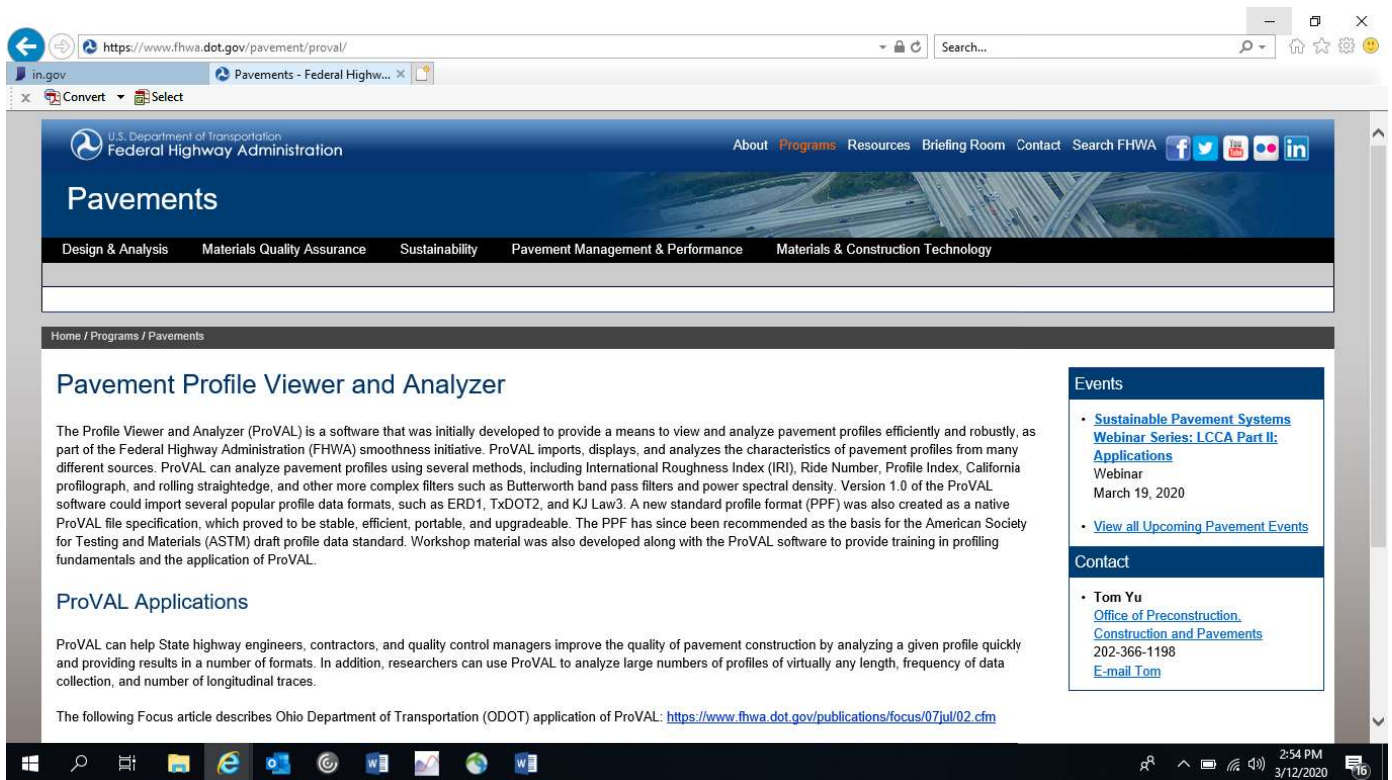# IRI Field Guide

(Areas of Localized Roughness – ALR)

*The steps in this Field Guide are intended to be completed by the contractor performing the high speed profile data collection. After preparing the files, analyzing the data, and generating reports in ProVal, all files are to be submitted to the PE/S for review. The PE/S will review the ProVal files and ALR reports as well as the contractors proposed corrective action plan. After a field review is completed by the PE/S, the guidance document in the appendix may be utilized to determine whether corrective grinding is necessary for each ALR area.

ProVAL Applications can be downloaded from FHWA website:

https://www.fhwa.dot.gov/pavement/proval/

1) Open up ProVAL by either going to the Start button -> All Programs -> FHWA -> ProVAL or typing ProVAL into the search bar located in the Start menu
(Windows 10)

or
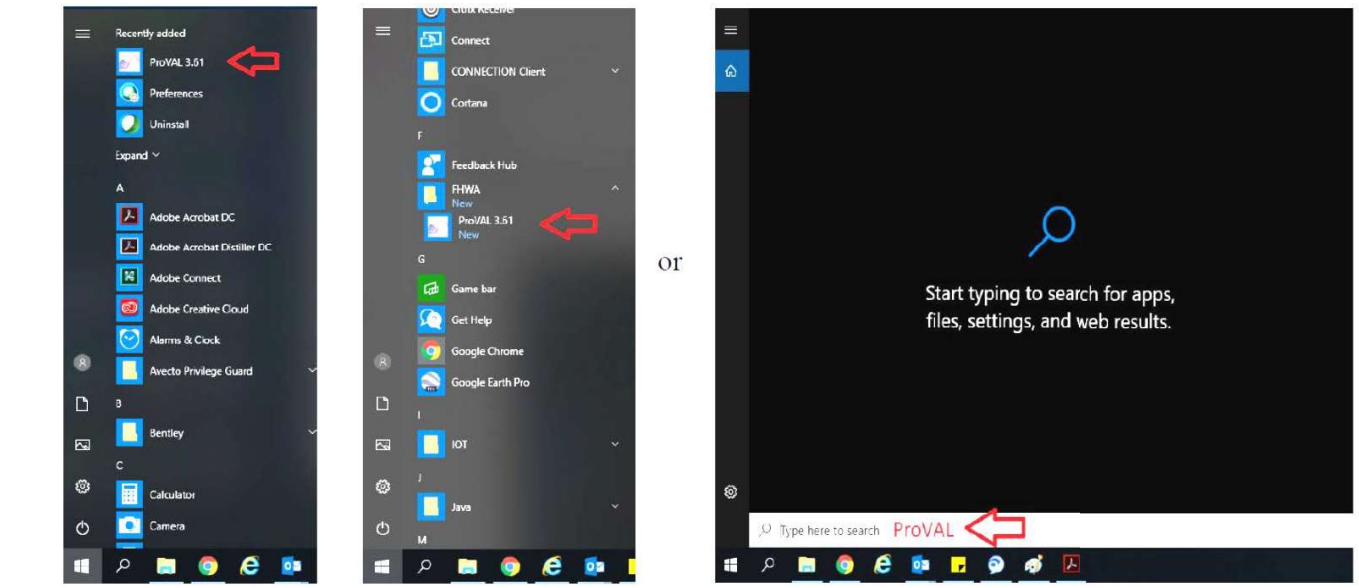
2) Select **New** to begin a new project file

3) The data file the Contractor has sent needs to be downloaded onto this project file. Select **Add Files** and browse the folders where you placed the Contractor's data file (window below is only an example of a folder location) and open it.
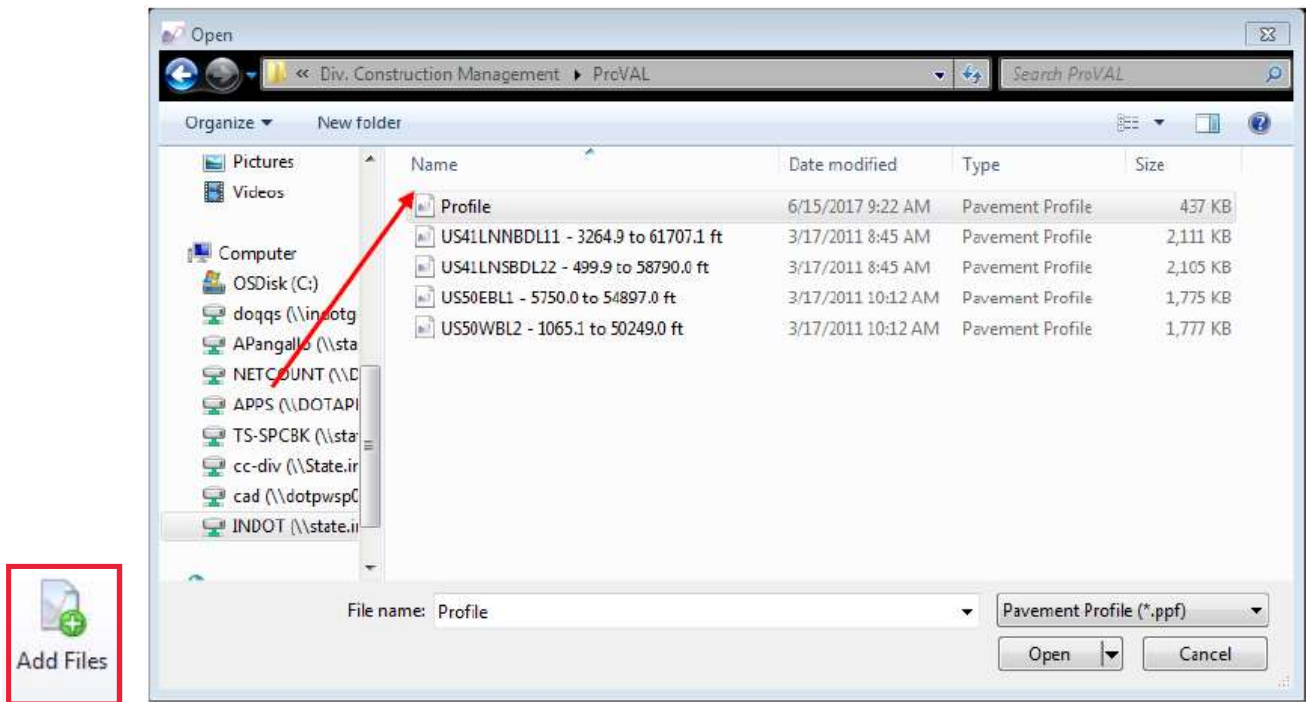
As more data is received, additional files should be added to this one project file to represent all the IRI testing for a contract.

4) A data file will automatically begin in the Viewer pane. Each file will have two checkboxes for left and right wheel path readings. Clicking on these checkboxes will display the IRI readouts for the Section tested. The x-axis is listed in feet starting at 0 feet and up to the distance measured by the inertial profiler.
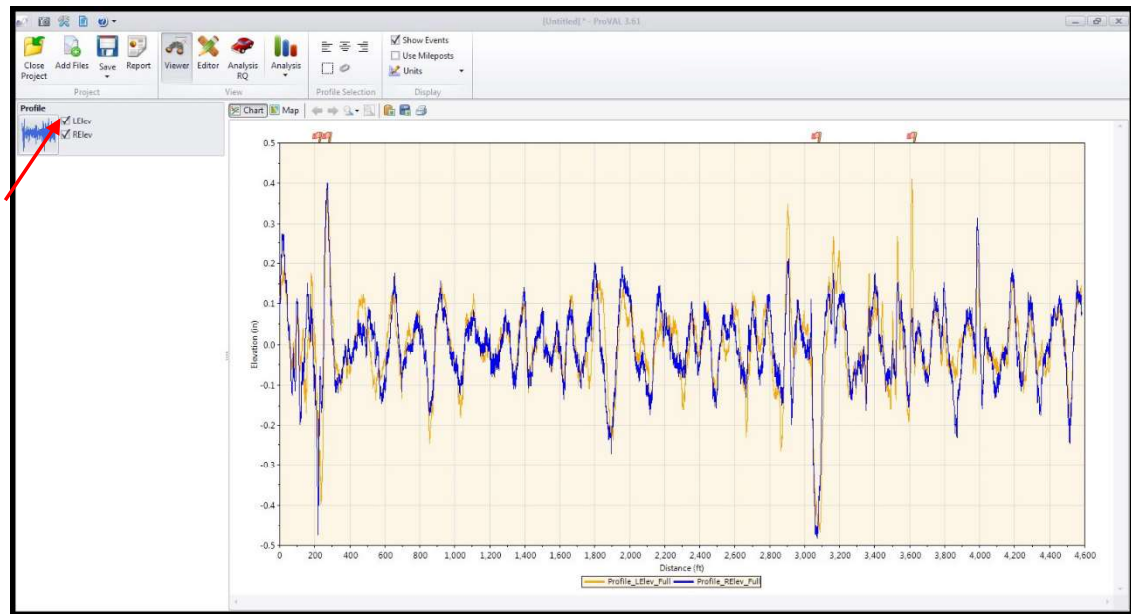
5) Next, the section needs to be identified for analysis. Not all sections start at 0 feet as can be seen above in the example. The starting feet on this graph needs to correspond with a station that represents the start of paving. To identify the section, select the Editor icon. Now select which file you want to use from the File dropdown.
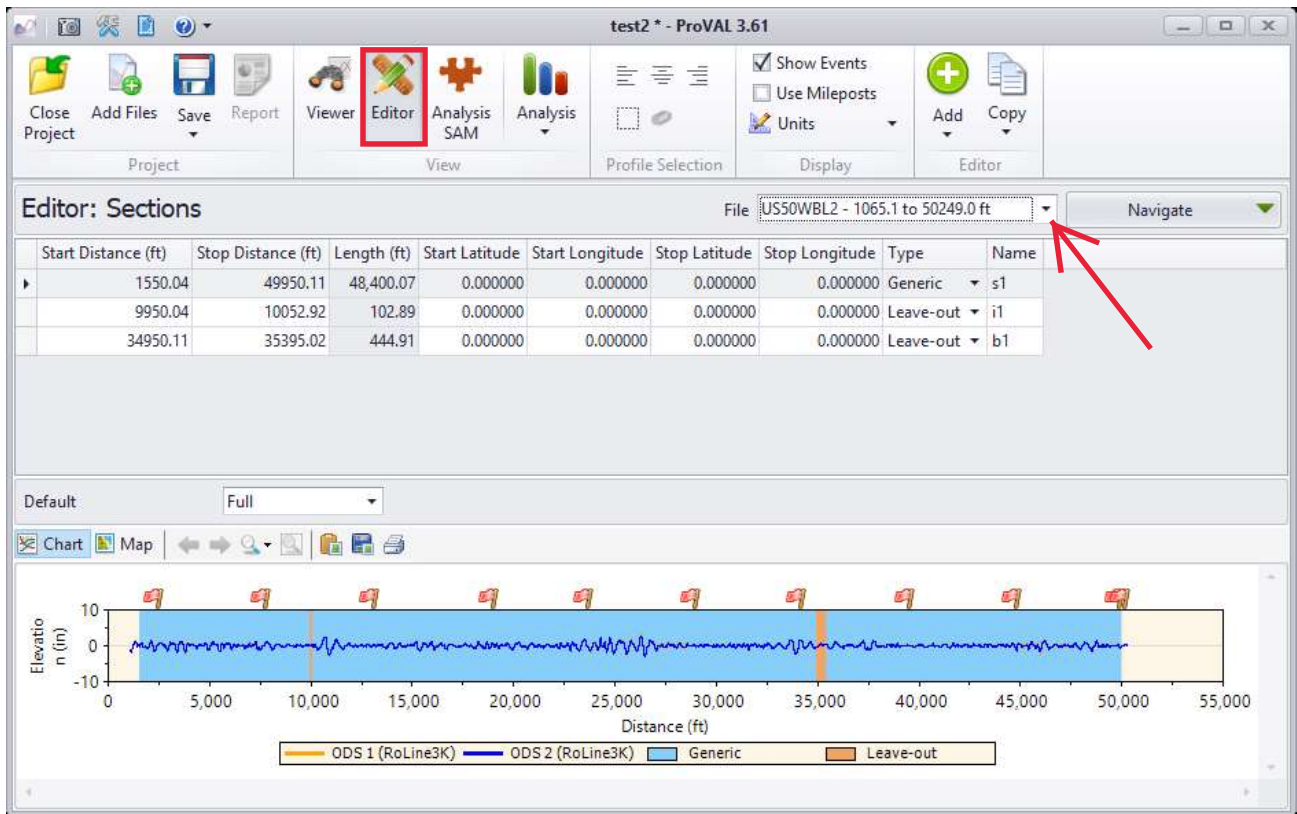
6) Once the file is selected, you will notice the IRI results appear as they did on the Viewer pane. Click the Navigate dropdown to the right of File dropdown and select **Sections**. Next, click the **Add** button and provide a meaningful name that helps identify this exact section (Line/Direction/Lane/etc.).
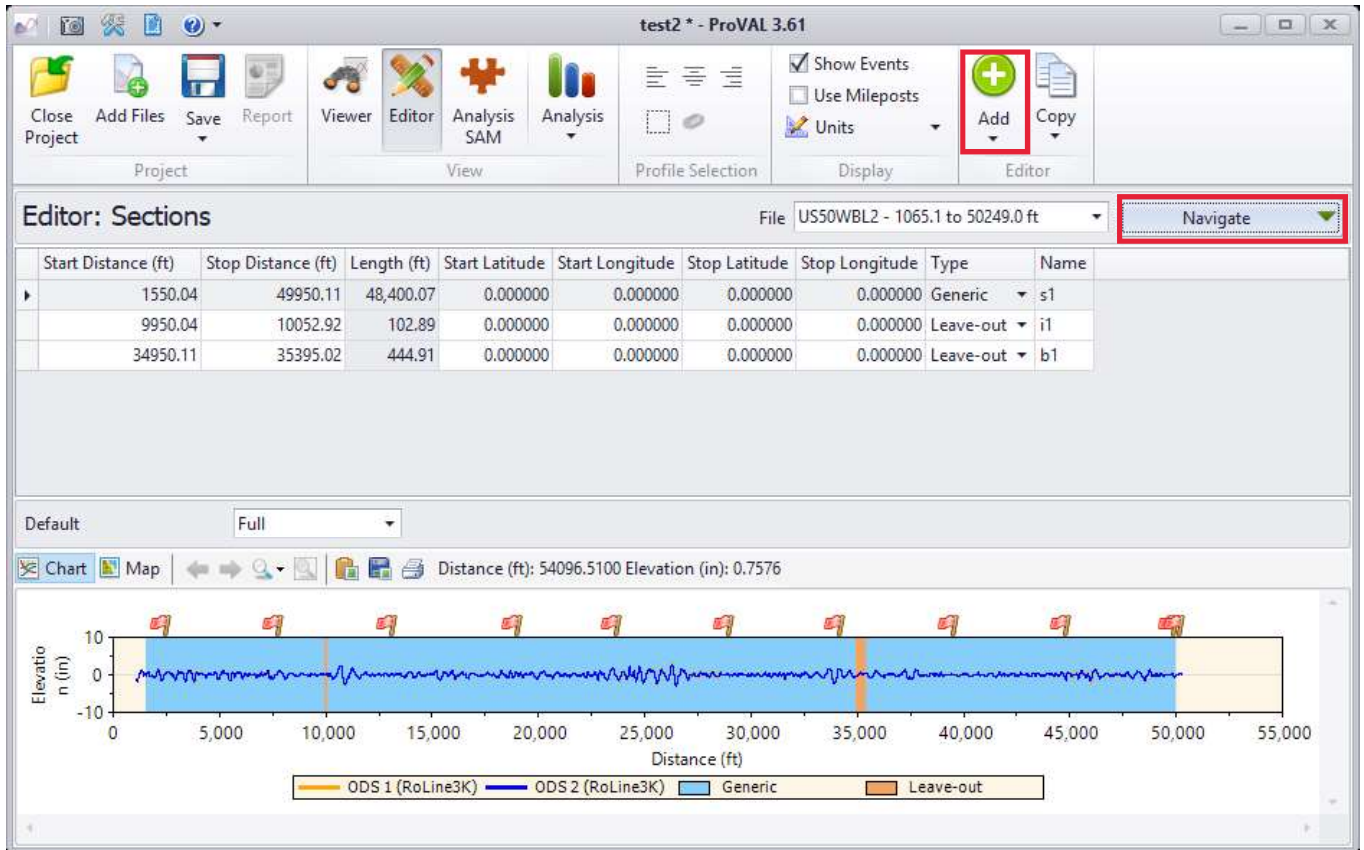
7) Provide the Start Distance and Stop Distance at which the Surface was measured for the contract. The distances will not always match up to your typical section stations. For example, the inertial profiler started taking measurements 500' before the construction limits and ended up 500' past the construction limits on the other side of the contract. The total distance measured was 4600'. The starting station for paving is 0+00. That means distance 500'would be station 0+00 since the inertial profiler started measuring 00' before the paving limits. One of the exceptions for the inertial profiler is the first and last 50' of paving. Therefore, the start Distance would be 550' and the Stop Distance would be 4050'. You will notice the blue shaded area will now shrink to the limits entered.
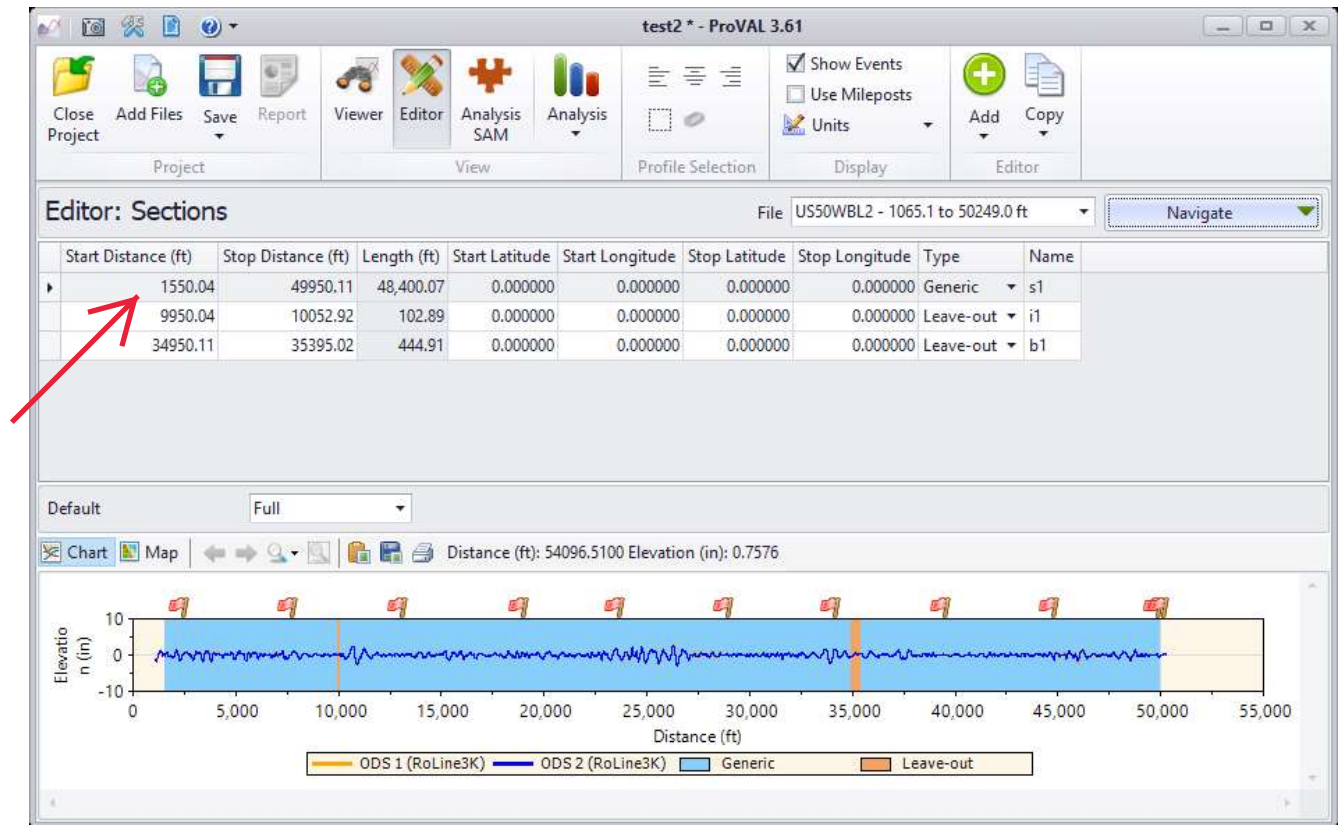
Red Flags can be seen right above the graph. These red flags represent **Events**. Events are usually accompanied by spikes in IRI because of a bridge, casting, railroad crossing or other feature that would cause a bump unrelated to the actual pavement. ITM 917 describes these and exempts 50' before through 50' after these features from measurement. The contractor should help identify these locations which should already be marked in the file before you receive it.

8) Once these exceptions are identified, these areas need to be excluded from measurement. Click Add button within Editor and provide a name that describes the exception such as STR 111 for a bridge. The Start Distance should be 50' before and then the Stop Distance should be 50' after the end of the feature. For example, there is a bridge that is 160' long with 20' approaches and the first approach begins at 3100'. The Start Distance should be entered as 3050' and the Stop Distance should be 3350'. The only difference between this section and the previous section is the selection for the dropdown under the Type column. Select **Leave-Out**.
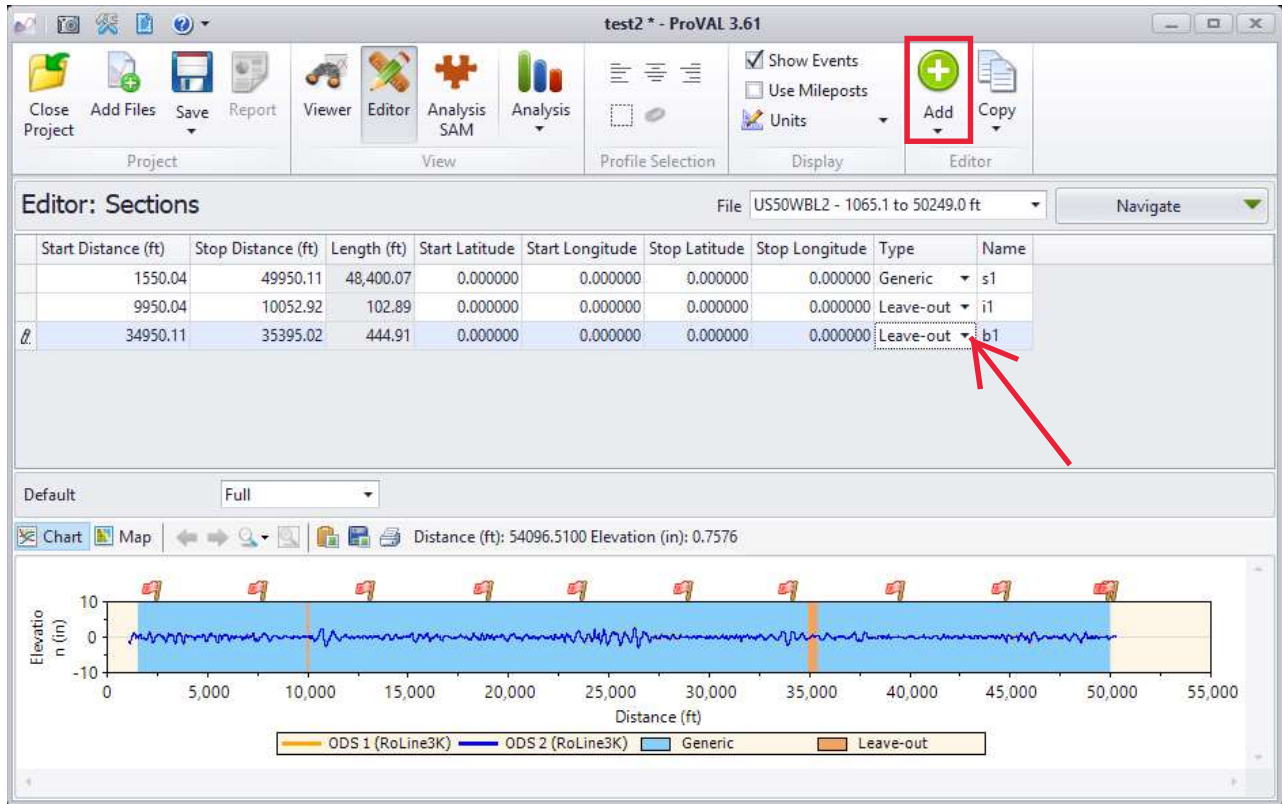
You will notice that the bridge can be seen as the orange shaded area. This area will now be excluded from IRI analysis. Repeat this process for all exceptions located within the section.

9) Now it is time to analyze the Section for Areas of Localized Roughness (ALR) and determine locations with roughness in excess of 160 in/mi that require corrective grinding work. Click the **Analysis** button and select **Smoothness Assurance** from the dropdown.
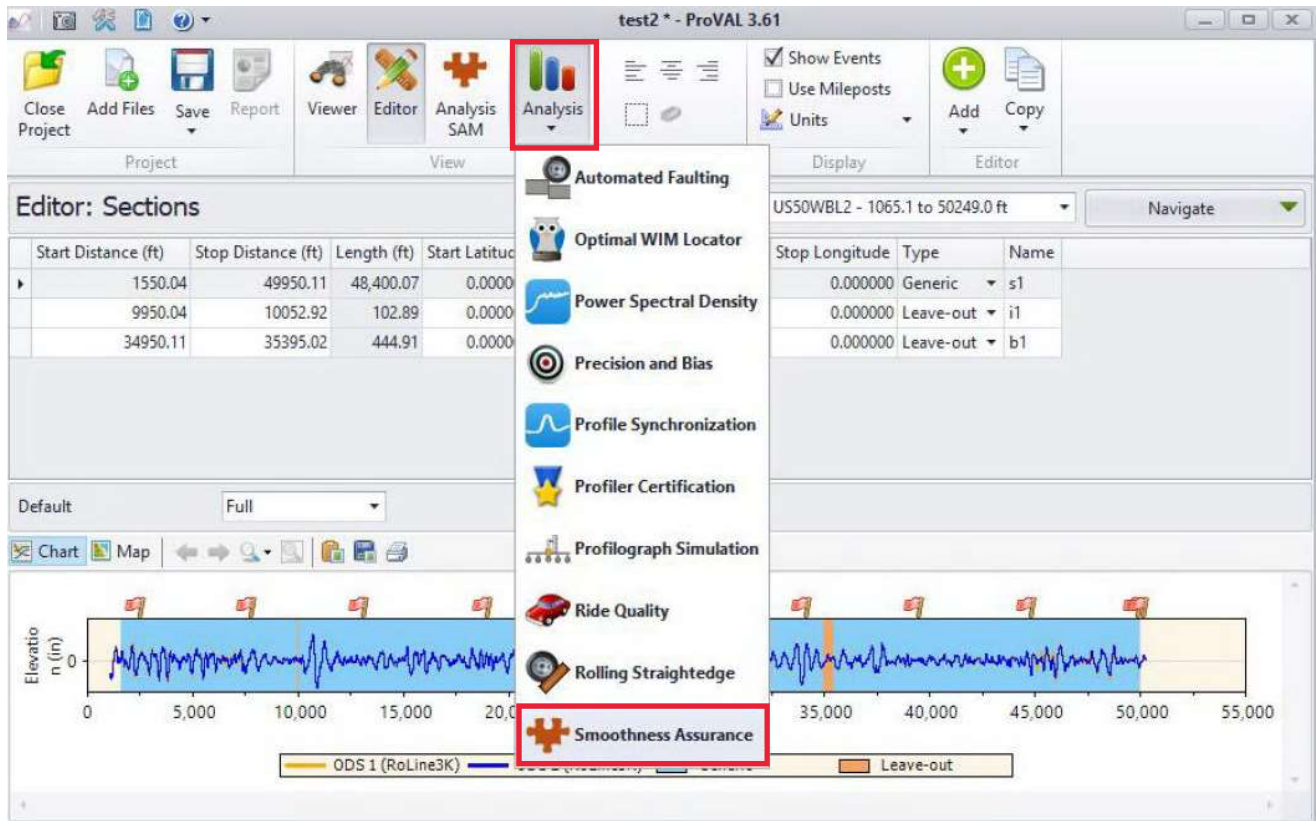
10) For (ALR) a continuous measurement with a 25 ft interval will be used for analysis with 160 in/mi being the threshold for correction action. To Set these parameters, you only need to be concerned with the Short Continuous row on the Ride Quality Table. The Segment Length is already set at 25 ft so no change is required there. Under the threshold column, **enter 160** for the value for **Short continuous**. **Histogram** on the Short continuous row can be left at default settings so no change is required there either.
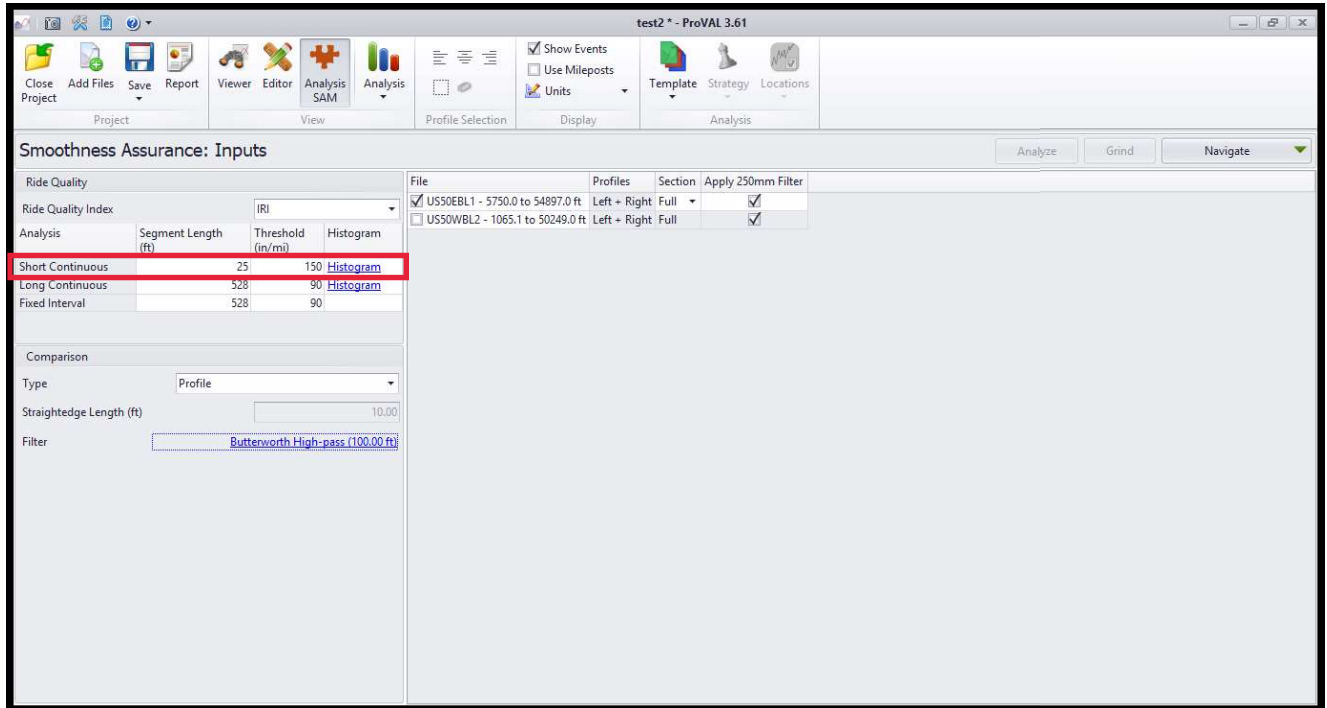
11) Notice just below the Ride Quality table is a Comparison. This tab will not change the IRI measurement but may help interpret the IRI data. Select **Profile** for the comparison type, then select the blue lettered filter type which will bring up the **Filter options**. Select **Butterworth High-pass** and input Wavelength(ft) of 100 ft as shown below.
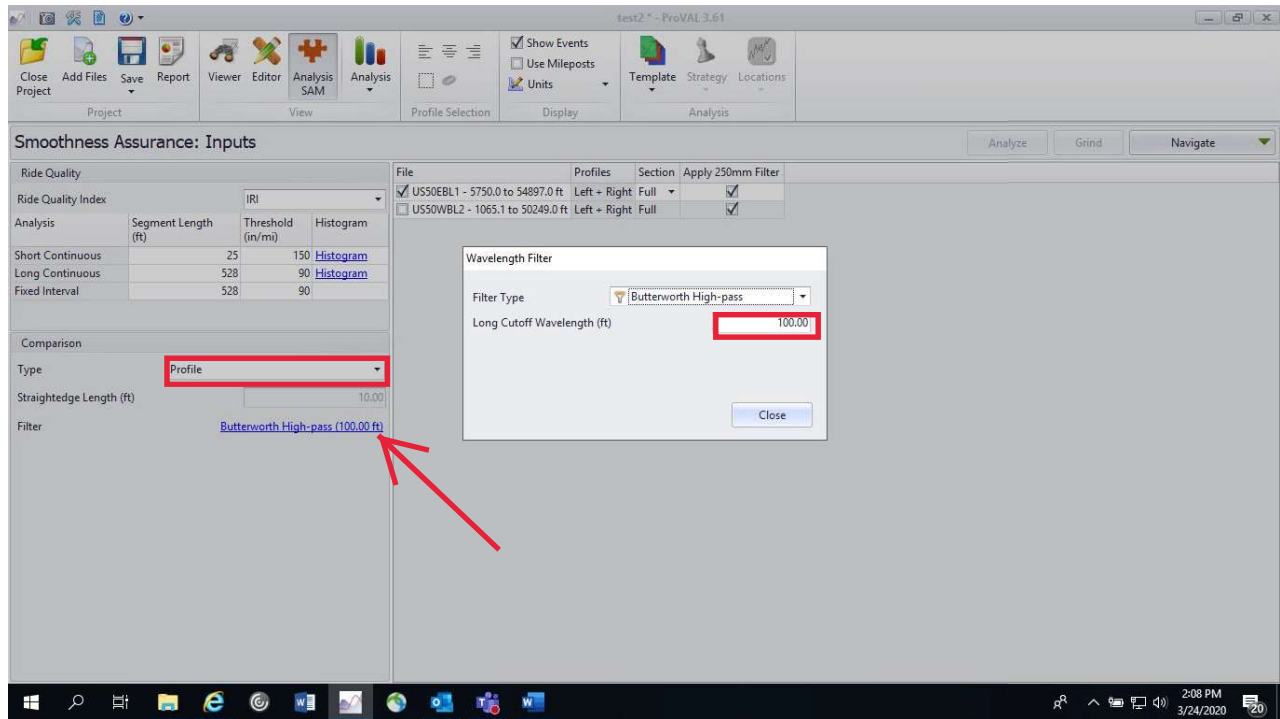
12) Now that the Short Continuous Analysis has been set to meet the specifications and the comparison type and filters have been selected, check the file and select the Section from the dropdown as seen in the screenshot. Also select to **Apply the 250 mm Filter** as shown. Click the **Analyze** button in the top right.
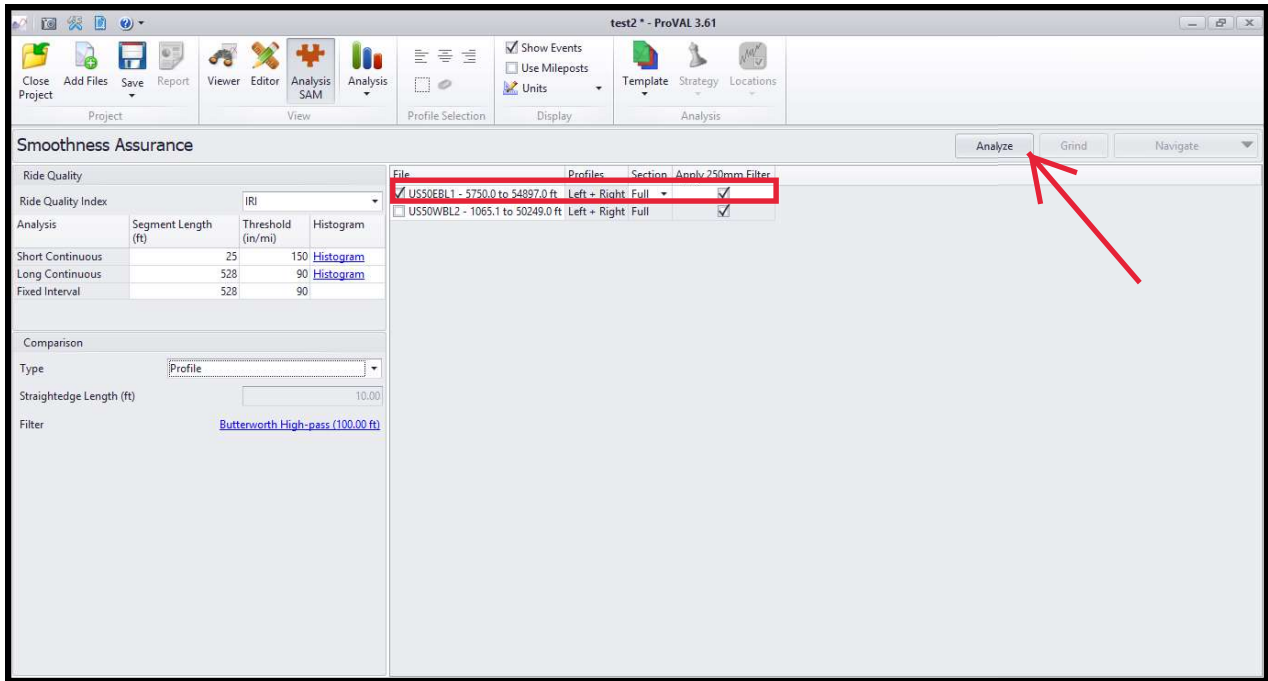
13) After the analysis is complete, select the **Navigate** button which will bring up a dropdown list then select **Left Profile -> Short Continuous** as shown below. Repeat for the **Right Profile -> Short Continuous** viewing as well in the same manner.
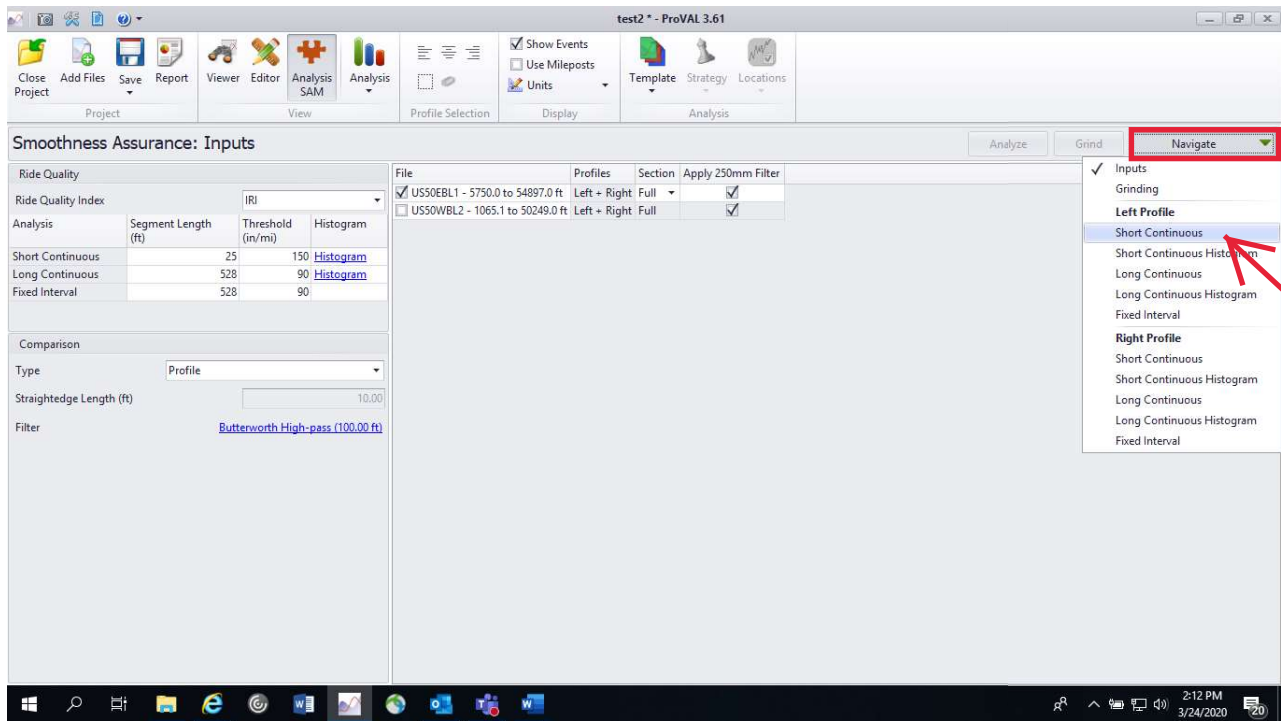
14) The **Smoothness Assurance: Short Continuous – Left Profile** should be visible as shown below. At this
point the upper graph window of the IRI (in/mi) vs Distance (ft) on the left gives a visual indication of
every location that requires grinding which exceeds the red solid line threshold located at 160 (in/mi).
The chart to the left provides a numerical tabulation of the same information.
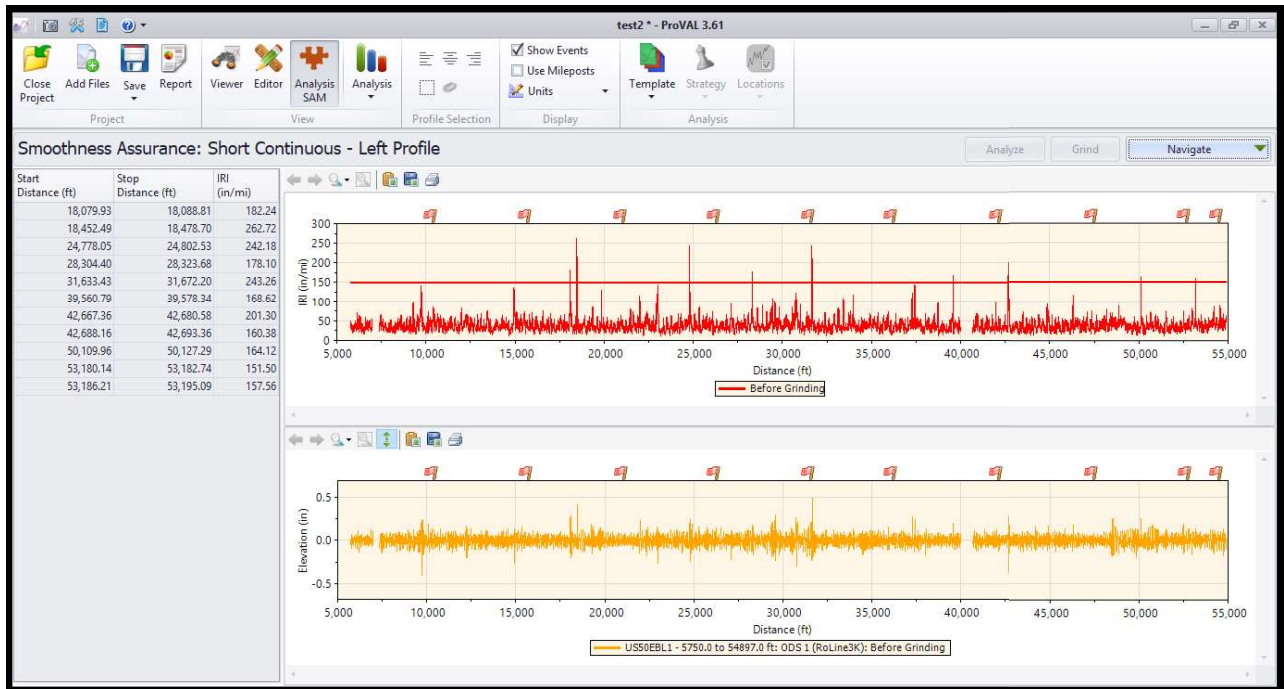
15) The final report of the results may be downloaded by selecting the **Report** button in the top right pane. A pdf of the report may be selected under Summary reports by clicking **PDF** or an excel version of the report may be selected by clicking **Excel**. Once PDF or Excel has been selected then click **Create** and the Report will be generated and may be saved to your computer. The engineer may need to correlate the distances shown to project stationing prior to providing the report to the contractor for grinding depending on the start station utilized during set up of the high speed profiler and ProVal editing of the files at the beginning.
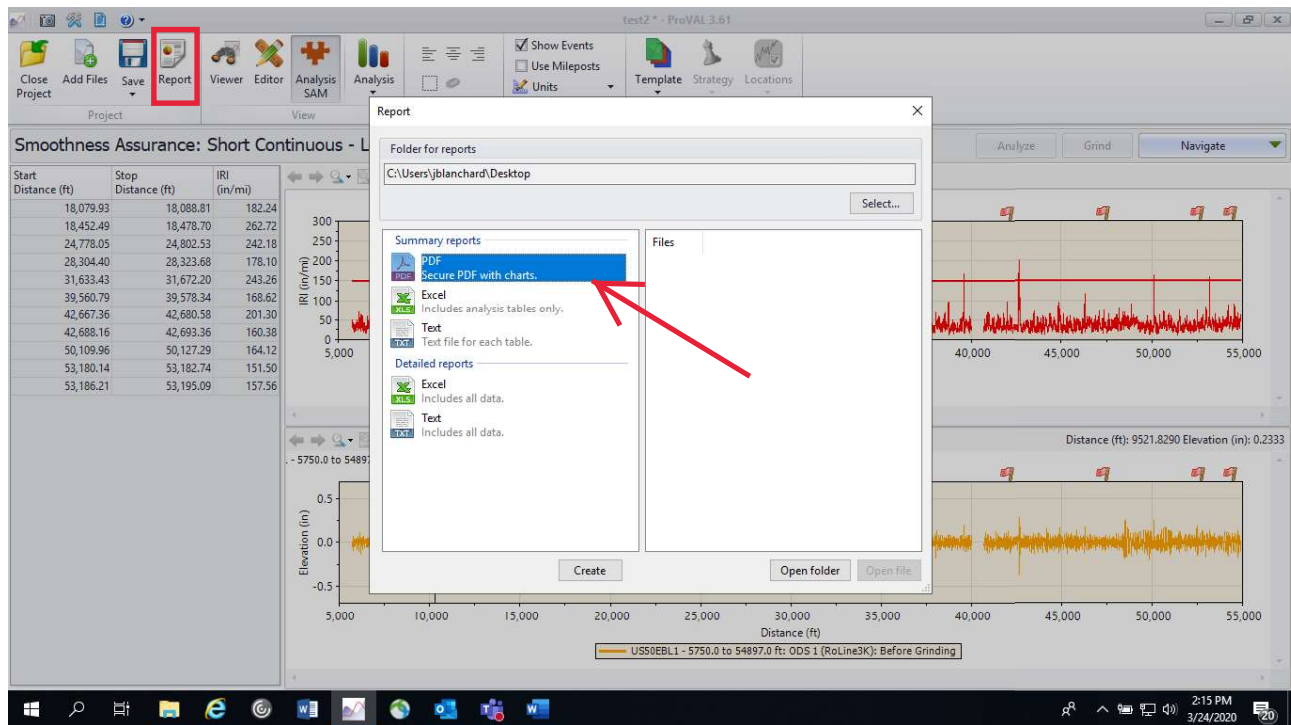
16) Below examples are information that should be shown in the PDF report, which can be used to determine ALR grinding locations. The **Defects before grinding** table on the next page is the summary information that should be utilized to locate grind locations in excess of 160 in/mi. Other information in the report shown this page may be useful to the PE/PS for review purposes.

Analysis: Smoothness Assurance

Selections

File	Section	Apply 250nm Filter
US50EBL1 - 5750.0 to 54897.0 ft	Full	Yes

Leave-outs

Start Distance (ft)	Stop Distance (ft)	Length (ft)	Name
7,000.072	7,349.892	349.819	b1
40,000.072	40,657.906	657.834	b2

Left Profile
Short Continuous

Segment Length (ft): 25.00
Threshold (in/mi): 150.00

Before Grinding
Total Percent Out of Spec (%): 0.38
Total Distance Out of Spec (ft): 182

Max IRI (in/mi)	Min IRI (in/mi)	Before Grinding (%)	Before Grinding (ft)
∞	85.00	1.99	958
85.00	80.00	0.36	172
80.00	75.00	0.41	195
75.00	70.00	0.70	338
70.00	65.00	1.37	659
65.00	60.00	2.34	1,125
60.00	55.00	4.00	1,924
55.00	50.00	6.48	3,116
50.00	45.00	8.76	4,211
45.00	40.00	12.25	5,889
40.00	35.00	15.70	7,550
35.00	30.00	18.32	8,805
30.00	25.00	15.32	7,365
25.00	20.00	8.95	4,302
20.00	15.00	2.81	1,350
15.00	10.00	0.25	118
10.00	5.00	0.00	0
5.00	0.00	0.00	0
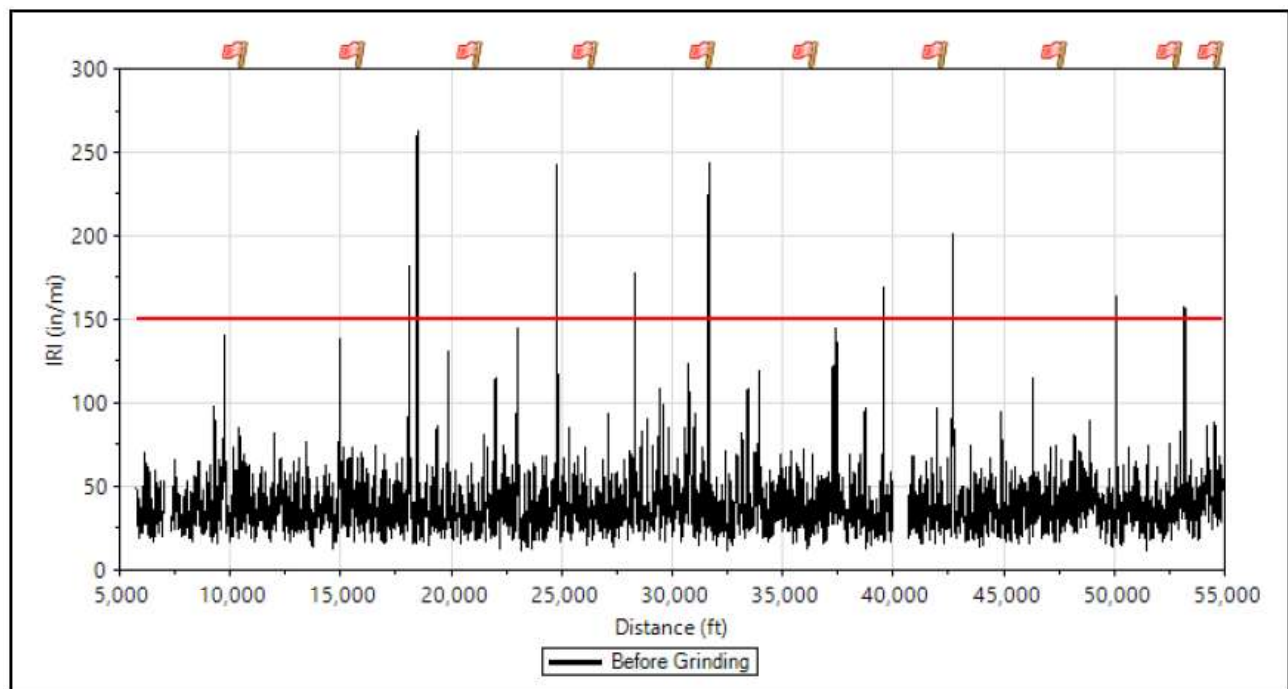
Defects before grinding

Start Distance (ft)	Stop Distance (ft)	IRI (in/mi)
18,079.93	18,088.81	182.24
18,452.49	18,478.70	262.72
24,778.05	24,802.53	242.18
28,304.40	28,323.68	178.10
31,633.43	31,672.20	243.26
39,560.79	39,578.34	168.62
42,667.36	42,680.58	201.30
42,688.16	42,693.36	160.38
50,109.96	50,127.29	164.12
53,180.14	53,182.74	151.50
53,186.21	53,195.09	157.56

17) Locating ALR corrective areas in the field may be aided by the use of the map function within ProVal. To view the map of corrective areas, go back to step 14 of this document "Smoothness Assurance - Short Continuous Profile" and **click on the map button** on the tool bar just above the upper window as shown below. After you click on the map button, the chart view of the profile of IRI vs distance will be replaced by the map view shown below. On the same toolbar just above the map, **click on the zoom button** to zoom in on the ALR locations which will be shown in red. **Move the mouse over each** location, and as you do notice the box that opens up with start and stop location as well as IRI roughness data. You can continue to move from location to location by zooming in and out; and also by clicking and holding with the mouse while at the same time moving the mouse forward or backward. (Note: if the map button is not shown on your toolbar, it may be that the equipment the contractor used was not GPS enabled which means it is not meeting contract requirements)
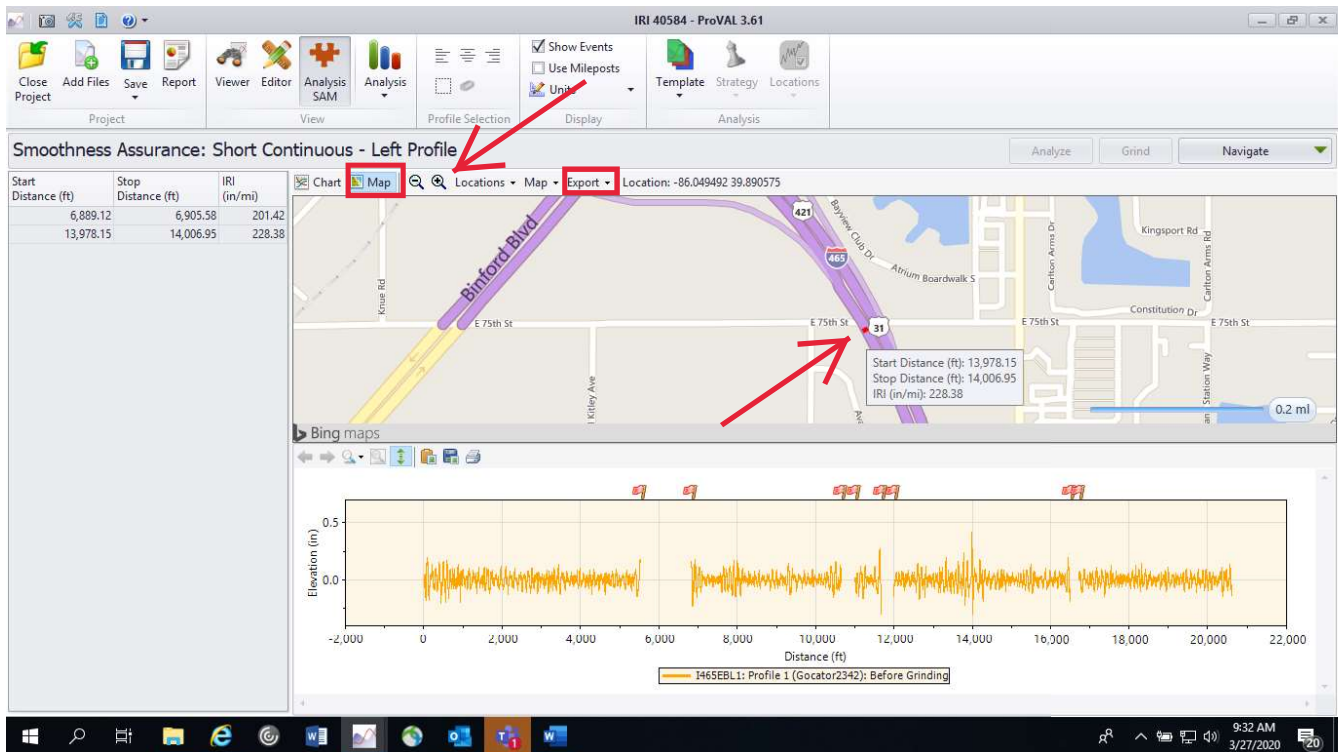
Note: The map image shown in the window can be exported by **clicking the export button** on the same toolbar and **selecting save image**, the current zoomed view is what will be exported as an image. You could choose to zoom in on each location requiring ALR shown on the map in red and export an image file for each; then print each image to pdf and combine the pdf files into a single document for use in the field. Another option is to **select copy image** instead of save image, and then paste each image into a Microsoft Word document. Every Location could then be summarized in the Word document with start/stop distance and IRI data followed by a mapped location moving systematically from start of project to end of project. (There may be other ways to utilize the export data as well not explained here.) This information can then be printed and provided to inspectors and contractors involved in the locating and grinding corrective areas, or it could be utilized by sharing electronically only.

APPENDIX A

ALR Guidance for PE/PS – Data Confirmation & Engineer Decisions on Grinding (HMA Surface Level Review)

1. Receive ALR ProVal analysis and ProVal files from Contractor; ProVal analysis should include locations requiring corrective action.
2. *Review Contractor ALR ProVal analysis to ensure completed in accordance with IRI Field Guide for ALR.*
3. Review ALR locations utilizing GPS mapping function in ProVal in preparation for driving the project. Utilize the distances and lengths shown in the ProVal report tied to field located anchor points rather than project stationing in order to locate bumps. An anchor point is a known location that corresponds to the high-speed profile distances and lengths such as the start and end points of the run or known bridges, railroads, or intersections within the run. Anchor point data such as a bridge may be found in the ProVal software under the editor module as a "section" that has a "leave out" and is in orange.
4. Drive the project in a vehicle at the speed limit and check off whether or not each ALR location can be "felt" or "found" with goal of deciding if ALR data is valid. (Note this is not to determine whether locations require corrective grinding but rather to confirm that the profile data is valid)
5. After review of all ALR locations in the field, determine how many locations could not be felt. If the % of locations that could not be felt is:
   a. Less than 10%; proceed to step six, or
   b. 10% or more; either consider the data bad and notify the contractor to run the same section again and repeat the overall process or contact the area engineer for further assistance. (Determination will need to be made as to the cause: equipment or operator error, filtering error, DMI or GPS error, etc.)
6. After ALRs have been validated as noted herein, a grinding simulation in ProVal should be performed by the contractor to see if the ALR can be corrected to an IRI value of less than 160 in/mi (Type A) or 170 in/mi (Type B) with no more than a ¼ in max grind depth at any spot. If the noted correction is not possible, then an ALR with an IRI value of less than 190 in/mi can remain uncorrected and an ALR with an IRI value of greater than 190 in/mi will require full depth removal and replacement of the surface course in accordance with the specification. However, if there is only one ALR in any two-lane mile section, then no smoothness correction will be required if the ALR does not exceed 190 in./mi and the overall segment smoothness of the two-lane mile section does not require any corrective action for segment smoothness in accordance with the specification. Contact the Area Engineer and Field Engineer for assistance as needed.
7. As a final check prior to performing corrective action, ensure that all exemptions noted in the specification and ITM 917 have been excluded.
8. Proceed with corrective action.

9. After completion of ALR corrective action, the contractor will perform a check run with the high-speed profiler and confirm that IRI values were brought to within an acceptable range. However, the check run will not be required if the overall segment smoothness for the contract was consistently at MRI of 90 in/mi or less and the total number of ALR corrective locations was less than 5 on the contract.
10. Prior to requesting multiple rounds of corrective action work of a Contractor, review the remaining ALR areas of concern with the Area Engineer to determine if further corrective action will achieve results.