GARMIN.

10   TERRAIN

10.1   Terrain Configurations

During power-up of the GTN 6XX, the terrain/obstacle database versions are displayed along with a disclaimer. At the same time, the Terrain system self-test begins. A failure message is issued if the terrain test fails.

Garmin provides the following terrain awareness solutions within the GTN 6XX environment:

- Terrain Proximity - This is the standard Terrain function and refers to the display of the relative terrain elevations on the moving map. No aural alerts of any type are provided by a Terrain configuration.

- TAWS-B (Optional) - A system developed to meet the terrain alerting and ground proximity requirements for Class B TAWS systems as defined in TSO-C151c. Garmin's GTN 6XX Terrain Awareness and Warning System (TAWS-B) is an optional feature and is intended to provide the flight crew with both aural and visual alerts to aid in preventing inadvertent Controlled Flight Into Terrain (CFIT).

- HTerrain Proximity - This is the standard Terrain function and refers to the display of the relative terrain elevations on the moving map. No aural alerts of any type are provided by a Terrain Proximity configuration.

- HTAWS (Optional) - A system to increase situational awareness and aid in reducing controlled flight into terrain. Garmin HTAWS satisfies TSO-C194 requirements for certification.

- TAWS-A (Optional) - A system to increase situational awareness and aid in reducing controlled flight into terrain (CFIT) as defined in TSO-C151c. TAWS-A provides visual and aural annunciations when terrain and obstacles are within the given altitude threshold from the aircraft.

> ✓ **NOTE:** *Obstacles are removed from the Terrain and TAWS pages at ranges greater than 10 NM.*

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

GARMIN.

10.2 General Database Information

Garmin TAWS and HTAWS use terrain and obstacle information supplied by government and private sources. The data undergoes verification by Garmin to confirm accuracy of the content. ***However, the displayed information should never be understood as being all-inclusive. Pilots must familiarize themselves with the appropriate charts for safe flight.***

> **NOTE:** *The data contained in the terrain and obstacle databases comes from government and private agencies. Garmin accurately processes and cross-validates the data, but cannot guarantee the accuracy and completeness of the data.*

10.2.1 Database Versions

The version and area of coverage of each terrain/obstacle database is shown on the System-System Status page. Databases are checked for integrity at power-up. If a database is found to be missing and/or deficient, the TAWS/HTAWS system fails the self-test and displays the TAWS/HTAWS system failure message.

10.2.2 HTAWS Database Requirements

To function properly, HTAWS requires the use of databases specific to helicopters and HTAWS. The databases required are:
- 2.5 arc-second Terrain Database
- Helicopter Obstacle Database
- Helicopter Navigation Database

10.2.3 Database Updates

For information on how to update databases, see section 18.2.

10.2.4   Terrain Database Areas of Coverage

The fixed-wing terrain database provides worldwide coverage. The following describes the area of coverage available in each helicopter terrain database. Regional definitions may change without notice.

Database	Coverage Area
Americas - North	Latitudes: 0° to N90° Longitudes: W180° to W30°
Americas - South	Latitudes: N30° to S90° Longitudes: W180° to W30°
Atlantic - North	Latitudes: 0° to N90° Longitudes: W30° to E90°
Atlantic - South	Latitudes: N30° to S90° Longitudes: W30° to E90°
Pacific - North	Latitudes: 0° to N90° Longitudes: E60° to E180°
Pacific - South	Latitudes: N30° to S90° Longitudes: E60° to E180°

Table 10-1 Terrain Database Coverage

> ✔ **NOTE:** *Because of higher resolution helicopter terrain data, the world-wide data won't fit on the terrain database card. Therefore, data is regionalized. If you have the wrong region database for your present position, then you get the message that terrain is unavailable for the current location and a crosshatched pattern on the terrain display.*

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

10.2.5 Obstacle Database Areas of Coverage

The following describes the area of coverage available in each database. Regional definitions may change without notice.

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Database	Coverage Area
United States (US)	Limited to the United States plus some areas of Canada, Mexico, Caribbean, and the Pacific.
US/Europe	Alaska, Austria, Belgium, Canada*, Caribbean*, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hawaii, Iceland, Ireland, Italy, Latvia, Lithuania, Mexico*, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, United Kingdom, United States
* Indicates partial coverage	

Table 10-2 Obstacle Database Coverage

NOTE: It is very important to note that not all obstacles are necessarily charted and therefore may not be contained in the Obstacle Database.

Obstacle databases created for GTN software v5.10 or later include all power lines or only HOT lines depending on the type of obstacle database installed. Hazardous Obstacle Transmission (HOT) Lines are those power lines that are co-located with other FAA-identified obstacles. The installed obstacle database type can be verified on the System Status page. Power line data is available for the contiguous United States as well as small parts of Canada and Mexico.

GARMIN.
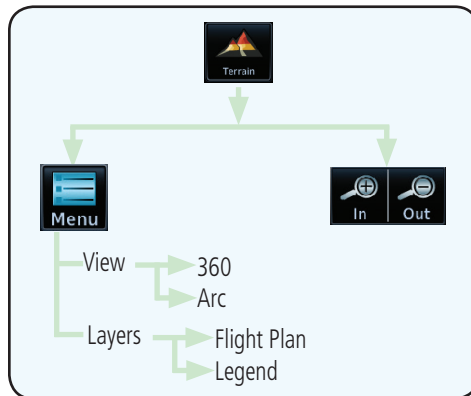
10.3   Terrain Proximity

Garmin Terrain Proximity is a non-TSO-C151c-certified terrain awareness system provided as a standard feature of GTN 6XX to increase situational awareness and help reduce controlled flight into terrain (CFIT). Terrain may be displayed on the Map and Terrain pages.

Terrain Proximity uses information provided from the GPS receiver to provide a horizontal position and altitude. GPS altitude is derived from satellite measurements. GPS altitude is converted to a Mean Sea Level (MSL)-based altitude (GSL altitude) and is used to determine Terrain alerts. GSL altitude accuracy is affected by factors such as satellite geometry, but it is not subject to variations in pressure and temperature that normally affect pressure altitude devices. GSL altitude does not require local altimeter settings to determine MSL altitude. Therefore, GPS altitude provides a highly accurate and reliable MSL altitude source to calculate terrain and obstacle alerts.

Terrain Proximity utilizes terrain and obstacle databases that are referenced to mean sea level (MSL). Using the GPS position and GSL altitude, Terrain Proximity displays a 2-D picture of the surrounding terrain and obstacles relative to the position and altitude of the aircraft. In this manner, Terrain Proximity can provide advanced alerts of predicted dangerous terrain conditions.

Terrain Proximity requires the following to operate properly:

- The system must have a valid 3-D GPS position solution.
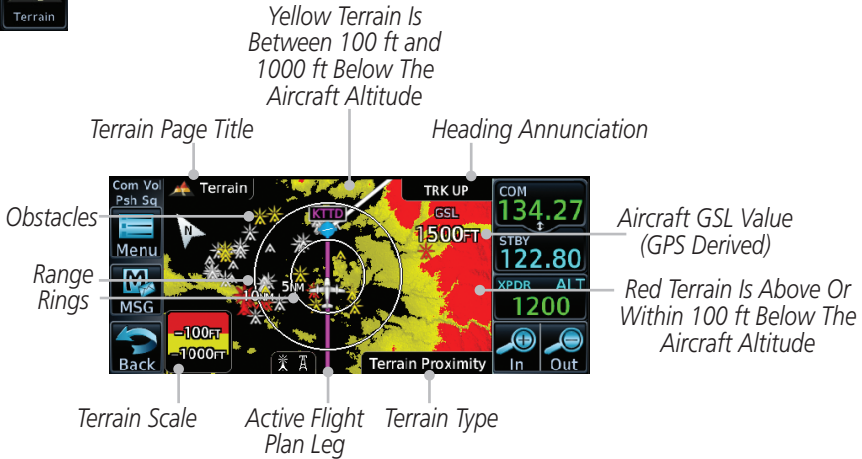- The system must have a valid terrain/obstacle database.

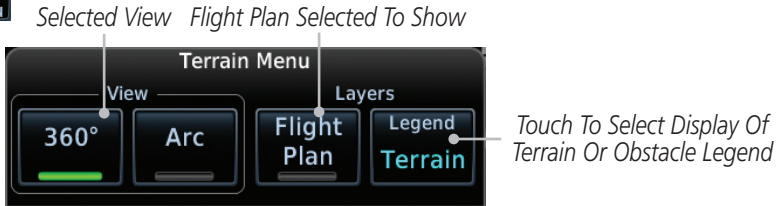**Figure 10-1 Terrain Proximity Page Functional Diagram**

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

10.3.1 Displaying Terrain Proximity

The Terrain page is in the Terrain function.

1. Touch the **Terrain** key on the Home page.

Yellow Terrain Is Between 100 ft and 1000 ft Below The Aircraft Altitude

Terrain Page Title

Heading Annunciation

Obstacles

Aircraft GSL Value (GPS Derived)

Range Rings

Red Terrain Is Above Or Within 100 ft Below The Aircraft Altitude

Terrain Scale

Active Flight Plan Leg

Terrain Type

Figure 10-2 Terrain Page

2. Touch the **Menu** key for options.

Selected View   *Flight Plan Selected To Show*

Touch To Select Display Of Terrain Or Obstacle Legend

Figure 10-3 Terrain Menu Options

10.3.1.1   Terrain Page 120° Arc or 360° Rings

Select the 120º Arc or 360º rings overlay for the Terrain page with either the **360** or **Arc** keys from the Menu.

[Menu icon]

1.   While viewing the Terrain page, touch the **Menu** key.

[360° key]

[Arc key]

2.   Touch the **360º** or **Arc** key.

Yellow Terrain Is Between 100 ft and 1000 ft Below The Aircraft Altitude

Heading Annunciation

Arc Range

120° Arc Outline

Aircraft GSL Value (GPS Derived)

Red Terrain Is Above Or Within 100 ft Below The Aircraft Altitude

Terrain Scale

Terrain Type

Icon shows point obstacle overlay is active (software v5.12, or later)

Icon shows wire obstacle overlay is active (software v5.12, or later)
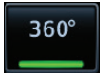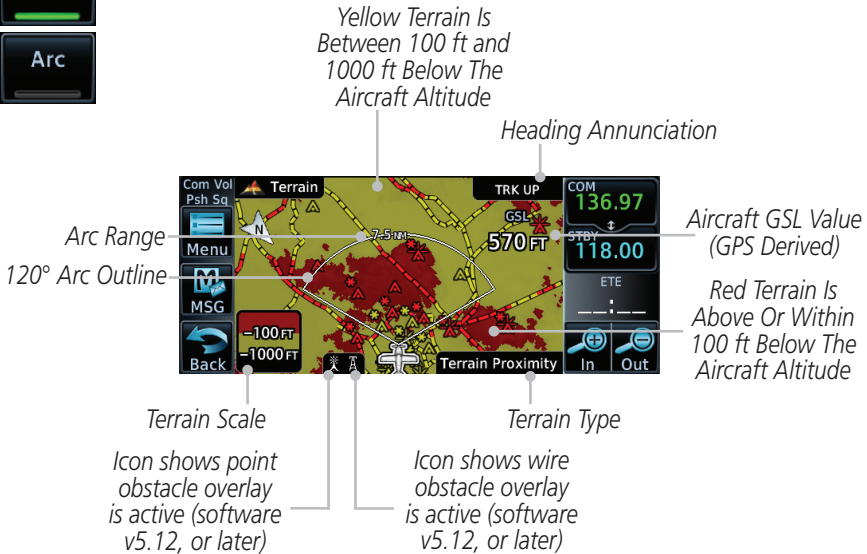
Figure 10-4 Terrain 120° Arc View

10.3.1.2   Display Flight Plan on Terrain Page

Select the display of the active flight plan on the Terrain page.
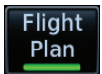
[Flight Plan key]

Touch the **Flight Plan** key to toggle the display of the active flight plan on or off.

10.3.1.3   Display Terrain or Obstacle Legend

Select the display of the Terrain or Obstacle Legend on the Terrain page.

[Legend Terrain key]

Touch the **Legend** key to select the display of the Terrain or Obstacle Legend.

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

10.3.2   Terrain Limitations

Terrain Proximity displays terrain and obstructions relative to the altitude of the aircraft. The displayed alerts are advisory in nature only. Individual obstructions may be shown if available in the database. However, all obstructions may not be available in the database and data may be inaccurate. Terrain information should be used as an aid to situational awareness. Never use this information for navigation or to maneuver to avoid obstacles.

Terrain Proximity uses terrain and obstacle information supplied by government sources. The displayed information should never be understood as being all-inclusive.

> ✓ **NOTE:** *The data contained in the Terrain Proximity databases comes from government agencies. Garmin accurately processes and cross-validates the data but cannot guarantee the accuracy and completeness of the data.*

> ✓ **NOTE:** *TERRAIN, TAWS-A, TAWS-B, HTAWS, or HTERRAIN PROXIMITY functionality will be available via the Terrain page, depending on the installed hardware and configuration. HTAWS or HTERRAIN PROXIMITY are available in software v4.00, or later. TAWS-A is available in software v5.00, or later.*

10.4   TAWS-B (Optional)

TAWS (Terrain Awareness and Warning System) is an optional feature to increase situational awareness and aid in reducing controlled flight into terrain (CFIT). TAWS provides visual and aural annunciations when terrain and obstacles are within the given altitude threshold from the aircraft.

TAWS satisfies TSO-C151c Class B requirements for certification. Class B TAWS is required for all Part 91 turbine aircraft operations with six or more passenger seats and for Part 135 turbine aircraft operations with six to nine passenger seats (FAR Parts 91.223, 135.154).

10.4.1   TAWS-B Requirements

TAWS requires the following to operate properly:

- A valid terrain/obstacle database
- A valid 3-D GPS position solution

GARMIN.

10.4.2   TAWS-B Limitations

> **NOTE:** *The data contained in the TAWS databases comes from government agencies. Garmin accurately processes and cross-validates the data but cannot guarantee the accuracy and completeness of the data.*

TAWS displays terrain and obstructions relative to the altitude of the aircraft. Compliance with TAWS B alerts and warnings is MANDATORY. When a TAWS B "pull up" annunciation is issued, the pilot is required to pull up.

TAWS uses terrain and obstacle information supplied by government sources. Terrain information is based on terrain elevation information in a database that may contain inaccuracies. Individual obstructions may be shown if available in the database. The data undergoes verification by Garmin to confirm accuracy of the content, per TSO-C151c.

10.4.3   Computing GPS Altitude for TAWS

TAWS uses information provided from the GPS receiver to provide a horizontal position and altitude. GPS altitude is derived from satellite measurements. GPS altitude is converted to a Mean Sea Level (MSL)-based altitude (GSL altitude) and is used to determine TAWS alerts. GSL altitude accuracy is affected by factors such as satellite geometry, but it is not subject to variations in pressure and temperature that normally affect pressure altitude devices. GSL altitude does not require local altimeter settings to determine MSL altitude. Therefore, GPS altitude provides a highly accurate and reliable MSL altitude source to calculate terrain and obstacle alerts.

The terrain and obstacle databases used by TAWS are referenced to Mean Sea Level. Using the GPS position and GSL altitude, TAWS displays a 2-D picture of the surrounding terrain and obstacles relative to the position and altitude of the aircraft. Furthermore, the GPS position and GSL altitude are used to calculate and "predict" the aircraft's flight path in relation to the surrounding terrain and obstacles. In this manner, TAWS can provide advanced alerts of predicted dangerous terrain conditions.

GARMIN.

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

10.4.4 Baro-Corrected Altitude Versus GSL Altitude

Baro-corrected altitude (or indicated altitude) is derived by adjusting the altimeter setting for local atmospheric conditions. The most accurate baro-corrected altitude can be achieved by frequently updating the altimeter setting to the nearest reporting station along the flight path. However, because actual atmospheric conditions seldom match the standard conditions defined by the International Standard Atmosphere (ISA) model (where pressure, temperature, and lapse rates have fixed values), it is common for the baro-corrected altitude (as read from the altimeter) to differ from the GSL altitude. This variation results in the aircraft's true altitude differing from the baro-corrected altitude.

10.4.5 Using TAWS-B

During unit power-up, the terrain/obstacle database versions are displayed. At the same time, TAWS self-test begins. One of the following aural messages is generated:

- *"TAWS System Test OK"*
- *"TAWS System Failure"*

TAWS information can be displayed on the Map page. Terrain and obstacles with heights greater than 200 feet Above Ground Level (AGL) are displayed in yellow and red. The GTN 6XX adjusts colors automatically as the aircraft altitude changes.
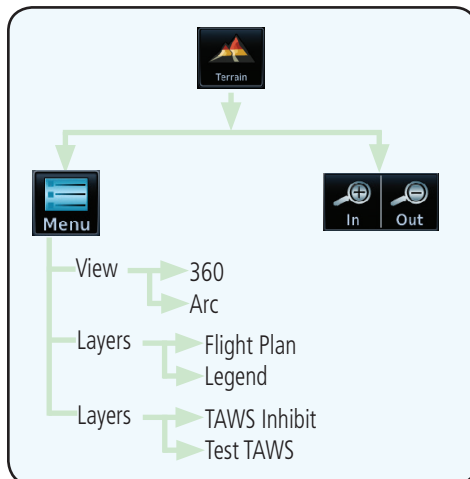
Figure 10-5 TAWS-B Page Functional Diagram

10.4.6   Displaying TAWS-B Data

TAWS uses yellow (caution) and red (warning) to depict terrain and obstacles alerts relative to aircraft altitude. Colors are adjusted automatically as the aircraft altitude changes. The colors and symbols shown below are used to represent terrain, obstacles, and threat locations. Obstacles are removed when more than 2000 ft below the aircraft.
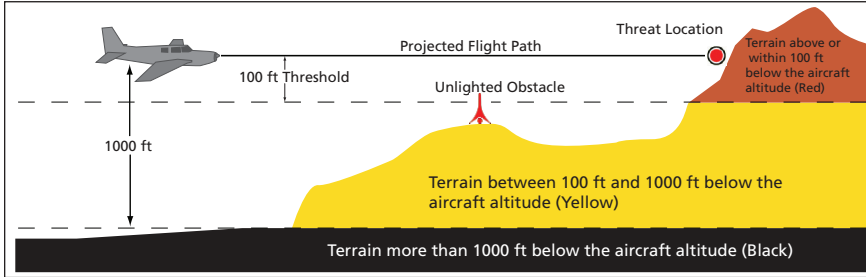
Figure 10-6 Terrain Altitude/Color Correlation for Terrain Proximity

Obstacle Symbol	Unlighted Obstacle		Lighted Obstacle		Threat Location Indicator	Terrain Color	Terrain/ Obstacle Location	Alert Level
	< 1000 ft AGL	> 1000 ft AGL	< 1000 ft AGL	> 1000 ft AGL				
	⬢	⬢	✳	✳	⬤	Red	Terrain/ Obstacle at or within 100 ft below current aircraft altitude	WARNING (Red)
	⬢	⬢	✳	✳	⬤	Yellow	Terrain/ Obstacle between 100 ft and 1000 ft below current aircraft altitude	CAUTION (Yellow)
	⬢	⬢	✳	✳		White	Terrain/ Obstacle between 1000 ft and 2000 ft below current aircraft altitude	

Table 10-3 TAWS-B Terrain/Obstacle Colors and Symbology

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Tower	Windmill	Windmill in Group	Power Line

Table 10-4 Obstacle Icon Types

Grouped obstacles are shown with an asterisk (as shown in the Windmill in Group example above). The color of the asterisks is tied to the relative altitude of the highest obstacle in the group, not other obstacles within that group. Obstacles are grouped when they would otherwise overlap.

10.4.7   TAWS-B Page

TAWS information is displayed on the Map and Terrain pages. The TAWS Page is specialized to show terrain, obstacle, and threat location data in relation to the aircraft's current altitude, without clutter from the basemap. Flight plan information (airports, VORs, and other NAVAIDs) included in the flight plan are displayed for reference. If an obstacle and the projected flight path of the aircraft intersect, the display automatically zooms in to the closest threat location on the TAWS Page.

Aircraft orientation on this map is always heading up unless there is no valid heading. If orientation is not heading up, it will be track up. Two views are available relative to the position of the aircraft: the 360° default display and the radar-like ARC (120°) display. Map range is adjustable with the **In** and **Out** keys from 1 to 200 NM, as indicated by the map range rings (or arcs).

10.4.7.1   Terrain Page Layers

1. While viewing the Terrain page, touch the **Menu** key.

Select Terrain View   Select Displayed Layer

Select TAWS Function
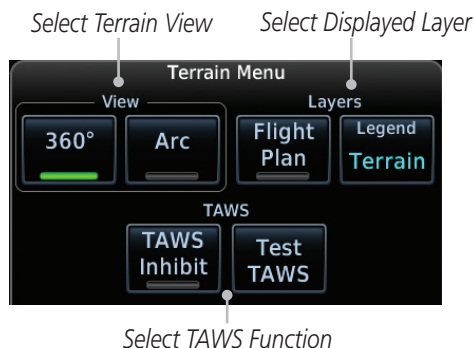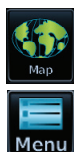
Figure 10-7 Terrain Page TAWS-B Menu
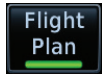
![GARMIN logo]

2. Touch the **Flight Plan** key to toggle the display of the active flight plan.

Obstacles — Com Vol Psh Sq — Terrain — TRK UP — *Terrain Overlay*

Terrain Legend — MSG — *Flight Plan*

Back — −100 FT / −1000 FT — TAWS B — *TAWS-B Annunciation*

Icon shows point obstacle overlay is active (software v5.12, or later)

Icon shows wire obstacle overlay is active (software v5.12, or later)
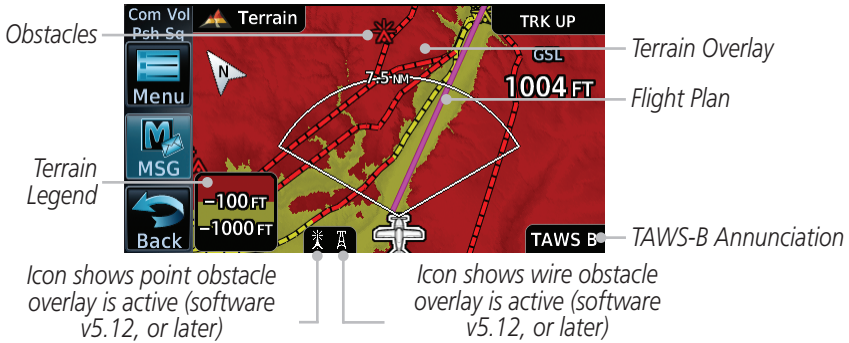
Figure 10-8 Flight Plan and Legend Shown On TAWS-B Terrain Page

10.4.7.2   Terrain Page View

Select the 120º Arc or 360º rings overlay for the Terrain page with either the **360º** or **Arc** keys from the Menu.

1. While viewing the Terrain page, touch the **Menu** key.

2. Touch the **360º** or **Arc** key.

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index
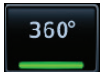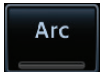
10.4.7.3   Terrain Page TAWS-B Selections

The TAWS selections allow you to inhibit aural TAWS alerts and to send a request to the TAWS equipment to run its internal tests. After cycling power, TAWS will no longer be inhibited.

1. While viewing the Terrain page, touch the **Menu** key.

2. Touch the **TAWS Inhibit** key to toggle the inhibiting of TAWS alerts.

TAWS Alerts Inhibited

Test TAWS - Only Available on Ground
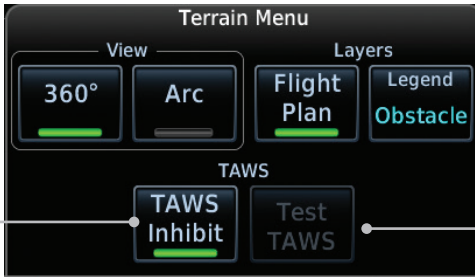
Figure 10-9 TAWS-B Alerts Inhibited Selected
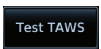
3. Touch the **Test TAWS** key to test the TAWS system. This function is not available when the aircraft is in the air.

TAWS Test Display

TAWS Test Annunciation
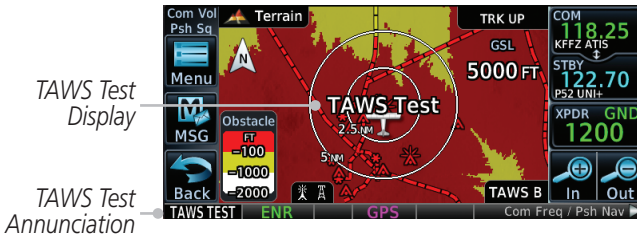
Figure 10-10 TAWS-B Test Selected

10.4.8   TAWS Alerts

Alerts are issued when flight conditions meet parameters that are set within TAWS software algorithms. When an alert is issued, visual annunciations are displayed and aural alerts are simultaneously issued. TAWS alert types are shown in the TAWS Alerts Summary with corresponding annunciations and aural messages.

When an alert is issued, annunciations appear on the TAWS page. If the TAWS page is not displayed at the time, a pop-up alert appears on the page being viewed.

Figure 10-11 Terrain Alert Pop-Up

Blinking Message

Touch To Display Terrain Page

Touch To Remove Pop-Up And Remain On Current Page

TAWS Annunciation

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

To acknowledge the pop-up alert:
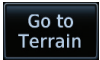
Touch the **Go to Terrain** key (accesses the TAWS Page)

OR
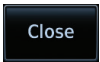
Touch the **Close** key to remove the pop-up alert

If the pilot takes no action, the pop-up will be removed when the alert is no longer active.

10.4.8.1   TAWS-B Alerting Colors and Symbology

Color and symbols are also associated with TAWS alerts. The three TAWS alert levels and their associated text coloring as well as any associated symbology are shown in the following table.

Alert Level	Annunciator Text	Threat Location Indicator	Example Visual Annunciation
Warning	White text on red background	🔴	**PULL UP**
Caution	Black text on yellow background	🟡	**TERRAIN**
Informational	Black text on white background	Not Applicable	**TAWS INH**

Table 10-5 TAWS-B Alert Colors and Symbology

Alert Type	Alert Annunciation	Aural Message
Excessive Descent Rate Warning (EDR-W)	PULL UP	"Pull Up"
FLTA Terrain Warning (RTC-W, ITI-W)	PULL UP	"Terrain Ahead, Pull Up; Terrain Ahead, Pull Up"* or "Terrain, Terrain; Pull Up, Pull Up"
FLTA Obstacle Warning (ROC-W, IOI-W)	PULL UP	"Obstacle Ahead, Pull Up; Obstacle Ahead, Pull Up"* or "Obstacle, Obstacle; Pull Up, Pull Up"
FLTA Wire Warning (ILI-W, RLC-W)	PULL UP	"Wire Ahead Pull Up, Wire Ahead Pull Up"
FLTA Terrain Caution (RTC-C, ITI-C)	TERRAIN	"Terrain Ahead; Terrain Ahead"* or "Caution, Terrain; Caution, Terrain"
FLTA Obstacle Caution (ROC-C, IOI-C)	OBSTCL	"Obstacle Ahead; Obstacle Ahead"* or "Caution, Obstacle; Caution, Obstacle"
FLTA Wire Caution (ILI-C, RLC-C)	WIRE	"Wire Ahead"
Premature Descent Alert Caution (PDA)	TERRAIN	"Too Low, Terrain"
Excessive Descent Rate Caution (EDR-C)	TERRAIN	"Sink Rate"
Negative Climb Rate Caution (NCR-C)	TERRAIN	"Don't Sink"* or "Too Low, Terrain"
Voice Call Out (VCO-500)	None	"Five-Hundred"

Alerts with multiple messages are configurable at installation and are installation-dependent. Alerts for the default configuration are indicated with asterisks.

Table 10-6 TAWS-B Alerts Summary

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

10.4.8.2 Excessive Descent Rate Alert

The purpose of the **Excessive Descent Rate (EDR)** alert is to provide notification when the aircraft is determined to be descending upon terrain at an excessive rate. The parameters for the alert as defined by TSO-C151c are shown below.

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index
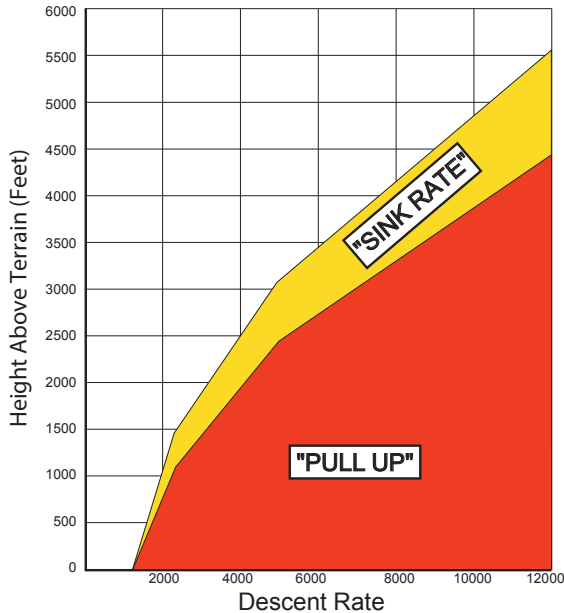
Figure 10-12 Excessive Descent Rate Alert Criteria

10.4.8.3 Forward Looking Terrain Avoidance

Reduced Required Terrain Clearance (RTC), Reduced Required Line Clearance (RLC), and **Reduced Required Obstacle Clearance (ROC)** alerts are issued when the aircraft flight path is above terrain, yet is projected to come within the minimum clearance values in the FLTA Alert Minimum Terrain and Obstacle Clearance Values table. When an RTC, RLC, and/or a ROC alert is issued, a threat location indicator is displayed on the TAWS Page.

Imminent Terrain Impact (ITI), Imminent Line Impact (ILI), and **Imminent Obstacle Impact (IOI)** alerts are issued when the aircraft is below the elevation of a terrain or obstacle cell in the aircraft's projected path. ITI, ILI, and IOI alerts are accompanied by a threat location indicator displayed on the TAWS Page. The alert is annunciated when the projected vertical flight path is calculated to come within minimum clearance altitudes in the following table.

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music
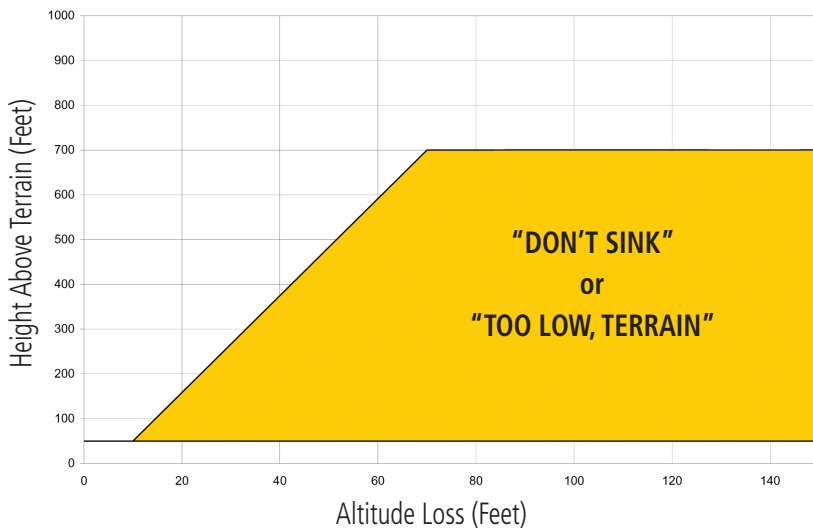
Utilities

System

Messages

Symbols

Appendix

Index

Flight Phase	Minimum Clearance Altitude (feet)	
	Level Flight	Descending
En Route	700	500
Terminal	350	300
Approach	150	100
Departure	100	100

Table 10-7 FLTA Alert Minimum Terrain and Obstacle Clearance Values

During final approach, FLTA alerts are automatically inhibited when the aircraft is below 200 feet AGL while within 0.5 NM of the approach runway or below 125 feet AGL while within 1.0 NM of the runway threshold.

10.4.8.4   Premature Descent Alerting

A Premature Descent Alert (PDA) is issued when the system detects that the aircraft is significantly below the normal approach path to a runway.

PDA alerting begins when the aircraft is within 15 NM of the destination airport and ends when the aircraft is either 0.5 NM from the runway threshold or is at an altitude of 125 feet AGL while within 1.0 NM of the threshold. During the final descent, algorithms set a threshold for alerting based on speed, distance, and other parameters.

Figure 10-13 PDA Alerting Threshold

PDA and FLTA aural and visual alerts can be manually inhibited. Discretion should be used when inhibiting TAWS and the system should be enabled when appropriate. When TAWS is inhibited, the alert annunciation "TAWS INHB" is shown.

10.4.8.5 Inhibiting/Enabling TAWS-B PDA/FLTA Alerting

TAWS also has an inhibit mode that deactivates the PDA/FLTA aural and visual alerts. Pilots should use discretion when inhibiting TAWS and always remember to enable the system when appropriate. Only the PDA and FLTA alerts are disabled in the inhibit mode. After cycling power, TAWS will no longer be inhibited.

TAWS Alerts Inhibited

TAWS Inhibited Annunciation
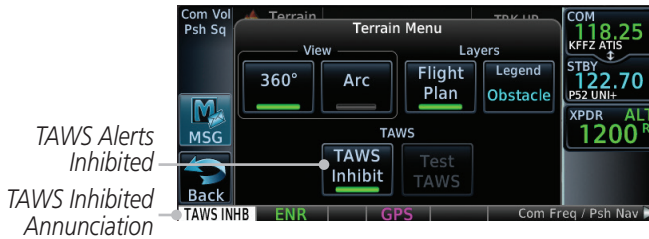
Figure 10-14 TAWS-B Alerting Disabled (TAWS Inhibited) Annunciation

1. While viewing the Terrain page, touch the **Menu** key.

2. Touch the **TAWS Inhibit** key to inhibit or enable TAWS (choice dependent on current state). A green bar in the key indicates the TAWS is inhibited.

10.4.8.6 Negative Climb Rate After Take-Off Alert (NCR)

The **Negative Climb Rate (NCR) After Take-Off** alert (also referred to as "Altitude Loss After Take-Off") provides alerts when the system determines the aircraft is losing altitude (closing upon terrain) after takeoff. The aural message "Don't Sink" is given for NCR alerts, accompanied by an annunciation and a pop-up terrain alert on the display. NCR alerting is only active when departing from an airport and when the following conditions are met:

- Height above the terrain is less than 700 feet

- Distance from the departure airport is 2 NM or less

- Heading change from the departure heading is less than 110º

The NCR alerting parameters as defined by TSO-C151c are shown below.

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Figure 10-15 Negative Climb Rate (NCR) Altitude Loss
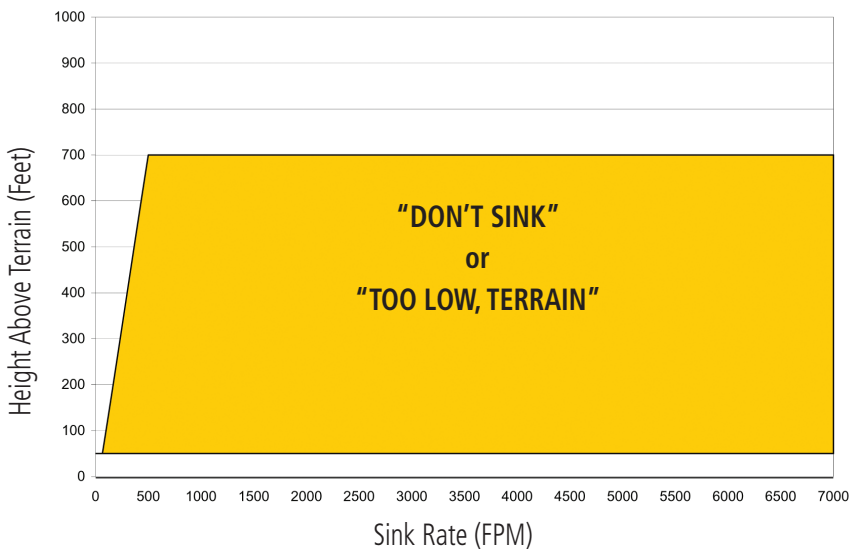
Figure 10-16 Negative Climb Rate (NCR) Sink Rate

10.4.8.7   Altitude Voice Call Out (VCO)

TAWS-B provides aural advisory alerts as the aircraft descends, beginning at 500 feet above the terrain, as determined by the radar altimeter (if greater than 5 NM from the nearest airport) or 500 feet above the nearest runway threshold elevation (if less than 5 NM from the nearest airport). Upon descent to this altitude, TAWS-B issues the aural alert message "Five-hundred."

10.4.8.8   TAWS-B Not Available Alert

TAWS-B requires a 3-D GPS position solution along with specific vertical accuracy minimums. Should the position solution become degraded or if the aircraft is out of the database coverage area, the annunciation "TAWS N/A" is generated in the annunciation window and on the TAWS-B page. The aural message "TAWS Not Available" is generated. When the GPS signal is re-established and the aircraft is within the database coverage area, the aural message "TAWS Available" is generated (when the aircraft is airborne).

10.4.8.9   TAWS-B Failure Alert

TAWS continually monitors several system-critical items such as database validity, hardware status, and GPS status. If the terrain/obstacle database is not available, the aural message "TAWS System Failure" is generated along with a "TAWS FAIL" annunciation.

10.4.9   TAWS-B System Status

During power-up, TAWS-B conducts a self-test of its aural and visual annunciations. The system test can also be manually initiated. An aural alert is issued at test completion. TAWS System Testing is disabled when ground speed exceeds 30 knots.

Alert Type	Alert Annunciation	Aural Message
TAWS Available	None	"TAWS Available"
TAWS System Test in Progress	TAWS TEST	None
TAWS System Test Pass	None	"TAWS System Test OK"
TAWS N/A	TAWS N/A	TAWS Not Available
TAWS Alerting is Disabled	TAWS INHB	None
TAWS System Test Fail	TAWS FAIL	"TAWS System Failure"

Table 10-8 TAWS-B System Test Status Annunciations

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

10.5   HTAWS (Optional)

10.5.1   Introduction

> ✓ **NOTE:** *TERRAIN, TAWS, HTAWS, or HTERRAIN PROXIMITY functionality will be available via the Terrain page, depending on the installed hardware and configuration. HTAWS or HTERRAIN PROXIMITY are available in software v4.00, or later.*

10.5.1.1   Overview

Garmin's Helicopter Terrain Awareness Warning System (HTAWS) is an optional feature to increase situational awareness and aid in reducing controlled flight into terrain. Garmin HTAWS is TSO-C194 authorized. Units installed in helicopters that do not have HTAWS installed will display HTerrain Proximity. This is noted by the five color terrain scale which is appropriate to the low altitude operating environment for helicopters.

HTAWS provides visual and aural annunciations when terrain and obstacles are a hazard to the aircraft.

HTAWS Relative Terrain Depiction

Rotorcraft Ownship

Figure 10-17 Map Page with Terrain

> ✓ **NOTE:**   *HTAWS-enabled units can be identified by going to the Terrain page and checking the lower right-corner for "HTAWS."*

10.5.1.2   Operating Criteria

Garmin HTAWS requires the following to operate properly:
- The system must have a valid 3D GPS position solution
- The system must have a valid terrain/obstacle database.

GARMIN.

10.5.1.3   Limitations

> ✏️ **NOTE:** *The data contained in the terrain and obstacle databases comes from government agencies. Garmin accurately processes and cross-validates the data, but cannot guarantee the accuracy and completeness of the data.*

HTAWS displays terrain and obstructions relative to the flight path of the aircraft. Individual obstructions may be shown if available in the database. However, all obstructions may not be available in the database and data may be inaccurate. Never use this information for navigation.

> ✏️ **NOTE:** *Terrain databases do not consistently represent foliage. Some trees may extend above HTAWS protection limits in some operating modes.*

Terrain information is based on terrain elevation data contained in a database that may contain inaccuracies. Terrain information should be used as an aid to situational awareness. Never use it for navigation or to maneuver to avoid terrain.

HTAWS uses terrain and obstacle information supplied by government sources. The data undergoes verification by Garmin to confirm accuracy of the content. However, the displayed information should never be understood as being all-inclusive.

10.5.2   HTAWS Operation

10.5.2.1   HTAWS Alerting

HTAWS uses information provided from the GPS receiver to provide a horizontal position and altitude. GPS altitude is derived from satellite measurements. GPS altitude is converted to a mean sea level (MSL)-based altitude (GSL altitude) and is used to determine HTAWS alerts. GSL altitude accuracy is affected by factors such as satellite geometry, but it is not subject to variations in pressure and temperature that normally affect pressure altitude devices. GSL altitude does not require local altimeter settings to determine MSL altitude. Therefore, GPS altitude provides a highly accurate and reliable MSL altitude source to calculate terrain and obstacle alerts.

HTAWS utilizes terrain and obstacle databases that are referenced to mean sea level (MSL). Using the GPS position and GSL altitude, HTAWS displays a 2-D picture of the surrounding terrain and obstacles relative to the position and

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

GARMIN.

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

altitude of the aircraft. The GPS position and GSL altitude are used to calculate and "predict" the aircraft's flight path in relation to the surrounding terrain and obstacles. In this manner, HTAWS can provide advanced alerts of predicted dangerous terrain conditions. Detailed alert modes are described later in this section.

10.5.2.2   Power Up

During power-up of the unit, the terrain/obstacle database versions are displayed along with a disclaimer to the pilot. At the same time, HTAWS self-test begins. HTAWS gives the following aural messages upon test completion:

- "**HTAWS System Test, OK**," if the system passes the test
- "**HTAWS System Failure**," if the system fails the test

A test failure is also annunciated visually for HTAWS, as shown in the HTAWS Alert Summary table.

10.5.3   HTAWS Page

HTAWS is shown on the Terrain page when HTAWS is available.

360° View

Terrain Legend

HTAWS Terrain Colorization Overlay

Rotorcraft Ownship

HTAWS Annunciation

Icon shows point obstacle overlay is active (software v5.12, or later)

Icon shows wire obstacle overlay is active (software v5.12, or later)
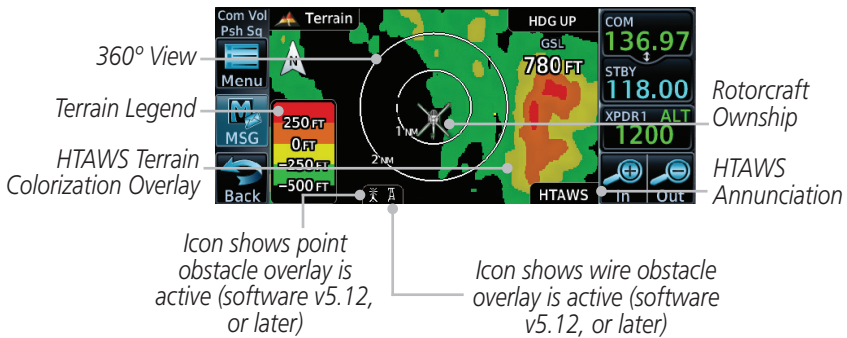
Figure 10-18 Terrain/HTAWS Page

Terrain information, aircraft ground track, and GPS-derived MSL altitude are displayed on the page. The "GSL" above altitude display in the top right corner of the display reminds the pilot that altitude is GPS-derived.

The HTAWS page menu provides options to acknowledge caution alerts, reduce protection, or inhibit alerting.

Figure 10-19 HTAWS Terrain Menu

10.5.3.1   View Selection

The HTAWS Page has two selectable view settings:

360° View

Terrain Legend

Relative Terrain Elevation depiction

Rotorcraft Ownship
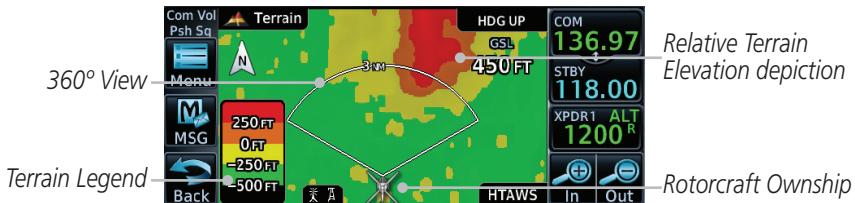
Figure 10-20 Terrain Page with HTAWS - 120° View

- 360° View—View from above aircraft depicting surrounding terrain on all sides.
- Arc (120°) View—View of terrain ahead of and 60° to either side of the aircraft flight path.

> *NOTE: If a heading source is available the HTAWS page will be oriented heading up. If no heading source is available the HTAWS page will be oriented track up.*

1. While viewing the Terrain/HTAWS Page, touch **MENU**. Touch **Arc** or **360˚**.

2. Touch **Back** to return to the Terrain/HTAWS display. The HTAWS Page displays the selected view. Repeat step 1 to select the alternate view, and press **Back**.

![GARMIN](GARMIN logo)

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

10.5.3.2   HTAWS Inhibit

HTAWS provides an "inhibit mode." This mode deactivates aural and visual alerts when they are deemed unnecessary by the aircrew. Pilots should use discretion when inhibiting the HTAWS system and always remember to enable the system when appropriate. VCO's are not inhibited in Inhibit Mode. See section 10.5.5 for more information on HTAWS alerts. When alerting is inhibited, all FLTA aural and visual alerting is suppressed. HTAWS should only be inhibited when in visual contact with terrain and when the pilot can be assured of maintaining clearance from terrain and obstacles. When conducting en route operations and operations from published airports and heliports, HTAWS should be operated in Normal mode. HTAWS configured units will always start up with HTAWS alerts uninhibited.

To inhibit HTAWS alerts:

1. While viewing the Terrain/HTAWS page, touch **MENU**.
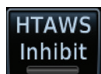
2. Touch **HTAWS Inhibit**. The green bar will show when HTAWS Inhibit is active.

3. Touch **Back** to return to the Terrain/HTAWS display. The HTAWS alerts are inhibited. The HTAWS INHB annunciation is displayed in the terrain annunciator field whenever HTAWS is inhibited.

> *NOTE: When the ground speed is less than 30 knots HTAWS will automatically display the "HTAWS INHB" annunciation. This indicates that HTAWS is no longer providing protection.*
>
> *This automatic "HTAWS INHB" cannot be removed by menu option selection. Menu selections for INHIBIT HTAWS and RP Mode remain available when HTAWS is automatically inhibited due to groundspeed. If the pilot selects a mode on the menu while HTAWS is auto inhibited because it is less than 30 knots then the unit will enter that mode once ground speed exceeds 30 knots. Hence, the presence of these selections on the Menu.*

10.5.3.3   External HTAWS Inhibit Control

An optional installation is allowed for providing an external HTAWS Inhibit switch. Pressing the external HTAWS Inhibit switch toggles the HTAWS inhibit on and off in the same manner as using the Terrain Menu selection.

10.5.3.4   Reduced Protection Mode

The Reduce Protection (RP) functionality allows operating with a reduction in the alerting thresholds, and suppresses visual and aural annunciation of caution alerts. Reduced protection allows low level operations and landings off airport with a minimum number of alerts while continuing to provide protection from terrain and obstacles. Reduced Protection should only be selected when operating in visual contact with the terrain as alerting times are significantly less than in normal mode. There is support for an external RP Mode switch and an external Alert Acknowledge switch.

To toggle protection:

1. While viewing the Terrain/HTAWS Page, touch **MENU**.

2. Touch the **RP Mode** key to toggle the RP mode on and off. The green bar will show when RP mode is active.

3. Touch **Back** to return to the Terrain/HTAWS display. The "RP Mode" annunciation is displayed in the terrain annunciator field and in the lower right corner of the terrain page whenever protection is reduced.

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

GARMIN

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

10.5.3.5 HTAWS Manual Test

Garmin HTAWS provides a manual test capability which verifies the proper operation of the aural and visual annunciations of the system prior to a flight.

To manually test the HTAWS system:

1. While viewing the Terrain/HTAWS Page, touch **MENU**.

2. Touch the **Test HTAWS** key.

3. Touch **Back** to return to the Terrain/HTAWS display.

An aural message is played giving the test results:

- "**HTAWS System Test, OK**" if the system passes the test
- "**HTAWS System Failure**" if the system fails the test

> *NOTE: HTAWS System Testing is disabled when in the air so as not to impede HTAWS alerting.*

10.5.3.6 HTAWS Legend

1. While viewing the Terrain/HTAWS page, touch **MENU**.

2. Touch the **Legend** key to select the Terrain Legend, Obstacle Legend, or to turn off the legend.

3. Press **Back** to return to the Terrain/HTAWS display.
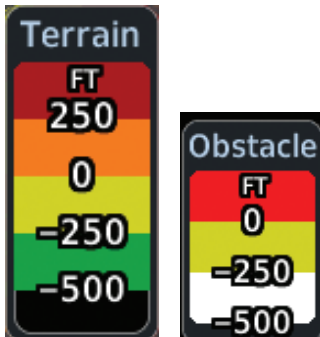
Figure 10-21 HTAWS Terrain and Obstacle Legends

Color	Description
Red	Terrain is more than 250 ft above the aircraft.
Orange	Terrain is between 0 ft and 250 ft above the aircraft.
Yellow	Terrain is between 250 ft and 0 ft below the aircraft.
Green	Terrain is between 250 ft and 500 ft below the aircraft.
Black	Terrain is more than 500 ft below the aircraft.

Table 10-9 HTAWS Terrain Altitude Color Description
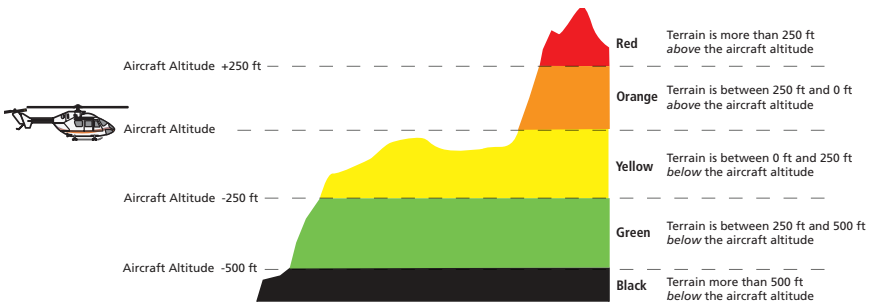
Figure 10-22 HTAWS Terrain Altitude Colors and Symbology

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

10.5.3.7   Flight Plan Overlay

1. While viewing the Terrain/HTAWS page, touch **MENU**.

2. Touch the **Flight Plan** key to toggle the overlay of the active flight plan on or off. The green bar will show when the Flight Plan overlay is shown.

3. Press **Back** to return to the Terrain/HTAWS display.

10.5.4   HTAWS Symbols

The symbols and colors in the following figures and table are used to represent obstacles and the location of terrain threats on the HTAWS Page. Each color is associated with a height above terrain.

Obstacles are ALWAYS shown on the HTAWS page at 10 NM and below.

> **NOTE:** If an obstacle or terrain cell and the projected flight path of the aircraft intersect, the display automatically zooms in to the closest threat location on the HTAWS Page.

	Unlighted Obstacle		Lighted Obstacle		Obstacle Color	Obstacle Location
	< 1000 ft AGL	> 1000 ft AGL	< 1000 ft AGL	> 1000 ft AGL		
Obstacle Symbol	▲	⋏	✳	✳	Red	Obstacle is at or above current aircraft altitude
	▲	⋏	✳	✳	Yellow	Obstacle is between 250 ft and 0 ft below current aircraft altitude
	▲	⋏	✳	✳	White	Obstacle is 250 ft, or more, below current aircraft altitude. Obstacles are removed when more than 500 ft below the helicopter.

Table 10-10 HTAWS Obstacle Colors and Symbology
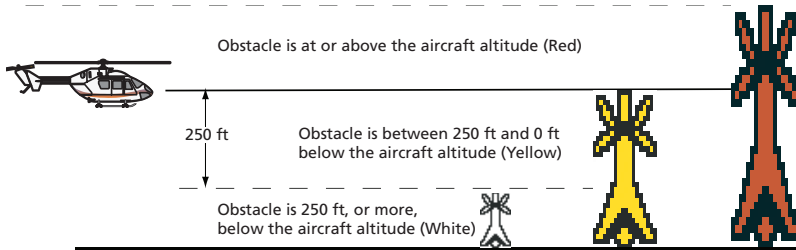
Figure 10-23 HTAWS Obstacle Altitude Colors and Symbology

Threat Location Indicator	Alert Level
🔴	WARNING (Red)
🟡	CAUTION (Yellow)

Table 10-11 HTAWS Alert Coloring and Symbology

Tower	Windmill	Windmill in Group	Power Line

Table 10-12 Obstacle Icon Types

Grouped obstacles are shown with an asterisk (as shown in the Windmill in Group example above). The color of the asterisks is tied to the relative altitude of the highest obstacle in the group, not other obstacles within that group. Obstacles are grouped when they would otherwise overlap.

10.5.5   HTAWS Alerts

Alerts are issued when flight conditions meet parameters that are set within HTAWS software algorithms. HTAWS alerts employ either a CAUTION or a WARNING alert severity level. When an alert is issued, visual annunciations are displayed. Aural alerts are simultaneously issued. Annunciations appear in a dedicated field in the lower left corner of the display.

Annunciations are color-coded according to the HTAWS Alert Summary table. Pop-up terrain alerts will occur if an HTAWS alert is activated while not on the HTAWS page. There are two options when an alert is displayed:

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

To acknowledge the pop-up alert and return to the currently viewed page:

Touch the **Close** key.

To acknowledge the pop-up alert and quickly access the HTAWS Page:

Touch the **ENT** key.

> **NOTE:** *To further capture the attention of the pilot, HTAWS issues aural (voice) messages that accompany visual annunciations and pop-up alerts. For a summary of aural messages, see the HTAWS Alert Summary table.*

> **NOTE:** *HTAWS Caution Alerts are displayed as constant black text on a yellow background; HTAWS Warning Alerts are displayed as constant white text on a red background.*

10.5.5.1   Forward Looking Terrain Avoidance

The unit will issue terrain alerts not only when the aircraft altitude is below the terrain elevation but also when the aircraft is projected to come within minimum clearance values of the terrain. This alerting, called Forward Looking Terrain Avoidance (FLTA), is also provided for obstacles.

The FLTA functionality looks ahead of the aircraft using GPS position information and the terrain and obstacle databases to provide alerts when the predicted flight path does not clear the terrain or obstacle by the required clearance. The amount of clearance required varies depending on position relative to airports and heliports, in order to reduce the occurrence of nuisance alerting.

Any threat locations are depicted on the display. There are 2 levels of severity for FLTA alerts. They are cautionary (amber) and warning (red) in nature and are described in further detail below.

FLTA CAUTION—Estimated potential impact in approximately 30 seconds after a caution pop-up alert and annunciation. FLTA caution alerts are accompanied by the aural message *"Caution Terrain; Caution Terrain."* **Similarly, a** *"Caution Obstacle; Caution Obstacle"* **alert is also provided. The time to an alert can vary with conditions, therefore there is no guarantee of a 30 second caution alert being issued.**

FLTA WARNING— Warning pop-up alerts are issued 15 seconds prior to an estimated potential impact in normal mode and approximately 10 seconds in RP Mode. FLTA warning alerts are accompanied by the aural message *"Warning- Terrain, Terrain"* **. Similarly, a** *"Warning - Obstacle, Obstacle"* **alert is also provided. The time to an alert can vary with conditions, therefore there is no guarantee of a 15/10 second warning alert being issued.**

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

The alerts are annunciated visually through the annunciator status bar, a pop-up alert box, and the red and yellow areas on the HTAWS page. The alerts are annunciated aurally through a voice message indicating the potential threat, such as "Caution - Terrain, Terrain" or "Warning - Obstacle, Obstacle."

10.5.5.2   HTAWS Voice Call Out Aural Alert

The purpose of the Voice Call Out (VCO) aural alert messages are to provide an advisory alert to the pilot that the aircraft is between 500 feet and 100 feet above terrain in 100 foot increments. When the aircraft descends within the selected distance from the terrain, the aural message for the selected height above terrain is generated. There are no display annunciations or pop-up alerts that accompany the aural message. HTAWS allows an additional 50 foot VCO alert with radar altimeter input.

10.5.5.3   HTAWS Voice Call Out Selection

The Voice Call Out (VCO) selection is available when HTAWS is installed. The VCO functionality provides a voice annunciation of the aircraft's height above terrain or the nearest airport, heliport, runway, or helipad when that threshold is first crossed. The available call outs include "Five Hundred" through "One Hundred" in one hundred foot intervals. The voice call outs can be enabled and disabled through the Voice Call Outs Selection option on the System - Audio page.

> **NOTE**: *VCOs are available down to 100 feet above terrain when HTAWS is installed and use GSL above terrain to generate call outs (no radar altimeter required). If a radar altimeter is interfaced to the GTN, alerts are available down to 50 feet and the height above terrain when the radar altimeter is used to generate the call outs.*

To select the Voice Call Out choices in the System - Audio page, select the Voice Call Out Selection item and then select the desired value.
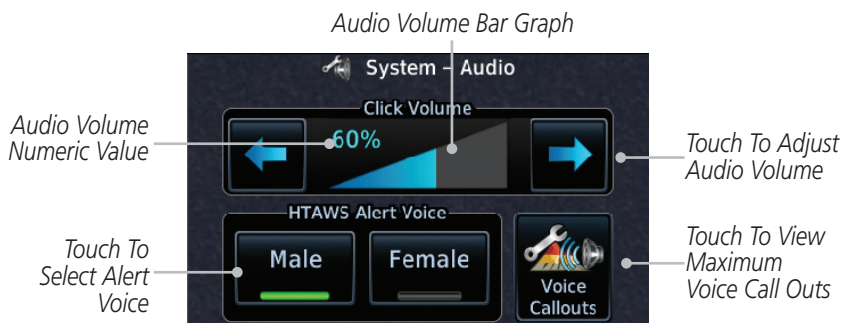
1. From the Main page, touch **System** and then **Audio**.

2. Touch the **Voice Callouts** key to view the Voice Call Outs page.

Audio Volume Bar Graph

Audio Volume Numeric Value

Touch To Adjust Audio Volume

Touch To Select Alert Voice

Touch To View Maximum Voice Call Outs

Figure 10-24 Select Voice Call Outs from the System Audio Page

3. Touch the **MAX Voice Callout** key to select the Voice Call Outs.

Touch To Set Maximum Voice Call Out Range

Maximum Voice Call Out Range - None Selected
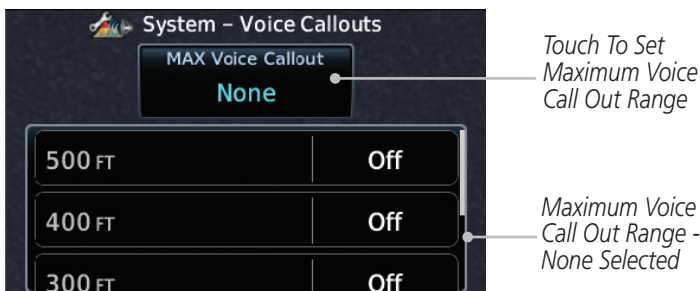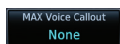
Figure 10-25 View the Maximum Voice Call Out Range (None Selected)

4. The values above the selected value will be disabled (Off).

Touch To Set Maximum Voice Call Out Range - 200 ft Selected

Maximum Voice Call Out Range - 200 feet Selected
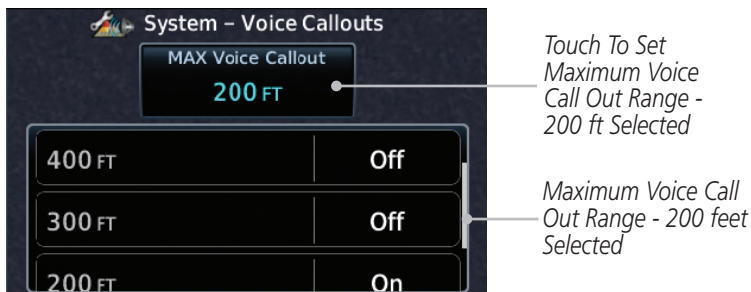
Figure 10-26 View the Maximum Voice Call Out Range (200 ft Selected)

GARMIN

10.5.5.4   HTAWS Not Available Alert

Garmin HTAWS requires a 3-D GPS navigation solution along with specific vertical accuracy minimums. Should the navigation solution become degraded, or if the aircraft is out of the database coverage area, the annunciation "HTAWS N/A" is shown in the annunciation window. When the GPS signal is re-established and the aircraft is within the database coverage area, the "HTAWS N/A" annunciation is removed.

10.5.5.5   HTAWS Failure Alert

HTAWS continually monitors several system-critical items, such as database validity, hardware status, and GPS status. If the terrain/obstacle database is not available, the aural message *"HTAWS System Failure"* is issued along with the "HTAWS FAIL" annunciation.

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

10.5.5.6 HTAWS Alert Summary

The aural alert voice gender is configurable to be either male or female. See your Garmin installer for further information on configuring the alert system.

HTAWS Annunciation	Pop-Up Alert	Aural Message	Description
HTAWS FAIL	None	"HTAWS System Failure"	HTAWS has failed
HTAWS INHB	None	None	HTAWS has been inhibited by the crew, or the aircraft ground-speed is below 30 knots (automatic inhibiting).
HTAWS N/A	None	"HTAWS Not Available"	HTAWS not available.
TERRAIN	CAUTION – TERRAIN	"Caution - Terrain, Terrain"	Forward Looking Terrain Avoidance Caution for Terrain
TERRAIN	WARNING – TERRAIN	"Warning - Terrain, Terrain"	Forward Looking Terrain Avoidance Warning for Terrain
OBSTACLE	CAUTION – OBSTACLE	"Caution - Obstacle, Obstacle"	Forward Looking Terrain Avoidance Caution for Obstacle
OBSTACLE	WARNING – OBSTACLE	"Warning - Obstacle, Obstacle"	Forward Looking Terrain Avoidance Warning for Obstacle
RP MODE	None	None	Alerting thresholds are reduced. Visual and aural annunciation of caution alerts are suppressed.

HTAWS Annunciation	Pop-Up Alert	Aural Message	Description
WIRE	CAUTION – WIRE	"Wire Ahead"	Forward Looking Terrain Avoidance Caution for Wire.
WIRE	WARNING – WIRE	"Wire Ahead Pull Up, Wire Ahead Pull Up"	Forward Looking Terrain Avoidance Warning for Power Lines.
None	None	"Five Hundred" "Four Hundred" "Three Hundred" "Two Hundred" "One Hundred" "Fifty"	HTAWS provides optional 500 ft through 100 ft (in 100 ft increments) altitude call out alerts. An additional value of 50 ft is available if a radar altimeter is installed.

Table 10-13 HTAWS Alert Summary

> ✓ **NOTE:** HTAWS Caution Alerts are displayed as constant black text on a yellow background; HTAWS Warning Alerts are displayed as constant white text on a red background.

10.5.6   Pilot Actions

If an HTAWS warning and associated aural are received, the pilot should immediately maneuver the rotorcraft in response to the alert unless the terrain or obstacle is clearly identified visually and determined by the pilot not to be a factor to the safety of the operation.

A HTAWS caution alert indicates terrain or obstacle nearby. If possible visually locate the terrain or obstacle for avoidance. A HTAWS warning alert may follow a HTAWS caution unless the aircraft's path towards the terrain or obstacle is changed.

> ✓ **NOTE:** Display of terrain and obstacles on the display is supplemental data only. Maneuvering solely by reference to the terrain and obstacle data is not recommended or authorized.

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

10.6   TAWS-A (Optional)

10.6.1   Introduction

> ✓ **NOTE:** *TERRAIN, TAWS-A, TAWS-B, HTAWS, or HTERRAIN PROXIMITY functionality will be available via the Terrain page, depending on the installed hardware and configuration. HTAWS or HTERRAIN PROXIMITY are available in software v4.00, or later. TAWS-A is available in software v5.00, or later.*

> ✓ **NOTE:** *The data contained in the TAWS databases comes from government agencies. Garmin accurately processes and cross-validates the data but cannot guarantee the accuracy and completeness of the data.*

TAWS-A (Terrain Awareness and Warning System - Class A) is an optional feature to increase situational awareness and aid in reducing controlled flight into terrain (CFIT). TAWS-A provides visual and aural annunciations when terrain and obstacles are within the given altitude threshold from the aircraft.

TAWS-A satisfies TSO-C151c Class A and TSO-92c requirements for certification.

Class A TAWS requires the following components and will not work properly without them:

- A valid terrain/obstacle/airport terrain database
- A valid 3-D GPS position solution
- Valid flap and landing gear status inputs
- A valid radar altimeter

TAWS-A uses terrain and obstacle information supplied by government sources. Terrain information is based on terrain elevation information in a database that may contain inaccuracies. Individual obstructions may be shown if available in the database. The data undergoes verification by Garmin to confirm accuracy of the content, per TSO-C151c. However, the displayed information should never be understood as being all-inclusive and data may be inaccurate.

TAWS-A uses information from the GPS receiver to provide a horizontal position and altitude, along with additional altitude input from the radar altimeter. GPS altitude is derived from satellite measurements. GPS altitude is then converted to a height above geodetic sea level (GSL), which is the height above mean sea level (MSL) calculated geometrically. GSL altitude accuracy is

affected by factors such as satellite geometry, but it is not subject to variations in pressure and temperature that normally affect pressure altitude devices. GSL altitude does not require local altimeter settings to determine MSL altitude. Therefore, GSL altitude provides a highly accurate and reliable MSL altitude source to calculate terrain and obstacle alerts.

The terrain and obstacle databases used by TAWS-A are referenced to mean sea level (MSL). Using the GPS position and GSL altitude, TAWS-A displays a 2-D picture of the surrounding terrain and obstacles relative to the position and altitude of the aircraft. Furthermore, the GPS position and GSL altitude are used to calculate and "predict" the aircraft's flight path in relation to the surrounding terrain and obstacles. In this manner, TAWS-A can provide advanced alerts of predicted dangerous terrain conditions.

Class A TAWS incorporates radar altimeter input with the GSL altitude to provide a more accurate position reference when at lower altitudes for certain alert types, and to retain a level of ground proximity warning capability in the unlikely event of an airport, terrain or obstacle database failure.

Baro-corrected altitude (or indicated altitude) is derived by adjusting the altimeter setting for local atmospheric conditions. The most accurate baro-corrected altitude can be achieved by frequently updating the altimeter setting to the nearest reporting station along the flight path. However, because actual atmospheric conditions seldom match the standard conditions defined by the International Standard Atmosphere (ISA) model (where pressure, temperature, and lapse rates have fixed values), it is common for the baro-corrected altitude (as read from the altimeter) to differ from the GPS-MSL altitude. This variation results in the aircraft's true altitude differing from the baro-corrected altitude.

TAWS-A provides the following alert types:

- Forward Looking Terrain Avoidance (FLTA) Alerting, which consists of:
    - Required Terrain Clearance (RTC) / Required Line Clearance (RLC) / Required Obstacle Clearance (ROC) Alerting
    - Imminent Terrain Impact (ITI) / Imminent Line Impact (ILI) / Imminent Obstacle Impact (IOI) Alerting
- Premature Descent Alerting (PDA)
- Ground Proximity Warning System (GPWS) Alerting, which consists of:

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

- Excessive Descent Rate (EDR) Alerting

- Excessive Closure Rate (ECR) to Terrain Alerting

- Flight Into Terrain (FIT) Alerting

- Negative Climb Rate (NCR) after takeoff Alerting

- Excessive below Glideslope/Glidepath Deviation (GSD) Alerting

- Altitude Voice Call Out (VCO) Alerting

10.6.1.1 Displaying TAWS-A Data

TAWS-A uses yellow (caution) and red (warning) to depict terrain and obstacle (with a height greater than 200 feet above ground level, AGL) alerts relative to aircraft altitude. Depictions of obstacles more than 200 feet below the aircraft are removed. Colors are adjusted automatically as the aircraft altitude changes. The colors and symbols in Figure 10-11 and Tables 10-7 and 11-12 are used to represent terrain, obstacles, and threat locations.
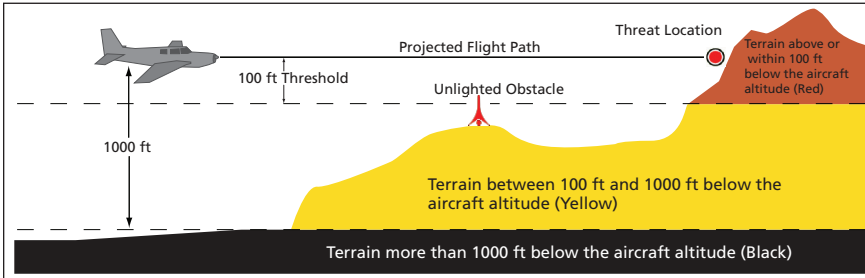
Figure 10-27 Terrain Altitude/Color Correlation for TAWS-A

Alert Level	Annunciator Text	Threat Location Indicator	Example Visual Annunciation
Warning	White text on red background	🔴	PULL UP
Caution	Black text on yellow background	🟡	TERRAIN
Informational	Black text on white background	Not Applicable	TER INHB

Table 10-14 TAWS-A Alert Colors and Symbology

Tower	Windmill	Windmill in Group	Power Line

Table 10-15 Obstacle Icon Types

Grouped obstacles are shown with an asterisk (as shown in the Windmill in Group example above). The color of the asterisks is tied to the relative altitude of the highest obstacle in the group, not other obstacles within that group. Obstacles are grouped when they would otherwise overlap.

	Unlighted Obstacle		Lighted Obstacle		Threat Location Indicator	Terrain Color	Terrain/Obstacle Location	Alert Level
	< 1000 ft AGL	> 1000 ft AGL	< 1000 ft AGL	> 1000 ft AGL				
Obstacle Symbol						Red	Terrain/Obstacle above or within 100 ft below current aircraft altitude	WARNING (Red)
						Yellow	Terrain/Obstacle between 100 ft and 1000 ft below current aircraft altitude	CAUTION (Yellow)

**Table 10-16 TAWS-A Terrain/Obstacle Colors and Symbology**

10.6.2   TAWS-A Display

The TAWS-A Page shows terrain, obstacle, and threat location data in relation to the aircraft's current altitude, without clutter from the basemap. Aviation data (airports, VORs, and other NAVAIDs) can be displayed for reference. If an obstacle and the projected flight path of the aircraft intersect, the display automatically zooms in to the closest potential point of impact on the TAWS-A Page.

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Aircraft orientation on this map is always heading up unless there is no valid heading. Two views are available relative to the position of the aircraft: the 360° default display and the radar-like ARC (120°) display. Map range is adjustable with the **In** and **Out** keys from 1 to 200 NM, as indicated by the map range rings (or arcs).
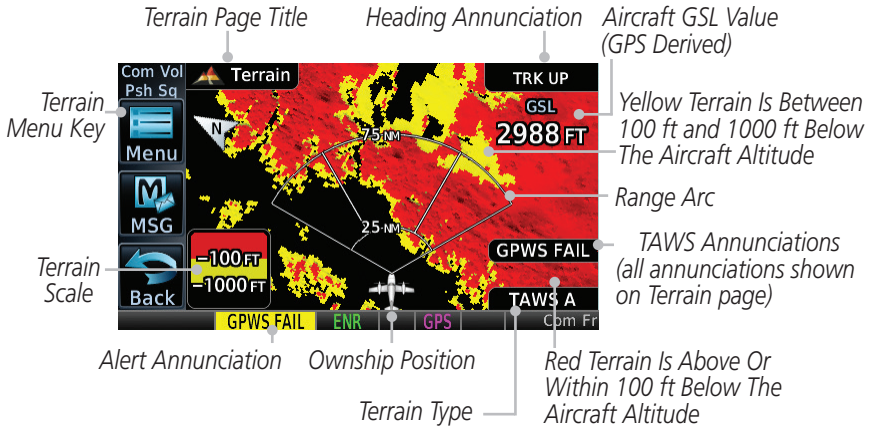
Figure 10-28 TAWS-A Page with Arc View
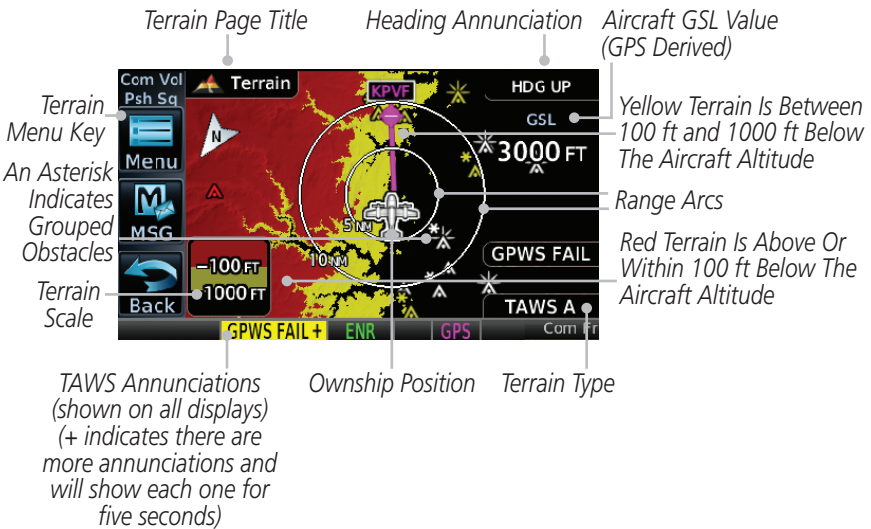
Figure 10-29 TAWS-A Page with 360° View

GARMIN.

1. While viewing the Terrain page, touch the **Menu** key.

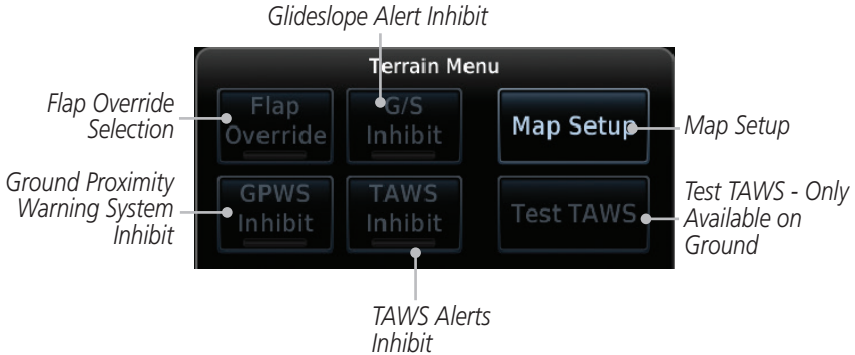2. Selections are grouped by function: the Terrain Menu and Map Setup.

Glideslope Alert Inhibit

Flap Override Selection

Ground Proximity Warning System Inhibit

Terrain Menu

Flap Override | G/S Inhibit | Map Setup — *Map Setup*
GPWS Inhibit | TAWS Inhibit | Test TAWS — *Test TAWS - Only Available on Ground*

TAWS Alerts Inhibit

Figure 10-30 TAWS-A Menu

3. Touch the **Map Setup** key make the desired selections for the Terrain map display.

Selected View   Flight Plan Selected To Show

Map Setup

View | Layers
360° | Arc | Flight Plan | Legend Terrain — *Touch To Select Terrain Or Obstacle Legend*

Figure 10-31 TAWS-A Map Setup Menu

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

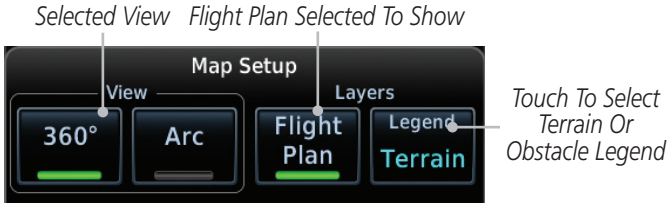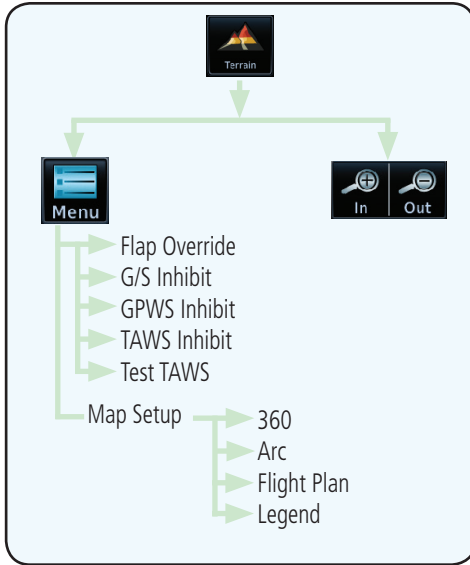Weather

Nearest

Services/ Music

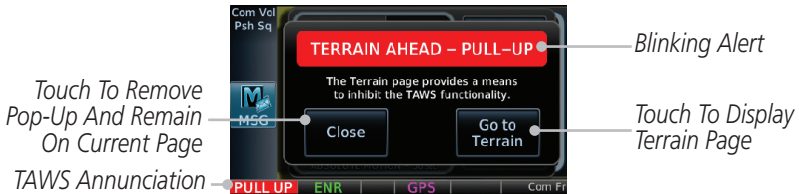Utilities

System

Messages

Symbols

Appendix

Index

Figure 10-32 TAWS-A Page Functional Diagram

10.6.3   TAWS-A Alerts

Alerts are issued when flight conditions meet parameters that are set within TAWS-A software algorithms. TAWS-A alerts employ a CAUTION or a WARNING alert severity level. When an alert is issued, visual annunciations are displayed and aural alerts are simultaneously issued. TAWS-A alert types with corresponding annunciations and aural messages are shown in Table 10-9.

When an alert is issued, annunciations appear on the display. The TAWS-A Alert Annunciation is shown on the lower left part of the display. If the TAWS-A Page is not already displayed, a pop-up alert appears while an alert is active.

Touch To Remove Pop-Up And Remain On Current Page

Blinking Alert

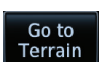*Touch To Display Terrain Page*

TAWS Annunciation

Figure 10-33 Terrain Alert Pop-Up

To acknowledge the pop-up alert:

Touch the **Close** key (returns to the currently viewed page), or

Touch the **Go to Terrain** key (accesses the TAWS-A Page)

10.6.3.1   TAWS-A Alerts Summary

Alert Type	Alert Annunciation	Pop-Up Alert (Except TAWS-A Page)	Aural Message
Reduced Required Terrain Clearance Warning (RTC)	**PULL UP**	TERRAIN – PULL–UP * or TERRAIN AHEAD – PULL–UP	"Terrain, Terrain; Pull Up, Pull Up" * or "Terrain Ahead, Pull Up; Terrain Ahead, Pull Up"
Imminent Terrain Impact Warning (ITI)	**PULL UP**	TERRAIN – PULL–UP * or TERRAIN AHEAD – PULL–UP	"Terrain, Terrain; Pull Up, Pull Up"* or "Terrain Ahead, Pull Up; Terrain Ahead, Pull Up"
Reduced Required Obstacle Clearance Warning (ROC)	**PULL UP**	OBSTACLE – PULL–UP * or OBSTACLE AHEAD – PULL–UP	"Obstacle, Obstacle; Pull Up, Pull Up"* or "Obstacle Ahead, Pull Up; Obstacle Ahead, Pull Up"
Imminent Obstacle Impact Warning (IOI)	**PULL UP**	OBSTACLE – PULL–UP * or OBSTACLE AHEAD – PULL–UP	"Obstacle, Obstacle; Pull Up, Pull Up"* or "Obstacle Ahead, Pull Up; Obstacle Ahead, Pull Up"
Excessive Descent Rate Warning (EDR)	**PULL UP**	PULL–UP	"<whoop> <whoop> Pull Up"
Excessive Closure Rate Warning (ECR)	**PULL UP**	PULL–UP	"<whoop> <whoop> Pull Up"
Imminent Line Impact Warning (ILI)	**PULL UP**	WIRE AHEAD – PULL–UP	"Wire Ahead, Pull Up; Wire Ahead, Pull Up" or "Wire, Wire; Pull Up, Pull Up"

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

Alert Type	Alert Annunciation	Pop-Up Alert (Except TAWS-A Page)	Aural Message
Reduced Line Clearance Warning (RLC)	**PULL UP**	WIRE AHEAD – PULL–UP	"Wire Ahead, Pull Up; Wire Ahead, Pull Up" or "Wire, Wire; Pull Up, Pull Up"
Reduced Required Terrain Clearance Caution (RTC)	TERRAIN	CAUTION – TERRAIN * or TERRAIN AHEAD	"Caution, Terrain; Caution, Terrain"* or "Terrain Ahead; Terrain Ahead"
Imminent Terrain Impact Caution (ITI)	TERRAIN	CAUTION – TERRAIN * or TERRAIN AHEAD	"Caution, Terrain; Caution, Terrain" or "Terrain Ahead; Terrain Ahead"
Reduced Required Obstacle Clearance Caution (ROC)	OBSTCL	CAUTION – OBSTACLE * or OBSTACLE AHEAD	"Caution, Obstacle; Caution, Obstacle"* or "Obstacle Ahead; Obstacle Ahead"
Imminent Obstacle Impact Caution (IOI)	OBSTCL	CAUTION – OBSTACLE * or OBSTACLE AHEAD	"Obstacle Ahead; Obstacle Ahead"* or "Caution, Obstacle; Caution, Obstacle"
Imminent Line Impact Caution (ILI)	WIRE	WIRE AHEAD	"Wire Ahead; Wire Ahead"* or "Caution, Wire; Caution, Wire"
Reduced Line Clearance Caution (RLC)	WIRE	WIRE AHEAD	"Wire Ahead; Wire Ahead"* or "Caution, Wire; Caution, Wire"
Premature Descent Alert Caution (PDA)	TERRAIN	TOO LOW – TERRAIN	"Too Low, Terrain"

Alert Type	Alert Annunciation	Pop-Up Alert (Except TAWS-A Page)	Aural Message
Excessive Descent Rate Caution (EDR)	TERRAIN	SINK RATE	"Sink Rate"
Excessive Closure Rate Caution (ECR)	TERRAIN	TERRAIN	"Terrain, Terrain"
Negative Climb Rate Caution (NCR)	TERRAIN	DON'T SINK * or TOO LOW – TERRAIN	"Don't Sink"* or "Too Low, Terrain"
Flight Into Terrain High Speed Caution (FIT)	TERRAIN	TOO LOW – TERRAIN	"Too Low, Terrain"
Flight Into Terrain Gear Caution (FIT)	TERRAIN	TOO LOW – GEAR	"Too Low, Gear"
Flight Into Terrain Flaps Caution (FIT)	TERRAIN	TOO LOW – FLAPS	"Too Low, Flaps"
Flight Into Terrain Takeoff Caution (FIT)	TERRAIN	TOO LOW – TERRAIN	"Too Low, Terrain"
Glide Slope Deviation Caution (GSD)	GLIDESLOPE	GLIDESLOPE	"Glideslope"
Altitude Voice Call Out (VCO)	None	None	"Five-Hundred," "Four-Hundred,"* "Three-Hundred,"* "Two-Hundred,"* "One-Hundred"*
TAWS Available	None	N/A	"TAWS Available"
TAWS System Test in Progress	TAWS TEST	N/A	None
TAWS System Test Pass	None	N/A	"TAWS System Test OK"
TAWS N/A	TAWS N/A	N/A	TAWS Not Available
TAWS Alerting is Disabled	TAWS INHB	N/A	None
TAWS System Test Fail	TAWS FAIL	N/A	"TAWS System Failure"

Alert Type	Alert Annunciation	Pop-Up Alert (Except TAWS-A Page)	Aural Message
Incorrect TAWS configuration, invalid/missing terrain, airport, or obstacle database, or TAWS audio fault.	`TAWS FAIL`**	N/A	"TAWS System Failure"
No GPS position	`TAWS N/A`	N/A	"TAWS Not Available"
GPS position unavailable/degraded, outside of terrain database coverage	`TAWS N/A`	N/A	"TAWS Not Available"
Sufficient GPS signal reception restored	None	N/A	"TAWS Available" (aural message only in flight)
Incorrect TAWS configuration, radar altimeter unavailable, GPS position unavailable/degraded, TAWS audio fault	`GPWS FAIL`*	N/A	"GPWS System Failure"
GPWS Inhibit	`GPWS INHB`	N/A	"GPWS System Failure"
GPWS Not Available. Incorrect TAWS configuration, radar altimeter unavailable, GPS position unavailable/degraded, TAWS audio fault.	`GPWS N/A`	N/A	None

Alert Type	Alert Annunciation	Pop-Up Alert (Except TAWS-A Page)	Aural Message
Glideslope Inhibit	G/S INHB	N/A	None
FLAP Override	FLAP OVRD	N/A	None

* Alerts with multiple messages are configurable. Alerts for the default configuration are indicated with asterisks.

** VCO alerts are not issued if both TAWS and GPWS systems have failed or are not available

† GSD alert will be available if a valid ILS is being used for navigation, even in no valid GPS signal is being received.

Table 10-17 TAWS-A Alerts Summary

10.6.3.2 Excessive Descent Rate Alert

The purpose of the **Excessive Descent Rate (EDR)** alert is to provide notification when the aircraft is determined to be descending upon terrain at an excessive rate. The parameters for the alert as defined by TSO-C151c are shown below.
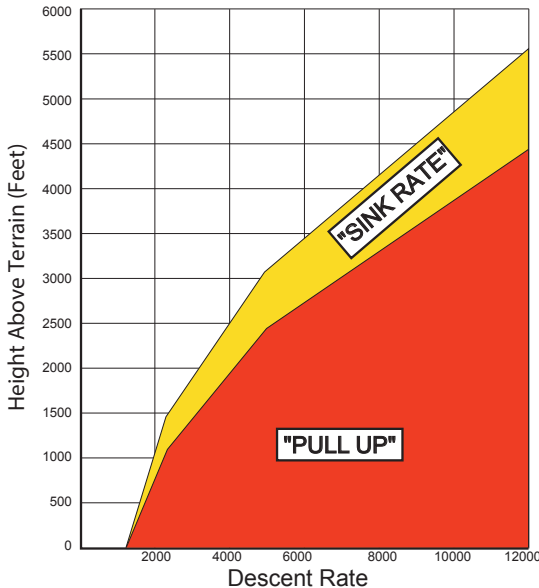
Figure 10-34 Excessive Descent Rate Alert Criteria

10.6.3.3   Forward Looking Terrain Avoidance

Reduced Required Terrain Clearance (RTC) Reduced Required Line Clearance (RLC), and **Reduced Required Obstacle Clearance (ROC)** alerts are issued when the aircraft flight path is above terrain, yet is projected to come within the minimum clearance values in the FLTA Alert Minimum Terrain and Obstacle Clearance Values table. When an RTC, RLC, and/or a ROC alert is issued, a threat location indicator is displayed on the TAWS Page.

Imminent Terrain Impact (ITI), Imminent Line Impact (ILI), and **Imminent Obstacle Impact (IOI)** alerts are issued when the aircraft is below the elevation of a terrain or obstacle cell in the aircraft's projected path. ITI, ILI, and IOI alerts are accompanied by a threat location indicator displayed on the TAWS Page. The alert is annunciated when the projected vertical flight path is calculated to come within minimum clearance altitudes in the following table.

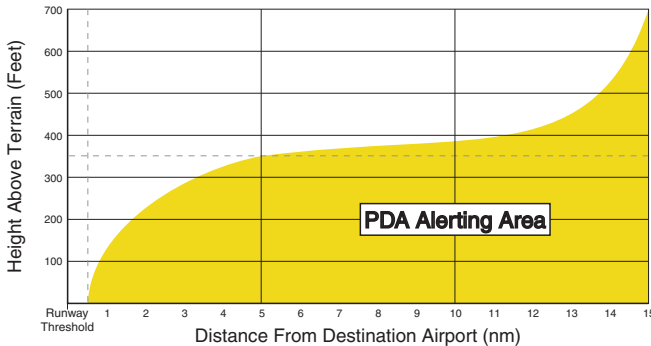| Flight Phase	Minimum Clearance Altitude (feet)	
	Level Flight	Descending
En Route	700	500
Terminal	350	300
Approach	150	100
Departure	100	100

Table 10-18 FLTA Alert Minimum Terrain and Obstacle Clearance Values

During final approach, FLTA alerts are automatically inhibited when the aircraft is below 200 feet AGL while within 0.5 NM of the approach runway or below 125 feet AGL while within 1.0 NM of the runway threshold.

10.6.3.4   Premature Descent Alerting

A Premature Descent Alert (PDA) is issued when the system detects that the aircraft is significantly below the normal approach path to a runway.

PDA alerting begins when the aircraft is within 15 NM of the destination airport and ends when the aircraft is either 0.5 NM from the runway threshold or is at an altitude of 125 feet AGL while within 1.0 NM of the threshold. During the final descent, algorithms set a threshold for alerting based on speed, distance, and other parameters.

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages
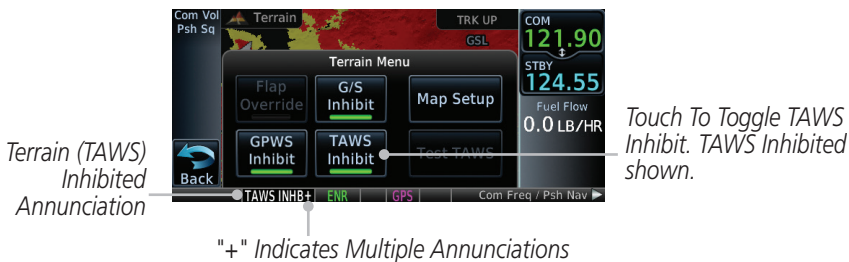
Symbols

Appendix

Index

Figure 10-35 PDA Alerting Threshold

PDA and FLTA aural and visual alerts can be manually inhibited. Discretion should be used when inhibiting TAWS and the system should be enabled when appropriate. When TAWS is inhibited, the alert annunciation "TER INHB" is shown.

10.6.3.5   Inhibiting/Enabling TAWS-A PDA/FLTA Alerting

TAWS-A also has an inhibit mode that deactivates the PDA/FLTA aural and visual alerts. Pilots should use discretion when inhibiting TAWS-A and always remember to enable the system when appropriate. Only the PDA and FLTA alerts are disabled in the inhibit mode. After cycling power, TAWS-A will no longer be inhibited.

Terrain (TAWS) Inhibited Annunciation

Touch To Toggle TAWS Inhibit. TAWS Inhibited shown.

"+" Indicates Multiple Annunciations

Figure 10-36 TAWS-A Alerting Disabled (TAWS Inhibited) Annunciation

1.   While viewing the Terrain page, touch the **Menu** key.

2.   Touch the **TAWS Inhibit** key to inhibit or enable TAWS (choice is dependent on current state). A green bar in the key indicates the TAWS is inhibited.

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

10.6.3.6   Excessive Closure Rate Alert

The **Excessive Closure Rate (ECR)** alert provides suitable notification when the aircraft is determined to be closing upon terrain at an excessive speed for a given aircraft gear and flap configuration.
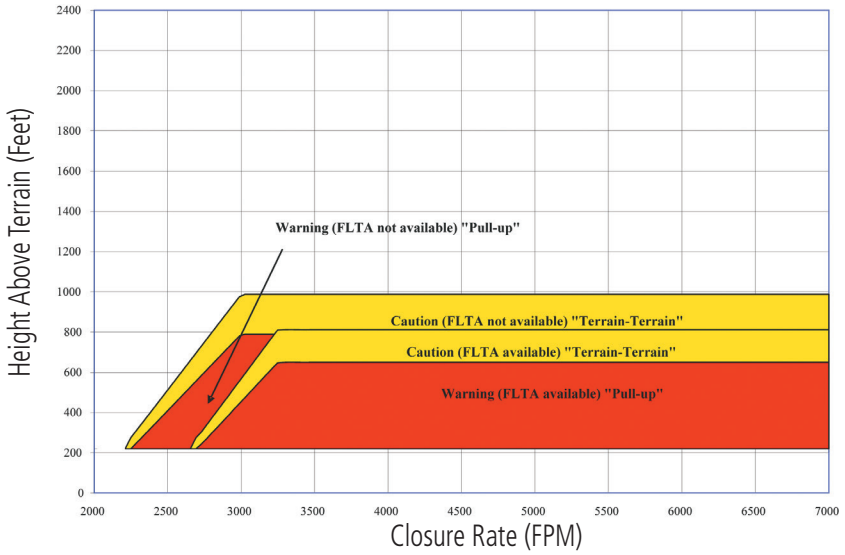
The following figures show the ECR alerting criteria for flaps in the landing configuration and for all other flight phases respectively.

ECR alerts are automatically inhibited when the aircraft is 5 NM from the nearest airport, except when FLTA is not available (causing the TAWS N/A or TAWS FAIL annunciation to be displayed), in which case ECR alerting will remain active until landing.
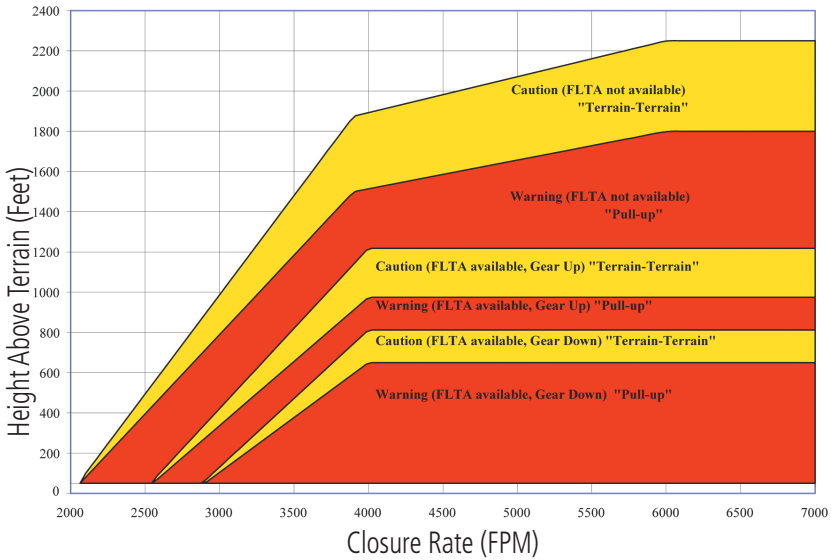
**Figure 10-37 Excessive Closure Rate Alert Criteria (Flaps Up or Takeoff Configuration)**

Figure 10-38 Excessive Closure Rate Alert Criteria (Flaps in Landing Configuration)

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

#### 10.6.3.7 Flight Into Terrain Alert

Flight Into Terrain (FIT) alerts occur when the aircraft is too low with respect to terrain based on landing gear status, flap position, and groundspeed. FIT caution alerts are issued when flight conditions meet the criteria shown below.
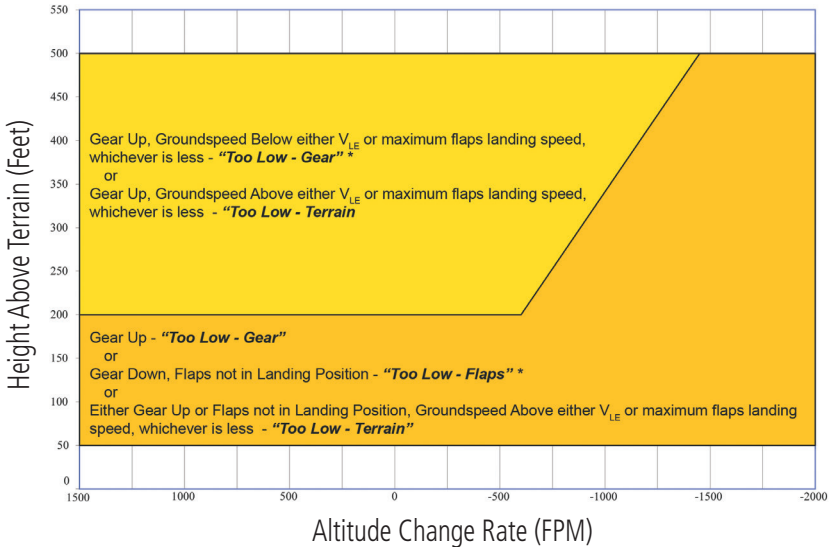
Flap position will not trigger alert if Flap Override option is enabled; see discussion below.

Figure 10-39 Flight Into Terrain Caution Alert Criteria

To reduce nuisance FIT alerts on approaches where flap extension is not desired (or is intentionally delayed), the pilot may override FIT alerting based on the flap position, while all other FIT alerting remains in effect.

Flap Override Selection

Flap Override Annunciation
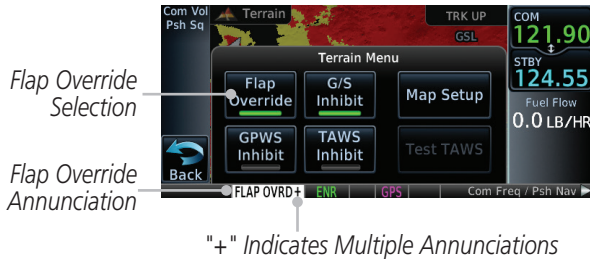
"+" Indicates Multiple Annunciations

Figure 10-40 TAWS-A Page Menu and FIT Flap Override Annunciation
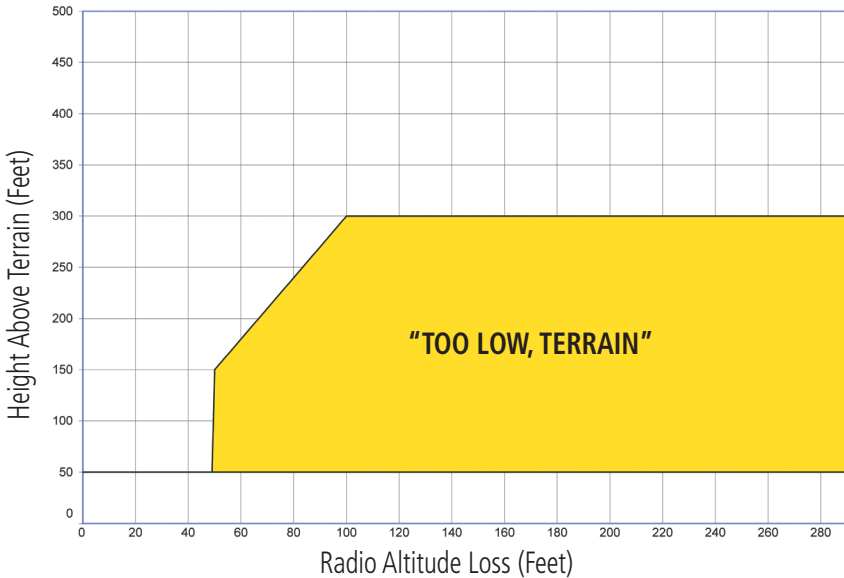
10.6.3.7.1 Overriding Flaps-based FIT alerting

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

| Menu | 1. | While viewing the TAWS-A Page, touch the **MENU** key. |

| Flap Override | 2. | Touch the **Flap Override** key to toggle the override state. |

When the Flaps Override option is enabled, the annunciation "FLAP O/R" is annunciated on the TAWS-A Page. If GPWS alerts are also inhibited (which include FIT), the "FLAP O/R" annunciation is not shown.

FIT alerts also occur during takeoff or go-around if the aircraft's height above ground level (as determined by the radar altimeter) is too close to rising terrain. TAWS-A will issue the aural message **"Too Low - Terrain"** and visual annunciations when conditions enter the caution alert area.

Figure 10-41 FIT Alerting After Takeoff

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

10.6.3.8   Negative Climb Rate After Take-Off Alert (NCR)

The **Negative Climb Rate (NCR) After Take-Off** alert (also referred to as "Altitude Loss After Take-Off") provides alerts when the system determines the aircraft is losing altitude (closing upon terrain) after takeoff. The aural message "Don't Sink" is given for NCR alerts, accompanied by an annunciation and a pop-up terrain alert on the display. NCR alerting is only active when departing from an airport and when the following conditions are met:

- Height above the terrain is less than 700 feet
- Distance from the departure airport is 2 NM or less
- Heading change from the departure heading is less than 110º

The NCR alerting parameters as defined by TSO-C151c are shown below.
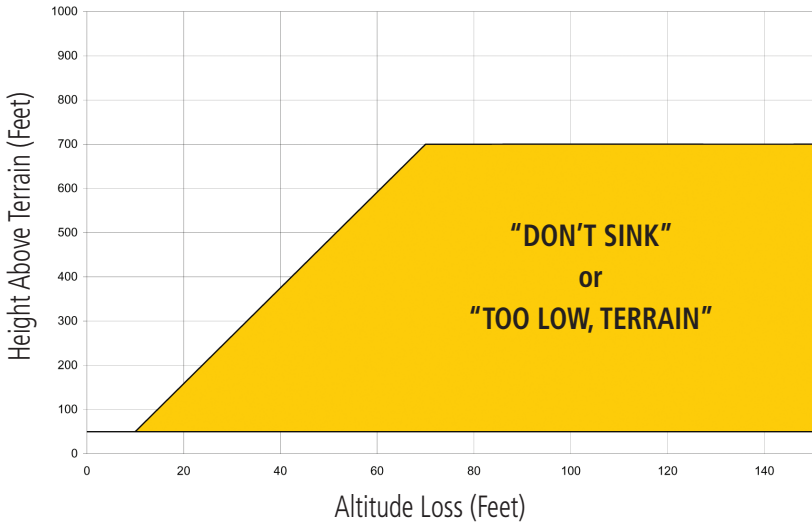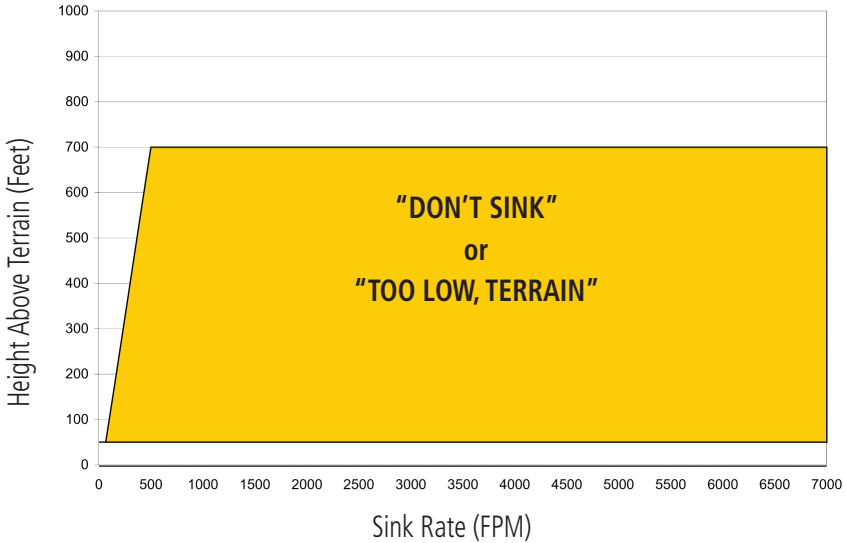

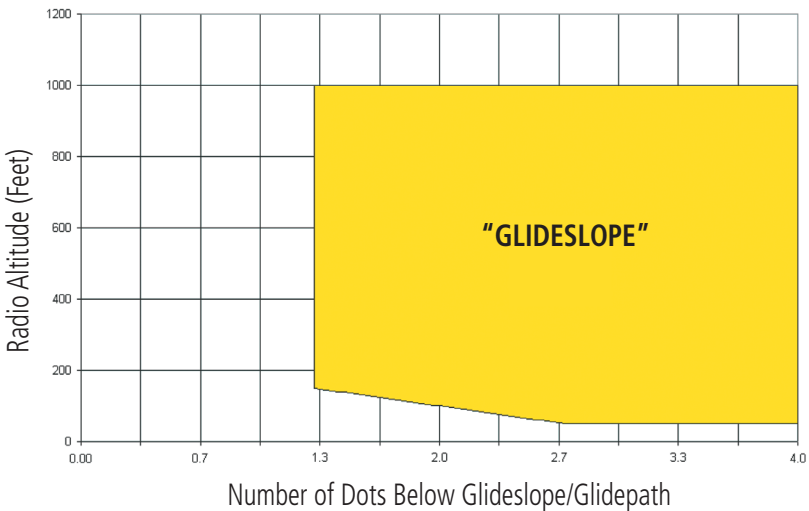**Figure 10-42 Negative Climb Rate (NCR) Altitude Loss**

Figure 10-43 Negative Climb Rate (NCR) Sink Rate

10.6.3.9   Excessive Below Glideslope/Glidepath Deviation Alert

A **Glideslope Deviation** or **Glidepath Deviation (GSD)** caution alert is issued when the system detects that the aircraft is significantly below the glidepath for the selected approach.

Figure 10-44 Excessive Below Glideslope/Glidepath Deviation Alert Criteria

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

GSD alerting is only active after departure and the following conditions are met:

- An ILS, LPV, LNAV/VNAV, or LNAV+V approach is active and vertical navigation indications are being displayed.
- Aircraft is below 1000 feet AGL.
- Gear is configured for landing.

When a GSD caution alert occurs on an ILS approach, the aural and visual annunciation "GLIDESLOPE" is issued. If a GSD caution alert occurs on an LPV, LNAV/VNAV, or LNAV+V approach, the aural and visual annunciation "GLIDESLOPE" is issued.

10.6.3.9.1 Inhibiting Glideslope Deviation (GSD) Alerts

> *NOTE: The G/S Inhibit function should be activated when flying a localizer backcourse approach to prevents nuisance GSD alerts. GSD alerts are inhibited independent from all other FLTA, PDA, and GPWS alerts.*

1. While viewing the TAWS-A Page, touch the **MENU** key.

2. Touch the **G/S Inhibit** key to inhibit or enable glideslope or glidepath alerts (choice dependent on current state).

> *NOTE: The G/S Inhibit function will only be active for a single approach and the inhibit function will not remain active for subsequent approaches. When G/S alerts are inhibited, they are only inhibited for a single approach. To inhibit G/S alerts on the next approach, the G/S Inhibit function must be activated again between the first and second approaches.*

> *NOTE: Glideslope Deviation alerts will not be available if the G/S INHB function is activated.*

10.6.3.10 Inhibiting GPWS Alerts (EDR, ECR, FIT, and NCR)

> ⚠ **NOTE:** *The "Inhibit GPWS" function only affects GPWS alerts (EDR, ECR, NCR, and FIT). Alerting for FLTA, PDA, and GSD is controlled independently from the GPWS alerts listed below.*

EDR, ECR, FIT, and NCR aural and visual alerts can be manually inhibited as a group. Discretion should be used when inhibiting alerts and the GPWS system should be enabled when appropriate. When these alerts are inhibited, the alert annunciation "GPWS INH" is shown on the TAWS-A Page annunciation window.

| **Menu** | 1. | While viewing the TAWS-A Page, touch the **MENU** key. |

| **GPWS Inhibit** | 2. | Touch the **GPWS INH** key to inhibit or enable GPWS alerts (choice dependent on current state). |

GPWS Inhibit Selection

GPWS Inhibit Annunciation

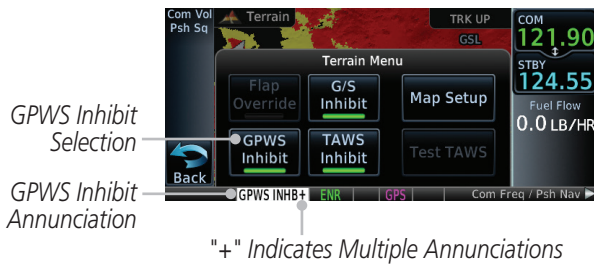*"+" Indicates Multiple Annunciations*

Figure 10-45   GPWS Inhibit Annunciation

10.6.4   Altitude Voice Call Out (VCO)

TAWS-A provides aural advisory alerts as the aircraft descends, beginning at 500 feet above the terrain, as determined by the radar altimeter (if greater than 5 NM from the nearest airport) or 500 feet above the nearest runway threshold elevation (if less than 5 NM from the nearest airport). Upon descent to this altitude, TAWS-A issues the aural alert message **"*Five-hundred.*"**

Foreword

Getting Started

Audio & Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/ Music

Utilities

System

Messages

Symbols

Appendix

Index

Foreword

Getting
Started

Audio &
Xpdr Ctrl

Com/Nav

FPL

Direct-To

Proc

Wpt Info

Map

Traffic

Terrain

Weather

Nearest

Services/
Music

Utilities

System

Messages

Symbols

Appendix

Index

10.6.5   TAWS-A System Status

During power-up, TAWS-A conducts a self-test of its aural and visual annunciations. The system test can also be manually initiated. An aural alert is issued at test completion. TAWS-A System Testing is disabled when ground speed exceeds 30 knots.

10.6.6   TAWS-A Abnormal Operations

TAWS-A continually monitors several system-critical items such as database validity, flap and landing gear position, radar altimeter input, and GPS status.

If the GTN does not contain Terrain, Airport Terrain, and Obstacle databases (or the databases are invalid), the aural message **"*TAWS System Failure*"** is generated along with the "TAWS FAIL" alert annunciation.

TAWS-A requires a 3-D GPS navigation solution along with specific vertical accuracy minimums. Should the navigation solution become degraded or if the aircraft is out of the database coverage area, the annunciation "TAWS N/A" is generated in the annunciation window and on the TAWS-A page, the aural message **"*TAWS Not Available*"** is generated if airborne, some TAWS-A terrain alerts will not be issued, and GPWS alerting (which are not dependent on GPS position) will continue to operate. When the GPS signal is re-established and the aircraft is within the database coverage area, the aural message "TAWS Available" is generated.

TAWS-A also requires radar altimeter input. Should the radar altimeter input fail or become degraded, the annunciation "GPWS FAIL" is generated in the annunciation window and on the TAWS-A Page. The aural message **"*GPWS System Failure*"** is also generated. The "GPWS FAIL" annunciation will also occur if both GPS altitude and barometric altitude are unavailable. If only the GPWS system has failed, GPWS-based alerts will not be available, while other TAWS-A alerting remains unaffected.

Multiple TAWS or GPWS annunciations cannot be displayed at the same time. When multiple annunciations exist, an asterisk will be present next to the annunciation. The display of each annunciation will alternate with each being displayed for approximately five seconds.