

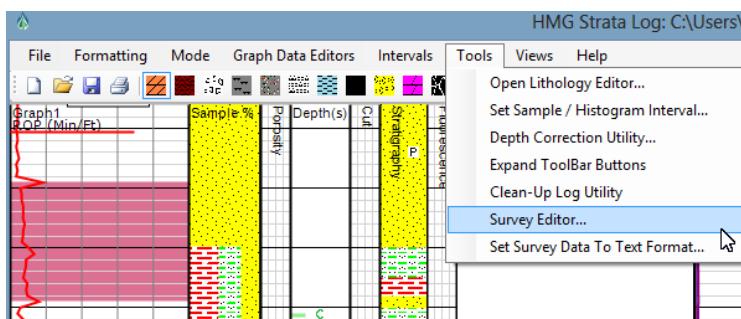
Chapter 4: Survey Data

HMG Strata Log uses survey data for several purposes. Survey data can be easily displayed along the log for information purposes. Survey data can also be exported as a file for sharing. Importantly, survey data inputs allow HMG Strata Log to correct log data (depths, gamma, gas, etc.) for true vertical depth (TVD) when the well is being drilled directionally. See Chapter 9 for TVD Mode and correlating. Chapter 4 will discuss how to enter, edit, import, export, and use survey data in the HMG Strata Log.

Abbreviations and Terms:

MD	Measured depth
INC	Inclination of the survey tool, where 0° is vertical and 90° is horizontal.
AZ	Azimuth of the survey tool, corrected for magnetic declination. (0°-360°)
TVD	True vertical depth – vertical distance from KB (kelly bushing) to survey tool, also called KBTVD
VS	Vertical section – the horizontal distance from surface hole location to the survey tool. Measured along azimuth from surface hole to planned TD target position.
NS	North/South – the map-view N/S coordinate for survey tool. Also called Northings, + values are North of surface hole location, - values are South.
EW	East/West – the map-view E/W coordinate for survey tool. Also called Eastings, + values are East of surface hole location, - values are West.
DLS	Dogleg°/ 100' – degree of curvature of well bore measured in degrees per 100' measured depth.

The MD, INC, and AZ are measured by survey tool and MWD personnel; TVD, VS, NS, EW, and DLS are derived survey values. Most directional companies, and HMG Strata Log, use the Minimum Curvature method to derive these values.



Survey Editor

To open the Survey Editor use Tools->**Survey Editor**. There is also a Survey icon in the toolbar, located near the *Graph Data* icons. This will open the Borehole Survey Data Sheet. A Tie-In Survey is necessary to begin the curve, then surveys can be added one at a time using “Add Survey” button, or multiple surveys can be imported as a *.csv file using the “Import Survey” button.

Borehole Survey Data Sheet

Tie-In Data							
MD	INC	AZ	TVD	VS	NS	EW	DLS
0	0	0	0	0	0	0	0
Edit/Add Tie-In Survey							
Direction (vertical section along azimuth): 270							
MD	INC	AZ	TVD	VS	NS	EW	Dogleg / 100'
492	1.76	173.71	491.92	-0.8	-7.51	0.83	0.36
525	1.76	171.51	524.91	-1.0	-8.52	0.96	0.20
587	0.35	128.44	586.90	-1.2	-9.57	1.25	2.46
648	0.62	10.95	647.89	-1.5	-9.37	1.46	1.38
709	2.02	356.8	708.88	-1.5	-7.97	1.46	2.34
770	3.08	353.54	769.82	-1.2	-5.27	1.21	1.75
832	4.13	352.83	831.69	-0.7	-1.40	0.75	1.70
893	5.28	353.72	892.49	-0.2	3.57	0.17	1.89
954	6.24	354.57	953.18	0.5	9.66	-0.45	1.58
1015	7.03	352.92	1013.77	1.2	16.67	-1.23	1.33
1077	7.56	350.95	1075.27	2.3	24.46	-2.34	0.95
1138	8	349.45	1135.70	3.7	32.60	-3.75	0.79
1199	8.18	349.77	1196.10	5.3	41.04	-5.29	0.30
1260	8.71	350.58	1256.44	6.8	49.87	-6.82	0.89
1321	9.41	350.04	1316.67	8.4	59.34	-8.44	1.16
1382	10.02	349.93	1376.80	10.2	69.47	-10.23	1.00
1443	11.26	350.96	1436.75	12.1	80.58	-12.09	2.06
1507	12.66	351.25	1499.36	14.1	93.68	-14.14	2.19
1570	13.98	351.95	1560.66	16.3	108.04	-16.26	2.11
1634	15.21	352.47	1622.60	18.4	124.02	-18.44	1.93
1697	15.83	352.93	1683.30	20.6	140.74	-20.58	1.00
1761	15.92	352.14	1744.86	22.9	158.10	-22.86	0.37
1824	15.65	351.93	1805.48	25.2	175.07	-25.23	0.44
1888	15.39	351.28	1867.15	27.7	192.01	-27.73	0.49

Edit Survey **Add Survey** **Export Survey (*.csv)** **Import Survey (*.csv)** **Done**

Delete Survey **Import Slide Data (*.csv)** **Export Slide Data (*.csv)**

Adding Surveys

The first step in adding surveys one at a time is the **Tie-In** survey. Go to Tools->**Survey Editor**. Then, at the top of the Borehole Survey Data Sheet, click *Edit/Add Tie-In Survey*. This is the survey from which all subsequent survey values will be based. Often the directional company will provide this, or use the first available survey. The *Direction* value is important; this allows HMG Strata Log to calculate the Vertical Section accurately. Again, the directional company will be able to provide a Direction or Vertical Section Along Azimuth value.

After the Tie-In survey is added, use the **Add Survey** button to add surveys one at a time. Input the MD, INC, and AZ, then click **Done**. HMG Strata Log will calculate the remaining survey values.

To **Edit** or **Delete** a survey, highlight the survey you'd like to change or remove, and click the corresponding button.

Matching the Directional Drillers' Values

Though there are other methods for computation of the derived survey values, the most common method on horizontal wells is the minimum curvature method. As long as the directional company is

Add New Survey

Enter Survey Data

Measured Depth	4578
Inclination	9.41
Azimuth	350.53

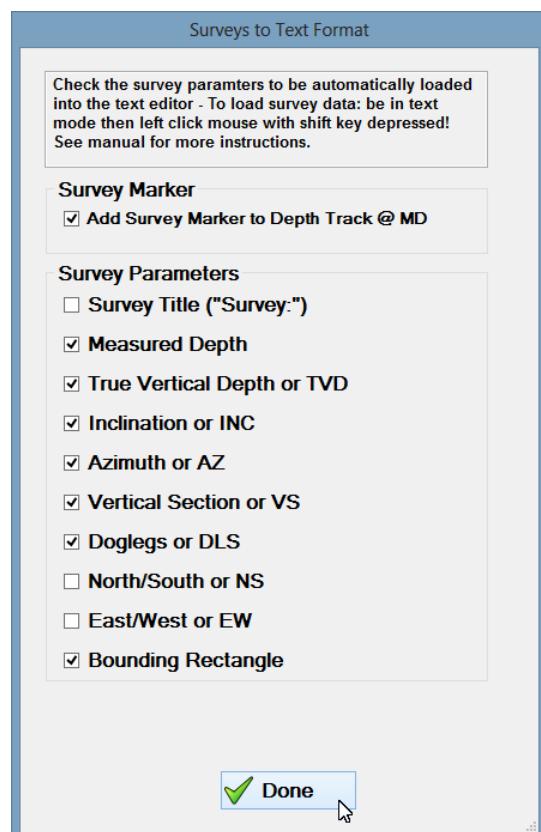
Cancel **Done**

using this method, the values derived from the HMG Strata Log software will match the values from the directional driller. At times rounding differences will result in values that differ by a few hundredths. If values differ by more than a few hundredths, examine your MD, INC, and AZ as well as the tie-in survey for data entry errors. Also remember that sometimes DD and MWD hands make mistakes too (though they may deny it).

	A	B	C	D	E	F	G	H
1	270	Direction						
2	MD	INC	AZ	TVD	VS	NS	EW	DLS
3	0	0	0	0	0	0	0	0
4	492	1.76	173.71	491.92	-0.8	-7.51	0.83	0.36
5	525	1.76	171.51	524.91	-1	-8.52	0.96	0.2
6	587	0.35	128.44	586.9	-1.2	-9.57	1.25	2.46
7	648	0.62	10.95	647.89	-1.5	-9.37	1.46	1.38
8	709	2.02	356.8	708.88	-1.5	-7.97	1.46	2.34
9	770	3.08	353.54	769.82	-1.2	-5.27	1.21	1.75
10	832	4.13	352.83	831.69	-0.7	-1.4	0.75	1.7

Importing Surveys

Formatting *.csv file to be imported into the survey editor is simple. Cell A1 is used for Direction, or Vertical Section along Azimuth (surface hole location to bottom hole location.) B1 is simply "Direction". Row 2 is used as header for the survey columns. Row 3 holds the Tie-In value. Rows 4 and onward are used for survey parameters MD, INC, and AZ. The other columns (TVD, VS, NS, EW, and DLS) will be calculated by HMG Strata Log when the survey .csv file is imported. See the above example for proper formatting of the survey file to be imported. After the file is formatted and all available or desired values are added, be sure to save the file as a *.csv (comma delimited). Close the spreadsheet file before using the **Import Survey** function. Importing a .csv file will delete and replace previous values, including the Tie-In.



To export the survey values which have been added to the Survey Editor as a *.csv file, just click the **Export Survey** button and save it to your computer.

Displaying Survey Data on your Log

Once the survey data has been entered into the program, displaying the survey data on your log is as easy as a click of the mouse key. The first step is to set the survey data to text format.

Set Survey Data To Text Format

The Tools->**Set Survey Data To Text Format** item will open a simple window which allows the user to choose which survey parameters will be added to the log as text. As shown to the left, select the parameters you want to display including if you want a bounding rectangle and a survey title.

Displaying Survey Data with a Click of the Mouse

Survey data can be displayed on the description track and any of the graph tracks. After surveys have been added to the survey editor, and Surveys to Text Format has been set to your liking, just hold the "Shift" key and click on the log Graph 1 track at or near the MD of the survey you want to display. The text editor will then open with the survey data entered. A survey marker at the correct depth will also be shown on the depth track (shown below).

