NavView User Guide – 12 Guidance Calculations

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4D Nav, LLC

REL	REV	ISSUE DESCRIPTION	PREPARED	REVIEWED	APPROVED	DATE
01	B	Added notes regarding tracking along geodesic	GAW	SW	GAW	Aug 28, 2024
01	A	Initial release	SW	GAW	GAW	June 12, 2024

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12. GUIDANCE CALCULATIONS

12.1 OVERVIEW

NavView supports the ability to navigate using Guidance Calculations. The source and destination of the guidance calculation are known as the **From** and **To** objects. These objects can be one of the following types:

- **Point:** A Guidance Point refers to a single point, which may or may not be moving. For instance, a waypoint is a static point which does not have a velocity. A vehicle is considered a point because it is tracked using a single reference point (CRP), but it can move, thus the point has a velocity associated with it
- **Route:** A Guidance Route is a series of nodes connected by segments, such as a pipeline, survey line, or catenary line
- **3D Line:** A 3D line in standard NavView is represented as a 3D Polyline Connection (refer to Connections section)

It is possible to create a guidance calculation in the following configurations:

- **Point to Point:** Waypoint to Waypoint, Vehicle to Waypoint, Vehicle to Vehicle, etc.
- **Point to Route:** ROV to Pipeline, Vessel to Survey Line, etc.
- **Point to 3D Line:** ROV to Mooring Line, etc.
- **3D Line to 3D Line:** Umbilical to Mooring Line, etc.

When configuring a new guidance calculation, the type of calculation is chosen by NavView based on the type of **To** and **From** objects. It is then possible to modify the calculation within that type. For instance, a Point to Point calculation between an ROV and a waypoint, the **From** and **To** objects can be changed to different waypoints or vehicles, but it is not possible to select a line/route for one of those items.

Note: The **Point to Route** tracking simultaneously supports tracking the respective survey line on the map grid and along the Geodesic. However, if tracking along the Geodesic it is important use a survey line that has had nodes inserted so the line itself follows the geodesic. For details, refer to section 10.8 in 4DN_NVUG_S10_01n-Survey Lines.

If Rolls and Privileges are enabled, the following are what is allowed for each role:

Roles	Privileges
Not Logged In/User	Cannot add, edit or remove guidance calculations
Online/Supervisor/ Administrator	Can add, edit and remove guidance calculations

12.2 GUIDANCE CALCULATIONS WINDOW

The guidance window is accessed by clicking the Guidance Calculations button in the Configuration section of the Setup Ribbon (see Figure 12-1) or project Explorer view (see Figure 12-2). Creation and editing of guidance calculations is done from the Configure Guidance Calculation window (see Figure 12-3).

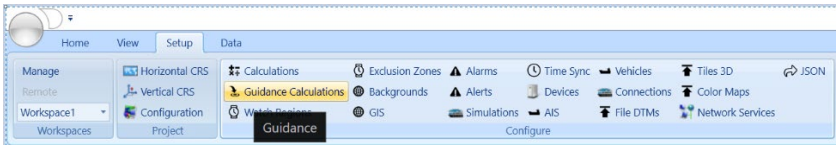

FIGURE 12-1 GUIDANCE CALCULATIONS - SETUP TAB RIBBON

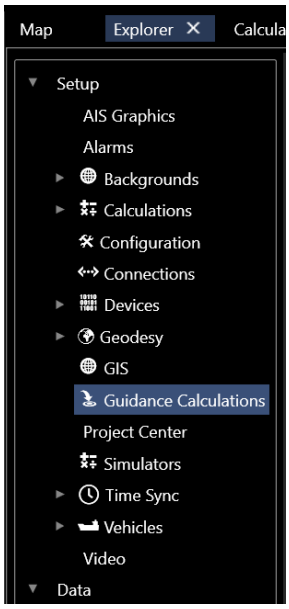

FIGURE 12-2 GUIDANCE CALCULATIONS – EXPLORER VIEW

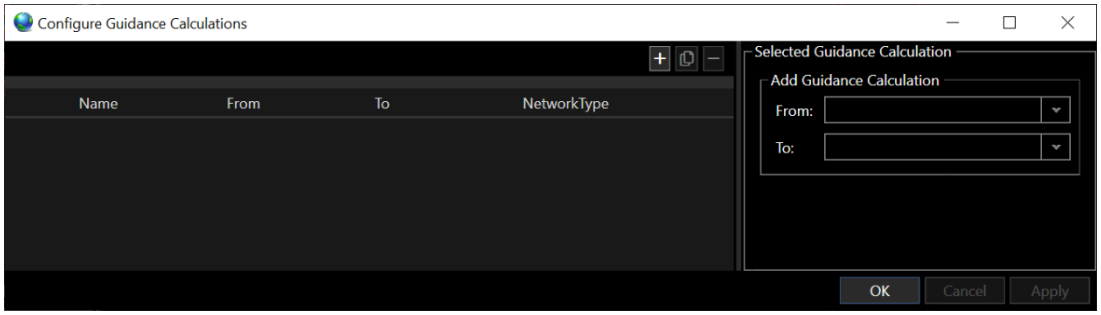

FIGURE 12-3 GUIDANCE CALCULATIONS - CONFIGURE GUIDANCE WINDOW

The Configure Guidance Window consists of the following components:

a. **Toolbar** 

 Click this button to add a new guidance calculation

 Click this button to remove the selected guidance calculation

 Click to copy the selected item

b. **Guidance Calculation List**

- All guidance calculations are listed in the data grid. The data grid provides an overview of the guidance information:
  - Name
  - From
  - To

- Network Type

c. Selected Guidance Calculations Dialog. The dialog contains three tabs for configuration and editing:
   - Details Tab
   - Graphics Tab
   - Graphics 3D Tab

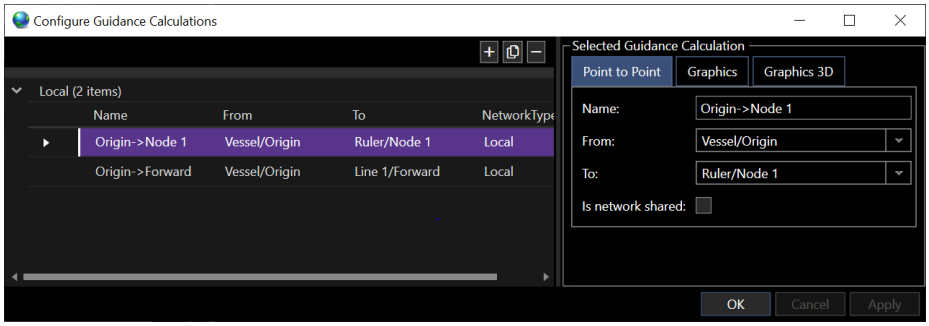

FIGURE 12-4 GUIDANCE CALCULATIONS - SELECTED GUIDANCE CALCULATIONS - POINT TO POINT DETAILS TAB

12.3 ADD A GUIDANCE CALCULATION

1. Click the [+] button.
2. The Selected Guidance Calculation Dialog is displayed (Figure 12-5)

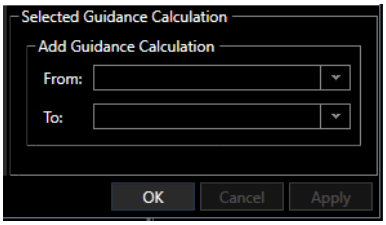

FIGURE 12-5 GUIDANCE CALCULATIONS - SELECTED GUIDANCE CALCULATION DIALOG

3. Expand the **From** drop-down button to select the *From* object. The **From** available items are presented in a hierarchical tree as shown in Figure 12-6 f for selection.

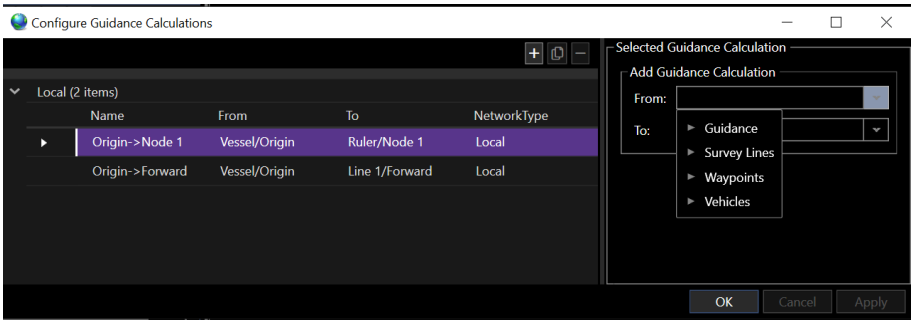

FIGURE 12-6 GUIDANCE CALCULATIONS - FROM OBJECT SELECTION

4. Expand the **To** drop-down button to select the *To* object. The **To** items are presented in a hierarchical tree as shown in (see Figure 12-7). In the case of Survey lines and pipelines, if selected as a line versus one of its nodes, the direction the line is being tracked must be selected.

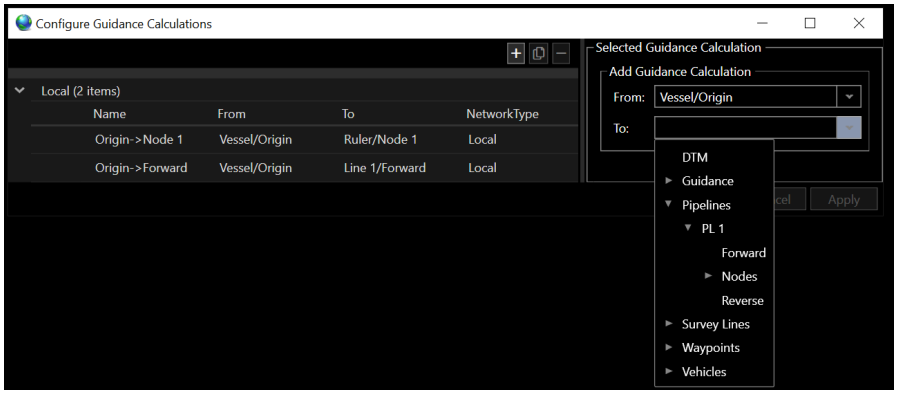

FIGURE 12-7 GUIDANCE CALCULATIONS - TO OBJECT SELECTION

Note: Upon clicking on an item that is selected as a **From** object, the menu will close. Objects that are not available to be a **From** object will not be selectable and will not close the menu. To abort choosing an item, click outside of the menu.

5. Once configured, click the **OK** button to add the Guidance Calculation and close the window, click the **Apply** button to add the Guidance Calculation and leave the window open or click the **Cancel** but to abort the process and leave the window open.

12.4 REMOVE A GUIDANCE CALCULATION

1. Select a Guidance Calculation in the list.
2. Click the remove button.
3. A dialog will appear asking for confirmation of the removal, click **Ok** to proceed.

12.5 EDIT GUIDANCE CALCULATION

Guidance Calculations can be edited from the Configure Guidance Calculations window.

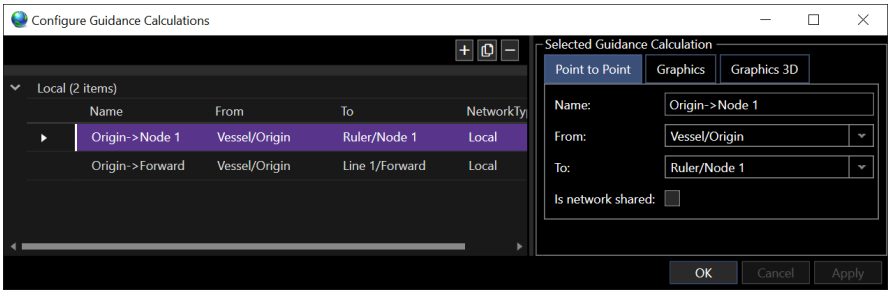

FIGURE 12-8 GUIDANCE CALCULATIONS – EDIT CALCULATION

1. Open Guidance Calculation window.
2. Select Guidance Calculation to be edited.
3. Edit the selected Guidance Calculation using the Selected Guidance Calculation dialog.
   a. **Details Tab:** The details tab header will depend on the type of guidance calculation that has been created (see Figure 12-4)
      - **Name:** The name of the guidance calculation is automatically created by NavView upon creation of the calculation, based on the *From* and *To* object names, this is editable by the user

- **From:** The *From* object can be changed from the **From** drop-down list
- **To:** The *To* object can be changed from the **To** drop-down list

Note: Some items in the list are not selectable and thus will not close the menu when clicking on them, such as the Vehicles header.

Note: Pipelines/Survey Lines appear in the list of guidance point to point objects because it is possible to select their individual nodes.

Note: If the calculation is a Point to Route calculation, only Guidance Routes will be available to choose from.

- **Is network shared:** Check box if the selected Guidance Calculation is to be shared on the network
- **Override tracked segment:** Check box to force tracking to a specific segment from the drop-down list

b. **Graphics Tab**

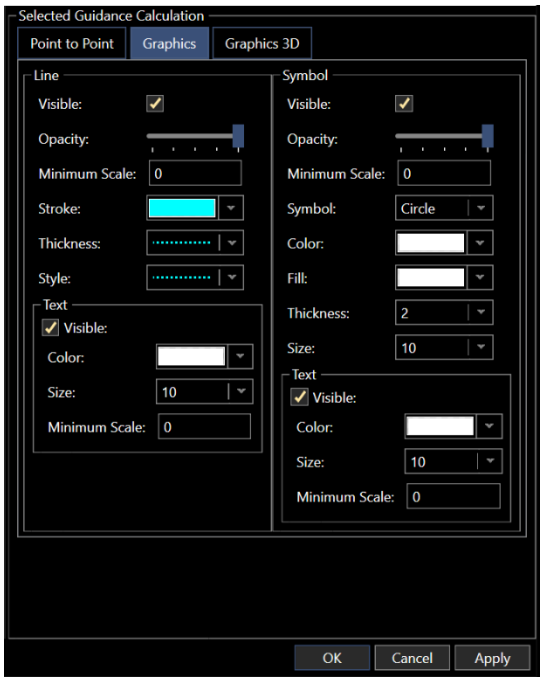

FIGURE 12-9 GUIDANCE CALCULATIONS – EDIT GUIDANCE CALCULATION - GRAPHICS TAB

This Graphics tab (see Figure 12-9) consists of the following options.

- **Line**
  - **Visible:** Check the box to display a rubber band line for the selected guidance in Map View
    The Guidance Calculation graphics will show a line from the *From* point to the *To* point for a Point to Point guidance
  - **Opacity:** Control the opacity of the line displayed using the slider, left being transparent and right being opaque

- **Minimum:** The Minimum Scale setting is based on the Map view scale as displayed in the Map views when the **Display scale bar option** is enabled (see Windows section). As the Map view is zoomed in, the scale increases, as it is zoomed out the scale decreases. The survey line will display when the scale is greater than the Minimum Scale setting
- **Stroke:** From the drop-down list select the line color
- **Thickness:** From the drop-down list select the line thickness
- **Style:** From the drop-down list select line style
- **Text:** Annotation added to guidance line. Check the box to display annotation in map view. Text color and size is selectable from the drop-down lists. Annotation will be visible in map view if map scale is greater than value set in Minimum Scale

Note: To be able to display the annotation in map view the line must be made visible.

- **Symbol**
  - **Visible:** Check the box to display a symbol at the Guidance Calculation *From* reference point in Map View
  - **Opacity:** Control the opacity of the symbol displayed using the slider, left being transparent and right being opaque
  - **Minimum Scale:** Symbol will be visible in map view if map scale is greater than limits set here
  - **Symbol:** From the drop-down list select the icon for the symbol
  - **Color:** From the drop-down list select the color for the symbol
  - **Fill:** From the drop-down list select the color for the symbol fill
  - **Thickness:** From the drop-down list select the line thickness for the symbol
  - **Size:** From the drop-down list select the symbol size
  - **Text:** Annotation added to the symbol, this being the guidance name. Check the box to display annotation in map view. Text color and size is selectable from the drop-down lists. Annotation will be visible in map view if map scale is within the limits set in Minimum/Maximum Scale

Note: To be able to display the annotation in map view the symbol must be made visible.

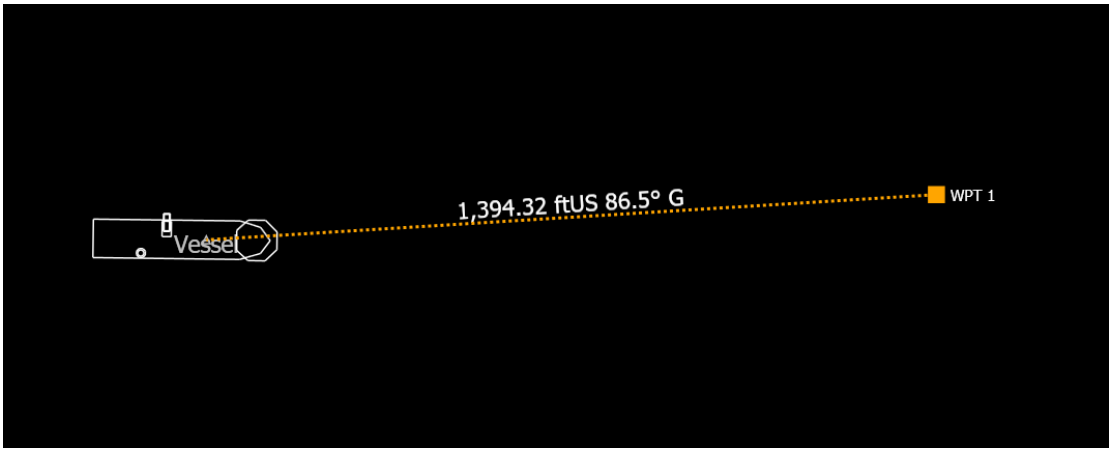

FIGURE 12-10 GUIDANCE CALCULATIONS – MAP VIEW - POINT TO PONT EXAMPLE

Note: The range annotation will change to statute mile if Foot or US survey foot is selected in Distance (Preferences) and the range is greater than a statute mile. If Meters is selected in Distance (Preferences) and the range is greater than 1000 m the range annotation will change to Km. The direction is always displayed as °Grid.

In the case of a Point to Route guidance calculation the currently tracked segment will be highlighted (see Figure 12-11)

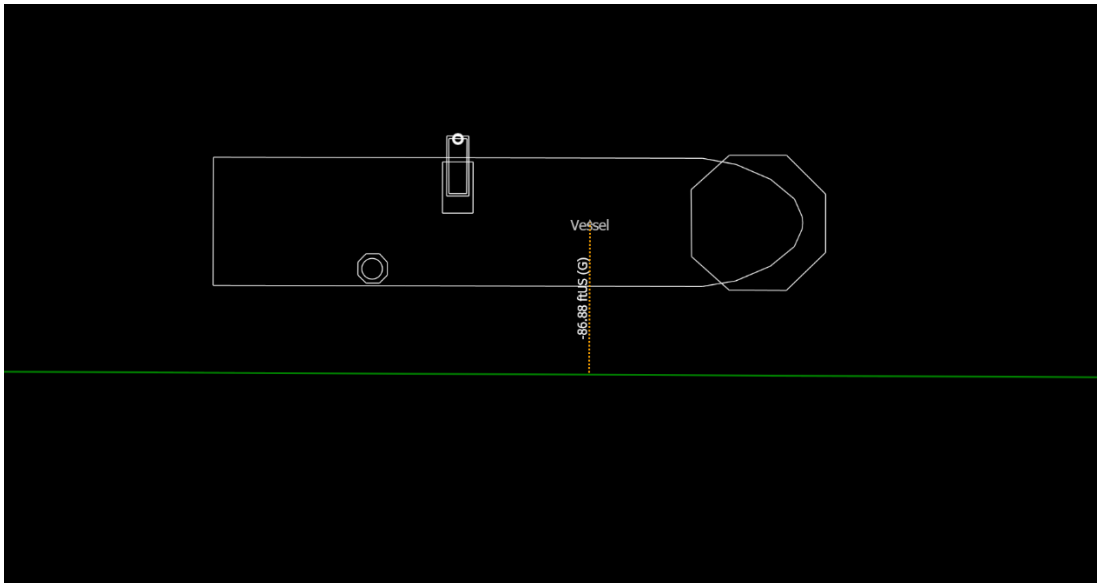

FIGURE 12-11 GUIDANCE CALCULATIONS – MAP VIEW - POINT TO ROUTE EXAMPLE

c. Graphics 3D Tab

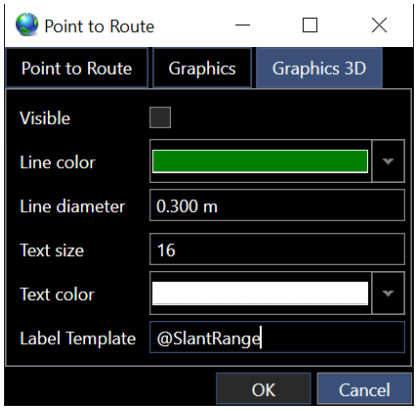

FIGURE 12-12 GUIDANCE CALCULATIONS - GRAPHICS 3D TAB

The Graphics 3D tab consists of the following settings:

- **Visible:** Check the box to display a rubber band line for the selected guidance in Map View
- **Color:** From the drop-down list select the color for the line
- **Line diameter:** Enter a value for the line diameter
- **Text Size:** Enter value for text size
- **Text color:** Select text color from the drop-down list
- **Label Template:** Guidance text option. Available options that can be entered are:
  - Slant Range @SlantRange
  - Grid Range @GridRange
  - True Range @TrueRange
  - Grid Bearing @Bearing
  - True Azimuth @Azimuth
  - Delta Z @DeltaZ

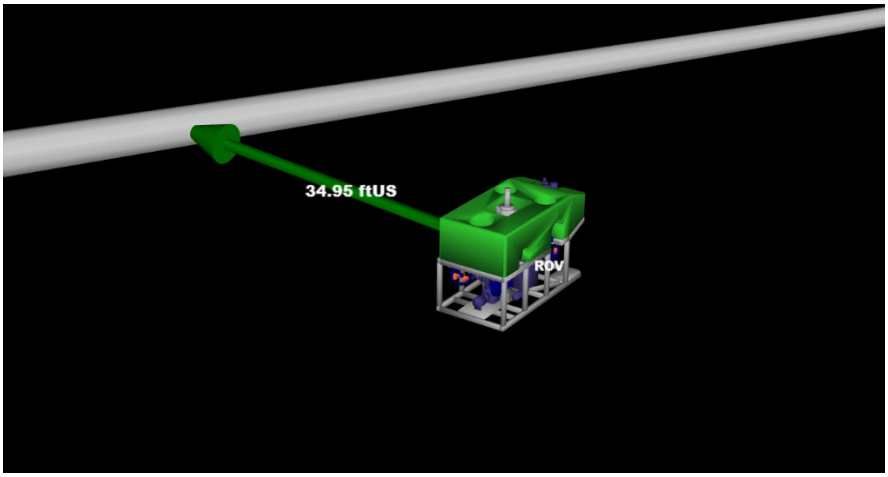

FIGURE 12-13 GUIDANCE CALCULATIONS – 3D MAP VIEW - POINT TO 3D LINE EXAMPLE

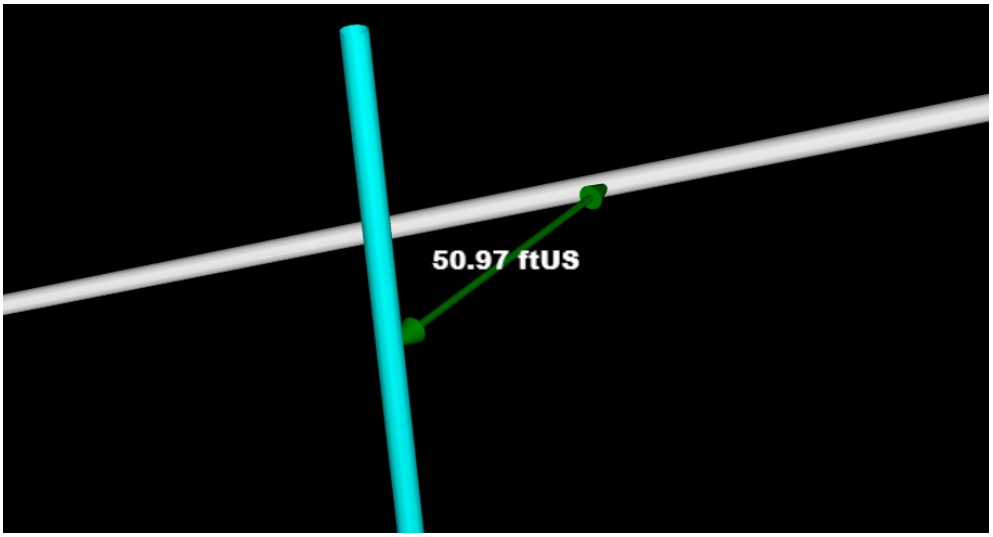

FIGURE 12-14 GUIDANCE CALCULATIONS – 3D MAP VIEW - 3D LINE TO 3D LINE EXAMPLE

12.6 GUIDANCE DISPLAYS

Guidance information within NavView can be viewed using Text windows, the Guidance Tracking window, 2D/3D Map and/or the offline display.

12.6.1 GUIDANCE IN THE TEXT WINDOWS

There are several data items created by a guidance calculation which are available for selection (see Figure 12-15) to display in the text windows. For details on the management of text windows (refer to Windows section).

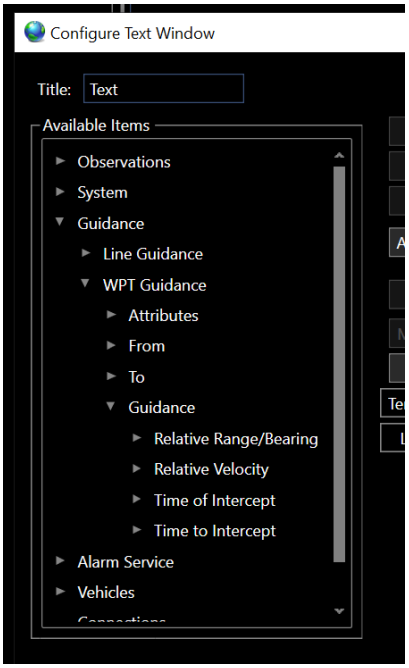

FIGURE 12-15 CONFIGURE TEXT WINDOW – GUIDANCE

12.6.1.1 POINT TO POINT GUIDANCE TEXT

The Point to Point Guidance creates a hierarchy of items to select from which includes a Point Text for each item, and details on the relative position and velocities.

Point to Point Guidance (Name at the top)

- **Attributes**
  - Name
  - Description
  - From Name
  - To Name
  - From Path
  - To Path
- **From**
  - Bearing
  - Attitude
  - Vertical Velocity
  - Name
  - Coordinate
  - Elevation
  - Velocity
- **To**
  - Bearing
  - Attitude
  - Vertical Velocity
  - Name
  - Coordinate
  - Elevation
  - Velocity
- **Guidance**
  - Relative Range/Bearing
  - Relative Velocity
  - Time of Intercept
  - Time to Intercept

12.6.1.1.1 RELATIVE VELOCITY

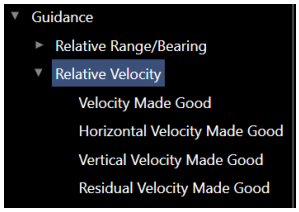

FIGURE 12-16 GUIDANCE CALCULATIONS – RELATIVE VELOCITY TEXT ITEMS

Velocity Made Good

Velocity Made Good (VMG) is the relative velocity of the objects, in the direction of the bearing between the objects. This can be likened to a vehicle approaching a target: the velocity made good is the velocity directly towards the target, where the total velocity of the body could be greater than this value.

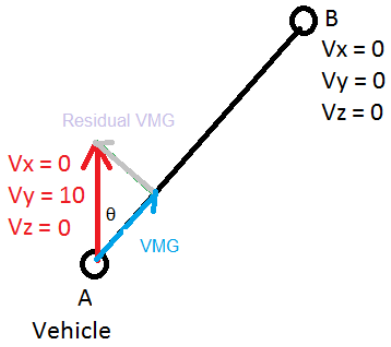

FIGURE 12-17 GUIDANCE CALCULATIONS - VELOCITY MADE GOOD EXAMPLE

Figure 12-17 describes a simple scenario. Vehicle A is moving at velocity 10 in the Y direction, and 0 in other directions, as denoted by the red arrow. The velocity made good is the projection of this velocity on the vector towards point B, as denoted by the blue line.

Horizontal Velocity Made Good

This is the horizontal component of the velocity made good. This is often useful for surface vessels where the vertical component is not relevant. In the example in Figure 12-17, the horizontal velocity made good will be equal to the total VMG, as there is no relative velocity in the Z direction.

Vertical Velocity Made Good

Vertical velocity made good is the pure vertical component of VMG. This is useful for scenarios such as determining when an object will surface or how long it will take to reach the bottom at a constant rate, showing crane payout speed, etc.

Residual Velocity Made Good

The Residual VMG is the wasted component of the velocity, i.e. the velocity that is perpendicular to the direction of interest. In Figure 12-17, Residual VMG is denoted by the gray arrow, and this is perpendicular to the vector between the two points.

12.6.1.2 TIME OF INTERCEPT

The time at which the intercept is predicted to take place, at the current velocity.

Note: If the VMG is negative, as when the two points are moving away from each other, there will be no predicted time of intercept.

TOI = Current Time + (Slope Distance) / VMG

12.6.1.3 TIME TO INTERCEPT

The time remaining until the intercept takes place.

TTI = (Slope Distance) / VMG

12.6.1.4 POINT TO ROUTE GUIDANCE TEXT

The Point to Route Guidance Text creates a hierarchy to select from which contains attributes, as well the details of the *From* point (shown as Reference), and the relative distances and velocities to the route in question. The hierarchy is shown below.

Point to Route (Name is shown)

- **Attributes**
  - Name
  - Description
  - From Name
  - To Name
  - From Path
  - To Path
- **Reference**
  - Bearing
  - Attitude
  - Vertical Velocity
  - Name
  - Coordinate
  - Elevation
  - Velocity
- **Route Name**
- **Tracking Data**
  - Route
    - Speed Along Line
    - Speed Cross Track
    - Station
    - Distance From Start (Distance from start of route)
    - Closest Point (Position of point on route perpendicular to the vessel tracking reference)

  - Distance From Route (Offline distance +ive starboard side of route forward, -ive port side of route forward)
  - Distance To Route (Distance to move to route, -ive move port, +ive move starboard)
  - Heading To Steer (Segment tracked)
  - To End
- Time of Intercept (Arrival Date and/or Time at end of route)
- Time to Intercept (Time remaining to end of route)
- Distance (Remaining route distance to end)
- Segment
  - Along Segment Distance (Distance travelled from start of segment, along segment)
  - Distance To End (Remaining distance to segment end, along segment)
  - Length (Length of tracked segment)
  - Start Node Name
  - End Node Name
  - Name
  - To Start Node (Relative horizontal distance and direction from vessel tracking reference to start of segment)
  - To End Node (Relative horizontal distance and direction from vessel tracking reference to end of segment)
  - Start Node to End Node (Relative horizontal distance and bearing from the segment Start Node to segment End Node)
- Geodesic
  - Station (True)
  - Distance From Route (True)
  - Distance To Route (True)
  - Forward Azimuth (True)
  - Next Forward Azimuth (True)
  - End Of Segment (True)
- Time of Intercept (Arrival Date and/or Time at end of segment)
- Time to Intercept (Time remaining to end of segment)
- Distance (Remaining route distance to end)
  - End Of Route (True)
- Time of Intercept (Arrival Date and/or Time at end of route)
- Time to Intercept (Time remaining to end of route)
- Distance (Remaining route distance to end)

12.6.1.5 POINT TO 3D LINE/3D LINE TO 3D LINE

The Point to 3D Line (3D Polyline Connection) Guidance Text creates a hierarchy to select from which contains attributes and guidance information to the 3D Line in question. The hierarchy is shown below.

Point to 3D Line (Name is shown)

- **Attributes**
  - Name
  - Description
  - From Name
  - To Name
  - From Path
  - To Path
- **Guidance**
  - Reference Position
  - Target Position
  - Azimuth (T)
  - Vertical Angle
  - Range (G)
  - Delta (G) X Y Z

12.6.1.6 GUIDANCE TEXT WINDOW

A wide variety of information from guidance calculations is available to be displayed on screen. Figure 12-18 shows a typical text view for Point-to-Point guidance. Figure 12-19 shows a typical text view for a Point to Route guidance. Figure 12-20 shows a typical text view for a Point to 3D Line guidance.

Text

Name	Vehicle to Waypoint
From Name	Origin
To Name	WP 1
Range (G)	380.96 ftUS
Bearing (G)	174.81°
Range (T)	380.20 ftUS
Azimuth (T)	172.77°
Horizontal Velocity Made Good	-0.776 knot
ETA	12:03:03.5

FIGURE 12-18 GUIDANCE CALCULATIONS - GUIDANCE POINT TO POINT TEXT EXAMPLE

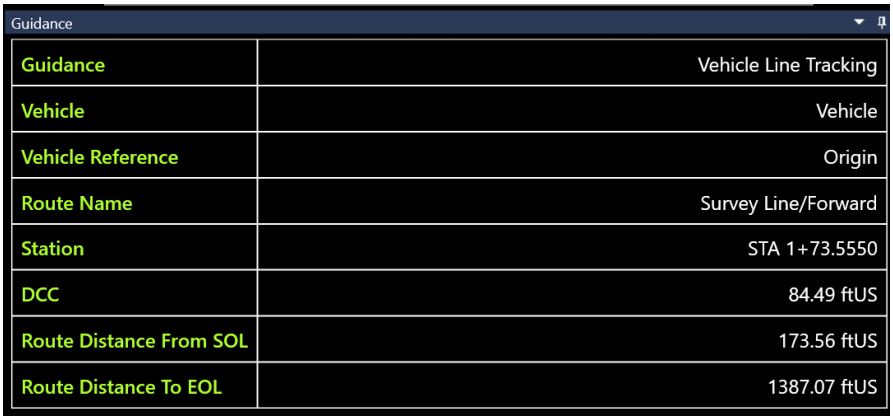

FIGURE 12-19 GUIDANCE CALCULATIONS - GUIDANCE POINT TO ROUTE TEXT EXAMPLE

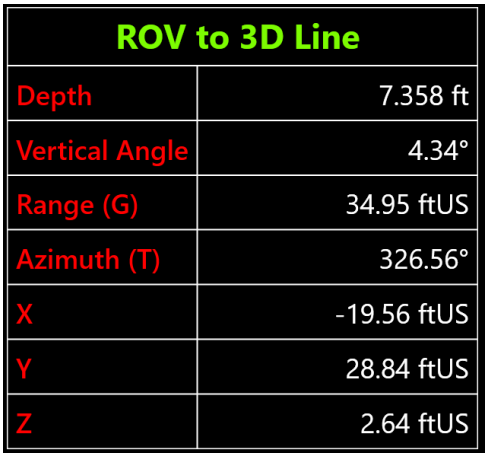

FIGURE 12-20 GUIDANCE CALCULATIONS - GUIDANCE POINT TO 3D LINE TEXT EXAMPLE

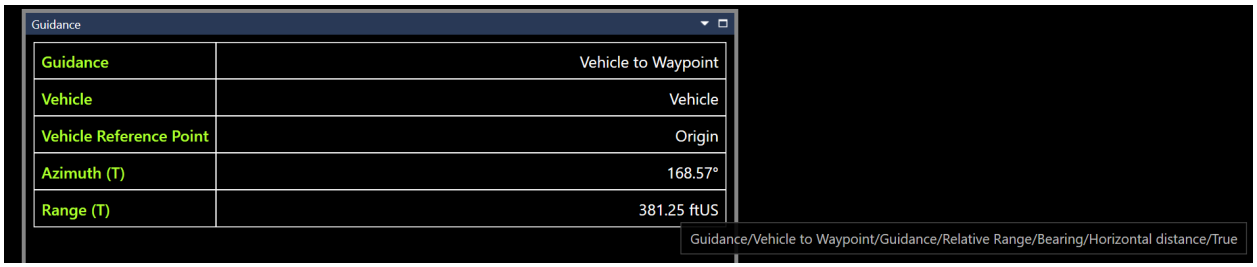

FIGURE 12-21 GUIDANCE CALCULATIONS – TEXT WINDOW - GUIDANCE ITEM PATH

The guidance item path can be displayed by putting the mouse pointer over the item as shown in Figure 12-21

12.6.2 GUIDANCE TRACKING WINDOW

Guidance tracking provides a polar display of a selected Guidance Calculation, **From** object to the **To** object.

To open the window, click on Guidance Tracking in the Windows section of the View ribbon.

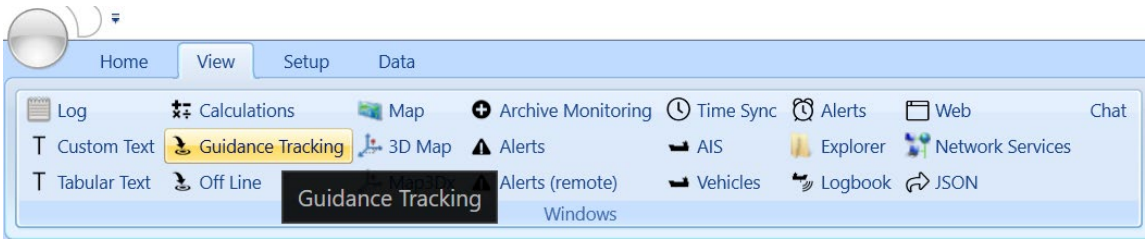

FIGURE 12-22 GUIDANCE CALCULATIONS - GUIDANCE TRACKING - VIEW TAB

The Guidance Tracking Window (see Figure 12-23) shows a polar view, with the **To** object always at the center and the **From** object to the west. The From object trail is the history of previous locations.

The radial scale uses the units configured in Preferences/Distance, so in the example in Figure 12-23 the *From* object is between the 1000 ftUS ring and the 500 ftUS ring. The details view in the top shows the True Range, True Azimuth and CMG between the objects.

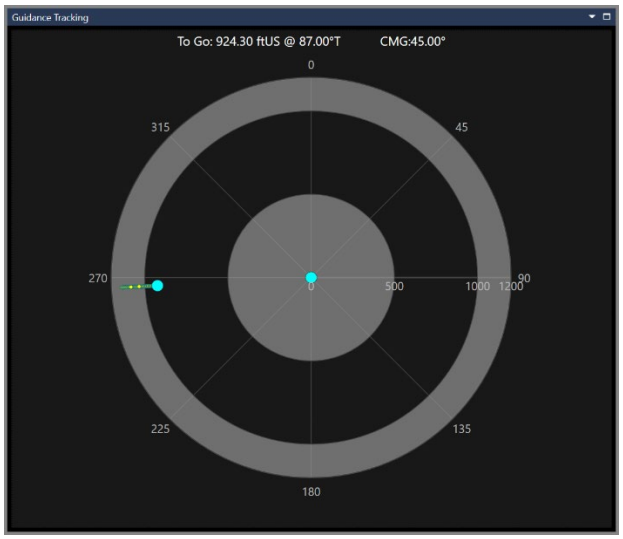

FIGURE 12-23 GUIDANCE CALCULATIONS - GUIDANCE TRACKING WINDOW

12.6.2.1 CONFIGURING THE GUIDANCE TRACKING WINDOW

The information displayed on the Guidance Tracking window is configured by a mouse right click within the window. This will open a pop-up menu giving the option of configuring the information to display or save chart as a PNG.

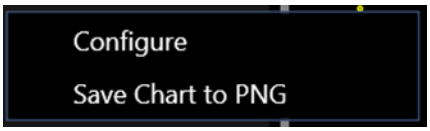

FIGURE 12-24 GUIDANCE CALCULATIONS – GUIDANCE TRACKING – POP-UP MENU

1. Selecting Configure opens a Configure Guidance Tracking dialog.

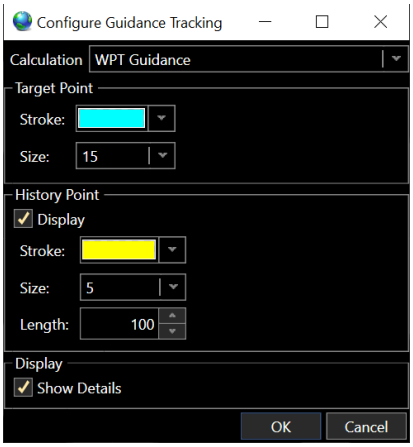

FIGURE 12-25 GUIDANCE CALCULATIONS - CONFIGURE GUIDANCE TRACKING DIALOG

a. **Calculation:** Select the guidance calculation to be displayed in the tracking view from the drop-down list
   - **Target Point:**
     - **Stroke:** Choose the color of the **From** and **To** symbols
     - **Size:** Choose the size of the **From** and **To** symbols
   - **History Point:**
     - **Display:** Check box to display history
     - **Stroke:** Choose the color of the history symbols
     - **Size:** Choose the size of the history symbols
     - **Length:** Select how many history points to display
   - **Display:**
     - **Show Details:** Check the box to display the True Range, Azimuth (T) and CMG in the Guidance Tracking View

2. Click **OK** to save changes, Cancel to discard changes.

Note: A Point to Route guidance calculation can be chosen for the guidance tracking view. It will show the guidance calculation to the end of segment.

12.6.3 OFFLINE DISPLAY

The Offline window shows a horizontal bar depicting the offline of the selected Point to Route Guidance Calculation **From** object relative to the **To** object (route).

To open the window, click on Offline in the Windows section of the View ribbon.

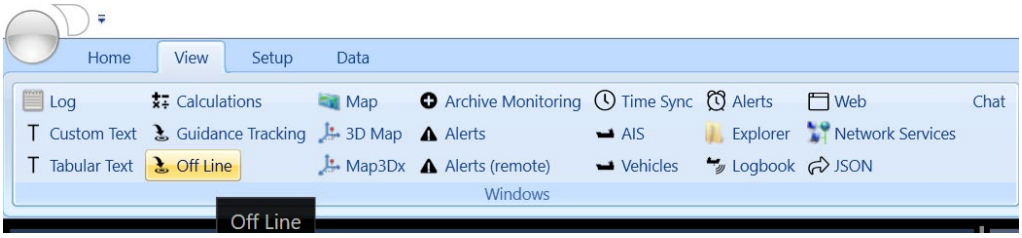

FIGURE 12-26 GUIDANCE CALCULATIONS – OFF LINE - VIEW TAB

FIGURE 12-27 GUIDANCE CALCULATIONS - OFFLINE DISPLAY

The Offline display shows a number bar centered at zero and showing a user configurable plus or minus amount. This shows the Offline Distance value from the Point to Route calculation, to the right for positive values, where the reference point is to the starboard side of the line, and to the left for negative values, where the reference point is to the port side of the line, looking forward along the line.

12.6.3.1 CONFIGURING THE OFFLINE DISPLAY

The information displayed on the Offline window is configured by a mouse right click within the window, this will open a pop-up menu to configure the display.

1. Click **Configure** on the context menu.
2. Edit settings as required.

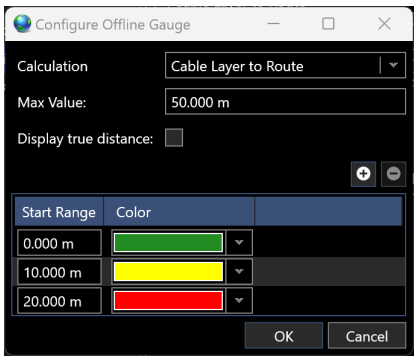

FIGURE 12-28 GUIDANCE CALCULATIONS - CONFIGURE OFFLINE GAUGE DIALOG

a. **Calculation:** Select the Point to Route Guidance Calculation to be used in the offline display from the drop-down list
b. **Max Value:** The maximum extent to the right and left side of the scale. Any offline values greater than this number will show the fully to one side, but the display does not auto scale
c. **Display true distance:** If tracking the survey line along the Geodesic, check this box
d. **Range Thresholds:** The range thresholds allow for the color of the bar to change when the offline distance goes outside of certain specifications. By default, when the offline window is first created, the max value is set to 25 ft or meters depending on the working unit, and range thresholds are created at 10ft/m and 20ft/m

Note: It is not possible to modify the range or remove the first item in the list, but it is possible to change the color.

3. Click **OK** to save changes or **Cancel** to discard them

12.6.3.1.1 ADDING A RANGE THRESHOLD

1. Open the Configure Offline Display dialog.
2. Click the  add button.
3. A new range threshold is added to the bottom of the list.

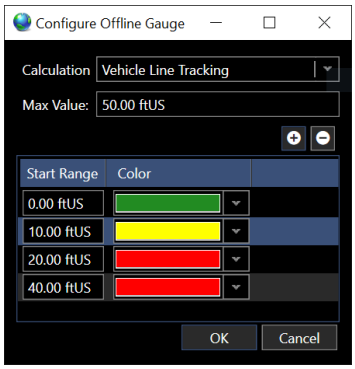

FIGURE 12-29 GUIDANCE CALCULATIONS – CONFIGURE OFFLINE GAUGE - ADDED RANGE THRESHOLD

Note: When a new range threshold is added, it automatically is given double the range of the previous item in the list and the same color.

a. **Start Range:** Specified Range from the center line at which the bar will display the color of this range threshold. To edit the range value, click in the text box of the item in the Start Range column and type a new distance
b. **Color:** The color with which to fill the offline display bar once the distance has exceeded the specified range. To change the color, click the drop-down button to expand the color picker and choose a new color. Figure 12-30 and Figure 12-31.

When the offline distance has exceeded the parameter specified, the bar is filled with the color configured in the settings.

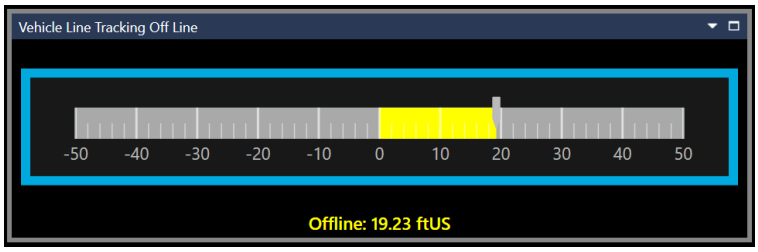

FIGURE 12-30 GUIDANCE CALCULATIONS - OFFLINE DISPLAY – THRESHOLD (YELLOW)

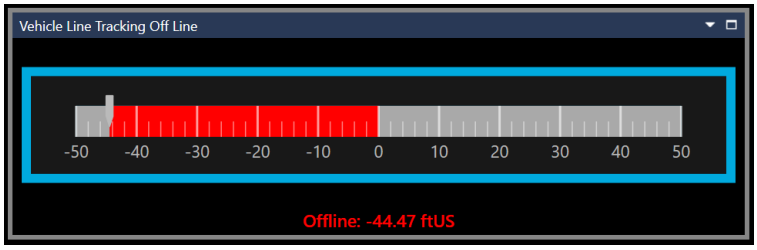

FIGURE 12-31 GUIDANCE CALCULATIONS - OFFLINE DISPLAY – THRESHOLD (RED)

4. Click **OK** to save changes or **Cancel** to discard them.

12.6.3.1.2 REMOVING A RANGE THRESHOLD

1. Open the configure offline display dialog.
2. Select a Range Threshold from the list.
3. Click the  remove button.