Patuxent River Navy Flying Club

RNAV APPROACHES

PRNFC

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OVERVIEW

This briefing mostly covers the differences between using the GNS-430 and GNS-530W, as well as a few related topics regarding instrument flight planning. It won't cover how to operate these instruments.

What is SBAS and WAAS?

GNS-430

- Filing
- Approach Display

Precision Approach?

Qualified Alternate and Weather Mins

GPS NOTAMs

GNS-530W

- Filing
- Approach Display

SBAS & WAAS

Satellite-based augmentation systems (SBAS)

- Generic term for the many systems used around the world.
- SBAS support wide-area or regional augmentation through the use of additional satellite-broadcast messages. Using measurements from the ground stations, correction messages are created and sent to one or more satellites for broadcast to end users as differential signal.

Wide Area Augmentation System (WAAS)

- WAAS is an SBAS developed by the FAA to augment Global Positioning System (GPS) in the United States.
- Accuracy
    - 25 feet 95% of the time
    - Typically: 3 feet laterally, 5 feet vertically

GARMIN GNS-430

Capabilities

- Not WAAS capable
- TSO-C129a – capable of Area Navigation (RNAV) navigation and approaches
- Includes Fault Detection and Exclusion (FDE)
- Includes baro-aiding to reduce the number of satellites required for RAIM calculations. (more on this below)
- Does not include Baro-VNAV or DME/DME

Approaches

- Lateral Navigation (LNAV)
- Circling

Receiver Autonomous Integrity Monitoring (RAIM)

- Developed to assess the integrity of GPS signals
    - Statistical analysis comparing solutions using different combinations of satellites to determine if one is in error.
    - Requires 5 satellites in view (only 4 with baro-aiding).
- RAIM can be performed in the air or using predictive software

RAIM PREDICTION

FAA Website

- https://sapt.faa.gov/
- Uses the Service Availability Prediction Tool (SAPT)
- Look for RAIM summary pages
  - Outages for Enroute and Terminal navigation are not common.
  - Look for red areas in the non-precision approach (NPA) map.

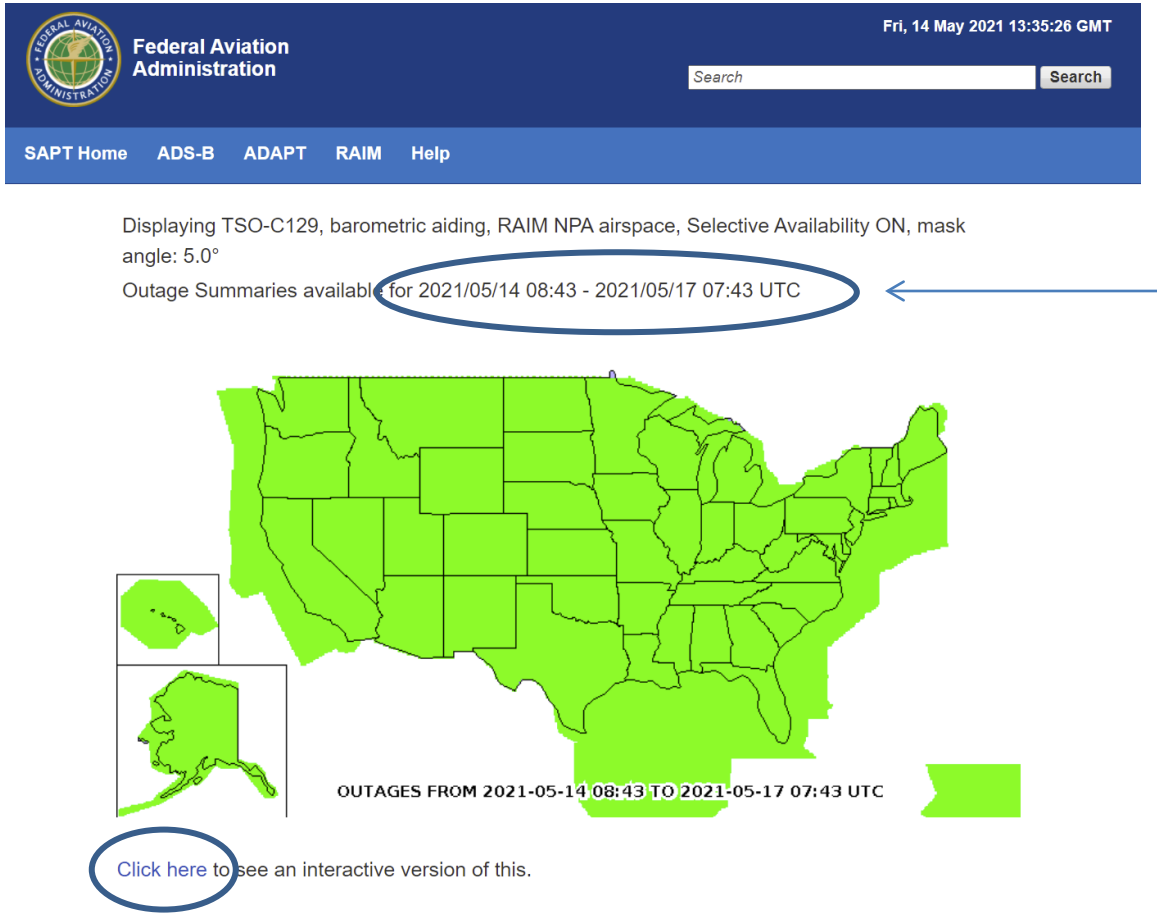
RAIM Summary Pages

Phase-of-flight	With Baro-Aiding	Without Baro-Aiding
En Route		
Terminal		
NPA		
Click on an image to view		

Use this column.

RAIM OUTAGE SUMMARY

Looking at the Outage Summary Page, it shows the entire US for the next three days. If there is no red, there are no outages and you're done!



Check the applicable dates and times.

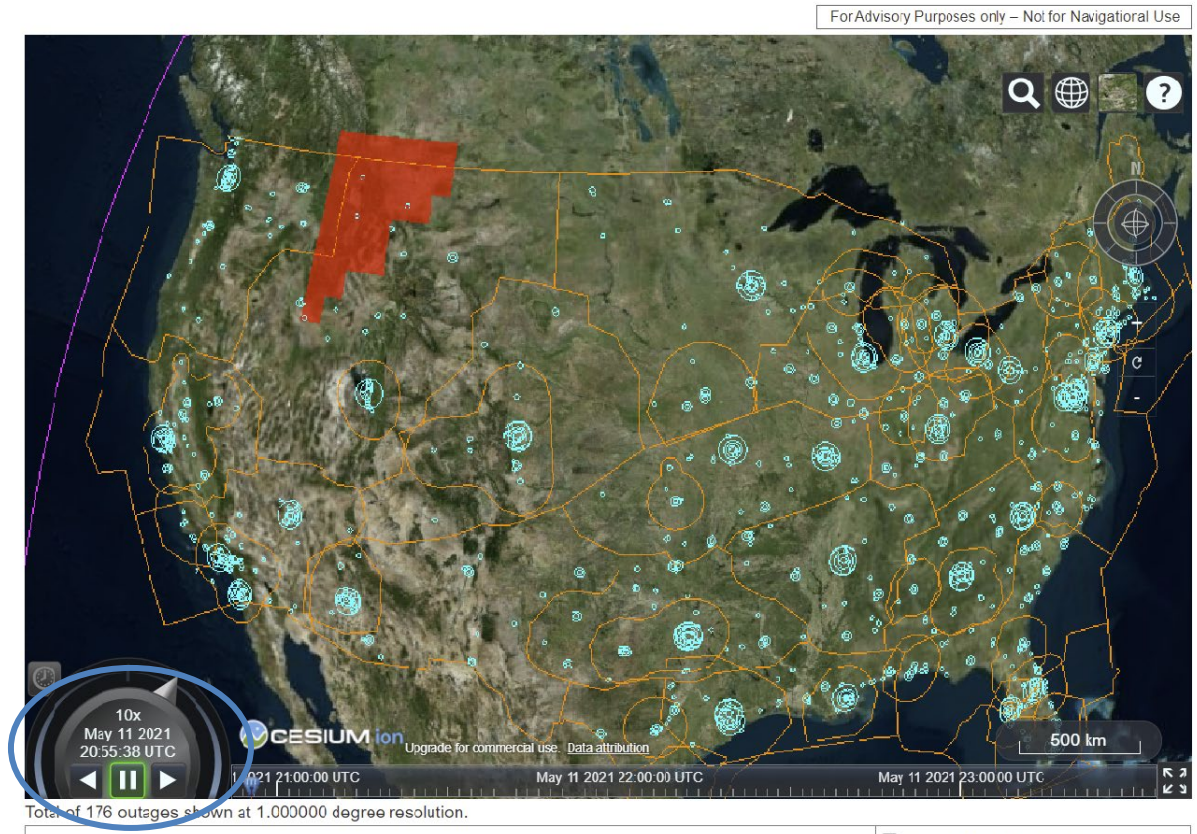
If there are any red areas on your route, click on the "Click here" link to go to the Interactive Tool. This will enable you to find the specific areas and times.

RAIM PREDICTION DISPLAY

Example from the RAIM Interactive Display using SAPT

Displaying TSO-C129, no barometric aiding, RAIM NPA airspace. Selective Availability ON, mask angle: 5.0°

* Outage Summaries available for 2021/05/11 09:22 - 2021/05/14 08:22 UTC



Displaying the time of interest is a little awkward. You can use the Look-ahead buttons and play/fast-forward/rewind controls.

Or, you can download the KML file and import into Google Earth.

GNS-430 FLIGHT PLANNING & FILING

RAIM Predication

- Use a predictive tool like the SAPT for your time of arrival.

Ensure Nav Data is up to date.

Destination

- If you use RAIM prediction and have FDE, you can file based on a GPS-based approach at your destination or your alternate, but not both.
- “file based on” means you use the weather required for those approaches.

Alternate

- With FDE, your alternate can be based on an RNAV approach, if you plan for a non-RNAV approach at the destination. (The AIM is a little hard to read on this point.)

Plan for an LNAV approach using the Minimum Descent Altitude (MDA).

GNS-430 FLIGHT

When you can use GPS navigation:

- Aircraft position relative to a NAVAID or fix
- Flying to or from a NAVAID
- Holding over a NAVAID or fix
- Flying a Distance Measuring Equipment (DME) arc.
- Even if a NAVAID is required on the Instrument Approach Procedure (e.g., “Note: ADF Required”)

When you can’t use GPS navigation:

- Localizer-based courses (including back-course localizer)
- When the approach is NOTAM’d “NA” (not authorized)
- Navigation on the final approach segment of a non-RNAV(GPS) approach (You can’t fly the course, you can identify fixes on final.)

RAIM PREDICTION IN-FLIGHT

Navigate to the Utility Page in the Aux Page Group:

- Push for the cursor and select RAIM Prediction.
- Press the ENT key.

To Compute RAIM. A good idea enroute, though the SAPT is better. Not required prior to each approach; the 430 does it automatically.

- Enter Waypoint, Arrival Date, Arrival Time.
- Highlight Compute RAIM and press ENT.
- RAIM Available: +/- 15 mins.
- RAIM Not Available: Fly a non-GPS approach or divert.

RAIM WARNING ANNUNCIATIONS

INTEG (Integrity) Annunciation

- Occurs if satellite coverage is insufficient.
- 430 will provide navigation information, but it should not be used for primary navigation.

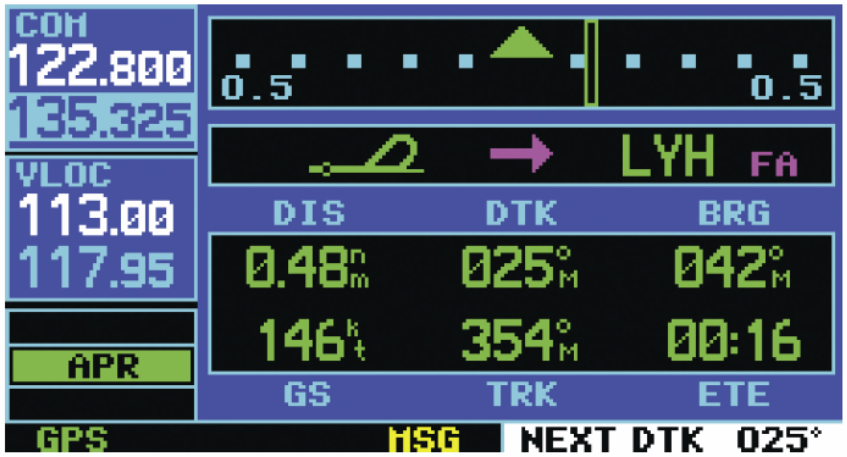
WARN (Warning) Annunciation

- "WARN" will be displayed where "INTEG" is shown.
- Indicates the 430 has detected a position error.
- All GPS navigation data is disabled.

GNS-430 FLYING THE APPROACH

Displays

Default Nav Display



Map Display

Note the “APR” indication.

PRECISION APPROACH?

RNAV approaches fall into two categories, with RNAV (GPS) approaches of the category type below:

- Non-Precision Approach (NPA)
  - Lateral Navigation (LNAV)
  - Localizer Performance without Vertical Guidance (LP)
- Approach with Vertical Guidance (APV)
  - Lateral Navigation/Vertical Navigation (LNAV/VNAV)
  - Localizer Performance with Vertical Guidance (LPV)

APVs are not considered precision approaches!

- FAA & ICAO requirements include lighting and monitoring, which APV approaches don't meet.

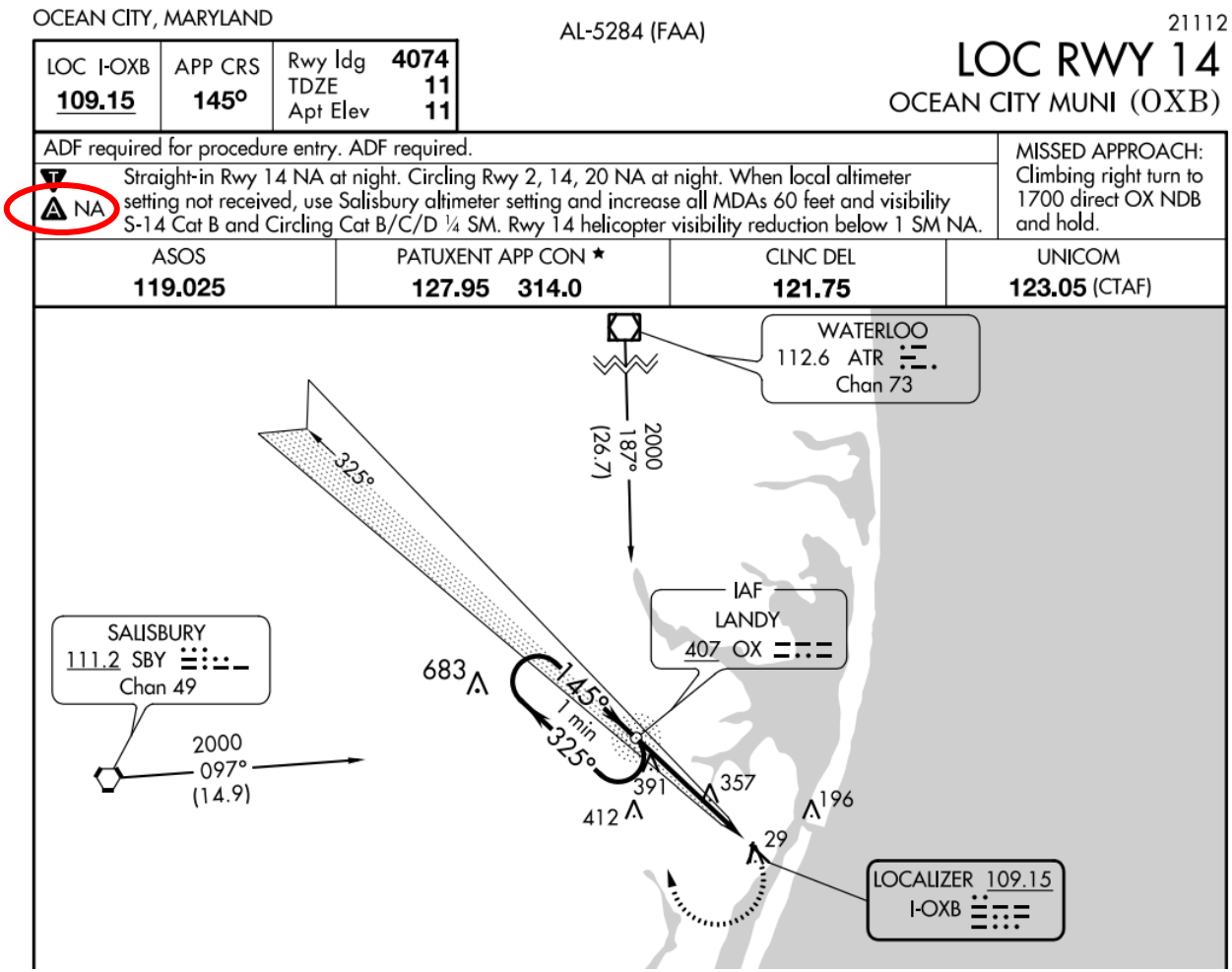
So, what?

- It's confusing to talk about. Glidepath does not equal precision approach.
- When filing an alternate for an RNAV approach, the weather must be 800/2, not 600/2 (even if it's an LPV).

QUALIFIED ALTERNATE

You can't use an alternate that's shown as "NA" (not authorized).

- Usually due to unmonitored altimeter settings.
- Shown here:



ALTERNATE WEATHER REQUIRED

Alternates often require minimums greater than 800/2.

- Shown here:

This airport cannot be filed as an alternate if local weather is not available. You have to check the NOTAMs before using it as an alternate.

CUMBERLAND, MD

GREATER CUMBERLAND RGNL (CBE).....**LOC/DME Rwy 23[14]**
RNAV (GPS) Rwy 5[2]
RNAV (GPS) Rwy 23[3]

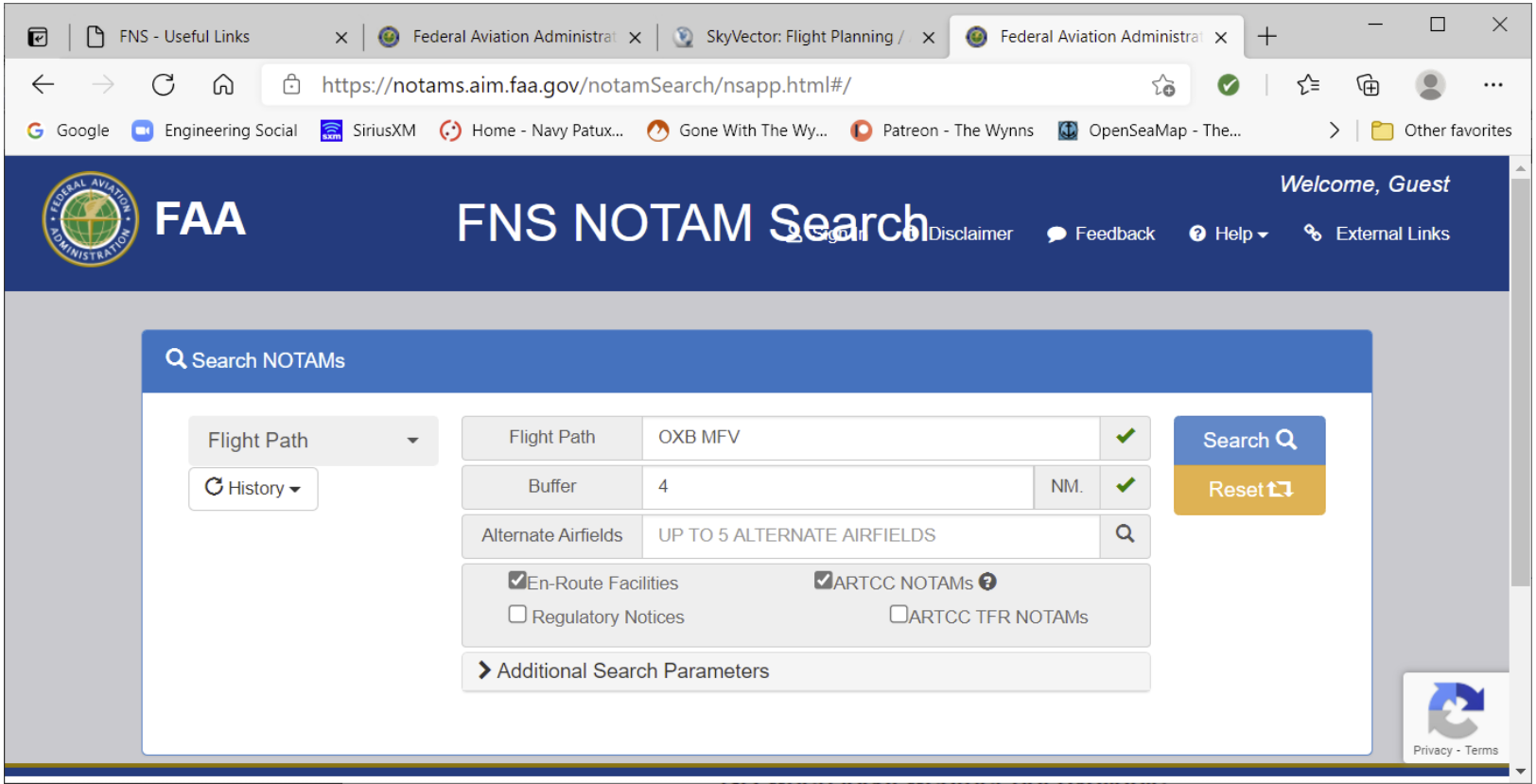
NA when local weather not available.
[1]Category A, 1000-2; Category B, 1400-2; Category C 1500-3, Category D 1600-3.
[2]Category A, 1100-2; Category B, 1400-2; Category C, 1500-3; Category D, 1600-3.
[3]Category A, 1100-2; Category B, 1400-2; Category C, 1500-3.
[4]NA when CBE FBO closed.

Note that the LOC/DME Rwy 23 approach can't be used to determine the weather required for an alternate when the Cumberland FBO is closed.

GPS NOTAM SEARCH ENTRY

Go to the FAA website: https://notams.aim.faa.gov/notamSearch/

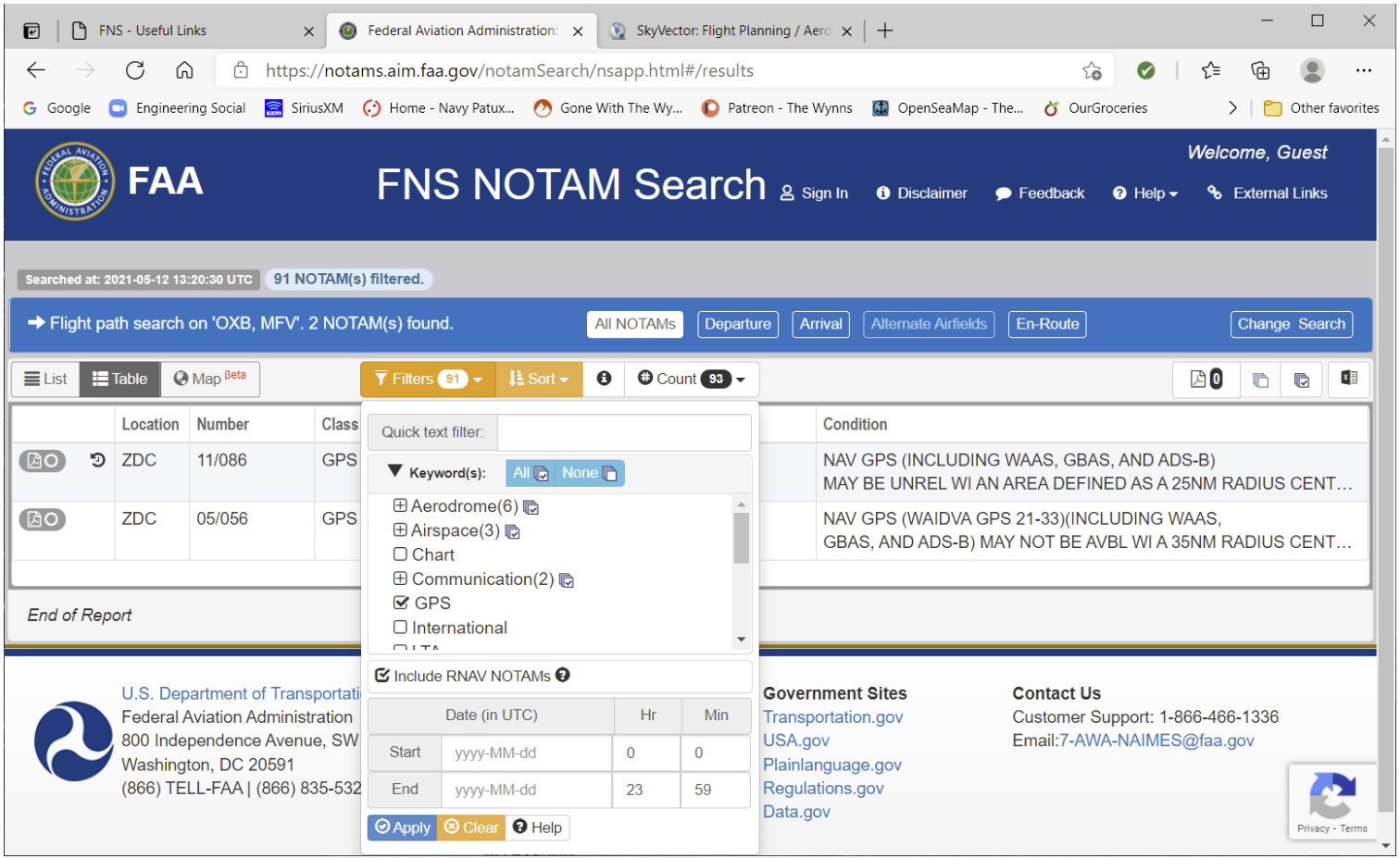
- **Enter Flight Path in the drop down box to the left.**
- **Enter a route in the Flight Path text box in the center.**
- **Check the ARTCC NOTAMs checkbox.**
- **Click on the Search button.**



GPS NOTAM SEARCH RESULTS

Go to the Filter drop down menu, select GPS, then click Apply at the bottom.

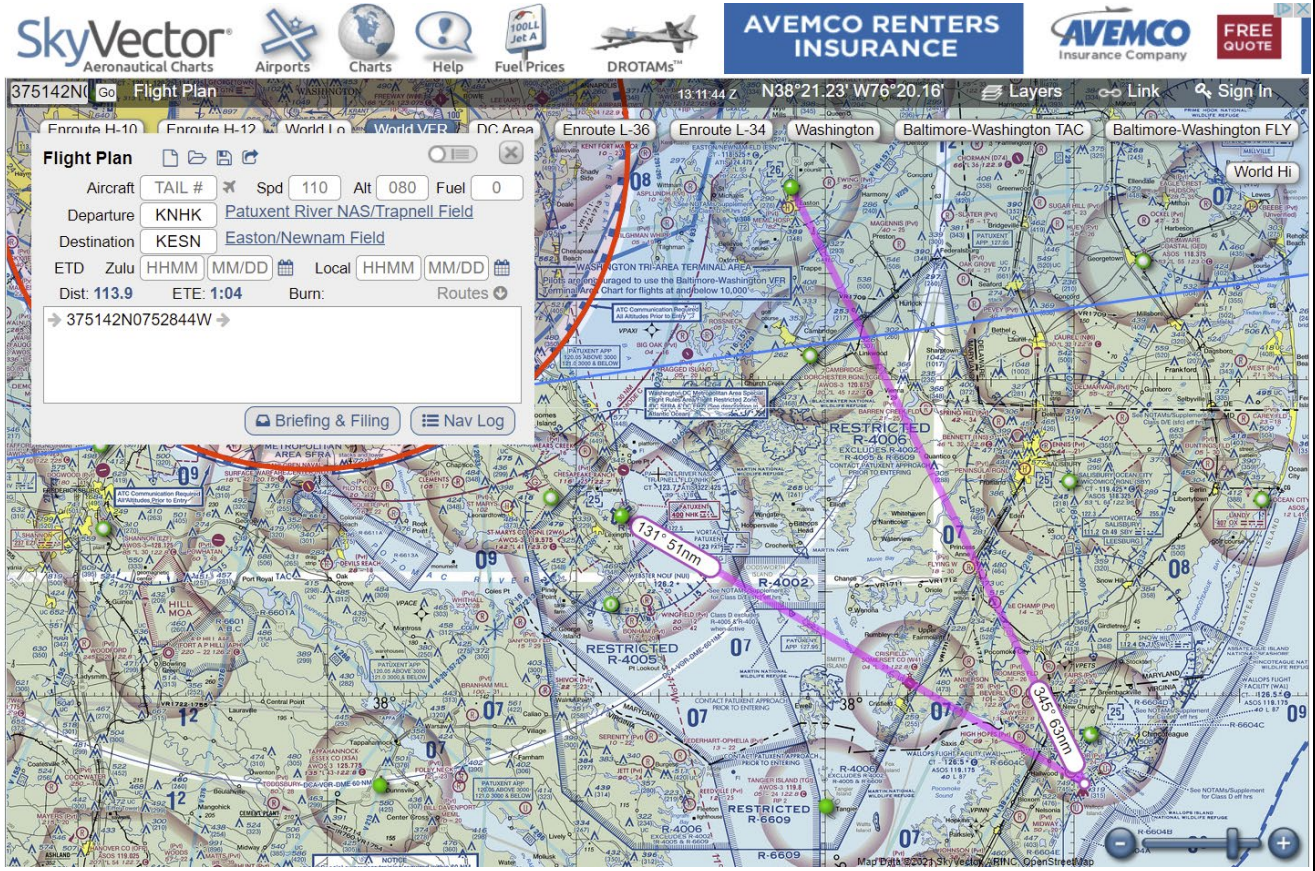
• The NOTAMs will display (if any). Click in the Condition column for a NOTAM, to see any individual NOTAM.



FINDING THE LOCATION OF NOTAM LAT/LONGS

Go to: www.skyvector.com

- Click “Flight Plan” in the dark bar that runs across the page near the top.
- Enter nearby airports in the Departure and Destination text boxes.
- Cut and paste the lat/long coordinates from the NOTAM into the large, white, route of flight text box.
- This shows the NOTAM to be centered on Wallops Island.



Note: There is a mapping feature on the FAA’s NOTAM Search Results page, but it is currently in beta-test and not very useful.

GARMIN GNS-530W

Capabilities

- WAAS capable!
- You can tell when the instrument is starting—the model number will be displayed. A “W” at the end of a Garmin model number means it’s WAAS-capable.
- TSO-C146a – capable of Area Navigation (RNAV) navigation and approaches
- Includes Fault Detection and Exclusion (FDE)
- Includes baro-aiding to reduce the number of satellites required for RAIM calculations.
- Baro-VNAV and DME/DME are irrelevant—WAAS is better.

Approaches

- Localizer Performance with Vertical Guidance (LPV)
- Localizer Performance without Vertical Guidance (LP)
- Lateral Navigation/Vertical Navigation (LNAV/VNAV)
- Advisory Vertical Guidance (LP+V, LNAV+V) (Garmin feature)
    - The pilot must ensure Final Approach Fix and Step Down altitude restrictions are met using the barometric altimeter.
- Lateral Navigation (LNAV)
- Circling

GNS-530W FLIGHT PLANNING & FILING

RAIM Predication

- Only required if the WAAS satellites are NOTAM'd out.

Ensure Nav Data is up to date.

Destination

- No restrictions for filing

Alternate

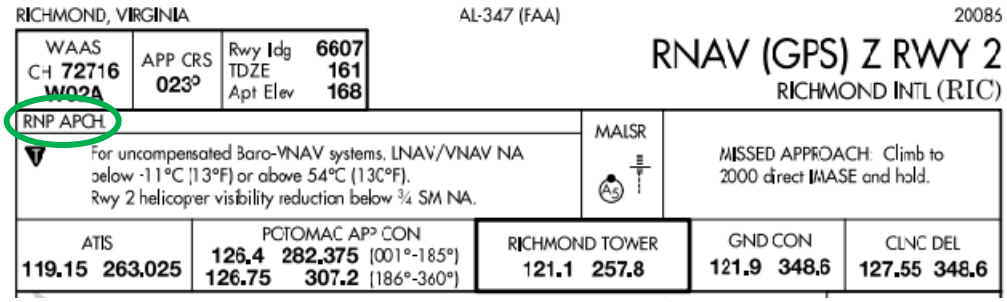
- If you plan for a RNAV(GPS) approach at your alternate, you must use 800/2 weather requirement.

GNS-530W RNP APPROACHES

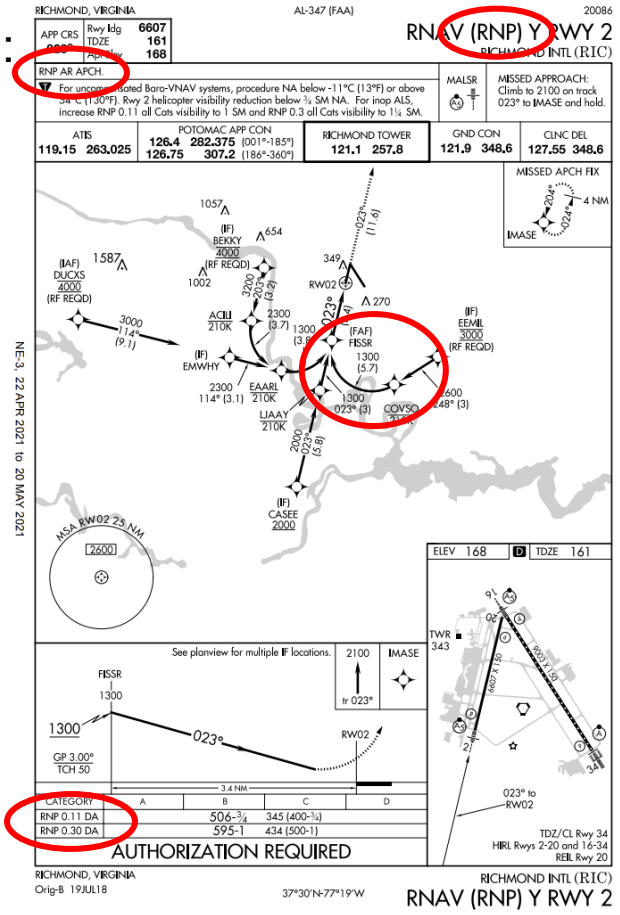
Required Navigation Precision (RNP):

- RNP 1.0 approaches are authorized, but not a number lower than 1.0.
- "RNP APCH" is normally allowed—look at the landing minima line. "RNP AR APCH" is not allowed, nor any approach with "(RNP)" in the title—special aircrew training is required.
- The 530W does not support approaches with curved flight paths (radius-to-fix, or RF).
- The GNS-530W will not load an approach that it doesn't support (e.g., approaches with an RF flight path).
- For an RNP APCH, maintain ½ CDI deflection or less. (AC 90-105A). Technique: use the autopilot on the LOC/NORM setting with the final approach course set on the heading bug (for the Arrow autopilot).

Allowed:



Not Allowed:

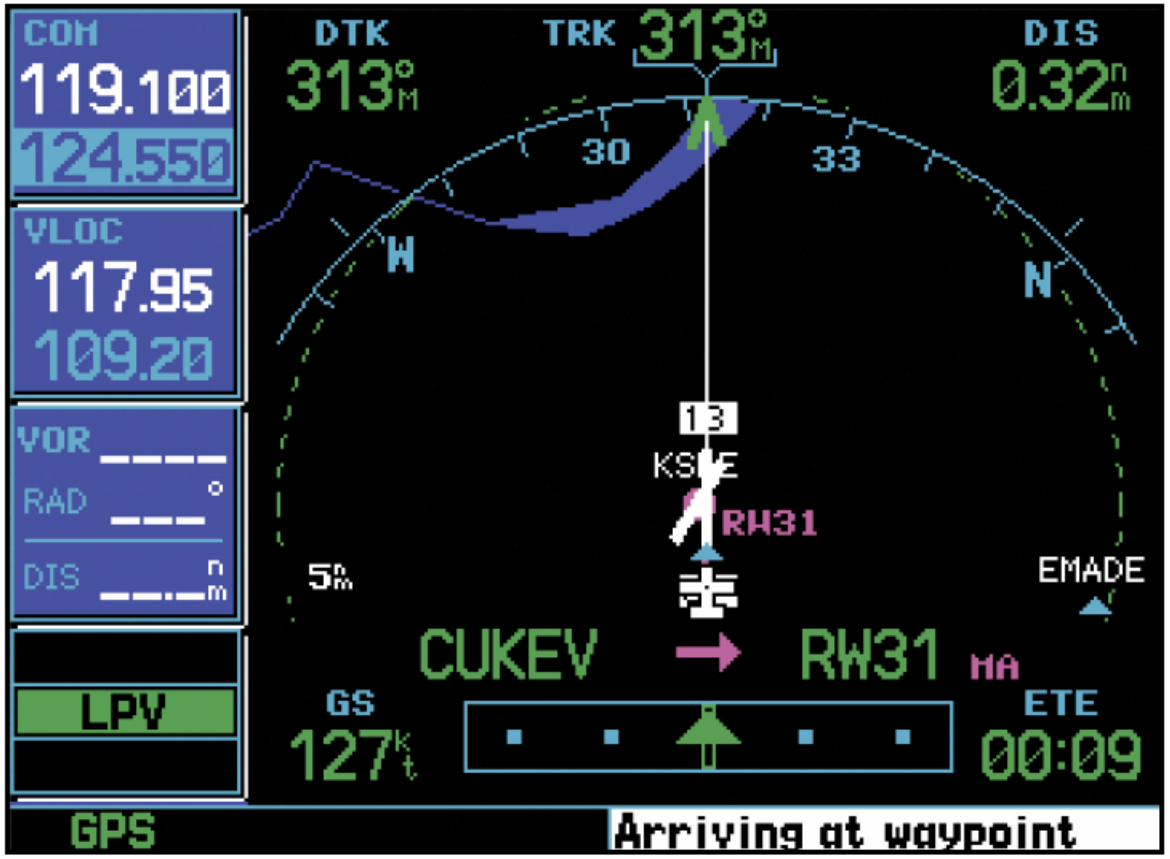


GNS-530W FLYING THE APPROACH

Display

Data Blocks from the GNS-430 Nav Page are now integrated onto a map.

After 1 minute prior to the Final Approach Fix (FAF) (about 2NM out), but before arriving at the FAF, check that the annunciator displays the intended approach name.



SUMMARY

Learn about RAIM prediction, even if you fly the 530W. GPS NOTAMs are a thing!

Ensure you have enough fuel for an appropriate alternate.

While the 430 & 530W are similar, they are complicated. You can practice using them by downloading the Garmin simulator at:

https://www8.garmin.com/support/download_details.jsp?id=3531