AIRPORT DEVELOPMENT PLAN

NORTHWOOD

AIRPORT FEASIBILITY STUDY

Northwood Municipal Airport

Prepared for

City of Northwood

By

H. R. Green Company
P.O. Box 456
Charles City, Iowa 50616
(515) 228-6700

Professional Design Services of Ia. Inc.
P.O. Box 191
Ankeny, Iowa 50021
(515) 964-1229

1989

This study was funded in part by a grant-in-aid from the Iowa Department of Transportation.

A

LIST OF FIGURES

LIST OF TABLES

COMMUNITY BACKGROUND

CHAPTER ONE

COMMUNITY AND AIRPORT BACKGROUND

INTRODUCTION

Planning Process:

The City of Northwood retained H.R. Green Company to carry out a scope of work designed to address the need, feasibility, and extent of airport facility development required to provide an adequate level of service within the Northwood Airport Service Area. Professional Design Services of Iowa Inc. was retained by H.R. Green to assist in the planning process.

The scope of work covered the first four phases of work typically found within the Airport Development Plan. Should it be determined that there is sufficient aviation demand to justify airport improvements, the remaining work phases of the airport development planning process would be completed.

A grant-in-aid was obtained from the Iowa Department of Transportation to carry out the plan objectives that are noted below and were incorporated into the planning process described in Table 1-1.

OBJECTIVES:

1. To inventory relevant background information pertinent to the development and maintenance of an airport facility to serve the City of Northwood and the surrounding area.

2. To prepare a forecast of aviation activity to include an estimate of based aircraft, aircraft operations, aircraft mix, and pilots for a twenty-year period.

3. To identify the level of airport development required over a twenty-year period to satisfy demand levels from the forecast of aviation activity.

4. To determine if there is sufficient aviation activity to justify inclusion of a Northwood Airport facility within the Iowa Department of Transportation State System of Airports.

TABLE 1-1: AIRPORT DEVELOPMENT PLANNING PROCESS

I. INVENTORY
- Existing airport site(s)
- Airport service area
- Goals and objectives
- Socioeconomic characteristics

II. FORECAST
- Registered aircraft
- Based aircraft
- Itinerant and local operations
- Air taxi operations
- Design aircraft
- Passenger and airfreight
- Decision Point

III. FACILITY NEED
- Wind Coverage
- Runway length, width strength
- Taxiway
- Landing & Navigational
- FAR Part 77
- Terminal area

IV. BENEFIT/COST ASSESSMENT
- Demand/Capacity
- Airport service level
- Airside, landside
- Decision Point

Citizen Participation: On-Going

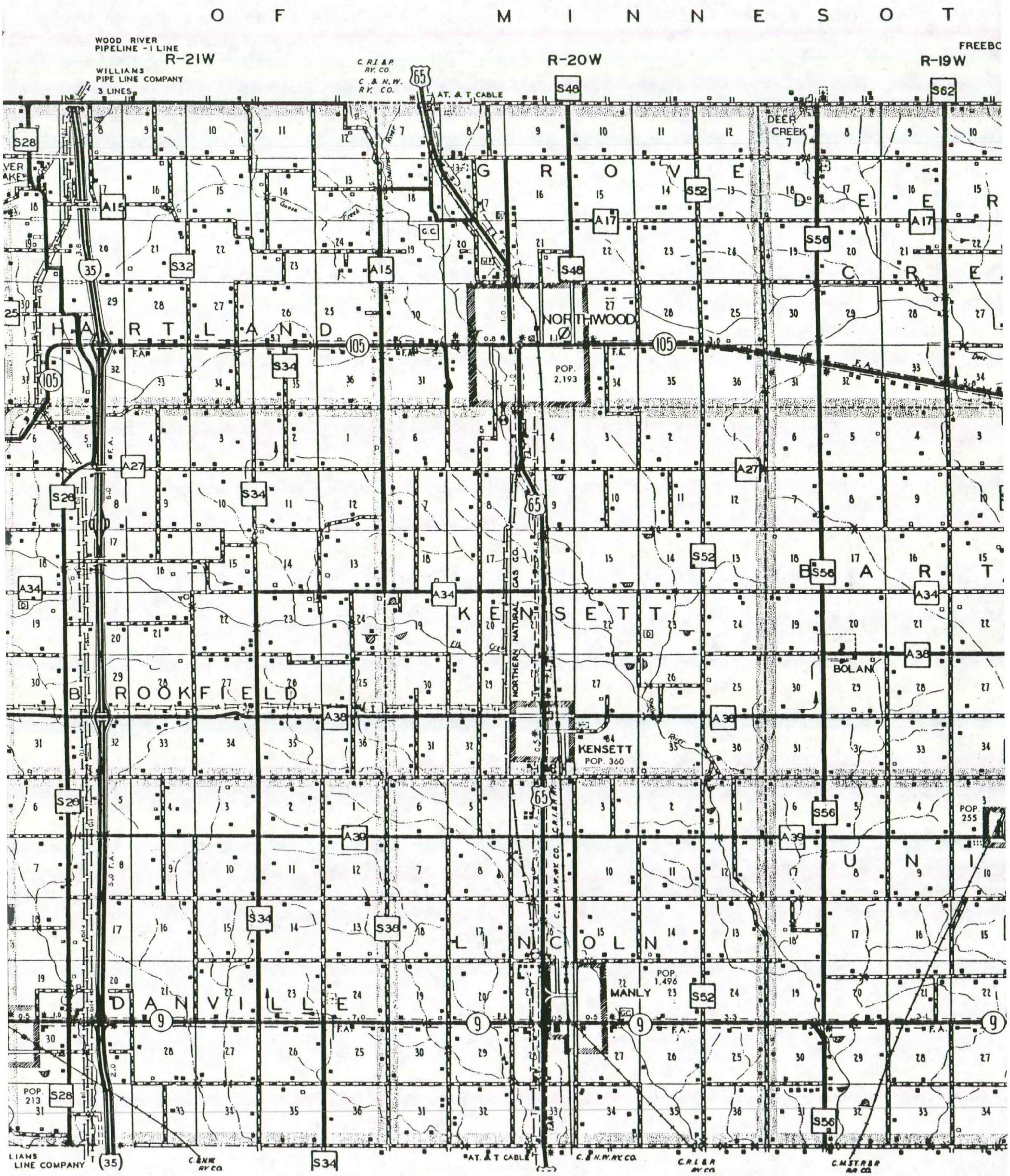
SOURCE: PDS, 1989

Based upon the estimate of aviation activity, the extent of facility development required to serve that demand will be identified. Phase four examines the cost of development and benefits extended from development should it take place. Should there be a positive relation of benefits to cost, a second grant-in-aid from IDOT will be requested for the purpose of completing the balance of the plan.

The report is presented in four chapters, the first of which summarizes relevant background information used in the preparation of Chapters Two through Four.

<u>Project Location:</u>

The City of Northwood is located approximately 20 miles north of Mason City via U.S. Highway 65 and six miles east of Interstate Highway 35 via State Highway 105. Northwood, the county seat of Worth County is located four miles south of the Iowa/Minnesota border. The existing airport is located on the east edge of the developed area of the community.


O F M I N N E S O T
WOOD RIVER PIPELINE - I LINE
WILLIAMS PIPE LINE COMPANY 3 LINES
R-21W
R-20W
R-19W
FREEBO
C.R.I.&P. RY. CO.
C.& N.W. RY. CO.
AT. & T. CABLE
DEER CREEK
G R O V E
D E E R C R E E
H A R T L A N D
NORTHWOOD
POP. 2,193
K E N S E T T
NORTHERN NATURAL GAS CO.
B A R T
BOLAN
B R O O K F I E L D
KENSETT
POP. 360
L I N C O L N
U N I
POP. 255
MANLY
POP. 1,496
D A N V I L L E
POP. 213
LIAMS LINE COMPANY
C.& N.W. RY. CO.
C.R.I.& P. RY. CO.
C.M.ST.P.& P. RR. CO.

AIRPORT SERVICE AREA

Geographic Area

The airport service area may be described in terms of a primary and secondary service area. The primary airport service area would coincide with the northeastern two-thirds of Worth County. The western one-third of the county as well as the southern one-third of the county falls within a fringe or secondary airport service area.

The primary service area is one in which much of the general aviation traffic generated would be served by the Northwood Municipal Airport. The secondary or fringe area is that which may be served by either the Northwood Municipal Airport or area airports located at Osage, Mason City, Forest City and Lake Mills. Airport facilities located at Albert Lea and Austin would serve those areas extending north from the Iowa/Minnesota border.

The service area defined herein is based upon the assumption that area airports would be brought to standard and maintained as such. Given the location of the Lake Mills airport, some opportunity would exist to combine the present airport service area with that of Northwood and construct a single facility to serve Lake Mills and Northwood. Should this scenario have merit, the airport service area of the new airport would be different than that described herein. Should no improvements be made at Lake Mills, the service area of the improved Northwood Airport would closely coincide with the northern two-thirds of Worth County.

The combined primary and secondary airport service areas coincide with Worth County. The combined service area contains twelve (12) townships and seven (7) communities. The combined area extends across 401 square miles of area and had a 1980 population of 9,075 persons.

TABLE 1-2: POLTICAL SUBDIVISIONS, AIRPORTS SERVICE AREA

INCORPORATED COMMUNITIES

Joice	Hanlontown	Fertile
Northwood	Kensett	Manly
Grafton		

TOWNSHIPS

Barton	Bristol	Brookfield
Danville	Deer Creek	Fertile
Grove	Hartland	Kensett
Lincoln	Silver Creek	Union

SOURCE: PDS, 1989

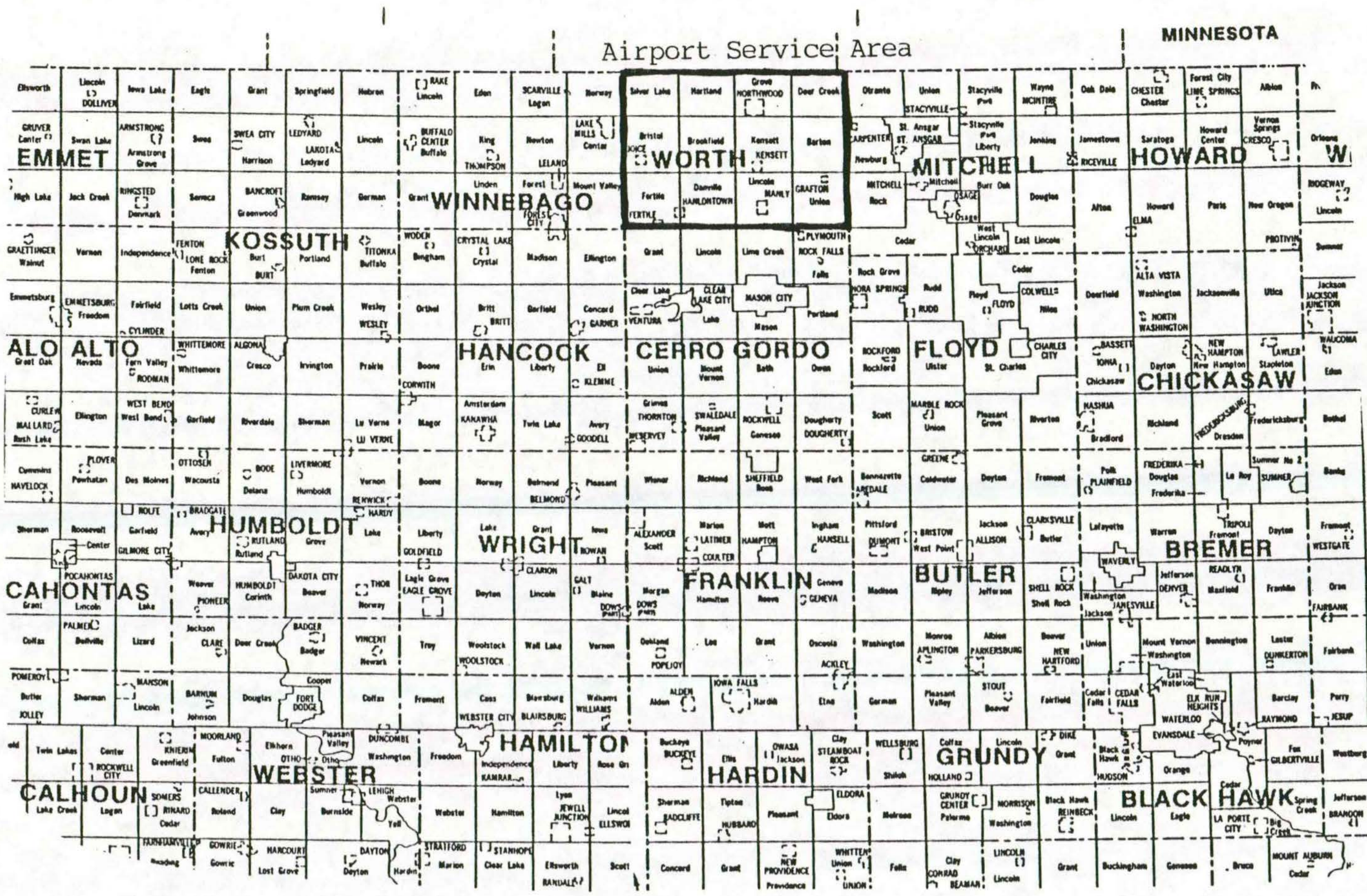


FIGURE 1 - 2: NORTHWOOD AIRPORT SERVICE AREA

Population

The combined service area population declined from 11,068 persons in 1950 to 8,968 persons in 1970. From 1970 to 1980, the combined airport service area population increased to 9,075 persons or by one percent within the 10 year period. Within the period 1980 to July 1, 1987, the airport service area according to U.S. Census Bureau estimates lost population. The population of Worth County as of July 1, 1987 was placed at 8,700 persons. While there is some disagreement over the U.S. Census Bureau estimates for Iowa, it does appear that the out-migration experienced in many Iowa counties has slowed. The Census Bureau estimates reveal that 41 of Iowa's 99 counties lost population in 1988 with 22 showing little or no change. The remaining 33 counties reported a population increase attributed to in-migration or births in excess of deaths. Worth County according to Census Bureau estimates experienced a population increase of one percent from 1987 to 1988.

Historically, the unincorporated area of the county experienced a large percentage of the population loss. With the exception of Grove township, the remaining townships recorded a population loss between 1960 and 1980. Of the seven incorporated communities, Hanlontown, Manly and Northwood experienced a population increase from 1970 to 1980. Of those three, Northwood recorded a numerical increase each decade since 1950.

The City of Northwood recorded a 12-5 percent population increase between 1970 and 1980 compared to a 10.3 percent increase from 1960 to 1970. The 1980 population for Northwood was placed at 2,193 persons or 243 more persons than the 1970 population. A large share of the population was within the age group of 15 to 34 which represents those persons in their family formation years. Future population change in Northwood should be positive due to the likelihood of increased births and continued in-migration.

TABLE 1-3: POPULATION CHANGE, AIRPORT SERVICE AREA, BY POLITICAL SUBDIVISION, 1960 - 1980

TOWNSHIP/ INCORPORATED AREA	1960	1970	1980	NUMBER	PERCENT
Barton Twp.	442	334	285	- 157	- 35.5
Bristrol Twp.	722	559	526	- 196	- 27.1
Joice	231	201	223	- 8	- 3.5
Brookfield Twp.	489	379	347	- 142	- 24.6
Danville Twp.	577	488	411	- 166	- 28.8
Hanlontown (part)	108	106	102	- 6	- 5.6
Deer Creek Twp.	381	272	262	- 119	- 31.2
Fertile Twp.	1012	897	891	- 121	- 12.0
Fertile	386	394	372	- 14	- 3.6
Hanlontown (part)	85	76	111	+ 26	+ 30.6
Grove Twp.	2075	2211	2448	+ 373	+ 18.0
Northwood	1768	1950	2193	+ 425	+ 24.0
Hartland Twp.	438	318	311	- 127	- 29.0
Kensett Twp.	803	685	658	- 145	- 18.1
Kensett	409	361	360	- 49	- 12.0
Lincoln Twp.	2051	1760	1961	- 90	- 4.4
Manly	1425	1294	1496	+ 71	+ 5.0
Silver Lake Twp.	502	387	324	- 178	- 35.5
Union Twp.	767	694	651	- 116	- 15.1
Grafton	273	254	255	- 18	- 6.6
TOTAL	10,259	8,968	9075	-1184	- 11.5

SOURCE: 1980 CENSUS, Number of Inhabitants, PC80-1-A17

Population loss within the airport service area may be attributed to out-migration and a declining birth rate. The states' birth rate fell from 16.4 births per 1000 population in 1980 to 13.4 births in 1988. However, the number of births in Iowa in 1988 recorded the first increase since 1980 suggesting that perhaps some moderation in the declining birth rate has been attained.

Future population totals within the airport service area are expected to change little over the next few years. While the service area can do little to change birth/death rates, it can develop aggresive policies that may create new job opportunities and thereby encourage an in-migration of persons taking advantage of employment opportunities.

TABLE 1-4: POPULATION CHANGE, AIRPORT SERVICE AREA, 1980 - 2000

YEAR	POPULATION (1) - (2)	YEAR	POPULATION (1) - (2)
1980	9,075 - 9,075	1995	8,300 - 9,000
1985	8,800 - 8,700	2000	8,100 - 9,200
1990	8,500 - 8,800	2009	8,100 - 9,200

SOURCE: (1) IOWA CENSUS DATA CENTER,
<u>Iowa Population Projections,</u> July, 1984
(2) PDS of Iowa, Inc.

Income

Table 1-5 summarizes income generated by employment as reported to Job Service of Iowa and covered by job insurance. Total private sector wages increased by 1,948,755 over the 1987 wages, and wages earaned within the governmental sector increased by 334,199 dollars. Manufacturing was the largest generator of income, followed in turn by local government and trade.

The average weekly wage paid by the government exceeded the average weekly wage paid by the private sector. Federal employment generated the largest average weekly wage in Worth County.

TABLE 1-5: TOTAL YEARLY AND AVERAGE YEARLY WEEKLY WAGES, WORTH COUNTY, 1987 AND 1988

	TOTAL YEARLY WAGES		AVG. YEARLY WAGES	
	1987	1988	1987	1988
Private Sector:				
Agriculture-Mining	604.145	578,612	227.81	247.27
Construction	1,648,084	1,602,209	326.74	317.65
Manufacturing	4,839,621	6,920,630	285.49	303.16
Transportation	227,375	196,119	273.29	314.29
Trade	4,262,342	4,178,028	200.41	202.90
Finance	1,128,837	1,092,832	281.93	296.00
Service	1,939,118	2,029,847	155.38	170.47
Subtotal	14,649,522	16,598,277	230.91	246.86
Government:				
Federal	1,003.147	993,206	401.90	397.91
State	300,246	275,665	320.77	353.41
Local	4,253,360	4,622,001	258.02	282.17
Subtotal	5,556,753	5,890,872	279.01	299.70
TOTAL	20,206,275	22,489,149	242.41	258.92

SOURCE: IOWA DEPARTMENT OF JOB SERVICE, Job Insurance by Major Industry Group, 1987 and 1988

Labor Force

Average annual employment within Worth County decreased from 4,250 in 1984 to 4,060 in 1986, followed in turn by a significant increase in 1987 and then again in 1988. As noted in the table below, the labor force dropped to a low of 4,410 in 1986 and then increased to 4,880 by 1988. Unemployment increased from 6.5 percent in 1984 to 9.0 in 1985, but has been decreasing steadily ever since.

TABLE 1-6: LABOR FORCE, ANNUAL AVERAGE, WORTH COUNTY, 1984-1988

	1984	1985	1986	1987	1988
Resident Civilian Labor Force	4550	4450	4410	4650	4880
Resident Unemployed	290	400	350	240	220
Percent Unemployed	6.5	9.0	7.9	5.2	4.5
Resident Total Employment	4250	4040	4060	4410	4660

SOURCE: JOB SERVICE OF IOWA, CPS Labor Force Summary 1984-1988

There is a relationship between economic variables that support the likelihood for the existence of another variable. In this situation, the demand for air travel is often measured by the number of people employed by industry for the county or region. In the past, there has been a consistent correlation between the type of employment and to the demand for air travel. Travel tendency, as measured by employment within Worth County was summarized in Table 1.7.

TABLE 1-7: EMPLOYMENT, WORTH COUNTY, 1984 - 1988

	1984	1985	1986	1987	1988
High Travel					
Manufacturing	190	190	190	330	430
Service & Mining	390	400	390	390	380
Public Admin.	360	360	360	390	390
Subtotal	940	950	940	1110	1200
Medium Travel					
Construction	80	90	90	100	90
Finance, Insurance, & Real Estate	120	80	80	80	70
Wholesale Trade	170	150	130	140	150
Retail Trade	270	260	250	270	260
Subtotal	640	580	550	590	570
Low Travel					
Transportation, Communication, & Public Utilites	80	80	60	60	50
Subtotal	80	80	60	60	50
TOTAL	1660	1610	1550	1760	1820

SOURCE: JOB SERVICE OF IOWA, CPS Labor Force Summary 1984-1988

A research organization, the ENO Foundation, classified travel tendency by three categories.

High Travel - Business and professional services, government, manufacturing, and mining

Medium Travel - Construction, finance, insurance and real estate, and wholesale and retail trade

Low Travel - Agriculture, communications, and utilties

The number of persons employed in the high travel industries remained fairly stable from 1984 - 1986, followed in turn by an increase in 1987 and again in 1988. Employment in the medium travel industries decreased from 640 in 1984 to 580 in 1985 and has remained fairly stable ever since, while employment within low travel industries has remained stable throughout the years.

By place of work, 86.0 percent of Worth County residents were employed within the county. Cerro Gordo County residents accounted for 6.1 percent of the labor force, followed in turn by Mitchell County with 3.8 percent. Reference may be made to Table 1-8 concerning place of residence of the Worth County work force.

TABLE 1-8: PLACE OF WORK BY PLACE OF RESIDENCE, AIRPORT SERVICE AREA, 1980 (Work in Worth County and Live in the following Counties)

County / State	No. Employed	Percent
Cerro Gordo / IA	147	6.1
Floyd / IA	3	0.1
Franklin / IA	8	0.3
Hancock / IA	4	0.2
Mitchell / IA	92	3.8
Winnebago / IA	40	1.7
Winneshiek / IA	14	0.6
Worth / IA	2064	86.0
Freeborn / MN	16	0.7
Kandiyoni / MN	12	0.5
TOTAL	2400	100.0

SOURCE: 1980 CENSUS, BLS Special Tabulation

As noted in the above table, a majority of those persons employed within Worth County also lived within the County. Approximately 14 percent of the work force resided outside the County.

Table 1-9 summarizes the place of work by Worth County residents. A number of the residents were employed in Cerro Gordo (23.3%) and Winnebago (8.1%) Counties.

Table 1-9: PLACE OF RESIDENCE BY PLACE OF WORK, AIRPORT SERVICE AREA, 1980 (Live in Worth County and Work in the following Counties)

COUNTY / STATE	NO. EMPLOYED	PERCENT
Broward / FL	5	0.1
Black Hawk / IA	9	0.2
Butler / IA	24	0.6
Calhoun / IA	12	0.3
Cerro Gordo / IA	880	23.3
Floyd / IA	9	0.2
Hancock / IA	31	0.8
Hardin / IA	6	0.2
Howard / IA	3	---
Mitchell / IA	8	0.2
Sac / IA	15	0.4
Scott / IA	4	0.1
Sioux / IA	6	0.2
Winnebago / IA	308	8.1
Worth / IA	2064	54.6
Faribault / MN	6	0.2
Freeborn / MN	226	6.1
Itasca / MN	12	0.3
Not Reported	156	4.1
TOTAL WORKERS	3784	100.0

SOURCE: 1980 CENSUS, BLS Special Tabulation

TAble 1-10 summarizes from the Community Quick Reference sheets prepared by the Iowa Development Commission, major employers within Northwood. The summary was based upon employment reported in 1986.

TABLE 1-10: MAJOR EMPLOYERS, NORTHWOOD

NAME	PRODUCT / SERVICE	NO. EMPLOYED
Carroll George, Inc.	accoustical products	75
Fieldstone Cabinet Co.	wood cabinetry	100
Northern Engineering	electronic components	6
Thompson Lumber	wood pallets	3
Northwood Co-op Elev.	feed/blended fertilizer	34
Northwood Meats	meat packaging	24

SOURCE: IOWA DEPARTMENT OF ECONOMIC DEVELOPMENT, Community Quick Reference, 1986

Retail Sales

On a comparative basis with other communities in Worth County, Northwood captured 60.6 percent of the 1988 retail sales followed in turn by Manly with 11.7 percent. Grafton and Fertile captured 5.6 and 7.9 percent, respectively. Since 1984 retail sales within the County have decreased 3,087,676 dollars or 11.6 percent. Retail sales within Worth County for the period FY 1984-FY 1988 are noted in Table 1.11.

TABLE 1-11: TAXABLE RETAIL SALES, AIRPORT SERVICE AREA, FY 1984 - FY 1988

COMMUNITY					
Manly	2,225,477	2,111,561	2,251,668	2,275,110	2,268,143
Northwood	13,945,671	12,712,579	12,250,991	12,380,634	11,764,113
Fertile	845,229	879,140	992,499	776,971	953,513
Grafton	1,161,612	1,276,291	1,067,323	1,081,660	1,081,173
Hanlontown	545,274	479,319	527,743	562,653	562,653
Joice	497,726	298,692	497,384	---	---
Kensett	964,171	766,288	674,857	792,600	585,899
Non-Permit	11,767	2,134	7,436	5,749	83,172
Other	2,254,737	1,986,024	9,047,703	6,279,025	2,094,322
TOTAL	22,480,664	20,512,028	27,317,604	24,106,214	19,392,988

SOURCE: DEPARTMENT OF REVENUE & FINANCE, Iowa Retail Sales & Use Tax Report, FY 1984 - FY 1988

As could be expected, Cerro Gordo County captured the largest percentage of retail sales within north central Iowa. As noted in Table 1-12, Cerro Gordo experienced a continued increase while the remaining five counties showed small annual decrease and/or increases. Mason City and Clear Lake are the dominant retail center in north central Iowa and could be expected to increase their share of the area total sales.

TABLE 1-12: TAXABLE RETAIL SALES BY COUNTY, FY 1984 - FY 1988

COUNTY					
Worth	22,480,664	20,512,028	27,317,604	24,106,214	19,392,988
Winnebago	50,595,869	49,020,084	47,665,061	50,193,204	49,377,078
Hancock	51,750,356	48,701,634	46,921,661	48,961,905	48,299,808
Mitchell	42,582,062	40,365,308	38,686,722	42,885,298	42,933,034
Cerro Gordo	285,587,453	295,742,521	302,823,539	325,798,253	333,730,273
Floyd	75,558,146	73,572,552	68,928,103	64,344,302	73,183,192
TOTAL	528,554,550	527,914,126	532,342,690	556,289,176	566,916,373

SOURCE: DEPARTMENT OF REVENUE & FINANCE, Iowa Retail Sales & Use Tax Report, FY 1984 - 1988

CITY OF NORTHWOOD

Comprehensive Plan

A Comprehensive Plan was prepared for the City of Northwood by the North Iowa Area Council of Governments in 1982. The report addressed existing conditions as well as future development. The plan did address the Northwood Municipal Airport as well as other modes of transportation.

The relationship of existing land use patterns to the existing airport site are depicted in Figure 1-3. Except to the south and southwest, the existing airport site is surrounded for the most part by agricultural land. Future growth directions identified in the plan are summarized as follows:

Four growth corridors can be defined at this time. The first corridor is industrial and commercial growth in the eastern portion of the city, particularly along the railroad (industry only) and Highway 105. The second area of growth is residential development in the north central part of the community. The third area is commercial growth along U.S. Highway 65 in the north part of town and residential growth to the west of the highway. The final growth corridor is commercial and residential in nature and is located along U.S. Highway 65 near the southern edge of town. These areas will most likely see the bulk of Northwood's future growth.

Objectives:

Implement planning goals through local control by responsible use of effective zoning districts and ordinances.

Encourage the development of lands already within developed areas to minimize the financial and environmental burden to the community.

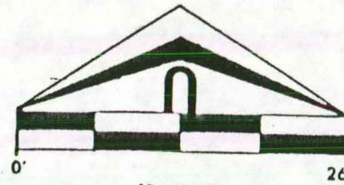
Encourage "buffer zones" between conflicting land uses.

Provide needed public improvements through the utilization of an effective capital improvements program. Improvements in public facilities should coincide with those areas specfified in the future Land Use Plan.

SOURCE: 1982 COMP. PLAN

Given existing and recommended land use patterns, there would appear some merit to the development of an all-industrial park in the immediate vicinity of the existing airport site should the existing site be able to accomodate facility needs.

NORTHWOOD



Existing Land Use

- Single Family Residential
- Multi-Family Residential
- Public/Semi-Public
- Commercial
- Industrial
- Vacant/Agricultural
- Flood Plain

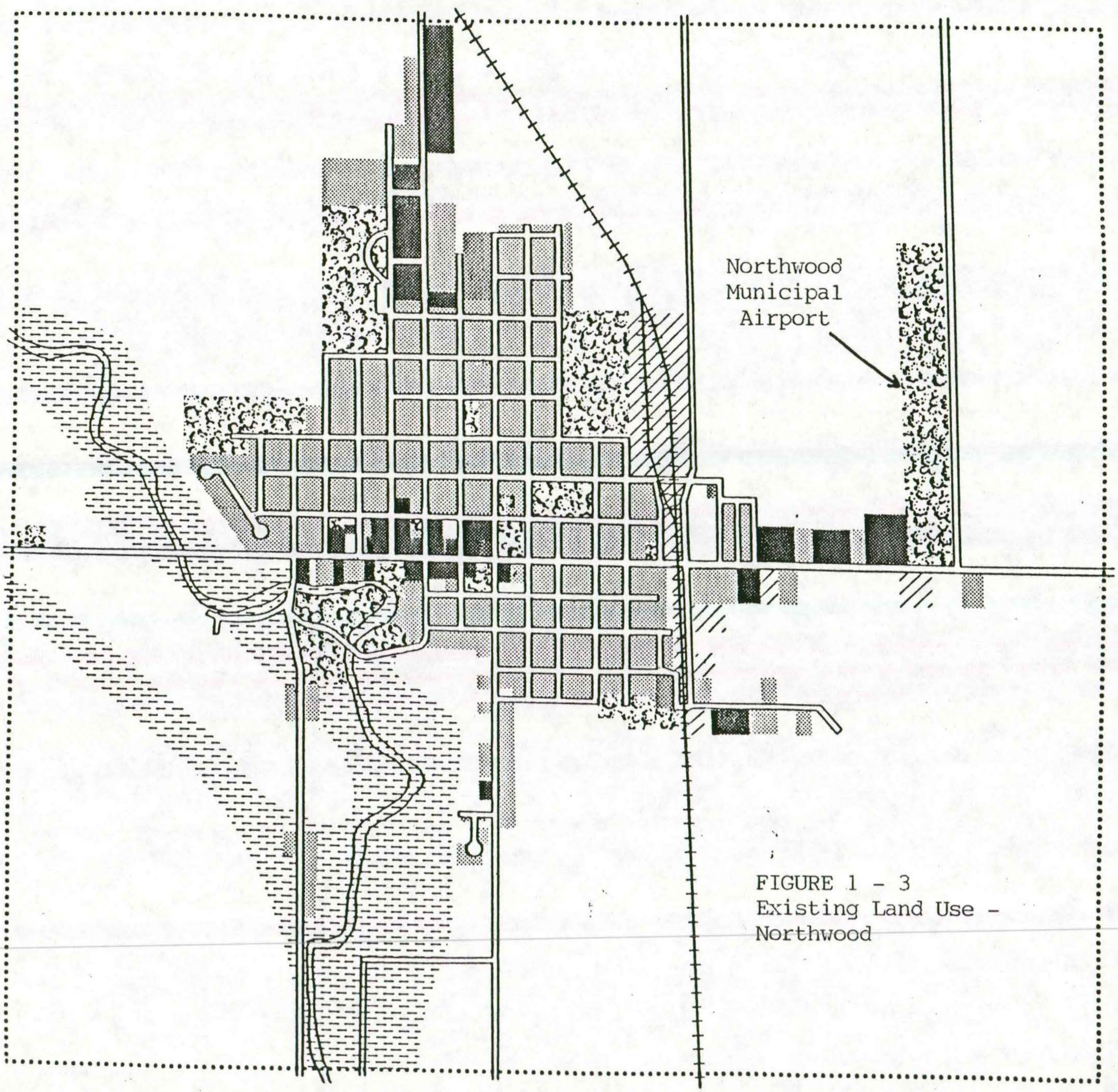


FIGURE 1 - 3
Existing Land Use - Northwood

Industrial Sites

Four (4) industrial sites are available for development in Northwood. All four sites are located on Highway 105 East. Two sites are owned by the private sector; one has approximately 25 acres and the other has approximately 40 acres for development.

The remaining two sites are owned by Northwood Development Corporations. The Watertower Site contains approximately 2.2 acres and the Great Plains Property contains approximately 10 acres. These sites are served by the following utilities.

TABLE 1-13: NORTHWOOD INDUSTRIAL SITES

	WATERTOWER SITE	GREAT PLAINS PROPERTY
Electricity	8,000/13,000 volts	8,000/13,000 volts
Water	12" main, 50 psi static; 48 psi residual; 2,200 gpm	10" main; 49 psi static; 48 psi residual; 1,810 gpm
Gas	2" line; 60 psi	2" line; 60 psi
Sewer	8" main	8" main

SOURCE: IOWA DEVELOPMENT COMMISSION, Community Quick Reference, 1986

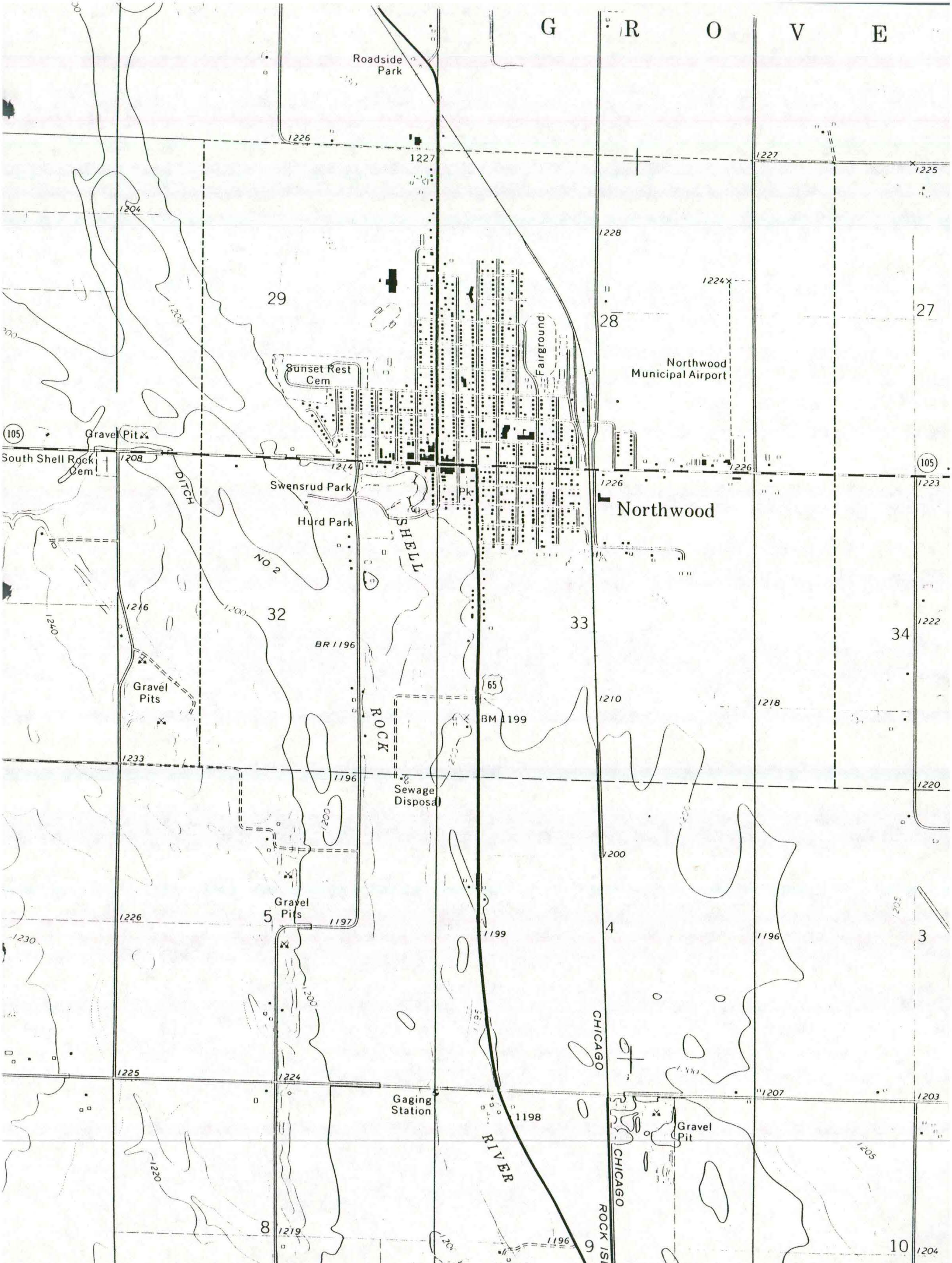
Physical Features

The landscape of the Northwood Airport Service Area consists of gently rolling topography. The majority of the City of Northwood lies at an elevation of 1,220 feet above sea level. The established airport elevation representing the highest point on the runway surface is 1,224 feet above sea level.

Primary drainage for the airport is provided by tributaries of the Shell Rock River.

Prevailing winds are from the north/northwest and south. Since wind data is not available for Northwood, wind data from Mason City is used to determine wind coverage provided by the existing runway facilities.

Temperature, elevation, wind speed, and wind direction are used within Chapter Three to determine present service levels and future facility needs. Temperature and elevation are variables used in determining runway length, while wind speed and direction are used to define wind coverage provided by the existing runway facilities.



G R O V E
Roadside Park
1226
1227
1227
1225
1204
1228
1224
29
1200
28
27
Fairground
Sunset Rest Cem
Northwood Municipal Airport
105
Gravel Pit
South Shell Rock Cem
1208
1214
DITCH
1226
1226
105
1223
Swensrud Park
Pk
Northwood
Hurd Park
SHELL
NO 2
1216
1240
1200
32
33
34
1222
BR 1196
Gravel Pits
65
1210
1218
ROCK
BM 1199
1233
1196
Sewage Disposal
1220
1200
1200
Gravel Pits
5
1197
1226
1230
1199
4
1196
3
CHICAGO
1225
1224
Gaging Station
1198
1207
1203
Gravel Pit
RIVER
CHICAGO
1220
1205
ROCK ISLA
8
1219
1196
9
10
1204

Transportation

Transportation plays a vital role in the growth of Northwood. The community is served by air, highway, and rail. Rail service is provided by Chicago and Northwestern. The railroad provides a daily switching service.

The City is served by U.S. Highway 65 which is a north-south highway and Iowa Highway 105 which is an east-west highway. Interstate 35 is approximately seven (7) miles west of Northwood. There are seven (7) motor freight carriers that serve Northwood. The length of time goods are in transit to or from Metropolitan areas are as follows:

Atlanta	980 miles	3 days	Los Angeles	1,900 miles	3 days
Chicago	350 miles	1 day	Milwaukee	290 miles	1 day
Cleveland	690 miles	2 days	Minneapolis	110 miles	1 day
Denver	800 miles	2 days	New Orleans	1,120 miles	2 days
Des Moines	120 miles	1 day	New York	1,150 miles	3 days
Detroit	715 miles	2 days	Omaha	250 miles	1 day
Houston	1,050 miles	2 days	St. Louis	440 miles	1 day
Kansas City	330 miles	1 day			

Summary

The economic structure of the airport service area will have an impact upon future aviation activity at the Northwood Municipal Airport. Services provided by the government to residents of Worth County together with retail, wholesale, professional, and personal services provided by the private sector represent a major component of the economy. Agriculture, along with manufacturing activities represent the more basic components of the ecomomy.

NORTHWOOD MUNICIPAL AIRPORT

Existing Development

The Northwood Municipal Airport is located within the Corporate boundary of the city. Access to the airport is provided via State Highway 105. The site consists of 28+1-acres and lies at an elevation of 1224 feet above sea level. The airport latitude is 43° 27' 05" north. The longitude is 93° 11' 25" west. Reference may be made to Figure 1-5.

The primary runway, RW 17/35, is 2685 feet in length and 100 feet in width. The clear zones associated with each runway approach coincides with the runway threshold since the runway is not hard surfaced. The turf runway is in good condition and well drained. Runway threshold markers are in place. Runway edge lights are currently (9/89) being installed.

A visual approach is maintained to each runway end. FAA Form 5010 (6/7/88) noted the presence of obstructions of each runway end. These are noted in the following table.

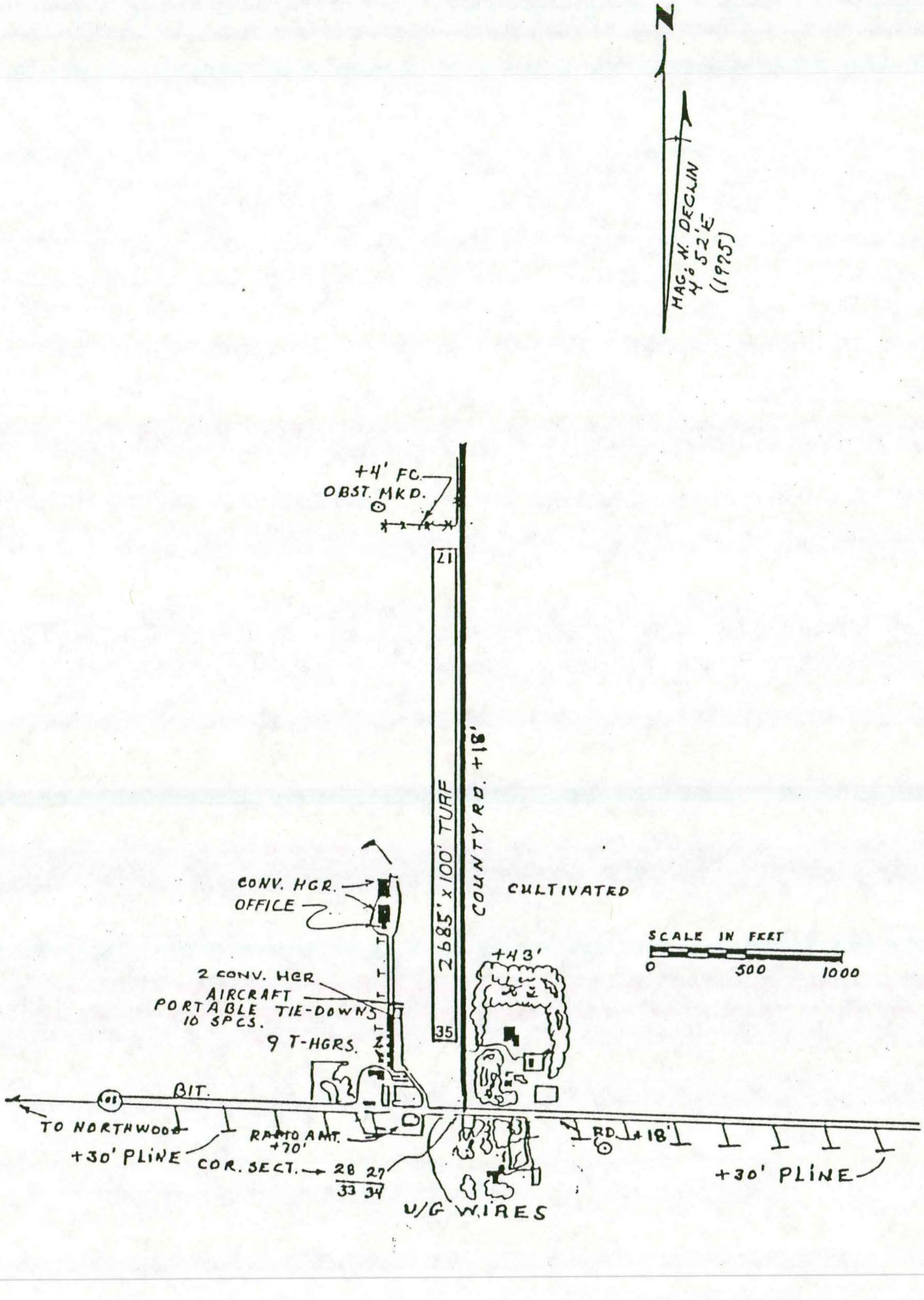
TABLE 1-14: OBSTRUCTIONS

	Runways	
	17	35
Obstruction	Fence	Road (Hwy. 105)
Height above runway end	4 feet	18 feet
Distance from runway end	625 feet	360 feet
Obstruction slope	Soil	Soil

SOURCE: FAA Form 5010, 6/7/88

There are a number of physical constraints related to the existing airport site. These are noted as follows:

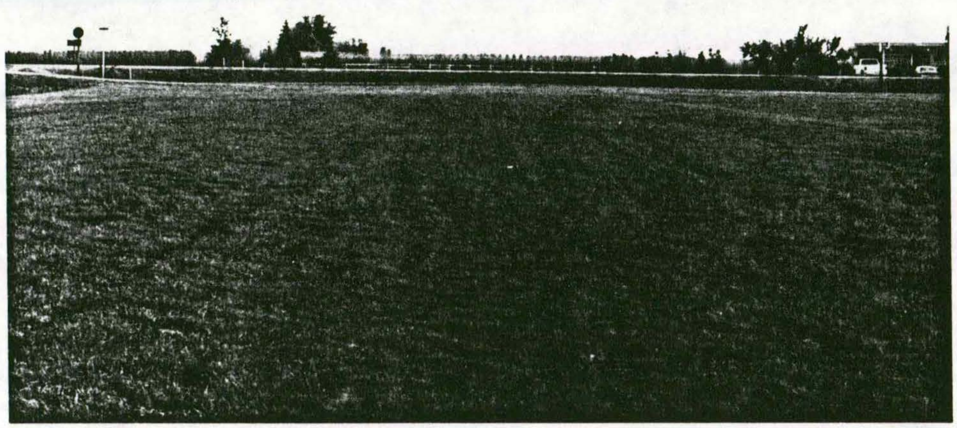
1. State Highway 105 (extends in an east/west direction 360 feet south of RW 35.
2. Hard surfaced County road approximately 100 feet east of the runway (extends in a north/south direction parallel to the runway centerline).


N
MAG. N. DECLIN 4° 52'E (1975)
+4' FC.
OBST. MKD.
17
35
2685' x 100' TURF
COUNTY RD. +18'
CULTIVATED
CONV. HGR.
OFFICE
SCALE IN FEET
0
500
1000
+43'
2 CONV. HGR
AIRCRAFT
PORTABLE TIE-DOWNS
10 SPCS.
9 T-HGRS.
BIT.
TO NORTHWOOD
RADIO ANT. +70'
+30' PLINE
COR. SECT.
28 27
33 34
RD. +18'
+30' PLINE
U/G WIRES

3. Existing terminal area

5. Towers and grain elevator in the immediate vicinity to the airport.

Threshold - Runway 17 from north / south county road



State Highway 105 from threshold of RW 35

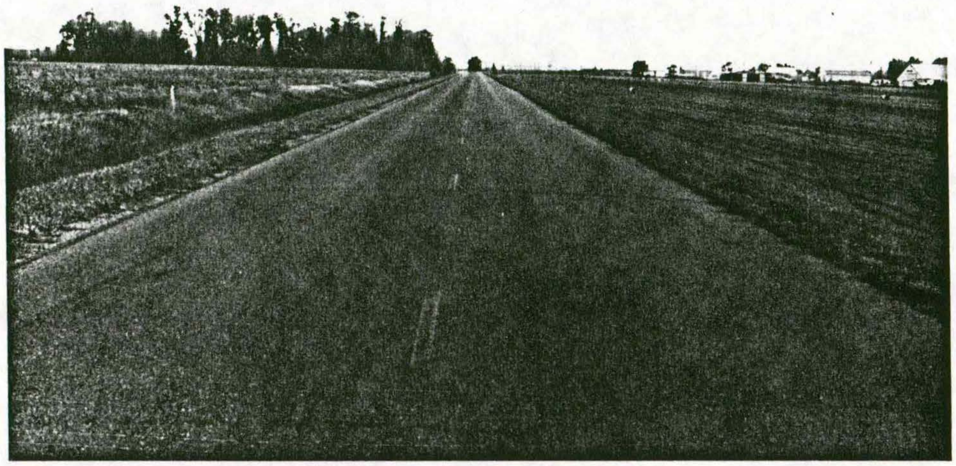
The level of service may be improved with the addition of the following:

1. Crosswind runway
2. Hard surfacing of the primary runway
3. Installation of runway end identifier lights and a visual approach slope indicator together with threshold and edge lights on the primary runway.
4. Non-directional radio beacon
5. Rotating beacon light
6. Segmented circle and light wind tee

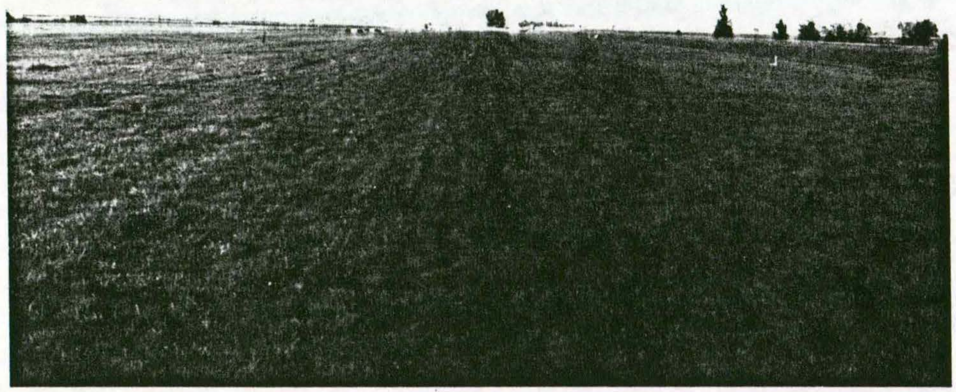
Chapters Three and Four of this study will address the above concerns. Chapter Four will address the benefits extended from the improvements as well as the cost of making such improvements. Due to the physical constraints of the site, an alternatiave site or additional land beyond present airport land will need to be acquired. Consideration must be given to the present investment in the airport and the cost associated with hangar relocation/construction should a new airport site be selected as the only viable alternative to improving the level of service.

The benefit and cost consideration will be viewed in relationship to the cost of maintaining the present level of service and using an alternative airport.

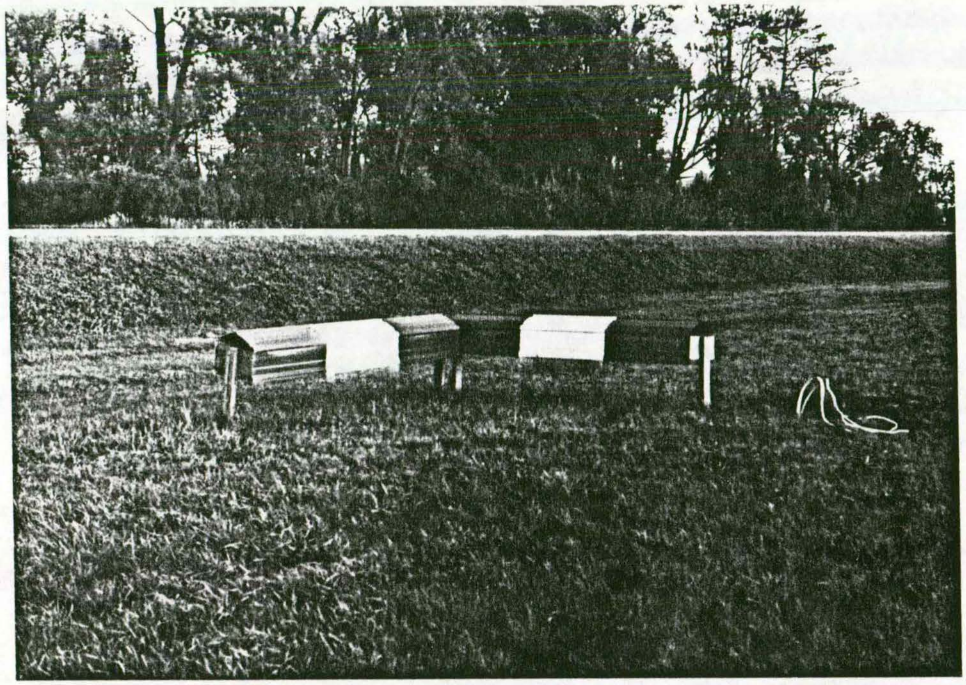
The present terminal area supports two conventional hangars, terminal office and ten individual tee hangars. An improved tiedown area is maintained between the tee hangars and conventional hangar area.



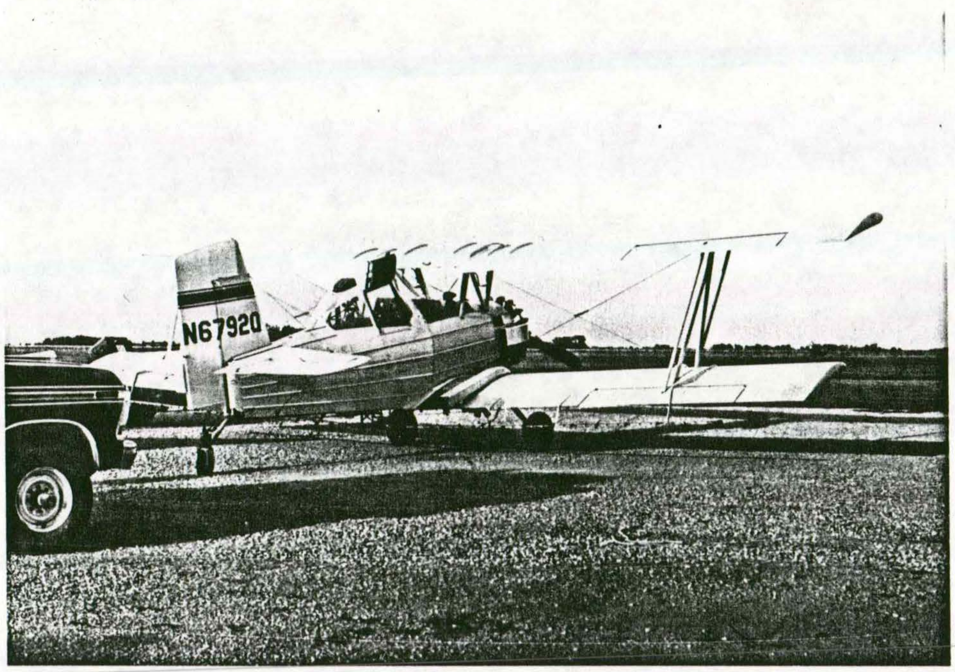
North / South County Road



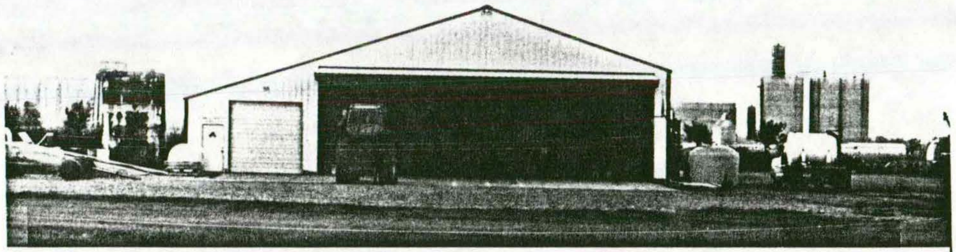
RW 17 / 35

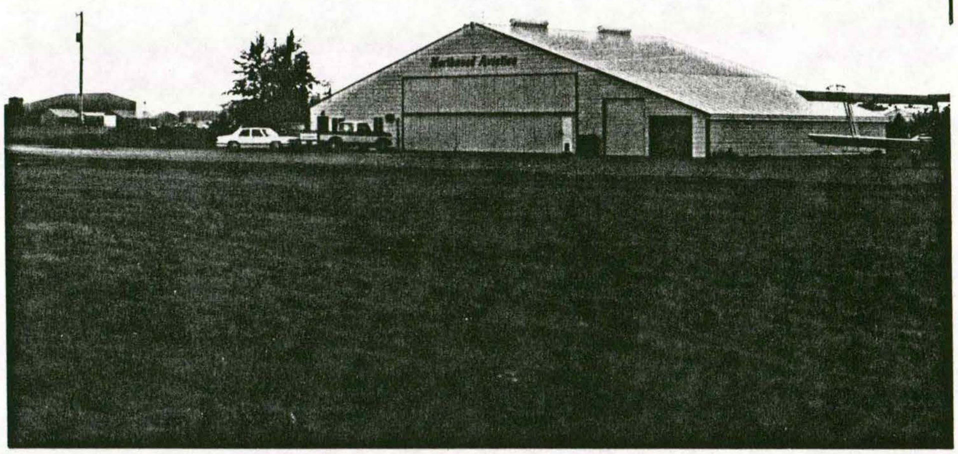


Typical Runway Marker

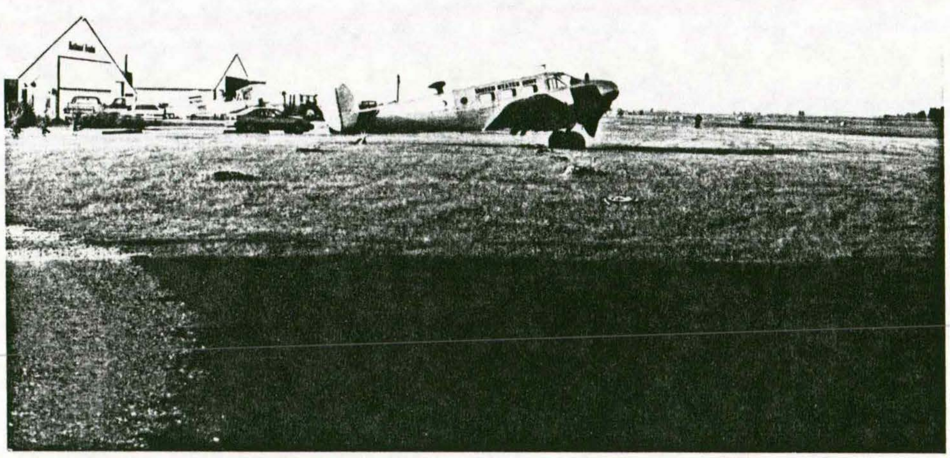


Airport Usage / Apron



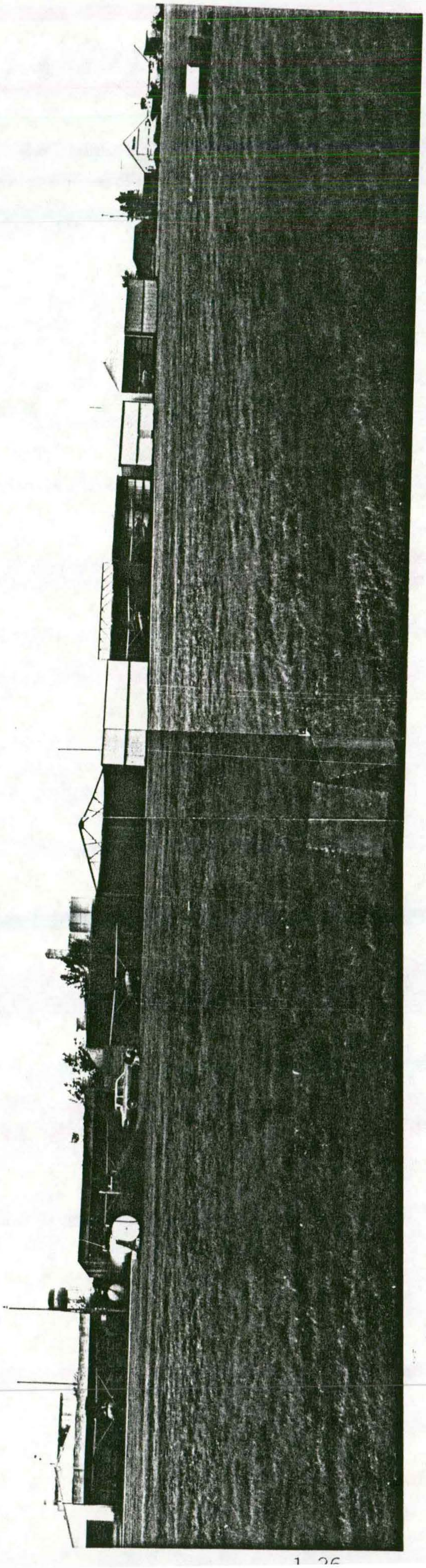


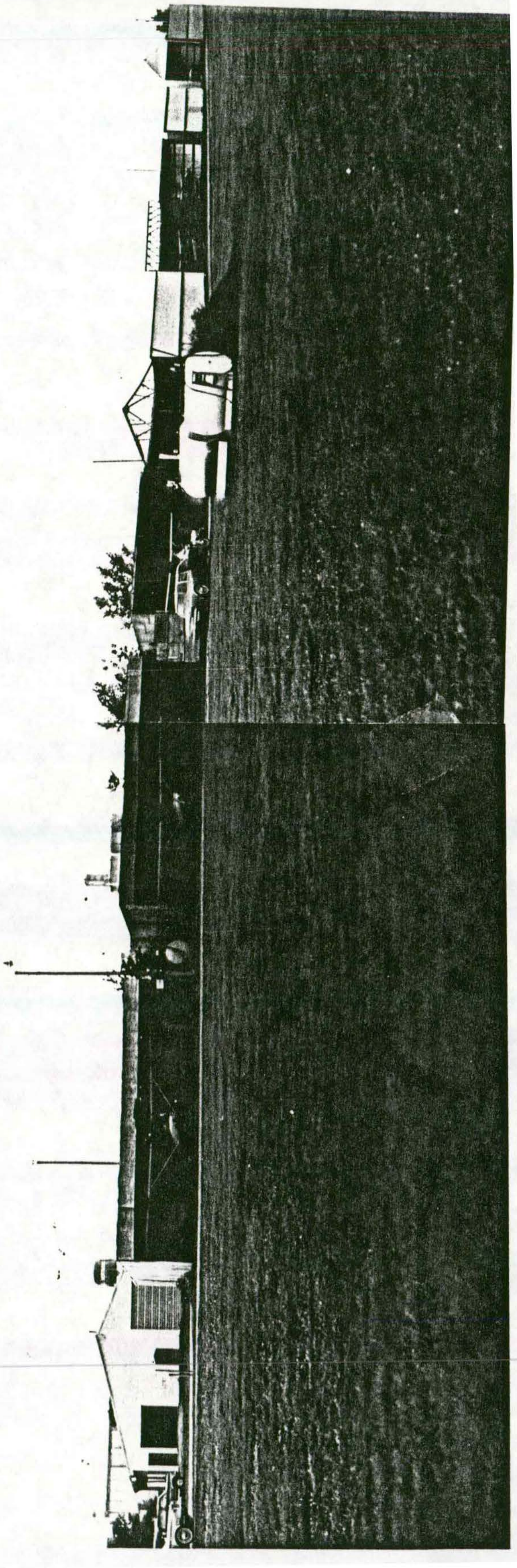
Convention Hangar Facilities



Airplane Tie downs

Tee Hangar Facilities





Airport Sufficiency Rating

The Iowa Department of Transportataion annually rates each airport in the state system. A numerical rating for each airport is obtained by comparing structural, safety, and service features to specified design criteria. A rating below 50 percent of maxium indicates that the item is below tolerable standards and should be considered for improvement.

TABLE 1-15: NORTHWOOD MUNICIPAL AIRPORT SUFFICIENCY RATING, 1988

	MAXIMUM POSSIBLE RATING	ACTUAL SUFFICIENCY RATING
STRUCTURAL RATING		
Runway		
Wearing Surface	8.0	7.0
Base / Subbase	10.0	7.5
Drainage	6.0	3.8
Taxiways / Aprons	6.0	4.0
TOTAL STRUCTURAL RATING	30.0	22.3
SAFETY		
Runway		
Length	5.0	4.6
Width	4.0	4.0
Surface Condition	9.0	7.0
Primary Surface Geometrics	11.0	8.0
Approach Obstructions	7.0	7.0
Turnarounds / Taxiways	4.0	4.0
TOTAL SAFETY RATING	40.0	34.6
SERVICE		
Runway		
Length	8.0	7.4
Lighting	5.0	4.0
Capacity	4.0	4.0
Airfield Lighting	5.0	1.0
Aprons - Terminal / Parking	4.0	4.0
Land Area	4.0	0.0
TOTAL SERVICE RATING	30.0	20.4
TOTAL BASIC RATING	100.0	77.3
TOLERABILITY ADJUSTED RATING	100.0	71.6
SYSTEM LEVEL ADJUSTED RATING	100.0	72.5

SOURCE: IDOT, 1988

AIRPORT SYSTEMS

State System of Airports

The 1985 Iowa Aviation System Plan includes all 112 public owned airports in Iowa. These airports provide access to the national system of airports by scheduled commercial carriers, air taxi, and general aviation aircraft. Of the 112 airports, eleven are classified as commercial airlines. The remaining 101 airports are served by air taxi and accommodate general aviation aircraft ranging in size from single engine aircraft to jet aircraft.

The state system of airports consists of five service classifications which are defined as follows:

General Aviation III:	Provides access to Iowa communities supporting low activity levels.
General Aviation II:	Provides access to Iowa's market and population centers requiring service by limited numbers of business jets and single engine or light twin engine aircraft.
General Aviation I:	Provides access to Iowa's market and population centers requiring significant service by business jets and twin engine piston or turbo aircraft.
Commercial Service II:	Provides scheduled passenger service by commuter aircraft.
Commercial Service I:	Provides scheduled passenger service by transport aircraft and qualifies for Federal primary airport improvement funding.

Each of the 112 airports within the system were placed in a service classification. The 1985 Iowa Aviation System Plan also developed design standards for each of the service classifications. In other words, for the airport to provide a given level of service, the airport must support facility development that will accommodate the level of aviation activity defined by the service classification.

The state system airports are listed by service and design classification in Table 1-16.

TABLE 1-16: IOWA AIRPORT SERVICE AND DESIGN CLASSIFICATION

Type Service	Commercial Service		General Aviation Airports				
Service Classification	Commercial Service I	Commercial Service II	General Aviation I	General Aviation II		General Aviation III	
Design Classification	General Transport	Basic Transport	Basic Transport	General Utility	Basic Utility-II	Basic Utility-I Paved	Basic Utility-I Turf
	Cedar Rapids	Burlington	Algona	Atlantic	Albia	Corning	Akron
	Des Moines	Clinton	Ames	Boone	Audubon	Cresco	Allison
	Sioux City	Dubuque	Carroll	Chariton	Bloomfield	Milford	Anita
	Waterloo	Fort Dodge	Council Bluffs	→ Charles City	Centerville	New Hampton	Bedford
		→ Mason City	Creston	Cherokee	Clarion	Onawa	Belmond
		Ottumwa	Davenport	Clarinda	Eagle Grove	→ Osage	Eldora
		Spencer	Denison	Decorah	Emmetsburg	Rockwell City	Grundy Center
			Forest City	Estherville	Greenfield	Sibley	Guthrie Center
			Iowa City	Fairfield	Humboldt	Waukon	Hartley
			Keokuk	Fort Madison	Ida Grove		Hawarden
			Marshalltown	Grinnell	Iowa Falls		Keosauqua
			Muscatine	Hampton	Manchester		→ Lake Mills
			Newton	Harlan	Mapleton		Lamoni
				Independence	Maquoketa		Manning
				Jefferson	Oelwein		Monona
				Knoxville	Osceola		Mount Ayr
				Le Mars	Pella		→ Northwood
				Monticello	Rock Rapids		Paullina
				Mount Pleasant	Sac City		Primghar
				Orange City	Sioux Center		Sully
				Oskaloosa	Tipton		Toledo
				Perry	Vinton		Traer
				Pocahontas	Washington		Wall Lake
				Red Oak	Waverly		Woodbine
				Sheldon	West Union		
				Shenandoah	Winterset		
				Spirit Lake			
				Storm Lake			
				Webster City			

The Northwood Municipal Airport was identified as a General Aviation III airport in terms of service classification. The General Aviation III category airport is one that provides access to communities supporting low activity levels. Based upon the service level to be provided each airport was placed in a design class. Lake Mills and Osage were also classified as General Aviation category airports. Charles City was classified as a General Aviation II Airport while Mason City was classified as a Commercial Service II category airport.

Table 1-17 summarizes minimum development standards by service classification. Development standards/guides for the Northwood Municipal suggest that an adequate level of service would be provided by a turf primary runway facility 2720 feet in length and 120 feet in width. A crosswind runway would not be considered a high priority.

TABLE 1-17: IOWA AIRPORT DESIGN GUIDES

Type Service	Commercial Service		General Aviation Airports				
Service Classification	Commercial Service I	Commercial Service II	General Aviation I	General Aviation II		General Aviation III	
Design Classification	General Transport	Basic Transport	Basic Transport	General Utility	Basic Utility-II	Basic Utility-I Paved	Basic Utility-I Turf
Primary Runway							
Length	*Critical Aircraft	5,000	5,000	4,000	3,400	3,400	2,720
Width	150	100	100	75	60	60	120
Surface	Hard	Hard	Hard	Hard	Hard	Hard	Turf
Taxiway	Full Parallel	Full Parallel	Partial Parallel	Turnaround	Turnaround	Turnaround	None
Secondary Runway							
Length	Same as Primary	4,000	4,000	3,400	2,720	2,720	None
Width	150	75	75	150	120	120	—
Surface	Hard	Hard	Hard	Turf	Turf	Turf	—
Taxiway	Full Parallel	Turnaround	Turnaround	None	None	None	—
Primary Runway Lights							
Edge-Intensity	HIRL	MIRL	MIRL	MIRL	MIRL	MIRL	LIRL
End Identifier	Yes	Yes	Yes	Yes	Varies	Varies	No
VASI	Yes	Yes	Yes	Yes	Varies	Varies	No
Approach	Yes	Yes	Varies	No	No	No	No
Navaids							
Beacon	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Seg. Circle	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lighted Wind Indicator	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NDB	Yes	Yes	Yes	Yes	Yes	Yes	—
Land							
Title	420	300	300	170	120	120	80

* Critical Aircraft: Aircraft which requires the greatest runway development.

SOURCE: 1985 IOWA AVIATION SYSTEM PLAN

Should aviation activity suggest that the Northwood Airport provide a different level of service than that suggested in the 1985 Iowa Aviation System Plan, a different design classification would also be recommended. Chapter Two will identify present and future levels of aviation activity.

National Plan of Integrated Airports

The Federal airport system consists of those airports; public, civil, and joint use (military/civil) within the U.S. and its territories considered necessary to provide a system of airports adequate to anticipate and meet the needs of the nation's civil aeronautics. Criteria for inclusion in the NPIAS is as follows:

> "An airport that was included in the predecessory to the current Plan should remain in the Plan if it is subject to a current compliance obligation resulting from a FAAP or ADAP grant."
>
> "An existing airport that is included in an accepted SASP or RASP may be included in the Plan if it has at least 10 based aircraft and services a community located 30 minutes or more average ground travel time from the nearest existing or proposed Plan airport. Proposed airports to serve such communities will be included if there is clear evidence that at least 10 aircraft will be based at the airport within the first year of its operation."

The Federal Aviation Administration (FAA), recognizing the need to reduce overall airport development costs, developed the airplane design group concept linking airport requirements to using aircraft. Consequently, Change 6 to FAA AC 150-3500-4B presented new dimensional criteria by airplane design groups based upon aircraft approach speed and wingspan.

Basic Utility - Stage I	Serves small engine aircraft generally under 3,500 pounds gross weight with approach speeds below 91 knots, and wingspans less than 49 feet. Typically these aircraft are used for personal, training, or agricultural flying. Precision instrument approach operations are not anticipated. (Approach Category A) (Design Group I)

Basic Utility - Stage II	Serves small single engine and light twin engine aircraft generally under 6,000 pounds with approach speeds below 121 knots, and wingspans less than 49 feet. Typically, these aircraft are used for personal, some business, and some charter flying. Precision instrument approach operations are not usually anticipated. (Approach Categories A and B) (Design Group I)
General Utility - Stage I	Serves single and twin engine aircraft under 12,500 pounds requiring greater runway lengths than provided at Basic Utility airports. Approach speeds are less than 121 knots and wingspans are less than 49 feet. These aircraft are typically used for business and charter flying. Precision instrument approach operations are not usually anticipated. (Approach Categories A and B) (Design Group I)
General Utility - Stage II	Serves large aircraft up to 60,000 pounds with approach speeds of less than 121 knots and wingspans of less than 79 feet, as well as large aircraft with approach speeds of less than 91 knots and wingspans of less than 118 feet. These aircraft range from typical corporate aircraft (including jets) to commuter airline aircraft. This airport class is capable of handling precision instrument approach operations. (Approach Categories A and B) (Design Groups I, II, and III) The GU II airport is primarily designed to accommodate airplane Design Groups I and II.

Transport	Serves virtually all aircraft including jet airliners. It serves large (up to 60,000 pounds) and heavy (up to 300,000 pounds) aircraft. This airport class is capable of handling precision instrument approach operations. (Approach Categories C, D, and E)

Airports recording substantial use (500 annual itinerant operations) by aircraft with an approach speed of 121 knots or more should be designed to standards set forth in FAA AC 150/5300-12, Airport Design Standards-Transport Airports. Transport category airports are further subdivided by aircraft size and weight. Turbojet airplanes - 60,000 pounds or less maximum certified take off weight:

A. 75% Fleet at 60% useful load
B. 75% Fleet at 90% useful load

For reference, selected aircraft listed in Appendix II of FAA AC 150/5300-4B, Chg. 6 are noted by approach speed and design group.

TABLE 1-18: FAA DESIGN STANDARDS

ITEM	DIM 1/	NONPRECISION & VISUAL RUNWAY — AIRPLANE DESIGN GROUP			PRECISION INSTRUMENT RUNWAY — AIRPLANE DESIGN GROUP			
		I 2/ Wingspan < 49'	I Wingspan < 49'	II Wingspan < 79'	I 2/ Wingspan < 49'	I Wingspan < 49'	II Wingspan < 79'	III Wingspan < 118'
Runway Length	A	- Refer to chapter 4 -						
Width	B	60 ft 18 m	60 ft 18 m	75 ft 23 m	75 ft 23 m	100 ft 30 m	100 ft 30 m	100 ft 30 m
Runway Safety Area 3/ Length Beyond Runway End 4/	2C	240 ft 72 m	240 ft 72 m	300 ft 90 m	600 ft 180 m	600 ft 180 m	600 ft 180 m	600 ft 180 m
Width	C	120 ft 36 m	120 ft 36 m	150 ft 45 m	300 ft 90 m	300 ft 90 m	300 ft 90 m	300 ft 90 m
Taxiway Width	D	25 ft 7.5 m	25 ft 7.5 m	35 ft 10.5 m	25 ft 7.5 m	25 ft 7.5 m	35 ft 10.5 m	50 ft 15 m
Taxiway Safety Area Width		49 ft 15 m	49 ft 15 m	79 ft 24 m	49 ft 15 m	49 ft 15 m	79 ft 24 m	118 ft 36 m
Separation Distance: Runway Centerline to; Parallel Runway Centerline		700 ft 210 m	700 ft 210 m	700 ft 210 m	- Refer to AC 150/5300-12 -			
Parallel Taxiway Centerline 5/	E	150 ft 45 m	225 ft 67.5 m	240 ft 72 m	200 ft 60 m	250 ft 75 m	300 ft 90 m	350 ft 105 m
Building Restriction Line and Aircraft Parking Area 6/	F	125 ft 27.5 m	200 ft 60 m	250 ft 75 m	7/ 7/	7/ 7/	7/ 7/	7/ 7/
Runway Centerline and End to; Object		- Refer to paragraph 16 -						
Property Line	G	- Refer to paragraph 19 -						
Taxiway Centerline to; Parallel Taxiway Centerline		69 ft 21 m	69 ft 21 m	103 ft 31.5 m	69 ft 21 m	69 ft 21 m	103 ft 31.5 m	153 ft 46.5 m
Parked Aircraft and Object	H	- Refer to paragraph 16 -						
Taxilane Centerline to; Parked Aircraft and Object		- Refer to paragraph 16 -						

1/ Letters are keyed to those illustrated in figure 7-2

2/ These dimensional standards are for facilities which are to serve only small airplanes.

3/ This runway safety area standard applies to all runways and runway extensions, that are constructed or upgraded after February 24, 1983. For other runways, the maximum feasible length and width of runway safety area should be provided.

4/ These distances may need to be increased to keep the stopway within the runway safety area.

5/ The location of a parallel taxiway may be adjusted such that no part of an aircraft (tail, wing tip) on taxiway centerline penetrates the obstacle free zone (OFZ).

6/ Objects located outside of the building restriction lines may penetrate the airport imaginary surfaces defined in Subpart C of FAR Part 77 where an FAA aeronautical study has determined that the specific penetration will not result in a hazard to air navigation.

7/ The building restriction line for a Category I ILS runway precludes any part of a building, tree, or parked aircraft from penetrating surfaces originating 300 feet (90 m) from runway centerline and sloping laterally outward 4 (horizontal) to 1 (vertical).

SOURCE: FAA AC 150, 5300-4, chg. 7 (9/23/83)

Area Airport Facilities

Table 1-19 summarizes existing conditions for selected airports that are part of the state aviation system.

TABLE 1-19: Area Airport Facilities: Northwood, Forest City, Osage and Mason City

	Northwood	Forest City	Osage	Mason City	Lake Mills
Ownership	Public	Public	Public	Public	Public
Elevation	1224	1230	1168	1213	1260
Longitude	93-11-25W	93-37-30W	92-48-00N	93-19-52W	93-30-30W
Latitude	43-27-05N	43-14-00N	43-17-00N	43-09-20N	43-25-00N
Acreage	28	250	34	800	----
Runway	17/35	9/27	17/35	12/30	18/36
Length	2685	2700	3400	5502	3395
Width	100	60	50	150	100
Surface	Turf	Asphalt	Concrete	Asphalt	Turf
Gross Weight	----	12.5SW	----	80SW	----
Lighting	----	MIRL	LIRL	MIRL	LIRL
Marking	----	BSC	BSC	NPI	----
VASI/PAPI	----	V2L	----	V4L	----
REIL	----	Yes	----	No	----
Runway	----	15/33	----	17/35	
Length	----	5800	----	6501	
Width	----	100	----	150	
Surface	----	Asphalt	----	Asphalt	
Gross Weight	----	30SW	----	80SW	
Lighting	----	MIRL	----	HIRL	
Marking	----	NPI-P	----	PIR	
Beacon	None	Yes	None	Yes	Yes
NDB	None	None	None	Yes	----
Wind Indicator	Yes	Yes	Yes	Yes	Yes
Based Aircraft	14	23	8	46	3
S.E.	13	17	8	35	3
M.E.	1	3	----	10	----
Jet	----	2	----	1	----
Helicopters	----	1	----	----	----
Military	----	----	----	----	----

SOURCE: FAA FORM 5010

Historic composition of the registered aircraft is presented in the following table. All of the aircraft registered in Worth County within the period 1981 through 1986 were single engine piston powered aircraft.

TABLE 2-10: REGISTERED AIRCRAFT BY TYPE, 1981 - 1986

		PISTON			
		Single Engine		Multi-Engine	
Year	Total	1-3	4-Plus	1-6	7 Plus
1981	18	6	12	---	---
1982	19	6	13	---	---
1983	23	9	14	---	---
1984	21	8	13	---	---
1985	22	9	13	---	---
1986	20	9	11	---	---

SOURCE: FAA, Census of U.S. Civil Aircraft, December 31, 1981-86
FFA Form 5010

The number of aircraft registered in Worth County over the 20 year planning period is expected to experience some annual variation and remain relatively constant with no significant increase nor decrease in aircraft ownership. This assumption is based upon the following:

* Positive economic and population growth within Northwood
* A stabilized rural population in Worth County
* A stronger farm economy within the airport service area
* Aggressive efforts to create new job opportunites

Aircraft ownership is expected to be concentrated in Northwood and will be influenced to some extent by the financial condition and business plan of local operator(s). For example, a decision to relocate a local FBO operation from one airport to another could impact future aircraft registrations within Worth County.

The number of aircraft based at a facility is dependent to some degree upon the geographic location of the facility as well as the extent of facility development and services provided. In assessing the number of aircraft that would be based at a public owned airport, consideration must be given to the relationship such a facility would have to existing private and public airports in the area.

To facilitate understanding of the estimates for specific airport location, reference is made to the 1978 SASP which concludes:

> "The choice of a site for basing an aircraft is not always directly related to the residence of the owner. The choice may be affected by such factors as hangar rental and maintenance fee structure, availability of terminal services, availability of navigational aids, runway length and condition, etc. An aircraft may be based several miles from the owner's place of residence in order to have access to more attractiave features. Current based aircraft figures would indicate that some airports which provide services desired by aircraft owners may attract a larger number of aircraft than are registered in the county, while in other areas the total aircraft based in the county is less than the total registered aircraft in the county."

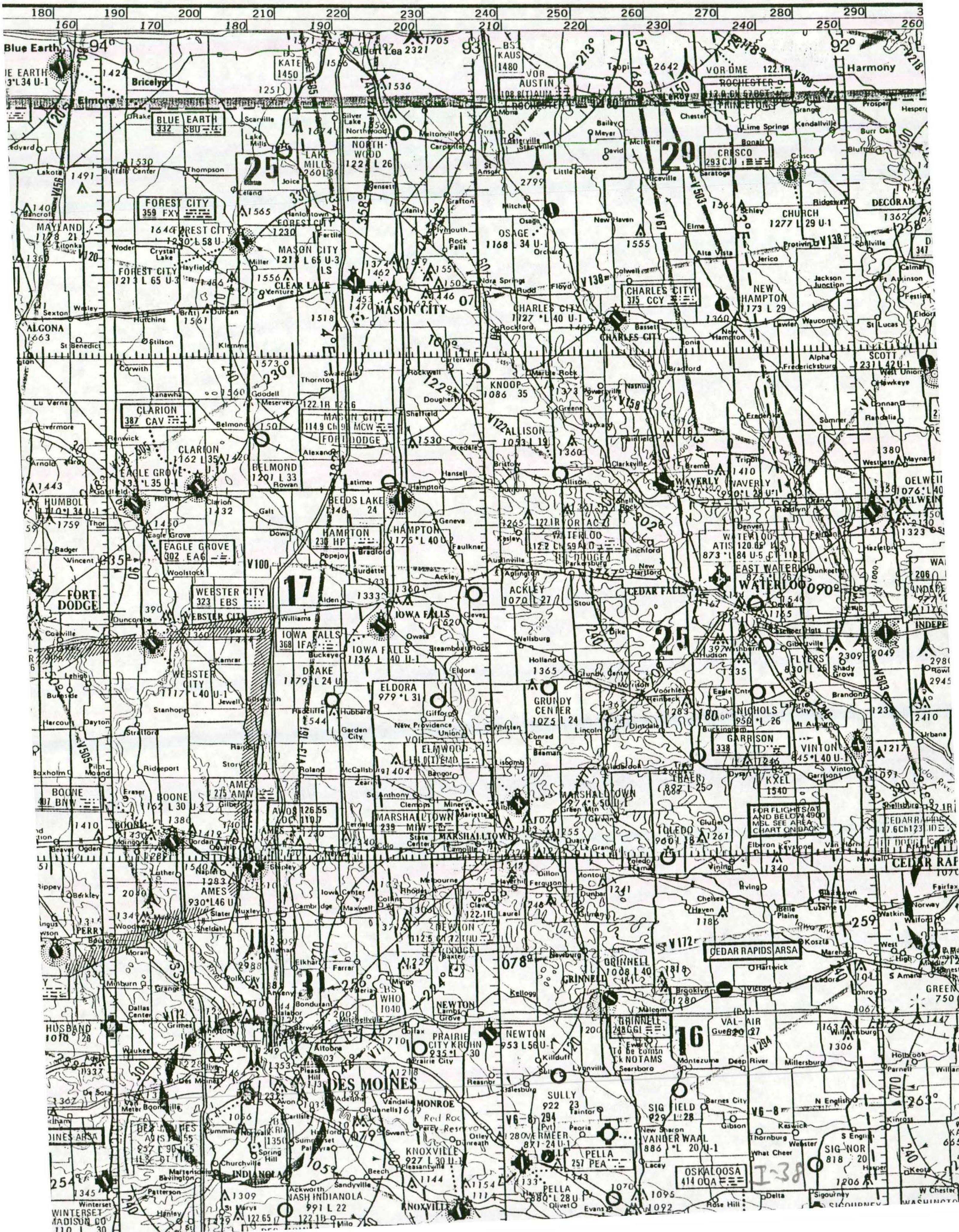
SOURCE: SASP, 1978

The above will explain some of the annual variations of general aviation aircraft registered or based at one airport or another. Those airports which now enjoy numbers of based aircraft owned by persons from outside the community or airport service area, may in the future lose their historical dominance.

> "Ideally, as airport development improves the quality of airports throughout the State, the attractiveness of the airports will become more similar causing the number of aircraft based in a county to more nearly equal the number registered in that county."

SOURCE: SASP, 1978 (p. 39)

With exception of years 1985 and 1986, the number of aircraft based at Northwood as a percent to registered aircraft within Worth County has generally increased. It is expected that in the near term 75 to 80 percent of the aircraft registered in the County would be based at the Northwood Municipal Airport. With improvements the number of based aircraft as a percent of total registered aircraft could be expected to increase and within the 20 year planning period may approach 90 percent.


Blue Earth
BLUE EARTH 332 SBU
Bricelyn
Elmore
Albert Lea
KATE 1450
LAKE MILLS 1260 L 34
NORTHWOOD 1224 L 26
Northwood
Lake Mills
Buffalo Center
Thompson
Lakota
FOREST CITY 359 FXY
FOREST CITY 1230 L 58 U
FOREST CITY 1213 L 65 U-3
MASON CITY 1213 L 65 U-3
MAYLAND 1138 21
Crystal Lake
CLEAR LAKE
MASON CITY
Manly
Plymouth
Rock Falls
Nora Springs
Rudd
Floyd
Osage
OSAGE 1168 L 34 U-1
Orchard
Mitchell
St Ansgar
Stacyville
Little Cedar
Riceville
VOR AUSTIN
VOR DME ROCHESTER
PRINCETON
CRESCO 293 CJU
Cresco
Saratoga
Elma
Alta Vista
CHURCH 1277 L 29 U-1
NEW HAMPTON 1173 L 29
New Hampton
Lawler
Waucoma
CHARLES CITY 375 CCY
CHARLES CITY 1127 L 40 U-1
Charles City
Rockford
DECORAH
Calmar
Ft Atkinson
St Lucas
ALGONA 1663
St Benedict
Wesley
Hutchins
Britt
Stilson
Corwith
Kanawha
Goodell
Meservey
Thornton
Swaledale
Rockwell
Sheffield
Dougherty
KNOOP 1086 35
ALLISON 1053 L 19
Allison
Greene
Marble Rock
Nashua
Bradford
Alpha
Fredericksburg
SCOTT 1231 L 42 U-1
Hawkeye
Luverne
Livermore
CLARION 387 CAV
CLARION 1162 L 35
Belmond
BELMOND 1201 L 33
Rowan
MASON CITY 114.9
FORT DODGE
Alexander
Latimer
Hampton
Hansell
Aredale
Bristow
Clarksville
Plainfield
Waverly
WAVERLY 990 L 28 U-1
Tripoli
Readlyn
Sumner
Fredericka
Westgate
Maynard
Randalia
OELWEIN
EAGLE GROVE 1133 L 35 U-1
Eagle Grove
EAGLE GROVE 302 EAG
Goldfield
HUMBOLDT 1110 L 34 U-1
Clarion
Galt
Dows
BEEDS LAKE 1148 24
HAMPTON 236 HPT
HAMPTON 1175 L 40
Geneva
Faulkner
Bradford
Popejoy
Woolstock
WATERLOO
WATERLOO ATIS
EAST WATERLOO
Denver
Finchford
Dunkerton
Hazleton
FORT DODGE
WEBSTER CITY 323 EBS
Webster City
Duncombe
Coalville
Iowa Falls
IOWA FALLS 368 IFA
IOWA FALLS 1136 L 40 U-1
Alden
Williams
Ackley
ACKLEY 1070 L 27
Aplington
Parkersburg
Stout
CEDAR FALLS
Hudson
Gilbertville
FLYERS 830 L 26
INDEPENDENCE
Eldora
ELDORA 979 L 31
Owasa
Steamboat Rock
Wellsburg
Holland
Grundy Center
GRUNDY CENTER 1075 L 24
Morrison
Reinbeck
Voorhies
Dike
NICHOLS 950 L 26
GARRISON 338
Buckingham
Brandon
Urbana
Vinton
VINTON 845 L 40 U-1
Mt Auburn
Kamrar
WEBSTER CITY 1117 L 40 U-1
Jewell
Stanhope
Harcourt
Dayton
Lehigh
Burnside
Stratford
DRAKE 1179 L 24 U
Buckeye
Radcliffe
Hubbard
Garden City
Gifford
New Providence
Union
Whitten
Conrad
Beaman
Lincoln
Dinsdale
ELMWOOD
Roland
McCallsburg
Zearing
St Anthony
Clemons
Minerva
Marietta
Liscomb
Albion
MARSHALLTOWN
MARSHALLTOWN 239 MIW
Marshalltown
State Center
Gladbrook
Garwin
Green Mtn
Dysart
TRAER 882 L 25
Traer
Garrison
KXEL 1540
Shellsburg
CEDAR RAPIDS
BOONE 407 BNW
BOONE 1162 L 30
Boone
AMES 275 AMW
AWOS 126.55
Gilbert
Story City
Ridgeport
Pilot Mound
Boxholm
Ogden
Beaver
Jordan
Nevada
Colo
Melbourne
Rhodes
Collins
Maxwell
Iowa Center
Cambridge
Slater
Huxley
Sheldahl
AMES 930 L 46 U
Ames
Luther
Madrid
Perry
PERRY
Woodward
Moran
Minburn
Granger
Polk City
Elkhart
Farrar
Baxter
NEWTON 122.1R
Laurel
Van Cleve
Ferguson
Dillon
Dumbar
Gilman
Montour
Toledo
TOLEDO 960 L 18
Tama
Chelsea
Haven
Irving
Luzerne
Belle Plaine
Blairstown
Elberon
Keystone
Van Horne
Newhall
Walford
Norway
Watkins
CEDAR RAPIDS ARSA
Marengo
Koszta
Hartwick
Ladora
Conroy
Brooklyn
Victor
Kellogg
GRINNELL 1008 L 40
GRINNELL 248 GGI
Grinnell
Newburg
Malcom
Montezuma
Deep River
Millersburg
VAL-AIR
Williamsburg
Parnell
Holbrook
HUSBAND 1010 26
Dallas Center
Grimes
Waukee
Ankeny
Bondurant
Mitchellville
Altoona
Berwick
Colfax
PRAIRIE CITY KROHN 935 L
Prairie City
Mingo
WHO 1040
NEWTON
Newton
NEWTON 953 L 56 U-1
Kilduff
Lynnville
Searsboro
DES MOINES
Des Moines
Adel
De Soto
Van Meter
Booneville
Cumming
Carlisle
Avon
Runnells
Monroe
Red Rock Reservoir
Reasnor
Sully
SULLY 922 23
Taintor
Peoria
Otley
Dunreath
SIGFIELD 929 L 28
Barnes City
Gibson
Thornburg
Keswick
Webster
What Cheer
N English
Kinross
DES MOINES ARSA
Spring Hill
Hartford
Palmyra
Swan
KNOXVILLE 1227 L 30
Pleasantville
VERMEER 871 24 U-1
PELLA 257 PEA
PELLA 880 L 28 U
Pella
VANDER WAAL 886 L 20 U-1
Lacey
OSKALOOSA 414 OOA
SIGOURNEY
SIG NOR 818 20
Sigourney
Harper
Keota
W Chester
WASHINGTON
Churchville
INDIANOLA
Martensdale
Bevington
Patterson
Beech
Ackworth
Sandyville
NASH INDIANOLA 991 L 22
Knoxville
KNOXVILLE
Olivet
Evans
Rose Hill
Delta
St Marys
Milo
Hanley
WINTERSET MADISON CO
Winterset
FOR FLIGHTS AT AND BELOW 4900 MSL SEE AREA CHART ON BACK
25
29
17
25
31
16
I-38

AVIATION DEMAND

CHAPTER TWO

FORECAST OF AVIATION DEMAND

INTRODUCTION

Forecast Methodology

The forecast of aviation activity provides a basis by which to evaluate present facility service capabilities against immediate and long range aviation activity. Consequently, unmet needs that exist can be identified and the service level of the facility improved. Facility improvements must be evaluated within the context of benefits and costs. The forecast of aviation activity then provides a basis by which to:

- Identify unmet facility needs
- Examine benefits and costs
- Identify a point in time when a specific improvement may be contemplated

Consideration should be given to distinguishing the difference between present activity and potential activity or demand. The forecast of aviation demand should be based upon the potential demand within the airport service area. In estimating potential demand, consideration must given to a number of variables which influence demand within the airport service area.

- Aircraft ownership (registered aircraft)
- Pilots
- Population change, income
- Labor force characteristics
- Major industrial and business users
- Existing airport facilities and services (FBO)
- Area airport facilities and services, state system

Economic activity within the airport service area, along with area airport facilities and services are the more important variables influencing aviation demand. In relatively small communities, the addition or elimination of a single industry can substantially change the level of aviation activity. In large communities, a plant opening or closure may have less impact upon total usage due to the mix of activity found.

Aircraft ownership is influenced by socioeconomic trends within the airport service area as well as the cost associated with aircraft ownership. Nationally, general aviation has undergone a major change with long-term growth of the active fleet slowing down. The FAA reported that for the period 1980 through 1986, the active general aviation fleet grew at a relatively constant annual rate of only 0.01 percent. An active aircraft is one that is flown at least one hour during the previous year. Production of a new aircraft has also declined with 1495 units being shipped in 1986 compared to 17,811 units in 1978. The slow down in historic growth of the general aviation fleet is influenced by a number of variables.

> "Factors such as the availability of low cost alternatives for recreational flying, changes in taster and preferences, declining student and private pilot populatiaons, rapidly rising prices and operating costs of conventional aircraft, and continued high interest rates may all be contributing to the downtown."

SOURCE: FAA, FAA Aviation Forecasts, FY1988 - 1999, FAA-/APO-88-1, February, 1988, page 71

Future aircraft ownership within the airport service area is expected to reflect national trends.

The forecast of aviation activity will also be influenced by the extent of facility development and accessibility of the airport site to the user. The assumption made herein that the existing airport site would be retained. Should in later phases of the planning process it be determined that the existing site can not be developed and an alternative site is selected, activity may be more or less than the estimates provided within the forecast data.

A final consideration falls within the realm of individual choice. The decision to base an aircraft at one facility or another is influenced by the extent of facility development and services provided. For example, the availability of aircraft storage facilities and associated costs are important considerations in basing an aircraft as are services provided by the Fixed Base Operator (FBO).

Touch and go operations generated by student traffic may be largely due in part to efforts by the FBO in promoting aviation while itinerant traffic is influenced by economic activity within the airport service area. The decision to travel or transport an item from one point to another is based upon a number of factors.

- Distance and accessibility, isolation
- Trip purpose and cost
- Commodity, value
- Availability of other modes

National Trends

The total number of general aviation aircraft within the United States increased from 198,800 in 1979 to 213,200 in 1982. A decrease in the number of general aviation aircraft was recorded in 1983 followed by annual increases in 1984 and 1985. As of January 1, 1987, the general aviation active fleet consisted of 220,044 aircraft, up 4.4 percent from 1986.

Of the 220,044 active general aviation aircraft, 78.1 percent were single engine piston powered aircraft. Multi-engine piston aircraft comprised 10.9 percent of the fleet in 1987 followed by rotorcraft with 3.1 percent. While the number of single and twin engine piston powered aricraft experienced little growth, the turbine-powered fleet recorded an annual growth within the period 1980-1987 of nearly eight percent.

Approximately 34.5 million total hours were flown by general aviation aircraft in FY1987. Single engine piston aircraft accounted for 63.7 percent of all hours flown, multi-engine piston aircraft, 14.2 percent; turbine-powered aircraft, 10.7 percent; and rotorcraft, 7.8 percent. Total hours flown by general aviation aircraft declined at an annual rate of 2.8 percent within the period 1970 to 1987. Reference may be made to Table 2-1.

TABLE 2-1: GENERAL AVIATION HOURS FLOWN, 1980 - 1999 (in millions)

	FIXED WING							
	PISTON				ROTORCRAFT			
FISCAL YEAR	SINGLE ENGINE	MULTI-ENGINE	TURBOPROP	TURBOJET	PISTON	TURBINE	OTHER	TOTAL
Historical*								
1980	28.8	6.6	2.1	1.3	0.9	1.8	0.4	41.9
1981	27.9	6.4	2.2	1.5	0.8	1.8	0.4	41.0
1982	25.2	6.0	2.1	1.6	0.6	1.8	0.4	37.7
1983	23.8	5.8	2.2	1.5	0.6	1.7	0.4	36.0
1984	23.4	5.7	2.4	1.6	0.6	1.9	0.4	36.0
1985	23.4	5.7	2.6	1.8	0.6	1.7	0.4	36.2
1986	22.2	4.9	2.7	1.7	0.8	1.8	0.4	34.5
1987E	22.0	4.9	2.7	1.8	0.8	1.9	0.4	34.5
Forecast								
1988	21.8	4.8	2.8	1.9	0.8	1.9	0.4	34.4
1989	21.8	4.7	2.8	1.9	0.7	2.0	0.4	34.3
1990	21.7	4.7	2.8	2.0	0.7	2.2	0.4	34.5
1991	21.7	4.7	2.9	2.1	0.6	2.3	0.4	34.7
1992	21.6	4.7	2.9	2.2	0.6	2.5	0.4	34.9
1993	21.6	4.8	3.0	2.3	0.6	2.6	0.5	35.4
1994	21.5	4.8	3.0	2.4	0.6	2.7	0.5	35.5
1995	21.5	4.8	3.1	2.4	0.5	2.8	0.5	35.6
1996	21.4	4.9	3.1	2.5	0.5	2.9	0.6	35.9
1997	21.4	4.9	3.2	2.6	0.5	3.0	0.6	36.2
1998	21.3	4.9	3.2	2.6	0.5	3.1	0.6	36.2
1999	21.3	5.0	3.3	2.7	0.4	3.2	0.7	36.6

* Source: FAA Statistical Handbook of Aviation

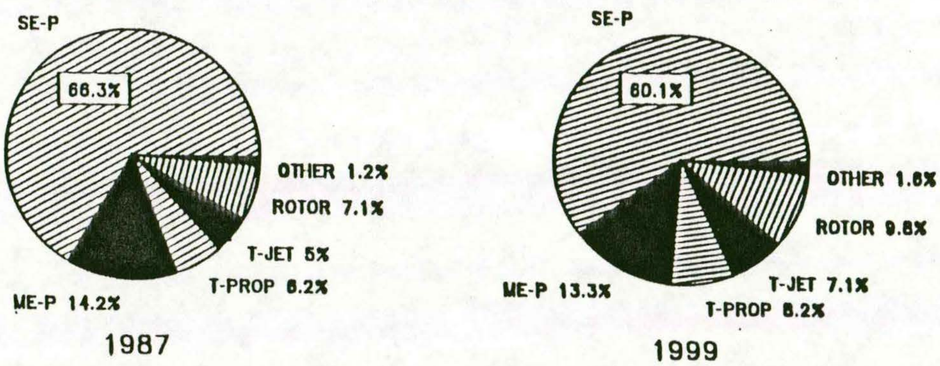
SOURCE: FAA, FAA Aviation Forecasts, FY1988 - 1999, FAA APO-88-1, page 149

Based upon usage, it should be noted that business use grew at an annual rate of 1.7 percent for the period 1970 to 1987. Within the same period, aircraft usage for instruction and personal use declined by 0.4 percent annually.

The FAA estimates that the number of hours flown by general aviation aircraft through 1999 will increase at an average annual rate of 0.4 percent. By 1999 hours flown by general aviation aircraft is expected to approach 36.6 million compared to 34.5 million hours recorded in 1987. Reference may be made to Figure 2-1 which illustrates past and future changes in hours flown by general aviation aircraft.

FIGURE 2-1: HOURS FLOWN BY AIRCRAFT TYPE, 1987 AND 1999

SE = Single Engine
ME = Multi-Engine



SOURCE: FAA FAA Aviation Forecasts, FY1988 - 1999, FAA APO-88-1, page 83

The total active general aviation aircraft fleet is expected to decrease in numbers from 220,000 in 1987 to 217,100 by 1990. A modest rate of increase is projected for the period beginning in 1993 and extending through 1999. The size of the general aviation aircraft in 1990 is expected to exceed the 1987 fleet by only 900 aircraft. Nationally as well as in the State of Iowa, the total number of active general aviation aircraft will first continue to experience a modest decrease in numbers through 1992 followed by a modest annual increase through 1999.

As noted in Table 2-2 and Figure 2-1, the composition of the fleet is also expected to change. The number of single engine piston aircraft is expected to decline yearly through 1999 while piston powered twin engine aircraft will decline in numbers through 1992 and then experience a modest annual increase through 1999. The number of turbine powered aircraft is projected to increase at an annual rate of 1.2 percent through 1999.

TABLE 2-2: ACTIVE GENERAL AVIATION AIRCRAFT, 1980 - 1999 (in thousands)

	FIXED WING							
	PISTON							
AS OF JANUARY 1	SINGLE ENGINE	MULTI-ENGINE	TURBOPROP	TURBOJET	ROTORCRAFT PISTON	ROTORCRAFT TURBINE	OTHER	TOTAL
Historical*								
1980	168.4	25.1	3.5	2.7	3.1	2.7	4.8	210.3
1981	168.4	24.6	4.1	3.0	2.8	3.2	4.9	211.0
1982	167.9	25.5	4.7	3.2	3.3	3.7	5.0	213.3
1983	164.2	25.0	5.2	4.0	2.4	3.7	5.2	209.7
1984	166.4	25.1	5.5	3.9	2.5	4.0	5.9	213.3
1985	171.9	25.5	5.8	4.3	2.9	4.2	6.3	220.9
1986	164.4	23.8	5.4	4.4	2.9	3.5	6.3	210.7
1987E	171.8	23.9	6.0	4.5	2.9	4.0	7.0	220.0
Forecast								
1988	170.2	23.8	6.1	4.6	2.8	4.2	7.3	219.0
1989	168.6	23.7	6.6	4.9	2.7	4.4	7.6	218.5
1990	167.0	23.5	6.4	5.1	2.6	4.6	7.9	217.1
1991	166.3	23.4	6.6	5.3	2.5	4.8	8.2	217.1
1992	165.5	23.3	6.7	5.6	2.5	5.0	8.5	217.1
1993	164.8	23.3	7.1	5.9	2.5	5.3	8.9	217.8
1994	164.3	23.4	7.4	6.2	2.4	5.6	9.2	218.5
1995	163.8	23.5	7.7	6.4	2.4	5.9	9.5	219.2
1996	163.3	23.6	7.9	6.6	2.3	6.1	9.6	219.4
1997	163.0	23.7	8.1	6.8	2.2	6.3	9.8	219.9
1998	162.8	23.8	8.3	7.0	2.1	6.5	9.9	220.4
1999	162.5	23.9	8.5	7.2	2.0	6.7	10.1	220.9

* Source: FAA Statistical Handbook of Aviation

Notes: Detail may not add to total because of independent rounding.

An active aircraft must have a current registration and it must have been flown at least one hour during the previous calendar year.

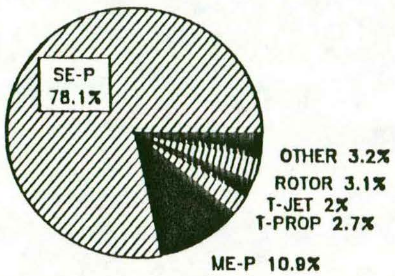
SOURCE: FAA, FAA Aviation Forecasts, FY 1988 - 1999, FAA APO-88-1, p. 147

As noted in Figure 2-2, single engine piston aircraft will make up 73.6 percent of the active fleet in 1999 compared to 78.1 percent in 1987. Turbo-prop and jet will increase comprising 7.1 percent of the total fleet in 1999 compared with 4.7 percent in 1987.

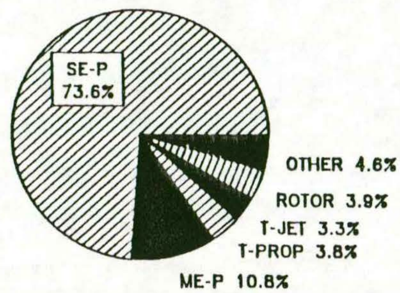
FIGURE 2-2: ACTIVE GENERAL AVIATION AIRCRAFT, 1980 - 1999

PERCENT BY AIRCRAFT TYPE

SE = Single Engine
ME = Multi Engine



1987



1999

SOURCE: FAA, FAA Aviation Forecasts, FY 1988 - 1999, FAA APO-88-1, p. 82

The distribution of the U.S. active general aviation aircraft fleet will also experience some change. The number of aircraft within the Central Region (Iowa, Nebraska, Kansas, Missouri) is projected to decrease in numbers from 13,100 in 1987 to 12,600 within the period 1991 through 1993. The number of active general aviation aircraft is expected to experience a slight increase by 1999.

TABLE 2-3: ACTIVE GENERAL AVIATION AIRCRAFT, CENTRAL REGION, 1980 - 1999 (in thousands)

YEAR	U.S. (1)	REGION (1)	CENTRAL AS % OF TOTAL	IOWA (2)	IOWA AS % OF REGION
1980	210.3	14.1	6.7	3.5	24.8
1981	211.0	14.1	6.7	3.4	24.1
1982	213.2	14.0	6.6	3.3	23.6
1983	209.8	12.8	6.1	3.1	24.2
1984	213.3	13.0	6.1	3.1	23.8
1985	220.9	13.1	5.9	3.0	22.9
1986	210.7	12.4	5.9	2.9	23.4
1987	220.0	13.1	5.9	---	---
1988	219.0	13.0	5.9	---	---
1992	217.1	12.6	5.9	---	---
1997	219.9	12.7	5.8	---	---
1999	220.9	12.8	5.8	---	---

SOURCE: (1) FEDERAL AVIATION ADMINISTRATION
(2) IOWA DEPARTMENT OF TRANSPORTATION

Iowa's share of the four state region decreased from 24.8 percent in 1980 to an estimated 23.4 percent in 1986. Within the period 1980 through 1986 the Central Region experienced a 12 percent decrease in the number of active general aviation aircraft compared with a 17.1 percent decrease for the State of Iowa.

Iowa Trends

Aviation activity in Iowa has also experienced considerable change. Table 2-4 summarizes the number of aircraft registered in the State of Iowa from FY74 through FY86. As noted, the number of aircraft experienced a continual increase to 1979 when 3,530 aircraft were registered in the State. Beginning in 1980, the number of aircraft registered has experienced a continual decrease with 3,079 aircraft registered in FY84, 2,962 in FY85, 2,925 in FY86, 2,599 in FY87, and 2,535 in FY88.

TABLE 2-4: REGISTERED AIRCRAFT, IOWA, FISCAL YEAR 1974 - 1988

YEAR	AIRCRAFT	YEAR	AIRCRAFT
1974	2,565	1982	3,417
1975	2,620	1983	3,335
1976	3,144	1984	3,099
1977	3,308	1985	2,962
1978	3,492	1986	2,926
1979	3,530	1987	2,599
1980	3,492	1988	2,535
1981	3,417		

SOURCE: IDOT, AERONAUTICS DIVISION, 1988 (Airworthy Aircraft)

Annual changes in aircraft ownership parallel economic changes. As the Gross State Product in real terms begins to grow in a positive direction, the number of aircraft may also increase. Historically, as the Gross State Product increased, so did the number of registered general aviation aircraft. This historic pattern however is expected to undergo some changes and are expected to reflect national trends. Consequently, the number of general aviation aircraft registered within the State of Iowa is expected to be somewhat less than that estimated in the <u>1985 State Aviation System Plan</u>.

TABLE 2-5: REGISTERED AIRCRAFT, IOWA, 1988 - 2007

YEAR	IDOT (1)	PDS (2)
1985	2,962	2,962
1988	---	2,974
1990	---	2,948
1992	3,250	2,948
1997	---	2,986
2000	3,875	3,000
2005	4,200	3,000
2007	---	3,000

SOURCE: (1) IOWA DEPARTMENT OF TRANSPORTATION
(2) PROFESSIONAL DESIGN SERVICES OF IOWA, INC.

Regional Trends

A six county area was selected for a more indepth comparative assessment than that provided by a review of statewide trends. Table 2-6 summarizes registered general aviation aircraft by county for the period 1980 through 1989. The number of registered aircraft within the six county area decreased from 223 aircraft in 1981 to 174 in 1988. As of June 1989, there were 189 registered aircraft within the six county area.

TABLE 2-6: REGISTERED AIRCRAFT, SELECTED COUNTIES, 1980-89

County	Year									
	1980	1981	1982	1983	1984	1985	1986	198	1988	1989
Cerro Gordo	93	90	79	75	76	75	69	65	60	69
Floyd	37	33	34	32	32	34	33	33	36	34
Hancock	9	28	26	24	22	18	20	21	18	19
Mitchell	15	19	19	20	18	18	17	16	13	17
Winnebago	42	35	33	32	34	33	33	29	29	28
Worth	19	18	19	23	21	22	20	19	18	22
Total	215	223	210	206	203	200	192	183	174	189

Worth County As	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
% of Total	8.8	8.1	9.0	11.2	10.3	11.0	10.4	10.4	10.3	11.6

SOURCE: FAA, Census of U.S. Civil Aircraft, December 31, 1980-1986
IDOT, AIR AND TRANSIT DIVISION, MAY 1987; AUGUST 1988;
and JUNE 1989

In 1989 Cerro Gordo recorded 36.5 percent of the total registed aircraft followed by Floyd County with 18.0 percent of the total. Nearly fifteen percent of the area aircraft were registered in Winnebago County while 11.6 percent of the aircraft within the six county area were registered in Worth County. Worth County captured 11.6 percent of the registed aircraft in 1989.

A downward trend is representative of the number of registered aircraft in Cerro Gordo and Winnebago counties. Within exception to a small annual variation, the remaining four counties showed a relative degree of stability.

The number of based aircraft at public owned airports within the six county area for the period 1980 through 1988 is summarized in Table 2-7.

The number of aircraft at the six public airports remained stable within the period 1980 through 1985 followed by significant decreases in 1987 and 1988.

TABLE 2-7: BASED AIRACRAFT, PUBLIC AIRPORTS, 1980 - 1988

Airport	1980	1981	1982	1983	1984	1985	1986	1987	1988
Forest City	19	12	15	18	20	20	22	22	22
Lake Mills	4	4	4	4	3	4	4	4	3
Mason City	74	74	74	63	63	55	45	45	45
Osage	11	10	12	12	13	11	9	8	8
Charles City	22	30	32	32	31	31	32	26	26
Northwood	8	11	11	12	15	18	18	14	14
Total	138	141	148	141	145	139	130	119	118
Northwood As % of Total	5.8	7.8	7.4	8.5	10.3	12.9	13.8	11.8	11.9

SOURCE: IDOT AIR & TRANSIT DIVISION, JUNE, 1989

The number of aircraft based at Northwood showed a modest decrease as did Lake Mills, Osage and Charles City. Mason City experience a significant decrease in the number of based aircraft. Forest City recorded a modest increase over the nine year period.

Of the 118 aircraft based at public airport facilities within the six county area, 38.1 percent were based at Mason City while 22.0 and 18.6 percent were based at Charles City and Forest City respectively. Northwood captured 11.9 percent of the area total.

Future numbers of based aircraft within the six county area are expected to be representative of trends statewide. Public airport utilization is expected to increase as the number of private facilities open to be public decrease. As the ecomony of the state improves, the number of registered and based aircraft may begin to stabilize. Some evidence of the stabilizing trend is evident from 1988 - 1989 data presented in tables 2-6 and 2-7.

Northwood Airport Service Area

As previously defined, the airport service area consists of a primary service area centered upon the City of Northwood and a fringe area consisting of the western and southern tier of townships. Should no airport improvements be made at Lake Mills, the primary service area would extend to the western edge of Worth County.

The communities of Manly, Grafton, Hanlontown, Fertile, and Joice are located within the fringe or secondaray airport service area. Northwood and Kensett are within the primary service area.

As of June, 1989, there were 22 registered aircraft within Worth County. Of those 68 percent reported a Northwood mailing address while the remaining 32 percent reported a mailing address within those communities located within the secondary service area.

TABLE 2-8: REGISTERED AIRCRAFT BY COMMUNITY, 1989

Community	No. of Aircraft	% of Total
Northwood	15	68.2
Manly	2	9.1
Joice	2	9.1
Grafton	2	9.1
Fertile	1	4.5
Total	22	100.0

SOURCE: PDS, 1989

Table 2.9 lists current registered aircraft by identification number and model. The table also identifies the mailing address of the owner as well as the airworthy status of the aircraft. It should be noted that nine of the 22 registered aircraft were reported as being sold out of state. One aircraft was classified as being unairworthy.

TABLE 2-9: REGISTERED AIRCRAFT, WORTH COUNTY, 1989

ID	Address	Model	Year	Airworthy Status (1)	Based Airport
182LW	Northwood	Cessna 182P	71	1	Northwood
2595R	Northwood	Cessna 182	67	1	-----
2726E	Manly	Cessna 172N	78	1	Northwood
44087	Joice	PA32-300	74	4	SOS
46189	Northwood	Cessna 172	74	4	SOS
5371L	Grafton	PA28 180	68	4	SOS
560D	Northwood	Beech 35R	47	4	SOS
6446G	Northwood	Cessna 150K	70	4	SOS
650NA	Northwood	Beech C-454	53	8	Northwood
653Y	Northwood	Grumman G-164	63	4	SOS
6697P	Grafton	PA24-250	60	1	Charles City
6792Q	Northwood	Grumman G164B	77	1	Northwood
67920	Northwood	Grumman G164B	77	1	Northwood
7221V	Northwood	Callair B-1A	67	4	SOS
73420	Northwood	Cessna 172	76	4	Northwood
7809U	Joice	Cessna 172	64	1	Northwood
78724	Northwood	Piper PA11	47	4	SOS
84455	Northwood	Cessna 172K	69	1	Northwood
84634	Northwood	Cessna 172	69	1	Northwood
8493F	Manly	PA28-151	77	1	Northwood
88IMP	Fertile	Taylor Mini-IMP	--	2	-----
983X	Northwood	Grumman G-164A	68	4	SOS

Code Airworth Status:

1 Airworthy
2 Unairworthy
4 Sold out of State
8 Dealer

SOURCE: IDOT AIR 7 & TRANSIT DIVISION June, 1989

The number of aircraft registered within Worth County since 1980 has been within a range of 18 to 23. In 1981 and 1988 there were 18 aircraft registered in the county while 23 were reported as registered in Worth County in 1983.

Historic composition of the registered aircraft is presented in the following table. All of the aircraft registered in Worth County within the period 1981 through 1986 were single engine piston powered aircraft.

TABLE 2-10: REGISTERED AIRCRAFT BY TYPE, 1981 - 1986

		PISTON			
		Single Engine		Multi-Engine	
Year	Total	1-3	4-Plus	1-6	7 Plus
1981	18	6	12	---	---
1982	19	6	13	---	---
1983	23	9	14	---	---
1984	21	8	13	---	---
1985	22	9	13	---	---
1986	20	9	11	---	---

SOURCE: FAA, Census of U.S. Civil Aircraft,
December 31, 1981-86
FAA Form 5010

The number of aircraft registered in Worth County over the 20 year planning period is expected to experience some annual variation and remain relatively constant with no significant increase nor decrease in aircraft ownership. This assumption is based upon the following:

* Positive economic and population growth within Northwood
* A stabilized rural population in Worth County
* A stronger farm economy within the airport service area
* Aggressive efforts to create new job opportunites

Aircraft ownership is expected to be concentrated in Northwood and will be influenced to some extent by the financial condition and business plan of local operator(s). For example, a decision to relocate a local FBO operation from one airport to another could impact future aircraft registrations within Worth County.

The number of aircraft based at a facility is dependent to some degree upon the geographic location of the facility as well as the extent of facility development and services provided. In assessing the number of aircraft based at a public owned airport, consideration must be given to the relationship such a facility would have to existing private and public airports in the area.

TABLE 2-11: BASED AIRCRAFT AS PERCENT OF REGISTERED

Year	Registered	Based	Based as % of Registered
1980	19	8	42%
1981	18	11	61
1982	19	11	58
1983	23	12	52
1984	21	15	71
1985	22	18	82
1986	20	18	90
1987	19	14	74
1988	18	14	78

SOURCE: PDS, September 1989

The number of aircraft based at the Northwood Municipal Airport is expected to remain fairly stable within the period 1990 to 2009. Reference may be made to Table 2-11. As of June 1989, eight of the 22 aircraft registered in Worth County were owned by a single individual. Decisions by that single individual as well as others will cause some annual variation in the number of registered and based aircraft as aircraft are purchased and sold.

A number of aircraft will be maintained on private fields while others will be based at area airports for one reason or another. Since many of the private airports are no longer open to public use due to liability costs, more of the registered aircraft are expected to be based at public owned airports.

TABLE 2-12: REGISTERED AND BASED AIRCRAFT, 1990 - 2010

Year	Registered Aircraft Northwood Airport Service Area	Based Aircraft Northwood Municipal Airport	
1990	22	12-16	(14)
1994	18-24	14-18	(16)
1999	18-24	14-18	(16)
2009	18-24	16-22	(19)

SOURCE: PDS, 1989

The mix of registered and based aircraft is expected to reflect current conditions. As of June, 1988, there were 13 single engine and one twin engine aircraft based at the Northwood Municipal Airport.

The future mix of based aircraft is expected to consist of single and twin engine aircraft with a gross weight under 12,500 pounds. Aircraft in excess of 12,500 pounds gross weight would most likely be based at Mason City.

Based aircraft characteristics:

Approach Speed	Under 91 knots
Wingspan	Under 49 feet
Gross Weight	Under 12,500 pounds

PILOTS

Introduction

The total number of pilots nationally has experienced a downward trend from 1981 through 1987. All categories of pilots experienced a decrease except the helicopter, glider, and airline transport categories. The number of students dropped from 210,200 in 1980 to 150,300 in 1987. The number of private pilots decreased in number from 343,276 in 1980 to 305,736 in 1987 or at a yearly rate of decline of 3 percent. Within the same period, the number of commercial pilots decreased from 183,400 to 147,800. Lighter-Than-Air certificate holders declined in number from 3,700 in 1981 to 1,100 in 1987. Historic (1980-1987) and future (1988-1999) pilot numbers are summarized in Table 2-13.

TABLE 2-13: ACTIVE PILOTS - UNITED STATES, 1980 - 1999 (in thousands)

AS OF JANUARY 1	STUDENTS	PRIVATE	COMMERCIAL	AIRLINE TRANSPORT	HELICOPTER	GLIDER	LIGHTER-THAN-AIR	TOTAL	INSTRUMENT RATED(1)
Historical*									
1980	210.2	343.3	182.1	63.7	5.2	6.8	3.4	814.7	247.1
1981	199.8	357.5	183.4	69.6	6.0	7.0	3.7	827.0	260.5
1982	179.9	328.6	168.6	70.3	6.5	7.4	3.0	764.2	252.5
1983	156.4	322.1	165.1	73.5	7.0	7.8	1.4	733.3	255.1
1984	147.2	318.6	159.5	75.9	7.2	8.2	1.3	718.0	254.3
1985	150.1	320.1	155.9	79.2	7.5	8.4	1.2	722.4	256.6
1986	146.7	311.1	151.6	82.7	8.1	8.2	1.1	709.5	258.6
1987E	150.3	305.7	147.8	87.2	8.6	8.4	1.1	709.1	262.4
Forecast									
1988	153.3	306.0	147.8	90.7	8.7	8.5	1.2	716.2	266.3
1989	156.4	306.6	148.5	94.3	8.8	8.6	1.2	724.4	269.0
1990	159.1	307.5	149.3	97.1	8.9	8.8	1.2	731.9	271.7
1991	161.5	308.2	150.8	100.1	9.0	8.9	1.2	739.7	273.6
1992	163.5	308.8	152.3	103.1	9.1	9.0	1.2	747.0	275.5
1993	165.1	309.7	153.8	106.2	9.3	9.1	1.3	754.5	277.4
1994	166.3	310.6	155.3	108.3	9.4	9.2	1.4	760.5	279.4
1995	167.1	311.6	156.9	110.5	9.5	9.3	1.5	766.4	281.3
1996	167.8	312.5	158.5	112.7	9.6	9.4	1.6	772.1	283.3
1997	168.3	313.4	160.1	114.9	9.7	9.5	1.7	777.6	285.3
1998	168.8	314.4	161.7	117.2	9.8	9.6	1.8	783.3	287.3
1999	169.3	315.3	163.3	119.6	9.9	9.7	1.9	789.0	289.3

* Source: FAA Statistical Handbook of Aviation.

(1) Instrument rated pilots should not be added to other categories in deriving total.

Notes: Detail may not add to total because of independent rounding.

SOURCE: FEDERAL AVIATION ADMINISTRATION

Nationally, all categories of pilots are expected to increase in number through 1999.

Regional / Worth County

The FAA reported 7,909 active pilots in Iowa as of December 31, 1986 or approximately 2.2 pilots per aircraft. Based upon data from IDOT, there were 28 pilots within Worth County in 1985 or approximately 31.5 pilots per 10,000 population.

Cerro Gordo had 18.2 pilots per 10,000 population compared to Winnebagao County with 41.5. The six county average was 32.6 pilots per 10,000 population. Worth County was slightly below the six county average. The number of pilots will be influenced by the effort of local instructors to recruit students and maintain a local interest in flying.

TABLE 2-14: PILOTS SELECTED COUNTIES, 1985

County	Population	Pilots / 10,000 Population	Air Transport Commericial	Private	Student	Total
Worth	8,900	31.5	9	14	5	28
Winnebago	13,000	41.5	13	33	8	54
Mitchell	11,800	33.1	7	27	5	39
Floyd	19,200	34.9	20	40	7	67
Cerro Gordo	47,800	18.2	12	59	16	87
Hancock	14,000	36.4	11	27	13	51

SOURCE: IDOT, FAA Pilots Registration Tape, December, 1985
Iowa Census Data Center

The number of pilots within Worth County is expected to remain stable within the period 1990 through 2009. Reference may be made to Table 2-15.

TABLE 2-15: PILOTS, WORTH COUNTY, 1990-2009

YEAR	PILOTS
1990	27
1994	26-28
1999	26-29
2009	26-29

SOURCE: PDS, 1989

AIRCRAFT OPERATIONS

Introduction

An aircraft operation is defined as the airbourne movement of aircraft in controlled and non-controlled airport terminal areas and about given enroute fixes or at other points where counts can be made. Each movement counts as an operation. A "touch and go", for example, counts as two operations.

Total annual aircraft operations are further broken down into local and itinerant operations. A local operation is defined as one by an aircraft that:

1. Operates within the local traffic pattern or within sight of the control tower;
2. is known to be departing for or arriving from local practice areas; or
3. executes simulated instrument approaches of low passes at the airport.

An itinerant aircraft operation is one that operates outside the local traffic pattern. A typical example of an itinerant operation is an air taxi operation. Aviation operations are most often discussed in terms of:

1. Total annual aircraft operations
   - Total annual local
   - Total annual itinerant
2. Peak day and peak hour operations

Aircraft operations are a function of the following elements:

1. Based Aircraft
2. Resident Pilots
3. Airport Facilities
4. Airport Management
5. Social & Economic Characteristics of the Airport Service Area
6. FBO and Air Taxi Services

National Trends

An indication of historic and future levels of aviation activity may be obtained from a review of activity at airports having FAA control towers. In 1980, 66,200,000 operations were conducted at 432 airports having control towers. Total operations decreased with the period 1980 through 1987 as did the numbers of FAA tower facilities. In 1987 there were an estimated 61,000,000 operations conducted at 399 tower locations.

Future aviation activity at the 399 airports with tower facilities is expected to increase annually. As noted in Table 2-16 total aircraft operations are expected to increase from 62,700,000 in 1988 to 81,400,000 in 1999. Operations by general aviation aircraft is expected to increase from 38,700,000 to 50,200,000 within the same period. Activity by air carrier and air taxi/commuter aircraft is also expected to increase.

TABLE 2-16: AIRCRAFT OPERATIONS AT TOWER LOCATIONS, 1980-1999 (in millions)

FISCAL YEAR	AIR CARRIER	AIR TAXI/ COMMUTER	GENERAL AVIATION	MILITARY	TOTAL	NUMBER OF FAA TOWERS
Historical*						
1980	10.1	4.6	48.9	2.5	66.2	432
1981	9.5	4.9	44.6	2.5	61.5	433
1982	9.0	5.1	34.2	2.3	50.6	375
1983	9.7	5.9	35.3	2.5	53.3	390
1984	10.9	6.6	36.8	2.4	56.8	403
1985	11.3	6.9	37.2	2.5	57.9	398
1986	12.3	6.9	37.1	2.6	59.0	399
1987E	13.1	7.3	37.8	2.7	61.0	399
Forecast						
1988	13.6	7.7	38.7	2.7	62.7	399
1989	14.0	8.1	39.6	2.7	64.4	399
1990	14.4	8.5	40.5	2.7	66.1	399
1991	14.8	8.8	41.4	2.7	67.7	399
1992	15.2	9.1	42.4	2.7	69.4	399
1993	15.5	9.4	43.4	2.7	71.0	399
1994	15.8	9.7	44.5	2.7	72.7	399
1995	16.1	10.0	45.5	2.7	74.3	399
1996	16.4	10.3	46.7	2.7	76.1	399
1997	16.7	10.6	47.9	2.7	77.9	399
1998	17.0	10.9	49.0	2.7	79.6	399
1999	17.3	11.2	50.2	2.7	81.4	399

* Source: FAA Air Traffic Activity.

Notes: 1982-1984 operations reflect the temporary closures of FAA Air Traffic Control Towers. Detail may not add to total because of independent rounding.

SOURCE: FAA, FAA Aviation Forecasts, FY 1988 - 1999, FAA APO-88-1, p. 153

Within the period 1988 through 1999, activity by general aviation aircraft is expected to increase by 29.7 percent compared to a 27.2 increase in air carrier operations and a 45.5 percent increase in aircraft operations by air taxi and commuter aircraft.

Local operations conducted in FY87 at the 429 airports totaled 15,700,000 compared to 22,600,000 itinerant operations. Approximately 40.9 percent of the operations were local in character. Through 1999 the percentage of local operations is expected to increase approximately one percent.

Iowa Trends

An insight regarding aviation activity within the State of Iowa may be obtained from reference to counts from the five tower airports in Iowa. These facilities are located at Dubuque, Des Moines, Waterloo, Cedar Rapids, and Sioux City. In FY 1987, there were 459,186 total aircraft operations conducted at the five tower airports compared with 412,936 in FY 1986. Air carrier activity increased by 16.7 percent, followed by a 15.0 percent increase in military operations. General aviation operations increased by 8.8 percent from FY86 to FY87 at the five airports. Air taxi operations increased by 5.3 percent.

TABLE 2-17: OPERATIONS, FIVE AIRPORTS, 1986 AND 1987

	1986	1987	CHANGE NUMBER	CHANGE PERCENT
Air Carrier				
Itinerant	50,754	59,214	8,460	16.7
Local	0	0	---	---
Total	50,754	59,214	8,460	16.7
General Aviation				
Itinerant	176,537	186,369	9,832	5.6
Local	106,053	121,194	15,141	14.3
Total	282,592	307,563	24,971	8.8
Air Taxi				
Itinerant	63,911	67,274	3,363	5.3
Local	0	0	---	---
Total	63,911	67,274	3,363	5.3
Military				
Itinerant	12,135	13,293	1,158	9.5
Local	9,546	11,842	2,296	24.1
Total	21,861	25,135	3,274	15.0
Total				
Itinerant	297,337	326,150	28,813	9.7
Local	115,599	133,036	17,437	15.1
Total	412,936	459,186	46,250	11.2

SOURCE: FAA, FAA Air Traffic Activity, FY87, p. 26

So as to better assess potential activity within the Northwood Airport Service Area historic general aviation activity at the five tower airports in Iowa was summarized for the period FY 1979 through FY 1987. Reference may be made to Table 2-18.

TABLE 2-18: GENERAL AVIATION OPERATIONS, TOWER LOCATIONS, FY1979-1987

	FISCAL YEAR								
	1979	1980	1981	1982	1983	1984	1985	1986	1987
CEDAR RAPIDS									
Local	52,945	43,848	34,391	31,317	24,801	26,730	29,475	26,119	28,836
Itinerant	51,864	50,498	48,910	37,228	37,645	36,681	35,636	35,248	36,965
Total	104,179	94,346	83,301	68,545	62,446	63,411	65,111	61,367	65,801
DES MOINES									
Local	52,945	45,805	33,974	28,016	25,083	22,200	21,828	27,735	30,137
Itinerant	107,460	103,458	94,351	80,841	77,395	75,478	75,643	70,735	73,769
Total	160,405	149,263	128,325	108,857	102,478	97,678	97,471	98,614	103,906
DUBUQUE									
Local	25,945	29,288	28,410	25,384	22,683	19,064	18,873	21,741	28,558
Itinerant	34,961	33,543	33,683	26,801	25,188	24,690	24,332	22,280	24,178
Total	60,636	62,831	62,093	52,185	47,871	43,754	43,205	44,021	52,746
SIOUX CITY									
Local	27,037	18,250	14,351	9,615	12,203	9,755	10,036	14,984	14,349
Itinerant	40,930	36,564	34,529	24,038	26,947	26,212	26,557	27,984	27,107
Total	67,968	54,814	48,880	33,653	39,150	36,967	36,593	41,996	41,456
WATERLOO									
Local	38,217	38,879	32,716	17,809	15,308	15,270	14,444	15,474	19,314
Itinerant	41,595	39,633	37,106	25,645	23,599	22,999	21,375	21,118	24,350
Total	79,812	78,512	69,822	43,454	38,907	38,269	35,819	36,592	43,664
TOTAL	473,000	439,766	392,421	306,694	290,852	279,079	278,199	282,592	307,563
Local	41.5	40.1	36.7	36.6	34.4	33.3	34.0	37.5	40.0
Itinerant	58.8	59.9	63.3	63.4	65.6	66.7	66.0	62.5	60.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE: FEDERAL AVIATION ADMINISTRATION

Total activity by general aviation aircraft decreased from 473,000 operations in FY 1979 to 278,199 in FY 1985. The 41.2 percent decrease in activity within the period FY79 to FY85 has been reversed with an increase in activity in FY86 and FY87. The increase in operations by general aviation aircraft may be due in part to an improved State economy. General aviation activity increased by 1.6 percent in FY86 and 8.8 percent in FY87 at the five tower airports indicating an end to the downward trend experienced from FY79 through FY85.

The type of aircraft operations has also undergone some changes. Since FY 1979 the number of local operations has generally declined. Beginning in FY85, the number of local operations as a percent of total operations has increased. In FY87, 40 percent of the total general aviation aircraft operations were local in character. For purposes of estimating future numbers of local and itinerants, the assumption herein is that approximately 40 percent of all operations will be local in nature while the remaining 60 percent will be itinerant in character.

The 1985 Iowa Aviation System Plan projects an increase in the number of aircraft operations conducted within Iowa. General aviation operations accounted for 89 percent of the total activity in 1984. The number of general aviation operations are expected to increase from 1,879,000 in 1985 to 2,893,000 in 2005.

The Iowa Department of Transportation initiated a program to count aircraft operations at non-tower airports using a sound-actuated counter. The tapes are audited to determine if the sound is from a single-engine aircraft, a multi-engine aircraft, jet, helicopter, or other source that should be eliminated from the count. Consequently, data accumulated can be used to identify activity over a 24 hour period as well as by day of the week. Using the recorded departure data, the IDOT is able to estimate the total number of annual operations conducted at an airport facility.

Total annual aircraft operations for 29 airports within the State of Iowa that were counted within the period 1985 through 1987 are summarized in Table 2-19. A total of 211,946 operations were conducted at the 29 airports counted. As noted, a majority of the operations were by single engine aircraft with the balance consisting of multi-engine and jet operations.

Activity at the 29 general aviation airports varied considerably in total numbers as well as by aircraft type. Orange City is interesting given only 2,070 operations and of those nearly 40 percent by twin engine aircraft. K-Products, Vogel Paints, and Harker Meats have plant locations adjacent to the airport. Northwestern College is also located in the community.

TABLE 2-19: ANNUAL AIRCRAFT OPERATIONS, 29 AIRPORTS

AIRPORT	FIXED WING FLEET OPERATIONAL MIX (PERCENTS) SINGLE ENGINE	MULTI-ENGINE	JET	ESTIMATED * TOTAL ANNUAL OPERATIONS (ARRIVALS AND DEPARTURES)
Algona	93.6	6.4	0	8290
Atlantic	94.9	5.0	.1	8146
Boone	93.1	6.8	.1	15766
Carroll	92.3	7.0	.7	5648
Charles City	93.6	6.3	.1	9104
Cherokee	86.9	13.1	0	8240
Clarinda	94.9	5.1	0	2376
Davenport	90.3	8.7	1.0	26354
Denison	94.3	4.7	1.0	7820
Eagle Grove	90.4	9.6	0	3642
Hampton	63.5	20.9	15.6	2434
Harlan	96.4	3.6	0	5020
Independence	93.1	6.9	0	4116
Iowa Falls	89.8	9.8	.4	4520
Jefferson	91.6	8.4	0	3268
Manchester	93.7	6.3	0	1596
Maquoketa	89.8	9.8	.4	4154
Marshalltown	86.5	10.4	3.1	10842
Monticello	94.4	5.6	0	7694
New Hampton	86.4	13.6	0	1086
Newton	67.7	31.4	.9	12120
Orange City	60.2	39.8	0	2070
Perry	97.9	1.9	.2	6850
Red Oak	91.4	8.6	0	7440
Shenandoah	96.1	3.7	.2	5122
Spencer	64.3	35.1	.6	11814
Vinton	97.3	2.7	0	6244
Webster City	96.4	3.4	.2	17082
West Union	86.5	12.7	.8	3088

* Does not include rotorcraft operations as it is usually not possible to differentiate between rotorcraft arrivals departures, hovering and ground operations using the RENS aircraft activity counter.

SOURCE: IDOT, Iowa Automated Aircraft Activity Counting, 1985-1987, August, 1988, p. 6

Given the number of based aircraft, there were approximately 324 operations conducted per based aircraft. Obviously not all the estimated operations were conducted by based aircraft and therefore the ratio may have little application other than as an indication of activity that may exist based upon the number of aircraft located at an airport. The count program also revealed the annual distribution of operations conducted at the 29 airports.

Spring	29.3%
Summer	33.0%
Fall	21.7%
Winter	16.1%

From a review of data, activity was often, but not necessarily in all cases, highest on the weekends as well as in the late afternoon. Weekend activity and late afternoon/early evening activity would generally indicate pleasure flying as well as student traffic. Those airports having a concentration of activity within the week day and a small seasonal variation would most likely represent a greater use of the facility for business reasons.

Except for Davenport, the remaining airports are located outside a metropolitan area. Davenport would be considered a reliever facility to Moline.

NORTHWOOD MUNICIPAL AIRPORT

Activity at the Northwood Municipal Airport will depend to some extent upon the number of based aircraft, airport facilities and services, number of pilots, commercial and industrial growth, as well as location of the facility in relation to the service area. As noted in Table 2-19 , the number of total annual aircraft operations can vary significantly by airport. For purposes of this study, a ratio of 324 operations to one based aircraft will be used as a basis by which to estimate total annual aircraft operations.

Total annual activity will be influenced by the type of aircraft using the facility. Some indication of the primary use of the aircraft by aircraft type is reflected in the following table. As noted, nearly 57 percent of the single engine aircraft are used for personal reasons followed in turn by business and instructional usage. Twin engine piston aircraft are used for business (40.0 percent) followed in turn by personal and executive usage. Given the mix of based aircraft at the Northwood County facility, the total number of operations will vary seasonally. There may also be a concentration of activity in late afternoon and on the weekend.

TABLE 2-20: PRIMARY USE BY AIRCRAFT TYPE
(Based upon National Average - 1985)

	PISTON SINGLE ENGINE	TWO ENGINE
Executive	1.3%	18.1%
Business	20.7	40.0
Personal	56.7	19.2
Instructional	7.8	2.8
Aerial Application	3.7	1.5
Aerial Observation	1.9	1.2
Other Work	0.7	0.1
Commuter Air Carrier	*	1.8
Air Taxi	1.2	11.7
Other	1.6	2.7
Rental	4.4	0.9
TOTAL	100.0%	100.0%

SOURCE: FAA, Census of U.S. Civil Aircraft, December 31, 1986

Operational activity at Northwood is expected to have the following characteristics:

- Increase in activity within the summer months followed by a decrease within the winter months
- Greater levels of activity in early afternoon, evenings and on weekends.

Should the Northwood Airport develop a hard surface runway, the distribution of activity within a typical week change slightly.

The number of aircraft operations is expected to increase from an estimated 4536 total annual operations in 1989-90 to 6156 within the 20 year planning period. The increase in activity is based upon the assumption that a hard surface runway would be developed at the airport.

Whereas the number itinerant operations at most airports exceed local operations; the number of local operations at Northwood is expected to represent a greater percentage of the total operations than typically found. Should the airport support a hard surface runway, the number of itinerant operations would be expected to increase.

TABLE 2-21: TOTAL ANNUAL AIRCRAFT OPERATIONS, 1990 - 2009

Year	Total Annual	Operation Itinerant		Local	
1990	4536	(50%)	2268	(50%)	2268
1994	5184	(55%)	2851	(45%)	2333
1999	5184	(55%)	2851	(45%)	2333
2009	6156	(60%)	3694	(40%)	2462

SOUCE: PDS, 1989

The actual number of aircraft operations will vary annually.

- Itinerant operations generated by local industry
- Itinerant operations generated by aerial applicators
- Local student and sky diving activity

Aerial application activity is defined as an itinerant operation.

The operational mix throughout the 20 year planning period is expected to consist for the most part of operations by single engine and light twin engine piston powered aircraft. Occasional use of the facility by turbo prop aircraft could be excepted.

The majority of aircraft operations will be conducted by aircraft with an approach speed under 91 knots and a wingspan up to but not including 49 feet. Occasional activity will be noted by aircraft having an approach speed in excess of 91 knots but less than 121 knots. Wingspan of those aircraft utilizing the Northwood airport facility would generally not exceed 49 feet.

An airport designed to Airplane Design Group I standards would provide an adequate level of service over the twenty-year planning period. Representative airplanes within Approach Category A and B with wingspans of less than 49 feet that may utilize the Northwood Municipal Airport are noted as follows:

Cessna 402	6,850 pounds
Piper Navajo	6,500 pounds
Beech Baron B55	5,100 pounds

As previously noted, an airport developed to Airplane Design Group I standards would generally accommodate those airplanes expected to be based at the airport over the next twenty year period. Such aircraft are representative of those having an approach speed of less than 91 knots and wingspans up to but not including 49 feet. Operations by itinerant aircraft would include those aircraft in Approach Categories A and B and wingspans up to but not including 79 feet.

Justification for constructing the airport to serve those aircraft with wingspans in excess of 49 feet but less than 79 feet would be found only upon evidence that 500 or more annual operations were conducted by such aircraft.

No indepth assessment of peak day and peak hour operational activity was made. Refernce to FAA AC 150/5060-5, Airport Capacity and Delay, provides the following scenario concerning airport capacity.

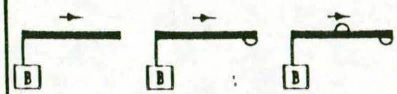
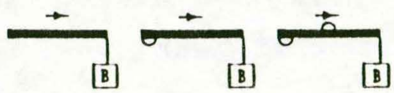
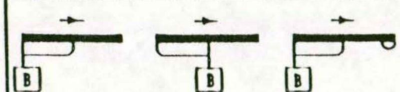
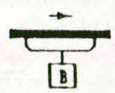
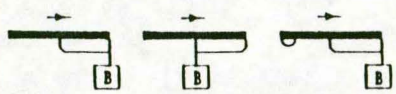
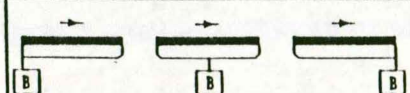
Conditions:

1. Class A and B Aircraft
2. Approved approach procedure
3. Arrivals equal departures
4. There are no airspace limitations affecting runway use

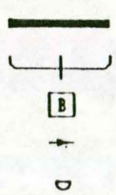
Variables:

1. Airport configuration
2. Percent touch and go operations
   - 0 - 25 percent
   - 26 - 50 percent

Configurations one and three, as shown in Figure 2-1, are descriptive of the existing airport. The illustrations reveal that under IFR conditions, 20 to 24 operations per hour could be conducted. Hourly operational capacity will vary under VFR conditions subject to the number of touch and go operations and direction of the operation. The existing airport with a single runway could accommodate in excess of 100,000 annual aircraft operations.

CONFIG. No.	AIRFIELD CONFIGURATION	HOURLY CAPACITY IN VFR PERCENT TOUCH-AND-GO 0 TO 25	HOURLY CAPACITY IN VFR PERCENT TOUCH-AND-GO 26 TO 50	HOURLY CAPACITY IN IFR
		(OPERATIONS PER HOUR)		
1		54 TO 66	66 TO 85	20 TO 24
2		59 TO 72	72 TO 92	20 TO 24
3		40 TO 50	50 TO 67	20 TO 24
4		82 TO 97	97 TO 117	20 TO 24
5		71 TO 85	85 TO 106	20 TO 24
6		60 TO 72	72 TO 92	20 TO 24
7		SEE CHAPTER 3		

LEGEND:



RUNWAY

TAXIWAY

BASING AREA

DIRECTION OF OPERATION

TURNAROUND

Hourly capacity of single runway airports, without radar coverage or ILS, serving small aircraft only.

FIGURE 2 - 2: HOURLY CAPACITY - SINGLE RUNWAY

FACILITY REQUIREMENTS

CHAPTER THREE
AIRPORT FACILITY REQUIREMENTS

INTRODUCTION

Development Concept

Chapter Three outlines those facilities required to meet and satisfy anticipated aviation activity through the year 2010. Facility requirements outlined herein are based upon Federal Aviation Administration (FAA) and Iowa Department of Transportation (IDOT) airport design standards and guidelines.

The FAA has continued to refine design standards for airport facilities. FAA AC 150/5300 - 13 dated 9/28/89 sets forth new requirements that contributes to the development and maintenance of a national system of safe, delay-free, and cost-effective airports.

The FAA has developed an Airport Reference Code (ARC) that relates the design of airport facilities to the operational and physical characteristics of the airplanes operating at the facility. The selection of an appropriate airport reference code is based not only upon present service level demands but future levels of aviation activity as well. The Airport Reference Code is based on two components that relate to the design aircraft or a group of aircraft with similar characteristics. These two components are:

(1) Aircraft Approach Category (Approach speed)
(2) Airplane Design Group (Wing span)

Current aircraft have been placed into five categories and are defined as follows:

Category A:	Speed less than 91 knots.
Category B:	Speed 91 knots or more but less than 121 knots.
Category C:	Speed 121 knots or more but less than 141 knots.
Category D: -	Speed 141 knots or more but less than 166 knots.
Category E:	Speed 166 knots or more.

The Airplane Design Group (ADG) are aircraft placed into grouping based on wingspan. These groups are as follows:

Group I:	Up to but not including 49 feet.
Group II:	49 feet up to but not including 79 feet.
Group III:	79 feet up to but not including 118 feet.
Group IV:	118 feet up to but not including 171 feet.
Group V:	171 feet up to but not including 214 feet.
Group VI:	214 feet up to but not including 262 feet.

Utility airports are those that serve aircraft in Approach Category A and B while a transport category airport is one designed, constructed and maintained to serve airplanes in Approach Category C and D. Utility airports are subdivided based upon the level of service they are expected to provide.

Airport Classification	Airport Reference Code
Basic Utility - Stage I	ARC B-I
Basic Utility - Stage II	ARC B-I
General Utility - Stage I	ARC B-II
General Utility - Stage II	ARC B-III

A majority of aircraft operations at low activity general aviation airports will be by aircraft with a gross landing and/or take-off weight under 12,500 pounds. The approach speeds would typically be less than 91 knots while wingspans would generally not exceed 49 feet. Where there is measurable operational activity by business aircraft, the airport would find increased activity by aircraft with an approach speed in excess of 91 knots but less than 121 knots and a wingspan less than 79 feet.

The Wisconsin Department of Transportation grouped current aircraft into sets based upon approach speed, wingspan, weight, and engine classification. Using FAA criteria, the type of airport required to serve that set of aircraft was identified. Reference may be made to Table 3-1 which identifies the aircraft set by a four digit code. The fourth number designates the airport type which should serve that aircraft.

AIRCRAFT SETS

For airport design purposes, all aircraft have been grouped into sets which reflect commonality in size or operating characteristics. The aircraft sets are coded according to the following 4-digit identification:

1st column designates the aircraft's approach speed category:

A =< 91 knots
B = 91-120 knots
C = 121-140 knots
D = 141-166 knots
E => 166 knots

2nd column designates the aircraft's wing span design group:

1 =< 49'
2 = 49'-78'
3 = 79'-117'
4 = 118'-170'
5 = 171'-196'
6 = 197'-262'

3rd column designates the aircraft's weight and engine classification:

A =< 12,500 lbs./single engine
B =< 12,500 lbs./multiple engine
C = 12,500 lbs.-59,999 lbs.
D = 60,000 lbs.-300,000 lbs.
E => 300,000 lbs.

4th column designates the airport type which should serve the particular aircraft:

1 = Basic Utility Stage I
2 = Basic Utility Stage II
3 = General Utility Stage I
4 = General Utility Stage II
5 = Transport
0 = Local Service

The following listing groups individual aircraft models by aircraft set designation.

TABLE 3-1: AIRPORT TYPE AND ASSOCIATED AIRPLANES

SOURCE: WISCONSIN DEPARTMENT OF TRANSPORTATION
Wisconsin Airport System Plan: 1986 - 2010, December, 1986

A1A1 (2.5)

PLANE MAKE	MODEL
ABCO	SPECIAL
ACRO SPORT	II
ADVENTURE FARRIS	P51D
AERO COMMANDER	112
AERO COMMANDER	100
AERO COMMANDER	100-180
AERO COMMANDER	112-A
AERO COMMANDER	S-2
AEROCAR	III
AERONCA	50-L
AERONCA	65-TL
AERONCA	50-C
AERONCA	C-3
AERONCA	65-TC
AERONCA	50-F
AERONCA	65-LA
AERONCA	K
AERONCA	65-CA
AERONCA	0-58-B
AERONCA	65-LB
AERONCA	7-EC
AERONCA	0-58-B
AERONCA	65-TAL
AERONCA	7-DC
AERONCA	65-C
AERONCA	7-AC
AERONCA	15-AC
AERONCA	11
AERONCA	7-CCM
AERONCA	15
AERONCA	6
AERONCA	7
AERONCA	11-CC
AERONCA	11-AC
AERONCA	11-BC
AERONCA	7-BCM
AEROTEK-PITTS	S-2A
AIR TRACTOR	301-A
ALON	A-2A
AMERICAN EAGLET	231
B/6 DART	150
BAKENG-HURD	DOUBLE DUCE
BAKER	SPECIAL 001
BARNEY OLDFIELD	BABY GREAT LAKE
BARRACUDA	CA-2
BECKHAM-SHEAHAN	CASSUTT M
BEDE	BD-4
BEDE	BD-5B
BEDE	BD-5
BEDE-HALEY	BD-5
BEDE-MCCOOK	BD-4
BEDE-THOMPSON	BD-5 JET
BEE AVIATION	HONEY BEE
BEECHCRAFT	B-17-L
BEECHCRAFT	D-17-S
BEECHCRAFT	E-33-C
BEECHCRAFT	F-33-A
BEECHCRAFT	D-45
BEECHCRAFT	B-24-R
BEECHCRAFT	A-23-19
BEECHCRAFT	C-24-R
BEECHCRAFT	E-17-L
BEECHCRAFT	C-33-A
BEECHCRAFT	A-24-R
BEECHCRAFT	A-36-TC
BEECHCRAFT	A-23-24
BEECHCRAFT	A 23-19
BEECHCRAFT	E-33-A
BEECHCRAFT	A-23-A
BEECHCRAFT	M-35
BEECHCRAFT	G-17-S
BEECHCRAFT	A-19
BEECHCRAFT	S-35
BEECHCRAFT	33
BEECHCRAFT	23
BEECHCRAFT	YQU-22A
BEECHCRAFT	22

A1A1 (2.5)

PLANE MAKE	MODEL
BEECHCRAFT	B-33
BEECHCRAFT	H-35
BEECHCRAFT	F-33
BEECHCRAFT	J-35
BEECHCRAFT	A-33
BEECHCRAFT	K-35
BEECHCRAFT	G-35
BEECHCRAFT	N-35
BEECHCRAFT	BE-77
BEECHCRAFT	P-35
BEECHCRAFT	35
BEECHCRAFT	E-33
BEECHCRAFT	C-33
BEECHCRAFT	U-35-B
BEECHCRAFT	B-19
BEECHCRAFT	V-35
BEECHCRAFT	A-23
BEECHCRAFT	V-35-A
BEECHCRAFT	D-35
BEECHCRAFT	V-35-B
BEECHCRAFT	77
BEECHCRAFT	V-35-B-TC
BEECHCRAFT	A-36
BEECHCRAFT	B-24
BEECHCRAFT	E-35
BEECHCRAFT	A-35
BEECHCRAFT	F-35
BEECHCRAFT	B-77
BEECHCRAFT	36
BEECHCRAFT	C-24
BEECHCRAFT	B-23
BEECHCRAFT	A-24
BEECHCRAFT	C-35
BEECHCRAFT	C-23
BEECHCRAFT	B-35
BELLANCA	14-13
BELLANCA	17-30-A
BELLANCA	17-30-A
BELLANCA	17-30
BELLANCA	17-30A
BELLANCA	14-19-2
BELLANCA	7-ACA
BELLANCA	14-19-3
BELLANCA	14-13-2
BELLANCA	CH-300
BELLANCA	7-ECA
BELLANCA	7-KCAB
BELLANCA	8
BELLANCA	14
BELLANCA	8-GCBC
BELLANCA	7-GCBC
BELLANCA	8-KCAB
BELLANCA	17
BELLANCA	7
BLAIR-FLOOD	SIDEWINDER
BOEING	N-2-S-4
BOEING	A-75
BOEING	A-75-N-1
BOEING	E-75-N-1
BOEING	A-75-L-3
BOEING	B-75-N-1
BOEING	A-75-L-300
BOEING	E-75
BOEING	PT-17-A
BOEING-JONES	75
BOWERS FLY BABY	1-A
BOWERS-HAUGE	FLY-BABY
BREEZY	RUL
BREEZY	RUL-1
BUCKER	BU-133
BUCKER	BU-133-L
BUCKER-JUNGMANN	CASA 1.131
BUD	A
BURNS	BA-42
BUSHBY-ARMSTRONG	MUSTANG II
BUSHBY-CARLSON	MIDGT MUSTANG
BUSHBY-DEWEESE	MUSTANG II

A1A1 (2.5)

PLANE MAKE	MODEL
BUSHBY-GRIMM	MUSTANG II
BUSHBY-KROGMAN	MUSTANG II
BUSHBY-LAREAU	MIDGET MUSTAN
BUSHBY-MACHUS	MUSTANG II
BUSHBY-MALICK	MUSTANG II
BUTT	ALPHA
CA-61/ANDERSON	MINI-ACE
CANADAIR	F-86 MK.5
CANADIAN	T-33
CANADIAN CAR & FOUNDRY	HARVARD MKIV
CASSUTT	II
CASSUTT	II-M
CASSUTT	III-M
CASSUTT	0
CASSUTT-CORE	SPORT RACER
CASSUTT-ELG	III-M
CENTRAIR	PEGASUS 101-A
CESSNA	152-II
CESSNA	
CESSNA	180-K
CESSNA	P-210
CESSNA	175-A
CESSNA	R-182RG
CESSNA	182-RG
CESSNA	182-B
CESSNA	A-185-F
CESSNA	182-E
CESSNA	172-C
CESSNA	182-C
CESSNA	172-A
CESSNA	T-210-F
CESSNA	170-B
CESSNA	150-D
CESSNA	170
CESSNA	172-M
CESSNA	150-M
CESSNA	182-D
CESSNA	150-L
CESSNA	210
CESSNA	150-H
CESSNA	210-M
CESSNA	207
CESSNA	172-N
CESSNA	U-206-F
CESSNA	172-P
CESSNA	206
CESSNA	172-RG
CESSNA	U-206
CESSNA	172-IP
CESSNA	205-A
CESSNA	175
CESSNA	TU-206-F
CESSNA	L-19
CESSNA	205
CESSNA	175-B
CESSNA	TU-206-C
CESSNA	177
CESSNA	180-J
CESSNA	177-A
CESSNA	T-41-B
CESSNA	177-B
CESSNA	195-B
CESSNA	177-RG
CESSNA	140
CESSNA	180
CESSNA	195
CESSNA	180-A
CESSNA	T-210-M
CESSNA	180-C
CESSNA	190/195
CESSNA	180-D
CESSNA	T-210
CESSNA	180-E
CESSNA	190
CESSNA	180-F
CESSNA	172-K
CESSNA	180-H

PLANE MAKE	MODEL
CESSNA	180-H
CESSNA	188-A
CESSNA	180-I
CESSNA	R-172-IP
CESSNA	210-L
CESSNA	188
CESSNA	210-J
CESSNA	P-206-B.
CESSNA	210-H
CESSNA	185-A
CESSNA	210-G
CESSNA	A-188-B
CESSNA	210-D
CESSNA	185
CESSNA	210-B
CESSNA	170-A
CESSNA	210-A
CESSNA	182
CESSNA	150-J
CESSNA	182-G
CESSNA	U-206-G
CESSNA	182-A
CESSNA	U-206-A
CESSNA	150-E
CESSNA	TU-206-G
CESSNA	182-Q
CESSNA	150-C
CESSNA	150-B
CESSNA	T210L
CESSNA	182-P
CESSNA	140-A
CESSNA	172-E
CESSNA	T-41
CESSNA	182-N
CESSNA	172-F
CESSNA	172-H
CESSNA	172-I
CESSNA	182-M
CESSNA	R-182
CESSNA	P-210-N
CESSNA	P-206-C
CESSNA	182-L
CESSNA	C-38
CESSNA	172-B
CESSNA	172
CESSNA	182-K
CESSNA	150-G
CESSNA	150-F
CESSNA	172-D
CESSNA	182-J
CESSNA	TR-182
CESSNA	150
CESSNA	120
CESSNA	182-H
CESSNA	172-G
CESSNA	182-R
CESSNA	R-172-K
CESSNA	A-185-E
CESSNA	182-F
CESSNA	A-152
ESSNA	U-206-C
ESSNA	A-150-M
ESSNA	150-A
ESSNA	A-150-L
ESSNA	172-L
ESSNA	A-150-K
ESSNA	152
ESSNA	210-N
ESSNA	T-210-L
ESSNA	TU-206-E
ESSNA	P-206-A
ESSNA	150-K
S-PETERSON	HAWK
S-PETERSON	650
AMPION	7
AMPION	7-EC
AMPION	7-GCAA

PLANE MAKE	MODEL
CHAMPION	7-FC
CHAMPION	7-GCB
CHAMPION	7-ECA
CHAMPION	7-KCAB
CHAMPION	7-GC
CHAMPION	7-HC
CHAMPION	7-GCBC
CHANCE-VOUGHT	F4U-4
CHESTER	SPECIAL
CHRISTEN-BOYD	EAGLE II
CHRISTEN-DOYLE	EAGLE II
CHRISTEN-HUMPHREY	EAGLE II
CHRISTEN-JOHNSON	EAGLE
CHRISTEN-ROSS	EAGLE II
CHURCH	JC-1
CLANCY	SKYBABY
CLOYD-HOMEBUILT	SH-2
COMMONWEALTH	185
CONSOLIDATED	BT-13
CORBEN	C-1
CORBEN	E-JR ACE
CORBEN	BABY ACE
CORBEN-FUCHS	JUNIOR ACE E
CORBEN-GRUNSKA	BABY ACE D
CORBEN-LAMBERT	BABY ACE D
CORBEN-OLSEN	BABY ACE
CUBBER II	C-1
CULVER	V
CULVER	LCA
CURTISS-WRIGHT	C-1 ROBIN
CURTISS-WRIGHT	CW-1
CURTISS-WRIGHT	O-52
CURTISS-WRIGHT	E-8-75
CURTISS-WRIGHT	E-4000
CURTISS-WRIGHT	4000
CURTISS-WRIGHT	E-8-90
CURTISS-WRIGHT	TRAVEL AIR 12
CURTISS-WRIGHT	TRAVEL AIR 16-E
CYGNET	2F-2A
DART	GK33
DAVIS	DA-2-A
DAVIS	D-1-W
DAVIS	D-2
DAVIS-VAN BELKOM	DA-2
DICKAU	ESPERANZA
DIXON	FORMAL VEE
DREWS	B-1-A
DYKE-WHITE	DELTA JD-2
EAA	ACRO SPORT
EAA	POBER PIXIE
EAA-BEYERSDORF	BIPLANE P-2
EAA-CHOMO	EAA BIPLANE
EAA-ERICKSON	ACROSPORT II
EAA-GORES	ACRO SPORT II
EAA-GUNDERSON	BIPLANE AG-1
EAA-KNUTSON	AERO-SPORT II
EAA-MASSOPUST	ACRO SPORT II
EAA-MEADE	BIPLANE GAM-1
EAA-RODER	ACRO SPROT-15
EAA-UNERTL	BIPLANE P-1
ELMENDORF	A-1
ERCOUPE	415-E
ERCOUPE	415
ERCOUPE	415-D
ERCOUPE	415-G
ERCOUPE	415-C
ERCOUPE	415-CD
ERCOUPE-ALON	A-2A
ERCOUPE-ALON	A-2
ERCOUPE-FORNEY	F-1
ERCOUPE-MOONEY	M-10 CADET
ESTUPINAN	HOVEY WD-A
EVANS-DION	VP-1
EVANS-KEMMER	VP-1
EVANS-MOCKRUD	VP-1
EVANS-SHAFFER	VP-1
FAIRCHILD	24-W-41-A

PLANE MAKE	MODEL
FAIRCHILD	FC-2-W-2
FAIRCHILD	24-W-46
FAIRCHILD	24-C-8-F
FAIRCHILD	24-C-8-A
FAIRCHILD	24-C-8-C
FAIRCHILD	24-J
FAIRCHILD	24-W-40
FAIRCHILD	M-62-A-4
FAIRCHILD	24-W
FAIRCHILD	M-62C
FAIRCHILD	24-R-46
FAIRCHILD	M-62-A-3
FAIRCHILD	M-62-C
FAIRCHILD	PT-26
FAIRCHILD	M-62-A
FAIRCHILD	PT-26A
FIKE	D
FLAGLOR	SCOOTER
FLAGLOR-DURLEY	SCOOTER
FOCK WULF	F W 190
FOCKE-WULF REPLICA	FW-190
FOKKER	D 6 1/2
FOKKER	D-VI
FOKKER	DR-1 TRI-PLAN
FORSGREN	LF-1
FRANKLIN SPORT	90
FULWILER-DERJAEGE	WWI
GANTZER	NESMITH-COUGAR
GDISIS	GLASAIR
GOLDWING-PETERSON	GOLD DUSTER ST
GREAT LAKES	2T-1A-2
GREAT LAKES	2-T-1-A
GREAT LAKES	2T-1A
GREAT LAKES	2T-1A-E
GREAT LAKES	2-T
GREAT LAKES-ADAMS	2T-1
GRIFFIN-PITTS	S-1C
GROB	G-109
GRUMMAN	J-2-F-6
GRUMMAN	G-164
GRUMMAN	AF-2S
GRUMMAN	G-164-A
GRUMMAN AMERICAN	AA-5B
GRUMMAN AMERICAN	AA-5A
GRUMMAN AMERICAN	AA-1C
GRUMMAN AMERICAN	AA-1B
GRUMMAN AMERICAN	AA-1A
GRUMMAN AMERICAN	AA-1
GRUMMAN AMERICAN	AA-5
GRUMMAN-AMERICAN	AA-5-A
GRUMMAN-AMERICAN	AA-5-B
GUMM	MINICAB-MOD
GUNDERSON	TRAINER
GUPPY-MINTZLAFF	SNS-2
HALBERSTADT-SWANSON	D IV
HARLOW	PJC-2
HATZ	CB-1
HATZ-SCHMUNK	CB-1
HATZ-STRUB	LB-1
HATZ-VANDERGEEST	CB-1
HAWK	3
HEATH	PARASOL
HEATH-BAUMER	PARASOL
HEATH-DEANGELO	PARASOL
HEGY/CHUPAROSA	R C H I
HELIO COURIER	H-391
HOLLANDER-CASSUTT	III-M
HOWARD	DGA-15-J
HOWARD	DGA-15-P
HU-GO CRAFT	VPS
INMAN	ACRO SPORT I
INTERSTATE	S-1-A
JEANIES	TEENIE
JEWETT-LOURDES	O
JEWETT-MULLIKEN	Q-2
JEWETT-SAVELS	Q-2
JEWETT-SWANNINGSON	QUICKIE

PLANE MAKE	MODEL
JEWETT-UNGERECHT	Q-2
JEWETT-WOLETZ	QUICKIE
JOHNSON	MINICOUPE
JOHNSON	O-I-L
JOHNSON	ROCKET 185
JURCA	MJ-5J2
KIRK-LUMLEY	COTTONTAIL
KOSTLEVY	FHK HAWK
LAIRD	SPECIAL
LAIRD	LC-DW500
LAKE	LA-4-200
LAKE	LA-4
LAPAN	XT-400
LINCOLN	PT-K
LITTLE ABBIE	KW-1
LOCKHEED	VEGA-5-C
LOVING-OMERNICK	LOVINGS LOVE
LUSCOMBE	8-C
LUSCOMBE	8-E
LUSCOMBE	8
LUSCOMBE	8-I
LUSCOMBE	8-F
LUSCOMBE	11-A
LUSCOMBE	T-8-F
LUSCOMBE	8-A
LUTON-SPONEM	MINOR
MARANDA-TURNER	AMF-S-14-D
MAULE	M-4
MAULE	M-5-235C
MAULE	M-4-210-C
MAULE	M-5
MAULE	M-4-220C
MAULE	M-5-220-C
MEADOWCROFT	CHINNOK
MESSERSCHMITT	ME-109-C4K
MESSERSCHMITT	BO-209
METKE	1-MOD
MEYER	LITTLE TOOT
MEYERS	OTW
MEYERS	200-A
MIDGET MUSTANG	M-1
MIDGET MUSTANG	MM-1
MIGNET	HM-293
MONG SPORT	MS-2
MONG SPORT	MS-2-K
MONNETT	MONEX
MONNETT	SONERAI II
MONNETT	MONI
MONNETT-BECK	MONI
MONNETT-BUTLER	SONERAI II
MONNETT-CULVER	SONERAI-II
MONNETT-DENIL	SONERAI II
MONNETT-EISENBRANDT	SONERAI II
MONNETT-GABLE	SONERAI II
MONNETT-KAMKE	MONI
MONNETT-KEIP	SONERAI II
MONNETT-KLUDY	SONERAI I
MONNETT-LARSON	SONERAI II
MONNETT-LASEURE	SONERAI II
MONNETT-LAVIN	SONERAI IIL
MONNETT-MALZAHN	SONERAI II
MONNETT-MANGAN	SONERAI II
MONNETT-MAREK	MONI
MONNETT-MCCOY	SONERAI-I
MONNETT-MIRACLE	SONERAI II
MONNETT-NELSEN	SONERAI II
MONNETT-NIELSEN	SONERAI ILL
MONNETT-NOVAK	SONERAI II
MONNETT-ROBERTS	SONERAI II
MONNETT-SIKORA	SONERAI II
MONNETT-SONERIA	SONERIA II LTS
MONNETT-TAPPON	SONERAI II
MONNETT-WARNING	MONI
MONNETT-WOOD	SONERAI II
MONOCOUPE	110 SPECIAL
MONOCOUPE	110
MONOCOUPE	90-A

PLANE MAKE	MODEL
MONOCOUPE	113
MOONEY	M-20-E
MOONEY	M-20-G
MOONEY	M-20-D
MOONEY	M-18
MOONEY	M-20-B
MOONEY	M-20-A
MOONEY	M-20-F
MOONEY	M-20-J
MOONEY	M-20-C
MOONEY	M-20-K
MOONEY	M-18-L
MOONEY	M-20
MORANE-SAULNIER	181
NAVION	NAVION
NAVION	L-17-B
NAVION	G-1
NAVION	B
NAVION	A
NAVY	N3N-3
NICHOLAS BEAZLEY	NB-8-G
NORTH AMERICAN	SNJ-5
NORTH AMERICAN	IP-51
NORTH AMERICAN	P-51D
NORTH AMERICAN	AT-6D
NORTH AMERICAN	P-64
NORTH AMERICAN	NAVION E
NORTH AMERICAN	P-51-D
NORTH AMERICAN	T-28C
NORTH AMERICAN	T-28
NORTH AMERICAN	HARVARD MK-4
NORTH AMERICAN	T-28-A
NORTH AMERICAN	AT-6
NORTH AMERICAN	T-28-B
NORTH AMERICAN	AT-6-G
NORTH AMERICAN	NAVION
NORTH AMERICAN	AT-6-A
NORTH AMERICAN	P-51
NORTH AMERICAN	F-51D
OLAH	CASSUTT III-M
OLDFIELD SPECIAL	BABY GREATLAKES
OLDFIELD-LARSON	BABY GREATLAKES
OLDFIELD-TRIDLE	BABY GREATLAKES
OWEN	S-1
PARKER	JP-001
PAZMANY-FLYNN	PL-4
PAZMANY-RODENCAL	PL-4
PAZMANY-THOMAS	PL-2
PEEREIA-MAHLER	OSPREY II
PEREIRA-BOREMANS	OSPREY II
PEREIRA-RICHARTZ	OSPREY II
PEREIRA-SCHAEFER	OSPREY II
PEREIRA-SCHIFFERER	OSPREY II
PEREIRA-SCHIFFERER	O SPREY II
PEREIRA-TROWBRIDGE	OSPREY II
PEREIRA-WILSON	OSPREY II
PERTH AMBOY	BIRD BK
PETE MYERS SPCIAL	M1
PHEASANT	OLB
PIEL-BENTLEY	CP 750 BERYL
PIEL-BORREMANS	CP-311 EMERAU
PIEL-FOBES	SUPR EMERAUDE
PIEL-GULTCH	EMERAUDE 301A
PIEL-MCCONNELL	CP-304-A EMERAU
PIEL-WEAVER	CP-301
PIERERA-SCHAEFER	OSPREY II
PIETENPOL	AIRCAMPER
PIETENPOL	GN-1
PIETENPOL-BEESON	AIRCAMPER
PIETENPOL-CHALLIS	CHAFFINCH
PIETENPOL-KNIGHT	AIR CAMPER
PIETENPOL-LOEHNDORF/DU	AIRCAMPER
PIETENPOL-MARTALOCK	AIR CAMPER
PIETENPOL-MOCK	AIR CAMPER
PIETENPOL-SWENSON	AIRCAMPER
PIPER	PA-28-200-R
PIPER	140

PLANE MAKE	MODEL
PIPER	140
PIPER	PA-36-300
PIPER	PA-28R-201
PIPER	PA-28-181
PIPER	PA-28-180-B
PIPER	PA-28-160
PIPER	PA-36-285
PIPER	PA-28-235
PIPER	PA-28-161
PIPER	PA-28-235 C
PIPER	PA-32-301
PIPER	PA-28-235-B
PIPER	PA-28-151
PIPER	PA-28-235-C
PIPER	PA-32-300-E
PIPER	PA-28-235-D
PIPER	PA-28-180-F
PIPER	PA-28-235-F
PIPER	PA-32-300-C
PIPER	PA-28-236
PIPER	PA-25-260-C
PIPER	PA-28R-180
PIPER	PA-32-300
PIPER	PA-28R-200
PIPER	PA-28-180-D
PIPER	PA-28-180-C
PIPER	PA-32-260-C
PIPER	PA-32-260
PIPER	PA-28-160-B
PIPER	PA-28RT-201T
PIPER	PA-32-260-B
PIPER	PA-28-140-C
PIPER	PA-28-140
PIPER	PA-28-180-G
PIPER	PA-28R-201T
PIPER	PA-28-180-E
PIPER	PA-38-112
PIPER	PA-28-160-C
PIPER	E-2
PIPER	PA-28-140-B
PIPER	PA-28-140-D
PIPER	PA-28-180
PIPER	PA-25-235-D
PIPER	PA-28-140-E
PIPER	PA-28RT-201
PIPER	PA-22-150
PIPER	J-3-C-85
PIPER	PA-20-115
PIPER	PA-18A-150
PIPER	PA-25-235
PIPER	J-3-F-60
PIPER	PA-18-135
PIPER	J-3-C-75
PIPER	PA-18-150
PIPER	J-3-F-65
PIPER	PA-18-95
PIPER	J-4-A
PIPER	PA-18-A
PIPER	PA-24-250
PIPER	PA-18-S
PIPER	PA-14
PIPER	PA-18A-135
PIPER	PA-24-260
PIPER	PA-22-108
PIPER	L-4
PIPER	PA-20-150
PIPER	PA-20-135
PIPER	PA-25-150
PIPER	PA-18-105 SPE
PIPER	PA-24-400
PIPER	PA-18-125
PIPER	PA-22-160
PIPER	PA-22-20 CONV
PIPER	PA-24-260-C
PIPER	J-5-A
PIPER	PA-20-125
PIPER	PA-22-125

A1A1 (2.5)

PLANE MAKE	MODEL
PIPER	PA-22-125
PIPER	J-3-L-65
PIPER	PA-24-180
PIPER	PA-18-105
PIPER	PA-18A-135 RS
PIPER	J-4-E
PIPER	PA-24-260-B
PIPER	PA-22-20
PIPER	J-3-C-65
PIPER	PA-22-135
PIPER	PA-25-235-C
IPER	PA-36
IPER	PA-28
IPER	PA-15
IPER	PA-18
IPER	PA-12
IPER	J-3
IPER	PA-17
IPER	PA-22
IPER	PA-24
IPER	J-5
IPER	PA-39
IPER	PA-20
IPER	J-2
IPER	PA-11
IPER	PA-25
IPER	PA-16
IPER	PA-38
ITCAIRN	PA-39
ITTS	S-1S
ITTS	S1S
ITTS	SC-1
ITTS	SPECIAL
ITTS	S-2A MOD
ITTS-BARNEY	S-1C
ITTS-BAUMGARTNER	S-1
ITTS-EAA	S-2
ITTS-FERGUS	SC-1
ITTS-GARCIA	S-1
ITTS-GRIFFIN	S-1C
ITTS-HEGY	S-1C
ITTS-HEIRONIMUS	S-1S
ITTS-HINCHCLIFFE	S-1
TTS-KILLOUGH	S-1S
TTS-KING	S-1S
TTS-LIND	S-1D
TTS-MERRICK	S-1
TTS-MILES	S-1C
TTS-MUMM	S-1C
TTS-OTTERBACK	S-1
TTS-POBEREZNY	P-6
TTS-POBEREZNY	P-7
TTS-SCHLAMER	51E
TTS-SCHMIDT	S-1S
TTS-SHEA	S-1C
TTS-SWEET	SA-1
TTS-WERNER	S-2E
TTS-WHEELER	S-1
TTS-WOOLAWAY	S-1C
IER SPORT	P-5
IER SPORT	P-12
TER	GEIST
ER SPORT	P-5
TERFIELD	LP-65
TERFIELD	35-70
TERFIELD	CP-65
NCE	BUSH-HOPPER I
HER	WOODS-CHAPTER
	112-1
	112-A
D	KR-2
D ROBINSON	KR-1
D-ANDREW	KR-1
D-BAK	KR-2
D-BEILFUS	KR-2
D-EIDE	KR-2
D-KINKEMA	KR-2

A1A1 (2.5)

PLANE MAKE	MODEL
RAND-LUDTKE	KR-2
RAND-THOMA	KR-2
RAND-TIMLER	KR-2
RAND-TIMLER	KR-1
RAND-WARNELL	KR-1
REARWIN	9000
REARWIN	8135-T
REARWIN	7000
REARWIN	8135 CLOUDSTER
REARWIN	8500
REARWIN	8500
REARWIN	8135
REARWIN	175
REPLICA-NIEUPORT	NIEUPORT
REPUBLIC	RC-3
REPUBLIC-DOWNER	RC-3
REZICH BROTHERS	SPECIAL
RICHARD	190A
ROCKWELL	112-A
ROCKWELL	112-TC
ROCKWELL	112
ROCKWELL	114
RUTAN	VARIVIGGEN
RUTAN	VARIEZE
RUTAN-AMS/OIL	68
RUTAN-COX	VARIEZE
RUTAN-ESH	LONG-EZ
RUTAN-HILLESHEIM	VARIEZE
RUTAN-LEMASTER/PAGE	VARI-EZE
RUTAN-PALMER	VARI-EZE
RUTAN-PASCARELLA	VARI EZE
RUTAN-PAVLOVICH	VARIEZE
RUTAN-RADTKE	VARIEZE
RUTAN-ZABLER	VARIEZE
RYAN	ST-3
RYAN	SCW-145
RYAN	NAVION B
RYAN	ST-3-KR
RYAN	NAVION
RYAN	A
RYAN	SCW
SAWYER	GLASAIR
SCORPION	SCORPIAN 133
SCOTT	IS-1
SH/KLAPMEIER	GLASAIR
SHAFOR	GANAGOBIE
SKY HOPPER	22
SKY HOPPER	10
SLO-JO	SJ-165
SMITH GREGORIE	MINIPLANE DSA-1
SMITH MINIPLANE	DSA-1
SMITH-GREGORIE	MINIPLANE DSA-1
SMITH-KLEIN	MINIPLANE
SMITH-MINIPLANE	DSA R-1
SMITH-MINIPLANE	DSA-1
SMITTYS TERMITE	JT-1
SMYTH-PIEPER	SIDEWINDER
SMYTH-RAICOS	SIDEWINDER
SNOW	600
SNOW	AIR TRACTOR
SNOW	600S2C
SNOW	S-2-C
SNOW	AT-301
SNOW	S-2
SOUTH BAY	CA-61
SOUTHWORTH TANDEM	S-1 TEDDYBEAR
SPARTAN	C-3165
SPARTAN	EXECUTIVE 7W
SPENCER	SPECIAL
SPEZIO-JAROS	SPORT
SPINKS	AKROMASTER
STARDUSTER	TOO
STARDUSTER	SA-200
STATE SECURITIES	ARROW F
STEARMAN	4-C
STEEN	SKYBOLT
STEEN-ALLEN	SKYBOLT

A1A1 (2.5)

PLANE MAKE	MODEL
STINSON	108
STINSON	108-1
STINSON	10A
STINSON	108-3
STINSON	SM-8A
STINSON	SR-5A
STINSON	L-5-E
STINSON	SM-6B
STINSON	10-A
STINSON	108-2
STINSON	SR-8C
STINSON	SR-7B
STINSON	HW75
STINSON	SR-9C
STINSON	V77
STITS	SA-3
STITS	SA-6-A
STITS	SA-7-D SKYCOUPE
STITS	SA-9A
STITS	SA-11-A
STITS	SA-3-B
STITS	SA-3-A
STITS	SA-7-D
STITS	SA-6
STITS-SKEETO	SA-8
STOLP-CORNING	STARDUSTER TO
STOLP-DANIELS	SA300
STOLP-DELEY	SA-100
STOLP-EHLERS	ESA300
STOLP-ERIKSEN	STARDUSTER TOO
STOLP-ERIKSEN	STARDUSTER TOO
STOLP-GROOM	STARDUSTER TOO
STOLP-HENDERSON	STARDUSTER
STOLP-KENNEDY	STARDUSTER
STOLP-LIEN	STARDUSTER TO
STOLP-PFUNDHELLER	SA-300
STOLP-SEABRIGHT	SA-100
STOLP-STARLET	866-01-AB
STORY	WD-6
SWALLOW	TP
SWALLOW-KARAMIT IS	B
SWANSON	HALBERSTADT D 4
SWIFT	GC-1B
SWIFT	GC-1
TAYLOR	MONOPLANE
TAYLOR	T-2
TAYLOR-BECKHAM	MONO HB
TAYLOR-STEEVES	COOT-A
TAYLORCRAFT	BC-12-65
TAYLORCRAFT	F-19
TAYLORCRAFT	L-2M
TAYLORCRAFT	BC-12-D
TAYLORCRAFT	BL
TAYLORCRAFT	BC-65
TAYLORCRAFT	BL-65
TAYLORCRAFT	BC-12-DL
TAYLORCRAFT	BF-50
TAYLORCRAFT	BL-12-65
TAYLORCRAFT	BF-12-65
TAYLORCRAFT	DC-65
TAYLORCRAFT	BC-12-85
TAYLORCRAFT	BC-12D-1
TAYLORCRAFT	L-2-M
TAYLORCRAFT	L-2
TAYLORCRAFT	A
TAYLORCRAFT	DCO-65
TAYLORCRAFT	BL-65
TAYLORCRAFT	DC-65
TAYLORCRAFT	F-19
TAYLORCRAFT	BC-12
TAYLORCRAFT AVIAT	B-2 CHUMMY
TEMAN-KENNY	MONO-FLY
TERATORN	TIERRA I
TERATORN	TIERRA II
TERATORN-MARSHALL	TIERRA II
TERRATORN	TIERRA II
TERRATORN	TIERRA II

A1A1 (2.5)

PLANE MAKE	MODEL
TERRATORN-MCDANIEL	TIERRA
TESCHENDORF	FOUR-RUNNER
THOMAS-DICKAU	ESPERANZA-4
THORP	T-18
THORP-EWING	T-18
TIMM	N-2-T-1
TROJAN	A-2
TURNER	T-40-A
UEBEL-KNIGHT-TWIS	LIGHT WEIGHT
ULTRA LIGHT	HAWK 4
VANGRUNSVEN-PEDERSON	RV-3
VANTUIL	SPORTSMAN
VARGA	2150 A
VELLINE	BREEZY RLU-1
VELOON	COUGAR
VIKING-FLANAGAN	DRAGONFLY
VIKING-HAZELWOOD	DRAGONFLY
VIKING-HAZELWOOD	DRAGONFLY
VIKING-SWAN	DRAGONFLY
VOLKSPLANE	VP-2
VOLKSPLANE	VP-1
VOLKSPLANE	WE-1
VOLMER	VJ-22
VOLMER-FINN	SPORTSMAN VJ22
VULTEE	BT-13
VULTEE	BT-15
VULTEE	BT-13-A
WAG-AERO-POBEREZNY	CUBY
WACO	10
WACO	GXE
WACO	VKS-7-F
WACO	CUC
WACO	CTO
WACO	YOC
WACO	YKS-7
WACO	YKS-6
WACO	YKC
WACO	RNF
WACO	CJC
WACO	DJC-6
WACO	ARE
WACO	RPT
WACO	ASO
WACO	UPF-7
WACO-SOCATA	MS-894-A
WAG-AERO	ACRO TRAINER
WAG-AERO	CHUBBY-CUBY
WAG-AERO	WAG A BOND
WAG-AERO	CUBY
WAG-AERO-BARTLING	CUBY
WAG-AERO-EVENSON	SUPER CUBY
WAG-AERO-MCMANUS	SPORTSMAN 2+2
WAG-AERO-NYHOLM	CUBY
WAG-AERO-SCHNEIDER	SPORT TRAINER
WAG-AERO-SCHWEFEL	CUBY
WARWICK	W-4
WEBER-RAND	KR-2
WEFEL FLYING FLEA	HM-360
WHITAKER	CENTERWING
WITTMAN	WITTS V
WITTMAN	W-8
WITTMAN	TAILWIND
WITTMAN	W-10
WITTMAN	WO
WITTMAN	BONZO
WITTMAN	DFA
WITTMAN	W-37
WITTMAN	W-9-L
WITTMAN-COUGHLIN	W-10
WITTMAN-HUCH	TAILWIND
WITTMAN-MCQUISTON	TAILWIND W-8
WITTMAN-THIESSEN	TAILWIND
WOODY	PUSHER
WRIGHT-JVL VOTEC	FLYER REPLICA
ZENAIR-ASHWORTH	CH-200 ZENITH
ZENAIR-PHILLIPS	CH-250
ZENAIR-ROMBOUGH	CRICKET MC-12

A1A2 (3.0)

PLANE MAKE	MODEL
BEECHCRAFT	B-36-TC
CESSNA	T-210-N
DEHAVILLAND	DH-89A MKIV
DEHAVILLAND	TIGER MOTH82A
DEHAVILLAND-REPLICA	BE2C
PIPER	PA-32R 300
PIPER	PA-32R-301T
PIPER	PA-32-301T
PIPER	PA-32-160
PIPER	PA-32RT-301T
PIPER	PA-32RT-300
PIPER	PA-32R
PIPER	PA-32RT-300T
PIPER	PA-32R-300
PIPER	PA-32

A1A3 (3.5)

DE HAVILLAND	DHC-2
DEHAVILLAND	DHC-1
DEHAVILLAND	DHC-2

A1B1 (3.0)

ZENAIR-EBNETER	CRICKET MC-12

A1B2 (3.5)

AERO COMMANDER	560-F
AERO COMMANDER	560
BEECHCRAFT	76
BEECHCRAFT	T-34-A
BEECHCRAFT	EA-76
BEECHCRAFT	T-34-B
BEECHCRAFT	T-34-C
BEECHCRAFT	T-34
CESSNA	337-A
CESSNA	320-A
CESSNA	337-B
CESSNA	337-C
CESSNA	337-E
CESSNA	337
CESSNA	320-E
CESSNA	320-C
CESSNA	337-F
CESSNA	337-D
CESSNA	T-337-G-P
CESSNA	337-G
CESSNA	320-D
DORNIER	DO-28-A-1
DORNIER	DO-28-B-1
DORNIER	DO-28
GRUMMAN	G-44-A
GRUMMAN	G-44
GRUMMAN AMERICAN	GA-7 COUGAR
GULFSTREAM AMERICAN	GA-7
HALSMER	SAFETY TWIN #3
PARTENAVIA	68B VICTOR
PIPER	PA-601P
PIPER	PA-34-200
PIPER	PA-601B
PIPER	PA-34-T
PIPER	PA-34
PIPER	PA-34-200T
PIPER	PA-34-200-T
PIPER	PA-44-180
PIPER	PA-23-250-D
PIPER	PA-23-235
PIPER	PA-23-250-B
PIPER	PA-23-250
PIPER	PA-23-150
PIPER	PA-23-250-C
PIPER	PA-23-250-E
PIPER	PA-23-160
PIPER	PA-44
PIPER	PA-30
PIPER APACHE	PA-23

A1B3 (4.0)

PLANE MAKE	MODEL
AEROSTAR	601
BAUMAN	B-290
BONANZA	T-34
CESSNA	320
LEARFAN	2100
NOMAD	N-22-B
NOMAD	N-24
NOMAD	N-22
PIAGGIO	P-136-L
PIAGGIO	P-168 PORTOFINO
PIPER	PA-34-220-T
PIPER	PA-34-220T
PIPER	PA-34-
PIPER	PA-23-250-I
PIPER	PA-23-250-F
PIPER	PA-34
ROCKWELL	500-S
ROCKWELL	500-S
ROCKWELL	500

A1C4 (5.0)

DeH HERON	114

A2A2 (3.5)

PILATUS	PC-6

A2B2 (4.0)

AERO COMMANDER	500-B
AERO COMMANDER	500

A2B3 (4.5)

AERO COMMANDER	680
AERO COMMANDER	500-U
AERO COMMANDER	680T
AERO COMMANDER	720
AERO COMMANDER	681
AERO COMMANDER	500-S
AERO COMMANDER	680S
AERO COMMANDER	680-E
AERO-COMMANDER	680S
AERO-COMMANDER	680S
ANTONOV	AN-14
BEECHCRAFT	E-18-S
BEECHCRAFT	E-18
BNA-2A	TRISLANDER
DeH DOVE	104
PZL	M-15
PZL	AN-2
YU SHI	11

A2C4 (5.5)

ANTONOV	AN-28
BREGUET	941S
CASA	C212 AVIOCAR
DEHAVILLAND	DH6
GAC	100
IAI	ARAVA-201
NORTH AMERICAN	B-25-N
NORTH AMERICAN	B-25-J
PZL	AN-28
VOLPAR	CENTENNIAL

PLANE MAKE	MODEL
AIDI	YC-2
DEHAVILLAND	DHC7
DEHAVILLAND	DHC-7-102
DEHAVILLAND	DHC-7-103
DEHAVILLAND	DHC-4
DOUGLAS	DC-3-GZOZA
DOUGLAS	DC-3-GZOZA
DOUGLAS	C-47-D
DOUGLAS	A-26-C
DOUGLAS	DC-3-A
DOUGLAS	DC-3-C
DOUGLAS	DC-3
HERALD	HP
ILYUSHIN	IL-12

A3D4 (6.5)

PLANE MAKE	MODEL
ANTONOV	AN-72
FAIRCHILD	C-123
MAI-QSTOL	QSTOL

A4D5 (7.5)

PLANE MAKE	MODEL
BOEING	YC-14
LOCKHEED	1649

B1B2 (4.0)

PLANE MAKE	MODEL
BEECHCRAFT	B-58
BEECHCRAFT	56-TC
BEECHCRAFT	B-55
BEECHCRAFT	C-55
BEECHCRAFT	A-55
BEECHCRAFT	C-50
CESSNA	310
CESSNA	310-B
CESSNA	310-A
CESSNA	310-D
CESSNA	310-C
PIPER	PA-30-B
PIPER	PA-30-C

B1B3 (4.5)

PLANE MAKE	MODEL
AERO COMMANDER	690-A
AERO COMMANDER	690
AEROSTAR	
AJI	HUSTLER
EECHCRAFT	D-50-A
EECHCRAFT	C-45-H
EECHCRAFT	G-18-S
EECHCRAFT	C-45
EECHCRAFT	D-18-S
EECHCRAFT	D-95-A
EECHCRAFT	AT-11
EECHCRAFT	58-P
EECHCRAFT	B-60
EECHCRAFT	D-55
EECHCRAFT	BE-60
EECHCRAFT	60
EECHCRAFT	C-18-S
ECHCRAFT	D-95
ECHCRAFT	95
ECHCRAFT	58
ECHCRAFT	G-18
ECHCRAFT	E-55
ECHCRAFT	D-18
ECHCRAFT	99
ECHCRAFT	F-90
ECHCRAFT	65
ECHCRAFT	58P
ECHCRAFT	B-100
ECHCRAFT	B-95
ECHCRAFT	56
ECHCRAFT	58TC
ECHCRAFT	A-100
SSNA	310-G

PLANE MAKE	MODEL
CESSNA	410
CESSNA	402-B
CESSNA	310-J
CESSNA	421-B
CESSNA	305
CESSNA	401-A
CESSNA	340
CESSNA	414
CESSNA	T-310-R
CESSNA	402
CESSNA	650
CESSNA	310-Q
CESSNA	401-B
CESSNA	425
CESSNA	310-R
CESSNA	310-K
CESSNA	421
CESSNA	310-L
CESSNA	401
CESSNA	310-N
CESSNA	404
CESSNA	310-P
CESSNA	305-A
CESSNA	500
CESSNA	310-F
CESSNA	421-A
CESSNA	310-H
CESSNA	411
CESSNA	310-I
CESSNA	421-C
CESSNA	340-A
CESSNA	414-A
CESSNA	501
CHEYENNE	
EMBRAER	326
FORD	4-AT-E
HAMILTON	WESTWIND
LOCKHEED	12-A
MITSUBISHI	MU-2B-36A
MITSUBISHI	MU-2B-30
MITSUBISHI	MU-2-B-25
MITSUBISHI	MU-2-F
MITSUBISHI	MU-2-B
MITSUBISHI	MU-2-B-20
MITSUBISHI	MU-2-J
MITSUBISHI	MU-2
PIPER	PA-31-325
PIPER	PA-31-350
PIPER	PA-31-T
PIPER	PA-31-P
PIPER	PA-31-310
PIPER	PA-31-352
PIPER	PA-31T
PIPER	PA-31
PIPER	PA-601
ROCKWELL	681-B
SIKORSKY	S-76

B1C4 (5.5)

PLANE MAKE	MODEL
BREGUET	FAL-10
BREGUET	FAL-20
EMBRAER	121
FAIRCHILD SWEARINGEN	METRO
LEAR JET	28-29
MITSUBISHI DIAMOND	MU-300
NORTH AMERICAN	NA-265-40-A
NORTH AMERICAN	NA-265-40
NORTH AMERICAN	NA-265
PIAGGIO	PD-808
ROCKWELL	SABRE 40
SWEARINGEN	SA-227-AC
SWEARINGEN	SA-226
SWEARINGEN	SA-226-TC
SWEARINGEN	SA-26-T
SWEARINGEN	SA-226-T(B)
SWEARINGEN	MERLIN III-C

PLANE MAKE	MODEL
AERO COMMANDER	600
BEECHCRAFT	B-80
BEECHCRAFT	E-90
BEECHCRAFT	UC-45-J
BEECHCRAFT	H-18-S
BEECHCRAFT	BA-560
BEECHCRAFT	A-90
BEECHCRAFT	B-90
BEECHCRAFT	H-18
BEECHCRAFT	C-90
CESSNA	441
KING AIR	90
ROCKWELL	840
TURBO COMMANDER	200

B2C4 (6.0)

PLANE MAKE	MODEL
AERO COMMANDER	1121
BEECHCRAFT	300
BEECHCRAFT	B-200
BEECHCRAFT	200
CESSNA	550
DASSAULT-PAN AM	FANJET
DASSAULT/SUD	FAN JET FALCON
EMBRAER	EMB 110
FALCON	50
GRUMMAN	G-73
GRUMMAN	G-159
GRUMMAN-AMERICAN	G-159
HANDLEY PAGE	JETSTREAM
HAWKER SIDDELEY	DH125-400
HAWKER SIDDELEY	HS-125-700A
HAWKER SIDDELEY	DH-125-3-AR
HAWKER SIDDELEY	DH-125-400A
HAWKER SIDDELEY	HS-125-400
HAWKER SIDDELEY	DH-125-
KING AIR	200
NORD	1101
NORD	262
ROCKWELL	SABRE 60
ROCKWELL	SABRE 65
SHORT BROS.	330
SHORT BROS.	360
SHORTS	SD3-30

B3C5 (7.0)

PLANE MAKE	MODEL
ANTONOV	AN-30
ANTONOV	AN-24
CASA	C-207A AZOR
CONVAIR	580
CONVAIR	340
CONVAIR	240
CONVAIR	440
DEHAVILLAND	DHC-5
FAIRCHILD HILLER	FH227
FOKKER	F-27
FOKKER FAIRCHILD	F27
HINDUSTANI	748
HS-748	ANDOVER C
HS-748	ANDOVER
MARTIN	404
NIHON	YS-11

B3D5 (7.5)

PLANE MAKE	MODEL
BREGUET	200
DEHAVILLAND	COMET 4C

B4E5 (8.5)

PLANE MAKE	MODEL
ILYUSHIN	IL-76

PLANE MAKE	MODEL
GATES LEARJET	55
HANSA	HAB-320
HS 125	1-406
HS-748	700
HS-748	600
LEAR JET	23
LEAR JET	55
LEAR JET	24-F
LEAR JET	25-B
LEAR JET	35-A
LEAR JET	24-B
LEAR JET	24
LEAR JET	25
ROCKWELL	JC 1121
ROCKWELL	SABRE 75A

C2B4 (6.0)

PLANE MAKE	MODEL
ROCKWELL	980

C2C5 (7.0)

PLANE MAKE	MODEL
CANADAIR	CHALLENGER
LOCKHEED	1329-25
REPUBLIC	F-84
ROCKWELL	NA-265-60
ROCKWELL	SABRE 80
ROCKWELL	NA-265
ROCKWELL	601
SABERLINER	JET

C3C5 (7.5)

PLANE MAKE	MODEL
YAKOVLEV	YAK-40

C3D5 (8.0)

PLANE MAKE	MODEL
AW-650	ARGOSY
BAC	111-300
BAC	111-400
BAC	111-200
BAC	111-475
BOEING	B-17-G
BOEING	727-200
BOEING	737
BOEING	727-100
DOUGLAS	DC9 10/20 SER.
DOUGLAS	DC9 30/40 SER.
DOUGLAS	DC9 SUPER 80
DOUGLAS	DC9-50
DOUGLAS	DC-9
DOUGLAS	DC-6A
DOUGLAS	DC-9-80
DeH TRIDENT	121-2
DeH TRIDENT	121-2E
FAIRCHILD	C-119
FOKKER	F-28
GULFSTREAM AMERICAN	G-1159A
GULFSTREAM AMERICAN	G-1159
HS-NIMROD	MK2
LOCKHEED	P-3
LOCKHEED	188
SUD	210
TUPOLEV	TU-124
VICKERS	VC-2
YAKOLEV	YAK-42

PLANE MAKE	MODEL
AIRBUS	A-310
ANTONOV	AN-10
ANTONOV	AN-12
BOEING	720B
BOEING	C-97-G
BOEING	720
BOEING	757
BREGUET	1150
CANADAIR	CL-600
CANADAIR	CL-44
CANADAIR	CL 600
LOCKHEED	1011-600
LOCKHEED	100-20
LOCKHEED	400
LOCKHEED	100-30
TRANSALL	C-160

C4E5 (9.0)

PLANE MAKE	MODEL
AIRBUS	A-300
BOEING	707-100
BOEING	707-420
BOEING	767
BOEING	707-320B
BOEING	707-320
LOCKHEED	1011-200
LOCKHEED	1011-1
LOCKHEED	C-141A
LOCKHEED	C-141B
TUPOLEV	TU-114
VICKERS	VC-10-1150
VICKERS	VC-10-1100
VICKERS-VISCOUNT	745-D

C5E5 (9.5)

PLANE MAKE	MODEL
BOEING	747-SP

C6E5 (10)

PLANE MAKE	MODEL
ANTONOV	AN-22
LOCKHEED	C-5A

D1C5 (7.0)

PLANE MAKE	MODEL
LEAR JET	31CJ
LEAR JET	35
LEARJET	35-A

D3D5 (8.5)

PLANE MAKE	MODEL
BAC	111-500
BRITISH AEROSPACE	146
BRITISH AEROSPACE	B11
BRITISH AEROSPACE	146-200A
DeH TRIDENT	121-3
DeH TRIDENT	121-3B
TUPOLEV	TU-134

D4D5 (9.0)

PLANE MAKE	MODEL
BOEING	707-200
CONVAIR	990
CONVAIR	880
TUPOLEV	TU-154

PLANE MAKE	MODEL
BOEING	777
DOUGLAS	DC-10 30/40
DOUGLAS	DC-8-61
DOUGLAS	DC-8-63
DOUGLAS	DC8 60/70 SER.
ILYUSHIN	IL-86
ILYUSHIN	IL-62
LOCKHEED	1011-400
LOCKHEED	1011-500
LOCKHEED	1011-250
LOCKHEED	T-33-A
LOCKHEED	P-38L
LOCKHEED	T-33
LOCKHEED	L1011-500 SER.
LOCKHEED	10-E ELECTRA
ROCKWELL	B-1

D5E5 (10)

PLANE MAKE	MODEL
BOEING	B-52
BOEING	747
BOEING	E-4
BOEING	747-SR

E2D5 (8.5)

PLANE MAKE	MODEL
LOCKHEED	SR-71

E3E5 (9.5)

PLANE MAKE	MODEL
TUPOLEV	TU-144

H1H0 (2.0)

S1S0 (1.5)

U1U0 (1.0)

Y1Y0 (0.5)

Z1Z0 (0.0)

Z7Z0 (0.0)

Service Level

Airplanes with the following characteristics at present represent the largest share of operational activity at the Northwood Municipal Airport. These airplanes would fall into ARC, A-1.

Approach Speed	Less than 91 knots
Wingspan	Less than 49 feet
Gross Weight	Under 8,000 pounds

Additional activity by airplanes with an approach speed in excess of 91 knots, but less than 121 knots and a wingspan under 49 feet may use the facility occasionally. Representative of such aircraft are the following:

Cessna:	402, 404, 414, 421
Mitsubishi:	MU - 2G
Piper:	31-300, 400 LS, 60 - 602 P
Rockwell:	690 A
Beech:	58, 58 P, B 60, B 100, F 90

The above aircraft have a gross take-off weight under 12,500 pounds and a wing span less than 49 feet.

Occasional activity is found by aircraft with a wingspan in excess of 49 feet but less than 79 feet. These aircraft have an approach speed under 121 knots and a gross take-off weight less than 12,500 pounds. Representatives of such aircraft are the following:

Beech:	C90 - 1, B 200, E-185
Cessna:	441
Rockwell:	840

These aircraft would fall into ARC B - II or A - II.

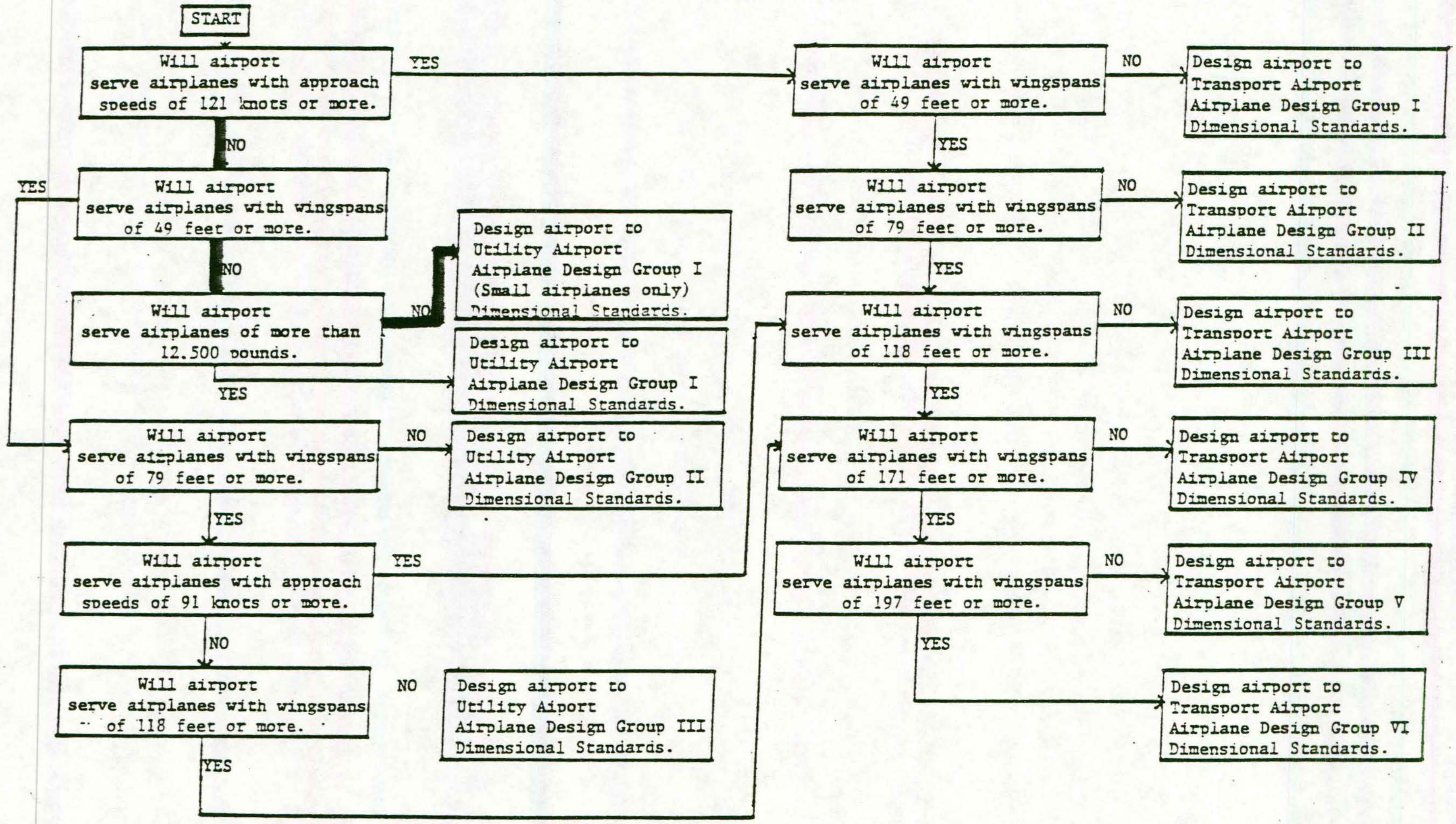
The airport service level at the Northwood Municipal Airport should accomodate those aircraft with a gross take-off weight under 12,500 pounds and an approach speed up to, but not including 91 knots. The wingspan of aircraft using, and expected to use the facility would not exceed 49 feet.

Given the operational and physical characteristics of the airplanes expected to use the Northwood Municipal Airport, facilities designed to standards set forth in Airport Reference Code (ARC) B-I should provide an adequate level of service

FIGURE 3-1: AIRPLANE DESIGN GROUP CONCEPT

Northwood Municipal Airport
* Approach Speed: Less than 91 knots
* Wingspan: Less than 49 feet

DESIGN
* Utility Airport (Basic Utility Stage I)
* Airplane Design Group I



RUNWAYS AND TAXIWAYS

Runway Alignment and Wind Coverage

Runway alignment is based upon a number of factors to include topography, cultural features, physical features, land ownership, and environmental and climatic conditions. Of these, wind coverage provided by an existing or proposed runway is a primary concern.

The optimum runway orientation is one which will provide the airport a 95 percent level of wind coverage at a crosswind component value not exceeding 12 m.p.h. (10.5 knots) for small airplanes and 15 m.p.h. (13 knots) plus for large airplanes. A large airplane is defined as an airplane of more than 12,500 pounds maximum certificated take-off weight.

In Iowa, the wind is so varied that consideration must be given to supplemental wind coverage. Of primary concern is the affect of the crosswind component on small airplanes. Historically, the primary runway alignment has been one that will obtain maximum wind coverage at 12 m.p.h. crosswind component value. The primary runway alignment for most airports in Iowa fall between 0 00' and N 30 00' w. A north/northwesterly alignment typically provides wind coverage of 78 to 88 percent at the 12 m.p.h. crosswind.

A second or crosswind runway aligment was then selected to provide the airport with a 95 percent level of wind coverage. The crosswind alignment was generally N 90 00'E to N 29 00'E. The IDOT, as a rule of thumb, recommended a minimum 60 degree separation between runway facilities. Although this is not a standard, it does minimize a duplication of wind coverage.

For the most part, the primary runway has been hard surfaced while the crosswind runway has been maintained as a turf facility. Even though the same airplane may use both runways, limited funds for construction and maintenance has precluded hard surfacing of the crosswind runway at most general aviation airports in Iowa. Where the crosswind component exceeded the operational characateristics of the airplane, an alternate airport could be used. When benefits extended from hard surfacing the crosswind runway are compared to construction and maintenance costs, use of an alternate airport appears the most realistic choice for low activity general aviation airports.

Where a crosswind runway can not be constructed due to topographic conditions, cultural features an/or environmental constraints, the primary runway may be increased in width as a means of achieving the 95 percent level of wind coverage by a single runway. Reference may be made to Appendix 1 of FAA AC 150/5300 - 13 which discusses runway width and allowable crosswind.

TABLE 3-2: RUNWAY WIDTH VS. ALLOWABLE CROSSWIND

Runway Width	Allowable Crosswind
Less than 75 feet	10.5 knots (12 m.p.h.)
75 feet but less than 100 feet	13.0 knots (15 m.p.h.)
100 feet but less than 150 feet	16.0 knots (18.4 m.p.h.)
150 feet or more	20.0 knots (23 m.p.h.)

SOURCE: FAA AC 150/5300 - 13 p.87

Where a crosswind runway does not exist, has limitations, or does not provide adequate supplement wind coverage, consideration may be given to increasing the width of the primary runway. Where there is substantial use of the airport by small airplanes, a crosswind runway may still be desired even though it may never be hard surfaced or lighted.

Since wind data is not availabe for the Northwood Municipal Airport, wind data tabulated for Mason City was selected as being most representative. Reference may be made to Figure 3-2 which depicts an all-weather wind rose for Mason City.

Runway Length and Width

Prior to the cancellation of FAA AC 150/5300 - 4B, Utility Airports, runway length was obtained runway length curves based upon performance information from aircraft flight manuals and the following assumptions:

- Zero headwind component.
- Maximum certified takeoff and landing weights.
- Relative humidity and runway gradient were accounted for by increasing the takeoff or landing distance of the groups most demanding aircraft by 10 percent.

Runway elevation and temperature (normal maximum in degrees Fahreheit) were left as variables.

Given the following:

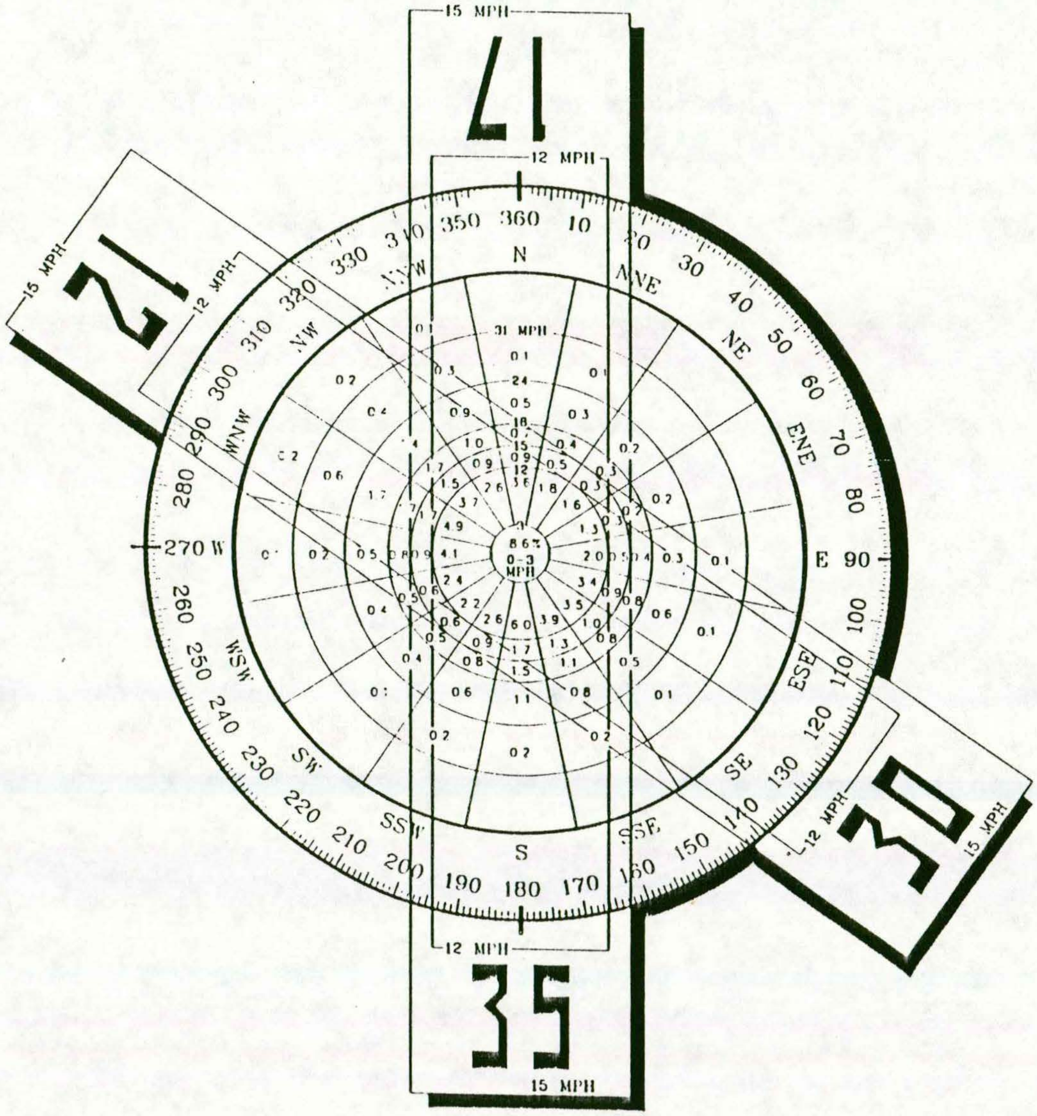
- Elevation: 1224 feet (ASL)
- Temperature: 87 degrees

The runway length requirement based upon FAA AC 150/5300 - 4B is 3400 feet. The FAA combined a number of advisory circulars into a single publication dated 9/29/89 and referenced as AC 150/5300 - 13, Airport Designs. The prior method found in FAA AC 150/5300 - 4B is no longer used. Runway length requirements are now determined from a computer program, reference to airplane flight manuals and/or FAA AC 150/5325 - 4, Runway Length Requirements For Airport Design.

A runway 3400 feet in length is expected accommodate nearly all aircraft desiring to use the facility. Aircraft with an approach speed in excess of 91 knots and a gross weight in excess of 12,500 pounds may use area airport facilities. Based upon the ARC B-I, the runway should be no less than 60 feet in width. Elimination of a crosswind runway may be considered provided that the width of the primary runway in increased in order to compensate for crosswind effects.

Given the extent of aviation activity, it is recommended that a turf corsswind runway be developed. The length should be no less than 2,200 feet. The turf runway should be no less than 120 feet in width. The recommended turf runway width coincides with the runway safety area width for ARC B-I.

In addition to wind coverage, topographic conditions will determine if the alignment selected represents a prudent choice. While the runway may be constructed, the cost may be such that an alternative alignment while sacrificing wind coverage may be the more prudent choice. Crop patterns and ownership should also be considered in identifying runway aligment alternative.



SOURCE:
Ceiling-Visibility Wind Tabulations
Mason City, IA
Mason City Municipal Airport
Mason City, IA
OBSERVATIONS:
105,491 Observations
1948-1978

WIND COVERAGE		
	12 MPH	15 MPH
Runway 12-30	*84.7%*	*90.0%*
Runway 17-35	*84.2%*	*91.2%*
Combined Coverage	*96.0%*	*97.8%*

FIGURE 3-2: All weather wind rose (mph)

Obstactle Free Zone, (OFZ)

The Obstacle Free Zone (OFZ) is a three dimensional volume of airspace. The runway OFZ extends 200 feet beyond each end of the runway and to a width of 250 feet for non-precision instrument and visual runway serving small airplanes with an approach speed 50 knots or more.

The approach OFZ applies to runways with an approach light system. The inner-transitional surface OFZ applies only to precision instrument runways. The obstacle free zone is to be maintained free of all objects except frangible navigational aids.

Runway Object Free Area, (OFA)

The runway object free area (OFA) is a two dimensional ground area surrounding the runway. The OFA extends 500 feet beyond the runway end and outward 200 feet from the runway centerline for non-precision instrument and visual runway constructed to Airplane Design Group I standards.

For visual and non-precision instrument runways constructed to Airplane Design Group II standards, the OFA extends outward 600 feet from the runway end and 250 feet out from the runway centerline.

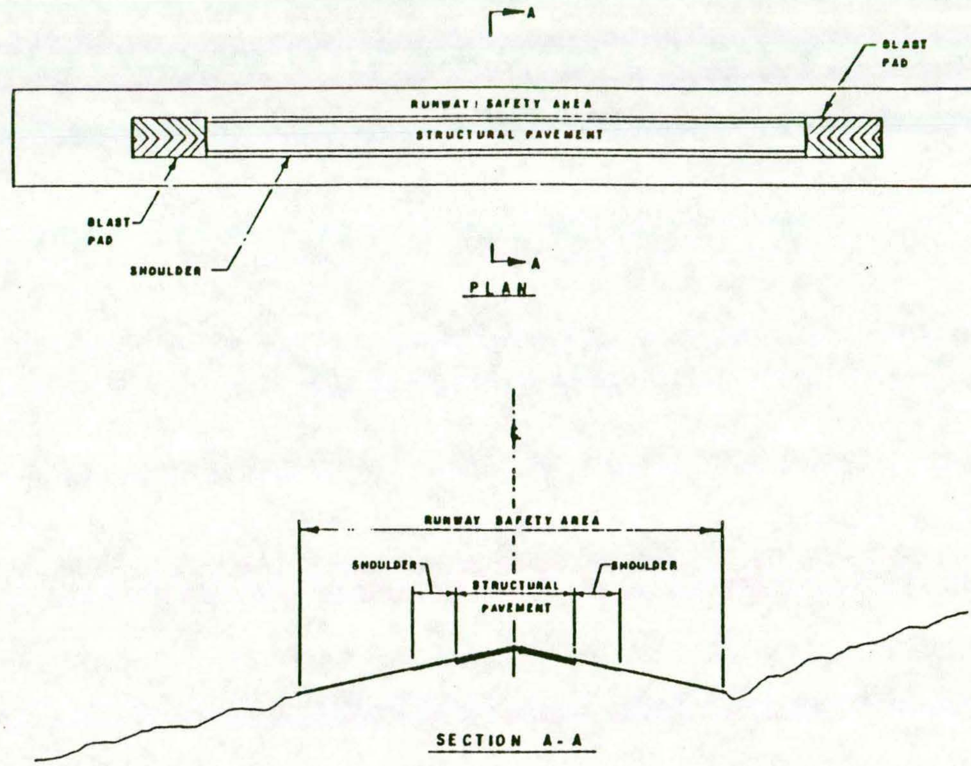
The runway obstacle free area clearing standard precludes parked aircraft and objects.

Runway Safety Area,(RSA)

The runway safety area represents an area extending along and outward from the runway that is capable of supporting airplanes which veer off, undershoot or overrun the runway. Design standards set forth in AC 150/5300 - 13 require the runway safety area to be capable, under dry conditions of supporting snow removal equipment, aircraft rescue and firefighting equipment as well as an aircraft without causing structural damage to the aircraft.

Consequently, the RSA must be graded and free of objects except for frangible mounted structures.

For nonprecision instrument and visual runways designed to Airplane Design Group I standards, the RSA extends 240 feet beyond the runway end and 60 feet outward from the runway centerline.



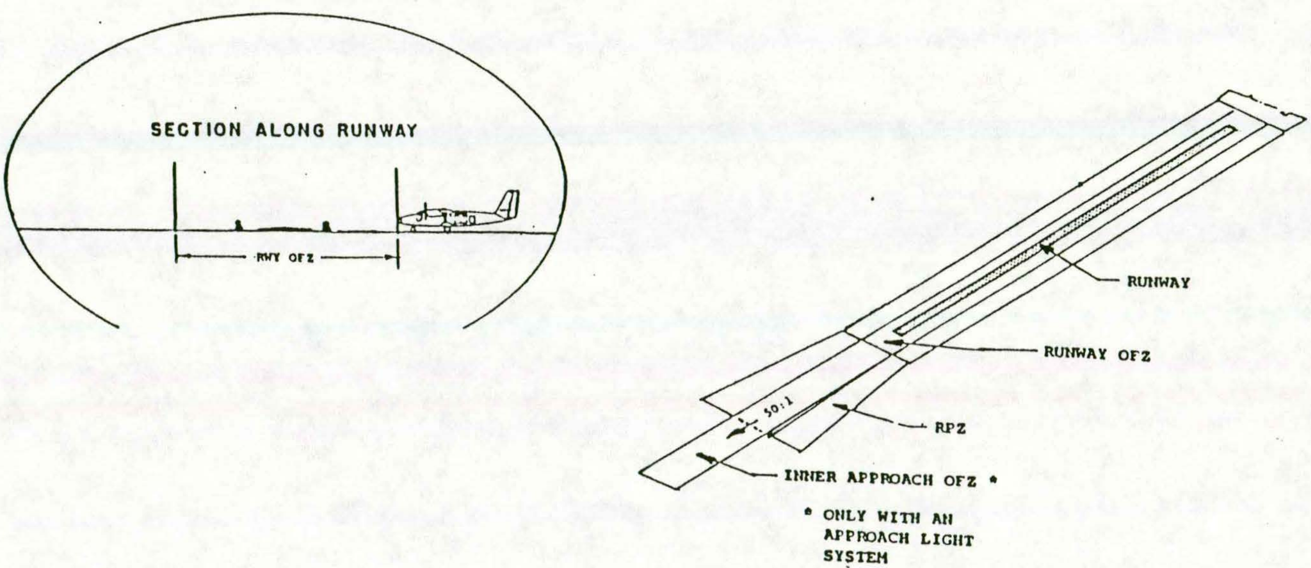


FIGURE 3-3: RUNWAY SAFETY AREA AND OBSTACLE FREE ZONE

Clearway

The clearway is an area 500 feet in width extending from the runway end outward and upward at a slope not exceeding 1.25% above which no objects or terrain may penetrate. The clearway should be under control of the airport owner and generally extends no more than 1,000 feet from the runway end. The clearway increases the allowable airplane operating take off weight without increasing runway length.

Stopway

The stopway is an area constructed and maintained for the purpose of aircraft declaration. The stopway extends beyond the threshold for a distance established by the airport owner. The width should be no less than the associated runway width.

Declared Distance

The declared distance standards may be used under special circumstances when the runway can not be constructed to conventional runway standards.

> "Conventional runway configurations, i.e. runways with safety areas beyond both runway ends and without displaced thresholds, clearways, or stopways, are recommended."
> SOURCE: FAA AC 150/5300 - 13 p. 22

Prior approval by the Federal Aviation Administration is required before using declared distances standards.

Taxiways

Taxiways are constucted for the purpose of moving aircraft between various components of the airport. As activity increases, taxiways become necessary for the purpose of increasing airport capacity and providing for increased safety.

The Iowa DOT, as a rule of thumb, generally finds justification for a full parallel taxiway system when total annual operations exceed 50,000 and a partial parallel taxiway when annual operations approach 30,000. Based upon the forecast of aviation demand and IDOT criteria, there would appear to be no justification for the construction of a full parallel taxiway to increase runway capacity. A full and/or partial parallel taxiway would be expected to receive a low priority in terms of implementation. For purposes of the Airport Layout Plan (ALP), it is recommended that a full parallel taxiway be shown for dimensional purposes even though construction is considered remote.

Should a partial or full parallel taxiway be constructed, the following minimum criteria should be maintained.

- Runway Centerline to Taxiway Centerline:
  225 feet (Design Group I)
  240 feet (Design Group II)

- Taxiway Centerline to Parallel Taxiway and/or Taxilane Centerline:
  69 feet (Design Group I)
  105 feet (Design Group II)
  1.2 times the wingspan of the most demand airplane plus 10 feet.

- Taxiway Centerline to Parked Aircraft and objects: 0.7 times the wingspan of the most demanding airplane plus 10 feet.
  44.5 feet (Design Group I)
  65.5 feet (Design Group II)

- Taxiway Width:
  25 feet (Design Group I)
  35 feet (Design Group II)

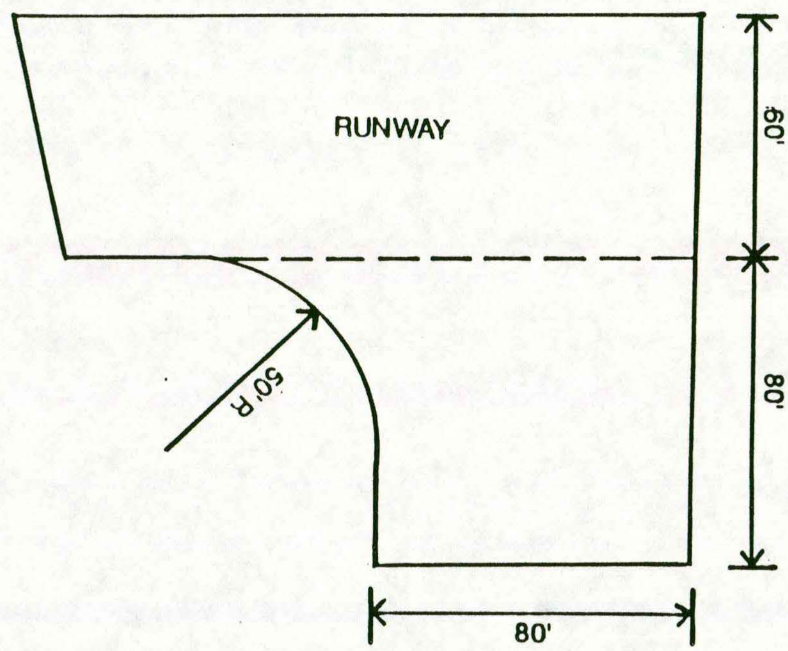
- Radius of Taxiway Turn: 75 feet

- Taxiway Safety Area:
  49 feet (Design Group I)
  79 feet (Design Group II)

- Taxiway Object Free Area:
  89 feet (Design Group I)
  131 feet (Design Group II)
  or 1.4 times the wingspan of the most demanding airplane plus 20 feet.

Taxiway exits should be located based upon activity. At low activity airports, a right angle taxiway exit located at the runway end and near the mid-point of the runway would provide an adquate level of service.

FIGURE 3-4: TURNAROUND



SOURCE: FAA AC 150/5300 - 4B, CHG. 6

The taxilane is defined at that portion of the aircraft parking area used for access between taxiways, aircraft parking positions, hangars, and storage facilities.

The width of the taxilane should be 0.6 times the wingspan of the most demanding aircraft plus ten feet. Using a wingspan of 48.9 feet (Airplane Design Group I), the taxilane should be 80 feet. Consequently, no hangar, fence, etc. should be located within 40 feet of the taxilane centerline. The internal taxiway system providing access to tee-hangars should be no less than 20 feet in width.

Drainage

An adequate drainage system is important for the safety of aircraft operations and for the longevity of the pavements. Improper drainage can result in the formation of puddles on pavements which are hazardous to aircraft landing or taking off. Improper drainage can also reduce the load bearing capacity of subgrades and the anticipated life of expensive pavement structures.

Surface drainage systems should be designed on a five year frequency of storm. Methods of computation are contained in FAA Advisory Circular 150-5300-5B, Airport Drainage.

Subsurface drainage systems are desirable where water may rise to within one foot of the pavement section. Water in the subgrade contributes directly to frost boil and heaving action. Also, saturated subgrades exhibit a greatly reduced load bearing capacity. For these reasons, soil conditions and subsurface water conditions play an important part in airport design.

A subsurface drainage system consisting of 4 and 6 inch perforated tile may be required under the paved areas of the airport.

Runway, Taxiway, and Apron Paving

Airport pavement is intended to provide a smooth and safe all weather surface free from particles and other debris that may be picked up by propeller wash. The pavement should be of sufficient thickness and strength to accommodate the anticipated loads without undue pavement stress. Pavement for the Northwood Municipal Airport Facility should be designed to accommodate single wheel gear.

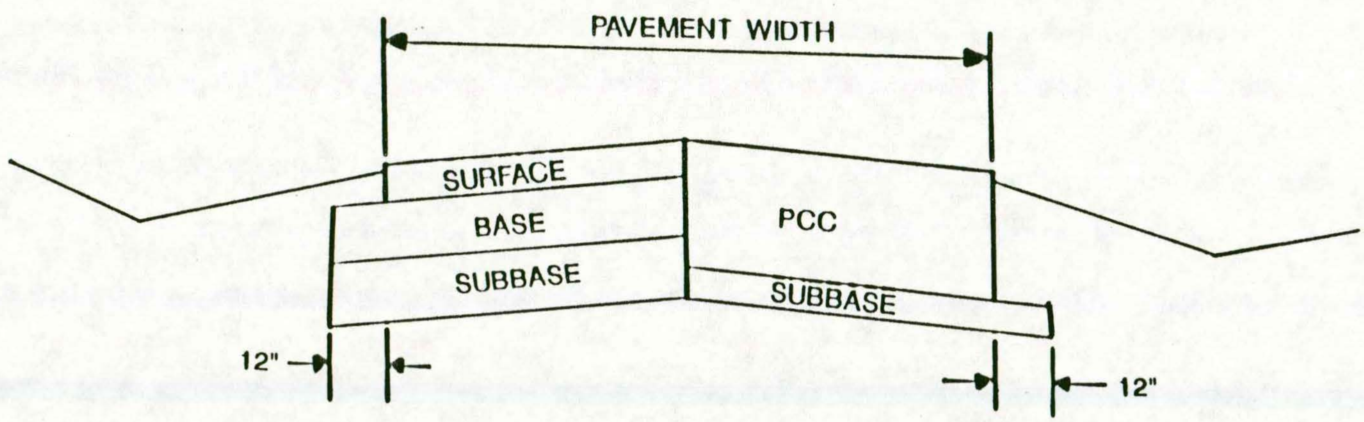
The various pavement courses are shown graphically in Figure 3-5 and described as follows:

SURFACE COURSE: Includes Portland cement concrete, bituminous concrete, aggregate bituminous mixtures, or bituminous surface treatments.

BASE COURSE: Consists of a variety of different materials which generally fall into two main classes, treated and untreated. The untreated bases consist of stone, gravel, limerock, sand-clay, or a variety of other materials. The treated bases normally consist of a crushed or uncrushed aggregate that has been mixed with cement or bitumen.

SUBBASE COURSE: Consists of a granular material or a stabilized soil

FIGURE 3-5: TYPICAL PAVEMENT SECTION



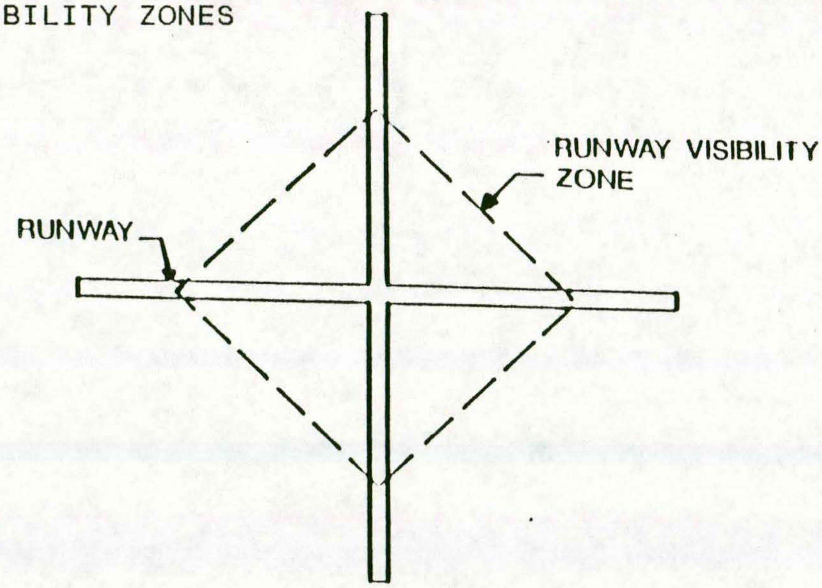
SOURCE: FAA AC 150/5320-6C

Runway Grade Change and Visibility

Consideration must also be given to runway grade changes, line of sight along and between runways as well as elimination of obstructions within the obstacle free zone (OFZ). The following line of sight criteria should be obtained:

> Runway grade changes should be such that any two points five feet above the runway centerline will be visible along the entire length of the runway where a full parallel taxiway does not exist. Where a full parallel taxiway does exist, the criteria may be reduced to one half the runway length rather than the entire runway length.
>
> Where intersecting runways exist, a runway visibility zone is created as depicted in the following figure.

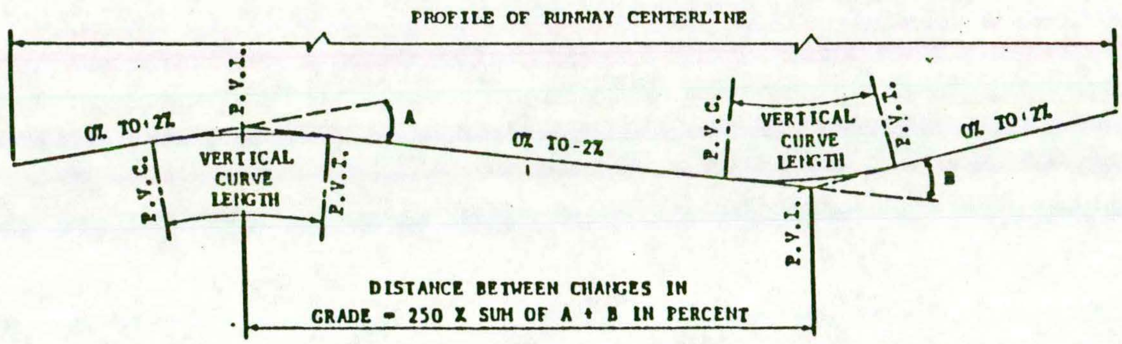
FIGURE 3-6: VISIBILITY ZONES



Runway grades, terrain, etc. must be such that a line of sight is maintained within the visibility zone of the intersecting runways five feet above the centerlines. Reference may be made to FAA AC 150/5300-13 concerning the location of runway visibility points.

Maximun grade changes should not exceed two percent where vertical curves are required. The length of the vertical curve should not be less than 300 feet for each percent grade change. No vertical curves are required when the grade change is less than 0.4 percent.

Traverse grades on the runway should be at least one percent and no more than two percent. Within ten feet of the pavement edge, the grade should have a minimum slope of three percent and not to exceed five percent. Reference may be made to Figure 3-7 concerning a typical runway cross section.

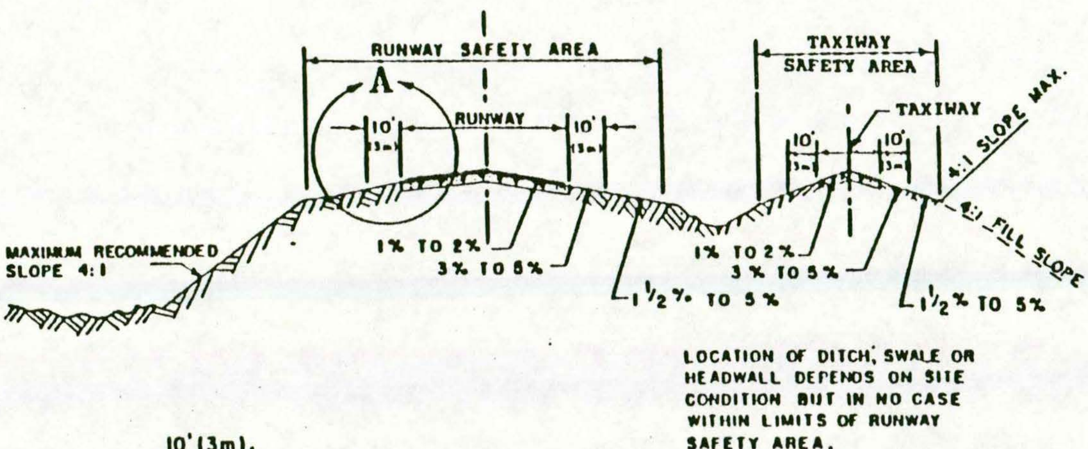


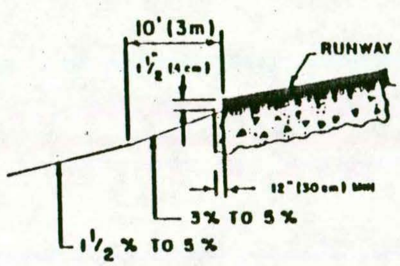
VERTICAL CURVES

LENGTH OF VERTICAL CURVES WILL NOT BE LESS THAN 300' FOR EACH 1% GRADE CHANGE, EXCEPT THAT NO VERTICAL CURVE WILL BE REQUIRED WHEN GRADE CHANGE IS LESS THAN 0.4%.

GRADE CHANGE

MAXIMUM GRADE CHANGE SUCH AS (A) OR (B) SHOULD NOT EXCEED 2%.





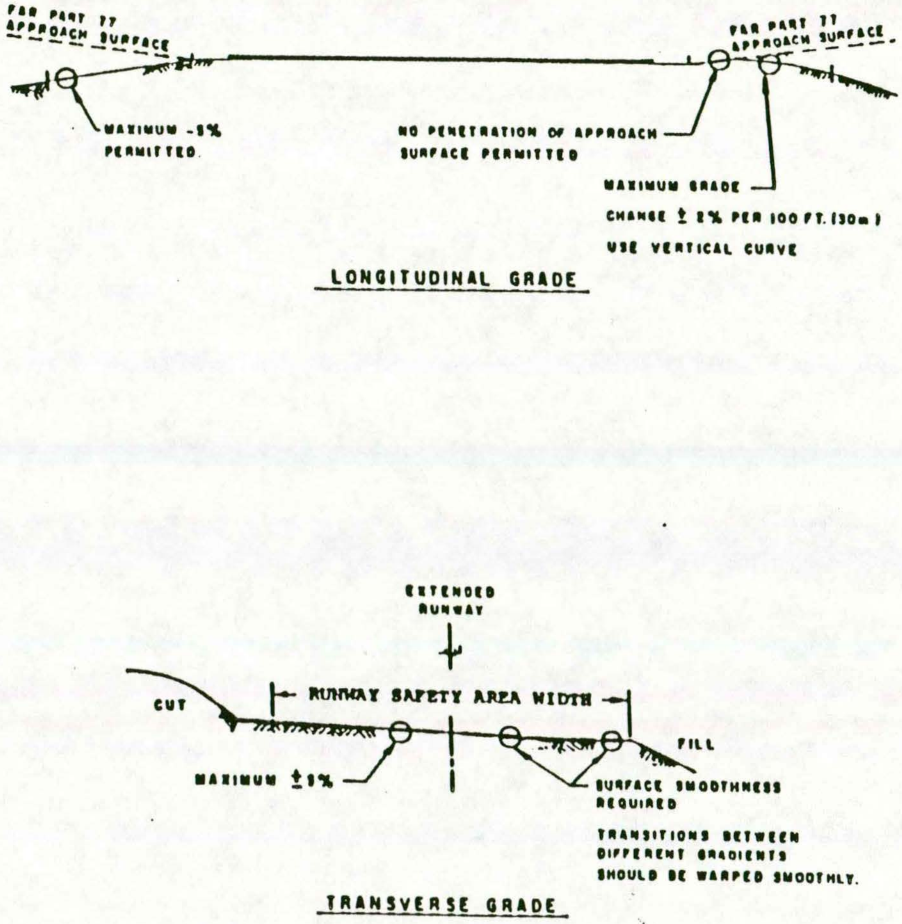
DETAIL A

TRANSVERSE SLOPES SHOULD BE ADEQUATE TO PREVENT THE ACCUMULATION OF WATER ON THE SURFACE.
SLOPES SHOULD FALL WITHIN THE RANGES SHOWN ABOVE.
THE RECOMMENDED $1\frac{1}{2}$" (4 cm) PAVEMENT EDGE DROP IS INTENDED TO BE USED BETWEEN PAVED AND UNPAVED SURFACES.
IT IS DESIRABLE TO MAINTAIN A 5% SLOPE FOR THE FIRST 10' (3m) OF UNPAVED SURFACE IMMEDIATELY ADJACENT TO THE PAVED SURFACE.

FIGURE 3-7: GRADE CHANGES

The longitudinal grade extending outward from the threshold should not exceed three (3) percent with any slope being downward. Beyond 200 feet the maximum allowable negative grade is five (5) percent. No part of the runway safety area longitudinal grade should penetrate the approach surface. Reference may be made to FAA AC 150/5300-13 concerning longitudinal and traverse gradient standards for taxiways safety areas.

Figure 3-8: Longitudinal/Transverse Grade



Pavement Markings

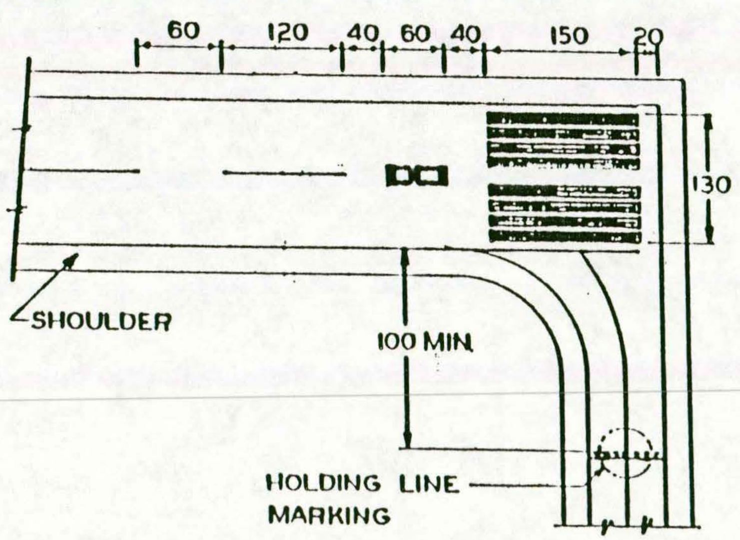
A non-precision instrument runway is one to which a non-precision approach has been approved. NPI markings consist of basic marking in addition to threshold markings.

- Centerline markings: The centerline markings consist of a broken line having 120 foot dashes and 80 foot blank spaces. The minimum width is 18 inches.
- Designation markings: Each runway end is marked with designated numbers representing the magnetic azimuth, measured clockwise from north of the centerline from the approach end and recorded to the nearest 10 degrees with the last zero omitted.
- Threshold markings: Threshold markings consist of eight 150' x 12' stripes. Each stripe is separated by three feet except the center where the separation is 16 feet. Where the runway is less than 150 feet, the width of the stripes and separation is reduced proportionally.
- Fixed distance marking: Two solid longitudinal bars located either side of the runway centerline 1,000 feet from the threshold.

Non-precision instrument markings should be placed on the primary runway provided a non-precision instrument approach has been approved for that runway. Otherwise basic runway markings should be maintained. Reference may be made to Figure 3-9. Unpaved runways are normally defined by placing markers at the corners of the runway and at 400 foot intervals along the length of the runway.

Taxiways are marked by a continuous stripe, six inches in width, along the taxiway centerline. Holding lines are located on the taxiway 150 feet from the runway edge. Additional information on pavement markings may be obtained from FAA AC 150/5340-1E.

FIGURE 3-9: NON-PRECISION INSTRUMENT MARKINGS



LANDING AND NAVIGATIONAL AIDS

Runway and Taxiway Lighting

A Medium Intensity Runway Light (MIRL) system should be installed on those runways with a non-precision instrument approach. A low intensity system would provide an adequate level of service on a turf runway.

Runway lights are used to outline the edges of the runway during periods of darkness or low visibility. Each runway edge light fixture emits a white light except on instrument runways where yellow is substituted for white on the last 2,000 feet or one-half the runway length whichever is less. The yellow lights are located on the end opposite the landing threshold or instrument approach end. The edge light fixtures should be located no more than ten feet from the defined runway edge and spaced 200 feet on center. The runway light stake should be no less than 30 inches high due to snow removal and grass cutting. The lights, located on both sides of the runway should be directly across from each other and perpendicular to the runway centerline. Special requirements exist at runway intersections.

Two groups of threshold lights, the second part of a runway light system, are located symmetrically about the runway centerline. The threshold lights emit a 180 red light inward and 180 green light outward. The threshold lights should be located no closer than two feet and no more than ten feet from the runway threshold. The two groups of lights contain no less than three fixtures for a VFR runway and four fixtures for an IFR runway. The outer most light is located in line with the runway edge lights. The remaining lights are placed in ten foot centers towards the runway centerline extended. Air-to-ground radio control for the runway light system should also be maintained.

Taxiway edge lights should be located no more than ten feet from the taxiway edge on 200 foot centers. The taxiway edge light which emits a blue light define the lateral limits of the system. Reflectors may be used in lieu of taxiway lights where activity is minimal.

Reference may be made to the following FAA Advisory Circulars:

AC 150/5300-24 Runway and Taxiway Edge Lighting Systems
AC 150/5340-27 Air-To-Ground Radio Control of Airport Lighting Systems

Precision Approach Path Indicator, (PAPI)

The Precision Approach Path Indicator (PAPI) provides a visual aid to aircraft on approach. The colored light beam enables the pilot to determine if his/her approach is high, on course, or low.

L-881: System containing of two light bars
L-880: System containing of two light units

The PAPI system should be located on the left side of the runway (approach end) and so sited and aimed that it defines an approach path with adequate clearance over obstacles and a minimum threshold crossing height. Reference may be made to FAA AC 150/5345-28D. A PAPI system is recommended for installation on the primary runway.

Runway End Identification Lights, (REIL)

Runway End Identification Lights (REIL'S) should be placed on the primary runway. REIL'S should be located in line with the threshold lights, 75 feet from the runway edge. IDOT recommends installation of a REIL system when the annual operations exceed 3,000. Reference may be made to FAA AC 150/5300-14B, AC 150/5300-2C, and AC 150/5340-25 concerning REIL design and siting requirements.

Rotating Beacon

An airport beacon light is recommended for installation. The beacon light, which emits alternating white and green flashes of light, should be located no closer than 750 feet to a runway centerline. Reference may be made to FAA AC 150/5340-21, AC 150/5345-12.

Segmented Circle and Lighted Wind Indicator

The segmented circle consists of a 100 foot diameter circle with a minimum of 18 segments constructed around the surface wind indicator. The marking system may be used to convey traffic patterns. A lighted wind indicator should be installed at the center. Reference may be made to FAA AC 150/5345-5. The segmented circle should be located between the terminal area and runway.

Nondirectional Beacon

A nondirectional radio beacon (NDB) should be installed to provide for a non-precision instrument approach. Future metal buildings, power lines, metal fences, etc. should be located no closer than 100 feet to the NDB. The NDB radiates a signal which can be used by pilots to provide electronic directional guidance to the airport. This consists os two 65 foot poles spaced approximately 350 feet with two wires strung between them. The ground should be smooth, level, and well drained. The location should take into account the obstruction standards described in this report.

Terminal Very Height Frequency Omni-Directional Range, (TVOR)

The TVOR when combined with Distance Measuring Equipment (DME) provides the pilot with alignment and position location information.

The TVOR, used to provide azimuth information, may also be used for the development of a non-precision instrument approach to the runway. The off airport TVOR facility preferred is one that is located on the runway centerline extended anywhere from 1,200 feet to seven miles. When a centerline site is not available, a site which would meet TERPS' operational criteria for a straight-in-approach to the runway should be selected.

It is unlikely that a TVOR facility would be located on the Northwood Airport within the 20 year planning period.

FAR PART 77

Obstruction Standards

Part 77 of Volume XI, Federal Aviation Regulations, sets forth a number of standards to be used in identifying obstructions to air navigation. These standards are of considerable importance. The discussion herein is primarily extracted from Part 77. These standards are used as a guide in the assessment of airport development alternatives as well as the basis for tall structure zoning.

An obstruction is considered to be any object of natural growth, terrain, or structures of permanent or temporary construction if if it is higher than any of the following heights or surfaces:

A. A height of 500 feet above ground level at the site of the object.

B. A height that is 200 feet above ground level or above the established airport elevation, whichever is higher, within 3 nautical miles of the established reference point of an airport. That height increases in the proportion of 100 feet for each additional nautical mile of distance from the airport up to a maximum of 500 feet.

C. The surface of a takeoff and landing area of an airport or any imaginary surface established under paragraphs 77.25, 77.28, or 77.29 (FAR Part 77). However, no part of the takeoff or landing area itself will be considered an obstruction.

The height of traverse ways to be used for the passage of mobile objects are increased as follows:

A. 17 feet for an Interstate Highway.
B. 15 feet for any other public roadway.
C. 10 feet of the height of the highest mobile object that would normally traverse the road, whichever is greater, for a private road.
D. 23 feet for a railroad.
E. For a waterway or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it.

Hazard Determination

All objects which penetrate the imaginary surfaces of the airport are considered an obstruction and a hazard to air navigation unless a FAA aeronautic study determines that it does not have a substantial adverse effect upon the efficient use of navigable airspace by aircraft or on the operation of air navigation facilities.

Prior to construction, the Airport owner is required to give notice of proposed construction no less than 30 days prior to construction.

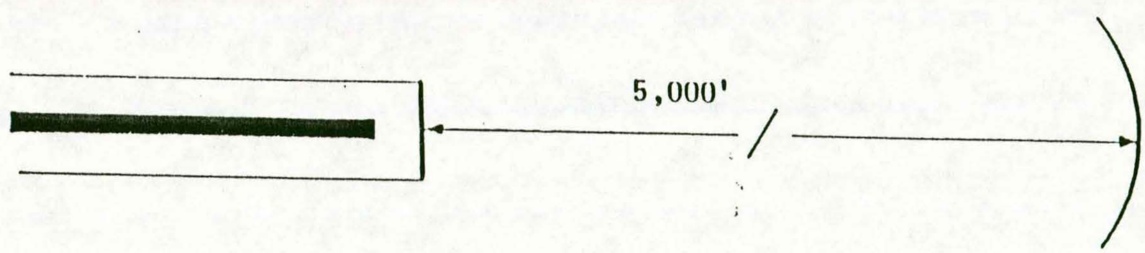
Object clearance requirements are as follows:

A. Object Free Area (OFA)
B. Runway and Taxiway Safety Areas
C. Obstacle Free Zone (OFZ)
D. Threshold
E. Navigational Aids
F. Airport Airspace (Subpart C of FAR Part 77)

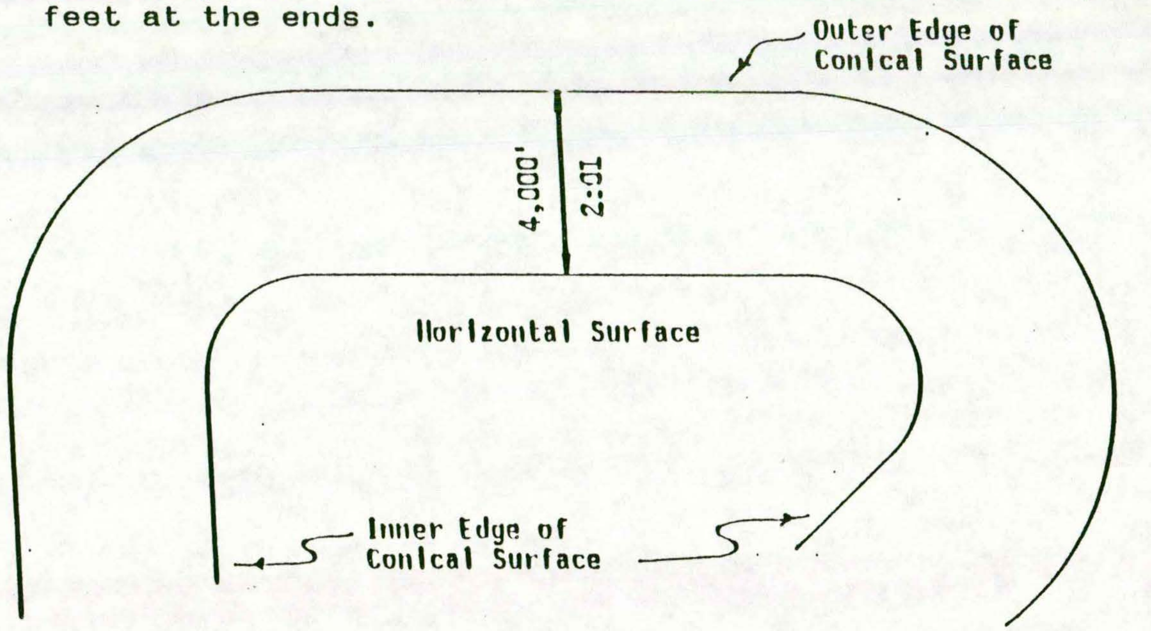
Imaginary Surface

Imaginary surfaces establish areas where any object penetrating that surface would be considered an obstruction to air navigation. The imaginary surface establishes an imaginary line that separates ground activities from aircraft activities. In order to select the applicable imaginary surface, the type of approach to each runway must be considered.

A. Horizontal Surface: The horizontal surface is a plane 150 feet above the established airport elevation. It is constructed by swinging arcs of specific radii from the center of each end of the primary surface and by connecting the arcs by line tangent to those arcs.
   - NPI Radius of 10,000 feet (Runway larger than Utility)
   - NPI Radius of 5,000 feet (Utility Runway)



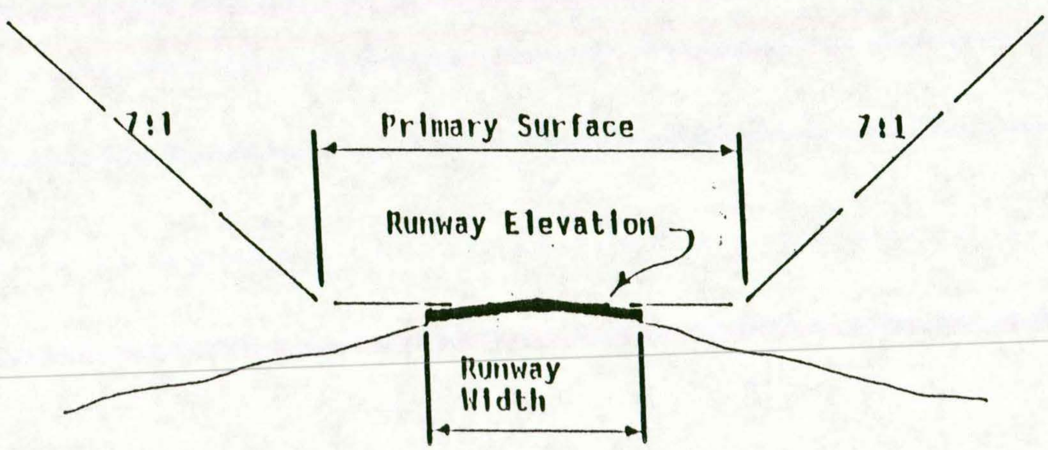
B. Conical Surface: The conical surface extends outward and upward from the periphery of the horizontal surface at a slope of 20:1 for a horizontal distance of 4,000 feet at the ends.



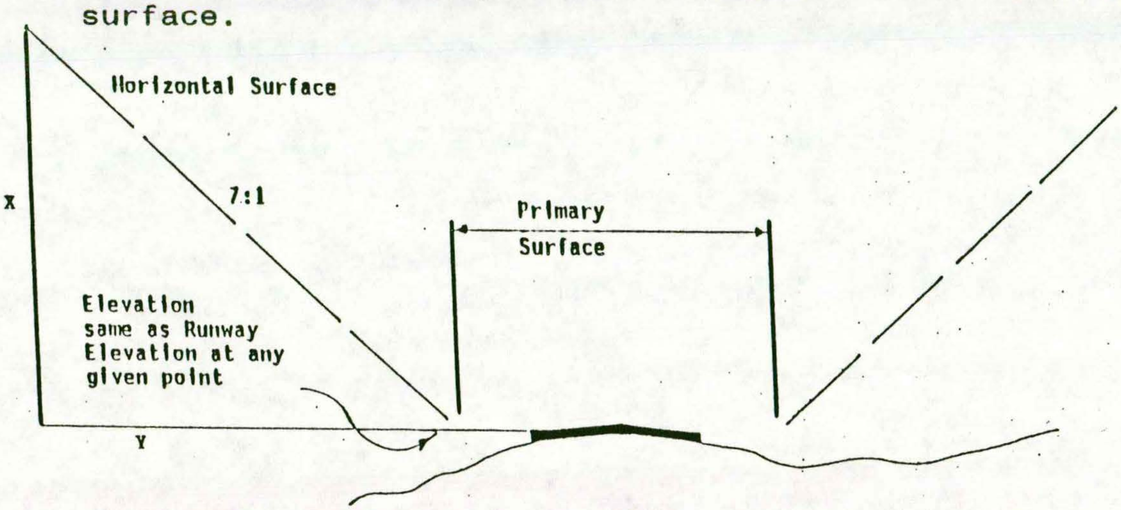
C. Primary Surface: The primary surface is longitudinally centered on the runway and extends 200 feet beyond the runway end in the case of a paved runway. The primary surface end coincides with the runway end in the case of a turf runway. The width of the primary surface varies with the approach.

	WIDTH	END OF RUNWAY	
Utility			
NPI	500'	200'	(Visibility minimum greater than 3/4 mile)
Larger than Utility			
NPI	500'	200'	
NPI	1000'	200'	(Visibility minimum as low as 3/4 mile)

The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline.



D. Transitional Surface: The transitional surface extends upward at a slope of 7:1 from the edge of the primary surface and approach surfaces. They extend outward and upward from the runway centerline and runway centerline extended until they intersect with the horizontal surface.



E. Approach Surface: The approach surface is longitudinally centered on the extended runway centerline. The inner edge of the approach surface coincides with primary surface and expands uniformly outward to a width determined by the type of approach:

NPI: 500' x 5,000 x 2,000' (Utility Runways)

NPI: 500' x 10,000' x 3,500' (Runway larger than Utility with visibility minimum greater than 3/4 of a mile.)

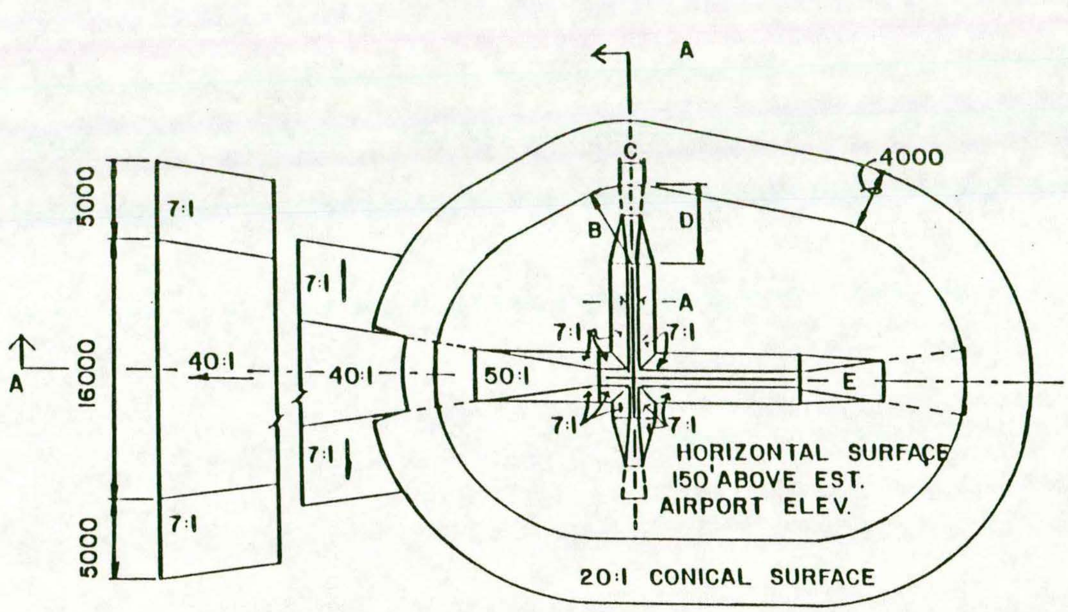
NPI: 1,000' x 10,000' x 4,000' (Runway larger than Utility with visibility minimum as low as 3/4 mile.)

Precision Instrument: 1,000' x 10,000' x 16,000'

The approach slope also varies:
NPI: 34:1 (Larger than Utility)
NPI: 20:1 (Utility Runways)

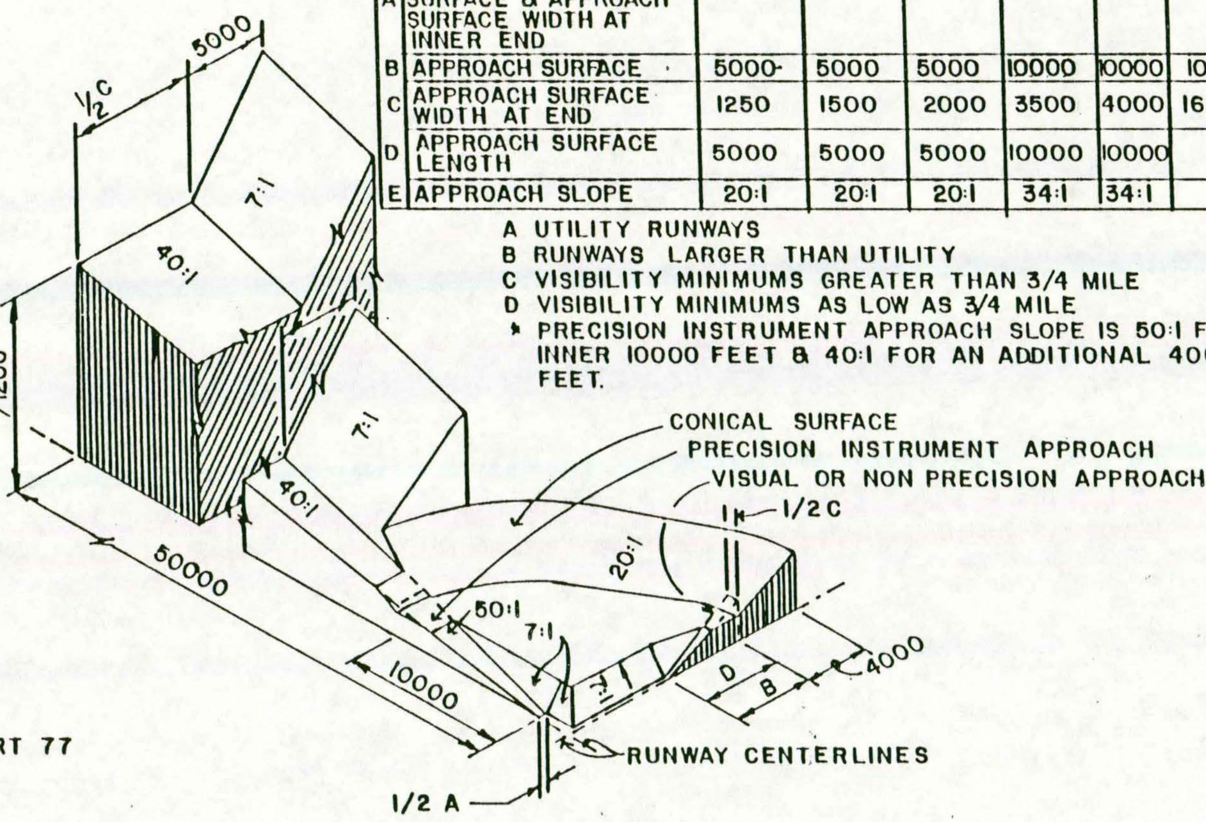
Reference may be made to Figure 3- 10 for applicable dimensional standards for precision instrument runways.

FIGURE 3-10: AIRPORT IMAGINARY SURFACE



	ITEM	DIMENSIONAL STANDARDS (In feet)					
		VISUAL RUNWAY		NON-PRECISION INSTRUMENT RUNWAY			PRECISION INSTRUMENT RUNWAY
		A	B	A	B		
					C	D	
A	WIDTH OF PRIMARY SURFACE & APPROACH SURFACE WIDTH AT INNER END	250	500	500	500	1000	1000
B	APPROACH SURFACE	5000	5000	5000	10000	10000	10000
C	APPROACH SURFACE WIDTH AT END	1250	1500	2000	3500	4000	16000
D	APPROACH SURFACE LENGTH	5000	5000	5000	10000	10000	*
E	APPROACH SLOPE	20:1	20:1	20:1	34:1	34:1	*

A UTILITY RUNWAYS
B RUNWAYS LARGER THAN UTILITY
C VISIBILITY MINIMUMS GREATER THAN 3/4 MILE
D VISIBILITY MINIMUMS AS LOW AS 3/4 MILE
* PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10000 FEET & 40:1 FOR AN ADDITIONAL 40000 FEET.



Source: FAR PART 77

LAND USE

Land Use

Airport land use may be discussed in terms of the:

- Impact of adjacent land uses on the airport.
- Impact of the airport on adjacent land uses.

Each of the two general areas can further be broken down into specific impacts. The impacts may not all be negative as some impacts are quite positive in nature. The objective is to insure that the land use conflicts are reduced to a minimal level in view of the fact that it may not be possible to alleviate all problems. The following land use goals in the vicinity of the airport will provide a set of parameters upon which to design specific land use policies. These goals are not static nor is the list all inclusive. Throughout the planning period, goals are expected to change to meet unforeseen demand.

Goals

- The airport and associated imaginary surfaces should be protected from encroachment of land uses that might impair operational capabilities of the facility.

- Having identified the ultimate level of airport development, care should be exercised throughout the planning period to insure that future expansion of the facility is not compromised.

- Adjacent airport environs should be protected against aircraft operations and noise.

- Establish or organize land uses on the airport and off the airport that will complement each other.

Land Use Compatibility

Land use compatibility depends upon a number of factors. In other words, to imply that an industrial activity is compatible depends upon the type to include processes. The latter is of concern where considerable amounts of heat is released.

The following adjacent land use activities, identified by the FAA, are potentially compatible. Potentially compatible may be defined as a land use that does not, for example, exceed Part 77 requirements, or has properly been designed so that noise is not a problem.

Natural Corridors

Rivers	Canals	Natural Buffer Area
Lakes	Drainage Basins	Forest Reserves
Streams	Flood Plain Areas	Land Reserves and Vacant Land

Open Space Areas

Memorial Parks and Pet Cemeteries	Archery Ranges
Water & Sewage Treatment Plants	Golf Driving Ranges
Water Conservation Areas	Go-Cart Tracks
Marinas, Tennis Courts	Skating Rinks
Golf Courses	Passive Recreation Areas
Reservation/Conservation Areas	Park & Picnic Areas
Botanical Gardens	Sod and Seed Farming
Bowling Alleys	Tree and Crop Farming
Landscape Nurseries	Truck Farming

Industrial and Transportation Facilities

Textile & Garment Industries	Foundaries
Bus, Taxi, & Trucking Terminals	Saw Mills
Brick Processing Industries	Machine Shops
Clay, Glass, Stone Industries	Office Parks
Chemical Industries	Industrial Parks
Tire Processing Companies	Public Buildings
Food Processing Plants	Auto Storage
Public Workshops	Parking Lots, Gas Stations
Research Labs	Railroad Yards
Freight Terminals	Warehouse & Storage Buildings
Fabricated Metal Products Industries	
Paper Printing & Publishing Industries	

Airport and and Aviation Oriented Facilities

Airparks	Aerial Survey Labs
Aerospace Industries	Banks
Aircraft Repair Shops	Airfreight Terminals
Hotels	Aircraft Factories
Aviation Research & Testing Labs	Motels
Aviation Schools	Aircraft & Aircraft Parts
Restaurants	Employee Parking Lots
Manufacturers	

Commercial Facilities

Retail Business	Professional Services
Shopping Centers	Gas Stations
Parking Garages	Real Estate Firms
Finance & Insurance Companies	Wholesale Firms

BENEFIT / COST

CHAPTER FOUR
BENEFIT / COST CONSIDERATIONS

Introduction

Methodology

The economic impact from the proposed airport development can be described in terms of direct, indirect, and induced benefits. The primary benefit of an airport is the time saved and cost avoided by the user over the next best alternative mode of transportation or airport facility. Benefits of direct nature accrue primarily to the user and on-site activities. Indirect benefits derive from off-site economic activities that are attributable to the airport. Induced benefits are the multiplier effects of the direct and indirect impacts.

Direct benefits are summarized as follows:

* Transportation
  - Time saved
  - Reduced ground travel cost
* Reduced delays at air carrier airports
* Community benefits
  - Hospital/medical
  - Civil defense
  - Law enforcement
* Stimulation of business
  - Consideration in industrial siting
* Access to the National Airport System
* Commercial activities
  - Passengers and air cargo (FBO)
  - FBO operation
  - Aerial applicators

Indirect benefits are summarized in terms of:

* Off-site economic activities
  - Employment and wages paid
  - Expenditures for goods and services
  - Capital expenditures
  - Business efficiency
  - Taxes

Induced benefits:

* Multiplier
  - 2.5 times the direct and indirect benefits

While much emphasis is placed upon the number of based aircraft, an important consideration often overlooked are those businesses located elsewhere that may do business locally and use aviation to transport cargo and passengers. The airport provides accessibility to a national system of airports. In a number of situations, the local business or industry may not own or use aviation, but those that do business with them do. Therefore the number of itinerant aircraft operations are perhaps an equal or better measure of economic benefit than the number of based aircraft.

Costs may also be described in terms of direct and indirect costs.

Direct costs would be those associated with capital construction and annual operation and maintenance (O & M) costs. Indirect costs are those accrued by the user in the utilization of the facility. Other costs of an indirect nature may be those revenues lost to government from land that may be kept on the tax role as well as land utilization for other uses that produce income (commercial, agriculture, etc.).

Of concern to public decision makers is whether or not the proposed facility would return benefits in excess of costs. For purposes of discussion herein, the identification of benefits and costs should first be described.

Benefits:

1. Employment - Direct and Indirect
    - A. Airport employees (public)
    - B. Business located on the airport (private)
    - C. Business located off the airport which use the facility (private - indirect)
2. Revenue - Direct
    - A. Tenants lease
    - B. Grants-in-aid
    - C. Business taxes

Costs:

1. Expenditures - Direct
    - A. Capital expenditures
    - B. Operating and maintenance
2. Revenue - Direct
    - A. Property and business taxes
3. Indirect Costs
    - A. Environmental/agricultural land
    - B. Other uses

The above describe a broad base for discussion. Key concerns appear to center upon the following:

1. Annual O & M costs; Capital costs, Debt amortization
2. Availability of area airports: Mason City, Albert Lea, Austin, Osage, and Forest City
3. Usage by local business and industry

Concerns regarding environmental issues are beyond the scope of this project. Such concerns would typically be addressed within an environmental assessment of the proposed action. However, the proposed action may produce benefits and costs that are not addressed within. An example may be the loss of prime agricultural land or wildlife habitat.

Benefit / Cost Ratio

Benefits

The methodology used to identify a benefit/cost scenario for the proposed airport is based for the most part on the transportation benefit realized given alternative public airport locations.

A study entitled Measuring the Regional Economic Significance of Airports is reproduced in part as supplemental background information. The study prepared by Stewart E. Butler of the Economic Analysis Division, Transportation System Center and Laurence J. Kiernan from the National Planning Division, Federal Aviation Administration, provides useful measures that may be applied locally.

TABLE 4-1: APPROXIMATE BENEFITS FOR VARIOUS ACTIVITY LEVELS - TRANSPORTATION BENEFIT

BASED AIRCRAFT	ANNUAL COMMERCIAL PASSENGERS (1)	B-D (2)	VALUE OF TIME SAVED	REDUCTION IN TRAVEL COST	TOTAL ANNUAL TRANSPORTATION BENEFIT
10	0	20	$ 83,333	$ 14,400	$ 97,733
20	0	20	166,666	28,800	195,466
50	0	20	416,665	72,000	488,665
100	0	20	833,330	144,000	977,330

1. Includes only origin and destination traffic; does not include through or transfer passengers.
2. Highway mileage measured from the point where trips begin or end, typically the traveler's residence or place of business.

SOURCE: STEWART E. BUTLER AND LAURENCE J. KIERNAN, Measuring the Regional Economic Significance of Airports

Based upon the methodology summarized herein, the authors calculated the transportation benefits for various activity levels. The activity levels illustrated are applicable to the Northwood airport facility. Given the probability of 10 to 20 based aircraft and a 20 mile travel distance, the total transportation benefit annually would fall somewhere between 97,733 and 195,466 dollars.

Table 4-2 summarizes the variables and associated values used to compute site specific transportation benefits.

TABLE 4-2: TRANSPORTATION BENEFIT VARIABLES

SYMBOL		TYPICAL VALUE
G	Itinerant operations per based aircraft per year (1). 300 ops./based aircraft at rural airport	varies
N	Number of based aircraft at airport A	varies

d	Ground access distance to airport A (miles)	varies
E	Passenger time value ($/hour) (2)	$25
F	Number of passengers per trip (3)	2.5
P	Car speed (m.p.h.)	45
Q	Car costs, including amortization ($/mile) (4)	0.25
b	Ground access distance to alternative airport C (miles)	varies
Y	Annual passengers in commercial service	varies

Three additional variables are needed when use of the alternative airport substantially changes flight distance, i.e. a = c

a	Direct flight distance from origin airport A to destination airport B	varies
c	Alternative airport C to destination airport B flight distance	varies
s	General aviation or regional airline aircraft speed (m.p.h.)	varies

1. An operation is either a landing or a takeoff. The FAA estimates that general aviation aircraft made 164.1 million operations at public airports in 1984, 65.7 percent of which, or 107.8 million, were itinerant. There are approximately 220,000 active general aviation aircraft, so there would have been an average of about 490 itinerant operations per year per based aircraft. The lower number used as a typical value in this analysis may be more representative of low activity rural airports and would result in a conservative estimate of benefits. Actual data should be used when they are available.

2. There is no source of precise data on passenger time. The FAA used $25 per hour for estimating the value of aircraft owners' and pilots' time for internal reporting purposes. The Aircraft Owners and Pilots Association (AOPA) reports that the average annual income of its 260,000 members is $53,200, which equates to $25.58 per hour.

3. The average number of passengers per trip varies with aircraft type and is 1.5 for single engine piston aircraft with 3 seats or less, 2.3 for single engine piston aircraft with 4 seats or more, and 3.1 for multi-engine piston aircraft.

4. The American Automobile Association reports that a medium-sized automobile driven 15,000 miles a year costs $0.243 per mile to operate in 1985.

Time Saved

Annual Passengers = FGN + Y
O-C-B time = b/P + c/S
O-A-B time = d/P + a/S
Annual Benefit = E(FGN +Y) (b/P + c/S - a/S - d/P)

Reduced Ground Travel Cost

Annual Ground Trips = GN + Y

GN, The number of annual itinerant GA operations, is equal to the number of GA-related ground trips on the assumption that passengers making a GA trip together will share one automobile i n traveling between the trip origin and the airport. Y, the number of annual commercial passengers, equals the number of ground trips related to commercial service on the assumption that each commercial passenger requires a separate motor vehicle.

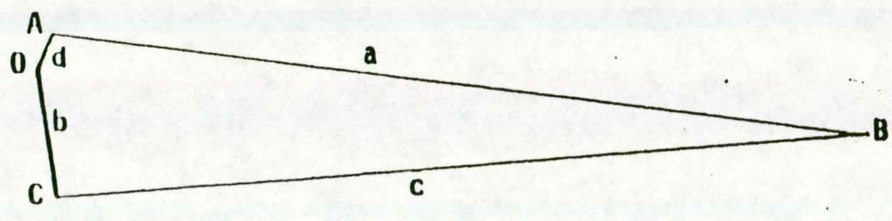
O-C-B trip costs = Qb
O-A-B trip costs = Qd
Annual Benefit = (GN + Y) (Qb - Qd)

Total Benefit

Where a = c
Total Annual Benefit = E(FGN + Y) (b/P - d/P) + (GN + Y) (Qb - Qd)

SOURCE: STEWART E. BUTLER AND LAURENCE J. KIERNAN, Measuring the Regional Economic Significance of Airports

FIGURE 4-1: TRANSPORTATION BENEFIT OF AN AIRPORT



Variables a,c, and s are not considered relevant to the Northwood Airport Facility.

The mileage from Northwood to the nearest public owned airport is summarized as follows:

Northwood to:	Mason City	26 miles +/-
	Osage	29 miles +/-
	Forest City	33 miles +/-
	Lake Mills	17 miles +/-

The closest public owned airport in Iowa is the Mason City Airport which is located approximately 26 miles from Northwood via U.S. Highway 65 and

18. The ground access time from Northwood is approximately 30 minutes. The airport facility at Lake Mills although only 17 miles from Northwood does not provide the extent of facility development recommended in Chapter Three and is not considered an acceptable alternative.

The number of aircraft operations at the Northwood facility is as follows:

TABLE 4-3: NORTHWOOD DATA, 1990 - 2009

	OPERATIONS		PASSENGER
YEAR	ITINERANT	LOCAL	ENPLANEMENTS & DEPLANEMENTS
1990	2268	2268	3402
1994	2851	2333	4277
1999	2851	2333	5541
2009	3694	2462	5541

SOURCE: PDS, 1990

The total annual transportation benefit calculated for the Northwood Airport is 387,402 dollars based upon 1990 values increasing to 630,975 dollars in 2009.

TABLE 4-4: TOTAL ANNUAL TRANSPORTATION BENEFIT, 1990 - 2009

YEAR	BENEFIT	YEAR	BENEFIT
1990	$387,403	1999	$487,000
1994	$487,000	2009	$630,975

SOURCE: PDS, 1990

Economic impact of a direct nature in addition to the transportation benefit noted in Table 4-4 would include airport generated employment. At low activity airports, airport generated employment is limited to FBO operations, air taxi, aerial application, etc. The average full time employment may range from one person upwards to ten persons or so.

One job per seven based aircraft may be used to estimate average airport generated employment. Two to five airport generated jobs could be anticipated at Northwood.

Employment 2 persons X $20,000 annual salary = $ 40,000
Employment 5 persons X $20,000 annual salary = $100,000

Given an induced multiplier of 0.75, approximately $75,000 to 175,000 may be added to the local economy.

Indirect benefits are more difficult to quantity in dollar terms. Local public support for airport improvements provides some insight. Such support may come from local business and industry that would find increased accessibility beneficial and/or are dependent to some degree upon general aviation as a integral part of their transportation need.

Grants-in-aid represent a benefit to the community as revenue that would otherwise not be brought into the County unless the facility is constructed. The grant-in-aid will impact the community in a number of ways.

* Direct benefit as revenue from an outside source.
* Induced benefit as each dollar is spent.
* Indirect benefit as operational efficiency of local business is increased.

The cost of a grant-in-aid for airport improvements should be viewed as being generated by the airport user. It is often argued that the user should pay for the cost of airport improvements. The fact is that the user does pay indirectly the major share of the cost of airport construction through the contributions made to the aviation trust fund.

A grant-in-aid is accounted for herein as a benefit since it is derived from a source outside the community service area. It represents a major infusion of money into the community having a short term impact in terms of construction expenditures (labor and materials).

<u>Operating and Maintenance Costs / Airport Revenue</u>

Should the proposed facility be constructed, an annual operating and maintenance budget must also be established. At many general aviation airports in Iowa maintenance is sometimes deferred in an attempt to balance airport generated revenue with annual expenditures.

Revenue generated at most general aviation airports in Iowa is limited to the following sources:

* Hangar rental
* Crop sales / farm income
* Tax on aviation fuel (.01 to 0.5 cents per gallon)
* Lease of terminal space; conventional hangar space

Those airports having considerable farm income often are able to generate revenue equal to annual O & M expenditures. Often transfers from the general fund are required in order to balance the budget. Items typically included in an O & M budget are noted as follows:

* Salaries (airport management, maintenance)
  - Public employee
  - Contract services
* Utilities
* Office (telephone, postage, supplies, publication, etc.)
* Equipment maintenance (landing, navigational aids)
* Vehicle maintenance, operation
* Insurance
* Professional services
* Building and ground maintenance (snow, grass, etc.)
* Depreciation

Prior to preparing an estimate of O & M expenditures that may be encountered in the operation of the proposed airport, a number of basic assumptions must be drawn. For example, should the public owner employ a staff to manage and maintain the facility or should the owner contract with the private sector. The theoretical O & M budget is based in part upon the discussion herein.

1. **Maintenance of airside components.** The scenario assumes that all airport facility components will have twenty (20) year life. Consequently, no major reconstruction of components would be contemplated. Runways will require marking every three (3) to five (5) years.

2. **Maintenance of land side components.** The scenario assumes that all hangar facilities will be constructed and maintained by the private sector. Consequently, no maintenance cost would be incurred by the public sector while the hangar facilities were under private ownership. Building costs would be incurred for the terminal building, should one be constructed.

3. **Airport management.** The scenario assumes that the airport will be managed through a contract with the fixed base operator. Chariton, Ames, Marshalltown, and Council Bluffs provide for airport management through arrangements with an FBO. The basic question is if the FBO will find the location profitable. Attracting a well qualified FBO is a problem at many small general aviation airports in Iowa. With the projected number of based aircraft at the proposed facility, attracting FBO facilities is not expected to be a concern. The assumption here is that the private sector will invest in conventional hangar and lease the facility to the FBO. The arrangement for airport management services by the FBO is a negotiable item. For purposes here it is assumed that the FBO will generate no revenue to the public sector nor will the public sector incur any cost for management services.

4. **Hangar construction and maintenance.** The scenario, as previously indicated, assumes that hangar facilities would be constructed by the private sector. Such construction should meet specifications set forth by the airport owner and follow the terminal area development plan. The hangars would be constructed with private capital on airport property with the hangars to be deeded to the airport owner in trade for a long term lease. At some point in time, the airport owner would assume management of the hangar facilities and incur the cost of maintaining the structures.

5. **Grounds maintenance.** Snow removal, as well as grass mowing, can be accomplished in a number of ways. The most appropriate method would be for the airport owner to provide the service or contract with the county. The FBO may also be contracted to provide the service.

Since proposed construction of hangar facilities is to be accomplished by the private sector, minimal income is expected to be produced from hangar rental. It is recommended that hangar facilities revert to public ownership after a ten (10) to twenty (20) year period. Such would allow the private sector an opportunity to amortize the cost of hangar construction. Some income may be generated through leasing the land upon which the hangars are constructed. While this would produce some immediate income, it would also increase the cost of amortization. As hangar units are constructed and amortized over a period of years, the airport would begin to realize increasing revenues from rental. Off setting the revenue would of course be an increase in maintenance costs.

Other revenue may be realized from the lease of airport land for aviation related business. Acquisition of land is expected to represent a minimum amount necessary to accommodate airport facilities. Unlike many general aviation airports, little revenue would be generated from cropping.

The airport may generate income from tiedown fees and sale of aviation fuel. One general aviation airport in Iowa is currently charging a landing fee. It would appear that the cost of collection and the fact that virtually no other public owned facilities charge a landing fee would suggest that this is not nor will be a viable revenue source.

For purposes of this study, an annual O & M budget of 40,000 dollars is recommended. The largest variable is the cost providing for airport management. The assumption made that revenue generated from the lease of facilities to the FBO would be canceled out by the cost of retaining the FBO to manage the airport.

Capital Costs

The capital costs associated with airport development would provide for land acquisition in fee title and clear zone protection. The capital costs would provide for the development of primary runway, 60' X 3400' feet, connecting taxiway, and a medium intensity runway/taxiway light system. Runway end identifier lights and a precision approach path indicator would also be installed on the primary runway. A non-precision instrument approach is proposed to each runway. Development would also include a rotating beacon light and non-directional radio beacon.

The crosswind runway would consist of a turf facility with a low intensity runway light system. A taxiway connecting the primary runway to the terminal area would also be constructed.

At the present time Federal assistance is limited to ninety (90) percent of the project cost; State assistance is limited to seventy (70) percent. With the exception of hangar facilities, vehicle parking, and terminal buildings, the remaining airport components are eligible for assistance.

The assumption herein is that project feasibility rests upon the ability of the airport sponsor/owner to acquire State and/or Federal assistance. The proposed action must be found by the FAA to meet criteria set forth in the National Plan of Integrated Airport Systems (NPIAS). The Iowa Department of Transportation must find the airport to be of State wide significance.

System Benefit - Cost

The Iowa Department of Transportation developed a methodology to assess public benefits occurring as a result of estimated airport use, location and development cost. The cost also includes an operating and maintenance factor. The methodology does not attempt to identify direct benefits to the community from airport generated income and employment or induced benefits. The primary objective was to estimate the value of a given airport facility in terms of the entire state system of airports. The methodology is appropriate herein in terms of examining the benefits and costs of the proposed airport with respect to Mason City and other public airports in north central Iowa.

Benefits per aircraft operation were determined by accounting for the following:

- Value of time
- Travel time
- Automobile operating costs
- Distance to nearest alternative airport (public)

$$\text{Benefit Per Operation (B)} = \frac{W D}{M} = XD, \text{ where}$$

W = Value of time for all aircraft operations, \$25.00
D = Distance to nearest alternative system airport, Des Moines International: 26 miles
M = Average automobile speed - 45 m.p.h.
X = Average total automobile operating cost per mile: \$0.24

The benefit per operation was calculated to be \$20.67. Using the above methodology, benefits were calculated to be as follows:

TABLE 4-5: PRESENT VALUE BENEFITS

YEAR	TOTAL ANNUAL	ITINERANT ONLY
1990	$ 993,283	$ 496,642
1994	$1,135,182	$ 624,306
1999	$1,135,182	$ 624,306
2009	$1,348,038	$ 808,905

SOURCE: PDS, 1990

The terminal area should support no less than three improved surface tiedown spaces for itinerant aircraft usage. Terminal area improvements may include apron and taxiway construction adjacent to existing hangar facilities. The total capital cost will vary with site conditions and airport geometrics. The assumption herein is that a new primary runway alignment would be selected. However, the existing terminal area would not be relocated. Facility development would include the following:

* Primary runway (60' X 3400')
* Connecting taxiway and itinerant apron
* MIRL, PAPI, REIL, Segmented Circle, rotating beacon
* NDB
* Terminal area taxiway access to existing hangars

* Land acquisition

Development would satisfy Airplane Design Group I dimensional standards. The estimated capital investment is summarized as follows:

* Public Sector
  - Land Acquisition and Fencing $ 160,000-
  - Grading and Drainage $ 301,000-
  - Runway, Taxiway (connecting) $ 712,937-
  - Lighting & Navaids $ 98,270-

  Total Public Sector $1,272,207-

* Private Sector
  - Hangars $ -0-

  Total Private Sector $ -0-

* Total Investment $1,272,207-

A total investment of 1.27 million dollars would be required in the initial phases of development. The cost estimate is <u>not</u> "site-specific"

The benefit - cost ratio for the proposed development through 2009 is summarized in Table 4-6.

TABLE 4-6: SYSTEM BENEFIT - COST, 1990 - 1994

		BENEFITS (PVB)		RATIO (BCR)	
YEAR	COSTS (PVC) (1)	TOTAL	ITINERANT	TOTAL	ITINERANT
1990	1,272,207-	993,283	496,642	0.78	0.39
1994	1,272,207-	1,135,182	624,306	0.89	0.49
1999	1,272,207-	1,135,182	624,306	0.89	0.49
2009	1,272,207-	1,348,038	808,905	1.06	0.64

(1) Not including interest

SOURCE: PDS, 1990

The benefit/cost ratio (BRC) based upon total operations in 1990 was placed at 0.78. Should the benefit/cost ratio be calculated only upon the itinerant activity, the ratio would be considerably less. Based upon 1990 itinerant operations, 39 cents in benefits would be realized for each dollar of cost. If total annual operations were used, 89 cents in benefits would be realized compared to one dollar in cost.

Based upon the value calculated for just itinerant operations, the development of a public owned airport to the standards set forth in Chapter Three would be questionable in terms of importance to the state system of airports. Using total operations, the BCR would approach and exceed one (1) sometime within a ten to 20 year time frame.