

**“The Flowsheet  
Processor”**

# **GENERAL (SG X SIZE) WIZARD MANUAL**

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## 1. INTRODUCTION

The biggest difference between the 1D\_Verical wizard and the General (SG x Size) Wizard is the introduction of density intervals as well as size intervals. If one does have good densimetric data for the ore to be treated then the General (SG x Size) may be a better approach to simulating the flowsheet.

## 2. DRAWING THE FLOWSHEET

It is recommended that one draws the flowsheet by hand on paper before using the LIMN draw function. This will save the user having to redraw the flowsheet to get the spacing correct.

### 2.1 Drawing the flowsheet on paper

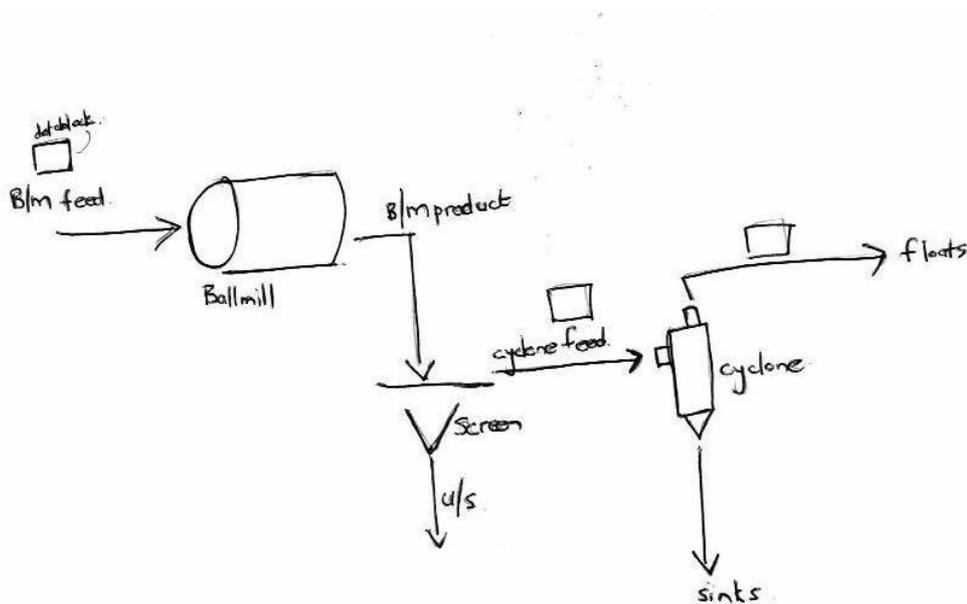


Figure 1: Drawn flowsheet

Make sure that the flowsheet, unit operations and spacing is correct before drawing the flowsheet using LIMN. Much time can be saved by making corrections before drawing the flowsheet using LIMN.

## 2.2 Using the LIMN Draw function

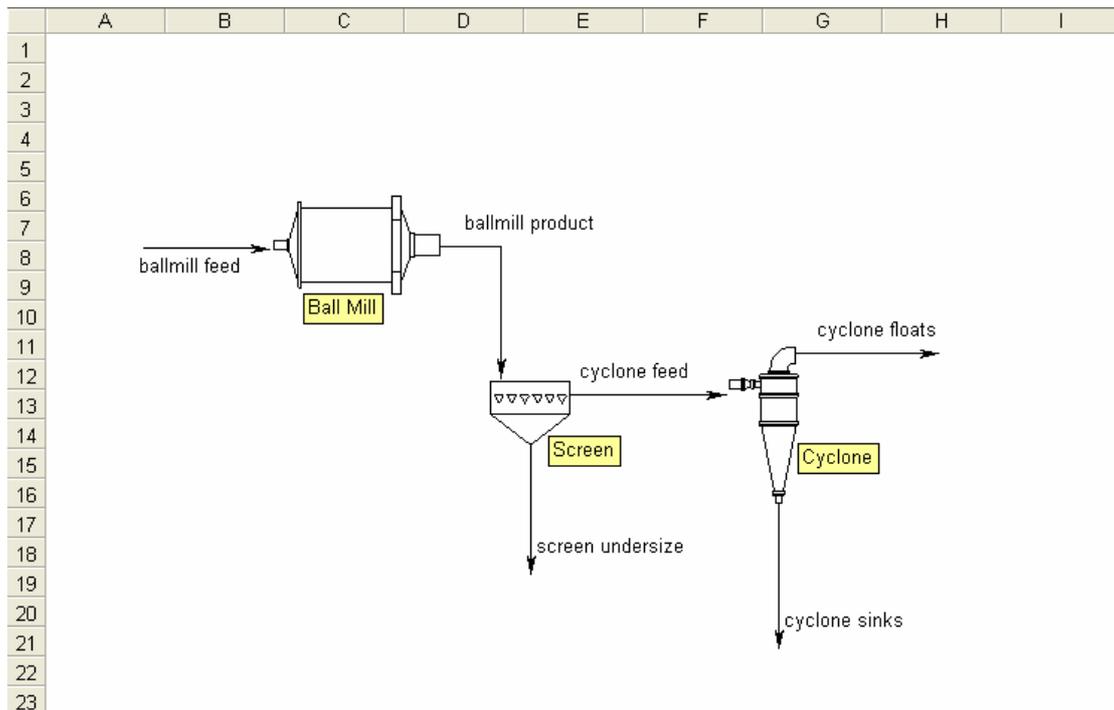


Figure 2: LIMN drawn flowsheet

- 2.2.1 Click on the LIMN draw button. 
- 2.2.2 Add each of the three icons by clicking on the New Icon button. 
- 2.2.3 The icons can be found by searching through the Icons lists, see figure 3 below.

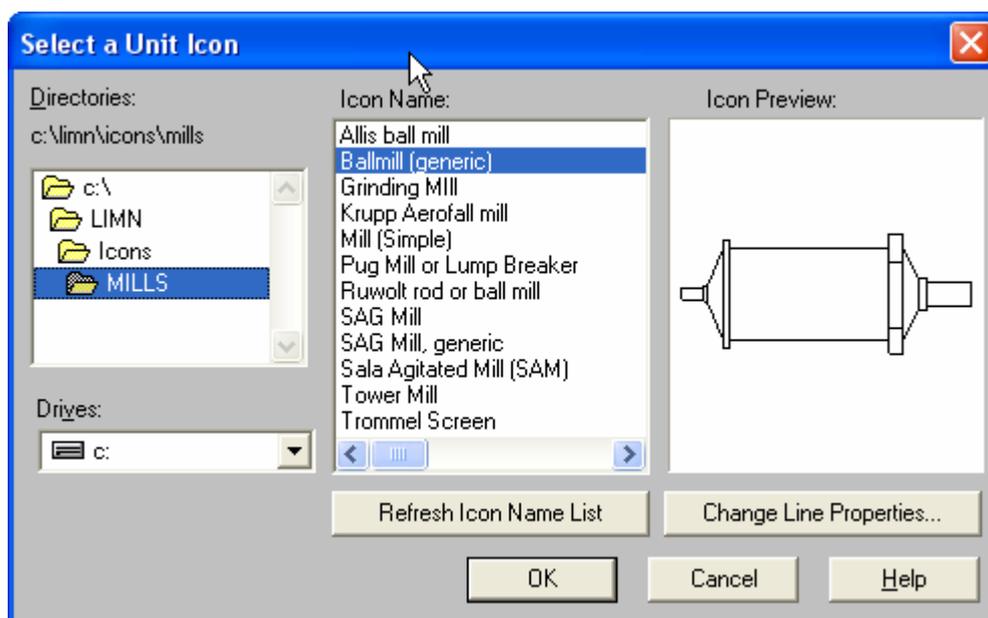


Figure 3: Icon list

- 2.2.4 Be careful when connecting the streams to the unit operations. Make sure that the arrow of the stream changes to the connection arrow before connecting, check the LIMN demo.
- 2.2.5 Label the unit operations by clicking on the unit and then entering the unit operation name in the Select Limn Object textbox. The unit operation names are: Ball Mill; Screen; Cyclone.

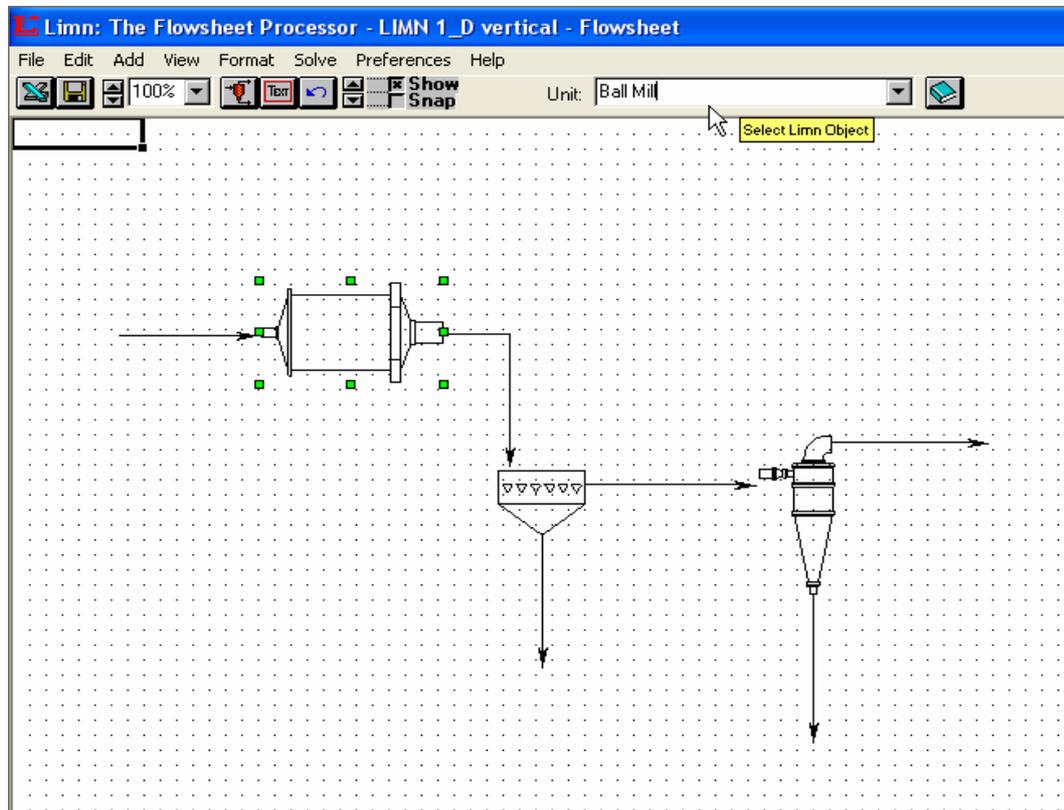


Figure 4: Naming Units

Note: When naming the unit operations and the streams one can switch from item to item by using the TAB key.

- 2.2.6 Label the streams by clicking on the stream and then entering the stream name in the Select Limn Object textbox. The stream names are: ballmill feed; ballmill product; screen undersize; cyclone feed; cyclone floats; cyclone sinks.
- 2.2.7 To display the labels of the unit operations and streams on the flowsheet click on the Add menu and then select Label All. Make sure that attach labels dialogue boxes are ticked. Position the labels as required.

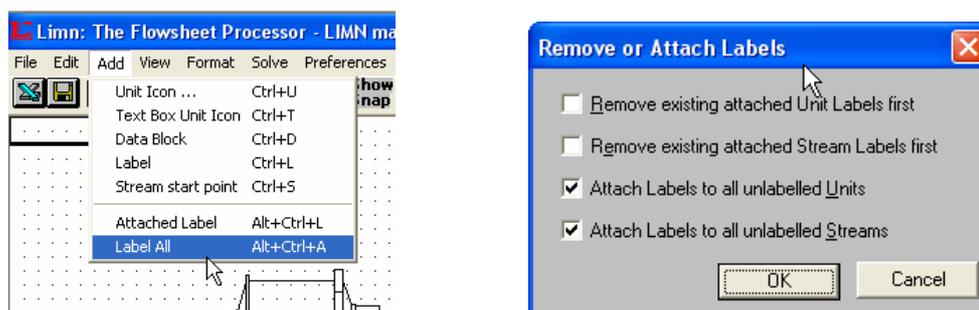


Figure 5: Adding Labels

## 2.3 Cloning a flowsheet

During the Data Wizard manual example the flowsheet in figure 6 was created. This flowsheet can be cloned and used for the General (SgxSize) wizard example.

2.3.1 Open the Excel workbook file that was saved for the Data Wizard example.

2.3.2 Click on the flowsheet for the Data Wizard example.

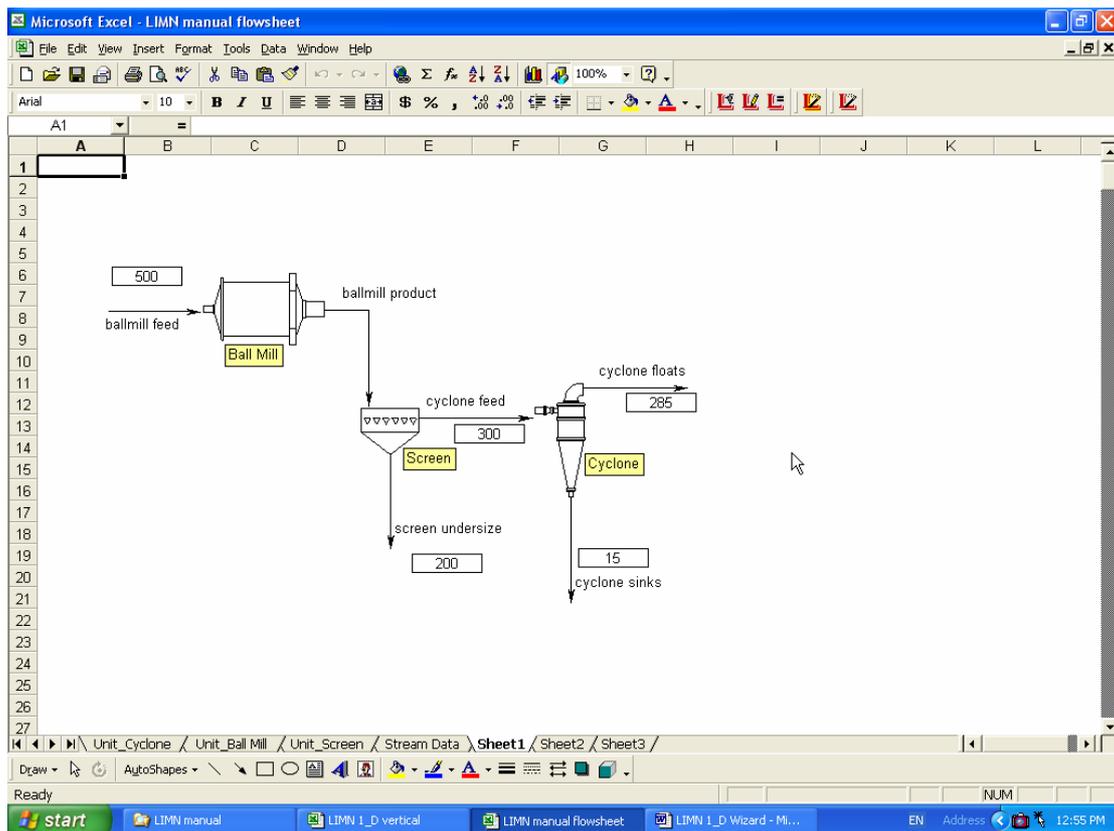


Figure 6: Data Wizard flowsheet

2.3.3 Click on the LIMN: Wizards Icon. 

2.3.4 Click on the Other Useful LIMN Related Functions... button.

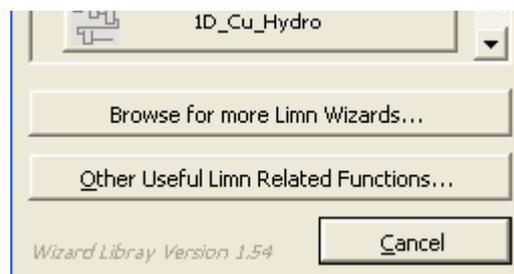


Figure 7: LIMN: Wizards

2.3.5 Click on the create a clone button.

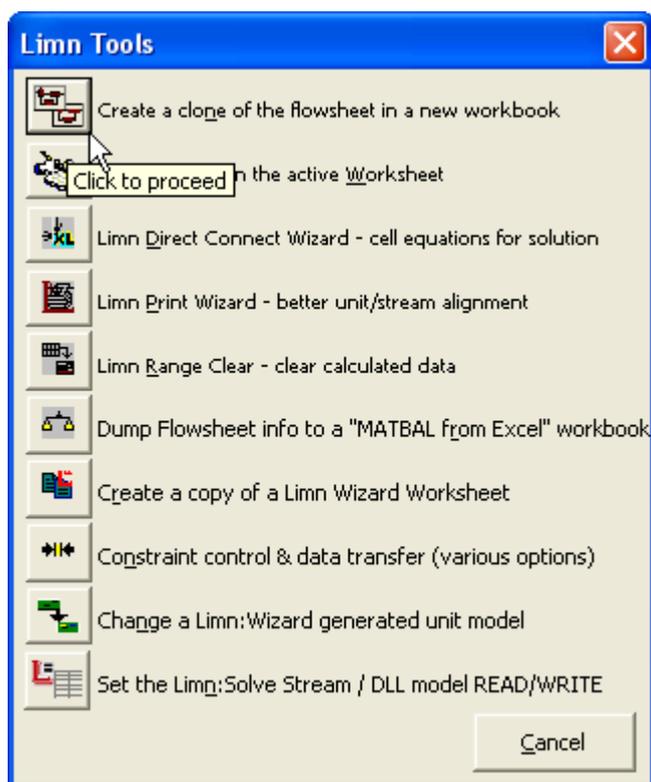


Figure 8: Other Useful Functions Menu

2.3.6 Click on the LIMN Draw button once the flowsheet has been cloned to a new workbook. 

2.3.7 Save the workbook.

### 3. RUNNING THE GENERAL (SG X SIZE) WIZARD

3.1 Click on the Limn: Wizards button. 

3.2 Click on the General(SG x Size) button.



Figure 9: Limn wizards menu

For step 1 of 6 click on Next.

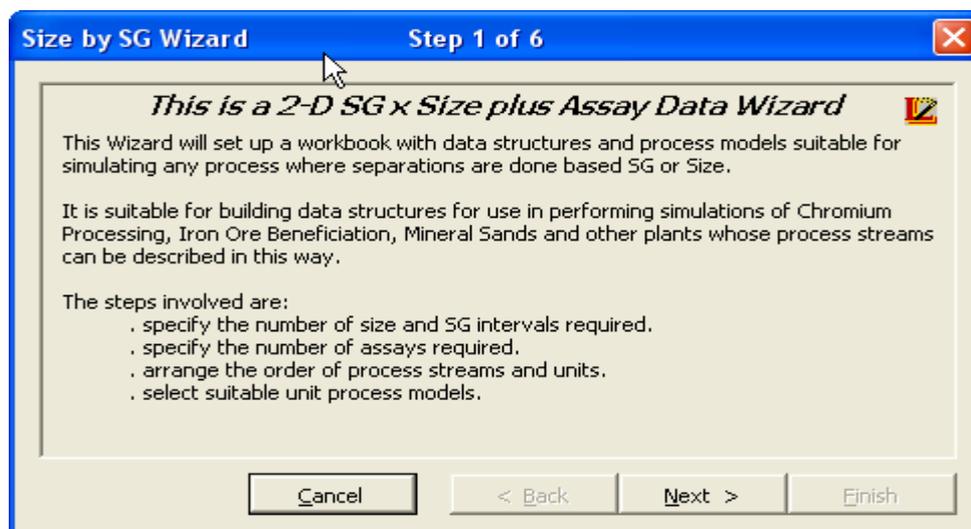


Figure 10: Step 1 of 6

For step 2 of 6 change the number of size fractions to 5, the number of SG fractions to 4 and the number of assays to 1. Click Next.

**Enter Numbers of Sizes, SGs and Assays** Step 2 of 6

Number of Size Fractions: 5

Number of SG Fractions: 4

Number of Assays: 1

This Wizard uses a 2-dimensional array of Size x SG to represent the data in a process stream.

Enter the number of fractions you require in each category...

And enter the number of assays that are required.

Cancel < Back Next > Finish

Figure 11: Step 2 of 6

Check that the stream names are correct and then click Next.

**Sort/Arrange the Stream Names** Step 3 of 6

?	Stream Name	Stream Type
+	ballmill feed	Feed
+	ballmill product	Inter-unit
+	cyclone feed	Inter-unit
+	cyclone floats	Product
+	cyclone sinks	Product
+	screen undersize	Product

Sort by Type/Alpha

Sort Alphabetically

Sort and arrange the Stream names in preferred order.

↑  
move  
↓

This determines the order of Streams on the Stream\_Data worksheet

Cancel < Back Next > Finish

Figure 12: Step 3 of 6

Check that the unit operations are correct then click Next.

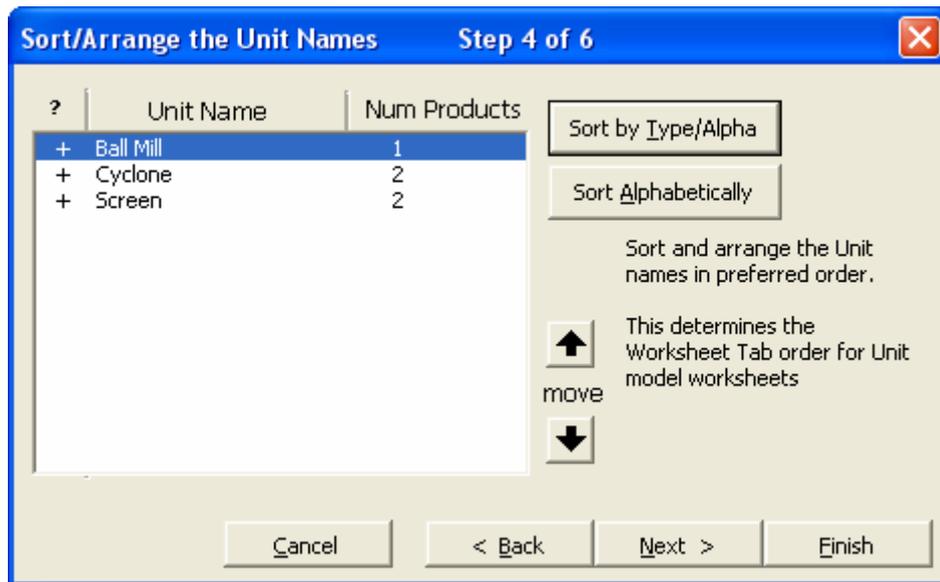


Figure 13: Step 4 of 6

Select the models for the unit operations by clicking on the stream name then selecting the model from the drop down list.

Ball Mill: 1Product PSD\_Comminution  
 Cyclone: 2Product DMSeparator(Generic)  
 Screen: 2Product SingleDeckScreen

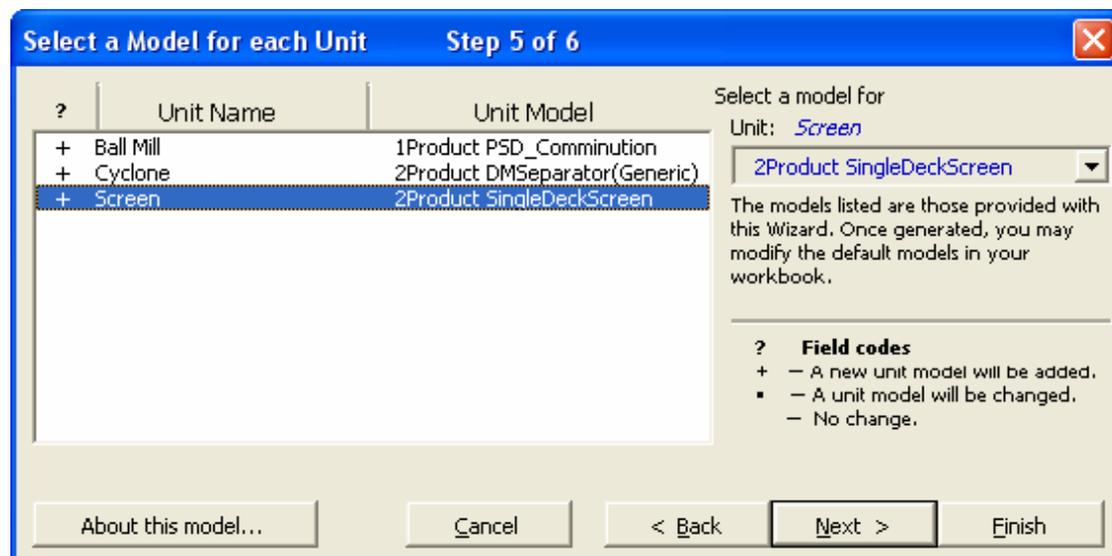


Figure 14: Step 5 of 6

For step 6 of 6 click Finish.

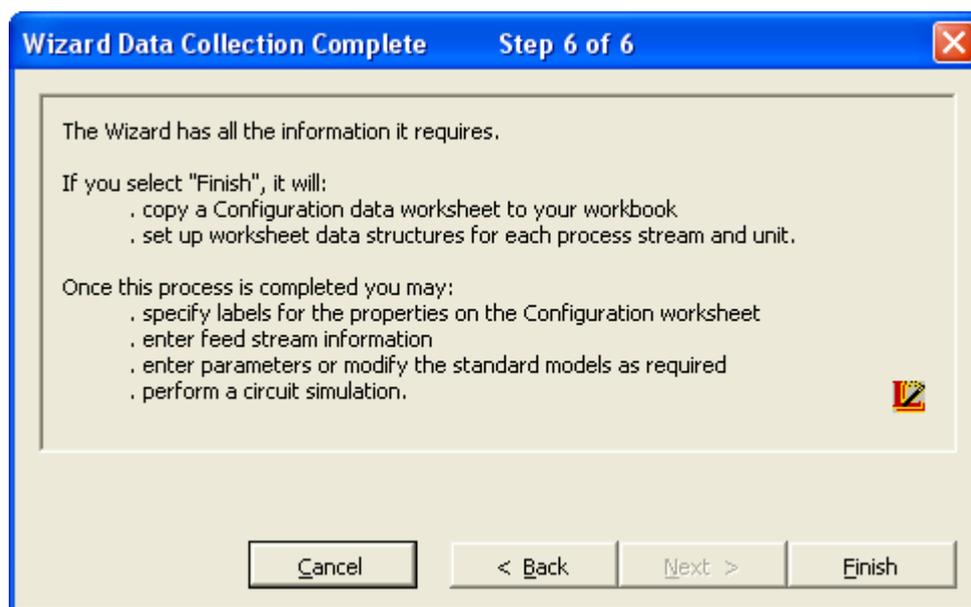


Figure 15: Step 6 of 6

When the wizard has finished setting up the worksheets save the workbook as Limn General (SG x Size) example.xls.

## 4. POPULATING THE WORKSHEETS

When one begins to populate the worksheets the difference in appearance between the 1D\_Vertical and General (SG x Size) wizards becomes apparent.

### 4.1 The Configuration Sheet

	A	B	C	D	E
1					
2	<b>Configuration Data</b>		Created with Wizard : 20		
3					
4	<u>Property 1 Definition</u>				
5		Name :		Size	
6	<b>Size Ranges</b>				
7	Lower	Upper	Mean	Text	
8	20.00	25.00	22.361	+20	
9	15.00	20.00	17.321	+15	
10	10.00	15.00	12.247	+10	
11	5.00	10.00	7.071	+5	
12	0.00	5.00	3.536	-5	
13					
14	<u>Property 2 Definition</u>				
15		Name :		SG	
16	<b>SG Ranges</b>				
17	Lower	Upper	Mean	Text	
18	2.00	2.50	2.25	Floats - 2.50	
19	2.50	3.00	2.75	2.50 - 3.00	
20	3.00	3.50	3.25	3.00 - 3.50	
21	3.50	4.00	3.75	3.50 - Sinks	
22					
23	<u>Additional Components Definition</u>				
24			Name	SG	
25					
26	Liquid		Water	1.00	
27	Medium		FeSi	6.70	
28	Solid		Solids	2.60	
29			Solids Bulk Density	1.56	
30					

Figure 16: The Configuration Sheet

- 4.1.1 Enter the lower size fractions for the simulation: 20; 15; 10; 5; 0. Do not enter the units "mm" as the numbers are used to calculate the mean.
- 4.1.2 Enter the upper size fraction of 25 in cell C8. The wizard calculates the mass balance according to the Mean value.
- 4.1.3 Enter the Lower SG fraction of 2 in cell B18.
- 4.1.4 Enter the Upper density ranges for the simulation: 2.5; 3.0; 3.5; 4.0.
- 4.1.5 Leave the Water, FeSi and Solids SG's as is. We will not be doing a water or FeSi balance in the example.

### 4.2 The Stream\_Data(Input) sheet

Data input for streams that FEED the flowsheet circuit												
% SG in each Size interval												
<b>ballmill feed</b>												
Solids t/h	500.00	<b>Size</b>		<b>SG</b>				<b>Size</b>				
Water t/h	0.00	+20	22.36	Floats - 2.50	2.50 - 3.00	3.00 - 3.50	3.50 - Sinks	2.25	2.75	3.25	3.75	Distribution
% Solids	100.0	+15	17.32	10.00	30.00	40.00	20.00	10.00	30.00	40.00	20.00	40.00
FeSi t/h	0.00	+10	12.25	10.00	30.00	40.00	20.00	10.00	30.00	40.00	20.00	25.00
Assay I	0.00	+5	7.07	10.00	30.00	40.00	20.00	10.00	30.00	40.00	20.00	20.00
		-5	3.54	10.00	30.00	40.00	20.00	10.00	30.00	40.00	20.00	10.00
		<b>SG Distribution</b>		10.00	30.00	40.00	20.00					5.00

Figure 17: The Stream\_Data(Input) sheet

- 4.2.1 Enter the total mass of ballmill feed (500) in cell C18.
- 4.2.2 Enter the size % PSD of the ballmill feed in column K as per figure 17 above.
- 4.2.3 Enter the density % PSD of the ballmill feed in the SG table as per figure 17 above.
- 4.2.4 Leave the water (C19) and FeSi (C21) as 0.

### 4.3 The Unit\_Ball Mill sheet

Model for Unit: Ball Mill					
<b>Model Summary</b>					
	Feed	ballmill product	Audit Check		
Solids t/h	500.00	500.00	OK		
Water t/h	0.00	0.00	OK		
% Solids	100.00	100.00			
FeSi t/h	0.00	0.00	OK		
Assay I	0.00	0.00			
<b>Model Parameters</b>		<b>Required Product Size Distribution</b>			
		<b>SG</b>			
		Floats - 2.50	2.50 - 3.00	3.00 - 3.50	3.50 - Sinks
<b>Size</b>		2.25	2.75	3.25	3.75
+20	22.36	5.00	5.00	5.00	5.00
+15	17.32	10.00	10.00	10.00	10.00
+10	12.25	15.00	15.00	15.00	15.00
+5	7.07	20.00	20.00	20.00	20.00
-5	3.54	50.00	50.00	50.00	50.00

Figure 18: The Unit\_Ball Mill sheet

- 4.3.1 Enter the required PSD of the ballmill product as per figure 18 above. One can specify the required product PSD for each density interval.

### 4.4 The Unit\_Cyclone sheet

	A	B	C	D	E	F	G	H	I	J	K	
1	<b>Model for Unit: Cyclone</b>											
2												
3												
4	<b>Model Summary</b>											
5		<b>Feed</b>	<b>cyclone floats</b>	<b>cyclone sinks</b>	<b>Audit Check</b>							
6	<b>Solids t/h</b>	252.537	104.594	147.943	OK							
7	<b>Water t/h</b>	0.00	0.00	0.00	OK							
8	<b>% Solids</b>	100.00	100.00	100.00								
9	<b>FeSi t/h</b>	0.00	0.00	0.00	OK							
10	<b>Assay 1</b>	0.00	0.00	0.00								
11												
12	<b>Model Parameters</b>											
13	<b>Water Split</b>											
14	Water Split to cyclone floats					0.50						
15	<b>Medium Split</b>											
16	Medium split to cyclone floats					0.50						
17	<b>Tromp Curve Parameters (to cyclone floats)</b>					<b>SG</b>						
18						Floats - 2.50	2.50 - 3.00	3.00 - 3.50	3.50 - Sinks			
19		<b>Size</b>		<b>Ep</b>	<b>Rho50</b>	2.25	2.75	3.25	3.75			
20		+20	22.36	0.05	3.10	1.000	1.000	0.036	0.000			
21		+15	17.32	0.05	3.10	1.000	1.000	0.036	0.000			
22		+10	12.25	0.05	3.10	1.000	1.000	0.036	0.000			
23		+5	7.07	0.05	3.10	1.000	1.000	0.036	0.000			
24		-5	3.54	0.05	3.10	1.000	1.000	0.036	0.000			

Figure 19: The Unit\_Cyclone sheet

- 4.4.1 Enter the Ep values for the different size fractions in column E (0.05).
- 4.4.2 Enter the cut point density in the cyclone in column F (3.10).
- 4.4.3 One can see the effect of the Ep and cut point values by looking at the partition fractions for the split to the cyclone floats in the SG table.

### 4.5 The Unit\_Screen sheet

	A	B	C	D	E	F	G	H	
1		<b>Model for Unit_Screen</b>							
2		<b>Model Summary</b>							
3									
4									
5			Feed	cyclone feed	screen undersize	Audit Check			
6		Solids t/h	500.00	252.537	247.463	OK			
7		Water t/h	0.00	0.00	0.00	OK			
8		% Solids	100.00	100.00	100.00				
9		FeSi t/h	0.00	0.00	0.00	OK			
10		Assay 1	0.00	0.00	0.00				
11									
12									
13									
14									
15		<b>Model Parameters</b>							
16		Water Split							
17			Water split to cyclone feed	0.50					
18		Medium Split							
19			Medium split to cyclone feed	0.50					
20									
21									
22									
23									
24		<b>Efficiency Curve Parameters - to Oversize</b>							
25			Alpha	30.00	<b>SG</b>				
26			Rf	0.01	Floats - 2.50	2.50 - 3.00	3.00 - 3.50	3.50 - Sinks	
27			Nominal Aperture	5.00	2.25	2.75	3.25	3.75	
28			SG specific d <sub>50</sub>		5.00	5.00	5.00	5.00	
29			+20	22.36	1.000	1.000	1.000	1.000	
30			+15	17.32	1.000	1.000	1.000	1.000	
31			+10	12.25	1.000	1.000	1.000	1.000	
32			+5	7.07	1.000	1.000	1.000	1.000	
33			-5	3.54	0.010	0.010	0.010	0.010	

Figure 20: The Unit\_Screen sheet

- 4.5.1 Enter the Alpha value (30) in cell D25.
- 4.5.2 Enter the Rf value (0.01) in cell D26.
- 4.5.3 Enter the Nominal screen aperture in cell D27.
- 4.5.4 One can observe the effect of the variables on the split to cyclone feed by the partition fractions in the SG table.

## 4.6 The DataBlocks sheet

	A	B	C	D
1				
2		Number of cell rows to display		1
3		Number of cell columns to display		1
4				
5			Row	Column
6		Legend / Drop down location	1	7
7				
8		Add data blocks to flowsheet (below stream labels)		
9				
10				
11		Add data blocks to flowsheet, (adjacent to stream segment 1)		
12				
13				
14				
15		Remove data blocks from flowsheet		
16				
17				
18				
19				
20				
21				
22				

Figure 21: DataBlocks sheet

- 4.6.1 Change the number of rows to display to 1.
- 4.6.2 Change the number of columns to display to 1.
- 4.6.3 Click on the add datablocks adjacent to stream segment button.
- 4.6.4 Click on the flowsheet.
- 4.6.5 Click the Limn:Draw button and position the datablocks as required.
- 4.6.6 Save the workbook.

## 5. RUNNING THE LIMN SOLVER

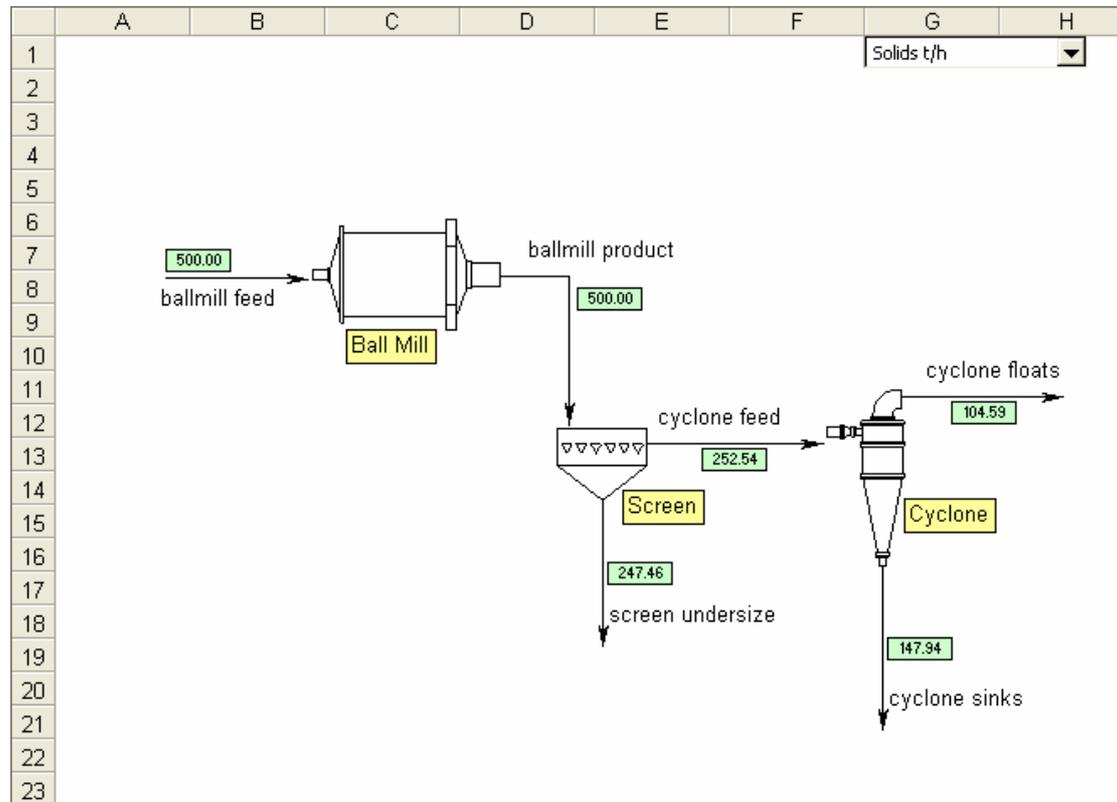


Figure 22: The solved flowsheet

5.1 Click on the flowsheet sheet.

5.2 Click on the Limn: Solve button. 

5.3 Check that the values for the different streams are the same as figure 22 above.

5.4 Click on the Summary sheet.

	A	B	C	D	E	F	G	H																																										
1	<table border="1"> <thead> <tr> <th>Stream</th> <th>Solids t/h</th> <th>Water t/h</th> <th>% Solids</th> <th>FeSi t/h</th> <th>Assay 1</th> </tr> </thead> <tbody> <tr> <td>ballmill feed</td> <td>500.00</td> <td>0.00</td> <td>100.00</td> <td>0.00</td> <td>0.00</td> </tr> <tr> <td>ballmill product</td> <td>500.00</td> <td>0.00</td> <td>100.00</td> <td>0.00</td> <td>0.00</td> </tr> <tr> <td>cyclone feed</td> <td>252.54</td> <td>0.00</td> <td>100.00</td> <td>0.00</td> <td>0.00</td> </tr> <tr> <td>cyclone floats</td> <td>104.59</td> <td>0.00</td> <td>100.00</td> <td>0.00</td> <td>0.00</td> </tr> <tr> <td>cyclone sinks</td> <td>147.94</td> <td>0.00</td> <td>100.00</td> <td>0.00</td> <td>0.00</td> </tr> <tr> <td>screen undersize</td> <td>247.46</td> <td>0.00</td> <td>100.00</td> <td>0.00</td> <td>0.00</td> </tr> </tbody> </table>								Stream	Solids t/h	Water t/h	% Solids	FeSi t/h	Assay 1	ballmill feed	500.00	0.00	100.00	0.00	0.00	ballmill product	500.00	0.00	100.00	0.00	0.00	cyclone feed	252.54	0.00	100.00	0.00	0.00	cyclone floats	104.59	0.00	100.00	0.00	0.00	cyclone sinks	147.94	0.00	100.00	0.00	0.00	screen undersize	247.46	0.00	100.00	0.00	0.00
Stream									Solids t/h	Water t/h	% Solids	FeSi t/h	Assay 1																																					
ballmill feed									500.00	0.00	100.00	0.00	0.00																																					
ballmill product									500.00	0.00	100.00	0.00	0.00																																					
cyclone feed									252.54	0.00	100.00	0.00	0.00																																					
cyclone floats									104.59	0.00	100.00	0.00	0.00																																					
cyclone sinks									147.94	0.00	100.00	0.00	0.00																																					
screen undersize									247.46	0.00	100.00	0.00	0.00																																					
2																																																		
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5																																																		
6																																																		
7																																																		
8																																																		
9																																																		
10																																																		

Figure 23: Summary sheet

5.5 Check that the values are the same as figure 23 above.

5.6 Save the workbook.

## 6. THE STREAM DATA SHEET

Click on the Stream Data sheet.

**Stream Summary - % SG in each Size interval**

ballmill feed		SG						
Solids t/h	500.00	Floats - 2.50	2.50 - 3.00	3.00 - 3.50	3.50 - Sinks	Size		
Water t/h	0.00	2.25	2.75	3.25	3.75	Distribution		
% Solids	100.0	+20	22.36	10.00	30.00	40.00	20.00	40.00
FeSi t/h	0.00	+15	17.32	10.00	30.00	40.00	20.00	20.00
Assay 1	0.00	+5	7.07	10.00	30.00	40.00	20.00	10.00
		-5	3.54	10.00	30.00	40.00	20.00	5.00
		SG Distribution		10.00	30.00	40.00	20.00	

**Mass in each SG / Size interval**

ballmill feed		SG					
Solids t/h	500.00	Floats - 2.50	2.50 - 3.00	3.00 - 3.50	3.50 - Sinks	Water t/h	
Water t/h	0.00	2.25	2.75	3.25	3.75	0.00	
% Solids	100.00	+20	22.36	20.00	60.00	80.00	40.00
FeSi t/h	0.00	+15	17.32	12.50	37.50	50.00	25.00
Assay 1	0.0	+10	12.25	10.00	30.00	40.00	20.00
		+5	7.07	5.00	15.00	20.00	10.00
		-5	3.54	2.50	7.50	10.00	5.00

Figure 24: The Stream Data sheet

The table at the top of the sheet (shaded grey) is a % PSD lookup table.

One can select any of the streams by using the drop down list in cell B3.

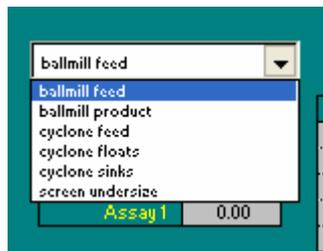


Figure 25: Stream drop down list

The tables below are the mass of material per size interval per size fraction for each of the streams.

### APPENDIX A: GENERAL (SG X SIZE) WORKED EXAMPLE

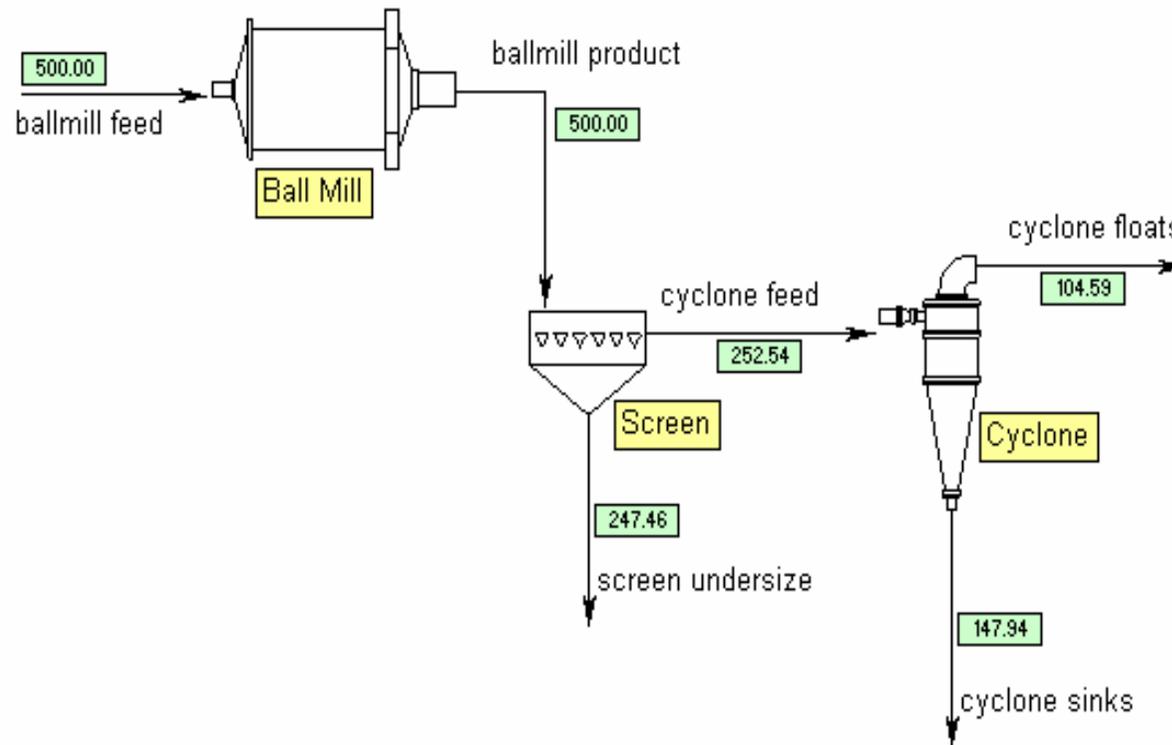


Figure 26: General (SG x Size) wizard example