

## Exercise objective:


To predict lithology logs using the “*Lithology classification tool*”, which is part of the machine learning plugin.

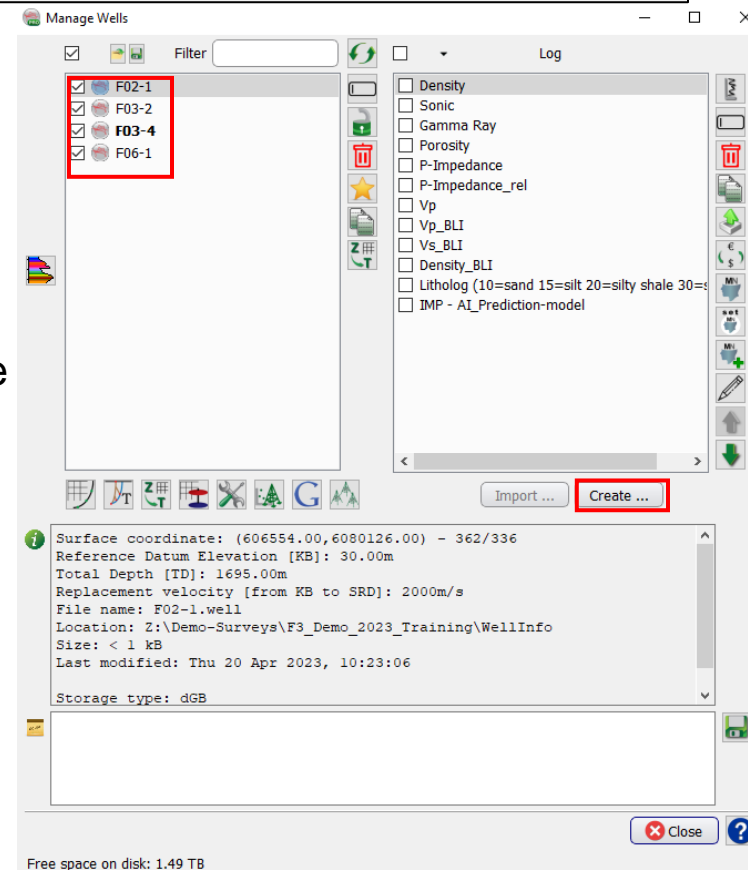
### Well data Preparation

**Well**(s) need to be available in the survey. If not, **import** wells (track, logs, markers, optionally time-depth curve or checkshot).

### Workflow:

For the purpose of this exercise, we will create a fake lithology log using Mathematics (as no lithology log exists in the survey)

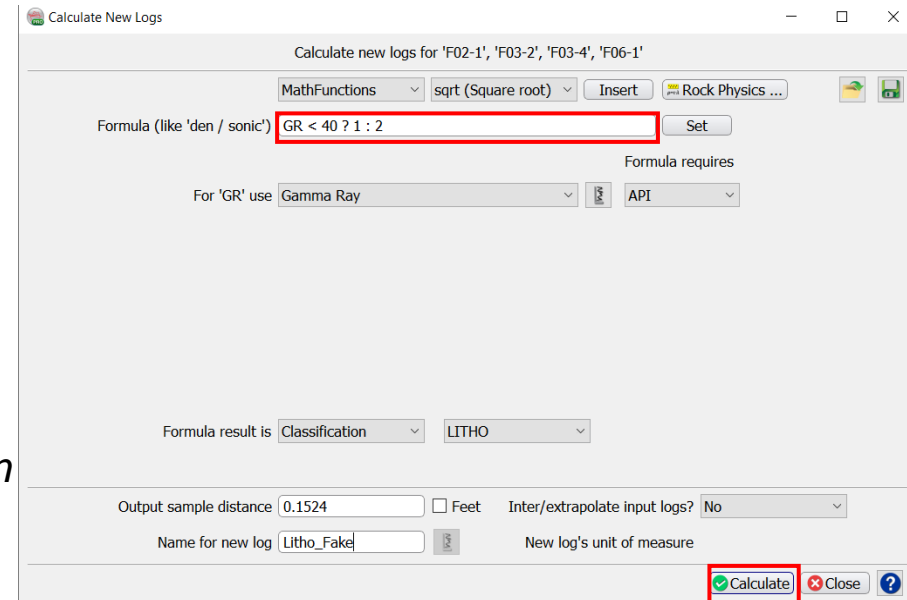
1. **Open** the Well Manager .
2. **Select** All Wells in the “Well Manager”, and **Hit Create**.



## Workflow cont'd:


3. In the “Calculate a New Well Log” window, **Specify** the parameters as indicated below to create a fake litho-log:

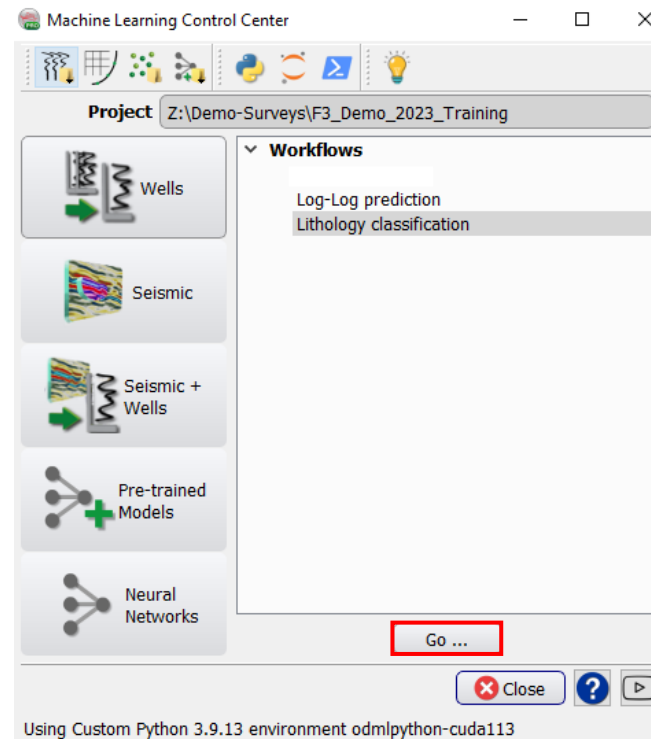
- a. **Select**: Math Functions.
- b. **Type** the Formula:  $GR < 40 ? 1 : 2$
- c. **Hit** Set.
- d. **Select** Gamma Ray log.
- e. **Select** for the *Formula Results, Classification*
- f. **Type** Name for new log: Litho\_Fake.
- g. **Select** Output Unit of Measures: None.



4. **Press** Run.

## Workflow cont'd:

5. **Open** the Machine Learning Control Center with the  icon.
6. **Click** on Wells.
7. **Select** *Lithology classification*.
8. **Hit** Go.





## Workflow cont'd:

We will select the following wells : F03-2, F03-4, and F06-1 for data extraction and training. F02-1 will be the blind well test

11. In the select logs for data extraction window, select the input logs that will be used (GR, and Sonic). The color of the selected logs cells will turn to **blue**
12. **Select** the *Sonic*, *Gamma Ray*, and *Density* logs
13. Select the target logs, the color of the targeted log cell will turn to **orange**
14. Select the **Litho** log
15. **Press** on Ok

The screenshot shows the 'Select Logs for Data Extraction' window. The table below displays the selected logs for wells F02-1, F03-2, F03-4, and F06-1. The 'DT', 'GR', and 'Density' logs are selected (blue), and the 'LITHO' log is targeted (orange).

Well name	UWI	Well Type	X (m)	Y (m)	TDMD (m)	TDSS (m)	KB (m)	GL (m)	DT	GR	IMP	LITHO	PHI	RHOB	VEL	Seasurface	MFS11	FS11
1 F02-1		Unknown	606554.00	6080126.00	1695.00	1665.00	30.00		Sonic	Gamma Ray	P-Impedance	Litho_Fake	Porosity	Density	Vp	30	553.6	576.023
2 F03-2		Unknown	619101.00	6089491.00	2140.00	2110.00	30.00		Sonic	Gamma Ray	P-Impedance	Litho_Fake	Porosity	Density	Vp	30	486.14	522.2
3 F03-4		Unknown	623255.98	6082586.87	2048.00	2013.71	34.10		Sonic	Gamma Ray	P-Impedance	Litho_Fake	Porosity	Density	Vp	30	479.74	515.342
4 F06-1		Unknown	607903.00	6077213.00	1701.00	1672.36	28.64		Sonic	Gamma Ray	P-Impedance	Litho_Fake	Porosity	Density	Vp	30	580	598.034

## Workflow cont'd:

We will select the following wells : F02-1, F03-2, F03-4 for data extraction and training. F06-1 will be out blind well test

16. In the Log-Log prediction window, All wells, input logs, and Targets should be listed each at the appropriate column

17. Set the level of extraction

18. Give a name to the extracted example

19. **Press** on Extract

Lithology Classification

Extract Train Apply

Select Well Data

Wells	Inputs	Target(s)
F03-2 F03-4 F06-1	GR DT PHI RHOB	LITHO

Log upscaling to (m) 0.1524

Extract between <Start of data> <End of data>

Extra Z above/below (m) 0 0

Stepout from center log sample 10

Edge/Gap Policy  Exclude incomplete  Add data

Output Deep Learning Example Data DL\_Example\_Data\_Lithology\_st10

## Workflow cont'd:

20. Click on the “*Train*” tab

21. We train the extracted examples using the default learning algorithm (e.g. Scikit-learn). **Select** “New” at the Training Type checkbox.

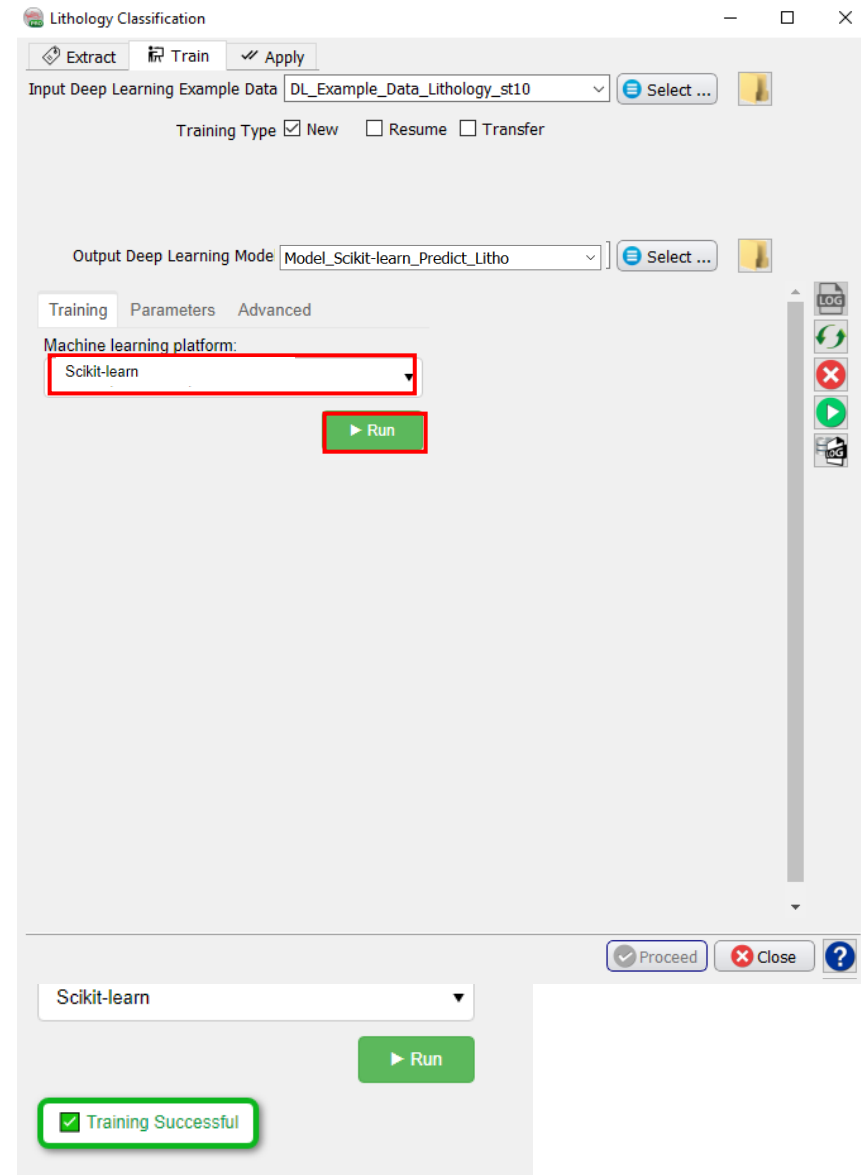
The default algorithm scikit-learn gives decent results when applied. This exercise should not be using keras-tensorflow as the training platform, except for R&D purposes. Tensorflow has not proven to be stable for these workflows, and it should be strongly advised not to use it for this workflow.

22. **Keep** the defaults parameters.

23. **Specify** a new *Output model* name (e.g. Model\_Scikit-learn\_Predict\_Litho)

24. **Press** Run.

25. You should see “ Training Successful “

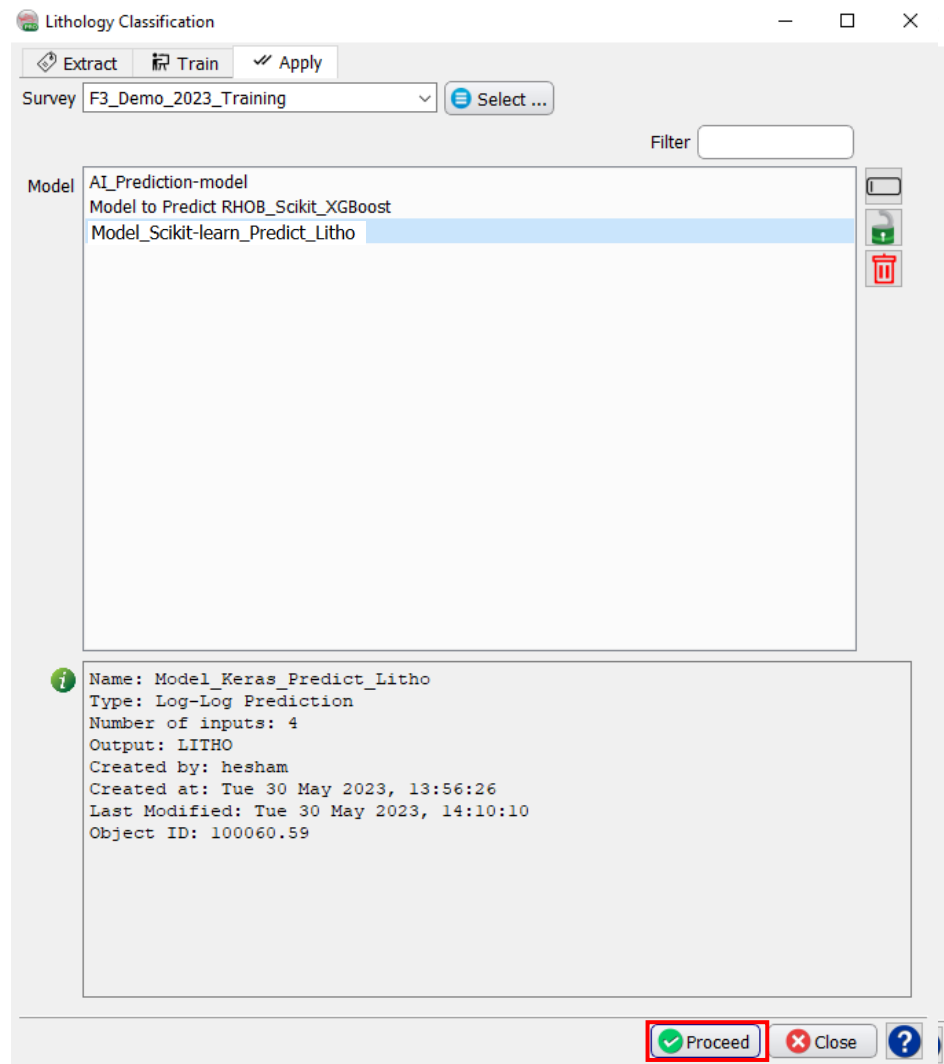


## Workflow cont'd:

26. **Select** the “Apply” tab

27. Highlight the model name

28. **Press** Proceed.




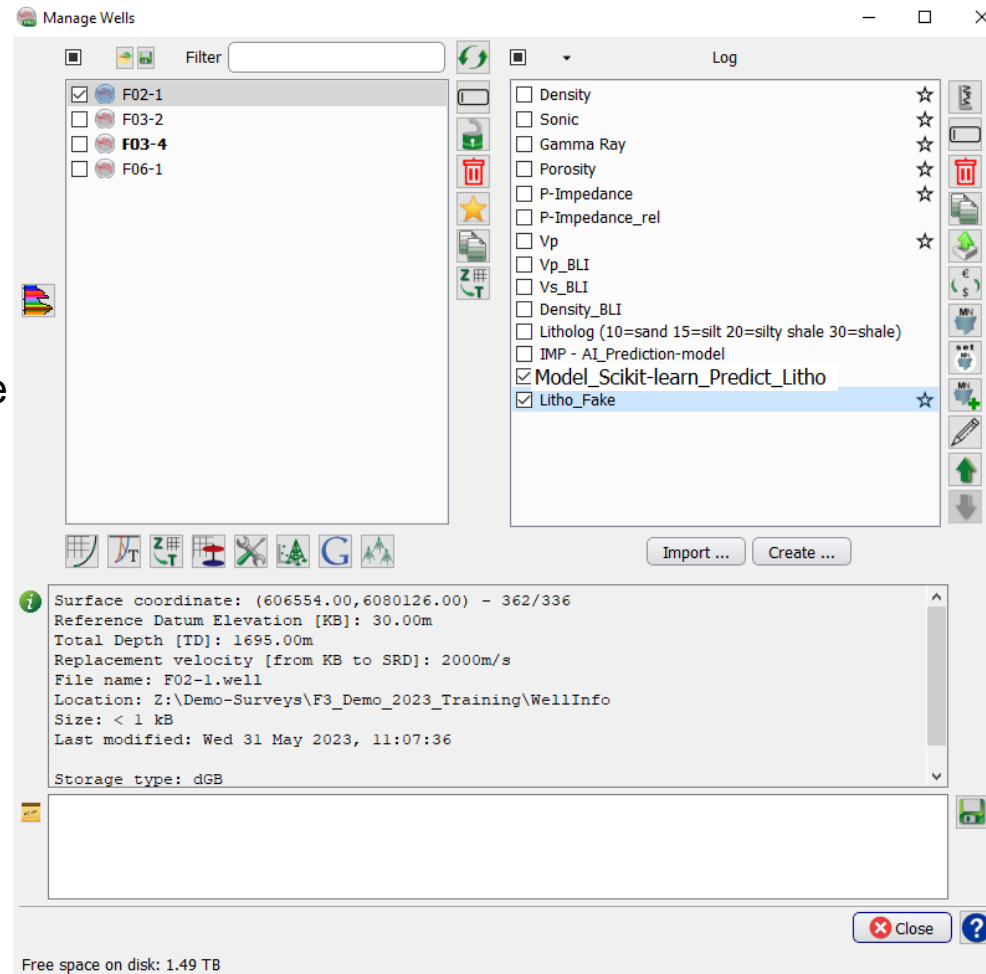




## Workflow cont'd:

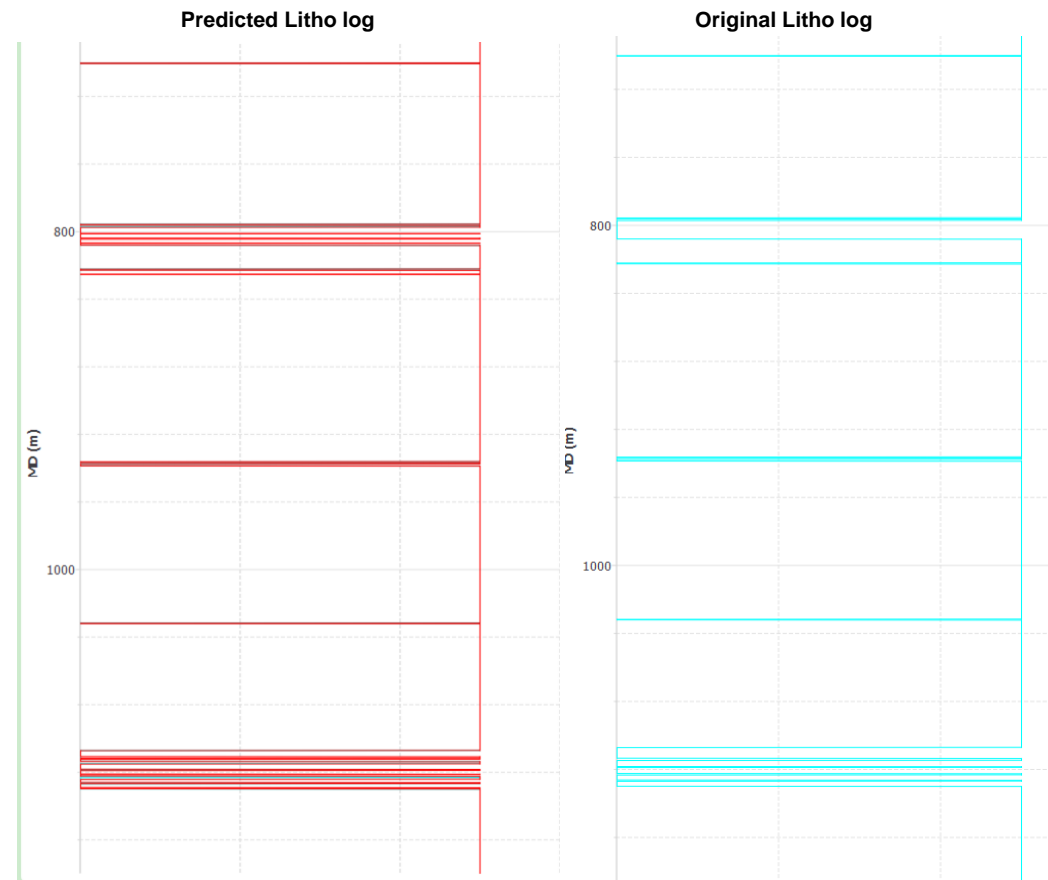
QC results by displaying the predicted log adjacent to the recorded log

33. **Click** on the Well Manager  icon.
34. **Select** the blind well F02-1, Litho\_Fake and Model\_Scikit-learn\_Predict\_litho.
35. **Click** on view logs.



## Workflow cont'd:

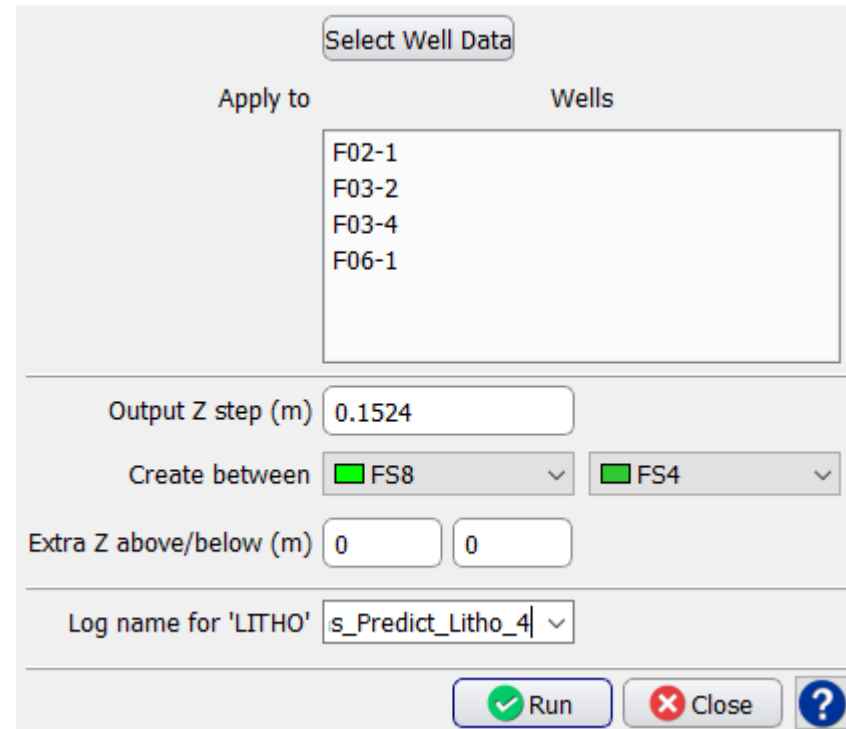
36. **Compare** the original vs predicted litho-log.



## Workflow cont'd:

If the results are satisfactory, go back to the "Apply training" window, and apply the trained model to all the wells where you want to make predictions.

37. **Select** All Wells. Keep default parameters as indicated in the window.
38. **Press** Run to continue.



Select Well Data

Apply to	Wells
	F02-1
	F03-2
	F03-4
	F06-1

Output Z step (m) 0.1524

Create between  FS8  FS4

Extra Z above/below (m) 0 0

Log name for 'LITHO' s\_Predict\_Litho\_4