Charlevoix Municipal Airport

CHARLEVOIX, MICHIGAN

/// Master Plan Study

June, 2013

FINAL REPORT

Prepared By:

RW ARMSTRONG

CHARLEVOIX MUNICIPAL AIRPORT

Charlevoix, Michigan

Master Plan Study

FINAL REPORT

June, 2013

300 South Meridian Street
Indianapolis, Indiana 46225
(317) 786-0461
rwArmstrong.com

CITY OF CHARLEVOIX

City Manager
Rob Straebel
Airport Manager (Former)
Matthew Bailey

RW ARMSTRONG & ASSOCIATES

Director of Planning
Paul Puckli
Project Manager
Kevin Clarke
Project Planner
Aaron Lofurno
Project Engineer
Chad Ackley, P.E.

In professional association with:

QoE Consulting
Michael Borta, P.E.
Paul Shapter, P.E.

TECHNICAL ADVISORY COMMITTEE MEMBERS

Norman Carlson, Jr.	City of Charlevoix
Mike Spencer	City of Charlevoix
Jill Picha	City Council
Lyle Gennett	City Council
Diane Morse	FAA Detroit Airports District Office
Ernie Gubry	FAA Detroit Airports District Office
Dave Welhouse	FAA Detroit Airports District Office
David Baker	Michigan Bureau of Aeronautics
Mark Grennell	Michigan Bureau of Aeronautics
Kelly Crannell	Michigan Bureau of Aeronautics
Ralph Sims	Michigan Bureau of Aeronautics
Rachel Teague	Fresh Air Aviation
Angela Le Fevre (Welke)	Island Airways
Dave Guanci	Latitude 45
Don Seelye	Pilot/Land Owner
Erin Bemis	Chamber of Commerce
Terry Salmonson	Charlevoix Flying Club
Chuck Scherping	Emmet Sport Flyers
Bill McDonough	Beaver Island Boat Company

NOTICE

The preparation of this document was financed in part through a planning grant from the Federal Aviation Administration (FAA) as provided under Section 505 of the Airport and Airway Improvement Act as amended. The contents of this document do not necessarily reflect the official views of the FAA. Acceptance of this report by the FAA does not in any way constitute a commitment on the part of the United States to participate in any development depicted herein, nor does it indicate that the proposed development is environmentally acceptable in accordance with applicable public laws.

PREFACE

This document is the result of the Charlevoix Municipal Airport (CVX) Master Plan Study. The study was kicked off in June 2010 and involved collaboration between the Airport sponsor (the City of Charlevoix), the Federal Aviation Administration Detroit Airport District Office (FAA Detroit ADO), Michigan Department of Transportation (MDOT), QoE Consulting, RW Armstrong, and the Technical Advisory Committee (TAC). The TAC was established for the purpose of reviewing technical analyses at key points during the study process, providing technical input to the study team, distributing data, and serving as a conduit between interested parties and the study team. The TAC was comprised of City officials, FAA Detroit ADO and MDOT officials, Airport staff, and business and personal users of the Airport.

The recommendations of this document were developed in collaboration with the stakeholders listed above, and are reflected on the Airport Layout Plan (ALP) Set, which was officially approved by the FAA Detroit ADO on May 28, 2013. Because many of the components of this study are officially approved by the FAA Detroit ADO, this document was largely left unchanged in final production. Thus, there are many references to the "base year" which is listed as 2010 (Forecasts of Aviation Demand) or 2011 (Implementation Plan). While the actual schedule of implementation will vary in response to market conditions and funding priorities, it is believed that the development plan presented in this document represents the long-term vision necessary to meet the transportation needs of the community in the future, as concurred upon by the Airport sponsor (the City of Charlevoix), TAC, and FAA Detroit ADO.

PROJECT KEY DATES

April, 2010	Project Kickoff
October 20, 2010	TAC Meeting #1
December 7, 2010	Aviation Forecasts generally concurred upon by the FAA Detroit ADO
December 8, 2010	TAC Meeting #2
February 15, 2011	TAC Meeting #3
May 2, 2011	TAC Meeting #4
August, 2011	Final Draft Master Plan / ALP submitted to FAA Detroit ADO, MDOT
January 18, 2012	Final Draft Master Plan / ALP comments received from FAA Detroit ADO
March 28, 2012	FAA Detroit ADO comments addressed by RW Armstrong, QoE Consulting
May 24, 2012	Conference call held between the Airport sponsor, FAA Detroit ADO, RW Armstrong, and QoE Consulting to discuss how to proceed with the final review and approval
December 17, 2012	Additional ALP comments received by FAA Detroit ADO
March 19, 2013	FAA Detroit ADO review of ALP Set complete (pending minor revisions)
April 2012	Final ALP Set provided to FAA Detroit ADO
May 28, 2013	ALP officially approved by FAA Detroit ADO
June, 2013	Final Master Plan Report delivered to Airport sponsor, FAA Detroit ADO, MDOT
July 1, 2013	Master Plan Study complete / final presentation to Charlevoix City Council

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1 INTRODUCTION

The City of Charlevoix has retained the services of RW Armstrong to prepare a Master Plan Study for the Charlevoix Municipal Airport (CVX). This introductory chapter provides a brief overview and history of the Airport, as well as a discussion pertaining to the primary objectives of the Airport Master Plan. Consistent with the guidance provided in Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5070-6B, *Airport Master Plans*, the contents of this Airport Master Plan include:

- Chapter 1: Introduction
- Chapter 2: Inventory of Existing Facilities and Conditions
- Chapter 3: Forecasts of Aviation Demand
- Chapter 4: Facility Requirements
- Chapter 5: Airport Development Concepts
- Chapter 6: Implementation Plan
- Chapter 7: Financial Analysis
- Chapter 8: Airport Plans

The outcome of the Airport Master Plan will provide planning and development guidance necessary to address landside and airside facilities and land development considerations for the next 20 years and beyond. The final Master Plan document will serve as a strategic plan and marketing tool for the improvement of the Airport.

A Technical Advisory Committee (TAC), consisting of individuals with a vested interest in CVX and its operations, was established to support this Master Planning effort. Members of the TAC have reviewed working papers at various milestones throughout the course of the study to ensure that all relevant issues were adequately addressed. The TAC meetings were open to the public and additional public meetings with the City Council were held in June 2010 and May 2011 to brief the elected officials on the recommendations of the Master Plan, and to afford all interested individuals and/or groups the opportunity to provide input concerning the Plan and its adoption by the City.

1.1 STUDY OBJECTIVES

The purpose of the Airport Master Plan is to provide guidance for future airport improvements in order to satisfy regional aviation demand in a logical and financially-feasible manner. Consistent with this purpose, the following objectives were developed for this Master Plan Study:

- Provide a framework that allows the Airport to meet the long-term air transportation needs of the region in a safe, secure, and efficient manner and in compliance with all FAA and Michigan Bureau of Aeronautics requirements.
- Identify the airfield, terminal, and aviation support facilities that are necessary to accommodate future aviation demand and fulfill the needs of all airport users and stakeholders.
- Provide a financial plan that establishes a schedule of development priorities to adequately meet the needs of the future demand for aviation facilities and services at the Airport.
- Promote the Airport as a major contributor to regional economic activity.
- Identify strategies to best utilize the collective resources offered by the Airport and the community.
- Support the development of compatible land uses in the Airport vicinity in a manner that is sensitive to the surrounding environment.
- Actively solicit the input of the TAC and the public throughout the planning process.

In addition to addressing these objectives, this study will also fulfill the broad master plan goals set forth by the FAA in AC 150/5070-6B. These goals are:

- Document the issues that the proposed development will address.
- Justify the proposed development through the technical, economic, and environmental investigation of concepts and alternatives.
- Provide an effective graphic presentation of the development of the airport and anticipated land uses in the vicinity of the airport.
- Establish a realistic schedule for the implementation of the development proposed in the plan, particularly the short-term capital improvement program.
- Propose an achievable financial plan to support the implementation schedule.
- Provide sufficient project definition and detail for subsequent environmental evaluations that may be required before the project is approved.
- Present a plan that adequately addresses the issues and satisfies local, state, and federal regulations.

- Document policies and future aeronautical demand to support municipal or local deliberations on spending, debt, land use controls, and other policies necessary to preserve the integrity of the airport and its surroundings.
- Set the stage and establish the framework for a continuing planning process. Such a process should monitor key conditions and permit changes in plan recommendations as required.

1.2 AIRPORT BACKGROUND

Understanding the background of an airport and the region that is serves is important in making informed decisions pertaining to airport-related improvements. This section discusses CVX in the context of its location and history.

1.2.1 Location

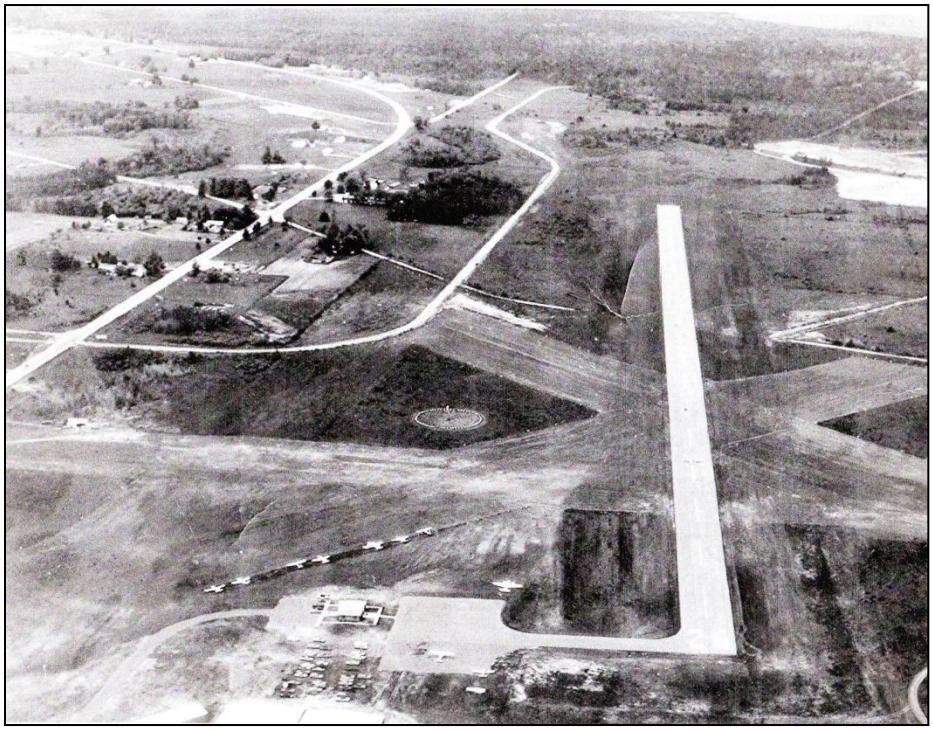
Charlevoix, Michigan is located in the northwestern part of the Lower Peninsula of Michigan and is situated between Lake Michigan and Lake Charlevoix. It is located approximately 160 miles directly north of Grand Rapids, and approximately 230 miles northwest of Detroit. The City of Charlevoix is the county seat of Charlevoix County. Charlevoix Township is a separate municipal entity that surrounds the City. The Airport is within city limits, located approximately ½ mile southwest of downtown Charlevoix, and encompasses approximately 205 acres of land. The elevation at the Airport is 669 feet above mean sea level (MSL). The Airport is accessible from U.S. Highway 31 which connects the Airport to the downtown district of Charlevoix. U.S. 31 continues southerly towards Traverse City and continues northerly towards Petoskey. M-66 also provides access to Charlevoix from the southern part of the state and terminates at U.S. 31 in Charlevoix. The general vicinity of Charlevoix and the Airport are shown on **Figures 1-2** and **1-3**.

1.2.2 History

The Airport was originally constructed in 1944 as a municipal airport, and was built to serve the Beaver Island community, which is the largest island in Lake Michigan and part of Charlevoix County. In 1945, Joe McPhillips flew mail to Beaver Island temporarily after the usual carrier was injured. This marked the beginning of regular air service to Beaver Island as McPhillips Flying Service, Inc. was formed. By the early 1960s, Runway 9/27 was paved and two other turf runways were in service, Runway 4/22 and Runway 15/33. Runway 15/33 has since been closed. Other major events at the Airport are presented in the timeline on the following page.

- 1944 – Airport constructed
- 1945 – Air carrier service from CVX to Beaver Island began
- 1960 (Approximately) – Runway 9/27 paved
- Mid 1960s – Non-directional beacon (NDB) installed
- Early 1980s – Runway 9/27 extended from 3,500 to 4,500 feet
- 1988 – Master Plan and ALP preparation begins
- 1991 – Master Plan completed
- 1992 – Ramp area extended and improved
- 1994 – New Runway 9/27 constructed, previous runway converted to parallel taxiway, perimeter fencing installed
- 1998 – Runway 9/27 extended to 4,550 feet
- 1999 – 2000 – First corporate hangar completed
- 2002 – Current terminal building completed
- 2003-2004 – Current parking lot completed
- 2004 –Taxiway to north hangar area rehabilitated, Automated Weather Observation Station (AWOS) installed
- 2008 – Second corporate hangar completed, ALP update began
- 2009 – Replacement terminal building design began
- 2010 – Master Plan effort began

Figure 1-1 – CVX Historic Photo



Source: City of Charlevoix Website, http://www.cityofcharlevoix.org/

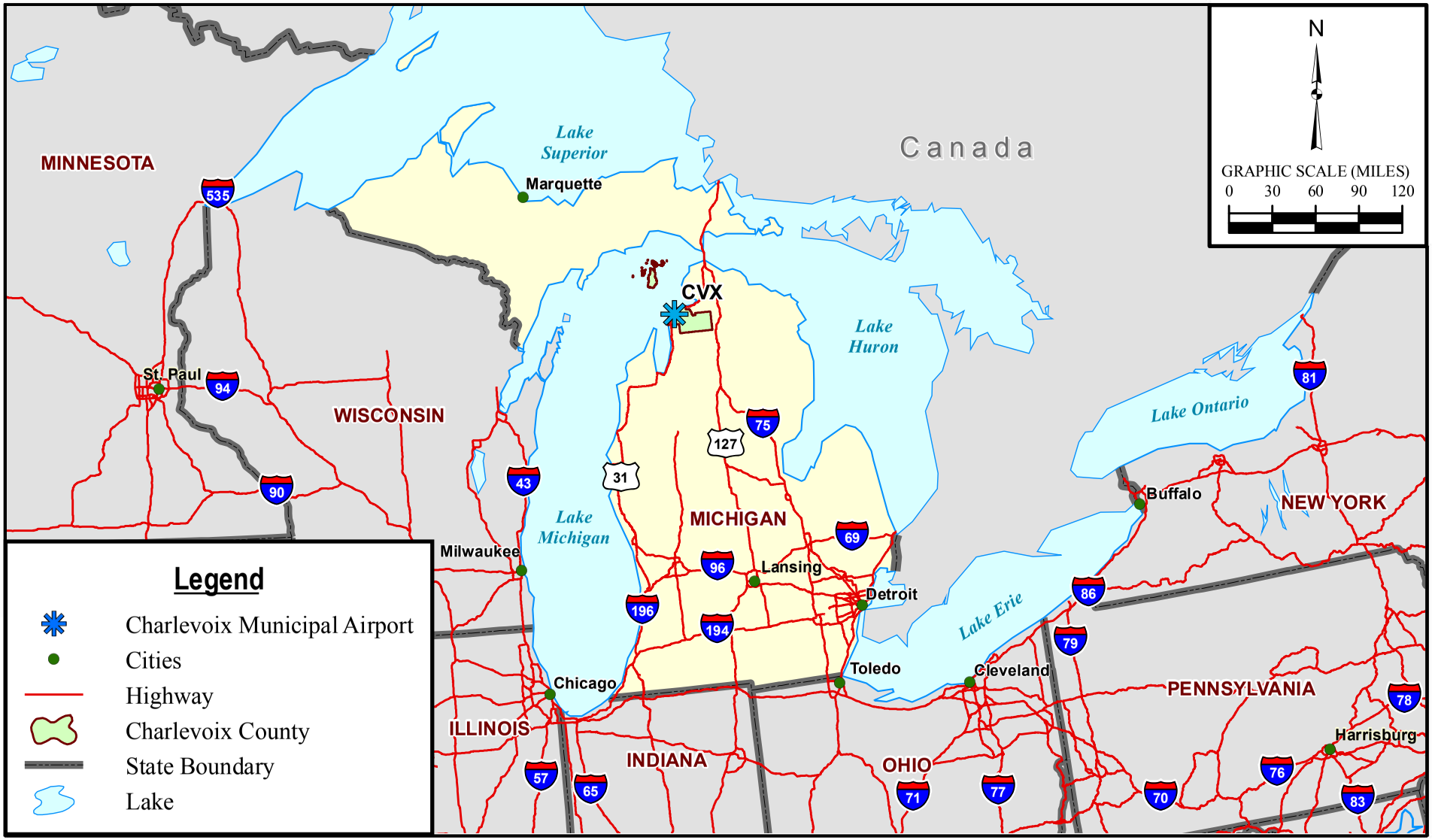


FIGURE 1-2

LOCATION MAP

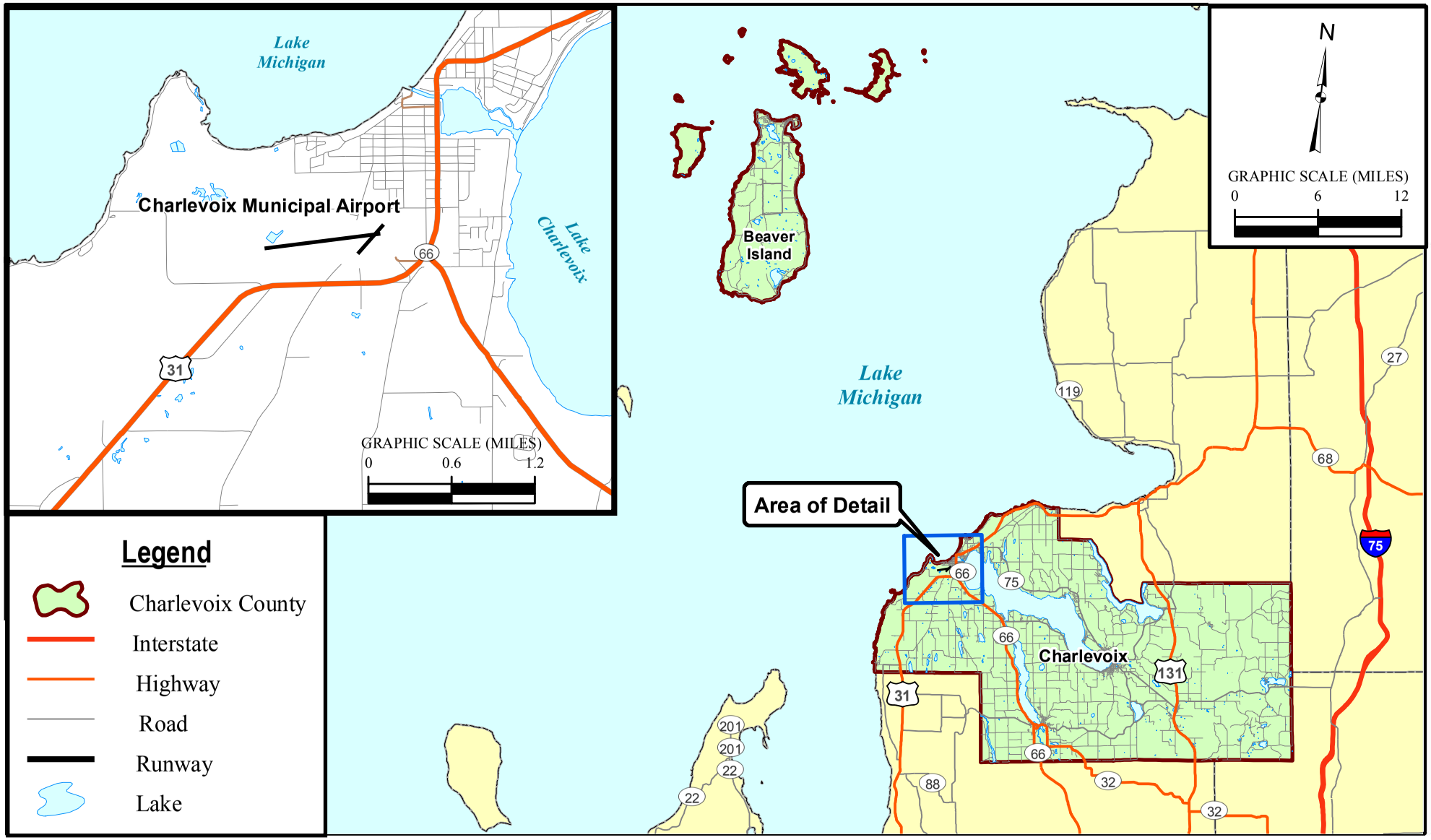


FIGURE 1-3

VICINITY MAP

1.2.3 Airport Role

The National Plan of Integrated Airports Systems (NPIAS) is a document created by the FAA to assist the agency in programming federal funds to support required aviation development at airports included in the NPIAS. According to the 2011-2015 NPIAS Report, the United States has approximately 5,179 public airports, of which 64 percent are included in the NPIAS (3,380 airports). Airports included in the NPIAS are considered significant to national air transportation and therefore, are eligible to receive grants under the FAA Airport Improvement Program (AIP). The NPIAS further categorizes the included airports based on types of service provided and quantity of passengers enplaned. Of the airports included in the NPIAS, 503 airports are considered a primary or non-primary commercial service airport.

Charlevoix Municipal Airport is classified as a non-hub primary commercial service airport in the 2011-2015 NPIAS. Commercial service airports that enplane less than 0.05 percent of all commercial passenger enplanements in the U.S. but have more than 10,000 annual enplanements are categorized as non-hub primary airports. There are 244 non-hub primary airports in the nation that together account for 3 percent of all enplanements.

CVX also plays a role in the *Michigan Airport System Plan* (MASP 2008). The MASP serves as an asset management tool for the Michigan Department of Transportation (MDOT) Bureau of Aeronautics staff involved in state airport system planning and airport capital development. It documents the planning process used by MDOT to identify the aviation role of public-use airports in Michigan through the year 2030. All airports are assigned to one of three tiers based on their contribution to each system goal. Tier 1 airports respond to essential/critical state airport system goals and should be developed to their full and appropriate level. Tier 2 airports complement the essential/critical state airport system and/or respond to local community needs. Focus at these airports should be on maintaining infrastructure with a lesser emphasis on facility expansion. Tier 3 airports duplicate services provided by other airports and/or respond to specific needs of individuals and/or small businesses. The following goals are the basis for determining an airport's tier:

- Airports should serve significant population centers
- Airports should serve significant business centers
- Airports should serve significant tourism/convention centers
- Airports should provide access to the general population
- Airports should provide adequate land area coverage
- Airports should provide adequate regional capacity, and
- Airports should serve seasonally isolated areas.

Charlevoix Municipal Airport is considered to be a Tier 1 airport based on business center proximity, tourism center proximity, land area coverage, and regional capacity.

To support these criteria, the MASP identifies a minimum airport classification standard that the airport should be developed to. This standard is based on the size and operational characteristics of the aircraft anticipated to use that airport. This standard coincides with the FAA Airport Reference Code standards which are further described in **Section 2.1.1**. CVX meets the minimum classification standards associated with the tourism, land area coverage, and regional capacity goals, which suggest either a B-I or B-II classification. CVX does not, however, meet the minimum classification standard associated with the business center proximity goal, which suggests a C-II standard.

Airport Reference Code (ARC) is an alphanumeric classification of aircraft based on approach speed (A-E) and wingspan (I-VI). The higher the letter or number – the faster or larger (respectively) the aircraft is.

1.2.4 Local Public Airports and Airport Service Area

There are many public use airports in the vicinity of CVX. These include NPIAS commercial service airports, NPIAS general aviation airports, non-NPIAS publicly owned airports, and non-NPIAS privately owned airports. In terms of attractiveness for potential revenue-generating businesses and users, the NPIAS airports could be considered competitors, due to the level or service and facilities offered by CVX and these other airports. The two airports that are the closest in proximity to CVX are East Jordan City Airport (Y94) and Boyne City Municipal Airport (N98), which are both located within Charlevoix County. Neither airport is included in the NPIAS. The closest NPIAS airports are Harbor Springs Airport (MGN) of Emmet County and Antrim County Airport (ACB) of Antrim County, which are 17 nautical miles northeast and 19 nautical miles south of CVX, respectively. Both Airports are general aviation airports. The closest NPIAS commercial service airports are Cherry Capital Airport (TVC) and Pellston Regional Airport (PLN), which are located 36 nautical miles southwest and 26 nautical miles northeast of CVX, respectively. A summary of the public use airports within 50 nautical miles of CVX is presented in **Table 1-1**. These Airports are displayed in **Figure 1-4**.

In terms of providing reasonable public access to the National Airspace System (NAS; discussed in **Section 2.5**), an airport's service area is commonly defined as being within a 30-minute drive time of the airport. For CVX, the service area includes portions of Charlevoix County, Emmet County, and Antrim County. While it is useful to examine the service area and the proximity to other airports, CVX is a rather unique situation due to the Airport being the only local airport that offers regular service to Beaver Island. As depicted in **Figure 1-5**, the only airports within the service area of CVX are the non-NPIAS East Jordan City Airport (Y94) and Boyne City Municipal Airport (N98). However, the service area for CVX overlaps with the service areas of other surrounding airports.

Table 1-1 – Local Public Use Airports

Airport		Runways (feet)	Best Approach	BAC	Enplanements	Operations
NPIAS Commercial Service Airports						
CVX	Charlevoix Municipal Airport	4,550 x 75 1,280 x 200 (turf)	NPI 919' & 1 mi	27	17,800	±30,000
TVC	Cherry Capital Airport	6,500 x 150 5,378 x 150	ILS 817' & 1/2 mi	97	183,400	92,500
PLN	Pellston Regional Airport	6,513 x 150 5,401 x 150	ILS 912' & 1/2 mi	36	26,200	16,400
NPIAS General Aviation Airports						
ACB	Antrim County Airport	5,000 x 100	NPI 908' & 1 mi	25	N/A	11,516
SJX	Beaver Island Airport	4,300 x 75 3,300 x 120 (turf) 2,130 x 120 (turf)	NPI 1,080' & 1 mi	3	N/A	9,210
6Y1	Bois Blanc Island Airport	3,498 x 75	N/A	7	N/A	3,500
SLH	Cheboygan County Airport	4,005 x 75 1,600 x 75 (turf)	NPI 1,060' & 1 mi	18	N/A	6,854
GLR	Gaylord Regional Airport	6,578 x 150 3,319 x 75	ILS 1,571' & 1 mi	39	N/A	8,118
GOV	Grayling Army Airfield (Military-owned)	5,000 x 150 5,000 x 150	NPI 1,700' & 1 mi	Unknown	N/A	4,691
MGN	Harbor Springs Airport	4,157 x 75	1,120' & 1 mi	15	N/A	16,500
83D	Mackinac County Airport	3,800 x 75	1,020' & 1 mi	14	N/A	33,050
MCD	Mackinac Island Airport	3,500 x 75	1,260' & 1 mi	2	N/A	11,100
Non-NPIAS Publicly Owned Airports						
N98	Boyne City Municipal Airport	4,000 x 75	N/A	14	N/A	9,202
Y65	Calvin Campbell Municipal Airport	3,006 x 50	N/A	15	N/A	3,590
Y94	East Jordan City Airport	3,250 x 50 1,800 x 120 (turf)	N/A	6	N/A	1,700
Y87	Empire Airport	2,600 x 50 2,275 x 150 (turf)	N/A	4	N/A	500
Y88	Green Lake Airport	2,800 x 170 (turf) 1,700 x 170 (turf)	N/A	4	N/A	300
Y89	Kalkaska City Airport	3,500 x 75	N/A	4	N/A	2,640
Y96	Leo E. Goetz County Airport	2,600 x 60 1,400 x 100 (turf)	N/A	1	N/A	200
D90	Mancelona Municipal	3,400 x 140(turf) 2,050 x 120 (turf)	N/A	1	N/A	50
5D5	Woolsey Memorial Airport	3,663 x 120 (turf) 2,670 x 150 (turf)	N/A	3	N/A	500
Privately Owned Airports						
6Y8	Welke Airport	2,512 x 30 3,500 x 140 (turf)	N/A	12	N/A	23,450

Source: Inventory conducted by RW Armstrong, 2010
Notes: Based Aircraft and Operational Figures have been obtained from FAA Form 5010, Airport Master Record, and are offered for relative comparison purposes only.

BAC - Based Aircraft Count
ILS – Precision Instrument Landing System
NPI - Non-Precision Instrument

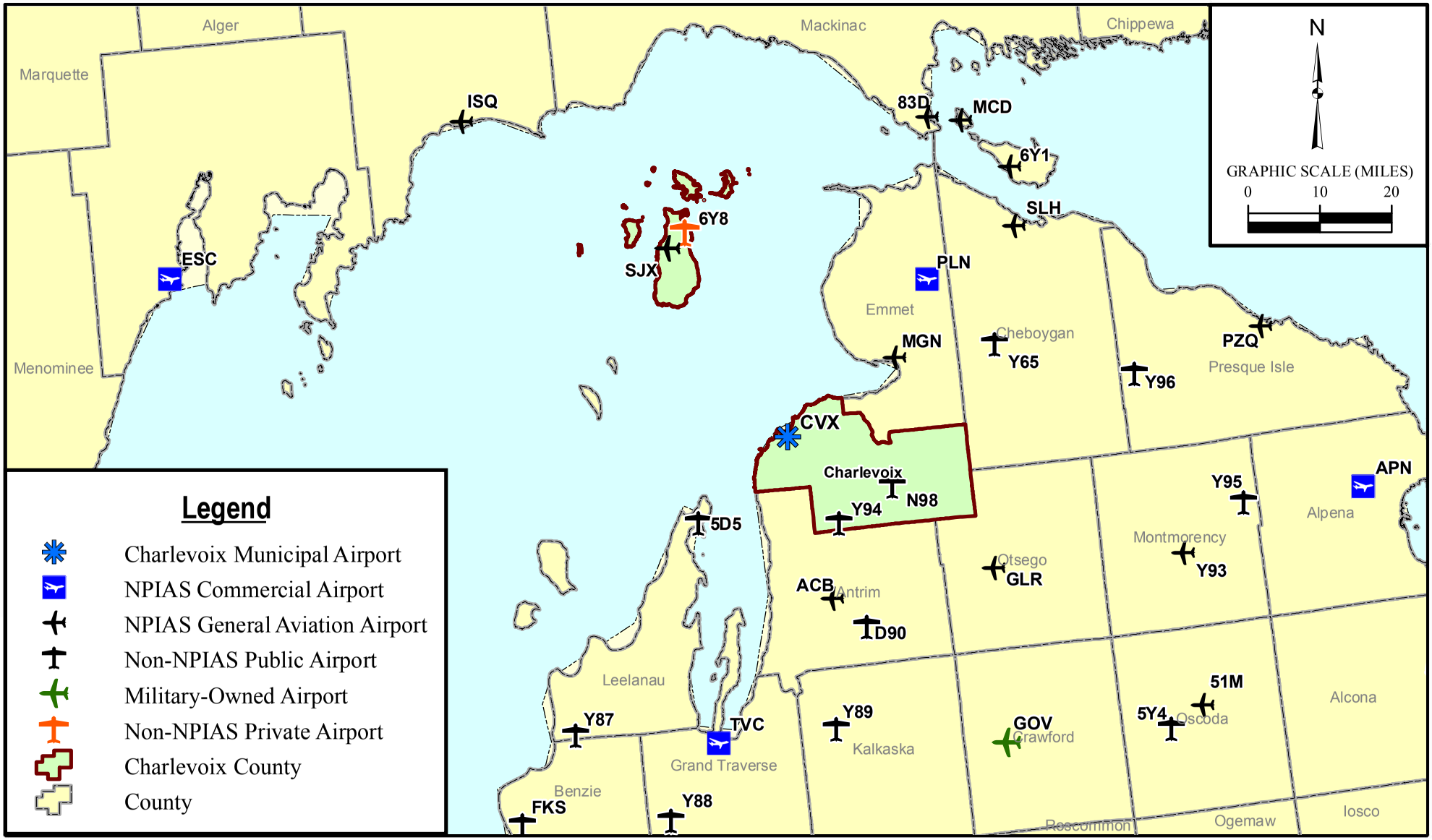


FIGURE 1-4

LOCAL PUBLIC AIRPORTS

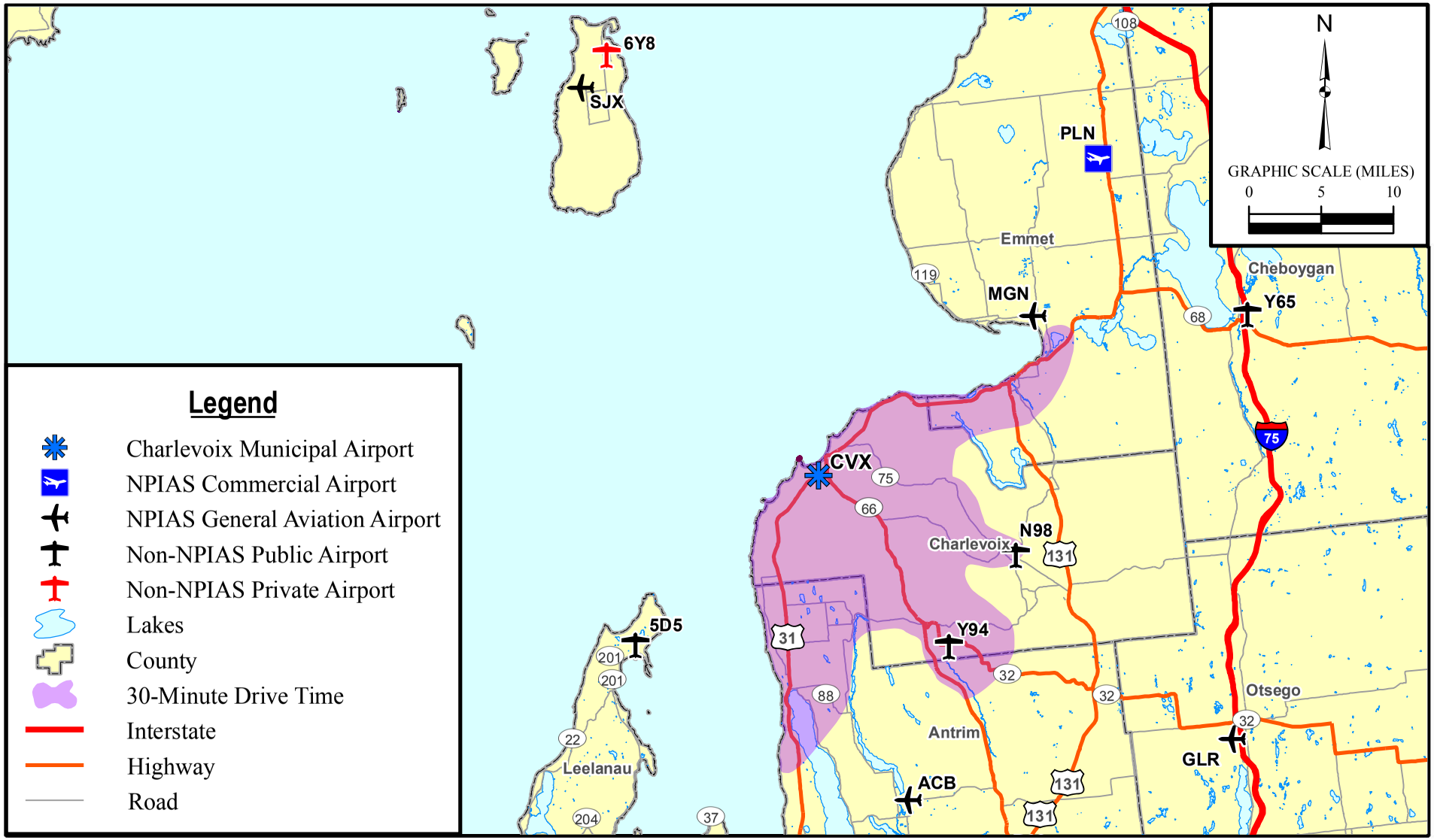


FIGURE 1-5

AIRPORT SERVICE AREA

1.3 AIRPORT ORGANIZATION

The Airport is owned by the City of Charlevoix. Airport operations are overseen by a full-time Airport Manager who is employed by the City. The City employs an airport operations staff of approximately eight full- and part-time employees that perform flight-line, fueling, facility/grounds maintenance, now removal and customer service duties.

There are currently two airlines operating from the Airport; Island Airways and Fresh Air Aviation. Both airlines offer scheduled and on-demand flights to-and-from Beaver Island (which is part of Charlevoix County) along with additional charter services to other locations. Island Airways occupies space in the existing terminal building and leases the adjacent hangar building. Island Airways also provides flight instruction.

There are four Through-the-Fence (TTF) operators located at CVX. TTF operators are businesses or individuals that have facilities outside of airport property but have access to the airfield. The TTF operators at CVX include Fresh Air Aviation which maintains facilities on Old Norwood Road and operates through the midfield gate. There are two privately owned corporate hangars located to the west of the midfield that access the airfield through their own gate. Another privately owned hangar is located to the northeast of the airfield which also has access through a private gate.

TTF operations are generally considered by the FAA as less desirable than maintaining aviation related activity, and access, within airport property. This TTF model has afforded the Airport the opportunity to attract corporate aircraft operators, and the revenues associated with corporate aviation, that would otherwise have gone elsewhere. Each TTF operator has an access agreement with the Airport, and the access rate is published in the Airport's fee schedule. It should be noted that the Airport is currently reviewing its TTF policies to address FAA and MDOT concerns and industry best management practices, to ensure that there is no disincentive, through the Airports fees structure, to develop on airport lands.

2 INVENTORY OF EXISTING FACILITIES AND CONDITIONS

The initial step in the master planning process is the development of an inventory of the existing physical conditions and operational characteristics of the Airport and its surroundings. Items that were inventoried include:

- Airside Facilities
- Landside Facilities
- Commercial Services
- General Aviation and Support Facilities
- Airspace Environment
- Meteorological Conditions
- Public Utility Infrastructure
- Off Airport Land Use Considerations
- Financial Data
- Environmental Considerations

The existing facilities (airside and landside) are presented in **Figure 2-1**. The terminal area facilities are presented in **Figure 2-2**. The information presented in this chapter provides the basis for evaluating the Airport's existing and future facility requirements.

2.1 AIRSIDE FACILITIES

Airside facilities are the elements of infrastructure that are most closely associated with the arrival and departure of aircraft. The airside components at CVX are described in the following subsections and include:

- Airport Design Criteria
- Runway System
- Taxiway System
- Terminal Area Apron
- Pavement Strength
- Airfield Markings
- Aircraft Storage
- Navigational Aids
- Airfield Signage and Lighting

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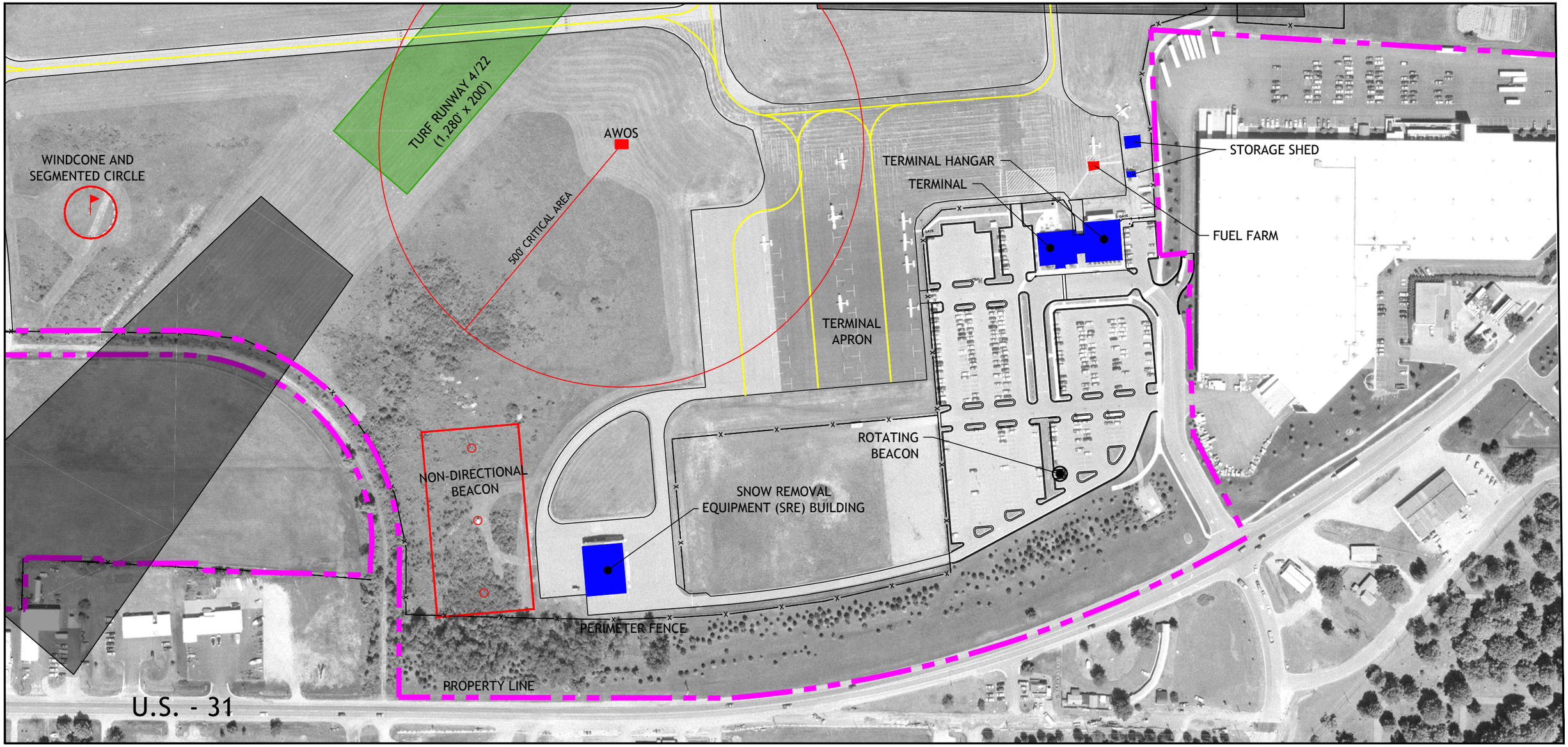
GRAPHIC SCALE (FEET)
0 125 250 500

FIGURE 2-1

EXISTING FACILITIES



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GRAPHIC SCALE (FEET)

0 50 100 200

FIGURE 2-2

TERMINAL AREA

2.1.1 Airport Design Criteria

The FAA classifies airports according to the size and operational characteristics of aircraft that the airport is designed to accommodate. The system of classification is known as an Airport Reference Code (ARC). The ARC classification consists of a letter designating the aircraft Approach Category (determined by approach speed) and a roman numeral designating the Airplane Design Group (ADG) (determined by wingspan or tail height). The aircraft approach speed affects runway length and other airfield facilities while the aircraft wingspan affects the required separation between the runway, taxiways, and above ground objects. These design criteria are described in FAA AC 150/5300-13, *Airport Design*. Aircraft can be further categorized by their Maximum Takeoff Weight (MTOW). Those with a MTOW of 12,500 pounds or less are classified as "small" aircraft and those over 12,500 pounds are classified as "large" aircraft. The previous 2004 Airport Layout Plan (ALP) identified CVX as an ARC B-II facility, with the turf crosswind runway designated for ARC A-I small aircraft only. The ARC criteria are described in **Table 2-1**.

Table 2-1 – Airport Reference Code

Approach Category			
Approach Category	**Airspeed (knots)**		**Example Aircraft**
A	<91		Cessna 152, Beech Bonanza A36
B	91 ≤ 121		Saab 340, Gulfstream I
C	121 ≤ 141		MD 80, CRJ
D	141 ≤ 166		Boeing 747, KC-135
E	166+		F-16, A-10
Airplane Design Group			
Design Group	**Tail Height (ft)**	**Wingspan (ft)**	**Example Aircraft**
I	<20	<49	Cessna 172, Cirrus SR-22
II	20-<30	49 ≤ 79	Cessna Citation II, Falcon 900, CRJ
III	30-<45	79 ≤ 118	Boeing 727, Boeing MD 80
IV	45-<60	118 ≤ 171	Boeing 757, MD 11
V	60-<66	171 ≤ 214	Airbus A340, Boeing 777
VI	66-<80	214 ≤ 262	Airbus A380, C-5 Galaxy

Source: FAA AC 150/5300-13 *Airport Design*

As shown in **Table 2-1**, approach categories A and B include small piston-engine aircraft and corporate jets with approach speeds of less than 121 knots, while categories C, D, and E include larger aircraft with approach speeds of 121 knots or greater. Aircraft in Approach Categories C, D, and E typically include those associated with commercial or military use. Similarly, design groups I and II include small piston-engine aircraft and light to midsize corporate jets, as well as single- and twin-engine turboprop aircraft.

Design groups III, IV, and V include larger corporate jets and the majority of the commercial jet fleet, as well as numerous military aircraft. Design group VI includes very large jets such as the Airbus A380 and the military C-5 transport aircraft.

The ARC signifies the airport design criteria necessary to accommodate the most demanding aircraft types expected to regularly operate at an airport. The most demanding aircraft is commonly referred to as the critical or design aircraft and must account for a minimum of 500 annual itinerant operations. An itinerant operation is defined as the takeoff or landing of an aircraft going from one airport to another, whereas local operations are those that remain within 20 nautical miles of the originating airport for the entire flight. Currently, CVX is designated as an ARC B-II facility, which indicates that the Airport is designed to accommodate aircraft such as the Cessna Citation II and the Dassault Falcon 900. In previous studies, the Beechcraft King Air C90 (B-II) was listed as the critical aircraft.

Figure 2-3 displays typical aircraft within each ARC.

A-I Single-Engine (Piston)

- Beech Baron 55
- **Beech Bonanza**
- Cessna 150
- Cessna 172
- Cirrus SR-22
- Piper Aztec
- Piper Seneca

A-I, A-II Multi-Engine / Turbo-Prop / Jet

- Britten-Norman Islander
- Cessna 208 Caravan
- Eclipse 500
- **Hawker Premiere I**
- Partenavia P-68
- Piper PA-46

B-I, B-II Under 12,500 Lbs.

- Beech Baron 58
- Beech King Air 90
- Beech King Air 200
- **Cessna 402**
- Cessna 441
- Piper Navajo
- Cessna Citation I
- Citation Mustang

B-I, B-II Over 12,500 Lbs.

- Super King Air 300
- Beech 1900
- Falcon 20, 50, 900
- **Citation II**, III, IV, V
- Beechjet 400
- Mitsubishi MU-300
- Jetprop Commander

C-I, D-I

- Learjet 35, 45, 55
- Israeli Westwind
- Hawker Siddeley 125
- **Piaggio Avanti**

C-II, D-II

- Bombardier CL-600
- Canadair Regional Jet
- Citation Sovereign
- Citation X
- Embraer Legacy 500
- **Hawker** 800 / **900 XP**
- Gulfstream II, III, IV

A-III, B-III

- **DHC Dash 8**
- DC-3
- Convair 580
- Fairchild F-27
- ATR 72
- ATP

C-III, D-III

- Boeing Business Jet
- B 727-200
- **B 737-300 Series**
- MD-80, DC-9
- A319, A320
- Gulfstream V
- Global Express

FIGURE 2-3

COMMON AIRCRAFT BY ARC

2.1.2 Runway System

The Airport operates two runways: Runway 9/27 and Runway 4/22. Runway 9/27 is the primary runway at the airfield, is constructed of bituminous pavement (not grooved) and has a blast pad that extends 250 feet beyond the Runway 27 threshold. This runway is intersected by Runway 4/22 near the Runway 27 end. Runway 4/22 is a turf runway that accommodates smaller recreational aircraft and, to some extent, provides crosswind capability to the primary runway. The runway is aligned in a southwest/northeast orientation and is marked with 3-foot yellow cones. The runway is only in use during Visual Flight Rule (VFR) conditions and typically only between May and October when it is not covered in snow. Island Airways utilizes the turf runway on occasion. **Table 2-2** presents the characteristics of each runway.

Table 2-2 – Existing Runway Specifications

	Runways	
	9/27	4/22
Length (feet)	4,550	1,280
Width (feet)	75	200
Runway End Elevation (feet above MSL)	(9) 669 (27) 643	(4) 646 (22) 640
Pavement Type	Bituminous Concrete (Asphalt)	Turf
Pavement Load Bearing	30,000 lbs. for dual wheel	N/A
Effective Runway Gradient	0.13%	0.07%
Aircraft Approach Category	B	A
Airplane Design Group	II	I
Runway Markings	Non-precision	Yellow Cones
Runway Lighting	MIRL, REILS, PAPI-4	None
Navigational Aids	NDB, GPS	None

Source: Airport Master Record for Charlevoix Municipal Airport, Form 5010-1, FAA, Federal Aviation Administration, 2009

2.1.3 Taxiway System

Runway 9/27 is served by a partial parallel taxiway constructed of bituminous pavement. The parallel taxiway extends from the terminal ramp area and is nearly the full length of the runway (length of taxiway is 4,300 feet long). Several taxiways extend off the parallel taxiway and provide access to the Midfield Hangar Complex and the TTF operators. A taxiway also extends from the terminal area apron providing access to the North Hangar Complex. The parallel taxiway is designed to accommodate Group-II aircraft standards and is 35 feet wide. All other taxiways (hangar taxiways, north hangar taxiway) are 25 feet wide (Group-I aircraft standards).

There are four perpendicular connector taxiways available for aircraft landing on Runway 9/27; two mid-field connectors, one exit taxiway located at the Runway 27 threshold, and one exit taxiway near the Runway 9 end.

2.1.4 Terminal Area Apron

Aircraft parking aprons provide space for aircraft parking, loading and unloading, and circulation. Charlevoix Municipal Airport maintains a single public apron that is located immediately north and west of the terminal building. The apron encompasses approximately 335,000 square feet of bituminous pavement and serves both itinerant aircraft and the commercial operations of Island Airways.

Most of the aircraft parking and tie-down positions are located on the western side of the apron. The current configuration can accommodate up to 52 Group-I aircraft. The eastern portion of the ramp is used for transient aircraft parking, passenger/cargo loading and unloading, and provides access to the terminal and adjacent hangar (leased by Island Airways). The fuel farm is also located on this side of the apron, northeast of the terminal, and will be further discussed in **Section 2.4**.

Figure 2-4 – Terminal Area Apron

Photo Taken By: RW Armstrong, June 2010

2.1.5 Pavement Strength

The pavement strength of a runway is determined by the structure of the pavement section and the landing gear configuration of the aircraft operating on the airfield (i.e. the number of tires which distributes the weight of the aircraft). The designed load bearing capacity of Runway 9/27 is 30,000 pounds for a dual-gear configuration.

A visual inspection of the pavement conditions (June 2010) was conducted for this Master Plan effort as well as a review of the 2009 *Pavement Management Report* prepared by Applied Pavement Technology. As described in the report, the pavement conditions were analyzed using the Pavement Condition Index (PCI) procedure; during which the types, severities, and amounts of distress present at a pavement's surface are quantified. This information is then used to develop a composite index that represents the overall condition of the pavement in numerical terms, ranging from 0 (failed) to 100 (excellent). According to the report, and depicted in **Figure 2-5**, the taxiways and apron are considered to be in "excellent" condition, and the runway is considered to be in "very good" condition.

2.1.6 Airfield Markings

The most recent pavement markings were completed in 2009 and are considered to be in excellent condition. Consistent with FAA AC 150/5340-1K *Standards for Airport Markings* guidelines for non-precision instrument runways, the following airside markings exist at the Airport:

<u>Runway 9/27</u>

- Runway designation numbers 9 and 27
- 18 inch white centerline runway strip
- Threshold marking at the end of each Runway
- Threshold bar at the Runway 27 end
- 150' x 20' aiming point fixed distance markers
- Chevrons marked on blast pad

<u>Taxiways</u>

- Taxiway centerline stripes
- Taxiway edge marking
- Runway holding position markings on taxiway
- 6-inch taxiway connector centerline stripe

<u>Apron</u>

- Taxilane marking to tie-downs and T-hangars
- Apron edge marking
- Paved tie-down markings

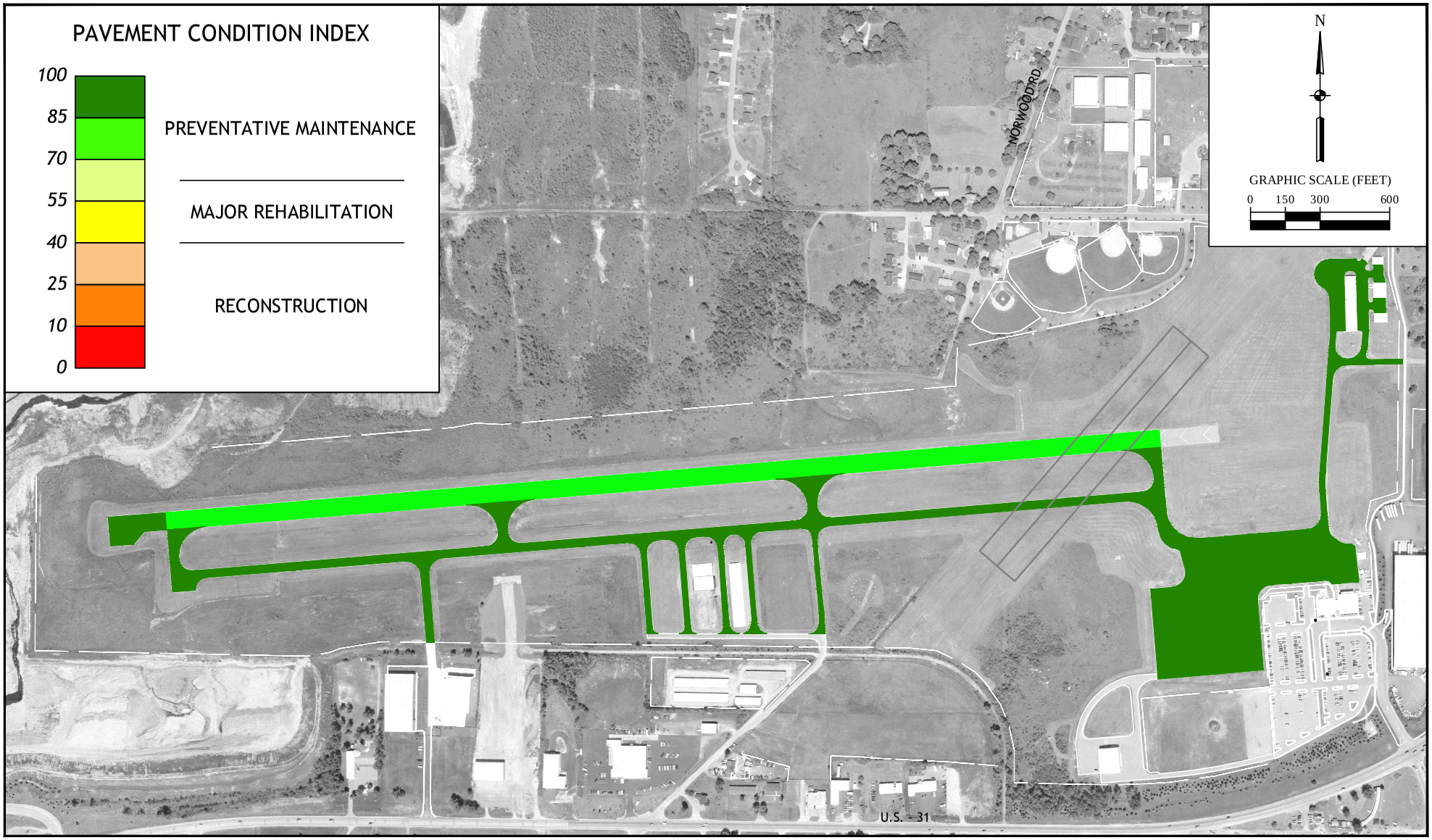

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FIGURE 2-5

PAVEMENT CONDITIONS

2.1.7 Aircraft Storage

Due to the harsh winter weather conditions at CVX, year-round based aircraft must be stored indoors. As such, the Airport offers a variety of hangar facilities. As of mid-2011 all of the hangars are occupied, and there is a waiting list for hangar space of 15 aircraft owners. The following section describes the existing hangar facilities.

A 5,600 square foot hangar (Terminal Hangar) is attached to the existing terminal with a breezeway that is used for cargo handling and storage. The hangar is utilized by Island Airways for aircraft storage/maintenance and general airline use, and is currently under a 40-year lease. All other hangars on the airfield are owned and operated by the City.

The Midfield Hangar Complex is comprised of eight hangars in three buildings. The Barnard Hangars consist of six box hangars that vary in size from approximately 1,800 to 2,000 square feet. Also located in the midfield are four conventional hangars (Mashni Hangars) which are approximately 2,000 square feet each. These hangars are the newest on the airfield and have amenities such as heated floors.

The North Hangar Complex consists of ten T-hangar units and three other box hangars. The T-hangars are approximately 1,200 square feet each. The box hangars are approximately 1,280 square feet, 1,600 square feet, and 3,200 square feet.

Table 2-3 – Existing Aircraft Storage

Hangar/Tenant	Location	Type	Hangar Area (sf)
Terminal Hangar	Terminal Area	Conventional	5,600
T-Hangars 1-10	North Complex	T-Hangars	1,196
Box Hangar B	North Complex	Conventional	1,632
Box Hangar C	North Complex	Conventional	3,264
Box Hangar D	North Complex	Conventional	1,280
Barnard Hangar M1	Midfield Complex	Conventional	1,806
Barnard Hangar M2	Midfield Complex	Conventional	1,806
Barnard Hangar M3	Midfield Complex	Conventional	1,806
Barnard Hangar M4	Midfield Complex	Conventional	1,935
Barnard Hangar M5	Midfield Complex	Conventional	2,064
Barnard Hangar M6	Midfield Complex	Conventional	2,064
Mashni Hangar G1	Midfield Complex	Conventional	4,000
Mashni Hangar G2	Midfield Complex	Conventional	3,980
Mashni Hangar G3	Midfield Complex	Conventional	3,980
Mashni Hangar G4	Midfield Complex	Conventional	4,000

Source: Inventory conducted by RW Armstrong, 2010

2.1.8 Navigational Aids

Airport navigational aids (NAVAIDs) assist pilots in safely and efficiently locating airports, landing aircraft, and taxiing and taking off from airports during all meteorological conditions. NAVAIDs are any visual or electronic device, airborne or on the surface, that provide point-to-point guidance information or position data to aircraft in flight. The existing NAVAIDs at CVX are discussed below and summarized in **Table 2-4**.

En-route Navigational Aids

En-route NAVAIDs assist pilots during navigation between airports. These facilities are usually ground-based and electronically emit signals that are received by aircraft on specific radio frequencies. They are almost always used in some manner by pilots operating on Instrument Flight Rule (IFR) flight plans but can also be used during VFR flights for position information.

The only ground-based NAVAID at CVX is the non-directional Beacon (NDB), which is located on airport property and has the three letter identifier CVX. NDBs radiate a signal which provides directional guidance to and from the transmitting antenna. Although not a ground-based NAVAID, satellite navigation (GPS) is becoming a widely-used form of en-route navigation. CVX has capabilities for both NDB and GPS non-precision instrument approaches, which are further described in **Section 2.5.3**.

There are additional en route NAVAIDs located near CVX, including the Gaylord VOR/DME, Pellston VORTAC, and Traverse City VORTAC.

Terminal Area Navigation and Landing Aids

The terminal area navigation and landing aids are visual in nature. The primary visual aid to assist pilot's in locating the Airport is the rotating beacon, which flashes green and white alternately, which signals that the airport is a civilian land airport. The rotating beacon generally can be seen 10 miles from the Airport. Also located on the airfield is a lighted wind cone and segmented circle designed to indicate wind direction and relative wind speed.

Another source of visual navigation that aids pilots in locating Runway 9/27 against competing light sources are the Runway End Identification Lights (REILs), located on both Runway 9 and Runway 27 ends. The REILs consist of two unidirectional strobe lights, located laterally on either side of the runway threshold, that flash to help the pilot establish the runway orientation during nighttime operations or low visibility. Runway 9/27 is also equipped with Precision Approach Path Indicators, or PAPIs. A PAPI consists of a series of lights that are located near the touchdown point of a runway. The lights have lenses that act as a prism and transmit either white or red light. These lights provide vertical guidance to the pilot to indicate to them if they are either too high or too low on an approach to the runway.

Table 2-4 – Navigational Aids and Airfield Lighting

Runway	Runway Markings	Lighting	Minimum Ceiling (MSL)/ Visibility	Approach Types	Navigational Aids
9	Non-precision	MIRL, REIL, PAPI-4	919' / 1 mile	RNAV (GPS), NDB	NDB
27	Non-precision	MIRL, REIL, PAPI-4	1,100' / 1 mile	RNAV (GPS), NDB	NDB
4	Yellow Cones	None	1,669' / 3 miles	Visual	None
22	Yellow Cones	None	1,669' / 3 miles	Visual	None

Source: Airport Master Record for Charlevoix Municipal Airport, Form 5010-1, Federal Aviation Administration, 2009
Notes:
MIRL – Medium Intensity Runway Edge Lighting System
REIL – Runway End Identifier Light System
PAPI-4 – Precision Approach Path Indicator
RNAV (GPS) – Area Navigation

2.1.9 Airfield Signage and Lighting

Airport guidance signs provide direction and information to taxiing aircraft and airport vehicles. The existing signage was installed in 2010. The signage includes runway/taxiway location signs and direction/runway exit signs.

In addition to the visual previously described, lighting on the airfield includes Medium Intensity Runway Lighting (MIRL) and Medium Intensity Taxiway Lighting (MITL), which were also installed in 2010. The airfield also offers a Pilot Controlled Lighting (PCL) system, which enables a pilot to control the airfield lighting on approach to the airport, including the REILs, PAPIs, MIRLs, and MITLs.

2.2 LANDSIDE FACILITIES

The landside facilities consist of the terminal/administration building, automobile parking, and ground access. The following sections describe the existing landside facilities and functions at the Airport.

2.2.1 Terminal Building

The terminal building is located on the southeast side of the airfield and can be accessed from U.S. 31 / Bridge Street. The building was constructed in 2002 and is approximately 3,600 square feet in size. Terminal building amenities include a lobby/passenger lounge, ticketing counter and work area for the air carrier (Island Airways), office space for airline and City personnel, restrooms, computer room, pilot's lounge with private restroom, and is accompanied by an exterior courtyard. The terminal building is presented in **Figure 2-6** and the terminal layout is depicted in **Figure 2-7**.

The lobby and passenger lounge accounts for approximately 1,000 square feet. The lobby provides access to the restrooms, pay phone, and vending area.

Figure 2-6 – Terminal Building

Photo Taken By: RW Armstrong, June 2010

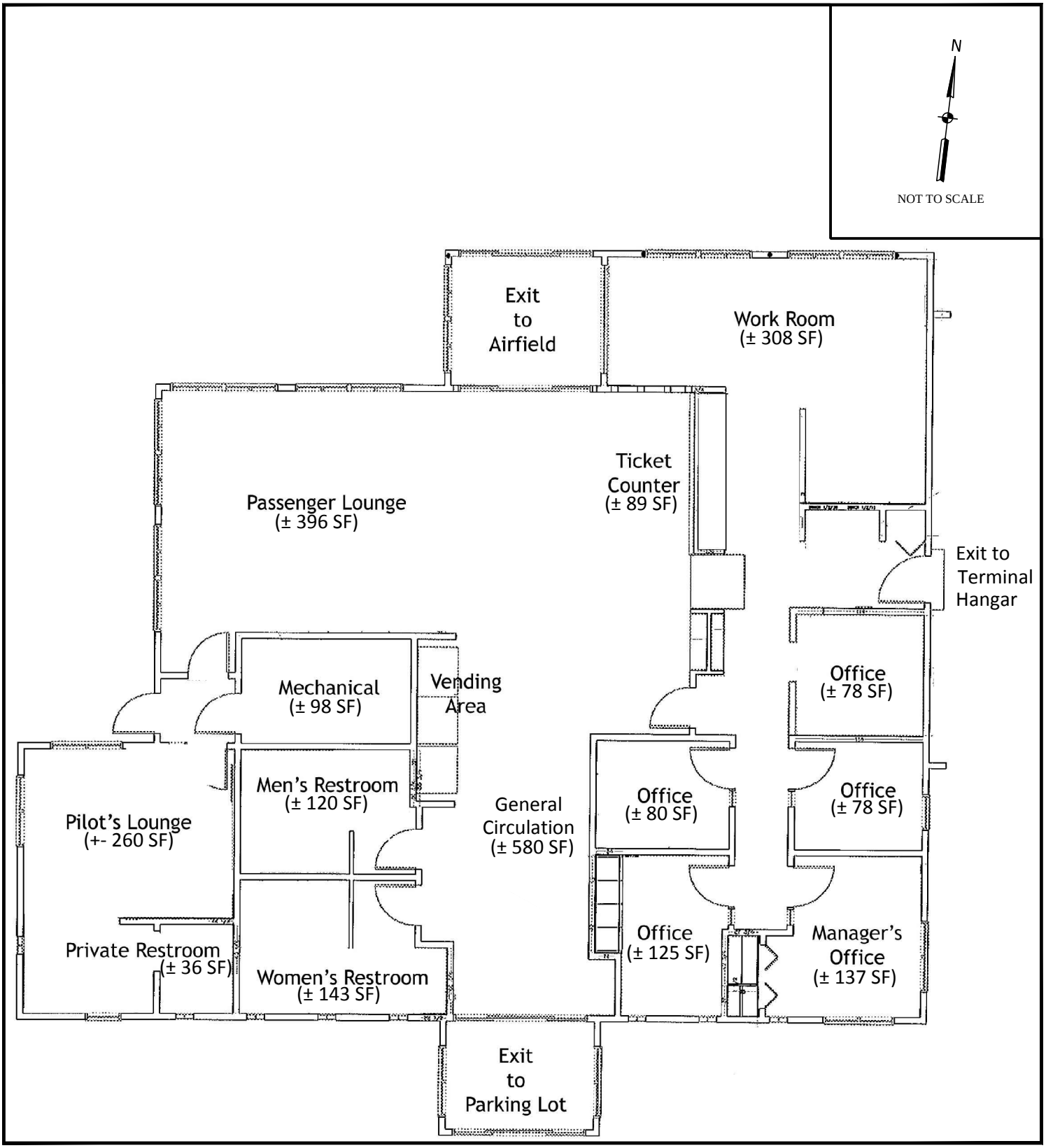


FIGURE 2-7

TERMINAL LAYOUT

2.2.2 Terminal Curb

The terminal curb is at ground-level and consists of 136 linear feet spanning the length of the terminal building and attached hangar. There are 11 drop-off/pickup parking positions.

2.2.3 Ground Access and Vehicle Parking

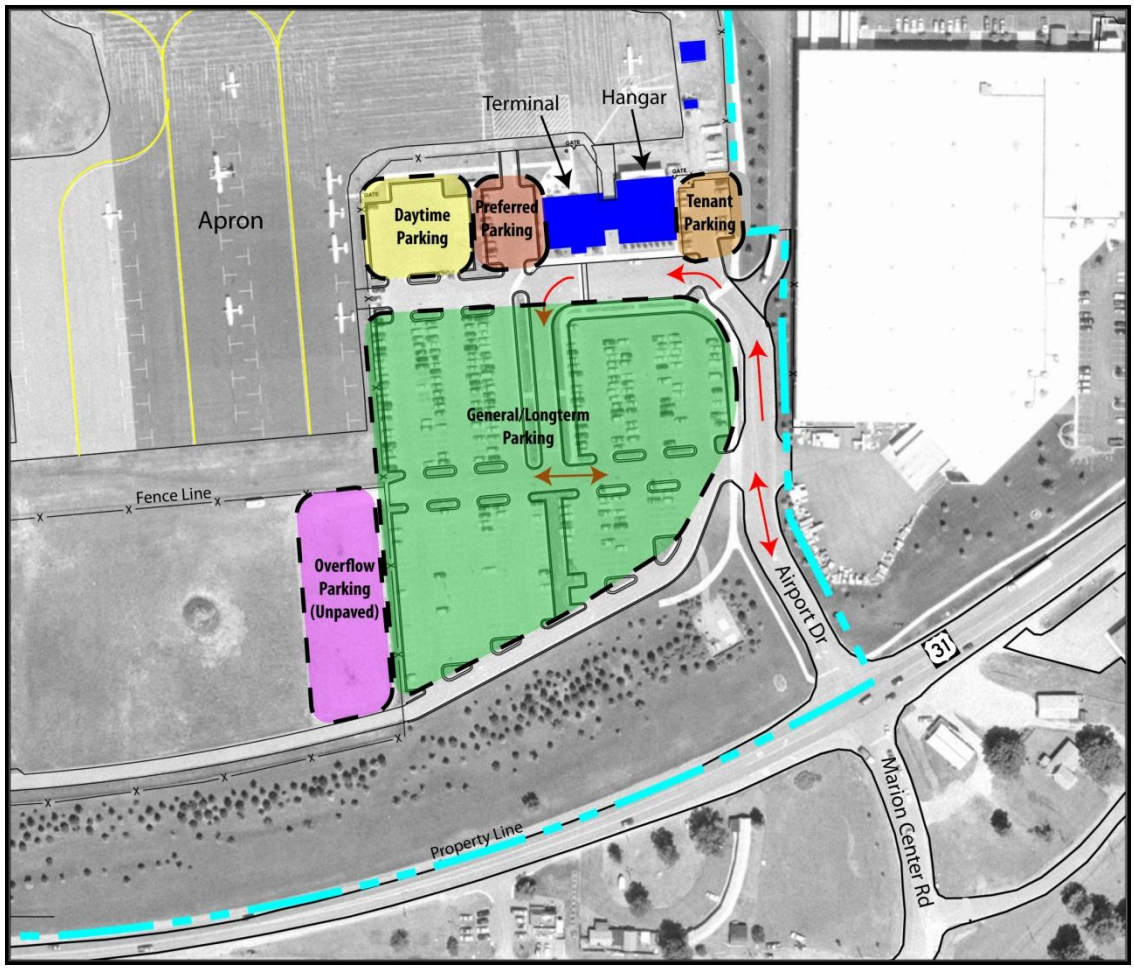
Access to the Airport is provided by U.S. 31/Bridge Street, which runs south to Traverse City and north to Petoskey. M-66 connects Charlevoix to the south and terminates at U.S. 31.

Access gates serve as access points between the landside and airside areas of the airport. CVX has five Vertical Pivot Lift (VPL) gates that were installed in 2010 (Gates 1, 3, 4, and 5). VPLs open vertically, lifting out of accumulated snow, and allowing maximum clearance for snow clearing equipment. Gate 1 is located to the east of the Terminal Hangar and is accessed through the tenant parking lot. Gate 2 is a sliding gate and is located west of the terminal building and is accessed through the preferred parking lot. Gate 3 provides access to the aircraft parking apron through the general parking lot. Gate 4 provides access to the Snow Removal Equipment (SRE) Building and is accessed by a paved road that runs east-west from the general parking lot. Gate 5 is located at the Midfield Hangar Complex and can be accessed through Old Norwood Road. Gate 6 is at the North Hangar Complex and can be accessed through Carpenter Road.

Two other access gates exist and are utilized by the TTF operators. One of the gates is located to the west of the Midfield Hangar Complex and is utilized by the corporate hangar users. Another gate exists to the southeast of the North Hangar Complex and is utilized by a private user whom has an off-airport hangar for his aircraft.

As depicted in **Figure 2-8**, a lighted vehicle parking lot is located near the terminal building and offers tenant parking, preferred parking, as well as daytime and long-term parking. Unpaved overflow parking is also available immediately adjacent to the paved lot. The number of available parking spaces, by type, are summarized in **Table 2-5**.

Figure 2-8 – Landside Access and Parking



Prepared By: RW Armstrong, 2010

Table 2-5 – Automobile Parking

Parking Lot	Spaces
Tenant	17
Preferred	17 (6 Handicapped)
Drop-off/Pickup	11
Daytime	40
General / Long-term	350 (3 Handicapped)
TOTAL	435 (9 Handicapped)

Source: RW Armstrong observations, June 2010

2.3 COMMERCIAL SERVICES

As stated previously, two airlines currently operate at CVX, Island Airways and Fresh Air Aviation. The following sections summarize these operators.

2.3.1 Island Airways

Island Airways was formed in 1975. In 1980, the airline merged with McPhillips Flying Service which had been offering service to Beaver Island since 1945. Island Airways employs approximately 20 people year-round (12 full-time, 8 part-time), and usually employs 4-5 seasonal employees. The airline primarily offers passenger and cargo service to Beaver Island but also offers regional charter service. The airline operates out of the current terminal and leases the attached conventional hangar.

The airline operates aircraft such as the Britain Norman Islander, the Piper Apache, and the Piper Aztec. Island Airways also owns a Cessna 150 that is used for flight training. These aircraft are associated with Airport Reference Code (ARC) A-I and A-II.

2.3.2 Fresh Air Aviation, Inc.

Fresh Air Aviation has been operating since 2006. They are a Through-the-Fence (TTF) operator and are located on Old Norwood Road. Fresh Air accesses the airfield through Gate 5. Their terminal building is approximately 1,200 square feet, and on-airport hangars are utilized for aircraft parking and storage. The airline employs 5 people year-round and 4 additional people during the peak season (3 full-time, 1 part-time). Fresh Air primarily offers service to Beaver Island but also offers on-demand charter service. The airline operates aircraft such as the Partenavia P68C, which is associated with ARC A-I.

2.4 GENERAL AVIATION AND SUPPORT FACILITIES

This section outlines the additional services and facilities offered at the airfield for pilots and other airport users.

2.4.1 General Aviation

CVX utilizes the existing terminal for both general aviation and commercial service uses. The terminal provides restrooms, a passenger waiting lobby, a pilot's lounge and flight planning stations with computer and phone access.

2.4.2 Support Facilities

The snow removal and grounds maintenance equipment is owned by the City and stored in the Snow Removal Equipment (SRE) building, which is located to the southwest of the existing apron.

Fueling service is provided by Airport staff. The fuel farm contains two underground fuel tanks; one 10,000 gallon Jet-A tank and one 12,000 gallon 100LL AvGas tank. The Airport operates two fuel trucks (leased by the City from the fuel providers). Both grades of fuel are also available through a self-serve station equipped with a credit card reader, which is located in the middle of the terminal apron as seen in **Figure 2-9**.

Figure 2-9 – Fuel Farm

Photo Taken By: RW Armstrong, June 2010

2.5 AIRSPACE ENVIRONMENT

The United States National Airspace System (NAS) is an integrated collection of controls, procedures, and policies put in place and regulated by the FAA to ensure safe and efficient air operations. The following sections describe the airspace classifications, aeronautical charts, and instrument approach capabilities at CVX.

2.5.1 Airspace Classification

The NAS has been divided into airspace classes to designate the level of Air Traffic Control (ATC) service and operating rules for a given area. Classes A, B, C, D, and E are the "controlled" airspaces and Class G is "uncontrolled".

Class A airspace is the most restrictive of the airspace classes. It covers the entire nation and is applied to airspace between 18,000 feet above mean sea level (MSL) and 60,000 feet MSL. Within Class A airspace, the aircraft must be operating under instrument flight rules (IFR), which requires the aircraft to have filed a flight plan with the FAA and to operate the aircraft in a certain manner.

Class B airspace surrounds the busiest airports in the nation (either greater than 3.5 million enplanements or operations greater than 300,000 annually, of which 50 percent are air carrier operations). Class B airspace is generally from the surface to 10,000 feet MSL. This airspace is designed to contain arriving and departing commercial air traffic operating under IFR. Any aircraft operating in the Class B airspace must have ATC clearance.

Class C airspace surrounds airports with moderate traffic (greater than 75,000 annual instrument operations, or greater than 250,000 enplanements annually). Class C airspace generally ranges from the surface to 4,000 feet MSL.

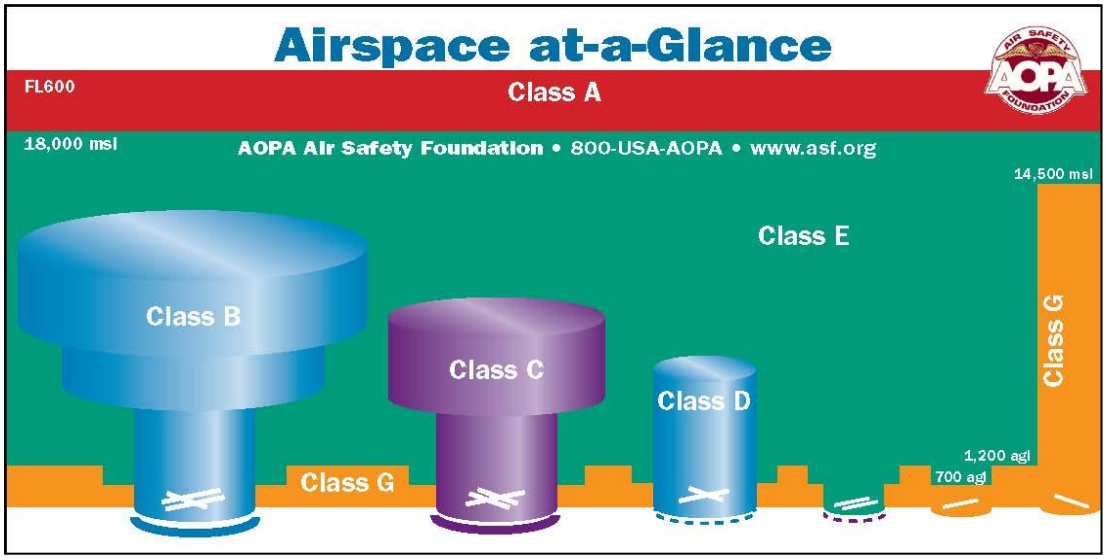
Class D airspace is used for smaller airports that have a control tower and do not meet the criteria established for Class C airspace. It generally ranges from the surface to 2,500 feet MSL. Aircraft operating in Class D airspace must establish two-way radio communication with ATC prior to entering the airspace.

Class E airspace represents all other controlled airspace. This class of airspace ranges from the surface to 18,000 feet above MSL at Class E airports and, when specified, from 700 feet above ground level (AGL) to 18,000 MSL. This is depicted on the aeronautical chart in **Figure 2-11** by a shaded purple line surrounding CVX (aeronautical charts are further described in the following section.) Airports within this class of airspace do not require a control tower but do have cloud clearance and visibility requirements. Class E airspace can also be considered the "filler" airspace under Class A, above Class G and between Classes B, C, and D and has the same operational requirements there as other Class E environments.

Class G airspace is uncontrolled airspace. It represents a mantle of low lying airspace beginning at the surface up to 700 feet AGL. In very remote areas, it has an upper limit at 14,500 feet MSL. Charlevoix Municipal Airport is located in Class G airspace.

A graphic of the NAS classifications is presented in **Figure 2-10**.

Figure 2-10 – U.S. Airspace Classifications



Source: AOPA Online, 2010

2.5.2 Aeronautical Charts

The National Aeronautical Charting Office (NACO) of the FAA publishes special aeronautical charts used by pilots to navigate through the National Airspace System. These charts are called "sectional charts" or "sectionals." A sectional chart provides detailed information on airspace classes, ground-based NAVAIDS, radio frequencies, longitude and latitude, navigational waypoints, and navigational routes. It also offers topographical features, such as terrain elevations, and ground features that are important to aviators, such as landmarks that will be identifiable from altitude. Although these charts are used for Visual Flight Rule (VFR) and Instrument Flight Rule (IFR) navigation, they are a VFR pilot's primary navigation tool. **Figure 2-11** displays a segment of the Green Bay Sectional Chart, centered on CVX.

2.5.3 Instrument Approach Capabilities

Until recently, instrument approach procedures relied on ground based electronic NAVAIDS and were classified as either "precision" or "non-precision". Non-precision approaches provided only lateral guidance, whereas precision instrument approaches provided both lateral and vertical guidance. The NAVAIDS supporting traditional

precision approaches are collectively called an instrument Landing System (ILS) and include a Localizer (providing lateral guidance), a Glideslope (providing vertical guidance) and an approach lighting system (providing close-in visual guidance).

With the expansion of Global Positioning System (GPS) based technology into the aviation arena, the FAA has implemented new navigation systems and approach procedures utilizing their Wide Area Augmentation System (WAAS). WAAS is a navigation service, owned and operated by the FAA, that uses a combination of GPS satellites and WAAS geostationary satellites to improve the GPS navigational system accuracy for en route, terminal, and approach procedures. This new navigational technology supports "vertically-guided instrument approach procedures" and provides ILS-like approach capability without the need for traditional ground-based ILS NAVAID equipment. The WAAS-enabled vertically-guided approach procedures are called LPV which stands for "localizer performance with vertical guidance[1]." Aircraft must be appropriately equipped with WAAS compatible avionics and pilots must be appropriately trained to use these systems and procedures.

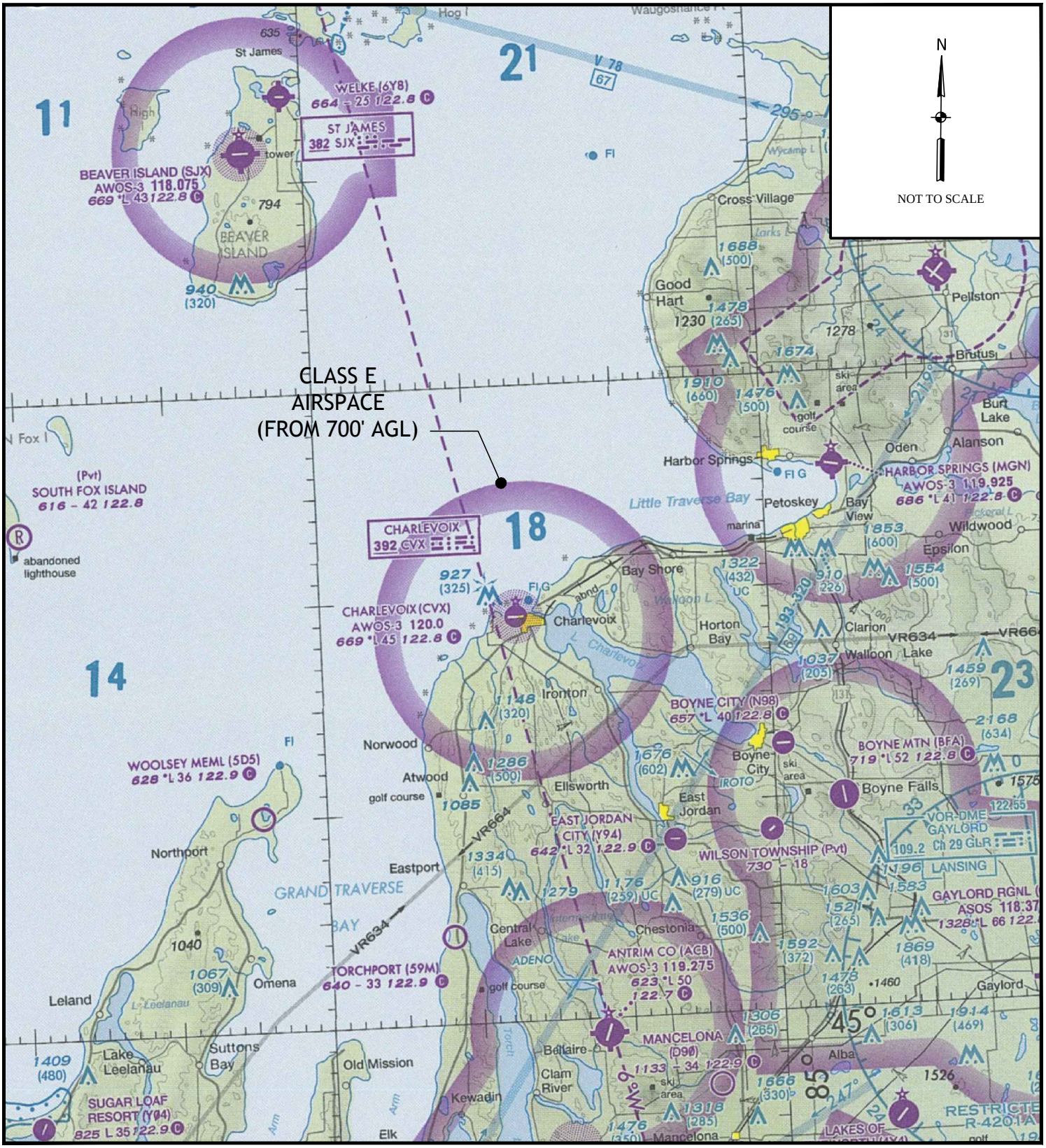
CVX has four established non-precision instrument approaches to Runway 9/27. Two utilize GPS technology, and two utilize the ground-based non-directional beacon (NDB) located on the Airport. An LPV procedure is provided to Runway 9. The approach minimums range from a 1,340 foot MSL ceiling with 2 ¼ mile visibility to a 919 foot MSL ceiling and 1 mile visibility. The approaches available to CVX are presented in **Table 2-6**. The procedures for these approaches are described in published charts called instrument approach plates. **Figures 2-12** through **2-15** display the published instrument approach plates at CVX.

Table 2-6 – CVX Approaches and Weather Minimums

Runway End	Approach Type	Approach Method	Minimums - Ceiling (MSL)/Visibility
Runway 9	Non-precision	RNAV (GPS)	919' / 1 mile
	Non-precision	NDB	1,340' / 1 mile
	Visual	None	1,669' / 3 mile
Runway 27	Non-precision	RNAV (GPS)	1,100' / 1 mile
	Non-precision	NDB	1,460' / 1 miles
	Visual	None	1,669' / 3 miles
Runway 4	Visual	None	1,669' / 3 miles
Runway 22	Visual	None	1,669' / 3 miles

Source: FAA Approved Instrument Approach Plates, January 2011

[1] In terms of FAA Airport Design Standards and FAR Part 77 airspace protection standards, LPV approaches are considered non-precision (as of 2011).



SOURCE: SKYVECTOR

FIGURE 2-11

SECTIONAL AERONAUTICAL CHART

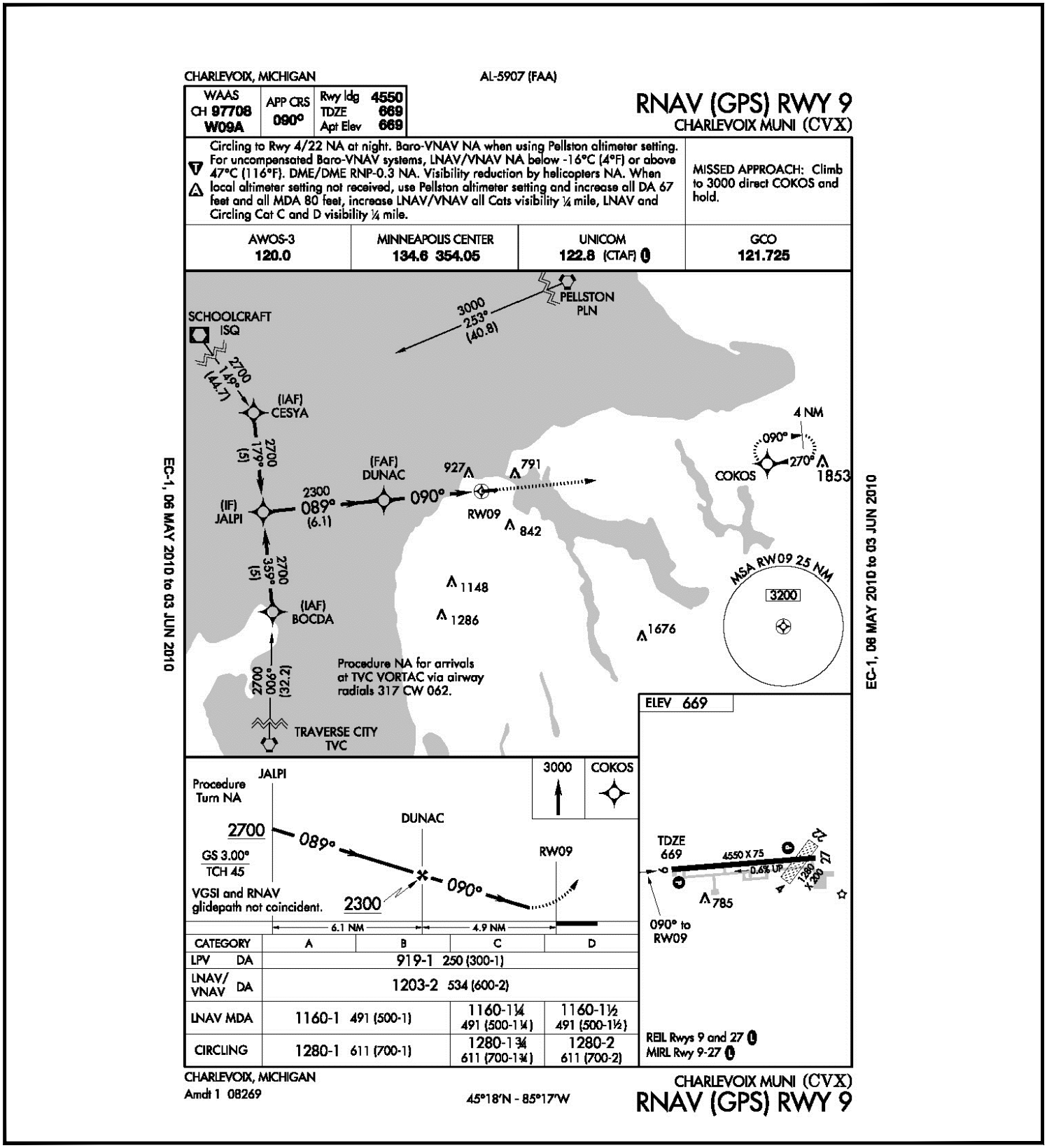


FIGURE 2-12

RUNWAY 9 GPS APPROACH

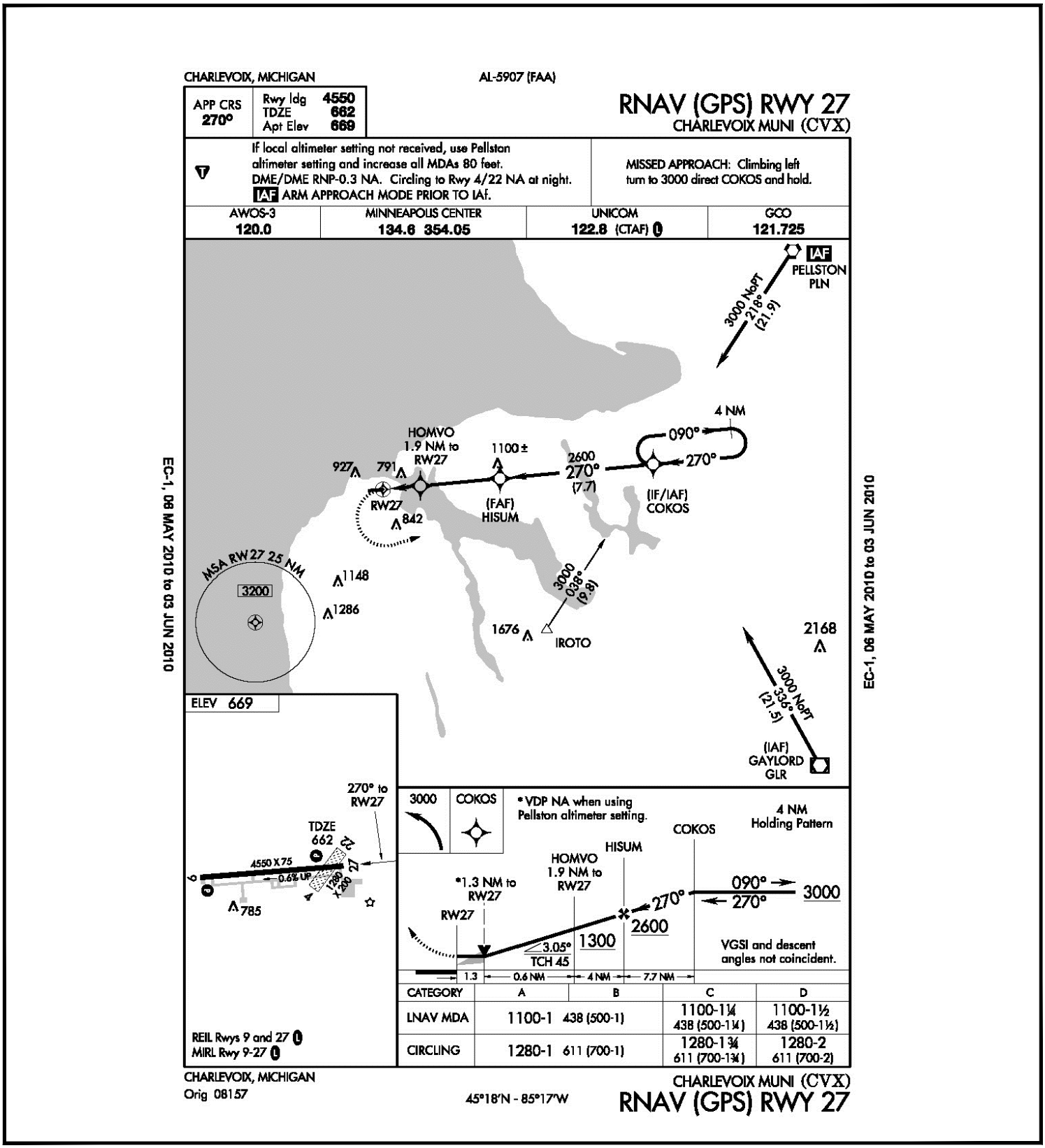


FIGURE 2-13

RUNWAY 27 GPS APPROACH

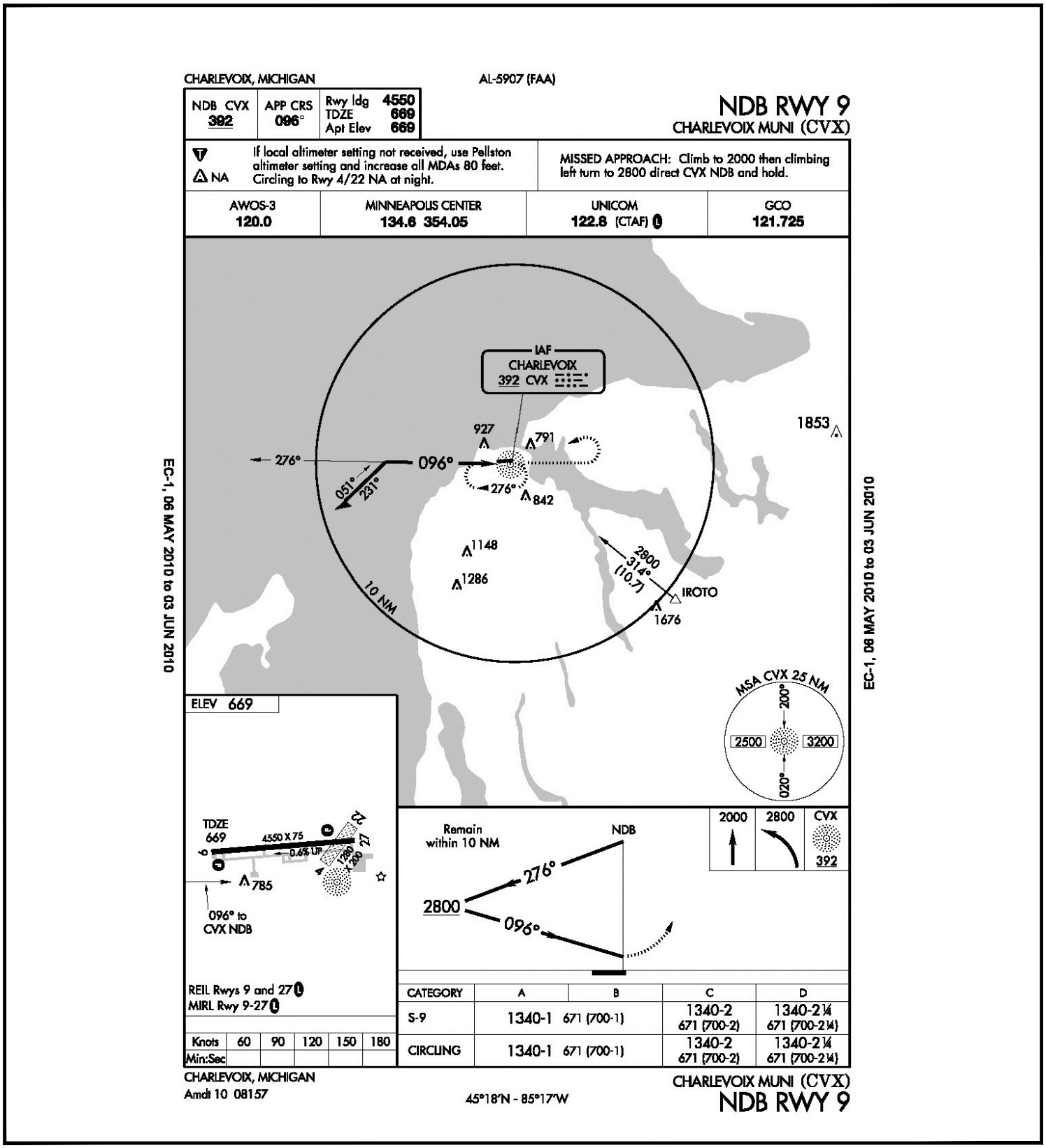


FIGURE 2-14

RUNWAY 9 NDB APPROACH

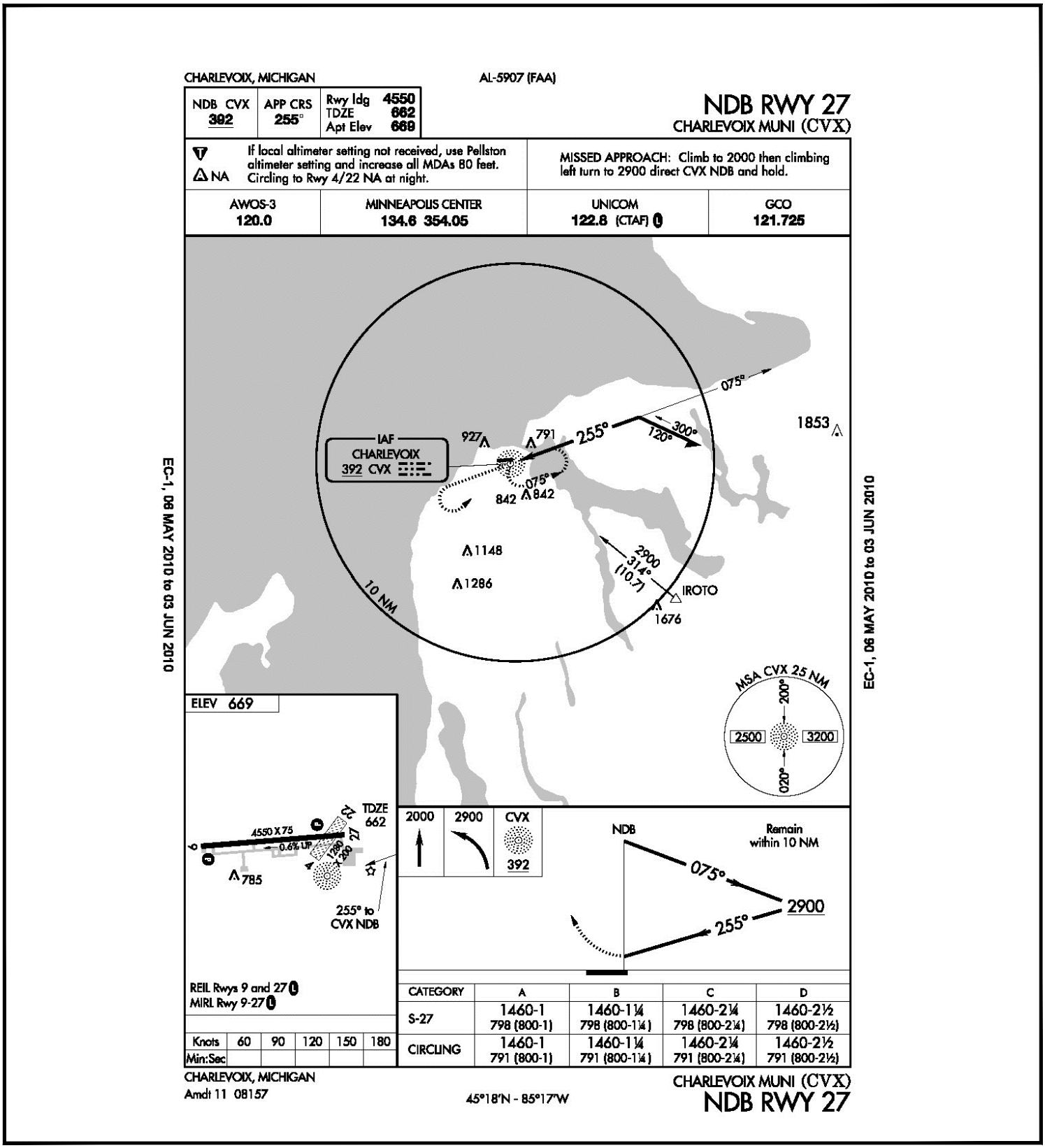


FIGURE 2-15

RUNWAY 27 NDB APPROACH

2.6 METEOROLOGICAL CONDITIONS

Meteorological conditions affect operations at an airport in many ways. Winds, precipitation, and temperature conditions influence decisions pertaining to NAVAIDS, runway orientation, and required runway length at an airport. CVX is equipped with an Automated Weather Observation System (AWOS) which is a weather data sensing, processing, and dissemination system designed to support weather forecast activities and aviation operations. Controlled and maintained by the MDOT Bureau of Aeronautics, the AWOS automatically takes weather observations at 20-minute intervals and broadcasts them via an automated VHF airband radio frequency (120.0 MHz) to pilots operating at or near CVX. The weather information provided by this AWOS can also be accessed via phone by calling 231-237-9703. The AWOS also broadcasts the weather data to the FAA's AWOS Data Acquisition System (ADAS) that polls the systems remotely, accessing the observations and disseminating them worldwide electronically in METAR[2] format.

2.6.1 Local Climate

The average annual temperature is 44.8 degrees Fahrenheit; the average low is 33.4 degrees Fahrenheit; and the average high is 56.3 degrees Fahrenheit. The mean temperature of the hottest month (July) has an average temperature of 67.9 degrees Fahrenheit. Average monthly precipitation ranges from 1.59 inches to 3.56 inches, with an annual average of 32.67 inches. Average monthly snowfall ranges from 0.3 inches to 36.0 inches (October to May), with an annual average of 117.8 inches. This climate data was gathered from the CVX AWOS, or the local East Jordan AWOS, based on availability.

2.6.2 Wind Coverage

In addition to climate data, the AWOS at CVX collects wind speed and direction data, which can influence airfield development decisions on runway orientation and length at an airfield. Ideally, a runway is oriented with the prevailing wind as aircraft landing and takeoff performance is enhanced by flying the aircraft into the wind. It is the recommendation of the FAA that the primary runway at an airport have at least 95 percent wind coverage, which means that 95 percent of the time, the wind at an airport is within certain limits of crosswind. Wind coverage is calculated using the highest crosswind component that is acceptable for the type of aircraft expected to use the runway system. Larger aircraft have a higher tolerance for crosswind than smaller aircraft, due to their size, weight and operational speed. **Table 2-7** provides the standard crosswind component by aircraft size.

[2] METAR is a standardized format for reporting weather information, predominantly used by pilots as a pre-flight weather briefing, and by meteorologists, who use aggregated METAR information to assist in weather forecasting.

Table 2-7 – Standard Crosswind Components

Aircraft Category	Maximum Crosswind Component
A-I and B-I aircraft	10.5 knots
A-II and B-II aircraft	13.0 knots
A-III and B-III and C-I through D-I	16.0 knots
A-IV and D-IV aircraft or higher	20.0 knots

Source: FAA AC/5300-13 *Airport Design*

In addition to the crosswind component, another factor in the wind coverage is the ceiling and visibility. The FAA considers four weather classifications: all weather, visual flight rule (VFR) conditions, instrument flight rule (IFR) conditions[3], and poor visibility conditions (PVC). According to the data collected by the CVX AWOS, VFR conditions occur approximately 92 percent of the time and IFR conditions occur approximately 8 percent of the time. During poor visibility conditions (0.6 percent of the time) the Airport is likely to be closed. **Table 2-8** outlines the weather classification criteria and the number of recorded observations at CVX between 2003 and 2008.

Table 2-8 – Weather Classification Criteria

Weather Class	Criteria	Recorded Observations at CVX (2003-2008)
All Weather	All ceiling and visibility weather conditions	51,789 (100%)
VFR Conditions	Ceiling ≥ 1,000' and visibility ≥ 3 miles	47,483 (91.7%)
IFR Conditions	Ceiling ≥ 200' and < 1,000' *and* Visibility ≥ ½ mile and < 3 miles	4,001(7.7%)
Poor Visibility Conditions	Ceiling < 200' and/or visibility < ½ mile	285 (0.6%)

Source: NOAA, National Climate Center; Station 72743 (2003-2008).

The combination of the crosswind and the weather classification allow for the calculation of the wind coverage, which for CVX is presented in **Table 2-9**. It may be noted that the wind coverage for the 10.5 knot category (i.e. A-I and B-I aircraft) does not meet the target 95 percent coverage during all weather or IFR conditions. This will be discussed further in **Chapter 4**.

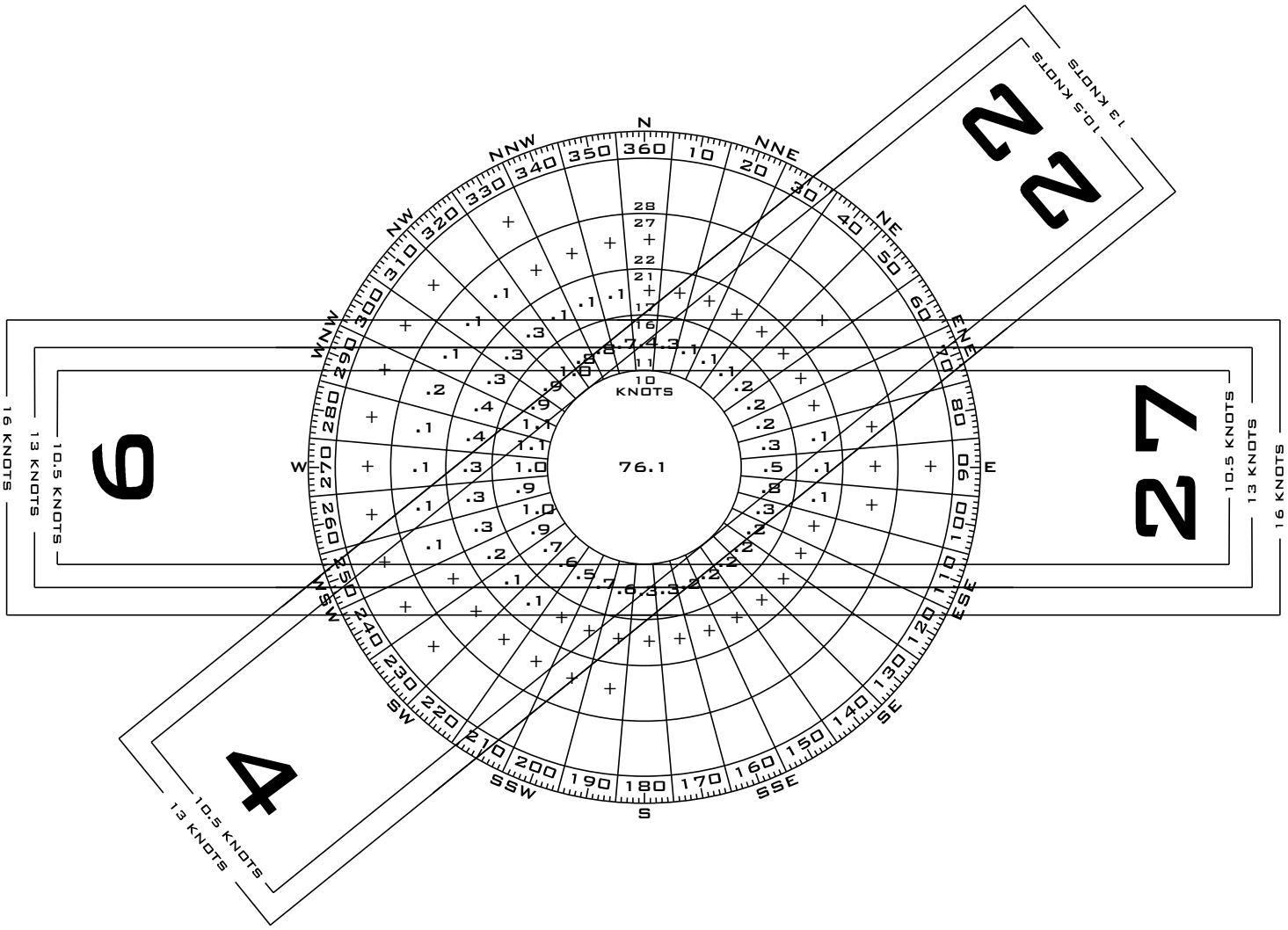
[3] Also termed Visual Meteorological Conditions (VMC) and Instrument Meteorological Conditions (IMC)

Table 2-9 – CVX Wind Coverage

	RWY	10.5 Knots	13 Knots	16 Knots	20 Knots
AW	9/27	91.71%	95.74%	99.07%	99.84%
	4/22	87.98%	93.13%	97.48%	99.24%
	All Combined	94.89%	97.79%	99.46%	99.93%
VFR	9/27	92.00%	95.93%	99.17%	99.88%
	4/22	88.60%	93.58%	97.76%	99.35%
	VFR Combined	95.17%	97.95%	99.53%	99.95%
IFR	9	55.45%	57.55%	59.62%	60.24%
	27	63.25%	67.68%	71.58%	73.05%
	IFR Combined	87.98%	93.34%	97.89%	99.51%

Source: NOAA, National Climate Center; Station 72743 (2003-2008).
Notes:
AW – All Weather
VFR – Visual Flight Rule
IFR – Instrument Flight Rule

Weather observations are presented in a format that is specifically designed by the FAA to be useful for evaluating weather conditions at an airport. Wind direction is grouped according to a 16-point compass rose (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, and NNW). Wind speed is tabulated into groups of 0-3, 4-12, 13-15, 16-18, 19-24, 25-31, and 32 knots per hour or greater. This data is typically displayed on a windrose for each weather classification. The all-weather windrose is presented in **Figure 2-16**, VFR windrose in **Figure 2-17**, and IFR windrose in **Figure 2-18**.



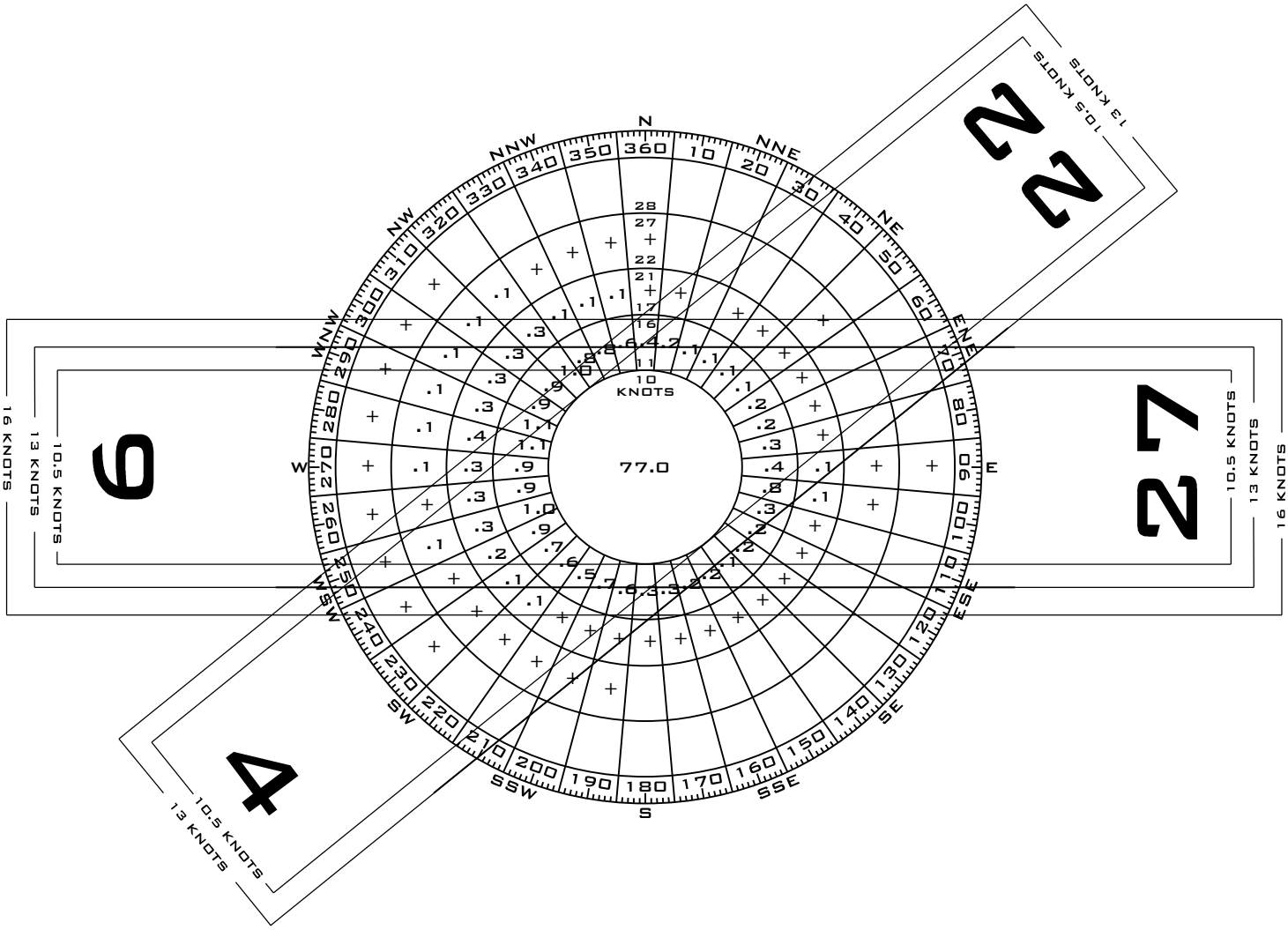
ALL WEATHER WIND ROSE

SOURCE: NOAA National Climatic Center
Asheville, NC
Charlevoix Municipal Airport
Charlevoix, MI

OBSERVATIONS: 51,789 Observations
2003-2008

FIGURE 2-16

ALL WEATHER WIND ROSE



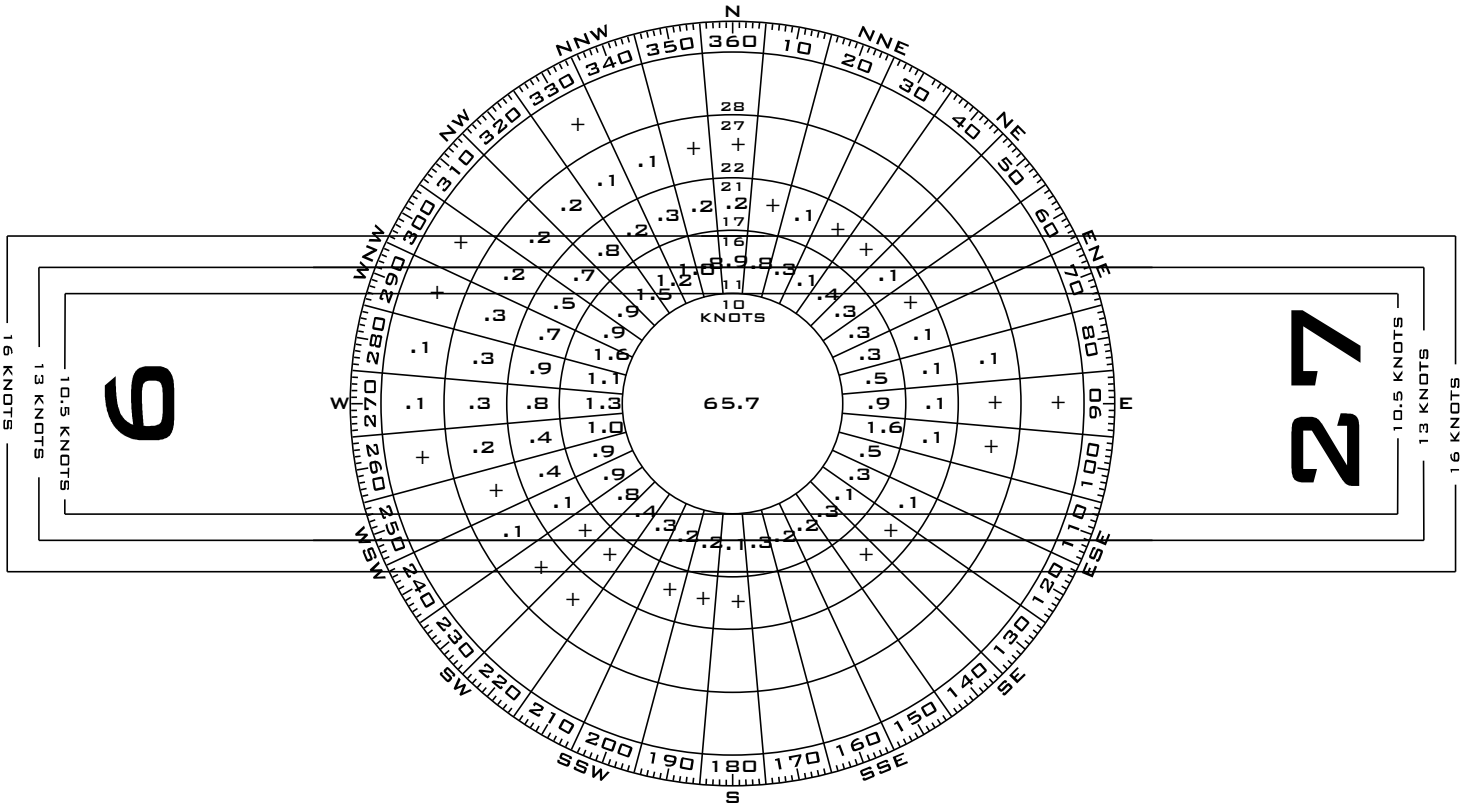
VFR WIND ROSE

SOURCE: **NOAA National Climatic Center**
Asheville, NC
Charlevoix Municipal Airport
Charlevoix, MI

OBSERVATIONS: **47,483 Observations**
2003-2008

FIGURE 2-17

VFR WIND ROSE



IFR WIND ROSE

SOURCE: **NOAA National Climatic Center**
Asheville, NC
Charlevoix Municipal Airport
Charlevoix, MI

OBSERVATIONS: **4,001 Observations**
2003-2008

FIGURE 2-18

IFR WIND ROSE

2.7 PUBLIC UTILITY INFRASTRUCTURE

CVX is served by public utilities including underground water, sewer, electricity, gas, and telephone. Water, sewer, and electricity are provided by the City of Charlevoix, who also serves the Charlevoix and Marion Townships. The known utility lines surrounding the Airport's terminal area are displayed in **Figure 2-19**.

2.8 OFF AIRPORT LAND USE CONSIDERATIONS

Charlevoix County includes three cities and 15 townships. Land use and comprehensive planning is under the jurisdiction of each townships and city, but not the County. Although Charlevoix County does have a Future Land Use Plan, the document is intended to provide a county-wide vision to support the local planning and zoning efforts, and not act as an official zoning ordinance. Since CVX is located at the edge of the City of Charlevoix limits, surrounding land uses are regulated by the City on the north and east side of the airfield, and by the Charlevoix Township on the south and west sides.

Overall, the surrounding land uses are considered compatible with airports. Land uses such as open space, agricultural, commercial, and industrial are generally considered compatible land uses. Non-compatible land uses can include residential and school uses, as this type of land typically can be sensitive to airport noise. A generalized display of the land uses surrounding CVX is depicted in **Figure 2-20**.

The City-regulated land uses (east side of airfield) closest to the Airport include Industrial, (I) Scenic Reserve (SR), and Community Service Commercial (C-1) uses. Single Family Residential (R-2) use is located further to the northeast of the airfield. The City of Charlevoix adopted a new Master Plan in February 2011 and is expecting to adopt a new Zoning Ordinance in the summer of 2013. The Land Use Map shows little change to the surrounding land use.

The Township-regulated land uses (west side of airfield) immediately surrounding the Airport include Industrial (I), Commercial (C), Mineral Resource District (MRD), and Agricultural (A) land uses. These are all considered compatible land uses. One-Family Dwelling Residential (R-1) and One & Two-Family Dwelling Residential (R-2) land uses are located further to the north of the airfield. The MRD represents the quarry to the north and west of the Airport. This quarry is owned by St. Mary's Cement Group. The Airport maintains an easement over portions of St. Mary's property that restricts land use and structure height. The limits of the easement are presented in **Figure 2-20**.

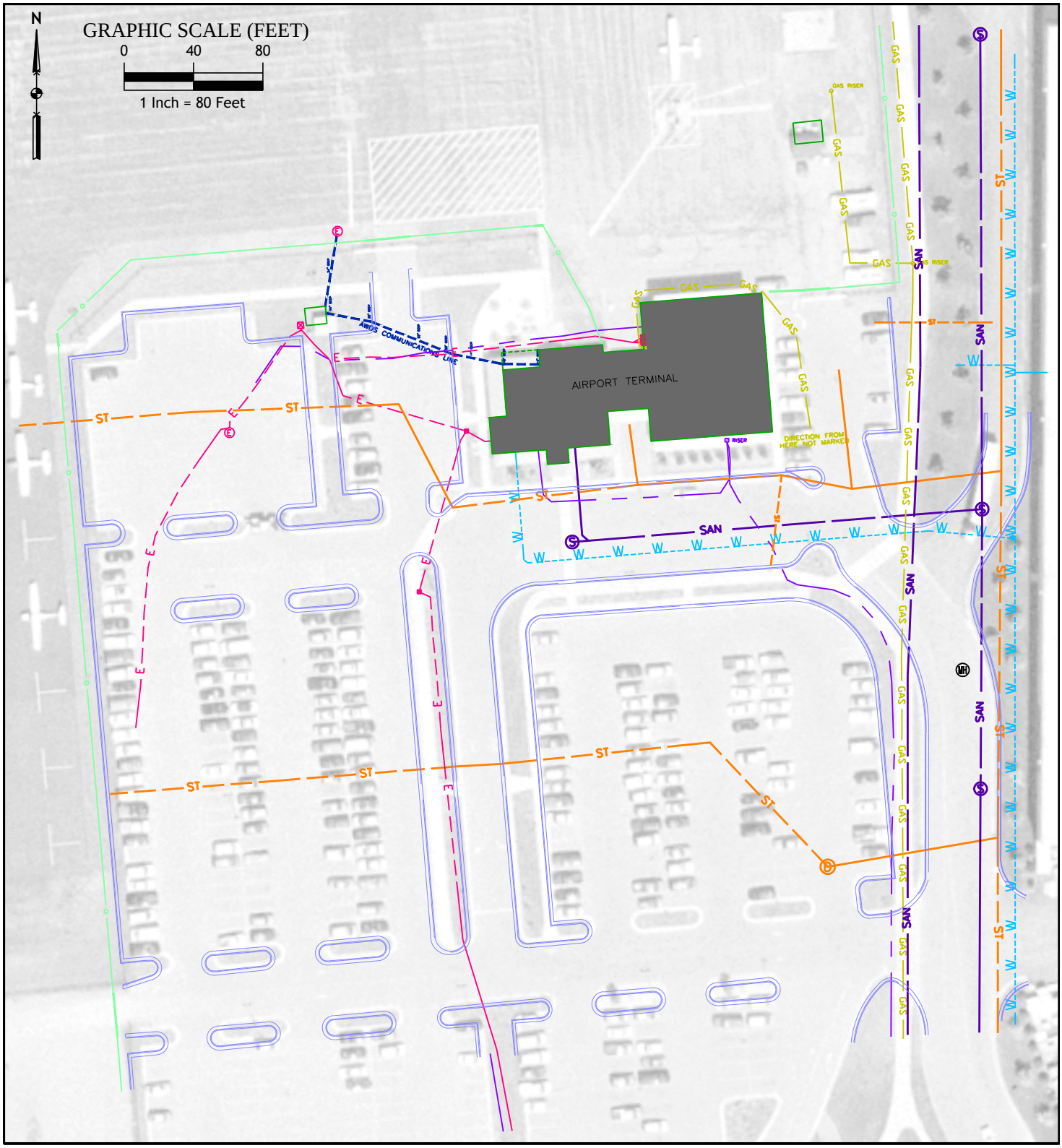
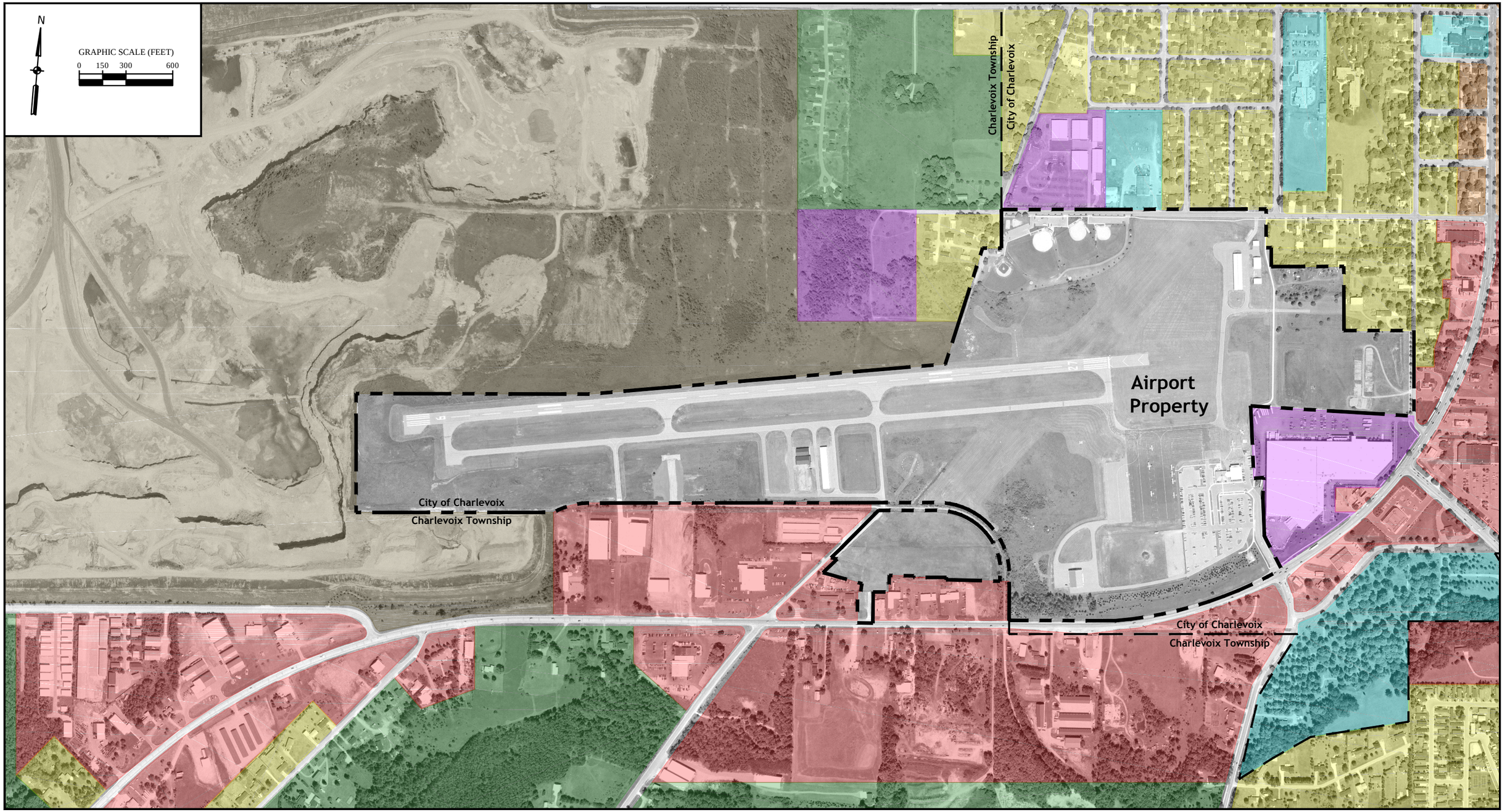


FIGURE 2-19

TERMINAL AREA UTILITIES

LEGEND:

- UTILITY MANHOLE
- ELECTRIC MANHOLE
- SANITARY SEWER MANHOLE
- STORM SEWER MANHOLE
- STORM SEWER
- WATER MAIN
- GAS MAIN
- TELEPHONE CABLE
- ELECTRICAL LINE
- AWOS COMMUNICATIONS
- SECURITY FENCE
- SANITARY SEWER



LEGEND:

- RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- AGRICULTURAL
- PUBLIC FACILITIES
- MINERAL DISTRICT

FIGURE 2-20

SURROUNDING LAND USE

In addition to the land use planning regulations imposed by local municipalities, areas in the vicinity of an Airport can be subject to state and federal land use regulations. In most cases, these regulations involve restricting structure heights within a certain vicinity of the Airport. The FAA maintains the grant assurances program that helps mitigate airspace hazards and non-compatible land uses. The State of Michigan maintains the *Tall Structures Act* which promotes safety by regulating the height, location, and visual identification characteristics of structures within the vicinity of airports. The areas surrounding CVX are subject to the land use and structure height restrictions imposed by these regulations.

2.9 FINANCIAL DATA

As with most publicly-owned, public use, general aviation and non-hub primary commercial service airports, the majority of CVX's capital improvement funding comes from federal and state grants. The FAA Airport Improvement Program (AIP) provides grants to public agencies for the planning and development of public-use airports included in the NPIAS. AIP grants typically cover 95% of an eligible project's costs. MDOT typically matches these grants at 2.5% of the eligible project costs, with the remaining 2.5% being the responsibility of the City.

Charlevoix Municipal Airport's two airlines provide scheduled air service and generate enough enplanements to qualify it as a Primary Commercial Service Airport (i.e. more than 10,000 passenger boardings each year[4]). As such, the Airport is eligible to receive up to $1 million per year of AIP entitlement funds and additional AIP discretionary funds as may be made available by the FAA on a project priority basis. **Table 2-10** identifies the AIP grants awarded to CVX from 1999 to 2009.

[4] FAA *NPIAS 2009-2013* and FAA Order 5100-38C *AIP Handbook*

Table 2-10 – AIP Grant History

Year	Grant Number(s)	Description	Grant Total
1999	None	N/A	N/A
2000	None	N/A	N/A
2001	None	N/A	N/A
2002	002	Install Perimeter Fencing	$115,000
2003	None	N/A	N/A
2004	003-004	Conduct Miscellaneous Study, Construct SRE Building, Construct Taxiway, Expand Apron, Install Weather Reporting Equipment, Rehabilitate Runway 9/27, Rehabilitate Taxiway	$943,413
2005	005-006	Construct SRE Building, Acquire Snow Removal Equipment (Blower, Front End Loader, Plow Truck)	$1,838,200
2006	008	Update Airport Master Plan Study (ALP)	$23,282
2007	009	Acquire Land for Approaches, Update Airport Master Plan Study	$905,000
2008	010	Acquire Snow Removal Equipment, Rehabilitate Runway 9/27, Remove Obstructions	$404,130
2009	011-012	Expand Terminal Building (Prelim. Design), Install Perimeter Fencing (Design), Install Runway Lighting for Runway 9/27 (Design)	$1,010,230

Source: FAA.gov, AIP Grant History
Note: Some descriptions are generalized by category and may not accurately reflect work completed.

Airport operating revenues come from sources such as land leases, fuel sales, ramp fees, landing fees, hangar rental fees, commercial operations fees and automobile parking fees. While the operating revenues come very close to meeting the Airport's operating expenses, the City of Charlevoix provides the balance of the Airport's operating fund requirement. The Airport's financial data is further discussed in **Chapter 7**, *Financial Analysis*.

2.10 ENVIRONMENTAL CONSIDERATIONS

Potential effects to the natural and human environment, as related to airport development and operation, must be considered when planning and designing airport facilities. The National Environmental Policy Act of 1969 (NEPA), FAA Order 5050.4B *NEPA Implementing Instructions for Airport Projects*, and various other Environmental Protection Agency (EPA) and Michigan state regulations provide evaluation processes and guidance on minimization and mitigation of impacts. Detailed environmental evaluation may be required in the future to pursue the recommendations that flow from this Master Plan Study. While that level of detail is not included in this Study, the following is offered as a brief overview of readily available environmental information relevant to CVX.

2.10.1 Noise and Compatible Land Use

Aircraft noise is often an airport's most noticeable environmental effect on the surrounding community. If the sound is sufficiently loud or frequent, it may interfere with various activities or be considered a nuisance. The FAA approved method of evaluating noise is based on cumulative day-night average noise levels (DNL). In simple terms, DNL is the average noise level over a 24-hour period, with noise occurring at night (defined as 10:00 p.m. through 7:00 a.m.), being artificially increased by 10 decibels (dB). The weighting reflects the added intrusiveness of nighttime noise events attributable to the fact that community background noise levels decrease at night.

FAA Order 1050.1E *Policies and Procedures for Considering Environmental Impacts* establishes guidelines for land use compatibility evaluation. These guidelines are based on extensive scientific research into noise-related activity interference and attitudinal response, as an individual's response to noise is highly subjective. The guidelines indicate that all land uses are normally compatible in areas with aircraft noise exposure levels below 65 DNL.

The 1991 Airport Master Plan concluded that there were no significant impacts to surrounding land uses caused from noise generated at the Airport. Based on the aircraft mix and operational levels described in **Chapter 3**, the limits of the existing (2010) and future (2020) 65 DNL noise exposure were calculated. These limits, or contours, are depicted on the "Land Use Plan" within the Airport Layout Plan drawing set. This analysis indicates that the 65 DNL contours remain almost entirely on airport property with a small portion extending over the St. Mary's Cement Company property and two industrial zoned properties (undeveloped) to the north and just slightly across the corner of a commercial property to the south, between Airport property and U.S. 31.

2.10.2 Air Quality

The EPA monitors certain air pollutants according to standards established under the Clean Air Act Amendments and identifies areas throughout the nation that are in compliance ("attainment"), out of compliance ("non-attainment") or areas of possible concern ("maintenance"). The six criteria air pollutants are *ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide, particulate matter*, and *lead*. According to the EPA "Green Book: Non-Attainment Areas for Criteria Pollutants" (as of June 15, 2010), Charlevoix County is categorized as an area of "attainment".

2.10.3 Archeological and Cultural Resources

There are no archeological sites or other cultural resources known to be on or near airport property.

2.10.4 Wetlands

Previous studies, including the 1992 ALP, have identified at least one wetland area on airport property. This noted area is located on the southwest corner of the property, near the Runway 9 end and parallel taxiway hold pad. Due to the age of these studies, and the fact wetland determinations are done on a site by site basis, further field evaluation and coordination with the Michigan Department of Natural Resources and U.S. Army Corps of Engineers would be needed to verify this, and identify any other areas of concern.

2.10.5 Floodplains

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) #2600570005B, no part of the airport property is located in a floodplain.

2.10.6 Coastal Resources

The airport property is outside of all Michigan state coastal zones.

2.10.7 Threatened and Endangered Species

The vast majority of airport property is either developed or maintained through regular mowing and brush removal. A sparse area of trees exists along U.S. 31 near the Snow Removal Equipment Building to the south and near the hangar buildings to the northeast. Considering this, the quarry activities to the north and west, and the commercial and transportation uses along U.S. 31, there is little potential for significant wildlife habitat on or near airport property.

While the Michigan Department of Natural of Resources (MDNR) recognizes that threatened and endangered species may occur in Charlevoix County, an online database search (http://www.mcgi.state.mi.us/esa/) indicates that federal and state endangered, threatened, special concern species, exemplary natural plant communities, or unique natural features are not known to occur at or near the Airport. Refer to Appendix A for the MDNR supporting information.

3 FORECASTS OF AVIATION DEMAND

Projecting the future demand of aviation activity at an airport is one of the most important and vital steps in the master planning process. The recommended aviation forecasts for Charlevoix Municipal Airport, for the 20-year planning horizon (2010-2030), were prepared using commonly accepted forecasting methods as prescribed by the FAA. In this chapter, the following elements of the forecasting effort for CVX are discussed:

- Forecast Background
- Factors Affecting Aviation Demand at CVX
- Previous Forecasts
- Collected Data on Aviation Activity
- Existing Based Aircraft & Operations - 2010
- Airport Activity Forecasts
- Summary of Forecasts

3.1 FORECAST BACKGROUND

Guidance on the preparation of aviation forecasts is provided in FAA Advisory Circular (AC) 150/5070-6B, *Airport Master Plans*.

3.1.1 Purpose of Aviation Forecasts

Forecasts of aviation activity serve as the basis for effective decision making in airport planning and management. The projections help guide airport development over the 20-year planning horizon by identifying current and future facility needs and providing a general timeline of when those developments would be needed. The forecast methodology and recommendations presented in this chapter were submitted to the FAA Detroit Airports District Office (ADO) for review and approval. The ADO concurred on these forecasts in December 2010. With that concurrence, the forecasts were then used to perform the *Facility Requirements Analysis* described in **Chapter 4**.

Activity forecasts were prepared for the short (1-5 years), intermediate (6-10 years), and long-term (11-20 years) planning horizons. Short-term forecasts are used to identify deficiencies that need immediate attention. Medium-term forecasts are usually used in planning foreseeable capital improvement needs. Long-term forecasts provide more generalized information and are typically used for conceptual space and land use planning to accommodate future potential demand. Due to the many uncontrollable and unforeseeable variables that could affect actual future outcome, it is often difficult to project future demand. For that reason, short-term projections are usually more accurate than the 10-20 year long-term projections.

3.1.2 Forecast Elements

Forecasts can be prepared for a variety of aviation demand elements. These elements are determined based on the type and level of activity expected at the airport over the planning horizon. For each specific airport, these elements can vary in relevance depending on the size and category of the airport and the basic objectives of the Master Plan. Typical aviation forecast elements include:

Based Aircraft – Defined as general aviation aircraft that use a specific airport as a home base. These are the aircraft that typically rent tie-downs or hangars for long periods of time and depending on state and local regulations are registered as based at that specific airport and may pay local users taxes to that jurisdiction.

Aircraft Mix – Is the breakdown of aircraft by specific type. Aircraft mix typically refers to the aircraft power plant such as: single-engine piston; multi-engine piston; turbo-prop; jet; and rotorcraft/helicopter. In some analyses it can also refer to an aircraft's approach category (i.e. A-E) and/or design group (i.e. I-VI).

Operations – Defined as either a take-off or landing of an aircraft. Operations are typically segregated into four categories based on the aircraft/operator's purpose and operating certifications. These categories include:

- **Air carrier** includes scheduled service on aircraft with 20 or more seats operated by carriers certified under Federal Aviation Regulations (FAR) Part 119 (Certification: Air Carriers and Commercial Operators), whose operations are governed under FAR Part 121 (Operating Requirement: Domestic, Flag and Supplemental Operations).
- **Air taxi** refers to carriers that operate aircraft with 60 or fewer seats or a cargo payload capacity of less than 18,000 lb, and carries passengers on an on-demand basis only (charter service) and/or carries cargo or mail on either a scheduled or charter basis. Air taxi carriers are governed under FAR Part 135 (Operating Requirements: Commuter and On-Demand Operations and Rules Governing Persons on Board Such Aircraft).
- **General aviation** encompasses all other operations not including air carrier, air taxi and commuter, and military. These operations are conducted under FAR Part 91 (General Operating and Flight Rules).
- **Military** includes operations conducted by the nation's military forces.

Operations are further categorized as either *Local* or *Itinerant*. *Local operations* are generally referred to as those that are performed by aircraft based at the airport and operate in the local traffic pattern or within sight of the airport. *Itinerant operations* are those that leave the local airspace.

Enplanements – Defined as the boarding of a passenger on an aircraft at an airport.

Peak Period – Most airports experience concentrated times throughout the year when their activity levels far surpass the average activity levels when viewed on an annualized basis. These peak periods can be evaluated for both operations and enplanements and can be influenced by seasonality, weather, holidays, and local events. Peak periods can be defined in terms of hours days or months depending on the analysis being performed. Understanding an airport's peaking characteristics is helpful in planning facility and operational needs such as terminal buildings, parking lots, apron space, fuel storage and staffing levels.

Depending on the functions of the airport and the types of businesses and aircraft operating at that airport, other aviation elements that forecasts could be prepared for include: domestic vs. international activity; air cargo activity; and passenger load factors (i.e. how many seats on a commercial aircraft are filled). General aviation (GA) airports typically focus on forecasts of based aircraft and operations, where passenger enplanements and load factors are of greater importance to commercial service airports.

3.1.3 Forecast Methodologies

There are a wide variety of forecasting methodologies that have been developed to address aviation activity and overall demand. The three most common methodologies include[5]:

Regression (or Locally-Adjusted) Analysis – In a regression analysis forecast, the dependent variables of the item being forecasted (i.e.; based aircraft) are compared to independent demographic variables of population, employment, educational attainment, tourism sales, and/or personal income to determine the strongest link between the two.

Trend Analysis – A trend analysis relies on projecting historic trends into the future. In trend analysis, a regression equation is used with time as the independent variable. While it is frequently used as a back-up or expedient technique, it is highly valuable in the planning process because of its ease of application. Sometimes trend analysis can be used as a reasonable method of projecting variables that would be complicated (and costly) to project by other means.

Market Share Analysis – A market share analysis can be applied to any measure for which a reliable higher-level (i.e., larger aggregate) forecast is

[5] Methodologies described in AC 150/5070-6B *Airport Master Plans*

available. Historical shares are calculated and used as a basis for projecting future shares. This approach is a "top-down" method of forecasting since forecasts of larger aggregates (e.g., geographic region) are used to derive forecasts for smaller areas (e.g., airports).

3.1.4 Forecast Process

The process for forecasting aviation activity at CVX was conducted using the methodologies previously described and includes the following steps:

1. Evaluation of the factors affecting aviation demand at CVX
2. Evaluation of previous forecasts at CVX
3. Collection and analysis of Airport activity data
4. Identification of current base year activity at CVX
5. Identification of forecast assumptions to be used
6. Forecast of based aircraft
7. Forecast of operations
8. Identification and forecast of peaking periods
9. Forecast of enplanements
10. Summarization of the recommended forecasts

3.2 FACTORS AFFECTING AVIATION DEMAND AT CVX

There are many factors that can affect aviation activity at a particular airport. Commercial service airports are typically influenced by national and regional trends in population, employment, per capita income, tourism, airport prominence, air service options, and aviation industry trends. GA airports are usually influenced by the same factors, but even more specifically influenced by local trends in population, income, employment, and airport prominence within the region in which the airport is located.

Charlevoix Municipal Airport is somewhat unique in that it has characteristics of both a general aviation and a commercial service airport. As described in **Chapter 2**, it is classified within the National Plan of Integrated Airport Systems as a Non-Hub Primary Commercial Service Airport due to its significant level of passenger enplanements. The airlines that serve CVX operate under FAR Part 135 certificates and generally function as scheduled charters and on-call air taxi providers. In this manner, along with the high volume of transient and itinerant GA traffic, the Airport is more similar to a GA airport, in terms of operational characteristics, than a larger commercial service hub airport served by national level air carriers. For this reason, it is presumed that the larger driving factors of aviation activity at CVX are local tourism and the Airport's prominence/location.

Regardless, a clear understanding of all these factors on a local, regional, and national level is important for developing a reasonable aviation activity forecast. To this end,

historic and projected data of population, employment, per capita income, and tourism (as indicated by retail/accommodation/entertainment sales) in the United States, Michigan, and Charlevoix County were compared. The primary source of this information was Woods & Poole Economics, Inc. which is an independent firm that specializes in long-term economic and demographic projections on a county-wide basis. The retail, accommodation, and entertainment sales data was obtained from the U.S. Census Bureau's *Economic Census*. Airport prominence, air service options, and national aviation trends were also analyzed.

3.2.1 Population

As presented in **Table 3-1**, the population for the United States, Michigan, and Charlevoix County from 2000-2010 grew by 9.88 percent, 1.14 percent, and 0.38 percent, respectively. This shows that the historic population growth rates of Michigan and Charlevoix County were rather stagnant in comparison to the United States. **Table 3-2** presents the projected growth in population, for the years 2010-2030. As shown, the population for the United States, Michigan, and Charlevoix County are projected to grow by 20.60 percent, 7.68 percent, and 15.59 percent, respectively. Although the predicted growth for Charlevoix County is still lower than the national average, the County is predicted to significantly outpace the State of Michigan's growth rate. **Figure 3-1** illustrates the historic and projected growth rates of the respective population groups.

Table 3-1 – Historic Population Growth

Year	Charlevoix County (000)	Percent Change	Michigan (000)	Percent Change	United States (000)	Percent Change
2000	26.2	-	9,955	-	282,172	-
2001	26.4	0.90%	10,004	0.49%	285,040	1.02%
2002	26.5	0.28%	10,037	0.33%	287,727	0.94%
2003	26.6	0.29%	10,066	0.28%	290,211	0.86%
2004	26.5	-0.35%	10,090	0.24%	292,892	0.92%
2005	26.4	-0.40%	10,093	0.03%	295,561	0.91%
2006	26.1	-0.86%	10,084	-0.09%	298,363	0.95%
2007	26.1	0.03%	10,050	-0.34%	301,290	0.98%
2008	25.9	-0.79%	10,003	-0.46%	304,060	0.92%
2009	26.1	0.72%	10,035	0.32%	307,050	0.98%
2010	26.3	0.73%	10,068	0.32%	310,063	0.98%
Historic 2000-2010		**0.38%**		**1.14%**		**9.88%**
AAGR[1] 2000-2010		**0.04%**		**0.11%**		**0.95%**

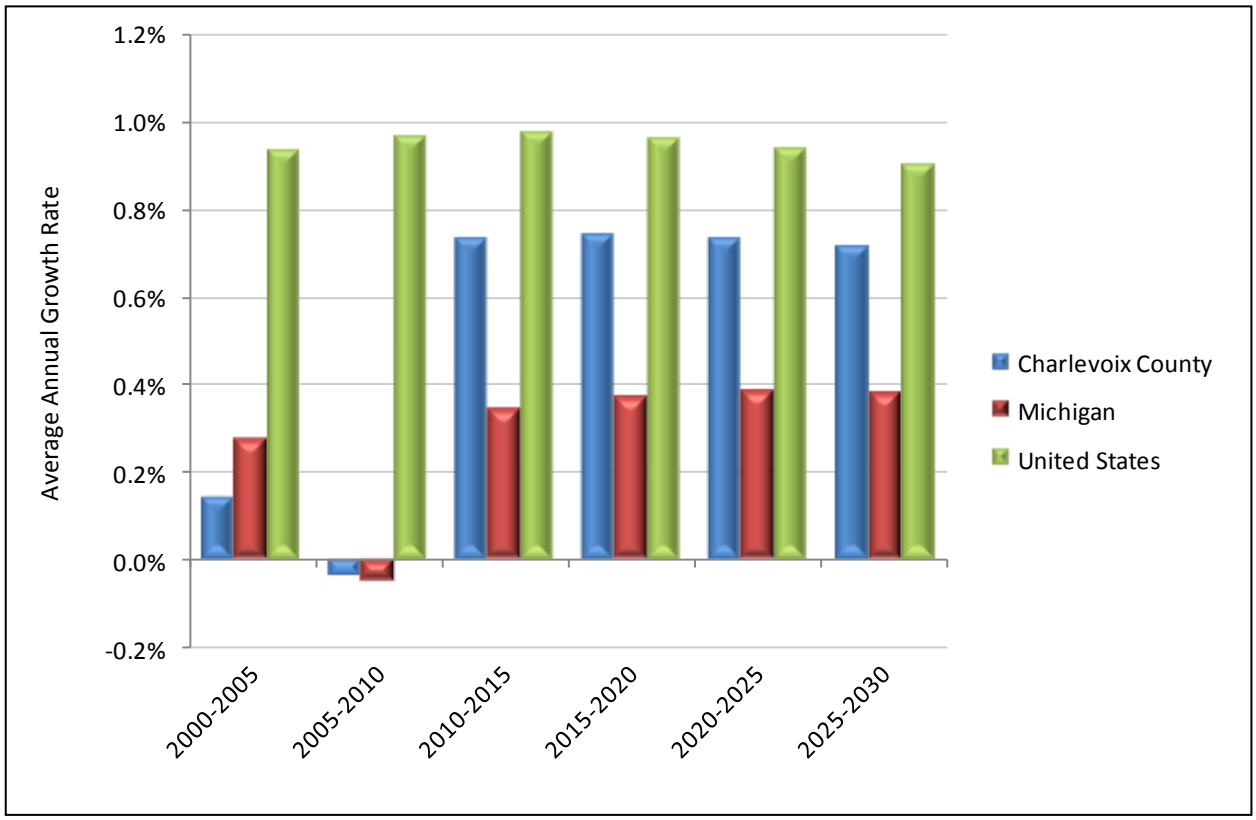
Source: Woods & Poole Economics, Inc., 2010
Note 1: AAGR – Annual Average Growth Rate

Table 3-2 – Population Growth Forecast

Year	Charlevoix County (000)	Percent Change	Michigan (000)	Percent Change	United States (000)	Percent Change
2011	26.5	0.72%	10,100	0.32%	313,071	0.97%
2012	26.7	0.73%	10,134	0.33%	316,117	0.97%
2013	26.9	0.73%	10,168	0.34%	319,189	0.97%
2014	27.1	0.74%	10,204	0.35%	322,294	0.97%
2015	27.3	0.74%	10,240	0.36%	325,422	0.97%
2016	27.5	0.74%	10,278	0.36%	328,569	0.97%
2017	27.7	0.74%	10,315	0.37%	331,741	0.97%
2018	27.9	0.74%	10,354	0.37%	334,925	0.96%
2019	28.1	0.74%	10,393	0.38%	338,128	0.96%
2020	28.3	0.74%	10,432	0.38%	341,344	0.95%
2021	28.5	0.74%	10,472	0.38%	344,573	0.95%
2022	28.7	0.73%	10,512	0.38%	347,814	0.94%
2023	28.9	0.73%	10,552	0.38%	351,059	0.93%
2024	29.2	0.73%	10,592	0.38%	354,320	0.93%
2025	29.4	0.73%	10,633	0.38%	357,582	0.92%
2026	29.6	0.72%	10,674	0.38%	360,843	0.91%
2027	29.8	0.72%	10,715	0.38%	364,116	0.91%
2028	30.0	0.71%	10,756	0.38%	367,394	0.90%
2029	30.2	0.71%	10,797	0.38%	370,672	0.89%
2030	30.4	0.70%	10,838	0.38%	373,944	0.88%
Projected 2010-2030		**15.59%**		**7.68%**		**20.60%**
AAGR[1] 2010-2030		**0.73%**		**0.37%**		**0.94%**

Source: Woods & Poole Economics, Inc., 2010
Note 1: AAGR – Average Annual Growth Rate

Figure 3-1 – Historic and Projected Population Growth Rates



Source: Woods & Poole Economics, Inc., 2010

3.2.2 Employment

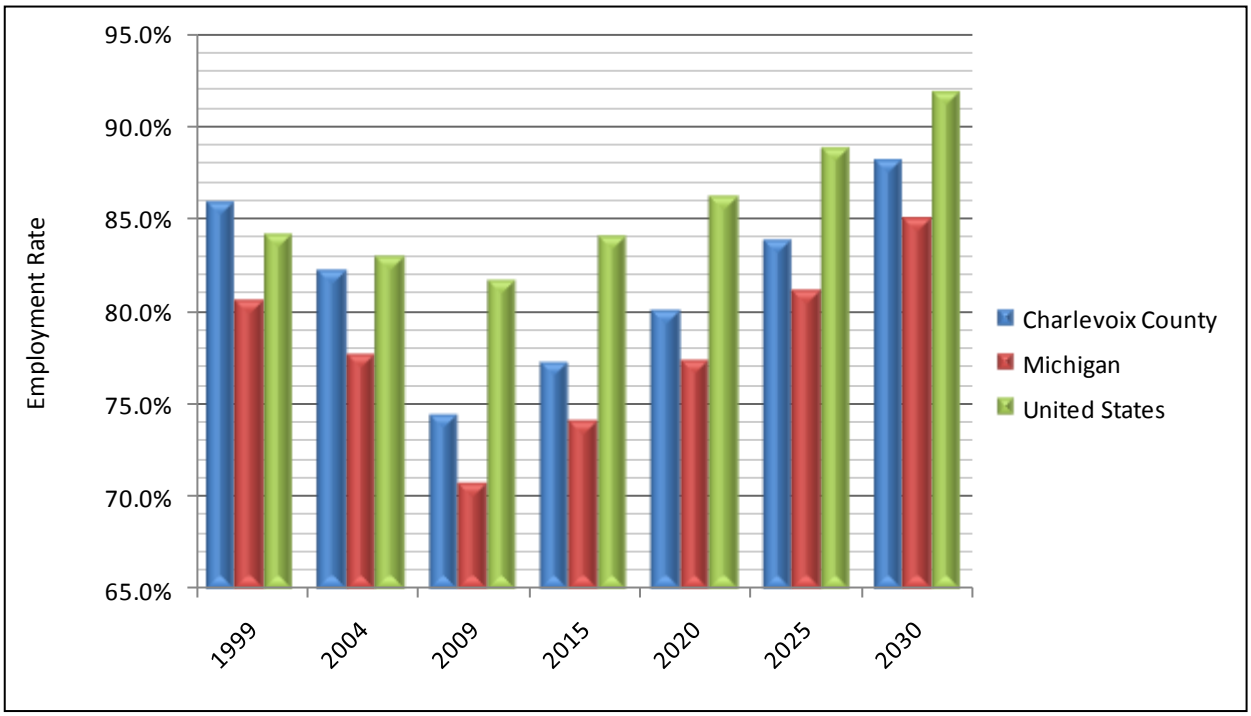
The working age is considered to be between the ages of 15 and 69. The historic and projected employment rates of the working age populations for the United States, Michigan, and Charlevoix County are shown in **Table 3-3**. Overall, Charlevoix County shows a lower percentage of the working age population employed than the United States, but higher than the State of Michigan. The Charlevoix County employment levels were approximately 74.4 percent in 2009 and are expected to increase to approximately 88.1 percent by 2030. These levels remain lower than the Unites States, but higher than the State of Michigan throughout the forecast period. **Figure 3-2** illustrates the historic and projected employment rates as a percentage of working age population for each region.

Table 3-3 – Employment Levels Based on Working Age[1] Population

Year	Charlevoix County (000)	Percent Employed	Michigan (000)	Percent Employed	United States (000)	Percent Employed
1999	15.1	85.8%	5,519	80.5%	162,956	84.1%
2004	15.0	82.1%	5,502	77.6%	170,513	82.9%
2009	13.6	74.4%	5,071	70.7%	177,667	81.6%
AAGR 1999-2009		**-1.0%**		**-0.8%**		**0.9%**
2010	13.9	75.6%	5,171	71.8%	181,631	82.6%
2015	14.7	77.2%	5,401	74.0%	192,314	83.9%
2020	15.5	80.0%	5,640	77.3%	203,625	86.2%
2025	16.3	83.7%	5,888	81.0%	215,602	88.8%
2030	17.2	88.1%	6,147	85.0%	228,284	91.7%
AAGR[2] 2009-2030		**1.2%**		**1.0%**		**1.3%**

Source: Woods & Poole Economics, Inc., 2010
Note 1: Working Age Considered Ages 15-69
Note 2: AAGR - Average Annual Growth Rate

Figure 3-2 – Historic and Projected Working Age Employment Rates



Source: Woods & Poole Economics, Inc., 2010

3.2.3 Per Capita Personal Income

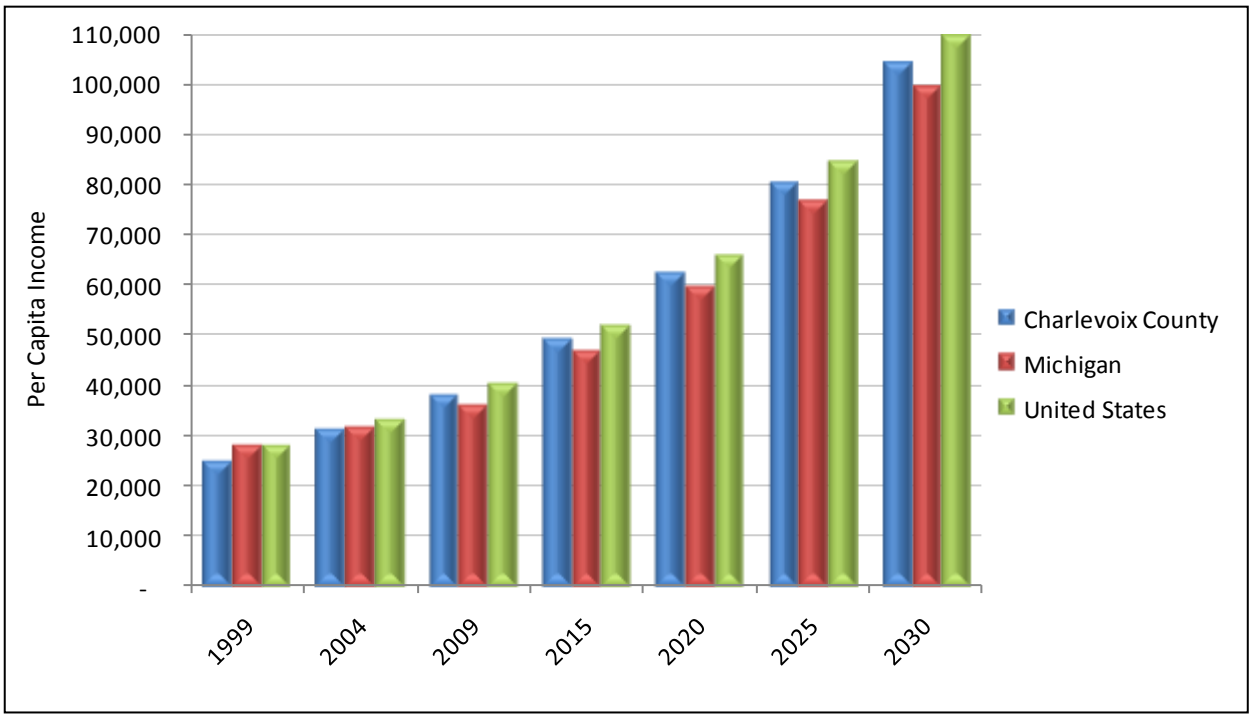
The historic and projected per capita income for the United States, Michigan, and Charlevoix County are shown in **Table 3-4**. The 2009 per capita income for Charlevoix County was $37,976, which was $2,279 below the U.S. total and $2,141 above the Michigan total. The average annual growth rate in per capita income from 1999-2009 for the United States, Michigan, and Charlevoix County was approximately 3.7 percent, 2.5 percent, and 4.3 percent, respectively. These trends show that the income growth of Charlevoix County has outpaced the State and the nation. For the years 2009-2030, the per capita income for United States, Michigan, and Charlevoix County are projected to grow annually by an average rate of approximately 4.9 percent, 5.0 percent, and 4.9 percent respectively. Therefore, Charlevoix County's growth in per capita income is projected to become consistent with that of the state and nation. **Figure 3-3** illustrates the historic and projected per capita income for each region.

Table 3-4 – Per Capita Income

Year	Charlevoix County ($)	Average Annual Growth	Michigan ($)	Average Annual Growth	United States ($)	Average Annual Growth
1999	24,997	-	28,095	-	27,939	-
2004	31,292	4.6%	31,588	2.4%	33,157	3.5%
2009	37,976	3.9%	35,835	2.6%	40,255	4.0%
AAGR 1999-2009		**4.3%**		**2.5%**		**3.7%**
2010	39,375	3.7%	37,188	3.8%	41,782	3.8%
2015	49,243	5.3%	46,665	5.4%	52,055	5.3%
2020	62,423	4.9%	59,367	4.9%	65,861	4.8%
2025	80,206	5.1%	76,537	5.2%	84,559	5.1%
2030	103,856	5.3%	99,403	5.4%	109,512	5.3%
AAGR[1] 2009-2030		**4.9%**		**5.0%**		**4.9%**

Source: Woods & Poole Economics, Inc., 2010
Note 1: AAGR - Average Annual Growth Rate

Figure 3-3 – Historic and Projected Per Capita Income



Source: Woods & Poole Economics, Inc., 2010

3.2.4 Tourism

As the primary indicator of the tourism industry, the historic sales values of the tangible components of the industry, such as retail, recreation and hospitality services were evaluated to identify relevant tourism trends. The particular industries analyzed (as defined by the North American Industry Classification System) were *Retail Trade*, *Arts, Entertainment and Recreation*, and *Accommodation and Food Services*.

The historic data spans the years 1997-2007 and is summarized in **Table 3-5**. The overall growth rate in total sales of the United States, Michigan, and Charlevoix County during this time period was 5.0 percent, 1.9 percent, and 1.5 percent, respectively. Although the growth in tourism sales in Charlevoix County is outpaced by the State and nation over the 10 year period, it should be noted that the County outpaced the State in growth between 2002 and 2007. In nearly all scenarios, the County and State are outpaced by the national growth rate; however, the data does indicate steady growth in tourism related sales for Charlevoix.

Table 3-5 – Tourism Industry Growth

	Industry	1997 (000)	2002 (000)	2007 (000)	Growth (97-02)	Growth (02-07)	Growth (97-07)	AAGR[1] (97-07)
Charlevoix Co.	*Retail Trade*	$202,772	$206,286	$221,210	1.7%	7.2%	9.1%	0.9%
	Arts, Entertainment, and Recreation	$9,989	$25,114	$17,729	151.4%	-29.4%	77.5%	5.9%
	Accommodation and Food Services	$45,006	$51,059	$60,229	13.5%	18.0%	33.8%	3.0%
	TOTAL	**$257,767**	**$282,459**	**$299,168**	**9.6%**	**5.9%**	**16.1%**	**1.5%**
Michigan State	*Retail Trade*	$93,706,078	$109,350,139	$109,102,594	16.7%	-0.2%	16.4%	1.5%
	Arts, Entertainment, and Recreation	$2,202,782	$4,715,019	$4,791,822	114.1%	1.6%	117.5%	8.1%
	Accommodation and Food Services	$10,158,693	$12,248,269	$14,536,648	20.6%	18.7%	43.1%	3.7%
	TOTAL	**$106,067,553**	**$126,313,427**	**$128,431,064**	**19.1%**	**1.7%**	**21.1%**	**1.9%**
United States	*Retail Trade*	$2,460,886,012	$3,056,421,997	$3,917,663,456	24.2%	28.2%	59.2%	4.8%
	Arts, Entertainment, and Recreation	$85,088,464	$141,904,109	$189,416,942	66.8%	33.5%	122.6%	8.3%
	Accommodation and Food Services	$350,339,194	$449,498,718	$613,795,732	28.3%	36.6%	75.2%	5.8%
	TOTAL	**$2,896,313,670**	**$3,647,824,824**	**$4,720,876,130**	**26.0%**	**29.4%**	**63.0%**	**5.0%**

Source: U.S. Census Bureau, 1997, 2002, and 1997 Economic Census
Note 1: AAGR – Average Annual Growth Rate

3.2.5 Airport Prominence and Air Service Options

Assuming no drastic changes in the economy, the City of Charlevoix and Beaver Island will continue to be a tourism and vacation destination. CVX is approximately ½ mile from downtown Charlevoix and is the closest airport to Beaver Island on the lower peninsula of Michigan. Commercial air service between CVX and Beaver Island has been maintained consistently between 1945 and present day. In addition to the regular service during the summer months, the Airport serves as a crucial connector to Beaver Island during the winter months, when the ferry cannot make the passage. Although passenger traffic decreases during the winter months, cargo and mail delivery to Beaver Island make CVX an important year-round airport and an asset to Charlevoix County. Therefore, it is held that CVX will remain prominent in the community over the forecast horizon.

3.2.6 Aviation Industry Trends

The aviation industry became noticeably weaker during the economic downturn in 2008-2009, especially the GA industry. According to figures released by the General Aviation Manufacturers Association (GAMA), U.S. manufacturers of GA aircraft delivered 48.5 percent fewer aircraft in calendar year (CY) 2009 than in CY 2008. CY 2009 marked a second consecutive year of decline in shipments that was preceded by four years of sustained growth. GA operations at FAA air traffic facilities declined 11.7 percent in 2009 while GA flight hours are estimated to have decreased by 10.3 percent. Despite this decline in aircraft deliveries, operations, and flight hours, the GA fleet is estimated to have increased by 0.2 percent in 2009.[6]

Despite the 2008-2009 downturn in the aviation industry, history has shown that the industry is cyclical and overall resilient. According to the *FAA Aerospace Forecast: Fiscal Years 2010-2030,* the industry is projected to recover in the years to come. There is however much uncertainty as to the timing and strength of the recovery. Nevertheless, the FAA developed a set of assumptions and forecasts consistent with emerging trends and structural changes currently taking place within the aviation industry. In terms of general aviation, the forecasts rely heavily on discussions and industry experts and the results of the *2008 General Aviation and Part 135 Activity Survey*.

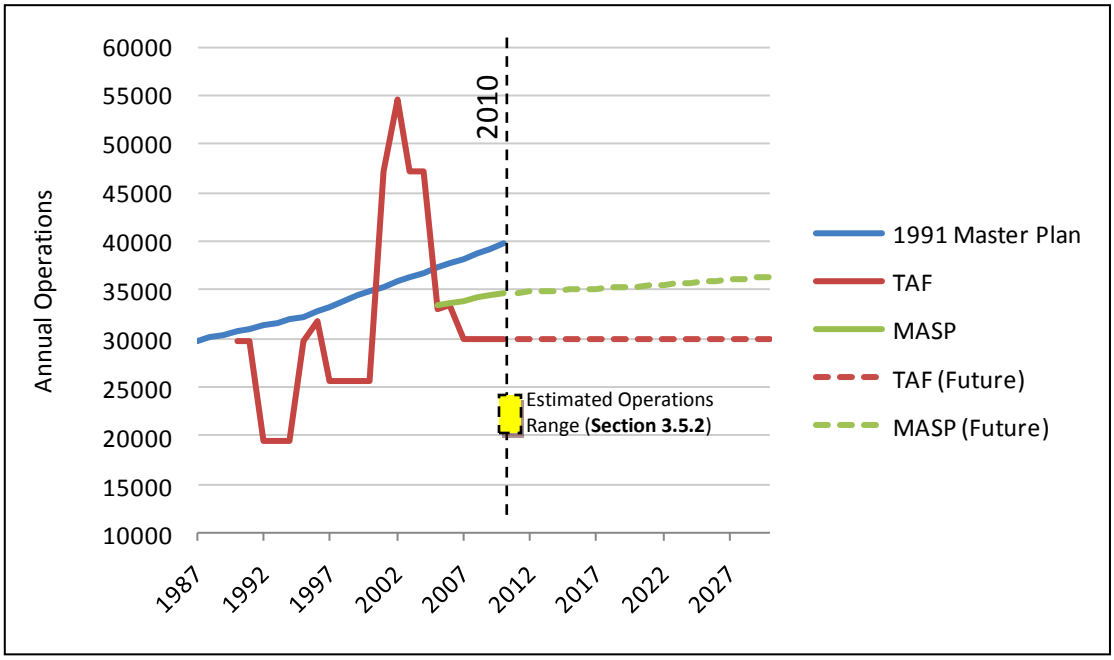
The FAA Aerospace Forecasts predict the GA fleet to increase at an average annual rate of 0.9 percent over the 20-year forecast period. More specifically the national active piston-powered aircraft fleet is projected to increase by 0.2 percent annually over the forecast period while the turbine-powered aircraft fleet is projected to increase by 3.0 percent annually.[2] These projections are based on assumptions of the operational use of the GA fleet. The first assumption is that the usage of business jet aircraft is expected to continue to grow, driven by new technologies, the introduction of very light jets (VLJs), and increasing foreign demand. In addition, concerns with corporate safety/security combined with increasing flight delays at U.S. airports have made fractional, corporate, and charter flights a practical business alternative in the aviation industry. With the continued introduction of new affordable technologies and increasing demand, the national turbine-powered fleet is expected to grow at a faster rate than the piston-powered fleet. In terms of operations, overall GA operations are expected to grow between 1.1 and 1.3 percent annually over the forecast horizon. Air taxi operations are expected to increase between 1.0 and 1.3 percent annually.

[6] "FAA Aerospace Forecast: Fiscal Years 2010-2030," February 2010, Federal Aviation Administration (FAA)

3.3 PREVIOUS FORECASTS

Review of the previous forecasting efforts for CVX is an important step in the master planning process. These forecasts provide an indication of past activity and the general assumptions and expectations of activity that the Airport had previously been operating under. The existing forecasts for CVX include the *1991 Master Plan* forecasts, the *2008 Michigan Airport System Plan (MASP)* forecasts, and the *2009 FAA Terminal Area Forecast (TAF)*. The operations forecasts from each document or database are illustrated in **Figure 3-4** and described in the following sub-sections.

Figure 3-4 – Previous Forecast Comparison (Operations)



Sources: 1991 Charlevoix Municipal Airport Master Plan Update
2008 Michigan Airport System Plan Report
2009 FAA Terminal Area Forecast

3.3.1 1991 Master Plan Forecasts

The forecasts presented in the 1991 Master Plan were based on activity projections prepared by the Michigan Department of Transportation. These forecasts estimated 29,780 operations in the base year (1987) and indicated a based aircraft count of 18. The based aircraft included 12 single-engine and 6 multi-engine aircraft. By dividing these two numbers, the Master Plan identified an Operations per Based Aircraft (OPBA) figure of 1650 operations per aircraft. This rather large amount was attributed to the high tourism activity of the area. While a forecast of based aircraft was not detailed, a forecast of operations through 2010 was presented. The results of that forecast are

presented in **Table 3-6**. Additionally, the peak hour demand was estimated at 34 operations during the peak hour of the busiest day.

Table 3-6 – 1991 Master Plan Operations Forecast

Operations Type	1987	1995	2000	2010
Itinerant Operations	17,870	19,100	20,700	23,200
Local Operations	11,910	13,200	14,200	16,600
Total Operations	**29,780**	**32,300**	**34,900**	**39,800**

Source: 1991 Charlevoix Municipal Airport Master Plan Update

3.3.2 2008 Michigan Airport System Plan (MASP) Forecasts

The forecast of future activity in the MASP focuses on the Great Lakes Region and the State aviation system as a whole. The document provides regional forecasts that are based on FAA assumptions. Between 2008 and 2025, 22 percent growth nationwide in total airport operations is forecasted, while in the Great Lakes Region operations are projected to grow 18 percent over the same time period. Similarly, the nationwide aviation fleet is expected to grow by 16 percent between 2008 and 2025, while the Great Lakes Region fleet is projected to grow by 13 percent.[7] In summary, while the Great Lakes Region is anticipated to grow with national averages, it will likely grow at a slightly lesser rate.

Included in the MASP are based aircraft and operations forecasts for individual airports. These forecasts were conducted using a top-down method that applied a regression analysis to grouped Michigan airports by classification, and then applying forecasts to the individual airports based on their market share. The MASP forecasts for CVX are presented in **Table 3-7**.

Table 3-7 – Michigan Airport System Plan (MASP) Forecasts

	2005	2010	2020	2030
Based Aircraft	**17**	**20**	**21**	**21**
Itinerant Operations	16,684	24,292	24,759	25,460
Local Operations	16,684	10,411	10,611	10,911
Total Operations	**33,386**	**34,703**	**35,370**	**36,371**

Source: Michigan Airport System Plan Report, 2008

[7] "Michigan Airport System Plan Report", 2008, Michigan Department of Transportation (MDOT)

3.3.3 2009 FAA Terminal Area Forecast (TAF)

The TAF contains historical aviation activity data and the FAA's forecasts for more than 460 airports receiving FAA contract tower and radar service. This database also includes data and projections for more than 3,000 other airports in the National Plan of Integrated Airport Systems (NPIAS). Note that for many airports without control towers or sophisticated record keeping systems, the operations and based aircraft data presented in the TAF may be based more on estimations and may not directly coincide with actual activity being experienced at a specific airport. These estimates are derived by the FAA from national estimates of aviation activity which are then assigned to individual airports based upon multiple market and forecast factors. According to the FAA TAF, approximately 30,000 total annual operations are estimated for CVX for 2010-2030. A summary of the TAF is presented in **Table 3-8**.

Table 3-8 – CVX Terminal Area Forecast Summary

Year	Based Aircraft	Local Operations			Itinerant Operations				Total Ops
		GA	Military	Total	GA	Air Taxi	Military	Total	
2000	22	9,970	0	**9,970**	5,630	10,000	0	**15,630**	**25,600**
2005	21	11,000	0	**13,100**	11,000	11,000	0	**22,000**	**33,000**
2010	17	8,000	0	**8,000**	9,500	12,000	500	**22,000**	**30,000**
AAGR 2000-2010	**-2.5%**	**-2.2%**		**-2.2%**	**5.4%**	**1.8%**		**3.5%**	**1.6%**
2011	17	8,000	0	**8,000**	9,500	12,000	500	**22,000**	**30,000**
2015	17	8,000	0	**8,000**	9,500	12,000	500	**22,000**	**30,000**
2020	17	8,000	0	**8,000**	9,500	12,000	500	**22,000**	**30,000**
2025	17	8,000	0	**8,000**	9,500	12,000	500	**22,000**	**30,000**
2030	17	8,000	0	**8,000**	9,500	12,000	500	**22,000**	**30,000**
AAGR[1] 2010-2030	**0.0%**	**0.0%**		**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

Source: FAA Terminal Area Forecast for Charlevoix Municipal Airport, 2010
Note 1: AAGR – Average Annual Growth Rate

3.4 COLLECTED DATA ON AVIATION ACTIVITY

CVX is a non-towered airport, and therefore, no definitive historic or existing operations data is available. With the unavailability of factual tower data, other data sets, including FAA flight plan records and user surveys, were collected. While this information is a clear indicator of activity at the Airport, the data provided is fractional in terms of overall airport activity. This information was used to support the chosen forecast methods and assumptions made on airport activity (which will be described later in this chapter). Both data sets also play a large role in the *Facility Requirements Analysis* (**Chapter 4**).

3.4.1 Instrument Flight Records

Flight plan records were obtained from Aviation Data Specialists. The provided data encompassed all completed flight plans filed with the FAA operating under Instrument Flight Rules (IFR) between January 2005 and September 2010 (with CVX as the origin or destination). IFR refers to the regulations and procedures for aircraft navigating entirely by instrument (as opposed to Visual Flight Rules – VFR). The data set includes the date of flight, tail number, aircraft type, origin, destination, departure time, arrival time, time of flight, and total mileage. While this data provides a record of actual operations at CVX, this data accounts for completed instrument flight plans only, and a majority of operations at CVX do not file IFR flight plans. Additionally, if a flight plan is cancelled during flight (i.e., the pilots opts to perform a visual approach and closes the flight plan en route), it is not recorded in the data set. Nevertheless, the data set provides valuable insight into the type of operations that occur at CVX. An overview of the data's analysis is contained in **Appendix B**. Notable indications about CVX air activity from the flight plan data includes:

- Approximately 75 percent of flights occur between May and September;
- Instrument flight plans increased by over 13 percent between 2006 and 2009;
- 488 instrument flight plans were completed by jet aircraft in 2005, which increased to 793 by 2009;
- Many ARC C-I or above aircraft are utilizing the Airport (300 completed flight plans in 2009);
- The majority of turbine-powered aircraft are travelling distances of 200 nautical miles or more.

3.4.2 Airfield User Surveys

User surveys have been an integral part of the planning process at CVX over the years. User surveys were conducted in 1989, 2007, and 2010. The purpose of the surveys was to gain insight on the type of activity that occurs at the Airport and the needs and desires of airport users.

1989 User Survey – The 1989 user survey was conducted to support the 1991 Master Plan Update. It consisted of a mail survey, comprised of 106 inquiries to Charlevoix area organizations and businesses, and an airport ramp survey, which elicited 21 responses. Of the businesses surveyed, seven indicated regular itinerant jet operations.

2007 User Survey – The 2007 survey was conducted to determine whether there was sufficient justification to lengthen Runway 9/27. The Survey polled over 40 airport users that fly B-II or C-II type aircraft. Ten responses indicated regular use of CVX, of up to one flight per week, and all supported or desired a runway extension.

2010 User Survey – The 2010 survey was conducted to support this Master Plan effort and to obtain supplemental information on the current usage of the Airport. Over 50 User Surveys were mailed to organizations, businesses, and other regular airport users. Additionally, user surveys were distributed at the airport terminal between July and September. Thirty-seven responses were received; 20 of which were from corporate users. Responses from corporate and private users alike indicated the desire for a longer runway, citing both safety and load capacity reasons. The responses also requested better instrument approach capability and improved terminal facilities. Twenty-nine responses were from transient users. A summary of the 2010 survey is contained in **Appendix C**.

3.5 EXISTING BASED AIRCRAFT & OPERATIONS - 2010

The base year for this master planning study is 2010. The existing based aircraft and operations for the base year were determined using information provided by airport management.

3.5.1 Existing Based Aircraft

Table 3-9 identifies the current based aircraft at CVX by aircraft type. It should be noted that Island Airways does not base their aircraft at CVX so the airline's fleet is not included in this total. Fresh Air's aircraft are stored on the field and are included in this count. Additionally, although no jets are currently based on airport property, two jets are included in the based aircraft total to account for the consistent occupancy of the Through-The-Fence (TTF) corporate hangars along the southwest boundary of the Airport. Furthermore, one of the single-engine aircraft in the total accounts for the TTF privately-owned hangar on the northeast side of the airfield.

Table 3-9 – 2010 Based Aircraft

Aircraft Category	Aircraft Count	% of Total
Single-Engine Piston	19	71%
Multi-Engine Piston	3	11%
Turbo-Prop	2	7%
Jet	2	7%
Rotorcraft	1	4%
Total	**27**	**100%**

Source: Charlevoix Municipal Airport, 2010

3.5.2 Existing Operations

As previously mentioned, CVX is a non-towered airport and no official historic or existing operational data is available. Therefore, GA, air taxi, and military operations must be calculated using commonly accepted methods. The estimated operations for base year 2010 are presented in **Table 3-10**.

Table 3-10 – 2010 Annual Operations

Operations Type	Count	% of Total
Local Operations	**3,375**	**15%**
GA	3,375	15%
Military	0	0%
Itinerant Operations	**18,735**	**85%**
GA	7,875	36%
Air Taxi	10,360	47%
Military	500	2%
TOTAL OPERATIONS	**22,110**	**100%**

Sources: Charlevoix Municipal Airport, 2010
RW Armstrong, 2010

GA operations were developed under the guidelines set forth in the FAA Order 5090.3C *Field Formulation of the National Plan of Integrated Airport System*, which suggests that activity statistics can be estimated by applying standard multipliers to the number of based aircraft. Typically the general guideline is 250 operations per based aircraft (OPBA) for rural general aviation airports with little itinerant traffic, 350 OPBA for busier general aviation airports with more itinerant traffic, and 450 OPBA for busy reliever airports. In unusual circumstances such as busy reliever airports with a large number of itinerant operations, the number of OPBA may be as high as 750 OPBA. In CVX's case, 450 OPBA was the chosen multiplier due to the high volume of itinerant traffic as supported by the FAA flight plan data and user surveys. The estimated annual operations from the OPBA multiplier was divided into local and itinerant traffic (70 percent itinerant, 30 percent local). The local/itinerant split is common for similar airports and corresponds with the *Michigan Airport System Plan*.

It should be noted that the two aircraft owned by Fresh Air Aviation and based at the Airport were removed from the GA operations calculation due to the fact that air taxi operations would be calculated separately. The estimated GA operations for base year 2010 are 3,375 local operations and 7,875 itinerant operations (using 25 based aircraft).

Air taxi operations were calculated based on information provided by the airlines and the assumptions as follows:

- The five month peak season is from May to September, as supported by the FAA flight plan data which suggests that approximately 75 percent of operations occur during these months.
- Each airline has approximately 10 flights a day (20 operations) on average during the peak season.

- Each airline has approximately 5 flights a day (10 operations) on average during the off season.

Calculations based on these assumptions result in 10,360 annual air taxi operations in the base year. Although this figure is slightly less than that indicated in the TAF (12,000 annual air taxi operations), it is thought to be reliable considering the calculation is based on information provided directly from the airlines.

Although no military services are based at CVX, occasional itinerant military operations are conducted and must be accounted for. The TAF estimates that approximately 500 military operations occur annually at CVX. According to the Operations Officer at the U.S. Coast Guard Air Station Traverse City, the Coast Guard performs 6 to 8 operations per week at CVX, resulting in an average of 364 operations annually. Assuming that other military units, such as the U.S. Army National Guard, operate at CVX approximately once a week (one arrival and one departure), the result of this estimation is slightly under 500 annual military operations. Therefore, the TAF forecast is assumed to be accurate for annual military operations and is adopted into the base year forecast.

3.6 AIRPORT ACTIVITY FORECASTS

Forecast of annual activity at CVX for the years 2010-2030 have been developed for based aircraft, aircraft mix, annual operations, peak period operations, annual enplanements, and peak period passengers. While it is important to analyze all of these forecast elements, it should be recognized that the largest driving factors of development at the airport will be the based aircraft demand and the peak period forecasts.

The forecasts prepared for this Master Plan are considered unconstrained, meaning that the growth of these forecasts does not take into consideration any airport or airspace capacity constraints that may negatively impact or hinder anticipated airport demand. It should be recognized, however, that due to the existing amount of based aircraft and activity, modest developments at the airport (e.g., additional hangar facilities) or changes in the airline service, could significantly influence the levels of activity ultimately experienced.

3.6.1 Forecast Assumptions and Conditions

In order to develop a forecast of aviation demand that is reasonable for planning purposes, there must be an understanding of the many variables which affect the aviation industry and the Airport (described in **Section 3.2**). Among the assumptions and conditions that were considered in developing the forecast of aviation demand for CVX are the following:

- The demographic trends and socioeconomic indicators presented in this Master Plan will remain viable over the forecast horizon.

- Based on the high level of itinerant traffic and the FAA flight plan data, the general aviation market for CVX includes local, regional and national traffic.
- Tourism will remain a strong component in Charlevoix and continue to grow steadily.
- The demand for service to Beaver Island will remain consistent throughout the planning horizon and grow commensurate with national air-taxi and local tourism trends.
- It is expected that CVX, due mostly to its location, will remain regionally prominent and that commercial air service options will maintain at least the same level of service over the forecast horizon.

3.6.2 Based Aircraft Forecast

Based aircraft forecasts were developed using a *locally-adjusted analysis* and a *market share analysis*. Due to the lack of reliable historic data, a *trend analysis* was not deemed reliable. In each of the chosen scenarios, the methods were applied to the 2010 based aircraft count identified in **Table 3-9**.

Locally-Adjusted Analysis

In the *locally-adjusted analysis*, the chosen demographic variable was population. Typically, population growth in an airport's local market has the highest correlation to based aircraft growth. If population growth is indeed an indicator of potential aircraft growth in a given market, then national aviation growth forecasts provided by the FAA should be revised to reflect the local market (either above or below national averages).

Table 3-11 shows the average annual growth rate of the national GA fleet by aircraft type, as per the FAA Aerospace Forecast. These numbers are projected nationally and do not account for local or regional variations in population growth rates. It is apparent that the population of piston aircraft is remaining consistent or declining while turbo-prop, rotorcraft, and jet aircraft populations are growing at a faster rate. Also displayed are the average annual growth rates for projected population.

Table 3-11 – Annual Growth Rates for GA Aircraft – National Average

Period	National Population	Single-Engine Piston	Multi-Engine Piston	Turbo-Prop	Jet	Rotorcraft
2010-2015	1.0%	-0.3%	-0.8%	1.5%	4.2%	3.5%
2016-2020	1.0%	0.0%	-0.9%	1.4%	4.4%	2.8%
2021-2025	0.9%	0.5%	-0.8%	1.4%	4.3%	2.5%
2026-2030	0.9%	0.7%	-0.8%	1.3%	4.1%	2.2%

Sources: FAA Aerospace Forecast FY 2010-2030
Woods & Poole Economics, Inc., 2010

As described in **Section 3.2.1**, Charlevoix County's population growth trends are below the national average. Therefore, the national FAA based aircraft forecasts should be adjusted downward to account for the projected below-average growth in Charlevoix's population. The Charlevoix population growth rate was directly compared to the national population growth rate, and the ratio by which the Charlevoix average is less than the national average was applied to the FAA Aerospace Forecast by aircraft type. For any category of aircraft that is expected to decline in population during the forecast period (e.g., multi-engine piston aircraft), the national average is used, in order to account for the worst-case scenario. The result is a Charlevoix-specific (or locally-adjusted) growth rate for based aircraft. **Table 3-12** details the locally-adjusted average annual growth rates for the forecast period.

Table 3-12 – Annual Growth Rates for GA Aircraft – Locally Adjusted

Period	Charlevoix County Population	Single-Engine Piston	Multi-Engine Piston	Turbo-Prop	Jet	Rotorcraft
2010-2015	0.7%	-0.3%	-0.8%	1.1%	3.1%	2.6%
2016-2020	0.7%	0.0%	-0.9%	1.1%	3.4%	2.1%
2021-2025	0.7%	0.4%	-0.8%	1.1%	3.4%	2.0%
2026-2030	0.7%	0.6%	-0.8%	1.1%	3.3%	1.8%

Sources: FAA Aerospace Forecast FY 2010-2030
Woods & Poole Economics, Inc., 2010

When the locally-adjusted growth factors are applied to the 2010 based aircraft figures at CVX, the number of based aircraft would be anticipated to increase from 27 to 31 during the planning period (as shown in **Table 3-13**), which constitutes a growth of approximately 14.8 percent over the forecast horizon (0.7 percent annually).

Table 3-13 – Based Aircraft Forecast (Locally-Adjusted Analysis)

Year	Single-Engine Piston	Multi-Engine Piston	Turbo-Prop	Jet	Rotorcraft	Total
2010	19	3	2	2	1	**27**
2015	19	3	2	2	1	**27**
2020	19	3	2	3	1	**28**
2025	19	3	2	3	1	**28**
2030	20	3	2	4	2	**31**
AAGR[1]	0.3%	0.0%	0.0%	3.5%	3.5%	**0.7%**

Source: RW Armstrong, 2010
Note 1: AAGR – Average Annual Growth Rate

Market Share Analysis

In the *market share analysis,* CVX's existing share of the national GA fleet was calculated and used as the basis for projecting future based aircraft totals. This analysis was developed utilizing the *FAA Aerospace Forecast Fiscal Years 2010-2030* General Aviation and Air Taxi Aircraft forecast as a baseline and assumes that CVX will maintain its share of the national GA fleet over the forecast period. **Table 3-14** shows the FAA forecasted national average annual growth rates for GA aircraft.

Table 3-14 – FAA National Average Annual Growth Rates for GA Aircraft

Period	Single-Engine Piston	Multi-Engine Piston	Turbo-Prop	Jet	Rotorcraft
2010-2015	-0.3%	-0.8%	1.5%	4.2%	3.5%
2016-2020	0.0%	-0.9%	1.4%	4.4%	2.8%
2021-2025	0.5%	-0.8%	1.4%	4.3%	2.5%
2026-2030	0.7%	-0.8%	1.3%	4.1%	2.2%

Source: FAA Aerospace Forecast FY 2010-2030

If CVX is expected to maintain the same share of the national fleet, then it is assumed the based aircraft at CVX will grow commensurate with the national average annual growth rates. When these rates are applied to the 2010 based aircraft figures at CVX, the number of based aircraft would be anticipated to increase from 27 to 33 during the planning period (as shown in **Table 3-15**), which marks an increase of 22.2 percent over the forecast horizon (1.0 percent annually).

Table 3-15 –Based Aircraft Forecast (Market Share Analysis)

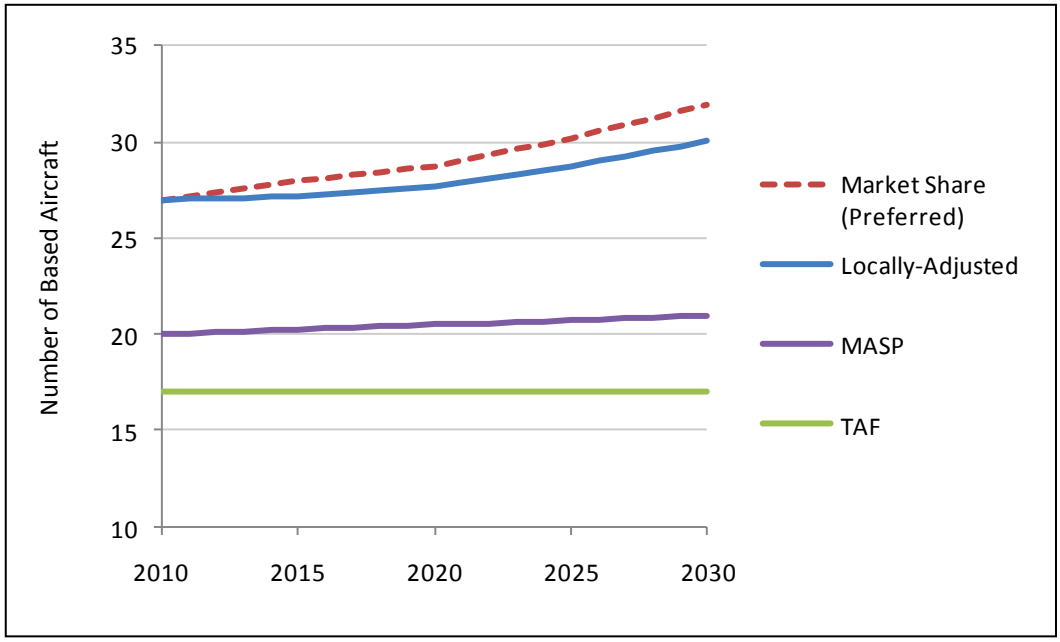
Year	Single-Engine Piston	Multi-Engine Piston	Turbo-Prop	Jet	Rotorcraft	Total
2010	19	3	2	2	1	**27**
2015	19	3	2	2	1	**27**
2020	19	3	2	3	1	**28**
2025	19	3	2	4	2	**30**
2030	20	3	3	5	2	**33**
AAGR[1]	0.3%	0.0%	2.1%	4.7%	3.5%	**1.0%**

Source: RW Armstrong, 2010
Note 1: AAGR – Average Annual Growth Rate

Preferred Based Aircraft Forecast

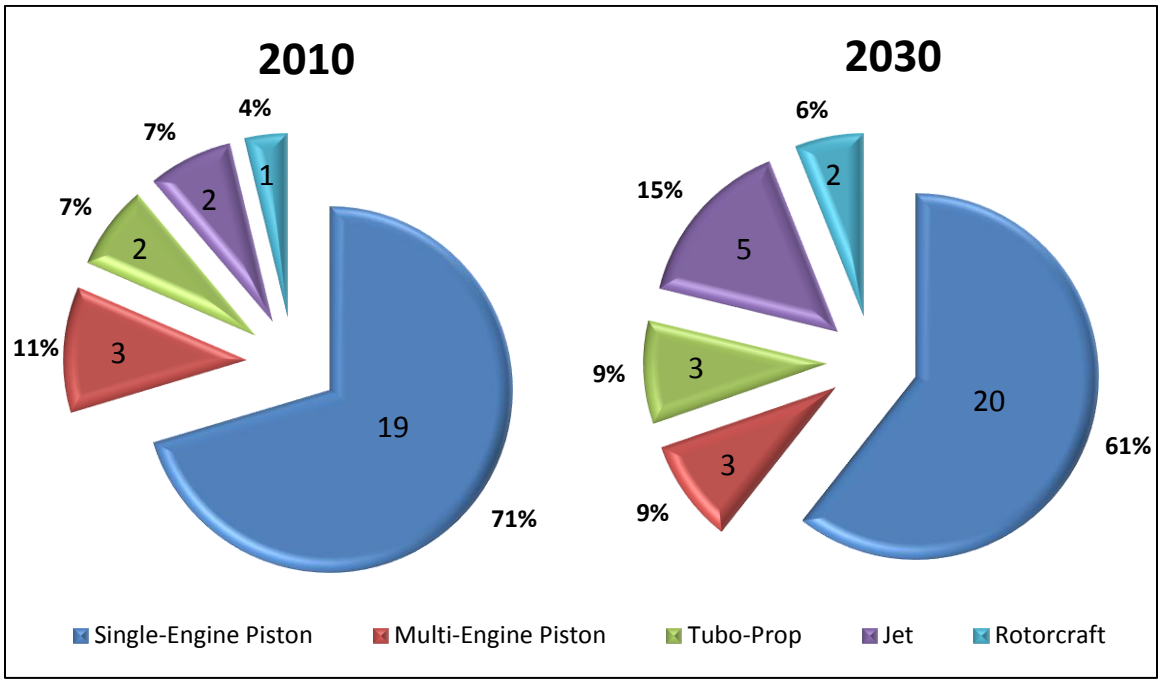
The preferred based aircraft forecast for this Master Plan is the *market share forecast,* which was the higher of the two forecasts. Although the *locally-adjusted forecast* can be directly related to the local demographic conditions of the region, there is assumed to be a latent demand for aircraft storage and that the existing based aircraft total would be higher if additional facilities were available at CVX. This is evidenced by an August 2010 hangar space waiting list of approximately 15 aircraft owners. With this latent and projected demand, for any growth in based aircraft to be actualized, additional hangar space would have to be developed. **Figure 3-5** provides a graphical comparison of the two methodologies pursued as well as the MASP and the FAA forecasts. **Figure 3-6** displays the 2010 based aircraft fleet mix and the projected 2030 fleet mix derived from the preferred based aircraft forecast.

Figure 3-5 – Based Aircraft Forecast Comparison



Source: Michigan Airport System Plan Report, 2008
FAA Terminal Area Forecast for Charlevoix Municipal Airport, 2009
RW Armstrong, 2010

Figure 3-6 – Projected Change in Fleet Mix



Source: RW Armstrong, 2010

As shown, the fleet mix is expected to change over the forecast horizon. The single-engine piston population is expected to grow, but it will hold a smaller share of the total GA fleet at CVX – dropping from 71 percent to 61 percent. Turbo-prop, jet, and rotorcraft types of aircraft are expected to grow at a faster rate and gain a larger share of the total GA fleet – the largest of that being the jet population, which is estimated to grow from 7 percent to 15 percent of the overall fleet.

3.6.3 Operations Forecast

Similarly to the estimations for existing operations as presented in **Section 3.5.2**, the forecast of future operations was developed by combining a variety of methods. Basically speaking, GA operations and airline (i.e., air taxi) operations were projected independently and then combined to come up with a total annual operations forecast for CVX.

GA operations were estimated by applying the 450 OPBA method to the preferred based aircraft forecast for the years 2011-2030. Once again, all aircraft that are owned by the airlines and are used for air taxi services were removed from the calculation. Throughout the forecast horizon, it was assumed that 70 percent of all estimated operations will be itinerant and 30 percent will be local. The result is 4,185 local GA operations and 9,765 itinerant operations in 2030, marking an overall increase of 24.0 percent.

Seeing that the airlines accommodate both local/residential and tourist passengers from around the country, the FAA projected national average growth rate in air taxi operations of 1.3 percent was applied to the base year air taxi operations. This resulted in an increase from 10,360 operations in 2010 to 13,414 in 2030 marking an increase of 29.5 percent. For comparison purposes, the projected average annual growth rate for tourism (1.5 percent) was applied to the base year air taxi operations and similar results are obtained (13,953 operations in 2030). The economic trends in tourism distinctly support moderate growth in air taxi operations over the forecast horizon.

As with air taxi operations, the national average annual growth rate is applied to the base year operations for itinerant military aircraft. The national forecasts actually suggest that itinerant military operations will decrease slightly over the forecast horizon. The result is 476 itinerant military operations in 2030 which marks a decrease of 4.8 percent.

The results of this exercise are presented in **Table 3-16**, which predicts that annual airport operations under this forecast scenario will grow from 22,110 in 2010 to 27,840 in 2030. This represents a growth of 25.9 percent over the forecast horizon.

Table 3-16 – CVX Preferred Operations Forecast 2010-2030

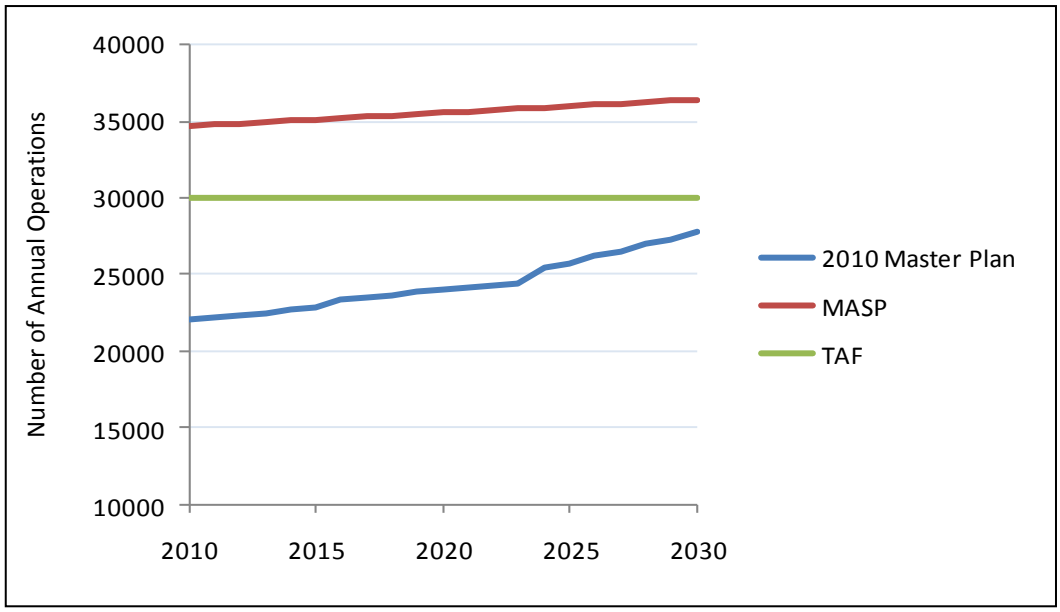
Year	Based Aircraft	Local Operations			Itinerant Operations				Total Ops
		GA	Military	Total	GA	Air Taxi	Military	Total	
2010	27	3,375	0	**3,375**	7,875	10,360	500	**18,735**	**22,110**
2015	27	3,375	0	**3,375**	7,875	11,051	500	**19,426**	**22,801**
2020	28	3,510	0	**3,510**	8,190	11,788	500	**20,478**	**23,988**
2025	30	3,780	0	**3,780**	8,820	12,575	488	**21,883**	**25,663**
2030	33	4,185	0	**4,185**	9,765	13,414	476	**23,655**	**27,840**
AAGR[1]	1.0%	1.1%		**1.1%**	1.1%	1.3%	-0.3%	**1.2%**	**1.2%**

Source: RW Armstrong, 2010

Figure 3-7 provides a graphical representation of the preferred operations forecast in comparison to the MASP and TAF forecasts. Although the preferred forecast of operations is below that of the MASP and TAF, this can generally be explained by the difference in overarching forecast methodologies and various or inconsistent data sources used as the forecast baselines (e.g., differing based aircraft counts and partial or anecdotal operations counts). The FAA projections are derived from national estimates of aviation activity which are then assigned to individual airports. This "top-down" method can provide a reasonable order of magnitude estimate but at non-towered airports like CVX, there is little data available to cross reference or validate the TAF forecasts. The MASP forecasts were developed in a similar "top-down" manner,

focusing on the state level, but still utilizing many of the same FAA forecast assumptions. The forecasts for this Master Plan were prepared from the "bottom up" and were based on information provided by the airlines and airport management as well as existing corporate and private users. FAA and MASP growth rates and assumptions were incorporated as appropriate.

Figure 3-7 – Operations Forecast Comparison

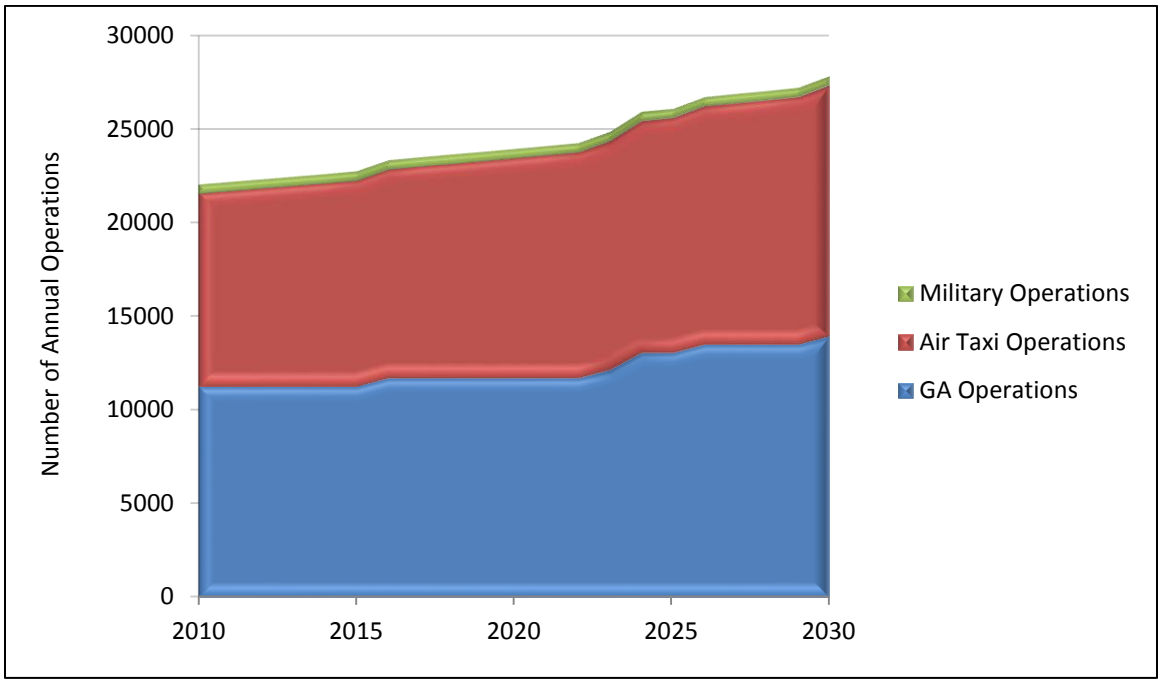


Sources: Michigan Airport System Plan Report, 2008
FAA Terminal Area Forecast for Charlevoix Municipal Airport, 2010
RW Armstrong, 2010

Seeing as how both the preferred and previous forecasts of total annual operations are below the operational capacity of the runway (as described in **Chapter 4**), it would be reasonable to consider these varying forecasts as a potential range of operations that could be experienced at the Airport and focus more directly on the seasonal peaking characteristics. These seasonal peak operations by both GA and commercial operations present the greatest demand on both airside (e.g., apron space) and landside (e.g., terminal and auto parking) facilities and have the greatest potential for being constrained.

Figure 3-8 graphically displays the volume and growth of the preferred forecast operations by type. As shown, the air taxi and GA operations are expected to grow at a similar rate and maintain a consistent share of total operations. Air taxi operations are expected to maintain a share of approximately 47 to 49 percent of total operations throughout the forecast horizon, while GA operations are expected to maintain a share of approximately 49 to 50 percent. Military operations account for approximately 2 percent throughout the forecast horizon.

Figure 3-8 – Operations Forecast 2010-2030



Source: RW Armstrong, 2010

Table 3-17 presents the forecast annual operations by fleet mix. The air taxi operations are accounted for in the multi-engine piston category. Military operations are also represented in an independent category and have been noted by airport management to be predominately by rotorcraft/helicopter.

Table 3-17 – CVX Operations Forecast by Aircraft Type

	2010	2015	2020	2025	2030	AAGR[1]
Single-Engine Piston	8,550	8,550	8,550	8,550	9,000	0.3%
Ex. Piston Cessna 172, Piper Arrow						
Multi-Engine Piston	10,810	11,501	12,238	13,025	13,864	1.3%
Ex. Britten-Norman Islander, Beech Baron						
Turbo-Prop	900	900	900	900	1,350	2.1%
Ex. King Air B200, Pilatus PC12						
Jet	900	900	1,350	1,800	2,250	4.7%
Ex. Lear 35, Citation II, Falcon 10						
Rotorcraft	450	450	450	900	900	3.5%
Ex. Bell 210, 427, Robinson R44						
Military	500	500	500	488	476	-0.3%
Total	**22,110**	**22,801**	**23,988**	**25,663**	**27,840**	**1.2%**

Source: RW Armstrong, 2010
Note 1: AAGR – Average Annual Growth Rate

The FAA flight plan data was compared with the operations by aircraft type for the base year, 2010. The turbo-prop and jet categories were the only categories analyzed for consistency because a high percentage of flights from these types of aircraft file IFR flight plans. According to the flight plan data, 780 turbo-prop flight plans and 793 jet flight plans were filed to or from CVX in 2009. Assuming 10 to 15 percent of total operations from these types of aircraft are not recorded in this data set, the results of the preferred forecasts are comparable to actual conditions at the airfield.

3.6.4 Peak Period Operations Forecast

Peak period operations typically occur during good weather, when traffic is most active. The methods for calculating peak period activity are derived from FAA Advisory Circular 150/5070-6B *Airport Master Plans* and Advisory Circular 150/5060-5 *Airport Capacity and Delay*. The suggestion is that the average daily demand for the peak month can typically be estimated by dividing the total annual activity by 12 months, and then 30 days, and then adjusting up by 10 percent. On account of the activity at CVX being significantly heavier in the peak season months (May – September) than it is in the off season months, airport-specific methods were developed. The FAA flight data denotes that 71 to 79 percent of operations occur during the peak season (75 percent on average). Therefore, in order to estimate peak day operations, 75 percent total annual operations were divided by 5 months, and then 30 days, and then adjusted up by 10 percent. The 10 percent increase is calculated in order to accommodate event-driven surges in operations, due to a holiday, or other events that would drive tourism. Peak hour estimations were calculated by dividing the peak day operations by 12 and adjusting up by 10 percent to account for the same event-driven surges.

The peak day and peak hour operations forecast play a significant role in planning airport development for CVX due to the high volume of traffic that is experienced at the Airport during these months, as compared to the off-season months. Analysis of the peak day and peak hour demand will help ensure that the Airport has the capacity to meet future demand. As seen in **Table 3-18,** peak day operations are estimated to rise from 122 in 2010 to 153 in 2030, marking an increase of 25.4 percent. Peak hour operations are anticipated to increase from 11 operations in 2010 to 14 operations in 2030.

Table 3-18 – Peak Period Operations Forecast

Year	Annual Operations	Peak Day Operations	Peak Hour Operations
2010	22,110	122	11
2015	22,801	125	11
2020	23,988	132	12
2025	25,663	141	13
2030	27,840	153	14
AAGR[1]	1.2%	1.1%	1.2%

Source: RW Armstrong, 2010
Note 1: AAGR – Average Annual Growth Rate

3.6.5 Air Taxi Enplanements Forecast

Annual enplanement data is available from 2000 to 2008 (2009 data is considered erroneous) through the *FAA Air Carrier Activity Information System*[8]. **Table 3-19** presents the historic enplanement figures. The methodologies pursued in the forecasting process for enplanements were a *trend analysis,* a *locally-adjusted analysis* (related to tourism), and a *national trend analysis* (related to projected air taxi operations). A *market share analysis* of enplanements would not be considered accurate, due to the seasonal and specific market at CVX (i.e., Beaver Island) and the fact that FAA national enplanement forecasts are predominately based on larger, commercial hub airports with regional and national air carriers. The results of these three forecasting methods are presented in **Table 3-20**.

Table 3-19 – Historic Enplanements

Year	Annual Enplanements
2000	15,357
2001	16,868
2002	49[1]
2003	15,465
2004	12,769
2005	14,549
2006	14,133
2007	16,544
2008	17,854
2009	259[1]
AAGR	**1.90%**[2]

Source: FAA Air Carrier Activity Information System[4], 2010
Note 1: Data considered to be erroneous
Note 2: For the years 2000-2008

In the *trend analysis*, the historic data between 2000 and 2008 was used to calculate an average annual growth rate (AAGR). The data shows a general growth rate of approximately 1.9 percent annually. When applied to the 2008 enplanement figure, this growth rate projects a rise in enplanements from 18,539 in 2010 to 27,013 in 2030.

[8] "Passenger Boarding (Enplanement) and All-Cargo Data for U.S. Airports", FAA website, http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/index.cfm?sect=collection, 2010

In the *locally-adjusted analysis*, the average local annual growth rate in tourism of 1.5 percent was applied to the 2008 enplanement figure. This scenario results in a growth from 18,394 enplanements in 2010 to 24,774 enplanements in 2030.

In the *national trend analysis*, the growth in enplanements was linked to the forecasted growth in air-taxi operations. Using the FAA's 1.3 percent average annual growth rate, this scenario resulted in an increase of enplanements from 17,854 in 2010 to 23,117 in 2030.

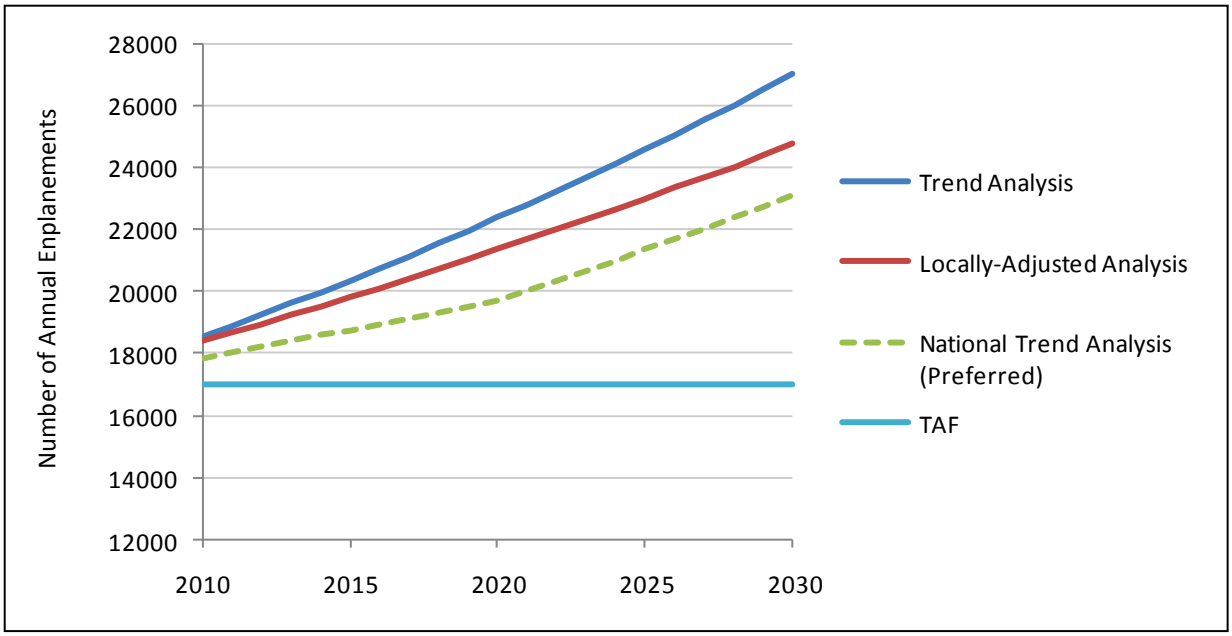
Table 3-20 – Enplanements Forecasts

Year	Trend Analysis	Locally-Adjusted Analysis	National Trend Analysis
2008	17,854	17,854	17,854
2010	18,539	18,394	17,854
2015	20,368	19,815	19,045
2020	22,378	21,347	20,315
2025	24,586	22,996	21,610
2030	27,013	24,774	23,117
AAGR	**1.90%**	**1.50%**	**1.30%**

Source: RW Armstrong, 2010

Due to the variation in the results of these three methodologies, the enplanements forecast can be separated into high, medium, and low categories representing different scenarios at the Airport. The *trend analysis* can be considered the "high" forecast which could be the result of unexpected events (i.e. loss of capacity at a nearby airport, unforeseen boom in tourism or development on Beaver Island). The locally adjusted analysis can be considered the "median" forecast and could represent a strong regional economic recovery bringing socioeconomic trends more in line with national averages. The *national trend analysis* can be considered the "low" forecast which could represent modest growth in demand which is, according to the airlines, currently being experienced or the result of a lingering economic recovery. Therefore, the *national trend analysis* was chosen as the preferred forecast for annual enplanements. **Figure 3-9** presents a graphical representation of the enplanements forecasting methodologies that were utilized.

Figure 3-9 – Enplanements Forecast Comparison



Source: RW Armstrong, 2010

3.6.6 Peak Period Passenger Forecast

In order to estimate demand on terminal and landside facilities, arriving passengers (deplanements) must be considered in addition to departing passengers (enplanements). It is assumed that deplanements are equal to enplanements at CVX and together can be considered as the annual passenger movements.

Without a detailed breakdown of enplanements by month, commonly-used peak period enplanements forecasting methods, as described in FAA AC 150/5360-9 *Planning and Design of Airport Terminal Building Facilities at Non-Hub Locations*, cannot readily be used. Therefore, based on information provided by the airlines and airport management, certain assumptions were made in order to calculate the peak day and peak hour passenger movements. It is assumed that the passenger load factors are higher during the peak season. The FAA flight plan data suggests that 75 percent of operations occur during the peak season. Therefore, 75 percent of passenger movements are assumed to occur during the peak season.

Peak day passenger movements were estimated by calculating 75 percent of total annual passengers (enplanements plus deplanements) and dividing by 5 months (peak season), and then 30 days, and then increasing by 10 percent. The 10 percent increase is calculated in order to accommodate event-driven surges in operations, due to a holiday, or other event that would drive tourism. To calculate peak hour passenger movements, the peak day passenger movements were divided by 12 hours, and then increased by 10 percent. The 10 percent increase accounts for the passenger surges

resulting in passengers who may arrive early, or to account for terminal guests waiting for arriving passengers. The results of these calculations are presented in **Table 3-21.**

Table 3-21 – Peak Period Passenger Movements[1] Forecast

Year	Annual Passenger Movements	Peak Day Passenger Movements	Peak Hour Passenger Movements
2010	35,708	196	18
2015	38,090	209	19
2020	40,630	223	20
2025	43,220	238	22
2030	46,234	254	23
AAGR[2]	1.3%	1.3%	1.2%

Source: RW Armstrong, 2010
Note 1: Passenger Movements are the sum of enplanements and deplanements.
Note 2: AAGR – Average Annual Growth Rate

3.7 SUMMARY OF FORECASTS

A summary of the activity forecasts for the various operational components at CVX over the 20 year planning horizon (2010-2030) is presented in **Table 3-22**. All forecasts within this Master Plan show moderate growth throughout the forecast period. These forecasts will be a driving factor in the *Facility Requirements Analysis* described in **Chapter 4**.

Table 3-22 – Summary of Forecasts

	2010	2015	2020	2025	2030	AAGR
Based Aircraft	**27**	**27**	**28**	**30**	**33**	**1.0%**
Single-Engine Piston	19	19	19	19	20	0.3%
Multi-Engine Piston	3	3	3	3	3	0.0%
Turbo-Prop	2	2	2	2	3	2.1%
Jet	2	2	3	4	5	4.7%
Rotorcraft	1	1	1	2	2	3.5%
Total Operations	**22,110**	**22,801**	**23,988**	**25,663**	**27,840**	**1.2%**
Local	3,375	3,375	3,510	3,780	4,185	1.1%
Itinerant	18,735	19,426	20,478	21,883	23,665	1.2%
Peak Day	122	125	132	141	153	1.1%
Peak Hour	11	11	12	13	14	1.2%
Enplanements	**17,854**	**19,045**	**20,315**	**21,610**	**23,117**	**1.3%**
Peak Day Passengers	196	209	223	238	254	1.3%
Peak Hour Passengers	18	19	20	22	23	1.2%

Source: RW Armstrong, 2010

4 FACILITY REQUIREMENTS

The City of Charlevoix recognizes the importance of both general and commercial aviation to the City and surrounding region. Acknowledging this importance, the City government has established a vision for the future of the Airport that entails "providing safe, efficient and attractive aviation facilities serving both the resident and business communities." A primary goal of this vision is to provide year-round, all-weather facilities to better serve the existing users and the types of aircraft currently operating at the Airport. This objective includes enhancing both airfield utility and capacity for all aircraft operators. In achieving this vision, the City is dedicated to being a good neighbor to the surrounding residential and business land uses and minimizing impacts to the community as long as the ability of the Airport to 1) meet the facility needs of the intended users, and 2) meet FAA safety, design and airspace protection standards, is not hindered.

In support of this vision, and based on the *Inventory of Existing Facilities and Conditions* presented in **Chapter 2** and the *Forecasts of Aviation Demand* presented in **Chapter 3** (which were concurred upon by the FAA in December 2010), each component of the Charlevoix Municipal Airport has been evaluated for its ability to accommodate the anticipated levels of demand over the 20-year planning horizon. This includes an evaluation of the Airport's ability to meet the design and safety standards established by the FAA in Advisory Circular (AC) 150/5300-13, *Airport Design*, and Federal Aviation Regulation (FAR) Part 77, *Objects Affecting Navigable Airspace*.

These evaluations of airport facility requirements were also conducted using guidance contained in several FAA publications, including AC 150/5060-5, *Airport Capacity and Delay*, AC 150/5325-4B, *Runway Length Requirements for Airport* Design, AC 91-79 *Runway Overrun Protection*, AC 150/5360-9 *Planning and Design of Airport Terminal Building Facilities at Nonhub Locations*, and Order 5090.3C *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)*. The facilities assessed in this chapter include:

- Airport Reference Code (ARC) and Critical Aircraft
- Airport Design Standards
- Runway and Taxiways
- Aircraft Storage and Parking
- Additional Support Facilities
- Terminal Building
- Auto Parking and Access
- Security and Safety Systems
- Approach Capability and Airspace Protection
- NAVAIDs and Lighting

4.1 AIRPORT REFERENCE CODE (ARC) AND CRITICAL AIRCRAFT

With consideration of the Airport's vision, the following goals have been established for the Aircraft Reference Code (ARC) and critical aircraft determination:

- To support general and commercial aviation;
- To provide facilities able to adequately accommodate existing and forecasted operations of the Airport;
- To supply safe, efficient facilities and increase the operational capacity; and
- To support the *Michigan Airport System Plan* (MASP) recommendation for "*Business, Tourism, and Activity Centers*".

As described in **Section 2.1.1**, the FAA classifies airports and establishes appropriate design criteria according to the size and operational characteristics of the aircraft that the airport is intended to accommodate. The classification is called the ARC and is determined by the most demanding or "critical" aircraft using the airport on a substantial, or regular basis. The following describes the ARC classification and critical aircraft pertinent to CVX.

4.1.1 ARC and Critical Aircraft Determination

AC 150/5325-4B *Runway Length Requirements for Airport Design* states that the "substantial use" threshold for determining an airport's critical aircraft, or family grouping of aircraft, is a minimum of 500 annual itinerant operations. This threshold becomes an important factor in justifying federal funding assistance for certain airport development projects (i.e., airfield improvements). However, the AC also states that under certain circumstances, adjustments may be made to this threshold, such as for airports with demonstrated seasonal traffic variations (such as CVX), or for airports situated in isolated or remote areas that have special needs.

Due to their size and operational characteristics, turbo-prop and business jet type aircraft are the most demanding at CVX. The 2004 ALP identified the Beechcraft King Air 90 (ARC B-II) as the critical aircraft for the majority of the airport facilities (excluding the turf runway). Analysis of the IFR flight plan data, as discussed in **Section 3.4.1**, suggests that the majority of turbo-prop and jet operations at CVX are conducted by ARC B-II aircraft (approximately 840 completed IFR operations in 2010 between January and September). Of these, approximately 500 were conducted by turbo-props and approximately 340 were by jets. Likewise, approximately 300 IFR operations were conducted at CVX by ARC C-I and C-II aircraft over the same time period. Of these, approximately 70 were by turbo-props and 230 were by jets. Approach Category C aircraft have shown the greatest growth in recent years, increasing by over 70 percent between 2005 and 2010. This is most notably due to one of Through-the-Fence operators maintaining a C-II aircraft at CVX for a large portion of the year.

Based on the forecasts presented in **Chapter 3**, as concurred upon by the FAA, turbo-prop and jet activity is anticipated to increase at an average annual growth rate of 2.1 percent and 4.7 percent, respectively. If these projected growth rates remain constant, the 500 operations threshold for C-I and C-II aircraft could be reached by 2021 (as shown in **Table 4-1**). Based on these factors and the goals established by the City's vision for the Airport, continued development to support B-II aircraft in the near-term is considered appropriate, with consideration for potential long-term development to ARC C-II standards. In support of smaller recreational aircraft, and existing airline operations, continued development of the crosswind runway to ARC A/B-I "small" standards is also appropriate.

Table 4-1 – Projected Growth by Turbo-Prop and Jet Aircraft

		Near-Term					Mid-Term					Long-Term
ARC	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
B-I	265	277	289	301	315	328	343	358	374	390	408	426
B-II	982	984	1,015	1,047	1,080	1,114	1,150	1,186	1,225	1,264	1,305	1,348
TOTAL	**1,247**	**1,261**	**1,304**	**1,348**	**1,395**	**1,442**	**1,493**	**1,544**	**1,599**	**1,654**	**1,713**	**1,774**
C-I	133	137	142	146	151	156	161	166	172	177	183	189
C-II	192	201	210	220	231	241	253	265	277	290	304	318
TOTAL	**325**	**338**	**352**	**366**	**382**	**397**	**414**	**431**	**449**	**467**	**487**	**507**

Source: Aviation Data Specialists, 2010
RW Armstrong, 2011
Note: 2010 data is extrapolated to include projected full year.

To further define the critical family of aircraft that operate at CVX, the B-II and C-II turbo-prop and jet aircraft models that had a significant number of operations (20 or more), as identified in the IFR flight data for 2010, are listed in **Table 4-2**. This critical aircraft family will be considered in the evaluation of primary facility requirements throughout this chapter.

Table 4-2 – Critical Aircraft Family

	ID	Manufacturer	Model	MTOW (lbs)	Number of IFR Ops in 2010[1]
B-II	BE90	Beechcraft	King Air 90	10,100	159
	B250	Beechcraft	King Air 200/250	12,500	112
	B350	Beechcraft	Super King Air 350	15,000	134
	C550	Cessna	Citation II / Bravo	15,100	148
	C560	Cessna	Citation V / Ultra	15,900	51
	C56X	Cessna	Citation Excel 560XL	20,000	95
	FA50	Dassault	Falcon 50	38,800	26
				Total	**725**
C-II	CL60	Bombardier	Challenger 300	38,850	20
	C680	Cessna	Citation Sovereign 680	30,300	24
	H25B	Hawker Beechcraft	Hawker 900XP	28,000	108
				Total	**152**

Sources: Aviation Data Specialists 2010
RW Armstrong, 2011
Notes: [1] Accounts for completed IFR operations between January and September in 2010

4.2 AIRPORT DESIGN STANDARDS

In accordance with the Airport's vision statement, a goal of this master planning effort is to meet all FAA design and safety standards related to the designated ARC of the airfield facilities. The ARC establishes the standards for airfield dimensions, separation distances, protection zones, clearance requirements, etc. The FAA design and safety standards as defined in AC 150/5300-13 *Airport Design* are described below.

Runway Width – The physical width of the runway.

Runway Safety Area (RSA) – Graded surface centered on the runway centerline. The RSA shall be free of objects (except for objects that need to be located in the RSA to serve their function) and capable, under dry conditions, of supporting snow removal equipment, aircraft rescue and firefighting (ARFF) equipment, and the occasional passage of aircraft without causing structural damage to the aircraft.

Runway Object Free Area (ROFA) – The ROFA is also centered on the runway centerline and requires the clearing of all above ground objects protruding above the RSA edge elevation (unless objects need to be located in the OFA for air navigation or aircraft ground maneuvering purposes).

Runway Object Free Zone (OFZ) – The OFZ is a defined volume of airspace centered above the runway centerline that extends 200 feet beyond each end of the runway surface that precludes taxiing or parked airplanes and object

penetrations, except for frangible visual NAVAIDs that need to be located in the OFZ because of their function.

Runway Protection Zone (RPZ) – The RPZ is a trapezoidal surface located 200 feet beyond the runway end and centered on the extended runway centerline. The RPZ enhances the protection of people and property near the airport through airport control over the RPZ. Such control includes clearing of RPZ areas of incompatible objects and activities.

Taxiway Safety Area (TSA) – The TSA is located on the taxiway centerline and shall be cleared and graded, properly drained, and capable, under dry conditions, of supporting snow removal equipment, ARFF equipment, and the occasional passage of aircraft without causing structural damage to the aircraft.

Taxiway Object Free Area (TOFA) – The TOFA is centered on the taxiway centerline and prohibits service vehicle roads, parked airplanes, and above ground objects, except for objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.

Runway and Taxiway Separation Standards – Separation distance between the runway, taxiways and other airport facilities are established to ensure operational safety of the airport and are as follows:

- Runway centerline to parallel taxiway centerline
- Runway centerline to holdline
- Runway centerline to edge of aircraft parking area
- Taxiway centerline to parallel taxiway/taxilane centerline
- Taxiway centerline to fixed or moveable object

Building Restriction Line (BRL) – Though not a specific FAA design standard, the BRL is a reference line which identifies suitable building area locations on an airport. On an airport by airport basis, the BRL should encompass the RPZs, the OFA, and any NAVAID critical area. The BRL is also typically established with consideration to airspace protection by identifying areas of allowable building heights such as 25 or 35 feet above ground level. These height restrictions are based on FAR Part 77 standards that will be described in more detail in **Section 4.9.**

Table 4-3 identifies the geometric requirements of the above standards as they apply to CVX with an ARC of B-II and non-precision instrument approach capability with 1-mile visibility minimums to the primary runway, and an ARC A/B-I for "small" aircraft and visual approach capability to the crosswind runway. C-II standards for potential long-term development are also identified. From a land use and property control perspective, **Figure 4-1** depicts the most relevant runway related standards as they currently exist for CVX (i.e., ROFA, RSA, RPZ, and BRL). ARC upgrade options to Approach Category C are discussed in **Chapter 5**.

Upon comparison of the existing facilities to these standards, it is evident that the primary runway and parallel taxiway comply with the identified ARC B-II standards. While the RPZ for Runway 9 extends beyond airport property, the land use of the quarry is considered compatible. The existing facilities do not, however, currently meet C-II standards (runway width, RSA, and ROFA dimensions; runway to parallel taxiway separation; holdline marking separation; and RPZ clearance). As for the crosswind runway, the facilities generally comply with ARC A-I "small" standards with the exception of the RPZs, which extend beyond airport property. The crosswind RPZs encompass several residential buildings to the north and a couple of commercial buildings to the south. It is recommended that the City pursue acquisition of these parcels to gain control over the RPZs and remove the incompatible land uses, unless other crosswind runway options are pursued. Alternative crosswind runway development scenarios are discussed in **Chapter 5**.

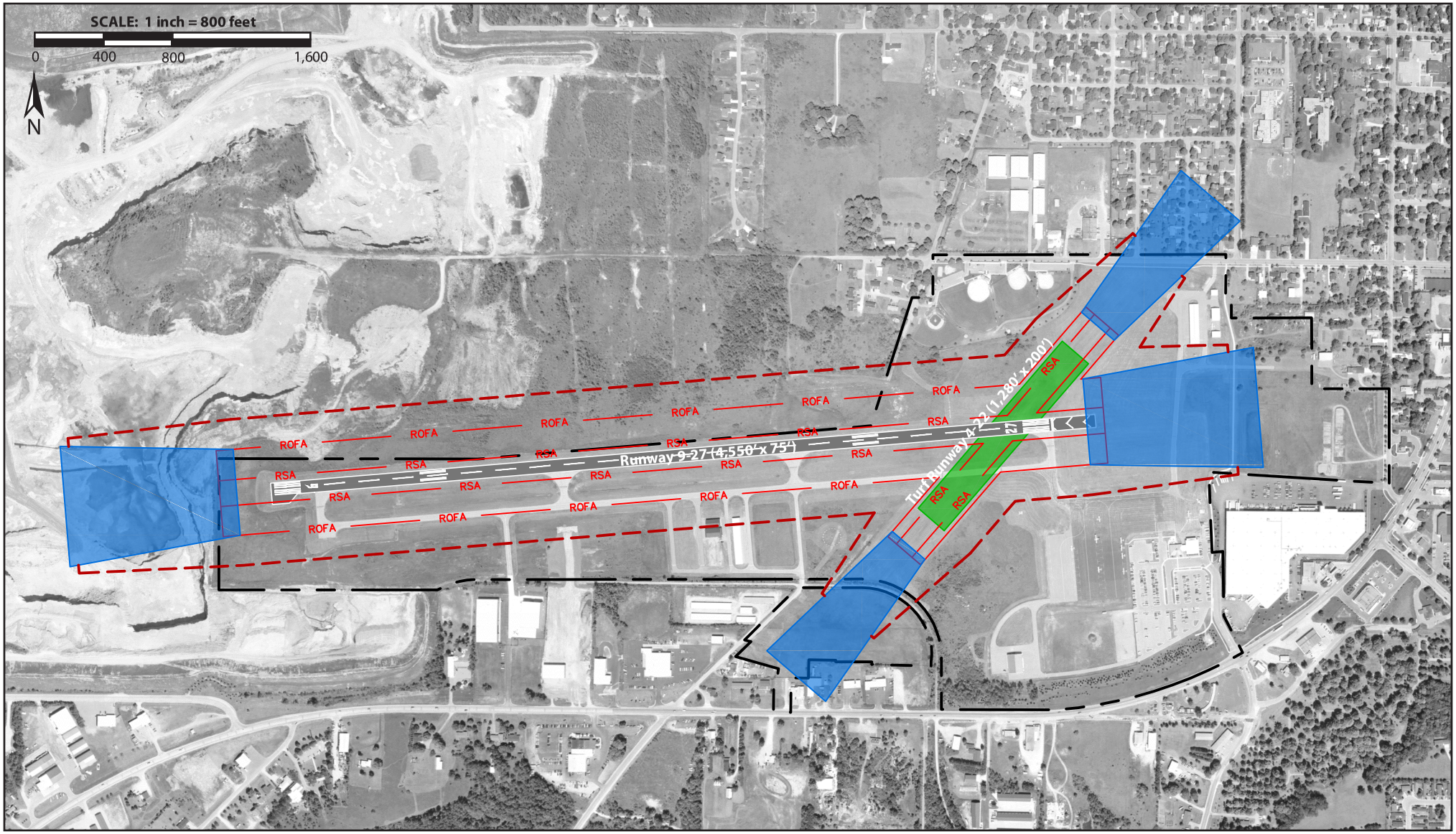
Table 4-3 – FAA Design Standards

Design Standard	Primary Runway (9/27)			Crosswind Runway (4/22)	
	Existing Conditions	B-II Standards[1]	C-II Standards[1]	Existing Conditions	A/B-I "small" Standards[2]
Runway Width	75 feet	75 feet	100 feet	200 feet (turf)	60 feet (if paved)
Parallel Taxiway Width	35 feet	35 feet	35 feet	N/A	25 feet
Runway Safety Area (RSA) Width	150 feet	150 feet	500 feet	120 feet	120 feet
RSA Length Beyond RW End	300 feet	300 feet	1,000 feet	240 feet	240 feet
Runway Object Free Area (ROFA) Width	500 feet	500 feet	800 feet	250 feet	250 feet
ROFA Length Beyond RW End	300 feet	300 feet	1,000 feet	240 feet	240 feet
Runway Obstacle Free Zone (OFZ) Width	400 feet	400 feet	400 feet	250 feet	250 feet
Separation Between:					
Runway Centerline to Parallel Taxiway Centerline	240 feet	240 feet	300 feet	N/A	150 feet
Runway Centerline to Edge of Aircraft Parking	>400 feet	250 feet	400 feet	>500 feet	125 feet
Runway Centerline to Holdline	200 feet	200 feet	250 feet	N/A	125 Feet
Taxiway Centerline to Parallel Taxiway Centerline	N/A	105 feet	105 feet	N/A	69 feet
Taxiway Centerline to Fixed or Moveable Object	>300 feet	65.5 feet	65.5 feet	>250 feet	44.5 feet
Runway Protection Zone (RPZ):					
Length	1,000 feet	1,000 feet	1,700 feet	1,000 feet[3]	1,000 feet
Width 200 feet from RW End	500 feet	500 feet	500 feet	250 feet[3]	250 feet
Width at Far End of RPZ	700 feet	700 feet	1,010 feet	450 feet[3]	450 feet

Sources: FAA AC 150/5300-13 *Airport Design*
RW Armstrong, 2011

Notes: [1] Considers non-precision instrument runway with 1 mile visibility minimums
[2] Considers visual approach only
[3] RPZ is not cleared of incompatible objects and activities.

= in compliance w/standard
= not in compliance w/standard



PROPERTY LINE

RSA — RUNWAY SAFETY AREA

ROFA — RUNWAY OBJECT FREE AREA

25' BUILDING RESTRICTION LINE

RUNWAY PROTECTION ZONE

FIGURE 4-1

EXISTING DESIGN STANDARDS
ARC B-II / A-I "Small"

RW ARMSTRONG
Inspiration to reality.

CHARLEVOIX MUNICIPAL AIRPORT
MASTER PLAN STUDY

4.3 PRIMARY RUNWAY

In accordance with the City's vision, the following goals have been established for the primary runway planning effort:

- To enhance utility and capacity for all users of the airfield;
- To meet runway length requirements for the critical aircraft family and existing operators; and
- To minimize off-airport impacts.

Runway 9/27 is 4,550 feet long by 75 feet wide and supports a variety of commercial, business, recreational and military aircraft operations. The following evaluates the primary runway requirements for CVX in terms of capacity and length.

4.3.1 Runway Capacity

Airfield capacity is primarily a function of the number and configuration of the runways and taxiways at an airport. When the operational demand at an airport reaches 60 percent of the total estimated capacity, the FAA recommends that the airport sponsor consider additional runways or alternative airfield configurations to accommodate that demand and mitigate any airfield congestion. An airport's Annual Service Volume (ASV) is the estimate of the total number of aircraft operations an airfield can accommodate based on runway layout, aircraft fleet mix, historical weather, and operational characteristics of the airport.

Using guidance provided in FAA AC 150/5060-5 *Airport Capacity and Delay*, the ASV for the primary runway at CVX was calculated at approximately 200,000 annual operations. The projected demand in 2030 will be approximately 27,500 annual operations, representing 14 percent of the estimated airfield capacity for a single runway configuration. Considering the crosswind runway is turf, and only open six months of the year, it was not factored into this calculation. Based on this evaluation, overall airfield capacity is not anticipated to be a concern over the planning horizon. That is not to say, however, that during specific times of peak demand, or high activity events, there will not be temporary congestion experienced on the airfield. For the purposes of this Master Plan, no additional capacity-enhancing improvements are recommended to accommodate these infrequent occurrences.

4.3.2 Runway Length

The critical family of aircraft, identified in **Table 4-2**, was used in determining the amount of runway needed at CVX over the planning horizon. Consistent with the City's vision for the Airport, providing adequate runway length is in the interest of offering aircraft operators the most utility and the highest margin of operational safety (whether experienced or perceived) during both takeoff and landing, in almost all weather

conditions. For lesser runway lengths, operators may have to sacrifice payload or trip distance, or choose another airport to operate from.

In the absence of a specific national or mandated runway length standard, FAA guidance suggests that airports plan to accommodate, at a minimum, 75 percent of the national aircraft fleet at 60 percent useful load. To calculate the runway length required for these aircraft, the guidance contained in FAA AC 150/5325-4B *Runway Length Requirements for Airport Design* and the use of the FAA-developed computer program, *Airport Design for Microcomputers*, was used to calculate valid estimates of required runway length. Consistent with AC 150/5325-4B, as well as AC 150/5300-13 *Airport Design,* a more detailed runway length analysis was conducted using aircraft-specific performance data of the critical aircraft family. All three of these methodologies were pursued in evaluating the runway length requirement at CVX. The results of these analyses are presented in the subsequent sections.

FAA Airport Design Software, Version 4.2D[9]

The FAA program *Airport Design for Microcomputers (Version 4.2d)* does not take into account the individual aircraft utilizing the airport. Instead, a suggested runway length is provided for groupings of aircraft (based on aircraft size). The analysis is based on airport conditions, such as elevation, temperature, and runway gradient. The majority of the Charlevoix-specific critical aircraft family falls into the "large airplanes of 60,000 pounds or less" category. The result of this exercise is presented in **Table 4-4** which indicates a runway length of 4,870 feet is needed under dry conditions and 5,310 feet is needed under wet conditions in order to accommodate 75 percent of the fleet at 60 percent useful load (as highlighted in orange).

[9] The FAA is no longer supporting this airport design software. This analysis was used for comparative purposes.

Table 4-4 – Runway Length Analysis (Airport Design 4.2D)

Airport Conditions		
Airport Elevation	669 feet	
Mean daily maximum temperature of the hottest month	67.9°F	
Maximum difference in runway centerline elevation	25 feet	
Criteria	**Dry Runway**	**Wet/Slippery Runway**
Small airplanes with approach speeds of less than 30 knots	320 feet	320 feet
Small airplanes with approach speeds of less than 50 knots	850 feet	850 feet
Small airplanes with less than 10 passenger seats		
75 percent of these small airplanes	2,490 feet	2,490 feet
95 percent of these small airplanes	3,000 feet	3,000 feet
100 percent of these small airplanes	3,580 feet	3,580 feet
Small airplanes of 10 or more passenger seats	4,010 feet	4,010 feet
Large airplanes of 60,000 pounds or less		
75 percent of these large airplanes at 60% useful load	4,870 feet	5,310 feet
75 percent of these large airplanes at 90% useful load	6,120 feet	6,750 feet
100 percent of these large airplanes at 60% useful load	5,170 feet	5,500 feet
100 percent of these large airplanes at 90% useful load	7,310 feet	7,310 feet

Sources: AC 150/5300-13 *Airport Design*
FAA Airport Design for Microcomputers, Version 4.2
RW Armstrong, 2011

= recommendation for CVX critical aircraft family

AC 150/5325-4B Guidance: Runway Length Requirements for Airport Design

The guidance provided in AC 150/5325-4B *Runway Length Requirements for Airport Design* is based on weight categories of airplanes applied to general performance curves developed by the FAA. These curves are based on groupings of aircraft representing 75 and 100 percent of the national fleet, as presented in **Table 4-5**. Aircraft that are included in the Charlevoix-specific critical aircraft family are highlighted in orange. Since the majority of the critical aircraft family at CVX is represented within the 75 percent of the fleet category, this performance curve was used. The airport elevation and average daily temperature of the hottest month are also factored. The performance curve representing 75 percent of the national fleet is shown in **Figure 4-2**.

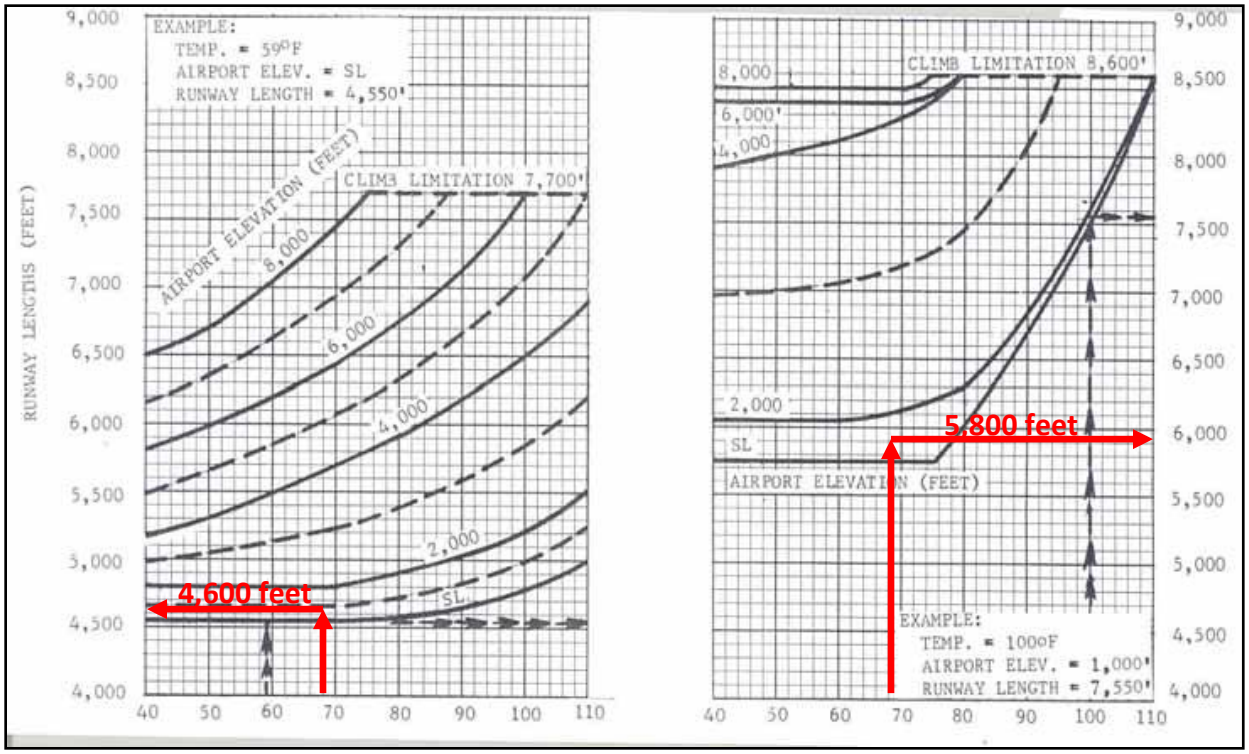
Table 4-5 – Airplanes that Make Up 75 Percent and 100 Percent of the Fleet

75 Percent				100 Percent	
Manufacturer	**Model**	**Manufacturer**	**Model**	**Manufacturer**	**Model**
Aerospatiale	SN-601 Corvette	Dassault	Falcon 10	BAE	Corporate 800/1000
BAE	125-700	Dassault	Falcon 20	Bombardier	600 Challenger
Beech Jet	400A	Dassault	Falcon 50/50 EX*	Bombardier	601/601-3A/3ER Challenger
Beech Jet	Premiere I	Dassault	Falcon 900/900B	Bombardier	604 Challenger
Beech Jet	2000 Starship	Israel Aircraft Industries (IAI)	Jet Commander 1121	Bombardier	BD-100 Continental
Bombardier	Challenger 300*	IAI	Westwind 1123/1124	Cessna	S550 Citation S/II
Cessna	500 Citation/501	Learjet	20 Series	Cessna	650 Citation III/IV
Cessna	Citation I/II/III*	Learjet	31/31A/31A ER	Cessna	750 Citation X
Cessna	525A Citation II (CJ-2)	Learjet	35/35A/36/36A	Dassault	Falcon 900C/900EX
Cessna	550 Citation Bravo*	Learjet	40/45	Dassault	Falcon 2000/2000EX
Cessna	550 Citation II	Mitsubishi	MU-300 Diamond	Israel Aircraft Industries (IAI)	Astra 1125
Cessna	551 Citation II/Special	Raytheon	390 Premier	IAI	Galaxy 1126
Cessna	552 Citation	Raytheon Hawker	400/400 XP	Learjet	45 XR
Cessna	560 Citation Encore	Raytheon Hawker	600	Learjet	55/55B/55C
Cessna	560/560XL Citation Excel*	Sabreliner	40/60	Learjet	60
Cessna	560 Citation V Ultra*	Sabreliner	75A	Raytheon Hawker	Horizon
Cessna	650 Citation VII	Sabreliner	80	Raytheon Hawker	800/800XP*
Cessna	690 Citation Sovereign*	Sabreliner	T-39	Raytheon Hawker	1000
				Sabreliner	65/70

Source: FAA AC 150/5325-4B *Runway Length Requirements for Airport Design*
Note: * Critical Aircraft family is asterisked and highlighted in orange.

= CVX critical aircraft family

Figure 4-2 – 75 Percent of Fleet at 60 or 90 Percent Useful Load



60 percent Useful Load **90 Percent Useful Load**

Source: AC 150/5325-4B *Runway Length Requirements for Airport Design*

Application of the performance curves in **Figure 4-2** results in a preliminary runway length calculation (as indicated by the red arrows). In accordance with AC 150/5325-4B adjustments were applied to these preliminary calculations to account for runway gradient and weather conditions (i.e., wet or dry). To account for the runway gradient, the required runway length is increased at a rate of 10 feet for each foot of elevation difference between the high and low points on the runway (for takeoff only). At CVX, there is a 25-foot difference between the high and low points of the runway; therefore, 250 feet was added to the suggested runway length in all scenarios. The AC also suggests that the runway length be increased to account for wet conditions for turbojet aircraft (for landing only). The AC states that the runway length obtained from the "60 percent useful load" curves are increased by 15 percent or up to 5,500 feet, whichever is less. Runway lengths obtained from the "90 percent useful load" curves are also increased by 15 percent or up to 7,000 feet, whichever is less. The results for this exercise are presented in **Table 4-6**. In order to accommodate 75 percent of the fleet at 60 percent useful load, a runway length of 4,850 feet in dry conditions and 5,500 feet in wet conditions is required (as highlighted in orange).

Table 4-6 – Runway Length Analysis (AC 150/5325-4B)

	Dry Conditions	Wet Conditions
75% of fleet at 60 Percent Useful Load	4,850'	5,500'
75% of fleet at 90 Percent Useful Load	6,050'	6,950'
100% of fleet at 60 Percent Useful Load	5,050'	5,500'
100% of fleet at 90 Percent Useful Load	7,450'	7,450'

Source: AC 150.5325-4B *Runway Length Requirements for Airport Design*
RW Armstrong, 2011

= recommendation for CVX critical aircraft family

Critical Aircraft Family Analysis

Runway length requirements were calculated for the critical aircraft family which includes the most common jets and multi-engine turbo-props operating at CVX (as described in **Section 4.1.1**). Suggested takeoff and landing lengths for each aircraft were identified from each aircraft's flight planning guide (FPG). These guides are published for the purpose of providing specific information for evaluating the performance of the aircraft.[10] Takeoff lengths obtained from the FPGs represent the greater of accelerate-stop, accelerate-go with one engine inoperative, or 115 percent of the all engine takeoff distance to a point 35 feet above the runway. Landing lengths obtained from the FPGs represent the horizontal distance at which the airplane can come to a full stop from a point 50 feet above the runway surface. The lengths were found using conditions similar to CVX (1,000 MSL elevation, 68°F ambient temperature). Additionally, the calculations assumed zero wind, anti-ice systems are off, and flaps are set to optimal settings (up during takeoff and down during landing).

Adjustments were made to these calculated takeoff and landing lengths to account for factors such as runway gradient, runway conditions (i.e. wet or dry), Part 135 operating requirements, and the weight of fuel and payload.

Factored Takeoff Lengths

Takeoff lengths were obtained from the FPGs at Maximum Takeoff Weight (MTOW) and at 60 percent useful load for each aircraft. The obtained lengths were then factored to account for runway gradient (slope) as suggested in AC 150/5325-4B *Runway Length Requirements for Airport Design*. The AC suggests that runway lengths be increased at a rate of 10 feet for each foot of elevation difference between the high and low points of the runway centerline. With a 25-foot difference in elevation on Runway 9/27, 250 feet was added to each obtained takeoff length.

[10] These documents are intended to be used for airport planning purposes and are not to be used for flight planning purposes, or in lieu of the FAA approved aircraft flight manual or operating manual.

Factored Landing Lengths

Landing lengths were obtained from the FPGs at Maximum Landing Weight (MLW). The landing lengths were then factored using the following steps:

1. According to Part 135 destination requirements, landing field length for transport category airplanes must allow a full stop landing at the destination airport within 60 percent of the effective length of the runway to prevent overrun. This guidance is contained in AC 91-79 *Runway Overrun Protection* as well as the aircraft FPGs. Therefore, the landing field lengths obtained from the FPGs were multiplied by 1.67 as suggested by this guidance.
2. Consistent with AC 91-79 and AC 150/5325-4B, an increase of 15 percent was then added to the runway length to account for wet runway conditions (for turbojet aircraft only).

Factored Runway Length Results

The factored runway lengths for the critical aircraft family are presented in **Table 4-7**. Length requirements that are shorter than the existing runway length of 4,550 feet are shaded green and length requirements that are longer than the existing runway length are shaded red.

Table 4-7 – Factored Takeoff and Landing Distances

Critical Aircraft Family			Factored Takeoff Length		Factored Landing Length	
	Manufacturer	Model	@ MTOW	@ 60% Load	@ MLW	@ MLW – Wet
B-II	Beechcraft	King Air C90	4,169 feet	3,540 feet	3,072 feet	3,072 feet
	Beechcraft	King Air 250	4,245 feet	3,972 feet	5,014 feet	5,014 feet
	Beechcraft	Super King Air 350i	4,878 feet	3,783 feet	4,668 feet	4,668 feet
	Cessna	Citation II / Bravo	4,750 feet	3,730 feet	5,661 feet	6,510 feet
	Cessna	Citation V / Ultra	3,890 feet	3,010 feet	4,910 feet	5,646 feet
	Cessna	Citation Excel 560XL	4,660 feet	3,750 feet	5,528 feet	6,357 feet
	Dassault	Falcon 50	5,550 feet	4,450 feet	5,010 feet	5,762 feet
C-II	Bombardier	Challenger 300	5,060 feet	Unavailable[1]	4,342 feet	4,993 feet
	Cessna	Citation Sovereign	4,070 feet	3,590 feet	4,593 feet	5,281 feet
	Hawker Beechcraft	Hawker 900XP	5,878 feet	4,478 feet	4,534 feet	5,214 feet

Source: Aircraft Flight Planning Guides, RW Armstrong, 2011
Notes: [1] Aircraft performance data unavailable.

= Required length accommodated by existing runway
= Required length not accommodated by existing runway

In order to account for changes in the national aviation fleet, business jet shipments were analyzed according to the *2009 and 2010 GAMA Statistical Databook & Industry*

Outlook. Trends are showing a shift to smaller Approach Category B aircraft and larger Category C aircraft. Although newer technologies in some of the Category B aircraft often allow for operation on a shorter runway, many would still have to reduce payload or fuel to operate at CVX. The highest selling business jets in 2009 (i.e. sold more than 25 units) and their factored runway lengths are presented in **Table 4-8**. It should be noted that the majority of the highest selling Category C aircraft are included in the critical aircraft family for CVX (such as the Challenger 300, Citation Sovereign, and the Hawker 900XP). The same factors that applied to the critical aircraft family were applied to these aircraft.

Table 4-8 – Factored Takeoff and Landing Distances for Additional Aircraft

Current Best Selling Business Jet Aircraft[1]			Factored Takeoff Length		Factored Landing Length	
	Manufacturer	Model	@ MTOW	@ 60% Load	@ MLW	@ MLW – Wet
A-II	Beechcraft	Premier IA	5,043 feet	3,933 feet	4,144 feet	4,765 feet
B-I	Cessna	Citation Mustang	4,500 feet	3,420 feet	4,142 feet	4,763 feet
	Cessna	Citation CJ3	4,440 feet	3,620 feet	6,012 feet	6,914 feet
	Embraer	Phenom 100	3,891 feet	3,086 feet	4,603 feet	5,293 feet
B-II	Dassault	Falcon 2000	5,835 feet	Unavailable[2]	4,392 feet	5,051 feet
C-II	Bombardier	Challenger 600	6,090 feet	Unavailable[2]	4,634 feet	5,329 feet
	Bombardier	Global 5000	5,790 feet	Unavailable[2]	4,459 feet	5,128 feet

Source: Aircraft Flight Planning Guides, RW Armstrong, 2011
GAMA 2009 and 2010 General Aviation Statistical Databook & Industry Outlook, 2010-2011
Notes: [1] Approach Category D Aircraft are not included.
[2] Aircraft performance data unavailable.

= Required length accommodated by existing runway
= Required length not accommodated by existing runway

Summary and Recommendation

FAA guidance suggests that airports should plan to accommodate at a minimum 75 percent of the fleet at 60 percent useful load. To achieve this, the analysis from both the FAA Airport Design Program and AC 150/5325-4B recommend a runway length of approximately 4,850 feet with dry conditions and approximately 5,300 to 5,500 feet with wet conditions. These analyses suggest the need for a runway extension of 300 to 1,000 feet at CVX. To further validate the results of these analyses, factored runway lengths were calculated for each aircraft in the critical aircraft family, plus the current best-selling aircraft that are entering the business jet fleet.

The factored takeoff lengths range from 3,010 feet to 4,478 feet (at 60 percent useful load) and 3,890 feet to 6,090 feet (at MTOW). The factored landing lengths range from 3,072 feet to 6,012 feet (under dry conditions at MLW) and 3,072 feet to 6,914 feet (under wet conditions at MLW). Based on these analyses, required landing distances and increased payload capacity are the driving factors for additional runway length at CVX. While it might be considered unreasonable to attempt to accommodate all aircraft desiring to use the airport under all weather conditions, considering the potential community impacts and the nearby airports that could be used during those times when weather conditions preclude the use of CVX, these analyses strongly indicate the need to lengthen Runway 9/27 to 5,500 feet.

An extension of the runway to 5,500 feet would allow over 70 percent of this aircraft group to land at MLW (under wet conditions). Likewise, 5,500 feet of takeoff length would allow over 70 percent of the aircraft to takeoff at MTOW. Options for achieving this needed length, as well as alternative lengths, are discussed in **Chapter 5**. **Figure 4-3** graphically displays the factored takeoff lengths at a 60 percent useful load and at MTOW in relation to the existing 4550-foot runway length and for comparison, to 5000- and 5500-foot runway lengths. Similarly, **Figure 4-4** graphically displays the factored landing distances of this aircraft group to the three various runway lengths.

Figure 4-3 – Factored Takeoff Distances

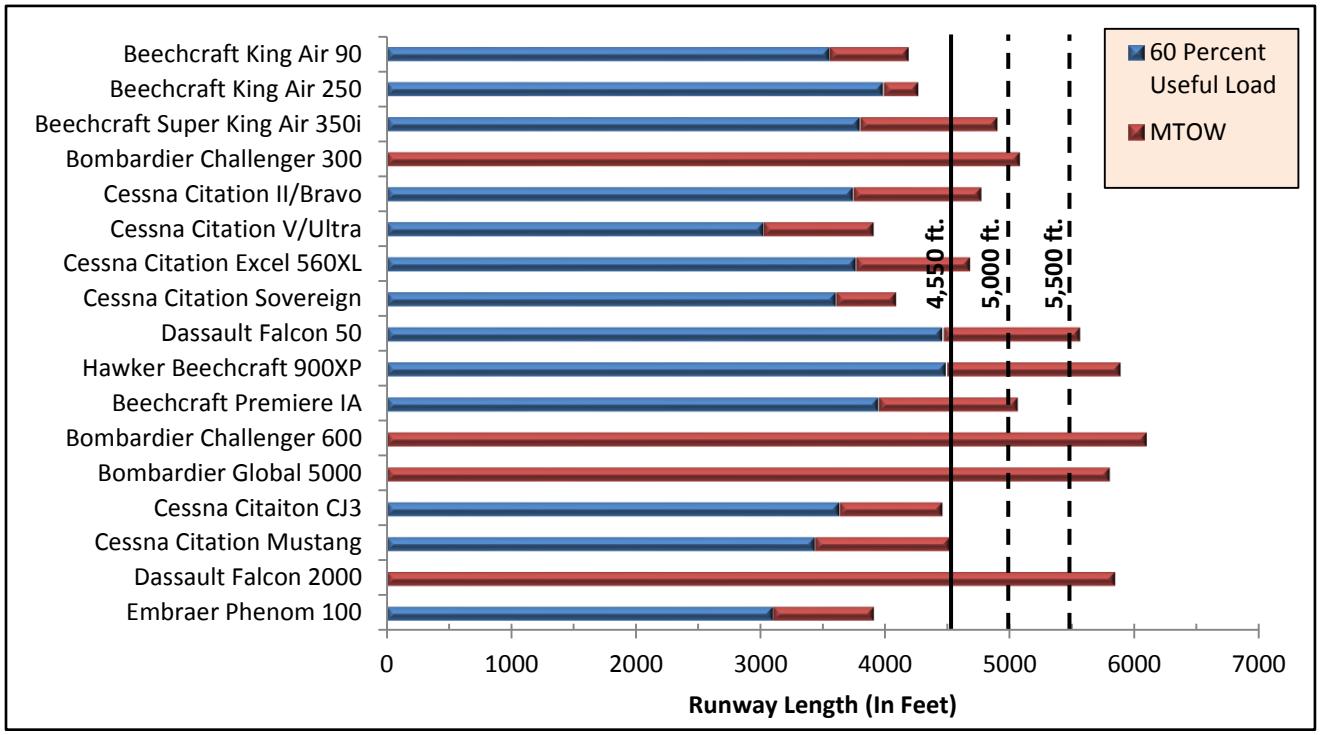
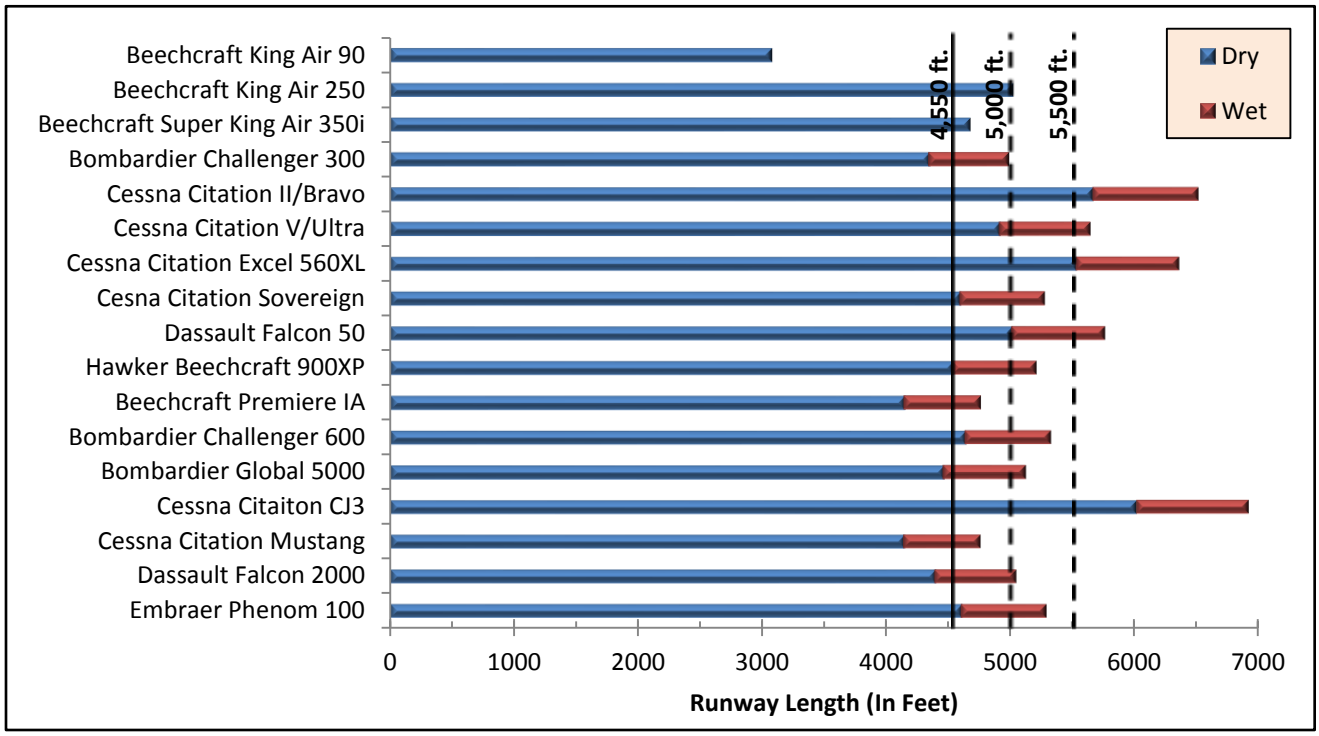


Figure 4-4 – Factored Landing Distances

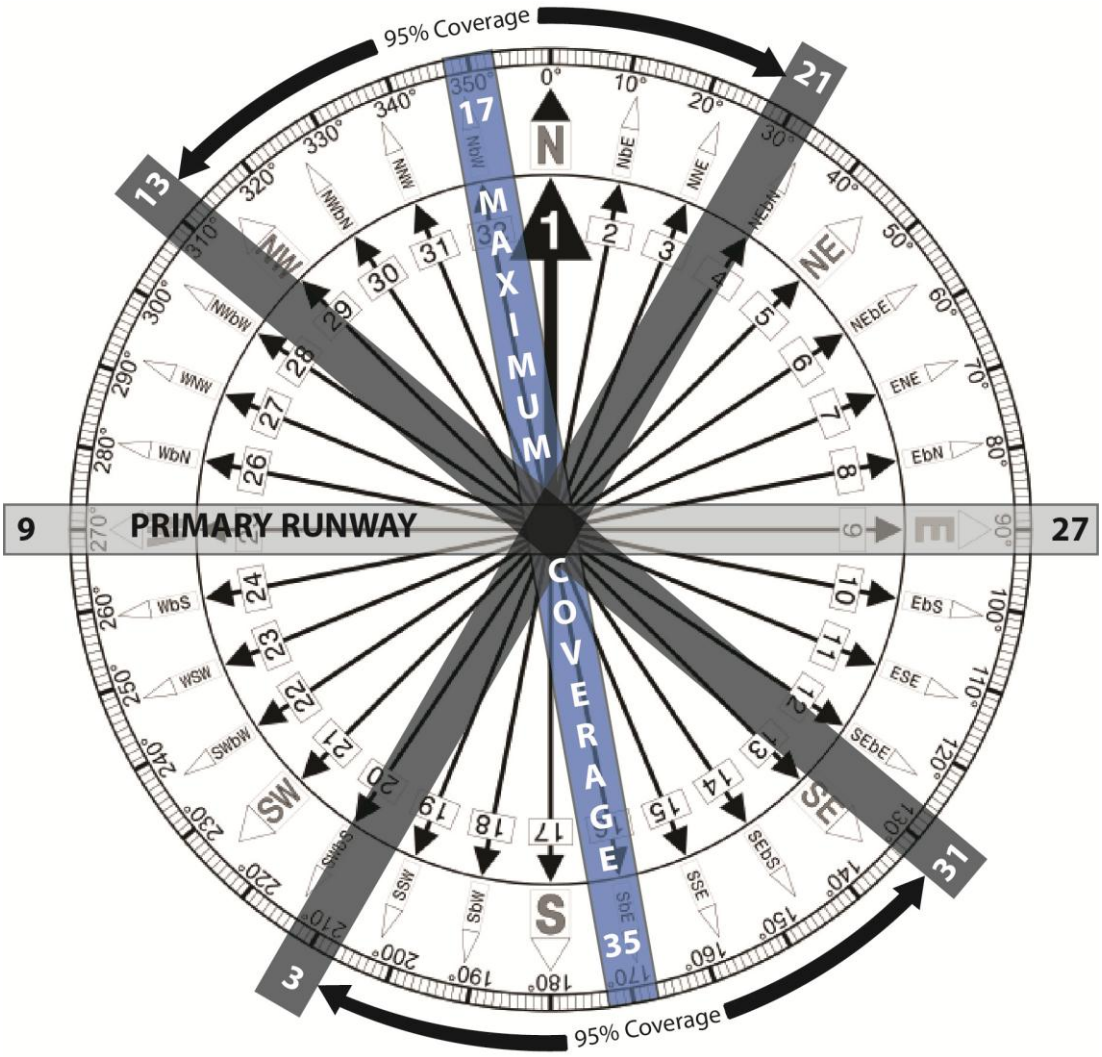


4.4 CROSSWIND RUNWAY

The current crosswind runway (4/22) is composed of turf, 1,280 feet long by 200 feet wide, and is typically closed from November to April. It is designated for use by A-I/B-I "small" aircraft (under 12,500 pounds) only and provides visual approach capability. Consistent with the City's vision, it is the goal of this master planning effort to enhance the utility and capacity for small recreational and flight training aircraft, as well as the existing airline service in all weather conditions. This includes maximizing runway length and establishing the crosswind runway for year-round operation while providing 95 percent wind coverage for small aircraft (in combination with the coverage of the primary runway).

As described in **Section 2.6.2**, the FAA recommends that a runway system provide at least 95 percent wind coverage, meaning that 95 percent of the time, the crosswind runway at an airport is within acceptable operational limits. At CVX, Runway 9/27 provides 95 percent wind coverage for the months of May through August (for Group-I aircraft under VFR conditions). That means that a secondary runway is needed September through April in order to provide 95 percent coverage for A-I/B-I "small" aircraft. The existing turf Runway 4/22 provides less coverage than the 95 percent threshold (94.01 percent) during these months, and it is closed due to snow and ice for a majority of this time frame anyway. **Figure 4-5** displays the range of crosswind runway orientation that would provide 95 percent combined coverage between September and April. In accordance with the established vision and goals for CVX, it is recommended that the crosswind runway be realigned and paved, thus providing 95 percent wind coverage year-round. Preliminary analysis suggests that the crosswind runway orientation that provides the maximum wind coverage under VFR conditions is a 17/35 (north/south) orientation.

Figure 4-5 – Potential Crosswind Runway Orientation



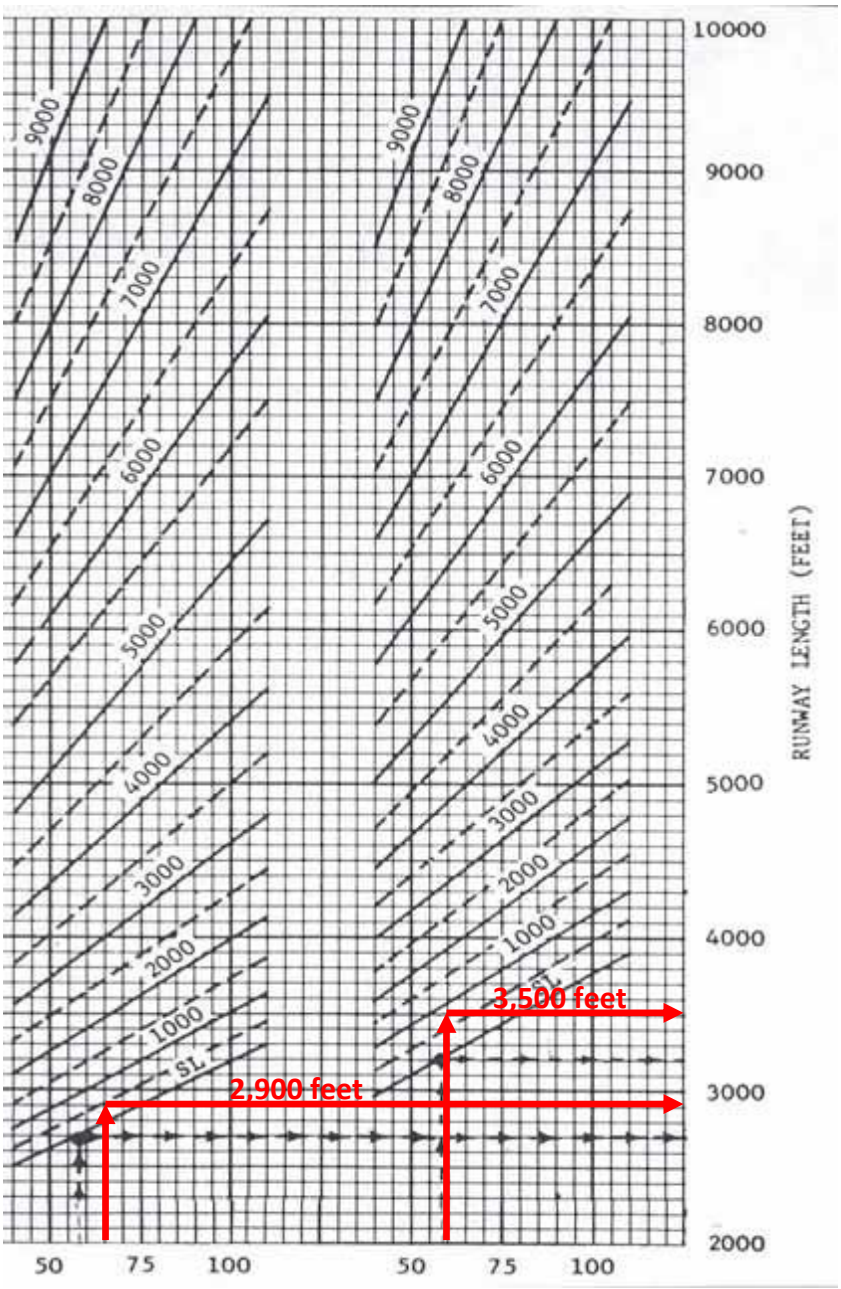
AC 150/5325-4B *Runway Length Requirements for Airport Design* suggests that a crosswind runway should be paved to 100 percent of the recommended runway length determined for the lower crosswind capable airplanes (i.e., A-I/B-I aircraft) using the primary runway. The requirements in this AC for runway length are based on the weight and approach speed of the aircraft intended to use the runway. After analysis of the based aircraft fleet, hangar waiting list, and IFR flight data, it was determined that the crosswind runway should be designed for A-I/B-I "small" aircraft (under 12,500 pounds) with approach speeds of 50 knots or more. A list of the based aircraft along with some common Group-I aircraft that regularly utilize CVX is presented in **Table 4-9**. The majority of these aircraft are sensitive to the high and often gusty level of crosswinds experienced at CVX. All the aircraft on this list are ARC A-I unless otherwise noted.

Table 4-9 – Small Aircraft at CVX

Based Aircraft	Approach Speed
American Champion	49
Beech Baron 55	90
Beech Bonanza	72
Cessna 172	61
Cessna 177	64
Cessna 182	64
Cessna 210	75
Cessna Corvallis TT	78
Partenavia P-68	73
Piper Cherokee	61
Piper Cherokee Six	61
Piper Cub	49
Britten Norman Islander (A-II)	46
Piper Navajo-Turbo (B-I)	100
Additional Aircraft	**Approach Speed**
Cessna 150	55
Cirrus SR-22	78
Van's RV-7	49
Cessna 421 (B-I)	96
Source: RW Armstrong, 2011	

For aircraft of this size and approach speed, performance curves are provided in AC 150/5325-4B. Similar to the methods pursued with the primary runway length analysis, performance curves are provided for various groupings of aircraft based on the "percentage of fleet." In the case for CVX, the "95 percent of the fleet" category is used as it applies to airports that are primarily intended to serve small population communities and remote recreational areas, whereas the "100 percent of the fleet" category is intended to be used for airports that serve communities on the fringe of a metropolitan area. This method of runway length analysis suggests a need for 2,900 feet of paved length for the crosswind runway (as shown in **Figure 4-6**).

Figure 4-6 – Small Airplanes with Approach Speeds of 50 knots or more



95 Percent of Fleet **100 Percent of Fleet**

Source: AC 150/5325-4B *Runway Length Requirements for Airport Design*
RW Armstrong, 2011

To supplement the runway crosswind runway length analysis, the FAA program *Airport Design for Microcomputers (Version 4.2d)* was used.[11] The program suggests a runway length of 2,490 feet for "75 percent of small airplanes with 10 or less passenger seats" This length would accommodate the majority of the based aircraft fleet and the transient general aviation recreational and flight training aircraft that utilize the Airport.

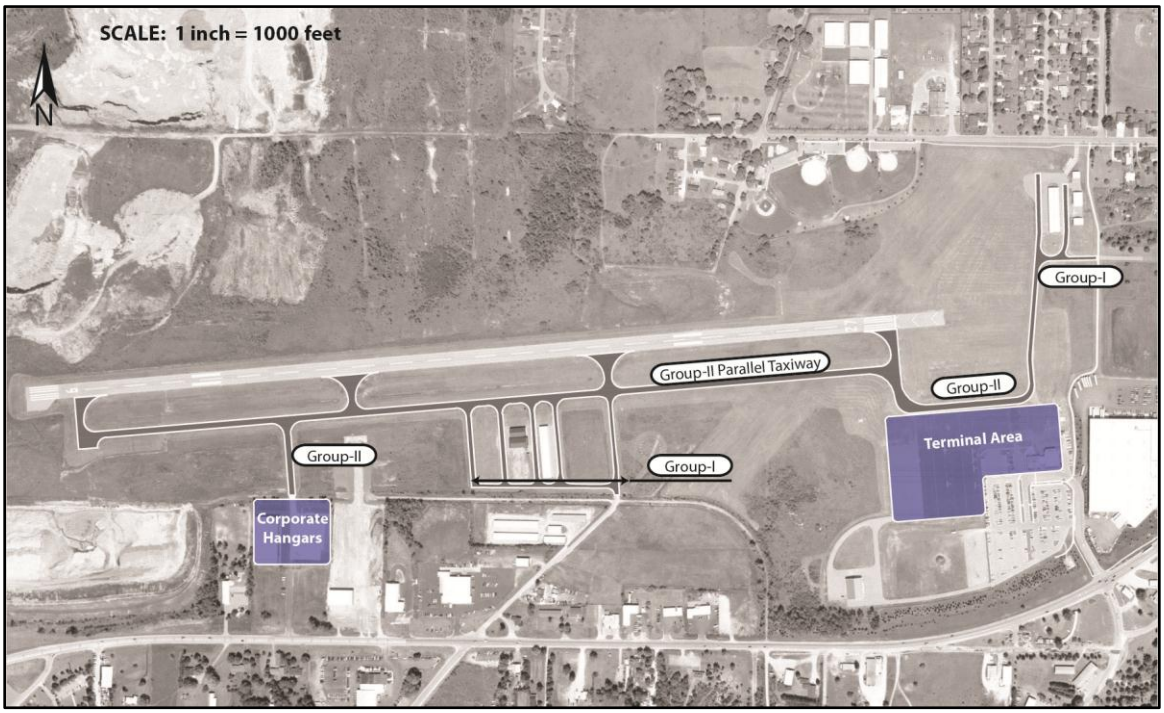
These analyses indicate that to best serve the users, and meet operational demand, the crosswind runway should be paved, lengthened to 2,500 feet, and reoriented in a north-south direction. Based on the existing level of activity by single-engine aircraft and the airlines during the months of November through April, it is believed that a paved crosswind would be utilized (i.e., preferred runway) by these aircraft approximately 600 or more times per year. Alternatives to implementing these improvements are discussed in **Chapter 5**.

4.5 TAXIWAYS

The taxiway system provides a link between the runway and other operational areas of an airport. An efficient taxiway system enhances operational safety and provides for the orderly flow of aircraft thereby reducing the potential for congestion and/or pilot confusion. **Figure 4-7** displays the existing taxiway system at CVX. The parallel taxiway along with the taxiways that provide access to the terminal area and the Through-the-Fence corporate hangars are intended to accommodate Group-II aircraft. All other taxiways are intended to accommodate Group-I aircraft.

[11] The FAA is no longer supporting this software. This analysis is included for comparative purposes.

Figure 4-7 – Taxiway System



4.5.1 Operational Capacity and Efficiency

The location, geometry, runway access points, and bypass capability of the taxiways can help to reduce runway occupancy times. While there are no apparent runway/taxiway capacity issues at CVX, some improvements would increase overall efficiency and maximize utility of the runway (which concurs with the goals of the City's vision). FAA guidance in AC 150/5300-13 suggests that a full parallel taxiway is recommended for runways with a nonprecision instrument approach and visibility minimums as low as 1 mile (such as at CVX). Additional guidance in MDOT's *Project Evaluation Process* document suggests that a full length parallel taxiway is justified at airports with over 15,000 operations (such as at CVX). The existing parallel taxiway ends approximately 250 feet short of the Runway 9 threshold. It is understood that this is primarily due to past funding constraints that precluded the taxiway from being extended concurrently with the runway extension in the mid-1990s. Additionally, holding pads or bypass areas should be provided near runway ends used primarily for departures, which for CVX would be Runway 27. Lastly, the Group-I taxiway leading to the North Hangar Complex is considered an "end-around" taxiway, which means that the taxiway is beyond the runway threshold within the approach area. End-around taxiways, particularly at non-towered airports, are highly discouraged as they can lead to pilot confusion of who has right-of-way when the runway is active.

Based on these guidelines, the following improvements are suggested:

- Extend the parallel taxiway to the full length of Runway 9/27.
- A holding pad should be located on the Runway 27 end due to it being the primary departure runway.
- Relocate the end-around taxiway so it crosses at the Runway 27 threshold.

Should the crosswind runway become paved in the future, as recommended by this Master Plan, it would not likely warrant a full parallel taxiway. However, properly placed runway exit taxiways would increase the safety margin by allowing aircraft to exit the runway promptly.

4.5.2 Taxiway Design Standards

Similar to the runways, taxiways are subject to ARC design requirements such as taxiway width, Taxiway Safety Area (TSA) dimensions, and Taxiway Object Free Area (TOFA) dimensions. As shown in **Figure 4-7**, some taxiways at CVX are designed to Group-II standards while others are designed to Group-I standards. While future on-airport development may be segregated by use for specific aircraft types (i.e., Group-I hangar area or a Group-II accessible apron), it is suggested that any future taxiway improvements be developed to Group-II standards, or at least given that consideration, in order to provide the most flexibility in airfield usage and the ability to meet future, yet unidentified operational needs or development opportunities.

4.6 RUNWAY AND TAXIWAY PAVEMENT

The primary runway and parallel taxiway pavements have a 30,000 pound design strength for dual-gear aircraft. They were rehabilitated in phases between 2004 and 2008. As described in **Section 2.1.5**, the 2009 *Pavement Management Report* noted that the runway pavement was in “very good” condition and the taxiway/apron pavements were in “excellent” condition. The design strength of the pavement at an airport is typically determined by the strength of the subgrade, the weight of the aircraft utilizing the airfield, and the number of operations from these aircraft. The maximum takeoff weights of the previously described critical aircraft family range from 10,100 pounds to 38,850 pounds, with the heaviest of these aircraft (those over 30,000 pounds) performing less than 30 operations in 2010. Considering the weights of the common aircraft are under 30,000 pounds at CVX and the typical 20 to 30 year design life of these pavement systems, routine maintenance is all that is recommended over the planning horizon with consideration for potential rehabilitation towards the end of the horizon. However, if operations should increase significantly by aircraft weighing over 30,000 pounds, it will reduce the lifespan of the pavements and strengthening may be warranted.

4.7 AIRCRAFT STORAGE, PARKING AND SUPPORT FACILITIES

Planning factors have been developed for all major facility requirements at CVX such as hangars, aprons, and support facilities, in accordance with the Airport's vision. These planning factors were applied to the operations forecasts presented in **Chapter 3** to calculate the anticipated demand for each type of facility. The calculated demand was then compared to the Airport's existing infrastructure and any deficit or potential surplus of facilities was identified. The result of this analysis will help guide the development of these facilities over the planning horizon.

4.7.1 Aircraft Storage

The City's vision has established the goal of providing adequate hangar space for based and transient aircraft and to accommodate forecasted growth. The demand for aircraft storage at is typically a function of based aircraft (number and type), owner preferences, and climate. Due to the harsh winters in Northern Michigan, it is assumed that all based aircraft at CVX will require hangar space. The projected growth in based aircraft along with the most recent hangar waiting list was compared with the existing aircraft storage facilities at CVX to calculate the future aircraft storage requirements. The following assumptions were used:

- 100 percent of single-engine piston aircraft require T-hangars or box hangars
- 100 percent of multi-engine piston aircraft require T-hangars or box hangars
- 50 percent of turbo-prop aircraft require T-hangars or box hangars
- Remaining 50 percent of turbo-prop aircraft require space in bulk hangars
- 100 percent of jet aircraft require space in bulk hangars
- 100 percent of helicopters require space in bulk hangars

As of early 2011, there are 10 T-hangar units and 13 box hangars at CVX and they are 100 percent occupied. Additionally there is a 16-person waiting list for hangar space, all with the desire to house small single-engine or multi-engine piston aircraft. The forecasts in **Chapter 3** project the addition of two to three aircraft of this type over the forecast horizon. However, these projections did not take the waiting list into account and may have been higher if more hangar space was available. Typical T-hangar and box hangar developments are constructed in multi-unit configurations. Therefore, it is recommended that development of at least one ten-unit T-hangar building be pursued during the short-term (1 to 5 year) forecast horizon to accommodate the latent and projected demand. When developing the site for this T-hangar building, design and infrastructure consideration should also be given to the potential development of future adjacent hangar facilities.

The larger and more sophisticated aircraft such as turbo-props, jets, and helicopters are typically stored in bulk hangars. There are currently 2 corporate hangars at CVX, but they are privately-owned and located off of airport property. The forecasts in **Chapter 3** project that up to 3 jet aircraft and 1 helicopter will be added to the based aircraft fleet by 2030. It is therefore recommended that the development of a bulk hangar able to accommodate these 3-4 additional aircraft be pursued over the forecast horizon. The development of second bulk hangar, or at least the site preparation for such, is also suggested. This second hangar would be available to accommodate overflow aircraft parking and transient aircraft storage, particularly during inclement weather in an effort to avoid aircraft icing and improve customer service by providing covered passenger loading.

4.7.2 Apron and Aircraft Parking

In accordance with the City's vision, the following goals have been established for this planning effort:

- Provide adequate parking for transient aircraft;
- Provide Group-II power-in/power-out parking positions; and
- Enhance apron circulation and provide adequate space for self-fueling and passenger loading.

As of early 2011 there is approximately 27,000 square yards of apron space and 52 Group-I tie-downs at CVX. There are no designated Group-II parking positions on the apron. The larger aircraft (Group-II and above) that visit CVX typically park on the north side of the apron, west of the fuel farm and terminal. Based on information provided by airport management, the Technical Advisory Committee (TAC) and the FAA, the existing apron configuration is prone to congestion problems, due to the lack of designated parking positions for Group-II aircraft, the location of the self-service fuel island, and the need for passenger loading space near the terminal.

Typically, aircraft parking facility requirements are presented in terms of based and transient aircraft. Due to the harsh winters in Northern Michigan, all based aircraft will require hangar facilities and therefore it is assumed that all aircraft requiring apron space will be transient. The requirements for apron and aircraft parking are based on the average peak day transient aircraft. These numbers are derived from the operations forecasts presented in **Chapter 3**. The following is assumed:

- 75 percent of annual operations occur between May and September
- 75 percent of all total aviation activity at CVX is transient
- 75 percent of all transient aircraft will require aircraft parking

These planning factors were used to calculate the average peak day transient aircraft demand as presented in **Table 4-10**.

Table 4-10 – Average Peak Day Transient Aircraft (Requiring Parking)

	2010	2015	2020	2025	2030
Single-Engine Piston	13	13	13	14	14
Multi-Engine Piston	1	1	1	1	1
Turbo-Prop[1]	2	2	2	2	3
Jet	1	1	2	3	3
Helicopter	1	1	1	1	1

Source: RW Armstrong, 2011
Note: [1] Military operations are accounted for in the turbo-prop category for purposes of apron planning.

To accommodate this transient demand, it is assumed that single-engine and multi-engine piston aircraft will require tie-downs and that the turbo-props and jets will require power-in/power-out parking configurations. To provide adequate apron space for airline operations, which are not factored into **Table 4-10**, it is assumed they will require an additional four power-in/power-out parking positions; two for multi-engine piston aircraft and two for turbo-prop aircraft.

Based on FAA guidance, industry experience, and common aircraft sizes, the following per-aircraft planning factors were used in determining the required apron space at CVX[12]:

- 880 square yards for single-engine piston aircraft (tie-down)
- 880 square yards for multi-engine piston aircraft (tie-down)
- 1,300 square yards for multi-engine piston aircraft (power-in/power-out)
- 2,440 square yards for turbo-prop aircraft (power-in/power-out)
- 2,940 square yards for jet aircraft (power-in/power-out)
- 1,000 square yards for helicopter (power-in/power-out)

Based solely on the peak transient aircraft demand, there is a lack of appropriate apron space at CVX and a deficit in Group-II parking positions. Additionally, congestion has been a major concern particularly near the terminal area and self-service fuel island. It is highly recommended that in the near-term horizon, the terminal apron be expanded to accommodate the experienced and forecasted demand and the parking positions be reconfigured to allow for power-in/power-out maneuvers, particularly by business jet type aircraft. This reconfiguration should also attempt to separate airline operations, and the associated passenger foot traffic, from the other GA aircraft and fueling operations. As presented in **Table 4-11**, the projected apron requirements and the associated surplus or deficit, indicate the need for expansion and reconfiguration of the apron in the near-term and additional expansion as warranted in the mid- to long-term horizons.

[12] Derivation of the space planning factors is provided in Appendix E.

Table 4-11 – Apron Requirements

	Group-I Tiedowns	Group-II Parking Positions	Total Square Yardage
Existing Conditions	**52**	**0**	**±27,000 SY**
2010 Requirements	**14**	**4**	**±28,620 SY**
Surplus / Deficit	*+38*	*-4*	*-1,620 SY*
2015 Requirements	**14**	**4**	**±28,620 SY**
Surplus / Deficit	*+38*	*-4*	*-1,620 SY*
2020 Requirements	**14**	**5**	**±31,560 SY**
Surplus / Deficit	*+38*	*-5*	*-4,560 SY*
2030 Requirements	**15**	**7**	**±37,820 SY**
Surplus / Deficit	*+37*	*-7*	*-10,820 SY*

Source: RW Armstrong, 2011
= surplus
= deficit

4.7.3 Support Facilities

Support facilities at CVX include the snow removal equipment (SRE) building and the fuel farm. The SRE building was constructed in 2005. According to airport personnel, this building is sufficient for their current demands and there is no anticipated need for additional equipment facilities over the forecast horizon.

The existing underground fuel storage tanks are located adjacent to the east edge of the terminal apron. The self-service fueling island is located on the terminal apron, in front of the Terminal Hangar. The capacity of the two tanks (10,000 gallons Jet-A and 12,000 gallons 100LL) is considered sufficient to meet the user demands over the planning horizon. Routine inspection and maintenance of the underground tanks will be needed throughout the life of these systems. When the tanks reach the end of their usable life, they should be replaced by appropriate above ground storage tanks, consistent with all local environmental requirements at that time. Due to the problematic location of the fueling island, in relation to the terminal, hangar, passenger loading, and transient aircraft parking areas, it is recommended that it be relocated in the near-term horizon concurrent with the apron reconfiguration previously recommended.

4.8 LANDSIDE FACILITY PLANNING FACTORS

Planning factors have been developed for all major landside facilities at CVX, such as the terminal building, automobile parking lot, fencing, and airport access.

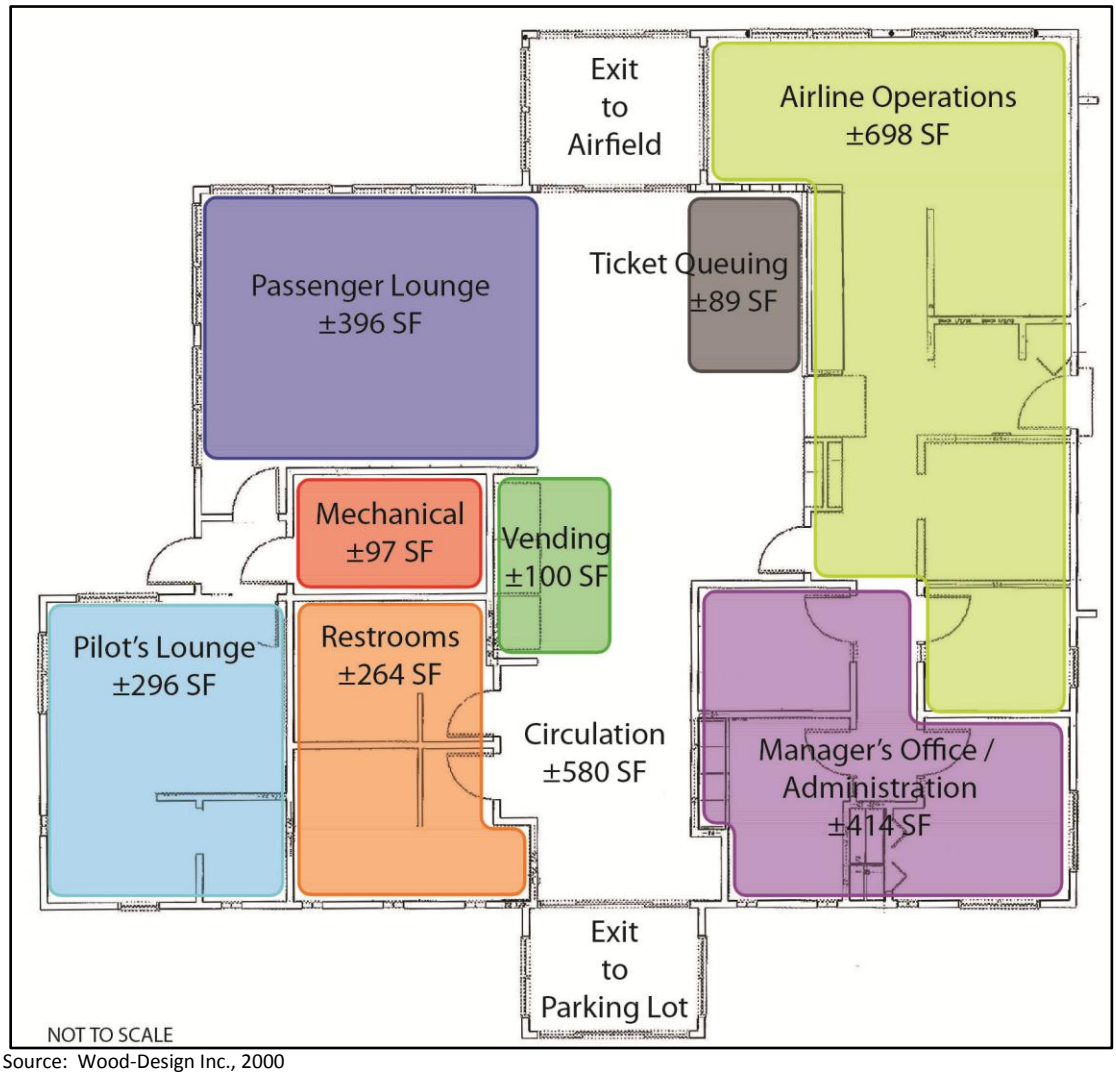
4.8.1 Terminal Building

The following goals have been established in concurrence with the City's vision for the terminal planning effort:

- Enhance efficiency and security of airlines by centralizing passenger operations;
- Improve pilot/passenger comfort and convenience by providing adequate terminal amenities;
- Provide adequate terminal amenities for general and recreational pilots; and
- Provide adequate space for concessions, airport administration and service providers.

The existing terminal building has approximately 2,930 square feet of useable space, excluding the 800 square foot baggage handling corridor which connects the terminal building to the adjacent terminal hangar. The building contains the passenger lounge, pilot's lounge, airline ticket counter and offices, airport manager office, a vending area, restrooms, and a mechanical closet. The functional areas of the existing terminal building are displayed in **Figure 4-8**. Airport management, the airlines, and other regular airport users have indicated that the building is heavily congested during peak times thereby inhibiting the orderly flow of passengers, baggage, and other general aviation activities. Additionally, a large number of the user surveys (as described in **Chapter 3**) indicate the desire/need for more terminal space, specifically in the passenger and pilot lounges and flight planning areas.

Figure 4-8 – Existing Terminal Facilities



Source: Wood-Design Inc., 2000
RW Armstrong, 2011

Using guidance in FAA AC 150/5360-9 *Planning and Design of Airport Terminal Building Facilities at Nonhub Locations*, as well as industry experience, equations were developed for calculating the required square footage for each functional area of the terminal building. These calculations are based on the operational and enplanement forecasts presented in **Chapter 3** and are summarized in **Table 4-12**. In some terminal areas, such as the passenger lounge and restrooms, a non-passenger ratio was applied. The non-passenger ratio is factored to accommodate the additional people that would be in the terminal building during peak times, such as meeters/greeters. This non-passenger factor could also be applicable during periods of inclement weather when multiple aircraft loads of passengers and pilots may be waiting for weather conditions to improve.

Table 4-12 – Terminal Planning Equations

Forecasts	Demand (Number of People)			
	2010	2015	2020	2030
Peak Hour Departure (PHDep)	5.5	5.5	6	7
Peak Hour Enplanements (PHE)	9	9.5	10	11.5
Peak Hour Deplanements (PHD)	9	9.5	10	11.5
Peak Hour Passengers (PHP)	18	19	20	23
Peak Hour Employees (PHEmp)	26	27	29	32
Peak Hour GA Pilots/Passengers (PHGA)	5	5	6	6
Annual Enplanements (AE)	17,854	18,765	19,722	23,115
Functional Area	**Equation**			
Passenger Lounge	**16 SF** x (PHP + PHGA) x **3 (Non-passenger Ratio)**			
Pilot's Lounge / Flight Planning	**75 SF** x PHDep			
Airlines				
Counter and Operations	**30 SF** x PHP			
Ticket Counter Length (LF)	**2 LF** x PHE			
Ticket Queuing Area	**10 SF** x PHP			
Baggage Claim	**10 SF** x PHD			
Baggage Handling / Cargo	**25 SF** x PHP			
Concessions / Vending	**5 SF** x (PHP + PHGA)			
Other Vendors / Revenues	**0.007 SF** x AE			
Manager's Office / Operations	**0.02 SF** x AE			
Restrooms	**2 SF** x (PHP + PHGA + PHEmp) x **3 (Non-passenger Ratio)**			
Mechanical / Maintenance / Storage	**0.01 SF** x AE			
Circulation	**25 Percent** of Total Square Footage			

Source: RW Armstrong, 2011
Notes: SF – Square Feet, LF – Linear Feet

Based on these planning factors and equations, the existing terminal building is undersized by approximately 20 percent for the 2010 level of activity and will continue to be undersized throughout the planning horizon. The requirement along with the existing deficit or surplus is presented in **Table 4-13**. It is therefore recommended that the terminal be expanded by approximately 2,200 square feet to meet the demand over the 20-year planning horizon.

Table 4-13 – Terminal Analysis Results

Facility Use Area	Existing Space (sf)	Minimum 2010 Requirement (sf)	Minimum 2015 Requirement (sf)	Minimum 2020 Requirement (sf)	Minimum 2030 Requirement (sf)
Passenger Lounge	396	1,104	1,152	1,248	1,392
Pilot's Lounge	296	413	413	450	525
Airline Counter & Operations	698	540	570	600	690
Airline Baggage Claim	0	90	95	100	115
Airline Baggage Handling	800	450	475	500	575
Airline Ticket Queuing	89	180	190	200	230
Concessions / Vending	96	115	120	130	145
Manager's Office / Operations	414	357	375	394	462
Restrooms	264	294	306	330	366
Mechanical / Storage	97	179	188	197	230
Circulation	580	917	957	1,023	1,166
TOTAL	**±3,730**	**±4,539**	**±4,841**	**±5,172**	**±5,896**

Source: RW Armstrong, 2011

= surplus

= deficit

4.8.2 Automobile Parking

As described in **Section 2.2.3**, the existing paved parking lot has a total of 435 spaces. There is an additional unpaved, "overflow" parking area located adjacent to the paved lot. Consistent with the terminal building planning factors, and the forecasts presented in **Chapter 3**, the requirement for automobile parking was calculated by providing one space for every peak hour employee, one space for every peak day GA operation, and one space for 25 percent of all peak day enplanements. This exercise results in approximately 141 parking spaces being needed in 2010 and approximately 184 spaces in 2030. Based on this calculation, there is no anticipated need for additional automobile parking over the planning horizon. However, since the City of Charlevoix may use portions of this parking lot for other events or services, it is recommended that at least a portion of the unpaved "overflow" parking lot remain undeveloped and be reserved for a potential expansion of the existing parking lot.

4.8.3 Security Fencing and Safety Management

Security at CVX will become increasingly more important as the number of tenants and based aircraft increase and as more resources are invested in airport infrastructure. Furthermore, reducing the threat of wildlife hazards on the airfield will also rely on substantial perimeter fencing. Much of the airport property is fenced, but there are some gaps in the northwest corner of the airfield. It is recommended that these gaps in the security fence be filled. Additionally, there are six access gates that serve various locations on the airfield. Five of the gates are vertical pivot lift (VPL) gates that were installed in 2010. VPL gates allow the gate to lift out of accumulated snow. These facilities are suitable for CVX and no additional access gates are anticipated to be necessary. However, additional hangar development may warrant additional gates to serve these specific areas. Such considerations should be addressed during the design of the facilities.

As of early 2011, the FAA is in the process of developing programmatic standards for the implementation of Safety Management Systems by all certificated airlines and airports. This program would require each certificate holder to establish a Safety Management System (SMS) for its entire airfield environment (including movement and non-movement areas) to improve safety at airports hosting air carrier operations. An SMS is a formalized approach to managing safety by developing an organization-wide safety policy, developing formal methods of identifying hazards, analyzing and mitigating risk, developing methods for ensuring continuous safety improvement, and creating organization-wide safety promotion strategies. In practice, an SMS provides a set of decision-making tools that airport management can use to improve safety. Planned implementation of this program will begin with the larger commercial service airports (i.e., Part 139 operating certificate holders), followed by NPIAS towered airports, and then all other NPIAS Commercial Service and General Aviation airports. This requirement is anticipated to take effect for CVX in the near term horizon, possibly by 2013 or 2014. Though not a specific facility requirements issue, this program is mentioned as it will influence the development and operation of airfield facilities in the near future.

4.8.4 Airport Access

Efficient and convenient airport access is desired by all users and is consistent with the Airport's vision of enhancing customer service. U.S. 31 (Bridge Street) provides convenient access to the Airport through Airport Drive. Airport Drive provides access to the vehicle parking lot, terminal, and airfield access gates. The North Hangar Complex is accessed via U.S. 31 and Carpenter Road. The convenient location and infrastructure of the existing roadway system appears sufficient for the planning horizon. Any future development of the North Hangar Complex, or the Midfield Hangar Complex along the southern border of the Airport adjacent to U.S. 31, may require the consideration of

turn lanes and/or acceleration/deceleration lanes consistent with local traffic design requirements.

Currently, the only internal access between the terminal area and the midfield hangars is the parallel taxiway. To segregate automobile traffic from aircraft operating areas, it is recommended that an internal access road be constructed to provide access to these facilities without having to leave airport property. Ideally, any new hangar development in this area will also provide adequate automobile parking and limit automobile access to the airfield.

4.9 AIRSPACE ENVIRONMENT

As directed by Federal Aviation Regulation (FAR) Part 77 *Obstructions to Navigable Airspace*, imaginary surfaces govern the height of objects on and within the vicinity of airports. These airspace protection requirements are determined by the approach capabilities to each specific runway end (described in **Section 2.5.3**).

4.9.1 Part 77 Imaginary Surfaces

FAR Part 77 establishes imaginary surfaces to govern the vertical height of obstacles within the vicinity of airports or heliports. The purpose of these surfaces is to protect the surrounding airspace to ensure safe air navigation of aircraft by identifying obstructions and then determining the best way to mitigate any potential hazards. These surfaces will vary in size and slope depending on the available approach procedures to each runway end. Any penetration of these imaginary surfaces by an object or structure is considered an obstruction to air navigation. Once objects have been identified as obstructions, the FAA must evaluate them to determine if they present a hazard to air navigation. If determined to be a hazard, the obstacle must be removed or altered to mitigate the penetration. Based on the approach capabilities (described in **Section 2.5.3**), and the requirements of FAR Part 77, the imaginary surfaces as they apply to CVX are described as follows:

Primary Surface – This surface is longitudinally centered on the runway and the elevation of any point on the surface is the same as the elevation of the nearest point on the runway centerline. For Runway 9/27 this surface is 500 feet wide and extends 200 feet beyond the ends of pavement usable for takeoff and landing. For Runway 4/22 the Primary Surface is 250 feet wide and ends at the runway ends.

Approach Surface – This surface is longitudinally centered on the extended runway centerline and extends outward and upward from the end of the Primary Surface. An Approach Surface is applied to each end of each runway based upon the type of approach available or planned for that runway end. The inner width of the Approach Surface is the width of the Primary Surface. The Approach

Surface extends at a specific slope to a uniform width and distance based on the approach capabilities of the runway. The slope for visual runways is 20 to 1, for non-precision runways is 34 to 1, and for precision runways is 50 to 1.

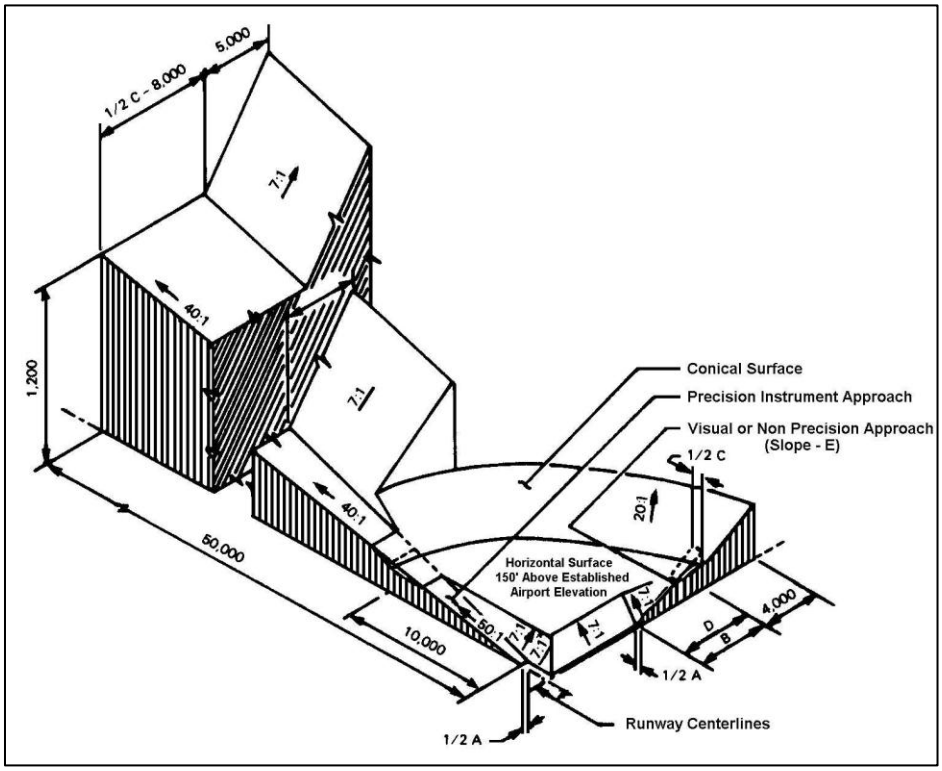
Transitional Surface – This surface extends outward and upward from the sides of the Primary Surface and from the sides of the Approach Surfaces at a slope of 7 to 1.

Horizontal Surface – This surface can be described as a horizontal plane 150 feet above the established airport elevation, the perimeter of which is constructed by swinging arcs of specified radii from the center of each end of the Primary Surface of each runway and connecting the adjacent arcs by lines tangent to those arcs. At CVX, the Horizontal Surface extends 10,000 feet from the ends of Runway 9/27, at an elevation of 819 feet MSL.

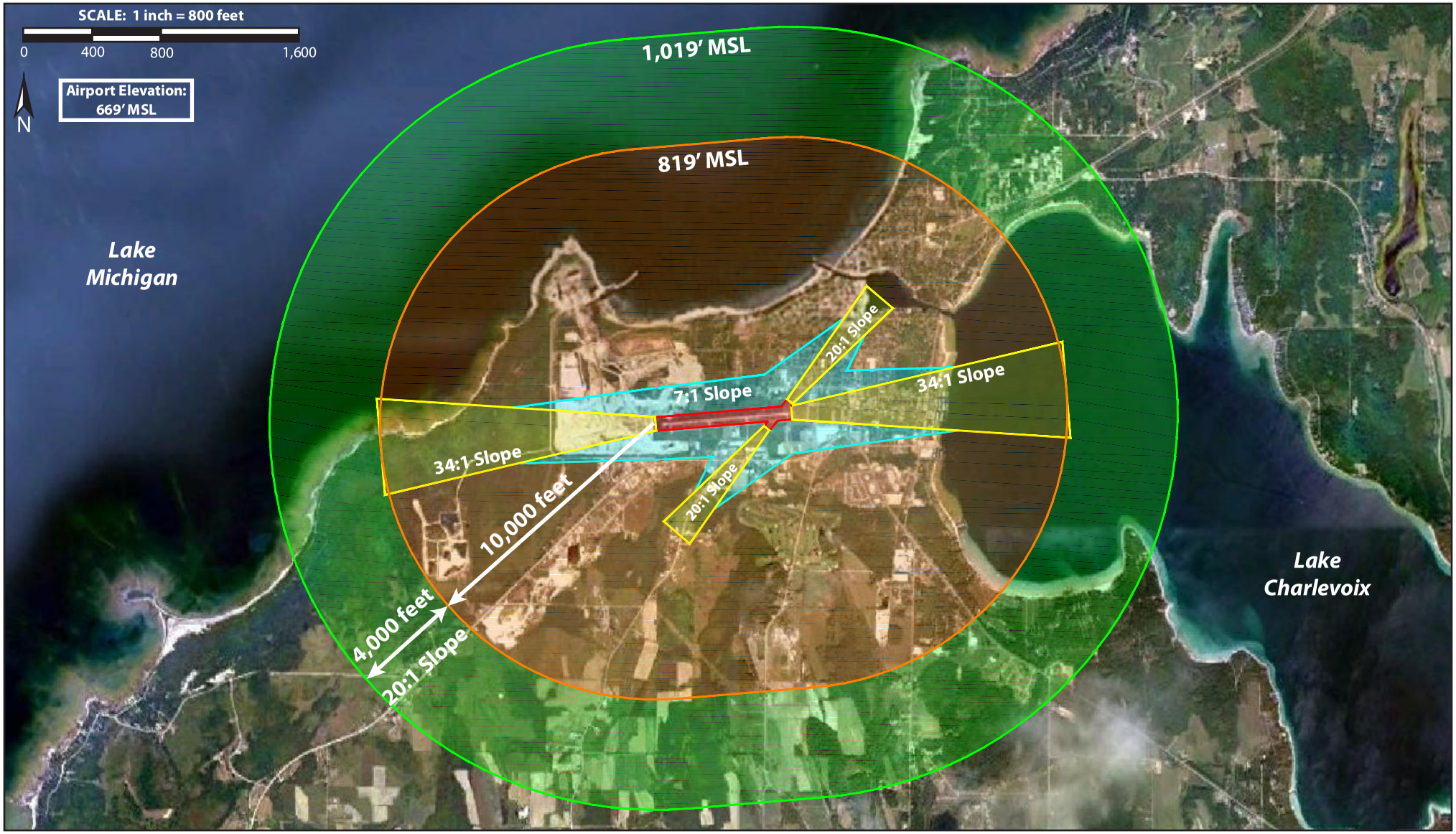
Conical Surface – This surface can be described as a surface extending outward and upward from the periphery of the Horizontal Surface. The Conical Surface extends at a slope of 20 to 1 for a horizontal distance of 4,000 feet.

Figure 4-9 graphically displays the typical Part 77 surfaces. **Figure 4-10** presents the existing Part 77 surfaces at CVX.

Figure 4-9 – FAR Part 77 Surfaces (3-D Diagram)



Source: NOAA website, National Geodetic Survey, http://www.ngs.noaa.gov/AERO/oisspec.html, 2010



PRIMARY SURFACE
APPROACH SURFACE
TRANSITIONAL SURFACE
HORIZONTAL SURFACE
CONICAL SURFACE

FIGURE 4-10

EXISTING PART 77 SURFACES AT CVX

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4.9.2 Part 77 Concerns

A preliminary airspace analysis was performed to identify areas containing potential obstructions to the Part 77 surfaces associated with the existing airfield configuration and approach capabilities. These areas of concern were evaluated by using terrain data and tree and obstacle heights obtained from a 2009 aerial survey of the Airport and nearby environs. This analysis establishes a baseline, or minimum areas of concern, that should be addressed in the overall operation of the Airport even if no airfield improvements were to be pursued. Airspace analysis relative to the airfield alternatives being considered in this Master Plan are addressed in **Chapter 5**. It should be reiterated that this is a preliminary analysis and further detailed analysis and coordination with the FAA, possibly including additional field surveys, may be needed prior to designing any obstruction removal or mitigation projects. Mitigation of obstructions could include removal, marking and lighting, reducing approach minimums, or possibly allowing the obstacle to remain in place; dependent of a determination by the FAA as to the level of hazard that obstacle might present.

In accordance with FAR Part 77, the Approach Surfaces for Runway 9/27 extend a horizontal distance of 10,000 feet at a slope of 34 to 1 (based on nonprecision instrument approach capability). For visual runways, such as crosswind Runway 4/22, the Approach Surfaces extend a horizontal distance of 5,000 feet at a slope of 20 to 1. To promote safe operations and overall airport sustainability, all obstacles within these standard Part 77 Approach Surfaces should be identified and mitigated. Areas of concern for both Runway 9/27 and Runway 4/22 are identified in **Figure 4-11**. Please note that the Runway 9 threshold and Approach Surface are not shown in this exhibit, as no areas of concern were identified.

4.9.3 Threshold Siting Concerns

According to FAA and Michigan Bureau of Aeronautics personnel, the Airport has historically protected a 20 to 1 Obstacle Clearance Surface (OCS) to Runway 27. This is consistent with FAA "Runway End Siting Requirements" as contained in Appendix 2 of AC 150/5300-13 for the "approach end of runways expected to support instrument straight-in night operations, serving approach category A and B aircraft only." FAA threshold siting criteria are applied to maintain safe operations when circumstances, either temporary or permanent, preclude the application of standard Part 77 Approach Surfaces. Such circumstances often include objects that penetrate the Part 77 surfaces that are unable to be removed. With the implementation of non-precision, GPS based, RNAV approach procedures at CVX, the current threshold siting standards include a 30 to 1 OCS for "approach end of runways expected to accommodate approaches with positive vertical guidance."

For runways that have been designated, by the airport sponsor in coordination with the FAA, as the primary departure runway, a 40 to 1 OCS is also applied beyond the

departure end of runway. Such a determination does not prohibit or negate the use of other runways - it only identifies the applicability of the 40 to 1 OCS to a specific runway end. Considering the amount of corporate/business jet traffic at CVX, and the City's objective of providing the highest level of safety for all operators, evaluation of these surfaces and mitigation of any obstacles should be pursued in addition to those identified solely by Part 77. In most cases, the 40 to 1 departure OCS is the most demanding of these surfaces however obstacle penetrations of less than 35 feet may not require any action. Areas of concern for these surfaces are also identified in **Figure 4-11**.

4.9.4 Approach Upgrade Potential

While improved instrument approach capability is typically desired by most operators (by either reducing the approach minimums or providing precision approach procedures), the wind data indicates that poor visibility conditions only occur 0.6 percent of the year (as described in **Section 2.6.2**). These poor visibility conditions refer to times when the ceiling height is less than 200 feet and/or the visibility is less than ½ mile. Since these weather conditions are below the approach minimums at CVX, the airport is effectively closed during poor visibility conditions, as aircraft are unable to operate. Improving the approach minimums would provide greater access to the Airport by allowing it to remain open during more of these poor weather periods; however, other airports in the area, such as Pellston Regional Airport or Cherry Capital Airport, provide instrument approach capability with minimums lower than at CVX thereby providing a nearby operational alternative for those times when CVX is effectively closed. Because of these alternate options, the impacts of reducing the minimums, and the need for additional NAVAID infrastructure, no improvements to the approach capability improvements are suggested at this time.

While this situation may not be the most desired by the management of CVX, due to the occasional loss of traffic and potential fuel sales, this situation may be remedied in time with the development and implementation of new navigation technologies and approach capabilities. Until recently, the method of reducing approach minimums included the installation of approach lighting systems (ALS) or development of a Precision Instrument Landing System (ILS). An ALS could lower visibility minimums by placing a series of light beacons in the approach area thereby giving the approaching pilots a visual reference to the runway end. An ILS, which provides electronic horizontal and vertical guidance, is composed of a Glideslope, Localizer, and an ALS. These systems are ground-based, require sufficient land interest, would increase the design standards (i.e., separation distances, RPZs), increase the Part 77 requirements, and they can be costly to install and maintain. Considering the level of traffic, and the nearby operational alternatives, it might be difficult to justify federal funding for development of either of these systems during the near-term.

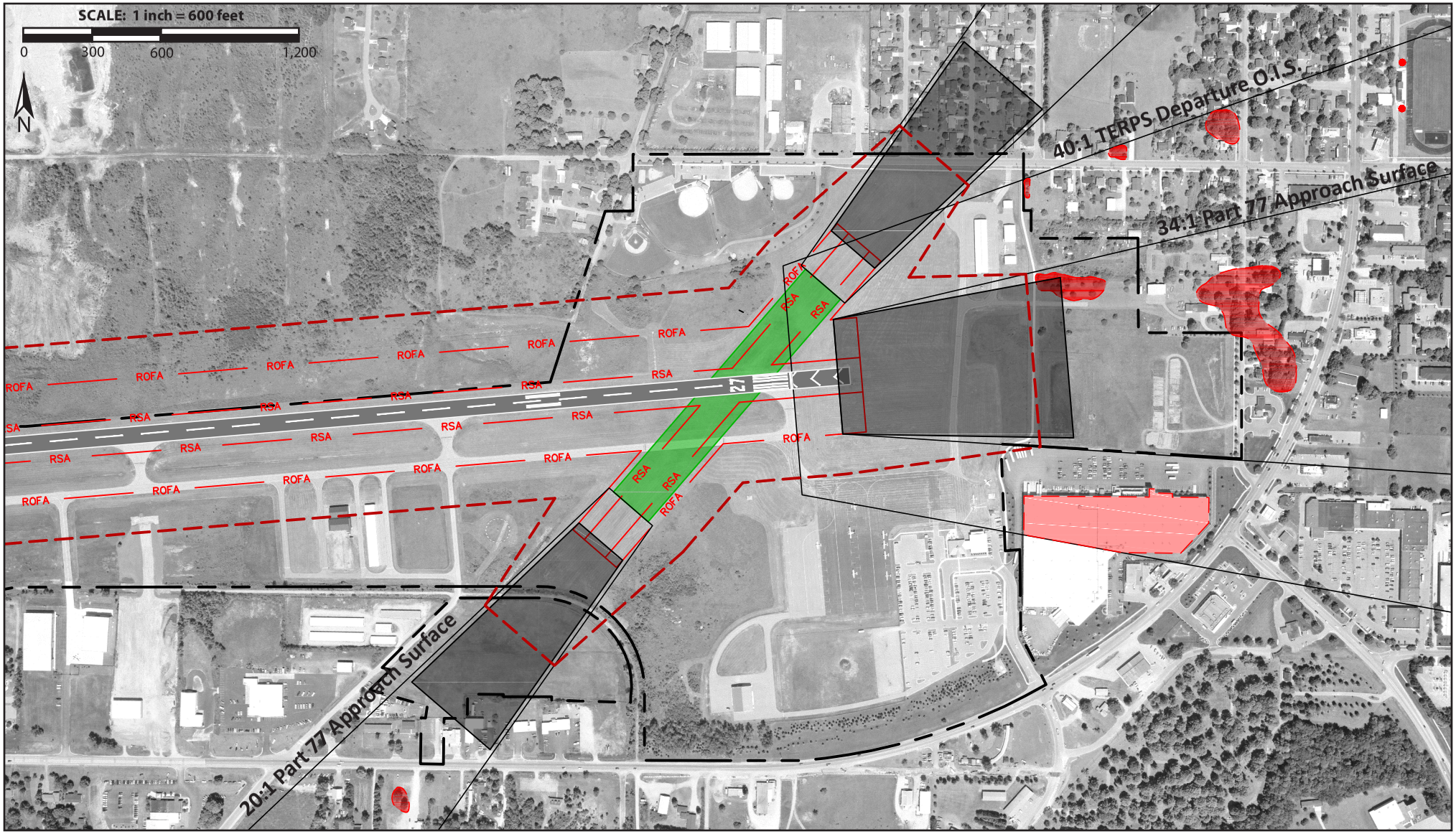
With the implementation of FAA "NextGen" technologies, these traditional ground based systems are envisioned to be replaced with the next generation of GPS-based navigation equipment and airspace procedures. This progression is already evident at CVX with the recent development of non-precision instrument approaches with vertical guidance that were unheard of only a few short years ago. The FAA's NextGen program is an umbrella term for the ongoing transformation of the National Airspace System. The vision of NextGen is to open America's skies to continued growth and increased safety while reducing aviation's environmental impact. This will be achieved through the development of aviation-specific GPS applications, improved weather forecasting, data networking and digital communications, new airport infrastructure and new procedures, including the shift of certain decision-making responsibility from the ground to the cockpit. It is the industries' belief that these technologies will continue to improve approach capabilities at airports, like CVX, while reducing the land requirements associated with the current design and airspace protections standards.

4.9.5 Land Use and Zoning

In addition to the FAA airspace protection standards, it is recommended that an airport overlay zone be created with the cooperation of the City of Charlevoix, Charlevoix Township, and Charlevoix County. This overlay zone should incorporate the requirements of FAR Part 77, the FAA Runway Threshold Siting Requirements, and the State of Michigan's Tall Structures Act. The airport overlay zone could then be used as a tool to regulate and restrict the height of structures, objects, natural growth, regulate the locations of noise-sensitive uses, and otherwise regulate the use of property in the immediate vicinity of CVX by creating the appropriate zones and establishing the boundaries thereof. It is understood that in early 2011, the City of Charlevoix amended their zoning ordinance in such a fashion that would allow the efficient development and adoption of an airport overlay zone if one should be pursued in the future.

As mentioned in **Section 1.3**, several through-the-fence (TTF) operators exist at CVX. Because TTF operations are not generally preferred by the FAA, and because of the loss of revenues for the Airport, it is recommended that these properties be purchased, or the operators be moved onto Airport property.

It should also be mentioned that discussions have occurred between the City of Charlevoix and the FAA regarding what the non-aeronautical use areas of the airfield (i.e. the baseball fields on the north side of the property). It is understood that the City intends to keep the ball fields in place and coordinate an amendable agreement. This being a widely discussed issue between the City and the FAA, no action is suggested as a result of this Master Plan effort. This Master Plan and the associated ALP will depict the ball fields remaining in place.



Note: Runway 9 threshold is not shown, as no areas of concern were identified in preliminary analysis.

PROPERTY LINE

RSA — RUNWAY SAFETY AREA

ROFA — RUNWAY OBJECT FREE AREA

25' BUILDING RESTRICTION LINE

RUNWAY PROTECTION ZONE

AREAS OF CONCERN

FIGURE 4-11

POTENTIAL OBSTRUCTIONS TO AIRSPACE

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4.10 NAVAIDS AND AIRFIELD LIGHTING

NAVAIDs provide information to assist pilots in locating an airport and landing aircraft. NAVAIDs are frequently paired with an airfield lighting system to increase their effectiveness. Lighting systems can include approach lights; runway end, edge, and centerline lights; and taxiway edge and centerline lights. As noted in **Section 2.1.8**, CVX is currently served by a non-directional beacon (NDB), rotating beacon, Runway End Identifier Lights (REILs), Precision Approach Path Indicators (PAPIs), Medium Intensity Runway Lights (MIRLs), and Medium Intensity Taxiway Lights (MITLs).

The assessment of NAVAIDs and approach lighting is directly related to the approach capabilities and requirements at the airfield. With no improvements to the approach capabilities recommended at this time, the existing NAVAIDs and lighting systems should be adequate throughout the planning horizon. Paving of the crosswind though, will likely include runway lighting, PAPIs, and possibly REILs. To accommodate these new circuits, improvements to the electoral vault and airfield cable systems may be needed. All other lighting systems at the airfield (PAPIs, REILs, MIRLs, MITLs) are considered to be in good condition and would only require routine maintenance throughout the forecast horizon.

4.11 SUMMARY OF FACILITY REQUIREMENTS

The ability of the facilities at Charlevoix Municipal Airport to accommodate the projected aviation demand was evaluated by applying reasonable assumptions and planning standards to the approved activity forecasts presented in **Chapter 3**. The facilities required to meet the operational demand over the 20 year planning horizon, as determined by this evaluation, include:

- Runway 9/27 should be lengthened to meet the operational requirements of the critical aircraft family. The preferred runway length is 5,500 feet. A recommended runway length will factor several criteria and will be determined in **Chapter 5**. The runway should be designed to non-precision instrument approach, B-II standards in the near-term. Long-term airfield planning should provide options for potentially upgrading the facility to C-II standards.
- Paving the crosswind runway to 2,500 feet in length and reorientation is recommended to provide the appropriate crosswind coverage, and year-round operational capability for A-I and B-I “small” aircraft.
- Extend the parallel taxiway to the full length of Runway 9/27.
- The end-around taxiway should be relocated so it crosses at the Runway 27 threshold.
- A new or expanded terminal building is recommended to accommodate the existing and forecasted passenger and pilot traffic.

- At least one, ten-unit T-hangar building should be constructed within the near-term (1 – 5 years) forecast horizon.
- Corporate aircraft storage should be provided for three to four aircraft over the forecast horizon in the form of bulk hangars or jet-pods, with at least one hangar being pursued in the near-term.
- In the very near-term, the terminal apron should be reconfigured, providing power in/power out parking positions for Group-II aircraft. The self-service fuel pumps should also be relocated to reduce congestion on the apron and provide more efficient circulation and separation of airline and general aviation operations. Approximately 12,000 SY of additional apron space and 12 Group-II power-in/power-out parking positions is needed over the planning horizon to accommodate demand.
- An ongoing obstruction mitigation program should be implemented in the near term. This program should include 34 to 1 Part 77 Approach Surfaces and 40 to 1 Departure Obstacle Clearance Surfaces for Runway 9/27. The program should also include protection of 20 to 1 Approach Surfaces for Runway 4/22. This program will continue to evolve, or be phased, consistent with any recommended airfield improvements or configuration changes.
- An airport overlay zone is recommended for the City of Charlevoix, Charlevoix Township, and Charlevoix County in order to protect airspace and surrounding land use.
- Fill gaps in perimeter fence on northwest quadrant of the airfield.
- All areas within designated RPZs should be purchased to assure positive land use control by the City.
- Through-the-fence (TTF) operators should be moved onto Airport property, or their properties purchased.
- An internal access road between the terminal area and the Midfield Hangar Complex is suggested in order to segregate automobile and aircraft operating areas.

5 AIRPORT DEVELOPMENT CONCEPTS

In order to satisfy the facility requirements identified in **Chapter 4**, various development concepts were prepared for the primary and crosswind runway facilities the Airport. Each of the alternative concepts was then evaluated on its potential impact to the surrounding community, associated costs, and overall ability to support the established vision and goals for the Airport. The purpose of this evaluation was to identify which alternative best met the operational and user needs over the planning horizon. The results of this analysis will be considered the Recommended Development.

Due to their associated land requirements and influence on the other airside and landside facilities, the runways are considered the driving factor in the overall configuration of the Airport. The other airport components, such as the terminal building, apron and aircraft parking, aircraft storage, automobile parking, airport access, and airport fencing and security, have greater planning flexibility and can be logically "filled in" around the runways and other existing infrastructure. For that reason, alternative concepts presented herein focus on the various runway configurations with the other airport facilities being located in a fashion that promotes efficiency and provides the City flexibility in developing those facilities as demand and opportunities arise.

Table 5-1 presents the criteria upon which the runway concepts were evaluated. Weighting and ranking factors were developed by the planning team, the City of Charlevoix staff and the Technical Advisory Committee.

As described in **Section 2.10**, potential environmental impacts related to the airport improvements proposed by this Master Plan will be evaluated in detail during any future environmental studies as required by the National Environmental Policy Act (NEPA). Due to the terrain and land uses surrounding the Airport, compatible land use, noise, and wetlands are the environmental factors that are likely to be of most concern during those future evaluations. For that reason, this Master Plan has focused on potential community impacts (i.e., property acquisition and residential relocations) and assumes that any potential impacts to the natural environment would be relatively similar for any of the development alternatives. It is further assumed, based on this cursory evaluation, that aside from temporary impacts during construction of the proposed improvements, there is little potential for long-term environmental impacts that could not be avoided or mitigated within the framework of the federal and state regulations.

Table 5-1 – Evaluation Criteria

	Evaluation Criteria	Weight	Parameters
City Vision and Goals	Improves utility and operational capacity	3	By providing increased payload capability, extended potential trip distances, and additional runway length and airspace protection for operations in all weather conditions.
	Supports corporate / business aviation	4	By providing the airfield facilities needed and desired by the operators of corporate/business aircraft.
	Supports airline operations / passenger convenience	4	By providing the airfield facilities needed and desired to support safe and efficient airline operations.
	Supports recreational and general aviation	2	By providing the airfield facilities needed and desired to support based and transient general aviation operations.
	Provides year-round / all-weather accessibility	1	By providing adequate runway facilities (i.e. length, crosswind coverage, paved surfaces) to accommodate all users types particularly in inclement weather conditions.
	Flexibility for future, unforeseen needs and opportunities	1	By providing a scalable, or phased, development program that can be adjusted to meet market demands over the course of the planning horizon.
	Supports airport revenue opportunities	3	By enhancing the City's ability to attract and retain operators and airport tenants.
	Scoring and Weighting: The weighting factors represent the respective priority of the individual criterion in the overall decision making process used by the City to achieve the airport vision. Each alternative concept is assigned a score of positive (+), neutral (0), or negative (-) based on its ability to support the vision and goals. The score is then multiplied by the weighting factor resulting in a comparative value between the concepts.		
	Evaluation Criteria	**Parameters**	
Impacts	Impact to residential property	The quantity of parcels to be acquired in fee simple or avigation easement and the number of associated relocations.	
	Impact to commercial property	The quantity of parcels to be acquired in fee simple or avigation easement and the number of associated relocations.	
	Ranking and Scoring: Each alternative concept is ranked based on its level of potential impacts to the specific evaluation criterion. The concept that would have the least impact is ranked with the highest value and the concept with the most impact is ranked with lowest value. For example; If there are four concepts being evaluated, the ranking values range from 4 (least impact) to 1 (most impact).		
	Evaluation Criteria	**Parameters**	
Costs	Implementation costs	Preliminary development costs including design, environmental approval, construction, acquisition, relocation, and obstruction mitigation.	
	Operation and maintenance costs	Relative ongoing operational and maintenance costs (i.e. repair and upkeep).	
	Ranking and Scoring: Each alternative concept is ranked based on its anticipated cost. The concept that would be the least costly is ranked with the highest value and the concept with that would be the most costly is ranked with lowest value. For example; If there are four concepts being evaluated, the ranking values range from 4 (least cost) to 1 (most cost).		

5.1 PRIMARY RUNWAY

Runway 9/27 is currently designed to non-precision instrument approach, B-II standards and is 4,550 feet by 75 feet. The facility requirements identified in **Chapter 4** relating to the primary runway include:

- Runway 9/27 should be lengthened to meet the operational requirements of the critical aircraft family. The preferred runway length is 5,500 feet. A recommended runway length will factor the evaluation criteria presented in **Table 5-1** and will be determined in this chapter. The runway should be designed to non-precision instrument approach, B-II standards in the near-term. Long-term airfield planning should provide options for potentially upgrading the facility to C-II standards.
- An ongoing obstruction mitigation program should be implemented in the near-term. This program should observe the standard 34 to 1 Part 77 Approach Surfaces and 40 to 1 Departure Obstacle Clearance Surfaces for both runway ends. The program will continue to evolve, or be phased, consistent with any planned airfield improvements or configuration changes.

Four concepts were evaluated for the primary runway; one for maintaining the existing runway configuration, two for providing the needed 5,500 feet of operational length, and one alternative length of 5,000 feet. As described in **Section 4.1.1**, annual operations by Approach Category C aircraft at CVX could potentially reach the 500 operations "substantial use" threshold in the 10-12 year planning horizon. Therefore, a long-term concept for developing the airfield to C-II standards is presented in **Section 5.1.6**.

5.1.1 No Development Concept

In this concept, Runway 9/27 is maintained at its existing orientation, length, and width. This alternative provides no additional benefit or utility to the airfield users and does not actively support the City's vision and goals. While this alternative provides the least impact to surrounding properties and the least cost, it does not meet the runway length requirements of the critical aircraft family, particularly that of the business/corporate type operators that have the potential to enhance the local economy and bring additional operational revenue to the Airport.

The recommended obstruction mitigation program would, however, still be pursued and would require that avigation easements be secured on eight properties. Obstructions to be addressed would include small or individual stands of trees on residential and commercial properties that could require select tree removal or topping pending FAA coordination.

The No Development Concept is presented in **Figure 5-1**.

5.1.2 Concept A1: 5,500 Foot Runway

This concept entails extending Runway 9/27 to 5,500 feet with full operational use of the pavement in both directions. Due to the proximity and depth of the quarry to the west of the Airport, the feasible option is an easterly extension of 950 feet. Extending to the west, into the quarry, would require extensive acquisition of quarry property and extensive amounts of fill (up to 150 vertical feet) to bring the site up to grade. Due to the established land use patterns surrounding the Airport, alternative primary runway orientations were not considered.

This easterly extension would shift the required Runway Protection Zone (RPZ) beyond existing airport property, thus requiring fee-simple acquisition of approximately 7.8 acres west of U.S. 31/Bridge Street and the relocation of five residences and four commercial developments. The obstruction mitigation program associated with this concept would require avigation easements be acquired on two residential properties and three commercial properties along both sides of U.S. 31. Tree removal would be required on those properties purchased, and select tree removal/topping would be needed on the avigation easement properties. Pending review and coordination with the FAA, additional avigation easements and obstruction mitigation (i.e. removal, marking and lighting) may be needed relative to the 40 to 1 Departure Obstacle Clearance Surface.

This runway length of 5,500 feet would allow the Airport to better accommodate the types of aircraft that frequent CVX (as determined by the FAA Flight Plan data described in **Section 3.4.1**). This length would allow aircraft such as the Beechcraft Super King Air 350, the Bombardier Challenger 300, the Cessna Citation II/Bravo, the Cessna Citation Excel, and the Beechcraft Premiere IA to operate at Maximum Takeoff Weight (MTOW). Similarly, this length would be able to accommodate additional aircraft at Maximum Landing Weight (MLW) during wet, or contaminated conditions, including the Beechcraft King Air 250 and Super King Air 350, the Bombardier Challenger 300, the Cessna Citation Sovereign, the Hawker Beechcraft 900XP, the Beechcraft Premiere IA, the Bombardier Challenger 600, the Bombardier Global 5000, the Cessna Citation Mustang, the Dassault Falcon 2000, and the Embraer Phenom 100.

Concept A1 is presented in **Figure 5-2**.

5.1.3 Concept A2: 5,500 Foot Runway with Declared Distances

This concept extends the pavement to 5,500 feet, as in Concept A1, but uses FAA guidance contained in AC 150/5300-13 *Airport Design* to establish a displaced Runway 27 threshold and declared distances. This allows the eastern RPZ to remain predominately on existing airport property, west of State Street, while providing 5,500 feet of takeoff length in the westerly direction and 5,500 feet of landing length in the easterly direction. Takeoff length to the east, and landing distance to the west would be 5,000 feet. While not providing the full 5,500 feet of operational length for all operations in all directions, this concept does increase the utility of the airfield for all aircraft operators.

Fee simple property acquisition for this concept would be approximately 3.8 acres and would include the relocation of two residences and no commercial properties. The obstruction mitigation program would require avigation easements over five commercial and five residential parcels with select tree removal/topping to comply with the 34 to 1 Part 77 Approach Surface. Additional easements and obstruction mitigation (i.e., removal, marking and lighting) may be needed relative to the 40 to 1 Departure Obstacle Clearance Surface, pending review and coordination with the FAA.

Concept A2 is presented in **Figure 5-3**.

5.1.4 Concept A3: 5,000 Foot Runway

This concept entails extending the runway 450-feet to the east for a total pavement length of 5,000-feet. While this concept does not provide 5,500 feet of runway length for operations in either direction, the Runway 27 landing threshold would remain in the same location as in Concept A2, so the off-airport impacts relative to RPZ land acquisition and obstruction mitigation would be the same. Costs associated with the land acquisition would be the same as Concept A2, however the lesser amount of pavement and grading required would reduce construction costs by about a fourth. Costs associated with avigation easements would also be moderately reduced.

While this concept does provide additional takeoff and landing length over the existing conditions, this concept would accommodate fewer aircraft at MTOW and MLW than Concept A1 and Concept A2. For instance, common aircraft at CVX such as the Bombardier Challenger 300 and the Beechcraft Premiere IA would not be able to operate at MTOW. Additionally, aircraft such as the Cessna Citation Sovereign, the Hawker Beechcraft 900XP, the Bombardier Challenger 600, the Bombardier Global 5000, the Dassault Falcon 2000, and the Embraer Phenom 100 would not be able to operate at MLW during wet, or contaminated, conditions.

Concept A3 is presented in **Figure 5-4**.

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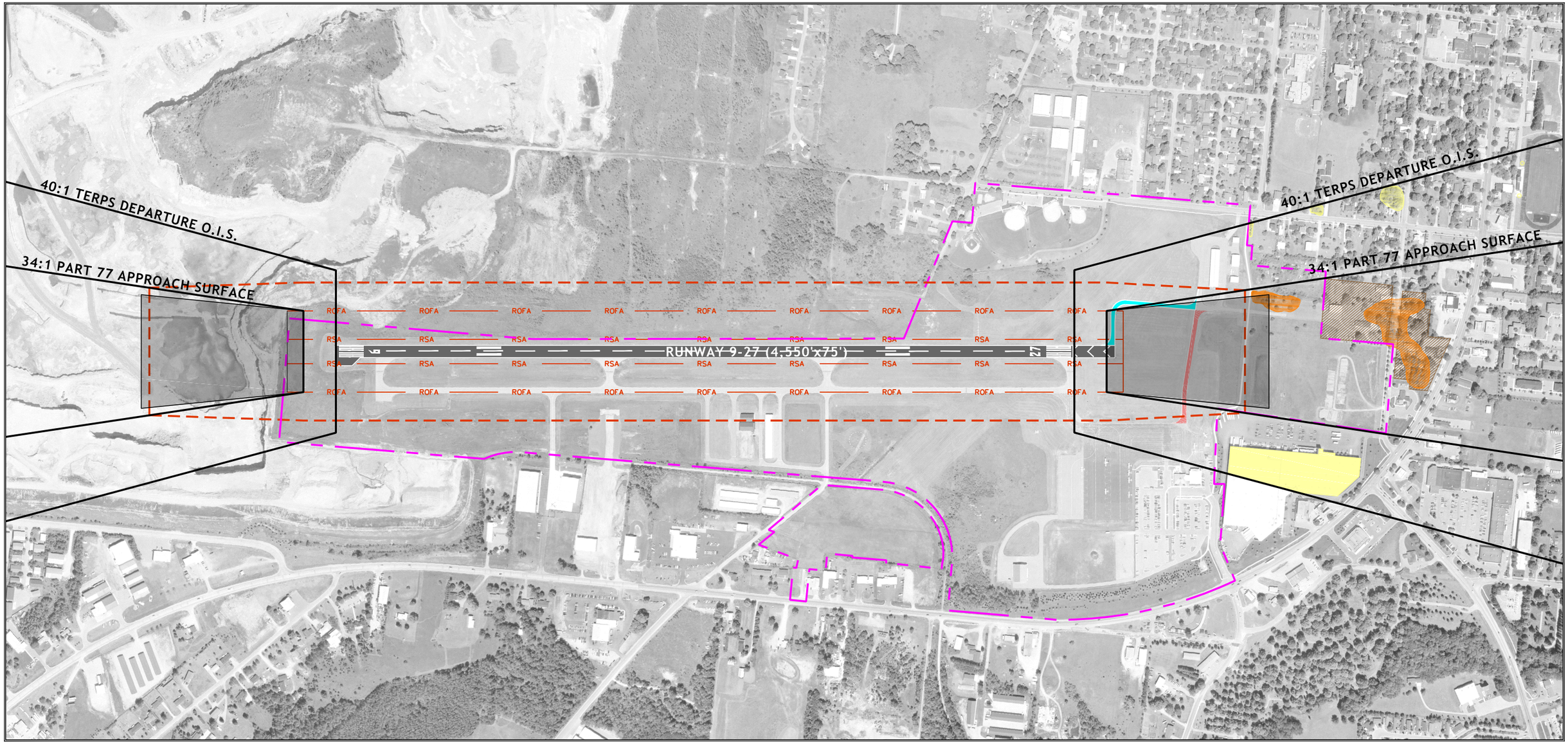

FIGURE 5-1

NO DEVELOPMENT CONCEPT: PRIMARY RUNWAY

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- OBSTRUCTIONS
- AVIGATION EASEMENT
- 25' BUILDING RESTRICTION LINE
- ROFA — RUNWAY OBJECT FREE AREA
- RSA — RUNWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE

N

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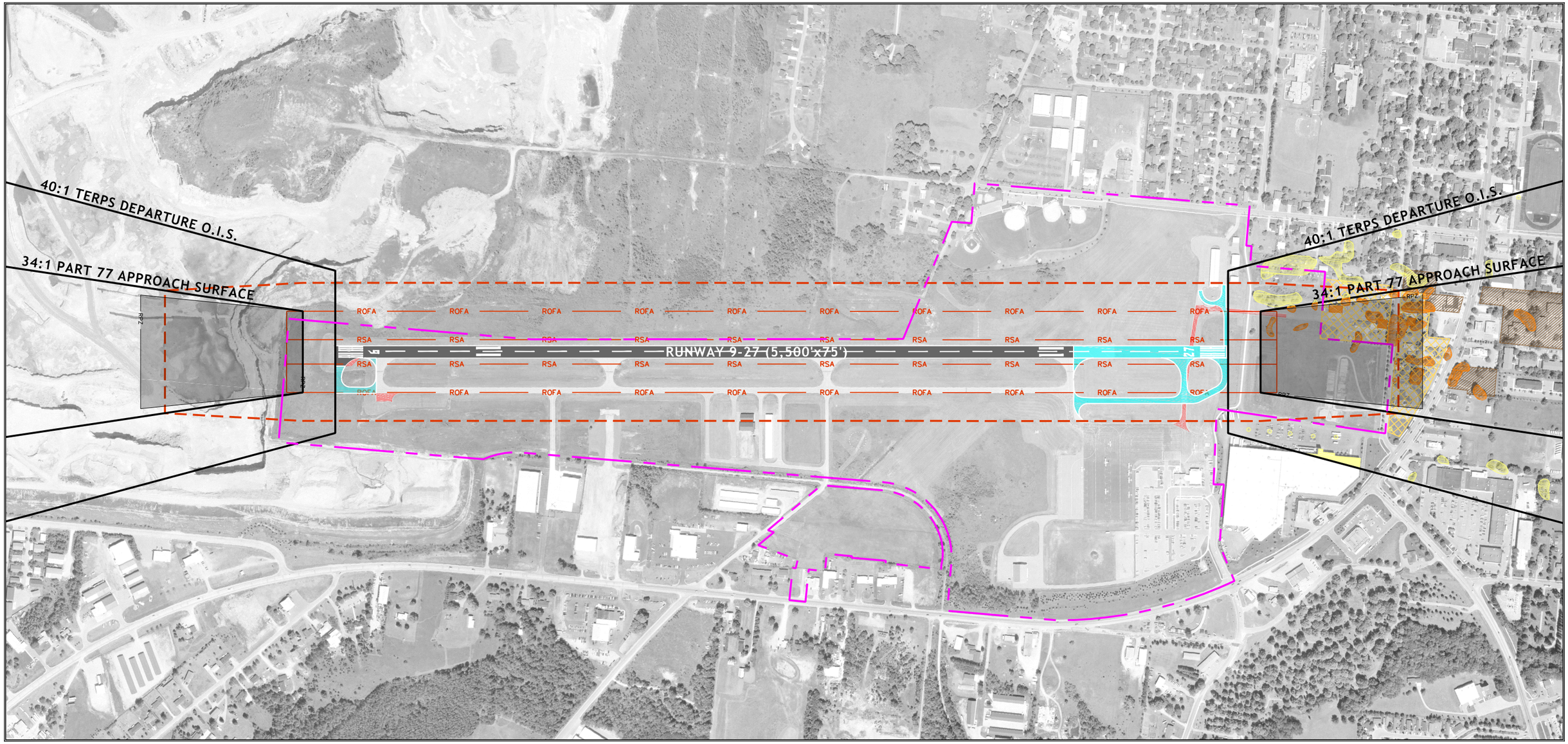

FIGURE 5-2

CONCEPT A1: 5,500' RUNWAY

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- OBSTRUCTIONS
- PROPERTY ACQUITISION
- AVIGATION EASEMENT
- 25' BUILDING RESTRICTION LINE
- ROFA — RUNWAY OBJECT FREE AREA
- RSA — RUNWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE

N

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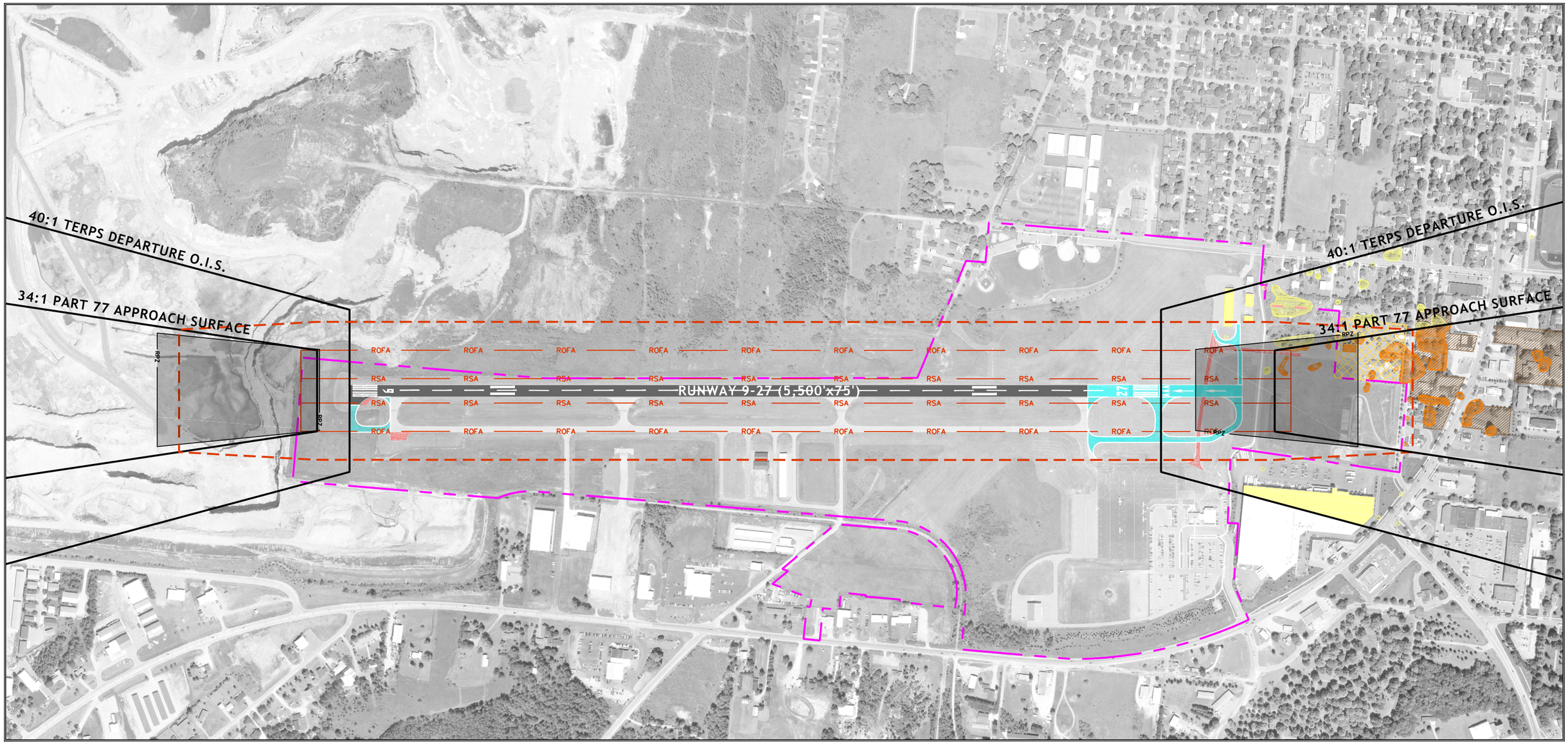

FIGURE 5-3

CONCEPT A2: 5,500' RUNWAY WITH DECLARED DISTANCES

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- OBSTRUCTIONS
- PROPERTY ACQUITISION
- AVIGATION EASEMENT
- 25' BUILDING RESTRICTION LINE
- ROFA — RUNWAY OBJECT FREE AREA
- RSA — RUNWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE

N

GRAPHIC SCALE (FEET)

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CHARLEVOIX MUNICIPAL AIRPORT
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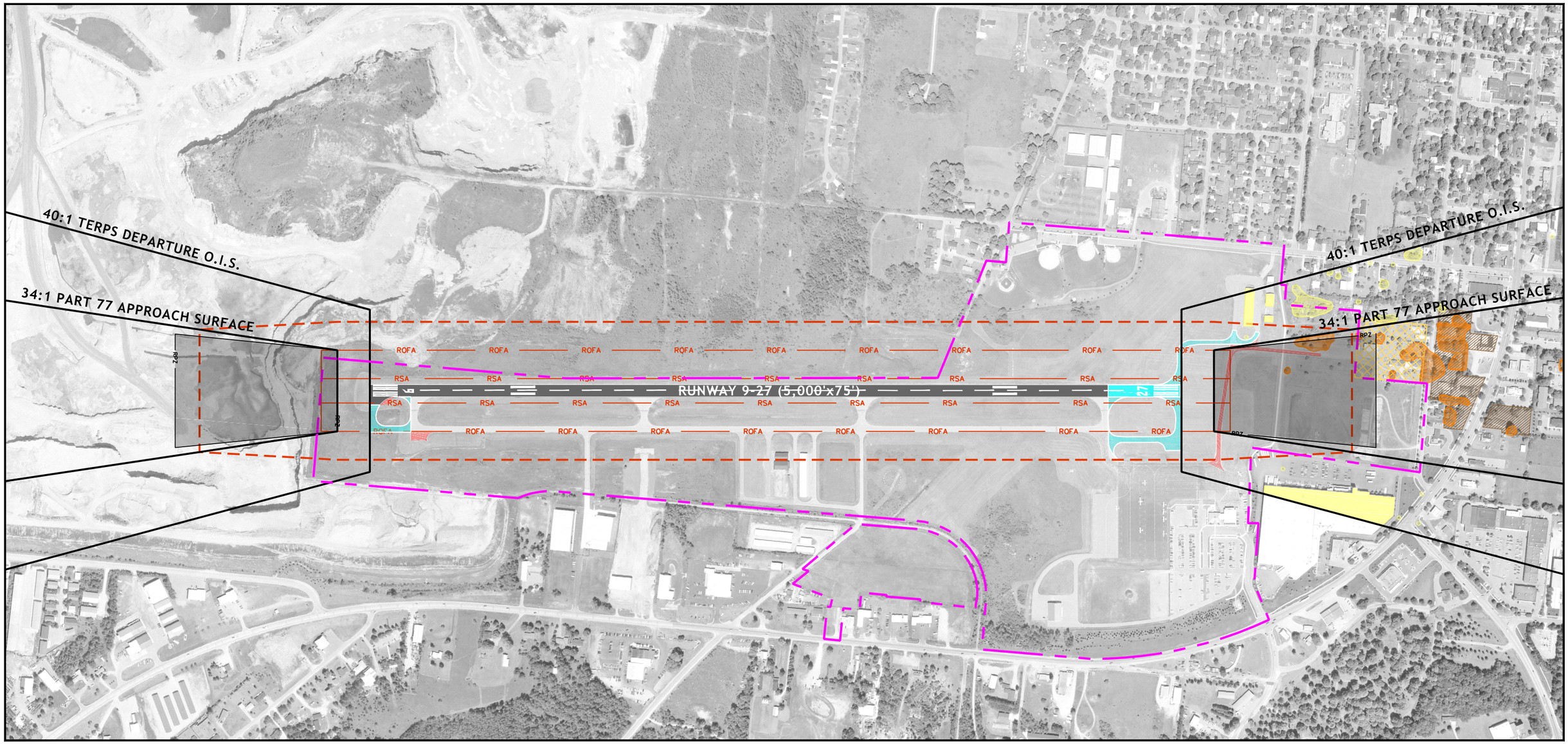

FIGURE 5-4

CONCEPT A3: 5,000' RUNWAY

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- OBSTRUCTIONS
- PROPERTY ACQUITISION
- AVIGATION EASEMENT
- 25' BUILDING RESTRICTION LINE
- ROFA — RUNWAY OBJECT FREE AREA
- RSA — RUNWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE

N

GRAPHIC SCALE (FEET)
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5.1.5 Comparison and Recommendation

Each concept for Runway 9/27 was evaluated on its potential level of impact to the surrounding community; overall implementation cost; and its ability to satisfy the vision and goals established by the City. The assumptions used in determining the acquisition and development costs are described in the cost estimation worksheets provided in **Appendix D**. A comparison of the potential impacts and costs of each concept is presented in **Table 5-2**.

Table 5-2 – Primary Runway Impact and Cost Comparison

Impact / Cost		Concept			
		No Development	A1 5,500' Runway	A2 5,500' Runway w/ Declared Distances	A3 5,000' Runway
Fee Simple Land Acquisition	**Residential Property**				
	Parcels	0	5	2	2
	Acres	0	±5.4	±3.8	±3.8
	Relocations	0	5	2	2
	Estimated Property Cost ($)[1]	0	±840,000	±330,000	±330,000
	Commercial Property				
	Parcels	0	4	0	0
	Acres	0	±2.4	0	0
	Relocations	0	4	0	0
	Estimated Property Cost ($)[1]	0	±1,425,000	0	0
Avigation Easements	**Residential Property**				
	Parcels	5	2	5	4
	Acres	±5.4	±0.9	±2.4	±2.1
	Estimated Cost ($)[2]	±336,000	±412,000	±616,000	±256,000
	Commercial Property				
	Parcels	3	3	5	4
	Acres	±1.5	±1.9	±3.1	±2.1
	Estimated Cost ($)[2]	±250,000	±390,000	±610,000	±430,000
Subtotal Property and Easement Cost ($)		586,000	3,067,000	1,556,000	1,016,000
Acquisition Fees and Services ($)[3]		*158,500*	*546,000*	*311,000*	*271,000*
Parcel Clearing & Obstacle Removal ($)		*17,000*	*577,000*	*114,000*	*111,000*
Total Property Cost ($)		**761,500**	**4,190,000**	**1,981,000**	**1,398,000**
Runway Construction Cost ($)[4]		**0**	**±2,630,000**	**±2,650,000**	**±2,020,000**
Total Implementation Cost ($)		**±761,500**	**±6,820,000**	**±4,631,000**	**±3,418,000**

Source: RW Armstrong, 2011
Notes:
[1] Property cost based on market value as provided by the City of Charlevoix, Department of Planning, 2011
[2] Easement cost is based on 40% of the property value as provided by the City of Charlevoix, Department of Planning, 2011
[3] Includes professional fees, appraisals, negotiation, and relocation expenses
[4] Includes estimated, design, bid, construction and inspection costs.

As presented in **Table 5-3**, each alternative concept was assigned a scoring value for each of the evaluation criterion established previously in **Table 5-1** of this chapter. The cumulative score for each alternative was compared and used in determining the *preferred* concept.

Based on this evaluation, the preferred concept for the primary runway is Concept A2, which provides a 5,500 foot, B-II runway with declared distances. This concept would have the same level of community impact as the 5,000 foot runway presented in Concept A3, but provides additional utility and operating length for the existing critical family of aircraft. Concept A2 would however, be more expensive to construct than A3 due to the additional pavement and grading required. After the preferred concept was chosen, it was then reviewed with the Airport management and the FAA. Because of the FAA's position that declared distances cannot be used in a runway extension project, along with the potential of it attracting larger (C-II) aircraft, the City of Charlevoix determined that Concept A3 is the most feasible and fiscally-responsible alternative and has selected that as their *recommended* primary runway concept.

Table 5-3 – Primary Runway Evaluation Matrix

	Evaluation Criteria	Weight	Concept							
			No Development		A1		A2		A3	
					5,500 feet		5,500 feet DD		5,000 feet	
			Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
City Goals and vision	Improves utility / operational capacity	3	(-)	**-3**	(+)	**+3**	(+)	**+3**	(+)	**+3**
	Supports corporate / business aviation	4	(-)	**-4**	(+)	**+4**	(+)	**+4**	0	**0**
	Supports airline operations / passenger convenience	4	0	**0**	0	**0**	0	**0**	0	**0**
	Supports recreational and general aviation	2	0	**0**	0	**0**	0	**0**	0	**0**
	Helps establish year-around / all-weather facility	1	0	**0**	(+)	**+1**	(+)	**+1**	(+)	**+1**
	Flexibility for future, unforeseen needs and opportunities	1	(-)	**-1**	(+)	**+1**	0	**0**	0	**0**
	Supports airport revenue opportunities	3	(-)	**-3**	(+)	**+3**	(+)	**+3**	(+)	**+3**
	Evaluation Criteria		**Score**		**Score**		**Score**		**Score**	
Impacts	Impact to residential property		**4**		**1**		**3**		**3**	
	Impact to commercial property		**4**		**1**		**2**		**3**	
Costs	Implementation Costs		**4**		**1**		**2**		**3**	
	Operation and maintenance costs		**4**		**2**		**2**		**3**	
	TOTAL SCORE		**5**		**17**		**20**		**19**	

Source: RW Armstrong, 2011

5.1.6 Potential Long-Term Development to C-II

In the long-term outlook for CVX (10-20 years), based on the forecasts presented in **Chapter 3**, annual operations at the Airport could potentially surpass the substantial use threshold (500 operations) by Approach Category C aircraft. In order to provide the City flexibility in accommodating this need should it arise, and satisfying the associated FAA design standards, a long-term plan for developing the primary runway to C-II standards has been developed. This long-term plan serves as a phased progression from the 5,000-foot, B-II runway recommended for the near- to mid-term planning horizons.

As described in **Section 4.2**, upgrading the primary runway from B-II to C-II standards would require:

- Increasing the runway width from 75 to 100 feet;
- Increasing the Runway Safety Area (RSA) from 300-feet wide to 500-feet and from 300-feet beyond the runway ends to 1000-feet;
- Increasing the Runway Obstacle Free Area (ROFA) from 500-feet wide to 800-feet and from 300-feet beyond the runway ends to 1000-feet;
- Increasing the runway to parallel taxiway separation distance from 240-feet to 300-feet; and
- Increasing the size of the Runway Protection Zone (RPZ) from approximately 14-acres to 29 acres, on each runway end.

The C-II development concept generally maintains the existing runway centerline, and widens the runway to 100 feet (pending engineering design this could be either 25-feet to one side or 12½–feet on each side). To accommodate the required RSA and ROFA dimensions, the Runway 9 threshold would be shifted approximately 700 feet to the east. In order to maintain, at minimum, 5,000 feet of landing and takeoff length in all directions, the runway would be further extended to the east.

Although the runway pavement would remain on existing airport property, to accommodate the overall RSA, ROFA and RPZ requirements, approximately 820 linear feet of State Street would be closed and additional residential and commercial property relocations, on both the east and west sides of U.S. 31, would be needed. Approximately 26 acres of land parallel to the northwest airport property line, including the existing easement area from St. Mary's quarry, would need to be acquired to accommodate the ROFA and RSA requirements. Similar to the existing easement in this area, an additional easement would need to be negotiated to accommodate the Category C ROFA requirements. The additional impacts and costs associated with upgrading the primary runway to Category C standards are summarized in **Table 5-4**. It should be mentioned that budgetary cost estimates for the acquisition of property from St. Mary's Cement Group are order of magnitude estimates, based on cursory discussions with St. Mary's, and would require additional preliminary engineering, appraisal and negotiation to determine an appropriate market value. Various strategies,

such as land swaps and engaging the Michigan Department of Natural Resources/State Parks may also result in a lower total cost for property acquisition.

Pending any future design of a C-II runway, runway OFA clearance requirements may affect portions of the existing Midfield Hangar Complex. Additionally, the continuing obstruction mitigation program may require avigation easements on additional residential properties. Selective tree removal/topping or marking and lighting would be pursued as appropriate.

This potential long-term scenario is depicted in **Figure 5-5** which also shows the associated relocated parallel taxiway. To maintain flexibility in accommodating future development opportunities, should C-II standards become warranted in the future, interim on-airport development, such as hangars, aprons, and fueling areas should be planned to preserve adequate space to accommodate the future C-II facilities.

Table 5-4 – Additional Impacts / Costs

Impacts / Costs		Recommended Concept A2 (B-II)	Additional Impacts of C-II Upgrade
Fee Simple Land Acquisition	**Residential Property**		
	Parcels	2	9
	Acres	±3.8	±7.4
	Relocations	2	9
	Estimated Property Cost ($)[1]	±330,000	±3,509,000
	Commercial Property		
	Parcels	0	14
	Acres	0	±9.9
	Relocations	0	12
	Estimated Property Cost ($)[1]	0	±5,170,000
	Mineral District Property		
	Acres	0	±26.4[2]
	Estimated Cost ($)	0	18,843,000[2]
Avigation Easements	**Residential Property**		
	Parcels	5	3
	Acres	±2.4	±0.6
	Estimated Cost ($)[3]	±616,000	±12,000
	Commercial Property		
	Parcels	5	0
	Acres	±3.1	0
	Estimated Cost ($)[3]	±610,000	0
	Mineral District Property		
	Acres	0	±2.3
	Estimated Cost ($)	0	±10,000
Subtotal Property and Easement Cost ($)		1,556,000	27,544,000
Acquisition Fees and Services ($)[4]		*311,000*	*1,089,000*
Parcel Clearing & Obstacle Removal ($)		*114,000*	*1,417,000*
Total Property Cost ($)		**1,981,000**	**30,050,000**
Runway Construction Cost ($)[5]		**±2,650,000**	**±11,010,000**
Total Implementation Cost ($)		**±4,631,000**	**±41,060,000**

Source: RW Armstrong, 2011

[1] Property cost based on market value as provided by the City of Charlevoix, Department of Planning, 2011
[2] *Assumes fee simple purchase of existing northside easement and additional property to extents of expanded Runway OFA. Could be pursued as combination of acquisition and easement. Budgetary cost estimate only – additional engineering, negotiation and appraisal needed to determine accurate cost.*
[3] Easement cost is based on 40% of the property value as provided by the City of Charlevoix, Department of Planning, 2011
[4] Includes professional fees, appraisals, negotiation, and relocation expenses
[5] Includes estimated, design, bid, construction and inspection costs.

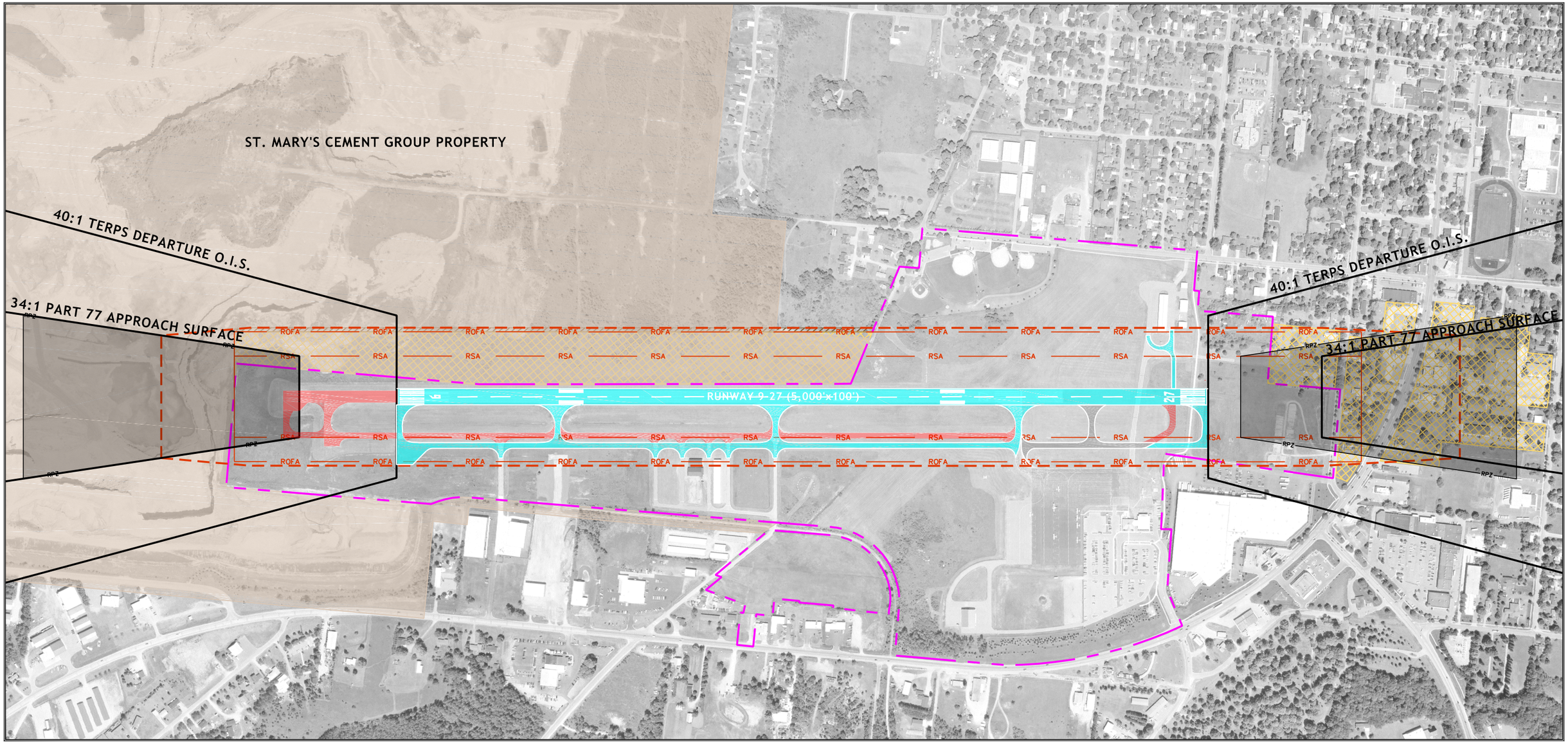

FIGURE 5-5

LONG-TERM POTENTIAL DEVELOPMENT CONCEPT: C-II AIRFIELD

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- PROPERTY ACQUITISION
- PROPERTY ACQUITISION
- 25' BUILDING RESTRICTION LINE
- ROFA — RUNWAY OBJECT FREE AREA
- RSA — RUNWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE

N

GRAPHIC SCALE (FEET)
0 150 300 600

RW ARMSTRONG

CHARLEVOIX MUNICIPAL AIRPORT
MASTER PLAN STUDY

5.2 CROSSWIND RUNWAY

The existing crosswind runway is composed of turf and is 1,280 feet by 200 feet. Based on the requirements presented in **Section 4.4**, the crosswind runway should ideally be paved to 2,500 feet in length and reoriented to provide the desired 95% crosswind coverage for A-I and B-I "small" aircraft, particularly between October and April, when high winds often prevent these smaller aircraft from operating on the primary runway. The following are descriptions of several concepts considered for achieving these requirements.

5.2.1 No Development Concept

The No Development concept maintains the existing turf runway in its existing location and orientation (4/22). No changes to the dimensions of the RSA, ROFA, RPZ, or 20 to 1 Part 77 Approach Surfaces would be necessary. Although there would be no changes to the existing Part 77 Approach Surfaces, measures to protect this airspace in the future should be taken through an appropriate obstruction mitigation program. Since the existing RPZs extend over residential properties to the north and commercial properties to the south, these parcels should be acquired by the City. Nineteen residential properties and two commercial properties, spanning approximately 6.7 acres of land, would be acquired. Sixteen residences and two businesses would be relocated.

Without the paving, this alternative does not provide all-weather, all-year utility as the turf crosswind runway would remain closed due to snow and ice for up to six months of the year. Additionally, this concept does not provide the runway length or crosswind coverage recommended by the FAA planning and design guidelines.

The annual crosswind coverage for the No Development Concept is summarized in **Table 5-5**. This concept is graphically depicted in **Figure 5-6**.

Table 5-5 –No Development Concept Crosswind Coverage

	RWY	10.5 Knots	13 Knots	16 Knots	20 Knots
AW	9/27	91.71%	95.74%	99.07%	99.84%
	4/22	87.98%	93.13%	97.48%	99.24%
	All Combined	94.89%	97.79%	99.46%	99.93%
VFR	9/27	92.00%	95.93%	99.17%	99.88%
	4/22	88.60%	93.58%	97.76%	99.35%
	VFR Combined	95.17%	97.95%	99.53%	99.95%

Source: NOAA, National Climate Center; Station 72743 (2003-2008).
Notes:
AW – All Weather
VFR – Visual Flight Rule

5.2.2 Concept B1: Runway 5/23

This concept incorporates the plans for crosswind runway associated with the 2004 ALP. It suggests a 5/23 orientation to slightly realign the flight paths eastward from the residential properties north of Carpenter Street, along Grant, Beacon and Charlo Streets. The 2004 ALP suggested a paved length of 1,647 feet, which is the maximum, taking into account ROFA and RSA requirements that could fit within existing airport property boundaries. The required property acquisition for the RPZs would be slightly more than that of the No Development alternative (approximately nine acres) and include 20 residential parcels and six commercial parcels. Seventeen total residences and six businesses would be relocated. Additionally, the existing St. Mary's "rail spur" right-of-way, that is planned to be utilized for the multi-use, hiker/biker "Lake to Lake Trail," would need to be realigned. The realignment would be necessary to provide adequate space for security fencing along the trail and corresponding Part 77 clearance for the approaches to Runway 5. Based on cursory conversations, it is believed that this realignment of the right-of-way would be acceptable to St. Mary's as long as they are able to maintain their access rights.

This alternative does not provide the necessary 95% combined wind coverage (it only provides 88.8% between October and April) and establishes the northern Approach Surface directly over densely populated residential neighborhoods between Carpenter Avenue and Crain Street. An obstruction mitigation program would be established maintaining 20 to 1 Part 77 Approach Surfaces.

The annual crosswind coverage for Concept B1 is summarized in **Table 5-6**. This concept is graphically depicted in **Figure 5-7**.

Table 5-6 – Concept B1 Crosswind Coverage

	RWY	10.5 Knots	13 Knots	16 Knots	20 Knots
AW	9/27	91.71%	95.74%	99.07%	99.84%
	5/23	87.87%	93.05%	97.43%	99.22%
	All Combined	94.97%	97.84%	99.47%	99.93%
VFR	9/27	92.00%	95.93%	99.17%	99.88%
	5/23	88.50%	93.50%	97.72%	99.33%
	VFR Combined	95.25%	98.00%	99.54%	99.95%

Source: NOAA, National Climate Center; Station 72743 (2003-2008).
Notes:
AW – All Weather
VFR – Visual Flight Rule

5.2.3 Concept B2: Runway 17/35

This development concept incorporates all the recommendations for the crosswind runway described in **Chapter 4**. These recommendations include paving a 2,500 foot runway in a 17/35 orientation. This alignment provides the best crosswind coverage (97.9% between October and April) for A-I and B-I aircraft out of the concepts evaluated.

This concept would require approximately 31 acres of property acquisition spanning 33 residential and five commercial properties. This includes approximately eight acres of land owned by St. Mary's Cement Company as well as the realignment of the "rail spur" right-of-way. There would be 12 residential relocations and four business relocations. The neighborhood of Applewood Estates would be completely removed. An environmental benefit of this alternative is that it aligns the northwest flight paths over the quarry property and away from the denser residential populations along Carpenter Avenue. Another benefit of this concept is that it opens up space in the northeast quadrant of the Airport, along Carpenter Street between State Street and the ball fields that could be developed for aviation uses, such as hangars. Similarly to Concept B1, an obstruction mitigation program would be established maintaining 20 to 1 Part 77 Approach Surfaces.

The annual crosswind coverage for Concept B2 is summarized in **Table 5-7**. This concept is graphically depicted in **Figure 5-8**.

Table 5-7 – Concept B2 Crosswind Coverage

	RWY	10.5 Knots	13 Knots	16 Knots	20 Knots
AW	9/27	91.71%	95.74%	99.07%	99.84%
	17/35	86.70%	91.89%	96.87%	98.96%
	All Combined	98.55%	99.66%	99.93%	100%
VFR	9/27	92.00%	95.93%	99.17%	99.88%
	17/35	87.27%	92.32%	97.15%	99.11%
	VFR Combined	98.63%	99.69%	99.94%	100%

Source: NOAA, National Climate Center; Station 72743 (2003-2008).

Notes:
AW – All Weather
VFR – Visual Flight Rule

5.2.4 Concept B3: Runway 15/33

This alternative is similar to Concept B2 in orientation and length, and is presented in **Figure 5-9**. The runway would be paved to 2,500 feet in length and aligned in a 15/33 orientation. This orientation is the same as one of the Airport's original turf crosswind runways that was closed in the early 1990s to provide space for apron and terminal area development. Overall, it is estimated that six commercial properties will need to be acquired and six businesses relocated. This alternative includes the acquisition of no residential properties; however, more land would be acquired from St. Mary's Cement Company (approximately 18 acres). As with the previous concepts, the "rail spur" right-of-way would need to be realigned.

As with Concept B2, this alternative would have the benefit of redirecting air traffic away from the northeastern residential areas during approach and departure, and would provide additional development opportunities within the northeast quadrant of airport property. Additionally, this runway orientation would provide the appropriate crosswind coverage (97.4% between October and April). As with all the alternatives, a 20 to 1 obstruction mitigation program would be implemented.

The annual crosswind coverage for Concept B3 is summarized in **Table 5-8**. This concept is graphically depicted in **Figure 5-9**.

Table 5-8 – Concept B3 Crosswind Coverage

	RWY	10.5 Knots	13 Knots	16 Knots	20 Knots
AW	9/27	91.71%	95.74%	99.07%	99.84%
	15/33	88.72%	93.67%	97.81%	99.38%
	All Combined	98.09%	99.57%	99.93%	99.99%
VFR	9/27	92.00%	95.93%	99.17%	99.88%
	15/33	89.12%	93.97%	97.99%	99.47%
	VFR Combined	98.10%	99.58%	99.93%	99.99%

Source: NOAA, National Climate Center; Station 72743 (2003-2008).

Notes:
AW – All Weather
VFR – Visual Flight Rule

5.2.5 Concept B4: Runway 15/33 (2,200 Feet)

The orientation of this concept is the same as Concept B3 and provides a 2,200-foot paved runway. This concept was developed after preliminary discussions with St. Mary's Cement Company in an effort to balance airport development needs and the mining potential of the quarry property. In this concept, the necessary grading area for the RSA and ROFA would be maintained south of Carpenter Road extended, which St. Mary's is currently using for an access road.

The benefits of this concept are similar to those of Concept B3. This concept would redirect air traffic away from densely populated residential areas, provide the appropriate crosswind coverage (97.4% between October and April), and it would open up development opportunities for the northeast quadrant of the airfield. Additional benefits of this alternative are the reduction in required land acquisition and the land barrier that would be provided between the runway and Applewood Estates. This concept suggests that 13.7 acres of land be acquired from St. Mary's Cement Company and the "rail spur" right-of-way be realigned to the southern limits of airport property, parallel to U.S. 31.

The annual crosswind coverage for Concept B4 is summarized in **Table 5-9**. This concept is graphically depicted in **Figure 5-10**.

Table 5-9 – Concept B4 Crosswind Coverage

	RWY	10.5 Knots	13 Knots	16 Knots	20 Knots
AW	9/27	91.71%	95.74%	99.07%	99.84%
	15/33	88.72%	93.67%	97.81%	99.38%
	All Combined	98.09%	99.57%	99.93%	99.99%
VFR	9/27	92.00%	95.93%	99.17%	99.88%
	15/33	89.12%	93.97%	97.99%	99.47%
	VFR Combined	98.10%	99.58%	99.93%	99.99%

Source: NOAA, National Climate Center; Station 72743 (2003-2008).

Notes:
AW – All Weather
VFR – Visual Flight Rule

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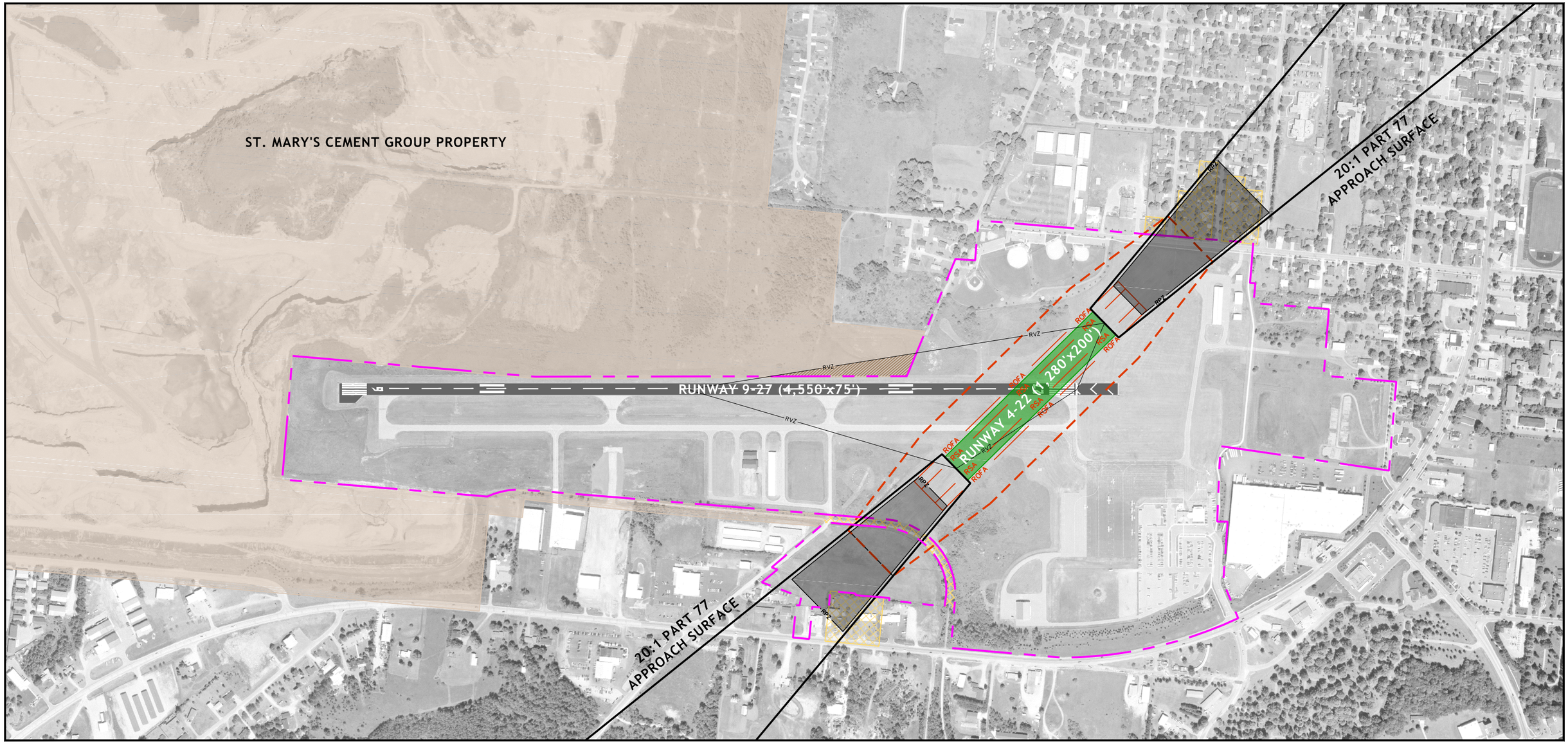

FIGURE 5-6

NO DEVELOPMENT CONCEPT: CROSSWIND RUNWAY

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- PROPERTY ACQUITISION
- AVIGATION EASEMENT
- 25' BUILDING RESTRICTION LINE
- ROFA — RUNWAY OBJECT FREE AREA
- RSA — RUNWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE
- RVZ — RUNWAY VISIBILITY ZONE

N

GRAPHIC SCALE (FEET)
0 150 300 600

RW ARMSTRONG

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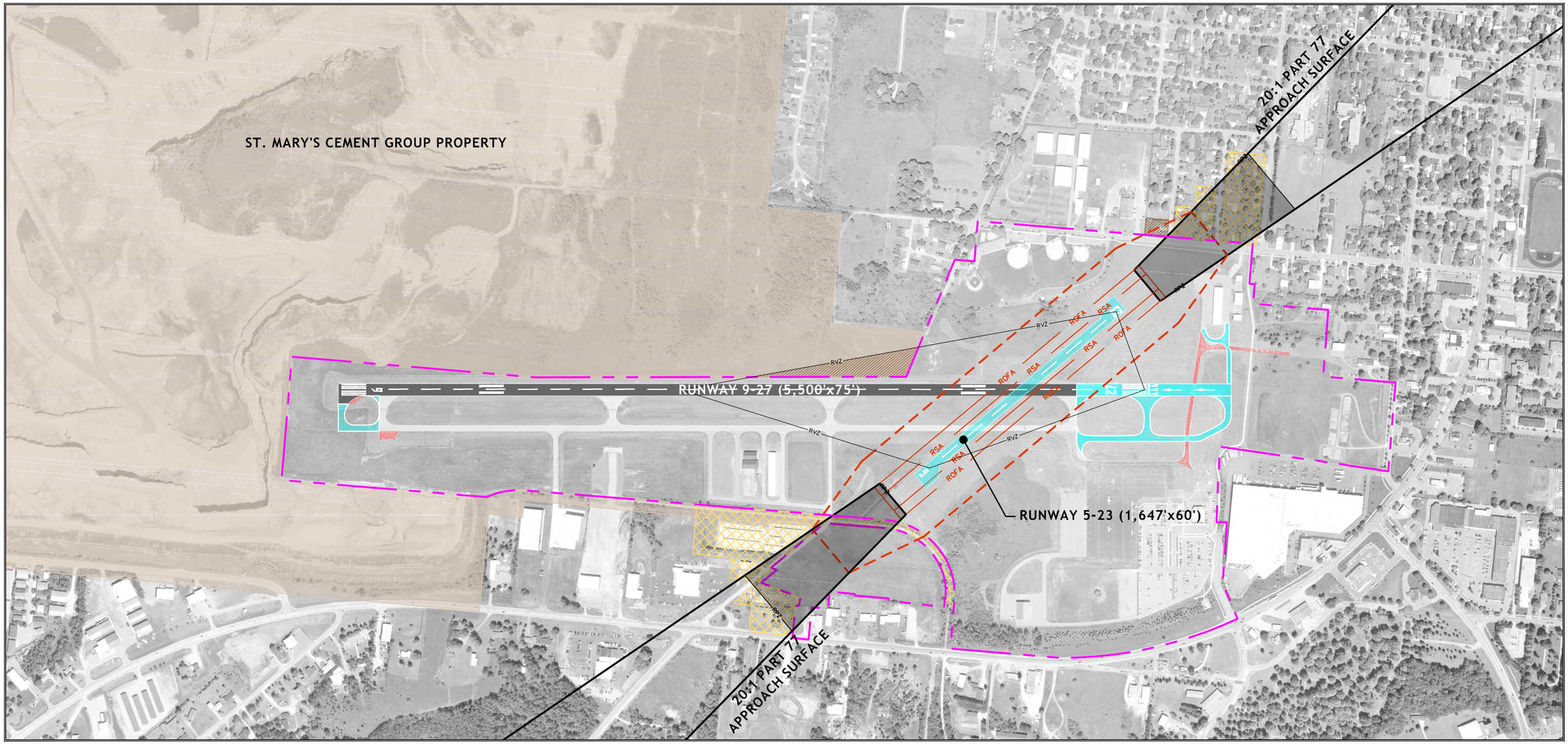

FIGURE 5-7

CONCEPT B1: CROSSWIND RUNWAY 5-23

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- PROPERTY ACQUITISION
- AVIGATION EASEMENT
- 25' BUILDING RESTRICTION LINE
- ROFA — RUNWAY OBJECT FREE AREA
- RSA — RUNWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE
- RVZ — RUNWAY VISIBILITY ZONE

N

GRAPHIC SCALE (FEET)
0 150 300 600

RW ARMSTRONG

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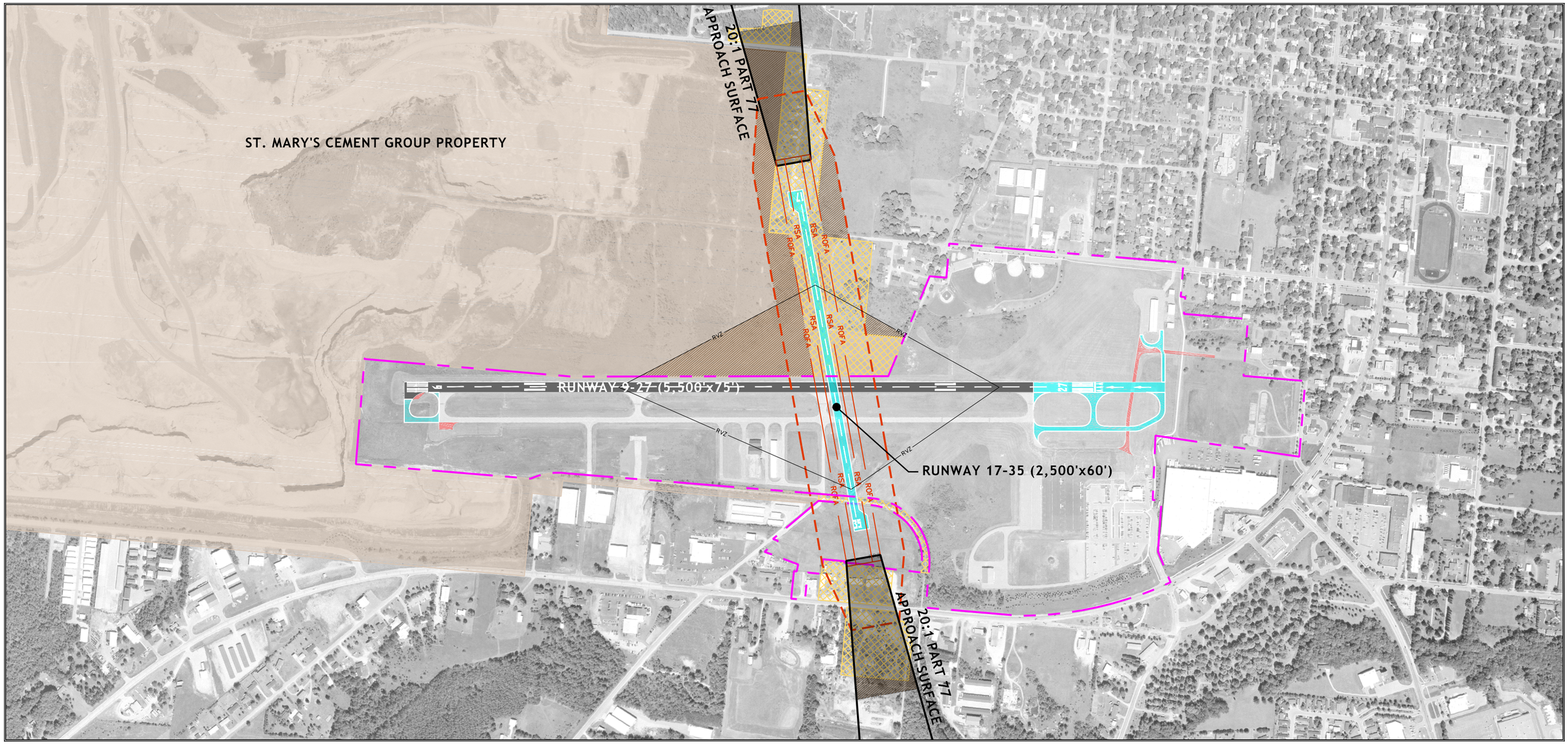

FIGURE 5-8

CONCEPT B2: CROSSWIND RUNWAY 17-35

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- PROPERTY ACQUITISION
- AVIGATION EASEMENT
- 25' BUILDING RESTRICTION LINE
- ROFA — RUNWAY OBJECT FREE AREA
- RSA — RUNWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE
- RVZ — RUNWAY VISIBILITY ZONE

N

GRAPHIC SCALE (FEET)

0 125 350 700

RW ARMSTRONG

CHARLEVOIX MUNICIPAL AIRPORT
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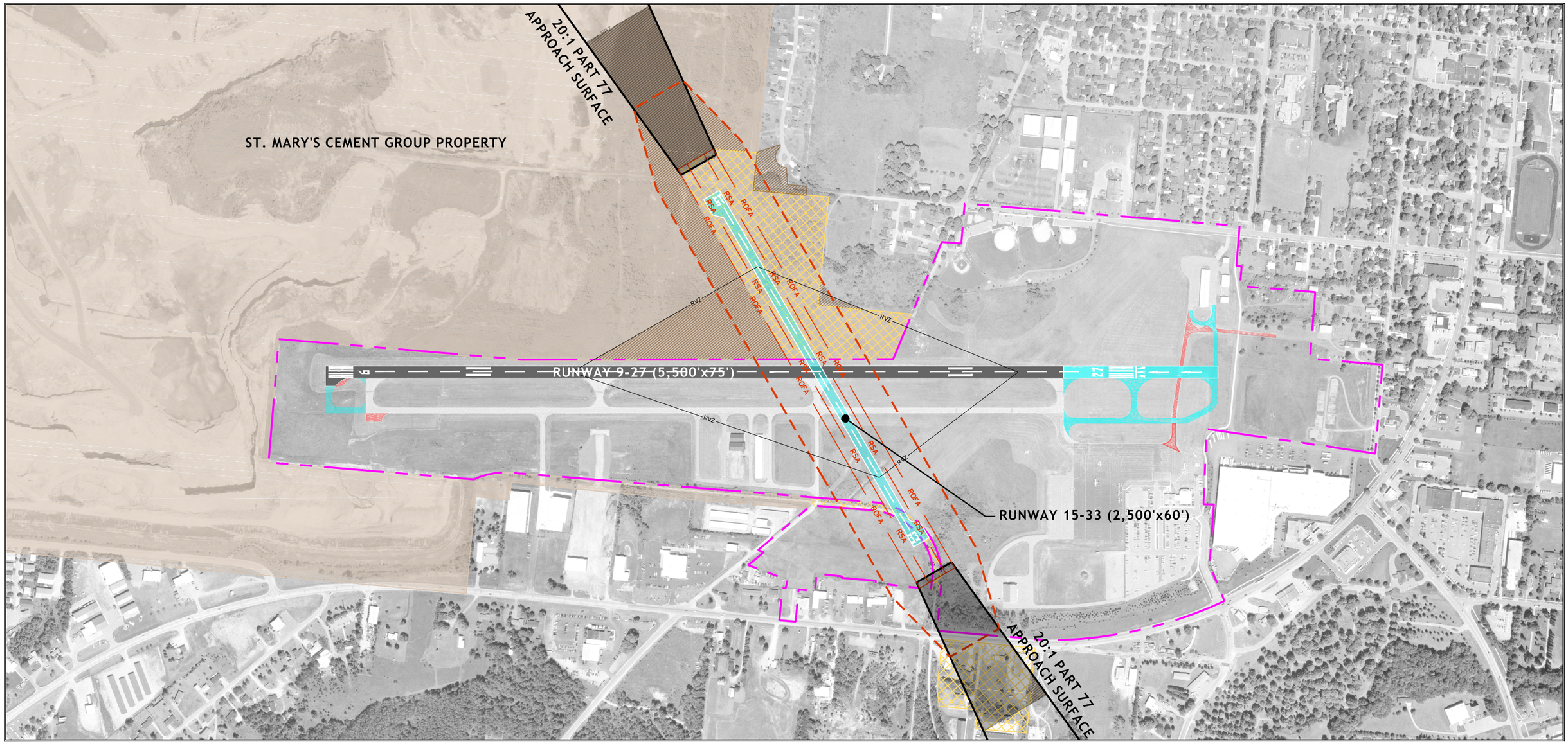

FIGURE 5-9

CONCEPT B3: CROSSWIND RUNWAY 15-33

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- PROPERTY ACQUITISION
- AVIGATION EASEMENT
- 25' BUILDING RESTRICTION LINE
- ROFA — RUNWAY OBJECT FREE AREA
- RSA — RUNWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE
- RVZ — RUNWAY VISIBILITY ZONE

N

GRAPHIC SCALE (FEET)
0 150 300 600

RW ARMSTRONG

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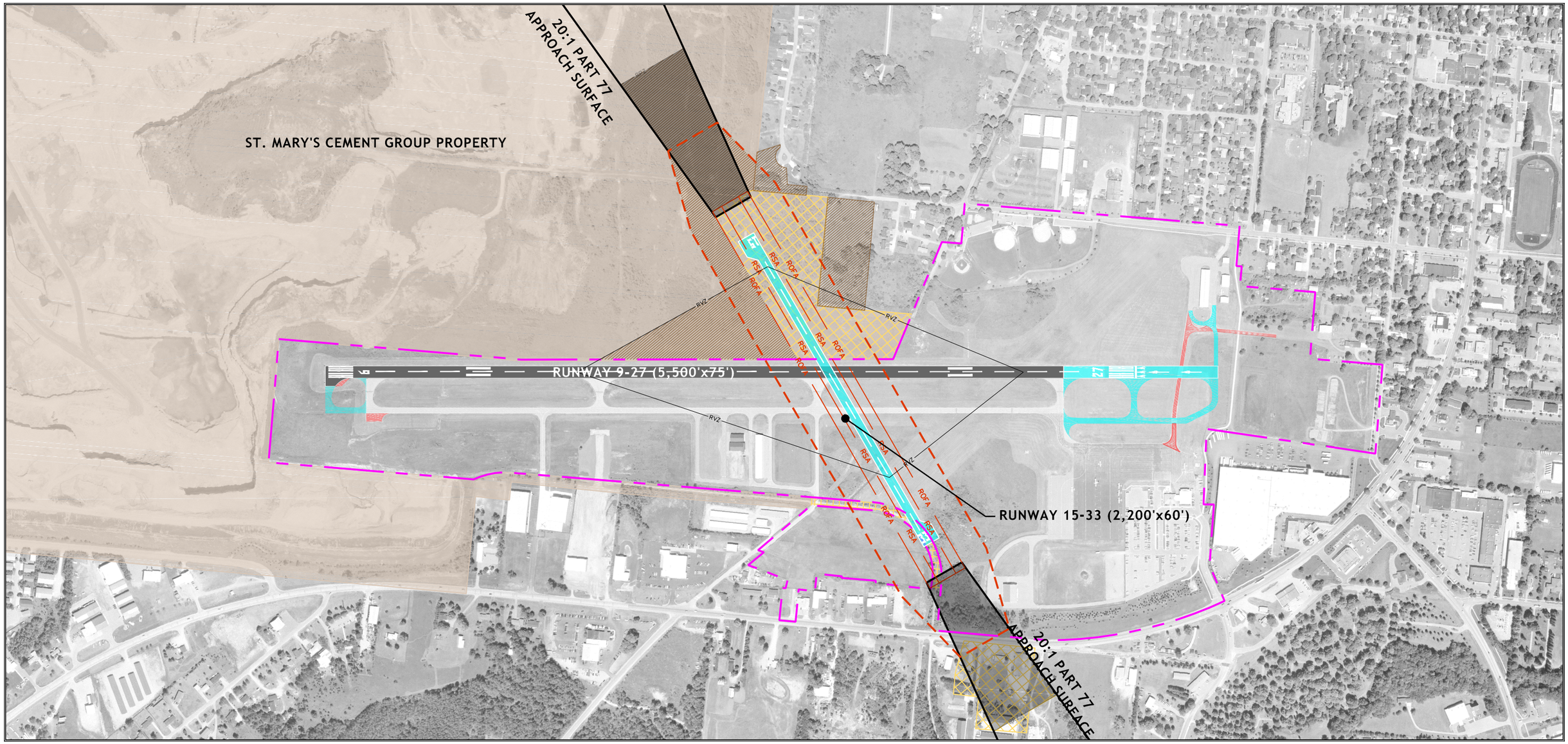

FIGURE 5-10

CONCEPT B4: CROSSWIND RUNWAY 15-33 (2,200 FEET)

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- PROPERTY ACQUITISION
- AVIGATION EASEMENT
- 25' BUILDING RESTRICTION LINE
- ROFA — RUNWAY OBJECT FREE AREA
- RSA — RUNWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE
- RVZ — RUNWAY VISIBILITY ZONE

N

GRAPHIC SCALE (FEET)

0 150 300 600

RW ARMSTRONG

CHARLEVOIX MUNICIPAL AIRPORT
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5.2.6 Comparison and Recommendation

Each concept for the crosswind runway was evaluated on its potential level of impact to the surrounding community; overall implementation cost; and its ability to satisfy the vision and goals established by the City of Charlevoix. The assumptions used in determining the acquisition and development costs are described in the cost estimation worksheets provided in **Appendix D**. Please note that due to the limits of the existing 2009 aerial survey data, the potential need for obstruction mitigation within the approach areas for the crosswind alternatives has not been evaluated. Additional analysis would be required to identify the need for, and costs associated with, any such obstruction removal and associated avigation easements.

Also please note that the budgetary cost estimates for the acquisition of property from St. Mary's Cement Group are order of magnitude estimates, based on cursory discussions with St. Mary's, and would require additional preliminary engineering, appraisal and negotiation to determine an appropriate market value. Various strategies, such as land swaps and engaging the Michigan Department of Natural Resources/State Parks may also result in a lower total cost for property acquisition.

For planning purposes, potential easement areas over St. Mary's Cement Group property have been identified to the limits of the RPZ and 25' BRL. Easements may not be needed, due to intended use of quarry property and sufficient City control to protect the airspace may be achieved through a usage agreement. To that end, a nominal easement cost has been included to cover possible coordination costs (i.e. no land value for easement area).

Even with these estimated elements, the potential impacts and costs of each concept, as presented in **Table 5-10**, provides a reasonable basis from which to compare the various concepts.

Table 5-10 – Crosswind Runway Impact and Cost Comparison

Impact / Cost		Concept				
		No Development	B1 Runway 5/23	B2 Runway 17/35	B3 Runway 15/33	B4 Runway 15/33 (2,200 Feet)
Fee Simple Land Acquisition	**Residential Property**					
	Parcels	19	20	33	0	0
	Acres	±4.1	±4.1	±14.2	0	0
	Relocations	16	17	12	0	0
	Estimated Property Value ($)[1]	±1,584,000	±1,573,000	±2,196,000	0	0
	Commercial Property					
	Parcels	2	6	5	8	8
	Acres	±2.6	±6.3	±9.2	±8.7	±8.7
	Relocations	2	6	4	7	7
	Estimated Cost ($)[1]	±410,000	±925,000	±1,410,000	±922,000	±922,000
	Mineral District Property					
	Acres	0	0	±8.0	±18.0	±13.7
	Estimated Cost ($)	0	0	±5,743,000[2]	±12,857,000[2]	±10,000,000[2]
Avigation Easements	**Residential Property**					
	Parcels	0	1	3	4	4
	Acres	0	0.3	2.9	1.6	5.7
	Estimated Cost ($)	0	±40,000	±17,000	±19,000	±74,000
	Commercial Property					
	Parcels	0	0	2	0	0
	Acres	0	0	1.3	0	0
	Estimated Cost ($)	0	0	±7,000	0	0
	Mineral District Property					
	Acres	1.4	2.0	15.5	19.8	18.3
	Estimated Cost ($)	±10,000	±10,000	±100,000	±100,000	±100,000
Subtotal Property Cost ($)[4]		2,004,000	2,548,000	9,473,000	13,898,000	11,096,000
Acquisition Fees and Services ($)[3]		*992,000*	*1,236,000*	*957,000*	*403,000*	*402,000*
Parcel Clearing & Obstacle Removal ($)[4]		*963,000*	*1,336,000*	*969,000*	*613,000*	*620,000*
Total Property Cost ($)[4]		**3,959,000**	**5,120,000**	**11,399,000**	**14,914,000**	**12,118,000**
Runway Construction Cost ($)[5]		**0**	**1,760,000**	**3,270,000**	**3,429,000**	**3,250,000**
Total Implementation Cost ($)		**3,959,000**	**6,880,000**	**14,669,000**	**18,343,000**	**15,368,000**

Source: RW Armstrong, 2011
[1] Property market value provided by the City of Charlevoix, Department of Planning, 2011
[2] Cursory, order of magnitude estimate only. Additional engineering, appraisal and coordination needed to refine budgetary cost.
[3] Includes professional fees, appraisals, negotiation, and relocation expenses
[4] Does not include the potential need or costs for avigation easements and obstacle clearing within the approach areas.
[5] Includes estimated environmental, design, bid, construction and inspection costs.

As presented in **Table 5-11**, each alternative concept was assigned a scoring value for each of the evaluation criteria established previously in this chapter (**Table 5-1**). The cumulative score for each alternative was compared and used in determining the recommended concept. Based on this evaluation, the recommended concept for the crosswind runway is Concept B4, which includes a paved 2,200-foot runway in the 15/33 orientation. This concept provides the best overall balance of providing the desired utility (i.e., year round usability, crosswind coverage, operational length) while mitigating impacts and costs. Ongoing coordination with St. Mary's Cement Company may result in minor alterations to this general concept as the land acquisition and design elements progress.

Table 5-11 – Crosswind Runway Evaluation Matrix

	Evaluation Criteria	Weight	Concept							
			No Development		B1 Runway 5/23		B2 Runway 17/35		B3 / B4 Runway 15/33	
			Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
City Goals and vision	Improves utility / operational capacity	3	(-)	**-3**	0	**0**	(+)	**+3**	(+)	**+3**
	Supports corporate / business aviation	4	0	**0**	0	**0**	0	**0**	0	**0**
	Supports airline operations / passenger convenience	4	(-)	**-4**	0	**0**	(+)	**+4**	(+)	**+4**
	Supports recreational and general aviation	2	(-)	**-2**	0	**0**	(+)	**+2**	(+)	**+2**
	Helps establish year-around / all-weather facility	1	(-)	**-1**	0	**0**	(+)	**+1**	(+)	**+1**
	Flexibility for future, unforeseen needs and opportunities	1	0	**0**	(-)	**-1**	(+)	**+1**	(+)	**+1**
	Supports airport revenue opportunities	3	(-)	**-3**	0	**0**	(+)	**+3**	(+)	**+3**

	Evaluation Criteria	Score	Score	Score	Score B3	Score B4
Impacts	Impact to residential property	**3**	**2**	**1**	**4**	**4**
	Impact to commercial property	**4**	**2**	**3**	**1**	**1**
Costs	Implementation Costs	**4**	**3**	**2**	**1**	**2**
	Operation and maintenance costs	**4**	**3**	**1**	**1**	**2**
	TOTAL SCORE	**2**	**9**	**21**	**21**	**23**

Source: RW Armstrong, 2011

5.3 TAXIWAY SYSTEM

Consistent with the recommendations described in **Chapter 4**, the end-around Group-I taxiway from the North Hangar Complex, located east of the primary runway would be relocated. The best way to achieve this would be to connect it to the new Runway 27 threshold. These efforts should be coordinated together.

In order to provide a full parallel taxiway to Runway 9/27, the existing Group-II parallel taxiway would be extended approximately 250 feet to the western end of the runway and eastward to the new Runway 27 end. Pending the timing of the runway/parallel taxiway extension, available funding and the potential long-term upgrade to C-II runway standards, an extension of the parallel taxiway on the eastern end should be designed to Approach Category C standards (i.e., 300-foot runway to taxiway separation). This will define the terminal area development envelope thereby providing long-term, overall development flexibility. The extension on the western end, if pursued in the near-term, should be designed to Approach Category B standards (i.e., 240-foot separation distance) since this pavement would likely have to be removed in the event of a future C-II upgrade (as shown in **Figure 5-5**).

5.4 TERMINAL BUILDING

The existing terminal building has approximately 2,930 square feet of usable space, excluding the attached 800 square foot baggage handling breezeway. Information from airport management, the airlines, regular airport users, and information obtained from the user surveys (discussed in **Section 3.4.2**) have indicated a need/desire for more terminal space. It has been stated that the building can become heavily congested during peak times, thereby inhibiting the flow of passengers, baggage, and other general aviation activities. Supporting these observations, the analysis presented in **Chapter 4** also indicates that the existing terminal is drastically undersized.

A terminal study and planning effort was initiated by the City and FAA in early 2009 (documentation located in **Appendix F**). Through this study, which included a focus group consisting of the airlines, tenants, airport staff and other users, it was determined that up to 85 persons or more can be in the terminal on a peak day especially if inclement weather delays flight operations. Conceptual terminal designs that flowed from that study, prepared by Mark Buday, Architect PPLC, focused on passenger and freight flows, airline and general aviation operations, pilot and passenger convenience, and providing adequate space for additional services as demand warrants. The plans also provided accommodations for both of the airlines currently operating at the Airport.

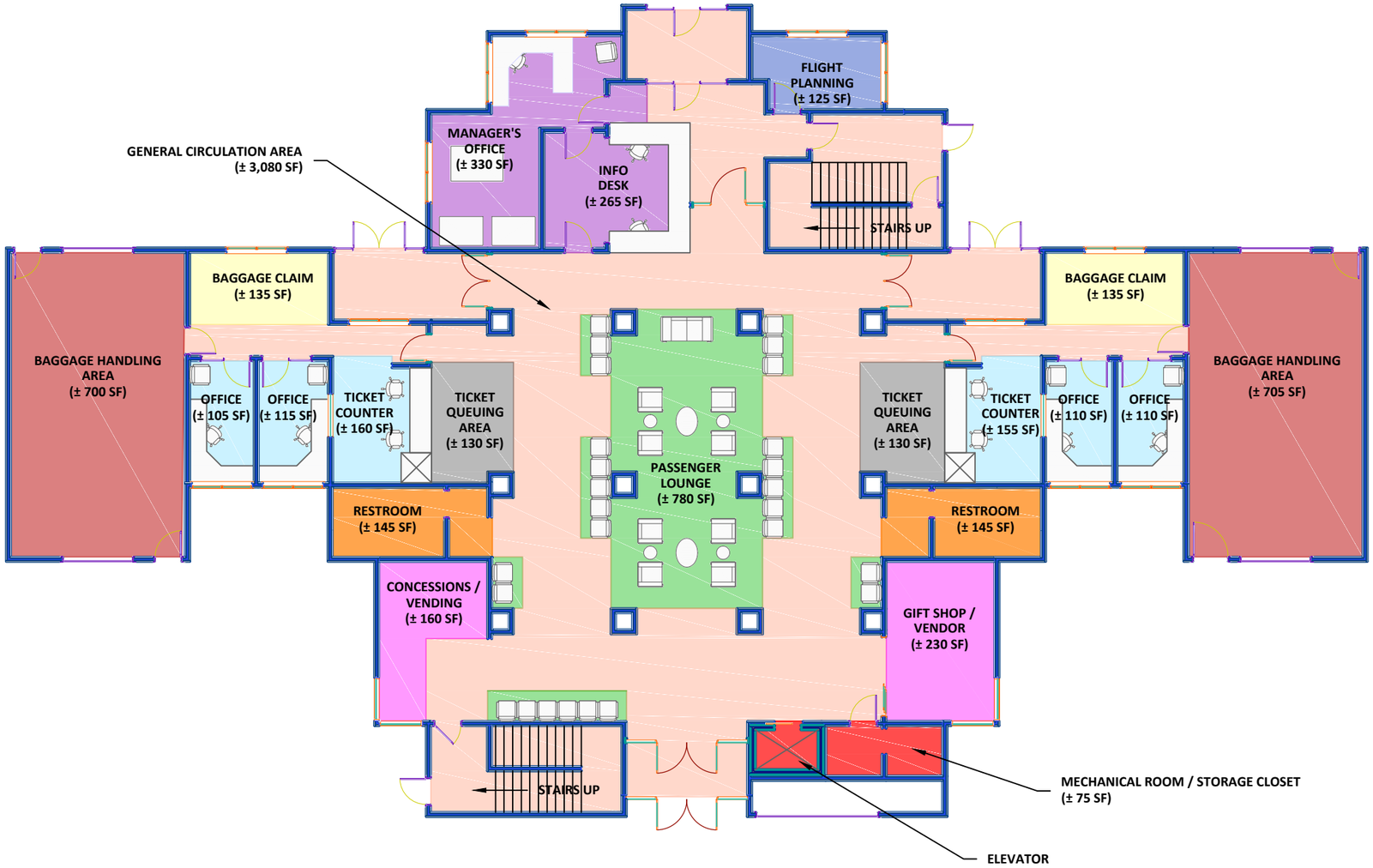
The study group determined that due to utility location, surface and existing infrastructure, the most cost-efficient means of constructing a replacement terminal would be to construct it on the existing location. Due to the surrounding site limitations

(apron to the north, Harbor Industries to the east, and the electrical vault to the west), it was further determined that a two-story building would be the best approach to achieve the needed terminal space. Preliminary designs for the replacement terminal were presented to the City of Charlevoix in January 2010. These plans are presented in **Figure 5-11 and 5-12**. The ability of these plans to meet the minimum calculated facility requirements described in **Chapter 4** is presented in **Table 5-12**. When combining the calculated minimum terminal building space requirements with the planning group's local experience, the proposed terminal building appears to meet the needs of the users, tenants and other stakeholders while providing flexibility to accommodate additional demands as they may might arise.

Table 5-12 – Space Requirements for Proposed Terminal

Facility Use Area	Proposed Terminal Space (sf)[1]	Minimum Calculated Space Requirement (sf)[2]			
		2010	2015	2020	2030
Passenger Lounge	1,685	1,104	1,152	1,248	1,392
Pilot's Lounge	830	413	413	450	525
Airline Counter & Operations	755	540	570	600	690
Airline Baggage Claim	270	90	95	100	115
Airline Baggage Handling	1,405	450	475	500	575
Airline Ticket Queuing	260	180	190	200	230
Concessions / Vending	390	230	240	260	290
Manager's Office / Operations	755	357	375	394	462
Restrooms	405	294	306	330	366
Mechanical / Storage	220	179	188	197	215
Circulation	4,245	1,279	1,335	1,426	1,625
TOTAL	**±11,220**	**±5,116**	**±5,339**	**±5,705**	**±6,500**

Sources: [1] Terminal Study Group & Mark Buday, Architect PPLC
[2] RW Armstrong, 2011



BASED ON CONCEPTS DEVELOPED BY AIRPORT MANAGEMENT, THE CITY OF CHARLEVOIX, AND MARK BUDAY, ARCHITECT P.L.L.C.

FIGURE 5-11

PROPOSED TERMINAL: MAIN LEVEL

LEGEND:

- PASSENGER LOUNGE
- PILOT'S LOUNGE / FLIGHT PLANNING
- AIRLINE COUNTER & OPERATIONS
- BAGGAGE CLAIM
- BAGGAGE HANDLING
- TICKET QUEUING AREA
- CONCESSIONS / VENDING
- MANAGER'S OFFICE & OPERATIONS
- RESTROOMS
- MECHANICAL / STORAGE
- GENERAL CIRCULATION

N

GRAPHIC SCALE (FEET)

0 15 30

1 inch = 15 feet

RW ARMSTRONG

CHARLEVOIX MUNICIPAL AIRPORT
MASTER PLAN STUDY

BASED ON CONCEPTS DEVELOPED BY AIRPORT MANAGEMENT, THE CITY OF CHARLEVOIX, AND MARK BUDAY, ARCHITECT P.L.L.C.

FIGURE 5-12

PROPOSED TERMINAL: UPPER LEVEL

LEGEND:

- PASSENGER LOUNGE
- PILOT'S LOUNGE / FLIGHT PLANNING
- AIRLINE COUNTER & OPERATIONS
- BAGGAGE CLAIM
- BAGGAGE HANDLING
- TICKET QUEUING AREA
- CONCESSIONS / VENDING
- MANAGER'S OFFICE & OPERATIONS
- RESTROOMS
- MECHANICAL / STORAGE
- GENERAL CIRCULATION

N

GRAPHIC SCALE (FEET)

0 15 30

1 inch = 15 feet

RW ARMSTRONG

CHARLEVOIX MUNICIPAL AIRPORT
MASTER PLAN STUDY

5.5 APRON AND AIRCRAFT PARKING

During peak activity levels at CVX, the terminal apron needs to accommodate Group-I and Group-II transient and based aircraft, passenger and cargo loading and unloading for the airlines, and fueling operations. The existing configuration is prone to congestion problems caused by lack of space and the intermixing of different aircraft types; large and small, jet and piston. The forecasts of aviation demand, supported by observations from airport staff, show a need for additional apron space and Group-II power-in/power-out parking positions. As the facility requirements indicate, the apron should be reconfigured in the near-term (1-5 years) and provide at a minimum of four Group-II parking positions by the year 2015. Experience of the airport staff indicates a current operational need for six to eight Group-II positions. Additionally, relocating the fuel island will reduce congestion and provide a separation between airline and general aviation activities. Over the 20 year planning horizon, approximately 11,000 SY of additional pavement and seven or more Group-II power-in/power-out parking positions will be required. Providing power-in/power-out Group-II parking positions may require the relocation of some Group-I parking positions. Additionally, expansion of the apron will require a relocation of the AWOS.

Taking into consideration the existing mix of aircraft and FAA separation standards, the most operationally efficient means of achieving these requirements would be to expand the apron to the north and west as shown in **Figure 5-13**. The fuel island would be relocated north of its current position thus providing additional space for circulation and fueling and airline activities. This will also allow for the area nearest the terminal to be reserved for airline operations. Group-II aircraft parking would be located on the north side of the apron with direct access to the parallel taxiway. A Group-II taxilane would provide separation between larger aircraft maneuvering under their own power and the airline operations and Group-I tie-down areas. This configuration minimizes jet blast effects particularly for the airline passengers boarding and deplaning on the open apron. Areas to the west of the existing apron will be reserved for long-term expansion, should additional apron space be needed in the future.

During design of the apron expansion, careful consideration should be taken of the existing and future ARC designation of the Airport. As stated in AC 150/5300-13, the maximum allowable apron grade is 2 percent for Aircraft Approach Categories A and B and 1 percent for Aircraft Approach Categories C and D. It is recommended that the apron be designed with a maximum grade is 1 percent, so that the Airport's ability to potentially upgrade to C-II design standards is not inhibited.

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RUNWAY 9-27 (5,000'x75')

RUNWAY 15-33 (4,200'x60')

RELOCATED AWOS

FUTURE DEVELOPMENT / APRON EXPANSION

RELOCATED FUEL ISLAND

GROUP-II PARKING

REPLACEMENT TERMINAL

U.S. 31

NOTES: Primary Runway is drawn to preferred length (as described in Section 5.11).

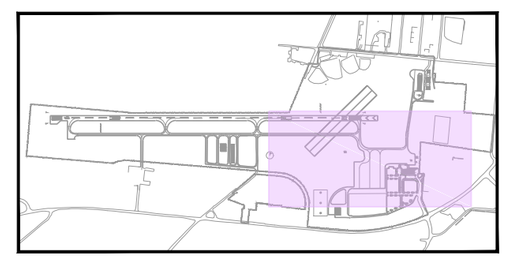
LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- PROPERTY ACQUISITION
- PROPERTY ACQUISITION - LONG-TERM
- TOFA — TAXIWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE
- RVZ — RUNWAY VISIBILITY ZONE

N

GRAPHIC SCALE (FEET)

0 50 100 200



KEYMAP

FIGURE 5-13

TERMINAL AREA DEVELOPMENT

5.6 AIRCRAFT STORAGE

As of early 2011, the 10 T-hangar units and 13 box hangars at CVX are all occupied and there is a waiting list for hangar space. The projected based aircraft demand suggests that additional T-hangars are warranted in the short-term development of the Airport (1-5 years). The forecasts also suggest that the Airport will experience an increase in the number of based turbo-props and jets, which are typically stored in bulk hangars or jet-pods. The facility requirements recommend space for three to four additional aircraft of this type within the forecast horizon. Development of one bulk hangar should be planned for the near- to mid-term horizon (1-10 years). The proposed location of the new hangars is presented in the Midfield Area Development Plan (**Figure 5-14**) and the Northern Area Development Plan (**Figure 5-15**).

Since unforeseen variables can affect the actual need for hangar space at the Airport, areas should be preserved for both T-hangars and bulk hangars to be built as demands arise and adequate funding and lease mechanisms can be coordinated. Considering the existing infrastructure (taxiways and utilities), the logical location for this initial hangar development is the Midfield Hangar Complex. Specific hangar locations would need to be constructed so as to not hinder potential future development of the airfield to C-II standards (i.e. taxiway to runway separation). Generally speaking, as demand and opportunities arise to develop additional hangars, the Midfield Complex and westward is best suited for corporate and bulk hangar development. Additional T-hangars, accommodating smaller aircraft, would best be developed in the North Hangar Complex. The reorientation of the crosswind runway to a northwest-southeast direction will open up additional space in the North Complex for continued development.

5.7 AUTOMOBILE PARKING

As discussed in **Chapter 4**, the existing parking lot appears to meet the parking demand at CVX over the forecast horizon. However, since the City of Charlevoix may use portions of the parking lot for other events or services, a portion of the unpaved, “overflow” parking lot should remain undeveloped and preserved for future expansion of automobile parking. To help prevent unauthorized access, and limit the number of automobiles on the airfield, sufficient parking should be provided near the areas of hangar development as site conditions allow.

5.8 SECURITY FENCING

Security will become increasingly more important as the number of based aircraft increase and as more resources are invested in airport infrastructure. The majority of the Airport is fenced, however in order to assure continued security and reduce the threat of wildlife hazards on the airfield, the fencing gaps in the northwest corner of the airfield should be filled. Additionally, the fence line and gate locations may need to be adjusted as development of the airfield progresses and additional properties are acquired.

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FUTURE AVIATION RELATED DEVELOPMENT

"RAIL SPUR" RIGHT-OF-WAY

PROPOSED T-HANGARS

PROPOSED BULK HANGARS

DEVELOPED INTO GROUP-II TAXILANE

RELOCATED AWOS

RUNWAY 15-33 (2,200'x60')

FUTURE DEVELOPMENT / APRON EXPANSION

RELOCATED AND UPGRADED NDB

PROPOSED INTERNAL ACCESS ROAD

U.S. 31

NOTES: Mid-term property acquisition to support crosswind runway and realignment of "rail spur" right-of-way.
Potential long-term property acquisition to provide additional aviation related development.
Area south of proposed access road will be reserved for St. Mary's Cement Group right-of-way and the City of Charlevoix's Lake-to-Lake Trail.

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- PROPERTY ACQUISITION
- PROPERTY ACQUISITION - LONG-TERM
- TOFA — TAXIWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE
- RVZ — RUNWAY VISIBILITY ZONE

N

GRAPHIC SCALE (FEET)
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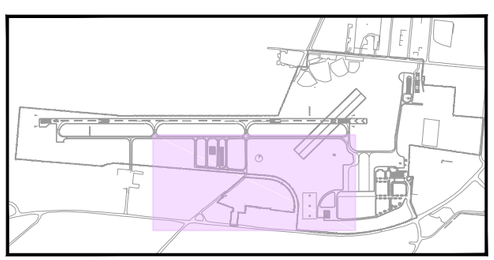
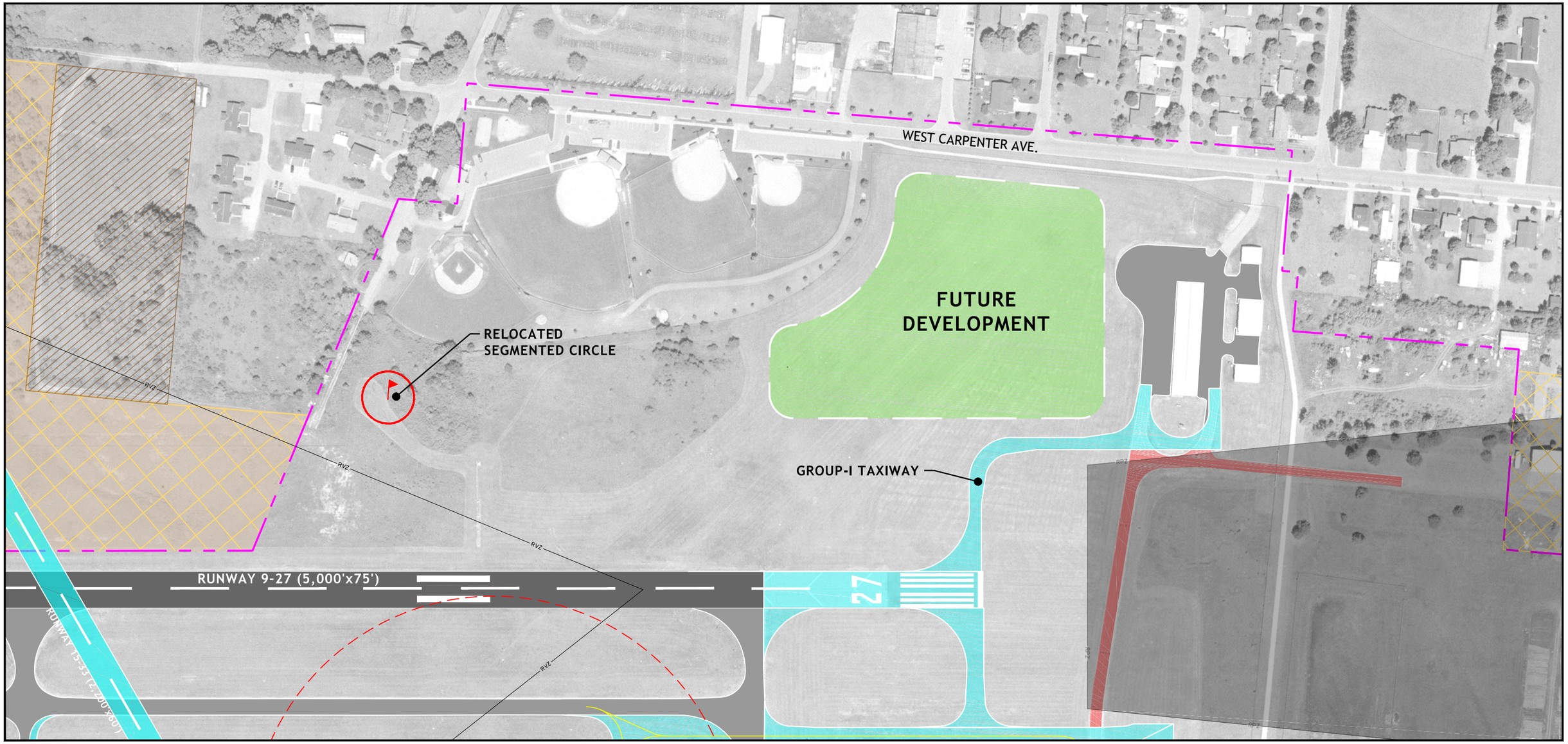


KEYMAP

FIGURE 5-14

MIDFIELD AREA DEVELOPMENT



NOTES: Primary Runway is drawn to preferred length (as described in Section 5.11).

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- PROPERTY ACQUISITION
- PROPERTY ACQUISITION - LONG-TERM
- TOFA — TAXIWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE
- RVZ — RUNWAY VISIBILITY ZONE

N

GRAPHIC SCALE (FEET)
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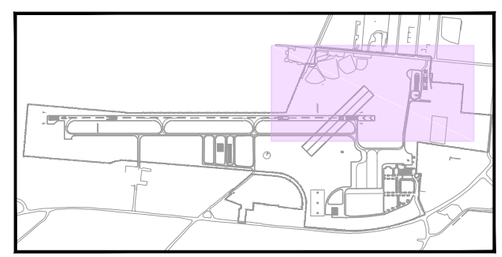

KEYMAP

FIGURE 5-15

NORTHERN AREA DEVELOPMENT

5.9 AIRPORT ACCESS

The current access to the Airport is directly adjacent to a major roadway. The access roadway is considered convenient and appropriate in size and therefore no improvements are suggested. However, an internal access road between the terminal area and the Midfield Hangar Complex is suggested. Currently, the Midfield Hangar Complex is accessed via the parallel taxiway or through Gate 5 on Old Norwood Road. An internal access road would allow for based aircraft tenants and airport personnel to move between the terminal area and the Midfield Complex without driving on the taxiways and without having to leave airport property.

As mentioned previously, reorientation of the crosswind runway would require that St. Mary's "rail spur" right-of-way, and planned Lake to Lake Trail (which run directly adjacent to the Airport property line on the south side), be realigned southward to provide space for security fencing and Part 77 airspace protection. To achieve this, up to two parcels along U.S. 31, adjacent to airport property, would likely be needed to accommodate the realignment. An internal access road could be developed alongside the right-of-way, while maintaining the development potential of existing airport property in this area. The proposed alignment of the "rail spur" right-of-way, alignment of the access road and needed parcel acquisition is presented in the Midfield Area Development Plan in **Figure 5-14**. This property, along with the other parcels between the "rail spur" and Old Norwood Road totaling approximately 8.6 acres, was previously denoted for acquisition on the 2004 ALP and has been valued, in early 2011, at approximately $1.5 million.

5.10 LONG-TERM POTENTIAL PROPERTY ACQUISITION

In addition to the property and easement acquisitions needed to accommodate the primary and crosswind runway improvements, it may become desirable for the City to acquire the remaining commercial properties between the airport boundary and U.S. 31 west of the "rail spur" right-of-way. The specific need for these properties to support the projected activity levels and user demand is not anticipated over the planning horizon, however these parcels could be developed for aviation use with airside access, thus ensuring compatible adjacent land use. Excluding the automobile dealership and the two parcels needed for the crosswind runway and realignment of the right-of-way, property in this area could provide up to 23 acres of additional hangar and aviation business related development.

These parcels do include two of the existing Through-The-Fence facilities which would thereby eliminate the need for use and access agreements. In the near- to mid- term planning horizon, acquisition of these parcels would be opportunistic in nature and would not likely be eligible for federal funding support. In the future however, should a demonstrated aviation capacity or safety need arise, these parcels could become eligible for reimbursement under the FAA Airport Improvement Program (AIP) program.

The private development potential of these parcels, and associated property and corporate tax base, would need to be weighed by the City to determine whose ownership of the property would provide the most benefit to the operational sustainability of the Airport and local business community as well as the revenue stream of the City. The City should maintain awareness of property opportunities in this area, as well as developer opportunities that could benefit the Airport in terms of attracting and securing aviation use tenants and their associated revenues.

5.11 RECOMMENDED AIRPORT DEVELOPMENT PLAN

The recommended runway, taxiway, apron, terminal, hangar, and other improvements presented in this chapter comprise the overall Recommended Development Plan for the Airport. This Development Plan best meets the City's vision and goals for the Airport while minimizing impacts to the surrounding community. This Recommended Development Plan is presented in **Figure 5-16**.

While the recommended primary runway concept will be presented on the ALP drawing set, it is still recommended that the long-term upgrade potential of the airfield to C-II standards be preserved and factored into all airport development projects. In support of this consideration, and to keep the City and Airport prepared for changing market conditions, a future Master Plan Update should be pursued in the seven to ten year time frame to reevaluate the user and operational demands and to determine whether or not such an upgrade is warranted.

ST. MARY'S CEMENT GROUP PROPERTY

RELOCATED SEGMENTED CIRCLE

RELOCATED AWOS

WEST CARPENTER AVE.

FUTURE DEVELOPMENT

RUNWAY 9-27 (5,000'x75')

RUNWAY 15-33 (2,200'x60')

FUTURE AVIATION RELATED DEVELOPMENT

"RAIL SPUR" RIGHT-OF-WAY

FUTURE EXPANSION AREA

RELOCATED FUEL ISLAND

PROPOSED T-HANGAR

PROPOSED BULK HANGAR

REPLACEMENT TERMINAL

RELOCATED AND UPGRADED NDB

GROUP-II PARKING POSITIONS

U.S. 31

PROPOSED INTERNAL ACCESS ROAD

RPZ

RVZ

LEGEND:

- NEW PAVEMENT
- PAVEMENT DEMOLITION
- PROPERTY ACQUISITION
- PROPERTY ACQUISITION - LONG-TERM
- TOFA — TAXIWAY SAFETY AREA
- RPZ — RUNWAY PROTECTION ZONE
- PROPERTY LINE
- RVZ — RUNWAY VISIBILITY ZONE

N

GRAPHIC SCALE (FEET)

0 150 300 600

FIGURE 5-16

RECOMMENDED DEVELOPMENT PLAN

6 IMPLEMENTATION PLAN

The Recommended Development Plan for Charlevoix Municipal Airport, as described in **Chapter 5**, spans over the next 20 years. The implementation plan described herein summarizes and prioritizes the proposed facility improvements into three general development timeframes:

- Phase 1: near-term (0-5 years)
- Phase 2: mid-term (6-10 years)
- Phase 3: long-term (11-20 years)

Project cost estimates have also been prepared for each of the facility improvements. These projects, and associated costs, will be combined with Charlevoix's existing Airport Capital Improvement Plan (ACIP) to develop a comprehensive financing strategy. The ACIP and financing strategy will be described in **Chapter 7**.

6.1 DEVELOPMENT PLAN BY PHASE

The near- and mid-term phases focus on providing adequate airside, aircraft storage and terminal area facilities to meet the existing and anticipated user needs. The long-term phase is more conceptual in nature and includes projects that could be pursued in the future if the user types and activity levels reach the point that upgrading the airfield to C-II design standards becomes warranted. In effect, the long-term phase represents a potential ultimate airfield build-out scenario. These represent generalized phasing schedules and variance from them may be necessary, especially during the latter time periods, due to changes in tenant/user demands, unforeseen business opportunities, changes in the regulatory environment and availability of funds.

It should also be noted that several of the recommended projects (i.e. runway extension, crosswind runway, land acquisition) will be dependent upon additional justification for funding and the findings of an Environmental Assessment. The City should work closely with the FAA to ensure that justification for the project is adequate. Additionally, in accordance with the federal and state funding programs, and in support of the National Environmental Policy Act of 1969 (NEPA), a determination from the FAA that the proposed projects will not have a significant impact on the environment will be needed prior to pursuing the improvement and prior to becoming eligible for grant-in-aid funding.

6.1.1 Phase 1: Near-Term Planning Horizon (0-5 Years)

Phase 1 of the Implementation Plan focuses on the capacity issues in the terminal area and the inadequacy of the primary runway. Improvements include the replacement terminal building, apron expansion/reconfiguration, Runway 9/27 extension and hangar

development. These improvements can be directly correlated with the existing and projected demand and capacity deficiencies described in **Chapters 3** and **4** of this Master Plan. These improvements will position the Airport to readily accommodate the existing and forecasted activity levels by providing adequate airfield, terminal and apron facilities.

From the onset of Phase 1, the City, Airport and FAA will continue working to document justification for the need of the extension, most likely in the form of tenant and user commitments and letters of support. This effort will build upon the support of the local businesses, corporate operators and tenants that has already been obtained and documented in this Master Plan.

Due to the fact that the replacement terminal building will be constructed on the same site as the existing terminal building and adjacent developed area, it is believed that this project will be considered a Categorical Exclusion (CATEX) within the NEPA process and can proceed with a minimal amount of agency coordination and will be eligible for federal funding support as early as 2011. Pending coordination with the FAA, the needed apron reconfiguration/expansion may also be able to be pursued under a CATEX however if the expansion limits are deemed significant enough, it may require a separate Short Form Environmental Assessment or be combined with the detailed Environmental Assessment required for the runway extension. These environmental evaluations are required under NEPA to assess, minimize and mitigate potential impacts to the surrounding natural and human environments. To ensure that these critical improvements are implemented expeditiously and are available to meet the user needs, environmental coordination must be pursued as early in Phase 1 as possible.

Contingent upon a favorable environmental finding, engineering design and land and easement acquisition associated with the runway extension would proceed. The western extension of the parallel taxiway, to the full length of Runway 9/27, could be treated as an independent project, however it may be more cost effective to combine it with the design and construction of either the runway extension or apron reconfiguration. As City or third party funding allows, design and construction of additional hangar facilities would also proceed. In accordance with recent FAA initiatives, it is likely that development of a Safety Management System and AGIS aerial survey would also need to be pursued within the near-term planning horizon.

6.1.2 Phase 2: Mid-Term Planning Horizon (5-10 years)

Assuming that it will take most of the Phase 1 five-year period to perform the environmental evaluation, design and land acquisition needed for the runway extension, the subsequent construction would be pursued early in Phase 2. The next major improvement project anticipated to be pursued is the crosswind runway. Paving and reorientation of the crosswind runway will provide year-round, all-weather capability and enhance the margin the safety, real or perceived, for the airlines and smaller

recreational type aircraft particularly during periods of high crosswind and during the winter months when the existing turf crosswind runway would be closed. Additional projects would likely include hangar development, pavement maintenance, fuel farm expansion, interior access road and security fencing (to incorporate newly acquired parcels).

Throughout Phase 1 and Phase 2, the City, Airport and FAA will continue working to document justification for the paving and reorientation of the crosswind runway. Support for this project will be in the form of tenant and user commitments and letters of support, particularly from the airlines identifying their need for and increased ability to utilize the proposed crosswind runway. Continued coordination with St. Mary's Cement Group, for the acquisition of property and usage agreements will also need to be pursued. As mentioned in **Section 5.2.6**, the acquisition of property from St. Mary's would require additional preliminary engineering, appraisal and negotiation to determine an appropriate market value.

The improvements being pursued in this phase will also need environmental approval prior to design and construction. Pavement maintenance projects are considered a CATEX and pending coordination with the FAA, some of the smaller projects (fencing, NDB relocation) may also be able to be pursued as a CATEX or possibly be evaluated with an abbreviated Short Form Environmental Assessment. The crosswind runway however, and any development of new or expanded areas of the airfield (i.e. hangar areas) will need to be evaluated through a more detailed Environmental Assessment effort. With the finding on an Environmental Assessment typically being valid for three years, timing of this Phase 2 Environmental Assessment may be considered an update to the previous Phase 1 assessment. Coordination with the FAA to determine the appropriate combination of projects to include in each Environmental Assessment will be needed to ensure that the intent of NEPA's "cumulative effects analysis"[13] is met.

With the highly dynamic economy, uncertainty of the FAA funding programs and fluctuation in the air travel industry, a Master Plan Update should be pursued during the mid-term planning horizon. This update would reassess the assumptions contained in this Master Plan and allow the City to confirm and/or refine the ongoing development program for the Airport. This update would pay particular attention to changes in the market and experienced levels of user demand relative to the improvements performed earlier in Phase 1 and Phase 2. This would include evaluating the potential need and ability to develop the Airport to ARC C-II standards.

[13] FAA Order 5050.4B *NEPA Implementing Instructions for Airport Actions*, Section 706 "EA Format and Content"

6.1.3 Phase 3: Long-Term Planning Horizon (10-20 years)

This phase is more conceptual in nature and will ultimately be dependent on what actually occurs over the preceding ten years. The concepts presented for the long-term planning of the Airport are intended to provide a framework for what the potential ultimate airport build-out could be. In that context, this phase should support decisions made in the earlier planning periods so as to not preclude, or inhibit the flexibility of the City in meeting yet unforeseen opportunities and user demand. Specifically, the long-term potential of upgrading the airfield to accommodate a larger class of corporate aircraft (i.e., ARC C-II) should be factored into the nearer term facility developments. When pursuing land and easement acquisitions, consideration should also be given to the long-term potential of the Airport and the City should take advantage of opportunities that may arise to gain positive control of adjacent parcels and land uses that could provide a development buffer for the airport facilities and any aviation dependent users/businesses that would consider proximity to the Airport a desirable business factor. Specific projects that could be pursued in this phase include the environmental evaluation, design and land acquisition associated with developing Runway 9/27 to ARC C-II standards, continued airfield maintenance, and possible property acquisition to the southwest along U.S. 31.

6.2 PRELIMINARY COST ESTIMATES

Preliminary cost estimates have been prepared for each of the projects included in the Recommended Development Plan. These estimates are based on 2011 dollars and were derived from similar, recent airport improvement projects with the implied assumption that incomes and expenses will generally rise commensurate with inflation. These estimates are intended for planning purposes only and should not be construed as detailed construction cost estimates, which can only be compiled following the preparation of detailed design documentation. The recommended improvement projects, and associated costs, for each of the three development phases are identified in **Table 6-1**.

Estimations for land/easement acquisition costs are based on property market values as provided by the City of Charlevoix's Department of Planning and include all anticipated fees and services, including but not limited to, consultant negotiations/labor, replacement housing payment (RPH), moving expenses, attorney/title fees, closing costs, Environmental Due Diligence Audit (EDDA), appraisal, demolition/site clearing, and obstruction removal/tree clearing. Construction cost estimates include design/bid, materials, demolition, earthwork, erosion and sediment control, pavement markings, lighting, electrical, drainage and construction administration. Spreadsheets, outlining the property acquisition and construction cost assumptions and calculations are provided in **Appendix D**.

Table 6-1 – Recommended Development Plan and Preliminary Cost Estimates – By Phase

Year	Project Description	Total Cost ($)
Phase 1: Near-Term Planning Horizon (0-5 Years)		
	Runway Extension Program Development	50,000
	Environmental Assessment – Phase 1 Improvements & Runway 9-27 Extension	350,000
	AWOS Relocation	150,000
	Terminal Apron Reconfiguration	1,680,000
	Western Parallel Taxiway Extension	600,000
	Replacement Terminal Building	4,065,000
	T-Hangar Development – Midfield Complex 10 units	735,000
	Security Fencing	25,000
	Total Phase 1 Cost	7,655,000
Phase 2: Mid-Term Planning Horizon (5-10 Years)		
	Environmental Assessment – Phase 2 Improvements	380,000
	Extend Runway 9-27 and Parallel Taxiway (5,000', B-II)	3,385,000
	Group Hangar Development – Midfield Complex 1 unit (approx. 100'x100')	906,500
	Relocate NDB	70,000
	Crosswind Runway 15-33 (paved, 2,200') *(see notes 3 and 4)*	15,368,000
	Interior Access Road	550,000
	Master Plan Update	350,000
	Total Phase 2 Cost	21,009,500
Phase 3: Long-Term Planning Horizon (10-20 Years)		
	Environmental Assessment – Phase 3 Improvements	410,000
	Southwest Property Acquisition for Hangar Area Expansion	1,405,000
	Runway & Parallel Taxiway Extension (5,000' C-II)	41,060,000
	Total Phase 3 Cost	42,875,000
	Total Program Development Cost (Phases 1-3)	71,539,500

Prepared by: RW Armstrong & QoE Consulting, 2011

Notes:

1. Cost estimates include all associated property/easement acquisition, design and construction phase services.
2. Cost estimates are in 2011 dollars.
3. Includes order-of-magnitude property cost of $10 million for 13.6 acres of property from St. Mary's Cement Group. Additional engineering and appraisal would be needed to determine fee-simple purchase price. Cooperative acquisition strategy including potential land swap and negotiation with Michigan Department of Natural Resources, regarding state parks, may result in lower overall cost.
4. Does not include potential Part 77 easement and clearing costs associated with reoriented crosswind runway.
5. Could be combined with runway extension design/construction, possibly reducing overall cost.

6.3 COMPREHENSIVE AIRPORT CAPITAL IMPROVEMENT PROGRAM

The following table combines the specific Recommended Development Plan projects (Phases 1 and 2 only) derived from this master planning effort, as presented in **Table 6-1**, with the Airport's existing ACIP thereby creating a comprehensive, updated 10-year funding program. The federal, state and local funding sources identified in **Table 6-2** are further described in **Chapter 7**.

The actual timing or phasing of the specific projects, or project elements, may change in response to tenant/user demands, unforeseen business opportunities, changes in the regulatory environment and availability of federal and state funds. Care must also be taken to provide for adequate lead-time for detailed planning, permitting and construction to ensure that the proposed facilities are operational when warranted by the user demands. It is also important to minimize any disruptive scheduling where a portion of one facility may become inoperative due to construction and to prevent extra costs resulting from improper project scheduling.

Table 6-2 – Proposed 10 Year Airport Capital Improvement Program (ACIP)

	Item	Fiscal Year	Description	Total Cost ($)	FAA Share ($)		Sponsor Share ($)	State Share ($)	Remarks/ Item Justification
					Entitlement	Discretionary			
Phase 1	1	2012	Terminal Phase II (Enviro, contract docs, bid, etc.) – Design (100%) (CATEX)	330,000	313,500		8,250	8,250	
	2	2012	Environmental Assessment – Runway/Taxiway Extension, Terminal Apron Reconfiguration, Hangar Development	380,000	361,000		9,500	9,500	
	3	2012	Auto Parking Lot – Construct	250,000	237,500		6,250	6,250	An existing parking lot will be lost during the terminal expansion
	4	2012	Terminal Apron Reconfiguration – Design/Bidding	140,000	133,000		3,500	3,500	
	5	2012	Security Fencing	25,000	23,750		625	625	Close gaps in existing fence line
	6	2013	Replace Ex Terminal Building – Construction (96% FAA Elig)*	3,735,000	3,406,320		235,305	93,375	
	7	2013	AWOS Relocation	150,000	142,500		3,750	3,750	
	8	2013	Midfield T-Hangar (10-unit) – Design	90,000	25,650		62,100	2,250	Assume 30% FAA eligibility for site elements
	9	2013	Midfield T-Hangar (10-unit) – Construct	645,000	122,550		506,325	16,125	Assume 20% FAA eligibility for site elements
	10[1]	*2013*	*Crackseal & Paint Airside Pavements*	*50,000*	*47,500*		*1,250*	*1,250*	
	11	2014	Terminal Apron Reconfiguration - Construction	1,540,000	1,361,000	102,000	38,500	38,500	
	12	2014	Safety Management System (SMS) Plan	110,000		104,500	2,750	2,750	Required by new FAA program
	13	2015	Runway 9/27 & Taxiway Extension, 5000' (B-II) – Design	168,000	159,600		4,200	4,200	
	14	2015	AGIS Aerial Survey	160,000	152,000		4,000	4,000	To support runway extension and crosswind runway, per new FAA guidance
	15	2015	Parallel Taxiway Extension West – Design	100,000	95,000		2,500	2,500	Possibly combine w/ Runway Extension Design to reduce overall cost
	16	2015	Land/easements for Runway 9/27 extension – incl. Services, Fees, Relocation & Clearing (Phase-1)	699,000	593,400	70,650	17,475	17,475	
	17	2016	Land/easements for Runway 9/27 extension – incl. Services, Fees, Relocation & Clearing (Phase-2)	699,000	664,050		17,475	17,475	
			Phase I (2012-2016) Totals	**9,271,000**	**7,838,320**	**277,150**	**923,755**	**231,775**	
Phase 2	18	2017	Runway 9/27 & Taxiway Extension, 5,000' (B-II) – Construction	1,852,000	1,335,950	423,450	46,300	46,300	
	19	*2017*	*New Runway 9/27 Lighting (LED)*	*500,000*		*475,000*	*12,500*	*12,500*	*Replace existing runway lights*
	20	2017	9/27 Parallel Taxiway Extension to West – Construction	500,000		475,000	12,500	12,500	Possibly combine w/ Runway Extension Construction to reduce overall cost
	21	*2017*	*Reconstruct Apron (concrete) – Design*	*150,000*		*142,500*	*3,750*	*3,750*	
	22	2018	Environmental Assessment – Crosswind Runway, Hangar Development, Security Fencing	380,000	361,000		9,500	9,500	
	23	2018	Midfield Group Hangar – Design	100,000	28,500		69,000	2,500	Assume 30% FAA eligibility for site elements
	24	*2018*	*Fuel Farm Addition*	*500,000*	*475,000*		*12,500*	*12,500*	
	25	2019	Land/easements for Crosswind Runway 15/33 – incl. Services, Fees, Relocation & Clearing (Phase-1)	1,059,000	1,006,050		26,475	26,475	**Cost does not include approach easements or St. Mary's property**
	26	2019	Midfield Group Hangar – Construction	806,500	76,500	76,734	633,103	20,163	Assume 20% FAA eligibility for site elements
	27	*2019*	*Reconstruct Apron (concrete) – Construction*	*1,200,000*		*1,140,000*	*30,000*	*30,000*	
	28	2020	Land/easements for Crosswind Runway 15.33 – incl. Services, Fees, Relocation & Clearing (Phase-2)	1,059,000	1,000,000	6,050	26,475	26,475	**Cost does not include approach easements or St. Mary's property**
	29	2020	Land/easements for Crosswind Runway 15/33 – incl. Services, Fees, Relocation & Clearing (Phase-3)	10,000,000		9,500,000	250,000	250,000	Assumes $10 million for 13.6 acres of St. Mary's property (fee simple). Additional Engineering, negotiation and appraisals will likely alter this cost estimate.
	30	2020	Crosswind Runway 15/33 – Design	268,600		255,170	6,715	6,715	
	31	*2020*	*Pave Gravel Parking Lot (free public parking) Phase II – Construct*	*300,000*		*285,000*	*7,500*	*7,500*	*Designed in 2011 per Airport Capital Improvement Program (ACIP)*
	32	2021	Crosswind Runway 15/33 – Construction	2,981,400	1,000,000	1,832,330	74,535	74,535	
	33	2021	Relocate NDB	70,000		66,500	1,750	1,750	
	34	2021	Master Plan Update	350,000		332,500	8,750	8,750	
	35	2021	Security Fencing – Design/Construct	160,000		152,000	4,000	4,000	For newly acquired parcels (+/- 6200 lf)
	36	2021	Interior Access Road – Design/Construct	550,000		522,500	13,750	13,750	(+/- 3800 lf) coordinate with relocated St. Mary's ROW and Lake to Lake Trail
	37	2021	Crackseal & Paint Airside Pavements	50,000		47,500	1,250	1,250	
			Phase 2 (2017-2021) Totals	**22,836,500**	**5,283,000**	**15,732,234**	**1,250,353**	**570,913**	

Notes: Estimates are in 2011 US Dollars and have not been adjusted for inflation.
Entitlement funds assumes $1million per year with a 2012 starting balance available of ±$3.17 million

[1] Italicized projects were carried over from existing ACIP and are not specifically included in the projects recommended by this Master Plan.

7 FINANCIAL ANALYSIS

As described in **Section 6.3**, the total projected cost in 2011 dollars for the Airport's comprehensive ACIP is approximately $32,107,500 over the next 10 years. **Table 7-1** provides a summary of the gross project costs and anticipated funding requirements by year.

Table 7-1 – ACIP Project Costs and Funding Sources

Year/Phase	Projected Costs	Federal[1]		Local Sponsor	State
		Entitlement	Discretionary		
2012	$1,125,000	$1,068,750	$0	$28,125	$28,125
2013	$4,670,000	$3,744,520	$0	$808,730	$116,750
2014	$1,650,000	$1,361,000	$206,500	$41,250	$41,250
2015	$1,127,000	$1,000,000	$70,650	$28,175	$28,175
2016	$699,000	$664,050	$0	$17,475	$17,475
Subtotal Phase I	**$9,271,000**	**$7,838,320**	**$277,150**	**$923,755**	**$231,775**
2017	$3,002,000	$1,335,950	$1,515,950	$75,050	$75,050
2018	$980,000	$864,500	$0	$91,000	$24,500
2019	$3,065,500	$1,082,550	$1,216,734	$689,578	$76,638
2020	$11,627,600	$1,000,000	$10,046,220	$290,690	$290,690
2021	$4,161,400	$1,000,000	$2,953,330	$104,035	$104,035
Subtotal Phase II	**$22,836,500**	**$5,283,000**	**$15,732,234**	**$1,250,353**	**$570,913**
Total ACIP (2012-2021)	**$32,107,500**	**$13,121,320**	**$16,009,384**	**$2,174,108**	**$802,688**

Notes: Cost estimates are intended for preliminary planning purposes and do not reflect a detailed engineering evaluation.

[1] Federal funds include the FAA Airport Improvement Program (AIP).

Source: RW Armstrong

It must be recognized that the projected ACIP costs are only a programming analysis and not a commitment on the part of the City, State, or the FAA. Before detailed planning on a particular project is developed, identification of the potential funding sources is needed to ensure that sufficient resources are available for the proposed improvements. If the cost of a project is not financially feasible, it should be deferred. To this end, the following provides a description of the potential ACIP funding sources and a pro-forma financial projection for the Airport through 2021.

7.1 FUNDING SOURCES OF THE CIP

Potential funding sources for the proposed improvements include a variety of federal, state, and local sources. Many of the available funds come in the form of grants, should the project meet eligibility requirements. Funding for an airport project need not be limited to a single source or single FAA grant. At the discretion of the City, and through coordination with the various funding agencies and stakeholders, multiple sources for the required capital can be used to finance the project either in whole, or on a respective pro-rata share basis. Additional financing options are available in the form of bonds or other debt vehicles. Note that private funding may be required to some extent to facilitate hangar development or other revenue generating projects; any private funds would reduce the Airport's CIP liability. Potential funding sources for the proposed airport improvements include:

- FAA Airport Improvement Program (AIP)
- Michigan Department of Transportation Funding Assistance
- Airport Revenue
- Private, Third-Party Investment or Financing
- Airport Bonds
- City Funds
- Federal Earmarks

7.1.1 Federal Grants

Administered by the FAA, the federal Airport Improvement Program (AIP) provides grants to public agencies for planning and developing public-use airports. AIP grants are funded through the national Aviation Trust Fund. FAA guidance indicates that eligible projects, or eligible portions of projects, can receive up to 95 percent of the cost from AIP funds. AIP funds can be used for most airport improvement needs (i.e., capital improvements) but not operating costs. Also note that, as a rule, AIP funds are only available for public-use facilities and not for those to be primarily used by a private business or organization. Projects of this kind typically include hangars, fixed-based operator (FBO) facilities, fuel storage, exclusive aircraft parking aprons, industrial aviation use facilities, non-aviation office, commercial or industrial developments, and other similar or revenue generating projects. Depending on the project specifics, revenue generating type improvements may however be partially eligible for funding depending on that project's involvement with other public use facilities or operational safety aspects of the Airport.

AIP grants represent a critical capital funding source to implement the projects recommended in this Master Plan. Although the future status of the AIP is currently uncertain, for the purpose of this Master Plan, it is assumed that the AIP will continue to be authorized and appropriated at levels consistent with the FY 2011 AIP appropriation.

The AIP consists of apportioned funds and discretionary funds. Apportioned funds, or entitlement funds, are allocated to an airport based upon its number of annual enplanements and the amount of landed weight of arriving cargo, while discretionary funds are distributed on an FAA priority basis. Charlevoix Municipal Airport is classified as a non-hub primary commercial service airport, and as such is eligible for both entitlement and discretionary funds.

With over 10,000 yearly enplanements, CVX is eligible for up to $1.0 million of entitlement funds annually. Based on the forecasted enplanements and operations, it is assumed that the Airport will receive $10.0 million in entitlement AIP grants from 2012 through 2021. As of August 2011, CVX has a banked amount of $3.1 million in entitlement funds available, that will carry over to FY 2012. Therefore, the base amount of entitlement funds available to CVX for FY 2012 will be approximately $4.1 million.

Additional discretionary funds are also available on a case-by-case basis. Each fiscal year, entitlement funds not used during the fiscal year are redistributed to other airport sponsors as discretionary funds.

As shown on **Table 7-1**, federal grants are estimated to be approximately $29.1 million from 2012 through 2021 to finance projects in the ACIP, at up to 95% of the total project costs. Of this amount, $13.1 million is assumed to be funded with entitlement grants and approximately $16.0 million with discretionary grants.

7.1.2 State Funding Assistance (MDOT)

The State of Michigan through the Michigan Department of Transportation (MDOT) Office of Aeronautics and Freight Services provides several aviation funding sources in addition to local share matching grants. The State of Michigan receives revenue to support aviation programs and services from aviation fuel taxes and user fees. Some of this revenue is used to provide a portion of the non-federal matching fund requirement associated with the federal AIP program - generally requiring the local airport to pay 2.5 percent of eligible costs, with the remainder of the eligible costs paid by the State. The State also administers the following five programs that provide funding to a specific group of airports or for a specific purpose:

- **Crack Sealing and Paint Marking** - The state provides up to 50 percent of a project's eligible cost for crack sealing and paint marking for runways. Funding is limited to $15,000 over any consecutive three year period.

- **Small Airports Program** - This program is open to airports with less than 100 based aircraft and/or one with less than 10,000 annual commercial enplanements. This opens up funding opportunities for some airports that are not eligible for federal assistance. The program provides funding for up to 90 percent of the eligible cost of projects that are important to the airport and the *Michigan Airport System Plan* (MASP). With over 10,000 enplanements, CVX is currently not eligible for this program.

- **Airport Loan Program** - Publicly owned airports in Michigan may borrow up to $100,000 for capital improvements through this program (i.e., the outstanding balance of any airport is limited to $100,000). Loans must be paid back within 10 years and each airport must pay at least 10 percent of the cost of the project for which funds are borrowed.

- **Safety and Security Program** - This program provides state funds for safety and security projects, which are matched with local funds on a 90/10 percent basis for non-hub primary and large general aviation airports and on a 95/5 percent basis for small general aviation airports.

- **Michigan Air Service Program** - The goals of the Air Service program are to sustain and/or improve existing levels of commercial air service to increase accessibility of Michigan's recreational, business and industrial centers, improve efficiency of handling scheduled passengers and cargo at air carrier airports, heighten awareness of the airport's role in supporting community growth and economic development, and secure increased federal entitlement funds for airport improvements through increased passenger enplanements. The program funds projects for capital improvement and equipment, carrier recruitment and retention, and airport awareness activities. Local matching requirements apply. The amount of match required varies by project type and the size of the airport (as measured by the number of enplanements).[14]

7.1.3 Private Investment and Private Financing

Many airports use private third-party investment, or third-party financing, when the planned improvements will primarily be used by a private business or other organization. As described in **Section 7.1.1**, such projects are not ordinarily eligible for federal AIP funding other than for specific site improvement elements. Often, airport funds for infrastructure, preliminary site work, and site access are required to facilitate privately developed projects on airport property. In some situations, private third-party financing may be used as the sole funding source by the airport sponsor, should the business case support such a venture.

Though the ACIP does not specifically call out the need for private capital for the completion of its listed projects, proposed hangar development in the Midfield Complex is a likely candidate for private development funding. For the purposes of ACIP planning, it is estimated that Federal AIP funds will be available for portions of the site development elements (i.e., ramp and taxiway); at 30 percent of the planning and design costs, and 20 percent of the construction costs for each hangar project. The remaining costs will be the responsibility of the Airport, State, City, private developers, or possibly a public-private partnership.

[14] Michigan Aviation System Plan, 2008

7.1.4 General Airport Revenue Bonds

Bonds, or debt securities, are common in the U.S. airport system and are typically used for funding large improvement projects. Airport revenue-backed bonds, issued and guaranteed by the City, are a potential funding source for financing some of the ACIP projects such as land acquisition, runway extension, crosswind runway or a combination of multiple projects. The Airport generates revenue through airline leases and fees, ground and facility leases, fuel sales, landing fees, and ramp fees. Typically, such revenues are used to cover operations and maintenance expenses along with debt servicing obligations. However, any surplus revenues can be applied directly to airport projects or earmarked for new revenue-backed bonds issued for specific projects. As shown on **Table 7-1**, approximately $2.2 million in local funding will be required from 2012 through 2021. This analysis assumes that all of the local funding requirement will be funded from airport revenues if possible; however, the City may consider issuing airport revenue backed bonds to spread the costs over multiple years.

7.1.5 Other Potential Funds

City Funds

At the discretion of the City, general revenue funds may be used to fund individual projects or used to meet the match requirements of AIP grants.

Airport Land Sales

The proceeds from any sale of airport land may be applied to the financing needs of an airport project. Note, however, that any sale of airport land is subject to the approval of the FAA. Typically, the FAA will approve airport land sales if it is demonstrated that the land is not needed for aeronautical purposes and the proceeds of the sale will be reinvested in the airport. At this point, no areas of the airfield have been identified as areas for potential land sale.

Federal Earmarks

Federal dollars can be assigned to specific local projects during the annual appropriations process (the budgeting of funds for discretionary projects and programs). Any airport project seeking such funds will need a sponsor at the Federal level (a local U.S. House Representative or U.S. Senator) to request the project funding in the Federal appropriations bill, and champion said project through the appropriations process.

7.2 FINANCIAL FEASABILITY

The final funding source of the ACIP is cash reserves (i.e., local match requirements and for AIP non-eligible projects). This section of the financial analysis presents the existing debt service, projected operating expenses, and projected revenues resulting from the

daily operation of the Airport. In addition, the expense and revenue increases resulting from the implementation of the ACIP are layered into the projections to determine if it is feasible for the Airport to undertake the program within the FY 2011 through FY 2021 planning period.

7.2.1 Debt Service

The Airport currently has two outstanding sources of debt that are expected to be retired by 2018. Payments totaling $30,500 annually on an outstanding bond are expected through 2013, with the final payment of $18,200 expected to occur in 2014. In addition, a low interest $100,000 advance from the local electric utility is expected to be retired in $25,000 annual increments by 2018. However the repayment of this debt can occur at the City's discretion; due to the low interest rate (1.0 percent annually), the City may choose to defer payments with limited financial impact.

7.2.2 Estimated Fuel Sales and Revenue

Fuel sales estimates for this analysis were developed from the based aircraft forecasts coupled with forecasted national average annual fuel consumption by aircraft type, as presented in the 2011 *FAA Aerospace Forecast*. Adjustments were made for the anticipated higher utilization rate of CVX multi-engine piston aircraft due to their use in regular air taxi operations. **Table 7-2** estimates the Airport's fuel sales in gallons and the associated net revenue based on an escalating target margin per gallon. The results of this analysis are included in the Airport's pro-forma financial analysis.

Table 7-2 – Fuel Sales Forecast

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Based Aircraft										
Single Engine Piston	19	19	19	19	19	19	19	19	19	19
Multi-Engine Piston	5	5	5	5	5	5	5	5	5	5
Turbo Prop	2	2	2	2	2	2	2	2	2	2
Jet	2	2	2	2	2	2	3	3	3	3
Rotor	1	1	1	1	1	1	1	1	1	1
Estimated Gallons of Fuel per Based Aircraft per Year (in thousands)										
Single Engine Piston	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Multi Engine Piston	10.2	10.2	10.0	9.7	9.5	9.4	9.3	9.2	9.2	9.1
Turbo Prop	21.1	20.9	21.0	20.9	20.5	20.4	20.3	20.0	20.0	19.9
Jet	109.5	117.3	116.7	115.9	115.3	114.3	112.9	111.8	110.7	109.6
Rotor	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Estimated Gallons of Fuel Sold per Year (in thousands)										
Single Engine Piston (100LL)	17.6	17.3	17.0	16.6	16.4	16.3	16.2	16.2	16.2	16.2
Multi Engine Piston (100LL)	51.2	51.1	50.0	48.4	47.5	47.0	46.5	46.1	46.0	45.7
Turbo Prop (Jet A)	42.2	41.8	41.9	41.8	41.0	40.7	40.6	40.0	40.0	39.8
Jet (Jet A)	219.1	234.7	233.4	231.8	230.6	228.6	338.7	335.3	332.2	328.9
Rotor	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Total Gallons	**346.5**	**361.3**	**358.7**	**355.0**	**352.0**	**349.0**	**458.4**	**454.0**	**450.8**	**447.1**
Target Margin Per Gallon	$0.70	$0.71	$0.73	$0.74	$0.76	$0.77	$0.79	$0.80	$0.82	$0.84
Estimated Fuel Revenue	**$242,529**	**$257,979**	**$261,218**	**$263,687**	**$266,682**	**$269,750**	**$361,366**	**$365,040**	**$369,752**	**$374,022**

Source: RW Armstrong, 2011

7.3 PRO FORMA CASH FLOW

Table 7-3 presents the pro-forma cash flow of the Airport for 2012 through 2021 based on the projection of operating revenues and operating expenses. As a result of the analysis discussed herein, net revenues are anticipated to increase from approximately $383,000 in 2012 to approximately $547,000 by 2021. Projected expenses, including the servicing of existing debt, will increase from $331,000 in 2012 to $348,000 in 2021. A 2.0 percent annual increase based on CPI projections was applied to both revenue and expenses unless otherwise noted. Revenue generated from new hangar facilities, and associated maintenance expenses, are accounted for in the year in which they are programmed.

Total airport income after payment of debt service is the amount that may be used to pay the local share of the ACIP or that may be deposited in the Airport's unrestricted account. Total airport net income is projected to increase from approximately $53,000 in 2012 to approximately $199,000 in 2021.

Table 7-3 – Pro Forma Cash Flow

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Revenues ($)										
Property	23,937	24,176	24,418	24,662	24,909	25,158	25,410	25,664	25,920	26,180
Airport Permits	29,492	38,787	48,085	48,566	49,051	49,541	50,037	56,537	57,102	57,673
Hangar Rents	6,767	6,835	6,903	6,972	7,042	7,112	7,184	7,255	7,328	7,401
Land Lease	55,550	50,000	50,500	51,005	51,515	52,030	52,550	53,076	53,607	54,143
Parking Fees	25,000	25,250	25,503	25,758	26,015	26,275	26,538	26,803	27,071	27,342
Tie Down/Landing Fees	242,529	257,979	261,218	263,687	266,682	269,750	361,366	365,040	369,752	374,022
Net Fuel Profit	383,275	403,027	416,627	420,650	425,213	429,867	523,084	534,375	540,780	546,761
Gross Revenue ($)	**23,937**	**24,176**	**24,418**	**24,662**	**24,909**	**25,158**	**25,410**	**25,664**	**25,920**	**26,180**
Expenses ($)										
Personnel Expenses	206,899	210,982	215,147	219,395	223,727	223,780	228,255	232,820	237,477	242,226
Supplies	1,500	1,500	1,500	1,500	1,500	1,500	1,530	1,561	1,592	1,624
Professional Services	10,000	10,140	10,283	10,428	10,577	10,577	10,789	11,004	11,224	11,449
Utilities & Phone	28,254	28,819	29,395	29,983	30,583	30,583	31,195	31,819	32,455	33,104
Insurance	18,870	19,247	19,632	20,025	20,425	20,425	20,834	21,250	21,675	22,109
Fuel Farm	20,800	20,800	20,800	20,800	20,800	20,800	20,800	20,800	20,800	20,800
Maintenance	6,560	7,661	7,785	7,910	8,038	8,103	8,265	9,430	9,619	9,811
Miscellaneous	6,200	6,200	6,200	6,200	6,200	6,200	6,324	6,450	6,579	6,711
Debt Services	31,500	19,200	44,700	1,500	26,000	26,000	26,000	0	0	0
Gross Expenses ($)	**330,583**	**324,549**	**355,442**	**317,741**	**347,850**	**347,967**	**353,991**	**335,135**	**341,421**	**347,834**
Net Income/(Loss) ($)	**52,692**	**78,478**	**61,185**	**102,909**	**77,364**	**81,900**	**169,093**	**199,241**	**199,359**	**198,927**

Source: RW Armstrong, 2011

7.4 SUMMARY

The financial projections were prepared on the basis of available information and assumptions set forth in this chapter. It is believed that such information and assumptions provide a reasonable basis for the projections to the level of detail appropriate for this Airport Master Plan. Based on these assumptions, the ACIP could be financed in the future by the City and result in key financial indicators that are consistent with the historical results of the Airport and industry comparables. However, some of the assumptions used to develop the projections may not be realized, and unanticipated events or circumstances may occur. Therefore, the actual results will vary from those projected, and such variations could be material.

8 AIRPORT PLANS

This Master Plan Study has resulted in a comprehensive long term development plan for the Charlevoix Municipal Airport. Evaluations of major airport facilities have been documented in the various chapters of this report. The Airport Layout Plan (ALP) drawing set is a graphical representation resulting from the findings in this report. The drawing set is an invaluable tool for the City, Airport Management, FAA, MDOT, and the general public for understanding the airport facilities, the standards by which the Airport is subject to, and the future and potential ultimate "build-out" plans for the Airport. The drawing set must be approved by the City of Charlevoix, the FAA Great Lakes Region and the MDOT Bureau of Aeronautics. In order for improvement projects to be eligible for federal Airport Improvement Program (AIP) funding, the projects must appear on a FAA-approved ALP. Pending FAA approval of the proposed projects, this ALP will serve as the guide for the ongoing development program at CVX.

The ALP drawing set is being prepared under a separate contract from this Master Plan and by a separate consultant. It is comprised of fifteen sheets, each of which is briefly described in the subsequent sections. These plans were prepared in accordance with FAA Advisory Circular 150/5070-6B, *Airport Master Plans*, Advisory Circular 150/5300-13, *Airport Design*, and the guidance in the FAA Great Lakes Region *Policy & Procedures Memorandum 5310.1* and associated *ALP Review Checklist* (dated 10/01/06). The drawings in the CVX ALP set include:

- Title Sheet
- Airport Data Sheet
- Existing Airport Layout
- Future Airport Layout Plan
- Ultimate Airport Layout Plan
- Airport Building Layout – West Side
- Airport Building Layout – East Side
- Existing Runway 9/27 Inner Approach Profile
- Future Runway 9/27 Inner Approach Profile
- Existing Runway 4/22 Inner Approach Profile
- Future Runway 15/33 Inner Approach Profile
- Obstruction Table Sheet
- FAR Part 77 Sheet
- Land Use Plan
- "Exhibit A" Airport Property Map

The following paragraphs describe the specific elements found on each drawing sheet. A reduced, or half-size, drawing set of the ALP is provided in **Appendix I**.

8.1 TITLESHEET

This introductory sheet provides basic information about the Airport and serves as the front cover for the ALP set. Information identified consists of a drawing set index, FAA, State, and City approval signature blocks, location maps, and other pertinent information required by the ALP Checklist. Also shown is the FAA grant number and disclaimer statement. The Title Sheet is identified as Sheet 1.

8.2 AIRPORT DATA

The Airport Data Sheet includes general airport data and detailed runway, taxiway and approach system data. The data includes the Airport Reference Code (ARC) which identifies the largest group of aircraft expected to operate at the Airport and therefore establishes the appropriate facility design standards. Also included are meteorological data and wind roses for all weather, visual flight rules (VFR) and instrument flight rules (IFR) weather conditions. All tables give information on existing, future, and potential ultimate conditions. Future information is based on the assumption that the improvements described in the previous chapters will be implemented. Ultimate information is conceptual in nature and represents a potential scenario of what the long-term future of the Airport could be, should sufficient user demand develop over that time. The Airport Data Sheet is identified as Sheet 2.

8.3 EXISTING AIRPORT LAYOUT

The Existing Airport Layout Plan details the existing conditions found at the Airport during this Master Planning process. This sheet identifies airfield pavements and associated clearances; critical areas; property line; terminal, support, and ancillary facilities; and ground access infrastructure. This sheet also identifies all existing buildings and, if available, the heights of these buildings as determined from aerial surveys. The Existing Airport Layout Plan is identified as Sheet 3.

8.4 FUTURE AIRPORT LAYOUT PLAN

The Future Airport Layout plan graphically depicts the Airport layout and proposed improvements to the Airport throughout the 20-year planning period. Included in the plan are: proposed airfield pavements with associated clearances, critical areas and dimensions; proposed terminal area improvements with support and ancillary facilities identified; and recommended ground access infrastructure improvements. The Future Airport Layout Plan is identified as Sheet 4.

8.5 ULTIMATE AIRPORT LAYOUT PLAN

The Ultimate Airport Layout Plan graphically depicts the long-term potential of upgrading the Airport to ARC C-II design standards should it become warranted and justifiable in the future. This sheet is prepared to support the FAA and the Airport in their off-airport land use planning and airspace protection activities. While, this sheet presents a concept for the long-term development potential of the Airport, a future Master Plan Update Study is recommended in the seven to ten year timeframe to reevaluate the need for such improvements. The Ultimate Airport Layout Plan is identified as Sheet 5.

8.6 BUILDING LAYOUT (EAST AND WEST SIDE)

Because of the scale of the Existing and Future Airport Layout Plan sheets, it is often difficult to clearly illustrate all of the proposed improvements. The Building Layout Sheets depict the proposed development at a larger scale for both the east and west sides of the airfield. These sheets focus on the terminal area and the midfield development area facilities and do not include all areas of the Airport. The Building Layout (East and West Side) Sheets are identified as Sheet 6 and Sheet 7.

8.7 EXISTING AND FUTURE RUNWAY 9/27 INNER APPROACH PROFILE

The Inner Approach Profile Sheets illustrate the plan and profile view of the existing and future inner Approach Surfaces of Runway 9/27. Each plan view depicts the boundaries of the Part 77 Approach Surface, the Appendix 2 Threshold Siting and Departure Surfaces, and the location of all significant objects enclosed by this area. The profile view depicts the appropriate Part 77 and Appendix 2 approach and departure surfaces, terrain profiles along the extended runway centerline, and the height of identified significant objects. A separate table identifies significant objects by type, overall height and degree of surface penetration (Sheet 12). It also identifies the proposed disposition of the object if it is determined to be an obstruction. The Existing Runway 9/27 Inner Approach Profile Sheet is identified as Sheet 8. The Future Runway 9/27 Inner Approach Profile Sheet is identified as Sheet 9.

8.8 EXISTING RUNWAY 4/22 INNER APPROACH PROFILE

This Inner Approach Profile Sheet illustrates the plan and profile view of the existing future inner Approach Surfaces of Runway 4/22. Each plan view depicts the boundaries of the Part 77 Approach Surface, and the location of all significant objects enclosed by this area. The profile view depicts the appropriate Part 77 Approach Surfaces, terrain profiles along the extended runway centerline, and the height of identified significant objects. A separate table identifies significant objects by type, overall height and degree of surface penetration, and the proposed disposition of the object if it is determined to

be an obstruction (Sheet 12). Since this runway is projected to be closed, no future inner approach profile was created. The Runway 4/22 Inner Approach Profile Sheet is identified as Sheet 10.

8.9 FUTURE RUNWAY 15/33 INNER APPROACH PROFILE

This Inner Approach Profile Sheet illustrates the plan and profile view of the future inner Approach Surfaces of Runway 15/33. Runway 15-33 is the proposed crosswind runway replacement for the turf Runway 4/22. Each plan view depicts the boundaries of the Part 77 Approach Surface and the location of all significant objects enclosed by this area. The profile view depicts the appropriate Part 77 Approach Surfaces, terrain profiles along the extended runway centerline, and the height of identified significant objects. A separate table identifies significant objects by type, overall height and degree of surface penetration, and the proposed disposition of the object if it is determined to be an obstruction (Sheet 12). The Runway 15/33 Inner Approach Profile Sheet is identified as Sheet 11.

8.10 OBSTRUCTION TABLE SHEET

The Obstruction Data Sheet outlines the significant objects identified in the Inner Approach Profile Sheets (Sheets 8 through 11). Each object is identified by its type, top elevation, penetration depth, and the proposed action. The Obstruction Table Sheet is identified as Sheet 12.

8.11 PART 77 SHEET

Federal Aviation Regulations (FAR) Part 77, *Objects Affecting Navigable Airspace,* regulates the airspace surrounding airports through the establishment of "Imaginary Surfaces," which include the Primary, Approach, Transitional, Horizontal, and Conical Surfaces. These surfaces are defined and discussed in **Chapter 4**. This drawing depicts the FAR Part 77 Imaginary Surfaces for Charlevoix Municipal Airport based on the future recommended airside development. Dimensions of most of the surfaces are controlled by the category of approach planned for each runway (i.e., visual, non-precision or precision). Penetration of these surfaces by fixed or moveable objects constitutes an obstruction to air navigation. Part 77 standards assist in protecting navigable airspace from encroachments by obstructions that may be detrimental to safe airport operations. In addition to the extents of the Imaginary Surfaces, this sheet identifies known obstructions within the airspace surrounding the Airport. The FAR Part 77 Plan is identified as Sheet 13.

8.12 LAND USE PLAN

The future land uses associated with CVX and the surrounding area are identified in the Land Use Plan. For planning purposes, this sheet identifies future on- and off-airport land uses that are expected to be adopted by the Airport and City. The on-airport land uses are associated with all areas within the proposed property line and consist of:

- Airfield Operations;
- General Aviation Use;
- Terminal Area Use;
- Support Facility Use; and
- Non-Aviation Related Use.

The Land Use Plan also identifies the land uses outside of the proposed property limits and includes existing and future anticipated noise levels. These noise levels serve as a planning tool to ensure land use compatibility around the Airport. The types of land use associated with this plan include:

- Residential;
- Commercial;
- Industrial;
- Public Facilities;
- Agricultural; and
- Mineral District.

The Land Use Plan is identified as Sheet 14.

8.13 "EXHIBIT A" AIRPORT PROPERTY MAP

The "Exhibit A" Airport Property Map identifies all property currently owned and proposed for purchase (both in fee simple and avigation easement) throughout the planning horizon. The current property boundaries, as depicted, were obtained from the City of Charlevoix and the Charlevoix Township property records; no specific plat survey or title searches were performed under this Master Plan Study. The Airport Property Map is identified as Sheet 15.