Ice Storm '98

This exercise is designed to demonstrate the effects of the ice storm that took place in eastern Canada in January 1998. Background information focuses on the damage that took place during the storm and the effect that it had those living in the area.   Both a physical and human component is taken into consideration in this exercise.

The Student Side

A) ArcView Fact Sheet

Here's a list and explanation of important features in ArcView:

Project : In ArcView, a file for organizing your work. Projects use five types of documents to organize information: views, tables, charts, layouts, and scripts.

View : A component of an ArcView project used for displaying, querying, and analyzing geographic themes.

Table of Contents: All themes in a View are listed to the left of the map. The Table of Contents shows the symbols used to draw features in each theme. The check box next to each theme indicates whether or not it is turned on or off in the map (whether it is currently drawn on the map).

Theme: A set of related geographic features, such as streets, parcels, or rivers, and the characteristics (attributes) of those features.

Tables : Information formatted in rows and columns. A component of an ArcView project used for displaying Tabular data.

Join: In ArcView, an operation used to attach Tabular data to a theme. The fields of one table are appended to another table (usually the theme table) using a common field.

Chart : A graphic representation of tabular data. A component of an ArcView project used for representing tabular data graphically.

Thematic Mapping: A form of desktop mapping that uses information stored in a spreadsheet or database to create map displays for graphic presentations.

X-axis: The horizontal axis in a graph or chart.

Y-axis: The vertical axis in a graph or chart.

Layout : The design or arrangement of elements in a digital map display or printed map. A component of an ArcView project used for creating presentation-quality maps.

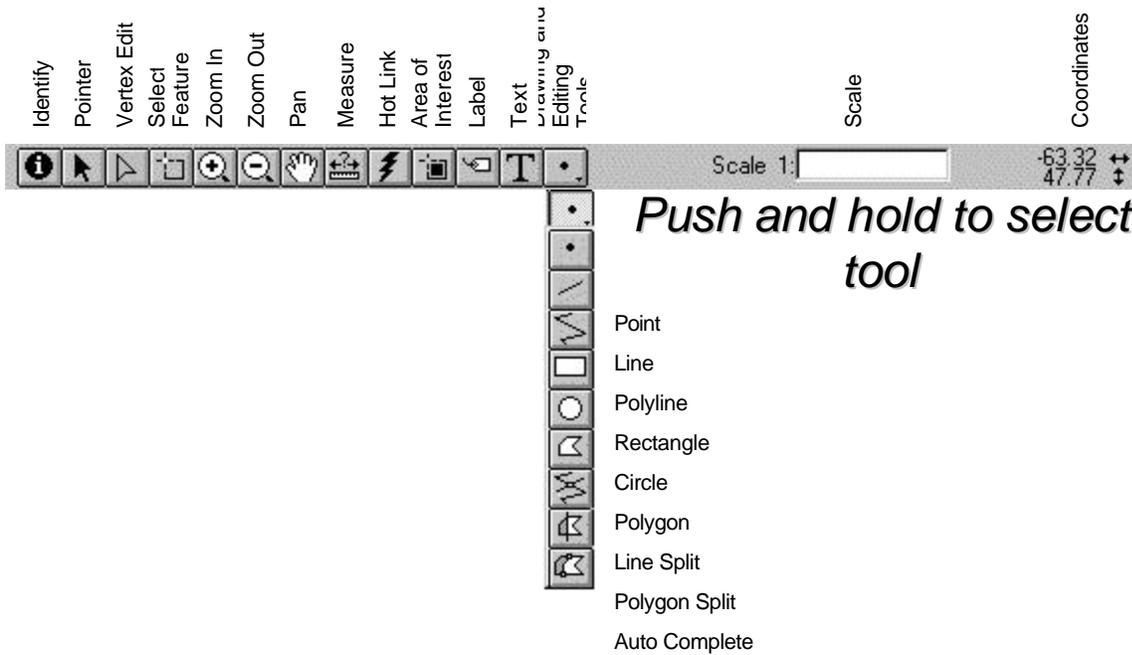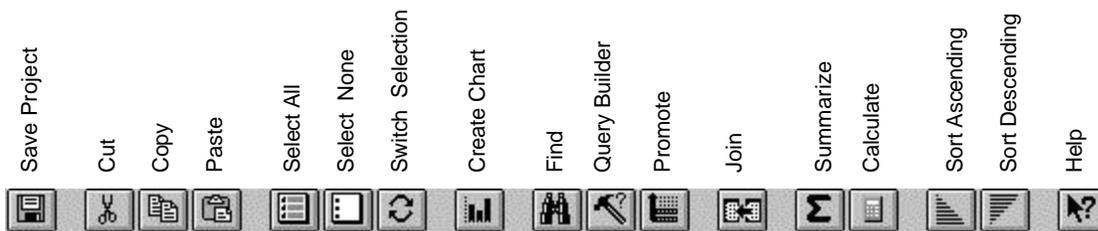## B) ArcView Icons - Reference Guide

View GUI - Buttons

Save Project | Add Theme | Theme Properties | Edit Legend | Open Theme Table | Find | Locate Address | Query Builder | Zoom to Full Extent | Zoom to Active Theme | Zoom to Selected | Zoom In | Zoom Out | Zoom to Previous Extent | Select Features using Graphics | Clear Selected Features | Help

View GUI – Tools

Identify | Pointer | Vertex Edit | Select Feature | Zoom In | Zoom Out | Pan | Measure | Hot Link | Area of Interest | Label | Text | Drawing and Editing Tools | Scale | Coordinates

Scale 1:   -63.32 ↔
                  47.77 ↕

Push and hold to select tool

- Point
- Line
- Polyline
- Rectangle
- Circle
- Polygon
- Line Split
- Polygon Split
- Auto Complete

Table GUI - Buttons

Save Project | Cut | Copy | Paste | Select All | Select None | Switch Selection | Create Chart | Find | Query Builder | Promote | Join | Summarize | Calculate | Sort Ascending | Sort Descending | Help

Table GUI - Tools

Record Counter | Select Tool | Edit Tool | Identify Tool

1 of   26 selected

Chart GUI - Buttons

Save Project
Undo Erase
Area Chart Gallery
Bar Chart Gallery
Column Chart Gallery
Line Chart Gallery
Pie Chart Gallery
Scatter Chart Gallery
Chart Properties
Series From Records/Fields
Find
Help

Chart GUI - Tools

Identify Tool
Erase Tool
Erase Within Polygon Tool
Chart Element Properties Tool
Chart Colour Tool

Layout GUI - Buttons

Save Project
Cut
Copy
Paste
Layout Properties
Group
Ungroup
Bring to Front
Send to Back
Undo
Zoom to Page
Zoom to Actual Size
Zoom to Selected
Zoom In
Zoom Out
Print
Help

Layout GUI - Tools

Pointer Tool
Vertex Tool
Zoom In Tool
Zoom Out Tool
Pan Tool
Text Tool
Drawing Tools
Frame Tools

BACKGROUND INFORMATION

What happened?

During the first week in January 1998, a massive ice storm struck eastern Ontario, Southern Quebec and the northeastern United States. Between January 5 and 10th, the total water equivalent of precipitation, comprising mostly of freezing rain and ice pellets and a bit of snow, exceeded 85 mm in Ottawa, 73mm in Kingston and 100mm in Montreal. The storm brutalized one of the most highly populated areas of North America leaving over four million people freezing in the dark, some for days and weeks.

Within several days, the storm had destroyed much of the region's electrical transmission network depended upon by a modern technological society. People were forced to adopt the survival techniques of pioneers by huddling around fireplaces and using candles for light.

Prolonged freezing rain brought down millions of trees, 120,000 km of power lines and telephone cables, 130 major transmission towers each worth $100,000 and 30,000 wooden utility poles costing $3000 each. The damage in eastern Ontario and southern Quebec was so severe that major rebuilding, not repairing, of the electrical grid needed to be undertaken. What it took human beings a half a century to construct took nature an matter of hours to knock down.

There were 15,875 troops (including reservists) that were deployed to help clear trees, move citizens to shelters, deliver flyers, operate field kitchens and maintain civil order. It was the largest humanitarian assistance mobilization of Canadian Forces in history.

Health Canada delivered 85, 088 stretchers, 75,900 blankets, 24,566 cots, 1,398 batteries and 569 flashlights to Ontario and Quebec. Natural Resources Canada provided more than 17,000 maps and aerial photos to Canadian Forces.

Months later, many people are still trying to recover from the losses they suffered during the storm. In some cases, it could take years before things return to normal.

What is "freezing rain"?

'Freezing rain' is a common term amongst Canadians and those who live in the northeastern United States. This term however, is often used incorrectly. Freezing rain is not to be used to describe rain that falls and then freezes when it hits the cold ground. Instead, the raindrops of freezing rain are actually **supercooled** – which means that they are already colder than 0 degrees Celsius but have not actually turned to ice yet. It

is the mechanical shock of the pellets striking a hard surface causes instantaneous formation of ice crystals, which rapidly build up as a tightly adhering mass of ice.

Super cooling is a bit of a complex procedure to explain. In essence, water can be kept in a laboratory at below freezing temperatures without becoming solid for a certain period of time. If there is any disturbance made to the water (contact with ice or shaking) it will freeze instantly. The raindrops are super cooled as a result of a particular meteorological situation. Hitting the ground is a simple enough disturbance to cause every drop to freeze. This freezing rain builds up on every surface it touches. During the storm, some trees were crumbling under layers of ice weighing 30 times their own weight.

How is it caused?

For freezing precipitation, the atmosphere must be properly layered – a layer of warm air aloft with temperatures above freezing, sandwiched between layers of colder air below freezing. Often in winter the warm moist air overrides the heavier, denser cold air near the surface.

When rain falls, or snow melts while falling through the intermediary warm layer, rain falls into the shallow cold layer hugging the ground. There, with the air temperature below freezing and / or the ground and objects still below freezing, the chilled raindrops freeze but not completely. Instead, they reach the surface as a supercooled liquid (water droplets at a temperature below 0 degrees Celsius) or as a mixture of liquid and ice. Upon striking a colder object, such as the pavement, hydro wires, tree branches, building walls or cars, the supercooled raindrops spread out and freeze almost immediately, forming a smooth, thin veneer of slick ice. This form of precipitation is called freezing rain or glaze. It contains no air bubbles and looks as smooth and clear as glass. If the drops are tiny (less than 0.5mm in diameter), the precipitation is called freezing drizzle.

Related Web Sites:

Here is a list of web sites that contain information about the ice storm. Links to these web sites are available on the ESRI K-12 website (http://www.esri.ca/k-12):

- **Storm 1998 - A Picture Essay**

  http://qsilver.queensu.ca/~6rhp/ICE/

- **Ice Storm Photo Gallery**

http://www.canoe.ca/CNEWSIceStorm/menu.html

- **Environment Canada's Ice Storm Coverage**

  http://www.tor.ec.gc.ca/events/icestorm98/

- **IceStorm98.com**

  http://www.icestorm98.com/

- **Montreal Ice Storm '98 Reporting Site**

  http://www.info-4-you.com/

- **Canadian Geographic's March / April issue**

  http://www.cangeo.ca/MA98/MA98toc.htm

Ice Storm '98

This exercise is divided into several different sections. Each section will demonstrate some of the capabilities of ArcView.

Starting ArcView

If ArcView is not already running you need to start it. How you do this depends on the operating system, and where ArcView was installed. If you don't know how to start ArcView on the machine you're in front of now, either consult you manual or ask the instructor.

Before you begin

To start, you need to load the "**icestorm.apr**" project. Projects in ArcView are files you use to manage your GIS data and analysis. When ArcView starts up, it looks like this:
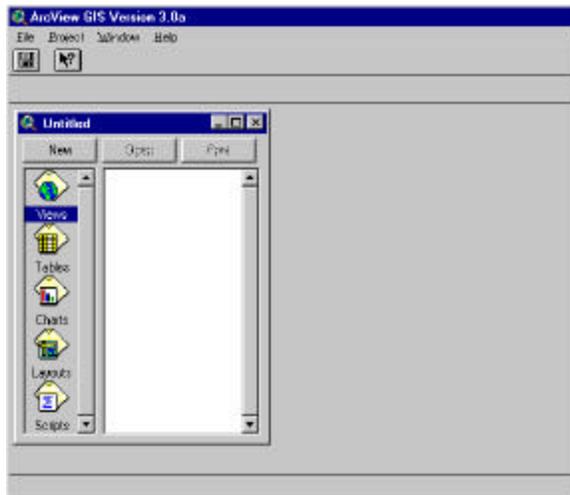
The words **File, Project, Window and Help** make up the **Menu Bar**. From the **Menu Bar**, click on the word **File**, and then select **Open Project…** like this:
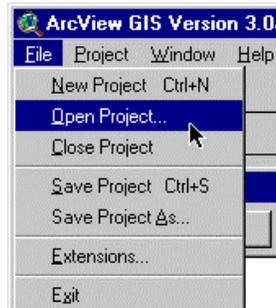
Using the dialog box that appears, navigate to the c:\icestorm directory. Click on the file called icestorm.apr and then click on OK.

THROUGHOUT THIS EXERCISE, WHEN YOU SEE THE "SAVE IT NOW" ICON, YOU SHOULD SAVE YOUR PROJECT. IT'S EASY, WHENEVER YOU SEE THIS:

Save It Now

Just click on the **Save Project** button. This button is located on **all** ArcView button bars.

Part 1 – Patterns of the Storm

1   In the **Project Window**, (called icestorm.apr) click once on **Part A – Patterns of the Storm**, and then click the <kbd>Open</kbd> button to open the View window.

2   You will now see a new window appear with a map in it. The **Table of Contents** on the left side of the window lists all the themes that are contained in your View. In this case you should see the following themes listed:

> Rivers
> Precipitation (mm)
> Lakes
> Elevation

     All the themes are **visible** except the Precipitation theme. We will be looking at that in a little while.

3   Inspect the themes in your **View** and visually attempt to identify the following valleys and mountain ranges on the map (the white areas indicate areas of higher elevation)

> The Ottawa Valley
> The Adirondak Mountains
> The Saint Lawrence Valley
> The Laurentian Mountains

4   Turn on the **visibility** of the **Precipitation** theme by placing a check mark the **visibility selector box** to the left of theme name. Your theme will now be **visible**.

     You should now see the area that the storm covered appear on top of your elevation map.

5   Examine the **Legend** that appears in the **Table of Contents** for the Precipitation theme and identify where the different levels of precipitation fell.

Considerations –

- Does the pattern of the ice storm appear normal compared to other storm patterns that you have seen?
- What are the physical characteristics of the area that you are examining?
- How do you believe elevation and land cover played a role in the movement of the storm?
- Can you explain what the "tails" (the areas that appear to move away from the heart of the storm) are here and why they exist?
- What is the relationship between the areas where the storm hit the hardest and the elevation of the area?

Based on your observations, you will now draw the course that the storm followed (from west to east). To do this you will use the drawing tool and draw arrows on map to indicate the path of the storm. These lines are merely graphics, not a new theme. Graphics can be drawn on top of any theme but do not have any associated attribute information.

6　　　Make the **Precipitation** theme active. To do this, you simply click once on the theme name and a gray box will appear around the theme, making it appear raised up.
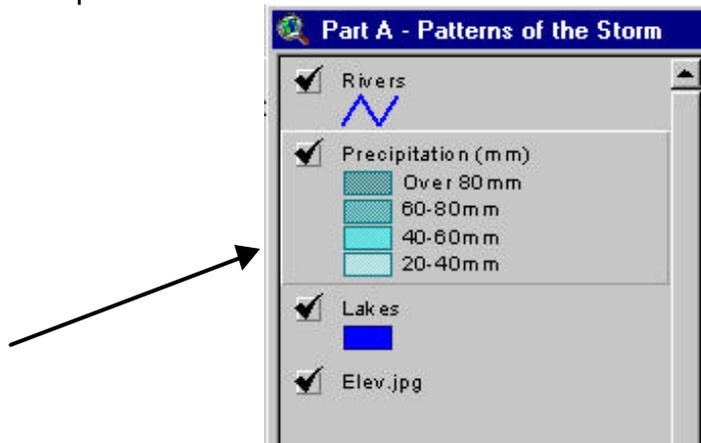
7   From the tool bar, click and hold down the **Draw Point tool** . A series of drawing tools will appear in a drop down list.

8   Select the **Draw Poly Line** tool . Your cursor will now appear as cross hairs.

9   To draw a line, **click once** at the starting point. If you move your crosshairs around, it will appear as though you are "dragging" a line with you and it is attached to your cursor.

10   **To change the direction** of the line, click the crosshairs once again and then move along to the next point where you want to change direction again.

NOTE: Every time you click the cursor, you are creating a node that will be anchored in that location allowing you to move the crosshairs in another direction.

11   When you have completed your line, **double click** the crosshairs in the same spot and the line will end. Handles will appear around the line.

12   To draw the next line, simply place the cursor at the new starting point and repeat the steps above. You should draw several lines in order to clearly indicate where the storm progressed.

13   Now that you have several lines on the map, you are going to change the line type so that the solid lines become arrows.

14   Click on the **Pointer** tool on the tool bar.

15   From the **Edit** menu, choose **Select All Graphics**. Handles will appear around all the lines.

16   From the **Window** menu, choose **Show Symbol Window**. This will bring up the **Pen Palette**.
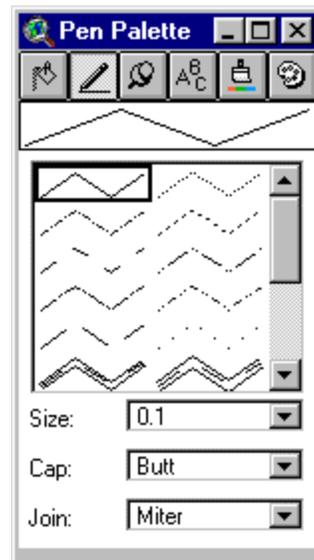
17   Scroll through the selection of lines until you see one that has arrows on it. Click on one of them (there are several choices, it doesn't matter which one you choose). You will see that the lines you have drawn have now changed to arrows.

18   Close the **Pen Palette** by clicking on the ☒ in the top right hand corner of the window.

19   To remove the handles from around the lines, select the **Pointer tool** ▣ from the tool bar and click anywhere in an empty part of the view.

20   From the **File** menu, choose **Close All**. You will now be back at the **Project Window** ("icestorm.apr")

      What can you say about the way the storm moved through the valleys and low-lying areas?

🖫 *Save it now!!*

Part B – Humans vs. Nature

In this portion of the exercise you will examine the effects of the storm on the population of the area.

1   You now need to open another **View** document. To do this, click once on "**Part B – Humans vs. Nature**" and then click the [Open] button.

2   A new view window will open and you will see the following themes listed in your **Table of Contents**:

> Rivers
> Precipitation (mm)
> Lakes
> Cnty-cd.shp

Once again, the **Precipitation** theme is **not "visible"** in your view right now. We will be dealing with them later on.

3   The **Cnty-cd.shp** theme represents the census divisions and counties located in eastern Ontario, southern Quebec and the northeastern United States. Right now they all appear as one solid color which is not very meaningful. You are going to create a thematic map that shows the population density throughout the area.

Make the **Cnty-cd,shp** theme active. (Remember, this means that you click once on the theme name and a gray box will appear around the theme making it appear raised up!)
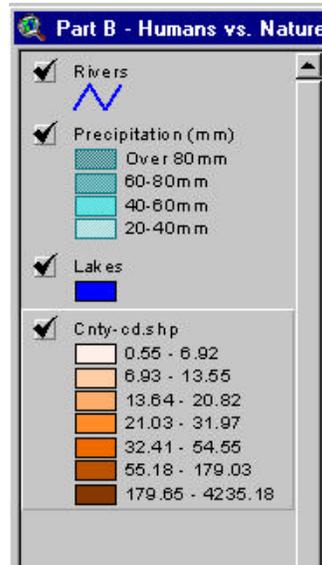
4   Click on the **Edit Legend** button ▨ on the button bar. This will bring up the
         Legend Editor. In ArcView, you use the **Legend Editor** to create thematic
         maps.

5   In the **Legend Type** box, choose **Graduated Color**.

6   In the **Classification Field** box, choose **Pop_1996**

7   In the **Normalize by** box, choose **Area_km**. (This means that you have divided
         the population values by the area of the census divisions and counties in order to
         obtain the population density.)
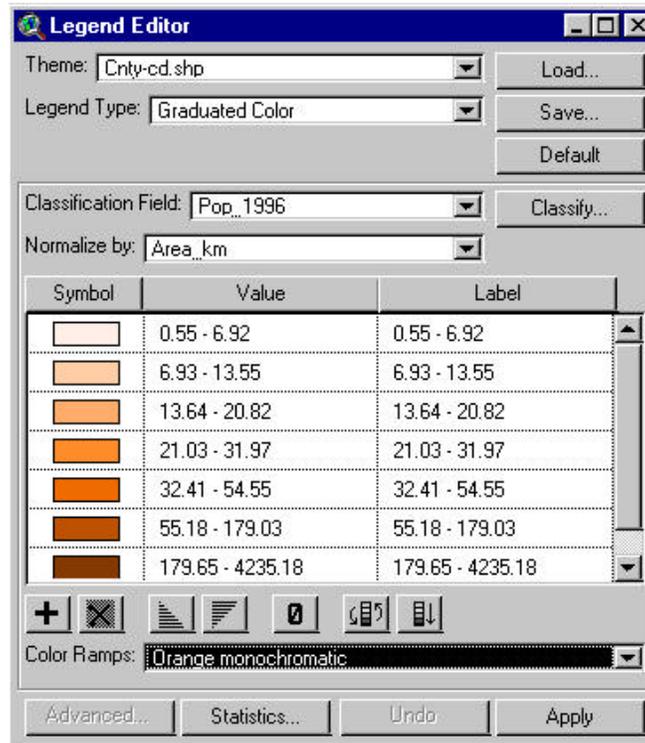
8　　Click on the **Classify** button. Use the drop down menus here to select the following information for each drop down menu.

Type:　　　　　　**Quantile** **Number of classes:**　　**7** **Round values at;**　**d.dd** Click on **OK**.	

9　　Change the **Color Ramp** to **Orange Monochromatic**.

10　Click on **Apply** and close the **Legend Editor.**

11　With the **cnty-cd** still **active**, click on the **Theme Properties** button. Change the **Theme Name** to **Population Density (pers/km2).**

The census divisions and counties map is classed by population density. This allows you to make some interesting observations.

- What can you say about the density of the population in the area where the storm occurred?

- Think back to the observations you made about the relationship between the elevation of the area and where the storm occurred. Can you also see a relationship between elevation and the distribution of population?

12   To find out the total area of the storm, make the **Precipitation** theme active. Click on the **Open Theme Table** button on the button bar.

13   In the table, click on the field heading name AREA. It now appears pushed in, indicating that it is the active field.

Shape	Id	Precip_m	Area
Polygon	0	20-40mm	185686.722
Polygon	0	60-80mm	21026.806
Polygon	0	Over 80mm	31092.454
Polygon	0	40-60mm	52962.859

14   From the **Field** menu, choose **Statistics**. A dialogue box will appear showing a variety of statistical information for the **AREA** field.

- Look at the information that is given. What is the total area that the storm covered?_____

15   Click on **OK** to close the **Statistics** dialogue box.

Save it now!

16   Close the **Attribute Table** by clicking on the X in the top right hand corner of the window and return to your **View**.

17   You will now use the **Population Density** theme to assess how many people were affected by the storm. Make the **Population Density** theme **active**.

18   From the **Theme** menu, choose **Select by Theme**. This brings up the **Select by Theme dialogue box**.

19   Below the words **"the selected features of"** there is a drop down menu. From here, choose **"Precipitation (mm)"**

20   Below the words **"Select features of active themes that"** there is another drop down menu. From here choose **"Have their Center In"**.

21   To complete the task, click on **New Set**. This will select all the census divisions and counties that have their center located within the area of the storm.

22   Make sure the **Population Density** theme is still active and click on the **Open Theme Table** button. Click on the **Promote** button to move all the selected records to the top of the table.

23   Click on the field heading called **Pop_1996**. It will appear pushed in, indicating that this is the active field. From the **Field** menu, choose **Statistics**. This will bring up the **Statistics dialogue box** that a variety of statistical information for the **Pop_1996** field. Because you have records that are selected (highlighted in yellow), the statistics that are derived represent only those selected records.

•   What is the total population affected by the storm?_____

24   Click on **OK** to close the Statistics dialogue box.

25   Click on the Select None button to clear the selected records. Close the Attribute Table and return to your view. Now there is nothing selected in your view. You can try and experiment with the select by theme function by trying out different possibilities if you would like.
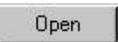
26   From the **File** menu, choose **Close All**.

Save it now!

Part C – Picture Perfect

In this part of the lesson you will hot link some pictures that were taken during the ice storm to some of the cities that were largely affected. You will also create a layout of your map to print.

1. Open the **View** called **"Part C – Picture Perfect"** by clicking once on the View name and then hitting the [Open] button.

2. You will now see that your view contains much the same information as the previous one, although this time there is a new theme called **Places**.

3. Your are now going to label some of the **Places** on the map. In the view's **Table of Contents**, make the **Places** theme active. Be sure to click on the name of theme, not the visibility check box.

4. You want to label Montreal, Kingston and Ottawa. To find out where these cities are located, click on the **Find button** 🔍.

5. Let's start with Montreal. In the dialog box that appears, type in **Montreal** (make sure you spell it properly!).

6. Click on **OK**. You will see the city of Montreal turn yellow, this means that it is selected.

7. Click on the **Label** tool 🔲. With the crosshairs, click once on the city and its name will appear.

8. Now go back and click on the **Find button** 🔍 again. This time you are going to type in **Ottawa** and then click on **OK**. Once it has become highlighted, click on your **Label tool** 🔲 once more and label the city of Ottawa.

9. Finally, click on the **Find button** 🔍 one more time and look for **Kingston**. **Label** (🔲)this city also.

10. Click on the **Clear Selected Features button** 🔳 to unhighlight the city of Kingston.

    The **Pointer tool** 🔼 can be used to resize or move a label. To move or resize a label, click once on the label you want to move with the **Pointer tool.** Handles appear around the label to show that it is selected. Now drag it anywhere you like, or resize it with the black handles. To delete a label, select it with the **Pointer** tool and press the **Delete** key on your keyboard.

    When finished, you can un-select any labels that are still selected by clicking on the map with the **Pointer** tool anywhere there's not a label (like the middle of the ocean).

    Once you have finished labelling, you are going to everything set up for hot linking.

11. Go to the **Window menu** and return to your **Project Window (icestorm.apr).**

12. Click on the **Views icon** 🌐 and then click on the **New** button. A blank View will appear.

13. Click on the **Add Theme button** ➕. Naviagte to the directory called **c:\icestorm**. At the bottom of the dialog box, change the **Data Source to Image Data Source**. Click on the Image called **Montreal.jpg**. The theme will now appear in the **Table of Contents** in your view. **Turn on** the visibility for this theme.
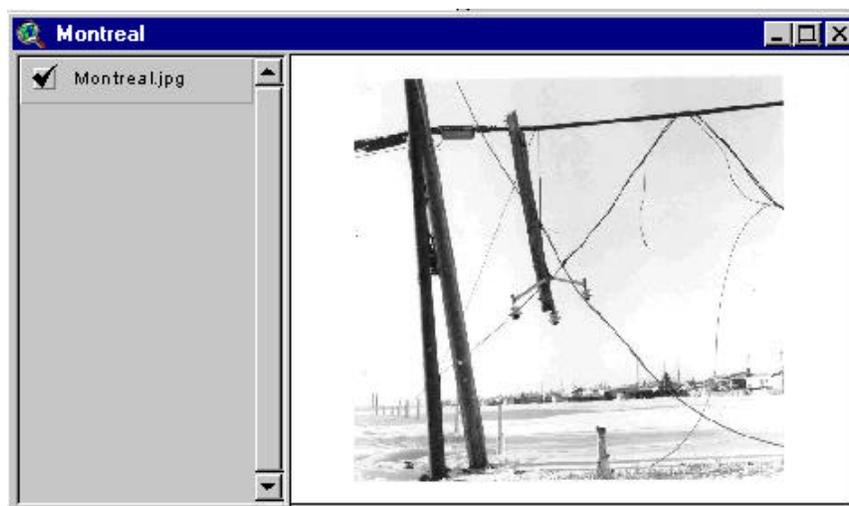
14. From the **View menu**, choose **Properties**. Change the name of the View to **Montreal**. Click on **OK**. Close the View by clicking the X in the top right hand corner.

15. From the **Window menu**, choose **"icestorm.apr"** to go back to your **Project Window**. Once again, click on the **Views icon** and then click on **New**. Another blank view will appear.

16. Click on the **Add Theme button**. This time you want to select **Kingston.jpg** and then click on **OK**. **Turn on** the visibility for the theme.

17. From the **View menu**, choose **Properties**. Change the name of the View to **Kingston**. Click on **OK**. Close the View window with the X in the top right hand corner.

18. Once again, go to the **Window menu** and choose "**icestorm.apr"** to go back to your **Project Window**. Click on the the **Views icon** and click on **New**.

19. Click on the **Add Theme button**. Choose the image called **Ottawa.jpg** and click on **OK**. **Turn on** the visibility for this theme.

20. From the **View menu**, choose **Properties** and then rename the View to **Ottawa**. Click on **OK**. Close the View window.

21. Go to your **Window menu** and choose **Part C - Picture Perfect**. You are now going to set up the Places theme for hotlinking. Make the **Places** theme **active** and then click on the **Open Theme Table button** .

22. Go to the **Table menu** and choose **Start Editing**. From the **Edit menu**, choose **Add Field**.

23. In the dialog box that appears, change the **Name** to **HotLink**. Change the **Type** to **String** and then change the **Width** to **20**. Click on **OK**. You will now see a new column added to the table.
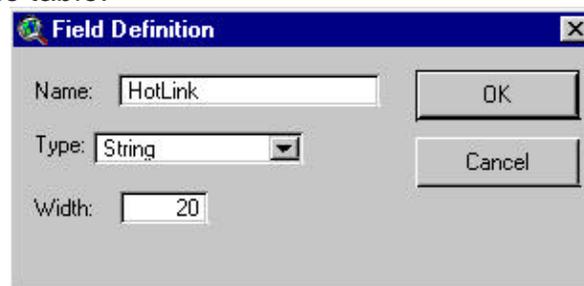
24. In your table, click on the field heading called **Name** so that it appears pushed in. Click on the **Sort Ascending** button to sort the place names by alphabetical order.

25. Scroll down until you see **Kingston**. Click on the **Edit tool**. Click in the empty space in the **HotLink field** next to the name Kingston. Type the word **Kingston** (make sure you spell it right or it won't work!). Hit **Enter** key on your keyboard.

26. Now scroll down your table again until you see **Montreal**. With the **Edit tool**, click in the empty space in the **HotLink field** next to the name **Montreal**. Type in the name **Montreal** and then hit the **Enter** key.

27. Finally, scroll down once again and locate the row containing **Ottawa**. In the blank space in the **HotLink field**, type the name **Ottawa** and hit the **Enter** key.

28. Go to the **Table menu** and choose **Stop Editing**. When asked if you want to save your edits, say **Yes**.

29. **Close** the **Theme Table**.

30. In your **View (Part C - Picture Perfect**), make sure the **Places** theme is still **active**. Click on the **Theme Properties button**. In the dialog box, scroll down on the left hand side and select the **Hot Link icon**.

31. Change the **Field to HotLink**. Change the **Predefined Action** to **Link to Document**. Leave the **Script** as **Link.Document** and then click on **OK**.

32. Back in your **View**, click on the **Hot Link tool**. Using the tip of the lightning bolt, click on one of the cities you labelled. The corresponding image will appear in a new view.

33. Now you can see how the storm's destruction took effect on each of the cities!

34. Now let's make a final printout of your map. From the **Window menu**, choose **Part C - Picture Perfect**.

35. From the **View** menu, choose **Layout**.

36. Next, in the dialogue box that appears, select the **Landscape** template.
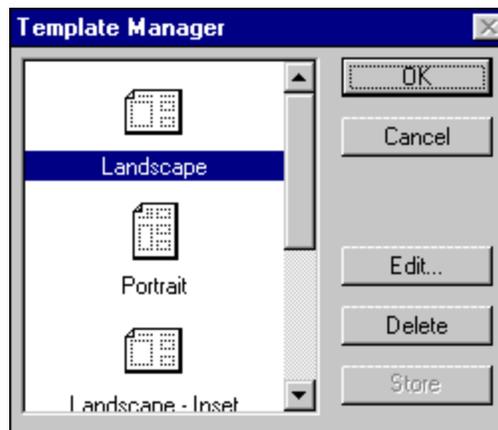
37. Press **OK**. ArcView automatically creates a layout that includes your map of the census divisions and counties classed by population density and the storm area, a legend, a title, a north arrow and a scale bar.

38. A layout makes it easy to produce a presentation quality map with ArcView. With a layout, you can assemble all the components you want to appear in your map, arrange them together to get the design you want, and then print out when it is ready.

39. By default, ArcView uses the view's name as the title of the layout. As your title does not reflect the purpose of your map, you should change the title.

40. With the Pointer ![pointer] tool, double click on the title.

41. In the Text Properties dialog that appears, delete the existing text ("Part C – Picture Perfect") and type in "Ice Storm 1998".

42. Click **OK**. The title on the layout change to "Ice Storm 1998". If you want to change the title's font, use the **Pointer tool** ![pointer] to select the title, then from the **Window**

menu, choose **Show Symbol Window**. You can change the font type and size here.

43. We have just one thing left to do – the **Units** on the **Scale Bar** are set to "miles". You should change these to read kilometers. To do this, double click on the **Scale Bar** using the **Pointer** ▣ tool. This brings up the **Scale Properties** box. Change the **Units** to read kilometers. Click **OK**.

44. You can also include one of the pictures of the storm in your layout. Click an hold on the View Frame icon. Select the last icon that appears called Image Frame.

45. With your cursor, drag a small box in an area where there are not any other components of the map.

46. In the dialog box that appears, choose the View called Kingston. Change the Display to Always. Click on OK.

47. You will now see your image show up on your layout.

48. Click on the Print button to print your map!

Congratulations, you have made your first map with ArcView!!