EXPLORING THE MORA WATERSHED: EXERCISE 1



Using ArcGIS Online

An instructional guided tour of the Mora Watershed using ArcGIS Online.

Funding to develop this exercise has been provided by the National Science Foundation (NSF) award #IIA-1329470. Any opinions, findings, conclusions, or recommendations expressed in the material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



Exploring the Mora Watershed: Exercise 1

USING ARCGIS ONLINE

Time to complete Approximately 60 minutes An Internet connection is required



Watershed Boundaries in the US

In this guided tour we will be using ArcGIS Online to: 1) Create or Sign In to an ArcGIS Online Account 2) Use ArcGIS Online to explore and visualize the Mora Watershed 3) Use Analysis Tools to create a watershed and trace a stream path 4) Share your Map Online

Introduction

What is a watershed? I am sure you have heard of a watershed but what really are they? Watershed boundaries define the extent of surface water drainage. Watershed boundaries follow the highest ridgeline around the stream channels and meet at the lowest point of elevation where water flows out of the watershed. For this exercise we will be exploring the Mora River Watershed Hydrologic Unit Code (HUC) 08 or an eight digit HUC. The USGS has categorized watersheds in the United States by unique Hydrologic Unit Codes based on six levels of classification ranging from 2 to 12 digit. The larger the number the smaller the watershed acreage. For this exercise we will be working in the region of the 8 digit watershed of the Mora River. In Part 1 we will be using ArcGIS Online mapping tools to explore the area in the Mora River Watershed. In Part 2 we will be using ArcGIS Online analysis tools to create a smaller watershed and trace a stream path to the ocean. In section 3 we will share our map results online.

For more information about Hydrologic Units Codes (HUC) please visit the USGS water resources page: <u>https://water.usgs.gov/GIS/huc.html</u>

Let's Get Started

In this section, we will introduce you to ArcGIS Online and will explore the area around the Mora River Watershed in Northern New Mexico. You will learn how to use ArcGIS Online analysis tools to create a watershed and trace a stream path.

Create an ArcGIS Online Account.

Before we can use ArcGIS Online we need to create a free ArcGIS Online account. Make sure you are connected to the internet. To sign in or create a new ArcGIS account go to: <u>https://www.arcgis.com/home/signin.html</u>

n In		
Don't have an ArcGIS account?		
Sign up for a 60-day trial.	Sign In	esri
TRY ARCGIS	Username	
ArcGIS Public Account An ArcGIS Public Account is a personal account with limited usage and capabilities and is meant for non-commercial use only. CREATE A PUBLIC ACCOUNT If you have signed up for an Esri Account, you have automatically been given access to an ArcGIS Public Account and you can use the same sign-in ordentials for both.	Password Password Keep me signed in Sign IN Forgot password? OR OR Sign in with ENTERPRISE ACCOUNT Sign in with G G	

Part I. Use ArcGIS Online to Explore the Mora Watershed

Once you have signed in, from the top menu click on **MAP**

This will open a new online map in which you can start to add some layers. Click on the **Add** Button and **Search for Layers**.



Under Find Type **"Mora Watershed HUC 08**". When you have found *Mora Watershed HUC 08* click **Add** and **Done Adding Layers.** This will open the Mora Watershed Boundary in an ArcGIS Map Viewer.

Step 1. Choose a Basemap to Display.



Once you have opened the in the map viewer on the ribbon, click on <u>Basemap</u> and chose different basemaps to view on your map. Be sure to try Imagery with labels and Terrain with Labels.

Zoom in and out of the map using the plus or minus buttons on the map or using the roller bar on your mouse. Click and hold your mouse pointer to pan around the map.



If you zoom out so far that you cannot see the Mora Watershed, you can easily find it again. Go to your Table of Contents which shows your layers displayed on your map. Click on the three dots below your Mora Watershed layer. This will bring up a drop down menu and click on **Zoom to.**

Contents	
Mora Watershed H	UC 08
	Zoom to
	Transparency
	🖄 Set Visibility Range

Step 2. Using Measurement Tools.

Change the Basemap to **Topographic**. We will use the Measure tool to identify distance and locations within the watershed. The Measure Tool is found at the top ribbon above the map.



Zoom out to the extent of the entire Mora Watershed. Click on the Measure tool and it will open a new

window. Select the **Distance** tool and **Miles** as the unit of measurement. Use the measure tool to measure the length of the Mora Watershed (Measure the longest distance going West to East, use the mouse and click on the beginning and double click on the ending point to make a line).

Find area,	length, or location
	📰 Miles 👻
_	Measurement Result

Degrees -

Measurement Result

Longitude

Latitude

How long is this distance in Miles?

Within the boundary of the Mora Watershed find the town of Mora. This time use the measurement

фщ

tool but select the **Location** tool. Use your mouse to click on the location of the town of Mora. You will notice the Latitude and Longitude location under the 'Measurement Result'. Write down your answer below. Also look for Fort Union National Monument and record the Latitude and Longitude

Mora: Latitude ______, Longitude _____

Ft. Union National Monument: Latitude ______, Longitude _____

** Hint, if you cannot find the town or other features you can type in a location at the top menu and click on search



Also within the boundary of the Mora Watershed find Lake Isabel. Next we will use the measurement tool to find the area of the lake. Click on the **Measure** tool and select the **Area Button** and change the units to **Acres.** Outline the area around the lake to get a general estimate of the total acreage. Click once to start the polygon and double click to end the polygon. When you have completed the polygon you will see the total acres listed under Measurement Result. Enter your acreage estimate below.

Lake Isabel = _____ Acres.



Step 3. Adding Data to Your Map

So far we have changed the basemap and used measurement tools in ArcGIS Online. There are lots of other information that we can add to our map.



Once you have added the <u>World Hydro Reference Overlay</u> layer you will notice it in your map and also in your Table of Contents.

Next let's add two other layers. From the main menu go to Add and then Search for Layers.

🚰 Add 👻 🛛 📅 Basemap	
Search for Layers	
Browse Living Atlas Layers	
Add Layer from Web	_
Add Layer from File	
Add Map Notes	

Within Search for Layers, in the **Find:** box type the word "**Roads**" and **IN:** select **ArcGIS Online** using the drop down menu. There will be lots of results but choose World Transportation by ESRI and then click **Add**. Next let's look for Stream Gauge information. Under **Find** type "**Stream Gauges**" IN: **ArcGIS Online**. Select Live Stream Gauges by esri and click **Add**

Search for Layers		4	
Find: roads In: ArcGIS Online Within map area	G	Search for Layers Find: Stream Gauges	
1604 Results Found World Transportation	Add	Within map area 78 Results Found	
World Topographic Map By esri	Add	Stream Gauge	Add
World Imagery By esri	Add	Live Stream Gauges	Add
		Live_Stream_Gauges	Add
		StreamGauge	Add

When you are done adding your layers click the button at the bottom. Done Adding Layers.

DONE ADDING LAYERS

Now look at your layers that you have in your map, zoom in to the watershed's extent if necessary. You can turn off or turn on layers by clicking on the check box next to the layer name. Review the area within the Mora Watershed and look for the Live Stream Gauge points.

Next 1) Turn off the Mora Watershed HUC 08 layer by unchecking the box next to the layer. Zoom into the area of one of the live stream gauges and use your mouse to 2) click on one of the orange points.3) You will see a pop-up menu in which you can go to the station page, click on More Info.



What is the name of the stream gauge?

What is the gauge reading for today or the most recent reading?

Next go back to your map and spend some time looking at your layers. Choose different basemaps and explore the area.



Add at least two more layers of your choosing. Go back to the **Add** button to choose either **Search for Layers** or **Browse for living Atlas Layers**.

Go through and find at least **two** other layers you would like to add to your map. When you are done adding your layers click the button at the bottom. **Done Adding Layers**.



When you are finished reviewing different layers do not save your map, but keep ArcGIS Online open in your browser.

Part II. Use Analysis Tools to Create a Watershed and Trace a Stream Path

Introduction.

As we mentioned in Part 1, a watershed is an area of land in which all of the water that enters it, drains into a common waterbody. Also known as drainage basins, watersheds act as a funnel, directing surface water into a stream, lake, ocean, or other reservoir.

When it rains have you ever wondered about the path that water travels across the landscape? In this exercise we will create a smaller watershed, also known as a subwatershed, and follow the path of a raindrop as it travels across the landscape to the ocean.

Step 1 Open a New Map

Let's start with a new map. To open a new map click on the words **New Map** at the top right hand corner of the screen. Do not save your old map if prompted. This will open a new ArcGIS Online Map. Next within the search tool where is lists "Find address or place" type in the words "**Fort Union National Monument**".

					New Map
🖬 Save 👻 📼 Share	📇 Print 🚸 Directions	🚔 Measure	🔟 Bookmarks	Fort Union National Monument	x Q

The map will zoom to Fort Union National Monument. Fort Union National Monument preserves the remains of three old forts that served to protect travelers and commerce along the Santa Fe Trail.

Change the Basemap_to Imagery with Labels,

Use the **Zoom in** button (the plus sign) to zoom into the National Monument you will notice the imagery becomes more detailed.

You will notice old remains of the fort and also a new building with a parking lot.



Step 2. Create a New Layer

Next we will create a new layer by adding a point on the map to represent a rain drop. To add a point we will use something called Map Notes.

From the top ribbon, Click Add, and Click Add Map Notes

🔁 Add 👻 🛛 🔚 Basemap	
Search for Layers	
Browse Living Atlas Layers	
Add Layer from Web	
Add Layer from File	
Add Map Notes	

Add	Map Notes	
Name:	Rain Drop	
Templat	e: Map Notes 💌	
	Use Map Notes to create basic shapes i variety of applications.	n a wide
	CREATE	ANCEL

For the name, type "**Rain Drop**". Leave the Template as Map Notes, then click **Create**



Next an Add Features menu will appear. From the top click on **Stickpin** to select the point graphic and then you will add the point to your map. Click on a location on your map near Fort Union National Monument. See graphic below.



Change the title to "Raindrop" and the Description to "Raindrop Feature Near Fort Union National Monument." So that you can see your symbol more easily, click Change Symbol.

Points		□ ×
Title	Raindrop	
Description	B I U A → M → = = = = = := Ø → Ø Ø ↔ Raindrop Feature Near Fort Union National Monument	1
Image URL	https://	
Image Link URL	https://	
DELETE CH4	ANGE SYMBOL CLOSE	

Change the style category change it **Numbers** and choose a Blue Number 1 style with a symbol size of 30 px. Then click **OK** to close and **OK** again to close the Map Note Dialog box.

9				Q			
SHAPE FILL OUTLINE	SH	APE				ILINE	
Numbers 💌	Num	here					
Shapes		0010					
A-Z Arrows	0	1	2	3	4	5	
Basic							
Business	6	7	8	9	10	T	
Cartographic							
Damage	Y	Ψ	4	Ψ	16	Ψ	
Disasters	18		20	01	22	23	
General Infrastructure	¥	¥	Y	Y	Y	Y	
Numbers	24	25	0	1	2	3	
Outdoor Recreation	-			-	-	-	
People Places	<u>Use ar</u>	n Imag	e				
Points of Interest	c	1.01					
Safety Health	Symbo	oi Size				od 4	
Iransportation		V				30	P

Step 3. Save the Map

Before working any further with our analysis let's save your map.

On the ribbon, click **Save** and choose **Save**.



In the **Save Map** window, for the title type "*Watershed Analysis_XYZ*" (*XYZ = Your Initials) For tags choose something similar to "Watershed, Flow Path, Stream trace". Be sure to put commas to separate your tags.

Then click **Save Map.** It will automatically save the map in your personal folder.

Save Map	
Title:	Watershed Analysis
Tags:	Watershed × stream trace × flow path ×
	Add tag(s)
Summary:	
Save in folder:	· · · · · · · · · · · · · · · · · · ·
	SAVE MAP CANCEL

Step 3 Create an Upstream Watershed

First we will create a watershed by keeping all of the default parameters.

In the left pane click the **Content** button so that you can see all of your layers.

() About	🖉 Content	📒 Legend	
Contents			
 Rain Drop Imagery with Labels 			

In the Contents pane, click on the Rain Drop layer and then click the **Perform Analysis** Icon. If you don't see the icon just double click on the Rain Drop Layer until it expands.

In the **Perform Analysis** pane, click **Find Locations** and click **Create Watersheds.** When the analysis window appears, use the following settings:

-Use a search distance of .5 miles

Change the result layer name to Upstream
 Watershed_xy ('xy' being your initials as it needs
 to be a unique filename)

- Uncheck Use current map extent box, then click Run Analysis

3 Result layer name	0
Upstream Watershed	
Save result in	
Use current map extent Show c	redits
RUN ANALYSIS	



Perform Analysis		
Summarize Data		0
▼ Fin	d Locations	0
	Find Existing Locations	0
7	Derive New Locations	0
	Find Similar Locations	0
4	Choose Best Facilities	0
	Create Viewshed	0
2	Create Watersheds	0

When the analysis has completed, two layers will be added to the map and appear in the Contents pane— 1) **Upstream Watershed** and 2) **Upstream Watershed – Adjusted Points.** The 'Adjusted Points' was the new point used to compute the watershed instead of your 'Raindrop point'. To find the watersheds, the analysis points will be adjusted so they fall precisely on a drainage line. The adjusted locations are written to the 'Adjusted Points' output layer.

Zoom out to see the larger extent of your watershed. Click on you watershed to see the pop-up. It will give you a description of the watershed and give you its area in square miles.

Write the area of your watershed ______ square miles.

Pan around to the watershed so you can see your point used to define your watershed. Zoom in so you can see the 'Adjusted Point' and your 'Raindrop' point.

On top menu, click the **Measure** button and click the **Distance** button.

On the map, first click the point you created, and double-click the adjusted point to find the distance between the two. Note that the distance is should be less than the 0.5 mile value you input before you ran the Watershed tool.

🔚 Save 👻 📾 Share 🚔 Print 🚸 Direct	ions Measure 🛛 Bookmarks Find
	Find area, length, or location
Fort Union National Mounment	₩ 🔛 🗄 Miles 👻 Measurement Result

Next we will add the Mora Watershed layer to our map to see where this new watershed fits within the boundary of the Mora Watershed.

From the top ribbon menu click on Add and Search for Layers

Search for the Layer 'Mora Watershed Huc 08'. When you have found that layer click **Add** and then click on button **Done Adding Layers.**

Sear	ch for Layers	4
Find:	Mora Watershed Huc 08	GO
In:	ArcGIS Online	-
	Within map area	
1 Re:	sult Found	
Mora_ by	_Watershed_HUC_08 / prdappen_NMHU	Add

🔁 Add 👻 📝 Edit	Ba
Search for Layers	
Browse Living Atlas Laye	ers
Add Layer from Web	
Add Layer from File	
Add Map Notes	

Next we will zoom to the full extent of the Mora Watershed to get a larger picture of the landscape.

In your Content List find the Mora Watershed HUC 08 and expand the layer. Click on the three dots to see more options and then select **Zoom To Layer**.



This will take you out to the full extent of the Mora Watershed. Notice if your newly created **Upstream Watershed** falls inside of the Mora Watershed and if it shares a boundary. Leave your map open for the next part of our exercise.

Step 3. Find the Downstream flow path of your raindrop point

In the previous lesson, you identified where a rain drop drain inside of a larger watershed. In this lesson, you will create a flow path, downstream from the raindrop point and see how far it would have to travel to find the ocean.

You'll use the Trace Downstream tool to find the downstream flow path.



In the Contents pane, Click on the **Rain Drop Layer** and then click the **Analysis** button below it.

On the Perform Analysis pane, click **Find Locations** and choose **Trace Downstream**.



This will open the Trace Downstream menu in which you can define the options of your downstream flow path. Since we don't know exactly how far it will take to reach the ocean, enter the maximum distance of the trace enter a number that is at least **2,000** miles. **Uncheck** the box by use current map extent. And then click **Run Analysis.**

Trace Downstream	0 (
1 Point features used as the starting locations for each downstream trace	0	
Rain Drops (Points) 👻		
2 Trace downstream settings (optional	1)	
Split the trace into line segments	0	
Miles	.	
Maximum distance of the trace	0	
2,000 Miles	Ŧ	
Clip output to	0	Be sure to give your
Choose study area 👻		such as "Rain Drops
3 Result layer name		(Points) trace xy" (xy being your initials).
Rain Drops (Points) Trace		
Save result in		
Use current map extent	Show credits	
RUN ANALYSIS		

After the process has ran, you will see the new layer Rain Drops (Points) Trace in your Contents Pane.

Contents
Rain Drops (Points) Trace
Mora Watershed UUC 08

Click on the table icon which will open the attribute table. One of the fields will tell you the distance of the Trace. How long is this Trace? ?





Next, you'll explore the length of the trace. Change the background map to the topographic map and start to zoom out to see the path that the Trace takes till it reaches the ocean. Take a few minutes to pan and zoom, exploring the flow path on the map. Next go back to the raindrop point and begin the write down all of the Rivers that the Trace follows until it reaches the ocean. Be sure you have the topographic map as your basemap as it will help identify the creeks and rivers along the way to the ocean. The raindrop trace will enter **Wolf Creek**, list the names of all of the rivers that come on its way to the ocean. Also list where it enters the Ocean :



When you are done save your map but don't close your map. In the next lesson, you will learn how to share your map with others by creating and online web map.

Step 4. Share your map Online

Before sharing your map Online, let's make a few edits to make your map look better. In this first step we will set the map extent, rename the layers and change symbols.

In your map zoom to the Raindrop Trace layer

In the **Contents** pane, click on the **Raindrop Trace** layer. Click the **More Options** button (the three dots) and choose **Rename**.



For Layer Name, type "Downstream Flow Path" and click OK



Next, turn on the Upstream Watershed layer (check the box next to the layer).

Point to the **Upstream Watershed layer – Adjusted Points**. Click the **More Options** button and choose Remove.

In the **Contents** pane, point to the **Upstream Watershed** layer and click the **Change Style** button.



Click the arrow next to **Choose an attribute** to

show and choose **Show location only.**



On the Location (Single symbol) drawing style, click Options.



Click **Symbols** to change the symbol.

Click a blue color of your choice to change the fill color of the symbol.

Next adjust the Transparency to 40% and then click **OK** and then **DONE.**

Save your Map



Share your map with others

On the ribbon, click **Share**.



Choose to share your map with everyone



In the Update Sharing window, click Update Sharing.

Update Sharing	×		
These layers in the web map may not be visible to others because they are not shared in the same way as the web map.			
Layer	Owner		
Storm Drain Trace yourname	yourname		
Upstream Watershed yourname	yourname		
Click Update Sharing to adjust the settings of the layers you own so they can be viewed in the web map. UPDATE SHARING CANCEL			

The layers in your map must have the same Sharing properties as your map. Any analysis layers you create are, by default, not shared, so you are now prompted to share the layers on your map.

To share your map with someone by email, copy the hyperlink (web address) shown in the **Link to this map** box and paste it in your message to them.

Link to this map http://arcg.is/2aAD0CW	f Facebook	💟 Twitter
 Share current map extent 		
Embed this map		
EMBED IN WEBSITE	CREATE A WEB APP	
Note: To embed your map, you must share it with Everyone.		

Click **Done** to save your changes.

Tools to view watersheds and hydrologic networks

To view Hydrologic networks across the United States, look at the Hydro Hierarchy Tool developed my ESRI: <u>http://maps.esri.com/rc/radial/index.html</u> If this website is not available just Google the

words **ESRI Hydro Hierarchy** . This mapping application displays the largest rivers in the continental United States. Move your mouse over the map to display the upstream and downstream river network in green and red respectively.



Another tool to visit is the Hydro Viewer, http://hydro bm.esri.com/HydroViewer/HydroViewer.html

The Esri Hydro Viewer presents information about watersheds, including spatial information about contributing watershed area.



This is the end of Exercise 1.

Ideas for this exercise were obtained from "No Dumping – Drains to Ocean" <u>https://learn.arcgis.com/en/projects/no-dumping-drains-to-ocean/</u>