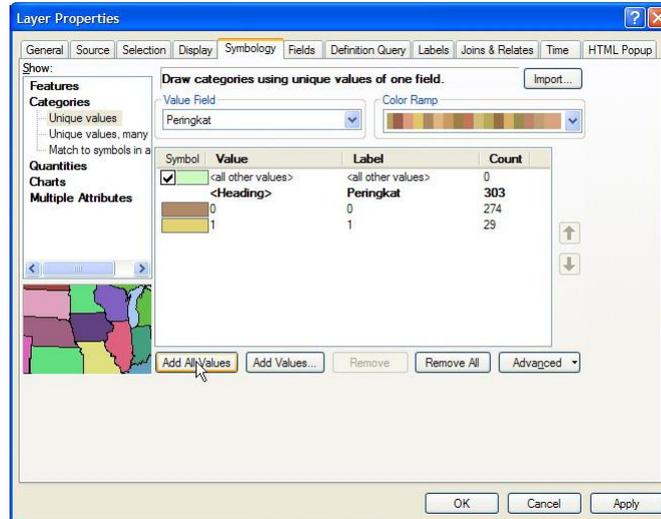
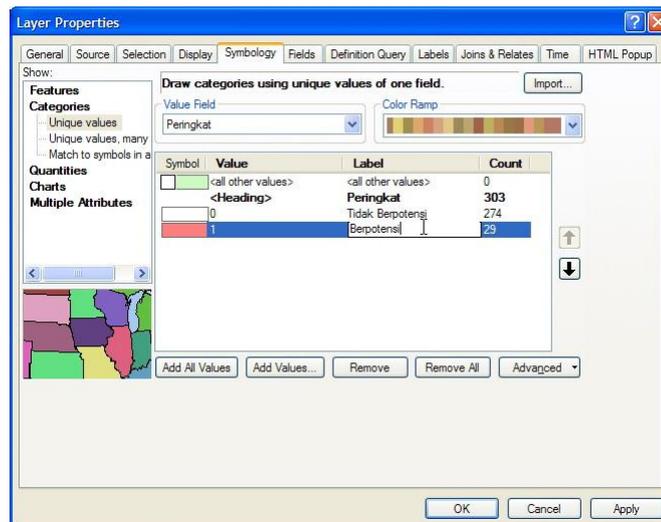


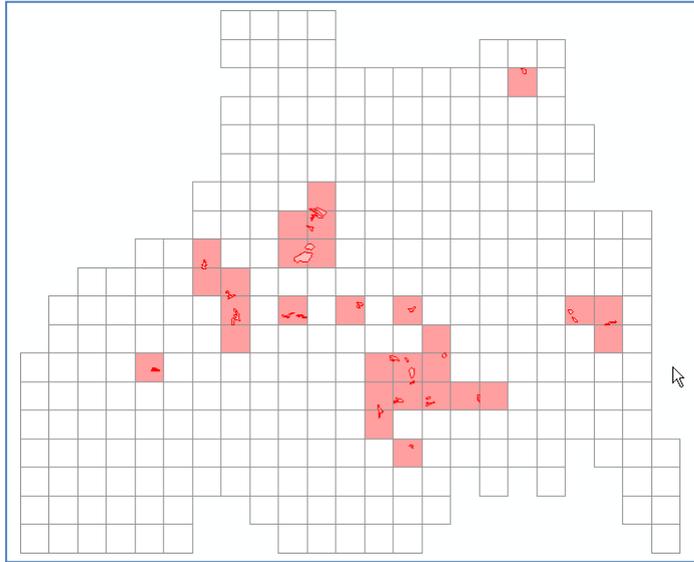
- 23) On part of Show: choose Categories and choose Unique values. On combo box of Value Field, choose Peringkat. Click Add All Values button, to display the values contained in the column “Peringkat”.



- 24) Changes the symbol for the value 0 become white color, and symbol for the value 1 become “Medium Coral Light” color. Change the label of the value 0 become “Tidak Berpotensi”, and for the value 1 become “Berpotensi”. Uncheck <all other values>. Press OK button.



- 25) The figure below shows the subarea data that potentially occur landslide based on the red color of the subarea. If the data of this subarea intersect to the "landslides area past" layer, the position correlation can be seen clearly.

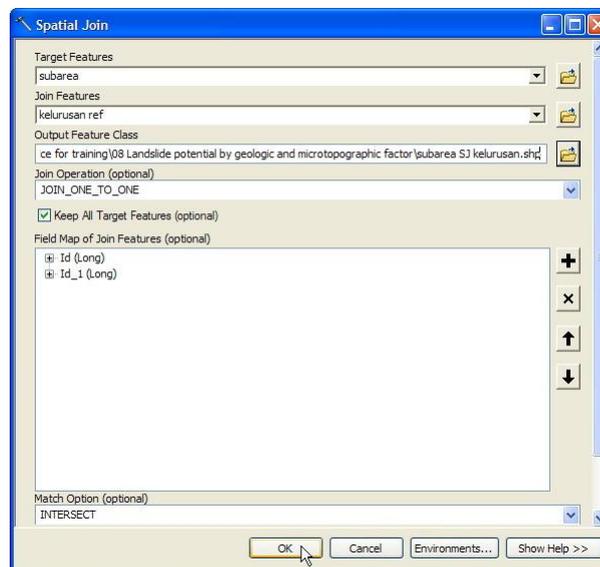


- 26) Save the ArcMap workspace into the folder: Data source for training\07 Landslide potential by past landslide factor, and give name "Potensi longsor dari kejadian longsor masa lalu.mxd".

III. Making Landslide Potential Map Based On Geological and Micro-topographic Factor

Step 1. Intersection of geological elements and micro-topographic data with sub-area data

- 1) Open/run ArcMap, choose Blank Map.
- 2) Input the file of “subarea ref.shp”, “kelurusan ref.shp”, “punggung bukit rata ref.shp”, “rayapan batu massal ref.shp” and “retakan busur lingkar ref.shp”, from the folder: Ref, into ArcMap workspace.
- 3) Run the toolbox of Spatial Join. On combo box of Target Features, choose “subarea ref” layer. On combo box of Join Features, choose “kelurusan ref”. On text box of Output Feature Class, save the file into the folder: Data source for training\08 Landslide potential by geologic and microtopographic factor, and give name “subarea SJ kelurusan.shp”. On combo box of Join Operation, choose JOIN_ONE_TO_ONE. Check “Keep All Target Features”. On combo box of Match Option, choose INTERSECT. Click OK button.



- 4) Do the steps of number 5 above for these elements with the parameter of Spatial Join toolbox:
 - punggung bukit rata ref; Join Features: punggung bukit rata ref, Output Feature Class: give name “subarea SJ punggung bukit rata.shp”
 - rayapan batu massal ref; Join Features: rayapan batu massal ref, Output Feature Class: give name “subarea SJ rayapan batu massal.shp”
 - retakan busur lingkar ref; Join Features: retakan busur lingkar ref, Output Feature Class: give name “subarea SJ retakan busur lingkar.shp”

Step 2. Processing of data table and determination of the two best elements

- 1) On this step we will find the best two (from four element), which are elements that has the highest value of hitting ratio and cover ratio.
- 2) Open file of “Analisa potensi longsor - source.xlsx”, and open sheet “Ekstraksi elemen geologi”. In this sheet there are two main column. The first main column contains subarea ID and landslide potential that has obtained from the previous step. The second main column is a template to insert data or the value of intersection results of geological and micro-topographic elements with subarea data. From this template, can be seen that there are places for four elements that are kelurusan, punggung bukit rata, rayapan batu massal, and retakan busur lingkaran.

In the main column of “Elemen-elemen faktor geologi dan mikrotopografi” there are several column for each element represented by specific color.

The green column represents kelurusan elements. Sub-column of “Jumlah elemen kelurusan” contains value that shows the total of kelurusan elements that intersect with a subarea; sub-column “Kehadiran elemen kelurusan” contains value that shows subarea that intersect with kelurusan elements; sub-column “Nilai S2 dari elemen kelurusan” contains value that shows subarea that potential to landslide and also intersect with kelurusan element.

And so forth for the element columns that are represented by another color.

- 3) By using Windows Explorer, enter into folder: Data source for training\08 Landslide potential by geologic and microtopographic factor. Open the file of “subarea SJ kelurusan.dbf” using Microsoft Excel.
- 4) Copy all of the content of column “Join_Count” and paste into column “Jumlah elemen kelurusan” on sheet “Ekstraksi elemen geologi” (Analisa potensi longsor - source.xlsx).

- 5) Do the copy and paste procedure of the content of column Join_Count for others elements with the following order:
 - punggung bukit rata (gentle ridge top)
 - rayapan batu massal (mass rock creep slope)
 - retakan busur lingkaran (circular arc crack)

6) Figure below is the view of the bottom of table that shows the total number of each column.

302	298	0	1	1	0	0	0	0	0	0	0	0	0	0
303	299	0	1	1	0	0	0	0	0	0	0	0	0	0
304	300	0	0	0	0	0	0	0	0	0	0	0	0	0
305	301	0	0	0	0	0	0	0	0	0	0	0	0	0
306	302	0	0	0	0	0	0	0	0	0	0	0	0	0
307	303	0	0	0	0	0	0	0	0	0	0	0	0	0
308		29	12	11	1	7	7	2	16	15	2	37	20	4
309														
310			S1	S2	S3	Hitting	Cover							
311	kelurusan	29	1	11	0.09	0.03								
312	punggung bukit rata	29	2	7	0.29	0.07								
313	rayapan batu massal	29	2	15	0.13	0.07								
314	retakan busur lingkak	29	4	20	0.20	0.14								
315	longsoran	29	29	303	0.10									

At the bottom of the table, there is a small table showing the three parameter values for the calculation of hitting ratio and cover ratio i.e. S1, S2 and S3.

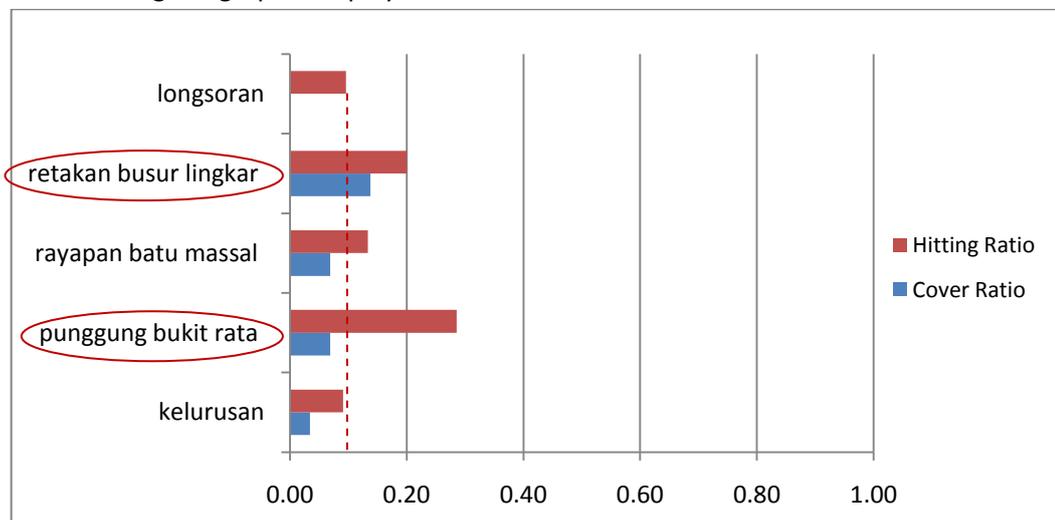
S1 is the number of subarea that have experienced landslide events, in this case there are 29 subarea.

S3 is the number of subarea that intersects with certain types elements. In this case, there are 11 subareas for kelurusan element, there are 7 subareas for punggung bukit rata element, there are 15 subarea for rayapan batu massal element, and there are 20 subareas for retakan busur lingkak element.

S2 is the number of subarea that intersects with certain types of elements and subarea that potential to landslide. In this case, there are 1 subarea for kelurusan element, 2 subareas for punggung bukit rata element, 2 subarea for rayapan batu massal, and 4 subarea for retakan busur lingkak elements.

On the table, there is also the value of S2 and S3 for the landslide events, where the value of S2 for landslide event is subarea number that experienced landslide events, while the value of S3 is the total subarea. We intend to find the hitting ratio of the landslide event to compare it with the hitting ratio from the other elements.

7) The following is a graphic display of its values.



Based on the data above, select two elements that have the highest value of hitting ratio and higher than the value of landslide events hitting ratio. Therefore, the selected element are element of "punggung bukit rata" and "retakan busur lingkak".

Step 3. Processing of data tables and the determination of the two best combination of elements

1) After known two elements of geological and micro-topographic that has the highest value of hitting ratio and cover ratio, the next step is to find the combination of element presence in its correlation with landslide events in a subarea.

Open file of "Analisa potensi longsor - source.xlsx", and open sheet "Kombinasi elemen".

2) The first and the second column is a copy or link from column "ID subarea" and column "Potensi longsor" from sheet "Analisa potensi longsor".

"Elemen 1 (A)" contains the parameter value of S3 that is a link from column "Kehadiran elemen punggung bukit rata", and the parameter value of S2 that is a link from column "Nilai S2 dari elemen punggung bukit rata".

"Elemen 2 (B)" contains the parameter value of S3 that is a link from column "Kehadiran elemen retakan busur lingkaran", and the parameter value of S2 that is a link from column "Nilai S2 dari elemen retakan busur lingkaran".

Kombinasi elemen geologi dan mikrotopografi										
			Elemen 1 (A)		Elemen 2 (B)		A dan B		A atau B	
	ID subarea	Potensi longsor	S3	S2	S3	S2	S3	S2	S3	S2
5	1	0	0	0	0	0	0	0	0	0
6	2	0	0	0	0	0	0	0	0	0
7	3	0	0	0	0	0	0	0	0	0
8	4	0	0	0	0	0	0	0	0	0
9	5	0	0	0	0	0	0	0	0	0
10	6	0	0	0	0	0	0	0	0	0
11	7	0	0	0	0	0	0	0	0	0
12	8	0	0	0	0	0	0	0	0	0
13	9	0	0	0	0	0	0	0	0	0
14	10	0	0	0	0	0	0	0	0	0
15	11	0	0	0	0	0	0	0	0	0

If Elemen 1 considered as A and Elemen 2 considered as B, so the possible combination from the two elements are "only A", "only B", "A and B", "A or B". Therefore the third and the fourth column is a combination of "A and B", "A or B".

The value of S3 in column "A and B" based on requirement: if the value of S3 in column A and column B both value is 1, so the value of S3 in column "A and B" will have value of 1, whereas if one or none of which have value of 1, so the value of S3 on column "A and B" will have value of 0.

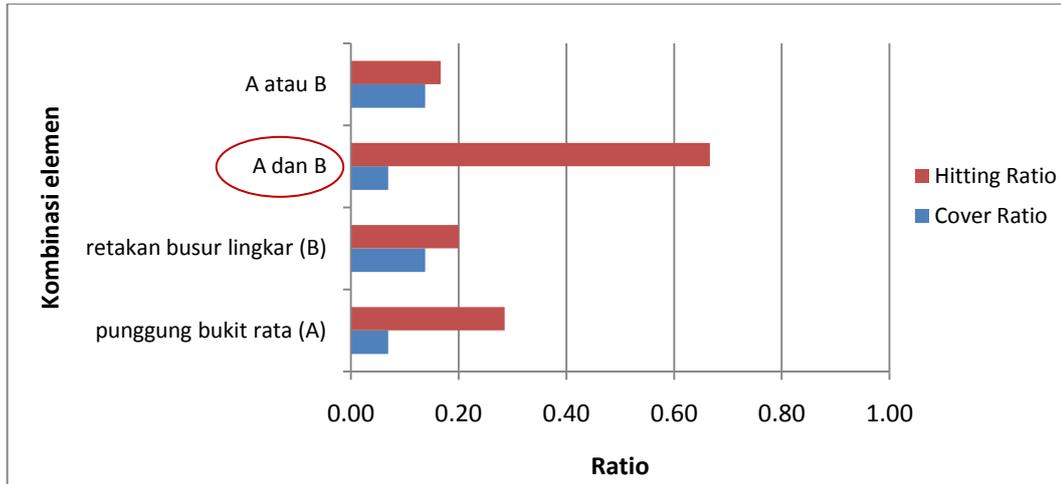
The value of S3 in column "A or B" based on requirement: if the value of S3 in column A and column B one or even both have value of 1, so the value of S3 in column "A and B" will have value of 1, whereas both column have value of 0, so the value of S3 on column "A and B" will have value of 0.

S2 value in column "A and B" or "A or B" is obtained by correlating the value 1 in column S3 with value of 1 in column "Potensi longsor".

3) The figure below is a view from the bottom of the table that shows the total of each column.

303	299	0	0	0	0	0	0	0	0	0
304	300	0	0	0	0	0	0	0	0	0
305	301	0	0	0	0	0	0	0	0	0
306	302	0	0	0	0	0	0	0	0	0
307	303	0	0	0	0	0	0	0	0	0
308		29	7	2	20	4	3	2	24	4
309										
310				S1	S2	S3	Hitting	Cover		
311	punggung bukit rata (A)			29	2	7	0.29	0.07		
312	retakan busur lingkaran (B)			29	4	20	0.20	0.14		
313	A dan B			29	2	3	0.67	0.07		
314	A atau B			29	4	24	0.17	0.14		

4) The following is a view the graph.



Based on the above chart, from the four combinations, select the combination of "A and B" because it has that largest value of hitting ratio (0.67).

[Another option: in fact we can choose circular arc cracks (B) because it has a value of hitting ratio and cover ratio that relatively big and balanced than others. We choose this option if you prefer the coverage parameters to be addressed]

Step 4. Making landslide potential area

1) Open sheet "Analisa potensi longsor". Connect the column "Potensi longsor berdasarkan faktor geologi dan mikrotopografi" with column "Elemen 3" sheet "Ekstraksi elemen geologi".

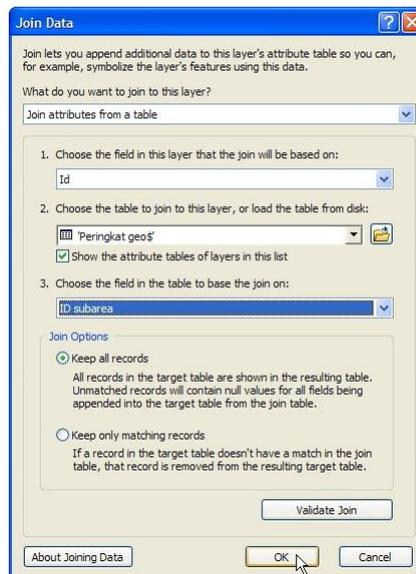
ANALISA POTENSI LONGSOR						Ekstraksi elemen geologi				
ID subarea	Faktor kejadian longsor gelincir		Faktor-faktor geologi dan mikrotopografi		Faktor topografi		Elemen 2 (B)		Elemen 3 (A dan B)	
	Jumlah kejadian longsor per subarea	Potensi longsor berdasarkan kejadian longsor masa lalu	Potensi longsor berdasarkan faktor geologi dan mikrotopografi	Jumlah titik potensi longsor	Potensi longsor berdasarkan faktor topografi (jumlah titik potensi longsor ≥ 25)	S3	S2	S3	S2	
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0

- 2) Open sheet “Peringkat geo”.

In this sheet, the first row is the column title, whereas from the second row and so forth on the first column contain or a link from column “ID subarea” sheet “Analisa potensi longsor”, and the second column contain or a link from column “Potensi longsor berdasarkan faktor geologi dan mikrotopografi” sheet “Analisa potensi longsor”.

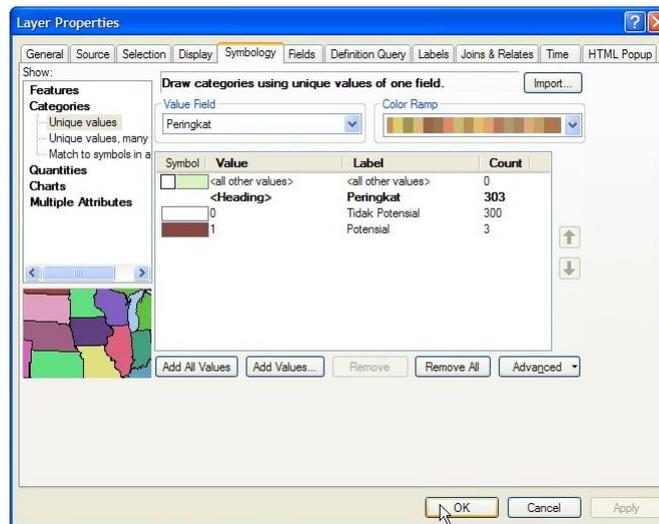
	A	B
1	ID subarea	Peringkat
2	1	0
3	2	0
4	3	0
5	4	0
6	5	0
7	6	0
8	7	0
9	8	0
10	9	0
11	10	0

- 3) Save the file of “Analisa potensi longsor - source.xlsx”.
- 4) On ArcMap workspace, click Add Data, then point into folder: Data source for training.
- 5) Double click file of “Analisa potensi longsor - source.xlsx”, then double click “Peringkat geo\$”.
- 6) Automatically, sheet or data from Peringkat longsor will enter to ArcMap workspace. This data will appear in Table Of Contents on part of “List By Source”.
- 7) On Table Of Contents window, press List By Drawing Order  button.
- 8) Next, connect the data from sheet “Peringkat geo” with the attribute data on “subarea ref” layer based on the same subarea ID.
Right click “subarea” layer, point the cursor to Joins and Relates, then click Join.
- 9) Next will appear Join Data window. On combo box of What do you want to join to this layer, choose Join attributes from a table. On combo box 1, choose Id. On combo box 2, choose Peringkat geo\$. On combo box 3, choose ID subarea. On radio button of Joins Options, choose Keep all records. Click OK button.

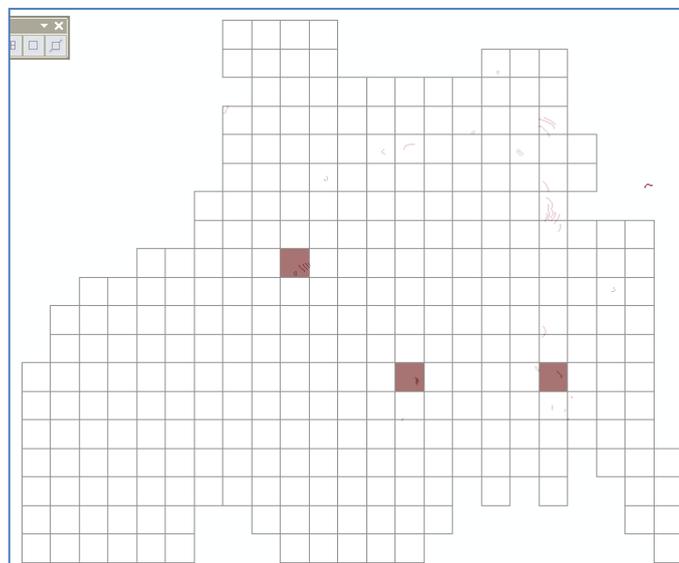


- 10) Right click “subarea” layer, point the cursor to Data, then click Export Data. Input the data that will be exported into folder: Data source for training\08 Landslide potential by geologic and mikrotopographic factor, and give name “potensial longsor berdasarkan geologi dan mikrotopografi.shp”. If there is question whether the exported data will be incorporated into ArcMap as a layer, answer Yes.

- 11) Right click “subarea ref” layer, point the cursor to Joins and Relates, then Remove Join(s) and click Remove All Joins.
- 12) Open attribute table of “potensi longsor berdasarkan geologi dan mikrotopografi” layer.
- 13) Right click “potensi longsor berdasarkan geologi dan mikrotopografi” layer and click Properties. On Layer Properties window, click Symbologi tab.
- 14) On part of Show: choose Categories and choose Unique values. On combo box Value Field, choose Peringkat. Click Add All Values button to shows the values contained in the of “Peringkat”. Changes the symbol for value 0 become white color, and symbol for value 1 become Cordovan Brown. Change the label of value 0 become “Tidak Berpotensi”, and for value 1 become “Berpotensi”. Press OK button.



- 15) The figure below shows the subarea data that potential to landslides based on a brown color subarea.

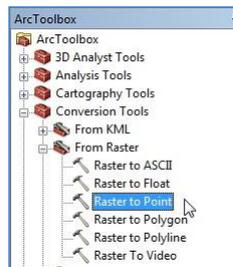


- 16) Save the ArcMap workspace into folder: Data source for training\08 Landslide potential by geologic and microtopographic factor, and give name “Potensi longsor berdasarkan geologi dan mikrotopografi”.

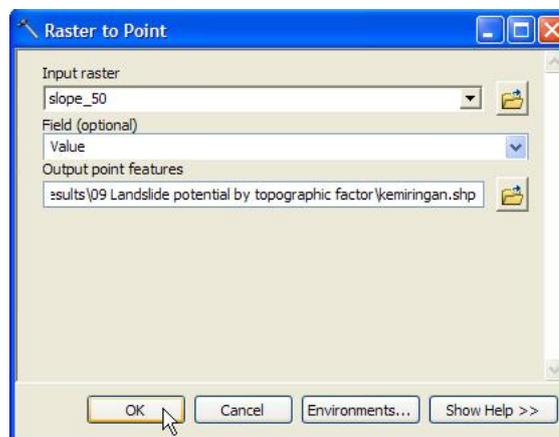
IV. Making Landslide Potential Map Based On Topographic Factor

Step 1. Making point data of slope and flow accumulation

- 1) Open/run ArcMap, choose Blank Map.
- 2) Insert file of “area longsoran masa lalu ref.shp” and “subarea ref.shp” from the folder: Ref, to ArcMap workspace.
- 3) Insert data of “slope_50” and “flowacc_50” from the folder: Data source for training\02 Contour data, to ArcMap workspace.
- 4) On ArcToolbox window, click + symbol on Conversion Tools, + symbol on From Raster, and click Raster to Point.



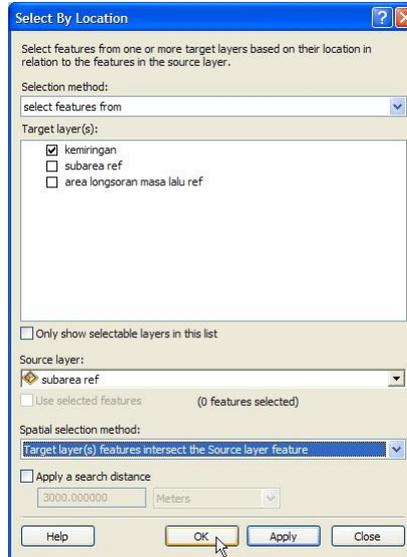
- 5) Next will appear Raster to Point window. On combo box of Input raster, choose “slope_50” layer. On combo box of Field, choose “Value”. On text box of Output point features, save the file into folder: Data source for training\09 Landslide potential by topographic factor, and give name “kemiringan.shp”. Next, will be formed “kemiringan” layer on Table of Contents of point data type.



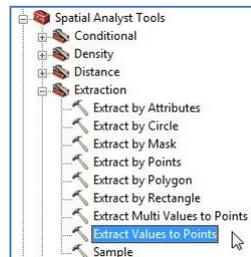
- 6) Open attribute table of “kemiringan” layer. In the attribute table of “kemiringan” layer, there are 2 column the formed that are column POINTID and column GRID_CODE. Column POINTID is ID number of each point, whereas GRID_CODE is the slope value in degree unit.

FID	Shape	POINTID	GRID_CODE
0	Point	1	2.706166
1	Point	2	5.860766
2	Point	3	7.204185
3	Point	4	9.154304
4	Point	5	3.592987
5	Point	6	8.209748
6	Point	7	12.667302
7	Point	8	10.357451
8	Point	9	13.078086

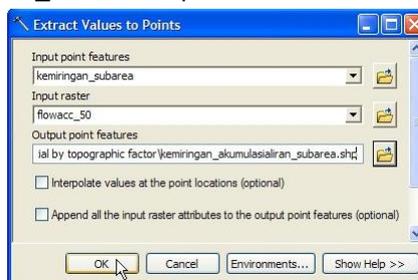
- 7) Click Selection on ArcMap main menu, then click Select By Location. Next will appear Select By Location window.
- 8) On combo box of Selection method, choose “select features from” and choose “kemiringan”. On combo box of Source layer, choose “subarea ref” layer. On combo box of Spatial selection method, choose Target layer(s) features intersect the Source layer feature. Click OK button.



- 9) After seen the selected data from “kemiringan” layer, next step is to export the selected data. Right click “kemiringan” layer, point the cursor to Data, then click Export Data. Give name “kemiringan_subarea.shp”.
- 10) On ArcToolbox window, click + symbol on Spatial Analyst Tools, + symbol on Extraction, double click on Extract Values to Points. Next will appear Extract Values to Points window.



- 11) On combo box of Input point features, choose “kemiringan_subarea” layer. On combo box of Input raster, choose “flowacc_50” layer. On text box of Output point features, save the file into folder: Data source for training\09 Landslide potential by topographic factor, give name “kemiringan_akumulasi aliran_subarea.shp”. Click OK button.



- 12) Below is the attribute table from “kemiringan_akumulasi aliran_subarea” layer. There is additional column that is RASTERVALU that contains the value of accumulation flow.

FID	Shape	POINTID	GRID_CODE	RASTERVALU
0	Point	29123	26.690792	136
1	Point	29124	27.623725	134
2	Point	29125	23.924046	130
3	Point	29126	21.612429	122
4	Point	29127	23.77759	106
5	Point	29128	26.671526	104
6	Point	29129	24.385925	100
7	Point	29130	22.740812	2
8	Point	29131	25.597136	0
9	Point	29132	23.747484	1
10	Point	29133	16.912209	1

- 13) Click Selection on ArcMap main menu, then click Select By Location.
 14) On Select By Location window, on combo box of Selection method, choose select features from. On Target layer(s), check “kemiringan_akumulasi aliran_subarea”. On combo box Source layer, choose layer “area longsor masa lalu ref”. On combo box Spatial selection method, choose Target layer(s) features intersect the Source layer feature. Click OK button.



- 15) After seen the selected data, next step is exporting the selected data. Right click “kemiringan_akumulasi aliran_subarea” layer, point the cursor to Data, and then click Export Data. Give name “kemiringan_akumulasi aliran_subarea_longsor.shp”.

Step 2. Determinaton of landslide potential points

- 1) Open file of “Tabulasi titik potensi longsor berdasarkan topografi - source.xlsx” contained in the folder: Data source for training.
 2) Below is the view of the content of “Tabulasi titik potensi longsor berdasarkan topografi - source.xlsx” file.

	A	B	C	D	E	F	G	H
	ID titik	Luas piksel	Nilai kemiringan	Nilai akumulasi aliran	Luas piksel * Akumulasi aliran	log(Luas piksel * Akumulasi aliran)	Seleksi titik potensial longsor	Titik potensi longsor
1								
2	29720	2500	8.5601	0	0	0.00	FALSE	0
3	29721	2500	8.96	0	0	0.00	FALSE	0
4	29722	2500	10.9957	0	0	0.00	FALSE	0
5	29723	2500	13.4148	0	0	0.00	FALSE	0
6	29724	2500	17.25	0	0	0.00	FALSE	0
7	29725	2500	17.0176	1	2500	3.40	FALSE	0
8	29726	2500	13.4622	16	40000	4.60	FALSE	0
9	29727	2500	11.9036	14	35000	4.54	FALSE	0
10	29728	2500	9.9516	13	32500	4.51	FALSE	0
11	29729	2500	7.0239	12	30000	4.48	FALSE	0

Inside sheet “subarea”,

The first column (A) is “ID titik”, which is ID from data of “kemiringan_akumulasi_aliran_subarea” or “kemiringan_akumulasi_aliran_subarea_longSORan”.

Column “Luas piksel” (B), contains the pixel area that is $50 * 50 = 2500$.

Column “Nilai kemiringan” (C), contains the value of slope from data of “kemiringan_akumulasi_aliran_subarea” or “kemiringan_akumulasi_aliran_subarea_longSORan”.

Column “Nilai akumulasi aliran” (D), contains the value of flow accumulation from data of “kemiringan_akumulasi_aliran_subarea” or “kemiringan_akumulasi_aliran_subarea_longSORan”.

Column “Luas piksel * Akumulasi aliran” (E), contains the value of the product of column (B) and column (D).

Column “log(Luas piksel * Akumulasi aliran)” (F), contains the logarithmic value from column (E).

Column “Seleksi titik potensi longSOR” (G), contains identity whether if a point has the potential of landslides or not.

Column “Titik potensi longSOR” (H), contains the value 1 and 0 result from conversion from column G column.

- 3) By using Windows Explorer, enter to the folder: Data source for training\09 Landslide potential by topographic factor, and open file of “kemiringan_akumulasi_aliran_subarea.dbf” using Microsoft Excel.
- 4) Copy all of the content of column “POINTID” (A), start from second row until the last.

	A	B	C
1	POINTID	GRID_CODE	RASTERVALU
2	29123	26.69079208	136.00000000
3	29124	27.82372475	134.00000000
4	29125	23.92404556	130.00000000
5	29126	21.61242867	122.00000000
6	29127	23.77758980	106.00000000
7	29128	26.67152596	104.00000000
8	29129	24.36592484	100.00000000
9	29130	22.74081230	2.00000000
10	29131	25.59713554	0.00000000

- 5) Paste the data to column “ID titik”, sheet “subarea”, file of “Tabulasi titik potensi longSOR berdasarkan topografi - source.xlsx”.

	A	B	C	D	E	F
	ID titik	Luas piksel	Nilai kemiringan	Nilai akumulasi aliran	Luas piksel * Akumulasi aliran	log(Luas piksel * Akumulasi aliran)
1						
2	29123	2500	8.5601	0	0	0.00
3	29124	2500	8.96	0	0	0.00
4	29125	2500	10.9957	0	0	0.00
5	29126	2500	13.4148	0	0	0.00
6	29127	2500	17.25	0	0	0.00
7	29128	2500	17.0176	1	2500	3.40
8	29129	2500	13.4622	16	40000	4.60
9	29130	2500	11.9036	14	35000	4.54
10	29131	2500	9.9516	13	32500	4.51
11	29132	2500	7.0239	12	30000	4.48

- 6) Fill the entire row on column “Luas piksel” with the value 2500.
- 7) Copy all of content of column “GRID_CODE”, and paste to column “Nilai kemiringan” on sheet “subarea”.
- 8) Copy all of content of column “RASTERVALU”, and paste to column “Nilai akumulasi aliran” on sheet “subarea”.

- 9) Fill the column E by using formula “=B2*D2”.
- 10) Fill the column F where the value on column F should be rounded into two numbers behind comma by using ROUND formula. Here is a sample formula for column F “=ROUND(IF(E2=0,0,LOG(E2)),2)”.
- 11) Do the steps number 3 – 10 above for “kemiringan_akumulasioaliran_subarea_longSORAN.dbf” file contained in the folder: Data source for training\09 Landslide potential by topographic factor. Copy and paste the entire data into sheet “longSORAN”.
- 12) The following is a table contained in the sheet "subarea" (similar to that in the sheet "longSORAN"), along with the explanation of each part of the table.

	J	K	L	M	N	O	P	Q	R	S
The range of log values (pixel area * accumulated flow)		3.4 - 3.7	3.7 - 3.88	3.88 - 4.1	4.1 - 4.44	4.44 - 4.72	4.72 - 5.11	5.11 - 5.4	5.4 - 5.7	5.7 <
	0 - 10	2366	1343	1463	1606	967	1130	801	840	3148
	10 - 15	2563	1332	1421	1430	770	825	552	564	1144
	15 - 20	2990	1539	1483	1409	779	722	401	369	653
The number of points corresponding range of values of slope and log(area of pixels * accumulated flow)	20 - 25	3011	1612	1384	1370	612	555	286	225	371
	25 - 30	2997	1580	1429	1209	503	371	165	89	165
	30 - 35	2941	1580	1286	1016	364	251	112	55	110
	35 - 40	2402	1279	1037	711	255	160	64	34	60
	40 <	3376	1997	1845	1406	440	258	79	22	58
									Total Mesh	75742

This table is located to the right of the previous columns (A – F), where the contents of this table is referenced to the content of column "nilai kemiringan" and column "log(Luas piksel * Akumulasi aliran)".

Here is a sample formula in the top left cell, =COUNTIFS(\$C2:\$C1048576,">=0",\$C2:\$C1048576,"<10",\$F2:\$F1048576,">=3.4",\$F2:\$F1048576,"<3.7)". The meaning of this formula is, count the number of points that meet the range of values of slope 0 - 10 degree and the log value range 3.4 - 3.7. Use this formula in each cell by replacing the value range.

- 13) The following is a table of sheet “longSORAN”.

	3.4 - 3.7	3.7 - 3.88	3.88 - 4.1	4.1 - 4.44	4.44 - 4.72	4.72 - 5.11	5.11 - 5.4	5.4 - 5.7	5.7 <
0 - 10	0	0	0	0	0	0	0	0	0
10 - 15	0	0	0	0	0	0	0	0	0
15 - 20	0	0	0	0	0	0	0	0	0
20 - 25	4	2	6	5	3	0	0	0	0
25 - 30	4	5	1	10	1	0	1	0	0
30 - 35	5	2	4	4	1	0	2	0	0
35 - 40	5	1	5	5	0	0	0	0	0
40 <	34	26	23	30	11	7	0	0	0
								Total Titik	207

- 14) Perform division process, where each table cell in a sheet "subarea" divided by each table cell in a sheet "longsoran". Value of the average ratio is the total point sheet "subarea" divided by the total point sheet "longsoran".

25		3.4 - 3.7	3.7 - 3.88	3.88 - 4.1	4.1 - 4.44	4.44 - 4.72	4.72 - 5.11	5.11 - 5.4	5.4 - 5.7	5.7 <
26	0 - 10	0	0	0	0	0	0	0	0	0
27	10 - 15	0	0	0	0	0	0	0	0	0
28	15 - 20	0	0	0	0	0	0	0	0	0
29	20 - 25	0.0013285	0.0012407	0.0043353	0.0036496	0.004902	0	0	0	0
30	25 - 30	0.0013347	0.0031646	0.0006998	0.0082713	0.0019881	0	0.0060606	0	0
31	30 - 35	0.0017001	0.0012658	0.0031104	0.003937	0.0027473	0	0.0178571	0	0
32	35 - 40	0.0020816	0.0007819	0.0048216	0.0070323	0	0	0	0	0
33	40 <	0.0100711	0.0130195	0.0124661	0.0213371	0.025	0.0271318	0	0	0
34										
35	Rasio rata-rata		0.003							

- 15) The following table is generated from each table cell division process of step 14, divided by the average ratio.

37		3.4 - 3.7	3.7 - 3.88	3.88 - 4.1	4.1 - 4.44	4.44 - 4.72	4.72 - 5.11	5.11 - 5.4	5.4 - 5.7	5.7 <
38	0 - 10	0	0	0	0	0	0	0	0	0
39	10 - 15	0	0	0	0	0	0	0	0	0
40	15 - 20	0	0	0	0	0	0	0	0	0
41	20 - 25	0.4860888	0.4539744	1.5862863	1.3354138	1.793644	0	0	0	0
42	25 - 30	0.4883595	1.1579221	0.2560556	3.0264961	0.7274421	0	2.2175963	0	0
43	30 - 35	0.6220731	0.4631688	1.1381132	1.4405645	1.0052291	0	6.533989	0	0
44	35 - 40	0.761664	0.2860855	1.76424	2.5731602	0	0	0	0	0
45	40 <	3.6850459	4.7638898	4.5613972	7.8073268	9.1475845	9.9276111	0	0	0

- 16) The following table is a final stage table showing the cells of step 15 table, which has value equal to or more than two times the average ratio values. The cells are indicated by the value "1000".

48		3.4 - 3.7	3.7 - 3.88	3.88 - 4.1	4.1 - 4.44	4.44 - 4.72	4.72 - 5.11	5.11 - 5.4	5.4 - 5.7	5.7 <
49	0 - 10	-	-	-	-	-	-	-	-	-
50	10 - 15	-	-	-	-	-	-	-	-	-
51	15 - 20	-	-	-	-	-	-	-	-	-
52	20 - 25	-	-	-	-	-	-	-	-	-
53	25 - 30	-	-	-	1.000	-	-	1.000	-	-
54	30 - 35	-	-	-	-	-	-	1.000	-	-
55	35 - 40	-	-	-	1.000	-	-	-	-	-
56	40 <	1.000	1.000	1.000	1.000	1.000	1.000	-	-	-

After the position of these cells is known, mark all the cells located on the right and below. In this step we know the range of slope and the value of log(luas piksel * akumulasi aliran) that potential to landslide.

- 17) Open again sheet "subarea", and mark or coloring table cells in this sheet according to the range value of slope and log (pixel area * accumulated flow) in step 16.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
	ID titik	Luas piksel	Nilai kemiringan	Nilai akumulasi aliran	Luas piksel * Akumulasi aliran	log(Luas piksel * Akumulasi aliran)	Seleksi titik potensial longsor	Titik potensi longsor			3.4 - 3.7	3.7 - 3.88	3.88 - 4.1	4.1 - 4.44	4.44 - 4.72	4.72 - 5.11	5.11 - 5.4	5.4 - 5.7	5.7 <	
1																				
2	29123	2500	26.69079208	136	340000	5.53	TRUE	1		0 - 10	2366	1343	1463	1606	967	1130	801	840	3148	
3	29124	2500	27.82372475	134	335000	5.53	TRUE	1		10 - 15	2563	1332	1421	1430	770	825	552	564	1144	
4	29125	2500	23.92404556	130	325000	5.51	TRUE	1		15 - 20	2990	1539	1483	1409	779	722	401	369	653	
5	29126	2500	21.61242867	122	305000	5.48	TRUE	1		20 - 25	3011	1612	1384	1370	612	555	286	225	371	
6	29127	2500	23.77758980	106	265000	5.42	TRUE	1		25 - 30	2997	1580	1429	1209	503	371	165	89	165	
7	29128	2500	26.67152596	104	260000	5.41	TRUE	1		30 - 35	2941	1580	1286	1016	364	251	112	55	110	
8	29129	2500	24.36592484	100	250000	5.40	TRUE	1		35 - 40	2402	1279	1037	711	255	160	64	34	60	
9	29130	2500	22.74081230	2	5000	3.70	FALSE	0		40 <	3376	1997	1845	1406	440	258	79	22	58	
10	29131	2500	25.59713554	0	0	0.00	FALSE	0											Total Titik	75742
11	29132	2500	23.74748421	1	2500	3.40	FALSE	0												
12	29133	2500	16.91220856	1	2500	3.40	FALSE	0											Jumlah titik potensi longsor =	15173
13	29134	2500	7.36267710	0	0	0.00	FALSE	0												
14	29135	2500	4.26277065	0	0	0.00	FALSE	0												

- 18) The next step is to create or define a formula for column G that is to find points that have same criteria with the specified range requirements. Inside the folder: Data source for training, open the file of "rumus penentuan titik potensi longsor.txt" in which there is a formula for the cell in column G. The following is a content of the formula:

```
IF(AND(C2>=25,C2<30,F2>=4.1,F2<4.44),1,0)
IF(AND(C2>=25,C2<30,F2>=4.44,F2<4.72),1,0)
IF(AND(C2>=25,C2<30,F2>=4.72,F2<5.11),1,0)
IF(AND(C2>=25,C2<30,F2>=5.11,F2<5.4),1,0)
IF(AND(C2>=25,C2<30,F2>=5.4,F2<5.7),1,0)
IF(AND(C2>=25,C2<30,F2>=5.7),1,0)
```

IF(AND(C2>=30,C2<35,F2>=4.1,F2<4.44),1,0)
 IF(AND(C2>=30,C2<35,F2>=4.44,F2<4.72),1,0)
 IF(AND(C2>=30,C2<35,F2>=4.72,F2<5.11),1,0)
 IF(AND(C2>=30,C2<35,F2>=5.11,F2<5.4),1,0)
 IF(AND(C2>=30,C2<35,F2>=5.4,F2<5.7),1,0)
 IF(AND(C2>=30,C2<35,F2>=5.7),1,0)

IF(AND(C2>=35,C2<40,F2>=4.1,F2<4.44),1,0)
 IF(AND(C2>=35,C2<40,F2>=4.44,F2<4.72),1,0)
 IF(AND(C2>=35,C2<40,F2>=4.72,F2<5.11),1,0)
 IF(AND(C2>=35,C2<40,F2>=5.11,F2<5.4),1,0)
 IF(AND(C2>=35,C2<40,F2>=5.4,F2<5.7),1,0)
 IF(AND(C2>=35,C2<40,F2>=5.7),1,0)

IF(AND(C2>=40,F2>=3.4,F2<3.7),1,0)
 IF(AND(C2>=40,F2>=3.7,F2<3.88),1,0)
 IF(AND(C2>=40,F2>=3.88,F2<4.1),1,0)
 IF(AND(C2>=40,F2>=4.1,F2<4.44),1,0)
 IF(AND(C2>=40,F2>=4.44,F2<4.72),1,0)
 IF(AND(C2>=40,F2>=4.72,F2<5.11),1,0)
 IF(AND(C2>=40,F2>=5.11,F2<5.4),1,0)
 IF(AND(C2>=40,F2>=5.4,F2<5.7),1,0)
 IF(AND(C2>=40,F2>=5.7),1,0)

the following are the results of the combined pieces of the above formula

IF(AND(C2>=25,C2<30,F2>=4.1,F2<4.44),1,0),IF(AND(C2>=25,C2<30,F2>=4.44,F2<4.72),1,0),IF(AND(C2>=25,C2<30,F2>=4.72,F2<5.11),1,0),IF(AND(C2>=25,C2<30,F2>=5.11,F2<5.4),1,0),IF(AND(C2>=25,C2<30,F2>=5.4,F2<5.7),1,0),IF(AND(C2>=25,C2<30,F2>=5.7),1,0),IF(AND(C2>=30,C2<35,F2>=4.1,F2<4.44),1,0),IF(AND(C2>=30,C2<35,F2>=4.44,F2<4.72),1,0),IF(AND(C2>=30,C2<35,F2>=4.72,F2<5.11),1,0),IF(AND(C2>=30,C2<35,F2>=5.11,F2<5.4),1,0),IF(AND(C2>=30,C2<35,F2>=5.4,F2<5.7),1,0),IF(AND(C2>=30,C2<35,F2>=5.7),1,0),IF(AND(C2>=35,C2<40,F2>=4.1,F2<4.44),1,0),IF(AND(C2>=35,C2<40,F2>=4.44,F2<4.72),1,0),IF(AND(C2>=35,C2<40,F2>=4.72,F2<5.11),1,0),IF(AND(C2>=35,C2<40,F2>=5.11,F2<5.4),1,0),IF(AND(C2>=35,C2<40,F2>=5.4,F2<5.7),1,0),IF(AND(C2>=35,C2<40,F2>=5.7),1,0),IF(AND(C2>=40,F2>=3.4,F2<3.7),1,0),IF(AND(C2>=40,F2>=3.7,F2<3.88),1,0),IF(AND(C2>=40,F2>=3.88,F2<4.1),1,0),IF(AND(C2>=40,F2>=4.1,F2<4.44),1,0),IF(AND(C2>=40,F2>=4.44,F2<4.72),1,0),IF(AND(C2>=40,F2>=4.72,F2<5.11),1,0),IF(AND(C2>=40,F2>=5.11,F2<5.4),1,0),IF(AND(C2>=40,F2>=5.4,F2<5.7),1,0),IF(AND(C2>=40,F2>=5.7),1,0)

- 19) Copy the formula and paste to the cell of column G with the formulation as follows:
 “=OR(→ paste the formula of step 18←).
- 20) If the formula used (in step 18) is correct, then the number of potential landslide points in column H sheet "subarea" landslide, will be equal to the number of points that calculated according to the potential landslide area is red. In this case the numbers are the same that is 15175.

5.4	5.4 - 5.7	5.7 <
1	840	3148
2	564	1144
1	369	653
6	225	371
5	89	165
2	55	110
4	34	60
9	22	58
Total Titik		75742
potensi longsor =		15175

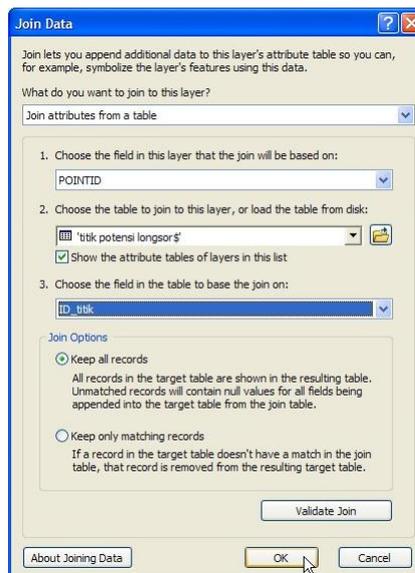
121194	2	5000	3.70	FALSE	0
121195	0	0	0.00	FALSE	0
121196	0	0	0.00	FALSE	0
121197	1	2500	3.40	FALSE	0
121198	3	7500	3.88	FALSE	0
121199	7	17500	4.24	FALSE	0
121200	8	20000	4.30	FALSE	0
121201	15	37500	4.57	FALSE	0
121202					15175

- 21) Open sheet “titik potensi longsor” on file of “Tabulasi titik potensi longsor berdasarkan topografi - source.xlsx”. In this sheet contains column “ID_titik” that contains or a link from point ID (column A) sheet “subarea”, and there column “Potensi” that contains or a link from “Titik potensi longsor” (column H) sheet “subarea”.

	A	B
1	ID_titik	Potensi
2	29123	1
3	29124	1
4	29125	1
5	29126	1
6	29127	1
7	29128	1
8	29129	1
9	29130	0

Step 3. Making landslide potential area

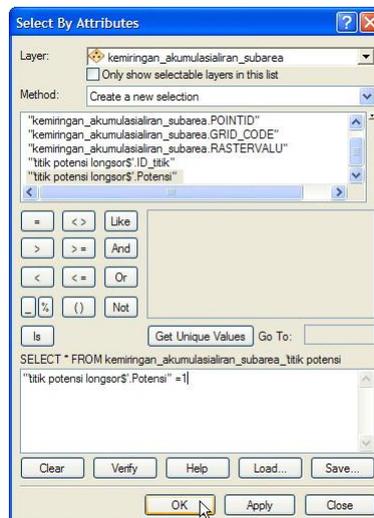
- 1) On ArcMap workspace, click Add Data, then point to folder: Data source for training.
- 2) Double click file of “Tabulasi titik potensi longsor berdasarkan topografi - source.xlsx”, then double click “titik potensi longsor\$”. Automatically, data from sheet “titik potensi longsor” will enter to ArcMap workspace.
- 3) On Table Of Contents window, click By Drawing Order List  button.
- 4) Next, connect the data on sheet “titik potensi longsor” with attribute data on layer of “kemiringan_akumulasi_aliran_subarea” based on the same point ID.
Right click layer of “kemiringan_akumulasi_aliran_subarea”, point the cursor to Joins and Relates, then click Join. Next will appear Join Data window.
- 5) On combo box of What do you want to join to this layer, choose Join attributes from a table. On combo box 1, choose column “POINTID”. On combo box 2, choose “titik potensi longsor\$” layer. On combo box 3, choose column “ID_titik”. On radio button of Joins Options, choose Keep all records. Click OK button.



- 6) Below is the attribute table from layer of “kemiringan_akumulasioaliran_subarea”. There area two new columns that are “ID_titik” and “Potensi”.

FID	Shape	POINTID	GRID_CODE	RASTERVALU	ID_titik	Potensi
0	Point	29123	26.690792	136	29123	1
1	Point	29124	27.823725	134	29124	1
2	Point	29125	23.924046	130	29125	0
3	Point	29126	21.612429	122	29126	0
4	Point	29127	23.77759	106	29127	0
5	Point	29128	26.671526	104	29128	1
6	Point	29129	24.365925	100	29129	0
7	Point	29130	22.740812	2	29130	0
8	Point	29131	25.597136	0	29131	0
9	Point	29132	23.747484	1	29132	0
10	Point	29133	16.912209	1	29133	0

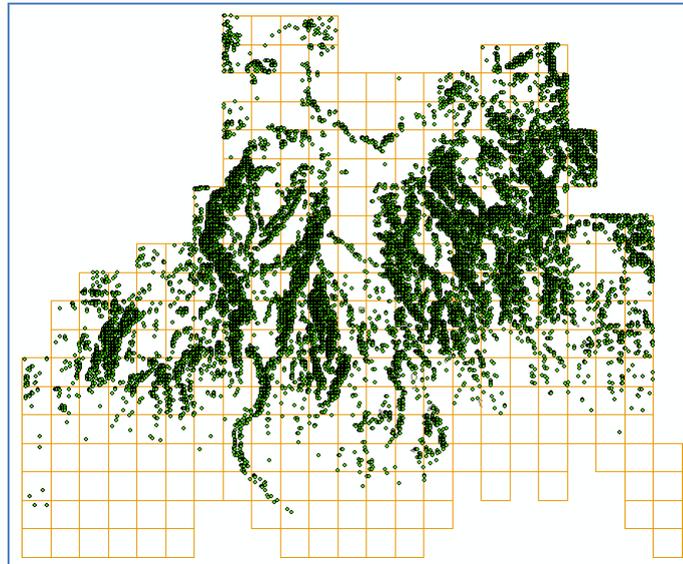
- 7) Click Selection on ArcMap main menu then click Select By Attributes. Next will appear Select By Attributes window.
- 8) On combo box Layer, choose “kemiringan_akumulasioaliran_subarea”. On combo box Method, choose Create a new selection, and double click “titik potensi longsor\$.Potensi”. Click “=” button and type number 1 to make formula of ""titik potensi longsor\$.Potensi" =1. Click OK button.



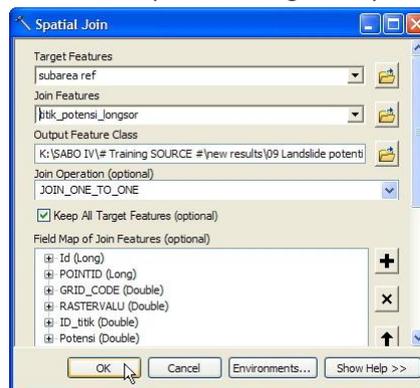
This selection process can run very long time.

- 9) After seen the results of the selection object, right click layer of “kemiringan_akumulasioaliran_subarea”, point the cursor to Data, then click Export Data. Insert the data that will be exported into folder: Data source for training\09 Landslide potential by topographic factor, and give name “titik potensi longsor.shp”. If there is question whether that exported data will be incorporated as a layer into ArcMap as a layer, answer Yes.

The distribution display of landslide potential points is as shown below.



- 10) On ArcToolbox window, click + symbol on Analysis Tools → Overlay, and double click Spatial Join.
- 11) Next will appear Spatial Join window. On combo box of Target Features, choose layer “subarea ref”. On combo box of Join Features, choose layer “titik_potensi_longsor”. On text box of Output, save the file into folder: Data source for training\09 Landslide potential by topographic factor, and give name “subarea SJ titik potensi longsor.shp”. Click OK button.



- 12) Open file of “Analisa potensi longsor - source.xlsx” and open sheet “Faktor topografi”.

Analisa faktor topografi								
ID subarea	Potensi longsor	Jumlah titik potensi longsor berdasarkan faktor topografi	Rentang jumlah titik potensi longsor berdasarkan faktor topografi					
			0 sampai 250	50 sampai 250	100 sampai 250	150 sampai 250	200 sampai 250	250 sampai 250
1	0	0	1	0	0	0	0	0
2	0	0	1	0	0	0	0	0
3	0	0	1	0	0	0	0	0
4	0	0	1	0	0	0	0	0
5	0	0	1	0	0	0	0	0
6	0	0	1	0	0	0	0	0
7	0	0	1	0	0	0	0	0
8	0	0	1	0	0	0	0	0
9	0	0	1	0	0	0	0	0
10	0	0	1	0	0	0	0	0

Column A and column B contains a link from “ID subarea” and “Potensi longsor” from sheet “Analisa potensi longsor”.

- 13) Open file “subarea SJ titik potensi longsor.dbf” from the folder: Data source for training\09 Landslide potential by topographic factor, using Microsoft Excel.
- 14) Copy the contents of column “Join_Count” and paste into column “Jumlah titik potensi longsor berdasarkan faktor topografi” on the file “Analisa potensi longsor - source.xlsx” sheet “Faktor topografi”.

	A	B	C	D	E	F	G	H
1	Join_Count	TARGET_Fl	Id	POINTI	GRID_CODE	RASTERVALU	ID_titik	Potensi
2	0	0	1	0	0.00000000	0.00000000	0.000000	0.000000
3	0	1	2	0	0.00000000	0.00000000	0.000000	0.000000
4	0	2	3	0	0.00000000	0.00000000	0.000000	0.000000
5	0	3	4	0	0.00000000	0.00000000	0.000000	0.000000
6	0	4	5	0	0.00000000	0.00000000	0.000000	0.000000
7	0	5	6	0	0.00000000	0.00000000	0.000000	0.000000
8	0	6	7	0	0.00000000	0.00000000	0.000000	0.000000
9	0	7	8	0	0.00000000	0.00000000	0.000000	0.000000
10	0	8	9	0	0.00000000	0.00000000	0.000000	0.000000

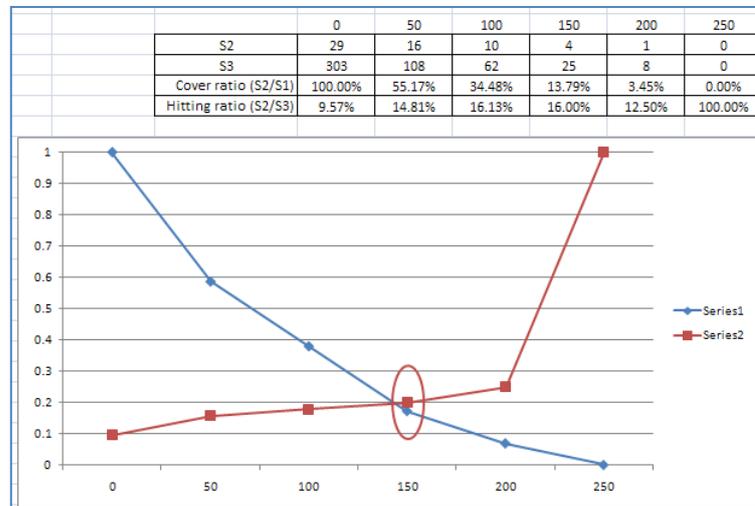
- 15) Column “Rentang jumlah titik potensi longsor berdasarkan faktor topografi” has several sub-columns that contain the value 1 and 0. These value shows if a subarea has the total of landslide potential point according with a certain minimum number.

Analisa faktor topografi									
ID subarea	Potensi longsor	Jumlah titik potensi longsor berdasarkan faktor topografi	Rentang jumlah titik potensi longsor berdasarkan faktor topografi						
			0	50	100	150	200	250	
			sampai 250	sampai 250	sampai 250	sampai 250	sampai 250	sampai 250	
1	0	0	1	0	0	0	0	0	0
2	0	0	1	0	0	0	0	0	0
3	0	0	1	0	0	0	0	0	0
4	0	0	1	0	0	0	0	0	0
5	0	0	1	0	0	0	0	0	0
6	0	0	1	0	0	0	0	0	0
7	0	0	1	0	0	0	0	0	0
8	0	0	1	0	0	0	0	0	0
9	0	0	1	0	0	0	0	0	0
10	0	0	1	0	0	0	0	0	0

For example sub-column D gives information whether a subarea has the point number that more than or equal with 0. Sub-column E gives information whether a subarea has the point number that more than or equal with 50, and so on. The formula example on the second row of sub-column E is “=IF(C7>=50,1,0)”, the formula example on the second row sub-column F is “=IF(C7>=100,1,0)” and so on. Write all of the formula for all of sub-column, from column D until column I.

In this case there are 6 units of sub-columns. In fact many sub-column is adjusted depending on the value of the potential maximum number of points shown in the column " Jumlah titik potensi longsor berdasarkan faktor topografi ", which in this case the maximum value is number potential points is 235.

- 16) Next step is to count the value of hitting ratio and cover ratio from column D until column I. from the calculation result, known that sub-column G or subarea that has number of landslide potential points is equal or more than 150, has the highest value of hitting ratio and cover ratio.

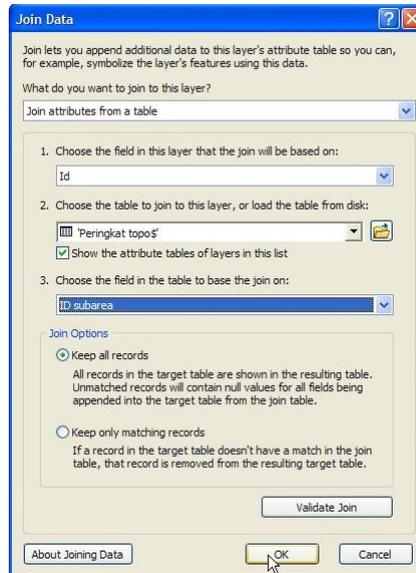


- 17) Open sheet “Analisa potensi longsor”. Column E (Jumlah titik potensi longsor) contains link to column C (Jumlah titik potensi longsor berdasarkan faktor topografi) on sheet “Faktor topografi”, whereas column F contains link to sub-column G sheet “Faktor topografi”.

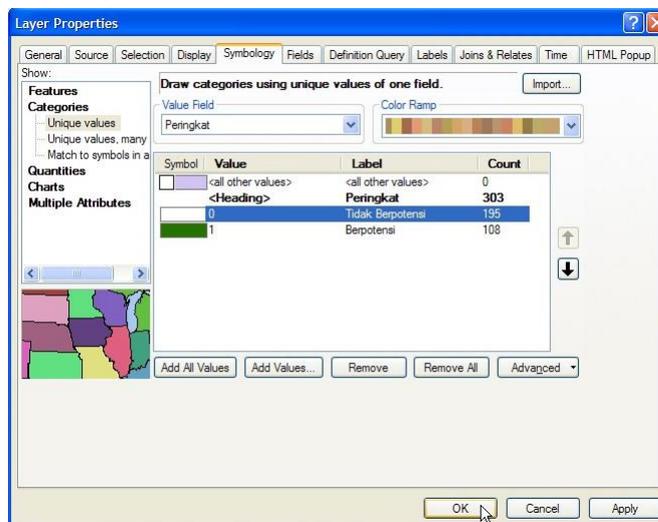
ANALISA POTENSI LONGSOR								
	Faktor kejadian longsor gelincir		Faktor-faktor geologi dan mikrotopografi	Faktor topografi		Potensi longsor		
ID subarea	Jumlah kejadian longsor per subarea	Potensi longsor berdasarkan kejadian longsor masa lalu	Potensi longsor berdasarkan faktor geologi dan mikrotopografi	Jumlah titik potensi longsor	Potensi longsor berdasarkan faktor topografi (jumlah titik potensi longsor ≥ 25)	ID subarea	Nilai potensi longsor	Peringkat potensi longsor
1	0	0	0	0	0	1	0	Tidak Potensial
2	0	0	0	0	0	2	0	Tidak Potensial
3	0	0	0	0	0	3	0	Tidak Potensial
4	0	0	0	0	0	4	0	Tidak Potensial
5	0	0	0	0	0	5	0	Tidak Potensial
6	0	0	0	0	0	6	0	Tidak Potensial
7	0	0	0	0	0	7	0	Tidak Potensial
8	0	0	0	0	0	8	0	Tidak Potensial
9	0	0	0	0	0	9	0	Tidak Potensial
10	0	0	0	0	0	10	0	Tidak Potensial

- 18) Open sheet “Peringkat topo”. In this sheet contains two column, column “ID subarea” is a link to column “ID subarea” sheet “Analisa potensi longsor”, whereas column “Peringkat” is a link to column “Potensi longsor berdasarkan faktor topografi” sheet “Analisa potensi longsor”.
- 19) Save the file “Analisa potensi longsor - source.xlsx”
- 20) On ArcMap workspace, click Add Data, then point to folder: Data source for training.
- 21) Double click file “Analisa potensi longsor - source.xlsx”, then double click “Peringkat topo\$”. Automatically, sheet or data from “Peringkat longsor” will enter to ArcMap workspace.
- 22) On Table Of Contents window,click List By Drawing Order  button.
- 23) Right click layer “subarea ref”, point the cursor to Joins and Relates, then click Join. Next will appear Join Data window.

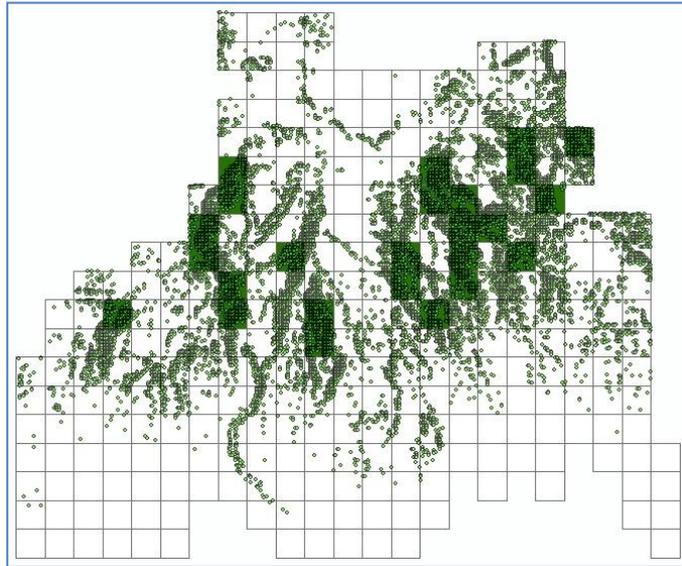
- 24) On combo box of What do you want to join to this layer, choose Join attributes from a table. On combo box 1, choose column "Id". On combo box 2, choose layer "Peringkat topo\$". On combo box 3, choose column "ID subarea". On radio button Joins Options, choose Keep all records. Click OK button.



- 25) Right click layer "subarea ref", point the cursor to Data, then click Export Data. Insert the data that want to exported into folder: Data source for training\09 Landslide potential by topographic factor, and give name "potensi longsor berdasarkan faktor topografi.shp". If there is question whether the exported data will insert into ArcMap workspace, answer Yes.
- 26) Right click layer "subarea ref", point the cursor to Joins and Relates → Remove Join(s), click Remove All Joins.
- 27) Right click layer "potensi longsor berdasarkan faktor topografi" and click Properties. On Layer Properties window, click Simbologi tab.
- 28) On part of Show: choose Categories and choose Unique values. On combo box of Value Field, choose column "Peringkat". Click Add All Values button, to show the values contained in column "Peringkat". Changes the symbol for the value 0 become white color, and symbol for the value 1 become "Fir Green" color. Change the value 0 become "Tidak Berpotensi", and for the value 1 become "Berpotensi". Press OK button.



- 29) Figure below shows subarea data that potential to landslide based on the color of subarea that is green color.



- 30) Save the ArcMap workspace into folder: Data source for training\09 Landslide potential by topographic factor, and give name "Potensi longsor berdasarkan topografi".

V. Making Landslide Potential Map Based On Combined Factor

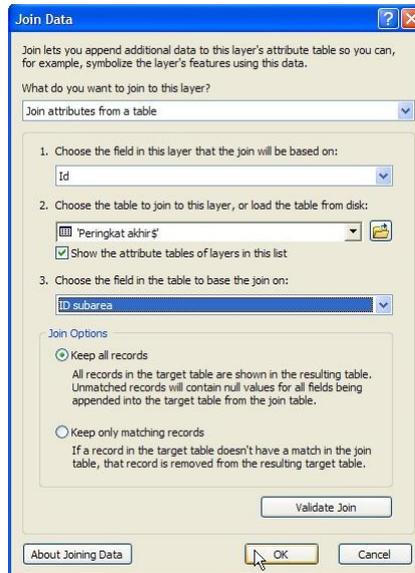
- 1) Open file “Analisa potensi longsor - source.xlsx” and open sheet “Analisa potensi longsor”.

	A	B	C	D	E	F	G	H	I
1	ANALISA POTENSI LONGSOR								
2									
3		Faktor kejadian longsor gelincir		Faktor-faktor geologi dan mikrotopografi	Faktor topografi		Potensi longsor		
4	ID subarea	Jumlah kejadian longsor per subarea	Potensi longsor berdasarkan kejadian longsor masa lalu	Potensi longsor berdasarkan faktor geologi dan mikrotopografi	Jumlah titik potensi longsor	Potensi longsor berdasarkan faktor topografi (jumlah titik potensi longsor ≥ 25)	ID subarea	Nilai potensi longsor	Peringkat potensi longsor
5	1	0	0	0	0	0	1	0	Tidak Potential
6	2	0	0	0	0	0	2	0	Tidak Potential
7	3	0	0	0	0	0	3	0	Tidak Potential
8	4	0	0	0	0	0	4	0	Tidak Potential
9	5	0	0	0	0	0	5	0	Tidak Potential
10	6	0	0	0	0	0	6	0	Tidak Potential
11	7	0	0	0	0	0	7	0	Tidak Potential
12	8	0	0	0	0	0	8	0	Tidak Potential
13	9	0	0	0	0	0	9	0	Tidak Potential
14	10	0	0	0	0	0	10	0	Tidak Potential
15	11	0	0	0	0	0	11	0	Tidak Potential
16	12	0	0	0	0	0	12	0	Tidak Potential
17	13	0	0	0	2	0	13	0	Tidak Potential

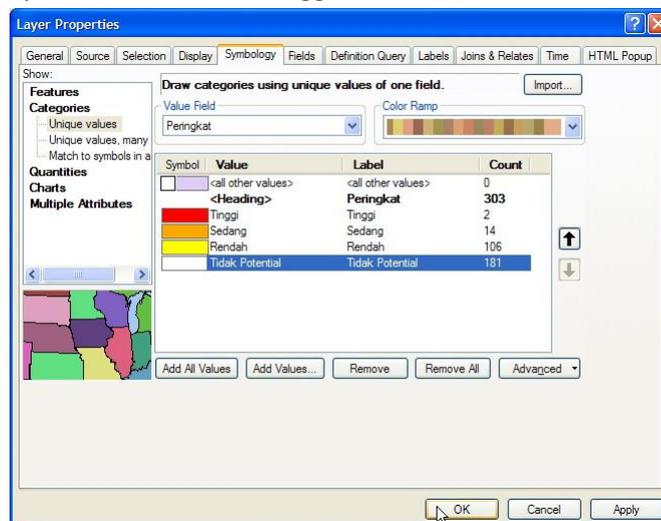
Look up part of column “Potensi longsor” (column G – I). Column G contains link from column A, column H contains sum of the value from column C, column D, and column F. Whereas column I contains information about level of each subarea.

- 2) Open sheet “Peringkat akhir”. This sheet contains three column that all are connected to column G, H, I from sheet “Analisa potensi longsor”. This sheet use for the purposes of merging attributes in ArcMap.
- 3) Open/run ArcMap, choose Blank Map.
- 4) Insert the file “subarea ref.shp” from the folder: Ref, to ArcMap workspace.
- 5) On ArcMap workspace, click Add Data, then point into folder: Data source for training.
- 6) Double click file “Analisa potensi longsor - source.xlsx”, then double click “Peringkat akhir\$”.
- 7) On Table Of Contents window, click List By Drawing Order  button.
- 8) Right click layer “subarea ref”, point the cursor to Joins and Relates, then click Join.

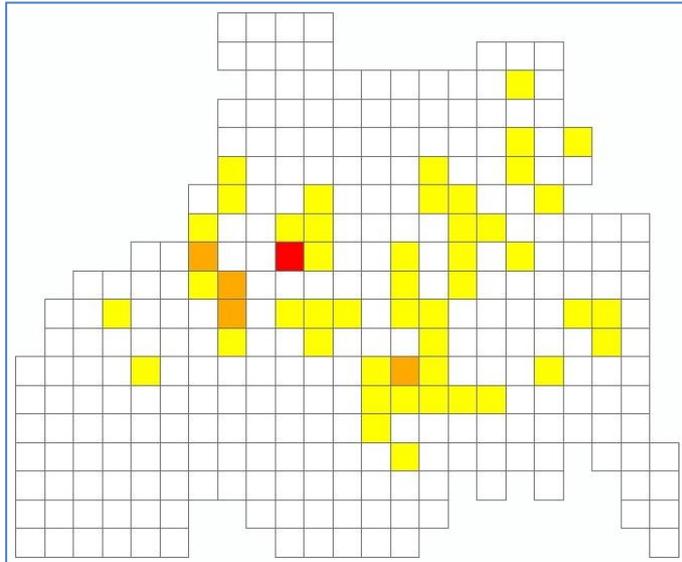
- 9) Then will appear Join Data window. On combo box of What do you want to join to this layer, choose Join attributes from a table. On combo box 1, choose column "Id". On combo box 2, choose layer "Peringkat akhir\$". On combo box 3, choose column "ID subarea". On radio button Joins Options, choose Keep all records. Click OK button.



- 10) Right click layer "subarea ref", point the cursor to Data, then click Export Data. Enter the data that will be exported into folder: Data source for training\09 Landslide potential by combine factor, and give name "potensi longsor berdasarkan faktor gabungan.shp". If there is question whether the exported data will insert into ArcMap workspace, answer Yes.
- 11) Right click layer "subarea ref", point the cursor to Joins and Relates, then Remove Join(s) and click Remove All Joins.
- 12) Right click layer "potensi longsor berdasarkan faktor gabungan" and click Properties. On Layer Properties window, click Simbologi tab.
- 13) On part of Show: choose Categories and choose Unique values. On combo box of Value Field, choose Peringkat. Click Add All Values button, to shows the values contained in column "Peringkat". Changes symbol for the value Tidak Potensial become white color, symbol for the value Rendah become "Solar Yellow" color, symbol for the value Sedang become "Electron Gold" color, and symbol for the value Tinggi become "Mars Red" color. Press OK button.



- 14) Figure below shows subarea data that potential to landslide based on combined factor.



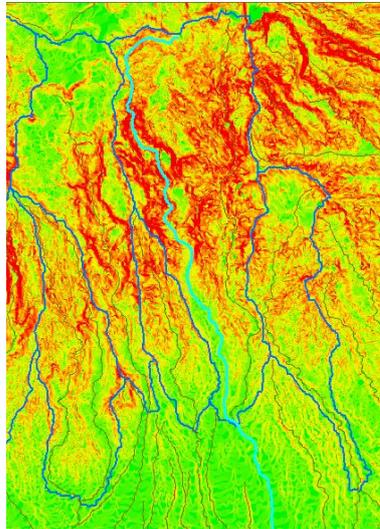
- 15) Right click layer “potensi_longsor_berdasarkan_faktor_gabungan”, click Save As Layer File. Save the file into folder: Data source for training\10 Landslide potential by combine factor, and give name “Potensi longsor berdasarkan faktor gabungan.lyr”.
- 16) Save the ArcMap workspace into folder: Data source for training\10 Landslide potential by combine factor, and give name “Potensi longsor berdasarkan faktor gabungan”.

VI. Making Banjir Bandang Hazard Area

Step 1. Chooseing main river object/feature

- 1) Open/run ArcMap, choose Blank Map.
- 2) Insert data "slope_10" and "dem_10" from the folder: Data source for training\02 Contour data.
- 3) Insert data "sungai utama.shp" from the folder: Data source for training\03 River vector data.
- 4) Insert data "das ref.shp" from the folder: Ref.
- 5) Next step is to choose one of river object/feature. The river feature that we want to choose is the river are expected to experience flash floods, based on information from a landslide potential map which showed that the upper river has a high potential for landslides.

By using Select Features by Rectangle  button on Tools toolbar, select main feature of main river that surround the watershed. For example here, the main river of Kali Jompo watershed.



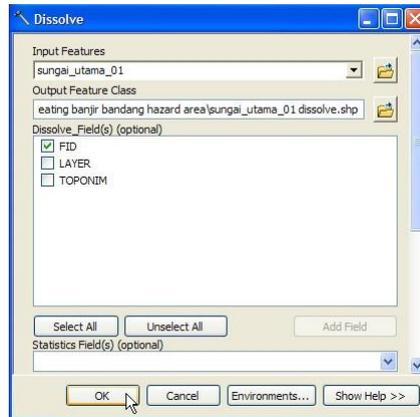
For tips, select an object that resembles a straight line. If there are other objects that are branching from the same river, the object is selected in the next step.

- 6) Right click layer "sungai utama" and export data or selected objects into folder: Data source for training\11 Creating banjir bandang hazard area. Give name "sungai utama 01". If there is question whether the exported data will insert into ArcMap workspace, answer Yes.
- 7) Press Clear Selected Features button.

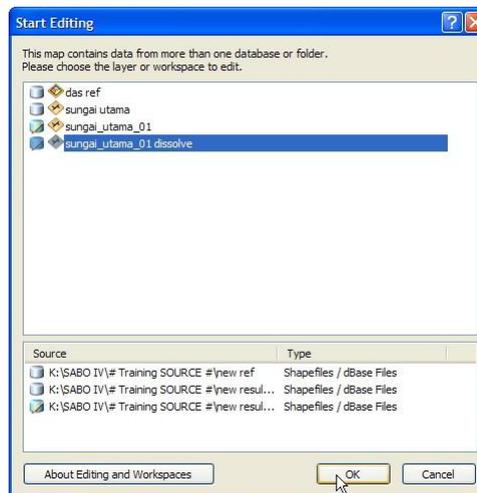
Step 2. Defining the banjir bandang hazard area boundary based on topographic slope

- 1) On ArcToolbox window, click + symbol on Data Management Tools → Generalization, double click Dissolve. Next will appear Dissolve window.

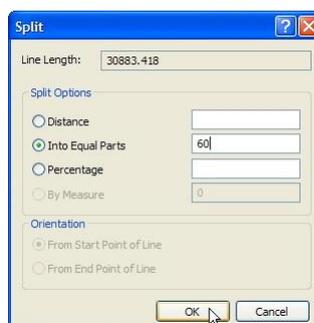
- 2) On combo box Input Features, choose layer “sungai_utama_01”. On text box Output Feature Class, save the data into folder: Data source for training\11 Creating banjir bandang hazard area, give name “sungai_utama_01_dissolve.shp”. Check FID on Dissolve Field(s) window. Click OK button. Next will be formed layer “sungai_utama_01_dissolve” ArcMap workspace.



- 3) On Editing toolbar, click Editor toolbar, and click Start Editing. On Start Editing window, click layer “sungai_utama_01_dissolve”, then click OK button.



- 4) Right click layer “sungai_utama_01_dissolve”, point the cursor to Selection, and click Make This The Only Selectable Layer.
- 5) To select the objects in the editing process, we use  button on Editor toolbar. Click  button and select the objects of layer “sungai_utama_01_dissolve”.
- 6) Click Editor button and click Split.
- 7) Next will appear Split window. Choose Into Equal Parts radio button and fill the value of 60. Click OK button.



Objects on layer “sungai_utama_01_dissolve” will split into 60 parts.