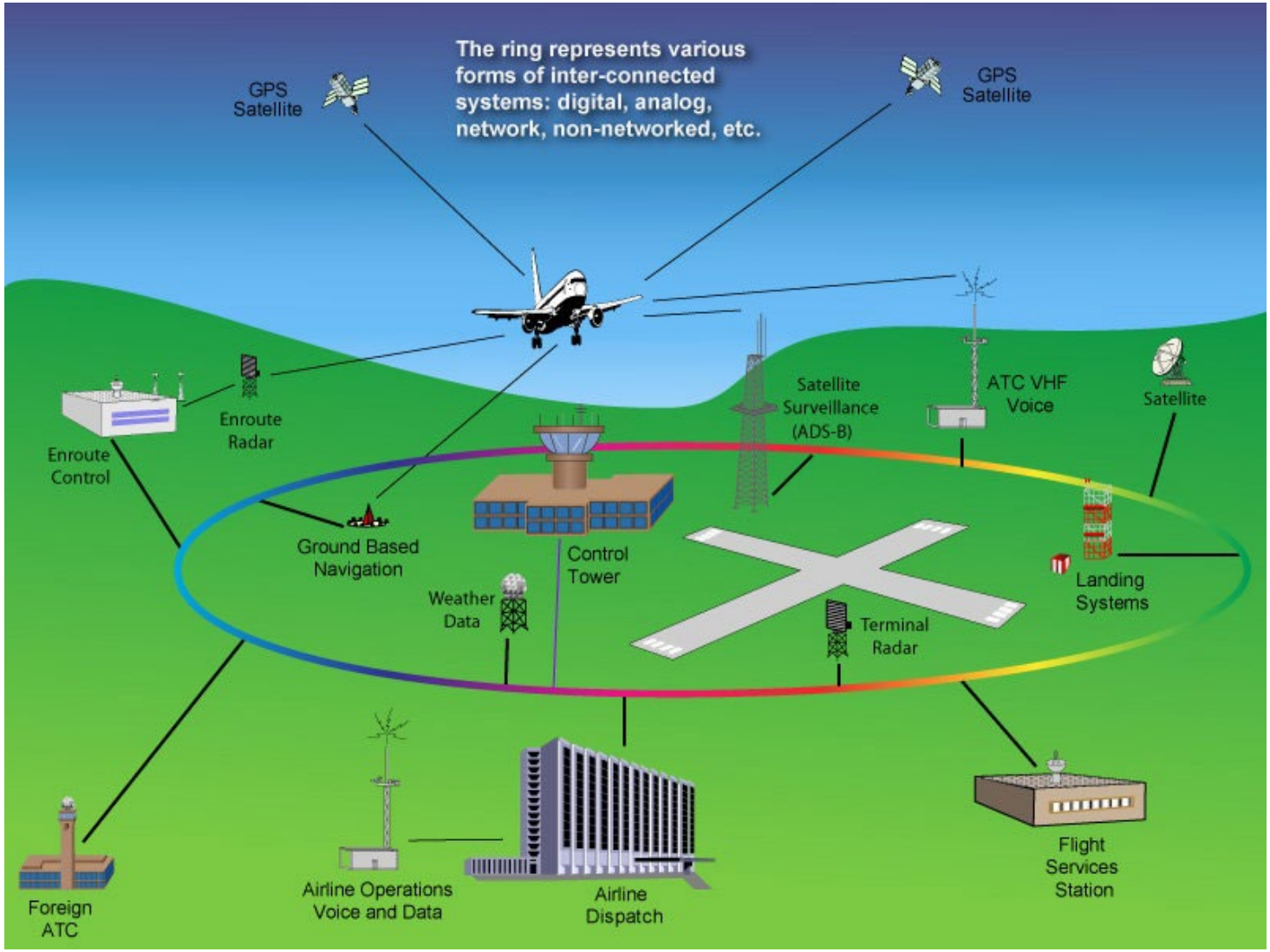
Intro to Small Unmanned Aircraft Systems & Recreational Drones

The mission of the FAA is **to provide the safest, most efficient aerospace system in the world** to satisfy the aviation needs of the United States

The FAA controls the **National Airspace System (NAS)**, which is a network of both controlled and uncontrolled airspace over land and sea. It includes air navigation, airports, aeronautical charts, information services, rules & regulations, procedures, and manpower & material.

National Airspace System (NAS)



Airspace & Drone Pilots

The FAA requires all drone pilots to have a basic understanding of the National Airspace.

The Part 107 Certified Remote Pilot test includes National Airspace questions. You must be able to proficiently read and understand the information and data on the FAA sectional charts used by Visual Flight Rule (VFR) pilots.

Airspace Classes

Class A – Airspace from 18,000 to 60,000 feet (MSL)

Class B – Large Airports with control tower

Class C – Medium Sized Airports with control tower

Class D – Small Airports with control tower

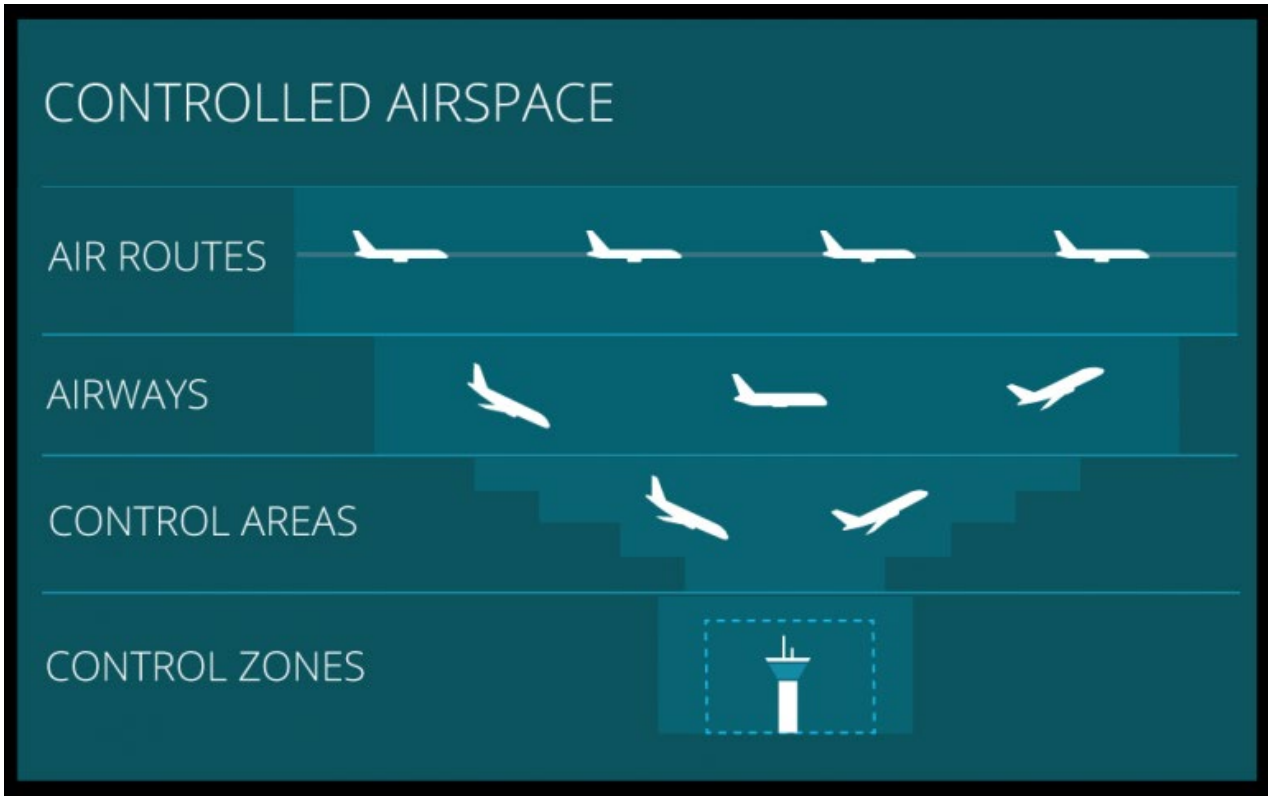
Class E – Small Airports or surface (SFC) & lateral airspace

Class G – Uncontrolled (ground up to controlled airspace)

* There is no **Class F** airspace in the US.

Controlled Airspace

Air Traffic Control services are provided in Controlled Airspace. The level of control varies with different classes of airspace.



Class A Airspace

- Not an issue for drone pilots – info only
- From 18,000 feet (MSL) to 60,00 feet (MSL)
- Instrument Flight Rules (IFR) only
- Altitudes are in “Flight Levels” not “Feet”
  - Flight Level 200 = 20,000 feet
  - Flight Level 500 = 50,000 feet

MSL = above Mean Sea Level

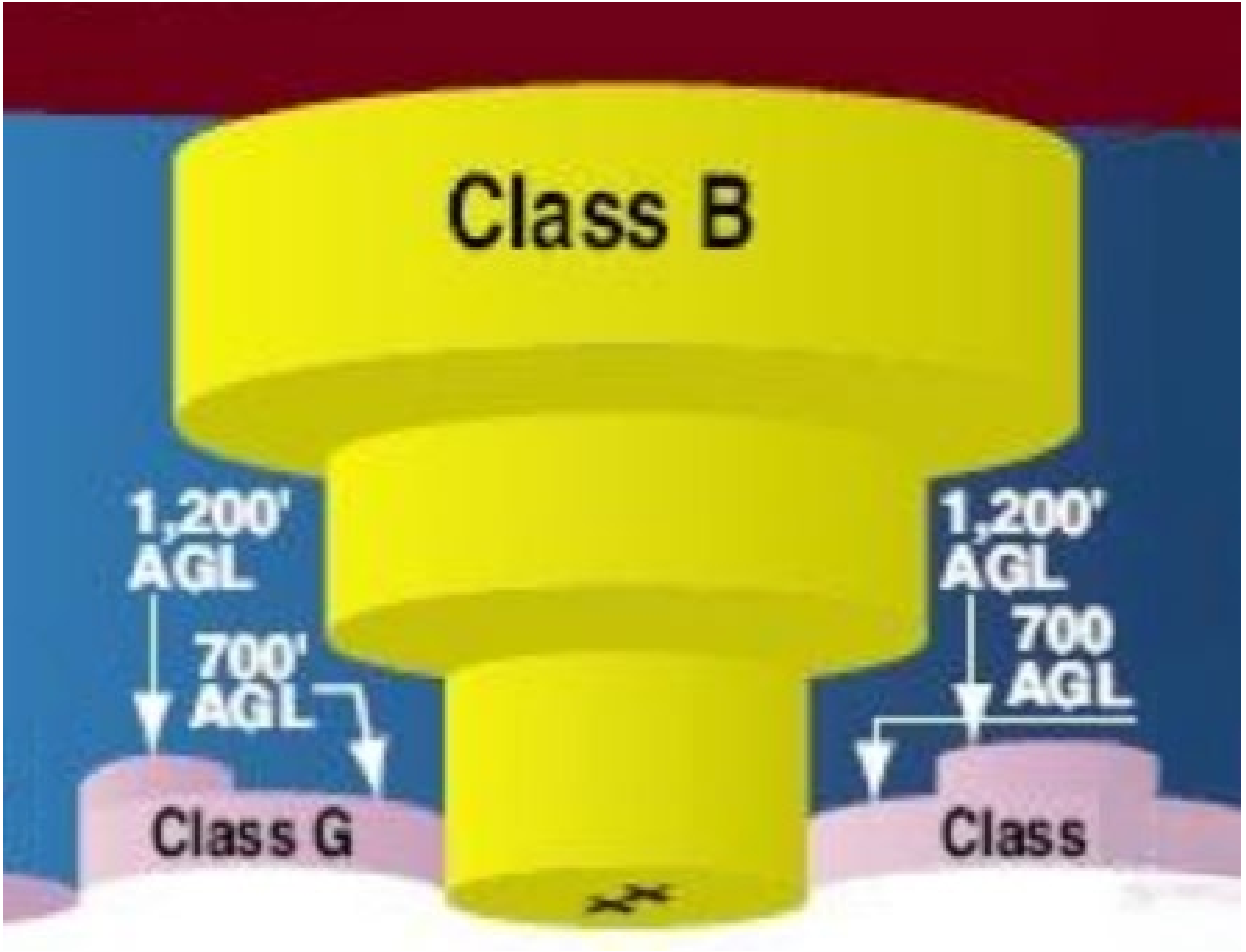
AGL = Above Ground Level

ALO is 873 feet above MSL

Class B Airspace

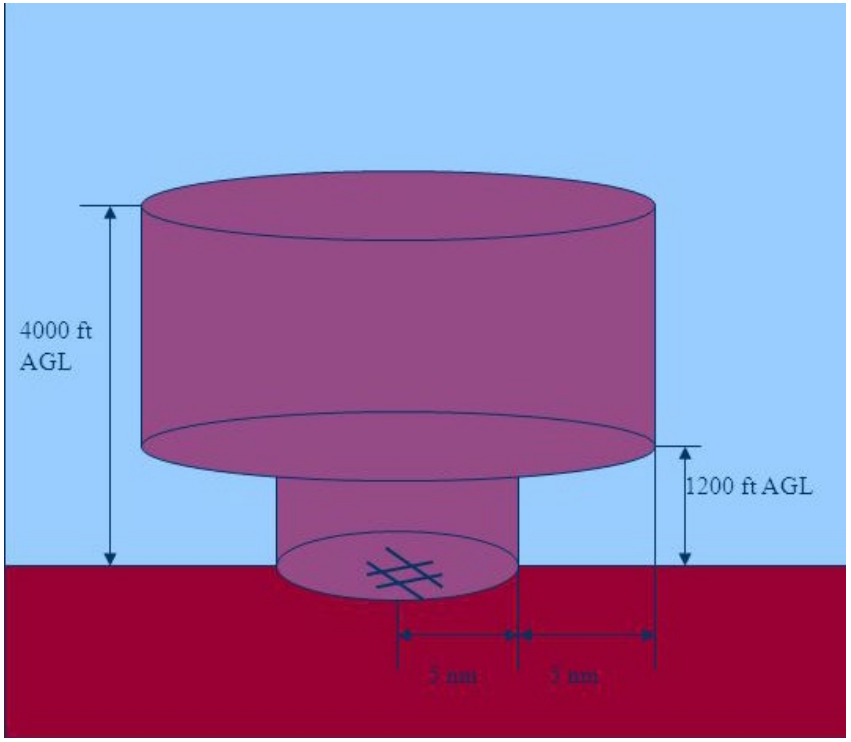
- Busiest Airports and Airspace
- Control from surface to 10,000 feet (AGL)
- Diameter of 30 NM (34.5 statute miles)
- There are 37 Class B airports in the USA. The nearest Class B airports are:
  - **ORD** – Chicago O'Hare
  - **MSP** – Minneapolis / St. Paul
  - **STL** – Lambert St. Louis
  - **MCI** – Kansas City

- Limited VFR allowed
- Information provided on Terminal Area Charts (TAC)


Class B
1,200'
AGL
700'
AGL
1,200'
AGL
700
AGL
Class G
Class

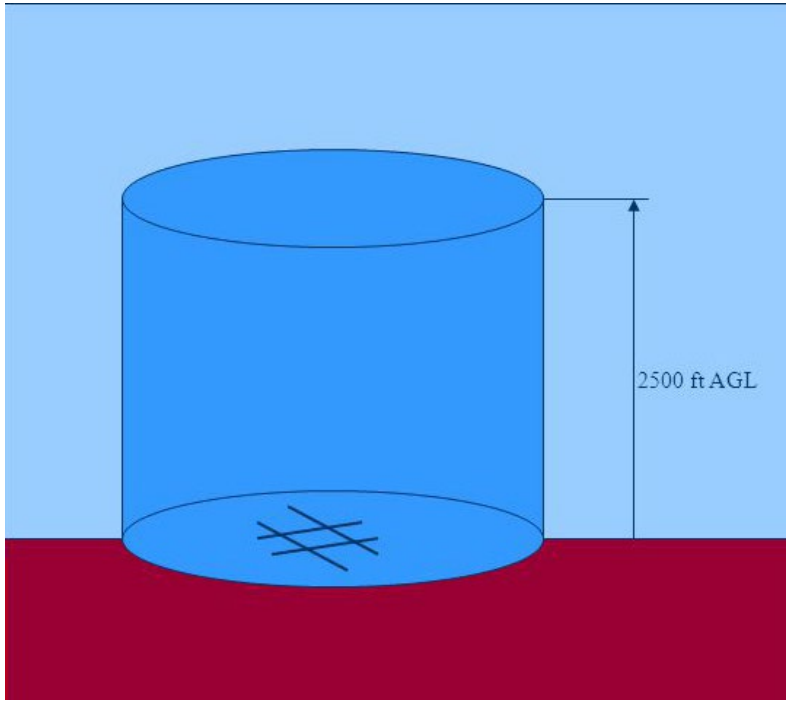
Class C Airspace

- Airport Traffic Control Tower (ATC)
- Radar approach control
- Requires a minimum number of Instrument Flight Rule (IFR) operations or passengers.
- Airspace usually consists of a surface area with a 5 NM radius (5.8 statute miles), an outer circle with a 10 NM (11.5 statute miles) radius that extends from 1,200 feet to 4,000 feet (AGL)



Class D Airspace

- Airport Traffic Control Tower (ATC)
- Instrument Flight Rule (IFR) operations
- Radar is optional
- May not have 24/7 operation
- Airspace usually consists of a surface area with a 4 NM radius (4.6 statute miles) that extends to 2,500 feet (AGL)



Waterloo Airport (ALO)

Waterloo Airport is FAA **Class D** airspace.

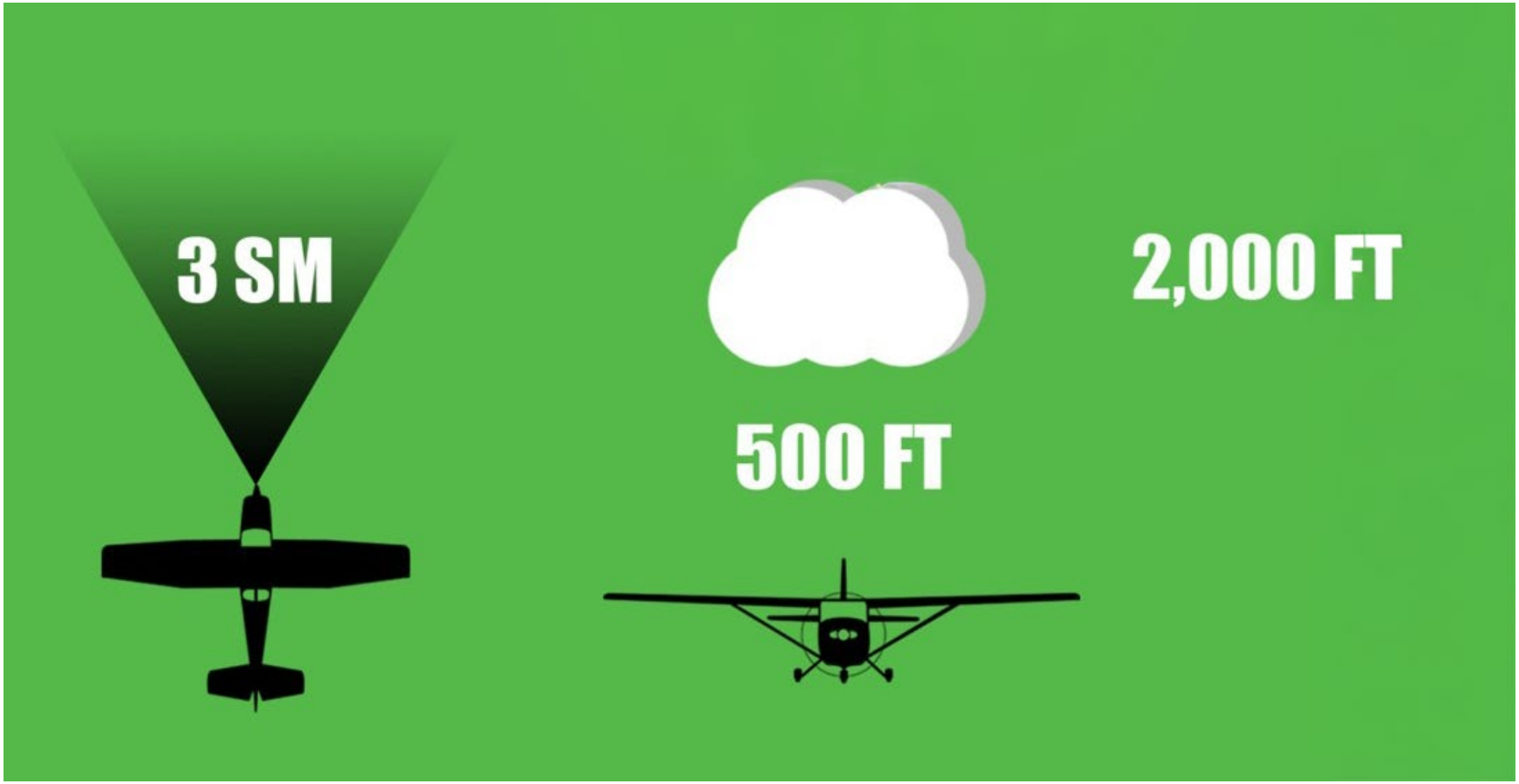
Class D airspace is generally cylindrical in form and normally extends from the surface to 2,500 feet AGL (above ground level).

On the chart, ALO airspace is 3,400 feet above MSL (mean sea level) or 2527 AGL.

Class E Airspace

- Class E Airspace is the most common Controlled Airspace and the most confusing!
- IFR aircraft must have ATC clearance to fly in Class E Airspace.
- VFR aircraft must have minimum clearance with clouds and 3 statute miles visibility.
- If an IFR aircraft comes out of the clouds, both aircraft have enough time to see and avoid the other aircraft.

Minimum Clearance & Visibility



Class E Airspace

Class E airspace is all the controlled airspace not described as A, B, C or D airspace.

- Most of this airspace is not near the surface, but aloft, where aircraft flying under IFR are in an en-route segment of flight.
- Over most of the country, the base of Class E airspace is at either 700 feet or 1,200 feet above the ground, so this isn't an issue for a drone operating at 400 feet and below.

Class E Surface (SFC)

Class E surface airspace extends down to the surface at some airports. All Class E surface airports are required to have a weather station and the ability for aircraft to contact Air Route Traffic Control Center (ARTCC) from the ground.

Class E surface airspace has a **dotted magenta** line indicating the Class E area.

Class E Surface Airport

Lateral Class E Airspace

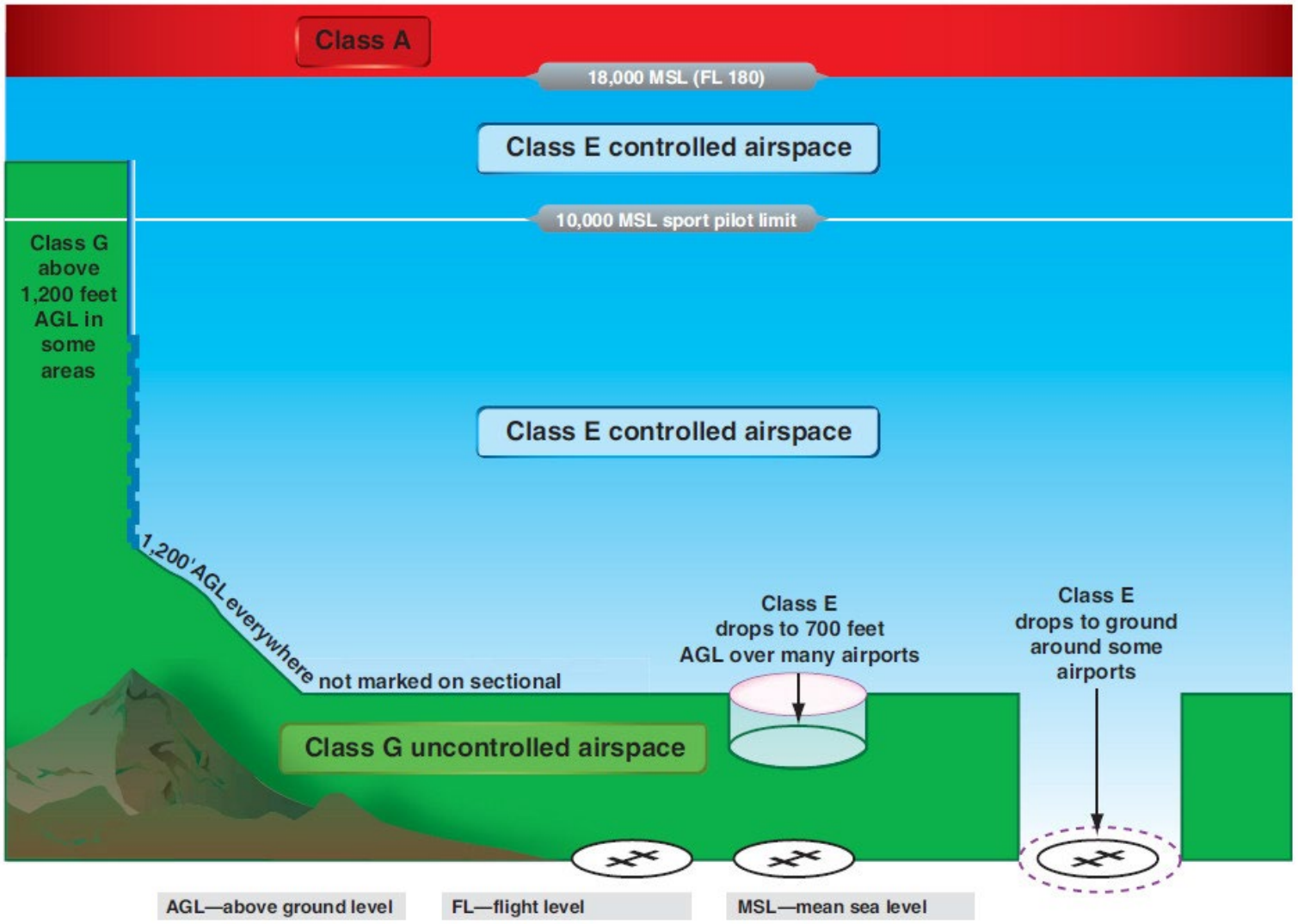


Figure 8-2. *Class G uncontrolled airspace and Class E controlled airspace.*

Lateral Class E Airspace

The lateral Class E Airspace lower altitude limits are shown on the Sectional Chart as follows:

Thin, dashed magenta (purple) line – surface up

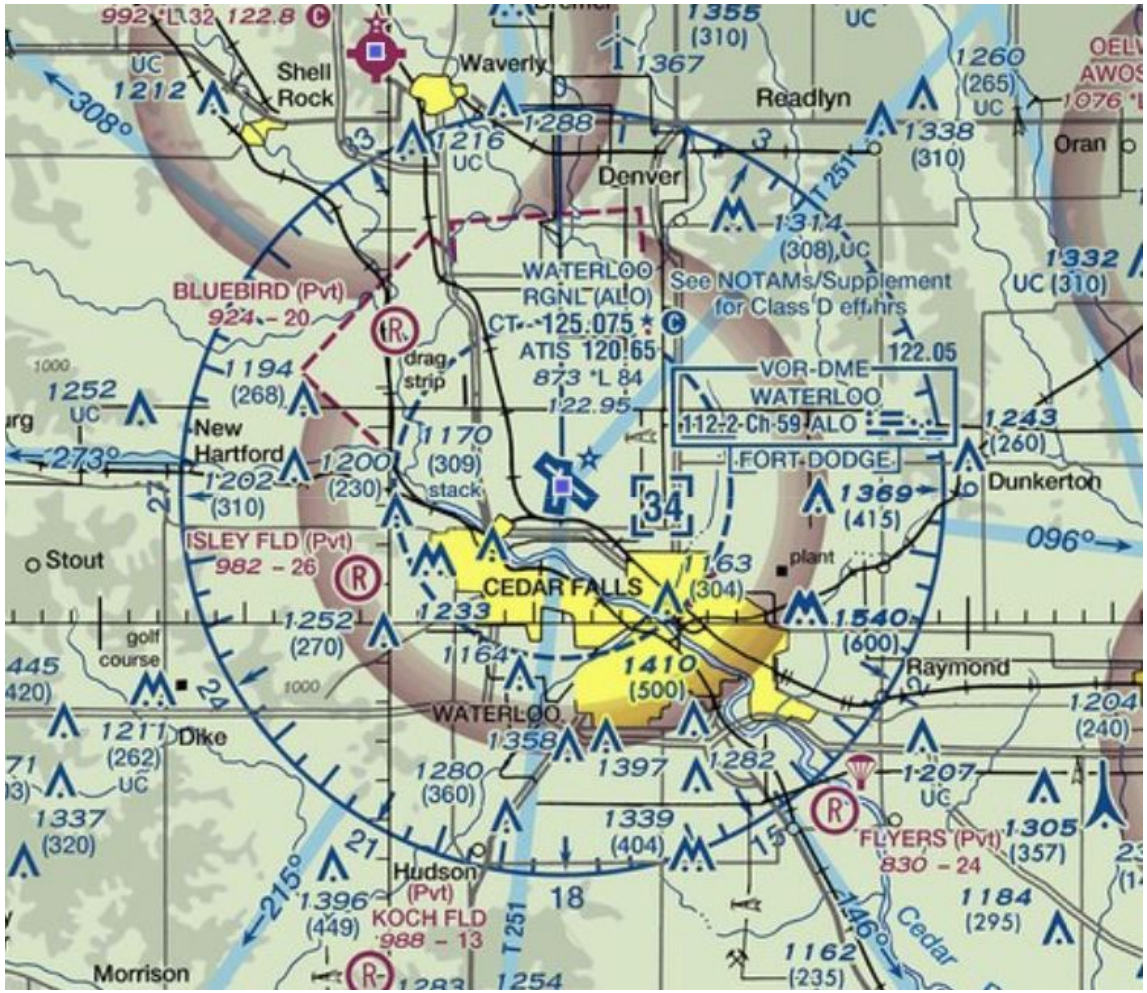
Shaded magenta (purple) – 700 feet (AGL) up

Shaded cyan (greenish-blue) – 1200 feet (AGL) up

Lateral Class E Airspace

Waterloo airport has Class E airspace extending from the runways beyond the normal 4 NM (4.6 statute miles) radius down to ground level shown with a thin, dashed **magenta** line on the Sectional Chart.

Waterloo Airport (ALO)



Class E Airspace

Approval is not required to fly a drone in Class E Lateral Airspace, but a minimum of 1000’ cloud ceiling is required when flying a drone in Class E Lateral.

Authorization is required to fly in Class E Surface airspace.

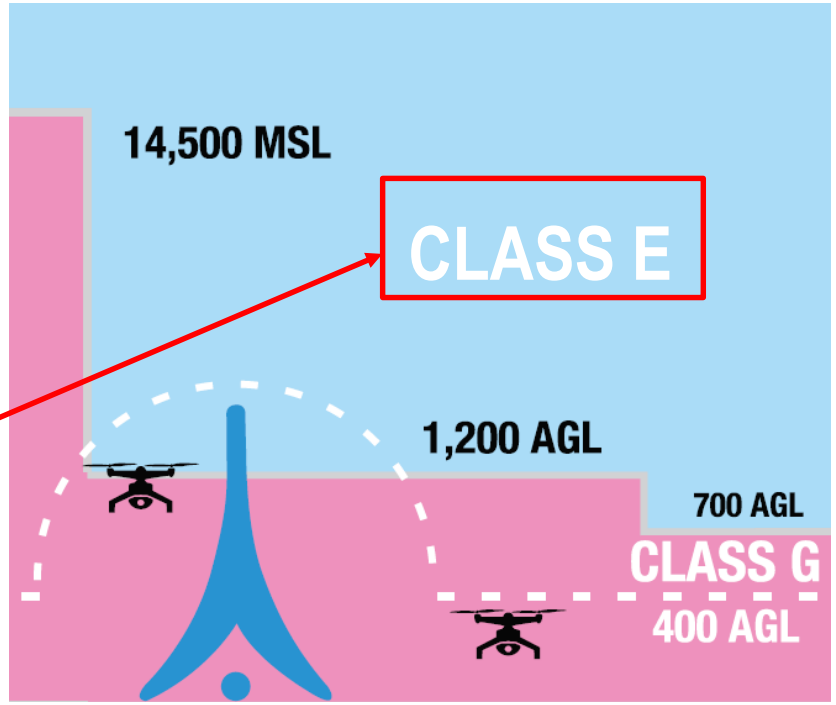
Class E Surface Airports in Iowa

CODE	AIRPORT	CITY
AMW	Ames Muni	AMES
BRL	Southeast Iowa Regional	BURLINGTON
CWI	Clinton Muni	CLINTON
DVN	Davenport Muni	DAVENPORT
FOD	Fort Dodge Regional	FORT DODGE
IKV	Ankeny Regional	ANKENY
MCW	Mason City Muni E	MASON CITY
MUT	Muscatine Muni	MUSCATINE
OTM	Ottumwa Regional	OTTUMWA
SLB	Storm Lake Muni	STORM LAKE
SPW	Spencer Muni	SPENCER
TNU	Newton Muni	NEWTON

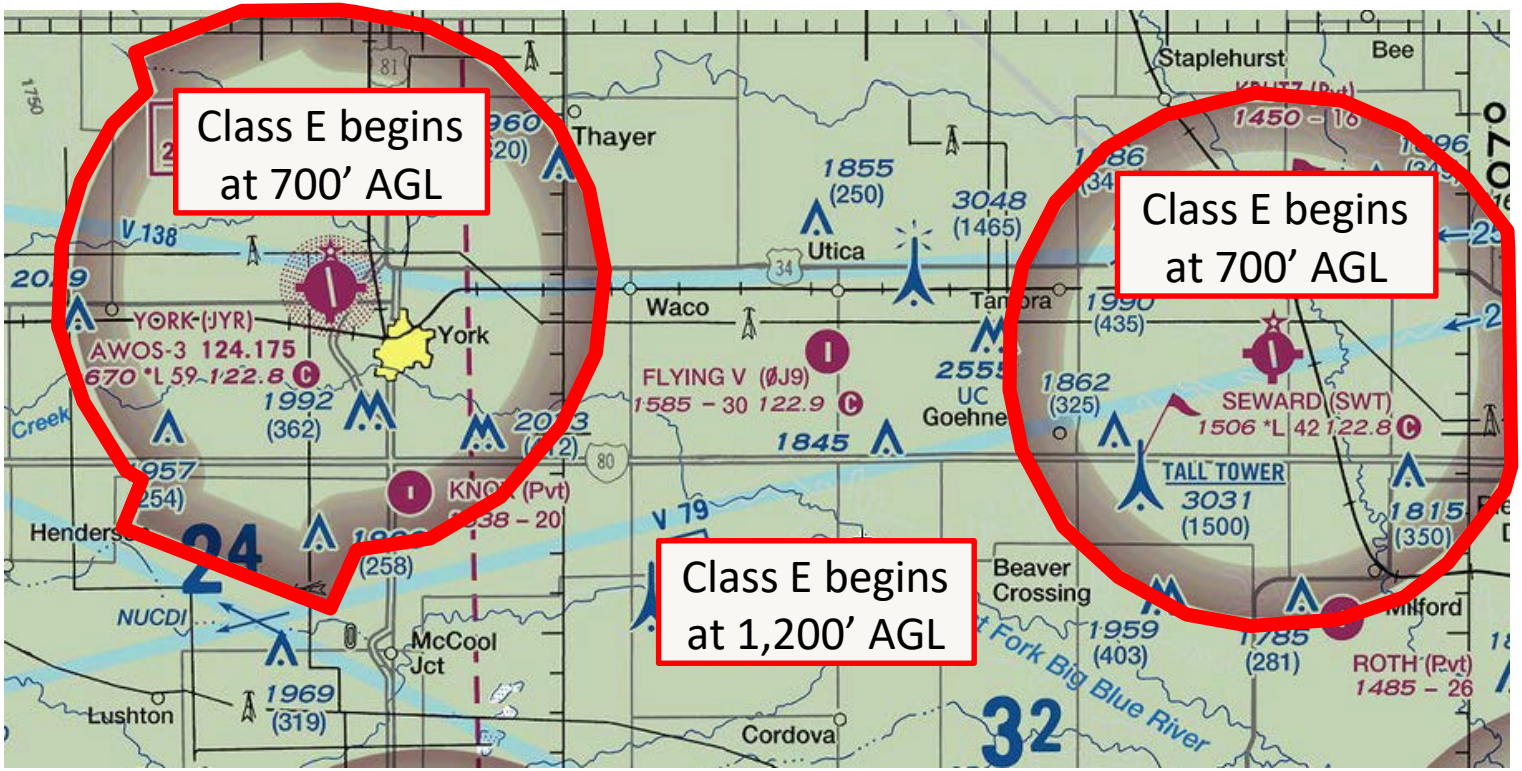
Class E Airspace

- Generally Class E begins where Class G ends
  - Typically, 700 ft or 1,200 ft Above Ground Level
  - Unless associated with an airport surface area

- ATC authorization not required for Part 107 operations



Class E Airspace



Class E Airspace

Tower Inspections:

- **§107.51(b)**
  - Limits maximum altitude to 400 ft Above Ground Level

- **Exceptions:**
  - Is flown within a 400-foot radius of a structure; and
  - Does not fly higher than 400 feet above the structure's immediate uppermost limit

No person may operate a small unmanned aircraft…within the lateral boundaries of the surface area of Class E airspace designated for an airport unless that person has prior authorization from Air Traffic Control (ATC)

(Small UAS Operating Rules) 14 CFR §107.41

FAA UAS SYMPOSIUM

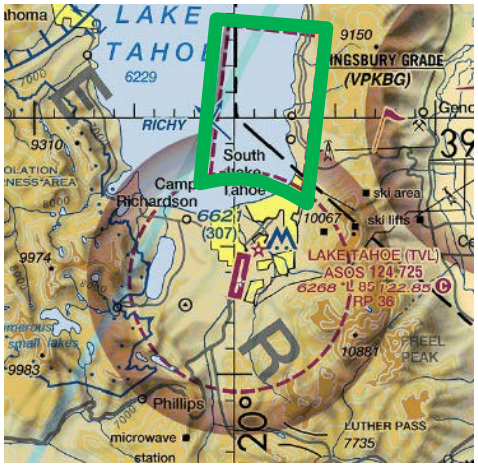
#UAS2019

Surface Class E Airspace

Starts at ground level:

- **Type E4**
  - Extension to Class D or E surface area
- **Type E3**
  - Extension to a Class C surface area
- **Type E2**
  - Surface area designated for an airport
  - **AUTHORIZATION NEEDED**

Surface Class E Airspace

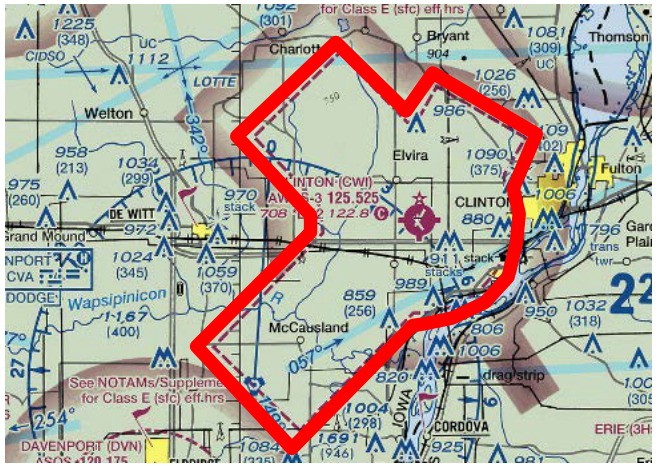


SURFACE E - E4

No ATC Authorization

SURFACE E - E3

No ATC Authorization

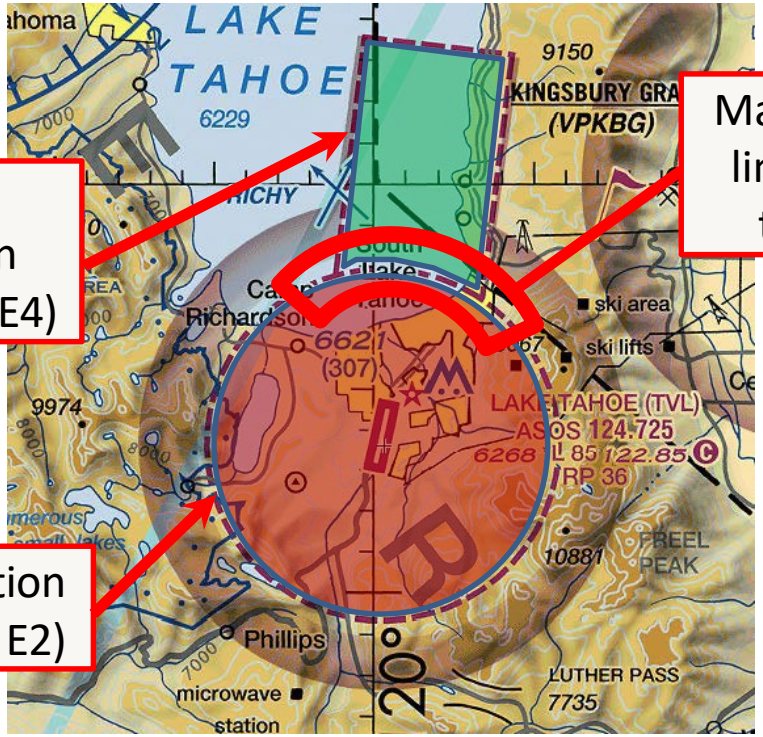


SURFACE E - E2

ATC Authorization Needed

Three different types of surface Class E airspace extensions

Surface Class E – Type E4



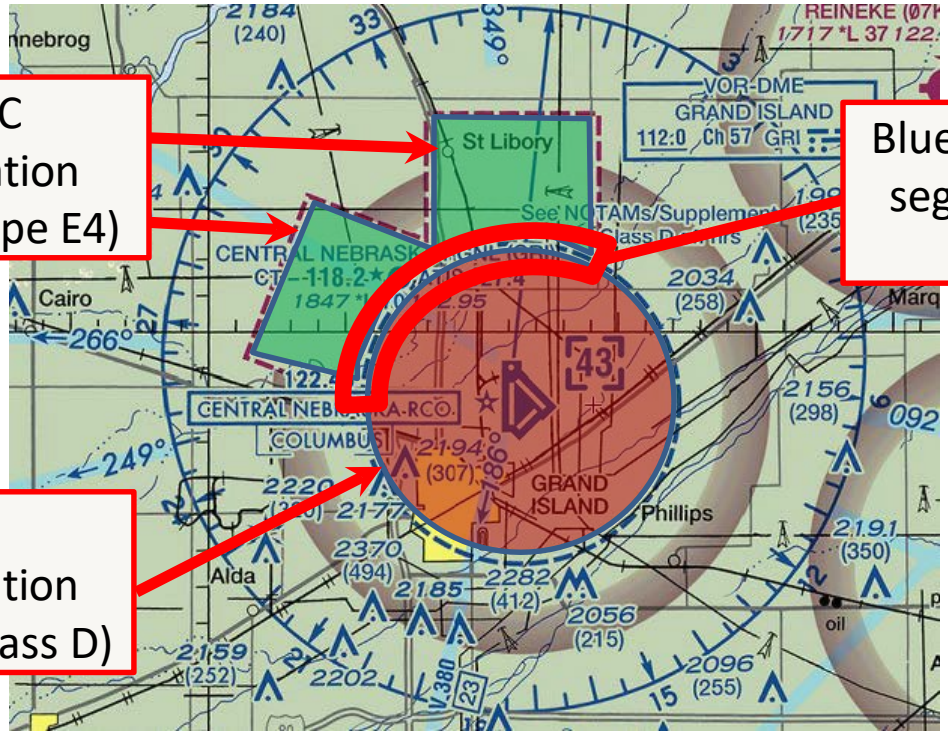
No ATC authorization needed (Type E4)

ATC authorization needed (Type E2)

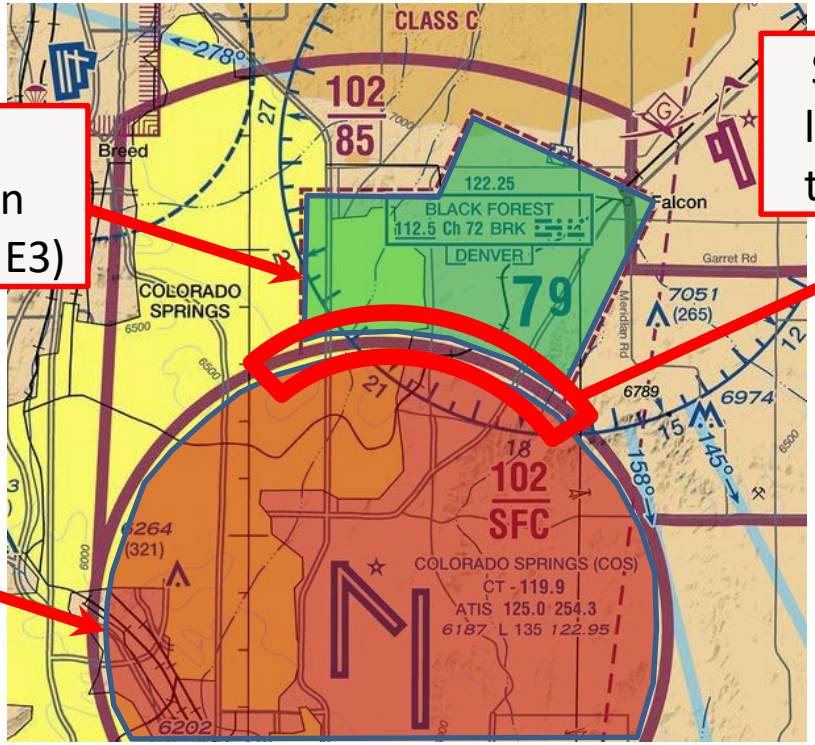
Magenta dashed line segregates the airspace

Extension to a Class E2 surface area

Surface Class E – Type E4



Surface Class E – Type E3



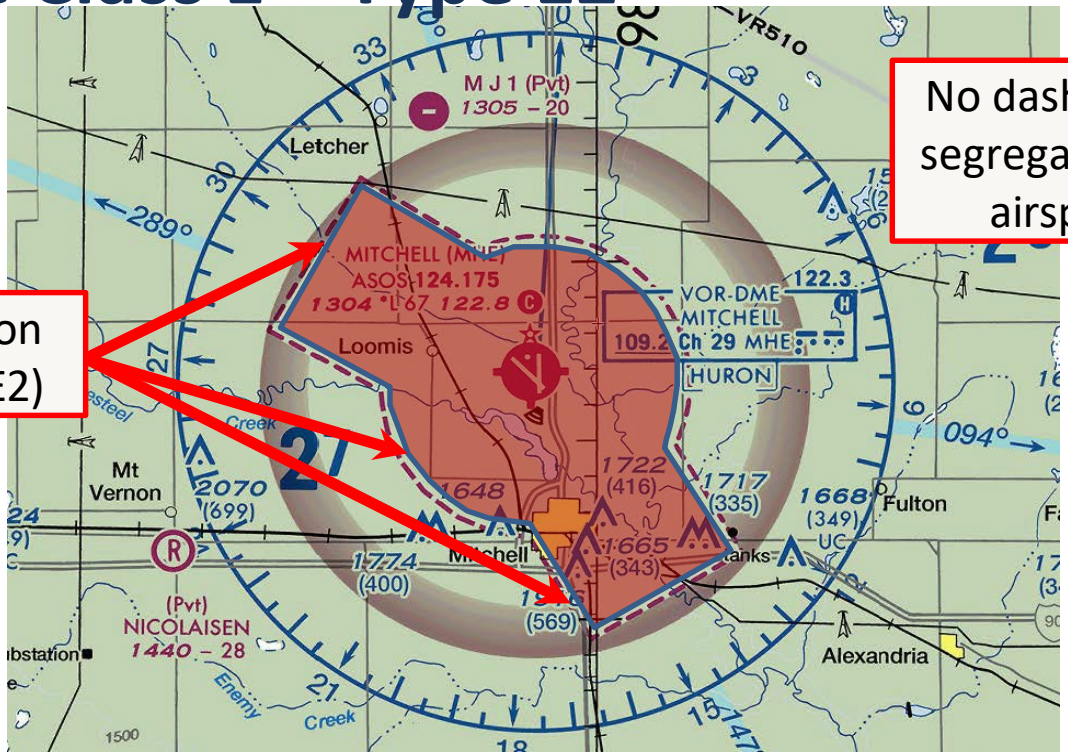
No ATC authorization needed (Type E3)

Solid magenta line segregates the airspace

ATC authorization needed (Class C)

Extension to Class C airspace

Surface Class E – Type E2



ATC authorization needed (Class E2)

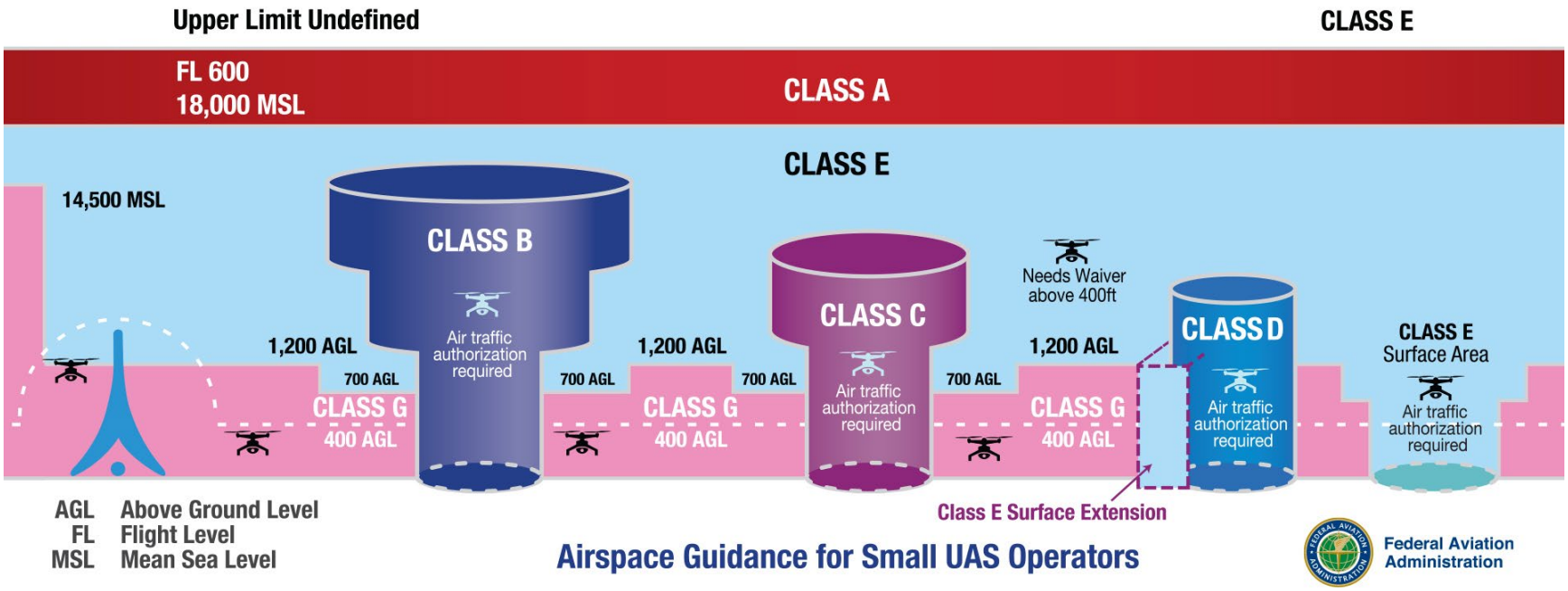
No dashed line segregating the airspace

Class E2 surface area

Class G Airspace

- Uncontrolled Airspace – No ATC
- From the ground to the bottom of the overlying Class E airspace
- Upper level is typically 700 feet to 1200 feet AGL with a maximum of 14,500 feet MSL in some areas over mountains.

Airspace Guidance



Sources of Information

Aeronautical Charts – 3 types of charts that cover any flying situation – Sectional, Terminal & En-Route

Chart Supplement U.S. – the most comprehensive information on a given airport

NOTAMs (Notice to Air Mission**) – Temporary time-critical aeronautical information**

Automated Terminal Information Service (ATIS) - weather, runways in use, specific ATC procedures and any airport construction activity that could affect taxi planning

Aeronautical Chart Types

VFR Sectional Chart – covers several states and provides information for VFR (Visual Flight Rules)

Terminal Area Chart (TAC) – covers the airspace around large Class B airport in a larger format

En-Route Chart – provides navigation information for IFR (Instrument Flight Rules)

VFR Sectional Aeronautical Chart

Sectional Aeronautical Charts are designed for visual navigation of slow to medium speed aircraft. The topographic information consists of a selection of visual checkpoints used for flight under Visual Flight Rules (VFR). The checkpoints include cities & towns, rivers & streams, roads, railroads, obstructions, airports, controlled airspace, restricted areas, and landmarks. The Sectional Charts also include radio aids for navigation.

These charts are updated every 56 days.

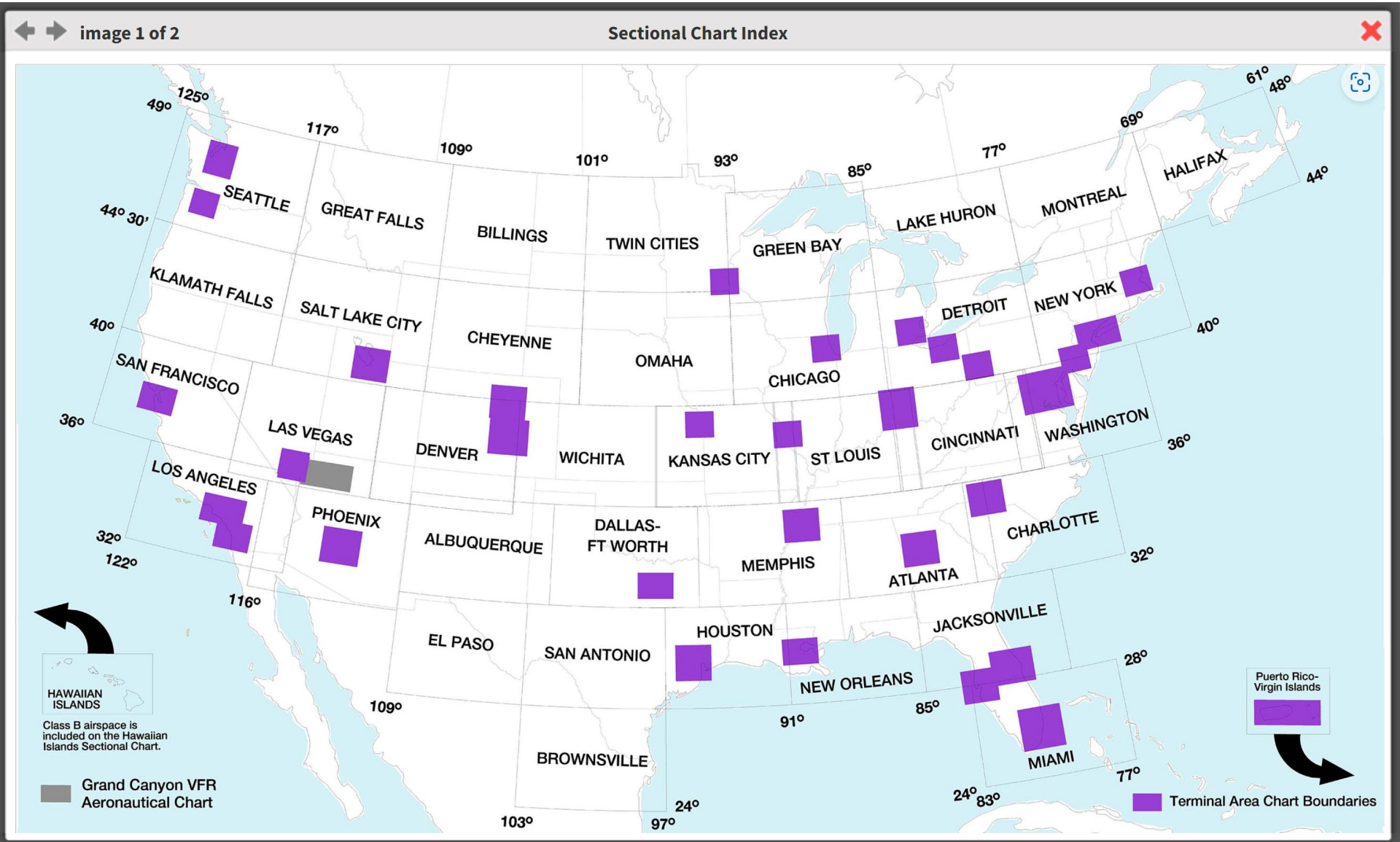
Terminal Area Chart (TAC)

Terminal Area Charts (TAC) are large-scale charts with more detail around major airports. They provide pilotage and local control requirements in airspace designated as Class B Airspace. Coverage of Terminal Area Charts are indicated by shaded boxes on the Sectional Chart.

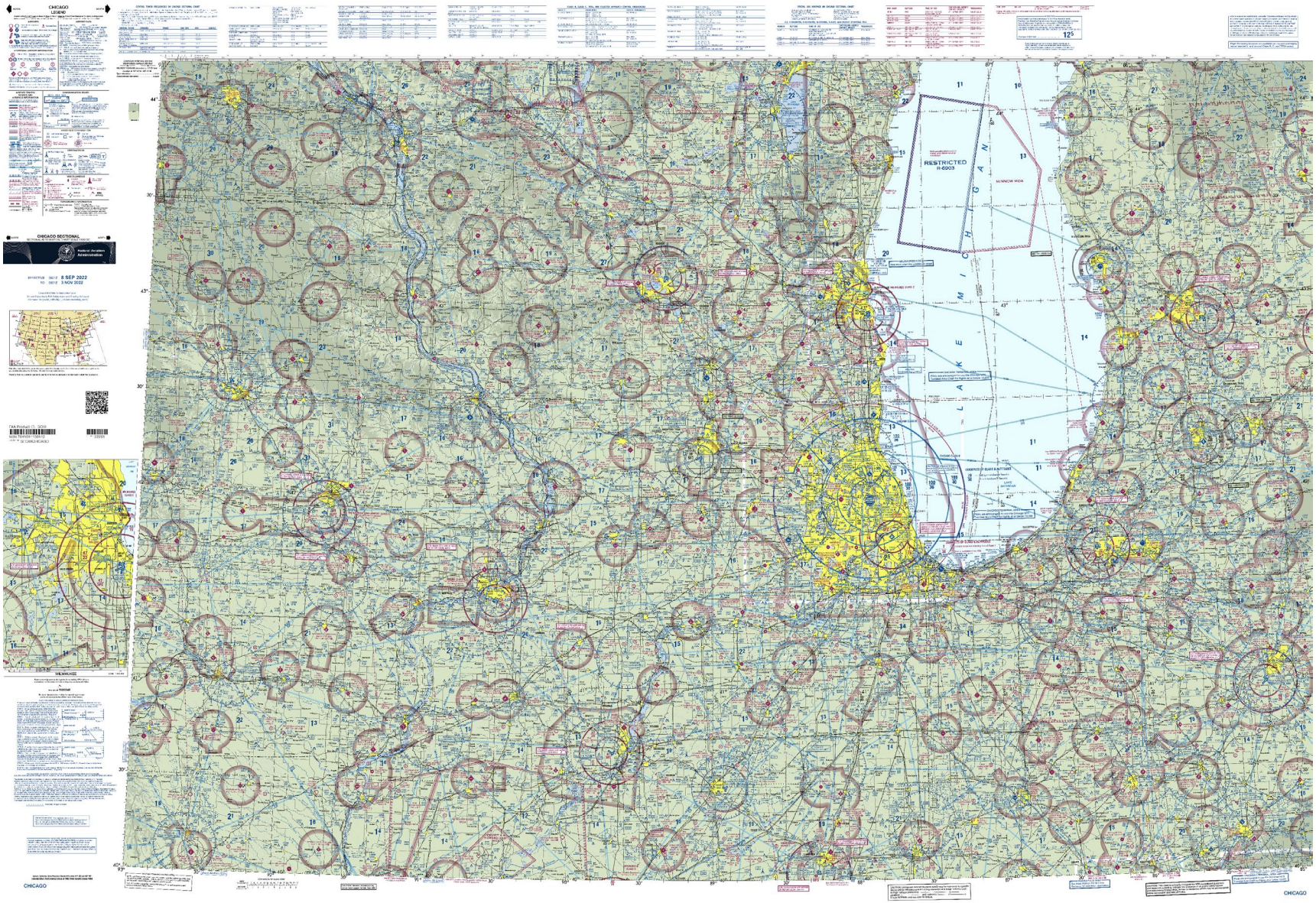
These charts are updated every 56 days.

Charted VFR Flyway Planning Charts are printed on the backs of selected Terminal Area Charts.

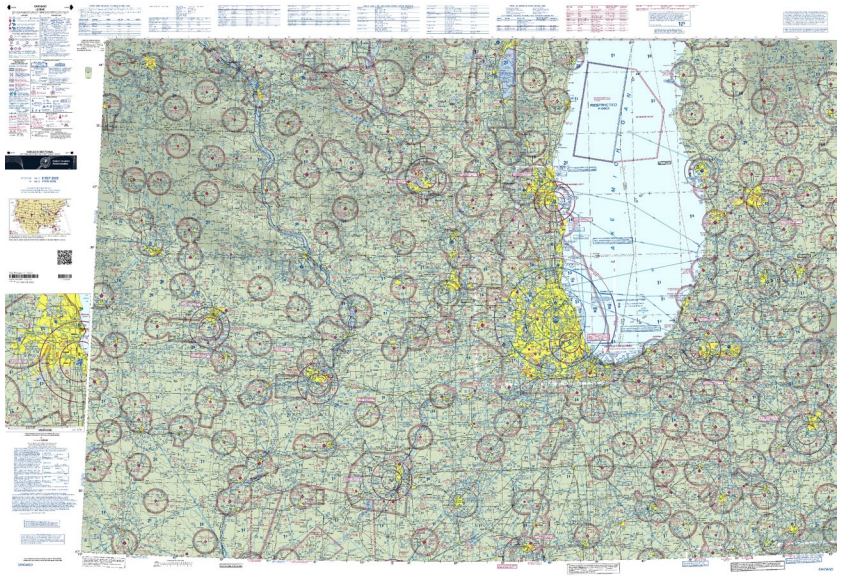
VFR Sectional Aeronautical Chart



VFR Sectional Aeronautical Chart



Why are Aeronautical Maps printed in funny colors?



You may be familiar with RGB digital color printing. Professional printing presses use four ink colors — cyan, magenta, yellow, and black — also known as the CMYK process. This method of printing limits the number of printing plates required to four.

VFR Chart Supplement

The Chart Supplements includes data that cannot be readily depicted in graphic form: e.g., airport hours of operation, types of fuel available, runway data and lighting codes

May be downloaded as PDF files.

Waterloo Chart Supplement

WATERLOO RGNL (ALO)(KALO) P (ARNG) 4 NW UTC-6(-5DT) N42°33.51′ W92°24.06′
873 B ARFF Index—See Remarks NOTAM FILE ALO
RWY 12–30: H8399X150 (ASPH-GRVD) S-55, D-75, 2D-140 PCN 59 R/A/X/T
HIRL
RWY 12: MALSR. PAPI(P4L)—GA 3.0° TCH 57′. RVR-T Tree.
RWY 30: MALS. VASI(V4L)—GA 3.0° TCH 52′. RVR-R
RWY 18–36: H6003X150 (ASPH-CONC-GRVD) S-50, D-75 PCN 51 F/B/X/T MIRL
RWY 18: REIL. VASI(V4L)—GA 3.0° TCH 42′. Tree.
RWY 36: REIL. PAPI(P4L)—GA 3.0° TCH 51′. Tree.

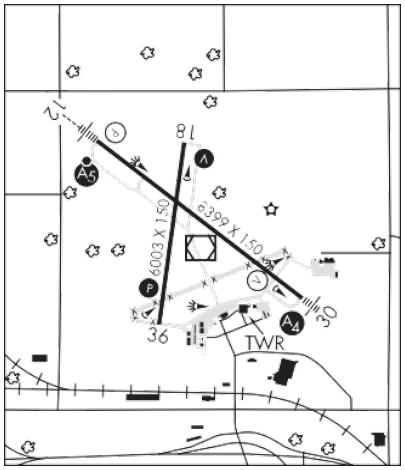
LAND AND HOLD-SHORT OPERATIONS

LDG RWY	HOLD-SHORT POINT	AVBL LDG DIST
RWY 30	18-36	4800
RWY 36	12-30	3650

RUNWAY DECLARED DISTANCE INFORMATION

RWY 12:	TORA-8399	TODA-8399	ASDA-8399	LDA-8399
RWY 18:	TORA-6003	TODA-6003	ASDA-6003	LDA-6003
RWY 30:	TORA-8399	TODA-8399	ASDA-8399	LDA-8399
RWY 36:	TORA-6003	TODA-6003	ASDA-6003	LDA-6003

SERVICE: S4 **FUEL** 100LL, JET A **OX** 1, 2, 3, 4 **LGT** When ATCT clsd ACTVT MALSR Rwy 12; MALS Rwy 30; VASI Rwy 18; PAPI Rwy 36; MIRL Rwys 18-36, and HIRL Rwy 12-30—CTAF.
MILITARY—FUEL
J4(Mil)-PPR. (NC-100LL, A - O/R 0400-1100Z‡, svc fee, C319-291-4483.)



AIRPORT REMARKS: Attended 1100-0300Z‡. Birds on and invof arpt. Arpt sfc conds unmon 0400-1030Z‡ dly. Fuel avbl on request, fee for service. Class I, ARFF Index A. Clsd to unsked acr opns with more than 10 psgr seats excp 72 hours PPR amgr. Call amgr 319-291-4483. Cell 319-529-1388. ARFF Index B provided. ARFF Index C avbl on 72 hrs req. Air carrier ops over 9 psgr seats not auth over 15 minutes before or after sked arr or dep times excp with prior coord with amgr. When departing all rwys, ends of other rwys not visible. Personnel and equipment performing snow removal ops will monitor CTAF. When ATCT clsd and durg snow events, all arr/dep acft annc their intns on CTAF 5 min prior to using the rwys. Rwy 30 is calm wind rwy.
MILITARY REMARKS: ARNG ARNG OPS ctc DSN 431-5520, C319-234-1372.
AIRPORT MANAGER: 319-291-4483
WEATHER DATA SOURCES: ASOS 120.65 (319) 233-8984.
COMMUNICATIONS: CTAF 125.075 **ATIS** 120.65 **UNICOM** 122.95
RCO 122.05 (FORT DODGE RADIO)
Ⓡ**APP/DEP CON** 118.9 126.75 (1200-0200Z‡)
Ⓡ**CHICAGO CENTER APP/DEP CON** 118.9 (0200-1200Z‡)
TOWER 125.075 (1200-0200Z‡) **GND CON** 121.9
ANG OPS 36.7 142.6 231.55
CLEARANCE DELIVERY PHONE: For CD ctc Waterloo ATCT at 319-233-4835.When Waterloo ATCT clsd, for CD ctc Chicago ARTCC at 630-906-8921.

AIRSPACE: CLASS D svc 1200-0200Z‡; other times CLASS E.
RADIO AIDS TO NAVIGATION: NOTAM FILE ALO.
(L) (L) VORW/DME 112.2 ALO Chan 59 N42°33.39′ W92°23.94′ at fld. 866/0E.
VOR unusable:
017°-062° byd 35 NM blo 2,500′
063°-073° byd 18 NM
074°-356° byd 35 NM blo 2,500′
357°-016°
DME unusable:
007°-026° byd 25 NM
027°-006° byd 35 NM blo 2,500′
ILS/DME 111.7 I-ALO Chan 54 Rwy 12. Class IA. Unmonitored when twr clsd.

WATERLOO RGNL (ALO)(KALO) P (ARNG) 4 NW UTC-6(-5DT) N42°33.51′ W92°24.06′
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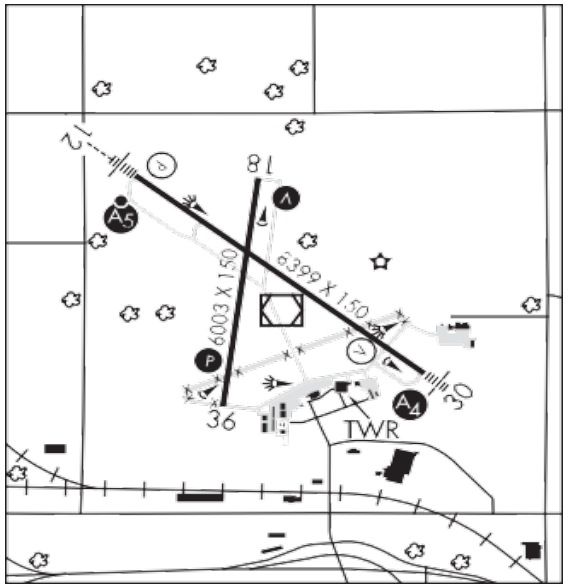
MILITARY—FUEL
J4(Mil)-PPR. (NC-100LL, A - O/R 0400-1100Z‡, svc fee, C319-291-4483.)



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RCO 122.05 (FORT DODGE RADIO)
®**APP/DEP CON** 118.9 126.75 (1200-0200Z‡)
®**CHICAGO CENTER APP/DEP CON** 118.9 (0200-1200Z‡)
TOWER 125.075 (1200-0200Z‡) **GND CON** 121.9

Attended 1100-0300Z Tower 1200-0200Z - Subtract 5 hours to convert to Central Daylight Time (CDT) or subtract 6 hours to convert to Central Standard Time (CST).

Waterloo Regional Airport

RUNWAY NUMBERS

Runway numbers are determined by rounding the magnetic compass bearing of the runway end to the nearest 10 degrees and truncating the last digit, meaning runways are numbered from 1 to 36....

So, if you're on runway 9, you're heading east (90° on a compass). The opposite end of runway 9 is numbered 27 (or 270° on a compass). If an airport has parallel runways, these would then be marked Left, Center and Right, e.g., 9L/9C/9R

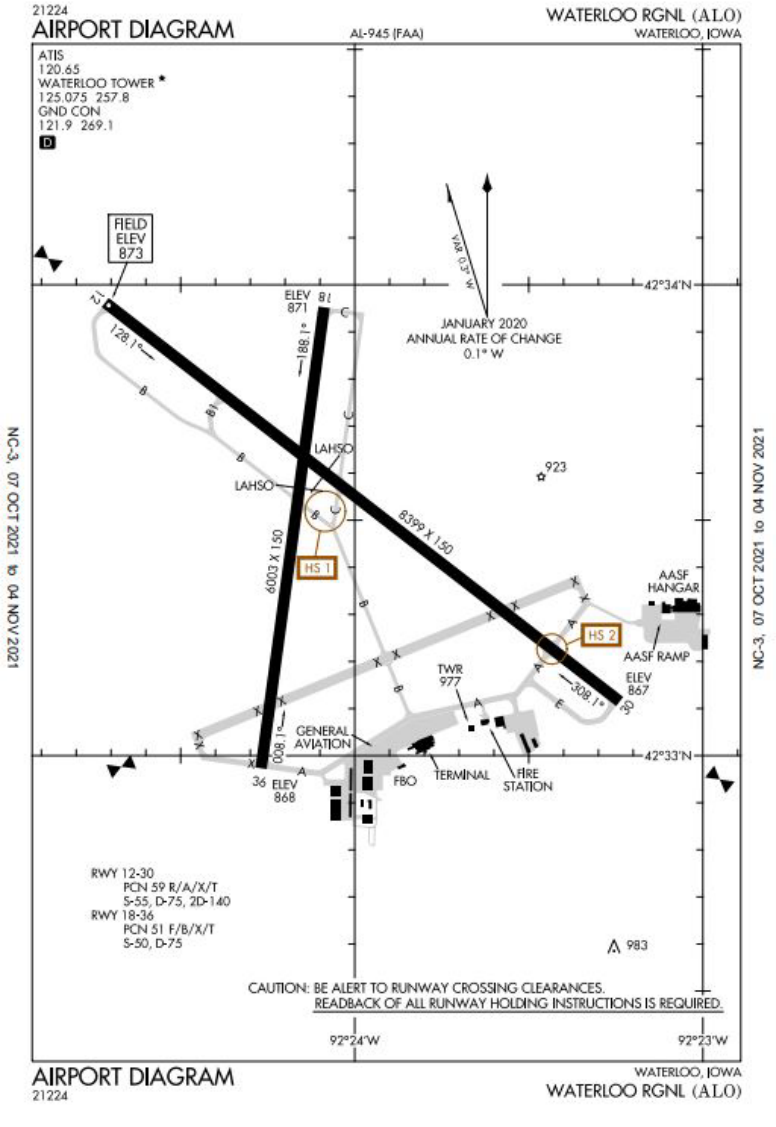
Waterloo Regional Airport

Runways

12/30

18/36

~~6/24~~



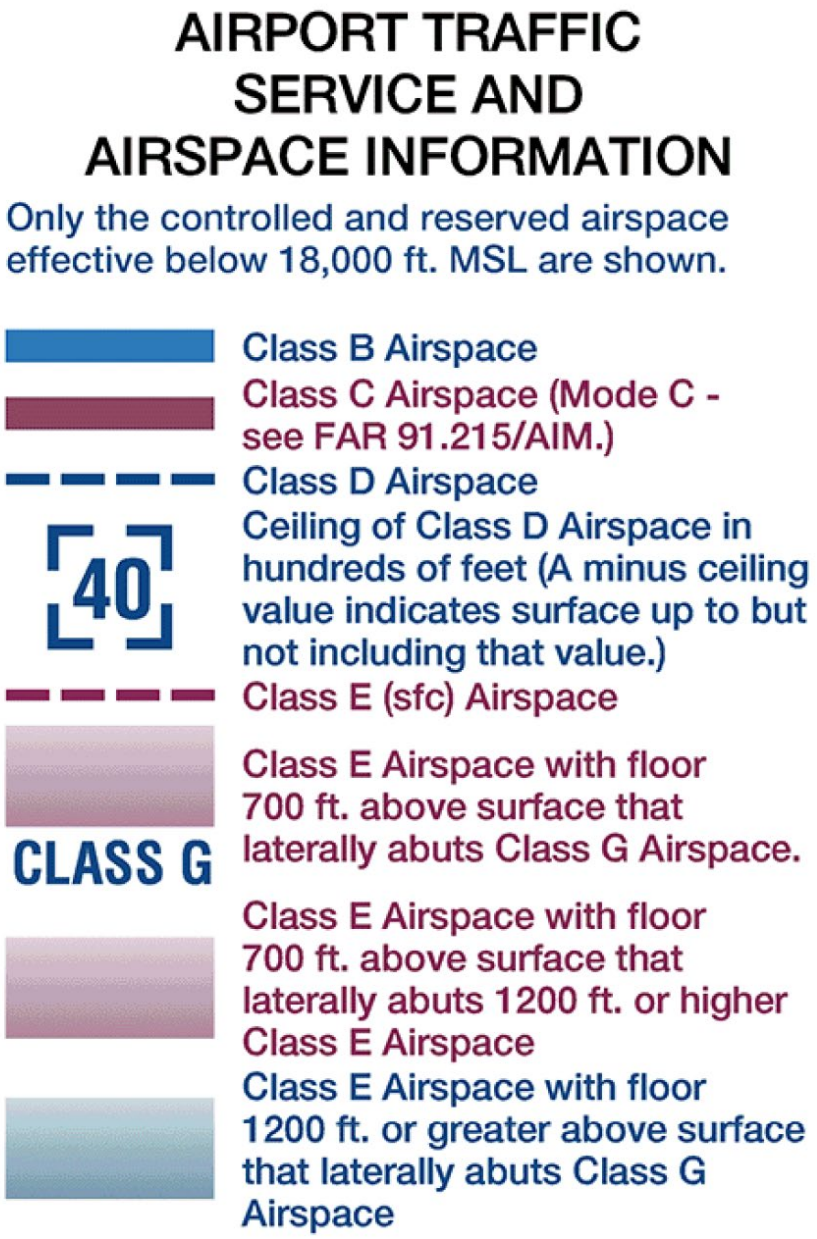
Airspace Symbols

Controlled airspace floors of 700' above the ground are defined by a **magenta** vignette.

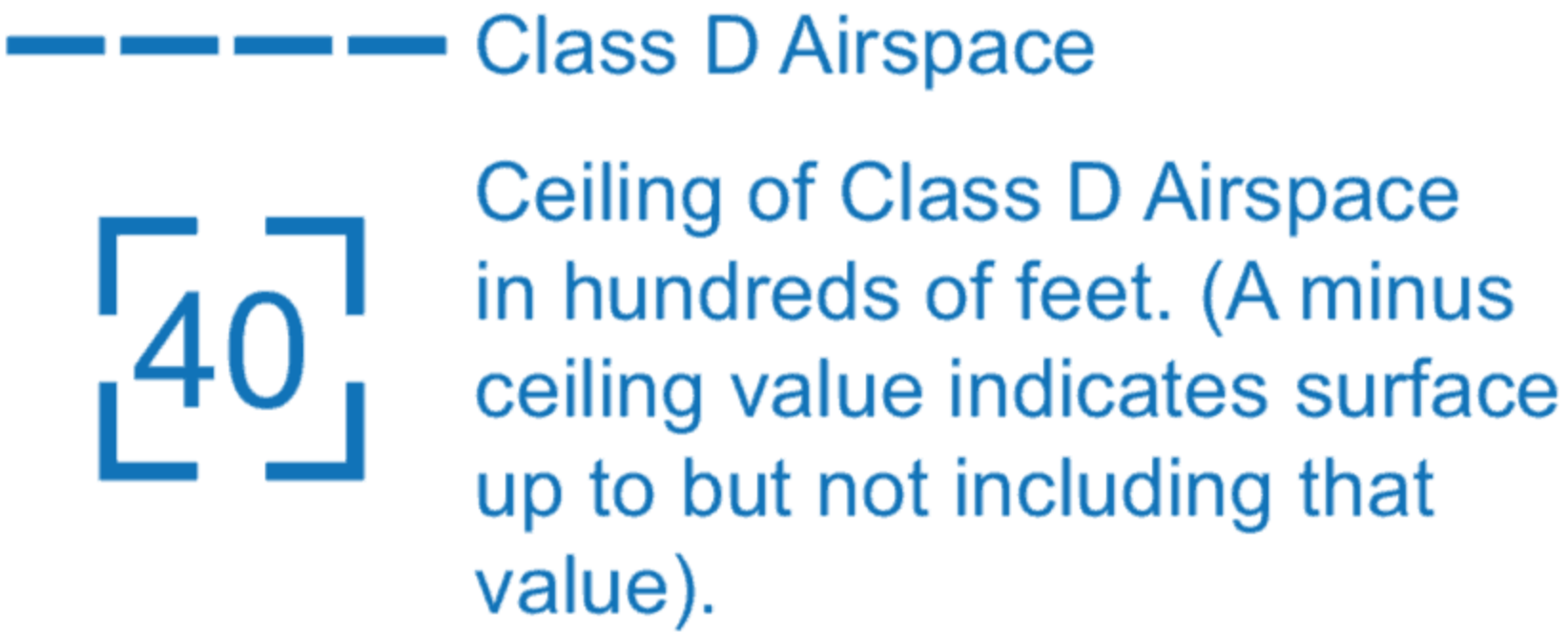
Controlled airspace floors other than 700' that laterally abut uncontrolled airspace (Class G) are defined by a **blue** vignette.

Differing floors greater than 700' above the ground are annotated by a symbols and a number indicating the floors.

Sectional Chart Airspace Identification



Class D Airspace Ceiling



Generally, Class D airspace extends from the surface to 2,500 feet above the airport field elevation. The number in the box represents the ceiling of Class D airspace in hundreds of feel MSL (mean sea level).

Airport Symbols

Airports with a **control tower** and their data are shown in **blue**. All other airports and their data are shown in **magenta**.

ADDITIONAL AIRPORT INFORMATION

Private "(Pvt)" - Non-public use having landmark value

Military - Other than hard-surfaced; all military airports are identified by abbreviations AFB, NAS, AAF, etc.

Heliport Selected

Unverified

Abandoned - paved having landmark value, 3000 ft. or greater

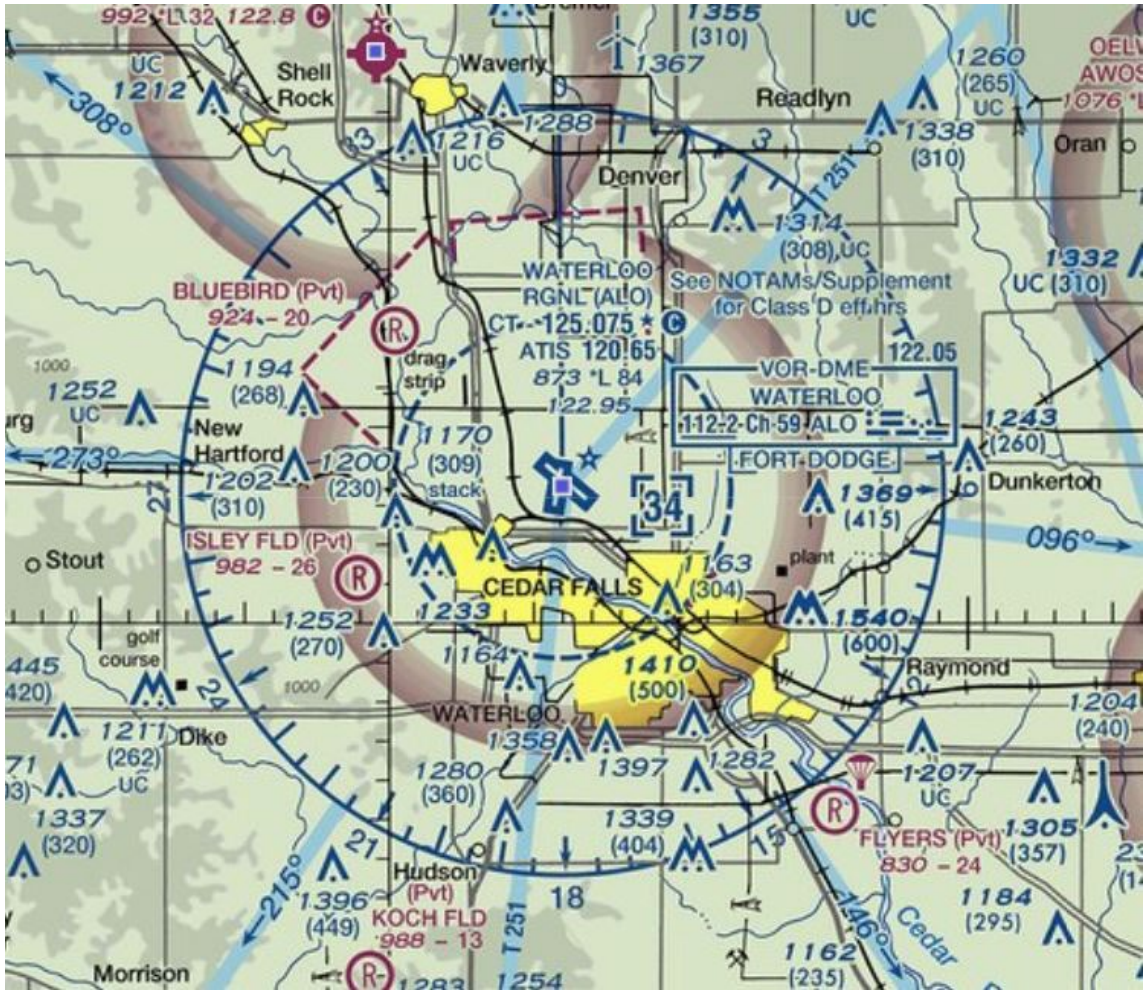
Ultralight Flight Park Selected

Fuel availability indicated by use of tick marks around basic airport symbol. Consult Supplement for details and availability at airports with hard-surfaced runways greater than 8069 ft.

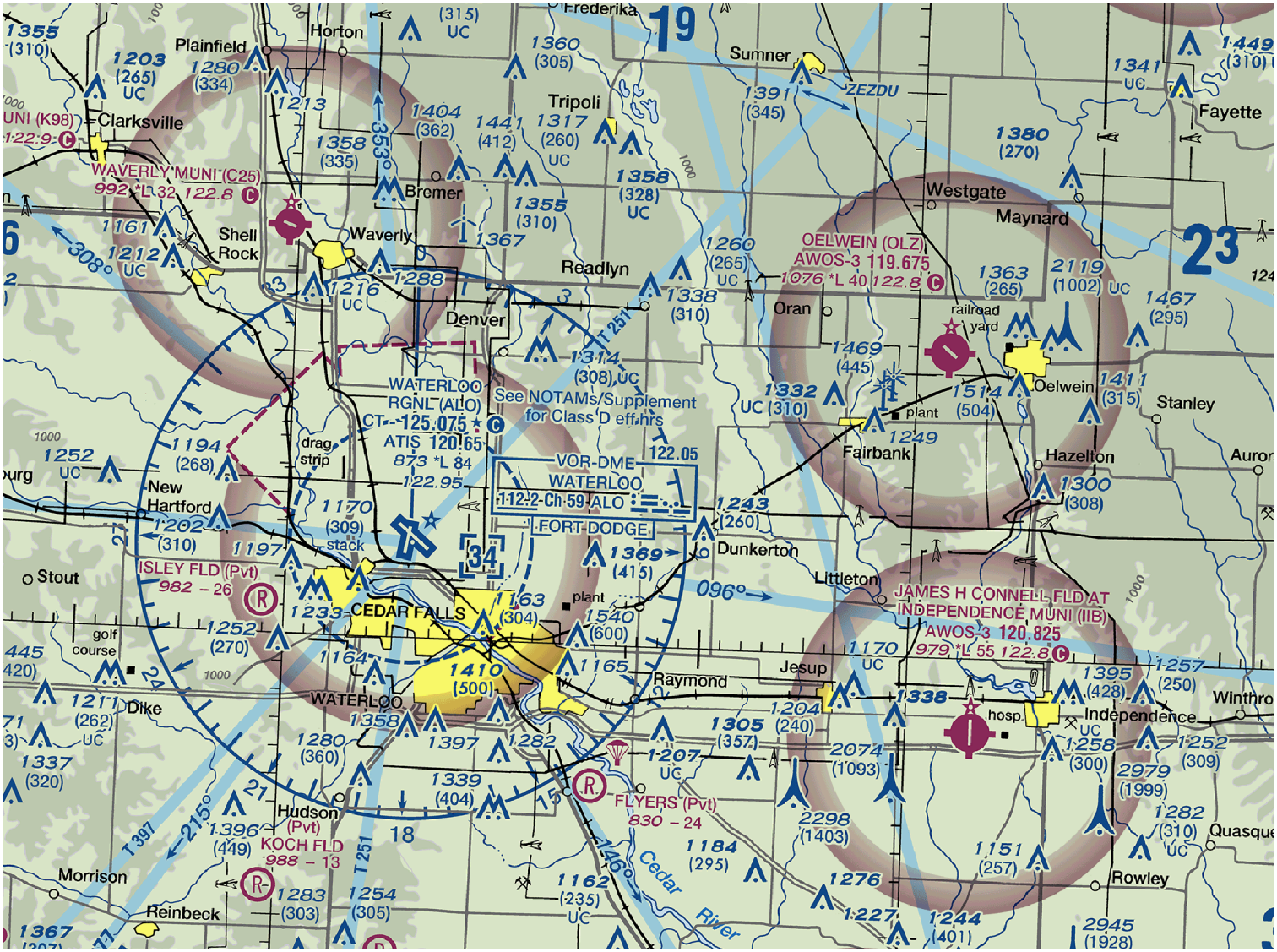
Rotating airport beacon in operation Sunset to Sunrise

OBJECTIONABLE - Airport may adversely affect airspace use.

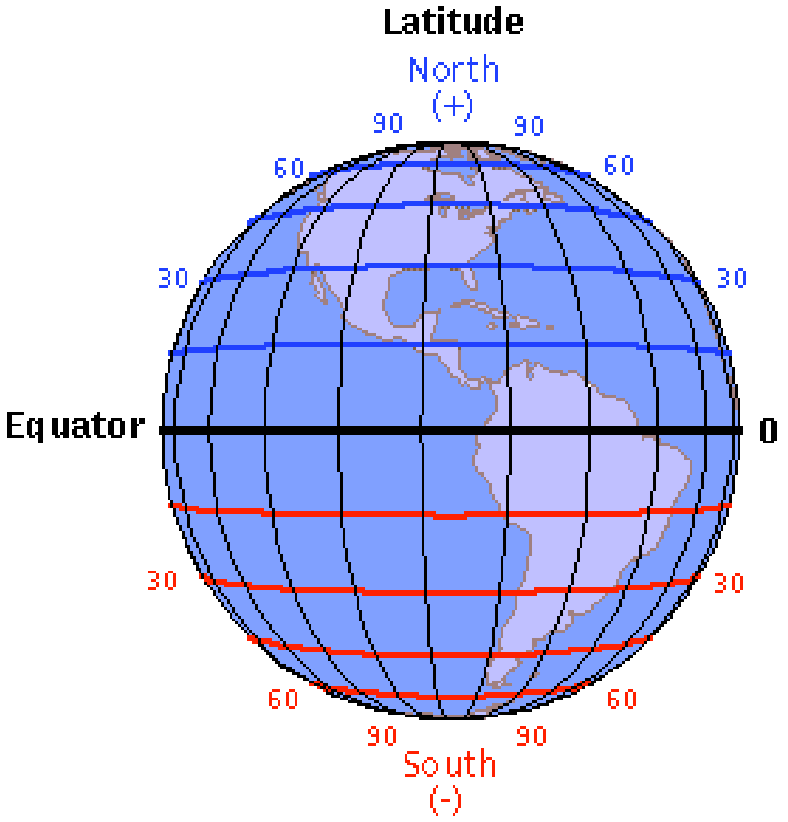
Waterloo Airport (ALO)

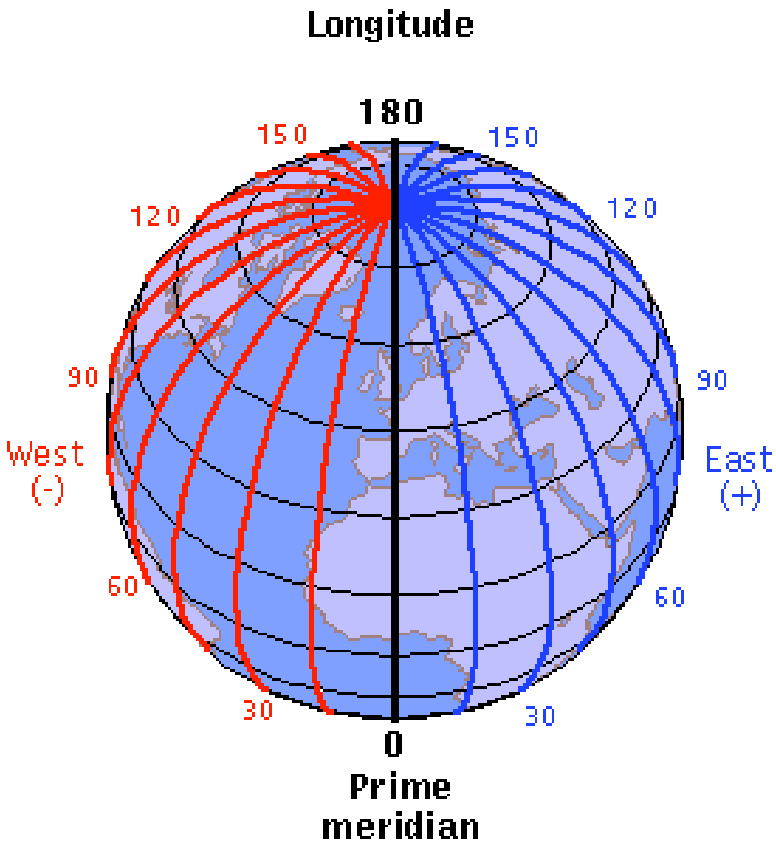


Airport Color Code



Latitude & Longitude

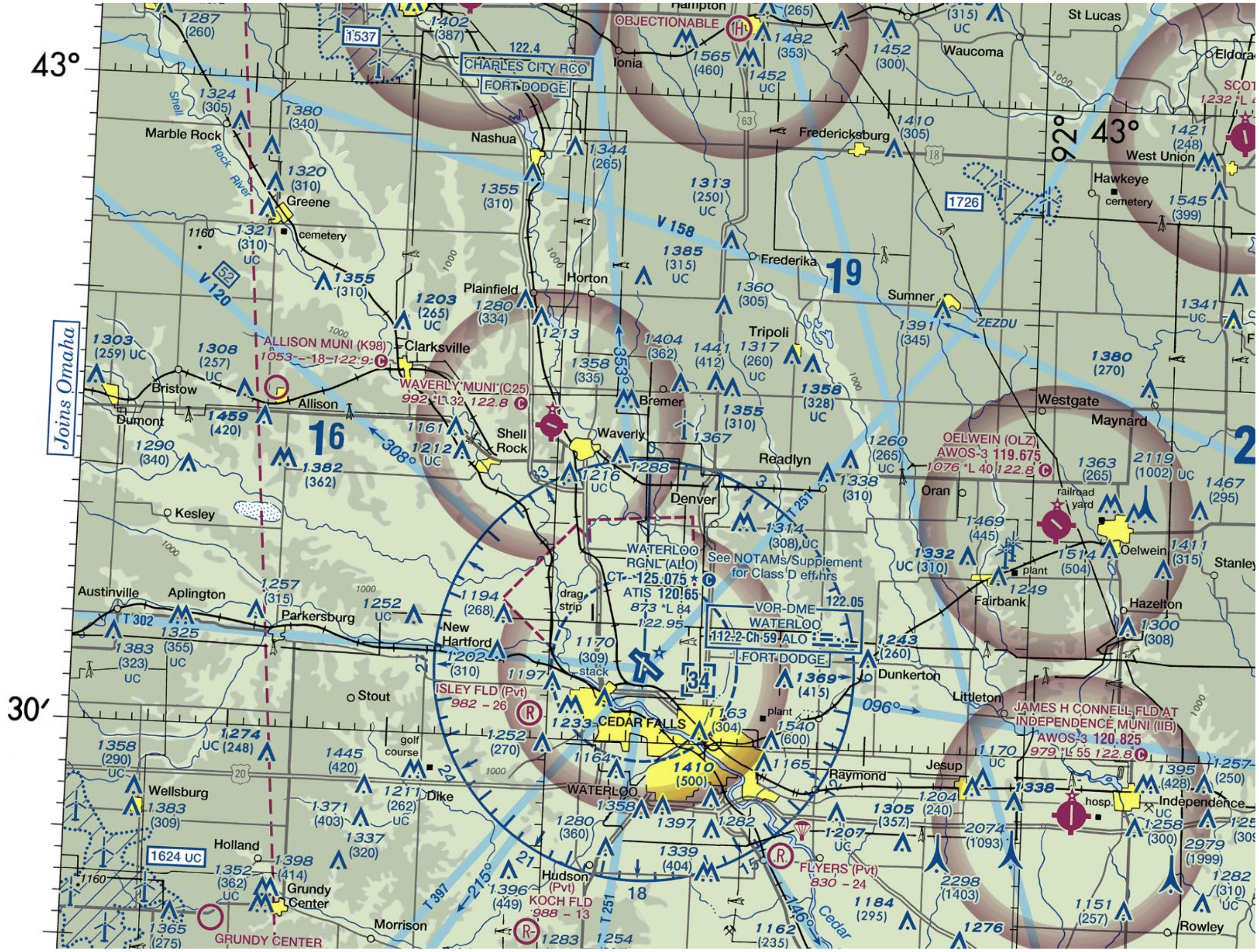




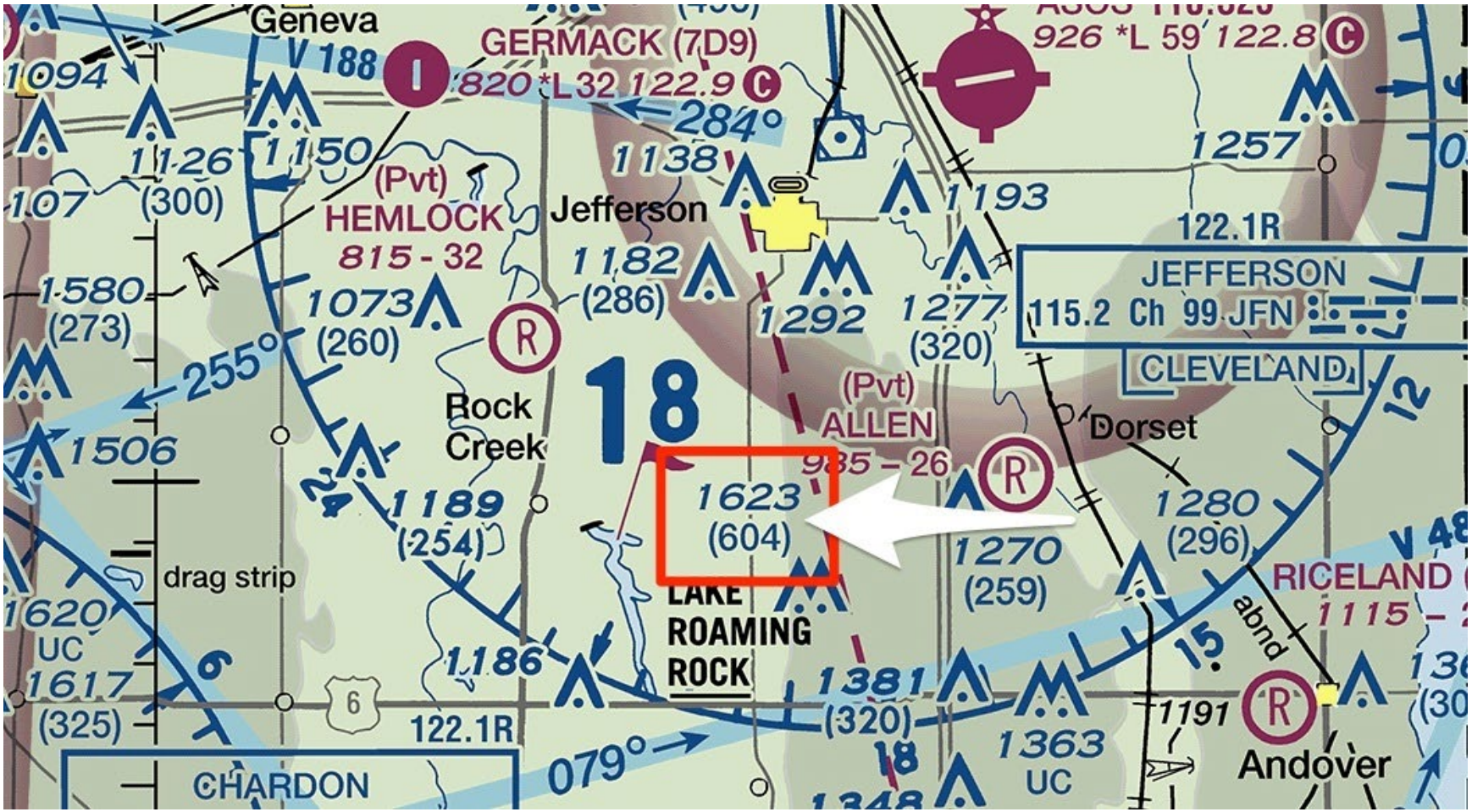
Microsoft Illustration

KALO Latitude 42° 33.51’ & Longitude -92° 24.06’

Latitude & Longitude

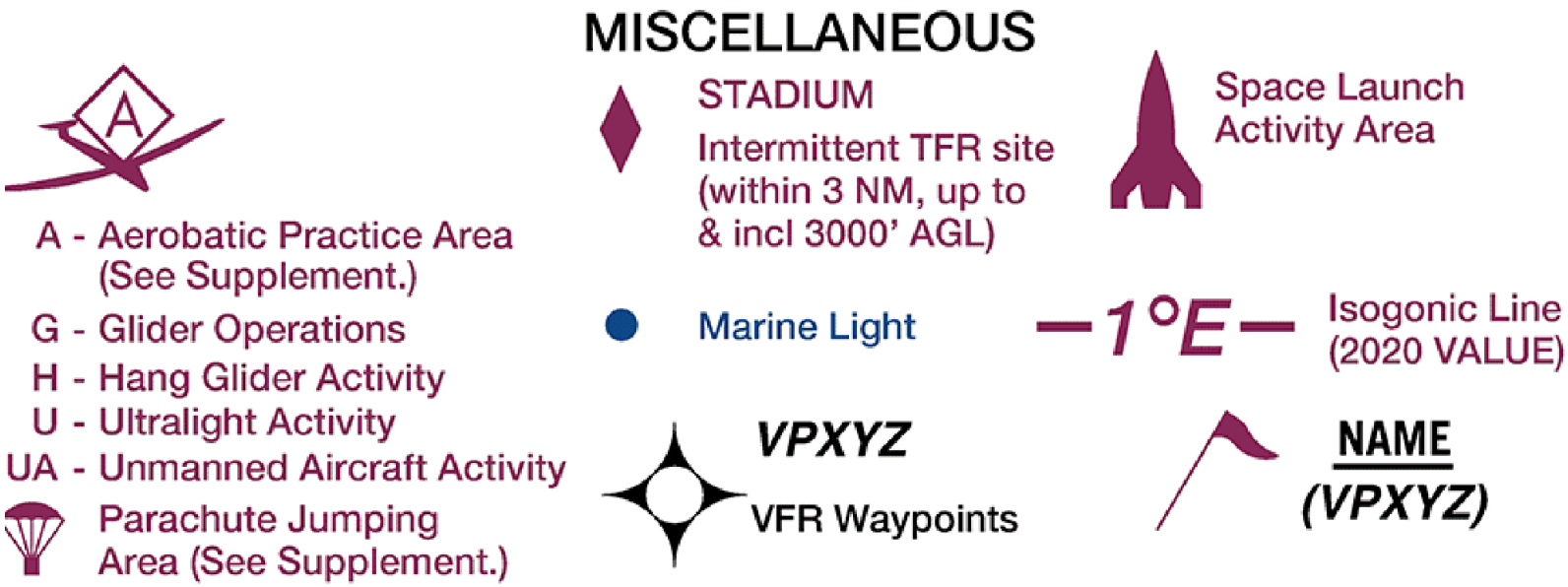


Maximum Elevation Figure (MEF)



MEF = highest point (MSL) + 100 feet rounded up to the next 100’ increment.

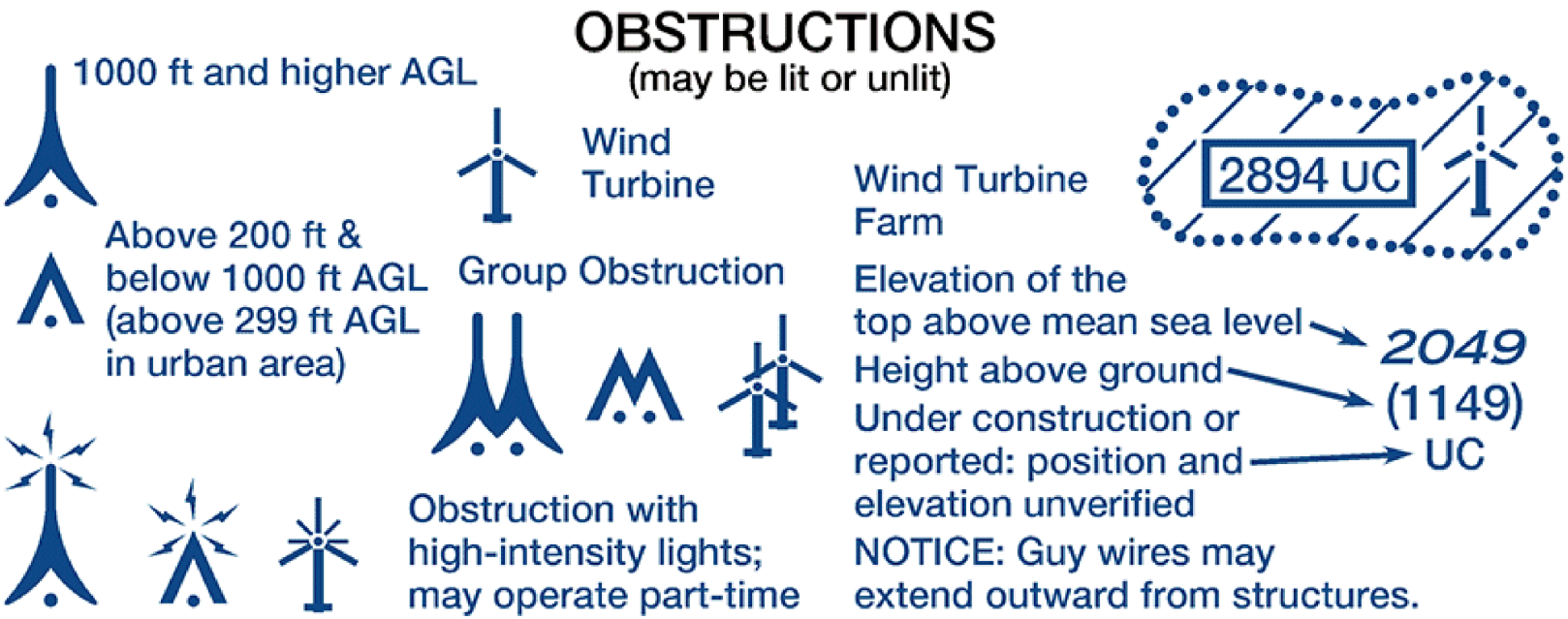
Sectional Chart Symbols



Isogonic lines are drawn on your sectional charts to show different lines of magnetic variation to help with planning your magnetic heading.

VFR Waypoints or Flags are VFR navigation aids. You would expect increased VFR activity around waypoints.

Sectional Chart Symbols



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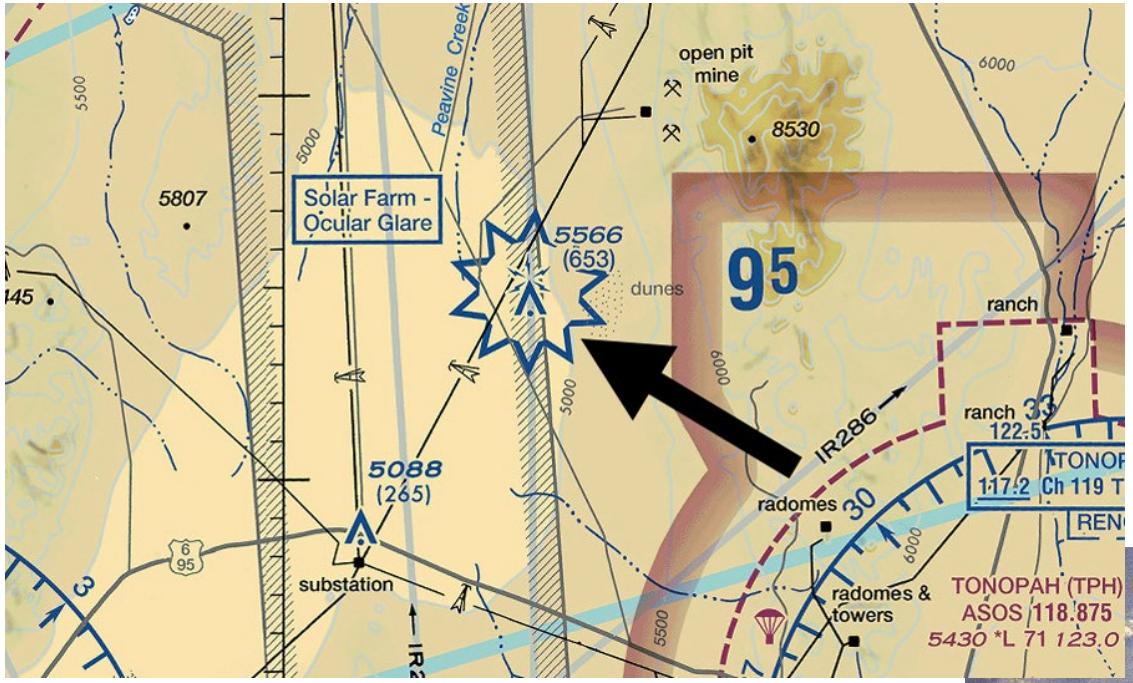

Sample Test Question

The most comprehensive information on the Waterloo airport is provided by:

1) Chart Supplements U.S.
2) Notice to Air Missions (NOTAMs)
3) Terminal Area Chart (TAC)

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Sample Test Question

What is the only type of Class E airspace that requires an airspace authorization?

1. Class E Surface Area
2. Class E Extension
3. Class E Transition airspace that starts at 700 ft AGL

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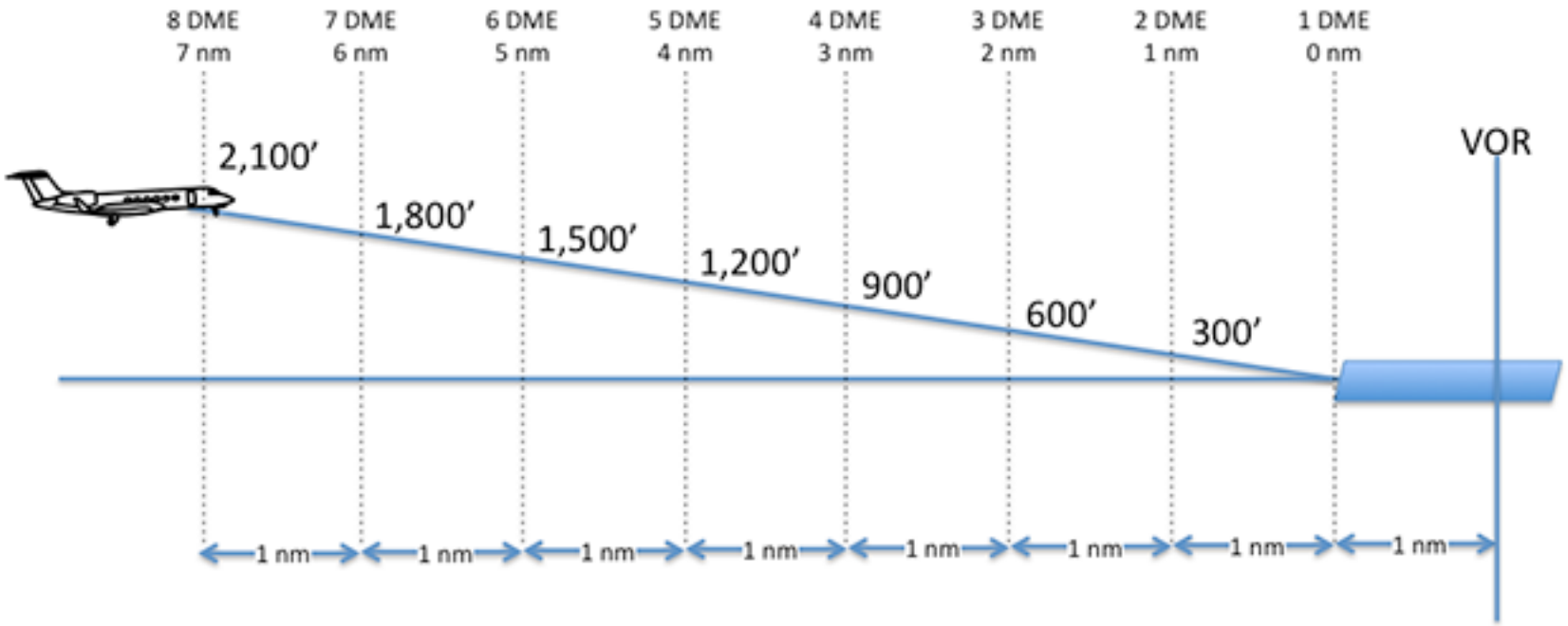
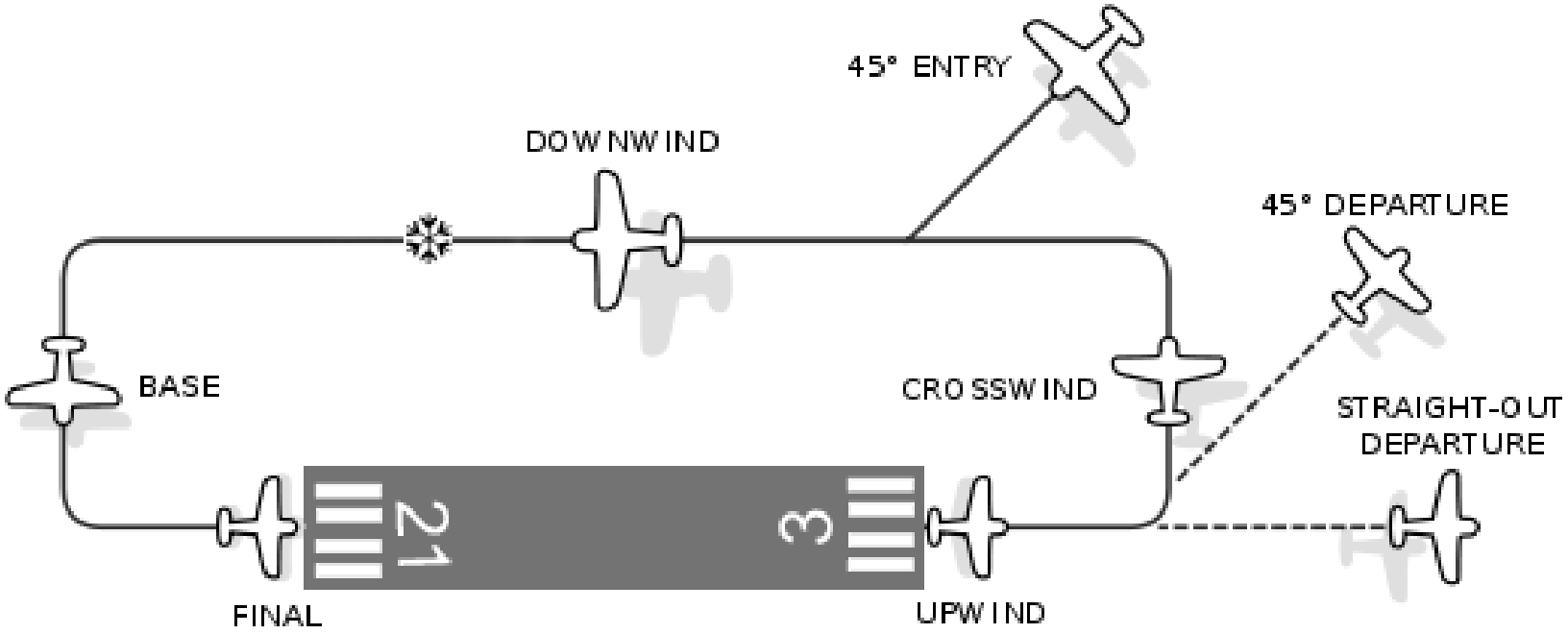
Aircraft Altitude (AGL) on Approach to Runway



Standard Airport Traffic Pattern

for uncontrolled airports



There are five different legs of the traffic pattern: Upwind, Crosswind, Downwind, Base and Final.

Sample Test Question

When flying near the Independence Iowa Airport, what direction will aircraft be landing from?

1) Northwest
2) Southwest
3) Northeast

Sample Test Question

When flying near the Independence Iowa Airport, what direction will aircraft be landing from?

1)Northwest
2)Southwest
3)Northeast

Sample Test Question

You are listening on a Common Traffic Advisory Frequency (CTAF) and an aircraft announces, *"left downwind for runway two six".* What is the aircraft's current heading?

1) 80 degrees
2) 160 degrees
3) 260 degrees

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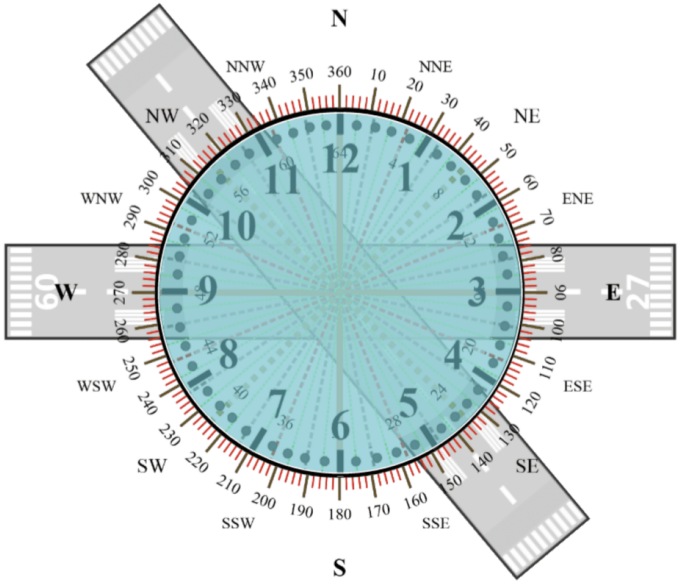
While monitoring Cooperstown Common Traffic Advisory Frequency (CTAF) an aircraft announces, *"left midway downwind to runway one three".* Where is the aircraft located relative to the runway?

1) The aircraft is East
2) The aircraft is South
3) The aircraft is West



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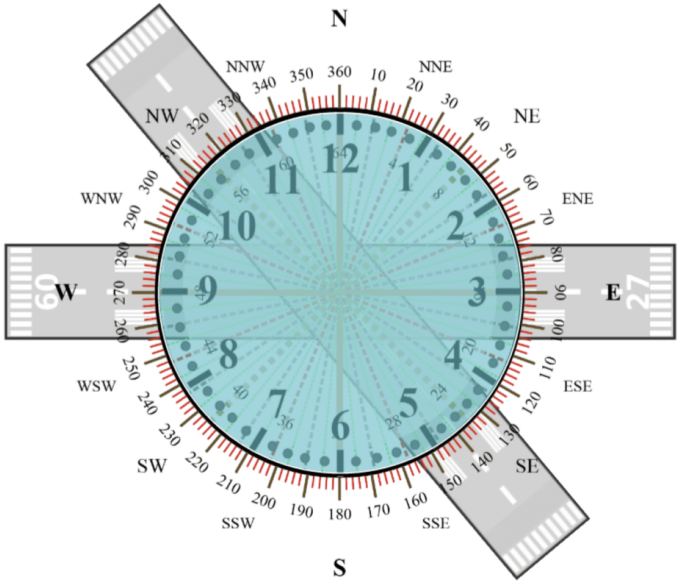

Sample Test Question

While monitoring the Common Traffic Advisory Frequency (CTAF) an ATC issues an advisory to a manned aircraft flying north, *“unmanned aircraft activity at 9 o’clock, 2 miles”*. Where should the Remote Pilot look for the aircraft?

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Two types of Airspace

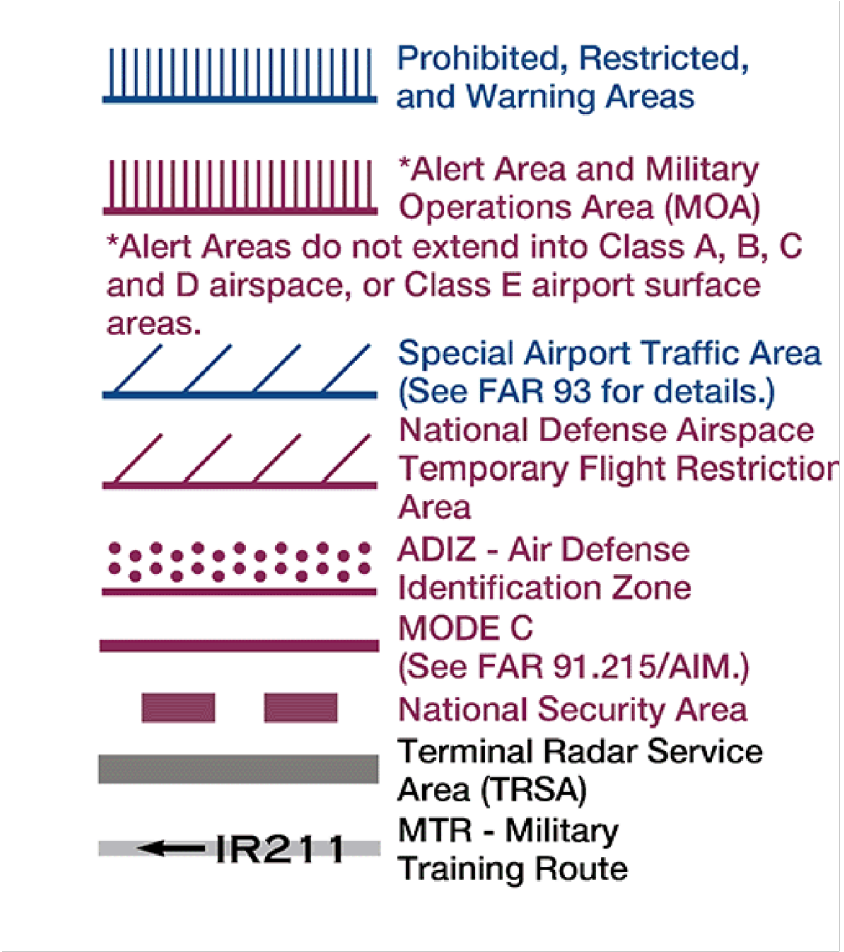
Regulatory – FAA rules apply

- Class A, B, C, D, and E
- Restricted
- Prohibited

Non-Regulatory – areas outside FAA control used by the military or over the ocean

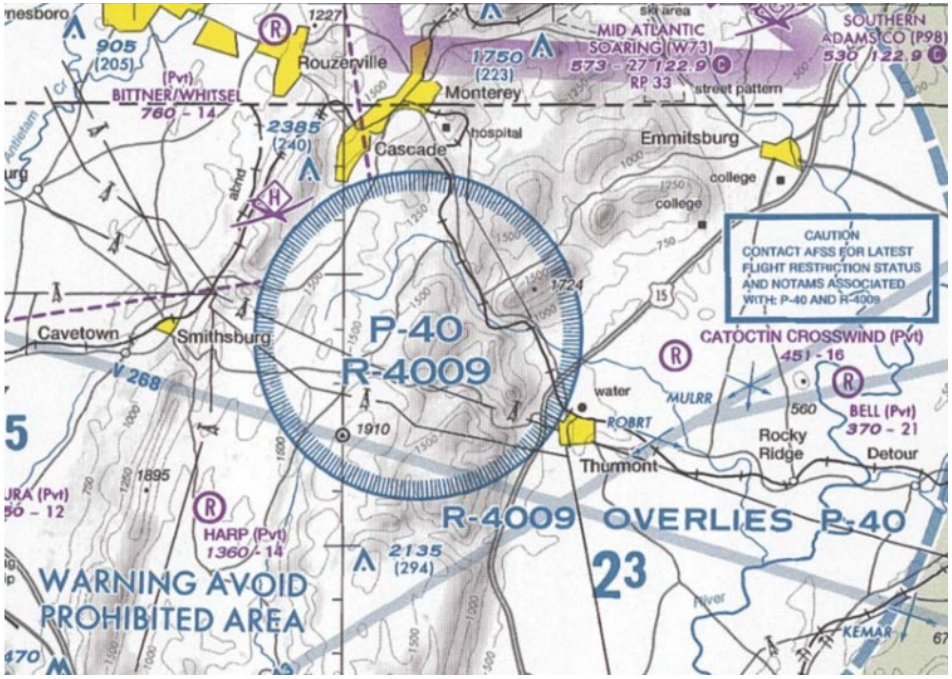
- Military operations area (MOA)
- Warning Areas
- Alert Areas
- Controlled Firing Areas

Special Areas



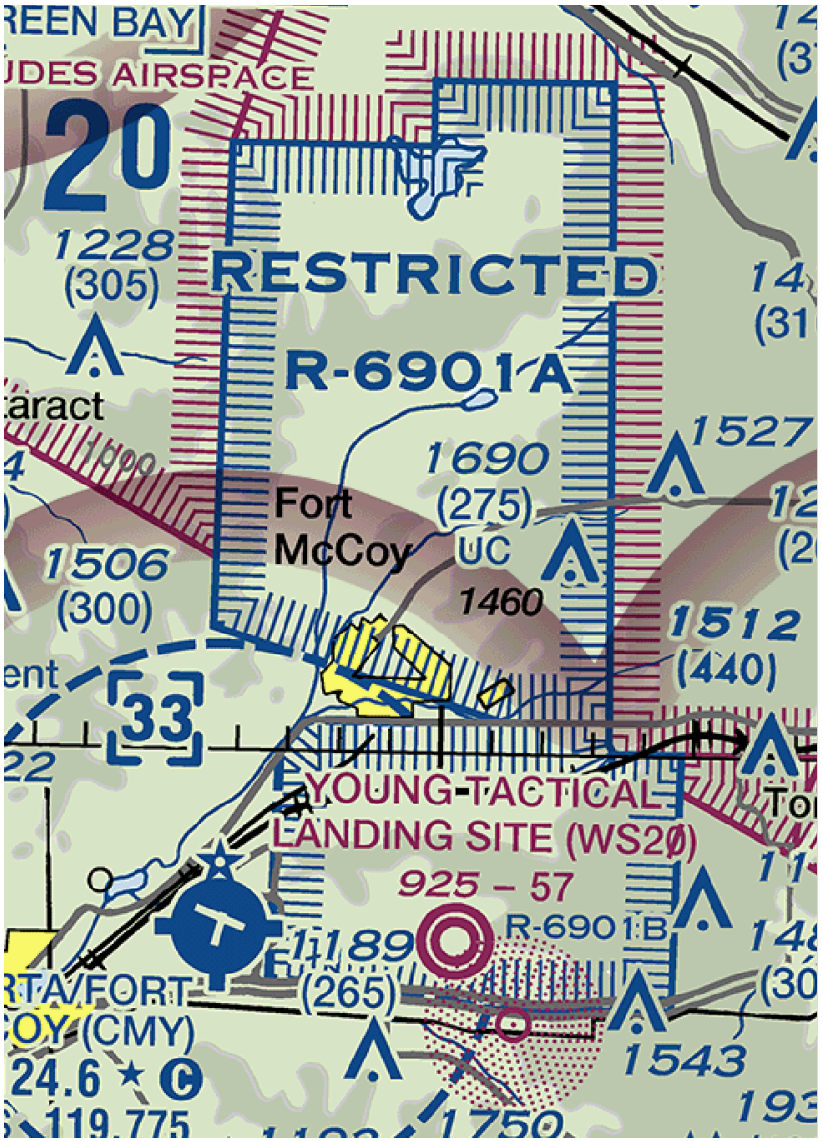
Special Use Airspace (SUAS)

Prohibited Area – charted as a "P" followed by a number (e.g., P-49) and a blue hatched line. Examples of include Camp David and the National Mall in Washington, D.C. Drone flights are always prohibited.



Special Use Airspace (SUAS)

Restricted – charted with an “R” followed by a number (e.g., R-6901) and a blue hatch line. Restricted airspace is usually a military base or facility, and drone flights are prohibited unless approved by the controlling military command.

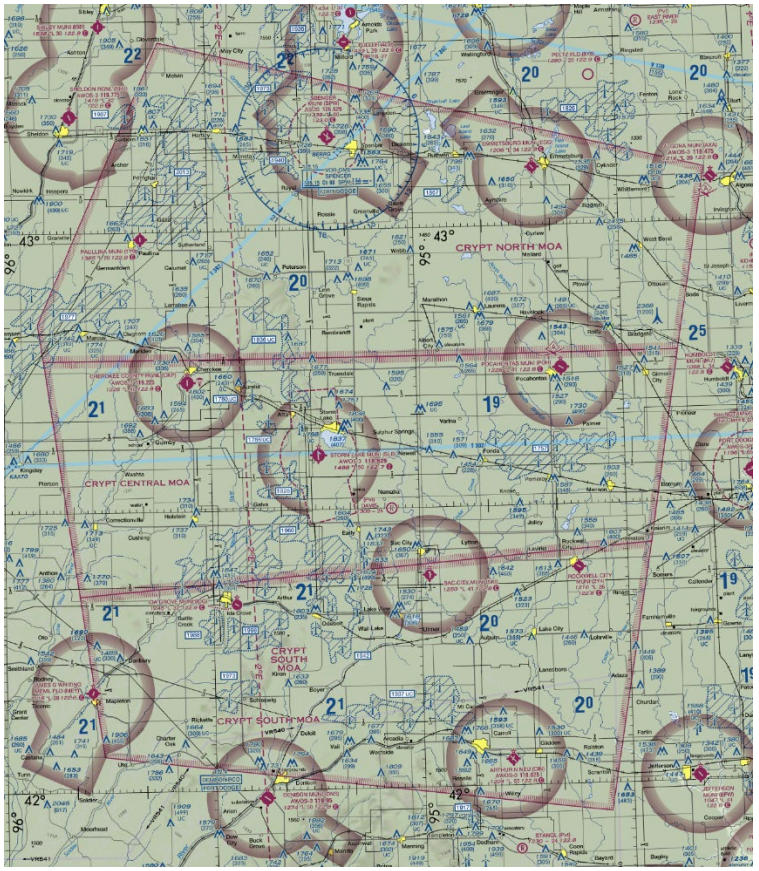


Special Use Airspace (SUAS)

Warning Area – designated with a “W” followed by a number (e.g., W-237) and a magenta hatched line is only found 3 NM offshore in US and international waters. It’s might be cool to fly there but it’s hazardous to nonparticipating aircraft..

Special Use Airspace (SUAS)

Military Operation Area (MOA) – depicted on sectional charts in magenta with a name (e.g., “CRYPT MOA”). MOAs are not restricted but require extra caution as military operations may take place in the area. For activity, altitude, time of use contact the controlling agency.



Military aircraft may fly at airspeeds in excess of 250 knots below 10,000 feet MSL within active MOAs.

CRYPT MOA in Iowa

The **CRYPT MOA** covers much of NW and Central Iowa. It's divided into 3 sections and has a floor of 8000 feet MSL.

Controlling Agency: Iowa Air National Guard, 133rd Air Control Squadron (ACS), Fort Dodge, IA

The Iowa Air National Guard 185 Air Refueling Wing (ARW) in Sioux City conducts operations in the CRYPT MOA.

The Iowa Air National Guard F16 Wing in Des Moines has been disbanded.

Special Use Airspace (SUAS)

Alert – depicted on aeronautical charts with an “A” followed by a number (e.g., A-211) and a magenta hatched line. May contain pilot training or an unusual type of aerial activity. Pilots should exercise caution in alert areas.

Special Use Airspace (SUAS)

Controlled firing areas (CFA) – CFA include rocket testing, ordinance disposal, small arms fire, chemical disposal, static testing of rockets and blasting.

- They are never found in NOTAMs
- There are no dimensions
- They are not charted
- There is no controlling agency to contact

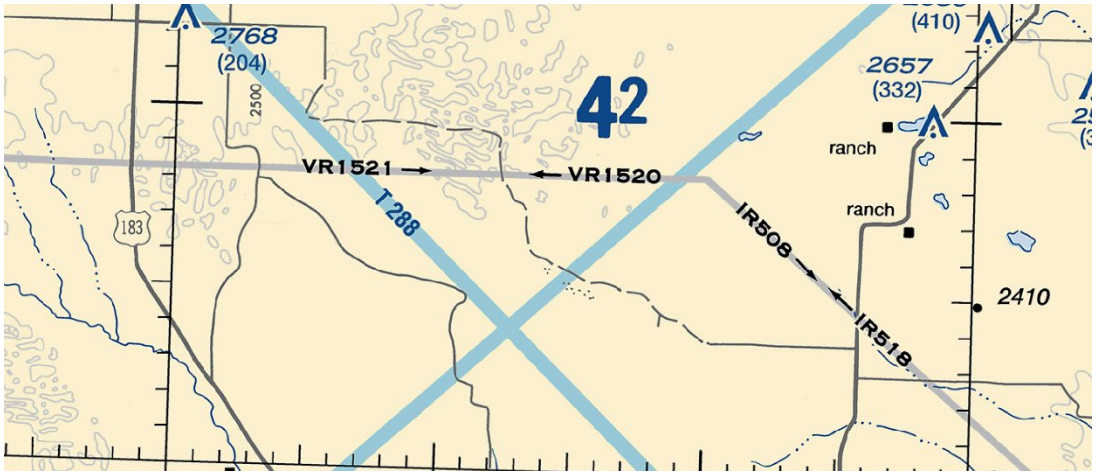
CFA activities are suspended when a spotter aircraft, radar or ground lookout indicates an aircraft is approaching the area.

Drone pilots are not allowed in CFA. They are usually fenced and/or posted "No Trespassing – Keep Out"

Special Area Of Operation (SAO)

Military Training Route (MTR) – routes used by military aircraft to maintain proficiency in tactical flying. VFR sectional charts depict IR and VR areas. Routes are identified in gray as IFR (IR), and VFR (VR), followed by a number.

- MTRs with no segment above 1,500 feet AGL are identified by four number characters (e.g., IR1206, VR1207).
- MTRs that include one or more segments above 1,500 feet AGL are identified by three number characters (e.g., IR206, VR207.



Sample Test Question

A Sectional Chart shows a gray line with *"VR1642 and VR1678".* Could these areas present a hazard for small UAS operations?

1) No, all operations will be above 400 feet.
2) Yes, these are military training routes with a least one segment below 1500 feet AGL.
3) Yes, military training routes are used to separate civilian air traffic from military air traffic.

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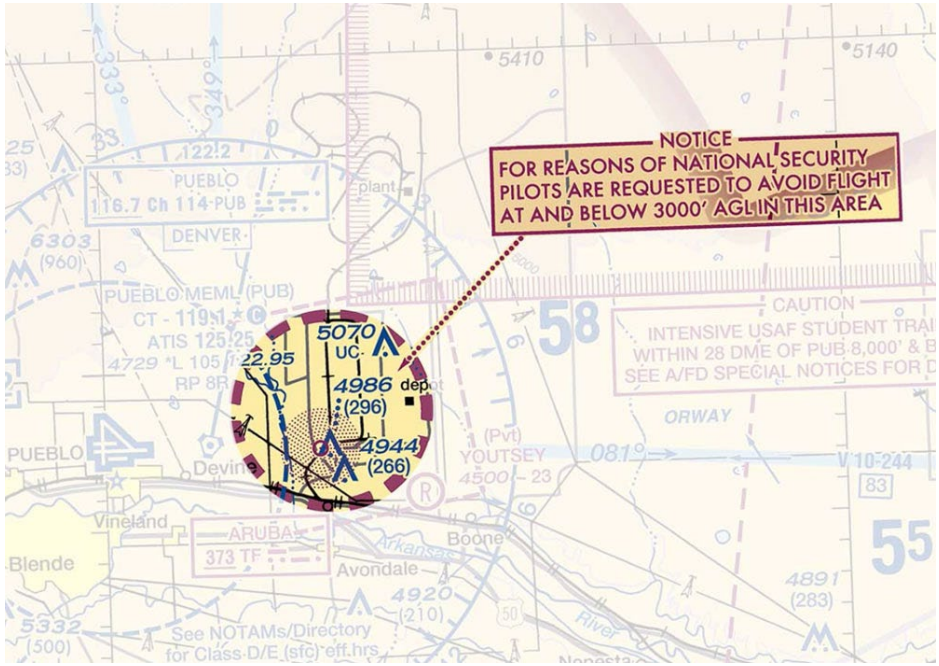
Special Area Of Operation (SAO)

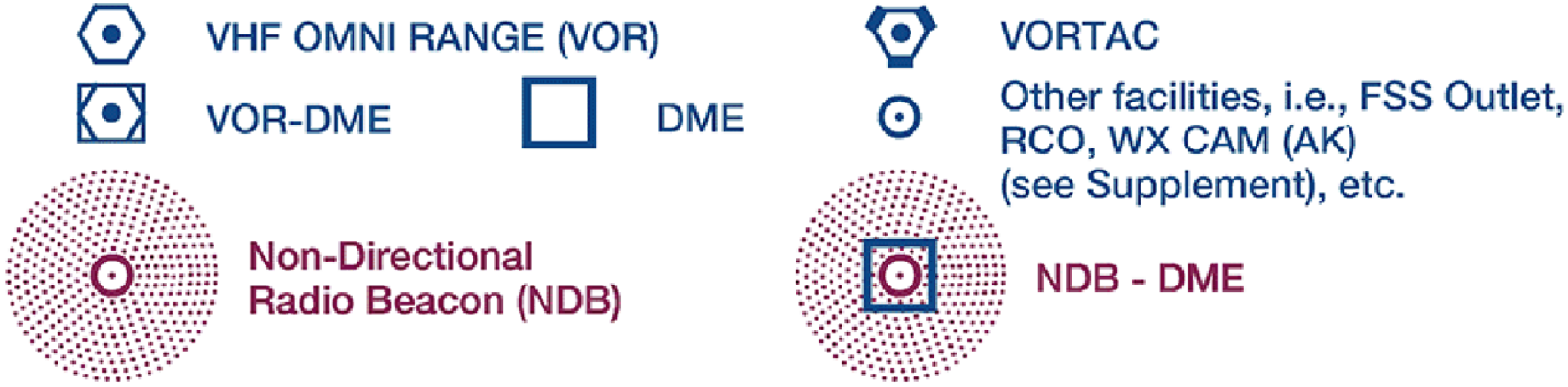
- **Temporary Flight Restriction (TFR) –** A Notice to Missions (NOTAM) is issued to designate a TFR.
- **Charted VFR Flyways–** for transitioning around, under, or through some complex airspace. These routes are generally found on VFR Terminal Area Charts.
- **Terminal Radar Service Areas (TRSA) –** areas with additional radar services. The purpose is to provide separation between IFR operations and VFR aircraft.

Special Area Of Operation (SAO)

National Security Areas (NSA) – NSAs are delimited by a **heavy dashed magenta border** and a special notation. An NSA airspace needs increased security of ground facilities. Pilots are requested to voluntarily avoid flying through these areas



RADIO AIDS TO NAVIGATION



VOR – VHF Omni Range – directional radio – gives pilot the heading to the VOR station – being phased out in favor of GPS
DME – Distance Measuring Equipment – indicates distance to DME station
VORTAC – VOR + TACAN (tactical air navigation system) – military DME system
NDB – non-directional radio beacon
RCO – Remote communications outlets relay communications to Flight Service Station (FSS)


Any
Questions