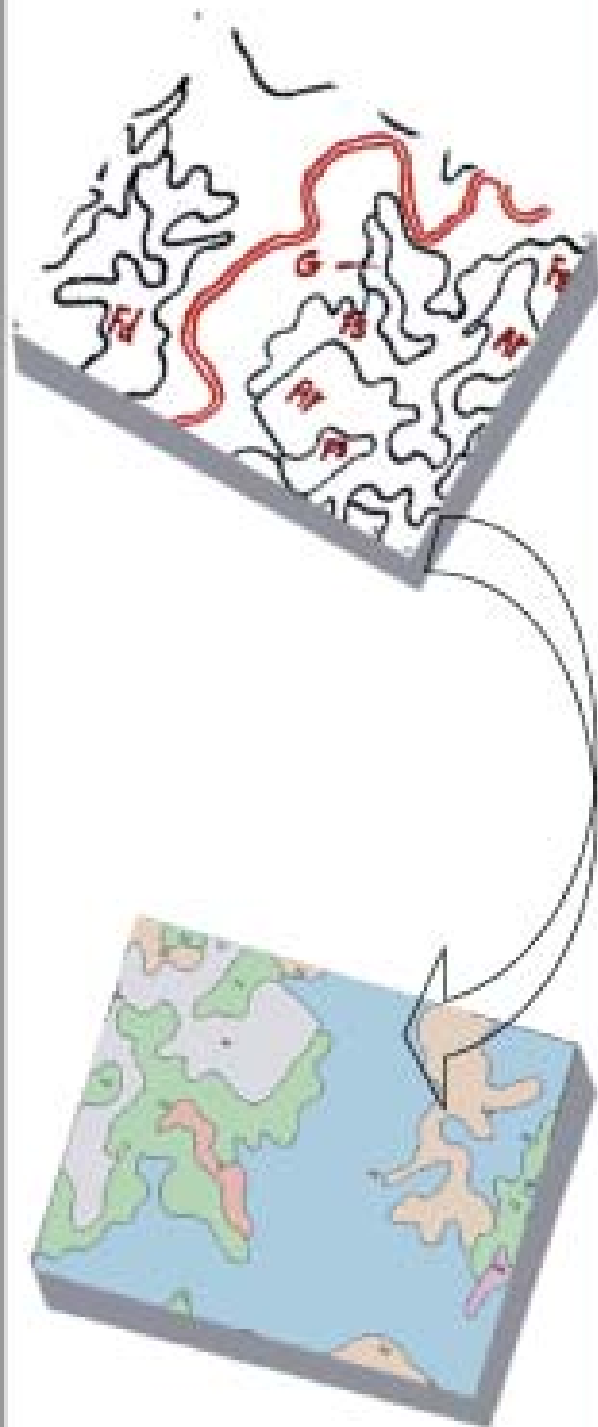
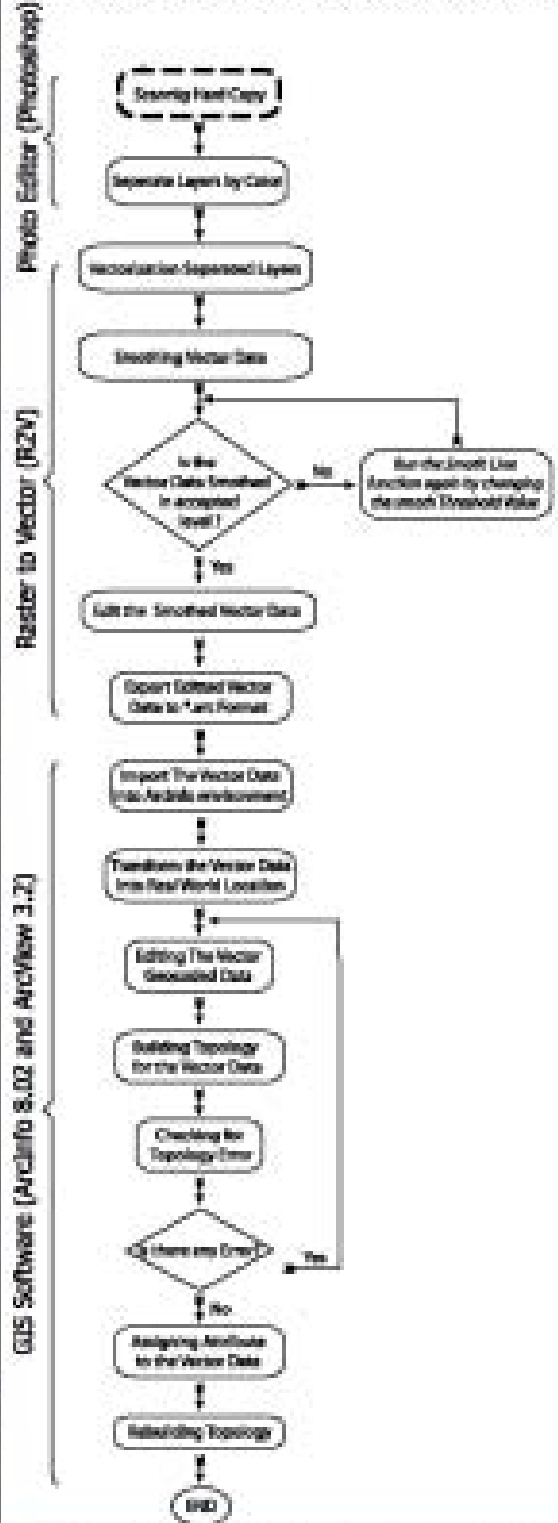


# **ANNEX V**

## **RASTER TO VECTOR CONVERSION MANUAL**

# RASTER TO VECTOR CONVERSION MANUAL

Flow chart of the Vector Abstraction Method



## Table of Contents

<b>1. Introduction .....</b>	<b>1</b>
<b>2. Software used .....</b>	<b>1</b>
<b>3. Methodology Flow chart .....</b>	<b>1</b>
<b>4. Scanning hard copy map .....</b>	<b>1</b>
<b>5. Working with Photo-editor environment (Photoshop software) .....</b>	<b>1</b>
5.1. Separate the image into Black layer .....	2
5.2. Separate the image into Red layer .....	2
<b>6. Working with Automatic digitizing software (R2V) .....</b>	<b>3</b>
6.1. Automatic vectorization .....	3
6.2. Smoothing the created vector lines .....	3
6.3. Editing and cleaning vector line .....	4
6.4. Exporting the vector lines .....	5
<b>7. Working with GIS software .....</b>	<b>5</b>
7.1. In ArcInfo Environment .....	6
7.2. ArcView Environment .....	10
<b>8. Exercise .....</b>	<b>12</b>

## Figures

Figure 8-1	Methodology Flow Chart .....	13
Figure 8-2	Scanned Original Image and Its GCPs .....	14
Figure 8-3	The Separated Black Layer .....	14
Figure 8-4	The separated Red Layer .....	15
Figure 8-5	Layer 1 and its Associated Vector Line (Green color on top) .....	15
Figure 8-6	Layer 1 and its Associated Vector Line Smoothed .....	16
Figure 8-7	Vector Line Before Editing .....	16
Figure 8-8	The mistake lines in the circle numbered 1 now have been removed .....	17
Figure 8-9	The mistake lines in the circle numbered 2 now have been removed .....	17
Figure 8-10	The Cleaned Vector Layer .....	18
Figure 8-11	Magic Wand Tool .....	18
Figure 8-12	Line Editor .....	18

## 1. Introduction

This module is an advanced raster to vector from image sources, such as scanned maps and drawings. The system combines the power of intelligent automatic digitizing technology with an easy-to-use and understands.

With this module of conversion, you can forget about slow and inaccurate hand tracing on a digitizing tablet, simply scan your map apply the module, you can get the result automatically, at a high accuracy level.

## 2. Software used

Image processing: Adobe Photoshop

Raster to vector conversion: R2V

GIS software: ArcInfo and ArcView

## 3. Methodology Flow chart

[Click here](#) to see the flow chart.

## 4. Scanning hard copy map

Scanning is a computer related process for conversion analog data (hard copy of any spatial data) to digital form (the form that can be displayed, edited and manipulated by computer).

For accuracy and ease in the onscreen digitization process the scanned image needs to have some characteristics according to level of preciseness you want to achieve such as *resolution*, *color deep*, *band mode* and *format*.

In this methodology, the used characteristics are indicated as below:

- Resolution = 300 dpi
- Color deep = 8 bits
- Band mode = RGB
- Format = \*.tif

## 5. Working with Photo-editor environment (Photoshop software)

In this tutorial, we will use only a portion of the scanned image in order to reduce the processing time. The selected portion of the image needs to include ground control points GCP at least four at the corners of that image. [Click here](#) to see the portion of the image and its associated GCP points.

Below is the coordinate system of the GCPs in UTM and Indian 60 datum.

Table 5-1

**Coordinate System of Ground Control Points (GCP)**

ID	X_coord	Y_coord
1	737270	1559840
2	733350	1559840
3	733350	1556970
4	737270	1556970

In order to make it easy for the vector abstraction from the scanned image, we have to separate the original image into layers according to the thematic layers

included in the original image. In this case we will separate the original image ([click here](#) to see the picture) into two layers according to its color the black color and the red color representing landuse and river respectively.

### **5.1. Separate the image into Black layer**

#### **To do this:**

1. Open the original image in Photoshop environment, if you have not done so,
2. Choose the “[Magic Wand Tool](#)” and click once on the black part of the image, you can see some black part of the image will be selected,
3. From *Select* menu, choose *Similar*, to select all of the black part of the image,
4. From *Select* menu, choose *Inverse*, to select the unwanted part of the image,
5. From *Edit* menu, choose *Clear*, to delete the unwanted part from the image,
6. From *File* menu, choose *Save As*, to save the layer, save it in image folder, Layer1 as the file name and \*.tif as file format. Except IBM PC option. To see the back layer, [click here](#)!

To see the Demo, [click here](#)!

### **5.2. Separate the image into Red layer**

This step is a bit more complicated than the first time because the four GCP points (in black color) need also to be included in the red layer. Meaning that we have to select two different colors for a layer.

#### **To do this:**

1. Open the original image in Photoshop environment, if you have not done so,
2. Choose the “Magic Wand Tool” and click once on the red part of the image, you can see some red part of the image will be selected,
3. From *Select* menu, choose *Similar*, to select all of the black part of the image
4. Use Zoom tool to zoom in one corner that we can see a GCP clearly,
5. Press on Shift key and use Magic Wand Tool to select the GCP included into our selection,
6. Do the same way to select the other three GCP points
7. From *Select* menu, choose *Inverse*, to select the unwanted part of the image,
8. From *Edit* menu, choose *Clear*, to delete the unwanted part from the image,
9. From *File* menu, choose *Save As*, to save the layer, save it in image folder, Layer2 as the file name and \*.tif as file format. Except IBM PC option.

To see the red layer, [click here](#)!

To see the Demo, [click here](#)!

## **6. Working with Automatic digitizing software (R2V)**

R2V provides an easy and complete solution to digitize vector data from image sources, such as scanned maps and drawings, aerial photos and satellite imagery. The entire raster to vector conversion process is fully automatic and needs no human intervention. You display the scanned image on screen and you select the vectorization command. That is all it takes! All the lines are extracted in seconds and displayed right on top of the image for you to verify and edit. Powerful editing and processing functions are provided to edit, geo-reference and label your data. R2V has all the tools to get a perfect set of vector data faster and easier than any other methods.

For the hold process, only layer1 will be used for demonstration. You can try by yourself for layer2 (red color).

### **6.1. Automatic vectorization**

This command performs the automatic vector extraction or vectorization algorithm to detect all the lines from the image and display the vector data on top of the image for verification and editing. All vectorized lines are stored in the current layer.

With this command, we will vectorize our layers, black and red layers. Then export the vector data into GIS environment for further processing.

#### **To do this:**

1. Run R2V software,
2. Open the black layer (layer1.tif), the image displayed in the R2V desktop screen,
3. From Image menu, choose conversion, then 24-bit RGB to GrayScale, to convert the image into gray scale mode,
4. Click once on Auto Vectorize tool. When the vectorization parameter dialog box appears, select the Center Line: Extract lines by tracing the center of all line features,
5. Click Start button to get the vector result.
6. From File menu, choose Save Project as..., the save as dialog box appeared,
7. Save the file in the image directory and give "project1" as the file name,
8. Click Save button. Below is the result of vectorization.
- 9.

To see Layer 1 and its Associated Vector Line, [click here](#).

To see the Demo, [click here](#)!

As you can see from this picture, the vector lines just created are not smoothed enough. The next step will use the command in R2V to smooth the lines.

### **6.2. Smoothing the created vector lines**

This command does a global nodes thinning using a user specified threshold. The threshold is a distance in pixel between a node and its line. When the distance

between a node and its line is less than the threshold, the node is removed from the line. If the threshold is set as 0, then only these duplicate or redundant nodes are removed, no further smoothing is performed.

When a selection rectangle is set in the image, you will have the option of applying this operation to the selected region only.

When the dialog box appears, the default value for the threshold is 1. If this is the first time, click “Apply” button to try it. Smoothed lines are displayed on screen when the processing is done. If more thinning is desired, enter a larger value and then click “Apply” button. Increment of 1 to the threshold can cause a significant thinning to the vector data. Be careful not to use too big of a threshold to avoid over thinning. When the thinning is done, select “OK” to confirm it. If you want to recover your original data without the thinning, select “Cancel”.

In this case we will smooth the vector lines that has just been created.

**To do this:**

1. With the project still open,
2. From Vector menu choose Smooth lines, the Smooth Line dialog box appears,
3. Keep the threshold value = 2 and click OK button,
4. The lines are smooth, look like the one in picture below. To see the smoothed vector lines, [click here!](#)

To see Demo, [click here!](#)

### **6.3. Editing and cleaning vector line**

With the [line editor](#), you can add new lines, add a node, move a node, delete a node, delete a line and delete all lines. When the tool is started, the cursor will change according to the editing mode. Use right mouse button to get the editing pop up menu or the tool bars for editing options. An option is checked if the corresponding editing mode is currently active.

As you can see from the picture below, even though the lines were smoothed there are some error line created along with the process of automatic vectorization as indicated by circle numbered 1 (short lines) and circle numbered 2 (longer lines). To correct those mistakes two methods will be used: automatic (for the short lines) and manual (for the long lines) corrections. To see the picture of *Vector Line Before Editing*, [click here!](#)

#### **(1) Automatic Editing**

**To do this:**

1. With the project still open, zoom into the place where there arc error lines exist to have a closer look,
2. From the *Vector* menu, click on *Delete Line by Length...*, the Remove Lines dialog box appears,

3. Under Enter Threshold option, type 5 for the max value, then click Apply button, if the lines are not remove keep increasing the value until the sort lines will be deleted automatically,
4. Then Click OK to accept the result.

To see the picture showing the mistake lines in the circle numbered 1 now have been removed, [click here](#).

To see the Demo, [click here](#)!

## **(2) Manual Editing**

1. With the project still open, zoom into the place of circle numbered 2 to have a closer look,
2. Click on *Line Editor* button to activate its associated buttons,
3. Click on the Delete Line tool, then click once on the error line to delete its,
4. Keep doing the same way until all of the error lines will be remove.

To see the picture showing the mistake lines in the circle numbered 2 now have been removed, [click here](#).

To see the Demo, [click here](#)!

## **6.4. Exporting the vector lines**

Now our [vector layer](#) is ready to be exported into a format that can be read by ArcInfo software. Later, we will export the layer as \*.arc format. The exported data need to have the information about its coordinate system in order to be used with others GIS data. So the 4 control points need to be remained with the data for the hold process.

### **To do this:**

1. With the R2V project file still open, from *File* Menu choose Export Vector. The save as dialog box appeared.
2. From the save as box, select the Ras2Vec directory from the save-in option. Type “Myvector1” as file name and choose \*.arc as file type. Then click *Save* button. [Click here to see the demo](#).

## **7. Working with GIS software**

This is the time to get into GIS software environment. Remember that we have just created a file “Myvector1.arc” stored in Ras2Vec directory. We will walk across two sections: ArcInfo and ArcView.

In ArcInfo environment, the following task will be performed:

1. Convert myvector1.arc file into ArcInfo Coverage,
2. Creating an empty coverage with real world coordinate system
3. Editing tic locations
4. Transform the coverage into its real world coordinate system,
5. Cleaning, building topology and editing the coverage,



In ArcView environment, the coverage will be displayed by the landuse code and associated with its image files.

### **7.1. In ArcInfo Environment**

#### **(1) Converting Myvector1.arc into ArcInfo Coverage**

We will use ArcInfo command “**Generate**” to convert Myvector1.arc into ArcInfo coverage named “**Myvector**”.

#### **To do this:**

1. Get into Ras2Vec workspace by typing “w ras2vec” from Arc prompt:  
“**Arc: w ras2vec**”,
2. To make sure that the file exists in the workspace, use the command:  
“**Arc: &sys dir \*.arc**”. The file will appear if the file was successfully exported from R2V environment.
3. Use the command Generate, subcommand Input and line as below:

```
Arc: generate myvector <enter>
Generate: input myvector1.arc <enter>
Generate: line <enter>
Generate: q <enter>
Arc: lc <enter>
```

After the last command entered, ArcInfo will list the coverage named “Myvector” indicating that the coverage was successfully created. [To see demo click here!](#)

#### **(2) To create empty coverage**

#### **To do this:**

1. Start ArcInfo and go to the Ras2Vec workspace if you have not done so,
2. Then create an empty coverage “MYVECTORT” by using the following commands:

```
Arc: create myvectort <enter>
      Creating coverage myvectort
Arc: lc <enter>
      Workspace:      C:\RAS2VEC
      Available Coverages
      -----
      MYVECTOR      MYVECTORT
Arc: tables <enter>
      Copyright (C) 1982-1998 Environmental Systems Research Institute, I
      All rights reserved.
      TABLES Version 7.2.1 (Thu Apr 2 15:59:38 PST 1998)
Enter Command: sel myvectort.tic <enter>
      0 Records Selected.
Enter Command: add <enter>
```

```

1
IDTIC: 1
XTIC: 737270
YTIC: 1559840
2
IDTIC: 2
XTIC: 733350
YTIC: 1559840
3
IDTIC: 3
XTIC: 733350
YTIC: 1556970
4
IDTIC: 4
XTIC: 737270
YTIC: 1556970
5
IDTIC: <enter>

```

**Enter Command:** *list <enter>*

Record	IDTIC	XTIC	YTIC
1	1	737270.000	1559840.000
2	2	733350.000	1559840.000
3	3	733350.000	1556970.000
4	4	737270.000	1556970.000

**Enter Command:** q <enter>; to return to Arc prompt.

[To see demo click here!](#)

### (3) Editing Tic locations

To do this:

- Get into ArcEdit environment:
  - Arc:** arcedit <enter>
  - Arcedit:** Display 9999 <enter>
- Draw the imported coverage “**Myvector**”:
  - Arcedit:** mape myvector <enter>
  - Arcedit:** edit myvector <enter>
  - Arcedit:** Drawe arc tic <enter>
  - Arcedit:** Draw <enter>, the coverage displayed on the Arcedit screen,
- Move tics from their current location to the actual locations:
  - Arcedit:** ef tic <enter>, to specify that the tic features will be edited,
  - From Arcedit menu *Pan/Zoon*, choose **extent**, and then use the cursor to zoom in on a tic that it can be seen clearly.
  - Arcedit:** select <enter>, use the cursor to select a tic,

- **Arcedit:** Move <enter>, to move the tic,
- 4. Repeat to do the same way until all of the tics will be moved into their actual location.
- 5. Save the work:
  - **Arcedit:** Save <enter>

To see demo, [click here!](#)

#### (4) Transform the coverage into its real world coordinate system

Our coverage that has just created does not have geo-reference information. With this process the coverage will be transformed into its real world coordinate system.

#### To do this:

Use the command Transform from Arc promp:

**Arc:** Transform <enter>, to see its usage,

Usage: TRANSFORM <in\_cover> <out\_cover> {AFFINE | PROJECTIVE | SIMILARITY}

Where <in\_cover> is “**Myvector**”and <out\_cover> is “**Myvectort**”. We will use projective option.

**Arc:transform myvector myvectort projective**<enter>, after the process finished the following message appears to show the accuracy of the transformed product.

Approximate scale = 5.117

RMS Error (input,output) = (0.000,0.000)

2D Projective  $X = (Ax + By + C) / (Gx + Hy + 1)$

$Y = (Dx + Ey + F) / (Gx + Hy + 1)$

A = 5.164 B = -0.062 C = 733309.058  
 D = 0.099 E = -5.247 F = 1559901.392  
 G = 0.000 H = 0.000

tic id	input x output x	input y output y	x error	y error
2	8.000	12.000		
	733350.000	1559840.000	0.000	0.000
1	774.002	11.960		
	737270.000	1559840.000	0.000	0.000
4	773.967	572.988		
	737270.000	1556970.000	0.000	0.000
3	8.001	573.002		
	733350.000	1556970.000	0.000	0.000

To see the demo, [click here!](#)

### (5) Cleaning, building topology and editing the coverage

The coverage now has geo-referent information. However before it can be used as a GIS database, the coverage need to be cleaned, built topology and edited.

#### 1) Cleaning

##### To do this:

Use command **CLEAN** from Arc prompt:

**Arc:** clean <enter>, to see its usage,

Usage: **CLEAN** <in\_cover> {out\_cover} {dangle\_length} {fuzzy\_tolerance}  
{POLY | LINE}

Where <in\_cover> is Myvectort, {out\_cover} is Myvectorc, Dagle\_length = 10  
and Fuzzy\_tolerance = 0.1

**Arc:** *clean myvectort myvectorc 10 0.1* <enter>, after the process  
finished the coverage will be cleaned.

To see Demo, [click here](#)!

#### 2) Building topology

##### To do this:

Use command **BUILD** from Arc prompt:

**Arc:** Build <enter>, to see its usage,

Usage: **BUILD** <cover> {POLY | LINE | POINT | NODE | ANNO.<subclass>}  
Where <cover> is myvectorc and poly option will be used,

**Arc:***build myvectorc poly* <enter>, after the process finished the topology  
of the coverage will be created.

To see Demo, [click here](#)!

#### 3) Editing

This is the time where we can add and delete lines; edit dangle and rebuilding topology for the coverage.

##### To do this:

1. Get into Arcedit environment and display the coverage setting features to be drawn as *arc node dangle*,
2. Chang the color of dangle node to be red:  
**Arcedit:** nodecolor dangle 2 <enter>  
**Arcedit:** draw <enter>

3. Deleting non-necessary arcs,  
**Arcedit:** ef arc <enter>  
46 element(s) for edit feature ARC  
Coverage has no COGO attributes  
**Arcedit:** sel box;delete <enter>, open a box around the arc to delete,  
Define the box  
4 element(s) now selected  
4 arc(s) deleted, the 4 arcs now deleted, repeat to do the same way until all of non-necessary arcs will be deleted.
4. Adding boundary to the coverage,  
**Arcedit:** add <enter>, use the following menu to add arcs to the coverage:  
  
-----Options-----  
1) Vertex            2) Node            3) Curve  
4) Delete vertex    5) Delete arc        6) Spline on/off  
7) Square on/off    8) Digitizing Options 9) Quit  
(Line) User-ID: 1 Points    5  
(Line) User-ID: 2 Points -----  
1 arc(s) added to C:\RAS2VEC\MYVECTORC
5. Cleaning the coverage,  
**Arcedit:** clean <enter>,
6. Editing dangle errors by deleting overshoot arc,  
**Arcedit:** sel box;delete <enter>  
Define the box  
1 element(s) now selected  
1 arc(s) deleted,
7. Repeat to do the same way until the overshoot arcs will be deleted,
8. Saving the changes,  
**Arcedit:** save <enter>

To see Demo, [click here!](#)

## **7.2. ArcView Environment**

In ArcView environment, the following tasks will be performed:

1. Overlaying the coverage with its original image,
2. Assigning landuse code to the coverage,
3. Display the coverage by landuse code characteristics.

**(1) Overlaying the coverage with its original image,**  
**To do this:**

1. Start ArcView 3.2 program,
2. Add Geo-referent image as a theme into a view,
3. Add the vector coverage “Myvectorc” as poly and arc into the same view.

To see Demo, [click here](#)!

**(2) Assigning landuse code to the coverage,**

**1) Adding “Class” field into theme attribute table**

**To do this:**

1. Click on the polygon theme of Myvectorc coverage to make it active,
2. Click once on “Open Theme Table” button, the table displays
3. In table menu, from **Table** menu, choose *Start Editing*, the table changes into editing mode,
4. From Edit menu, choose Add Field, a Field Definition box appears
5. Type “Class” for the field name, accepts type as String, Width sets to 3, click OK.
6. From Table menu, choose Stop Editing; accept the changes to be applied to the table.

To see Demo, [click here](#)!

**2) Assigning landuse attribute to the polygon coverage**

**To do this:**

1. Make the vector polygon theme active and visible,
2. Make sure that the attribute table is in editing mode,
3. From the view panel, use Select Feature tool to select a polygon (The biggest in the middle) its attribute can be seen for original image or hard copy paper, then its record in the table is also selected,
4. From table panel, use the Edit tool to add “As” as Class attribute in the selected record,
5. Repeat to do that until all of the polygons will has their class attributes,

To see Demo, [click here](#)!

**(3) Display the coverage by landuse code characteristics**

**To do this:**

1. Double click on the polygon theme “**Myvectorc**” to bring its legend tool box,
2. From the box, choose **Unique Value** for *Legend Type* and **Class** field for *Values Field*, all of the class attribute now displays in the Legend Editor box,
3. Click Apply button to apply those color arrangement to the polygon theme.

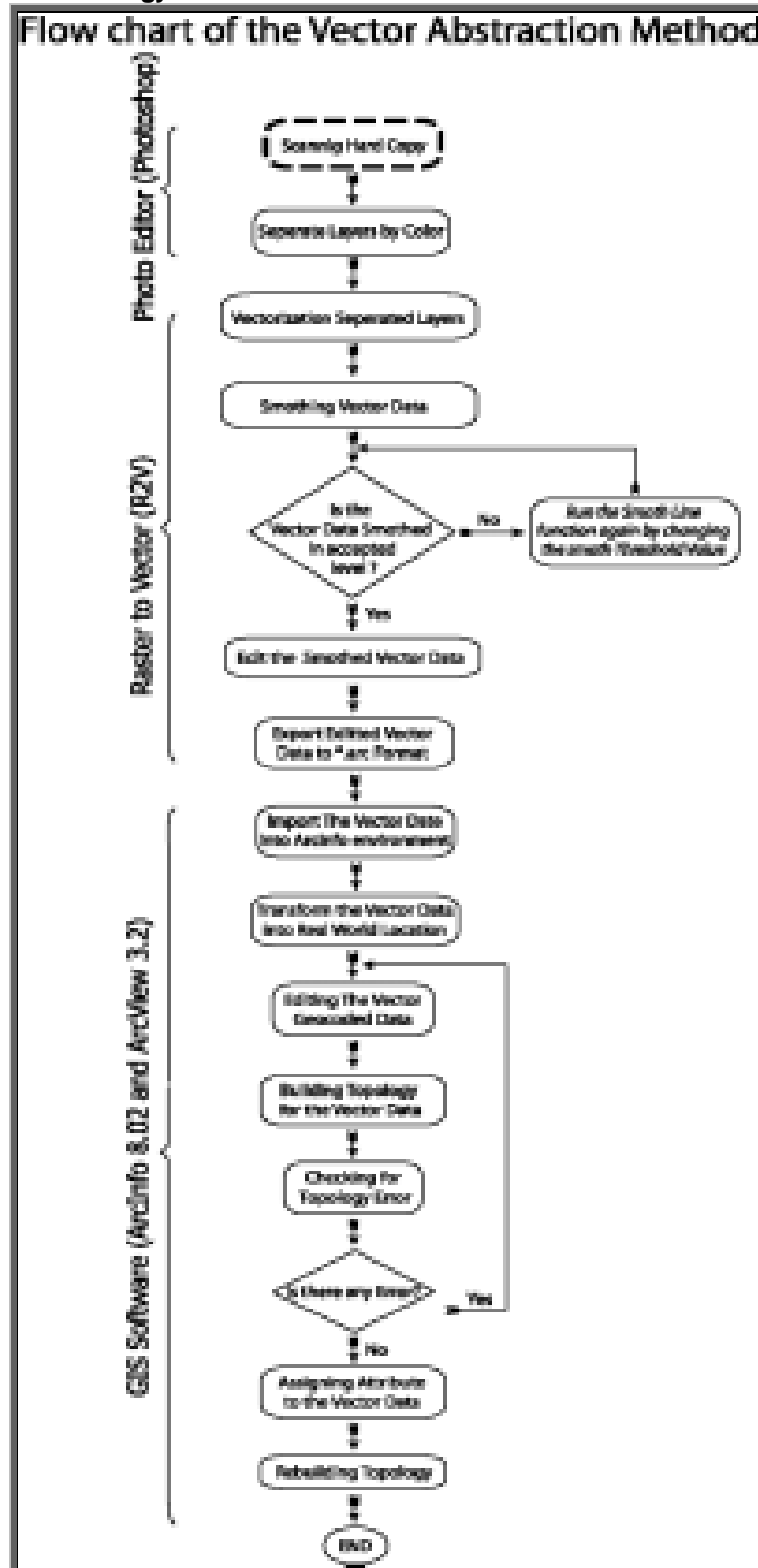
To see Demo, [Click here](#)!

**8. Exercise**

*Remember we still have one more raster layer “Layer2.tif” stored in C:\RAS2VEC\IMAGE folder.*

*Now your task is to convert a polygon vector coverage from that image using all software (Photoshop, R2V, ArcInfo and ArcView) and all method.*

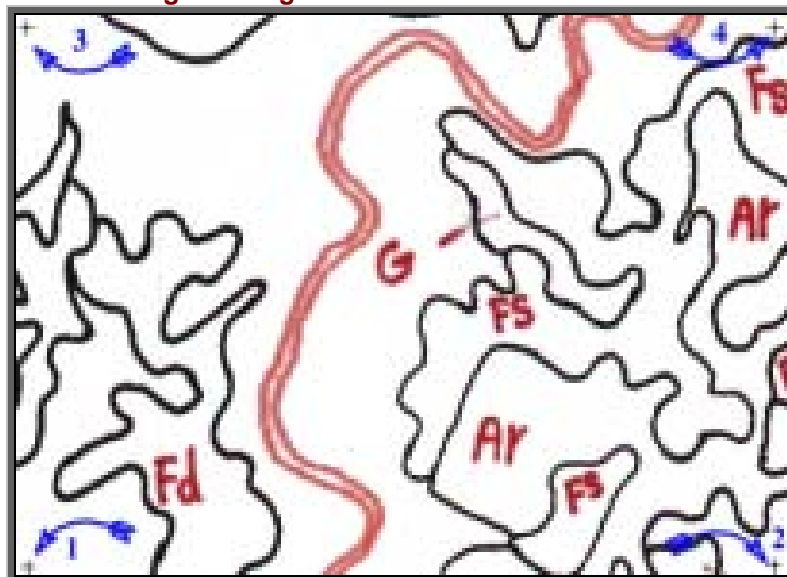
Figure 8-1 Methodology Flow Chart



[Go back](#)

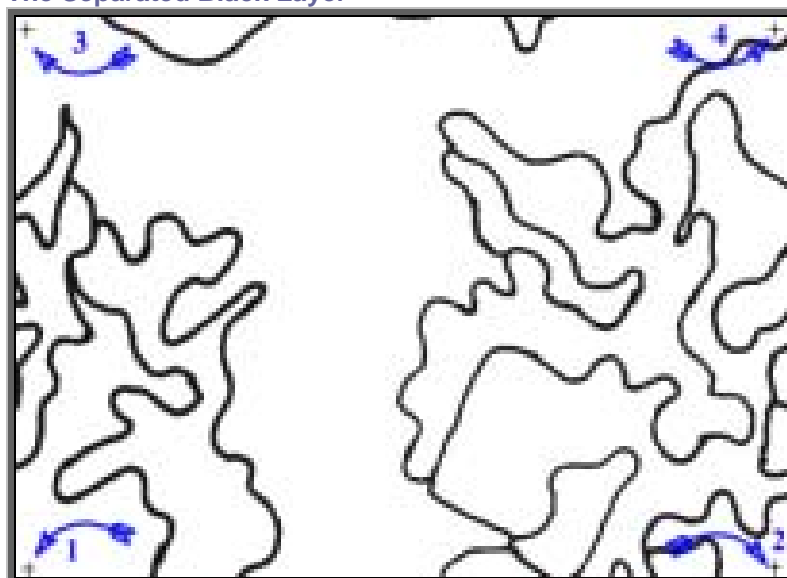


**Figure 8-2**      **Scanned Original Image and Its GCPs**



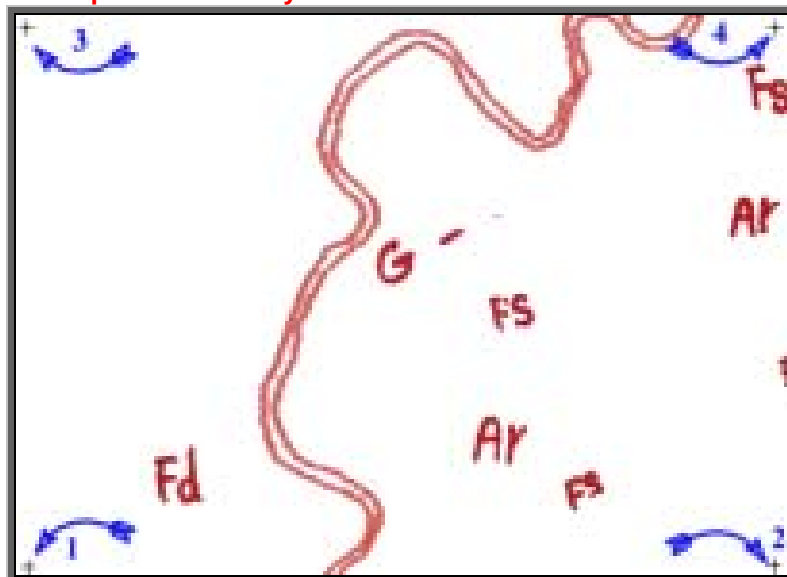
[Go Back](#)

**Figure 8-3**      **The Separated Black Layer**



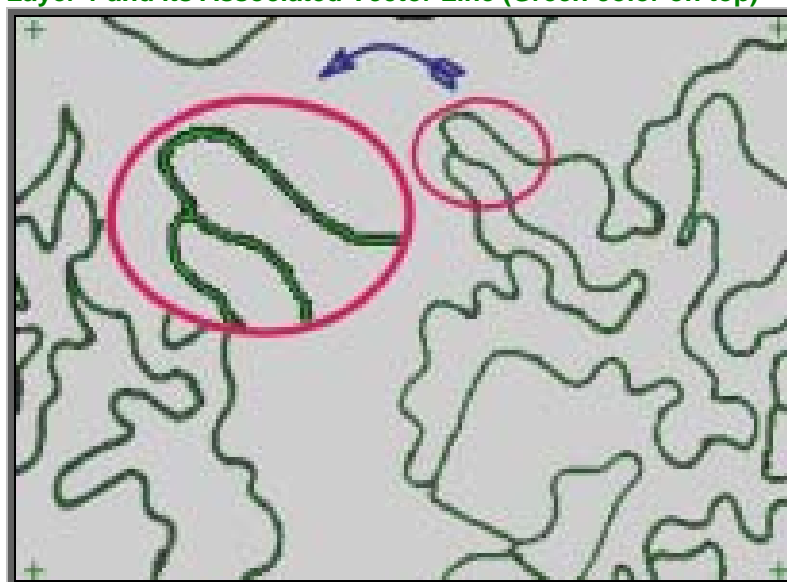
[Go Back](#)

Figure 8-4 The separated Red Layer



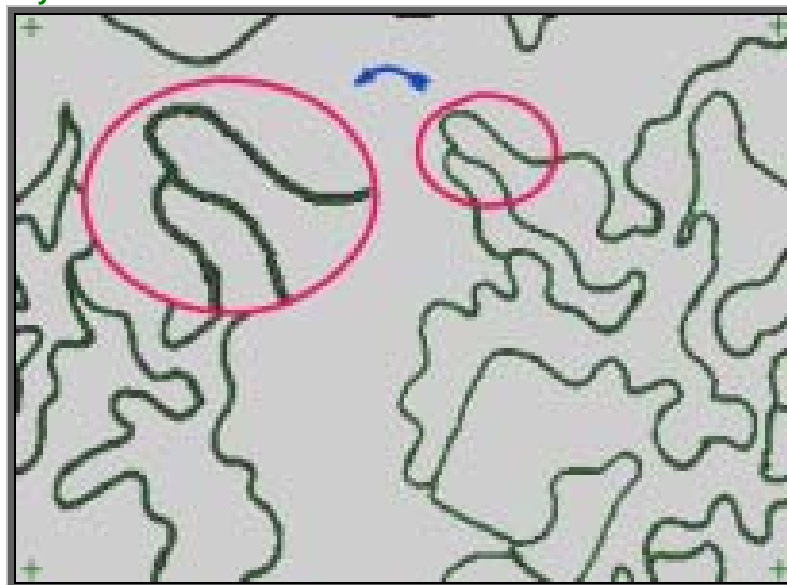
[Go Back](#)

Figure 8-5 Layer 1 and its Associated Vector Line (Green color on top)



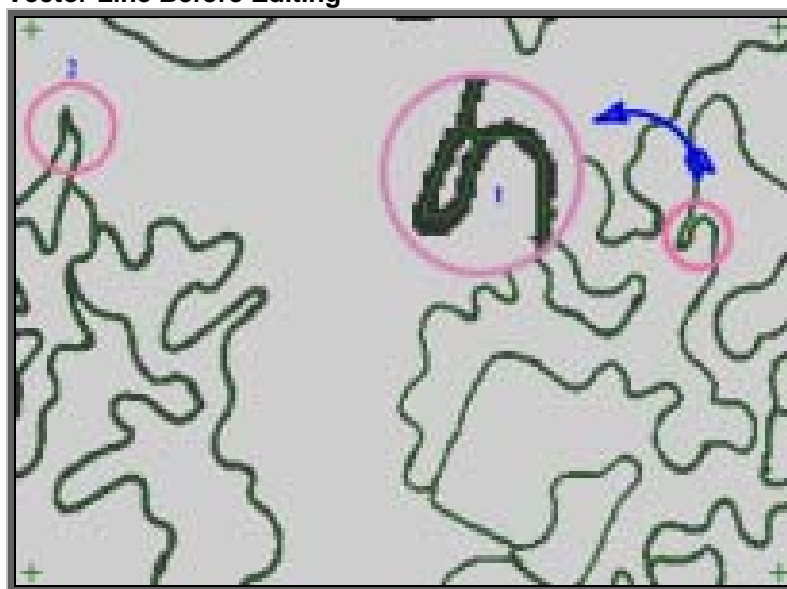
[Go back](#)

**Figure 8-6**      **Layer 1 and its Associated Vector Line Smoothed**



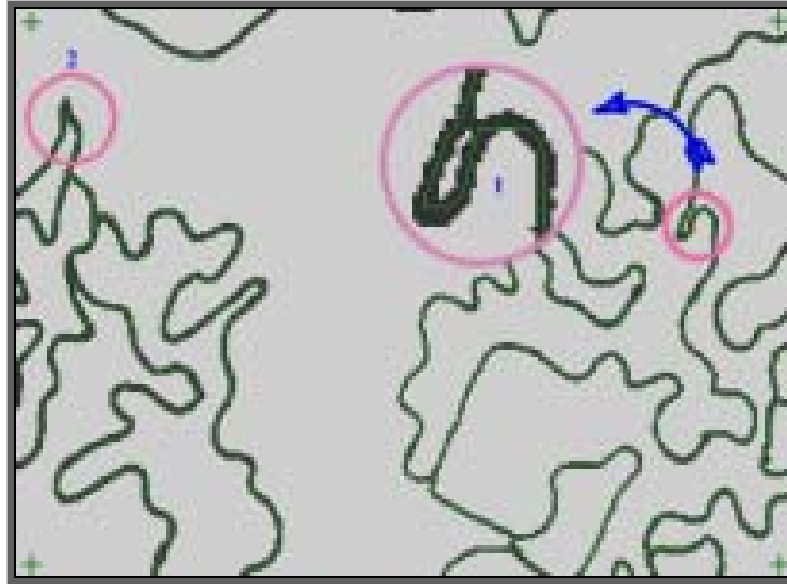
[Go back](#)

**Figure 8-7**      **Vector Line Before Editing**



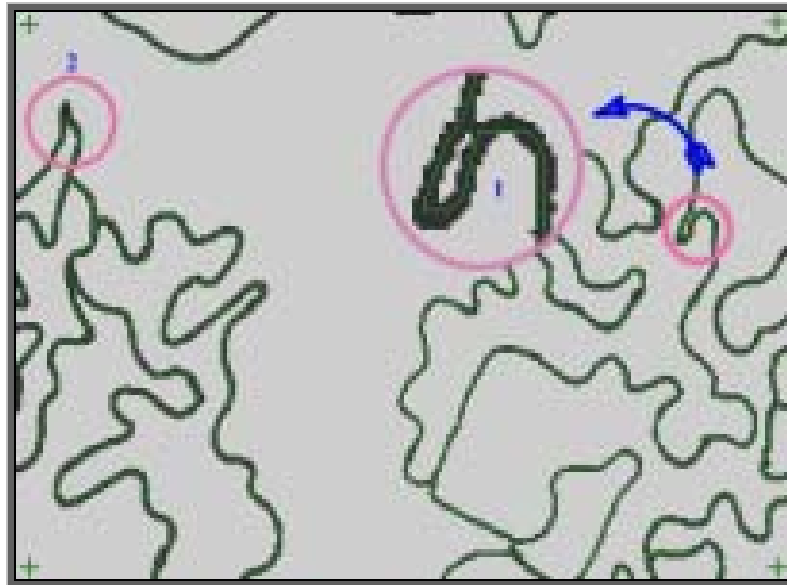
[Go back](#)

**Figure 8-8**      The mistake lines in the circle numbered 1 now have been removed



[Go back](#)

**Figure 8-9**      The mistake lines in the circle numbered 2 now have been removed



[Go back](#)

**Figure 8-10**    **The Cleaned Vector Layer**



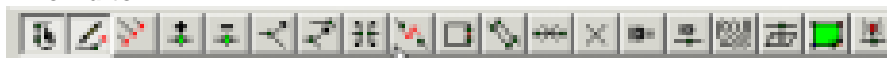
[Go back](#)

**Figure 8-11**    **Magic Wand Tool**



[Go back](#)

**Figure 8-12**    **Line Editor**



[Go back](#)