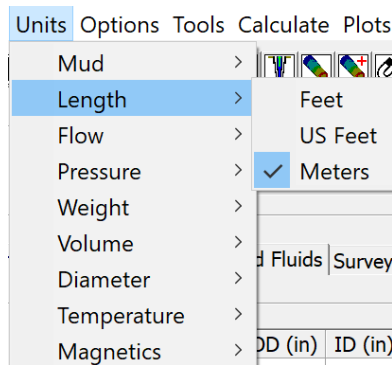


## Innova Engineering - Hydraulics Example

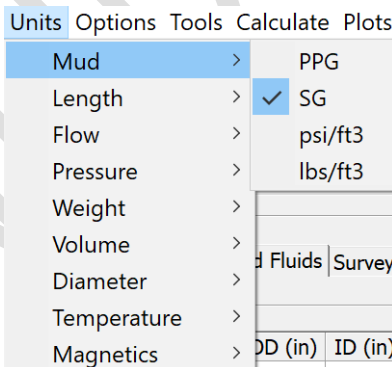
This tutorial demonstrates how to use Innova Engineering to generate hydraulics results for a high angle extended reach well.

This example project guide comes as part of the standard install and can be found in the following location: **C:\Program Files (x86)\Innova Drilling and Intervention\Innova Engineering\Manuals**

Create a new blank project and change the length units to meters from the unit menu



Change the mud units to S.G.



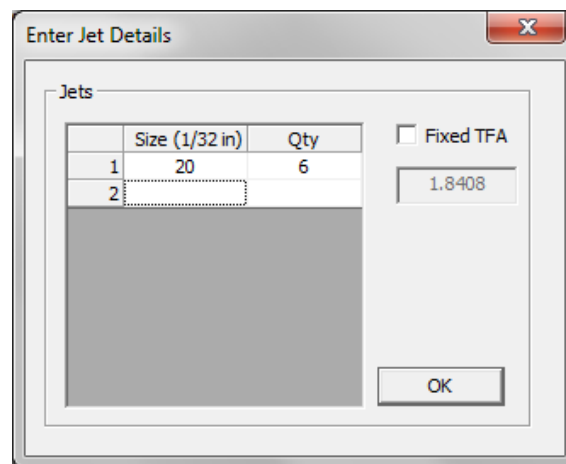
Enter the following Drill String

	Description	OD (in)	ID (in)	TJ OD (in)	TJ ID (in)	Weight (lb/ft)	Type	Length (m)	Total Length (m)	Non-Magnetic
1	PDC Bit	12.250	2.840			240.000	Bit	0.350	0.35	<input type="checkbox"/>
2	RSS	9.500	2.480			265.000	RSS	6.180	6.53	<input type="checkbox"/>
3	Drilling Dynamics	9.500	2.840			329.000	MWD/LWD	2.240	8.77	<input checked="" type="checkbox"/>
4	MWD	9.500	2.810			329.000	MWD/LWD	8.550	17.32	<input checked="" type="checkbox"/>
5	Pulser	9.500	2.810			329.000	MWD/LWD	6.320	23.64	<input checked="" type="checkbox"/>
6	LWD	8.250	2.813			240.000	MWD/LWD	10.930	34.57	<input checked="" type="checkbox"/>
7	Flexi NMDC	8.250	2.875			150.000	MWD/LWD	17.220	51.79	<input checked="" type="checkbox"/>
8	HWDP	6.625	4.000	8.000	4.000	80.000	Drill Pipe	74.650	126.44	<input type="checkbox"/>
9	Jar	8.000	3.000			110.000	Jar	11.340	137.78	<input type="checkbox"/>
10	HWDP	6.625	4.000	8.000	4.000	80.000	Drill Pipe	28.000	165.78	<input type="checkbox"/>
11	Accelerator	8.000	3.000			110.000	Accelerator	11.780	177.56	<input type="checkbox"/>
12	HWDP	6.625	4.000	8.000	4.000	80.000	Drill Pipe	28.250	205.81	<input type="checkbox"/>
13	Drill Pipe	5.731	5.153	6.563	4.250	27.060	Drill Pipe	6824.190	7030.00	<input type="checkbox"/>

Click on row 1 to bring up the properties of the PDC bit

Component Details	
SN	
Gauge OD (in)	
TFA (sq in)	
Connection Top	
Bit Formation Index (0-1)	
Bit Type	
Tensile Yield (klbs)	
Torsional Yield (kftlbs)	

Click on the cell for the bit TFA and click on the “...” button to bring up the bit jets dialog. Enter 6 x 20 jets or click the fixed TFA check box and enter 1.8408 and click the OK button.



The dialog box titled "Enter Jet Details" contains a table for jets and a "Fixed TFA" section. The jets table has columns for "Size (1/32 in)" and "Qty".

Size (1/32 in)	Qty
1	20
2	6

Fixed TFA:  Fixed TFA

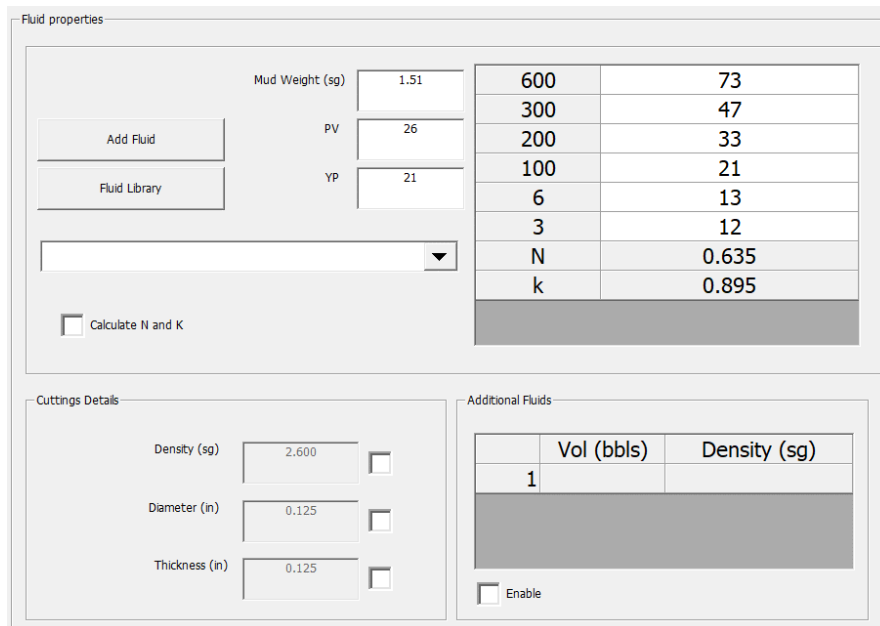
On the main drill string grid click on the row 4 for the MWD tool and edit its properties so it has a 750psi pressure Drop. The exact pressure loss for the tool will come from the supplier of the MWD tool. If there are multiple MWD tools in the string and the pressure loss for each is not know it is acceptable to group the pressure losses in to one and simply enter a pressure loss for a single tool.

Component Details	
SN	
Stab OD (in)	
Stab Blade Length (in)	
Stab Dist From Bottom (m)	
Connection Top	
Connection Bottom	
Pressure Drop (psi)	750.000
Stab Blade Width (in)	

Enter the well geometry

Well Geometry					
	Type	MD (m)	TVD (m)	ID (in)	OD (in)
1	Casing	1200.00	1124.258	12.347	13.375
2	Open Hole	8000.00	3110.712	12.25	12.250
3					

Enter the fluid details



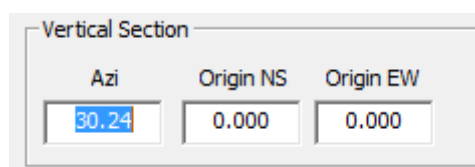
Click on the surveys tab and import the entire “**ERD – Well Plan Surveys.xlsx**” into the Well Plan listing. Import the “**ERD – Surveys.xlsx**” in to the Actual Surveys from 1143m MD. Both files can be located in **C:\Program Files (x86)\Innova Drilling and Intervention\Innova Engineering\Example Projects\Example Surveys**. This can either be achieved by copying and pasting direct form the excel file in to the survey tables in Innova Engineering, or by using the File > Import Survey method.

For detailed instructions on how to import surveys follow the **Survey Import Example.pdf** tutorial, located in **C:\Program Files (x86)\Innova Drilling and Intervention\Innova Engineering\Manuals**.

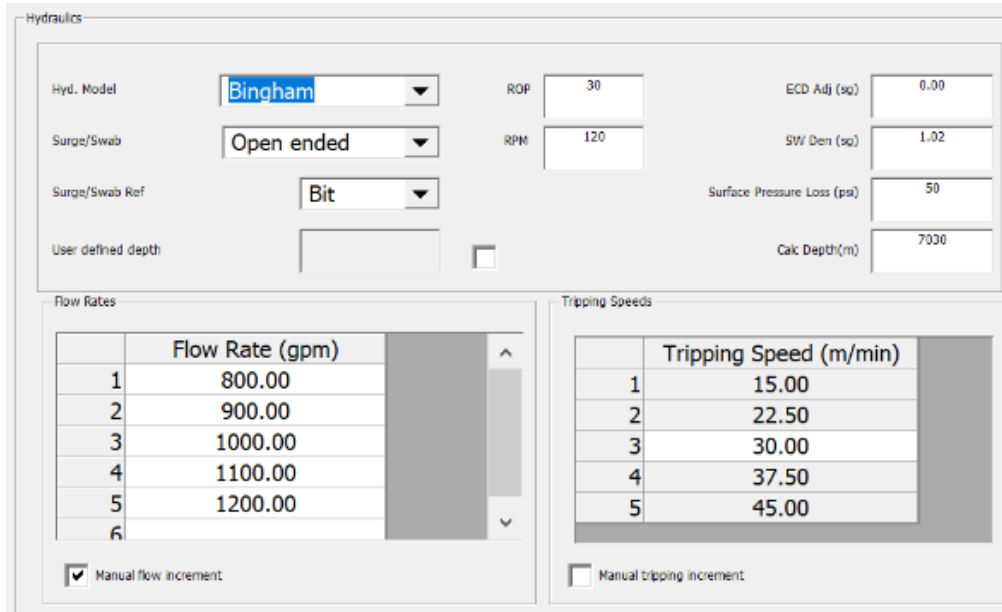
Set the tie on for the Actual Surveys to the following.

	MD (m)	Inc	Azi	TVD (m)	NS (m)	EW (m)	VS (m)
1	1143.00	37.51	87.09	1079.58	-161.63	226.44	-8.94

Set the vertical section azimuth to 30.24



Select the engineering parameters tab and enter the details as per the below seen shot.



The screenshot shows the 'Hydraulics' software interface with the following parameters and tables:

Hyd. Model	ROP	ECD Adj (sq)
Bingham	30	0.00

Surge/Swab	RPM	SW Den (sq)
Open ended	120	1.02

Surge/Swab Ref	Surface Pressure Loss (ps)
Bit	50

User defined depth	Calc Depth(m)
	7000

Flow Rates	Flow Rate (gpm)
1	800.00
2	900.00
3	1000.00
4	1100.00
5	1200.00
6	

Tripping Speeds	Tripping Speed (m/min)
1	15.00
2	22.50
3	30.00
4	37.50
5	45.00

Manual flow increment:  Manual tripping increment:

Select "Well Plan" from the survey selection drop down box



Survey selection: Well Plan

All parameters are now entered, and the calculation can now be run from the calculation menu or by pressing the calculate hydraulics button on the toolbar

- Calculate
- Plots
- Survey Correction
- Results
- Hydraulics**
- Torque and drag
- Wellpath magnetic interference
- BHA Analysis and SAG Correction
- Torque and Drag Snapshot
- BHA Sensitivity Analysis



The hydraulics results can now be viewed in the hydraulics results grid

Hydraulics Results

Flow (gpm)  Depth(m)

Type	P Loss (psi)	HHP	HHP /sqin	JV (ft/s)	IF (lbs)	800.00	900.00	1000.00	1100.00	1200.00	
1 Bit (TFA 1.8408)	219.20	102.31	0.87	139.06	726.40	SPP (psi)	3864.45	4513.87	5223.50	5993.99	6844.41
2 Surface Losses	50					Ann Ploss (psi)	403.71	419.38	435.05	452.49	491.80
3 MWD	750.000					Clean ECD (sg)	1.61	1.61	1.62	1.62	1.63
						Dirty ECD (sg)	1.62	1.63	1.63	1.63	1.64

Drill String Component	Hole Section	Pipe Press Loss (psi)	Ann Press Loss (psi)	AV (m/min)	Flow	Cuttings %	CCI	Top (m)	Bottom (m)
1 Drill Pipe	Casing	348.89	65.24	50.48	LAM	1.31	2.39	0.00	1200.00
2 Drill Pipe	Open Hole	1635.18	312.10	51.52	LAM	1.31	2.44	1200.00	6824.19
3 HWDP	Open Hole	24.78	1.99	57.57	LAM	1.30	2.73	6824.19	6852.44
4 Accelerator	Open Hole	41.08	1.17	69.42	LAM	1.29	3.29	6852.44	6864.22
5 HWDP	Open Hole	24.57	1.97	57.57	LAM	1.30	2.73	6864.22	6892.22
6 Jar	Open Hole	39.55	1.13	69.42	LAM	1.29	3.29	6892.22	6903.56
7 HWDP	Open Hole	65.49	5.25	57.57	LAM	1.30	2.73	6903.56	6978.21
8 Flexi NMDC	Open Hole	73.65	1.88	72.86	LAM	1.29	3.45	6978.21	6995.43
9 LWD	Open Hole	51.90	1.19	72.86	LAM	1.29	3.45	6995.43	7006.36
10 Pulsar	Open Hole	30.17	1.26	99.88	TUR	1.28	4.73	7006.36	7012.68
11 MWD	Open Hole	40.81	1.70	99.88	TUR	1.28	4.73	7012.68	7021.23
12 Drilling Dynamics	Open Hole	10.16	0.45	99.88	TUR	1.28	4.73	7021.23	7023.47

Results for different flow rates and depths can be viewed by changing the combo box and the depth button at the top of the results frame.

Flow (gpm)  Depth(m)

Charts and tabular data can be viewed from the “Hydraulics results” menu or the toolbar buttons

- Hydraulics Results TAD Results He
- Hydraulics Charts >
- Hole Cleaning Charts >
- Pump Pressure Data
- ECD Data
- Surge and Swab Data
- Minimum Flowrate Data

As a reference a completed Engineering Project file entitled **Hydraulics - Example Project.ieng** can be found in the following location: **C:\Program Files (x86)\Innova Drilling and Intervention\Innova Engineering\Example Projects.**