

METROPOLITAN AND STUDY AREA GROWTH FRAMEWORK

Construction of a Southeast Beltway or alternative roadway upgrading would be but one of several socio-economic forces shaping the nature and extent of future development in the eastern portion of the Des Moines metropolitan area. This section describes the evaluation of growth trends, policies and potentials in the metropolitan area as a framework for identifying and assessing highway development needs and impacts in the study corridor.

First, total metropolitan area population and employment growth was projected to the year 2000, based on a review and update of recent regional planning studies.

Second, component growth range estimates were made for the study corridor portion of the metropolitan area reflecting local and metropolitan area land use planning and the alternative highway development policies.

Third, in order to update corridor traffic projections, specific population and employment estimates for the year 2000 were made reflecting the effect of the highway alternatives on the distribution of growth (i.e. secondary impacts) among eight development assessment areas within the corridor.

A. METROPOLITAN GROWTH PROJECTION - 2000

1. Population

From 1960 to 1970, the eight-county Central Iowa Region encompassing the City of Des Moines grew in population from approximately 462,000 to 502,000. The 40,000 increase, an average annual growth rate of 0.87%, represented two-thirds of the total state population gain of 67,000. During the same period, the Des Moines metropolitan area, comprised by most of Polk County plus adjoining portions of northern Warren and eastern Dallas Counties, grew by approximately 24,000 to a total population of 291,200. The annual growth rate for the metropolitan area was 0.90%, or about the same as that for the eight-county region as a whole. However, growth slowed considerably as compared to the 1950's, when the metropolitan area grew from 225,600 to 266,900, an average annual growth rate twice (1.8%) that of the 1960's. The reduced growth rate reflected a sharply declining birth rate and a change in net migration from a pattern dominated by rural to metropolitan area movement of the younger age groups, to the pattern of net out-migration characteristic of the region and state through both the 1950's and 1960's.

Between 1965 and 1972, the Central Iowa Regional Planning Commission (CIRPC) conducted a number of studies of regional and metropolitan growth as part of an overall program of urban and regional land use and transportation planning, including the Des Moines Urbanized Area Transportation Study as required under the Federal Highway Act of 1962. In these studies CIRPC explored three alternative concepts for regional development: containment, decentralization, and centralization. Centralization, with the metropolitan area remaining the dominate growth center of the region, was identified as most closely reflecting the "pace of growth" in the region.

CIRPC population projections for its Initial Metro Plan Concept 1990/2000, a "basis for discussion" on the pattern and needs of future urban development in the Des Moines Metropolitan Area, and for the companion Initial Des Moines Urbanized Area Transportation Plan both reflect a centralized regional growth pattern. Originally, a 1990 population of 368,600 was projected for the Transportation Study Area, an area somewhat smaller than the Metropolitan Area (see Figure AI-1). For the Initial Metro Plan Concept, these figures were revised downward to Metropolitan Area projections of 330,000 by 1980, 360,000 by 1990 and 390,000 by 2000.

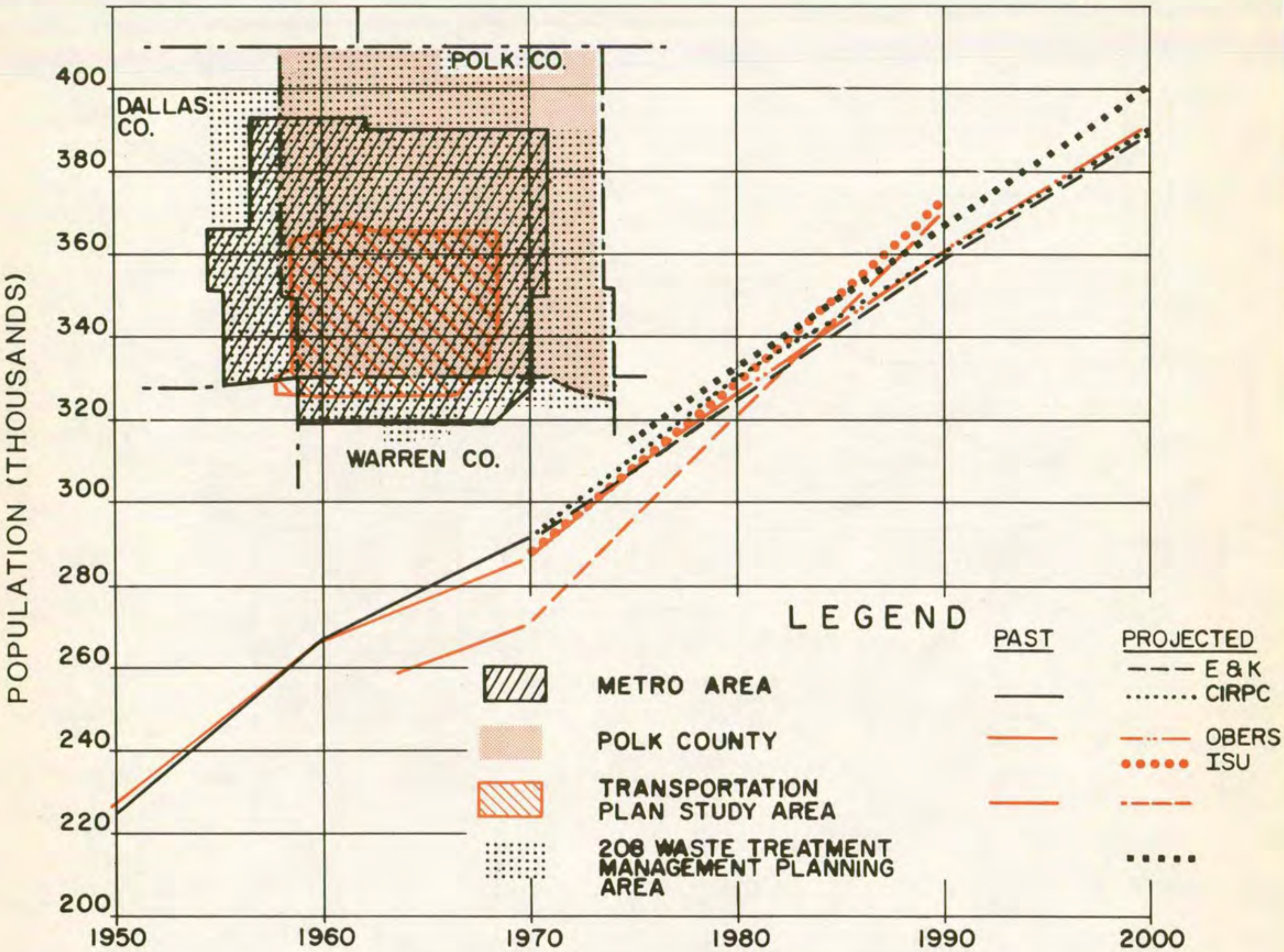
More recently, Real Estate Research Corporation (RERC), in studies for the Central Iowa Regional Association of Local Governments (CIRALG), successor to CIRPC, projected a 1990 Polk County population of 348,000. A corresponding 1990 projection on a Metropolitan Area basis would be approximately 360,000. Extended to 2000, the moderate annual growth rate of approximately 0.95% reflected in the RERC projections would produce a Metropolitan Area population of approximately 390,000, the same population level as projected under the Initial Metro Plan Concept.

CIRALG has further reviewed areawide population projections as part of its current "208" Areawide Waste Treatment Management program. Its Land Use Committee has approved, for 208 study use, a population projection of 400,000 by the year 2000 for the 208 study area, an area slightly larger than the Metropolitan Area as defined by CIRPC.

The above Metropolitan Area, Polk County and Transportation and "208" Study Area projections are compared in Figure AI-1. Also shown are Polk County projections: (1) prepared by Iowa State University, (2) based on the total of projections for individual local comprehensive plans of the various municipalities within Polk County, and (3) prepared by the U.S. Departments of Commerce and Agriculture ("OBERS" projections). For the purposes of this study, a Metropolitan Area growth to approximately 390,000 by 2000 has been used as a more reasonable base for assessing future urban development implications for the eastern, or study area, portion of the metropolitan area.

2. *Employment*

Studies of past and projected employment in the Des Moines area focus on Polk County rather than the "Metropolitan Area", since available areawide employment records are kept on a county basis. For purpose of this study, the estimated magnitude of future Metropolitan Area non-agricultural employment was considered to by approximately equivalent to estimates based on Polk County employment.



Ⓧ = TOTAL OF INDIVIDUAL PROJECTIONS FOR POLK COUNTY MUNICIPALITIES.

FIGURE AI-1

DES MOINES METROPOLITAN AREA POPULATION TRENDS AND PROJECTIONS

EDWARDS AND KELCEY INC.

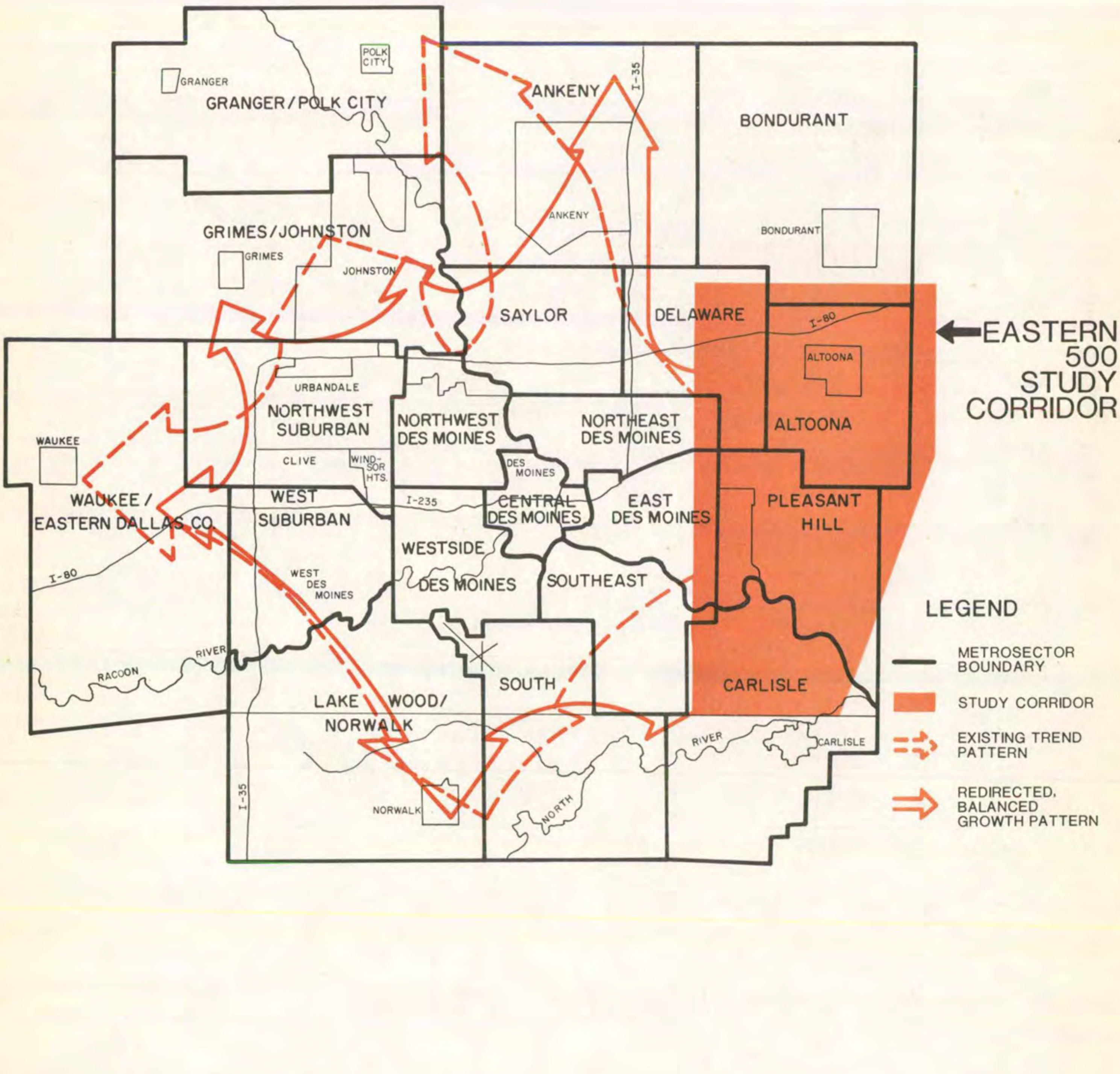


FIGURE AI-2

GROWTH OBJECTIVES-METRO DEVELOPMENT PATTERNS

EDWARDS AND KELCEY, INC.

TABLE AI-1

METROPOLITAN AREA NON-AGRICULTURAL EMPLOYMENT

Year	Metro Area Population (000's)	Estimated Non-Agricultural(1) Employment (000's)	Estimated Non-Agricultural(1) Employment (% Metro Pop.)	Estimated by Others: OBERS(2) (Polk Co.)	Estimated by Others: CIRPC(3) (Polk County)	Estimated by Others: Transp. Study(4) (Transp. Study Area)	Estimated by Others: CIRALG(5) (208 Study)
1960	266.9	103	39		115.1(1959)		
1965	279	111	40			94.2(1964)	
1970	291.2	131	45	124.2	136.8		
1975	308	148	48				142.0
1980	325	156	48	153.6	151.6		148.9
1990	360	175	48	170.2	163.9	163.1	163.2
2000	390	190	48	190.0	191.4		180.5

(1) E & K estimates based on <u>Population and Housing Projections for Local Jurisdictions of Polk County</u>, Real Estate Research Corporation (for CIRALG), p.16.

(2) U. S. Department of Commerce, Bureau of Economic Analysis and U. S. Department of Agriculture, Economic Research Service, OBERS 1972-E projections.

(3) "Regional Focus on Population/Economy 1950-2000", CIRPC Resource Report No.11, February, 1972, p.64.

(4) "Trip Generation and Analysis - Technical Memorandum No. 3", Des Moines Urban Area Transportation Study.

(5) <u>Preliminary 208 Intensity Development Considerations</u>, Central Iowa Regional Association of Local Governments, 1975.

While the metropolitan area labor force extends into Warren and Dallas Counties, most employment is, and will likely continue to be, located in the Polk County portion of the Metropolitan Area.

Using RERC employment trend estimates for Polk County as a base, total metropolitan non-agricultural employment was projected to the year 2000 as shown in Table AI-1. Non-agricultural employment, which accounts for nearly all urban area work trip production, is expected to reach an approximate level of 190,000 by 2000. Self-employed and agricultural employment levels are expected to remain at approximate current levels of 12,000 and 2,000 respectively.

These estimates compared favorably with CIRPC's and U.S. Commerce and Agricultural Department's "OBERS" projections for Polk County, and with The Urbanized Area Transportation Study projections, particularly when the latter is considered as applicable to the year 2000 (i.e., as opposed to the original 1990 projection year). Both CIRPC and OBERS projected an employment level of approximately 190,000 by 2000. Similarly, the Transportation Study Area projection of 163,000 would equate to nearly the 190,000 level on a total metropolitan area basis. Thus, while the original Transportation Study population projections were found to need a downward adjustment, the original total employment estimates remain basically valid. The higher employment to population relationship reflects the significantly higher proportion of adults in the population as a result of decreased birthrates.

Recent projections for the 208 Areawide Waste Treatment Management Planning Program include a slightly lower metropolitan employment total of some 180,000 for the year 2000, reflecting a lower estimated present (1975) employment level and decreased labor force participation. Use of the 180,000 areawide total (as compared to 190,000) would, however, not significantly affect the following estimates for the study corridor.

As shown in Table AI-2, employment in non-manufacturing sectors dominate both the present Des Moines economy and anticipated employment growth to the year 2000. The greatest number of new jobs are expected in the service, government and trade sectors. The service and government sectors are also capturing an increased proportion of jobs. Lesser increases are expected in the other non-manufacturing sectors, by an amount approximately equal to their present proportion of employment. Manufacturing jobs are expected to increase about 7,000 in number by the year 2000, but will represent a smaller proportion of total non-agricultural employment. The recent 208 study projections reflect a similar distribution among the various employment sectors.

B. STUDY AREA GROWTH

Distribution of the projected growth within the Metropolitan Area was examined using CIRPC's "Metrosector" units. In particular, growth implications were studied for the six eastern metrosectors most significantly reflecting the study corridor - Delaware, Altoona, Pleasant Hill, Carlisle, and Northeast and East Des Moines - as illustrated in Figure AI-2. CIRPC and subsequent CIRALG studies of present and projected metropolitan land use have revealed a reservoir of undeveloped land suitable for urban development far exceeding projected urban growth requirements through the year 2000. Primary concern, therefore, has been to identify locations best suited to future urban development and most consistent with overall comprehensive planning goals for the region.

1. Population

During the past two decades, most Metropolitan Area residential growth occurred in the suburbs to the west and northwest of Des Moines, stimulated by freeway (I-80/35) accessibility and the social desirability of the "west-side". Some southward development occurred, but growth to the east was minimal. The City of Des Moines itself grew during the 1950's, but dropped in population from 209,000 to 201,000 between 1960 and 1970. Losses in the central and eastern portions of Des Moines were even greater, but were offset in part by modest gains throughout the remainder of the city. While current indications show the overall city population stabilizing, similar internal shifts of lesser magnitude are likely continuing.

These recent growth trends were reflected in CIRPC's "Existing Trends" projected population distribution pattern, illustrated in Figure AI-2. Under the Existing Trend projections, over 80% of the Metropolitan Area population growth would occur in the western and northern suburban-rural metrosectors. Population in the eatern metrosectors would increase only slightly, with modest gains in Pleasant Hill and Altoona partially offset by losses in East/Northeast Des Moines and Delaware.

Metrosector population projections reflecting the existing trend growth distribution (Metropolitan Area growth of approximately 98,000 to a 390,000 total by the year 2000) are shown in Table AI-3. If "existing trends" as identified by CIRPC were to continue, population in the eastern metrosectors would be expected to increase approximately 8,000 between the years 1970 and 2000, with most of the development in the Altoona and Pleasant Hill sectors.

The dominant westward expansion, however, has produced increasing strains on public facilities. Continuation of the trend would require substantial additional roadway and utility facilities in areas where cost and disruption would be greatest and which are least suitable with respect to the natural topographic and drainage systems of the metropolitan area.

More efficient and less disruptive provision of areawide transportation facilities and utilities were among major factors influencing CIRPC's selection of a "redirected, balanced growth" concept as a basis for future planning in the Des Moines Metropolitan Area. Under CIRPC's Initial Metro-Plan Concept 1990/2000, areawide policy would encourage "larger amounts of growth to the south and east to balance out the growth which has been taking place to the north and west" (see Figure AI-2) and a re-emphasis on attracting growth within the City itself. The Central Iowa Regional Association of Local Governments (CIRALG) has retained the basic concept of balanced future growth in its current metropolitan area planning programs and policies. Within Des Moines itself, a number of renewal and development programs to enhance the desirability of city living are proposed or under way, including a major proposed residential community in the southeastern sector of the City.

TABLE AI-2

NON-AGRICULTURAL EMPLOYMENT DISTRIBUTION

	1970 (000's)	1970 (% Total)	2000 (000's)	2000 (% Total)	Increase (000's)	Increase (% Total)
Manufacturing	25	19	32	17	7	12
Services	23	17	39	21	16	27
Wholesale & Retail Trade	34	26	44	23	10	17
Construction	6	5	9	5	3	5
Transportation & Public Utilities	9	7	13	7	4	7
Finance, Insurance, Real Estate	15	11	23	12	8	14
Government	19	15	30	16	11	19
Totals (1)	131	100	190	100	59	100

(1) Percentages may not total due to rounding

Redirected, balanced growth population estimates for 2000 based on CIRPC metrosector distributions, and a metropolitan area total population of 390,000 are summarized in Table AI-3. Under the balanced growth concept, the metrosectors north and west of Des Moines would capture less than half the metro area growth, with most of the difference from existing trends directed into the east of the city. In the eastern metrosectors, overall growth would be approximately 11,000 greater than under existing trends, the eastern metrosectors "capturing" nearly twenty percent of the total metropolitan population growth. Most of the additional growth was projected by CIRPC to occur in the east and northeast Des Moines metrosectors.

Examination of most recent trends in the study corridor itself shows that corridor population has increased from an estimated 24,425 in 1970 to approximately 28,000 in 1975 (see Table AI-4). The increase of 3,575 represents over 21 percent of the estimated total metropolitan area growth during the same period. Continuation of the same trend would increase the corridor population by some 17,500 to a level of over 45,000 by the year 2000.

Increased accessibility of a new Southeast Beltway could further increase attractiveness for residential development. Construction of such a route in the virtually undeveloped eastern portion of the corridor would, in particular, increase pressures for accelerated residential development. Considering the continuing attractiveness and availability of lands in other portions of the metropolitan area and increasing public pressure and concern for maintaining and enhancing development in Des Moines and directly adjacent areas, however, it is unlikely the corridor would attract much in excess of 25 percent of the anticipated total metropolitan area growth.

Under a "No-build" Alternative, growth will continue but likely at a slower pace than for the "Build" Alternatives, particularly as traffic congestion develops in the corridor. Comprehensive plans for Altoona and Pleasant Hill each provide for medium range increases of some 2,700 persons between 1975 and 1990, or a total of over 10 percent of the projected Metro growth for the same period. In each case, recent special census studies have shown 1975 populations running ahead of the earlier Comprehensive Plan estimates.

The Capitol Heights area, most of which is presently zoned for residential development, and has (1) access to I-80, (2) generally suitable soil conditions for development, and (3) a location between presently developed areas of Des Moines and Altoona, minimizing service provision and agricultural disruption problems, would likely experience a residential development pace at or near levels occurring with a new beltway in the corridor. Original Urban Area Transportation Study population projections for this area of approximately 13,000 by 1990, or nearly 11,000 more than present levels will not likely be reached. However, a growth of approximately 3,000 - 5,000 by the year 2000 would appear quite reasonable, and well within the potential under current zoning and typical suburban densities. Within the Des Moines portion of the corridor, residential development is expected to remain near present levels under the preliminary 1990/2000 Land Use Plan. Thus, as a minimum, the corridor can be expected to attract somewhat in excess of 15 percent of the overall metro area 1975-2000 population growth.

TABLE AI-3

PAST AND PROJECTED METROPOLITAN POPULATION DISTRIBUTION

(Projected 2000 Metropolitan Population = 390,000)

Metrosectors		1970 Population	1970 % Metro	2000 Existing Trend Distribution (2) Population	2000 Existing Trend Distribution (2) % Metro	2000 Metro Plan Concept Distribution (2) Population	2000 Metro Plan Concept Distribution (2) % Metro
East & Northeast-	Change(1)			-400	-1/2	6,700	7
Des Moines	Total	65,300	22	64,900	17	72,000	19
Delaware	Change(1)			-400	-1/2	2,300	2
	Total	5,200	2	4,800	1	7,500	2
Altoona	Change(1)			3,100	3	3,500	4
	Total	3,500	1	6,600	2	7,000	2
Pleasant Hill	Change(1)			3,900	4	4,300	4
	Total	2,700	1	6,600	2	7,000	2
Carlisle	Change(1)			2,200	2	2,700	3
	Total	3,300	1	5,500	1	6,000	2
Eastern	Change(1)			8,400	8	19,500	20
(subtotal)	Total	80,000	28	88,400	23	99,500	26
Northern &	Change(1)			82,500	84	43,100	74
Western(3)	Total	67,400	23	149,900	38	110,500	28
Remaining Des	Change(1)			7,900	8	36,300	37
Moines & Southern(4)	Total	143,800	49	151,700	39	180,000	46

NOTES: Percentages may not total due to rounding.
(1) Change from 1970 (base year) to 2000 (projection year).
(2) Based on Central Iowa Regional Planning Commission reports "Initial Metro Plan Concept 1990/2000" and Central Iowa Profiles: Housing, Population & Metro Community Life, Resource Report No. 9, 1970.
(3) West and Northwest Suburban Waukee/Eastern Dallas, Grimes/Johnston, Granger/Polk City, Saylor, Ankeny, and Bondurant Metrosectors.
(4) Lakewood/Norwalk, South, Southeast, and Central, Westside and Northwest Des Moines Metrosectors.

2. *Employment*

Nearly half of the more than 130,000 non-agricultural employees in the Des Moines Metropolitan Area are concentrated in the Des Moines Central Business District. Most of the remainder are employed at other locations within the City. In recent years, however, employment in the western and northern suburbs has risen significantly as new commercial, office and industrial facilities have accompanied the spread of residential growth. Suburban and fringe area employment will likely continue to increase at a more rapid rate than employment in the City, particularly in the trade and service sectors which are expected to account for nearly half of the metropolitan employment growth through the year 2000. While outlying areas will capture an increasingly greater proportion of new employment growth, however, the bulk of total employment will likely remain within the boundaries of the City of Des Moines.

As of 1975, an estimated 3,200 persons, or only two percent of the metropolitan total, were employed in the study corridor. As discussed in Report Section III B 1, this employment is located mostly in the Altoona Business District and the Vandalia industrial section in Des Moines.

Most corridor residents are employed in Des Moines or northern and western suburban areas and likewise depend upon such areas for major shopping and related services. However, as the study corridor population base grows, an increasing proportion of retail commercial and service activities will locate within the corridor particularly in the vicinity of the Adventureland amusement-recreational complex and the business districts of Altoona and Pleasant Hill. In addition, the planned industrial districts in Pleasant Hill, Altoona and the Vandalia area of Des Moines should attract an increased proportion of industrial employment. Thus, it is likely that a minimum of at least ten percent of the projected 1975 to 2000 metropolitan employment increase, or some 4,000 jobs will locate in the corridor.

Improved accessibility (e.g., with Southeast Beltway), particularly to the planned industrial areas in Pleasant Hill and Vandalia, would significantly increase employment-related development potential in the corridor. More extensive residential development would also support higher levels of retail commercial and service employment. Attraction of up to 25 percent of new metro area retail trade, service and manufacturing jobs would appear possible. However, the corridor would unlikely attract more than ten to fifteen percent of other employment, particularly in view of policies and efforts to attract most new employment to the Des Moines Central Business District and the availability of adequate and attractive space for commercial and industrial growth in other sections of the metropolitan area. Thus, at most, the corridor could be expected to attract some twenty percent of total new employment, or some 8,000 plus new jobs between 1975 and 2000.

C. POPULATION AND EMPLOYMENT ESTIMATES

Estimated population and employment levels for the study corridor were developed for the specific purpose of adjusting the Urban Area Transportation Study traffic projections to account for:

(1) development within the corridor but outside the Transportation Study boundary:

(2) present planning policies and lower anticipated growth levels; and

(3) varying developmental influence of the highway development alternatives.

The estimates are not intended as projections of how development should or necessarily will occur, but as a reasonable reflection of the extent and distribution of land use activity consistent with the varying accessibilities and traffic service afforded by each of the study alternatives. Highway development is generally a stimulus, but is not necessarily a sufficient factor in itself to produce change. While highway improvements may allow for new or expanded development, actual development will depend on a number of additional factors such as local zoning policies, provision of utilities, and prevailing market conditions.

The estimates, while varying somewhat among the highway alternatives, are generally comparable on an overall corridor growth basis with the Alternate Intensity Development Plan "A" or "Adjusted Composite Plan" projections for the 208 Waste Treatment Management Planning Program. Plan "A" projections are based primarily upon the comprehensive plans of the individual governmental units within the 208 study area. Growth in the corridor under the Alternate Intensity Development Plans "B" or "C" would be extremely limited, overall population increases amounting to only 20 to 30 percent of those reflected in the local plans.

For purposes of the estimates, provision of urban services to support development compatible with the various alternatives has been assumed. For example, the "Outer Freeway" alternative would likely encourage accelerated development in the eastern portion of the corridor, particularly creating pressures for commercial and/or high density residential use in the vicinity of interchanges. The estimates assume that should this alternative be selected, compatible policies would also be implemented to provide the sewage facilities and other urban services necessary to support such development.

Initial traffic projections provided by the Iowa Department of Transportation and CIRALG were based on Urban Area Transportation Study 1990 demographic and land use projections for a Transportation Study Area that includes only a portion of the Route 500 study corridor (see Figure AI-1). The Transportation Study projections included a population of some 46,000 persons in that portion of the corridor covered, which did not include Altoona. By contrast, projections from more recent 208 (Intensity Plan "A"), Metro Plan Concept, Polk County, Pleasant Hill, Altoona and Des Moines planning studies reflect a population growth which does not reach the 45,000 plus level for the entire corridor, including Altoona, until approximately the year 2000.

Updated population and compatible employment estimates were therefore prepared for eight development assessment areas (covering parts of six Metrosectors*) in the study corridor, based upon:

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* CIRPS's "Metrosector" analysis areas. Small portions of two additional Metrosectors, Bondurant, Southeast Des Moines, and a small area outside the Metro Area boundary to the east were included with the six basic Metrosector areas for tabulation purposes. See Figure IV-1.

(1) Updated estimates of current (1975) population and employment levels and trends for each assessment area using 1970 census data, recent special census studies for Pleasant Hill and Altoona, building permit data for 1970-75, Chamber of Commerce estimates, and miscellaneous available reports;

(2) Current zoning and extent of developed use (see Report Section III);

(3) Comprehensive land use plans (see Report Section III) and general land use policies and goals (e.g., preservation of most valuable farmland);

(4) Capabilities and limitations (i.g., steep slopes, flood hazard, forested areas) of the undeveloped land within each area based on CIRALG and Soil Conservation Service study data;

(5) Development potential and limitations of the corridor within the context of total metropolitan area growth and competing forces and trends elsewhere in the metropolitan area, as discussed in the preceeding parts of this Growth Framework section.

The numerical population and employment estimates for the year 2000 were calculated on the basis of a percentage of the projected metropolitan area growth estimated to occur in each of the assessment areas. The percentages are based on the development potential ratings in Tables IV-1 and IV-2 of Report Section IV, which reflect the considerations listed above. The resultant estimates thus reflect both:

(1) the extent to which the highway alternatives would likely affect development levels in the corridor as a whole, and

(2) the extent to which the highway alternatives would influence the distribution and intensity of development among the various assessment areas.

These "secondary impact" growth estimates are summarized, along with current levels and Urban Area Transportation Plan projections in Tables AI-4 through AI-6.

TABLE AI-4

POPULATION PROJECTIONS BY ALTERNATIVE

(METRO POPULATION 1975 = 308,000; 2000 = 390,000; INCREASE = 82,000)

METROSECTOR (or PART)		1970	Estimated 1975	Transportation Study Projection 1990 (1)	Alternative 1 No Build 2000 % Metro	#	Alternative 2 Upgrade-Expwy. 2000 % Metro	#	Alternative 3 Inner Freeway East 2000 % Metro	#	Alternative 4 Inner Freeway West 2000 % Metro	#	Alternative 5 Outer Freeway 2000 % Metro	#
EAST & NORTHEAST DES MOINES														
Vandalia -														
Four Mile Area	Increase(2)				1	800	1	800	1	800	2	1,700	1	800
	Total		16,200	18,170		17,000		17,000		17,000		17,900		17,000
DELAWARE														
Capitol Heights Area	Increase(2)				4½	3,700	5	4,100	5½	4,500	5½	4,500	5	4,100
	Total		2,300	13,200		6,000		6,400		6,800		6,800		6,400
ALTOONA														
Altoona Area	Increase(2)				4½		4½		5		4½		4½	
Eastern Area	Increase				1		1		1½		1		4	
Southwestern Area	Increase				1½		2½		3		2		2½	
Metrosector Subtotal	Increase				7	5,800	8	6,600	9½	7,700	7½	6,200	11	8,600
	Total		4,900	N.A.		10,700		11,500		12,600		11,100		13,500
PLEASANT HILL														
Pleasant Hill-														
Carbondale Area	Increase(2)				3		5		5		5		4½	
Four Mile Area	Increase				1		1		1½		1		2½	
Metrosector Subtotal	Increase				4	3,300	6	4,900	6½	5,300	6	4,900	7	5,800
	Total		3,800	11,400		7,100		8,700		9,100		8,700		9,600
CARLISLE														
Avon Area	Increase(2)				½	400	1	800	2	1,700	2	1,700	2	1,700
	Total		800	3,100		1,200		1,600		2,500		2,500		2,500
STUDY AREA	Increase(2)				17	14,000	21	17,200	24½	20,000	23	19,000	25½	21,000
	Total		28,000	N.A.		42,000		45,200		48,000		47,000		49,000

Notes:

See Section IV, Figure IV-1 for Area Locations
* Negligible
N.A. - Not Available - Altoona outside Transportation Study Area

(1) Adjusted to account for differences between Transportation Study Traffic Zones and Metrosector boundaries.
(2) Increase from 1975 to 2000.

TABLE AI-5

EMPLOYMENT PROJECTIONS BY ALTERNATIVE

METROSECTOR (or PART)		Estimated 1975	Transportation Study Projection 1990 (1)	Alternative 1 No Build 2000 % Metro	#	Alternative 2 Upgrade-Expwy. 2000 % Metro	#	Alternative 3 Inner Freeway East 2000 % Metro	#	Alternative 4 Inner Freeway West 2000 % Metro	#	Alternative 5 Outer Freeway 2000 % Metro	#
EAST & NORTHEAST DES MOINES													
Vandalia -													
Four Mile Area	Increase(2)			1½	600	3	1,300	4	1,700	4½	1,900	2	900
	Total	900	3,340		1,500		2,200		2,600		2,800		1,800
DELAWARE													
Capitol Heights Area	Increase(2)			3½	1,500	4	1,700	5	2,100	5	2,100	3	1,300
	Total	300	2,700		1,800		2,000		2,400		2,400		1,600
ALTOONA													
Altoona Area	Increase(2)			3		3½		4		3½		3½	
Eastern Area	Increase			*		*		½		*		2½	
Southwestern Area	Increase			½		1½		1½		½		1	
Metrosector Subtotal	Increase			3½	1,500	5	2,100	6	2,500	4	1,700	7	2,900
	Total	1,500	N.A.		3,000		3,600		4,000		3,200		4,400
PLEASANT HILL													
Pleasant Hill -													
Carbondale Area	Increase(2)			1½		3½		5		3		2	
Four Mile Area	Increase			*		*		*		*		1	
Metrosector Subtotal	Increase			1½	600	3½	1,500	5	2,100	3	1,300	3	1,300
	Total	400	1,900		1,000		1,900		2,500		1,700		1,700
CARLISLE													
Avon Area	Increase(2)			*	*	½	200	1	400	1	400	1	400
	Total	100	100		100		300		500		500		500
STUDY AREA	Increase(2)			10	4,200	16	6,800	21	8,800	17½	7,400	16	6,800
	Total	3,200	N.A.		7,600		10,000		12,000		10,600		10,000

Notes:

See Section IV, Figure IV-1 for Area Locations

* Negligible

N.A. Not Available - Altoona outside Transportation Study Area

(1) Adjusted to account for differences between Transportation Study Traffic Zones and Metrosector boundaries.

(2) Increase from 1975 to 2000.

TABLE AI-6

SUMMARY: POPULATION AND EMPLOYMENT COMPARISON

Metrosector (or Part)	Estimated 1975	Transp. Study 1990 (equiv.)	Estimated 2000 Alt.1 No Build	Alt.2 Up. Expy	Alt.3 I.Fwy E.	Alt.4 I.Fwy W.	Alt.5 Out. Fwy
Population							
E & NE Des Moines-Vandalia-Four Mile Section	16,200	18,170	17,000	17,000	17,000	17,900	17,000
Delaware-Capitol Heights Section	2,300	13,200	6,000	6,400	6,800	6,800	6,400
Altoona - Total	4,900	N	10,700	11,500	12,600	11,100	13,500
Pleasant Hill-Total	3,800	11,400	7,100	8,700	9,100	8,700	9,600
Carlisle-Avon Section	800	3,100	1,200	1,600	2,500	2,500	2,500
Study Area	28,000	N	42,000	45,200	48,000	47,000	49,000
Employment							
E & NE Des Moines-Vandalia-Four Mile Section	900	3,340	1,500	2,200	2,600	2,800	1,800
Delaware-Capitol Heights Section	300	2,700	1,800	2,000	2,400	2,400	1,400
Altoona-Total	1,500	N	3,000	3,600	4,000	3,200	4,400
Pleasant Hill-Total	400	1,900	1,000	1,900	2,500	1,700	1,700
Carlisle-Avon Section	100	100	100	300	500	500	500
Study Area	3,200	N	7,600	10,000	12,000	10,600	10,000

N - Base data for estimate not available

APPENDIX II

TRAFFIC VOLUME FORECASTS

A. GENERAL

All traffic volume forecasts for the study were prepared by the Highway Division, Iowa Department of Transportation, for use by Edwards and Kelcey in the anlaysis of traffic related impacts.

The future traffic volumes for each of the five study alternative roadway systems were obtained from traffic assignments developed as a part of the Initial Des Moines Urbanized Area Transportation Study (DMUATS). In this process, the trip level for each traffic zone was based upon estimates of future land use, population, employment, and other variables, and the relationship between present land use variables and measured trip productions and attractions. The zonal trip productions and attractions were distributed by means of a Gravity Model technique with the special separation of the Network "E" system which inlcudes beltway links in a location similar to Alternative 5, the "Outer Freeway".

The Network "E" trip table was assigned to each of five roadway networks representing the five alternatives under study. Figure AII-1 shows the network for Alternative 3. The future trips were assigned to each alternative roadway network using an all-or-nothing minimum time-path assignment. Specific adjustments were performed, as required, to balance inequities resulting from the limitations of the all-or-nothing minimum time path assignment. For those roadway sections outside of the Des Moines Transportation Study Area, average section volumes were estimated based on current traffic counts and the development potential of the alternative under consideration.

These volumes were taken to represent study area base travel in the year 1990. Base traffic volume forecasts for the year 2000 were obtained by adding 40 percent to the 1990 volumes. Base volume forecasts for the year 1980 were obtained by subtracting about 29 percent from 1990 volumes (representing a 40 percent increase from 1980 to 1990).

B. ADJUSTMENTS

Assuming that the relationship between future trip productions and travel characteristics will remain similar to present patterns, the accuracy of the assigned traffic volumes within the study corricor is dependent upon the estimated future land use development for each alternative roadway system. The interrelationship between roadway improvements and land use development for each alternative was evaluated as a part of this study, (see Appendix I), and the results were compared with the estimated future development which was the basis for the DMUATS traffic assignments.

The differences in estimated future population and employment levels among alternatives, and between those estimated for this study and those used in the DMUATS assignments, were significant. As a result, it was felt necessary to

TABLE AII-1

NON - CORRIDOR TRAVEL

Alternative	Study Area[1] Population Forecast	Population Difference From Alt.5	1990 @ 2.5 trips/ person	Non-Corridor Trips (AADT) 1980 (1990/1.4)	1983 (2)	2000 (1990 x 1.4)
1	42,000	-7,000	17,500	12,500	14,000	24,500
2	45,200	-3,800	9,500	6,800	7,600	13,300
3	48,000	-1,000	2,500	1,800	2,000	3,500
4	47,000	-2,000	5,000	3,600	4,000	7,000
5	49,000	0	0	0	0	0

(1) See Table AI-6

(2) Assumes straight line growth between 1980 and 1990.

make adjustments to the initial traffic assignments for each alternative to account for these differences.

Edwards and Kelcey supplied estimates of future corridor population/employment levels expected under each alternative (Table AI-6) to the Highway Division. The Highway Division made final adjustments to the traffic assignments on the basis of this information. Traffic volumes for each alternative for the design year 2000 are shown on Figures V-1 through V-5.

C. NON-CORRIDOR TRAVEL

An adjustment was applied to calculations for air quality burdens, to correct for the difference in total trip levels within the study corridor for each alternative under study. Referring to Appendix I, total population levels and therefore total daily trips within the corridor for Alternatives 1 through 4 are less than for Alternative 5 which was the base alternative for traffic projection since Alternative 5 was estimated to have the highest population level of all alternatives.

It was assumed, for study purposes, that population and employment levels for the Des Moines metropolitan area remain constant for all alternatives. Thus, trips which would not take place within the corridor under Alternative 1 through 4, would, however, take place elsewhere in the metropolitan area (i.e., present, unbalanced growth distribution to north and west of Des Moines would likely continue) and therefore contribute to the areawide pollutant burden.

In order to compare all alternatives on a common basis (i.e., their respective pollutant burden impact on the total metropolitan area), it was necessary to add to the pollutant burden generated within the corridor for Alternatives 1 through 4, the burden generated by trips diverted from the corridor.

The burdens for these diverted, or "non-corridor", trips were calculated by using a trip level adjustment calculated from the population differences estimated for each alternative.

The relationship between population and trip ends produced was determined from the DMUATS zonal population and trip ends information for zones within the study corridor. For all zones within the study corridor, the number of trip ends per person ranged from 1.8 to 3.2. An average of 2.5 trip ends produced per person per day was selected for the calculation of non-corridor travel. To be compatible with the traffic forecasts, this number was taken as non-corridor travel in the year 1990. Adjustments to other years were made conforming to the traffic forecast procedure.

The population differences and resultant trip level adjustments are shown in Table AII-1.

For the calculation of pollutant burdens an average trip length of 4.6 miles and a speed of 35 miles per hour were assumed for non-corridor trips based on average tripmaking characteristics from the Transportation Study.

A similar adjustment was also applied to the trip levels used in the calculation of road user costs in the Engineering Economics portion of the study.

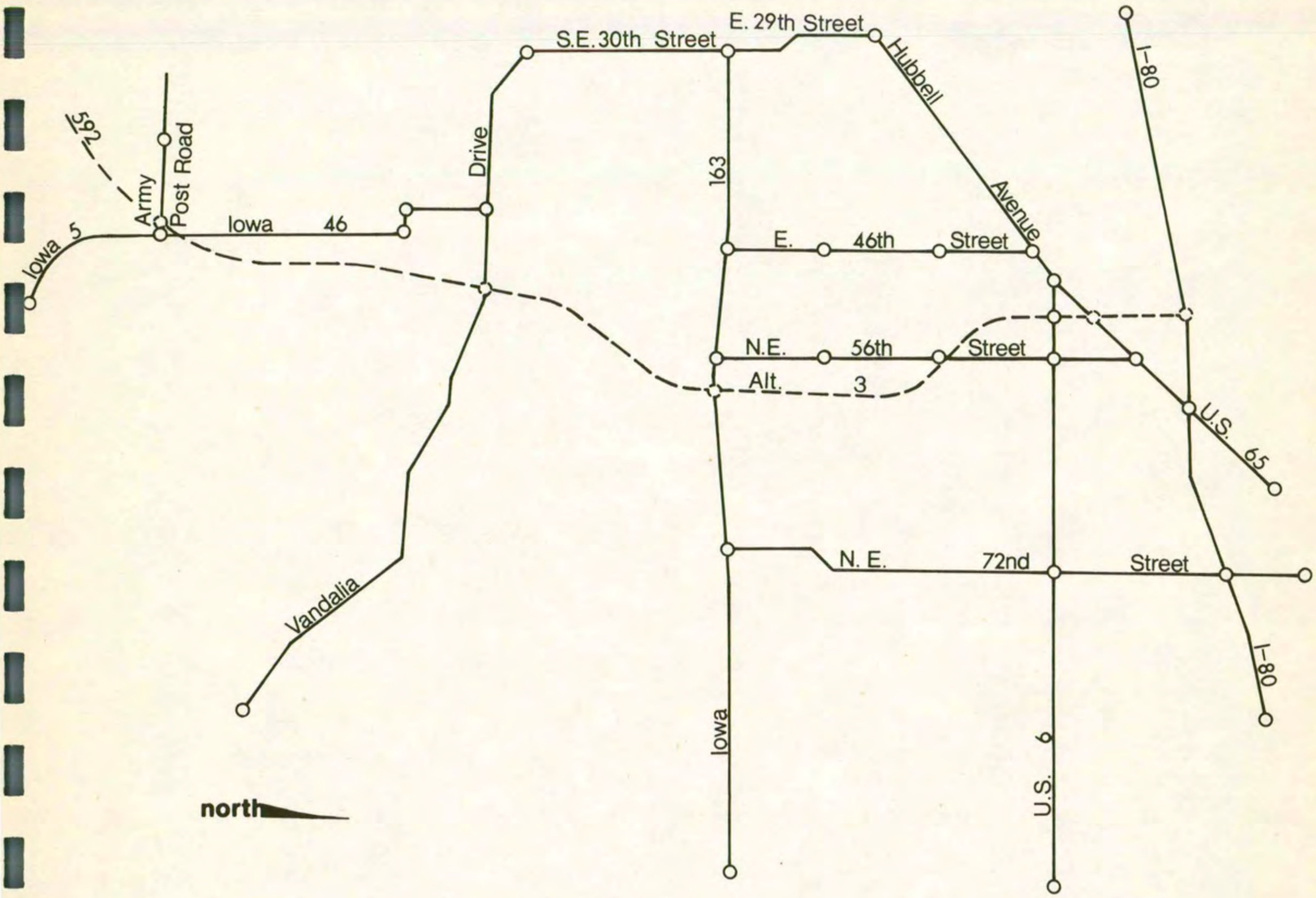


FIGURE AII-1

TRAFFIC ANALYSIS NETWORK

EDWARDS AND KELCEY, INC.

APPENDIX III

DEVELOPMENT OF ALTERNATIVES

Study requirements for highway improvements within the study corridor called for 1) an evaluation of several new alignment alternatives, 2) an investigation of the feasibility of upgrading the existing roadway network, and 3) an analysis of the implications of making no major improvements within the corridor; the "No-build" Alternative.

A. NEW ALIGNMENT ALTERNATIVES

Three new corridor alignments were identified as alternatives for detailed study investigation. These were developed in the context of the overall land use and transportation planning framework for the Des Moines metropolitan area, and on the basis of an analysis of land use and environmental characteristics within the study corridor.

1. *General Planning Considerations*

The consistency of the new alignment alternatives with areawide and local land use planning and with the Revised Initial 1990 Des Moines Urbanized Area Transportation Plan were major considerations in the selection of new alignment locations. The development implication of each alternative in terms of the Initial Metro Plan "balanced growth concept" and in terms of the ongoing 208 Planning Program Alternate Intensity Development Plans was considered in the evaluation of the alternatives.

The new alignment alternatives were also selected to provide for a connection with the Southern 592 segment of the Beltway System in the vicinity of the intersection of Iowa 5 and Iowa 46 near Avon.

2. *Corridor Characteristics*

Engineering, land use and environmental characteristics of the study corridor were taken into consideration through the use of a computer technique referred to as Factor Mapping. Selected characteristics or "Factors", which affect or would be affected by a highway were mapped for the study corridor on a grid made up of 4,090 ten-acre squares. The ten factors used fall into four general categories:

Engineering	---slope suitability ---soil suitability
Agricultural	---soil suitability ---crop yield
Developmental	---residential and commercial structures ---land area in developed use ---property disruption potential
Special Impact	---natural features ---special features ---public and institutional facilities

For each factor, individual grid squares were coded to indicate the general desirability or suitability of the square for highway development from the standpoint of that particular factor. Desirability rating codes for highway development ranging from optimum (0) to unsatisfactory (9) were used. Using these ratings, computer graytone factor maps (Figure AIII-1) of the study corridor were developed for each factor, lighter areas representing more desirable locations and darker areas less desirable locations for highway development.

The primary advantage of this process is that it provides the ability to input factors such as agricultural and natural feature values into the establishment of corridor alignments on a basis comparable with engineering and development values. In many previous highway studies, consideration of such values has come during the comparative analysis of alternative corridor alignments selected primarily on the basis of engineering and development factors. A related advantage is the ability to use the computer technology to allow concurrent or "composite" consideration of the various factors reflecting equal or varied emphasis or "weightings".

Input data relative to each of the ten factors considered was gathered, interpreted and coded as described in the following paragraphs. Input coding information for all factors is summarized in Table AIII-1.

Engineering Factors - The first two factors, slope and soil suitability, provide an indication of basic engineering suitability and, indirectly, engineering costs.

- Slope Suitability - Using a topographic map base, prevailing slopes within each cell were evaluated to determine the maximum slope of sufficient area (1/3 cell area) within the cell that would significantly affect the suitability of the cell from a highway engineering standpoint. Approximately 73% of all cells had a maximum significant slope of 5% or less and approximately 87% had a slope of 9% of less. From an engineering standpoint, slopes representing a critical constraint to highway development were 10% or greater.

- Soil Suitability - The rating for this factor involved a composite evaluation of soil characteristics obtained from the Soil Conservation Service (SCS) County Soil Surveys. The data which was evaluated included: soil description, parent material, borrow suitability, drainage characteristics, depth to water table, depth to bedrock, and topographic location (i.e., uplands or bottomlands). Grid square ratings were based on predominant soil type occurring in square, with the least suitable rating (nine) assigned to lakes and sewage lagoons, which are not included in the soil survey but would be least suitable for highway development.

Agricultural Factors - The second two factors, agricultural suitability and crop yield, provide alternative measures of agricultural or food producing value of land within the corridor. The first reflects the intrinsic or potential agricultural value independent of present use or level of production, while the latter is an indicator of agricultural value reflecting actual current production levels.

TABLE AIII-1

COMPOSITE MAPPING FACTORS AND CODING

	Code	Slope Suitability (Slope-%)	Soil Suitability (SCS Composite)	Agricultural Suitability (SCS Ratings)	Crop Yield (ASCS:Bu/Acre)	Residential & Commercial St. (Number)	Land Area in Developed Use (%)	Property Disruption Potential	Natural Features	Special Features	Public & Inst. Facilities
OPTIMUM	0	0 - 2	Best Suited in Corridor	Class VII	Not Farmed	0	0	-	None	None	None
	1	1 - 3		Classes V & VI	79	-	-	Minimal	-	-	-
SATISFACTORY	2	2 - 5		Class IV	80 - 90	1	10	-	-	-	-
	3	-	Generally Suitable	-	91 - 97	2	10 - 30	Low	Impact Probably Avoidable	Impact Probably Avoidable	Impact Probably Avoidable
	4	-		Class III	98 - 104	3 - 4	-	-	-	-	-
MARGINAL	5	5 - 9		-	105 - 111	5 - 6	30 - 50	Moderate	-	-	-
	6	-	Question-able Suitability	Class II	112 - 118	7 - 8	-	-	Some Impact Likely	Some Impact Likely	Some Impact Likely
	7	9 - 14		-	119 - 125	9 - 10	50 - 75	Substantial	-	-	-
UNSATISFAC-TORY	8	-	Unsuitable	Class I	126	11 - 15	75+	-	-	-	-
	9	14+	Lakes, Sewage Lagoons, Etc.	-	-	15+	100+	Severe	Substantial Impact Probable	Substantial Impact Probable	Substantial Impact Probable

- Agricultural Suitability - Soil Conservation Service classifications of soil suitability for cultivated crops were used. Classes rated as generally suitable for cultivated crops (Classes I-III) were rated least suitable for highway development. Approximately 25% of the corridor received a Class I rating and approximately 46% received a Class II rating, reflecting the generally high quality of agricultural land in the corridor.

- Crop Yield - Ratings were based on crop yield figures compiled by the U.S. Agricultural Stabilization and Conservation Service (ASCS), and measured in terms of bushels (of corn) produced per acre in 1972. As was the case for agricultural suitability, highest crop yield acreages were rated least satisfactory for highway development. For farmed acres not represented in available ASCS information, an assumed value was used based upon surrounding farm crop yield figures and upon the cell land characteristics. Non-farmed areas were rated as optimum for highway development from a crop yield viewpoint.

Development Factors - Factors five and six are measures of constraints imposed by existing development. These factors also provide a measure of potential impact on existing development due to the highway. Factor seven, property disruption potential, is a measure of impact to presently farmed agricultural areas.

- Residential and Commercial Structures - The rating for this factor was based upon the number of dwellings and commercial structures located within each grid square. Occurrence of five or more such structures in one ten-acre cell was considered likely to constitute a marginal to unsatisfactory location for highway development.

- Land Area in Developed Use - Since structures alone may not fully reflect the present level of development, a second development measure was used based on the percentage of land area in each grid cell presently in "developed use". "Developed use" for purposes of this factor was defined as:

    1) Farmsteads: the buildings and adjacent service areas (generally the area within the windbreaks).

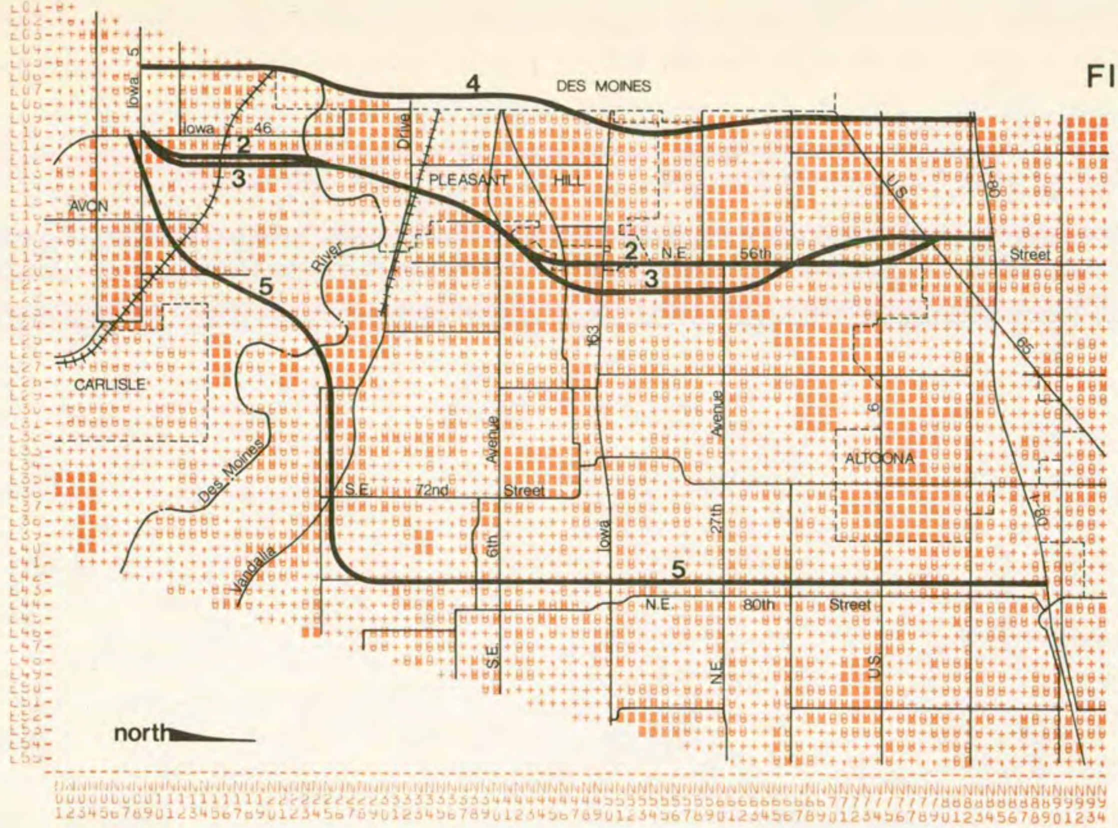
    2) Rural dwellings on large tracts: the area of the house and immediate environs (usually 3/4 - 1 acre).

    3) Subdivided areas: where roads exist. The entire platted area was included.

    4) Commercial and related: e.g., shopping centers, golf courses: area covered by buildings, parking lots and immediate environs. The ratings used for given percentages of cell coverage are shown in Table AIII-1.

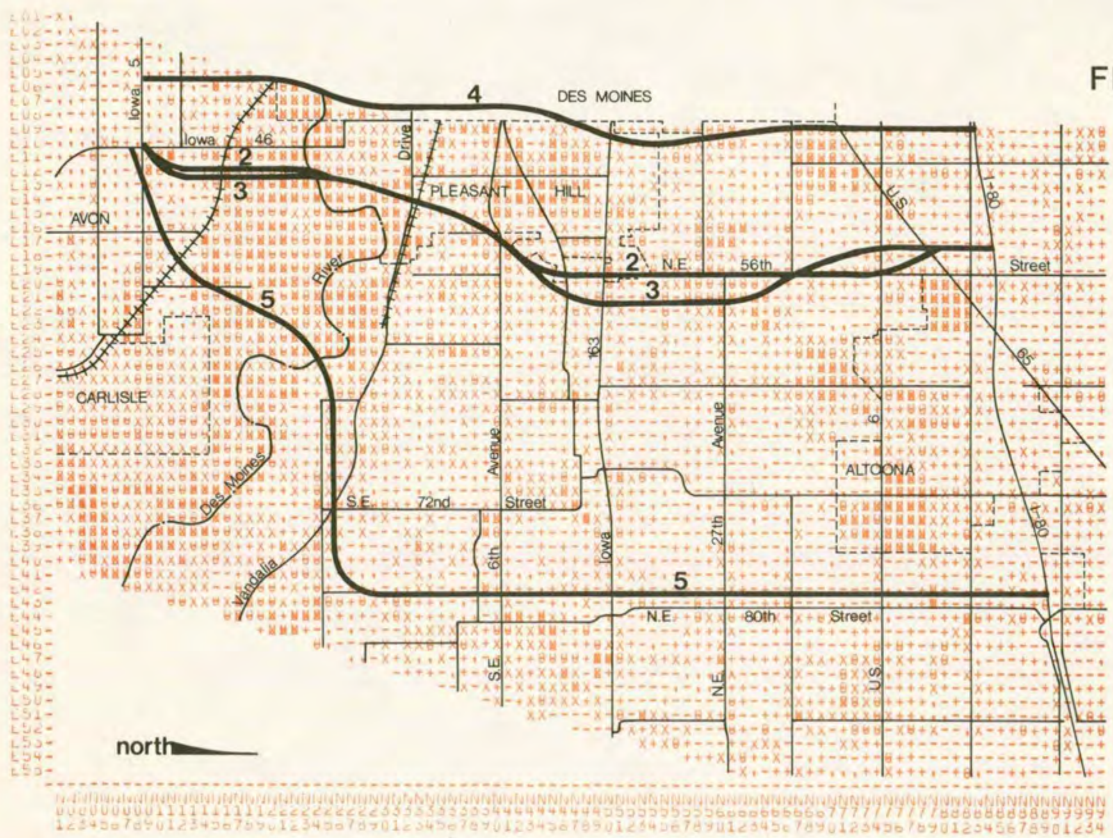
- Property Disruption Potential - While the location within the grid square and physical characteristics of a highway would determine actual extent of disruption, each grid was assessed in terms of a generalized

FIGURE AIII-1



MINIMUM PROPERTY DISRUPTION POTENTIAL

FIGURE AIII-2



COMPOSITE EQUAL WEIGHT

TYPICAL FACTOR MAPPING

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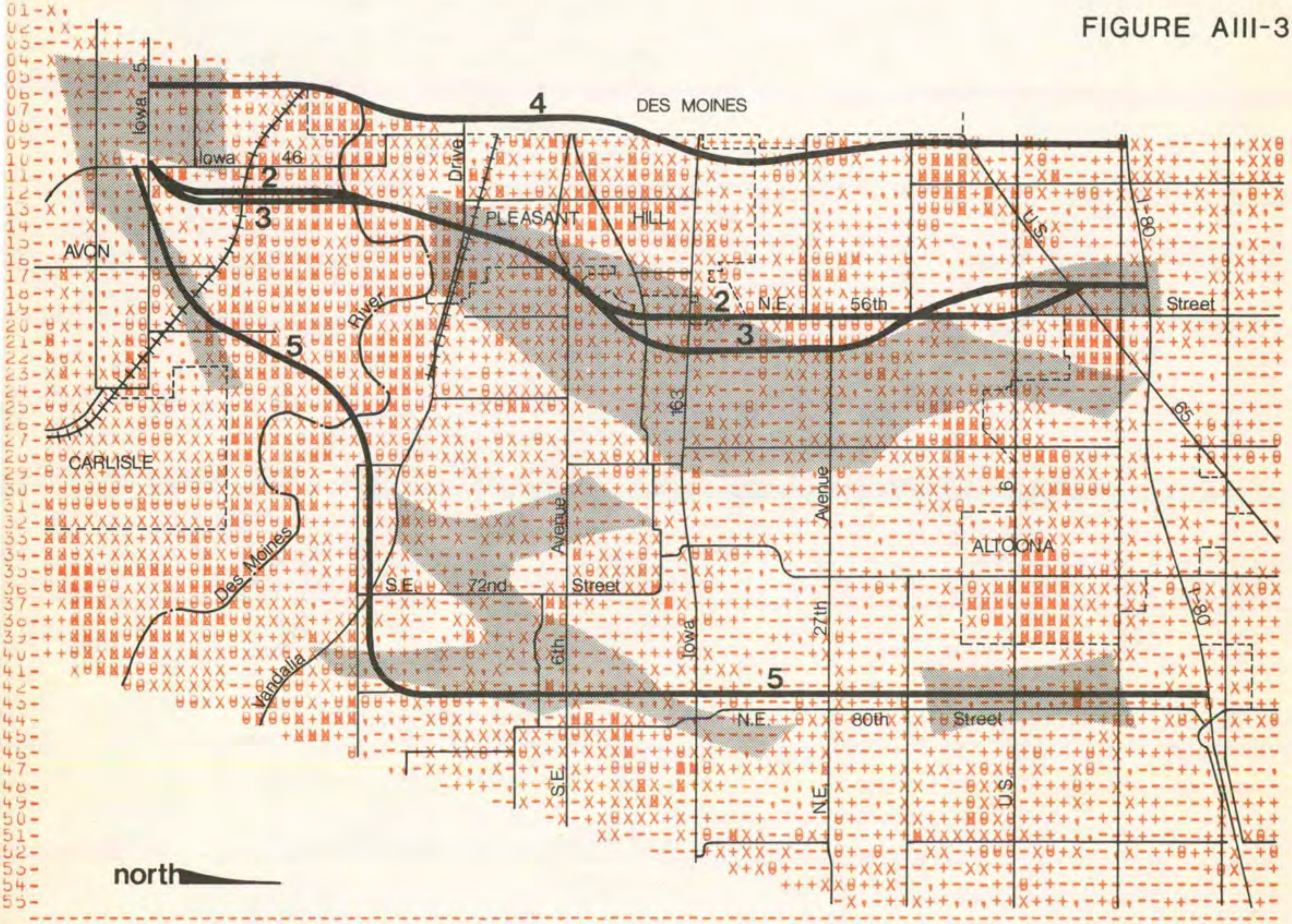
FIGURE AIII-3



COMPOSITE
EQUAL WEIGHT

PATHS OF
LEAST IMPACT

EDWARDS AND KELCEY, INC.

potential, or likelihood, of property disruption (e.g., takings, property severances). For example, for farmed properties the grid squares containing or immediately surrounding a farmstead were rated as least suitable, while land along property lines furthest away from the farmstead (minimal severance) was rated most suitable. The intention here was to determine a highway location which minimized the taking and severance of existing properties.

Special Impact Factors - The last three factors are measures respresenting potential impact on special features in the corridor, including natural and public resources requiring special consideration under Federal regulations. Impact potential was rated in terms of four general categories: 1) no impact (no significant feature in grid square), 2) impact probably avoidable, 3) some impact likely, and 4) substantial impact probable.

- Natural Features - This factor has the dual purpose of indicating the location of significant natural features and rating the impact which could be expected from a highway traversing the cells containing those features. Natural features were, for the most part, either wooded areas, lakes or streams. The impact analysis at this stage was confined to an estimate of potential for significant impact based on the size, nature and location of the feature within the cell.

- Special Features - Features included in this factor were parks, other recreation areas (e.g., golf courses), game management areas, the Red Rock flood pool and known historical or archaeological sites.

- Public and Institutional Facilities - This factor indicates potential for impact upon schools, churches, cemeteries, and utilities. While these facilities are relatively few in number, their importance to the community is very great.

3. Alignment Selection

The end product of the factor mapping process is a series of computer gray tone maps of the study corridor, an example of which is shown in Figure III-1. These maps illustrate the suitability of corridor lands for highway development. Lighter areas represent more suitable locations while darker areas represent less suitable locations. Maps were developed for each of the ten factors considered.

Composite maps (Figure AIII-2) were developed using a number of weightings reflecting a range of varied priorities. For example, composite maps were developed weighted both "toward" (up to five fold weight) and "heavily toward" (up to nonefold weight) the agricultural related factors. Others were weighted "toward" and "heavily toward" engineering, developmental or special impact factor categories and various other relevant combined factor weightings. In all, five different weighting composites, plus an equal weight map, were developed, and the areas of greatest and least suitability on each compared. This comparison identified "paths of least impact" through the study corridor (Figure AIII-3). These "paths" represented areas that are generally most suitable for highway construction regardless of whether greatest emphasis is placed on highway, agricultural, development or special feature factors. At the same time, areas which should be avoided were identified. The new alignments were developed to follow the "paths of least impact" and to avoid the unsuitable areas wherever possible.

B. UPGRADING ALTERNATIVE

In order for a major upgrading of the existing roadway system to fulfill the requirements of the Revised Initial Des Moines Urbanized Area Transportation Plan and to function at a level generally consistent with other segments of the State Arterial Highway System, the selected upgrading route, or routes, should meet certain conditions. The upgraded network should 1) provide a continuous link between the north and south ends of the corridor, 2) provide sufficient flexibility for a connection to the southern 592 Beltway segment, 3) allow for a suitable connection to proposed Arterial Highway 592 coming from the Knoxville area, and 4) provide operating conditions suitable for through traffic while continuing to provide for local travel desires and land service needs. There is at present no continuous north-south highway route through the study corridor. Study of the existing roadway network within the corridor indicated that an alternative utilizing existing sections of Iowa 46 and N.E. 56th Street would provide a direct, continuous route through the corridor while utilizing as much existing right-of-way as possible.

C. NO-BUILD ALTERNATIVE

The "No-build" Alternative would preserve the status quo with regard to major highway facilities within the study corridor. It was assumed that the improvements to local streets proposed in the Revised Initial Des Moines Urbanized Area Transportation Plan would be made. In addition, U.S. 6 (Broadway Avenue) was considered upgraded to a four-lane, median separated facility from the intersection with Hubbell Ave. to the eastern city limits of Altoona. This alternative was evaluated on its own merits and served as a basis for a comparative evaluation of all other alternatives.

APPENDIX IV

ENGINEERING CONSIDERATIONS

A. HIGHWAY DESIGN ENGINEERING

Mapping of the study corridor was prepared in two forms: photogrammetric mapping at a scale of 1" = 400', and topographic mapping at a scale of 1" = 1000', based on enlarged U.S.G.S. quadrangle maps. The 400 scale mapping was used in the detailed alignment studies and for display purposes at public meetings held during the course of the study. The 1000 scale mapping was used in the factor mapping process and appears as the base mapping in this report.

As previously mentioned, centerline alignments for Alternative 3, 4 and 5 were developed within the paths of minimum impact suggested by the factor mapping process. All alignments were developed according to design standards established by the Highway Division, Iowa Department of Transportation, and the American Association of State Highway and Transportation Officials (AASHTO).

While the factor mapping process indicates generalized paths of minimum impact on the various features of the corridor, it is the responsibility of the design team members, in the selection of centerline alignments, to further minimize the cost of each alternative in social, economic, aesthetic and environmental terms. Alignments were developed to minimize property severances and the taking of homes, farmsteads and businesses; to minimize the effect of air and noise pollution on existing and planned development; to preserve and enhance those aesthetically pleasing features existing within the corridor; and to minimize disruption of existing service areas. At the same time, high standards of design were maintained to ensure that the resultant facility will be a safe and efficient part of the areawide transportation system.

Proposed typical roadway sections for the Highway 500 alternatives are shown in Figures II-5 and II-6. Proposed profiles are shown in Figure A IV-1.

B. TRAFFIC ENGINEERING

Data required to carry out traffic engineering studies was obtained from several sources. The Highway Division, Iowa Department of Transportation supplied recent traffic turning volume counts for major intersections along U.S. 65, Interstate 80, U.S. 6, Iowa 163, and Iowa 46, average annual daily traffic (AADT) volumes on many secondary roads in the rural portions of the area, and roadway information for all U.S. and State highways. The City of Des Moines supplied recent traffic counts at several locations on city streets in the east Des Moines area. The consultant collected sufficient street inventory and accident history information within the City of Des Moines to carry out the analysis.

Basic roadway capabilities were determined for major roads in the study corridor based on methods developed in the 1965 Highway Capacity Manual.(1) Level of service "C" was used in the analysis of existing and future conditions.

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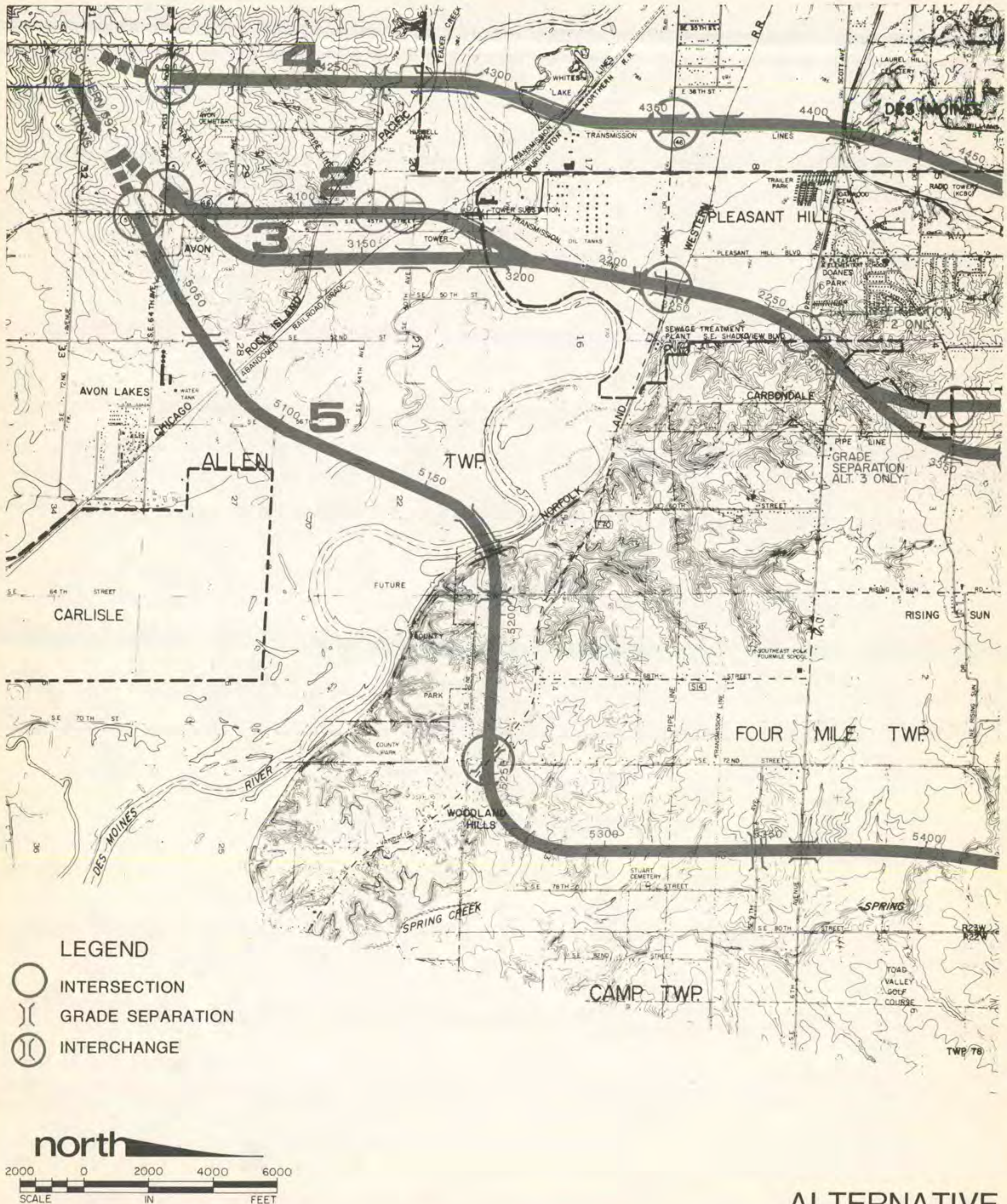
(1) Highway Research Board, Highway Capacity Manual 1965 (Highway Research Board Special Report 87), Washington, D.C. 1965



ALTERNATIVE ROUTES

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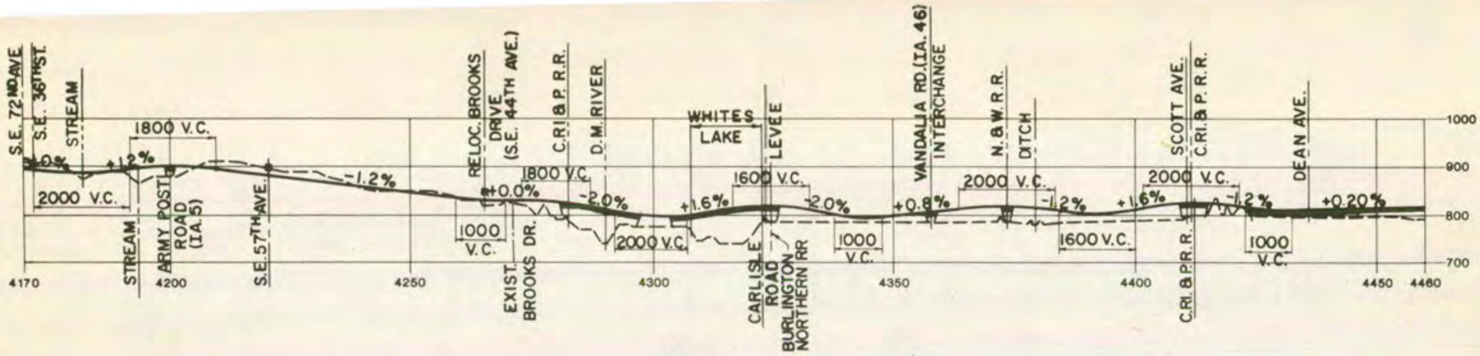
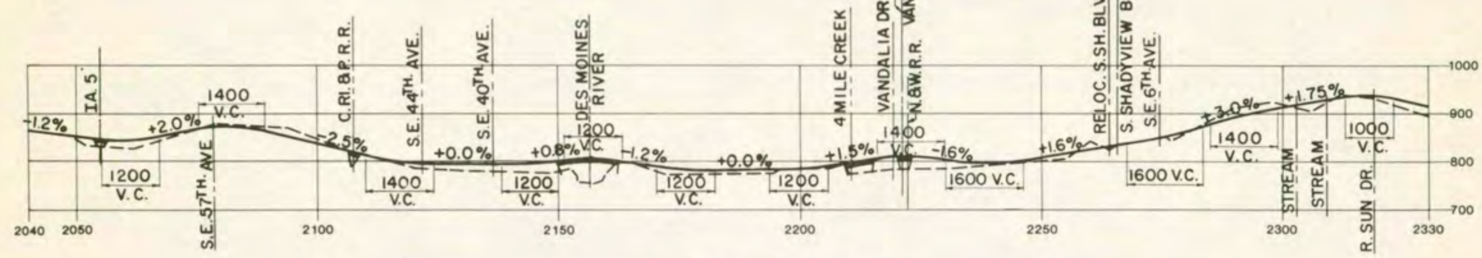
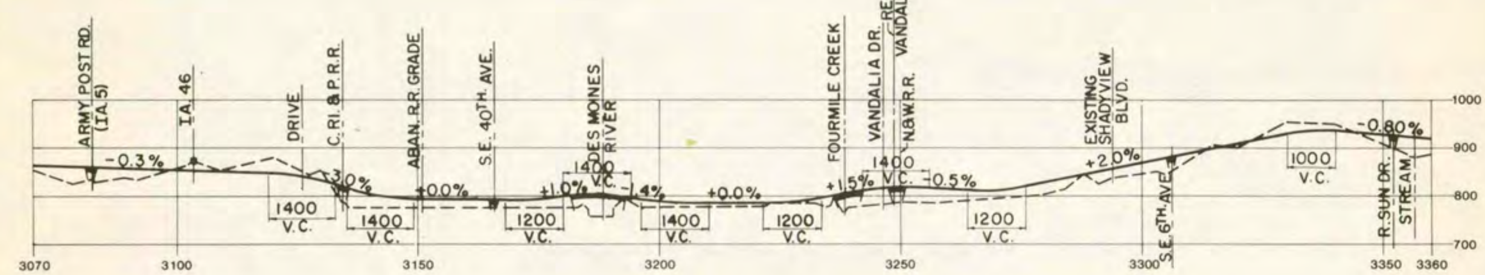


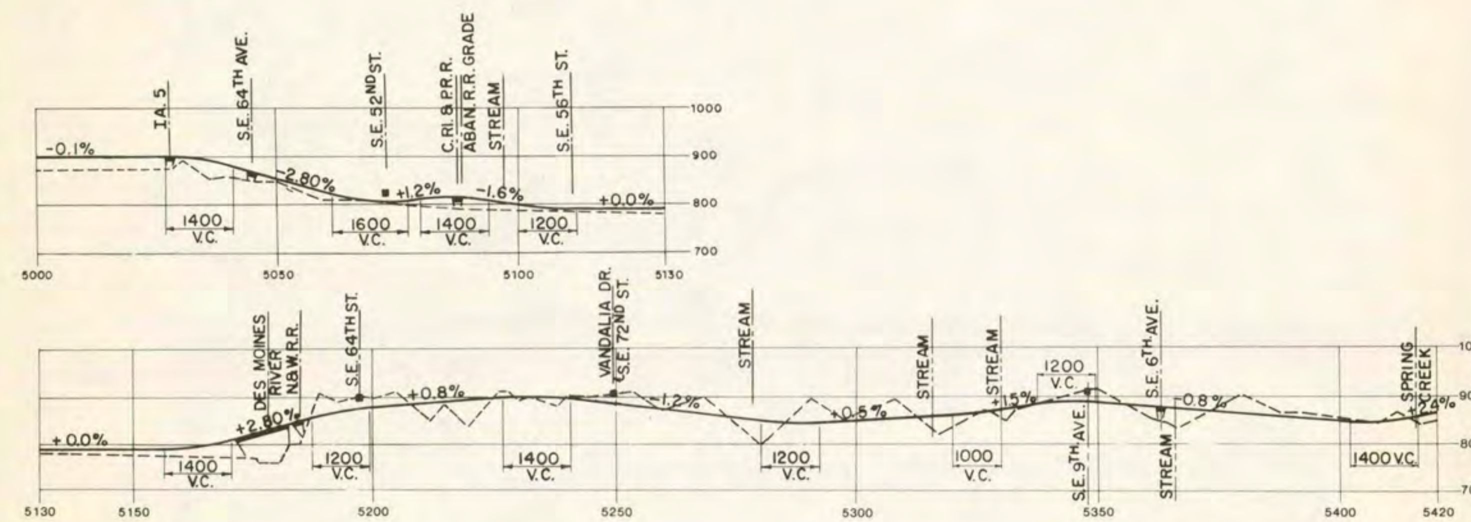
ALTERNATIVE 4



ALTERNATIVE 2



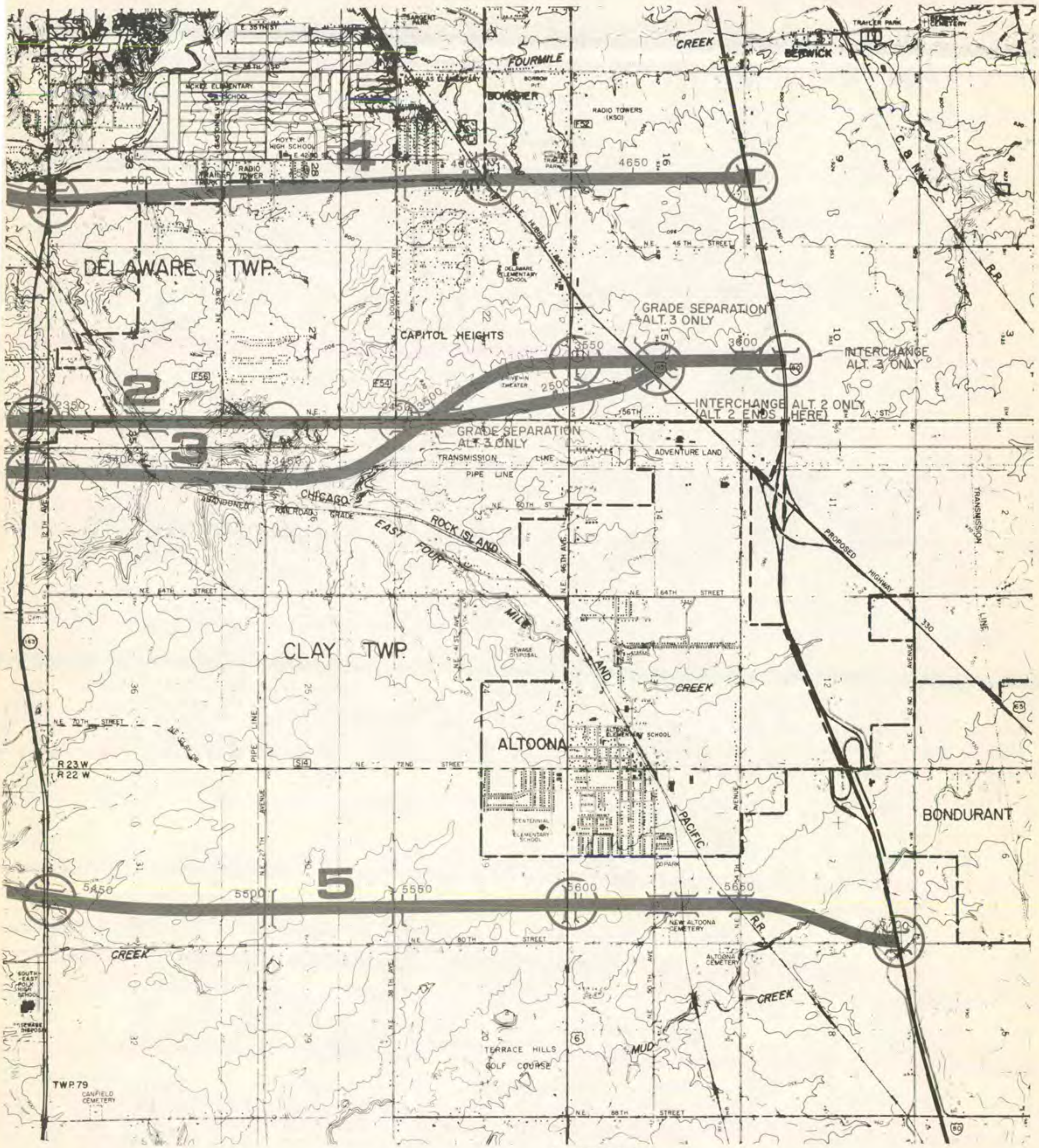
ALTERNATIVE 3



ALTERNATIVE 5

FIGURE AIV-1A

PROFILES



LEGEND

- INTERSECTION
- GRADE SEPARATION
- INTERCHANGE

north

2000 0 2000 4000 6000

SCALE IN FEET

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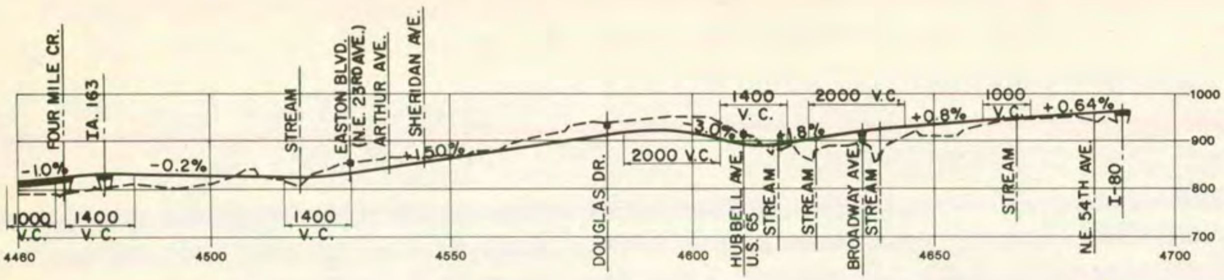
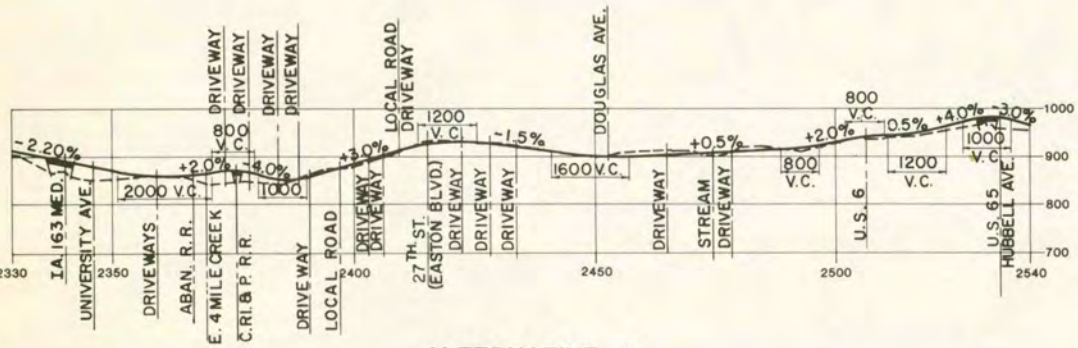
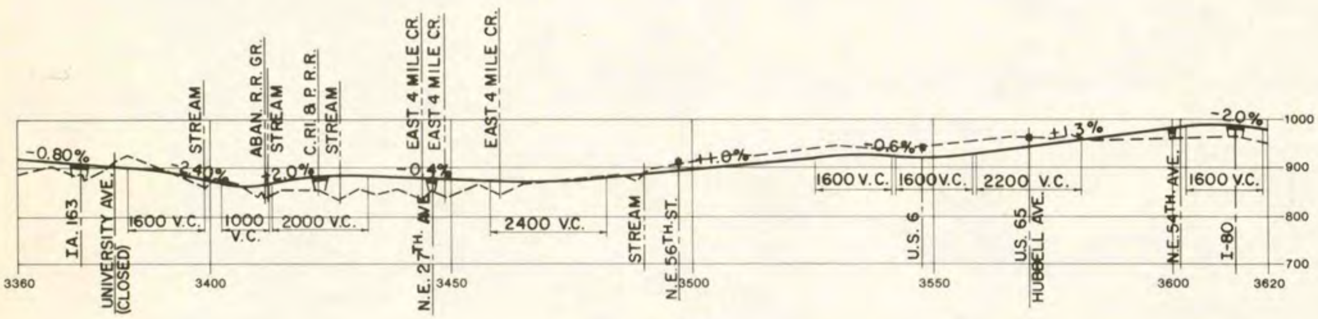
ALTERNATIVE ROUTES



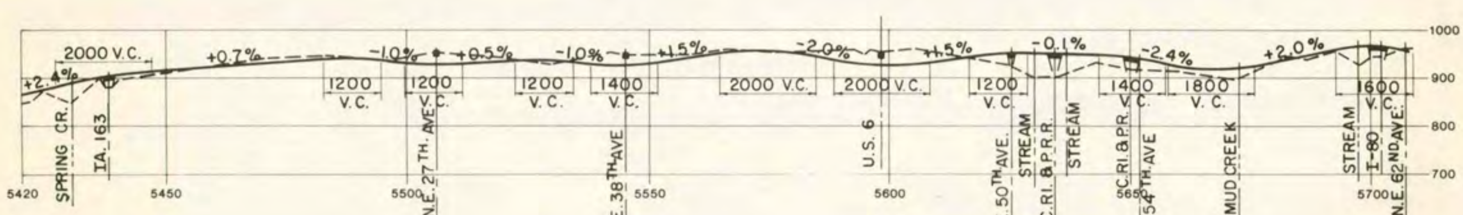
ALTERNATIVE 4



ALTERNATIVE 2



ALTERNATIVE 3



ALTERNATIVE 5

FIGURE AIV-1B

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PROFILES

The method used for the determination of level of service "C" capacity varied slightly with the type of information available. The procedure is diagrammed in Figure AIV-2.

This procedure was followed for analysis of the existing system and for those portions of the Network "E" system which do not reflect a significant upgrading from the existing system. For new roadways on the Network "E" system, and for roadways which are to be significantly upgraded, the procedure used to determine capacity paralleled the procedure shown in Figure AIV-2 for cases where no intersection counts were available.

G. GEOLOGY AND SOILS

The character of geologic and soils conditions found within the study corridor was described in Section III G of this report.

In general, soil conditions within the study corridor are good for highway construction. There are no areas of extensive poor soils which must be avoided. There are certain special problems related primarily to subgrade stabilization and slope stability which can be handled during design.

Loess, which covers about 20% of the study corridor, is a well-drained soil and one of the best in the study area for highway construction. However, the underlying impervious glacial till keeps the water table a few feet up in the loess during wet periods. Saturated loess is difficult to stabilize and very susceptible to frost heave. This can become a problem in cut areas where the saturated portion of the loess will be near grade. In cuts with only a few feet of loess remaining, lime stabilization or, more commonly, selected subgrade material will solve the problem.

The weathering of the Kansan till prior to the deposition of the loess resulted in an upper layer of stiff plastic clay called Gumbotil. It is difficult to work and poorly drained, and is not suitable for highway subgrade. It should not be allowed within several feet of grade. This condition could also exist in the portion of the corridor where a layer of loess lies between the Wisconsin and Kansan till layers.

Slope stability problems can be expected in areas where road cuts expose the loess/till interface. Groundwater held above the impervious till will tend to seep from the back slope of the cut. The loess is very susceptible to piping and will not be stable above the glacial till. This condition could also occur at the contact between the Wisconsin and Kansan till layers in the absence of loess. Benched cuts, face drains or granular filter blankets applied to the back slope may be required. The highly erodible nature of the loess will require cutoff trenches at the top of the back slope and pavement or sodding of all ditches.

Shale-derived soils occur on the slopes above streams. Usually the erosional surface of the shale dips toward the stream. There is often a pebbley zone in the soil just above the shale. The zone is porous and transmits groundwater. If a cut is planned where the surface of the shale dips toward the cut, there may be slope stability problems at the shale-soil interface.

Alluvium occupies the broad bottom lands of the Des Moines River and other corridor streams. By topographic location this soil is commonly flooded. The water table is seasonally variable but is generally shallow. The alluvium is principally fine sands and silts. It is low density material with a high moisture content. Frost susceptibility is high when the water table is near the surface.

The alluvium will support the embankment construction proposed within the Des Moines River and Four Mile Creek valleys. Special treatment to prevent scour of the embankment within areas which are periodically flooded should be considered during design. It appears that material required for embankment construction can be obtained from outwash deposits within the flood plain itself. Borrow areas should not be located immediately upstream of embankments in locations subject to flooding as such practice increases the risk of embankment scour.

The consideration of soils and geological factors in the initial selection of alternative alignments was achieved primarily through the factor mapping process described in Appendix III. The major factor considered was the general suitability of corridor soils for highway construction. The effect of ground slope on construction suitability was also taken into account.

D. HYDROLOGY

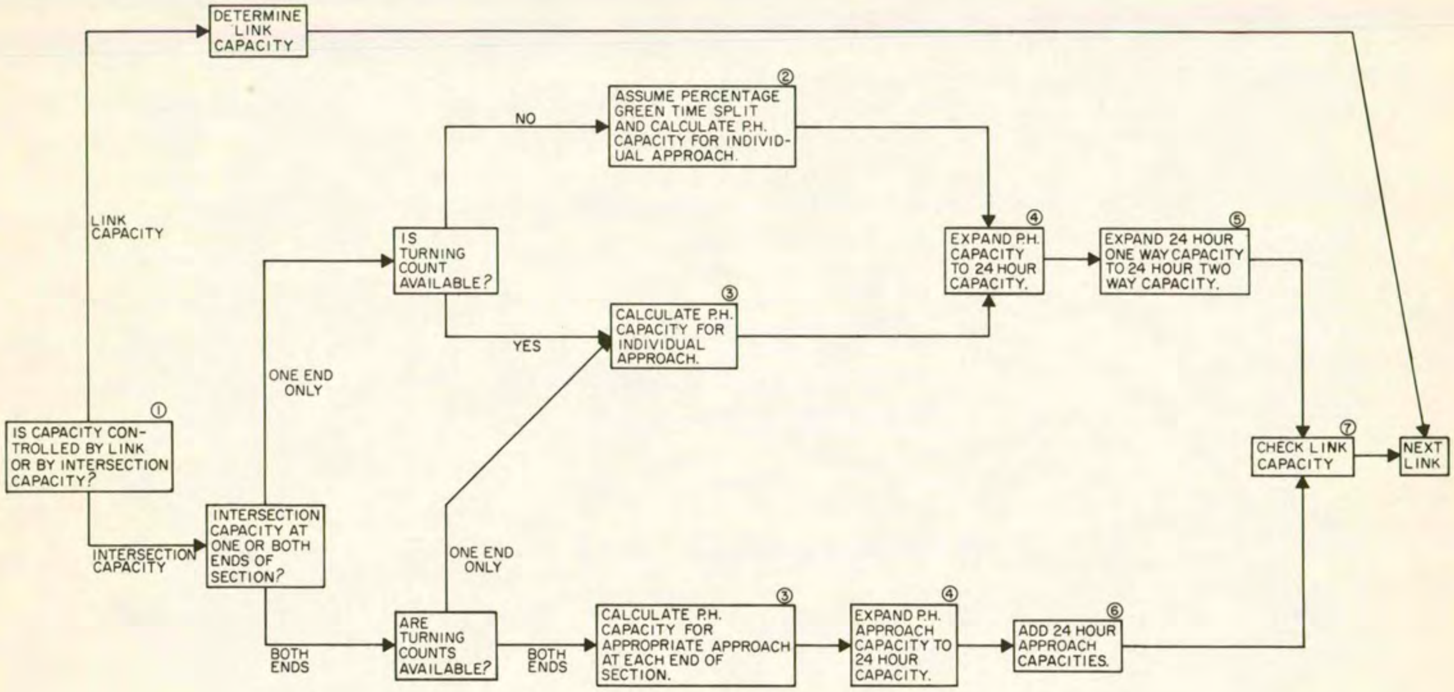
1. *Background*

The study corridor is located within the drainage basin of the Des Moines River which is a major tributary to the Mississippi River. The Des Moines River drains an area of 14,540 square miles in Iowa and Minnesota; approximately 10,400 square miles lie upstream of the study corridor. Other waterways within the corridor include Four Mile Creek, Spring Creek and Mud Creek. Four Mile Creek has a drainage area of 121 square miles while Spring Creek and Mud Creek drain 17.8 and 41.7 square miles, respectively. (See Figure III-10)

The Red Rock flood pool, which is controlled by the Corps of Engineers' dam near Pella (about 53 river miles downstream from the study corridor) extends upstream to within the Des Moines city limits. Both the river and the flood pool have a significant effect on the location of the proposed Highway 500 alternatives, all of which cross the river and the pool near the southern end of the study corridor.

The Saylorville dam and reservoir, a Corps of Engineers flood control project, was constructed on the Des Moines River about 20 miles upstream from the study corridor. Although environmental concerns have delayed operation of the facility, pending Congressional action should allow operations to begin within the next year or so. When operational, the Saylorville dam and reservoir will have a significant effect on flood flows on the Des Moines River within the corridor. These effects are discussed in detail in 2 following.

The Corps of Engineers has made thorough flood studies of the Des Moines River and Four Mile Creek. Their findings are contained in the Flood Plain Information prepared for the State of Iowa National Resources Countil (April 1970)



NOTES

1. An initial judgment — if any doubt existed, intersection capacities were checked.
2. Percent green time split assumed to be 50-40 for intersection of major street with minor street, and 45-45 for intersection of streets of equal importance.
3. One-way, peak hour capacity for the approach which represents capacity restraint on section being considered.
4. Based on known relationship between peak hour volume and 24-hour volume, or on assumed figure of 10%.
5. Based on known 24-hour directional split or on assumed figure of 50-50.
6. Two-way capacity is equal to sum of one-way capacities.
7. Checked to ascertain that capacity of intersections did not exceed actual roadway link capacity.

FIGURE AIV-2

ANALYSIS NETWORK CAPACITY CALCULATION

and the Detailed Project Report for Flood Control for Four Mile Creek in Des Moines, Iowa (February 1975).

In 1970, construction was completed on a 7 mile long levee system and other works to provide flood protection for a portion of Southeast Des Moines and a portion of the adjoining City of Pleasant Hill. The levee system affords protection against flooding from Red Rock pool elevations, against flooding from a small tributary called 7th Ward Ditch and against flooding from the lower reach of Four Mile Creek. Other remedial works construction in Pleasant Hill to provide flood protection against Red Rock flood pool elevations include: a new Vandalia Drive bridge over Four Mile Creek; a road raise for portions of Vandalia Drive and Pleasant Hill Boulevard: and a track raise for the Norfolk and Western Railroad east of Four Mile Creek. The Pleasant Hill remedial works do not afford protection against flooding from Four Mile Creek north of Vandalia Drive.

Flood prone areas beyond the limits of the Red Rock flood pool are shown in Figure III-10.

2. Design Criteria

The largest flood that can be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical region involved, excluding extremely rare combinations, has been computed by the Corps of Engineers, and is termed the Standard Project Flood. While no frequency of return is assigned to this flood, it could occur in any given year. For design purposes, a one hundred year frequency flood, known as the Intermediate Regional Flood, was also computed.

For the southeast Des Moines Remedial Works Project and the Flood Control Protection Project on Four Mile Creek, the Corps of Engineers has established design flood criteria by routing the Red Rock flood pool Standard Project Flood into Lake Red Rock. The result is a maximum pool elevation of 785.0 (M.S.L.) within the study corridor.

Operation of the Saylorville reservoir is uncertain at this time. The current proposal will limit outflow under normal conditions to 12,000 c.f.s. during the growing period (21 April to 15 December) and to 16,000 c.f.s. during the winter months (16 December to 20 April). Outflow during a 100 year return frequency flood is currently estimated to be 23,000 c.f.s. with Saylorville in operation. Routing this flow into the study corridor, and including the flows from the Raccoon River, flow in the Des Moines River during the intermediate regional flood is expected to be 100,000 c.f.s. with Saylorville in operation, and 156,700 c.f.s. without. Flow in Four Mile Creek during a 100-year flood is 22,500 c.f.s. as calculated by the Corps. Thus on the Des Moines River below Four Mile Creek, a 100-year frequency flow of 125,000 c.f.s. was assumed with the Saylorville Dam in operation, and a flow of 179,200 c.f.s. was assumed without Saylorville operating. These values also include flow from the Raccoon River.

The section of the Des Moines River within the study corridor is not navigable, and therefore no special navigation clearances are required. Bridge crossing configurations were developed to allow sufficient waterway opening to pass the Intermediate Regional Flood (100 year return frequency) within the backwater limitations of 1.5' in rural areas and 1.0' in urban areas as specified by the Iowa Natural Resources Council (INRC). A flow rate of 179,200 c.f.s., with Saylorville not operating, was used in these computations due to the indefinite time table for opening the dam, and the uncertain (at this time) release rates to be used while in operation. The required waterway opening computed here will likely have to be revised during preliminary design after final release rates have been determined. A freeboard of 3' above design highwater was used to set roadway profiles at crossing sites. A 1' freeboard was used for embankments.

Outside of the actual bridge crossing of the floodway, the remainder of the highway for Alternatives 2, 3, 4 and 5 within the flood pool limits will be constructed on embankment. The embankment will have negligible effect on the storage capacity of the Red Rock flood pool. In the Four Mile Creek valley between Des Moines and Pleasant Hill, that portion of Alternative 4 which lies within the preliminary floodway limits, as shown in the Corps of Engineers Four Mile Creek Flood Control Report, was placed on structure. Iowa Natural Resources Council and Corps of Engineers approval will be required for construction within the flood plain.

3. *Alternative Bridge Crossings*

Alternative 2 - Alternative 2 crosses the Des Moines River at a point 500 feet downstream from the existing Iowa 46 bridge. The design flood stage at this site, as computed by the Corps of Engineers for the Southeast Des Moines remedial works project, is 787.0 (M.S.L.). The river channel is approximately 520 feet wide at the crossing site and the flood plain width at elevation 787.0 is approximately 6100 feet. The highway crosses the river at a skew of approximately 30^{o} and a bridge with twelve spans of 110 feet each will be required to pass the flood discharge. Low steel elevation is 790.0.

Alternative 2 crosses Four Mile Creek at a point 1500 feet upstream from its confluence with the Des Moines River. A 155' bridge will provide the required waterway opening. Bridges will be required on two Vandalia Interchange ramps at this location as well as on the mainline. Low steel elevation is 788.0.

Alternative 3 - Alternative 3 crosses the Des Moines River at a point 1500 feet downstream from the existing Iowa 46 bridge. Channel and flood stage conditions at this site are the same as for Alternative 2. A bridge with ten spans of 110 feet each will be required to pass the flood discharge. Low steel elevation is 790.0.

The Four Mile Creek crossing for this alternative is identical to that for Alternative 2.

Alternative 4 - Alternative 4 crosses the Des Moines River at a point about 5000 feet upstream of the existing Iowa 46 bridge. The design flood stage at this site as computed by the Corps of Engineers, is 790.0. The river channel is 570 feet wide and the flood plain width at elevation 790.0 is 4140 feet. A bridge with ten spans of 110 feet will be capable of handling the flood flow. Low steel elevation is 793.0

North of the Burlington Northern Railroad, Alternative 4 is within an area protected from flooding by the Corps levee system. The alignment is thus protected until it crosses the Norfolk and Western Railroad embankment, 1600' north of Vandalia Drive. Between the Norfolk and Western Railroad embankment and Scott Avenue, the alignment passes on embankment through the Four Mile Creek flood plain, but does not encroach on the Corps of Engineers preliminary floodway limits.

Alternative 4 crosses Four Mile Creek just south of Iowa 163. A viaduct is proposed within the prescribed preliminary floodway limits between Scott Avenue and Iowa 163 to avoid unacceptable backwater effects. The viaduct is approximately 2500 feet long. Provision should be made for protection of the viaduct and embankment from the scouring effect of peak flow of Four Mile Creek in this area.

Alternative 5 - Alternative 5 crosses the Des Moines River about 2.5 miles downstream from its confluence with Four Mile Creek. The design flood stage at this location is 786.0. The river channel is 570 feet wide at the site and the width of the flood plain at elevation 786.0 is 8600 feet.

A bridge with ten spans of 110 feet will be adequate to handle the flood flow. Low steel elevation is 789.0.

APPENDIX V

RIGHT-OF-WAY ACQUISITION COSTS

With the aid of corridor base maps showing property lines and proposed right-of-way limits, parcels which would be affected by the various alternative alignments were identified through field survey. This survey provided a basis for determining the major cost characteristics associated with land and building acquisition, severance, relocation and administrative overhead factors for the study.

These figures were translated into estimates for each alignment using average acreage values in Polk County and the City of Des Moines. Some minor variations occur within each of these units due to alignment location. Average house values were determined from realtor listings and sale prices obtained locally, and were compared with a field survey of the homes and farm buildings to be acquired. The severance factor multipliers were based on Iowa Department of Transportation guidelines.

The cost estimates are included as a general planning tool to reflect the differential in alignment acquisition cost and are not intended for individual parcel or building evaluations.

Table AV-1 summarizes the major components of the right-of-way acquisition cost for each alternative alignment. Among the major determining factors are land/building values, severance damages, relocation expenses and administrative overhead associated with each parcel.

A. LAND VALUES

Information concerning land values within the City of Des Moines, and the unincorporated areas of Polk County, was obtained from a variety of sources. These sources included realtors' opinions as to value as well as asking and sale prices for properties listed in the "Sold" book used by the Des Moines Board of Realtors.

The information, while not completely documented, investigated and verified according to typical appraisal practice, does provide sufficient basis to estimate the approximate level of values which are likely to be encountered in the acquisition of right-of-way.

Land values tend to be increasing along major arterials radiating from the City of Des Moines especially along Hubbell Ave. (U.S. 65), University Ave. (Iowa 163), and Parkridge (S.E. 6th Ave.). Higher land values are reflected in development activity and in asking prices for land on the east side of Des Moines in suburban Pleasant Hill, and, to a lesser extent, around Altoona and Capitol Heights. Agricultural land near the east side of Des Moines is feeling the pressure of suburbanization and is selling from $2,000 to $5,000 per acre, depending on its proximity to the City and to major access routes. This is more than double the average value of about $1,000 per acre for agricultural land in Polk County.

TABLE AV-1

RIGHT-OF-WAY ACQUISITION COSTS

(Thousands of Dollars)

Alternative	1	2	3	4	5
Land Acquisition Cost including Severance Damages	$ 444	$1,777	$3,718	$2,997	$2,646
Relocation Payments	44	275	280	1,090	324
Residences/Business Acquisition	89	912	820	3,596	952
Administrative Overhead (1)	35	202	172	388	207
TOTAL	$ 612	$3,166	$4,990	$8,071	$4,129

(1) Calculated at $2,600 per rural parcel, $3,400 per urban parcel.

Changes in assessment practices are being considered which may seriously affect values of land for agricultural purposes, especially the amount of tax increment which would make the land undesirable for agricultural purposes. The flood plain area along the Des Moines River restricts the type of development which can be accommodated to agricultural uses, for the most part. Land values in this area reflect that condition.

Residential values in the study corridor are generally highest in the established residential communities of Pleasant Hill, Altoona and Carlisle. Homes in these areas can be found in the $30,000 to $50,000 price range. Older farm residences in the rural portions of the study area are in the $15,000 to $25,000 price range; this is consistent with other rural sections of Polk County.

Commercial development is relatively limited on the east side of Des Moines; there are no major concentrations to influence land values, except the recently opened Adventureland in Altoona near U.S. 65 and I-80. Some speculation has already occurred in this area, possibly inflating land values unrealistically beyond the level of development which can be reasonably expected.

B. SEVERANCE DAMAGE

According to Iowa Department of Transportation Highway Division guidelines, there are four basic categories of severance damage. These include property line, diagonal property line, parallel and diagonal severance. A multiplier from 1.5 to 3.0 respectively is applied to land values, reflecting the approximate acquisition cost associated with severance. It is generally acknowledged that while actual severance damage payments may be higher or lower for individual parcels, this technique will give a reasonable overall estimate for total damages. In addition, where acquisition of improved properties was required, a multiplier of 2.0 was used. This reflects typical court award experience in condemnation proceedings and is a high average value.

C. RELOCATION COSTS

For commercial and residential relocation, the maximum payment figure granted by the Federal Highway Administration was applied for those owners or tenants likely to be affected. For residential relocations, payments amount to $15,000 per property, while for commercial relocations a figure of $10,000 per property was used. Where agricultural properties were involved, the maximum $15,000 payment plus the $10,000 payment for the farm-related buildings was assumed. Without a detailed discussion with each of the property owners, it was difficult to ascertain whether an affected farm operation would be discontinued, relocated or whether some settlement would be reached. These estimates were generalized in order to reflect possible costs in this aspect of the acquisition. Based on the information available, it was not possible to determine whether tenants would be involved and what costs would be associated with their relocation.

D. ADMINISTRATIVE OVERHEAD

A per parcel factor was applied to rural and urban parcels to reflect the costs of legal fees, project offices, etc., associated with the right-of-way acquisition. Factors used were $2,600 for rural parcels (Alternatives 2, 3, 5 and portions of 4), and $3,400 for urban parcels (Alternative 4 only).

APPENDIX VI

NOISE STUDY

A. GENERAL

The need for conducting a noise analysis during project development has been established by the Federal Highway Administration (FHWA) in accordance with guidelines set forth in "Noise Standards and Procedures", Section 773 of the Federal-Aid Highway Program Manual. The FHWA has recently (Federal Register, Vol. 41, No. 80, April 23, 1976) promulgated final noise regulations for highway projects as a revision to Chapter I, 23 CFR, Part 772.

The basic steps in the noise impact assessment consist of the following:

- Identification of existing activities and land uses which may be affected by noise from the proposed highway project.
- Determination of the existing noise environment by means of a field measurement program or by prediction techniques.
- Prediction of future noise levels from the proposed highway alignments, based on projected traffic volumes.
- Comparison of predicted noise levels with existing noise levels and evaluation of potential impacts using established criteria for impact determination.
- Evaluation of alternative noise abatement measures for reducing or eliminating the noise impact, and determination of areas where noise abatement measures appear impracticable or not prudent.
- Evaluation of potential construction noise impacts and mitigative measures.

The first part of this section provides a general introduction to noise, how it is quantified, how people react to it, criteria for impact evaluation, and the parameters of highway noise. Subsequent parts provide information on land use, the existing noise environment, noise prediction methodology and the evaluation of the impact of predicted noise levels, and abatement measures.

B. INTRODUCTION

Of the environmental pollutants of current concern, noise is perhaps the most annoying to the average person. Noise, often defined as "unwanted sound", is everywhere. In urban areas, the sound of air conditioners, pneumatic hammers, aircraft, automobiles, trucks, and the neighbor's radio or television intrude on the natural quiet of the environment.

As an introduction, a brief discussion of the physical characteristics of sound and noise and their measurement is included, which will be helpful in understanding the results of the noise impact assessment for this project.

1. *Description of Noise*

The origin of sound is mechanical vibration, and the propagation of these vibrations in a gaseous medium such as air takes place in the form of density variations, which can be measured by determining the associated changes in pressure in terms of force per unit area (dyne/cm^2, or microbar). The weakest sound pressure detectable by a young person with extremely good hearing is 0.0002 microbar, while the largest sound pressure perceived without pain is of the order of 1000 microbar. Thus the scale of sound pressures covers a range of 1:10,000,000. The sound pressure scale is rather large, and since the ear responds to a change in sound pressure in a relative way, a relative scale called the decibel scale was developed. The decibel (dB) is defined as ten times the logarithm to the base 10 of the ratio between two quantities of power. Since the sound power is related to the square of the sound pressure, the decibel scale reduces the scale of sound pressure of 1:10,000,000 to sound pressure levels of 0 to 140 dB. The term "levels" is introduced because the decibel represents a quantity a certain level above a reference quantity, normally 0.0002 microbar which corresponds to 0 dB.

The three parameters of importance in describing a noise environment are the loudness, the frequency spectrum, and the time-varying character of the sound.

The simplest physical measure of a noise would be to determine its overall sound pressure level; however, such a measurement would give no indication of the frequency distribution of the noise, nor would it give any information as to the human perception of it. By relatively simple means, it is possible to give a noise measuring instrument certain characteristics which make the measured results much more useful. This capability has been realized with the now internationally standardized sound level meter. The sound level meter is supplied with a set of frequency weighting networks, the characteristics of which have been termed A, B and C. (The unit of frequency is the Hertz, or cycle per second). The A-weighting, which suppresses the loudness of low frequencies and very high frequencies, provides a scale similar to the response of the human ear. The present international standards for noise measurement and evaluation recommend the use of A-weighting in the evaluation of traffic-generated noise. Sound levels used in this report are based on A-levels, and are expressed in decibel units written as dBA.

While the dBA measure accounts for the loudness and frequency spectrum of a noise environment, it does not provide any indication of the time-varying character of the noise. Adjacent to a highway, the noise varies as the traffic along the highway changes. By measuring instantaneous noise levels at certain intervals over a period of time, and arranging the individual noise levels by order of magnitude, the noise level exceeded during any specific percent of time during the measurement period can be determined. The median noise level during the time of measurement (the noise level exceeded 50 percent of the time) is described as L_{50}.

Other commonly used single-number discriptors are L_{90} and L_{10}, the noise level exceeded 90% of the time and 10% of the time, respectively. Various methodologies have been developed in an attempt to relate these numerical descriptors to subjective evaluation of noise. At the present time, however, use of the L_{10} noise level in dBA units is felt to provide a valid means of describing a noise environment adjacent to a highway, since it provides an indication of the fluctuation in noise levels. Although the L_{10} noise level is always higher than the L_{50} level, at greater distances from the highway the difference between L_{10} and L_{50} is small, and either descriptor provides a good indication of the noise environment.

For reference and orientation to the decibel scale, Table AVI-1 relates common environmental noises to their respective dBA levels. A few general relationships may be helpful in understanding some of the principles of sound generation and transmission. A decrease of 10 decibels will appear to an observer to be halving of the noise. For example, the rock and roll band shown in the table at 100 dBA would sound only half as loud as the elevated train at 110 dBA, and the boiler room at 90 dBA would sound only half as loud as the rock and roll band. A doubling of the noise source produces only a 3 dBA increase in noise levels. For example, a single garbage disposal is shown at 80 dBA; two disposals at the same location would produce 83 dBA.

2. *Reaction to Noise*

Social survey studies have placed the effects of noise on people into three general categories: the subjective effects of annoyance, nuisance and dissatisfaction; interference with activities such as speech, sleep and learning; and physiological effects such as startle and hearing loss. Since the same sounds are perceived differently by different people, there can be no completely objective measure of subjective reaction to noise. In terms of interference with speech or sleep, however, quantitative measures of noise criteria have been established.

It is generally recognized that the efficiency of humans is considerably higher under comfortable conditions than when they are constantly annoyed by their surroundings. Also, a certain degree of environmental quietness is a desirable quality in itself. People in general do not like to live in the immediate vicinity of an airfield, roads with heavy traffic, or other noisy places. Noise may bear considerable economic importance, such as affecting the value of adjacent land.

Furthermore, in choosing utility items such as appliances, the quietness of the items is definitely considered by the buyer. The control of noise is therefore important not only from an annoyance and health point of view, but also from an economic viewpoint.

3. *Criteria for Impact Evaluation*

To assess the impact of a new noise source, it is necessary to determine the relationship between the new intrusive noise and the existing noise environment.

TABLE AVI-1

COMMON ENVIRONMENTAL NOISE LEVELS (dBA)

INDOOR NOISE LEVELS	DECIBELS	OUTDOOR NOISE LEVELS
	140 ---	THRESHOLD OF PAIN
	130 ---	Pneumatic riveter
Oxygen torch	120 ---	
	110 ---	Elevated Train
		Jet flyover at 1000 feet
Rock and roll band	100 ---	
		Farm tractor
		Lawn mower at 3 feet
Boiler Room	90 ---	Motorcycle at 25 feet
Food blender at 3 feet		
		Diesel truck, 40 mph at 50 feet
Garbage disposal at 3 feet	80 ---	
		Lawn mower at 100 feet
Shouting voice at 6 feet	70 ---	
		Car, 50 mph at 50 feet
Normal speech at 3 feet		
	60 ---	Heavy traffic at 300 feet
Average business office	50 ---	
Average residence		Bird calls
	40 ---	
Library		
	30 ---	
		Quiet rural area at night
Broadcasting studio		
	20 ---	Rustling leaves
	10 ---	
	0 ---	THRESHOLD OF HEARING

Reaction to the new noise environment can be categorized in a relative manner, based on the following information:

A one dBA increase in noise level cannot be distinguished by a listener.

A three dBA increase in noise level is a barely perceptible difference.

A five dBA increase in noise level is required to produce a change in community reaction to the noise environment.

A ten dBA increase is approximately equal to a doubling of the loudness.

On the basis of the preceeding information, and the guidelines in Highway Noise: A Design Guide for Highway Engineers (NCHRP Report 117), impacts of the proposed project were assessed in accordance with the following table.

TABLE AVI-2

IMPACT DUE TO CHANGE IN EXISTING NOISE

Increase or Decrease Over Existing Level	Degree of Impact
0 - 5 dBA	No Impact
6 - 10 dBA	Some Impact
11 - 15 dBA	Significant Impact
15 + dBA	Great Impact

The impact determination in terms of changes in the existing noise environment does not establish an upper limit on the noise levels from a highway facility. The Federal Highway Administration, under the mandate of the U.S. Congress, has established criteria to limit highway noise.

The Federal-Aid Highway Act of 1970 required the development and promulgation of standards for highway noise levels compatible with different activities. At the present time, interference with speech communication is the best documented and most readily quantified parameter for use in determining the acceptability of a noise environment. Conditions requiring a minimum of effort to maintain speech communication are an important index of enrivonmental quality. While consideration of annoyance and disturbance is also a desirable basis for evaluating a noise environment, the lack of an established relationship to a numerical descriptor of noise levels precludes its exclusive application to a noise standard at the present time.

The design noise levels shown in Table AVI-3 are the noise standards of the Federal Highway Administration and are based on speech interference factors. The single number descriptor L_{10} (the sound level exceeded for only 10 percent of the time during the period under consideration) provides an indication of both the

TABLE AIV-3

DESIGN NOISE LEVEL / ACTIVITY RELATIONSHIPS

Activity Category	Design Noise Levels Decibel Amperes		Description of Activity Category
	L_{10}	$L_{eq.}$	
A	60 dBA (Exterior)	57 dBA	Tracts of lands in which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Such areas could include amphitheaters, particular parks or portions of parks, or open spaces which are dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet.
B	70 dBA (Exterior)	67 dBA	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, picnic areas, playgrounds, active sports areas, and parks.
C	75 dBA (Exterior)	72 dBA	Developed lands, properties or activities not included in categories A and B above.
D	--		Undeveloped lands; future land use should be compatible with anticipated noise levels.
E	55 dBA (Interior)	52 dBA	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums. (For use when no exterior noise-sensitive land use is identified).

SOURCE: Federal-Aid Highway Program Manual, Section 773, U.S. Department of Transportation, Federal Highway Administration.

magnitude and frequency of occurrence of the loudest noise events. An alternative descriptor. L eq, is also provided for. L eq is the equivalent steady state sound level which in a stated period of time would contain the same acoustic energy as the time-varying sound level during the same time interval. The FHWA permits the use of either L_{10} or L eq design noise levels on a given project. The use of L eq levels is more appropriate to the study of low volume highways or to situations wherein the noise environment is affected by more than one major noise source. The L_{10} design noise levels are used on this project. The standards, developed from research data, represent what has been determined as acceptable noise levels for a particular land use and its associated human activity; the noise levels would not be objectionable to the majority of persons exposed to them.

The design noise levels set forth in the standards represent the highest desirable noise level conditions. Noise abatement measures are to be provided to achieve a reduction in noise levels whenever the predicted noise levels exceed the design noise levels. Partial abatement measures are to be used in cases where reduction of noise levels below design noise levels is not feasible. However, there may be sections of highway where it would be impractical to apply noise abatement measures to meet the design noise levels. The FHWA may grant exceptions to the noise standards, if, after consideration of noise abatement measures with respect to economic costs and benefits, aesthetic impact, air quality, highway safety and other similar values, it is determined that reduction of noise to design levels is not in the overall best public interest for that particular highway section.

4. Highway Noise Parameters

The three major parameters which affect traffic noise levels are the type and volume of traffic, the horizontal and vertical configuration of the roadway and the position of an observer with respect to the roadway.

Due to their different noise-generating characteristics, automobile and heavy-duty trucks are analyzed separately. Traffic volumes are generally described in terms of vehicles per hour. The corresponding operating speeds are determined by the traffic-carrying capacity of the highway or by posted speed limits.

For automobiles, the noise level increases as the volume and speed increase. For heavily traveled highways, the noise level will increase by about 3 dBA per doubling of traffic volume. Under normal cruising conditions, the engine-exhaust system and tire-roadway interaction are both major sources of noise.

Heavy-duty trucks, although representing a small proportion of the total vehicle population, are significantly noisier than cars. A single truck may generate noise levels on the order of 15 dBA higher than a single automobile operating under the same conditions. Since truck engines are generally operated at approximately constant rpm, truck noise is generally independent of speed. The engine and exhaust system is the predominant noise source, with tire-roadway noise of importance at higher speeds.

Roadway parameters affecting noise levels include the number of lanes, median width, pavement surface and gradient. Very smooth pavements can reduce noise from tire-roadway interaction, whereas a rough pavement increases the noise. While automobile noise is not affected by steep grades, truck noise levels can be increased by 2 to 5 dBA over level roadway conditions.

The noise heard by an observer adjacent to the highway can be affected by several factors, one of the most important being distance from the highway. Traffic noise will decrease by 4 to 6 dBA per doubling of distance, (for example, the noise level at 200 feet will be 4 to 6 dBA lower than the noise level at 100 feet from the roadway). Elevating or depressing the roadway can reduce the noise levels significantly. Natural ground contours blocking the line of sight to the roadway provide at least a 5 dBA reduction. Multiple rows of buildings or dense vegetation can reduce noise levels up to 10 dBA. Artificial roadside noise barriers, such as opaque walls or earth berms, under certain conditions, may provide up to a 15 dBA reduction.

C. INVENTORY OF LAND USE

The initial step in the noise analysis consisted of developing a generalized land use/activity inventory according to the broad categories described in the Federal Highway Administration noise standards. There were no Category A activities identified in the study corridor. Category B and C activities are indicated on Figure IV-5; areas not designated are basically either used for agricultural purposes or are undeveloped. As part of the inventory, particularly sensitive activities, such as churches and schools, were noted. These are shown on Figure AIII-6.

D. EXISTING NOISE ENVIRONMENT

To evaluate the potential impact of the proposed project adequately, it is essential that the existing noise environment be determined. To accomplish this, a field measurement program was conducted during a four-day period between July 21 and July 24, 1975. Using a calibrated, precision sound level meter, noise levels were observed at a number of locations in the project area, including significant noise sensitive activities identified during the land use/activity inventory.

The sampling procedure used consists of noting the instantaneous noise levels (in dBA) at ten-second intervals for a period of eight minutes and 20 seconds (until 50 samples have been recorded). During the measurement period, the noise levels are entered on a worksheet, in order from highest level to lowest. When the 50 samples have been taken, the data are tested using statistical criteria to determine if the L_{10} and L_{50} noise levels have been determined with 95 percent confidence. If the criteria are not satisfied, than an additional 50 samples are taken, and the total samples retested. This procedure may be repeated until sufficient data have heen taken, in groups of 50 samples, to satisfy the criteria.

While the results of the existing noise survey are valid only for the time period actually measured, with knowledge of the behavior of the noise sources in the area, such as hourly traffic variations, the existing levels may be determined for longer periods of time. The results of the existing noise field survey are summarized in Table AVI-4. The measurement locations and recorded noise levels are shown on Figure IV-5.

TABLE AV-4

EXISTING NOISE LEVELS (dBA)

	L_{50}			L_{10}		
Site *	Measured	95% Confidence Limits	Normalized to Peak Condition	Measured	95% Confidence Limits	Normalized To Peak Condition
2-1	51	+5,-3	51	73	±3	73
2-2	43	+1,-3	43	55	+1,-3	55
2-3	45	±3	47	59	±3	59
2-4	37	+1,-3	37	39	±3	39
2-5	53	±3	53	75	±3	75
2-6	53	+5,-3	56	63	±3	63
2-7	49	+3,-1	49	57	±3	57
3-1	41	±1	41	43	+1,-3	43
3-2	45	±1	51	49	±3	55
4-1	55	+1,-3	55	57	+1,-3	57
4-2	57	±3	57	69	±3	69
4-3	39	±1	39	41	+3,-1	41
4-4A	55	+1,-3	58	67	±3	68
4-4B	47	±3	50	55	±3	58
4-4C	55	±3	58	65	±3	68
4-5A	57	+1,-3	63	65	+3,-1	71
4-5B	51	±3	53	57	±3	59
4-5C	57	±3	61	67	±3	71
4-6	43	+1,-3	43	55	±3	55
4-7	41	±1	41	47	±3	48
4-8	41	±1	41	43	+3,-1	43
4-9	57	±1,-3	51	57	+3,-1	57
5-1	41	+1,-3	41	51	±3	51
5-2	41	+3,-1	43	47	±3	48
5-3	57	+3,-5	58	65	±3	63
5-4	39	+1,-3	39	43	±3	43
5-5	51	±3	52	59	±3	60
5-6	41	±1	41	45	+1,-3	45
5-7	59	+3,-5	59	69	+3,-3	69
5-8	39	±1	39	41	+3,-1	41

* For site locations see Figure IV-5.

During the measurement period, traffic counts were also taken at appropriate sites. The purpose of the traffic counts is to allow for adjustment of measured noise levels to peak conditions based on comparison of observed traffic and known peak traffic conditions (see Table VI-4). The traffic counts were also used to predict noise levels at the measurement sites to provide an indication of the accuracy of the noise prediction model.

The significant highway noise sources in the study area are limited to the major traffic carriers: Interstate 80, U.S. 65 and 6, Iowa 163, Iowa 46 and Iowa 5, Vandalia Drive, N.E. 56th Street, N.E. 72nd Street and a portion of Army Post Road. The effects of traffic noise from these roadways is generally only significant adjacent to the highways; most of the "interior" portions of the study area are not impacted by the major routes.

E. NOISE PREDICTION METHODOLOGY

To determine the potential noise impact, the future noise levels from the proposed highway must be predicted, then compared to both FHWA design noise levels and existing levels.

The noise prediction methodology used in this study is Highway Noise: A Design Guide for Highway Engineers (NCHRP Report 117). This prediction model has been approved by the FHWA for use in applying the noise standards. Certain refinements to the model, as suggested in Highway Noise: A Field Evaluation of Traffic Noise Reduction Measures (NCHRP Report 144) were employed where appropriate. The model can take into account variations in the highway noise parameters described in the preceding Section B 4.

To provide an indication of the accuracy of the prediction model, the observed traffic volumes and estimated speeds were used to predict noise levels at selected measurement sites, using the short method approximation (SMA) procedures outlined in NCHRP Report 117. Comparison of predicted levels with measured levels indicates that the SMA procedure tends to overpredict. Since the SMA method assumes an infinitely long, straight roadway, it is reasonable to expect overprediction in comparison to actual field conditions.

The existing noise measurement criteria require that the upper and lower error limits fall within a +3 dBA and -3 dBA respectively of the L_{10} or L_{50} value to fulfill the 95% confidence limits. (The 95% confidence limits mean that if the measurements were repeated a large number of times, the measured L_{10} or L_{50} would fall within the upper and lower limits in 95% of the tests.

Section 773 of the Federal-Aid Highway Program Manual provides the following options for selecting the traffic parameters used in predicting future noise levels:

> The automotive volume used shall be the future volume (adjusted for truck traffic) obtained from the lesser of the design hourly volume or the maximum volume which can be handled under traffic level of service "C" conditions. For automobiles, level of service "C" is considered to be the combination of speed and volume which creates the worst noise conditions. For those

highway sections where the design hourly volume or the level of service "C" condition is not anticipated to occur on a regular basis during the design year, the average hourly volume for the highest 3 hours on an average day for the design year may be used.

The truck volume used shall be the design hourly truck volume for those cases where either the design hourly volume or level of service "C" volume was used for the automobile volume. Where the average hourly volume for the highest three hours on an average day was used for automobile traffic, comparable truck traffic should be used.

The operating speed (as defined in the Highway Capacity Manual) shall be consistent with the traffic volumes determined in the preceding paragraphs.

The traffic forecasts for this study were described in Appendix II. Based on the traffic volumes assigned to each segment in the analysis network, (Figure AII-1) noise levels were predicted for design year traffic volumes. Using the predicted levels, graphs of L_{10} noise levels versus distance from the roadway were developed for each roadway segment. These graphs (Figure AVI-1) were then used to determine the offsets from the roadway segment to the noise contours of concern.

F. IMPACT EVALUATION

Using the noise graphs, L_{10} contours were determined in 5 dBA increments. The effect on corridor noise levels was determined by comparing the existing noise levels with the L_{10} contour levels for design year traffic, and evaluating the effect of projected increase or decrease in noise against the criteria shown in Table AVI-2.

These graphs were also used to determine the noise levels at critical receptors within the study corridor, which were then compared with the allowable FHWA Design Noise Levels shown in Table AVI-3. As a result of this process several potential noise problem areas were identified within the study corridor. These sites exist both along the proposed alternative Beltway alignments and along other segments of the roadway network which will carry increased volumes of traffic in the future. The extent of noise impact at these sites along with the feasibility of measures to reduce or eliminate the impact were discussed in Section IV D of this report.

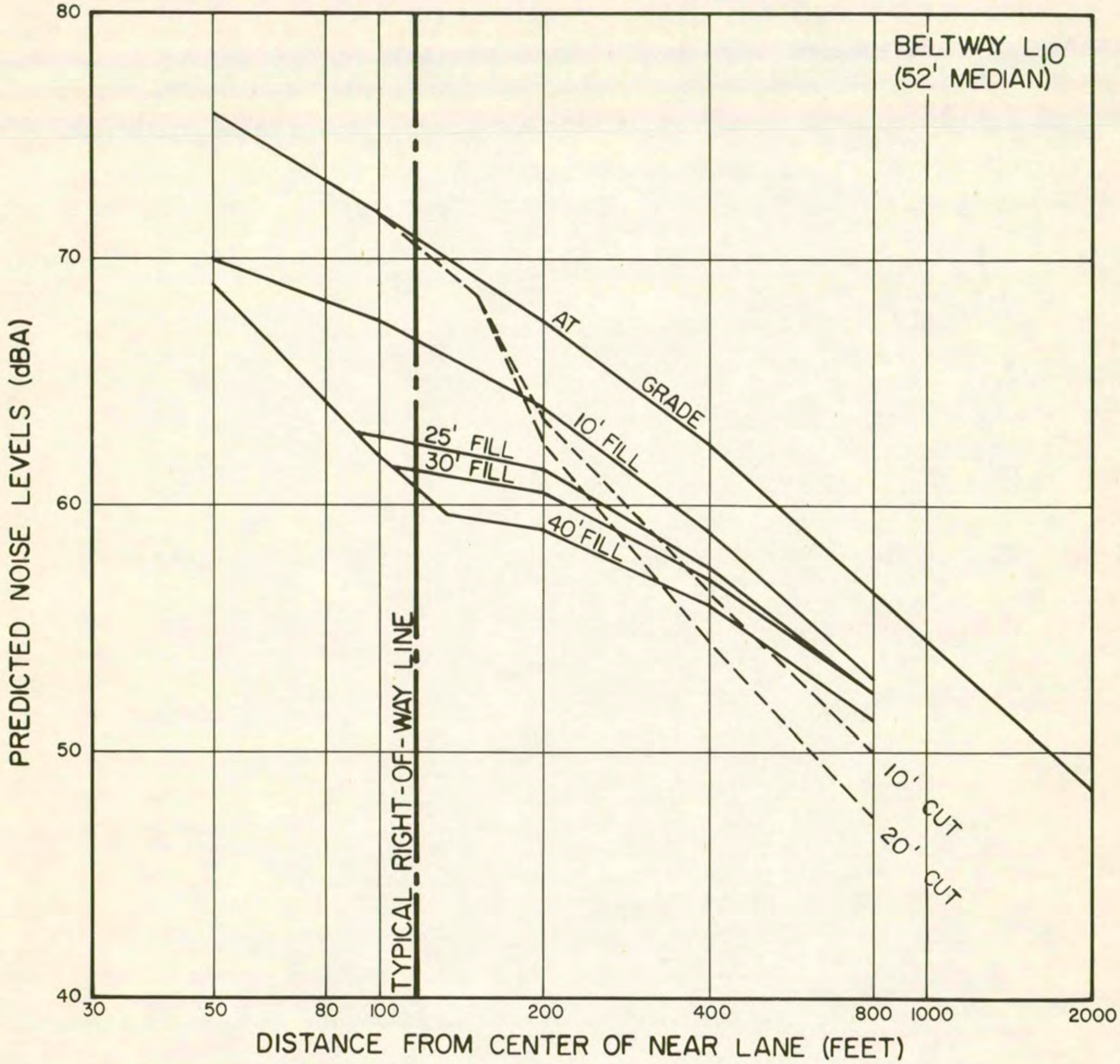


FIGURE AVI-1

PREDICTED L_{10} NOISE LEVELS (TYPICAL)

APPENDIX VII

AIR QUALITY STUDY

A. AIR POLLUTION DEFINED

Air pollution is the presence in the atmosphere of one or more air contaminants, or combination of contaminants, in sufficient quantities and duration as to be, or have a tendency to be injurious to human, plant and animal life, property, or which unreasonably interfere with the comfortable enjoyment of life, property and the conduct of business.

All transportation modes, especially those powered by the internal combustion engine, emit many types of pollutants. The primary pollutants from motor vehicles are carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_X). Particulates (mainly lead) and the oxides of sulfur are emitted in much smaller amounts.

Hydrocarbons and nitrous oxides undergo a reaction in the presence of sunlight to form photochemical oxidants, or smog.

B. DESCRIPTION OF POLLUTANTS

1. Carbon Monoxide [CO]

Carbon monoxide is a tasteless, odorless, colorless gas and is the most widely distributed and commonly occurring air pollutant. On a global basis, natural sources contribute four billion tons of CO annually; anthropogenic sources add an additional 400 million tons.

Carbon monoxide results from incomplete combustion of all types of carbonaceous fuels. The internal combustion engine, in both mobile and stationary applications, is the most significant source of CO, contributing about 73 percent of the human-caused CO emissions in the United States during 1970. Other sources include industrial processes, solid waste disposal operations and forest fires.

Human health effects of high level, long term CO exposure include central nervous system disorders, tissue respiration impairment and decreased ocular sensitivity. CO combines with hemoglobin (the oxygen carrying component of blood) about 200 times more readily than does oxygen. Thus, low levels of CO in the air have a greatly magnified effect on the body. At high concentration levels (1000 ppm or more), carbon monoxide paralyzes brain function and can lead to death. Exposure to CO concentrations as low as 30 ppm for several hours will inactivate about five percent of the hemoglobin, resulting in impaired performance on certain psychomotor tests; this indicates a significant effect on brain function. Preliminary evidence also indicates an increased death rate for persons hospitalized for heart attack when subjected to levels of 8-14 ppm.

Due to its unique mode of action, carbon monoxide is not known to have adverse effects on vegetation, visibility or material objects.

2. *Hydrocarbons [HC]*

The term "hydrocarbons" encompasses a group of compounds comprised of hydrogen and carbon. The major anthropogenic hydrocarbon source is the internal combustion engine; transportation sources contributed 60 percent of the total man-made source HC into the atmosphere in 1974. Other sources include the evaporation of organic solvents (from painting, dry cleaning, etc.), agricultural burning, and the storage and marketing of petroleum products.

At levels of HC typically found in urban areas, there are no known adverse human effects. Hydrocarbons, however, are an extremely important component in the production of photochemical oxidants; damaging levels of photochemical oxidants are related to HC concentrations, which are, alone, without adverse effect.

Specific hydrocarbon compounds do have other effects. Ethylene, for example, damages plants by inhibiting growth and causing leaves and flowers to fall.

3. *Oxides of Nitrogen [NO_X]*

Nitrogen gas (N_2), normally a relatively inert substance, comprises about 75 percent of the air around us. At high temperatures and pressures, such as those found in the internal combustion engine, it combines with oxygen to form several different gaseous compounds collectively called oxides of nitrogen. Although the major source of NO_X is fuel combustion (due primarily to motor vehicles), certain manufacturing and chemical operations can cause locally high concentrations.

Until recently, detection of NO_X in polluted air has been difficult; therefore, less is known about its health effects than, for example, the oxides of sulfur. Adverse health effects of NO_X seem to depend on concentration and length of exposure. Short-term exposures do not appear to be injurious to health; however, a gradual and cumulative effect on the respiratory system of certain individuals has been noted.

The oxides of nitrogen, at certain levels and exposure times, can cause serious injury to vegetation; the effects noted include the bleaching or death of plant tissue, the loss of leaves, and a reduced growth rate. NO_X can also cause fabric dyes to fade and fabrics themselves to deteriorate. Nitrate salts, formed from the oxides of nitrogen, have been associated with the corrosion of metals.

4. *Particulates*

Particulate matter is defined as any material, except uncombined water, which exists in a finely divided form as a liquid or solid at standard temperature and pressure. Particulate sources include many kinds of industrial and agricultural operations, as well as combustion products, including automobile exhausts.

Suspended particulate material ranges in size from 10 microns (1 micron = 1/1000 of a millimeter) in diameter to 0.1 microns or smaller. An area of increasing concern is the deposition and retention of submicron sized particulates which penetrate deeply into the lung alveoli. Transfer into the blood, lymph or intestinal tract may then exert harmful effects elsewhere in the body. Particulate matter in the respiratory tract may produce injury by itself, or may act in conjunction with other gases, altering their sites and modes of action. These combinations can decrease respiratory efficiency, producing respiratory irritation and breathing difficulties. In addition, many particulate compounds are suspected carcinogens.

Suspended particulates scatter and absorb sunlight, thereby reducing the amount of solar energy reaching the earth, producing hazes and reducing visibility. Particulate pollution causes a wide range of damage to materials. It may chemically attack materials through its own intrinsic corrosivity, or through the corrosivity of substances absorbed by it.

5. *Oxides of Sulfur [SO_X]*

Sulfur is a nonmetallic element found in carbonaceous fuels. When these fuels are burned, sulfur reacts with oxygen to form gaseous oxides of sulfur (the most prevalent of these compounds are sulfur dioxide (SO_2) and sulfur trioxide (SO_3). The major source of SO_X in the atmosphere is fuel combustion, while chemical plants, metal processing and trash burning constitute minor sources. The automobile supplies less than ten percent of the total sulfur oxide concentration in the atmosphere.

The oxides of sulfur are synergistic in combination with particulates; that is, the effect of the two toxic agents is greater than the sum of the effects of the agents alone. At sufficiently high concentrations, sulfur dioxide irritates the upper respiratory tract. Lower concentrations of both SO_2 and SO_3, especially when carried on particulates, can penetrate lung tissue and react with moist air forming sulfurous and sulfuric acids. There is strong evidence that bronchial asthma, chronic bronchitis, emphysema and lung cancer are aggravated by the synergistic effect of an SO_X-particulate combination.

Sulfur oxides, in combination with moisture and oxygen, can yellow plant leaves, dissolve marble, and eat away iron and steel. They can limit visibility and cut down insolation.

6. *Photochemical Oxidants [O_X]*

Photochemical oxidants are comprised of several different pollutants, notably ozone (O_3) and a group of chemicals known as peroxyacylnitrates (PAN). These substances are derived from several sources, all sharing the following properties: (1) they are formed by a chemical reaction among other pollutants ("-chemical"); (2) the reactions forming them proceed most rapidly in the presence of intense sunlight ("photo-"); and (3) they are extremely reactive chemically, acting as oxidizing agents ("oxidants"). All the reactants, products and effects of the photochemical process are not known at this time, but both hydrocarbons and nitreous oxides are known to be involved.

The various components of O_X can have several adverse effects. They can directly affect human lung and eye tissue, cause respiratory irritation, and possibly change lung function.

TABLE AVII-1

SUMMARY OF NATIONAL AMBIENT AIR QUALITY STANDARDS

Adopted April 30, 1971 Federal Register Vol. 36, No. 84, Part II

POLLUTANT	TIME OF AVERAGE	PRIMARY STANDARD**	SECONDARY STANDARD**
Particulate matter	Annual (Geometric Mean) 24 hour	75 μg 260 μg*	60 μg 150 μg*
SO_x (Measured as SO_2)	Annual (Arithmetic Mean) 24 hour 3 hour	80 μg (0.03 ppm) 365 μg (0.14 ppm)*	 1300 μg (0.5 ppm)*
CO	8 hour 1 hour	10 mg (9 ppm)* 40 mg (35 ppm)*	Same as Primary Same as Primary
Hydrocarbons (Nonmethane, measured as CH_4)	3 hour (6 to 9 a.m.)	160 μg (0.24 ppm)*	Same as Primary
NO_2	Annual (Arithmetic Mean)	100 μg (0.05 ppm)	Same as Primary
Oxidents (Measured as O_3)	1 hour	160 μg (0.08 ppm)*	Same as Primary

** Concentration in weight per cubic meter (corrected to 25° C and 760 mm of Hg)

* Concentration not to be exceeded more than once per year

Photochemical oxidants are extremely toxic to many kinds of plant life primarily affecting the leaf structure. In addition, O_X can physically weaken such materials as rubber and fabrics.

C. AIR QUALITY STANDARDS

The Environmental Protection Agency, acting under authority of the 1970 Amendments (Public Law 91-605) to the Clean Air Act (42 USC 1857 et. seg.), established primary and secondary National Ambient Air Quality Standards (NAAQS) for six major pollutants.

The primary standards establish levels of air quality which provide, given an adequate margin of safety, protection for public health. The intention of these standards is to protect sensitive receptors: the young, the aged, and those having respiratory weaknesses and difficulties. The secondary standards define levels of air quality considered necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Simply stated, the purpose of the secondary standards is to reduce financial losses due to crop damage and material deterioration caused by air pollution.

The primary and secondary National Ambient Air Quality Standards are shown in Table AVII-1.

D. METHODOLOGY

Assessment of the impact of transportation projects requires the quantitative prediction of pollutant concentrations within the area under study, with and without the proposed action. To fully reply to the National Environmental Policy Act of 1969, the predictive mathematical analysis should include both a burden (mesoscale) analysis and a highway corridor (microscale) analysis. The burden analysis estimates the variation in impact on overall air quality within the study corridor air basin due to the differences in corridor travel patterns associated with each of the alternatives, including the "No-build" Alternative. In the highway corridor analysis, estimates of carbon monoxide concentrations at reasonable receptor locations indicate the maximum level of CO expected at that location for both one-hour and eight-hour averaging times. All calculations were carried out using procedures accepted by the Federal Highway Administration (FHWA) and the U.S. Environmental Protection Agency (EPA).

1. Emission Factors

Automobiles (light duty gasoline, LDG), gasoline fueled trucks (heavy duty gas, HDG) and diesel powered trucks (heavy duty diesel, HDD) comprise most of the vehicles operating on the roadway network. Within each of these categories, powerplant and fuel variation results in significant differences in the type and amount of pollutants emitted. For example, diesel engines, in any application, demonstrate operating principles that are significantly different from those of the gasoline engine.

Highway vehicle emission factors change with time and must be calculated for a specific time period, normally one year. The reasons for this time dependence are the gradual replacement of vehicles without emission control equipment by vehicles with controlled emissions, and the gradual deterioration of that control equipment as the vehicles accumulate age and mileage.

Emission factors were calculated for the pollutants CO, HC and NO_X using the procedures outlined in "Preliminary Edition of Supplement 5 to Compilation of Air Pollutant Emission Factors (AP-42)" published April 16, 1975, by the Environmental Protection Agency. The emission factors for the pollutants listed were computed for the years 1975, 1983 and 2000; these correspond to existing corridor conditions, conditions at the estimated time of completion (ETC) and the design year, respectively.

Basic data input for the compilation of emission factors include: average vehicle speed, percent of cold vehicle operation, percent of travel by vehicle category (LDG, HDG and HDD) and ambient temperature. An average 24-hour vehicle speed was determined for each segment of the Traffic Analysis Network (TAN, see Appendix II). The average segment speed is based on a composite of driving modes (idle, cruise, acceleration, deceleration) at the level of traffic congestion anticipated for the traffic volumes and design type of roadway considered. The percent of cold vehicle operation is a composite of driving modes; cold transient phase (representative of vehicle start-up after a long engine-off period), a hot transient phase (representative of vehicle start-up after a short engine-off period), and a stabilized phase (representative of warmed-up vehicle operation). Three different cold transient/hot transient/hot stabilized splits were used for light duty gas vehicles, corresponding to local roads, minor arterial roadways and primary arterial roadways, respectively. The corresponding splits are 15/15/70, 10/10/80, and 5/5/90, respectively. All heavy duty vehicle operation was assumed hot stabilized. The percentage of travel by vehicle type was determined from traffic counts conducted by Iowa Department of Transportation. Forty-nine degrees Fahrenheit, the average annual temperature in the City of Des Moines, was used as the ambient temperature.

The calculation of emission factors for light duty gasoline vehicles is given by the relationship.

$$E_{npstwx} = \sum_{i=N-12}^{N} C_{ipn} M_{in} V_{ips} Z_{ipt} r_{iptwx}$$

Where

E_{npstwx} = Composite emission factor in grams per mile for calendar year n, pollutant p, average speed s, ambient temperature t, percent cold operation w, and percent hot operation x.

C_{ipn} = The FTP (1975 Federal Test Procedure) mean emission factor for the i^{th} model year during calendar year n and for pollutant p.

M_{in} = The fraction of annual travel by the i^{th} model year vehicles during the calendar year n.

V_{ips} = The speed correction factor for the i^{th} model year vehicle for pollutant p, and average speed s.

Z_{ipt} = The temperature correction factor for the i^{th} model year vehicle for pollutant p and ambient temperature t.

r_{iptwx} = The hot/cold vehicle operation correction factor for the i^{th} model year vehicles for pollutant p, ambient temperature t, percent cold start operation w and percent hot start operation x.

The calculation of hydrocarbon emissions from gasoline motor vehicles involves evaporative and crankcase emission factors, in addition to the exhaust emission factors.

2. *Burden Analysis [meso-scale]*

In this portion of the study, estimates of the pollutant load in tons per year for each alternative (including the "No-build") were made for the pollutants CO, HC and NO_X.

Data required for this part of the study includes network segment lengths, average annual daily traffic volumes, average travel speeds and the percentage of heavy duty gasoline and diesel powered vehicles in the traffic mix.

The raw emission factors were weighted according to roadway type, average operating speed and the anticipated vehicle mix to determine a composite emission factor for each analysis network segment. Pollutant burdens were calculated for each roadway segment and summed to determine total burden, by pollutant, for the Transportation Analysis Network using the relationship:

$$E_p = \sum_{i=1}^{n} e(\text{composite})_{sp} \times U_s \times L_s \times 4.0223 \times 10^{-4}$$

Where

E_p = Pollutant burden in tons per year for pollutant p.

$e(\text{composite})_{sp}$ = Composite emission factor in grams per vehicle-mile for pollutant p and roadway segment s.

V_s = Average annual daily traffic in vehicles per day for roadway segment s.

L_s = Length in miles of roadway segment s.

$4.0223\text{x}10^{-4}$ = Conversion factor, grams per day to tons per year.

Since analysis year pollutant burdens for Alternatives 1 through 4 are based on a lower overall corridor tripmaking level than is Alternative 5, a non-corridor adjustment was also calculated to reflect added pollutant burden occurring outside the corridor but within the metropolitan area (i.e., some 3,500 to 24,500 trips occurring in the corridor under Alternative 5 would likely occur elsewhere in the metropolitan area under Alternatives 1 through 4 in the year 2000, as described in Appendix II). An average trip length of 4.6 miles and speed of 35 miles per hour were assumed for these non-corridor trips, based on tripmaking characteristic data from the Revised Initial 1990 Des Moines Urbanized Area Transportation Study. Pollutant burdens were calculated as described above for the network segments. Total burdens for each alternative are shown in Table IV-13.

3. *Highway Corridor Analysis [Micro-Scale]*

In this portion of the analysis, carbon monoxide concentrations due to the traffic using each alternative were computed. This analysis allows comparison of the total CO concentration to the applicable State and Federal Standards.

Carbon monoxide is used almost exclusively to illustrate the vehicular contribution to air pollution for several reasons. First, the internal combustion engine contributed nearly seventy-three percent of all atmospheric CO in 1970 (virtually one-hundred percent in central business districts of large cities). Also, some fifty-six percent of all hydrocarbons and fifty percent of all nitrogen oxides came from the exhaust of internal combustion engines in that same year; a large portion of these engines are installed in motor vehicles and operate on public highways. Second, carbon monoxide is non-reactive with other pollutants and therefore works well in various diffusion models.

Diffusion Equations - The composite emission factors for CO, weighted according to roadway segment type, average operating speed and the anticipated vehicle mix, were combined with 1-hour and 8-hour traffic volumes on each segment of each beltway alternative. This computation provides the emission source strength for each segment according to the relationship:

$$Q_s = (1.73 \times 10^{-7}) \times (\text{vehicles per hour})_{sc} \times (\text{composite emission factor})_s$$

Where

Q_s = Vehicle source strenth in gm/sec-meter, for each beltway alternative transportation analysis segment s.

$(\text{vehicles per hour})_{sc}$ = The volume of traffic, in vehicles per hour, using roadway segment s during averaging period c, (either 1-hour or 8-hour).

$(\text{composite emission factor})_s$ = The composite emission factor, in grams per vehicle-mile for pollutant CO and roadway segment s.

(1.73×10^{-7}) = Conversion factor, gm/mi-hr to gm/m-sec.

The carbon monoxide concentration (parts per million) within the mixing cell was determined for all Beltway segments from the relationship:

$$C_s = \frac{(1.06\ Q_s\ (875))}{k_1\ u\ \sin \phi}$$

Where

C_s = CO concentration in parts per million within the mixing cell for roadway segment s.

Q_s = Vehicle source strength in gm/sec-m for roadway segment s.

u = Wind speed in m/sec.

k_1 = Empirically derived constant, assumed = 4.24.

ϕ = Angle of predominant wind based on a 16 point compass reporting system. ϕ will be one of the following angles using the highway as a reference or base line:

$\phi = 12.5^o$

$\phi = 22.5^o$

$\phi = 45^o$

$\phi = 67.5^o$

$\phi = 90^o$ (wind perpendicular to highway alignment)

1.06 = Emperical constant relating height of mixing cell (assumed = 12 feet) to the pollutant concentration.

875 = Conversion factor $\frac{gm}{M^3}$ (CO) to ppm (CO).

Carbon monoxide concentrations were computed using a "Worst Probable" combination of meteorological events. Pasquill stability Class F (most stable atmospheric conditions) and a wind speed of 2 m.p.h. were used in conjunction with the appropriate angle.

For any given perpendicular distance (d) from the mixing cell, or roadway, the ground level carbon monoxide concentration downwind from a highway line source was determined from the FHWA Air Quality Manual, Volume 5. Volume 5 provides a series of curves showing the relationship between ground level pollutant concentration ratio (= $\frac{Csd\ u\ k_1}{Qs}$) and the downwind distance from the pollutant source, for varying roadway and meteorological conditions. Entering the graph corresponding to appropriate stability class and roadway type at the desired downwind distance (d) and going at the appropriate wind angle (ϕ) a value (R) = $\frac{C_{sd}\ u\ k_1}{Q_s}$ can be determined. Rearranging and solving for the concentration C_{sd} yields:

$$C_{sd} = \left(\frac{R}{K_1 u}\right) \times Q_s \times 875$$

Where

C_{sd} = CO concentration in parts per million at distance d from the roadway for roadway segment s.

R = Value from FHWA Air Quality Manual, Volume 5.

Q_s = Vehicle source strength in gm/sec-meter for carbon monoxide and roadway segment s.

u = Wind speed in $\frac{m}{sec}$.

K_1 = Empirical coefficient assumed = 4.24.

875 = Conversion factor, $\frac{gm}{M^3}$ (CO) to ppm (CO).

Ambient Concentrations - There are four air quality monitoring stations operating within the study corridor. Two monitor particulates, while one location monitors sulfur dioxide and nitrogen dioxide and the last location monitors ozone. The only CO monitor in Polk County at this time is located within the Central Business District of Des Moines. Due to the lack of CO monitoring in the predominantly rural study corridor, ambient CO concentrations were assumed to be 2 ppm and 5 ppm for the 8-hour and 1-hour averaging times, respectively.

Final Concentrations - Final predicted CO concentrations for each Beltway segment analyzed were determined by adding the concentrations attributable to traffic on the Beltway segment to the assumed ambient concentrations. Final concentrations were determined within the mixing cell and at distances of 50, 100, 150 and 300 feet perpendicular to the roadway. The predicted CO concentrations are shown in Figure IV-8.

APPENDIX VIII

WATER QUALITY STUDY

The effects of the proposed action on water quality and aquatic life have been considered in five parts:

A. Stream Modification
B. Erosion and Subsequent Sedimentation Problems
C. Effects of Filling Within the Des Moines River Flood Plain
D. Runoff of Deicing or Other Control Products
E. Impact on Water Quality and Aquatic Life

A. STREAM MODIFICATION

Potential impacts due to stream modification may occur on East Four Mile Creek under Alternative 3. As Alternative 3 passes through the area of N.E. 27th Avenue, the alignment crosses East Four Mile Creek twice. The proposed alternative to these crossings involves realignment of East Four Mile Creek along the west side of the Beltway. The realignment would reduce a 1,500 reach of the existing channel to 900 feet (reduction of 40 percent). At this point East Four Mile Creek drains an area of 8.23 square miles.

Approval of the stream relocation by the Iowa Natural Resources Council would not be required because of the area drained is less than 10 square miles.[1]

B. EROSION AND SUBSEQUENT SEDIMENTATION PROBLEMS

Any construction activity involving earth moving increases the potential for erosion. The disturbance of vegetative cover and the excavation, stockpiling and grading of large amounts of loose soil make highway construction a potential cause of soil erosion impacts.

Erosion is a natural process that occurs on the land surface and in stream channels. In the natural environment, it proceeds at a measured rate with the controlling forces nearly at equilibrium. The rate of erosion is controlled by such variables as the amount of vegetative cover, rainfall, wind, stream velocity, topography, soil permeability and grain size.

Highway construction can accelerate the natural process of erosion in two ways. The first is a direct impact of short duration during the construction period. The disturbance of vegetative cover and major earthworks will increase the erosion potential at the construction site until soil stabilization measures are complete.

A second long term, indirect impact may result from drainage modifications. The rainfall runoff along a highway alignment is increased by impervious surfaces and unnaturally steep slopes. More importantly, the runoff from much of the

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(1) Iowa Natural Resources Council Rules, Chapter 4.2(2), July 20, 1973.

highway may be collected by ditches and culverts and transported swiftly to discharge points in local streams. The increased runoff and shortened time of concentration can make the local stream "flashy" with higher peak flows. The streams adjust to higher peak flows by enlarging their channels. The sediment released by channel scour can exceed by many times the soil released from the actual construction site. It may take many years for the stream to return to equilibrium and the base level of suspended sediment and turbidity will be increased for a long time.

1. *Site Conditions Related to Proposed Action*

As discussed in Report Section III G, the natural conditions which will affect erosion from highway construction are fairly uniform across the study area. When variations occur, they do so along east-west trends such as the Des Moines River flood plain or the southern limit of Wisconsin glaciation. The four "Build" alternatives are oriented north-south so each will cross more or less similar soil conditions. Thus difference in construction erosion potential for each alignment will primarily result from the grade and type of construction proposed.

Drainage conditions are less uniform across the study area. The alignments will infuence four tributaries to the Des Moines River (Four Mile, East Four Mile, Mud and Spring Creeks). In some cases the main body of the stream will be crossed; in others only the headwaters will be affected.

2. *Direct Short Term Impacts – Erosion During Construction Phase*

It is generally valid to assume that the alignment requiring the most construction will have the greatest potential for erosion. On this basis Alternative 5 would be the most erosive at 12.6 miles long. Alternatives 3 and 4 are about equal at 10.7 miles and 10.4 miles respectively. Alternative 2 is shortest, being 9.1 miles long.

Another variable of design affecting erosion potential is the properties of cut and fill construction. For a given set of dimensions, cut construction is considered more erosive than fill. During excavation the highway engineer must deal with the natural erodibility of the soil. During fill operations he can control erodibility by selecting a fill material that is least erodible for local conditions. An embankment can be contoured for limited erosion during construction and it is relatively easy to control the size of the working area. Both techniques are more difficult during excavation using large earth moving equipment.

Drainage design for embankment sections gives them less impact than road cuts. Drainage from embankments is usually released at the toe of the fill uniformly along the alignment. In contrast, cut drainage is often collected for long portions of highway and routed to a single discharge point. This intensifies the erosion impact by creating a few concentrated point discharge sources of sediment. Alternative 2 has the least cut construction, 14,200 feet, which comprises 30% of the alignment; Alternative 3 has 20,600 feet, or 36%; Alternative 4, 14,500 feet, or 26%, and Alternative 5, 30,500 feet, or 46%.

Once the alignments, soil types, grades and type of construction are fixed, estimates can be made of the amount of soil loss through erosion to be expected during construction. Using soil mapping by the Soil Conservation Service and a modified version of the Agricultural Research Service's Universal Soil Loss Formula, maximum potential soil losses were computed for each alternative. These figures represent the estimated soil loss if no erosion control measures are taken; (e.g. bare, unseeded slopes and no sediment traps). Standard erosion control measures will be required on Highway 500 as part of contract documents. Literature on the subject shows that erosion control measures for construction sites are at least 90 percent effective. Ten percent of the maximum uncontrolled erosion rate is used to calculate the expected soil loss from each alignments considered. As stated above, the drainage design of cut sections increases the impact of soil loss from these areas. As expected, the percentage of total soil loss that originates from cut sections is roughly equal to the percentage of cut construction on each alternative. To further understand the potential impact of eroded soil from road cuts, the size of the receiving stream must be considered. For relative comparison of stream size, the flow volume of each of the streams receiving cut section drainage was calculated for a 5 year storm (Q_5).

The discharge rate for each stream can be related to the expected cut section sediment that it will receive. This yields a ratio of sediment load to stream size. Comparison of these ratios (Table A VIII-1) indicates which alignment will produce the most concentrated sediment loads. Alternative 4, which discharges 1,170 tons into only 5 streams and has a sediment concentration ratio of 5.69, will have almost 2½ time the impact of Alternative 3, which discharges 1,420 tons into 6 streams and has a sediment concentration ratio of 2.43. The least impact occurs on Alternative 2, with a ratio of 0.605.

All of the previous quantities and ratios dealing with eroded soil are based on an average soil loss per year. Erosion at construction sites is a function of rainfall which is not uniform throughout the year, or from year to year. Sixty percent of the erosive rain falls between June 1st and September 1st. This increases the impact of any construction during that period. Rain storms are rated by intensity (amount of rainfall per unit time) and the erosive force of rain varies as its intensity. Data from the Agricultural Research Service shows that in Des Moines a storm will occur once in 2 years intense enough to erode 27% of the average annual soil loss in that single storm. Once in 5 years a storm will occur that will erode 40% of the average annual soil loss.

Using these figures, calculations were made to estimate the peak sediment concentrations that could be expected from highway cuts under construction during a 5 year storm. Fourteen of the 34 cut sections proposed in the alternatives were chosen for estimates. The samples were chosen for having the highest erosion potential. The estimated sediment concentrations from the 14 samples ranged from 14,000 mg/l to 81,000 mg/l. When dilution by the receiving streams is calculated, the concentrations drop to one-half to one-fourth of their original value. The impact of these sediment loads on local ecosystems is discussed below.

3. *Construction Sediment Impact on Drainage Systems*

As mentioned above, four tributaries to the Des Moines River, north of the river, are affected by the proposed alternatives. These are East Four Mile Creek, Four Mile Creek, Spring Creek, and Mud Creek.

TABLE AVIII-1

COMPARATIVE SEDIMENT LOADS

("Build" Alternatives)

Alternative	Soil Loss (tons per year)	% Of Alignment In Cut	% Of Total Soil Loss That Comes From Cut	Tons/Yr.	Streams into which cut section runoff discharges No.	Ave. Q5 cfs	Ratio*
2	1,690	30%	22%	380	10	149	0.605
3	3,434	36%	41%	1,416	6	185	2.43
4	3,957	26%	30%	1,168	5	92	5.69
5	4,367	46%	44%	1,938	13	139	2.09

* Composite ratio of quantity of sediment received from cut sections to discharge rate (Q_S) of receiving streams

North of Iowa 163 Alternatives 2 and 3 are all within the basin of East Four Mile Creek. Alternative 2 will have 7,800 feet of cut construction releasing an estimated 165 tons of sediment per year into the waterway. Alternative 3 has 13,500 feet of cut in the watershed and an estimated sediment release of 930 tons per year. Between Iowa 163 and Capitol Heights, Alternative 4 drains into an unnamed tributary of Four Mile Creek. There would be 7,300 feet of highway cut releasing an estimated 600 tons of sediment per year. North of Capitol Heights, 2,300 feet of cut would release 300 tons of sediment per year into another unnamed tributary of Four Mile Creek.

Alternative 5 goes north from the Des Moines River flood plain through the basin of Spring Creek. All drainage from Vandalia Road to N.E. 38th Avenue will flow to Spring Creek. This section has 20,000 feet of cut and will release an estimated 1,300 tons of sediment per year into Spring Creek. North of N.E. 38th Avenue, Alternative 5 is in the Mud Creek drainage basin with 4,200 feet of cut construction and an estimated 270 tons of sediment per year.

Each of the alternatives would involve cut construction south of the Des Moines flood plain. However, there are no well organized drainage systems crossed that will collect and concentrate the sediment impacts as occurs north if the Des Moines River.

A general way to compare erosion and sediment impacts from highway construction is to calculate soil loss per acre. The Des Moines Soil Conservation District has set the yearly loss of 5 tons per acre as an acceptable maximum for construction sites when sediment damage complaints are filed. Using the right-of-way acreage, Alternative 2 is well within the 5 tons maximum at 3.5 tons per acre. However, all other alternatives would probably exceed the maximum; Alternative 3, 6.9 tons per acre, Alternative 4, 9.9 tons per acre, and Alternative 5, 7.2 tons per acre.

4. *Indirect – Long Term Impacts*

Significant long term impacts can result from increased rainfall runoff and drainage collection along highways. The runoff from road cuts is collected and channelled directly into local streams. This increases the flood volume and the flood peak of the receiving stream. Rivers and streams tend to exist in a state of quasi-equilibrium. They adjust their channel size such that banks-full flow is exceeded, on the average, about once in 1.5 to 2 years. When the runoff from highway sections is added to natural flowage, the frequency and magnitude of floods are increased. The streams will respond by eroding larger channels and attempting to re-establish equilibrium. The suspended sediment loads of the stream will be increased by the eroded soil. The highway runoff from large storms will have a disproportionately large impact on receiving streams compared to runoff from small storms. Since the larger storms are less frequent events, it may take many years for the streams to reach equilibrium with peak flood flows. During this period, increased sediment and turbidity base levels can be expected.

To compare the relative impacts of each alternative on drainage systems, a ratio of collected drainage length to receiving stream size was prepared for each drainage discharge point. The ratios for each of the alternatives were averaged with the following results: Alternative 2, 23.6, Alternative 3, 35.4, Alternative 4, 51.1, Alternative 5, 28.9.

Alternative 2 will have a drainage impact on ten receiving streams. However, because the streams are large in relation to the highway drainage length, the channel relocation and sediment release will be far less than that caused by Alternative 4, which affects only five streams. This can be seen by comparing the ratios.

To further quantify potential drainage impacts, the estimated runoff, 5 year discharge, for 16 highway cuts was compared to the 5 year storm flow of the streams that would receive the discharge. The average increase in stream flow resulting from highway runoff ranges from 41% to 52%. To remain in equilibrium, a stream can be expected to enlarge its channel a proportional amount. If this enlargement takes place along ¼ mile of stream, hundreds of tons of soil would be eroded during the stream adjustment period. Very little velocity data is available for the small streams in the study area. However, if 2.5 feet per second is assumed as a velocity, the soil loss due to channel enlargement could be as much as 4 to 6 times the loss predicted for the construction of a given road cut. During the construction phase, water quality impacts from construction soil loss and channel erosion could be expected simultaneously.

C. EFFECTS OF FILLING WITHIN THE DES MOINES RIVER FLOODPLAIN

A special construction impact could result from the large embankment that is required to cross the Des Moines River flood plain. Alternatives 2 and 3 will require a 15,000 foot crossing. The crossings for Alternative 4 and 5 will be 12,000 and 10,000 feet long, respectively. The embankments will average 15 to 25 feet high with a short section nearly 70 feet high in the bluff area at the north side of the flood plain on Alternative 5. Elsewhere on the alignments, eroded soil from embankments has not been considered a major pollutant, since vegetative buffer strips will trap most of the soil before it reaches streams. On the flood plain, any soil that is trapped at the base of an embankment could be swept into the river during a flood. If a flood occurred during construction, additional soil could be eroded from the embankment where armoring or stabilization is not complete. Every effort should be made to complete construction and slope protection during periods of low flood potential. Any construction or excavation below the water line in the river should be done within sediment containment structures.

D. DEICING SALT AND HIGHWAY SPILLS

A long term impact that will result from the proposed action is the release into the environment of deicing salts and products of highway spills. Salt applied to road cuts travels with runoff meltwater directly into streams. Of the deicing salts applied to embankment sections, a portion is transported in overland runoff to streams. The remainder infiltrates to the groundwater and eventually reaches streams through groundwater base flow. When released into the environment, common salt disassociates into its constituents; sodium and chloride. Much of the sodium becomes fixed to soil particles as an absorbed ion during filtration or runoff. However, chloride is a very mobile ion and remains free for transport in groundwater or streams. Thus the principal impact of road salting is increased chloride concentration. Ultimately, most of the chloride applied within a drainage basin leaves the basin via groundwater or surface runoff.

The primary deicing salt used in Iowa is sodium chloride. It is applied at the average rate of 8 tons per two-lane mile per salting season. Using this application rate, the total salt applications for each alignment were calculated. Obviously, the longest alternative will require the greatest amount of salt. Alternative 2 will involve 146 tons per season; Alternative 3, 171 tons; Alternative 4, 166 tons; and Alternative 5, 201 tons per season.

As mentioned in the discussion of drainage and sediment impacts, significant portions of each of the alternatives will drain into single drainage systems. Alternatives 2 and 3 will release 64 and 61 tons of salt respectively into the East Four Mile Creek basin per season. Alternative 5 will release 80 tons of salt to the Spring Creek drainage basin, and 38 tons to the Mud Creek Basin.

Calculations were made using average precipitation quantities per salting event and highway area and drainage design. Assuming that all salt from each application runs off prior to the next storm, i.e., that there is a uniform release of salt throughout the season, chloride concentrations in the runoff at highway cut discharge points would be in the range of 350 to 500 parts per million (ppm). These concentrations will be significantly diluted when released into local streams. Impacts on ecosystems are discussed in the following section.

Pollutants from highway spills are subject to the same runoff, transport, and distribution mechanisms as deicing salts. The longest alternative would appear to have the greatest potential for impact from highway spills.

E. IMPACT ON WATER QUALITY AND AQUATIC LIFE

The primary impacts of the proposed project will originate from two sources: (1) the temporary increase in sediment load due to the effect of rain on bare soil exposed during construction and the long-term increase in sediment load due to drainage modification and the resultant channel scour, and (2) from the dispersion of traffic-related chemicals and deicing chemicals employed in the maintenance of ice-free roads during the winter season.

1. Sedimentation

Exposing soil during construction is unavoidable and the problem is most critical during excessively rainy periods at which time soil is eroded and carried by the rainwater into the main streams. The creeks in the study corridor and the Des Moines River carry a heavy sediment load during these times of heavy runoff; in spite of this, aquatic life continues to exist and survive in these conditions. The impact of increased sediment of aquatic life in the Des Moines River will be minimal because of the dilution effect provided by the large river flows, and because the aquatic organisms which exist there have adapted themselves over a period of many hundreds of years to survive in sediment-laden prairie streams. The evolutionary significance is that the organisms found surviving and breeding in the Des Moines River are especially tolerant of soil erosion activities and sediment loads.

The problems encountered by aquatic organisms in Mud Creek and Spring Creek are somewhat different. The drainage basin of each of these two creeks is less than 100 square miles; this means that they are intermittent streams and will occasionally run dry. Increased sediment load is the least of the problems of aquatic organism in intermittently flowing streams. The most drastic problem that these organisms have is survival during periods of desiccation. This survival period is marked by quiescence on their part, and is characterized by mechanisms to prevent water loss such as encasement, burrowing, prolonged egg stage, pupal stage, etc. During storm events, when increasing volumes of water are carrying the shock load of sediment or deicing salt or toxic substances, these organisms are only slightly affected because they are not active. Ordinarily, the proper stimulus must be present (in the form of water at the proper temperature and chemical composition for a given period of time) to reactivate these organisms. Because of this time lag, most of the organisms in intermittent stream beds will respond after the storm has been initiated, when there is a better chance of surviving. The problem that confronts these organisms is to strike a compromise between a quick return to the active stage when water comes and the avoidance of annihilation should the water not last long enough for development of the life cycle. Thus, the sediment shock load may have passed before the organisms return to a vulnerable form.

Four mile Creek is the stream most likely to be adversely affected by the increased sediment movement and resultant turbidity. This is because the drainage basin is large enough that it is unlikely to run completely dry, and the flora and fauna that would persist from season to season would be a typical stream biota. A typical stream biota is more susceptible to the effects of turbidity than the biota of an intermittent stream for the reasons stated previously. On the other hand, the basin is much smaller than the Des Moines River basin, and the dilution effect will not be as great as found in the larger river.

Of the fourteen cut section discharge points selected for detailed study, sediment concentrations of the runoff are expected to range from 14,000 to 81,000 mg/l (see preceeding Section B 2).

The impact of this runoff would be to increase the existing stream sediment concentration by values ranging from 5,000 mg/l to 19,000 mg/l.

Studies done on the impact of sediment and its resultant turbidity on aquatic organisms have shown that three species of fish are sensitive to values of turbidity less than 100,000 mg/l. At turbidities causing death, the opercular cavities were found to be matted with soil and the gills had a layer of soil on them (Wallen, 1951). The pumpkinseed fish shows mortality when exposed to turbidity values of 69,000 mg/l for 13 days of continuous exposure; the rock bass shows similar response to 38,250 mg/l after 3.5 days; and the channel catfish shows similar mortality to 85,000 mg/l after nine days of continuous exposure. All other fish species tested showed significant mortality only when exposed to turbidity values in excess of 100,000 mg/l.

In addition to being directly lethal, excessive turbidity in water can have other detrimental effects. By interfering with the penetration of light, turbidity mitigates against photosynthesis by algae and other plants and thereby decreases the primary productivity upon which fish-food organisms depend. As a consequence, fish production is diminished. By excluding light, turbidity makes it difficult for fishes to find food; conversely smaller fish may be protected from predators because of this same effect. Turbid water also tends to be cooler than less turbid water because it reflects incoming solar radiation. This could delay or shorten the development of some aquatic organisms. Other effects are seen when the larger particles begin to settle to the bottom. Frequently, these particles carry organic wastes with them where processes of decay may continue over a long period leading to potential oxygen depletion in the water. These same particles may blanket-over and eliminate habitat for certain aquatic insects. clog the filtering mechanism of various invertebrates, completely smother algae beds, destroy spawning beds of fish, and fill existing pools. The harder particles may cause abrasive damage and injury to delicate external organs of fish and aquatic insects, such as gills, spiracles, and fins. And the extremely fine particles may be detrimental as they tend to coat and destroy the eggs of fish and other stream animals.

The impact resulting from the released turbidity due to the proposed project is expected to be temporary. Some aquatic organisms will merely migrate from the area only to return when conditions have once again stabilized. Other organisms will survive in the wet soil adjoining the stream bed. Animals found occupying the capillary water of the adjacent soil include many micro-invertebrates and some species of aquatic insects, including recently hatched midge larvae, mayflies, and stoneflies. Once the initial shock has passed, these organisms will quickly recolonize the stream bed. No permanent alteration of benthic fauna is anticipated as a result of the proposed project, nor is it expected that temporary increased sediment loads will have any adverse effect on fishes, amphibians and reptiles indigenous to the creeks and the Des Moines River. Recovery of the stream after each storm event and the increased sediment load will take place within a few weeks or months, especially by those species possessing short life cycles.

2. *Traffic Related Chemicals*

Effect on surface water runoff from the completed highway surface is also likely to induce a shock effect as the accumlated substances such as salt, heavy metals, and other inorganic substances are abruptly introduced during storm events. Such events will occur several times over the course of a year and permanent changes in downstream biota may result even though the chemical composition of the receiving water reverts to normal after cessation of runoff.

Many of the highway surface contaminants which get into the headwaters are representative of the local geology and, to a lesser extent, products abraded from the highway surfaces. Most of the traffic related BOD, chloride, nitrogen compounds, solids, and phosphorus compounds arise from sources other than motor vehicles themselves. Phosphorus compounds are most likely derived from area soils and roadway surface abrasion. Chlorides may be of natural mineral origin but are most likely to be artificial sources associated with road salting. The normally low levels of traffic-related nitrogen compounds are contributed by soils and plant materials carried onto the roadway by motor vehicles. The contribution of these substances to highway runoff is similar in many respects to sanitary sewage. Calculations based on a hypothetical but typical U.S. city indicate that street runoff from the first hour of a moderate-to-heavy storm (brief peaks to at least ½ in./hr.) would contribute 75% of the total suspended solids and 15% of the total BOD of that normally found in sanitary sewage (Shallen, 1975). It is expected, therefore, that the contribution of highway runoff with respect to the above mentioned substances will have little, if any, deleterious impact of the aquatic life.

Traffic-related heavy metals, with zinc and lead being the most prevalent, constitute the most serious contaminant when compared with sewage. For example, close to 100% of the lead entering urban receiving water is from traffic-related sources (Shallen, 1975). Traffic-related lead is deposited principally through the use of leaded fuels; however, some results from the wear of tires in which lead oxide is used as a filler material. Zinc is also used as a filler in tires and at high concentrations in motor oil as a stabilizing additive. When metals associated with street runoff are compared to the metal content of sanitary sewage, most of the runoff metals are 100 to 1000 times greater than the sewage metals on a slug load (lbs./hour, kg/hr) basis, and from 10 to 100 times on a concentration (mg/l) basis (Pitt and Amy, 1973). The most significant thing about this impact is that the metal content of street runoff is usually not sufficient to cause noticeable reductions in biological treatment efficiency in sewage treatment plants handling combined sanitary and storm sewage. Because it rarely hampers this biological process, it is reasonable to assume that no deleterious impact would result from streams receiving a similar loading directly from highway runoff. No permanent alteration of aquatic life is expected as a result of introduction of traffic-related heavy metals in the streams within the study corridor.

The second most significant impact that the proposed project could have on water quality will result from deicing practices. The relatively inert sand and ash used as abrasives will add suspended solids to the stormwater runoff (the effects of increased sediment have already been considered). The deicing chemicals, principally sodium chloride, applied to winter road surfaces to maintain ice-free roadways, are not only significant pollutants in water but serve as significant contributors to highway and vehicle deterioration as well. Specific studies have shown quite high salt levels in waterways:

> "Runoff samples collected from a downtown Chicago expressway in the winter of 1967 showed chloride content from 11,000 to 25,000 mg/l. It has been calculated that 600 lbs. salt when applied to a one-mile section of roadway 20 feet wide containing 0.2 inches of ice, will produce an initial salt solution of 69,000 to 200,000 mg/l in the temperature range of 10 F - 25 F. At Milwaukee on January 16, 1969, extremely high chloride levels of 1,510 to 2,730 mg/l were found in the Milwaukee, Menomonee and Kinnickinnic Rivers, believed directly attributable to deicing salt entering these streams via snow melt. The dumping of extremely large amounts of accumulated snow and ice from streets and highways, either directly or indirectly into nearby waterbodies, could constitute a serious pollution problem. These deposits have been shown to contain up to 10,000 mg/l sodium chloride, 100 mg/l oil, and 100 mg/l lead." (EPA, 1971)

Salt is readily dissolved in the precipitation that falls during the months when it is applied and this salt solution is either splashed onto the shoulders and penetrates into the soil, or it finds its way into a nearby surface water course. As mentioned previously, the sodium ion is not very mobile when it gets into soil. Its positive electrovalence causes it to be absorbed and held by clay particles. The chloride ion is not held by ionic attraction and is highly mobile such that it is a constituent of major importance in highway runoff.

The chloride concentration of roadway runoff which enters directly into the streams adjacent to the proposed project will range from 350 to 500 mg/l (see Section D above). The chloride concentration in runoff water may vary considerably from storm to storm depending primarily upon the quantity of salt available and upon weather conditions before and after application. If the snow cover from an individual storm melts and runoff occurs prior to the next snowfall, in all probability that runoff will contain, in solution, practically all of the road salt that had been applied before the snow melted. This is due to the fact that salt is very soluble in water and, in solution, is a very stable form. On the other hand, if no runoff occurs during the entire winter snowfall period, the early spring runoff would be expected to carry in solution all of the salt applied during that winter. The chloride concentration of such runoff might be considerably less than that of the first example because of the additional dilution brought about by precipitation that fell as rain after the salting season ended.

The ecological significance of this is that if the salt accumulated during the winter and comes off all at once in the spring, the accompanying water will dilute it so greatly that it will have little or no effect on the stream biota. Should the salt come into the headwaters after each storm event during the winter, the ecological effects will also be greatly diminished because of the life histories of the stream biota. The headwaters of drainage streams are highly variable habitats and only those organisms that can tolerate great environmental extremes can survive. The organisms which survive do so through the possession of such mechanisms as encasement, burrowing, prolonged egg stage, or pupal stage. During those months when salt is applied for ice-free roadway maintenance, these organisms are in some quiescent state in response to lack of water and/or reduced temperature. A cold brine solution hardly constitutes a sufficient stimulus to reactivate these organisms, and they survive in what would apparently be an extremely harsh environment, that is, chloride concentration of several thousand milligrams per liter.

Many small crustacea and other fish-food organisms, as well as fish fry, are immobilized by chloride concentrations above 3,100 mg/l (McKee and Wolf, 1963). It appears that most fresh water organisms can survive in and carry out life histories in water with a chloride concentration of 2,000 mg/l or less.

In summary, the expected chloride concentration from deicing practices on the proposed project will have little or no ecological impact on the aquatic organisms of the study corridor creeks or the Des Moines River.

3. Effects on Groundwater

Groundwater is a resource of some importance in the study corridor. It is the primary source of water for both individual and municipal/industrial systems. The greatest groundwater resources are from several hundred to several thousand feet below the surface, and are too deep to be impacted by the proposed action. However, there may be shallow wells serving individual homes near all of the alignments. Though near-surface groundwater is not a widespread resource of great importance, it will be vulnerable to potential impacts from the highway. Highway salts or spill pollutants could contaminate a nearby aquifer, making the water unusable. This would be a long-term impact and might be unnoticed for many years. Highway cuts that intersect the water table can drain away groundwater and have a drastic effect on small local aquifers. During the preliminary design phase of the proposed action, any potential small aquifer, and nearby (within 500 feet of the selected alignment) shallow domestic wells should be noted. Steps to mitigate these impacts are a normal part of the design process.

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