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Michigan State
Airport System Plan

TASK GROUP 5 REPORT: GENERAL AVIATION PLAN

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I INTRODUCTION

This report describes the results of Task Group 5 of the Michigan State Airport System Plan Study. The principal objective of this task group is to develop a 1990 plan for a system of airports to serve general aviation aircraft. In support of this objective, study activity has included:

1. forecasts of general aviation activity
2. identification of a system of general aviation airports to serve the forecasted activity
3. estimates of facility requirements for each airport in the system
4. an estimate of the approximate total airport development cost for the recommended system

After a review of the Task Group 5 results by the Study Advisory Committee, the plans for the general aviation system will be integrated with those for the air carrier system and the timing of recommended improvements will be specified. These refinements will be undertaken in the last task group (Task Group 4) of the study.

Summary of Results

The recommended 1990 system for general aviation includes 164 airports.* Of these, 58 are new airports. Airport development costs for the system are estimated to total \$186.9 million.

Aviation Goals and Objectives

In preparing the system plan for general aviation, guidance has been provided by overall goals and objectives for aviation in Michigan. The goals, as identified by the Michigan Aeronautics Commission,** are:

1. To develop a comprehensive aviation system in Michigan
2. To achieve an efficiently operating aviation system in Michigan
3. To promote a safe aviation system in Michigan
4. To provide a convenient aviation system
5. To enhance economic values
6. To improve environmental quality
7. To shape future settlement patterns

Objectives related to these goals for general aviation are listed in Table 1, together with standards for each objective.

*This number does not include air carrier airports, nor does it include general aviation airports outside the scope of the plan (e.g. some privately owned airports).

**National Transportation Planning Study: Phase One--Aviation Goals for the State of Michigan, prepared by Michigan Department of Commerce, Aeronautics Commission, February 1971.

TABLE 1

MAC GOALS, OBJECTIVES AND STANDARDS

Goal: To Develop a Comprehensive Aviation System in Michigan

Objectives

Standards

Provide adequate number of general aviation airports

Service area of general aviation airport is 15 minutes except in major metropolitan areas

Maximize interface with other travel modes and facilities

Airports should be located within two (2) miles of major arterial road system

Goal: To Achieve An Efficiently Operating Aviation System

Minimize air facility congestion

At least 50 percent of total general aviation aircraft should be based at general aviation airports

Better ground transportation to airport from major service areas

Ground transportation time of 15 minutes for a general aviation airport's service area (except in large urban areas where access time for ground transportation prohibits rapid vehicular movement and sparsely populated areas)

Provide accessibility to all airports

Provide VOR coverage to all parts of the State at 1,000' above the ground and higher

Maximize accessibility to major public airports

Provide published instrument approaches to all public airports with paved runways and lights

Achieve public ownership of the aviation system

All air carrier and major general aviation airports should be publicly owned

Achieve short and long range coordinated system planning

"Airport master plans" and improvement plans should be developed and periodically updated at all major airports

Implement short range improvement program implemented

All elements of short range improvement programs implemented

Goal: To Promote a Safe Aviation System

Protect airspace from obstructions

No cases of non-conformance with height restrictions as specified in airport zoning at public airports

TABLE 1 (Continued)

<u>Objectives</u>	<u>Standards</u>
Encourage land development that is compatible with air traffic	Clear zones should contain only open space uses at public owned airports
Encourage land development that is compatible with air traffic	Approach zones should avoid encroachment on medium and high density residential development, places of public assembly, large employment centers, hospitals and rest homes within two (2) miles of public owned airports
Maximize use of general aviation airports	At least 50 percent of total general aviation aircraft should be based at general aviation airports
Maximize runway illumination	All air carrier and major general aviation airports should have lighted runways
Provide accessibility to all airports	Provide VOR coverage to all parts of the state at 1,000' above the ground or higher
Maximize accessibility to major public airports	Provide published instrument approaches to all public airports with paved runways and lights
Maximize accessibility to major public airports	Provide instrument landing systems at the general aviation airports with runways long enough to accommodate jet aircraft
Availability of land needed for airport expansion	Purchase land needed for airport development in foreseeable future
Availability of land needed for airport safety	Purchase all clear zones at airports by either "fee" or through "easement"
Maximum use of "land use" and "height" zoning	Zone all public owned airports according to Act 23 of 1950 and State and Federal rules
Goal: To Provide A Convenient Aviation System	
Provide adequate accessibility to airports	Airports should be located within two (2) miles of major arterial road system
Provide adequate accessibility to airports	All airports should be within two (2) miles of primary regional population concentrations
Maintain adequate aviation services	All major airports should have at least one trained mechanic at the airport or "on call"

TABLE 1 (Continued)

<u>Objectives</u>	<u>Standards</u>
Provide convenient aircraft parking	Airports should afford tiedown facilities or hangars for all general aviation aircraft
Provide convenient auto parking	Adequate parking space for general aviation passengers
Goal: To Enhance Economic Values	
Increase economic viability of regions in Michigan	Increased travel potential for existing and potential industries
Goal: To Improve Environmental Quality	
Reduce Noise Pollution	No residential areas within any approach zone exposed to high aircraft noise
Encourage land development that is compatible with air traffic	Approach zones should avoid encroachment on medium and high density residential developments, places of public assembly, large employment centers, hospitals and rest homes within two (2) miles of public owned airports
Goal: To Shape Future Settlement Patterns	
Improve access to all areas of Michigan	At least one general aviation airport strategically located to provide reasonable access to the air transportation system by each organized community in the state

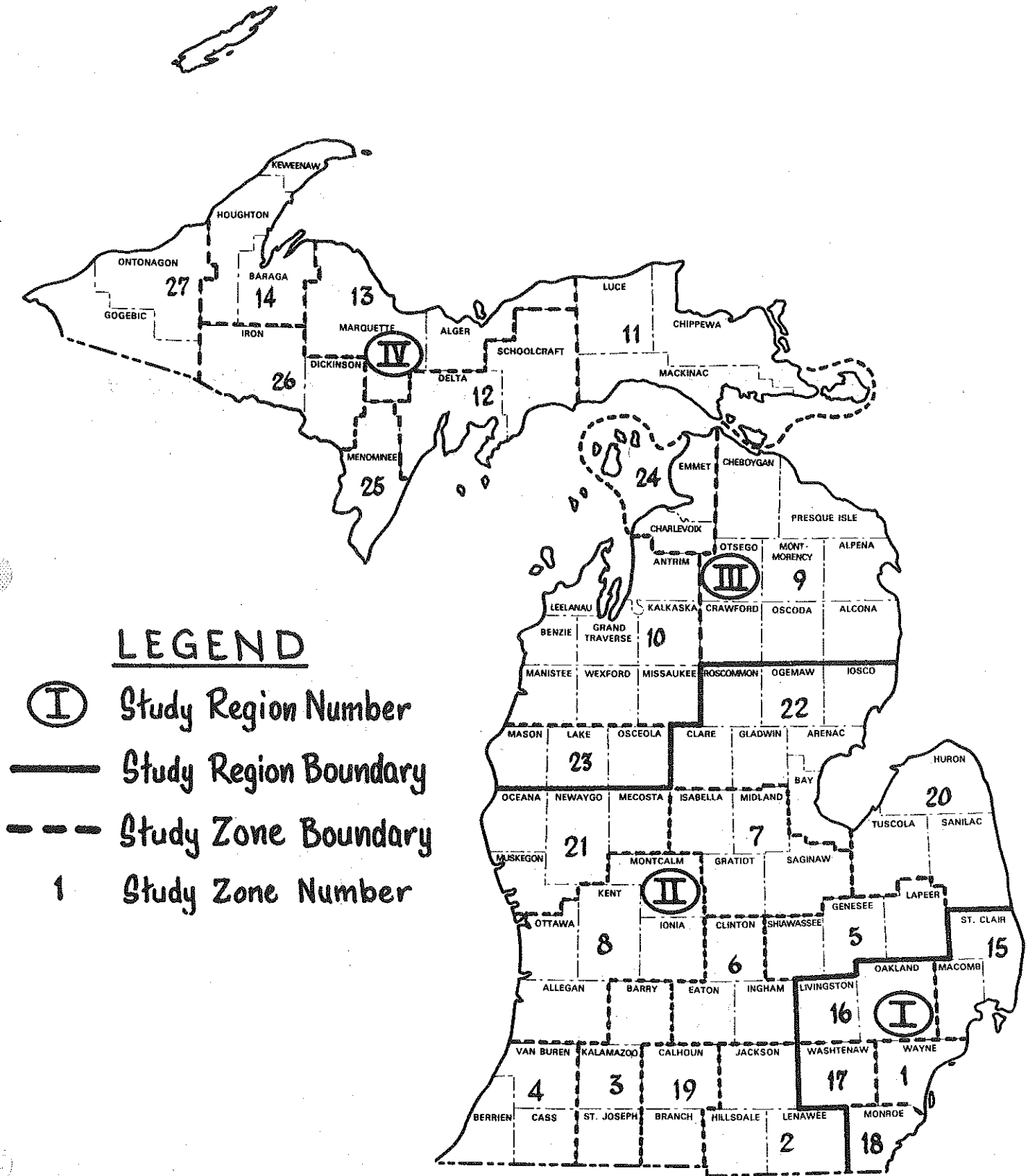
II. FORECASTS OF 1990 GENERAL AVIATION ACTIVITY

Future aviation requirements for the state-wide general aviation system are based on forecasts of activity. Two (2) types of activity have been forecast:

1. numbers of based general aviation aircraft
2. numbers of general aviation aircraft operations
(an aircraft operation is defined as a takeoff or landing.)

For forecasting purposes the state has been divided into four (4) study regions and 27 travel zones. These regions and zones are displayed in Figure 1.

FIGURE 1 GENERAL AVIATION STUDY AREAS



Forecasts of Based Aircraft

The report entitled, "Interim Report - Data Collection and Analysis Methods," (July, 1972) noted that based aircraft would be forecast as a function of the population of each travel zone. Thus, to forecast the number of aircraft, the zone's projected population is multiplied by a computed factor, shown below:

PLANNING FACTORS FOR FORECASTING BASED GENERAL AVIATION AIRCRAFT

<u>Study Region</u>	<u>Study Zones</u>	<u>Based Aircraft Factor (to be multiplied by zone population in thousands)</u>	
		<u>1970</u>	<u>1990</u>
I	1, 15, 16, 17, 18	0.47	0.94
II	2, 3, 4, 5, 6, 7, 8, 19, 20, 21, 22	0.77	1.54
III	9, 10, 23, 24	0.88	1.76
IV	11, 12, 13, 14, 25, 26, 27	0.60	1.20

The population figures used for the based aircraft forecasts were developed by Howard Bevis, a sub-contractor of Stanford Research Institute. Previous population projections made by the State of Michigan were also considered in the analysis.

Based on the method explained above, forecasts of numbers of based aircraft have been made for each zone. Figure 2 and Table 2 show projected based aircraft and compare these projections with

actual 1970 based aircraft.* The forecasts indicate substantial growth in based general aviation aircraft by 1990 -- for the state, the number of aircraft is expected to more than double. On this basis, Michigan's general aviation growth would parallel that expected for the entire United States. One important feature of the forecasts is the underlying assumption that future growth will follow past trends. The potential effects of substantially higher costs for general aviation flying -- such as that suggested in the preliminary results of the Federal Department of Transportation's Aviation Cost Allocation Study -- have not been incorporated in the forecasts.

Projection of based aircraft at a level of detail finer than the zone level is properly the function of an individual airport master plan. However, for subsequent steps of the state-wide planning process, it was necessary to estimate numbers of based aircraft for small geographic areas. Therefore, an allocation of based aircraft to communities within each zone has been made in this study. The approximate number of 1990 based aircraft is shown for each airport in Tables 7 thru 10.

Forecasts of Aircraft Operations

To effectively analyze the adequacy of airport facilities, it is necessary to forecast the number of general aviation operations (an aircraft operation is defined as a takeoff or landing). The

*In the analysis, the five (5) travel zones in southeastern Michigan have been treated as a single zone.

FIGURE 2
GENERAL AVIATION BASED AIRCRAFT
BY ZONE for 1970 & 1990

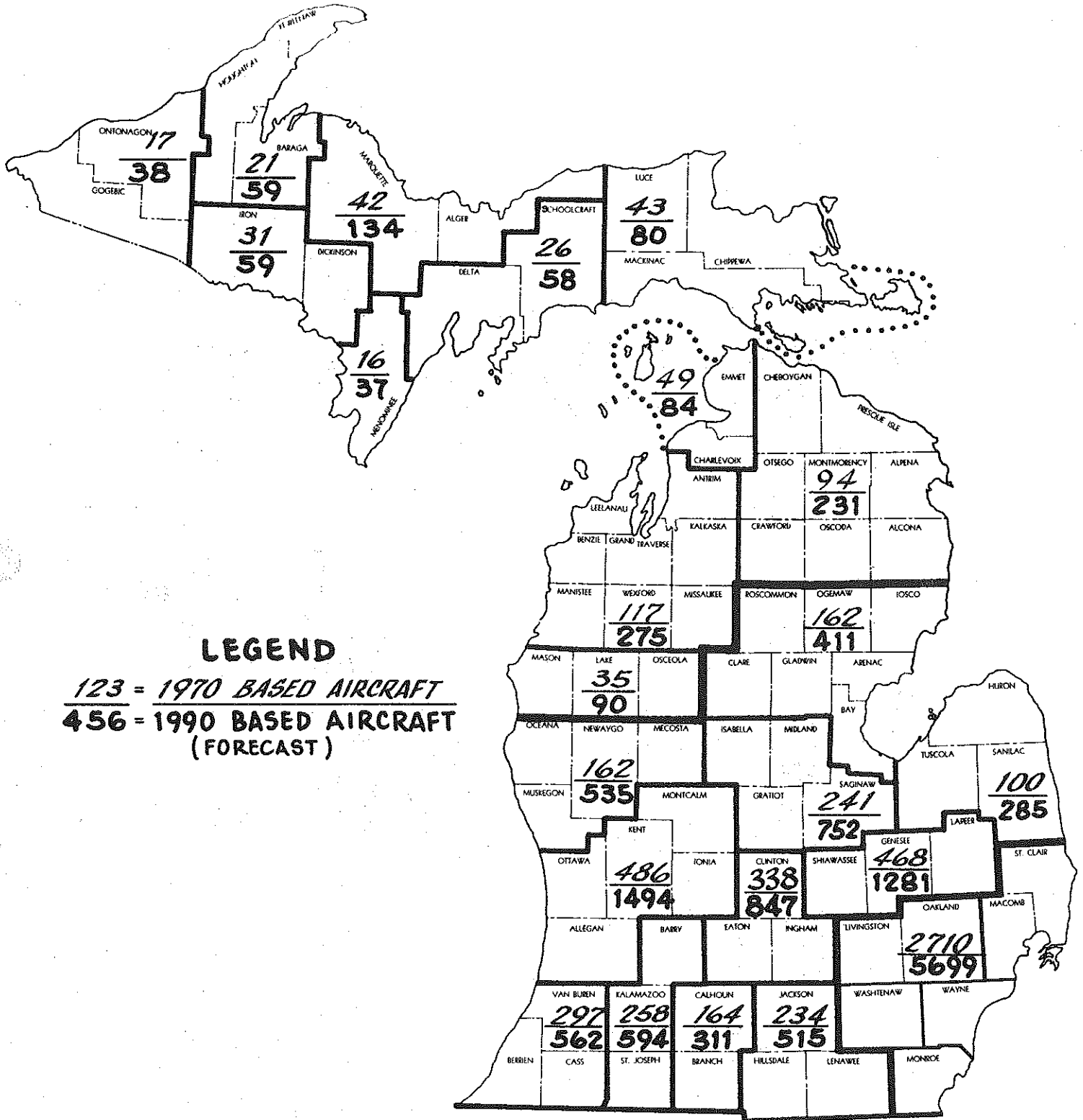


Table 2
Based Aircraft Forecast

<u>Zones</u>	<u>Based Aircraft</u>		<u>Ratio</u> <u>1990 ÷ 1970</u>
	<u>1970</u> <u>Actual</u>	<u>1990</u> <u>Forecast</u>	
SEMOG (1, 15, 16, 17, 18)	2,710	5,699	2.1
2	234	515	2.2
3	258	594	2.3
4	297	562	1.9
5	468	1,281	2.7
6	338	847	2.5
7	241	752	3.1
8	486	1,494	3.1
9	94	231	2.5
10	117	275	2.4
11	43	80	1.9
12	26	58	2.2
13	42	134	3.1
14	21	59	2.8
19	164	311	1.9
20	100	285	2.9
21	162	535	3.3
22	162	411	2.5
23	35	90	2.6
24	39	84	1.7
25	16	37	2.3
26	31	59	1.9
27	<u>17</u>	<u>38</u>	<u>2.2</u>
State Total	6,093	14,431	2.4

method used in this study to compute the number of aircraft operations considers numbers of based aircraft, taking into account the differences in levels of operations by type of airports. Two (2) types of airports have been identified:

1. airports which serve air carriers or which have control towers
2. airports which serve general aviation only and do not have control towers

Planning factors are given in Table 3, below.

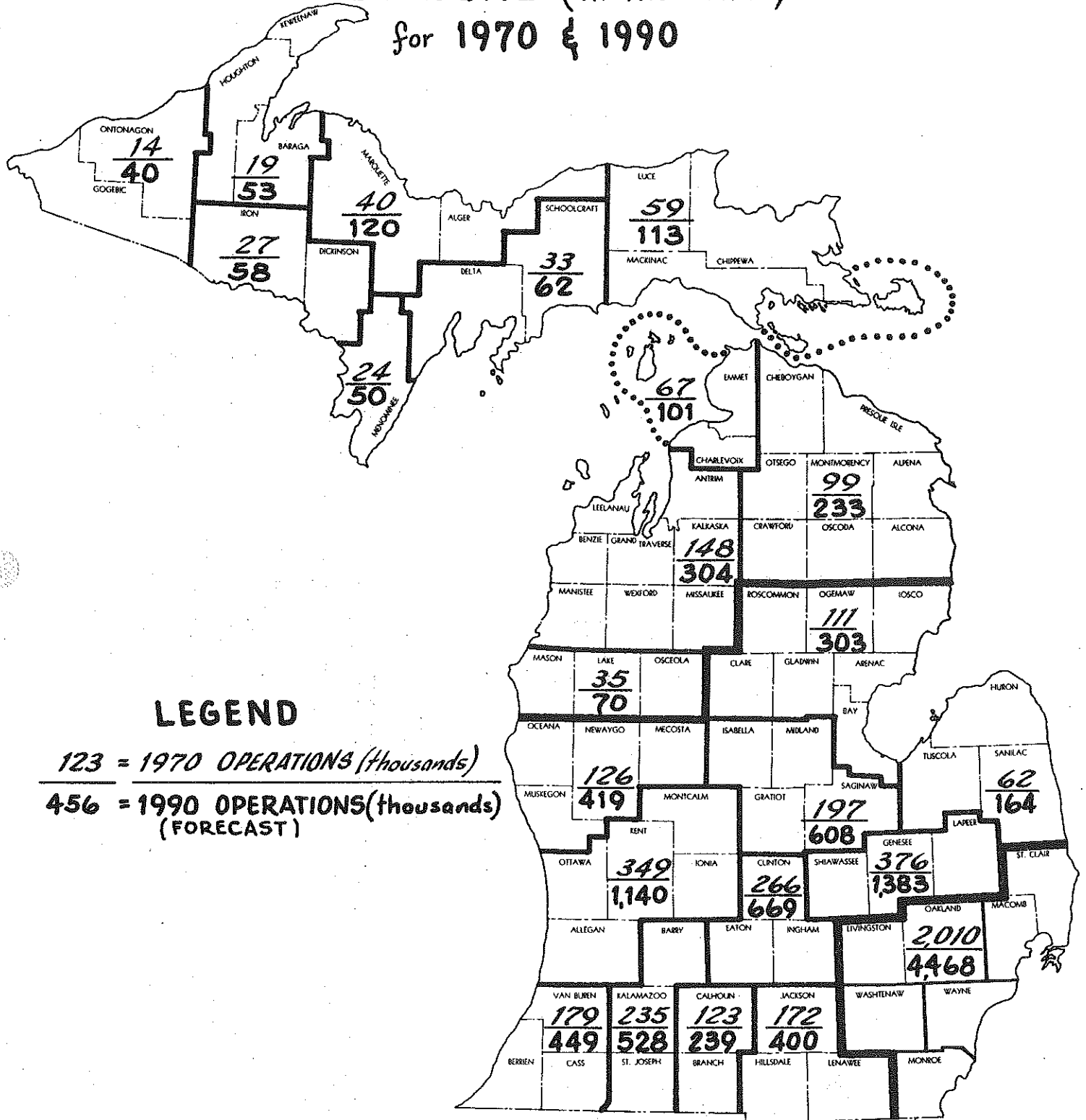
Table 3
Planning Factors for General Aviation Operations

Study Region	Airport Type	Annual Operations per Based Aircraft		
		Itinerant	Local	Total
I	Air carrier and/or tower	350	350	700
	General aviation only, no tower	275	550	825
II	Air carrier and/or tower	450	450	900
	General aviation only, no tower	250	500	750
III	Air carrier and/or tower	450	550	1,100
	General aviation only, no tower	500	500	1,100
IV	Air carrier and/or tower	300	475	775
	General aviation only, no tower	450	900	1,350

These factors are judged to be sufficiently accurate for general planning purposes. However, the method is not recommended for projections of aircraft operations at the master planning level. Unacceptable levels of error may occur due to unique operating patterns of individual airport.

Based on the method explained above, aircraft operations were computed for each of the study zones. Figure 3 shows the resulting forecasts of operations in 1990 and estimated operations for 1970.

FIGURE 3
GENERAL AVIATION OPERATIONS
BY ZONE (in thousands)
for 1970 & 1990



III STUDY CRITERIA FOR NEW AND EXISTING AIRPORTS

There are two (2) basic measures as to whether a particular airport is included in the 1990 general aviation system plan:

1. To provide aviation capacity sufficient to accommodate forecast levels of general aviation activity in a given geographic area
2. To provide a reasonable geographic distribution of airports throughout the state

Aviation Capacity

In some areas of Michigan, existing general aviation airports are sufficient in number to accommodate forecasted 1990 general aviation activity levels. However, in many of the major urban areas of the state (e.g., Detroit, Flint and Grand Rapids) activity is expected to exceed the capacity of existing airports. In these major urban areas, both existing and new airports are included in the plan to provide sufficient aviation capacity.

Geographic Distribution

Not all of the airports in the 1990 Plan are included by reason of aviation capacity. Some airports are included to achieve a general aviation system that is convenient to all areas within Michigan.

To establish a convenient aviation system that is also cost-effective, the cost and time of airport ground access for general

aviation users have been considered in relation to costs of airport development. Table 4 illustrates this concept. The table is an example of the levels of expenditure that can be justified for a new airport in terms of the ground access cost savings. For instance, if the new airport would save an average of 20 minutes per trip to the airport, and if 20 aircraft are expected for the new site, then an expenditure of approximately \$1 million (table value is \$1080 thousands) would be cost-effective (under the assumptions noted). This amount of money represents the total discounted savings in user ground access costs during the economic life of the airport. A sample calculation of the annual cost savings that lead to the values in Table 4 is displayed in Table 5.

Other Considerations

In addition to providing sufficient aviation capacity at a geographically balanced set of airport locations, other factors have been considered in the general aviation airport plan for 1990. These factors relate to the economic value of a general aviation airport to the community it serves.

Throughout the U.S., many communities have discovered that among the many factors vital to the economic health of their area is the availability of adequate general aviation airport facilities -- their industries are dependent on general aviation aircraft.

The number of general aviation aircraft used by business is, according to a 1970 estimate by the National Business Aircraft Association,

TABLE 4

JUSTIFIABLE EXPENDITURE FOR A NEW GENERAL
AVIATION AIRPORT

(\$ 000)

Average time saved per ground access trip to new site (minutes, one-way)	Based Aircraft at New Site				
	2	5	10	20	50
5	27	68	135	270	672
10	55	135	270	540	1,350
20	107	270	540	1,080	2,700
30	162	405	810	1,620	4,050
60	324	810	1,620	3,240	8,100

Major Assumptions:

Value of time for general aviation users = \$10.00 per hour.

Economic life of airport development = 25 years

Discount rate for the opportunity cost of capital = 7 percent

TABLE 5

CALCULATION OF ANNUAL GROUND ACCESS COST SAVINGS
FOR A NEW GENERAL AVIATION AIRPORT

1. Assume, for purposes of illustration, that the average time saved by users of the new site would be 20 minutes per trip (as opposed to accessing other airports). This implies that the new site is approximately 13 miles closer than other airports (40 miles per hour).
2. Assume that the average general aviation user values his time at \$10 per hour.
3. Assume an average of 2.5 persons per flight and further, that all persons in the party travel to and from the airport in one automobile.
4. From Items 1 and 2, the value of time savings per person-trip is: $20 \text{ minutes} \times \$10/\text{hour} = \$3.33$
5. From Items 1 and 3, the vehicle cost savings per person are calculated as: $13 \text{ miles} \times 7 \text{ cents/mile} \div 2.5 \text{ persons} = \0.36
6. From Items 4 and 5, the cost savings per one-way airport access person-trip totals $\$3.33 + \$0.20 = \$3.69$
7. Assume, for purposes of illustration, that 10 aircraft would be based at the new site.
8. Assume that the average aircraft makes 400 annual itinerant operations -- each of which implies trips to or from the airport.
9. Assume that the average aircraft also makes 500 annual local operations and that each 5 local operations generates one trip to or from the airport.
10. From Item 3 and Items 7 through 9, the annual number of person-trips to and from the airport is calculated as:

$$2.5 \times 10 \times \left(400 + \frac{500}{5} \right) = 12,500$$
11. From Items 6 and 10, the savings in annual ground access costs totals $\$3.69 \times 12,500 = \underline{\$46 \text{ thousand}}$.

25,000. Nearly 375 of the companies listed in Fortune Magazine's top 500 industrials operate business aircraft. These aircraft, according to Federal Aviation Administration estimates, are used to fly more than seven (7) million hours a year, which compares with fewer than five (5) million revenue hours flown in scheduled domestic service of the passenger/cargo certificated route air carriers.

In Michigan, some examples of airports which have been improved or established to stimulate or keep pace with business are Mt. Pleasant, Gladwin and Cheboygan. In the case of Cheboygan, justification for the development of a new airport consisted of statements of potential use by business, which would account for over 800 operations per year.

In many parts of the State of Michigan, recreation is a major industry and must be considered in airport planning. Examples of airports which serve resort areas may be found at Bellaire, Charlevoix and Mackinac Island. At all three (3) of these airports, traffic for the resort area has justified the expenditure of funds for improvements to serve large aircraft, including charter flights.

The demand for both business and recreational flying is expected to increase and the Michigan Aeronautics Commission is attempting to provide adequate general aviation facilities to meet these future demands.

IV GENERAL AVIATION AIRPORT CLASSIFICATION

In the preceding section, an explanation was given as to criteria used to include airports in the State System Plan. Once an airport was included in the Plan, it was then necessary to estimate the role of the airport in the 1990 system.

For the purpose of planning and design, the Federal Aviation Administration has developed the "Utility" and "Transport" concepts for airports. A utility airport is designed to accommodate general aviation aircraft weighing under 12,500 pounds gross weight. A transport airport is designed to accommodate aircraft over 12,500 pounds including business jets. In order to keep Michigan's State Airport Plan compatible with the Federal Aviation Administration's National Airport Plan, the airport classification system used in this study is based on the one developed by the Federal Aviation Administration.

The four (4) principal types of airports considered in this study are listed in Table 6 and discussed below. A description of airport facilities and development costs for each airport type is provided in the Appendix.

Utility Airports

The utility airports, which will accommodate most general aviation aircraft (including turbo prop aircraft but not pure jets), are

divided into three (3) categories:

1. Basic Utility Stage I
2. Basic Utility Stage II
3. General Utility

BASIC UTILITY STAGE I (B-I) - This type of airport accommodates about 75 percent of the propeller aircraft under 12,500 pounds. It is primarily intended to serve low activity aircraft locations, such as small population communities and remote recreational areas. If an airport in the plan is projected to have less than 10 based aircraft by 1990, it is recommended for inclusion in the Plan as a Basic Utility Stage I airport. These airports would not normally meet the minimum criteria for inclusion in the Federal Aviation Administration's National Airport System Plan and, therefore, construction costs would have to be absorbed by the State and Local communities.

BASIC UTILITY STAGE II (B-II) - This type of airport will accommodate about 95 percent of propeller aircraft under 12,500 pounds. This classification is recommended when an airport is projected to have over 10 based aircraft but not enough activity to be recommended as a General Utility airport. Since 10 based aircraft are normally the minimum for including the airport in the Federal Aviation Administration's National Airport System Plan, it can be assumed for planning purposes that the airport will qualify for Federal, as well as State and local funding. (If at a later date Federal funds are requested, it must be shown that the airport does in fact meet the activity requirements for Federal funding).

GENERAL UTILITY (G.U.) - This type of airport accommodates substantially all propeller aircraft of less than 12,500 pounds. It is primarily intended to serve (1) communities located on the fringe of a metropolitan area and, (2) relatively large communities remote from a metropolitan area. In either case, there should be a substantial usage of aircraft having a gross weight of over 8,000 pounds. Past experience has shown that in Michigan, an airport usually meets the minimum requirements of the General Utility classification when there are over 20,000 operations per year. Therefore, when the plan projects that an airport will have over 20,000 operations, the airport is included in the plan as a General Utility airport.

Transport Airports

The Federal Aviation Administration has developed design standards for two (2) types of transport airports; basic transport and general transport.

BASIC TRANSPORT (B.T.) - The basic transport airport accommodates turbo powered airplanes up to 60,000 pounds gross weight. This type of airport is planned for use by "business jets," "corporate jets," and "executive jets." If an airport is anticipated to have substantial operations by business jets, it will fall into the basic transport classifications. Unlike the Utility classifications, there is no activity level that will indicate when an airport will qualify as a Basic Transport or "business jet" classification. In the absence of

other data, the Michigan Aeronautics Commission takes the general position that each county should have a basic transport airport (or at least reasonable access to this type airport).

Business jet runway requirements vary in length from 4400 feet to 7000 feet based on the type of jets and their length of haul. Since it is beyond the scope of the state-wide planning study to determine exactly which business jets will use each airport, 5000 foot runways are recommended for planning purposes. This length is sufficient to handle most jets in the business jet fleet.

GENERAL TRANSPORT (G.T.) - The general transport airports accommodates airplanes up to 175,000 pounds gross weight. In planning the general aviation system, it has been assumed that the general transport type aircraft will be accommodated at the Michigan airports that currently have air carrier service.

TABLE 6

GENERAL AVIATION AIRPORT CLASSIFICATION

<u>Airport Type</u>	<u>Level of Activity</u>	<u>Length of Longest Runway</u>	<u>Approximate Percentage of General Aviation Aircraft Accomodated</u>
Basic Utility Stage I (B-I)	Less than 10 based aircraft	2700'	75 %
Basic Utility Stage II (B-II)	More than 10 based aircraft, less than 20,000 operations/year	3700' to 3900'	95 %
General Utility (G.U.)	More than 20,000 operations per year	3700' to 3900'	98 %
Basic Transport (B.T.)	500 + operations per year by business jets	5000' +	100 %

V RECOMMENDED 1990 GENERAL AVIATION SYSTEM

Locations and Types of Airports

Figures 4 thru 7 show the recommended 1990 system of airports to serve general aviation that has resulted from the Task Group 5 analysis. A general aviation classification is shown for each airport and symbols indicate whether the airports are "existing" or whether they are proposed "new" facilities. By 1990, a total of 58 new airports are proposed for the state; of this number, 31 are to replace existing airports that cannot be feasibly expanded to accommodate 1990 needs and 27 are for communities that do not currently have a general aviation airport. Accompanying each figure is a table providing additional information for airports in the general aviation plan*.

*The tables do not include air carrier airports.

FIGURE 4

PROPOSED 1990 MICHIGAN GENERAL AVIATION AIRPORT SYSTEM STUDY AREA I

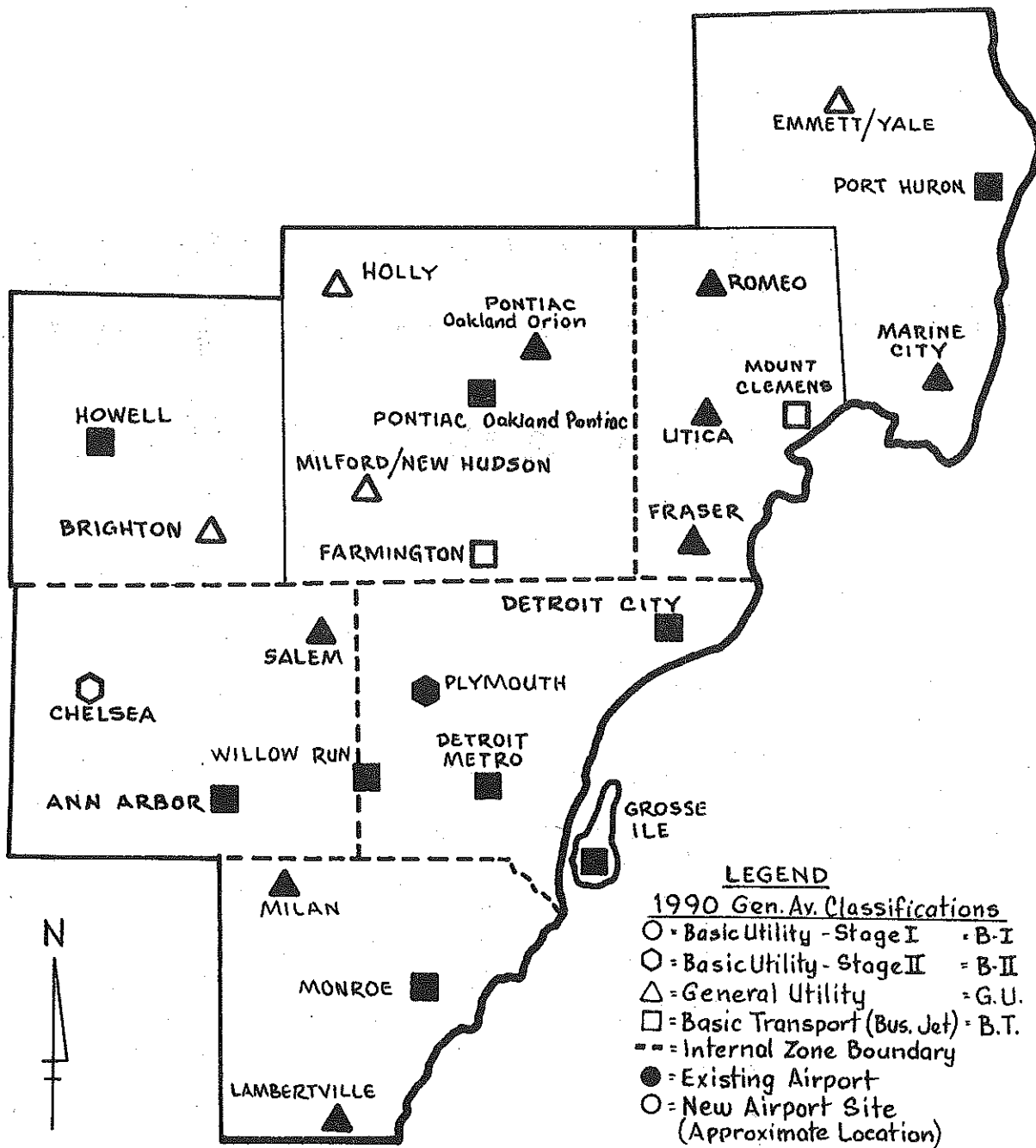


TABLE 7

Planning Region I Airports

Zone	City and Airport	Estimated 1990 Based Aircraft	Length of Primary Runway*		Basis For Including Airport in System Plan	
			1970	1990	Ground Access Consideration	Provide Adequate Capacity
1	Detroit - Detroit City	300 - 400	5,000	5,000	x	x
	Detroit - Grosse Ile	300 - 400	4,980	4,980	x	x
	Detroit - Willow Run	300 - 400	7,500	12,500	x	x
	Plymouth - Mettetal	200 - 300	2,600	3,200		x
15	Emmet/Yale - New	30 - 40	---	3,800	x	
	Fraser - McKinley	200 - 300	2,900	3,800		x
	Marine City - Marine City	75 - 100	2,100-T	3,800	x	
	Mt. Clemens - New	300 - 400	---	5,000	x	x
	Port Huron - St. Clair Co.	150 - 200	5,100	5,100	x	
	Romeo - Romeo	150 - 200	3,600	3,800	x	x
	Utica - Berz - Macomb	200 - 300	---	4,200		x
16	Birmingham - Grand Prix	200 - 300	3,855	3,800	x	x
	Brighton - New	75 - 100	---	3,800	x	x
	Farmington - New	200 - 300	---	5,000	x	x
	Holly - New	75 - 100	---	3,800	x	
	Howell - Livingston Co.	100 - 150	3,000	5,000	x	
	Milford/New Hudson - New	200 - 300	---	3,800		x
	Pontiac - Oakland Pontiac	over 500	5,300	6,200	x	x
	Pontiac - Oakland Orion	200 - 300	2,400	3,900		x
17	Ann Arbor - Municipal	300 - 400	3,500	5,000		x
	Chelsea - New	25 - 50	---	3,200	x	
	Salem - Salem	200 - 300	2,400	3,800	x	x
18	Lambertville - Wagon Wheel	100 - 150	3,400	3,800	x	
	Milan - Milan	50 - 75	2,500-T	3,800	x	
	Monroe - Custer	200 - 300	2,600	5,000	x	

* T = (Turf Runway)

FIGURE 5

PROPOSED 1990 MICHIGAN GENERAL AVIATION AIRPORT SYSTEM STUDY AREA II

LEGEND

1990 Gen. Av. Classifications

- = Basic Utility - Stage I -B-I
- ◌ = Basic Utility - Stage II -B-II
- △ = General Utility -G.U.
- ◻ = Basic Transport (Bus. Jet)-B.T.
- - - Internal Zone Boundary
- = Existing Airport
- = New Airport Site (Approximate Location)

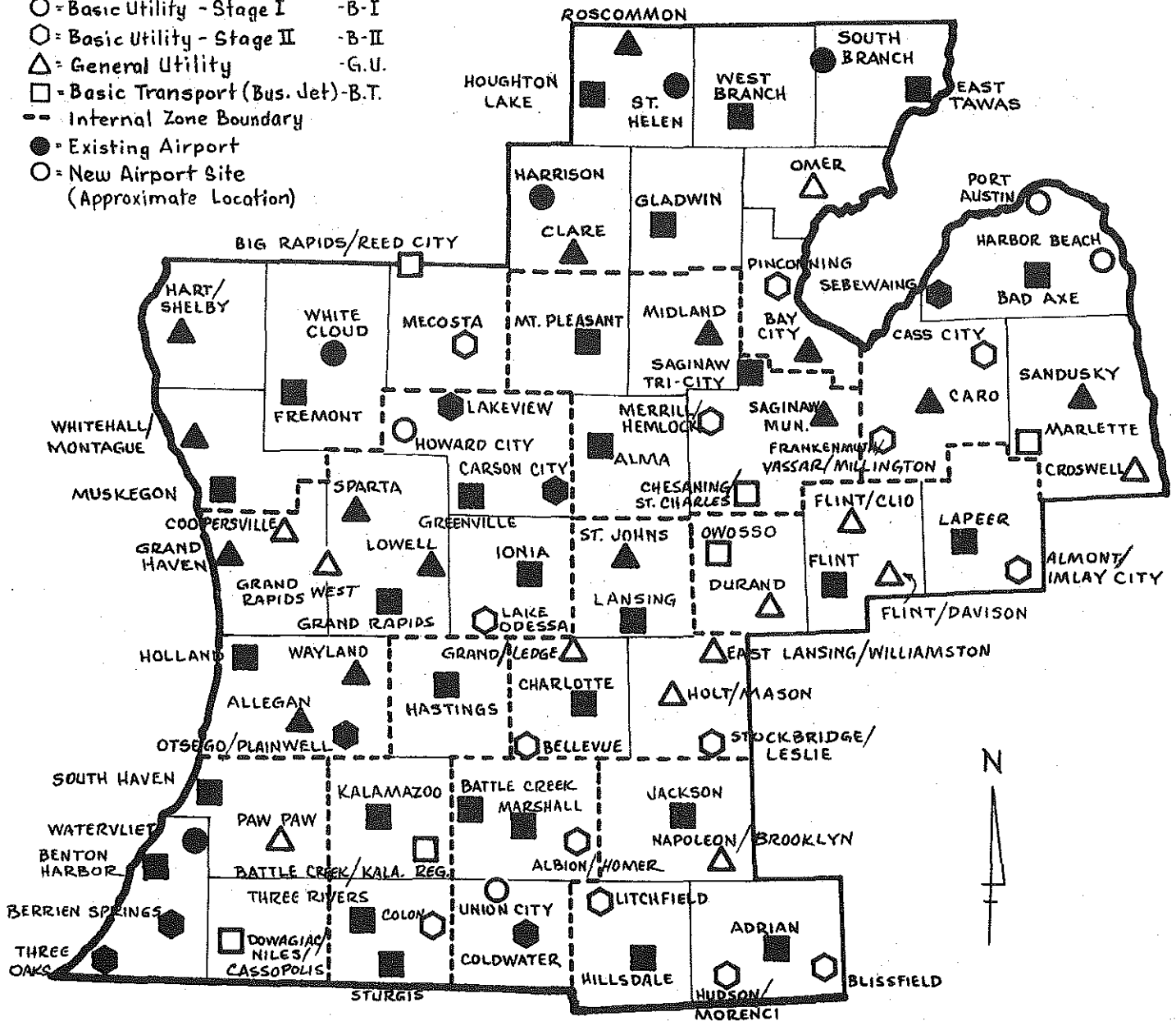


TABLE 8

Planning Region II Airports

Zone	City and Airport	Estimated 1990 Based Aircraft	Length of Primary Runway*		Basis for Including Airport in System Plan	
			1970	1990	Ground Access Consideration	Provide Adequate Capacity
2	Adrian - Lenawee County	75 - 100	3,250	5,000	x	
	Blissfield - New	10 - 25	---	3,200	x	
	Hillsdale - Municipal	50 - 75	3,200	5,000	x	
	Hudson/Morenci - New	10 - 25	---	3,200	x	
	Litchfield - New	10 - 25	---	3,200	x	
	Napoleon/Brooklyn - New	50 - 75	---	3,800	x	
	Tecumseh - Tecumesh Products	25 - 50	3,300	3,800	x	
3	Colon - New	10 - 25	---	3,200	x	
	Hastings - Municipal	50 - 75	3,000	5,000	x	
	Kalamazoo - Municipal	200 - 300	5,300	5,300	x	x
	Sturgis - Krisch	50 - 75	4,450	5,700	x	
	Three Rivers - Dr. Haines	25 - 50	2,800	5,000	x	
4	Berrien Springs - Andrews University	10 - 25	---	3,200	x	
	Dowagiac/Niles/Cassopolis - New	150 - 200	---	5,000	x	
	Paw Paw - New	50 - 75	---	3,900	x	
	South Haven - Municipal	50 - 75	2,900	5,000	x	
	Three Oaks - Oselka	10 - 25	2,770	3,200	x	
	Watervliet - Watervliet	25 - 50	2,900-T	2,500	x	
5	Almont/Imlay City - New	25 - 50	---	3,200	x	
	Durand - New	50 - 75	---	3,800	x	x
	Flint/Clio - New	200 - 300	---	3,800	x	x
	Flint/Davison - New	200 - 300	---	3,800	x	x
	Lapeer - Dupont Lapeer	100 - 150	2,600	5,000	x	
	Owosso - New	100 - 150	---	5,000	x	

TABLE 8 (Continued)

Zone	City and Airport	Estimated 1990 Based Aircraft	Length of Primary Runway*		Basis for Including Airport in System Plan	
			1970	1990	Ground Access Consideration	Provide Adequate Capacity
6	Bellevue - New	10 - 25	---	3,200	x	
	Charlotte - Fitch H. Beach	100 - 150	3,000	5,000	x	
	East Lansing/Williamston - New	75 - 100	---	3,800	x	x
	Grand Ledge - New	100 - 150	---	3,800	x	x
	Holt/Mason - New	100 - 150	---	3,800	x	x
	St. Johns - New	25 - 50	---	3,800	x	
	Stockbridge/Leslie - New	10 - 25	---	3,200	x	
7	Alma - Gratiot Community	50 - 75	4,000	5,000	x	
	Chesaning/St. Charles - New	25 - 50	---	5,000	x	
	Merrill/Hemlock - New	25 - 50	---	3,200	x	
	Midland - Jack Barstow	150 - 200	3,000	3,800	x	
	Mt. Pleasant - Municipal	75 - 100	3,000	5,000	x	
	Saginaw - Municipal	100 - 150	3,300-T	3,800	x	
8	Allegan - Padgham Field	25 - 50	3,500	3,800	x	
	Carson City - New	10 - 25	---	3,200	x	
	Coopersville - New	25 - 50	---	3,800	x	
	Grand Haven - Memorial	75 - 100	3,750	3,800	x	
	Grand Rapids/West - New	200 - 300	---	3,800	x	x
	Greenville - Greenville	75 - 100	3,000	5,000	x	
	Holland - Tulip City	100 - 150	2,360	5,000	x	
	Howard City - New	10 - 25	---	2,700	x	
	Ionia - Ionia Co.	50 - 75	3,700	5,000	x	
	Lake Odessa - New	10 - 25	---	3,200	x	
	Lakeview - Lakeview	10 - 25	2,500	3,300	x	
	Lowell - Lowell	50 - 75	2,000-T	3,800	x	x
	Plainwell - Otsego Plainwell	50 - 75	2,650	2,650	x	
	Sparta - Saprta	100 - 150	2,450	3,800	x	
Wayland - Wayland	50 - 75	2,300-T	3,800	x		

TABLE 8 (Continued)

Zone	City and Airport	Estimated 1990 Based Aircraft	Length of Primary Runway*		Basis for Including Airport in System Plan	
			1970	1990	Ground Access Consideration	Provide Adequate Capacity
19	Albion/Homer - New	10 - 25	---	3,200	x	
	Battle Creek - W.K. Kellogg Regional	100 - 150	7,000	7,000	x	x
	Coldwater - Branch Co. Memorial	75 - 100	3,500	5,000	x	
	Marshall - Brooks Field	50 - 75	3,500	5,000	x	
	Union City - New	10 - 25	---	2,700	x	
20	Bad Axe - Huron Co.	25 - 50	3,200	5,000	x	
	Caro - Municipal	25 - 50	3,000	3,800	x	
	Cass City - New	10 - 25	---	3,200	x	
	Crosswell - New	10 - 25	---	3,800	x	
	Frankenmuth/Vasser/Millington - New	10 - 25	---	3,200	x	
	Harbor Beach - New	under 10	---	2,700	x	
	Marlette - New	25 - 50	---	5,000	x	
	Port Austin - New	under 10	---	2,700	x	
	Sandusky - Sandusky	25 - 50	3,000	3,800	x	
	Sebewaing - Sebewaing	10 - 25	2,178	3,200	x	
21	Big Rapids/Reed City - New	75 - 100	---	5,000	x	
	Fremont - Municipal	25 - 50	3,500	5,500	x	
	Hart/Shelby	25 - 50	1,800	3,800	x	
	Mecosta - New	10 - 25	---	3,200	x	
	White Cloud - White Cloud	10 - 25	1,800	2,700	x	
	Whitehall/Montague - New	25 - 50	---	3,800	x	
22	Bay City - James Clements Municipal	100 - 150	3,200	3,700	x	
	Clare - Municipal	25 - 50	2,500	3,800	x	
	East Tawas - Iosco Co.	50 - 75	3,500	5,000	x	
	Gladwin - Municipal	25 - 50	3,538-T	5,000	x	
	Harrison - Clare Co.	under 10	3,300-T	2,700	x	
	Houghton Lake - Roscommon Co.	10 - 25	2,900	5,000	x	
	Omer - New	10 - 25	---	3,800	x	
	Pinconning - New	10 - 25	---	3,200	x	
	Roscommon - Conservation	10 - 25	3,600	3,600	x	

TABLE 8 (Continued)

<u>Zone</u>	<u>City and Airport</u>	<u>Estimated 1990 Based Aircraft</u>	<u>Length of Primary Runway*</u>		<u>Basis for Including Airport in System Plan</u>	
			<u>1970</u>	<u>1990</u>	<u>Ground Access Consideration</u>	<u>Provide Adequate Capacity</u>
22 (cont)	South Branch - Timbers Skyranch	10 - 25	2,200-T	2,700		x
	St. Helen - St. Helen	under 10	2,600-T	2,700		x
	West Branch - Community	25 - 50	3,200	5,000		x

* T = (Turf Runway)

FIGURE 6

PROPOSED 1990 MICHIGAN GENERAL AVIATION AIRPORT SYSTEM STUDY AREA III

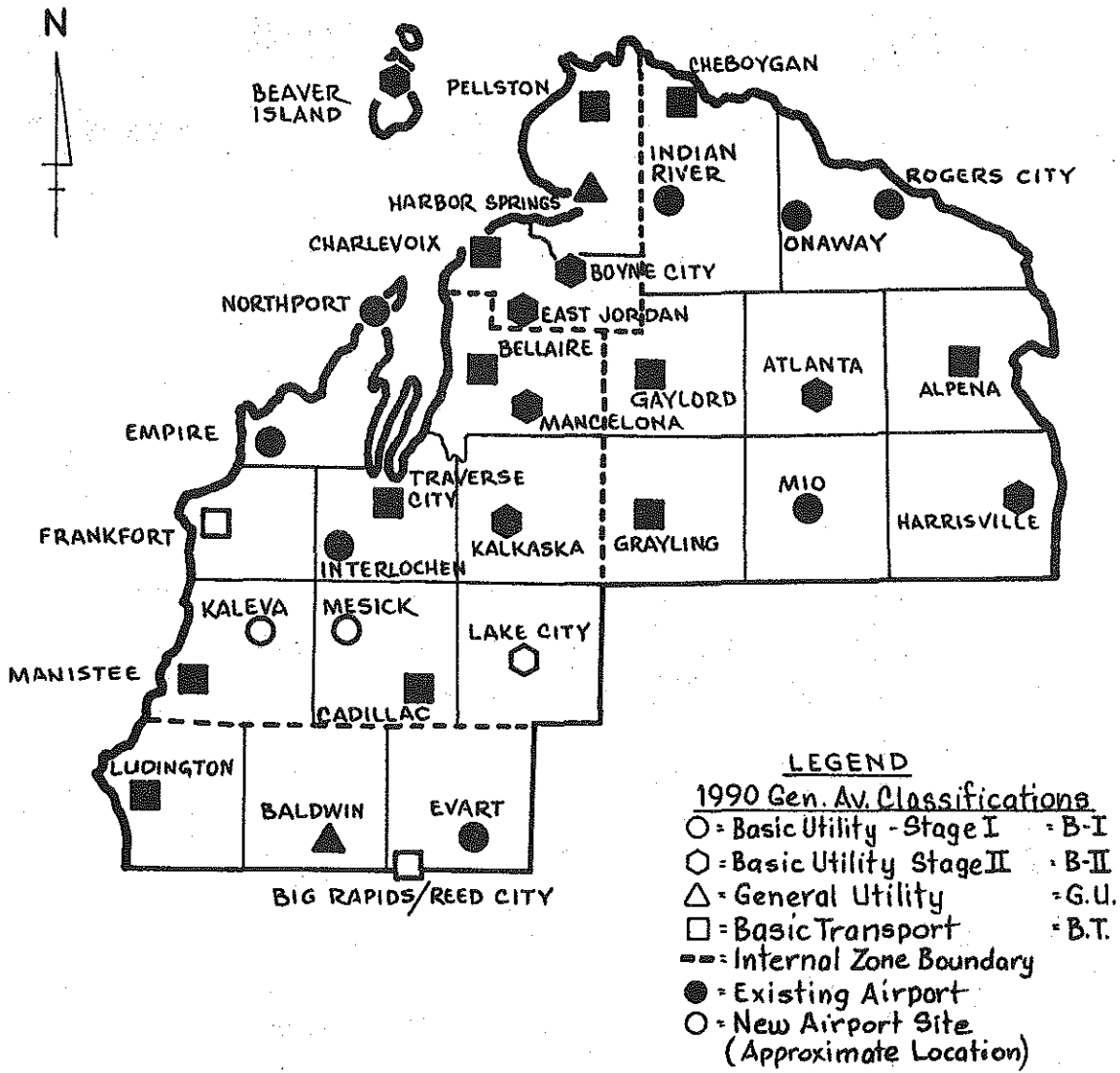


TABLE 9

Planning Region III Airports

Zone	City and Airport	Estimated 1990 Based Aircraft	Length of Primary Runway*		Basis for Including Airport in System Plan	
			1970	1990	Ground Access Consideration	Provide Adequate Capacity
9	Atlanta - Atlanta	10 - 25	3,100-T	3,200	x	
	Cheboygan - Cheboygan	25 - 50	---	4,500	x	
	Gaylord - Otsego Co	25 - 50	5,000	5,000	x	
	Grayling - Area Airport	10 - 25	5,000	5,000	x	
	Harrisville - Harrisville	10 - 25	2,150-T	3,200	x	
	Indian River - Calvin Campbell	under 10	3,100-T	2,700	x	
	Mio - Mio	under 10	3,100-T	2,700	x	
	Onaway - Onaway	under 10	3,100-T	2,700	x	
Rogers City - Presque Isle Co.	10 - 25	3,000	5,000	x		
10	Bellaire - Antrim Co.	25 - 50	5,000	5,000	x	
	Cadillac - Wexford Co.	25 - 50	5,000	5,000	x	
	Empire - Empire	under 10	2,700-T	2,700	x	
	Frankfort - New	10 - 25	---	5,000	x	
	Interlochen - Green Lake	under 10	2,800-T	2,700	x	
	Kalava - New	under 10	---	2,700	x	
	Kalkaska - Kalkaska	10 - 25	3,600-T	3,200	x	
	Lake City - New	10 - 25	---	3,200	x	
	Mancelona - Municipal	under 10	3,000-T	2,700	x	
	Mesick - New	under 10	---	2,700	x	
Northport - Woolsey Municipal	under 10	2,650-T	2,700	x		
23	Baldwin - Baldwin	10 - 25	3,800	3,800	x	
	Evart - Municipal	under 10	2,200	2,700	x	
	Ludington - Mason Co.	50 - 75	3,500	5,000	x	
24	Beaver Island - Beaver Island	under 10	3,500-T	3,200	x	
	Boyne City - Boyne City	10 - 25	3,240-T	3,200	x	
	Charlevoix - Charlevoix	10 - 25	3,500	4,500	x	
	East Jordan - East Jordan	10 - 25	3,200-T	3,200	x	
	Harbor Springs - Harbor Springs	10 - 25	2,000-T	3,900	x	

* T = (Turf Runway)

FIGURE 7

PROPOSED 1990 MICHIGAN GENERAL AVIATION AIRPORT SYSTEM STUDY AREA IV

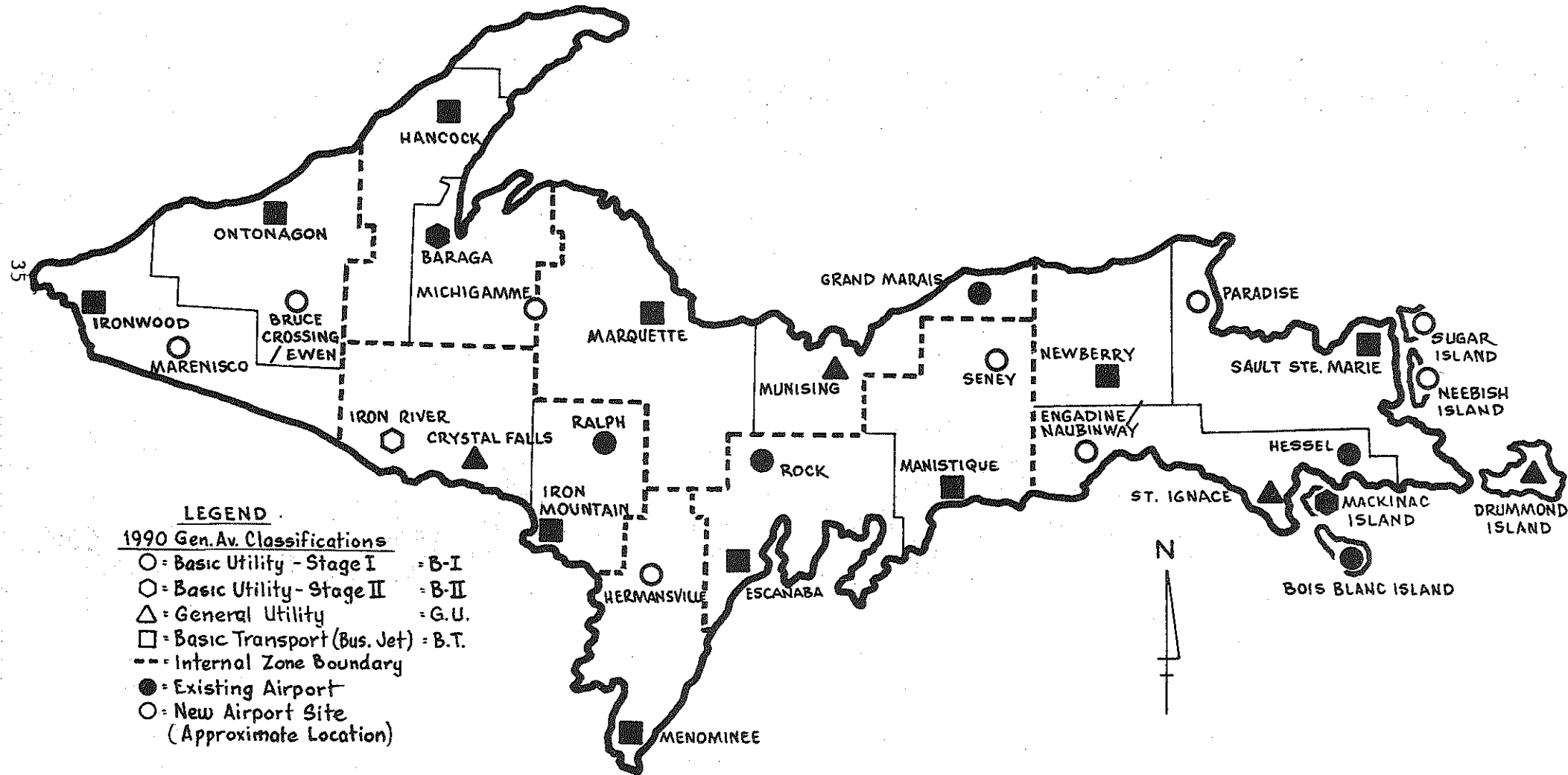


TABLE 10

Planning Region IV Airports

Zone	City and Airport	Estimated 1990 Based Aircraft	Length of Primary Runway*		Basis for Including Airport in System Plan	
			1970	1990	Ground Access Consideration	Provide Adequate Capacity
11	Bois Blanc Island - Bois Blanc	under 10	2,600-T	2,700	x	
	Drummond Island - Drummond Island	10 - 25	3,660-T	3,800	x	
	Engadine/Naubinway - New	under 10	---	2,700	x	
	Hessel - Hessel	under 10	3,300-T	2,700	x	
	Mackinac Island - Mackinac Island	under 10	3,500	3,500	x	
	Neebish Island - New	under 10	---	2,700	x	
	Newberry - Luce Co.	10 - 25	3,500	5,000	x	
	Paradise - New	under 10	---	2,700	x	
	St. Ignace - Mackinac Co.	10 - 25	3,200	3,800	x	
Sugar Island - New	under 10	---	2,700	x		
12	Manistique - Schoolcraft Co.	10 - 25	3,000	5,000	x	
	Rock - Bonnie Field	under 10	2,900-T	2,700	x	
	Seney - New	under 10	---	2,700	x	
13	Grand Marias - Grand Marias	under 10	4,400-T	2,700	x	
	Michigamme - New	under 10	---	2,700	x	
	Munising - Munising	10 - 25	3,050-T	3,800	x	
14	Baraga - Carlson	10 - 25	2,080-T	3,200	x	
25	Hermansville - New	under 10	---	2,700	x	
26	Crystall Falls - Iron Co.	under 10	3,700	3,800	x	
	Iron River - New	10 - 25	2,165	3,200	x	
	Ralph - Ralph	under 10	2,000-T	2,700	x	

* T = (Turf Runway)

Airport Development Costs

The approximate costs of airport development for the 1990 general aviation system are shown in Table 11. These costs are in 1970 dollars and represent the estimated total development cost between 1973 and 1990. Cost estimates are based on state-wide averages for airport construction. The estimates do not include the cost of developing airports that are expected to serve air carriers in 1990.

TABLE 11

Estimated Cost of General Aviation System Recommendations
1973 thru 1990
(\$ millions)

<u>Zone</u>	<u>Cost</u>
1, 15, 16, 17, 18 (SEMCOG)	73.0
2	7.8
3	5.8
4	6.6
5	9.5
6	7.5
7	9.5
8	13.2
9	4.7
10	5.2
11	3.8
12	0.6
13	1.1
14	0.4
19	5.8
20	8.2
21	5.2
22	9.7
23	2.5
24	3.4
25	0.2
26	0.9
27	<u>1.3</u>
State Total:	\$186.9

APPENDIX

For planning purposes, the following generalized development specifications have been recommended to satisfy the needs of the various utility and transport airport classifications used in this study. Modifications to these generalized specifications have been made for some existing airports in order for the state's plan to be compatible with, (1) the Federal Aviation Administration's National Airport System Plan and (2) existing airport development. The recommended development and associated costs are based on state averages and they should not be construed as exact engineering estimates. The generalized costs shown are expressed in 1970 prices and are applicable only to a new site. Costs for an existing airport would be based on the amount of development needed to meet the higher classifications.

BASIC UTILITY - STAGE I

1. Land: 180 acres
2. Airfield Paving:
 - Runway 2700' x 60'
 - Stub Taxi 400' x 30'
 - Apron 100' x 200'
3. Administration Building

4. Other:

Fencing

Auto Parking

Entrance Road

Segmented Circle and Wind Cone

Runway Marking

Obstruction Removal

Average cost: \$175,000 plus 180 acres of land at local prices.

BASIC UTILITY - STAGE II

1. Land: 300 acres

2. Airfield Paving:

Primary Runway 3200' x 60'

Crosswind Runway (turf) 3200' x 100'

Partial Parallel Taxiway 800' x 30'

Taxi Streets 800' x 30'

Stub Taxi 400' x 30'

Apron 100' x 250'

3. Airfield Lighting:

Runway and Taxiway

Lighted Wind Cone

Rotating Beacon

4. Approach Aids:

Visual Approach Slope Indicator (VASI)

Runway End Identifier Lights (REIL)

5. Administration Building

6. Other:

Fencing

Auto Parking

Entrance Road

Segmented Circle

Runway and Taxi Marking

Obstruction Removal

Average cost: \$380,000 plus 300 acres of land at local prices.

GENERAL UTILITY

1. Land: 450 acres

2. Airfield Paving:

Primary Runway 3800' x 75'

Crosswind Runway 3000' x 75'

Parallel Taxiways 7600' x 40'

Taxi Streets 800' x 30'

Stub Taxi 400' x 40'

Apron 100' x 500'

3. Airfield Lighting:

Runway and Taxiway

Rotating Beacon

Lighted Wind Cone

4. Approach Aids:

Visual Approach Slope Indicators (VASI)

Runway End Identifier Lights (REILS)

5. Administration Building

6. Other:

Fencing

Auto Parking

Entrance Road

Segmented Circle

Runway and Taxi Marking

Obstruction Removal

Average cost: \$850,000 plus 450 acres of land at local prices.

BASIC TRANSPORT - BUSINESS JET

1. Land: 800 acres

2. Airfield Paving:

Primary Runway 5000' x 100'

Crosswind Runway 3800' x 75'

Parallel Taxiways 10,000' x 40'

Taxi Streets 800' x 30'

Connecting Taxi 800' x 40'

Apron 100' x 500'

3. Airfield Lighting:

Runway and Taxiway

Lighted Wind Cone

Rotating Beacon

4. Approach Aids:

Visual Approach Slope Indicators (VASI)

Runway End Identifier Lights (REIL)

Microwave Landing System (MLS)

5. Administration Building

6. Other:

Fencing

Entrance Road

Auto Parking

Segmented Circle

Runway and Taxi Marking

Obstruction Removal

Average cost: \$1,480,000 plus 800 acres of land at local prices.