

Quality Control Automatization of Road Object and River Object Stereocompilation Results on Establishing Indonesia Topographic Map Scale of 1 : 5000 using Arcgis Data Reviewer

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Abstract. Establishing Indonesia Topographic Map scale of 1:5000 from aerial image consists of several substantial steps. Proceeding one-step to another could be done by passing the quality control. One of the steps is stereo-compilation. To proceed on to the next step, the stereocompilation result must pass the quality control checking. The quality control checking is based on the quality control form created by Geospatial Information Agency. This form contains the quality control parameters. The quality control process of stereocompilation result is done by using ArcGIS Data Reviewer software. In this research the studied objects are road objects and river objects and quality control checking process is bounded by automatic checking by using automated review which is one of the menus on Data Reviewer. The checking is purposed to examine the parameters from the QC form thoroughly and missing points from the quality control process previously. Based on the examination that is done there is parameter addition for the QC form that stands at the moment which is road vertex that intersects needs level elevation. Next thing to notice is the geometry from stereocompilation result is categorized in what order, because the present quality control of the stereocompilation result takes a while to correct the data to match the QC parameters.

1. Introduction

Topographic Map of Indonesia (RBI) is one of the base maps and one of the elements of basic geospatial information (IGD). Basic Geospatial Information (IGD) based on the general requirements in the Constitution of 2011 No. 4 article 12 is geospatial information which contains objects that can be viewed directly or measured from the physical appearance of earth and do not change for amount of time. Topographic Map of Indonesia (RBI) consists of coastline, hypsography, waters, topographic names, borderline, transportation and utilities, buildings and public facilities and land covers.

IGD can be spread widely to the people but before it has to pass through the Quality Control and Quality Assurance processes. This is based on the Constitution of 2011 No. 4 article 49 section 1 that states GI (Geospatial Information) users have the rights to know the GI quality they receive. The received GI by the user has to be in the best quality. Currently, the best GI quality is the one to pass through the quality control and quality assurance processes done by the Geospatial Information Agency (BIG). Quality Control is a system of checking or testing against the quality specifications of manufactured product in order to assess the production process potential adhered to the product specification standards [14]. Topographic Map of Indonesia quality control involves checking on the



data result from every production stages in digital Topographic Map of Indonesia establishment. The quality control that becomes the main focus in this research is stereo-compilation stages on Topographic Map of Indonesia scale of 1:5000. The stereo-compilation output next will go through stereo-compilation output checking or known as quality control of stereo-compilation stage and the result must correspond to the QC form created by Geospatial Information Agency (BIG).

Quality Control aims to monitor the map establishing so it correspond to the map establishing procedures from Geospatial Information Agency (BIG) and to achieve the supply chain continually to intend “zero error” [14]. Quality control on this stereo-compilation output of Topographic Map of Indonesia scale of 1:5000 used the ArcGIS Data Reviewer software. ArcGIS Data Reviewer is part of the Production Mapping extensions from ArcGIS that is used to implement the quality control. The method used in quality control can be done automatically (automated review and batch review) or manually (visual review). Data reviewer consists of some elements such as reviewer workspace, reviewer session, reviewer table and a toolbar [9].

Stereo-compilation quality control output using Data Reviewer will be reviewed especially on some QC parameters for road and river objects. The study case in this research is Bogor Regency and the data used is stereo-compiled data from aerial images made in 2014.

2. Literature

Generally Topographic Map of Indonesia (RBI) is a map showing natural and man-made features. Natural features show rivers, mountains, valleys, seas and lakes, while man-made features show roads, villages, houses and buildings [7]. Topographic Map of Indonesia (RBI) is obtained from aerial image, LIDAR and high resolution satellite imagery that includes the appearance of topographic features which can be grouped into seven themes such as buildings of public facilities, transportation and utilities, hypsography, administrative boundaries, land cover, hydrography and toponym. This research solely embody transportation elements especially road and water objects, rivers in particular.

2.1. Topographic Map Accuracy

Based on the Head of Geospatial Information Agency Regulations No. 15 Year of 2014 about Base Map Technical Guidelines, base map accuracy covers.

Geometric Accuracy is value that represents the position coordinate uncertainty of map object compared to object coordinate position which is considered as the real position. Topographic Map of Indonesia Geometric Accuracy can see in table 1.

Table 1. Topographic Map of Indonesia Geometric Accuracy (BIG, 2014)

Scale	Contour Interval (m)	Topographic Map Scale					
		Class 1		Class 2		Class 3	
		Horizontal (CE90 in m)	Vertical (LE90 in m)	Horizontal (CE90 in m)	Vertical (LE90 in m)	Horizontal (CE90 in m)	Vertical (LE90 in m)
1 : 5000	2	1	1	1,5	1,5	2,5	2,5

Accuracy values in every class are obtained from the conditions shown in the table 2 below:

Table 2. Topographic Map of Indonesia Accuracy Based On The Class (BIG, 2014)

Accuracy	Class 1	Class 2	Class 3
Horizontal	0,2 mm x scale number	0,3 mm x scale number	0,5 mm x scale number
Vertical	0,5 x contour interval	1,5 x accuracy class 1	2,5 x accuracy class 1

The accuracy value of the base map is CE90 for the horizontal accuracy and LE90 for the vertical accuracy, which mean the position error of the base map does not exceed the accuracy value above with

90% of confidence level. Attribute accuracy standards that need to be fulfilled will be shown in the table 3 below

Table 3. Topographic Map Of Indonesia Accuracy Based On The Class (BIG, 2014)

No.	Attribute Accuracy	Accuracy
1	Coastline	Based on Accuracy of Map Geometry
2	Hypsography	Based on Accuracy of Map Geometry
3	Waters	85%
4	Topographic Name	90%
5	Administrative Boundaries	90%
6	Transportation and Utilities	90%
7	Buildings and Public Facilities	85%
8	Land Cover	85%

2.2. Stereocompilation

Stereo-plotting or stereo-compilation is compiling process from aerial images. Stereo-plotting is digitizing the nature and man-made features process that is done to the stereo model with the following order: waters, break lines, mass points, transport networks, buildings and houses and also land covers [1].

Topographic mapping implementation instructions in scale of 1:5000 which refers to the Constitution No.4 Year of 2011 about geospatial information also explain the steps of plotting existing elements on earth surface as follows:

1. Waters
2. Hypsography Elements
3. Transportation
4. Bridges
5. Tunnels
6. Utilities
7. Open field vegetation
8. Building and Public Facilities

2.3. Quality Control

Quality Control (QC) as maintaining standard to meet internal standard, process and the procedure stand to control and to monitor the quality. Control process intend to detect any error in order for a correcting action to take place in the manufacturing product process and system [3].

QC is necessary in Topographic Map of Indonesia establishment to maintain stable map quality. Through this control process, the compatible product results to the define specifications is helped and so it can meet the user's expectance about the product service they receive [13].

Topographic Map of Indonesia's quality control in scale of 1:5000 adheres to the Topographic Map of Indonesia's in scale of 1:5000 standard procedures. Every operations done need to go through quality control about the output results. If it qualified the technical guidance standard, the output result then will proceed further. Quality control of stereo-compilation stage on Topographic Map of Indonesia in scale of 1:5000 uses the ArcGIS Data Reviewer software. Quality control using Data Reviewer must refer to the technical guidelines of Topographic Map of Indonesia's in scale of 1:5000 using Data Reviewer. Obtained results have to meet the parameters that lie in quality control form on Topographic Map of Indonesia's in scale of 1:5000 stereo-compilation.

2.4. Data Reviewer

ArcGIS Data Reviewer is part of the production mapping extension which is used in quality control procedures automatically (automated review) as well as visual review. ArcGIS Data Reviewer software provides 3 basic components that allow the composite check of the features on the map as below:

Visual review is performed to check data completeness and accuracy based on visible features from the aerial image. Visual review eases the process to recognize un-plotted visible features and later on plotting error will be given a description so that the stereo-plotting performer could identify visible feature that require re-plotting.

Automated review is used to edit visible features that mismatch the aerial image by doing it automatically. Automated review process must qualify the QC form. The following are some tools that can be accessed to do the transportation, water, building, public facilities elements checking in this research:

- a. Duplicate Geometry Check
- b. Multipart Line Check
- c. Evaluate Polygon Perimeter And Area Check
- d. Find Dangle Check
- e. Different Z At Intersection Check
- f. Slope Direction Change (Monotonicity) Check
- g. Adjacent Vertex Elevation Change Check

3. Research methodology

Quality control procedures in stereo-compilation stage are shown in the flow-chart diagram figure 1 below:

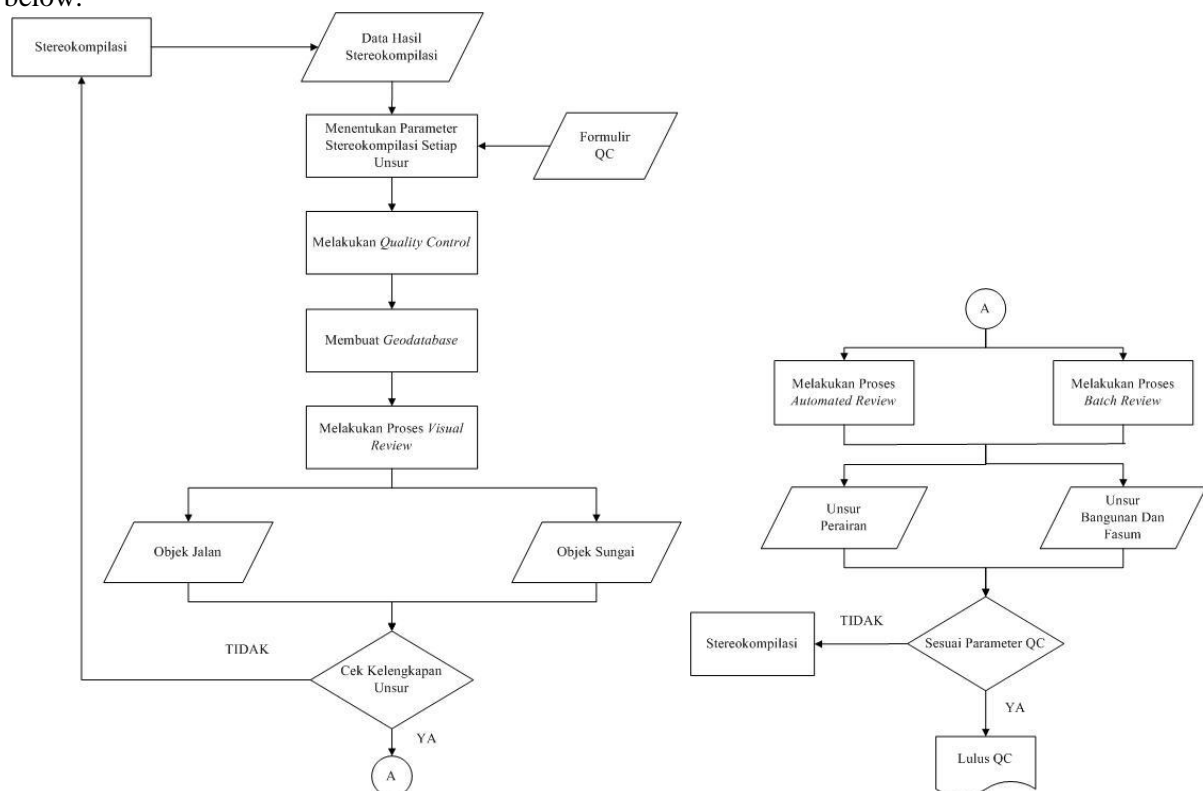


Figure 1. Flow Chart Quality Control Procedures

Quality control procedures in stereo-compilation stage is processed from deriving the stereo-compilation data then determining the quality control's parameters for the road and river objects referring to the QC form. Next is creating geodatabase which is used to store the errors in plotting process. This process begins from checking manually using *visual reviewer* menu from the Data Reviewer. This manually checking process is completed to check the elements completeness. If there are any un-plotted elements, then plotting has to be done. If the elements are complete then it can

proceeds further action which is automatic checking with automated reviewer or batch reviewer. In case there are any elements that are not qualified to the QC parameters, re-plotting or reviewing the error is suggested. While if the elements qualified the QC parameters, the stereo-compilation data passed the QC and can proceed further steps which are topology and polygon forming.

3.1. Automatic quality control result

Based on the quality control performed, some stereo-compilation results are not accordance with the quality control parameters. This quality control only focuses on the automatic processing using automated review *menu* or batch review. The results of automatic processing assuming each parameter do not apply tolerance to the height value in the process will be show in table 4:

Table 4. The results of automatic processing assuming each parameter do not apply tolerance to the height value in the process

No.	Checktitle	Origintabl	Originchec	Record
1	Road can only be captured once	TRANSLN	Duplicate Geometry Check	16
2	River can only be in one segment	PRNLN	Multipart Line Check	83
3	River is not allowed to float	PRNLN	Find Dangles Check	51
4	Every road must connect and form a network	TRANSLN	Find Dangles Check	132
5	Intersecting road has vertex with equal height	TRANSLN	Different Z at Intersection Check	869
6	Intersecting river has vertex with equal height	PRNLN	Different Z at Intersection Check	47
7	River's elevation vertex flows down consistently from upstream to downstream	PRNLN	Slope Direction Change (Monotonocity) Check	29
8	Left and right margin line of the river has relatively same height	PRNLN	Adjacent Vertex Elevation Change Check	40

Road can only be captured once (Scale 1:1000)

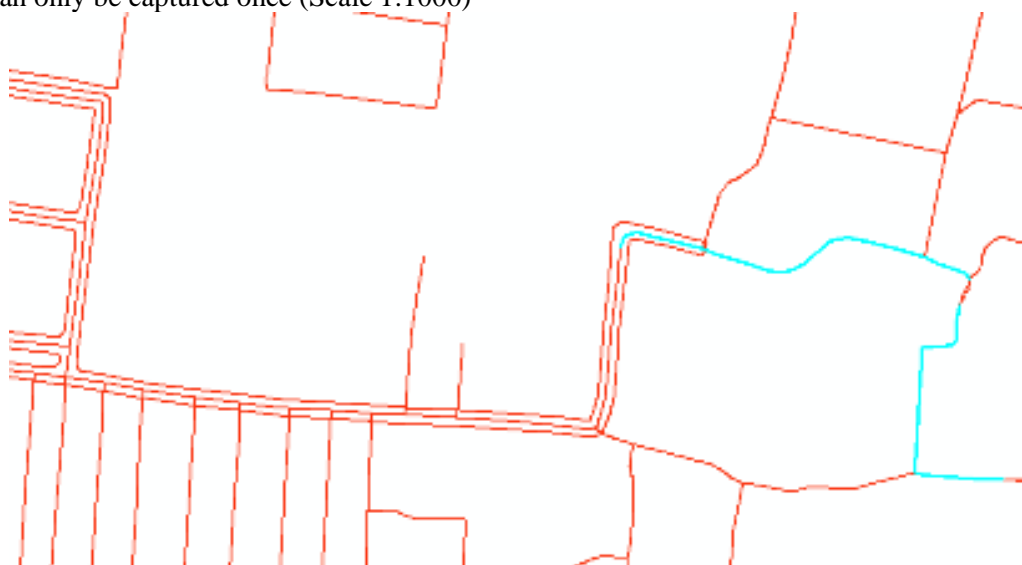


Figure 2. Road can only be captured once (Scale 1:1000)

Figure 2 is one of the mistakes made in plotting and isn't accordance with QC parameters of road can only be captured once. The blue line is the error shown by Data Reviewer. If any mistakes are found then one of the lines must be eliminate to remove the errors.

River can only be in one segment (scale 1:5000)



Figure 3. River can only be in one segment (scale 1:5000)

The blue line in figure 3 shows one of the errors found by Data Reviewer. Error such as river in more than one segment can be completed by merging every river segments into one.

Every road must connect and form a network (Scale 1:1000)

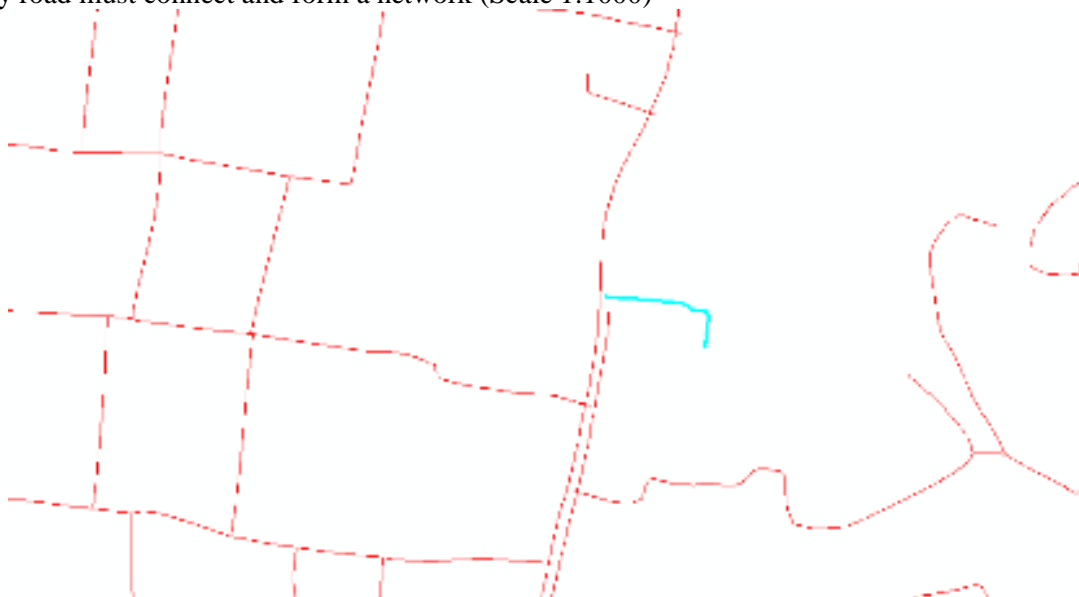


Figure 4. Every road must connect and form a network (Scale 1:1000)

Plotted road objects should connect one to another and create network. Based on the figure 4 shown above some road objects are disconnected and defined as an error, in the other hand, road objects located at the NLP border are not defined as error.

River is not allowed to float.



Figure 5. River is not allowed to float.

Similar with the road object, the river object is not allowed to float and must create network in figure 5. From the figure shown above some river objects are floating and Data Reviewer defined them as errors. If the river objects are located on the NLP borders then it is not defined as an error.

Intersecting road has vertex with equal height (Scale 1:500)

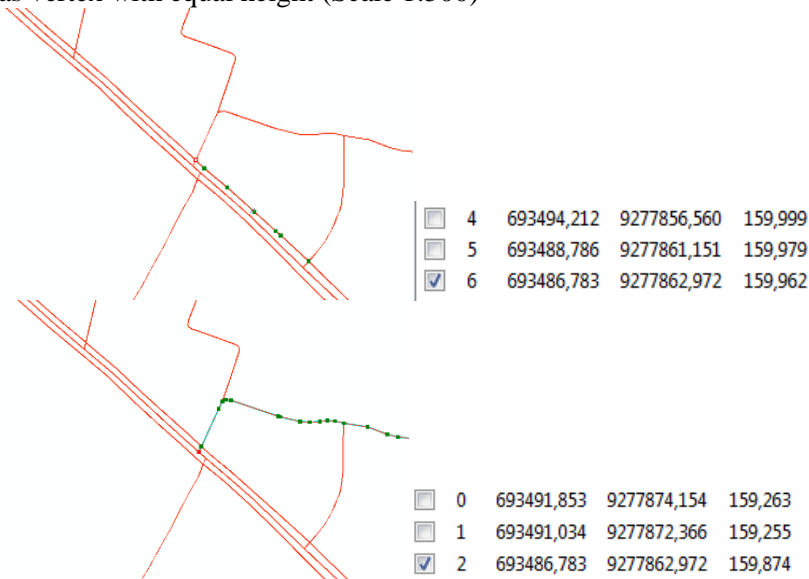


Figure 6. Intersecting road has vertex with equal height (Scale 1:500)

Road vertex that intersects must has vertex with same elevation value but there are some road vertex that intersects and has completely different elevation value, so it is defined as an error by the Data Reviewer in figure 6. The quality control form does not mention that the road vertex with equal elevation, it is better to mention it in the first place considering on the same points it is proper to have same coordinate and elevation values. In plotting process, any error can occur. Intersecting road vertex value difference probably can be solved by applying proper tolerance according to the geometry accuracy map order that is going to be made.

Intersecting river has vertex with equal height.

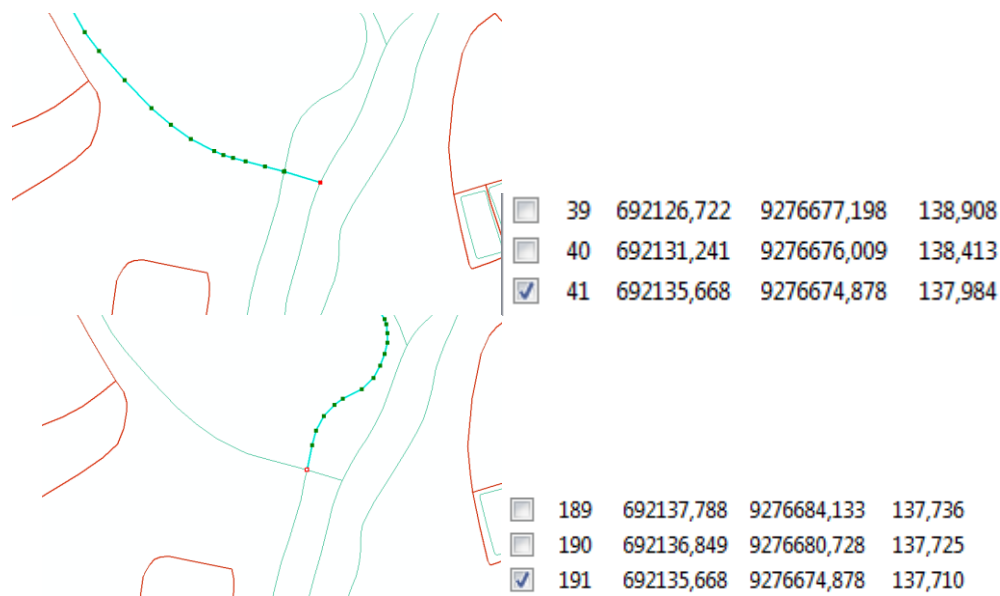


Figure 7. Intersecting river has vertex with equal height

Intersecting river vertex is required to have equal elevation value but there are some intersecting river vertex with different elevation level so that Data Reviewer presumes it as an error in figure 7. Vertex's elevation value of the minor tributary of the river has to level up to the vertex's elevation value of the main river. In plotting process, any occurrence of error can emerge. Value difference of intersecting river vertex can be overcome by applying tolerance in accordance with geometry accuracy of map order that will be worked on.

River's elevation vertex flows down consistently from upstream to downstream

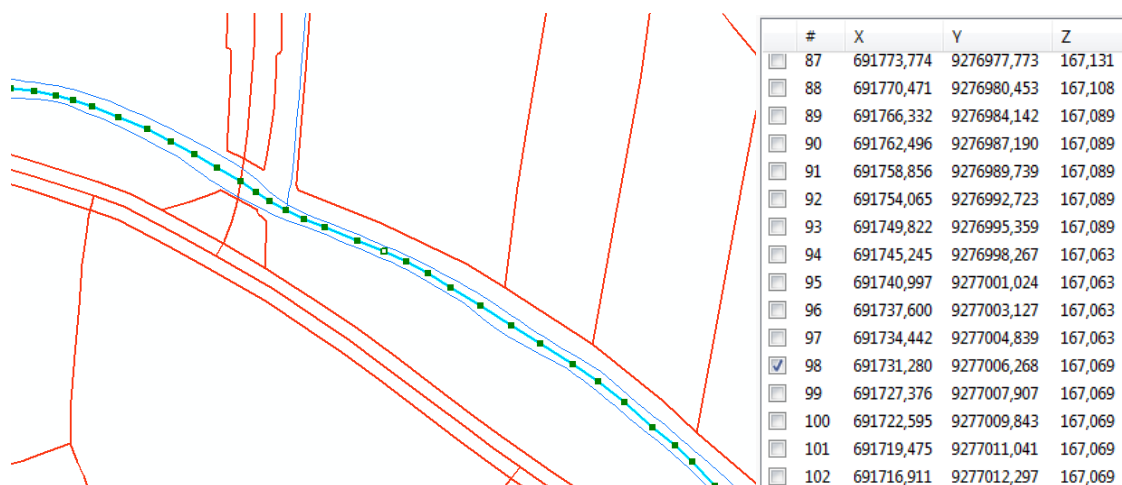


Figure 8. River's elevation vertex flows down consistently from upstream to downstream

River's vertices elevation from upstream to downstream ought flows down consistently but from the figure shown above some river's vertices are found inconsistently not flowing down in figure 8.

Left and right margin line of the river has relatively same height.

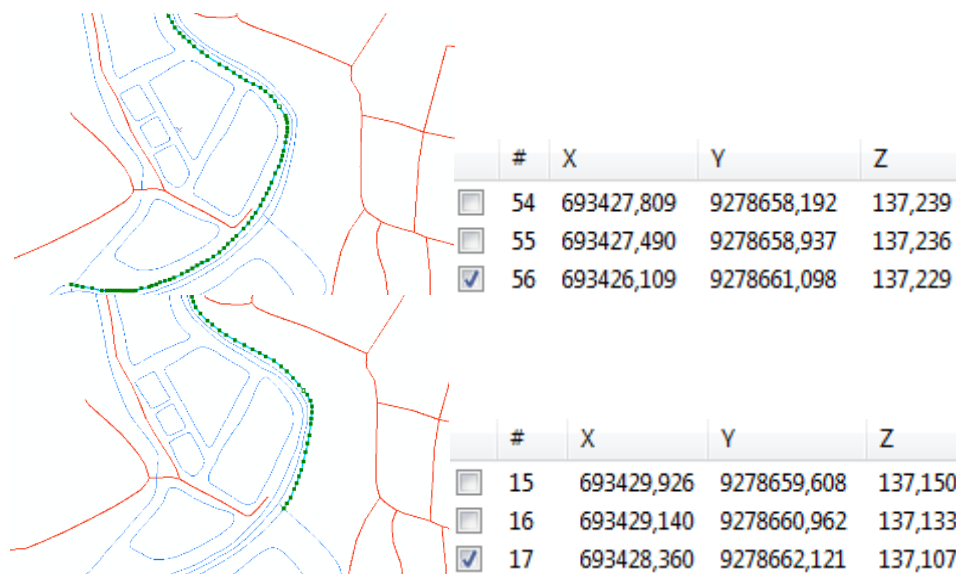


Figure 9. Left and right margin line of the river has relatively same height

White vertex in the figure shows vertex that is placed in the same position but with different elevation value in figure 9. The difference values of vertex elevation are not significant but still defined as error. To minimize the error in map establishing, applying tolerance referred from the geometry accuracy of map order is needed. Beside, from the stereo-model we can see the elevation value or take re-plotting action for a better result of accuracy.

4. Conclusions

Conclusions that can be drawn from this research are: Quality control process uses two methods which are manual and automatic method referring to the quality control parameters. Addition for quality control parameters is added by inserting the road vertex that intersect with same coordinate and elevation value. This research only focuses in automatic process using automated review or batch review. In addition to the suggestions, this quality control can consider to apply tolerance in accordance to the geometry accuracy of the map order. Detected errors can be reduced by considering the tolerance value application.

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