Goals of the Exercise

This exercise introduces you to ArcGIS using the Mangatainoka catchment in the Manawatu region as a case study region. You create a map of the catchment, then calculate the length of its rivers and size of its drainage area.

Computer and Data Requirements

To carry out this exercise, you need to have a computer, which runs ArcGIS Desktop version 10.5. This exercise will also work with version 10.4.1 if you do not have access to Version 10.5.

In the first part of this exercise using ArcGIS Desktop, you will be working with the following spatial datasets:

- 1. A polygon shapefile of zones within the Mangatainoka catchment, called **SubManagementZones-Mangatainoka**
- 2. A line shapefile of river reaches, called Mangatainoka-REC-V4
- 3. A point shapefile of stream gaging sites, called WaterLevelSites-Mangatainoka

You can get these data from this zip file:

<u>http://www.caee.utexas.edu/prof/maidment/Canterbury/Ex1/Ex1Data.zip</u> or from the UC Learn web site. You need to establish a working folder to do the exercise. This can be in any convenient location on the computer you are working on (e.g. ...\Ex1\Ex1Data). After you have downloaded the zip file **Ex1Data.zip** double click on the file and you should see Winzip or other zip utility to open the file on your computer (if it doesn't open you'll have to unzip this file on a computer that has a zip utility installed).

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pen	▼ Bu	ırn	New folder	-				
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Extract all files from the zip file to the working folder that you've set up to do this exercise. You should end up with a file list that looks like this.

Name	Date modified	Туре	Size
Mangatainoka-REC-V4.cpg	1/16/2018 1:22 PM	CPG File	1 K
Mangatainoka-REC-V4.dbf	1/16/2018 1:26 PM	DBF File	4,089 K
Mangatainoka-REC-V4.prj	1/16/2018 1:22 PM	PRJ File	1 K
Mangatainoka-REC-V4.qpj	1/16/2018 1:22 PM	QPJ File	1 K
Mangatainoka-REC-V4.sbn	2/19/2018 10:58 PM	SBN File	10 K
Mangatainoka-REC-V4.sbx	2/19/2018 10:58 PM	SBX File	1 K
Mangatainoka-REC-V4.shp	1/16/2018 1:26 PM	SHP File	217 K
Mangatainoka-REC-V4.shx	1/16/2018 1:26 PM	SHX File	8 K
SubManagmentZones-Mangatainoka.cpg	1/16/2018 1:14 PM	CPG File	1 K
SubManagmentZones-Mangatainoka.dbf	1/16/2018 1:14 PM	DBF File	11 k
SubManagmentZones-Mangatainoka.prj	1/16/2018 1:14 PM	PRJ File	1 K
SubManagmentZones-Mangatainoka.qpj	1/16/2018 1:14 PM	QPJ File	1 K
SubManagmentZones-Mangatainoka.sbn	2/19/2018 10:58 PM	SBN File	1 K
SubManagmentZones-Mangatainoka.sbx	2/19/2018 10:58 PM	SBX File	1 K
SubManagmentZones-Mangatainoka.shp	1/16/2018 1:14 PM	SHP File	173 K
SubManagmentZones-Mangatainoka.shx	1/16/2018 1:14 PM	SHX File	1 K
WaterLevelSites-Mangatainoka.cpg	2/19/2018 10:58 PM	CPG File	1 K
WaterLevelSites-Mangatainoka.dbf	2/19/2018 10:58 PM	DBF File	28 K
WaterLevelSites-Mangatainoka.prj	1/16/2018 1:02 PM	PRJ File	1 K
WaterLevelSites-Mangatainoka.qpj	1/16/2018 1:02 PM	QPJ File	1 K
WaterLevelSites-Mangatainoka.sbn	2/19/2018 10:58 PM	SBN File	1 K
WaterLevelSites-Mangatainoka.sbx	2/19/2018 10:58 PM	SBX File	1 K
WaterLevelSites-Mangatainoka.shp	2/19/2018 10:58 PM	SHP File	1 K
WaterLevelSites-Mangatainoka.shx	2/19/2018 10:58 PM	SHX File	1 K

Procedure

Please note that the following procedure is a general outline, which can be followed to complete this lesson. However, you are encouraged to experiment with the program and to be creative.

1. Map of Mangatainoka Catchment

Our goal in this part of the exercise is to prepare a location map of the Mangatainoka Catchment like this:



This map is developed using a *basemap* showing roads, towns and vegetation in the region, and three *feature classes*:

- A polygon feature class of subcatchments of the Mangatainoka drainage area
- A *line* feature class of river and stream segments of the Mangatainoka river and its tributaries;
- A *point* feature class of water level and flow recording sites in the Mangatainoka catchment

Using Windows, hit the Start button and you'll see a series of options for ArcGIS. The appearance is slightly different depending on whether you are using Windows 7,8 or 10. Here is what you see if you are opening ArcGIS 10.4.1 from Windows 7 on the UC campus



Here is what you see if you are opening ArcGIS 10.5 using Windows 10



Select ArcMap.



If you are using Windows 8 or 10, then just type "ArcMap.." and you'll see the program symbol appear.

Click on Ok to select **Blank Map** for the map display.

ArcMap - Getting Started						
Open existing map or make new m	Open existing map or make new map using a template					
Existing Maps Browse for more New Maps My Templates Templates Standard Page Sizes Architectural Pag ISO (A) Page Siz ISO (A) Page Siz	My Templates					

Use the Add Data button to add the data for this exercise to the ArcMap display.

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File Edit View Book	marks Insert Se	election Geoprocessing	Customize	Windows	Help
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• • • • • • • • • • • • • • • • • • •	 Add Data 				
Table Of Contents	📽 🛛 Add Basem	nap			
≿	😬 Add Data F	Add Basemap			
		Choose a basemap from ArcGIS Online. These basemaps are map services that require an Internet connection for them to draw in your map.			

And select the NZ Community in the lower left corner of the display as the Basemap



Initially you may not see much in the map display area (it is all blue for the sea!), so right click on the Generic/newzealand label and select **Zoom to Laye**r, and you'll see a map appear



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File	Edit	View	Bookmarks	Insert	Selection
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Select the **Zoom In** button 1 and zoom into the lower North Island and then **Pan** 1 to centralize the map display on this region.



Use **File/Save As** to save a copy of this map document display as **Ex1.mxd**. This file stores your choice of feature classes and symbology so that you can restart ArcMap with the current map display shown if you close the program for any reason.

File	Edit View Bookmar	ks Insert				
	New	Ctrl+N				
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Save As						
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Select the Add Data button again, and to enable navigation to the folder that contains the data, first select **Connect to Folder**

Add Data		
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and navigate to the folder that contains your files. Then navigate to the folder containing the exercise data and select all three files at once by using the shift key. Click the **Add** button to add the data to your ArcMap display.

Add Data		×
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	a-REC-V4.shp entZones-Mangatainoka.shp tes-Mangatainoka.shp	
Name:	Mangatainoka-REC-V4.shp; SubManagmentZones-Mangatainc Add	
Show of type:	Datasets, Layers and Results	

Use the **Zoom In** button to zoom to the area where your data are displayed. You'll see a **Table of Contents** on the left that lists your three feature classes, and a **Map Display** on the right that shows them with arbitrary color choices.

Use **File/Save As** to save an updated copy of this map document display as **Ex1.mxd**. Keep doing this at frequent intervals in case you have a crash at some point.

Now let's tidy up the map display a bit. Initially when the files are added, they are all shown in blue in the Table of Contents (which means all the feature classes are being treated as one dataset). Just click somewhere lower in the Table of Contents to get rid of this blue display

Double click on the symbol displayed for the Submanagement areas	(yours might be
a different color than that shown here)	





Select Hollow Hollow with Outline Color Green and Outline Width 2.

Current Symbol	
Fill Color:	
Outline Width: 2	
Outline Color:	

Then hit **OK** to change the map display to this Symbology. Ok, this looks a bit better now.



Save this new version of the Ex1.mxd file.



Let's make the rivers and streams a bit more understandable. Right click on the **Mangatainoka – Rec4** layer and select **Properties.**



Number of classes, and light blue for Template

Select Symbology, with Graduated Symbols for Quantities, Value for S-Order, 6 for

Template

. This orders the streams

according to the Horton stream ordering system in which 1 is the most upstream tributary and successively larger numbers denote stream reaches downstream of confluences (be careful to choose **Quantities/Graduated Symbols** to go down the right path here).

	Joi	ns & Relates		Time		HTML Popu
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and the result appears as:



If you change a display and it doesn't refresh itself on the screen, go to the bottom left of the screen and hit the refresh button



Now let's highlight and label the stream gaging sites. Click on the **Symbol** for the ^{III} WaterLevelSites-Mangatainoka

WaterLevelSites-Mangatainoka feature class • (yours may be a different color by default).

Make this red with symbol size 8, and hit Ok to make the gaging stations red.

Current Symbol					
	•				
Color:	·				
Size:	8.00				

Click on the **SubManagementZones** feature class in the **Table of Contents** and drag it above the streams so that you can see the zones more clearly. Ok, this is starting to look more understandable now.



Let's label the gaging stations with their station names. Right click on the **WaterLevelSites** feature class and select, and in **Properties** the **Layer Properties** window, select the **Labels** tab with **Sitename** for the **Label** field and **12** for the Symbol size. Hit for **Ok** these choices to be confirmed. Your map won't change yet.

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Apply these label choices by right clicking on the **WaterLevelSites** feature class again and selecting **Label features**.



Repeat this labeling function for the **SubManagementZones** feature class using **Catch_Name** as the Label Field, **Green** as the color and **12** as the Text size. Use Refresh if

necessary to get the map to display correctly.

Text String Label Field:	Catch_Name	∽ Expression
Text Symbol		
ŀ	AaBbYyZz	 ☑ Arial ∨ 12 ∨ B <i>x</i> <u>u</u> Symbol

You'll see the names of the SubManagement Zones appear. These show that the Mangatainoka River has a large tributary called the Makakahi River, and there are four SubManagement zones within the catchment area.



Use the Pan and Zoom tools to recenter your map display so you can get some spatial context for where this catchment is located in relation to cities and towns in the area. Use **File/Save As** to save a copy of this map document display as **Ex1Part1.mxd**. You have completed the first part of this exercise.

and use the **Snip tool**, **Snip**ping Tool Desktop app

or another screen capturing tool, to capture a copy of the map for your Exercise 1 report.

To be Turned in: A screen capture of a map of the Mangatainoka Catchment, showing the SubManagement Zones, river network, water level sites and a background map.

2. Explore the Rivers

Each feature in a GIS feature class has an associated record in its Attribute table that contains descriptive information about the feature. Let's explore a few of these attributes. Zoom in to the location of the Mangatainoka at Pahiatua Town Bridge, and turn off the green label for the SubManagementZone. Add labels for the **Mangatainoka – REC** feature class using **HydroID** as the attribute to be labeled in blue type-face with size **12**. The acronym REC refers to **River Environment Classification** developed by the **National Institute for Water and Atmospheric Research** (NIWA) <u>https://www.niwa.co.nz/freshwater-and-estuaries/management-tools/river-environment-classification-0</u>



Click on the box next to SubManagementZones to turn off their display. Use the Identify tool it to click on the REC blue line next to the Pahiatua Town Bridge gaging site. You'll see that this reach extends from one river confluence to the next and that it has **HydroID** = **834914**. The next downstream reach has **HydroID** = **834685**. Each reach is one river segment from confluence to confluence and has a unique identifying number. This is a property of the Arc Hydro data model for surface water resources, which was used in building the REC dataset.

Save the new map display using File/Save as Ex1Part2.mxd

 SubManagmentZones-Mangatainok Mangatainoka-REC-V4 S-Order 1 		entify	Land fill	83457 834641 8 ³⁴⁶
- 2	Ide	entify from:	<top-most layer=""></top-most>	
 4 5 6 □ Basemap 		Mangatainoka-F 241354		634685
 ■ LINZ/geotiffs ■ Basemap 	Lo	ocation: 1,	840,264.542 5,518,744.712 Meters	
	835026 OB	D 33 appe P 33ECTID_1 22 33ECTID 22 droID 8 extDownID 8 MTAREA 6 JM_AREA 44	olyline 11354 41354 49914 34685	Mangatainöka at Pahiatua Towr

You can see that the reach with HydroID of 834914 has a NextDownID of 834685. This means that each reach knows what reach it flows into.

Right click on the feature class name and select **Open Attribute Table**.

	☑ Mangatainoka S-Order - 1	₫ ×	Copy Remove		
	- 2		Open Attribute Table	e	
	- 3 - 4	a	John Attribute Z Table]	•
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-	🗆 Basemap	~	layer name OR		
-			CTRL + T. Eait Features]	•

You can select a feature on the map using the select tool





If you then click on the reach 834914 in the map and click on the **Show Selected Records** at the bottom of the Attribute Table, you'll see the same attributes as you saw in the Identify tool earlier.



Scroll across this table, and you'll come to an attribute called **Shape_Len**. This gives the length of the reach in map units, which are meters. In other words the length of this stream reach is 1224.39 m or 1.22 Km.

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Μ	Mangatainoka-REC-V4 ×									
	headw_dist	segslpmean	LID	reachtype	FROM_NODE	TO_NODE	Shape_Leng	Shape_Le_1		
•	65733	0.05849	0	0	246847	246612	1224.39452	1224.39452		
<								>		
н	····· 1 · ·· ■■ (1 out of 958 Selected)									
Ν	langatainoka-RI	EC-V4								

Now let's look at the lengths of all the river reaches in the Mangatainoka Catchment. Right click on the feature class and select **Selection/Clear Selected Features**.



Then click on the box at the bottom of the Attribute Table that says **Show All Records**. Now you can see them all again.

Mangatainoka-REC-V4 ×											
	segslpmean	LID	reachtype	FROM_NODE	TO_NODE	Shape_Leng	Shape_Le_1	FLOWDIR			
	0.64857	0	0	245461	245130	1962.89709	1962.89709	1	Π		
	0.06181	0	0	245544	245545	1080.14378	1080.14378	1	Г		
Γ	0.04404	0	0	245545	245420	1786.47643	1786.47643	1	П		
1	0.66281	0	0	245637	245545	524.75277	524.75277	1	Γ		
	0.61456	0	0	245786	245637	931.59208	931.59208	1	Γ		
	0.98639	0	0	245813	245304	2669.83199	2669.83199	1	Γ		
	0.26735	0	0	245938	245786	1700.0656	1700.0656	1	Γ		
	0.29841	0	0	245939	245637	1461.49297	1461.49297	1	Γ		
	0.1746	0	0	246122	246123	136.11493	136.11493	1	Γ		
	1.49032	0	0	246164	246165	1112.08427	1112.08427	1	Γ		
	1.88758	0	0	246166	246165	702.23408	702.23408	1	Γ		
								>			
	44		1 (050 6 1	())							
1		= (0 c	out of 958 Sel	ected)							

Right click on the Shape_Len field header and select Statistics.



This generates a summary table for the statistics of this field.

Statistics of Mangatainoka-REC-V4	
Field Shape_Leng	Frequency Distribution
Statistics: Count: 958 Minimum: 30.0068 Maximum: 9479.92073 Sum: 725385.25409 Mean: 757.187113 Standard Deviation: 710.056348 Nulls: 0	400 300 200 0 30.0 2411.8 4793.7 7175.5 1220.9 3602.7 5984.6 8366.4

Similarly, you can open the Attribute Table of the SubManagementZone feature class, and you'll see some information about catchment areas.

Tak	Table •									
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Su	SubManagmentZones-Mangatainoka ×									
	FID	Shape *	Number	Area	Perimeter	Hectares	Catch_Name	Parent_(
	0	Polygon	15	203906161.913	157.1404	20390.6162	Makakahi	Manawatu		
	1	Polygon	0	66861525.8223	58.16456	6686.15258	Upper Mangatainoka	Manawatu		
	2	Polygon	0	120744727.483	110.08634	12074.47275	Middle Mangatainoka	Manawatu		
	3	Polygon	0	40643100.4635	59.45994	4064.31005	Lower Mangatainoka	Manawatu		
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M	angata	ainoka-REC	-V4 SubM	anagmentZone	s-Mangataino	ka				

You have completed the exercise. Save your map document as Ex1Part2.mxd.

To be turned in: How many river reaches are there in the Mangatainoka Catchment? What is their total length (Km) and average length (Km). How many SubmanagementZones are there in the catchment? What is their total area (Km^2) and average area (Km^2)?

Summary of Items to be Turned In:

(1) A screen capture of a map of the Mangatainoke Catchment, showing the SubManagement Zones, river network, water level sites and a background map.

(2) How many river reaches are there in the Mangatainoka Catchment? What is their total length (Km) and average length (Km). How many SubmanagementZones are there in the catchment? What is their total area (Km²) and average area (Km²)?