

INNOVA ENGINEERING HOLE CLEANING GUIDE

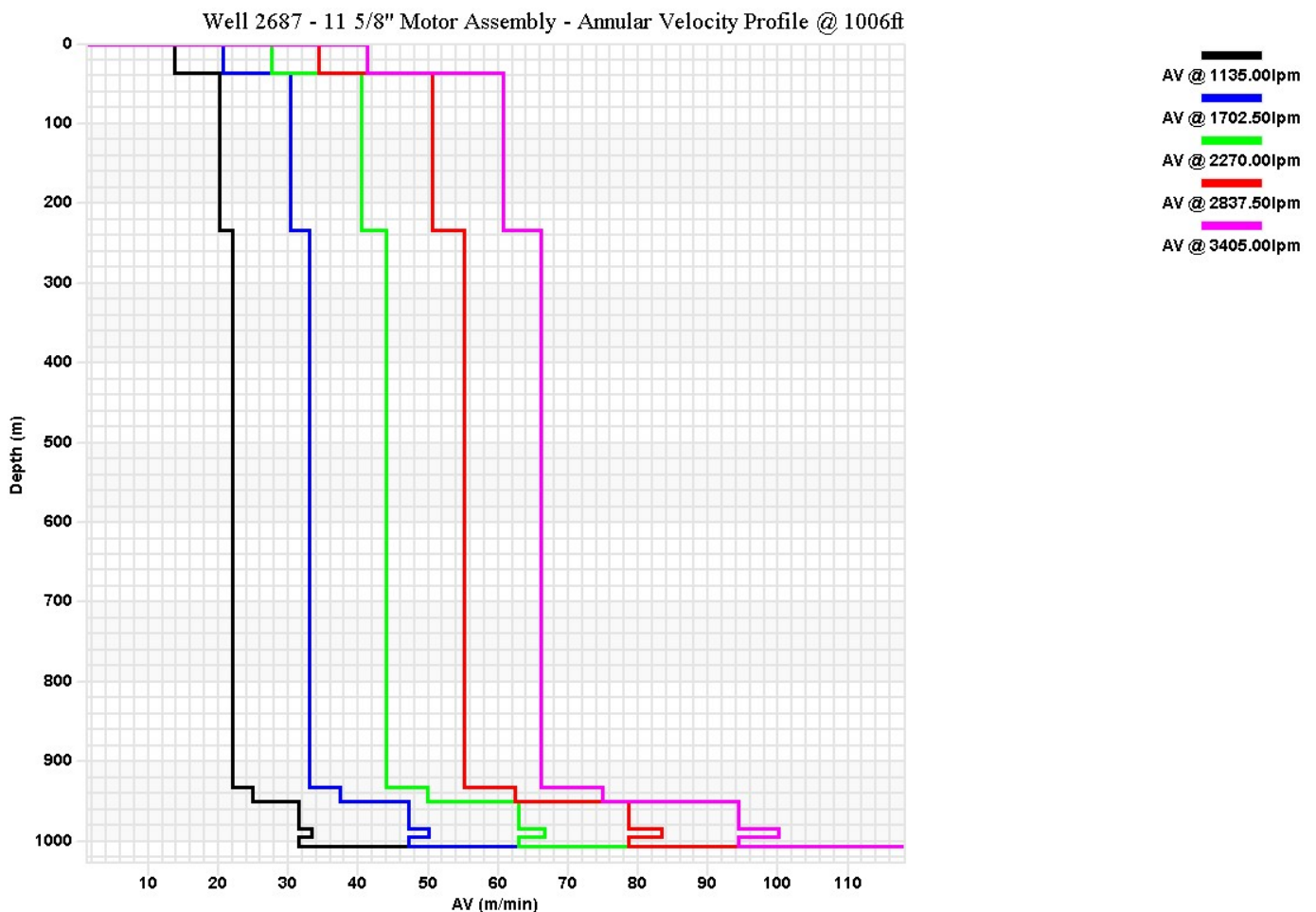
In the Hydraulics Module of Innova's Engineering software, there are 4 plots dedicated to hole cleaning. This document is a guide to these plots and how to interpret the results.

Once a hydraulics calculation has been run, you can check the hole cleaning charts by going to: **Hydraulics Results - Hole Cleaning**.

Annular Velocity Profile Plot

Flow rate is the dominant factor in cuttings removal while drilling directional wells. An increase in flow rate will result in more efficient cuttings removal under all conditions. However, how high a flow rate can be increased may be limited by:

- The maximum allowed ECD
- The susceptibility of the openhole section to hydraulic erosion
- The availability of rig hydraulic power



This is a snapshot chart and shows the Annular Velocity at all different points in the wellbore when the assembly is at a given depth for various different flow rates.

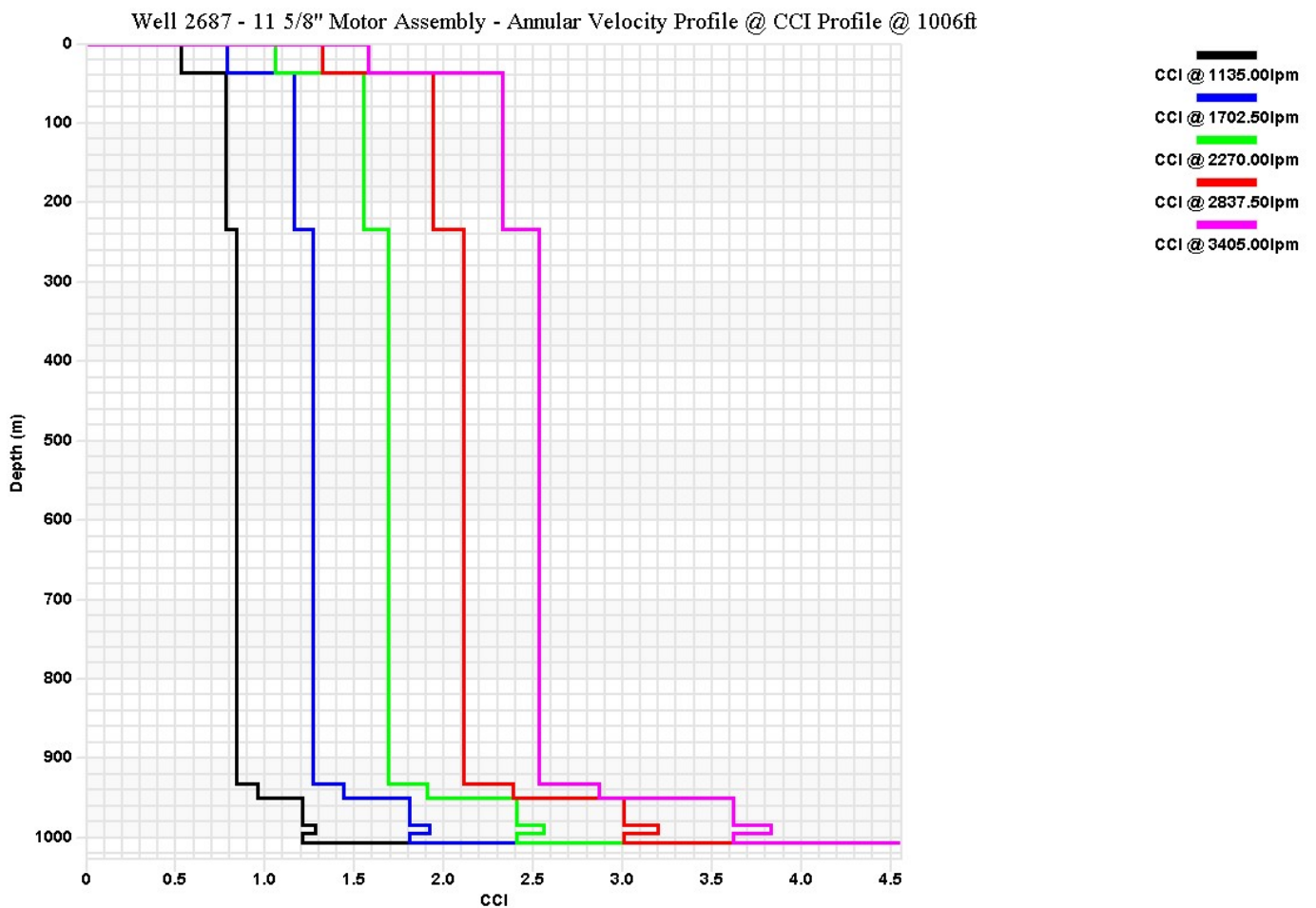
CCI (Cuttings Carrying Index) Plot

CCI (Cutting Carrying Index) is a measure of how clean a vertical (0-35° inc) well is.

- 0.5 or less and hole cleaning is poor & problems may be seen
- Greater than or equal to 1.0 indicates good hole cleaning

Annular Velocity and Mud weight (along with PV & YP values) are used in this calculation.
The higher the annular velocity, the higher the CCI.

For sections of the wellbore where the inclination is greater than 35°, hole cleaning should be evaluated using the Cuttings % Plot.

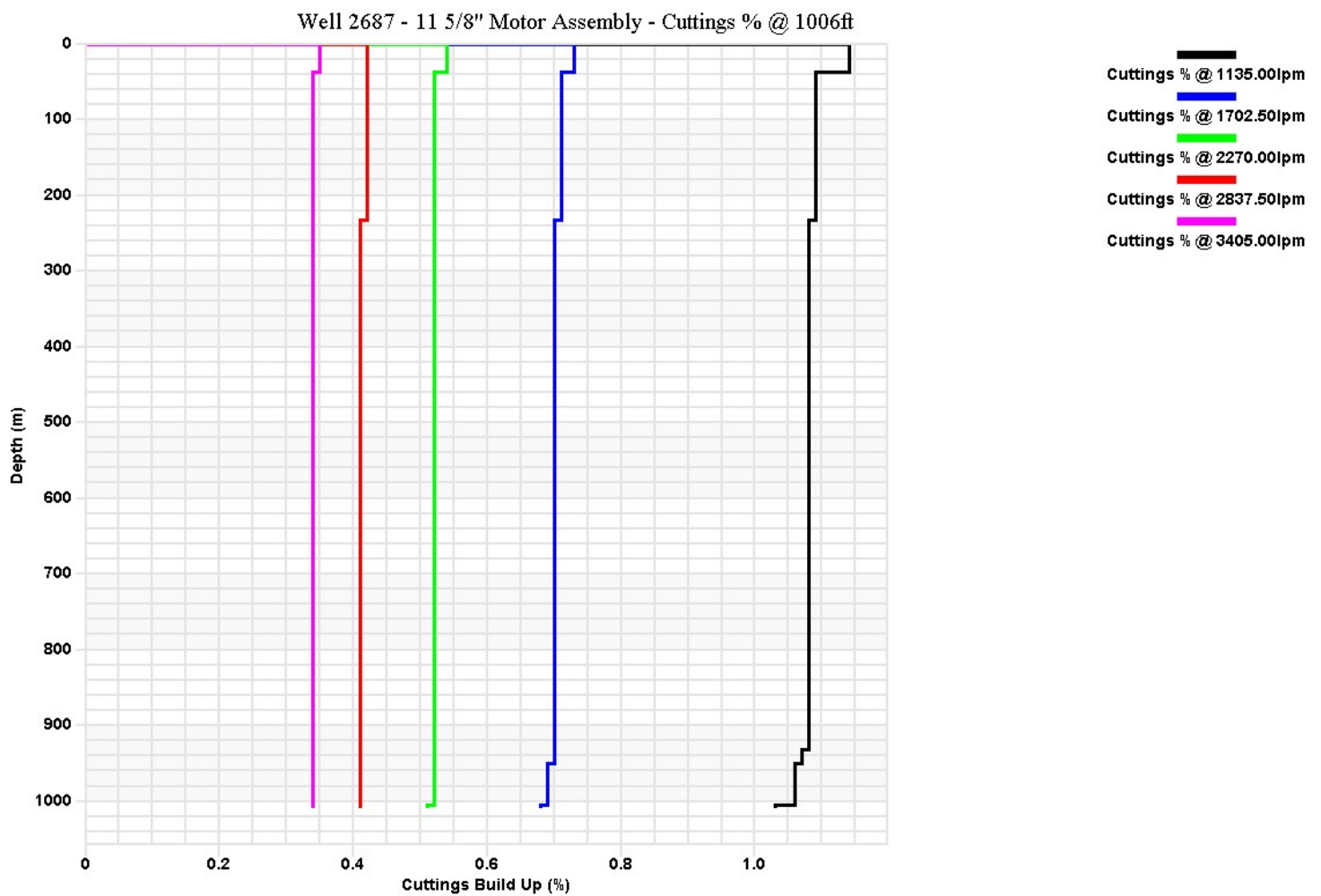


This is a snapshot chart and shows the CCI at all different points in the wellbore when the assembly is at a given depth for various different flow rates.

Cuttings % Plot

The Cuttings % plot represents the percentage of the annulus which is taken up with cuttings. Anything above 5% should be considered a problem.

Unlike the CCI plot, this measure of hole cleaning is not limited by inclination and can be used for any well profile. This calculation is also affected by ROP. Increased ROP, increases the cuttings %.



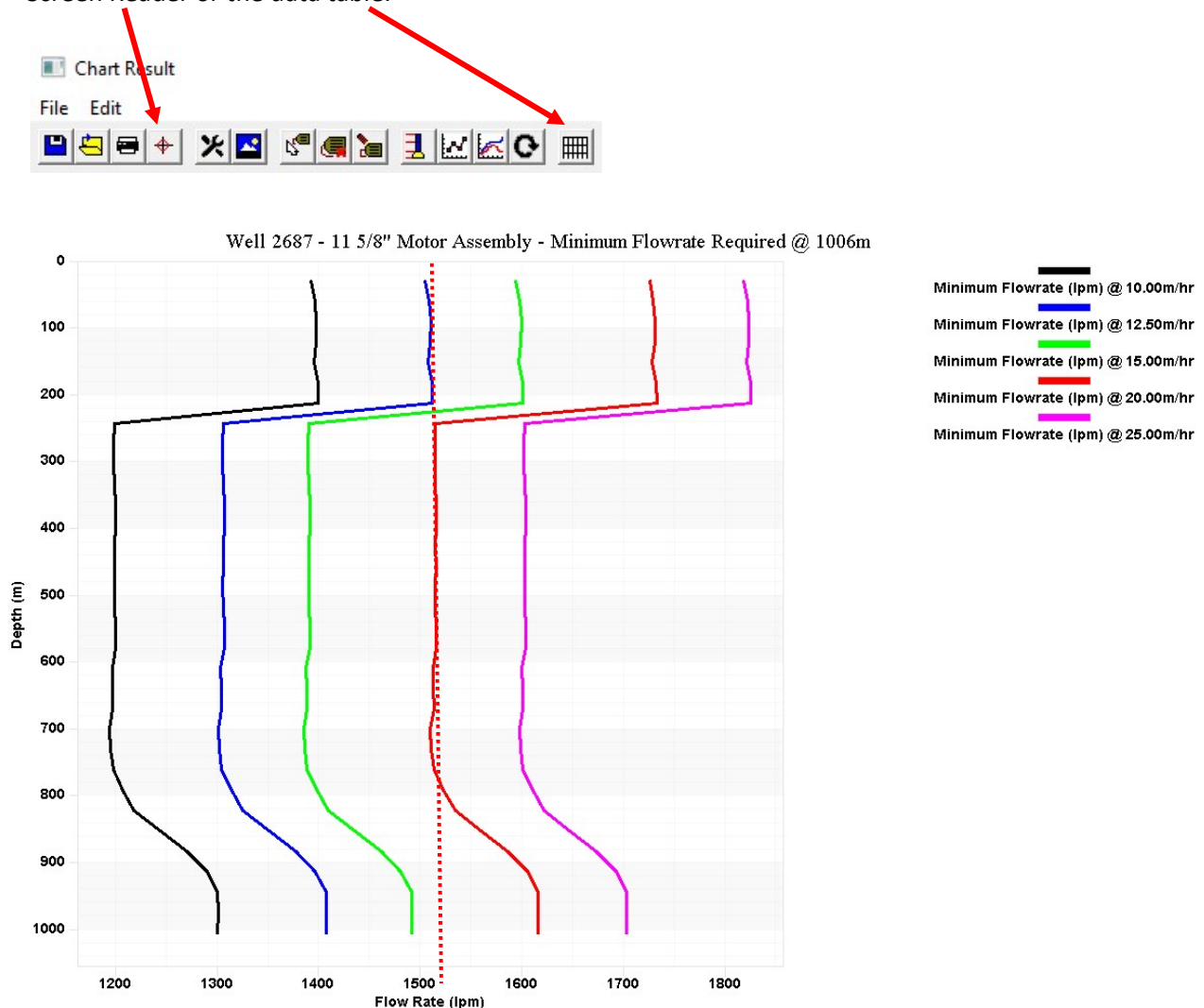
This is a snapshot chart and shows the Cuttings % at all different points in the wellbore when the assembly is at a given depth for a given ROP at various different flow rates.

Minimum Flow Rate Plot

The minimum flow rate plot is a snapshot chart which shows the minimum flow required to keep the hole clean at all points in the wellbore for a range of ROPs at a certain depth.

The ROP value selected in the hydraulics setup (in this example 10m/hr) will be used as the lowest ROP and 4 additional ROP values will be displayed which are automatically generated by the program and are pre set percentages of the original (125%, 150%, 200% & 250%). These percentages are built into the program and are not adjustable by the user.

To interpret the plot, you need to find the largest flow rate for any one ROP and that will be the minimum flow that is required at that depth to keep the hole clean. This can be done by using the Screen Reader or the data table.



In the plot above, for an ROP of 12.5m/hr @ 1006m MD, the minimum flow rate required to keep the hole clean would be ~1,512 lpm.