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SURFACE SYSTEMS & INSTRUMENTS, INC. smoothroad.com

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# On-Grinder GPS Tool

Featuring NovAtel GPS Receivers
(Terrastar or SBAS/WAAS Corrections)

## Introduction

The SSI On-Grinder GPS Tool was developed for contractors to eliminate the need to physically layout the areas of localized roughness (ALR). The system can also be used to layout ALR on a truck using paint. The system is primarily operated through the SSI Profiler V3 program with the correct operator license. If the grinding tool is not available in your version of Profiler please contact your SSI Customer Support representative.

The On-Grinder GPS Tool is a GPS based system. The accuracy and precision of the device depends on the satellite reception and environment. Accuracy is the approximation to the true value, whereas precision is the proximity of all collected points to each other. If a low quality GPS unit is used with this software there may be high precision, but low accuracy. For best results the inertial profiler data should be collected with the same high resolution GPS receiver that the On-Grinder GPS Tool will be operating with. The highly accurate GPS system that SSI offers is a NovAtel Flexpak6 with Terrastar that boasts a 0.1 meter accuracy at 20 Hz.

## Collection of Data with Inertial Profiler (IP)

The inertial profiler can collect data at up to 70 M.P.H. With a 10 Hz GPS system at a speed of 50 M.P.H. the IP will collect a GPS sample every 7.3 feet. To increase the GPS density, drive slower during the collection. This example illustrates that the current position line will jump 3.67 feet at a time between each GPS note, unless Interpolate Lock-On is checked under Settings>GPS Options.

SSI recommends to use the DB-9 serial port on the white housing for GPS input whenever possible. The efficiency and speed of signal processing of the DB-9 serial cable surpasses the abilities of the USB cable. As long as the SSI electronics has a health string with a capital ‘G’ such as: SSI Profiler 2.2: Q0G0r0r0d0P1P0x0 the system can use the serial cable connection. Contact SSI to verify that your electronics can accept the serial GPS signal. Usually, the serial port connection on the computer is COM 1.
Also use the COM 1 output port on the GPS receiver.
***Note:* The baud rate for the receiver must match the required settings for the SSI electronics (38400). Newer or updated SSI systems have a baudrate of 9600. Check with your SSI representative about your system.**

***The USB cable has proved to work well when mounted on the slow moving grinder.***

**Processing the RSD Files**

Currently, the processing for grind locations must be completed within ProVal until SSI releases their version of a grinding simulator.
Once the PPF is created from the RSD file and imported into ProVal, navigate to the Smoothness Assurance Module (SAM). SAM allows the user to "grind" the profile and depicts the best strategy; one track at a time.

The grinding simulator uses waveband analysis to determine to optimal locations to grind the pavement and reduce IRI. One area of localized roughness can be split up as many times that is needed so that the grind locations do not highlight a dip.

***To import:***

1) Set the IRI thresholds in the SAM window of ProVal for the current selected track,
    a. 528 feet for Long Continuous and Fixed Interval (40-80 in/mile)
    b. 25 feet for Short Continuous (80-200 in/mile)
2) Select Analyze to calculate the areas of localized roughness (ALR),
3) Under Navigate>Grind, enter the grinder properties,
4) Select AutoGrind to get ***estimated*** grind locations,
5) Right click in the Grind Locations ProVal table and copy locations to clipboard,
6) Paste the ProVal grind locations in a notepad (.txt) file and save it for each wheel path,
7) Open the RSD file in Profiler V3,
8) Navigate to the Advanced Tools Section,
9) Select ***Manage Grind Info***,
10) Choose the correct track,
11) If the station direction is down – reverse station numbers,
12) Import the text file into the program,
13) Select OK,
14) Repeat for Track 2, starting at step 2,
15) Make sure to save the grinding locations in the RSD file.

These text files are not tied to the RSD file. The grind locations can be edited through the Manage Grinds window at any time.

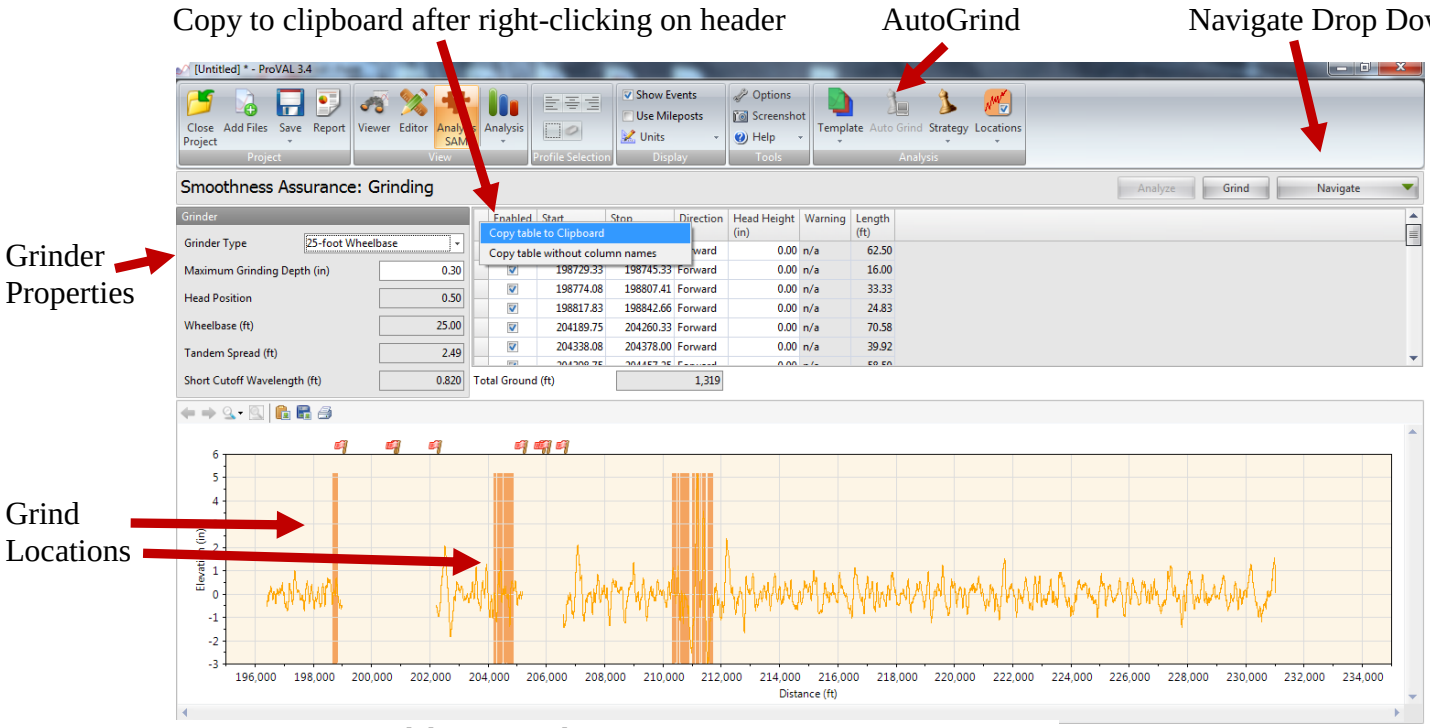



Figure 1: SAM Module in ProVal to get ALR

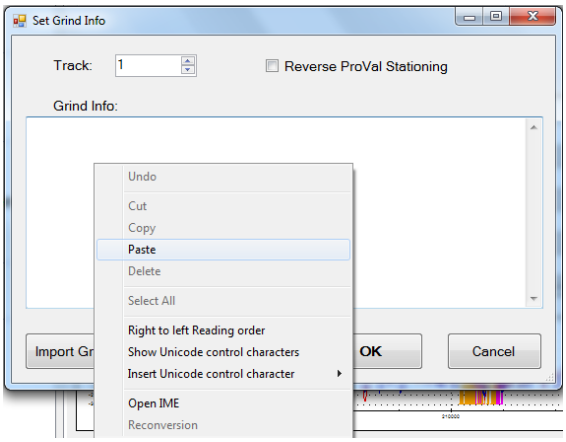



Figure 3: Import Grind Info Window

Paste the Grind locations in the open white area. Then save the grind information to a file.

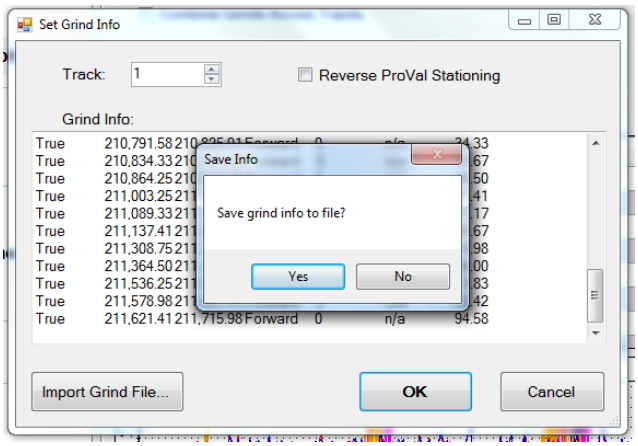



Figure 2: Save grind areas to a text and the RSD file

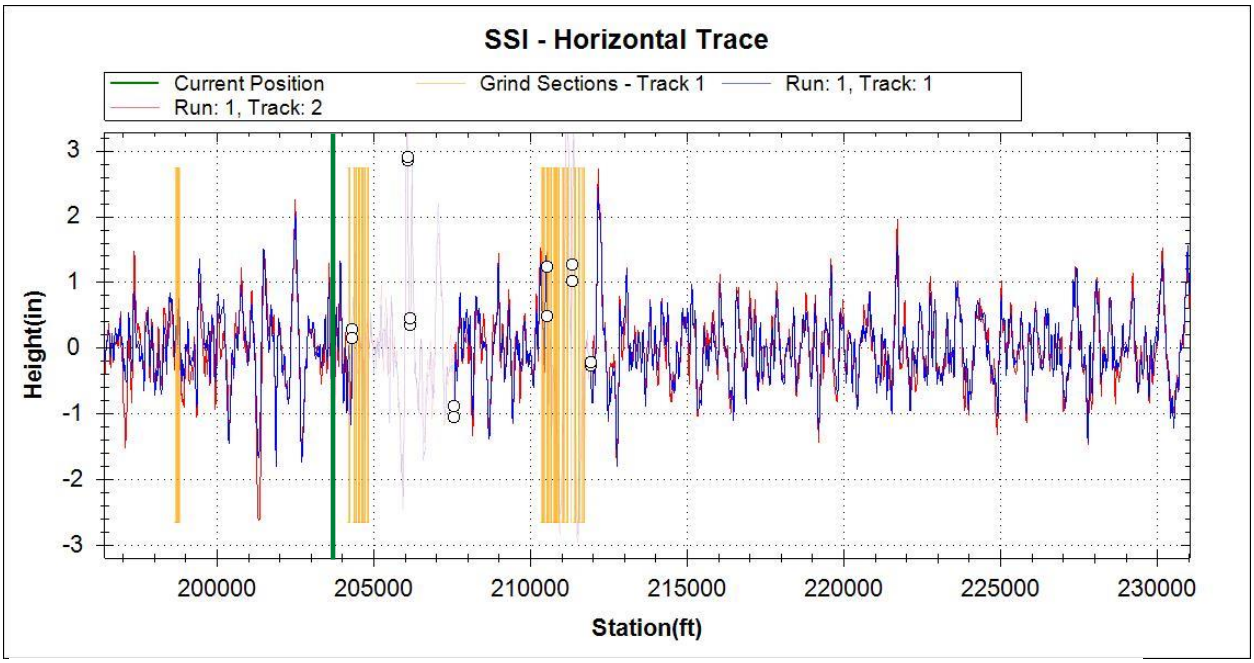


Figure 4: Grind locations for Track 1 and current position in Trace View of Profiler V3

At this point the grinds can be navigated to using the visual graph on the computer, shown above. Verify the GPS integrity periodically throughout use of this tool. The operator may select the GPS Information icon in the Trace View tab to check the GPS status.

**Connecting to NovAtel Connect**

NovAtel Connect is the mother-program for all of the NovAtel receivers. To connect on a new connection, make sure all of the USB or serial drivers are installed on your computer. When the receiver is powered on and connected to the computer for the first time, Windows will install the required drivers. Once these drivers are installed, the COM port will be shown in the Control Panel under Device Manager. There will be three COM ports for the receiver in the Device Manager. Choose the COM port number at the top of the list. This COM port number will never change as long as the connection port remains the same. To set up a connection in NovAtel Connect, choose New Connection and select the type; serial (DB-9) or USB. Follow with entering the COM number displayed for the NovAtel receiver in the Device Manager. The receiver will be discovered and the information about the device will be available. If the receiver does not connect, unplug the power for the device, wait 5 seconds, then reconnect the power and try to connect again.

The main window for the NovAtel Connect program gives the accuracy for the receiver. This will improve until 0.1 meter is reached; usually in less than 5 minutes.

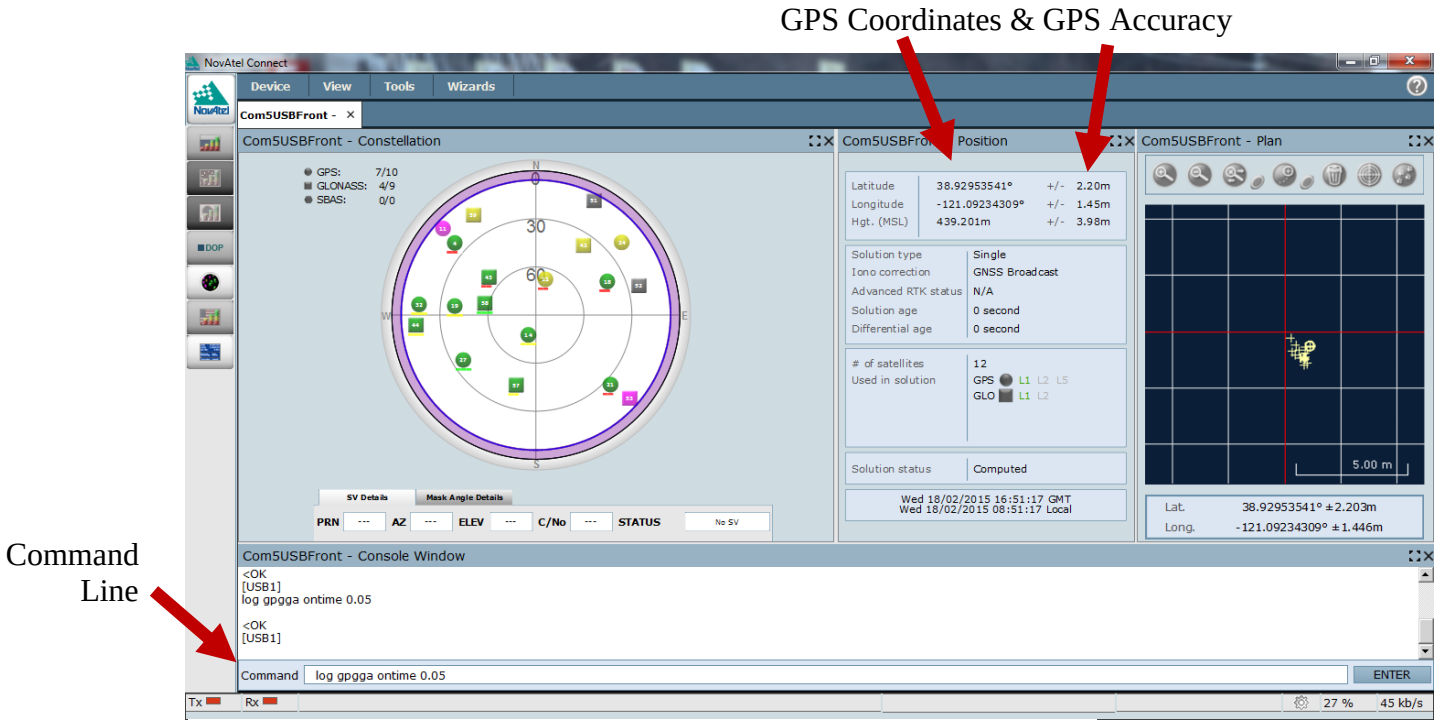



Figure 5: NovAtel Connect Main Window

When setting up a new receiver for Terrastar enter these commands. If the L-Band is not enabled the Terrastar subscription will not activate. To check if the L-Band is enabled use the LOG LBANDTRACKSTAT command and verify that there is a "00c2" in the results.

***When setting up a new receiver enter these commands in bold:***

1) UNLOGALL
    i. Stops all current logs the receiver is outputting.
2) UNLOCKOUTALL
    i. Unlocks all satellites.
3) ASSIGNLBANDBEAM AUTO
    i. Enables L-Band signal. ***Must*** be enabled for Terrastar; Verify with LOG LBANDBEAM command.
4) COM COM1 38400 N 8 1 N OFF ON
    i. Sets the baud rate for COM1 for serial (DB-9) use into SSI electronics.
    ii. Replace the COM1 with your COM port number.
5) LOG COMCONFIG ONCE
    i. Review your COM port settings.
6) LOG GPGGA ONTIME 0.05
    i. Instructs the receiver to start sending GPGGA GPS strings at 20 Hz (0.05).
7) SAVECONFIG
    i. Saves your settings. Now you may exit NovAtel Connect.

***To check the status of your Terrastar Subscription:***

LOG TERRASTARSTATUS

If Terrastar is enabled, the results of this log command will return "enabled" in the first column.

***Logging GPGGA String:***

SSI Profiler only reads the GPGGA string from the receiver. To set the GPGGA string and frequency:

LOG GPGGA ONTIME 0.05

Or if using COM1 (DB-9 serial) to connect to the SSI electronics you may send:

LOG COM1 GPGGA ONTIME 0.05

***To review the LBand status that the Terrastar signal uses:***

LOG LBANDTRACKSTAT

If the L-Band signal is connected you will see one of the columns displaying "00c2".

To exit NovAtel Connect, either close the program or choose close connection from the Menu Bar. NovAtel Connect sends a parse code to the receiver when it disconnects. To connect to GPS from within the SSI Profiler program, open Putty.exe and enter the settings from the COM port number for the operating computer. Select Connect.

There will be no information sent between the receiver and the computer at this time. To solve this enter into Putty (you will not see this entered on the screen):

LOG GPGGA ONTIME 0.1

Now the GPGGA strings will appear at a frequency of 10 Hz. Disconnect from Putty and you may now connect to GPS through external serial or USB within SSI Profiler.

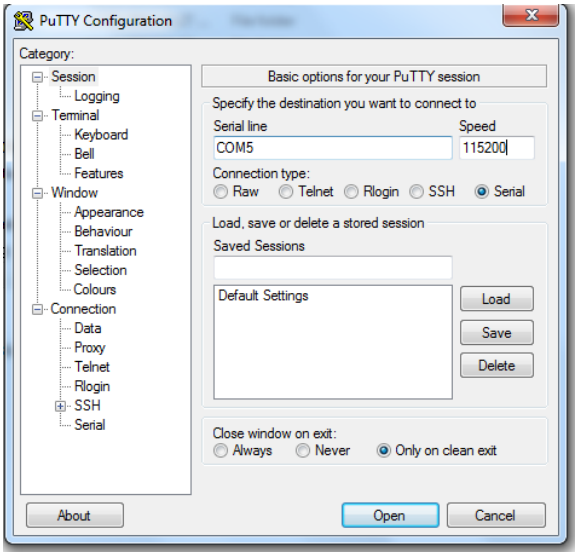



Figure 6: Putty Settings; Screen 1

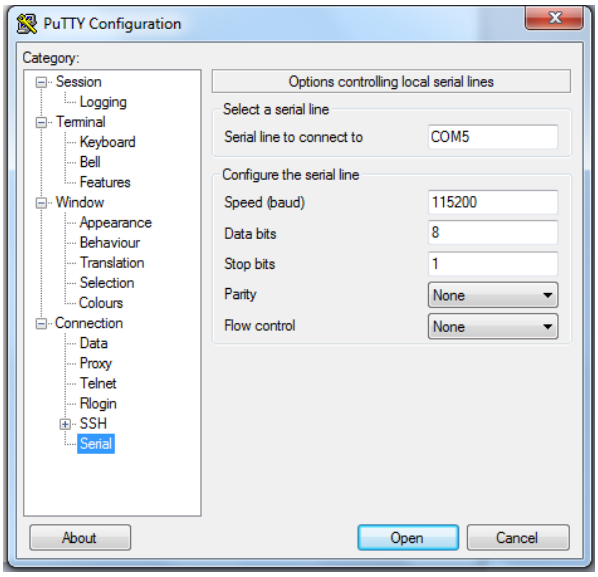



Figure 7: Putty Settings; Screen 2

## GPGGA String

The SSI Profiler program only reads the GPGGA NMEA string. This GPS coordinate string encloses information for the time, GPS coordinates, and the number of satellites and the GPS fix type. For Terrastar to work to its full ability the GPGGA string will have a correction factor of 5. Based on the string below the bold underlined number is the correction factor. This number 5 means that the PPP positioning is locked onto the Terrastar corrections.

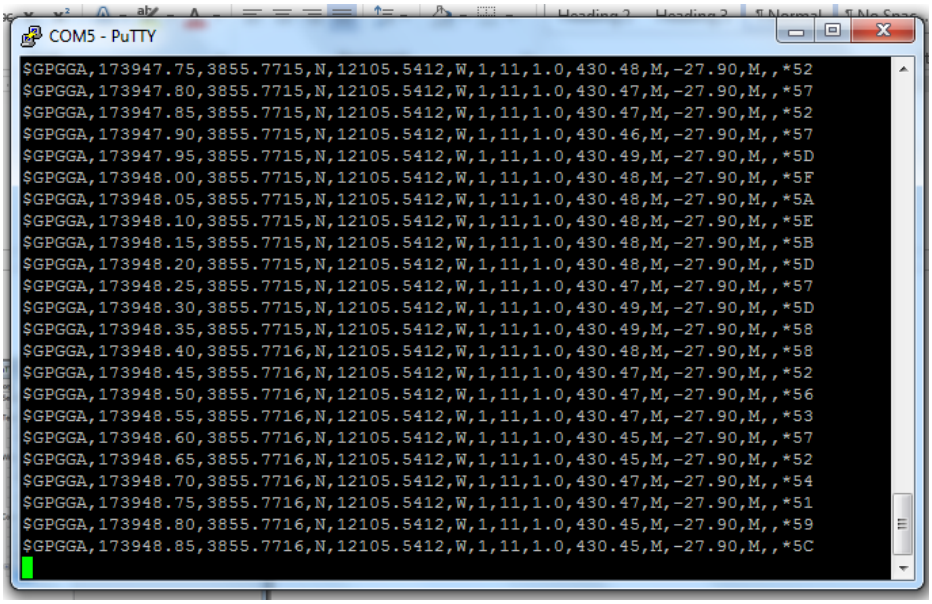



Figure 8: GPGGA output after sending GPGGA log command in Putty

Table 1: GPGGA GPS Fix Information

| Number | Type of Fix |
|---|---|
| 1 | DGPS Fix, Basic |
| 2 | DGPS, Basic Corrections |
| 3 | PPS Fix |
| 4 | RTK Fix |
| 5 | RTK Float; Terrastar Fix |

$GPGGA,231801.55,3855.7694,N,12105.5412,W,**5**,12,1.2,437.10,M,-27.90,M,,*55

***GPGGA String Components:***

$GPGGA, Time, Latitude (38N 55.7694'), Longitude (121W 05.5412'), Fix Type, Number of Satellites, Horizontal Dilution of Position, Alt. above Sea Level, Geoid Height (WGS84), Time Since Last Correction, DGPS Station Number, *Checksum

## Using the Grinding Tool

The grinding tool is located in the Trace View tab. Load the RSD file with the grinding locations saved to it (from the steps above) and view the shaded grinding regions. Under Plot Options the features that ***must*** be selected are:

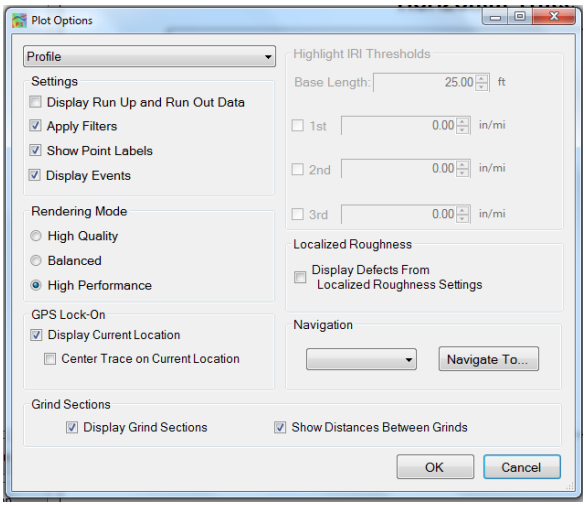
1) Display Current Location
2) Display Grind Sections

## Optional Features:

1) Center Trace on Current Location (for hands-free operation),
2) Display Distance Between Grinds,
3) Display Areas of Localized Roughness.

After the settings are applied within the Plot Options, select OK and refresh the trace graph. With Track 1 and Track 2 visible you will see three separate shades of color. The peach color is Track 1, the purple is Track 2 and the dark brown color will be the overlap of both Track 1 and 2.

Verify the type of GPS you are using under Settings>GPS Options. If a USB cable is used, select Toughbook and choose the COM port number that is displayed in the Device Manager. If the serial DB-9 is connected through the white housing electronics, leave the selection on Collection Device. For smooth movement, select "GPS Lock On-To Run" and "Interpolate Lock-On."
Note: If using a Toughbook GPS (USB) do not select Collect before discovering GPS. The Toughbook USB GPS will not be found if the SSI Profiler software is searching for hardware.




**Must Select:**

1) Display Current Location
2) Display Grind Sections

**Optional Features:**

1) Show Distances Between Grinds
2) Center Trace on Current Location

Figure 9: Plot Options

When the settings and options are selected, choose OK and refresh the Trace View graph to view the grind locations and the current position. To pan, zoom or fit the trace on the screen use the tools beneath the elevation trace.

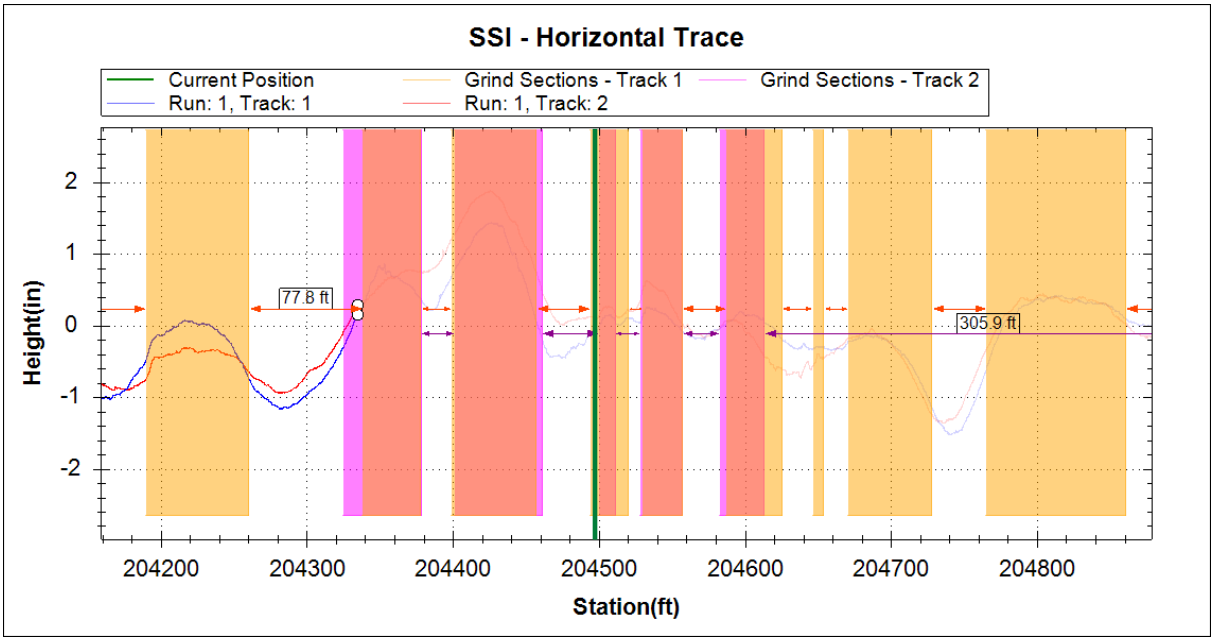



Figure 10: Grinding and layout during operation for Tracks 1 and 2

With the grinding areas for Tracks 1 and 2 imported and GPS connected the operation of this feature may begin.

**Notes:**

- GPS can drift with changes in the constellation or loss of signal. If signal is lost or position changes rapidly, wait for the GPS to find corrections and stabilize again.
- At the sign of any issues, closing the program and restarting usually resets the problem. (Make reloading simple by selecting Load Previous File in General Settings).

**Troubleshooting**

- ***Check Connection***
  Always make sure the USB or serial connection from the GPS receiver is secure. If the cable disconnects, reconnecting the cable should not introduce issues. The GPS receiver will still have power and will be sending its GPGGA string.

- ***GPS Accuracy Inquiries***
  If any doubt is with the GPS system, review the GPS offsets of the profiling machine, and open NovAtel Connect to review the output. See connecting to NovAtel Connect in the section above. Operator may have to restart GPGGA string through Putty after NovAtel Connect is opened.