UNIVERSITY OF TORONTO
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ArcGIS Pro: Loading and Manipulating Data

Presented By: Cole White, GIS Analyst
Map and Data Library

Download the workshop data:

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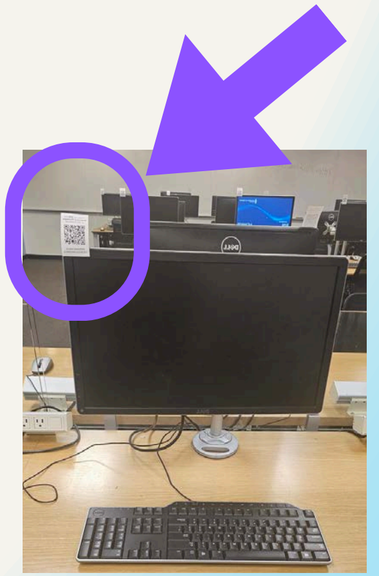
Please choose a lab computer with this sticker:



Agenda

01 Introduction

02 Project Creation

03 Adding Vector Layers

04 Vector Symbology

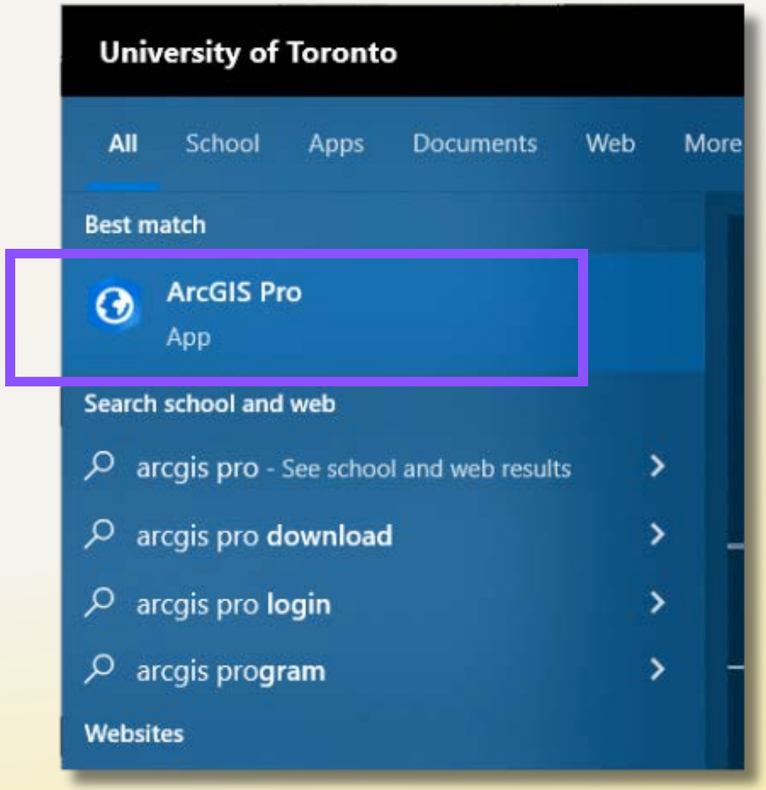
05 Filtering Data

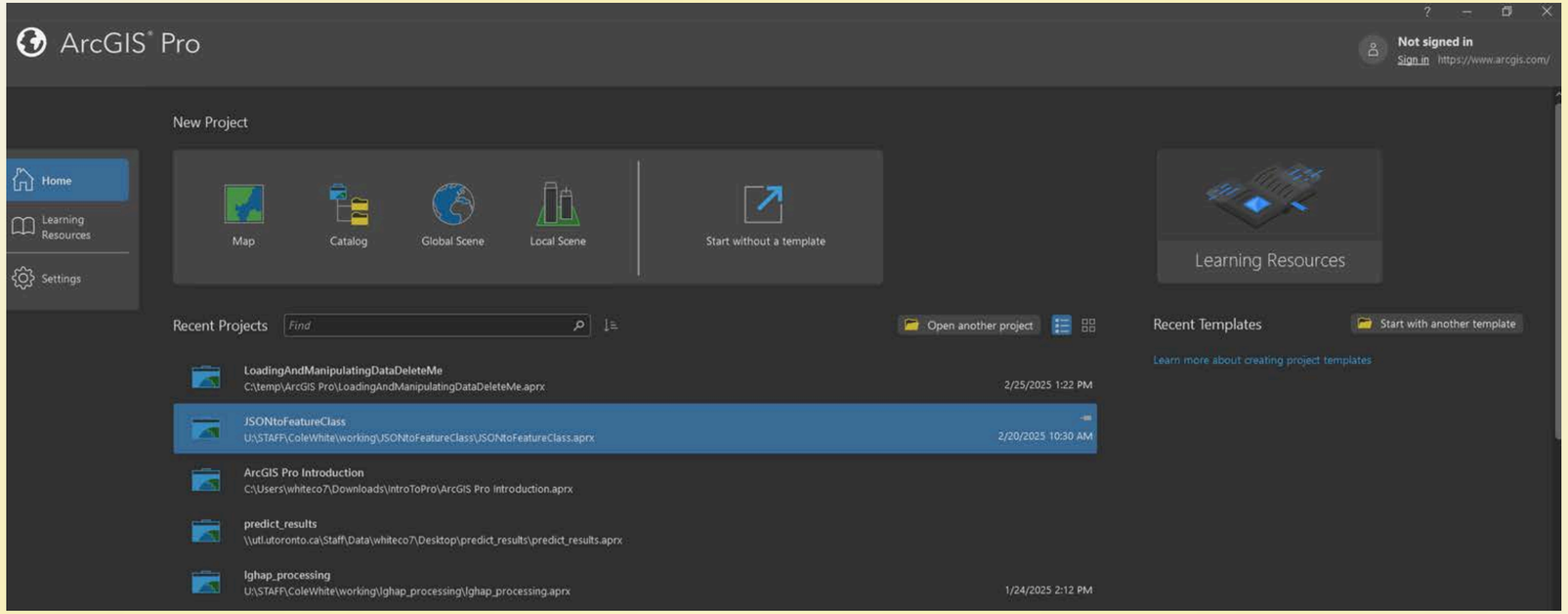
06 Geoprocessing

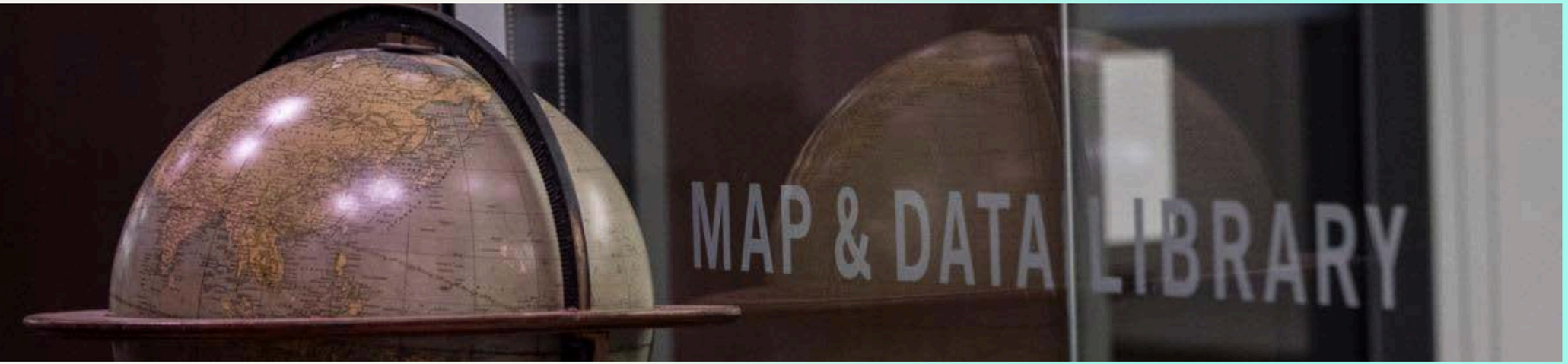
07 Working With Raster Data

08 Getting Help

But first, some troubleshooting







Introduction

The Map and Data Library

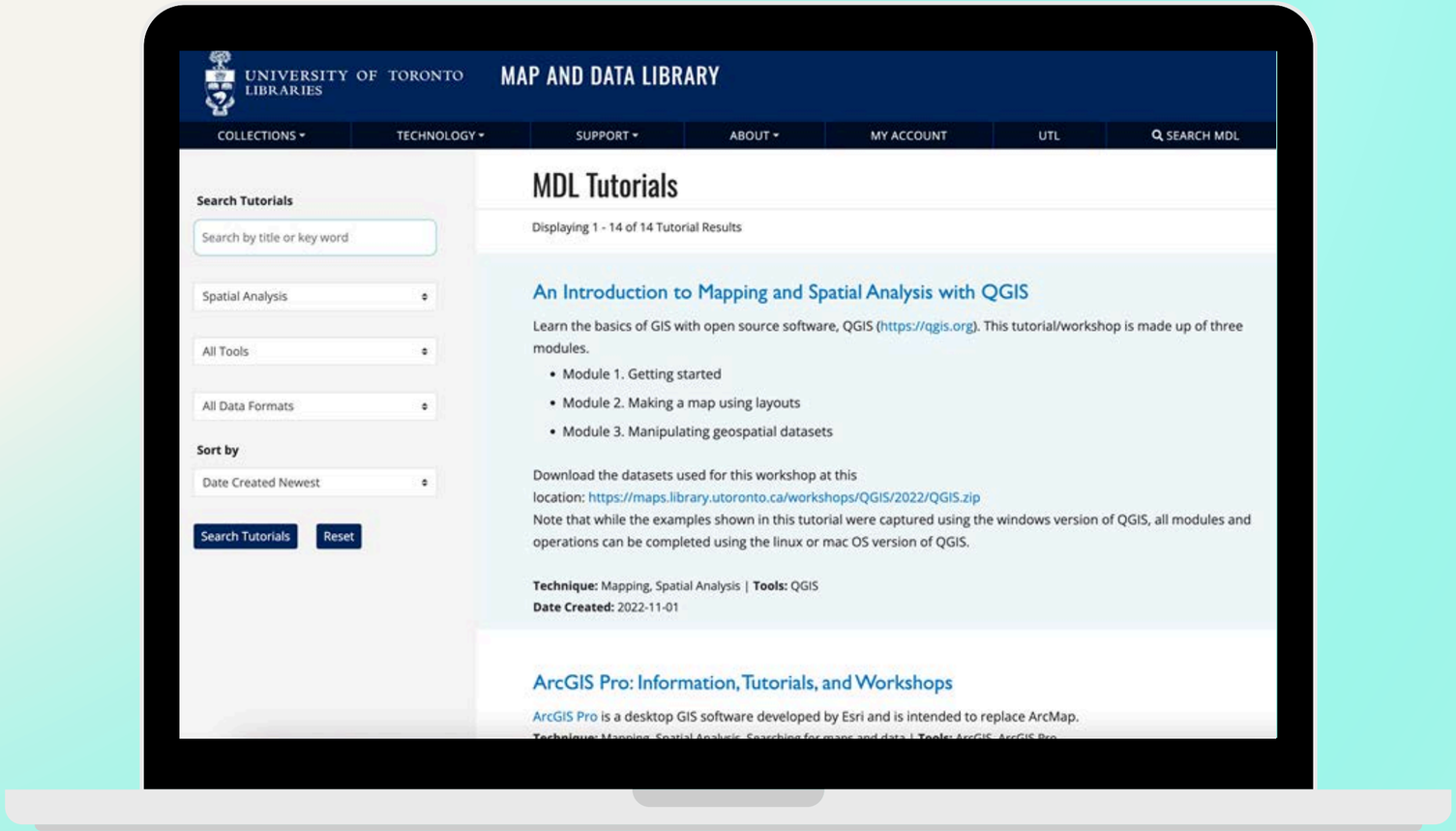
- Access data collections
- Workshops and training
- One-on-one consults
- Appointment-only until summer 2025 (?)

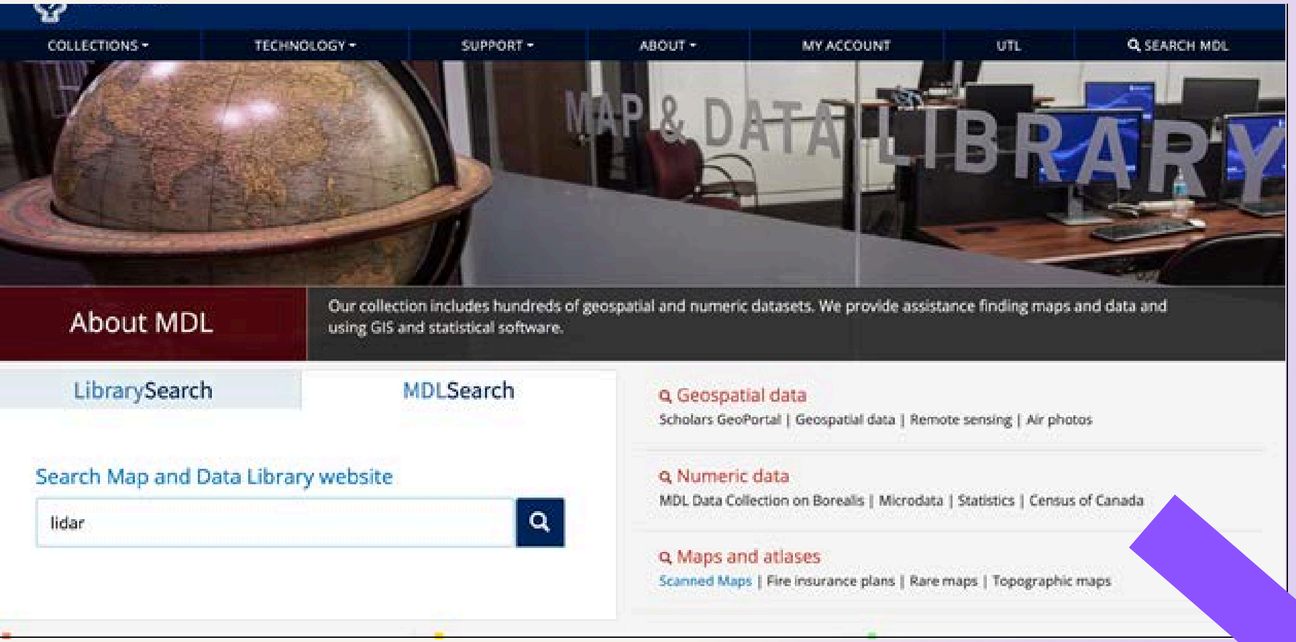
https://mdl.library.utoronto.ca/
mdl@library.utoronto.ca
416-978-5589
11am - 5pm, Monday - Friday

Map and Data Library

Tutorials and Workshops

https://mdl.library.utoronto.ca/support/tutorials
https://mdl.library.utoronto.ca/support/workshops-and-training

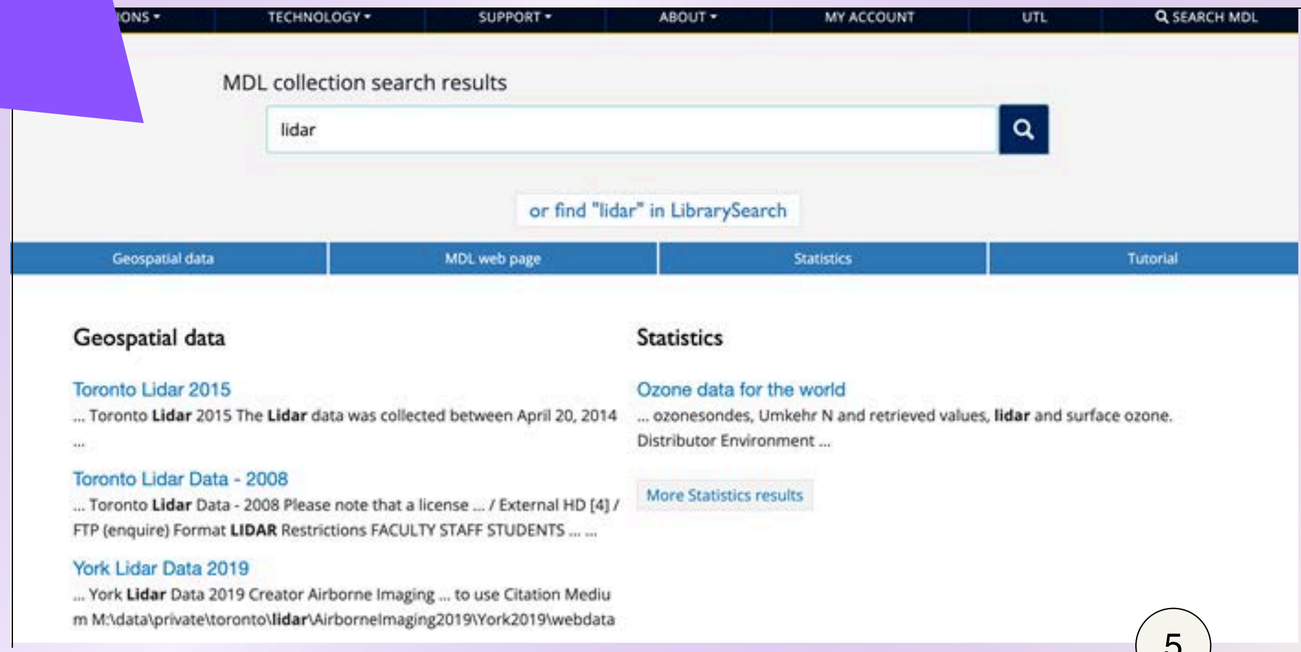




Finding Data

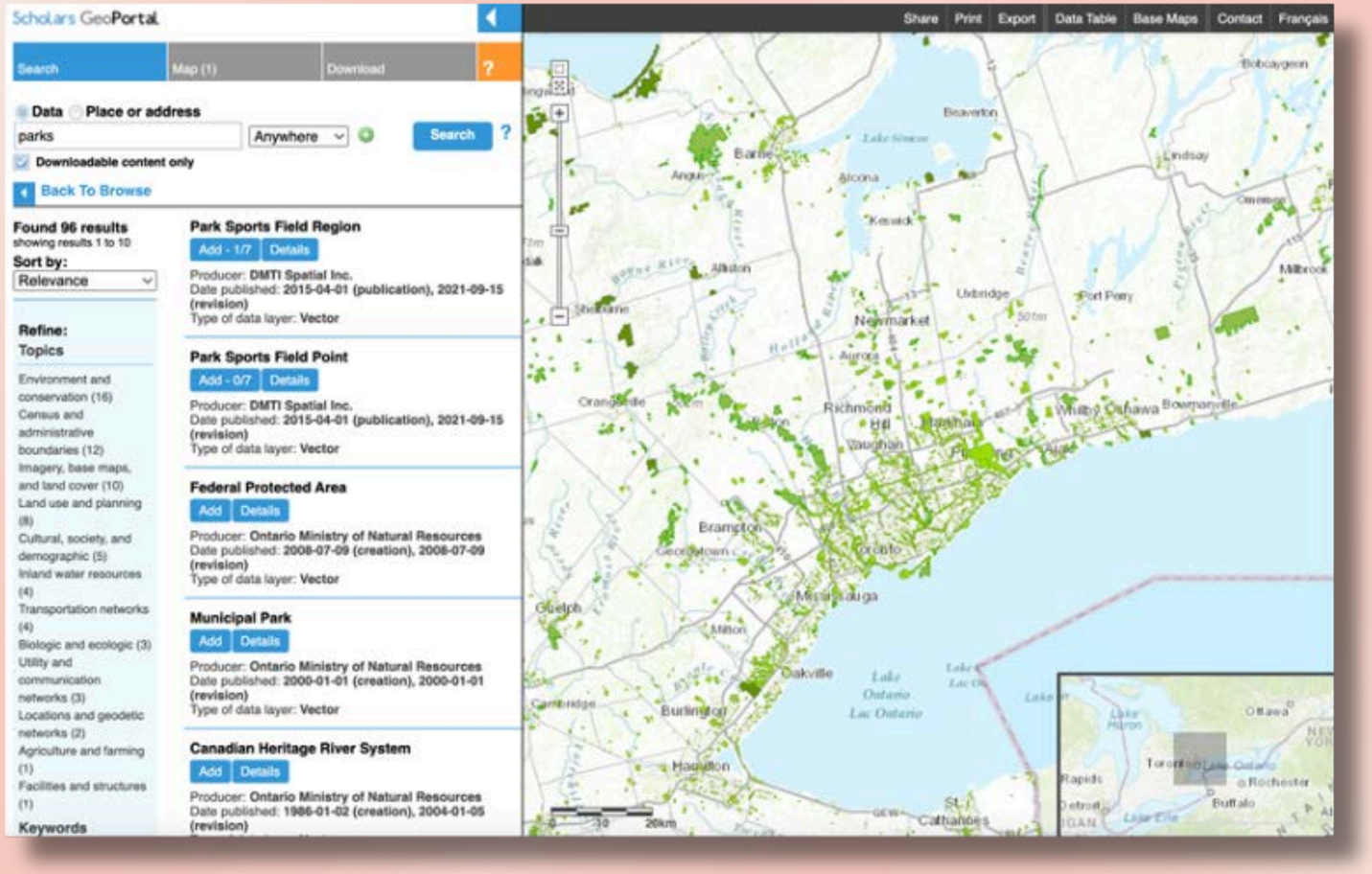
Map and Data Library collection:

https://mdl.library.utoronto.ca/



Scholars Geoportal

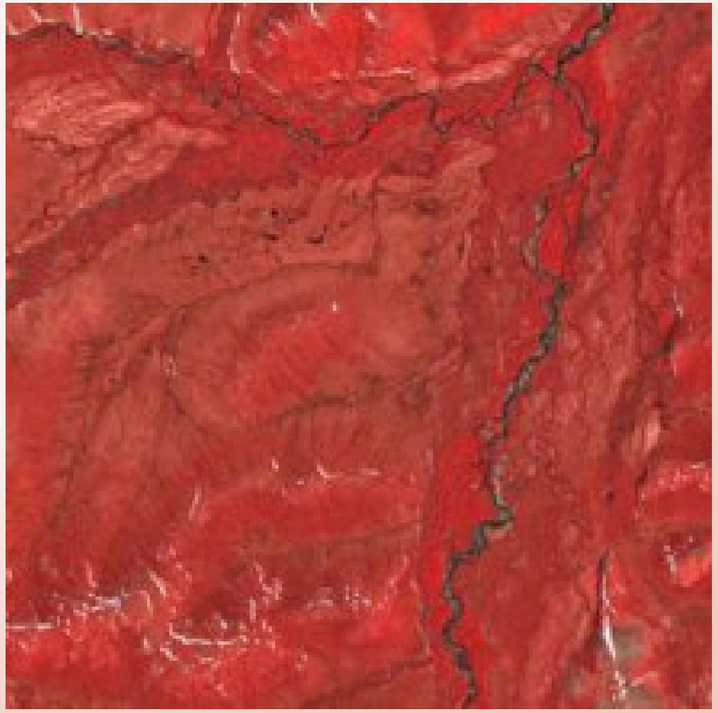
https://geo2.scholarsportal.info/

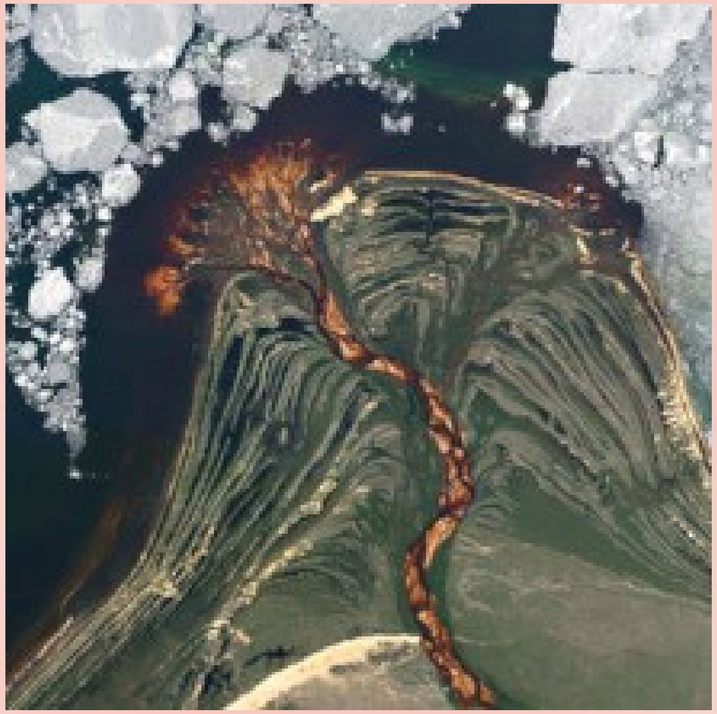


Planet.com

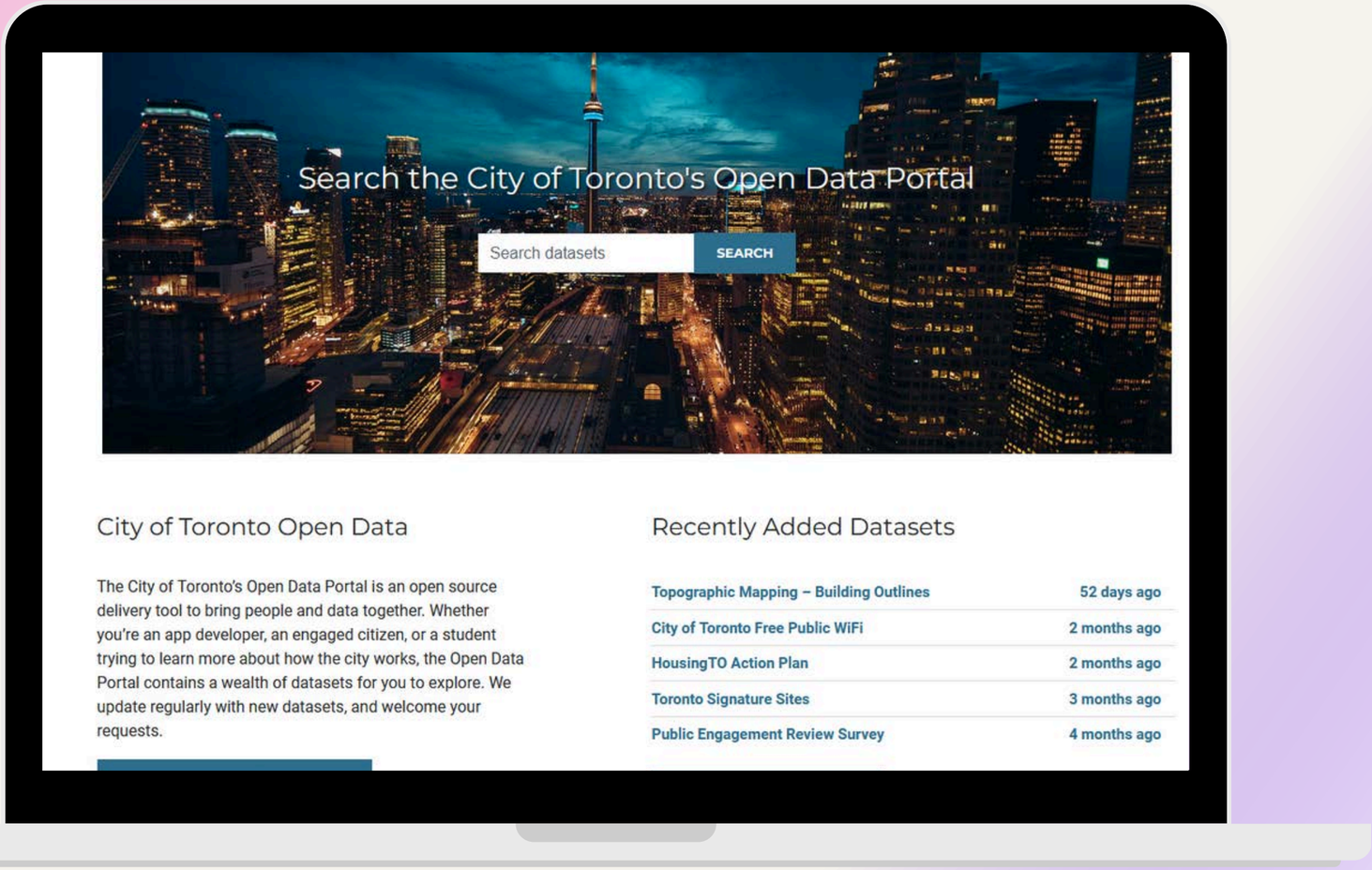
Access instructions:

https://mdl.library.utoronto.ca/collections/data-portal/planetcom





Open data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The City of Toronto's Open Data Portal is an open source delivery tool to bring people and data together. Whether you're an app developer, an engaged citizen, or a student trying to learn more about how the city works, the Open Data Portal contains a wealth of datasets for you to explore. We update regularly with new datasets, and welcome your requests.
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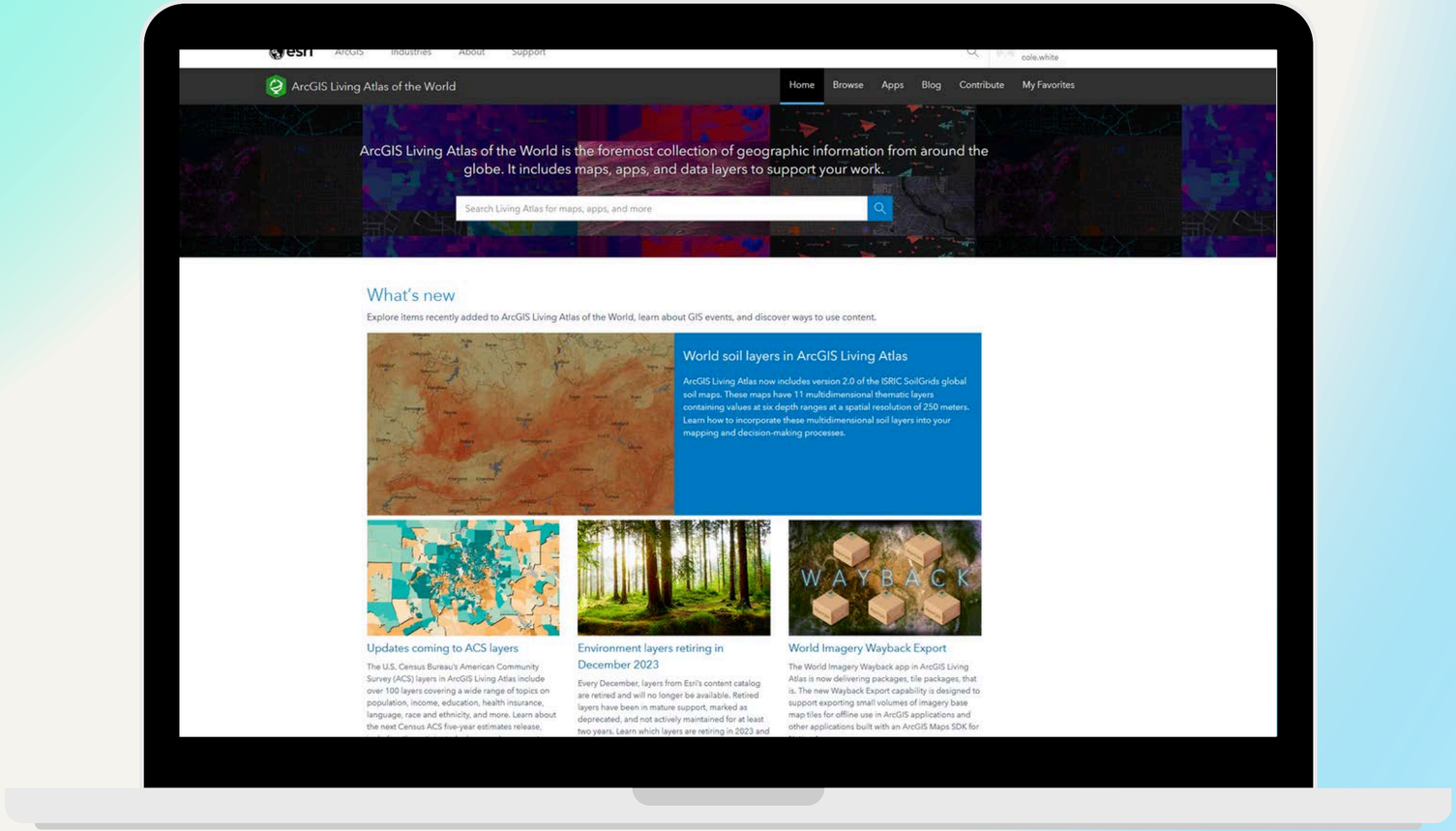
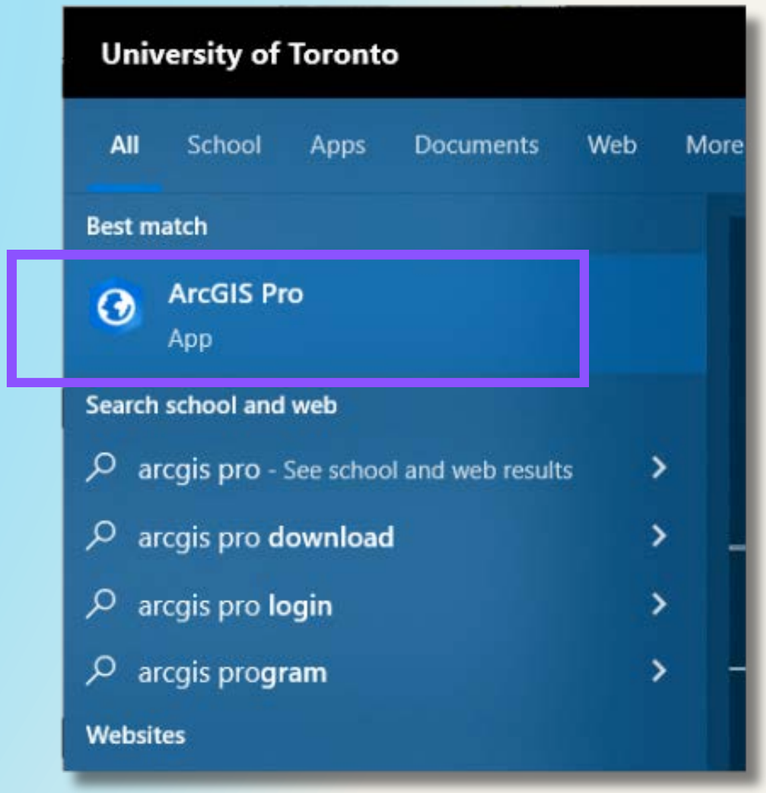
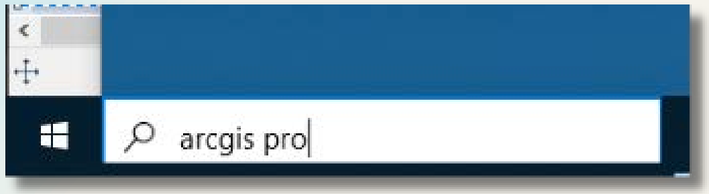
ArcGIS Online and Living Atlas



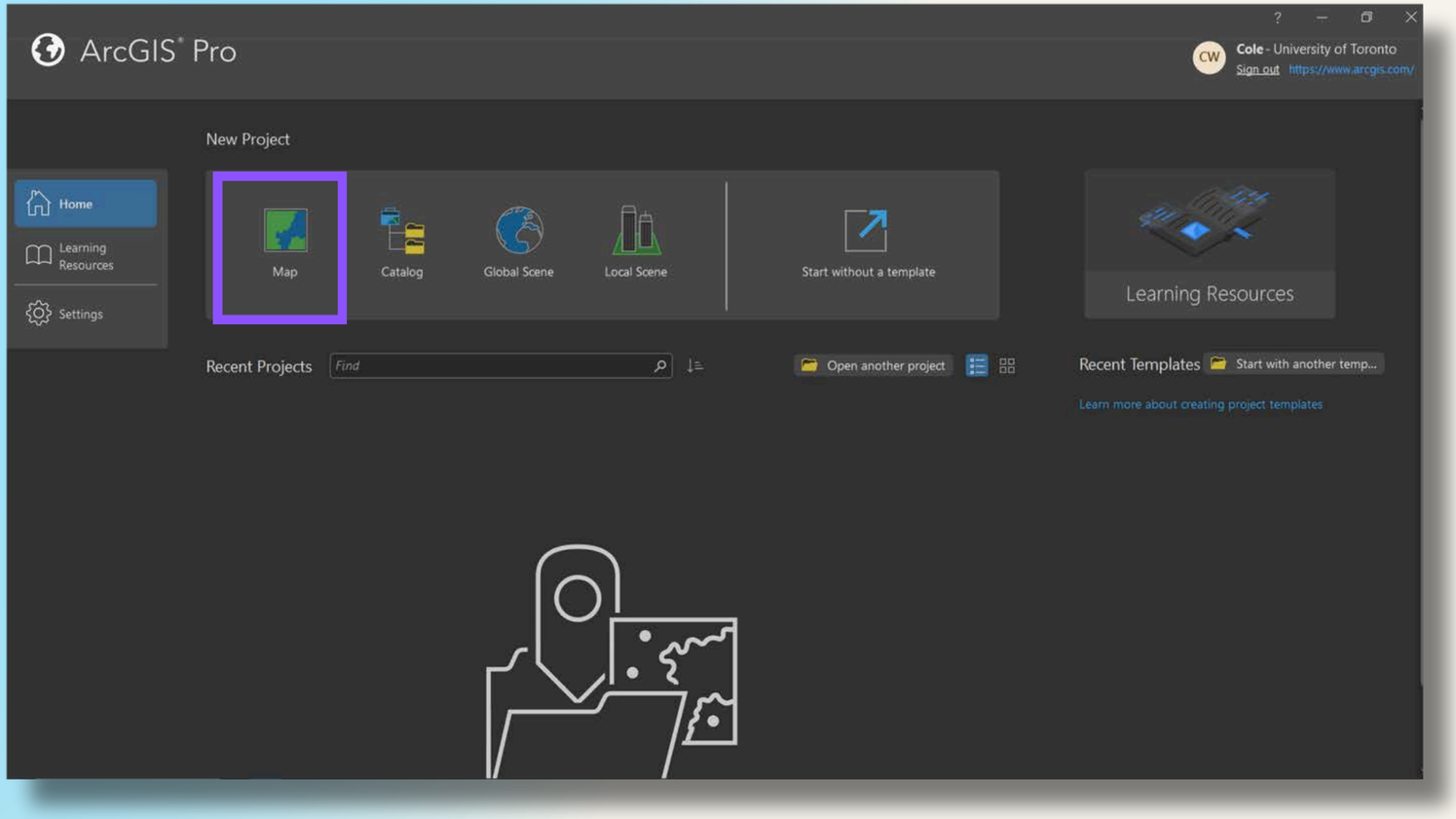
Creating a New Project

- Launch Pro from the Windows Start Menu

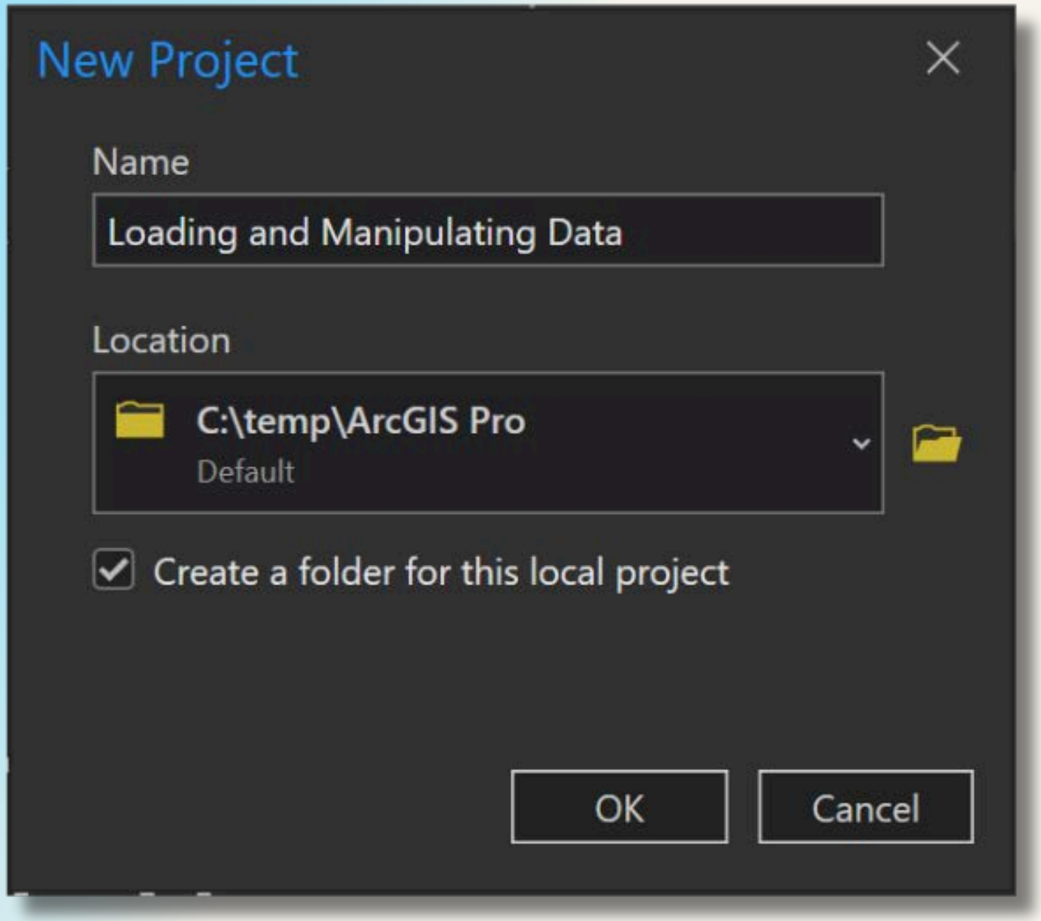




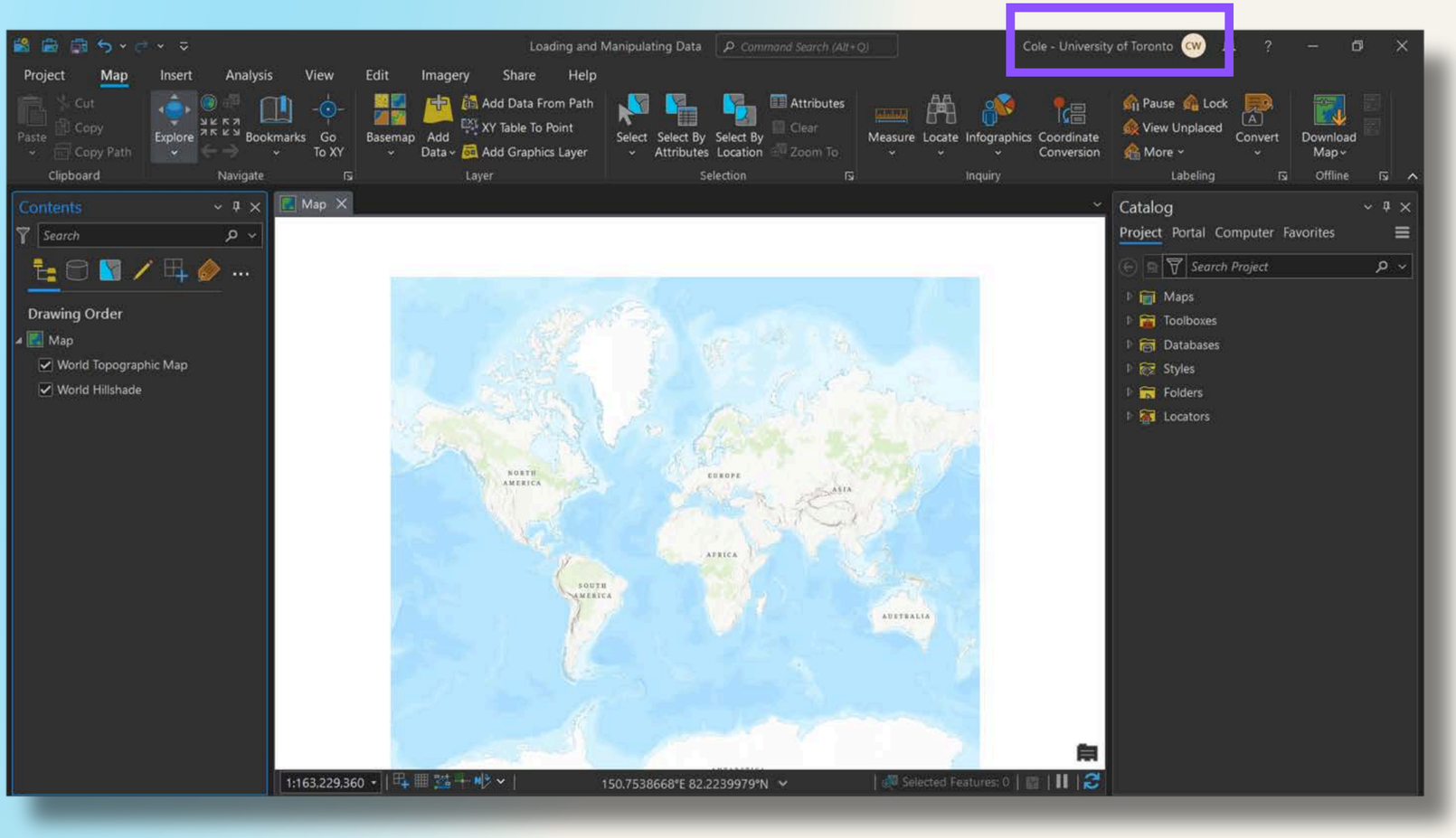
- From the intro screen, create a new project using the **Map** template.



- Give your new project a name.
- Choose a location on your filesystem to save the project.
- Check the box to create a new folder for the project.
- Click **OK**.



- A new project containing a **map view** will open.
- The map will be empty except for a default **basemap**.
- Make sure you're signed in with your U of T credentials.

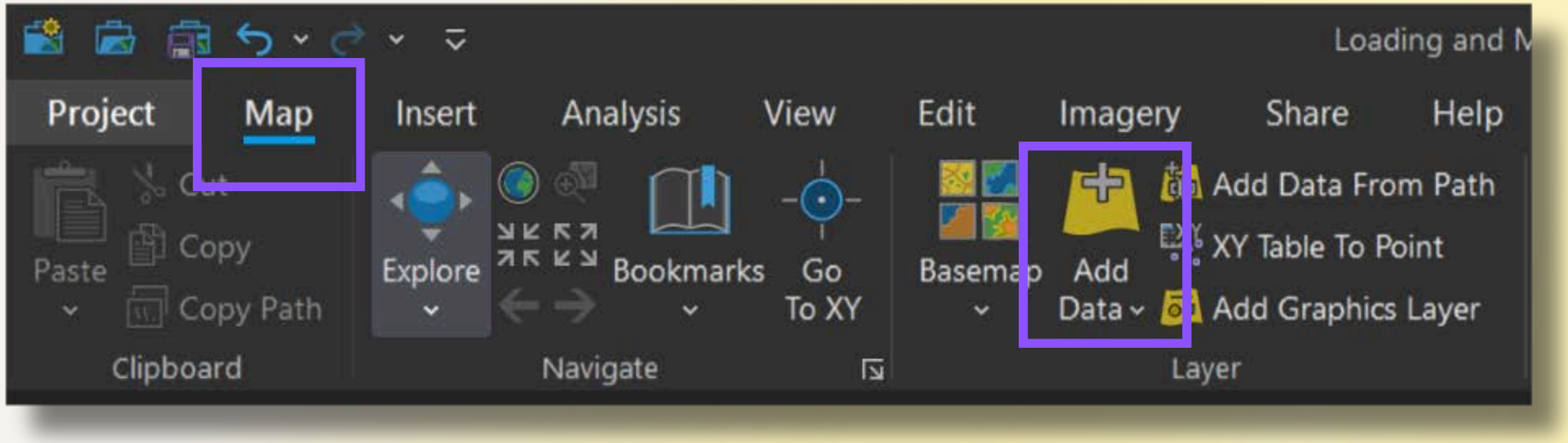


Working with Vector Data:
Add a data layer from a shapefile

Shapefile (.shp) - a very common GIS vector file format.

- **Other GIS-compatible vector formats:**
  - **.dwg, .dxf** - CAD drawings *(survey plans often use this format)*
  - **.kml, .kmz** - Google Earth file
  - **.geojson** - GeoJSON *(often used in web mapping)*

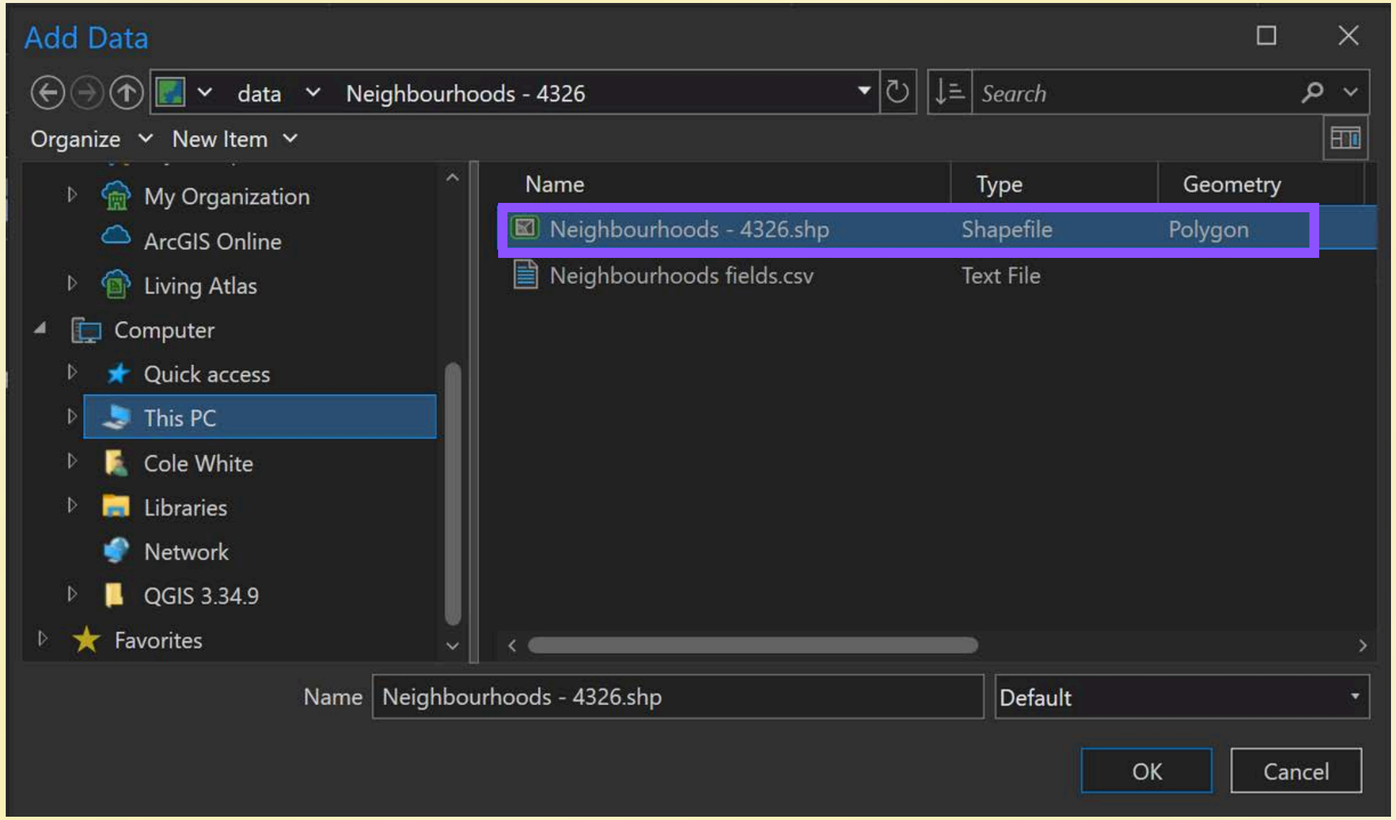
Add a data layer from a shapefile



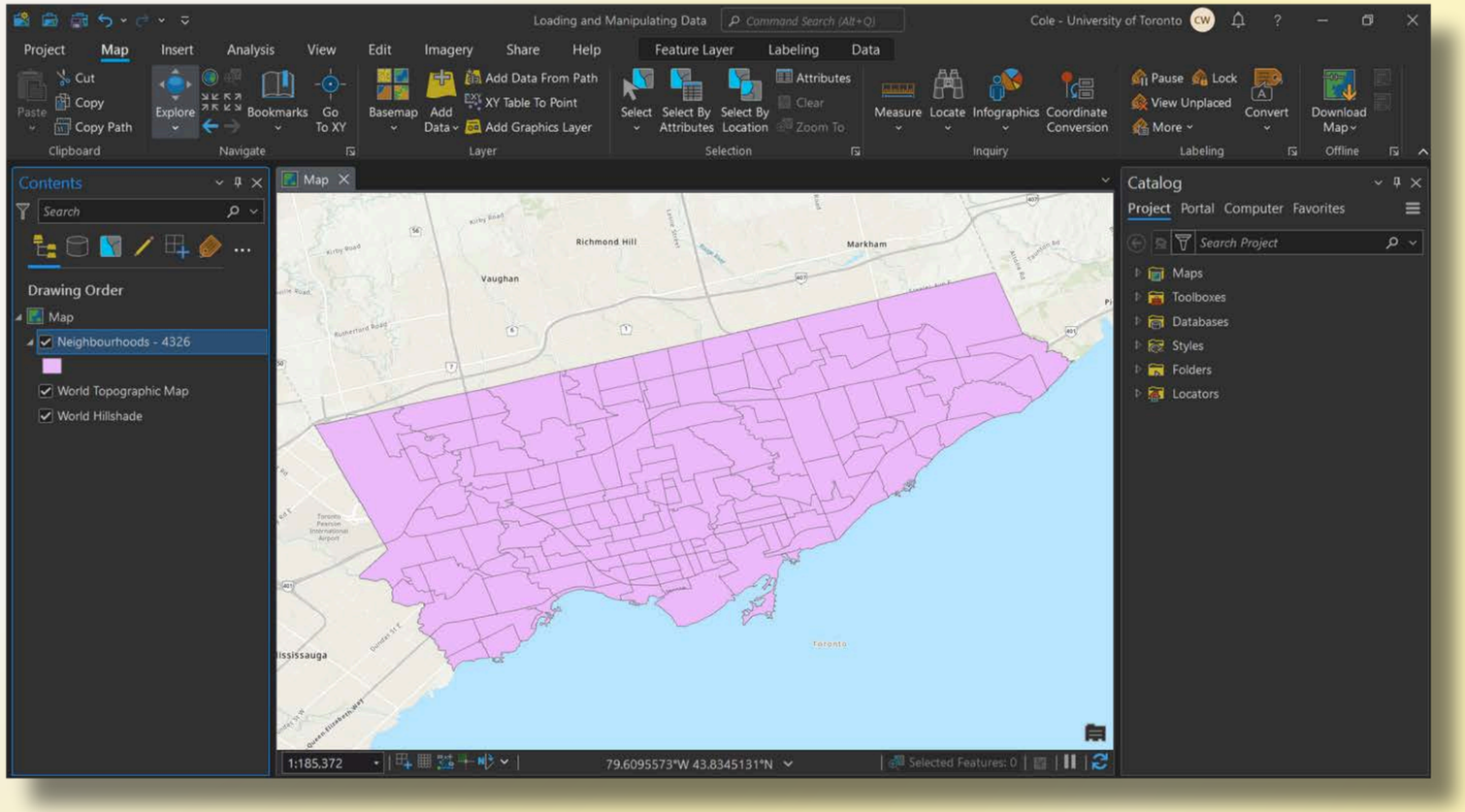
- From the **Map** tab, click the **Add Data** button.

Add a data layer from a shapefile

- Navigate to the location where you've saved the sample data.
- Select **Neighbourhoods - 4326.shp** and click **OK**.



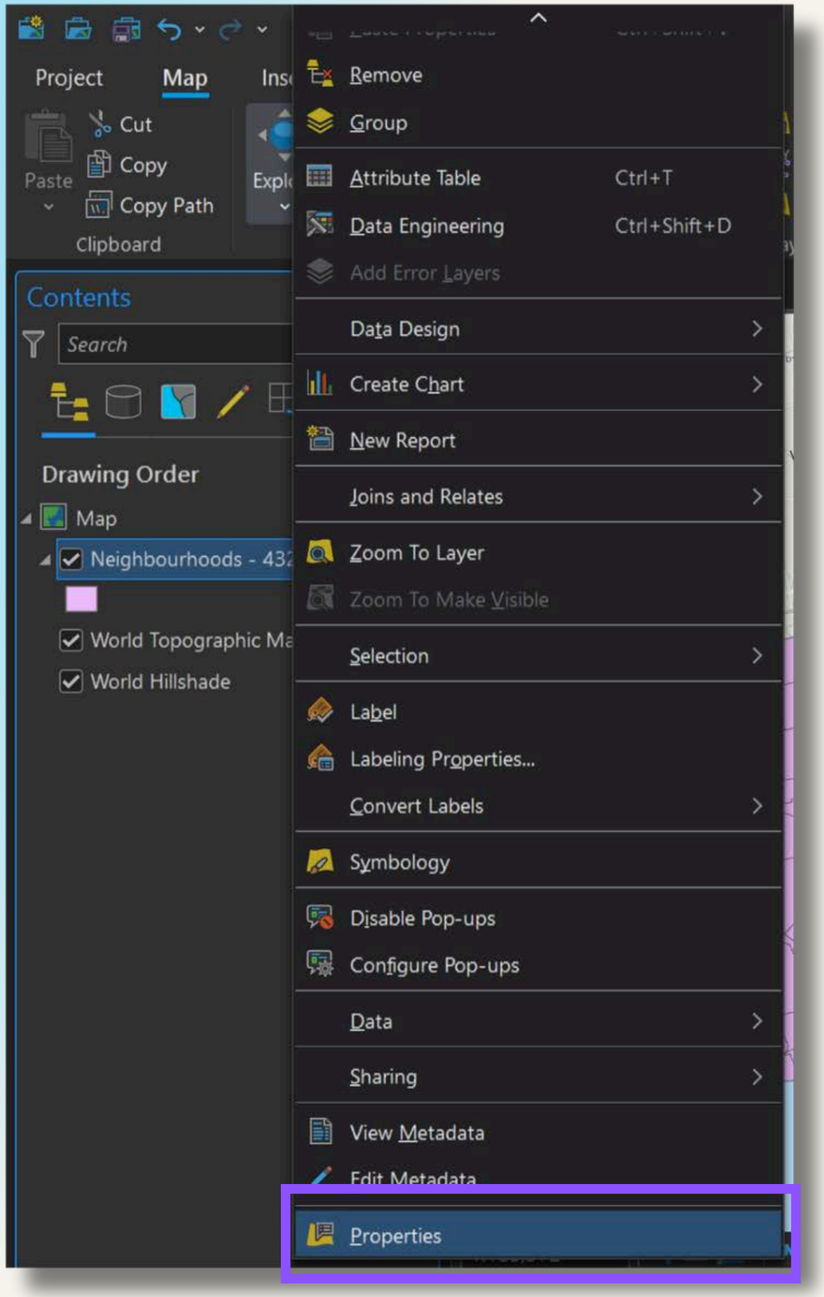
Add a data layer from a shapefile



- The layer will be added to your map view.
  - **Note**: This dataset was acquired from the City's open data portal website: https://open.toronto.ca/dataset/neighbourhoods/

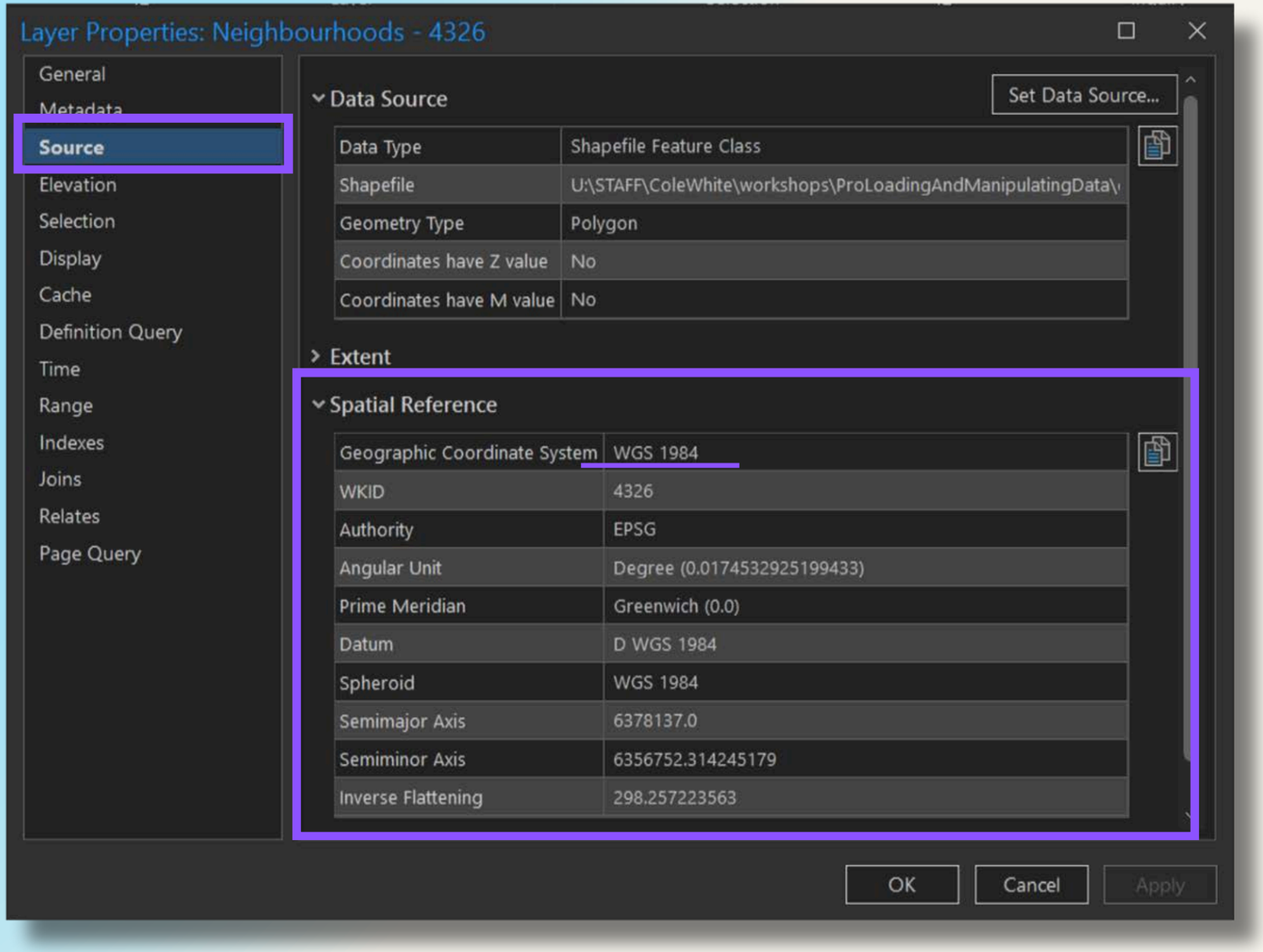
Projections

- Right-click the Neighbourhoods layer and select **Properties** from the contextual menu. (Or, double-click the layer name.)

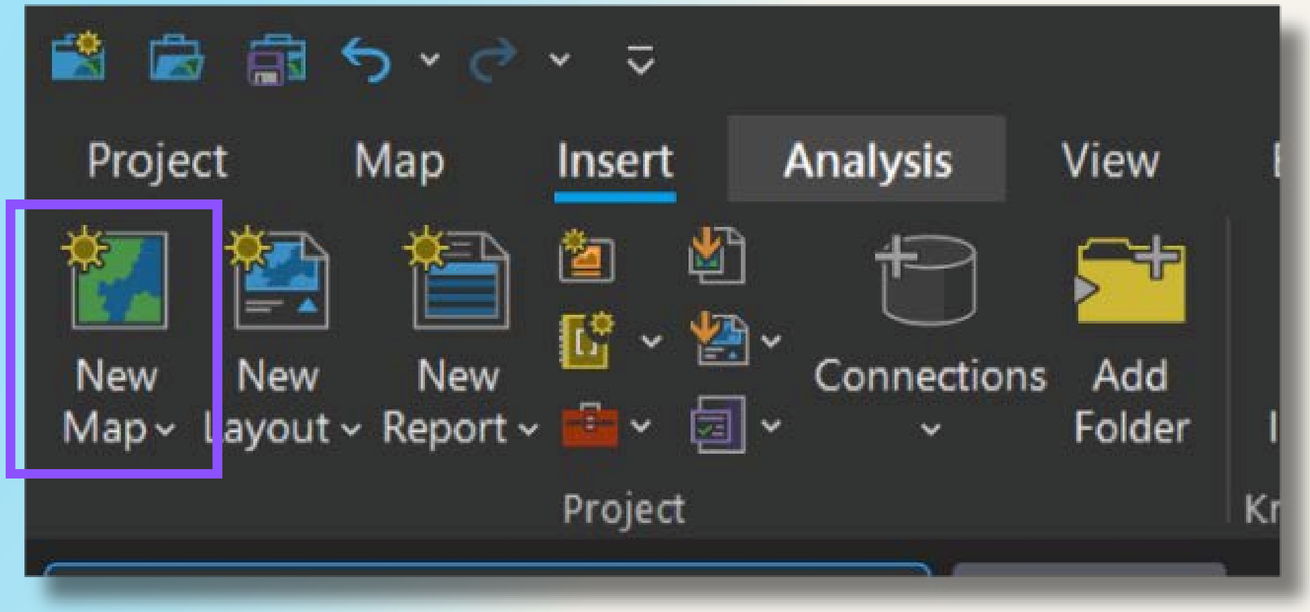


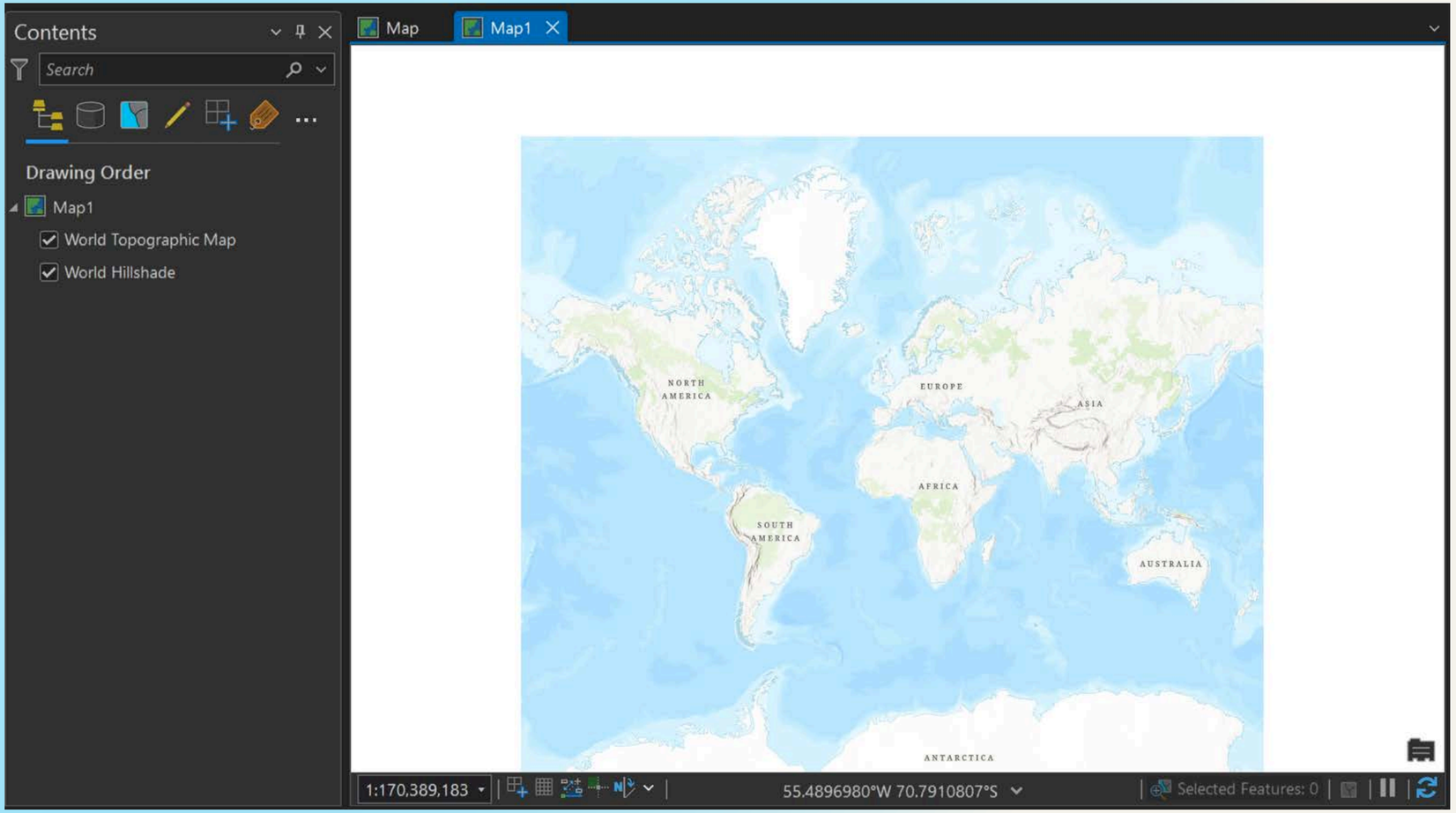
Projections

- Click on the **Source** tab.
- Take a look at the information in the **Spatial Reference** section.
- Note that this layer uses the **WGS 1984** geographic coordinate system.
- Click **OK**.



- From the Insert tab on the Pro Ribbon, click **New Map**.

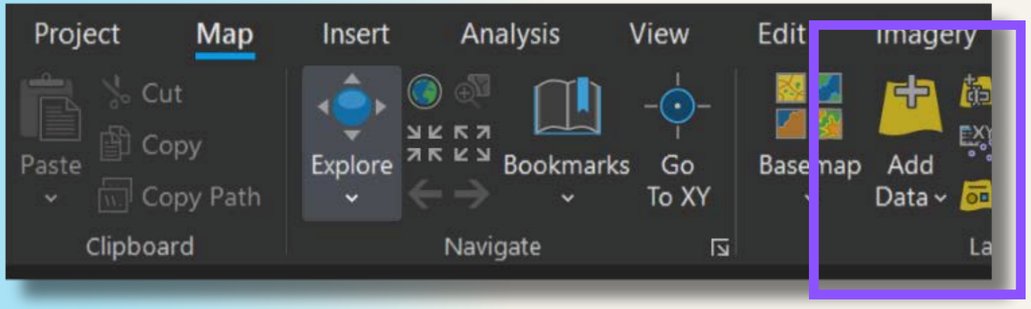


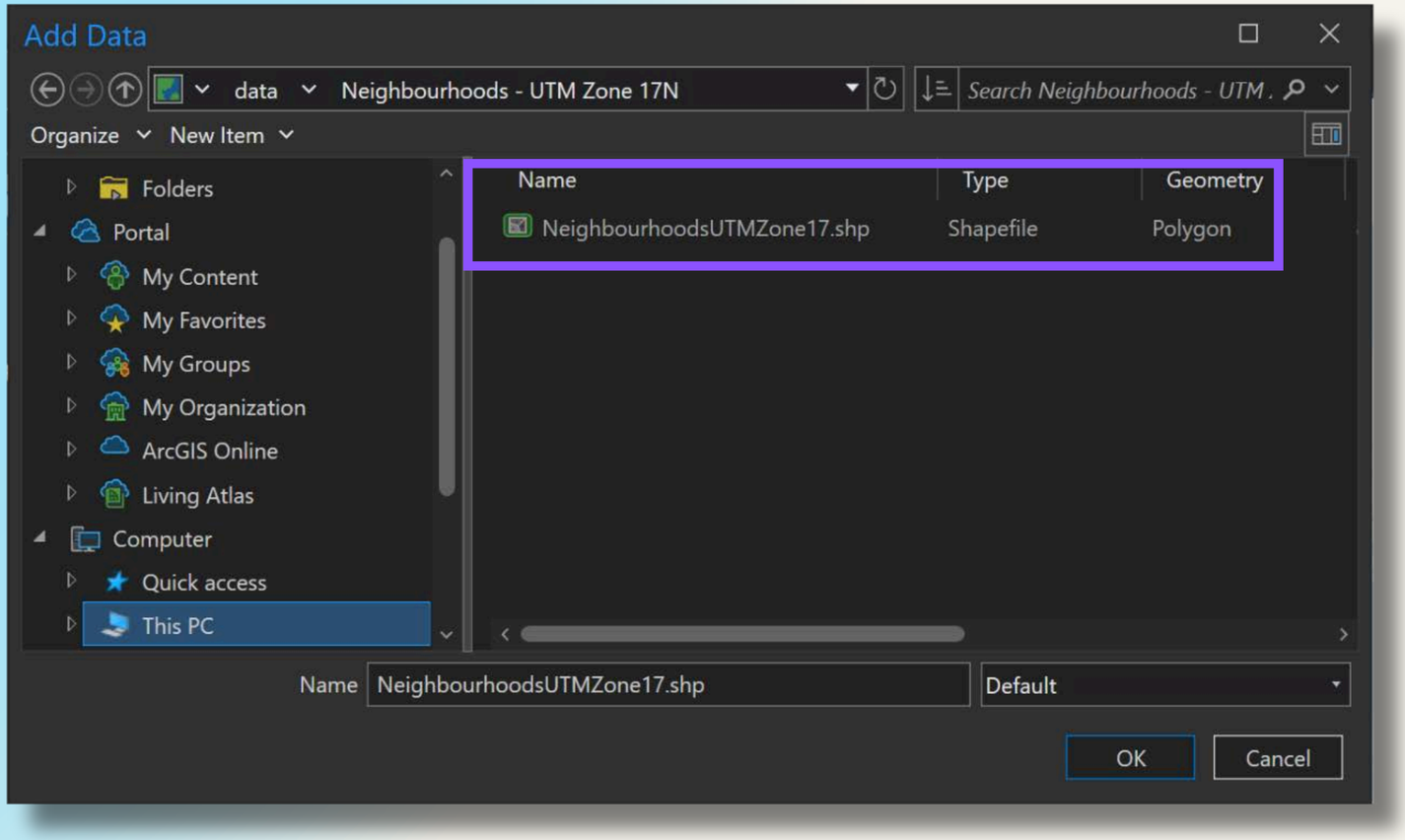


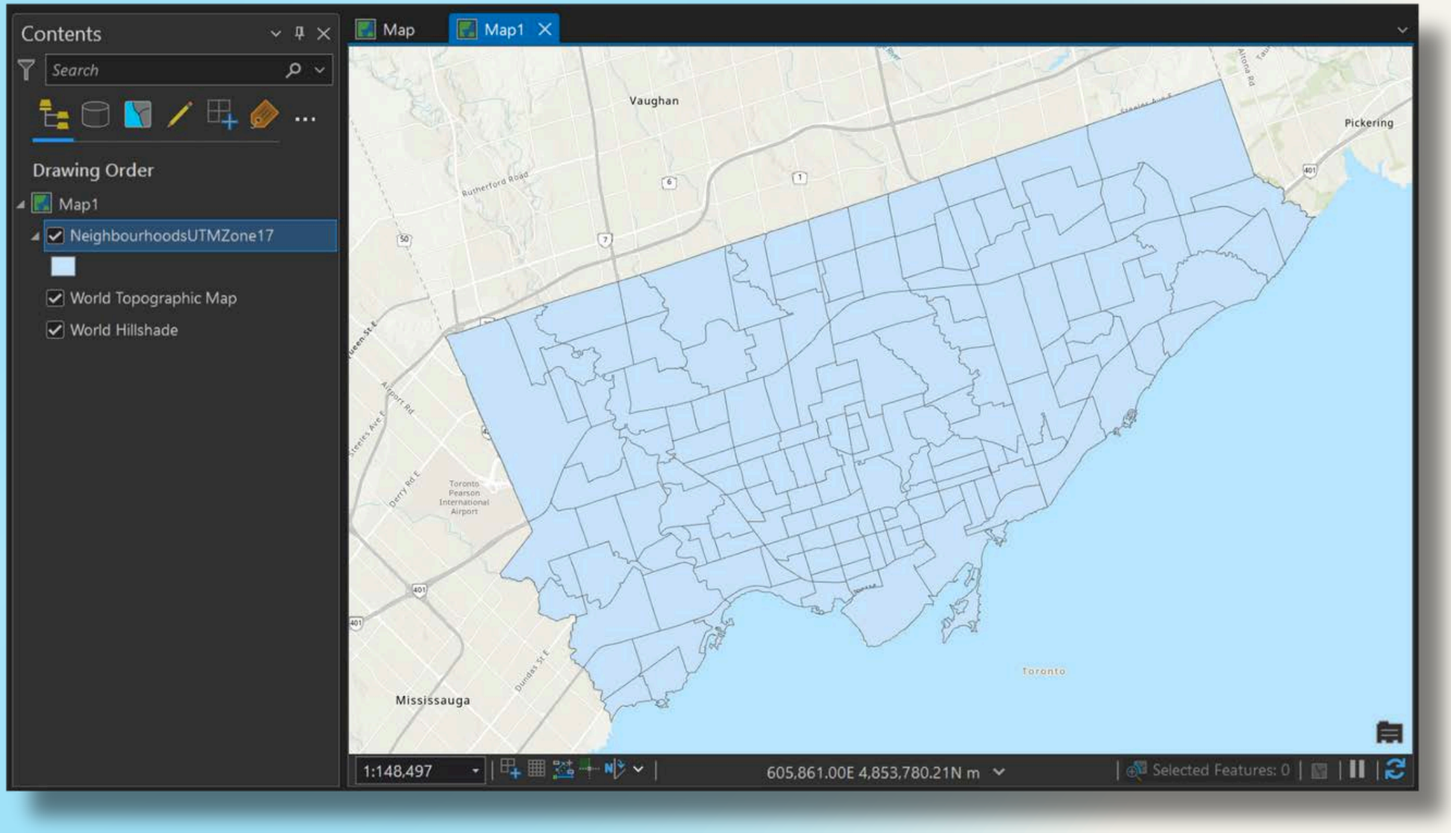
- A new, blank map will be added to your project.

- Click the **Add Data** button.

- Navigate to and open **NeighbourhoodsUTM Zone17.shp**

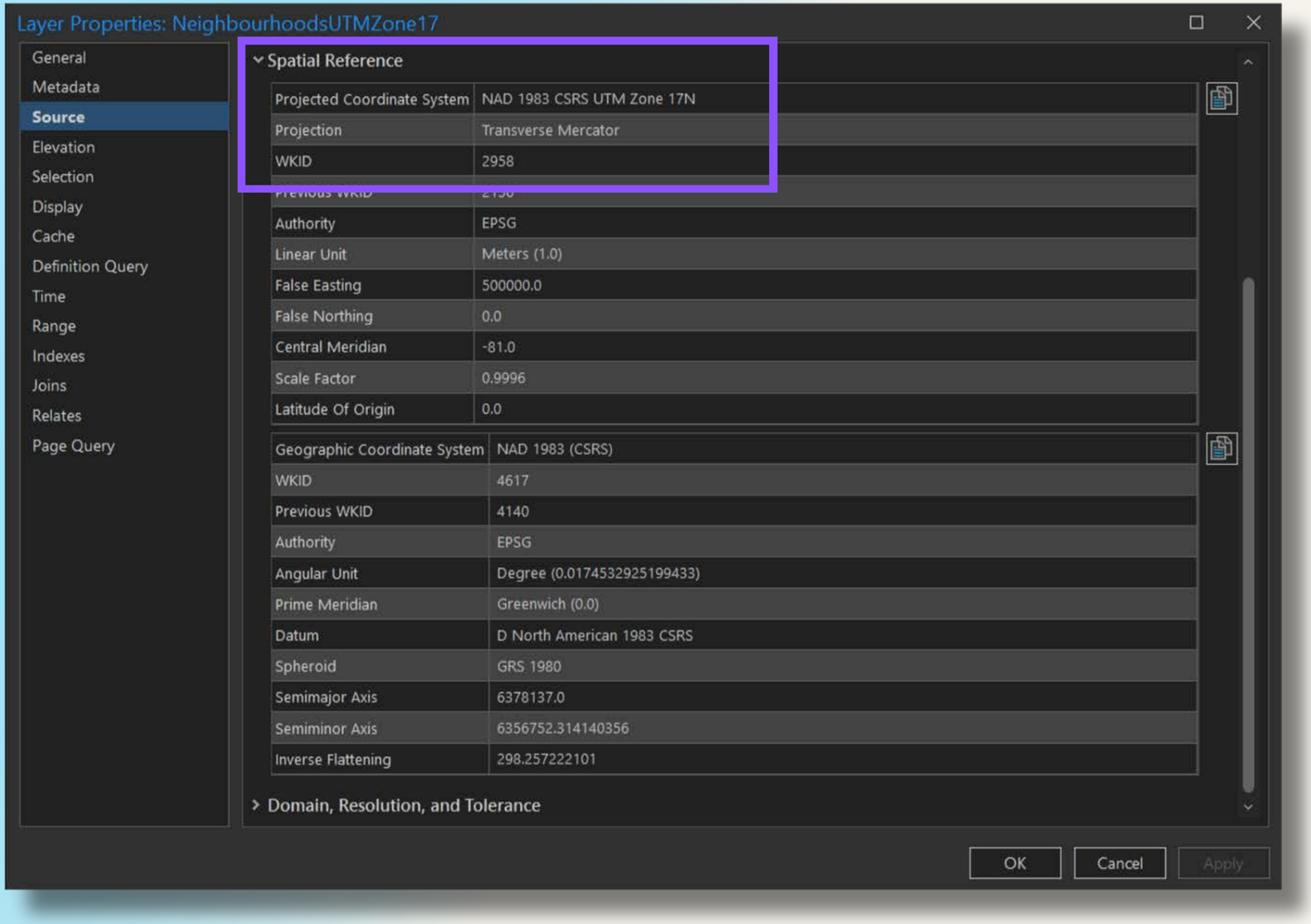






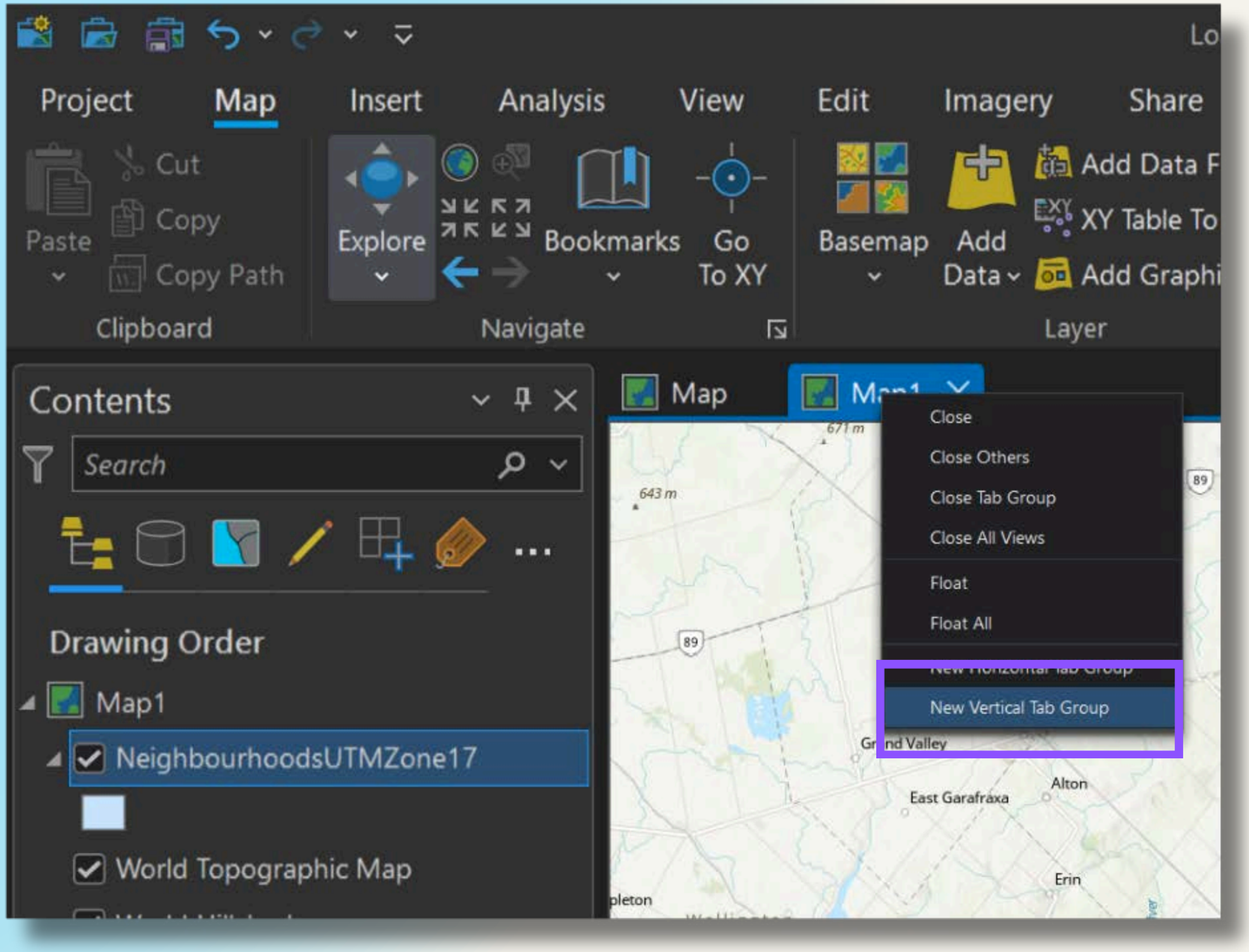
- A second version of the **Neighbourhoods** layer will be added to your new map.

- Open the **Properties** pane for this version of the Neighbourhoods layer.
- Note the **Spatial Reference** details.
- Click **OK**.



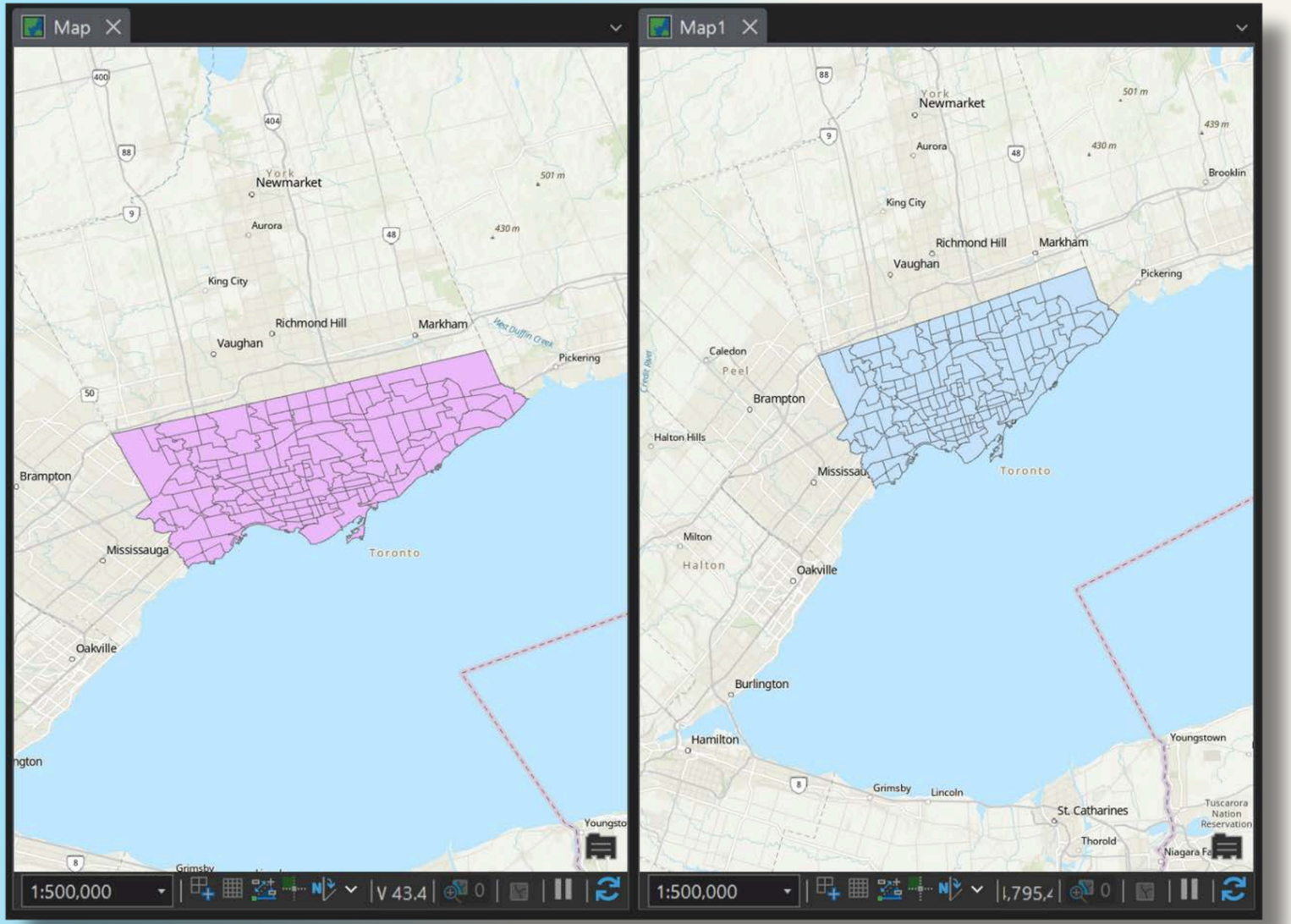
Projections

- Right-click the **Map1** tab.
- Select **New Vertical Tab Group**.



Projections

- Compare the two map views side by side
- Note that the shape of the neighbourhoods layer is quite different between the two maps.
- This is due to two different **spatial reference systems** being used.

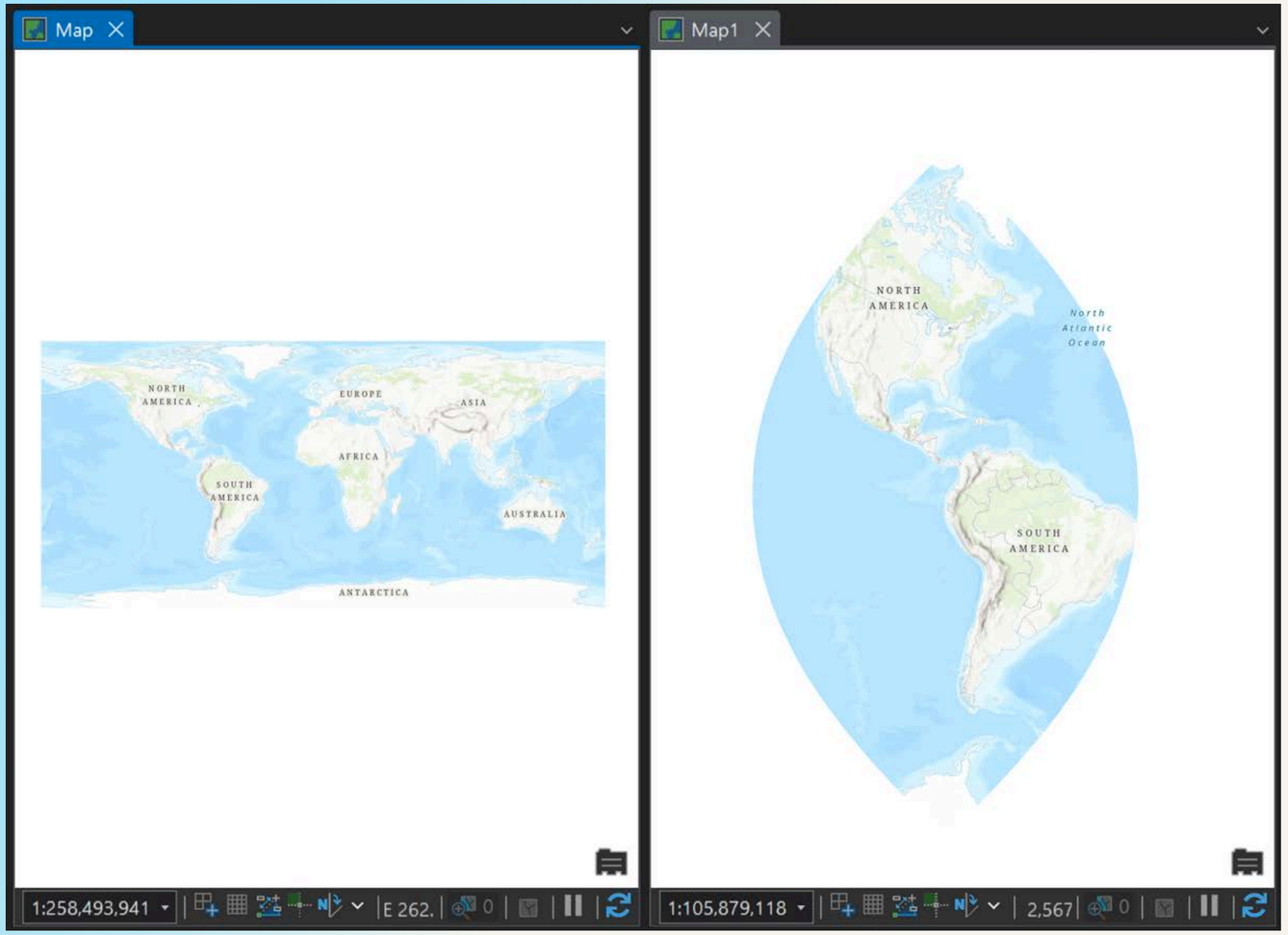


WGS84 Geographic Coordinate System

Universal Transverse Mercator (UTM) Zone 17N Projection

Projections

- **Zoom out** to view the entire world on each map view.



WGS84 Geographic Coordinate System

Universal Transverse Mercator (UTM) Zone 17N Projection

World Geodetic System 1984 (WGS84)

- **Scope**: Worldwide
- **Units**: Degrees (latitude and longitude)

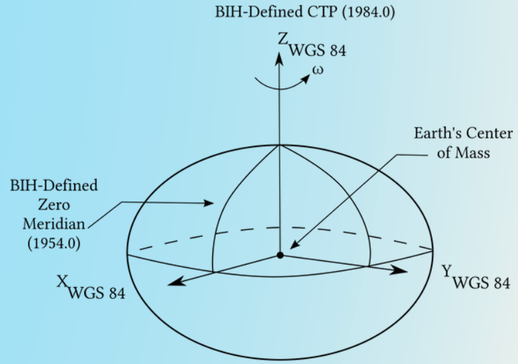
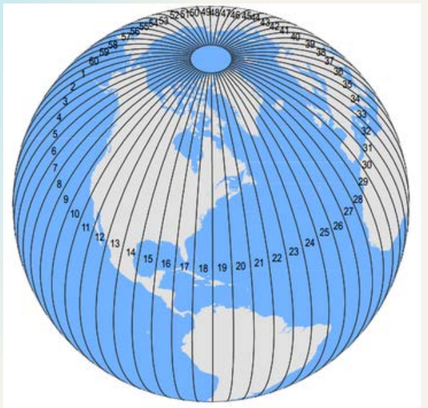


Figure 1.1 WGS 84 Reference Frame

NAD83 CSRS UTM Zone 17

- **Scope**: Centered on -81 degrees longitude
  - Allows Southern Ontario to be mapped quite accurately on a flat surface
- **Units**: Metres



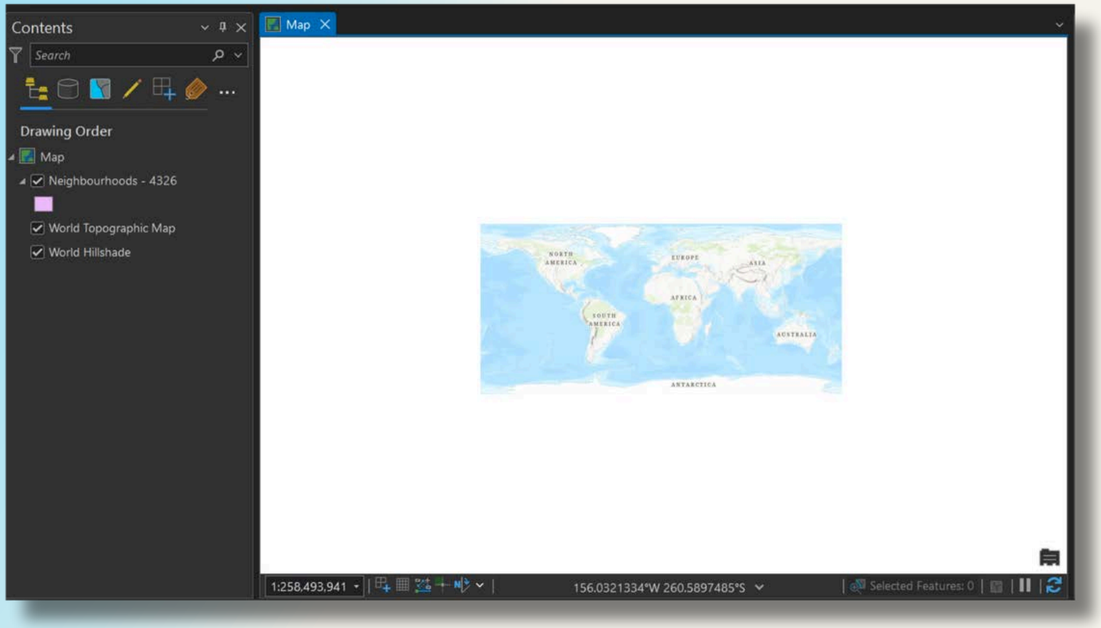
More information: https://gisgeography.com/map-projections/

Projections

- To maintain spatial consistency and accuracy, as well as avoid potential data issues, it’s best for all layers within a map to use the same spatial reference.

- Data can be **reprojected** using ArcGIS Pro’s geoprocessing tools if necessary.

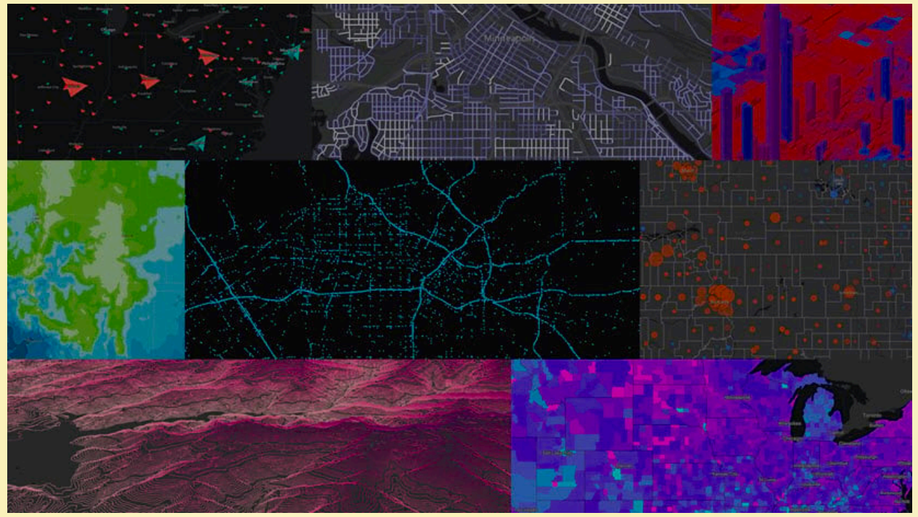
- **Close the Map1 tab**. We will continue working with the WGS84 map.



Add data from Living Atlas or ArcGIS Online

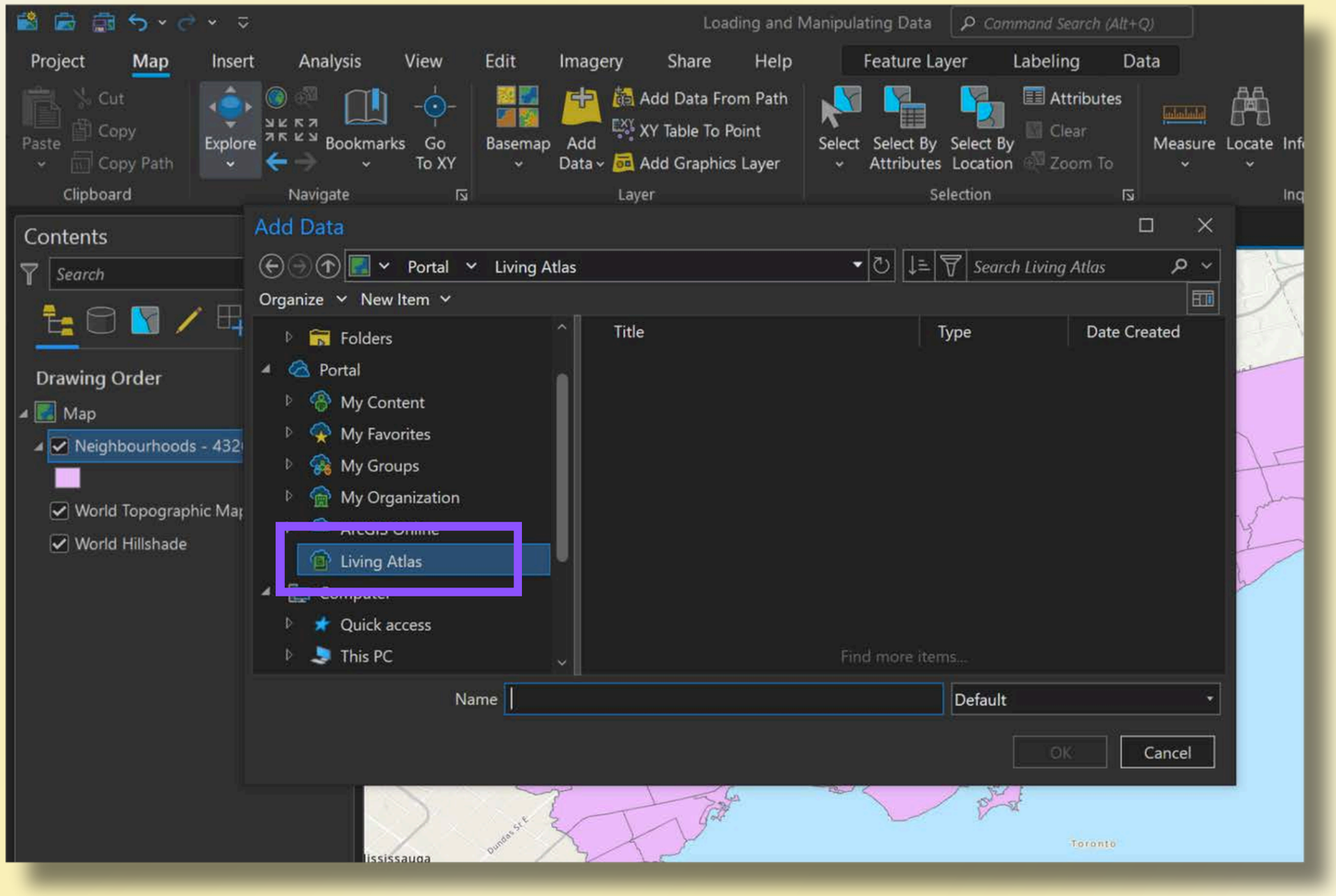
- **Living Atlas** is a curated selection of authoritative spatial datasets provided by Esri via the **ArcGIS Online** platform.

- Living Atlas content can be added to ArcGIS Pro maps as **Web Services** (more info about those later).



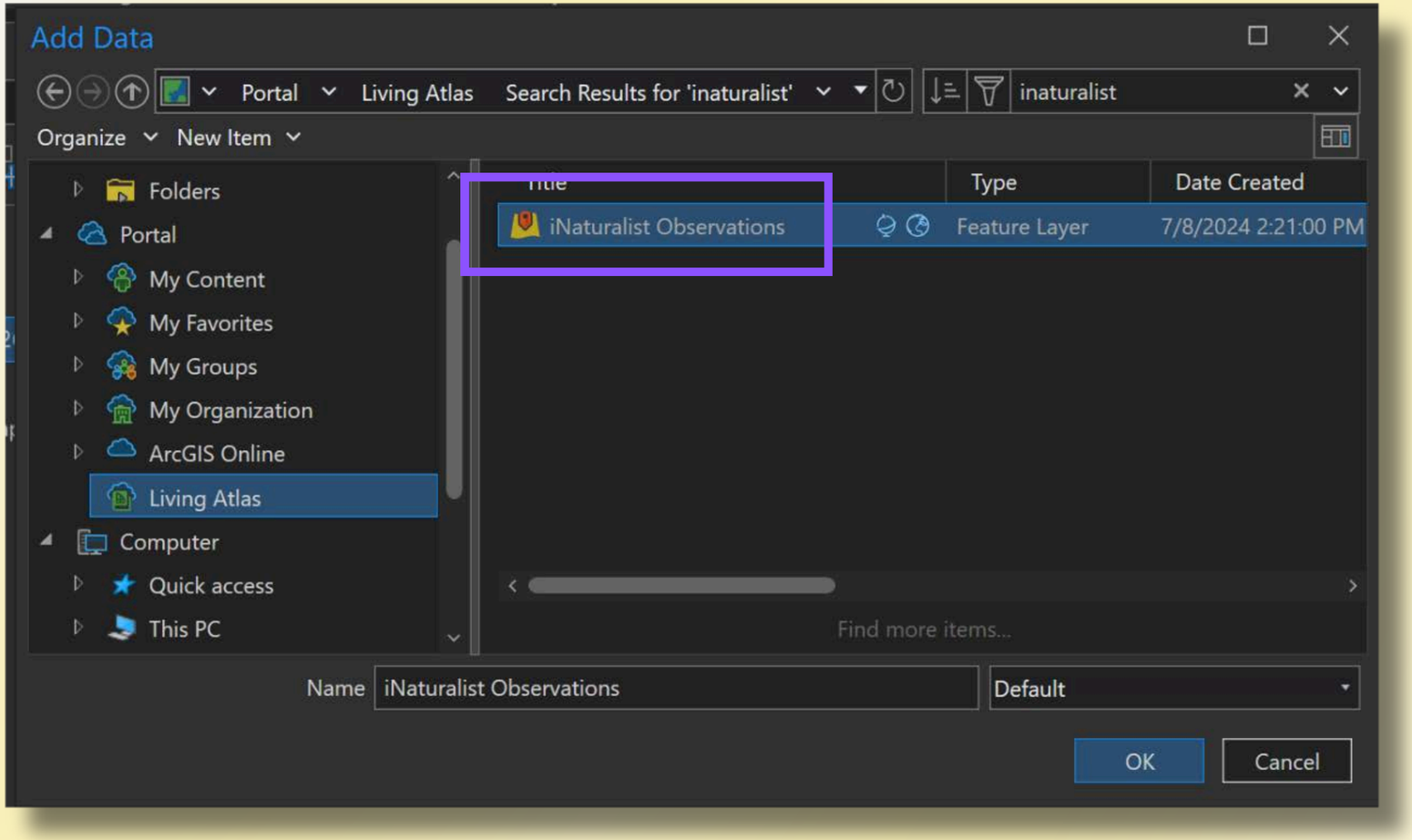
https://livingatlas.arcgis.com/

- Click the **Add Data** Button.
- Select the **Living Atlas** tab.



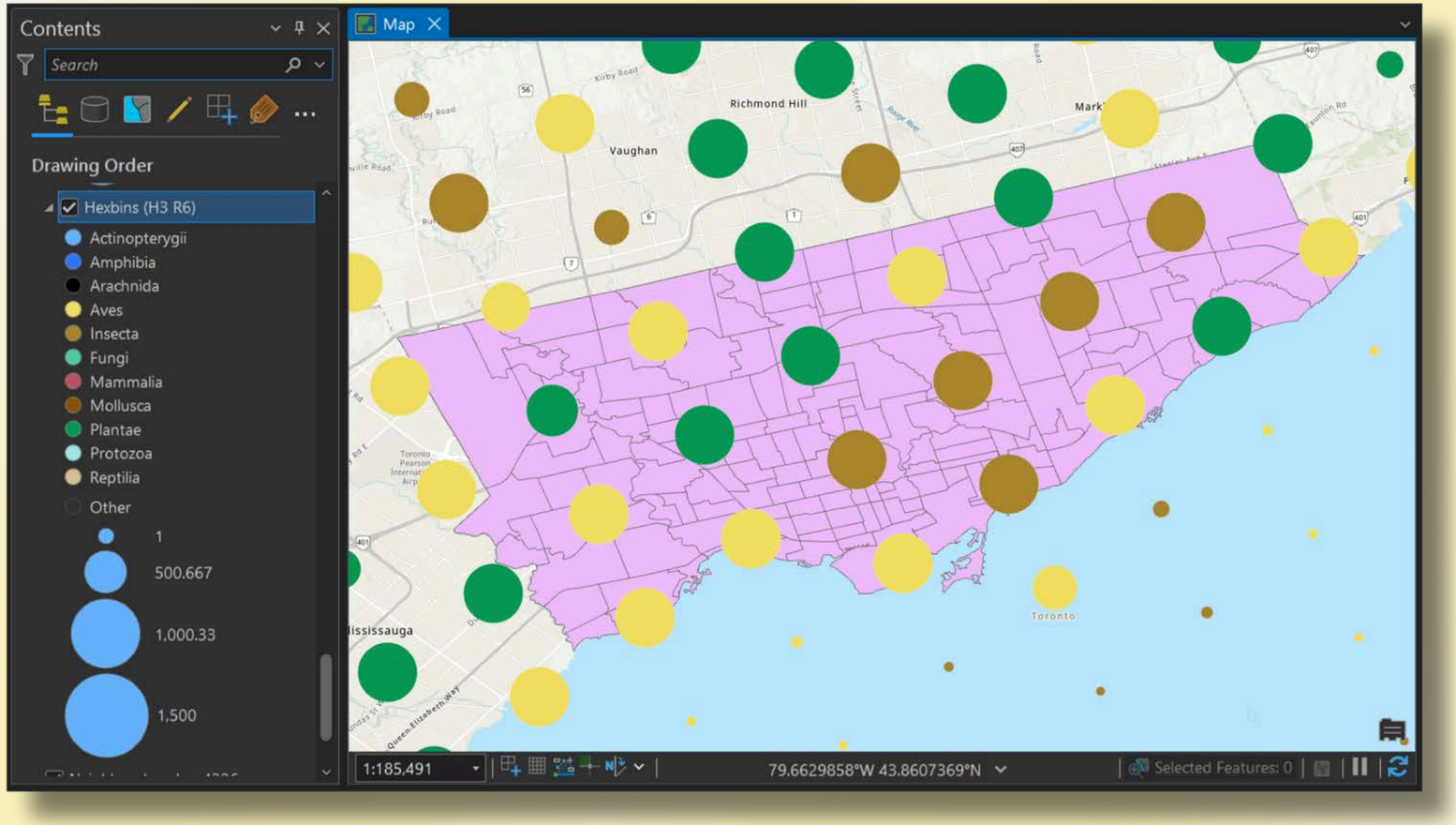
- Type **iNaturalist** in the search box and press Enter.

- Select the **iNaturalist Observations** Feature Layer and Click **OK**.



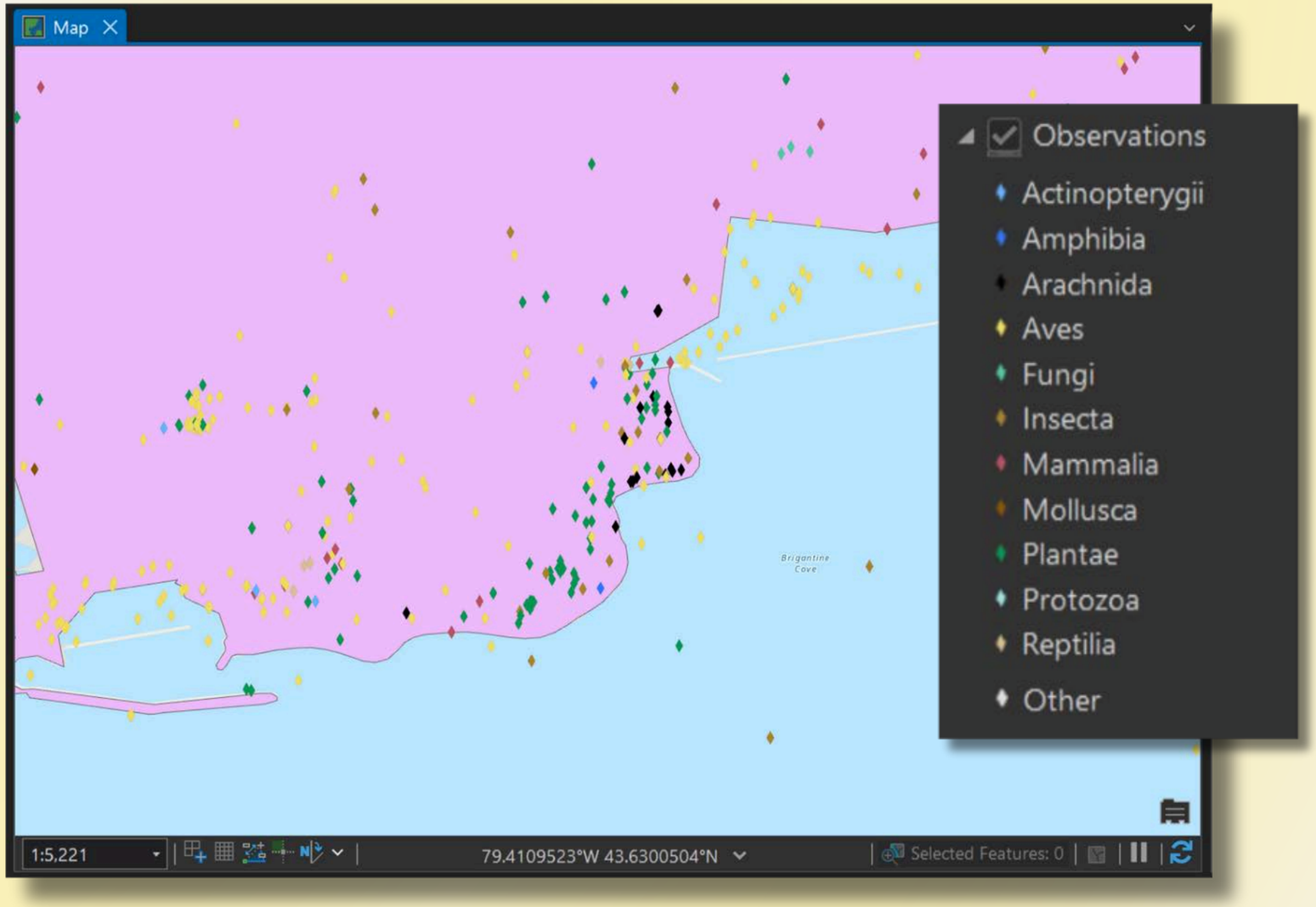
- This dataset contains crowdsourced wildlife observations.

- When zoomed out, the individual observations are **aggregated** into bins denoting the number of observations per area.



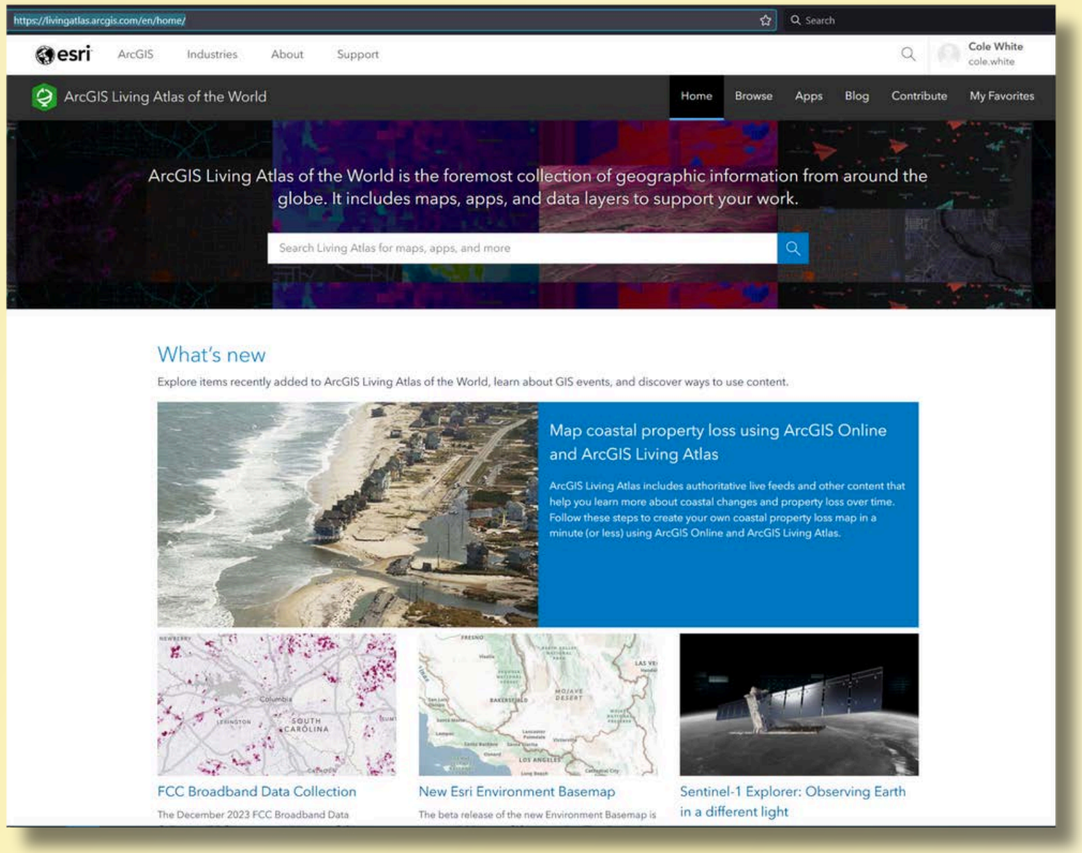
- Zoom in to display individual observation points.

- Note that the points have been symbolized by **category** (taxonomic class)



Visit the Living Atlas website to browse other available datasets:

https://livingatlas.arcgis.com/en/home/

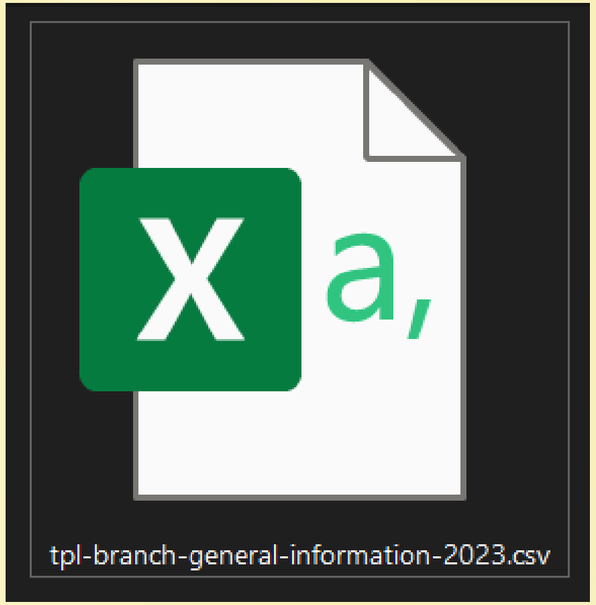


Add data from a spreadsheet

- One of the most common ways of importing data into GIS is by using **spreadsheets** (.csv, .xlsx, etc.)

- Spreadsheets can be transformed into spatial layers if they contain geographic information.

- Spreadsheet data can also be **joined** to spatial layers via a **key field**.



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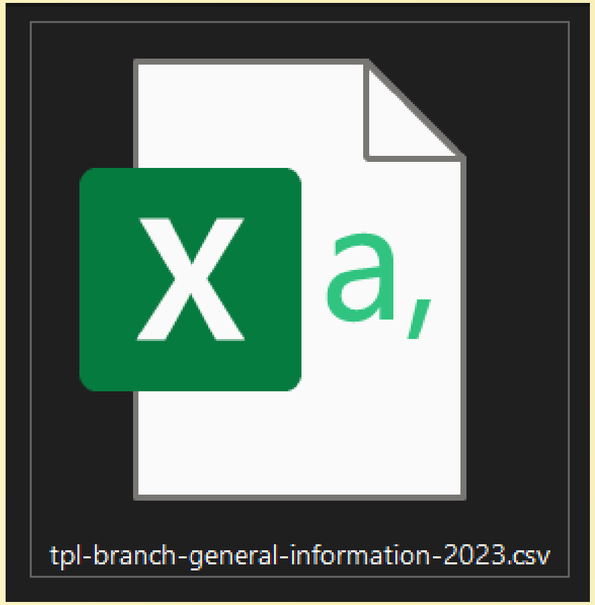
10	9	BB	1	Brookbank	210 Brookl	M3A 2T8	https://ww	416-395-5	7933	20	0	0	0	0	0	0	0	9	NL		43.75951	-79.3259		150	Fenside-Pa	0	16	Don Valley	1968	
11	10	BC	1	Black Creek	North York	M3L 1B2	https://ww	416-395-5	5782	shared	0	0	0	0	0	0	0	7	NL		43.72122	-79.5105		26	Downsview	1	7	Humber Ri	2002	
12	11	BD	1	Bendale	1515 Danfo	M1J 1H5	https://ww	416-396-8	8500	30	0	0	0	0	0	0	0	9	NL		43.75106	-79.2441		157	Bendale So	1	21	Scarboroug	1961	
13	12	BE	1	Beaches	2161 Quee	M4L 1J1	https://ww	416-393-7	8000	0	0	0	0	0	0	0	0	12	NL		43.67013	-79.2985		63	The Beache	0	19	Beaches-Ea	1914	
14	13	BF	1	Barbara Fr	20 Covingt	M6A 3C1	https://ww	416-395-5	29417	6	0	1	1	0	1	1	1	30	DL		43.72075	-79.4322		32	Englemoun	0	8	Eglinton-La	1992	
15	14	BKONE	0	Bookmobile One			https://www.tpl.ca/bc												NL										
16	15	BKTWO	0	Bookmobile Two			https://www.tpl.ca/bc												NL										

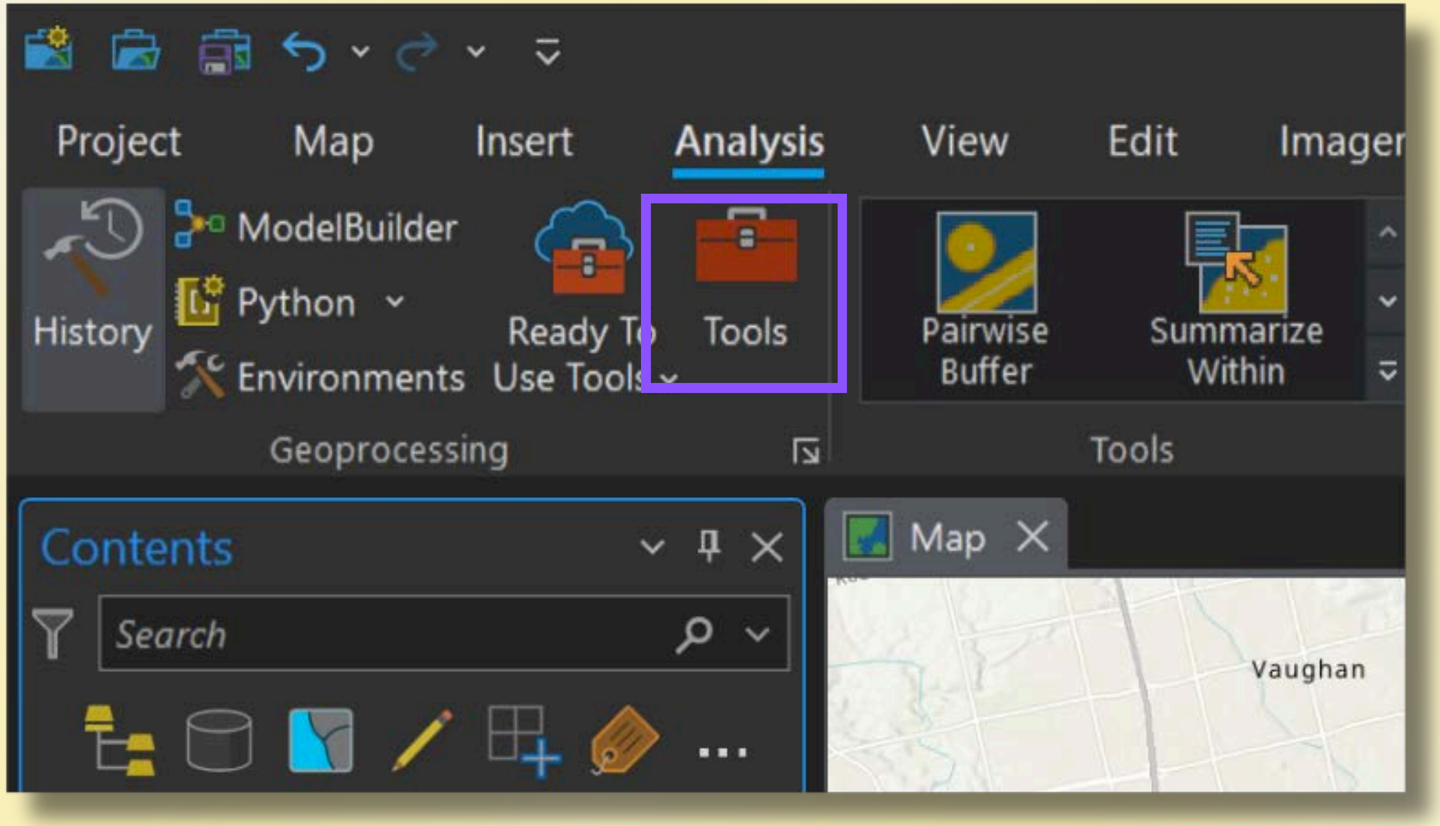
Add data from a spreadsheet: XY coordinates

- In Windows Explorer, navigate to the sample data folder.
- Open **tpl-branch-general-information-2023.csv** in Excel or other spreadsheet software.
- Each row in the spreadsheet contains information about one public library location. Note the **Lat** and **Long** columns.
- Exit Excel.

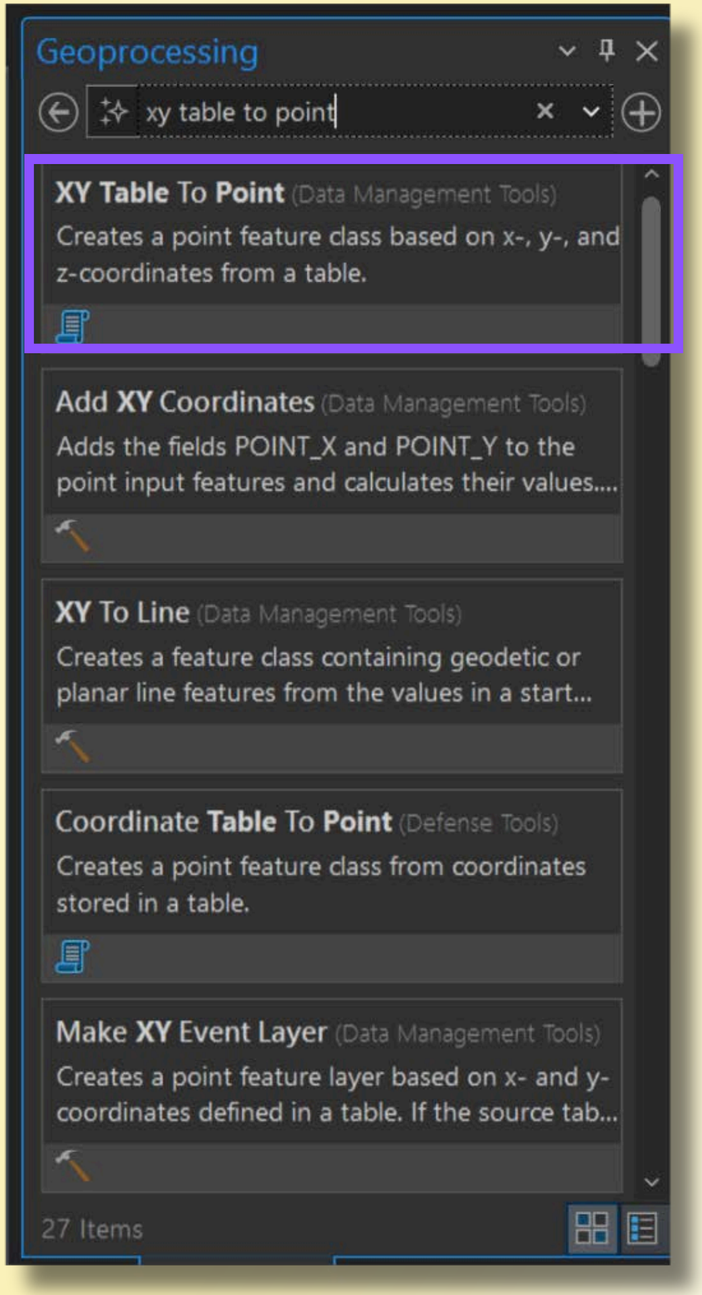


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	_id	BranchCod	PhysicalBra	BranchNan	Address	PostalCode	Website	Telephone	SquareFoo	PublicParki	KidsStop	LeadingRea	CLC	DIH	TeenCounc	YouthHub	AdultLitera	Workstatic	Servi	Tier	Lat	Long	NBH	No	NBHDNam	TPLNIA	WardNo	WardName	PresentSiteYear	
2	1	AB	1	Albion	1515 Albio	M9V 1B2	https://ww	416-394-5	29000	59	1	1	1	1	1	1	1	38	DL		43.73983	-79.5841		2	Mount Oliv	1	1	Etobicoke I	2017	
3	2	ACD	1	Albert Cam	496 Birchm	M1K 1N8	https://ww	416-396-8	28957	45	0	1	1	1	1	1	0	36	DL		43.70802	-79.2693		120	Clairlea-Bir	1	20	Scarborou	1971	
4	3	AD	1	Alderwood	2 Orianna I	M8W 4Y1	https://ww	416-394-5	7341	shared	0	0	0	0	0	0	0	7	NL		43.60194	-79.5473		20	Alderwood	0	3	Etobicoke-I	1999	
5	4	AG	1	Agincourt	155 Bonis /	M1T 3W6	https://ww	416-396-8	27000	86	0	1	1	1	0	1	0	42	DL		43.78517	-79.2934		118	Tam O'Sha	0	22	Scarborou	1991	
6	5	AH	1	Armour He	2140 Aven	M5M 4M7	https://ww	416-395-5	2988	shared	0	0	0	0	0	0	0	5	NL		43.73934	-79.4219		39	Bedford Pa	0	8	Eglinton-La	1982	
7	6	AL	0	Answerline			https://ww	416-397-5											RR										
8	7	AN	1	Annette St	145 Annett	M6P 1P3	https://ww	416-393-7	7806	0	0	0	0	0	0	0	0	11	NL		43.66336	-79.4663		90	Junction Ar	0	4	Parkdale-H	1908	
9	8	AP	1	Amesbury	1565 Lawr	M6L 1A8	https://ww	416-395-5	6320	22	0	0	0	0	0	0	0	6	NL		43.70646	-79.4857		30	Brookhave	1	5	York South	1967	
10	9	BB	1	Brookbank	210 Brookl	M3A 2T8	https://ww	416-395-5	7933	20	0	0	0	0	0	0	0	9	NL		43.75951	-79.3259		150	Fenside-Pa	0	16	Don Valley	1968	
11	10	BC	1	Black Creek	North York	M3L 1B2	https://ww	416-395-5	5782	shared	0	0	0	0	0	0	0	7	NL		43.72122	-79.5105		26	Downsview	1	7	Humber Ri	2002	
12	11	BD	1	Bendale	1515 Danfo	M1J 1H5	https://ww	416-396-8	8500	30	0	0	0	0	0	0	0	9	NL		43.75106	-79.2441		157	Bendale So	1	21	Scarborou	1961	
13	12	BE	1	Beaches	2161 Quee	M4L 1J1	https://ww	416-393-7	8000	0	0	0	0	0	0	0	0	12	NL		43.67013	-79.2985		63	The Beache	0	19	Beaches-Ea	1914	
14	13	BF	1	Barbara Fri	20 Covingt	M6A 3C1	https://ww	416-395-5	29417	6	0	1	1	0	1	1	1	30	DL		43.72075	-79.4322		32	Englemoun	0	8	Eglinton-La	1992	
15	14	BKONE	0	Bookmobile One			https://www.tpl.ca/bc												NL										
16	15	BKTWO	0	Bookmobile Two			https://www.tpl.ca/bc												NL										

- From Pro's **Analysis** tab, click **Tools**.

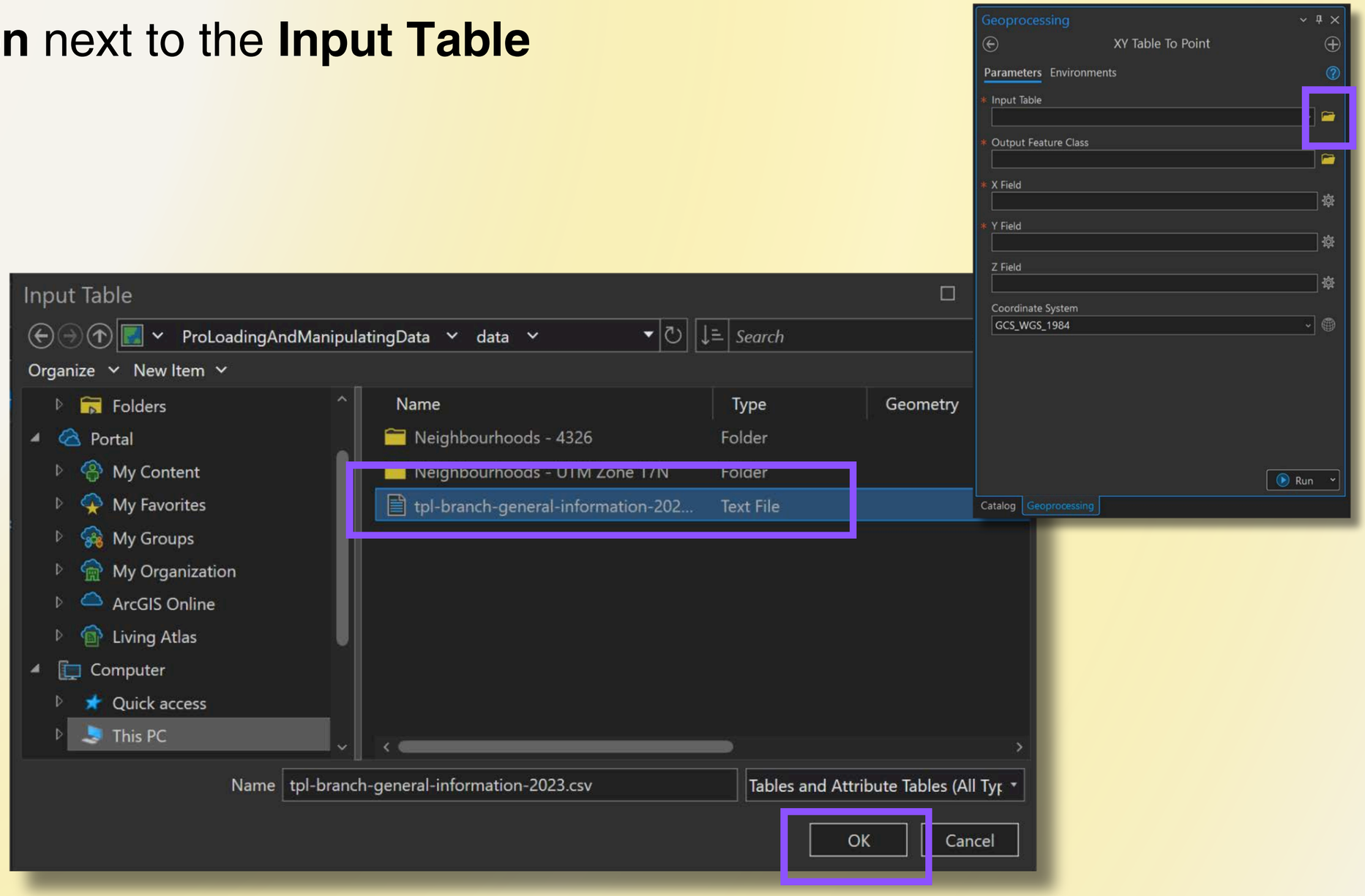


- The **Geoprocessing** pane will open.
- In the search bar, start typing '***xy table to point***'.
- Click the first search result to open the tool.



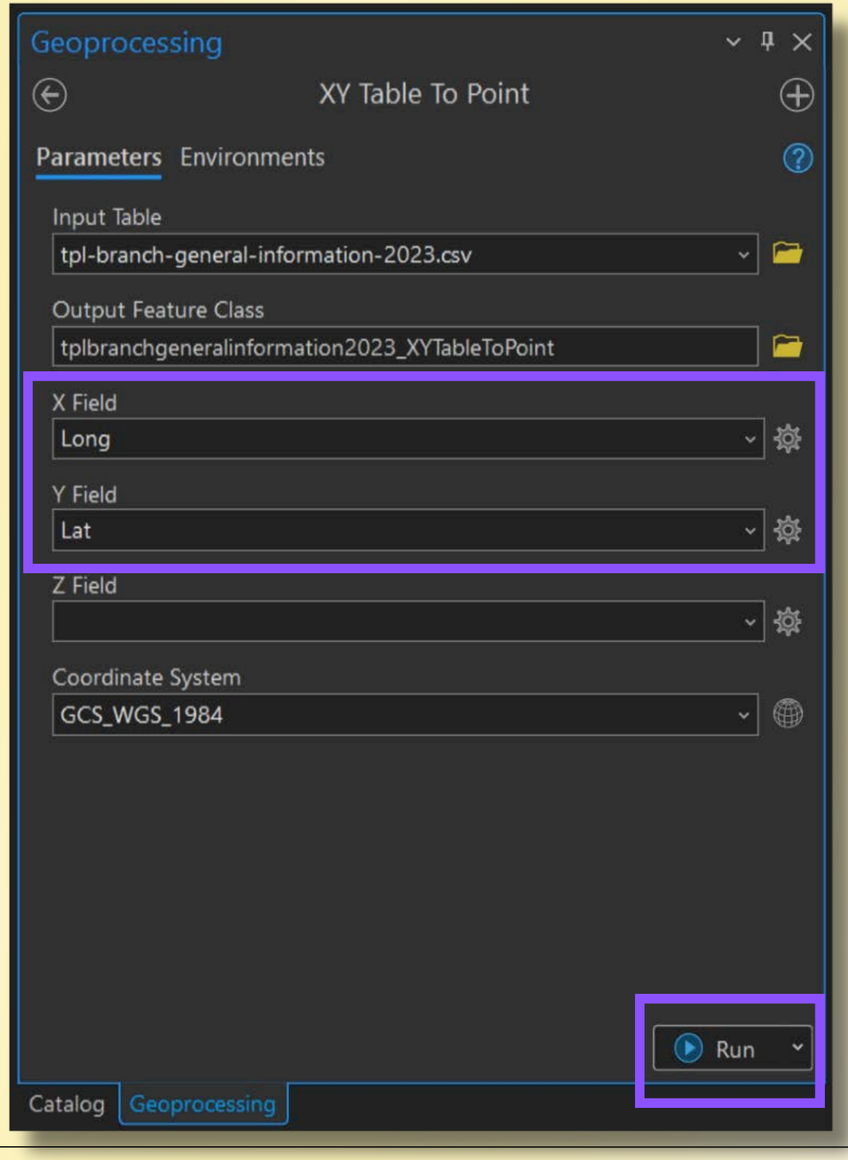
- Click the **folder icon** next to the **Input Table** input box.

- Navigate to the CSV file. Select the file and click **OK**.

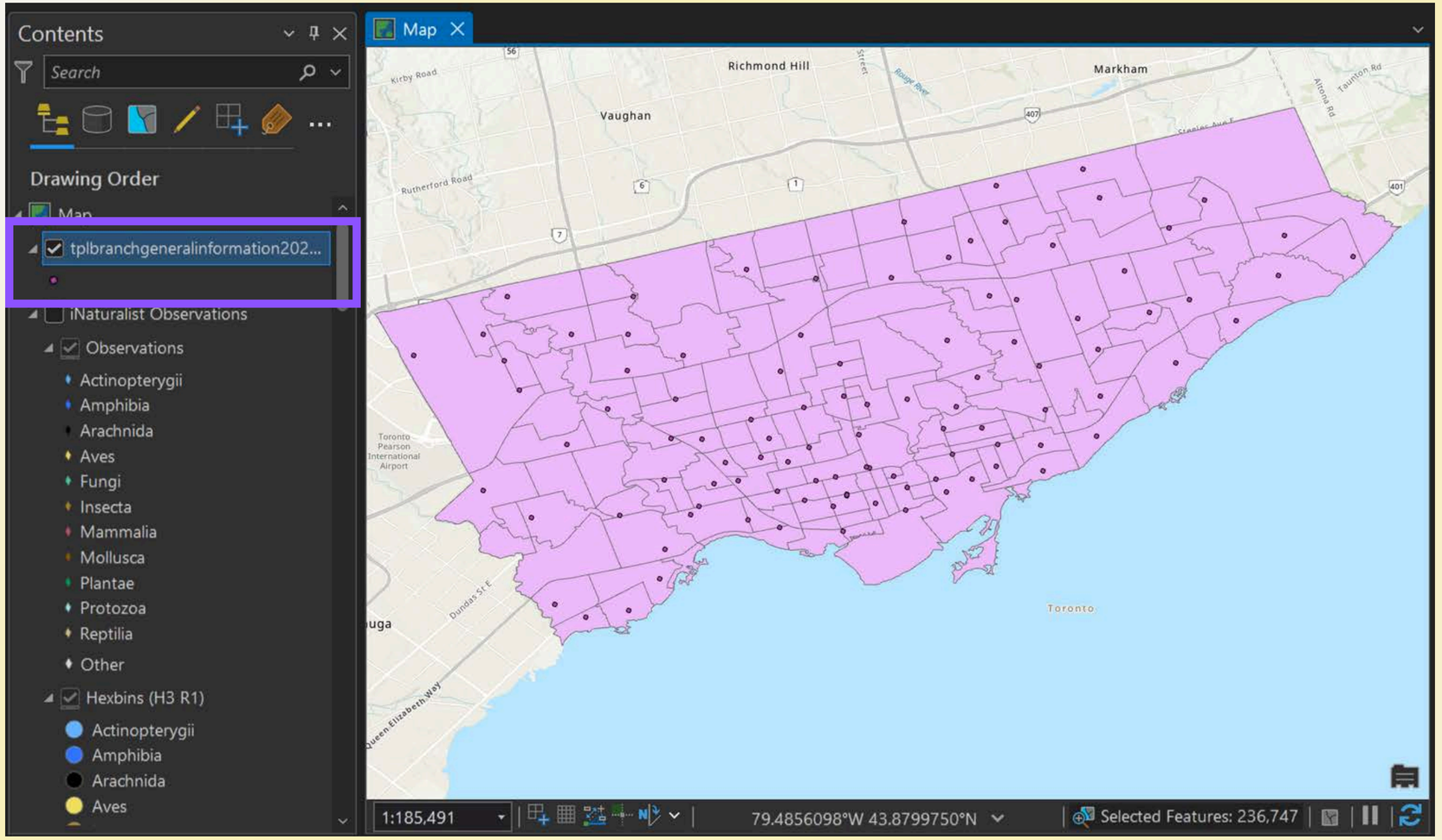


- Select **Long** from the **X Field** dropdown and **Lat** for the **Y Field** dropdown (if these don’t automatically populate).

- Click **Run**.

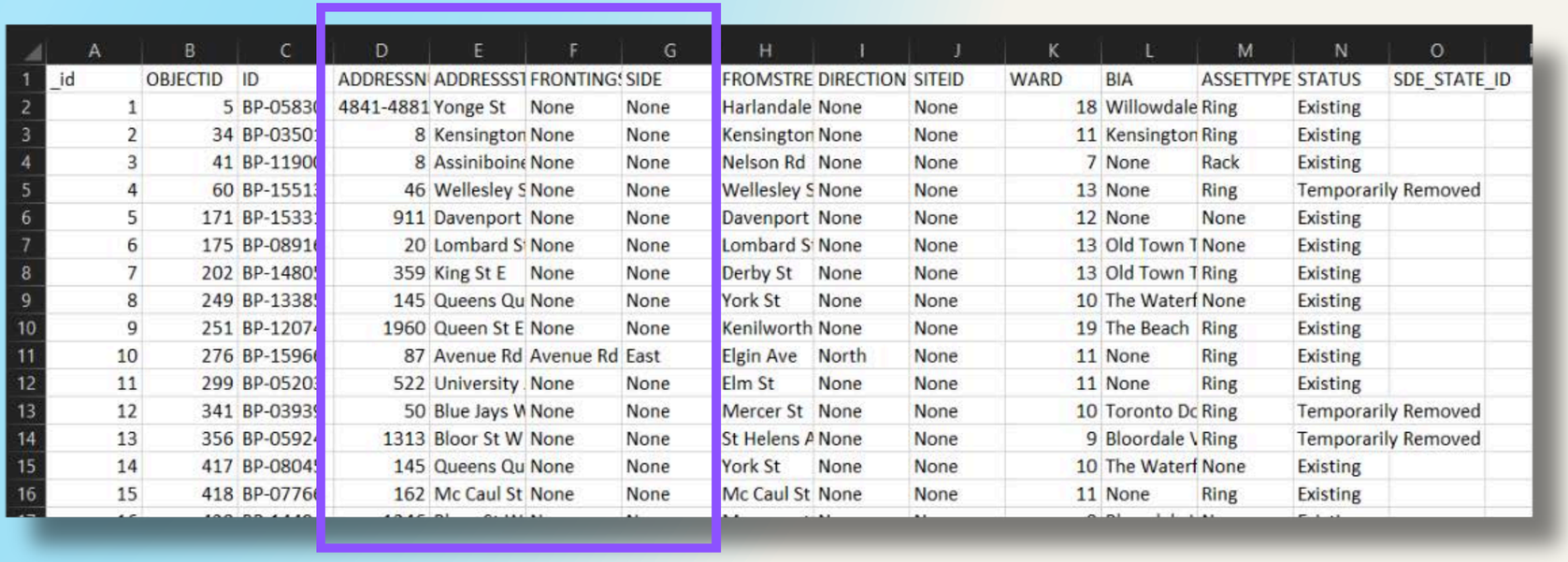


- A new layer showing library locations has been added to the map.



Add data from a spreadsheet: Geocoding

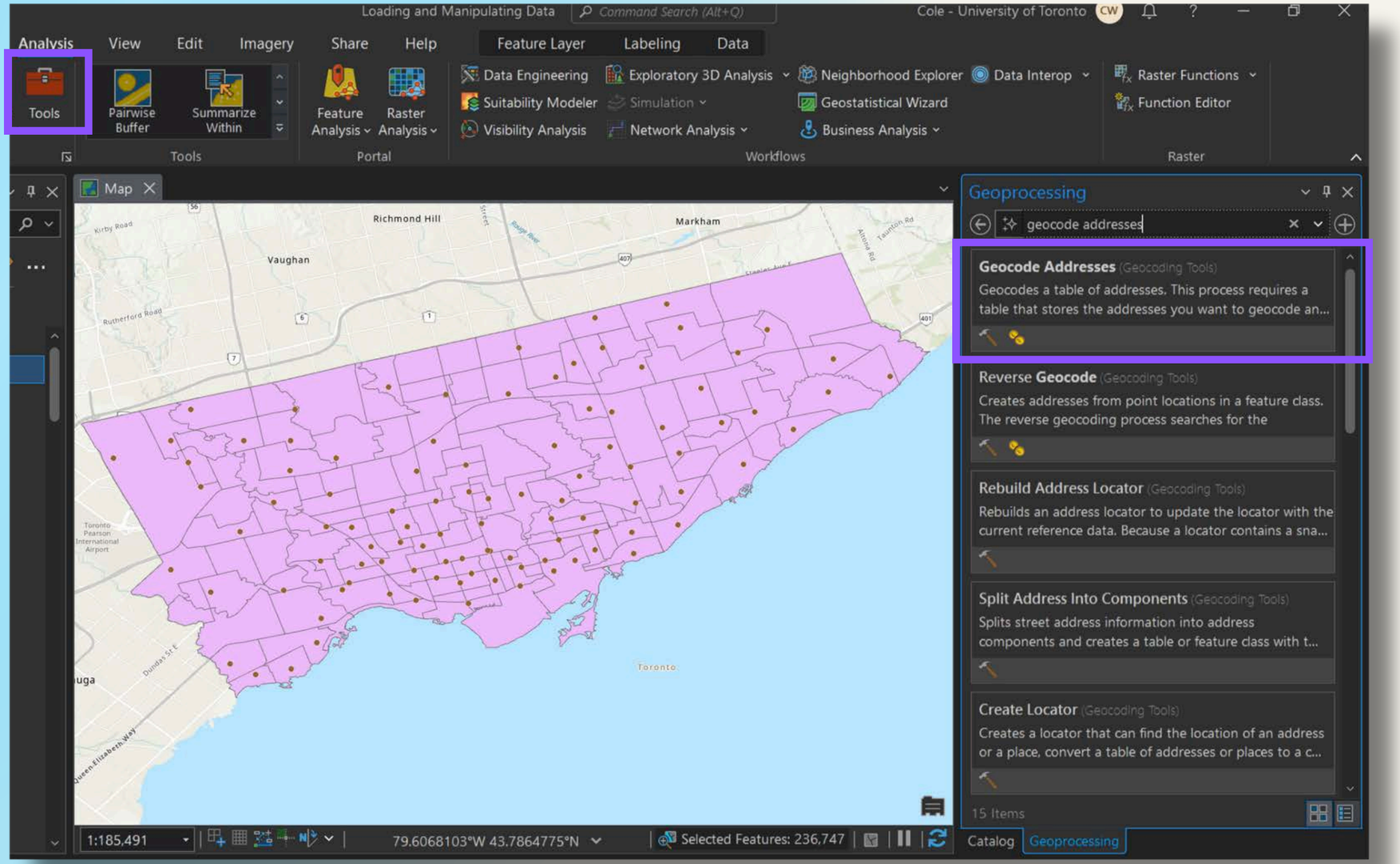
- Review the **Street furniture-Bicycle parking data - 4326.csv** file from the sample data in Excel.
- Note that this dataset contains no lat/long information; however, it **does** include **columns with street address** information.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	_id	OBJECTID	ID	ADDRESSN	ADDRESSST	FRONTING	SIDE	FROMSTRE	DIRECTION	SITEID	WARD	BIA	ASSETTYPE	STATUS	SDE_STATE_ID
2	1	5	BP-0583	4841-4881	Yonge St	None	None	Harlandale	None	None	18	Willowdale	Ring	Existing	
3	2	34	BP-0350	8	Kensington	None	None	Kensington	None	None	11	Kensington	Ring	Existing	
4	3	41	BP-1190	8	Assiniboine	None	None	Nelson Rd	None	None	7	None	Rack	Existing	
5	4	60	BP-1551	46	Wellesley S	None	None	Wellesley S	None	None	13	None	Ring	Temporarily Removed	
6	5	171	BP-1533	911	Davenport	None	None	Davenport	None	None	12	None	None	Existing	
7	6	175	BP-0891	20	Lombard S	None	None	Lombard S	None	None	13	Old Town T	None	Existing	
8	7	202	BP-1480	359	King St E	None	None	Derby St	None	None	13	Old Town T	Ring	Existing	
9	8	249	BP-1338	145	Queens Qu	None	None	York St	None	None	10	The Waterf	None	Existing	
10	9	251	BP-1207	1960	Queen St E	None	None	Kenilworth	None	None	19	The Beach	Ring	Existing	
11	10	276	BP-1596	87	Avenue Rd	Avenue Rd	East	Elgin Ave	North	None	11	None	Ring	Existing	
12	11	299	BP-0520	522	University	None	None	Elm St	None	None	11	None	Ring	Existing	
13	12	341	BP-0393	50	Blue Jays W	None	None	Mercer St	None	None	10	Toronto Dc	Ring	Temporarily Removed	
14	13	356	BP-0592	1313	Bloor St W	None	None	St Helens A	None	None	9	Bloordale V	Ring	Temporarily Removed	
15	14	417	BP-0804	145	Queens Qu	None	None	York St	None	None	10	The Waterf	None	Existing	
16	15	418	BP-0776	162	Mc Caul St	None	None	Mc Caul St	None	None	11	None	Ring	Existing	

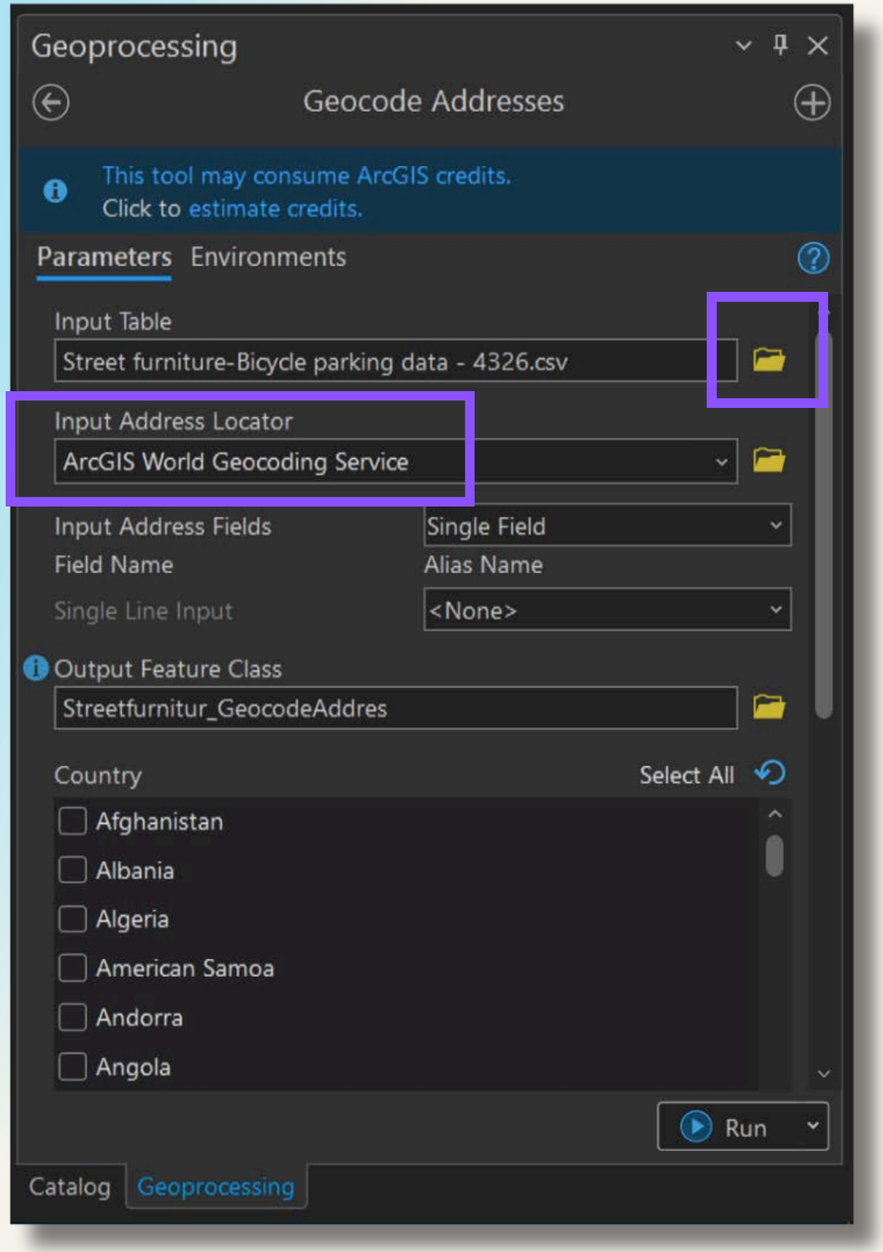
- Open the **Geoprocessing** pane by clicking the **Tools** button (**Analysis** tab)

- Search for and open the **Geocode Addresses** tool



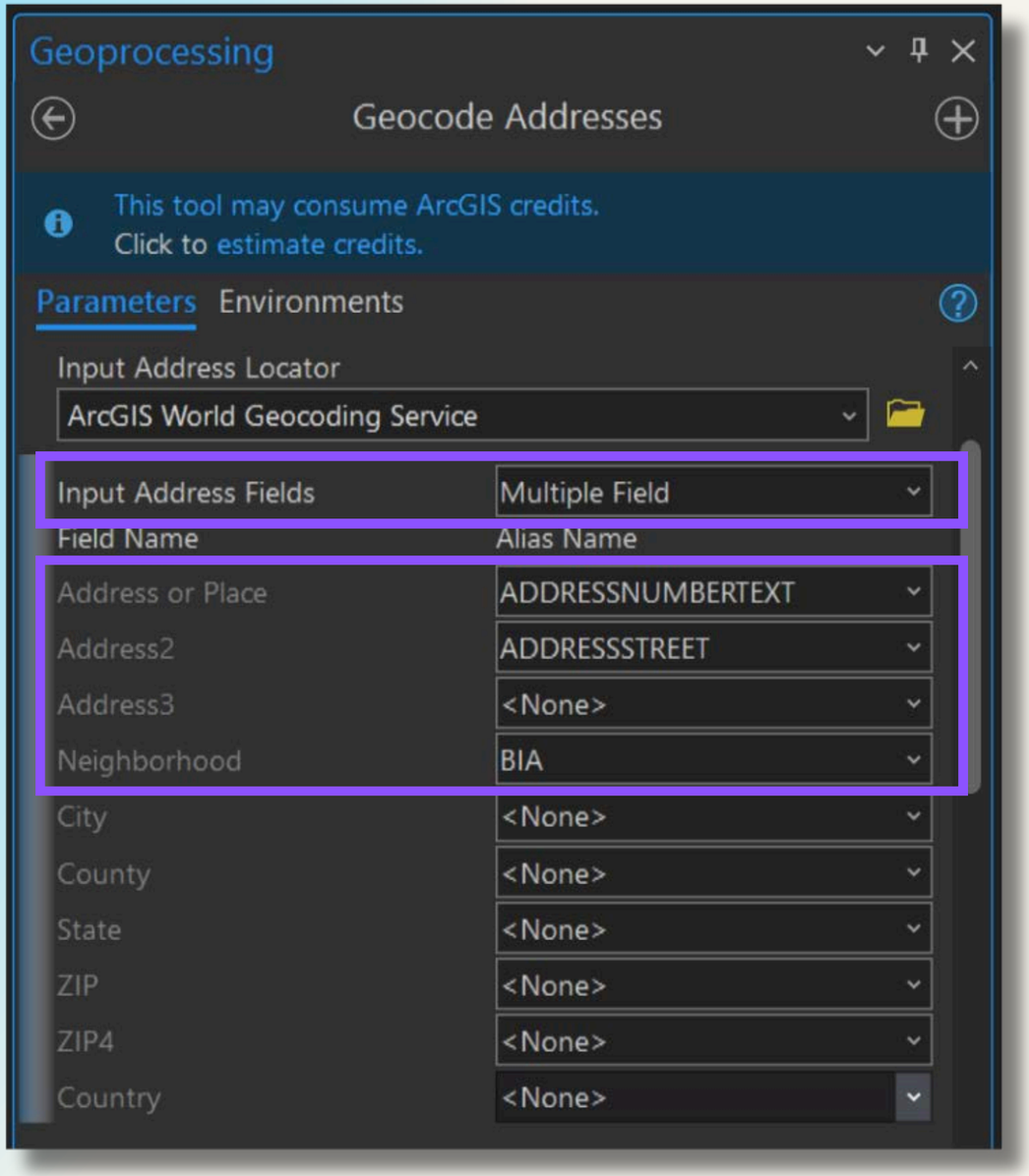
- Provide the **Input Table** parameter by clicking the **folder icon** and navigating to the bicycle parking csv file.

- For the **Input Address Locator** parameter, select **ArcGIS World Geocoding Service** from the dropdown.

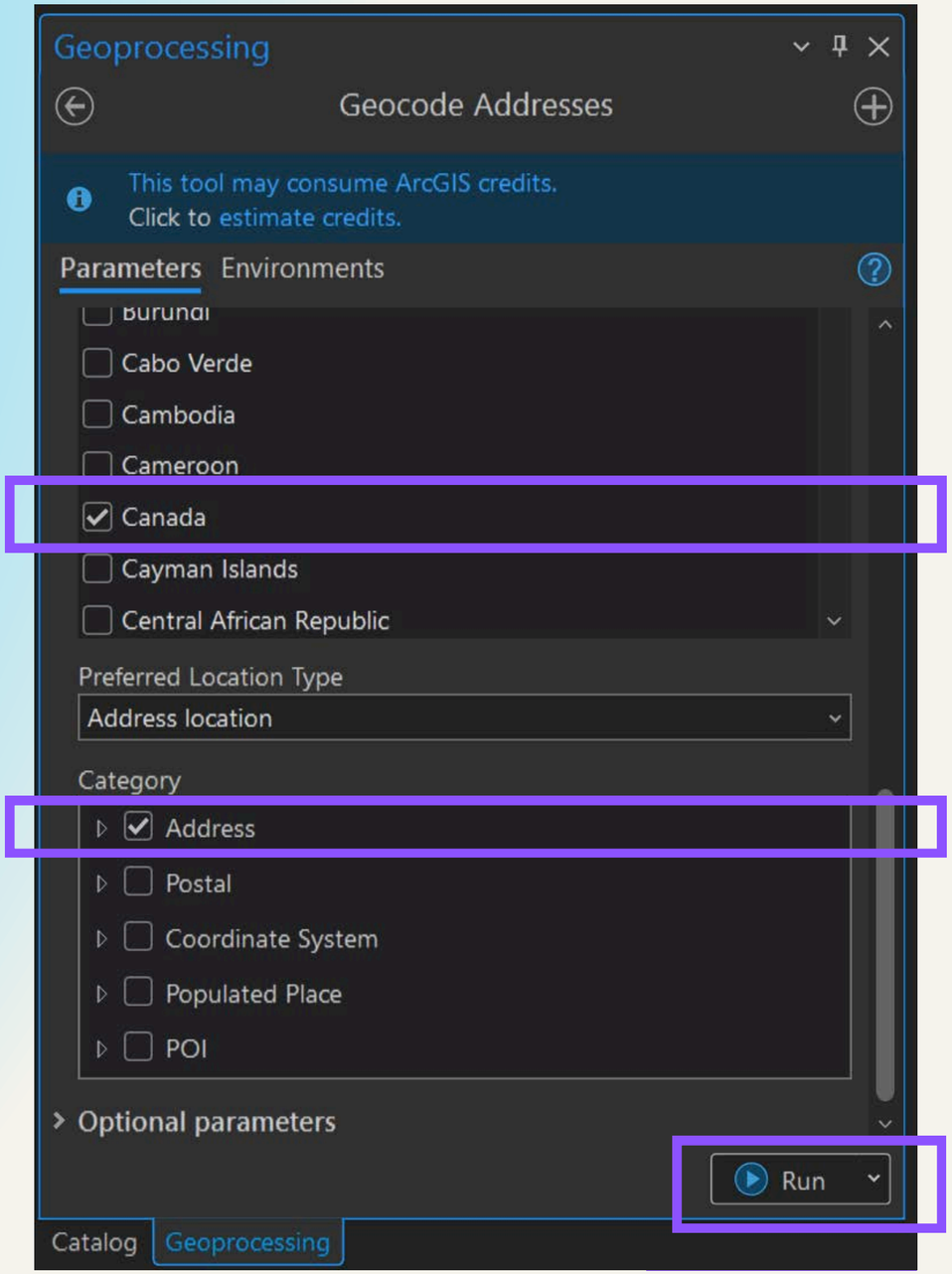


- Select **Multiple Field** for the **Input Address Fields** parameter.

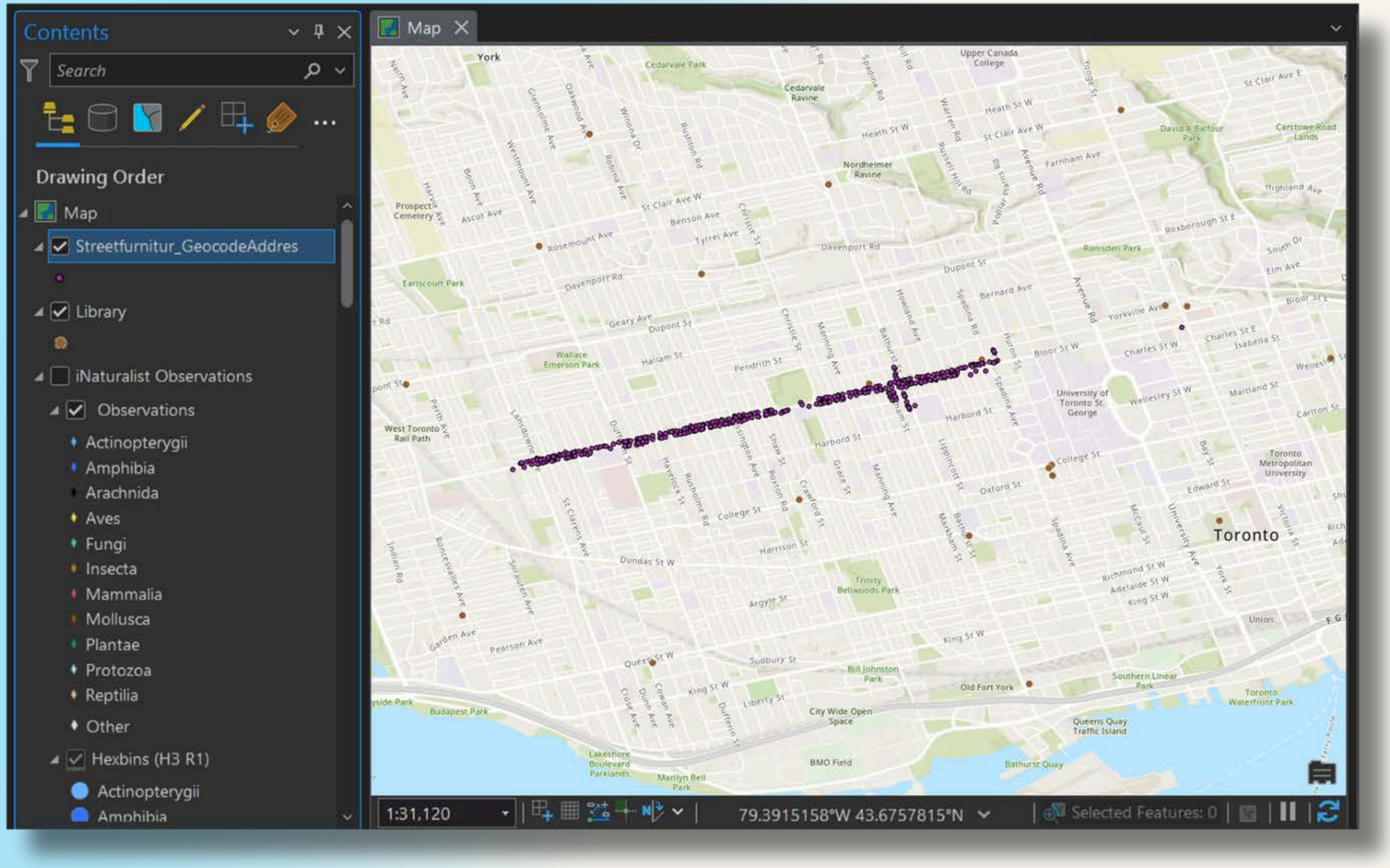
- Referring to the names of the spreadsheet columns, provide values for the **Address or Place**, **Address2**, and **Neighborhood** parameters.



- Check **Canada** for the **Country**.
- Leave the **Preferred Location Type** as **Address location.**
- Select **Address** for the **Category**.
- Click **Run**.

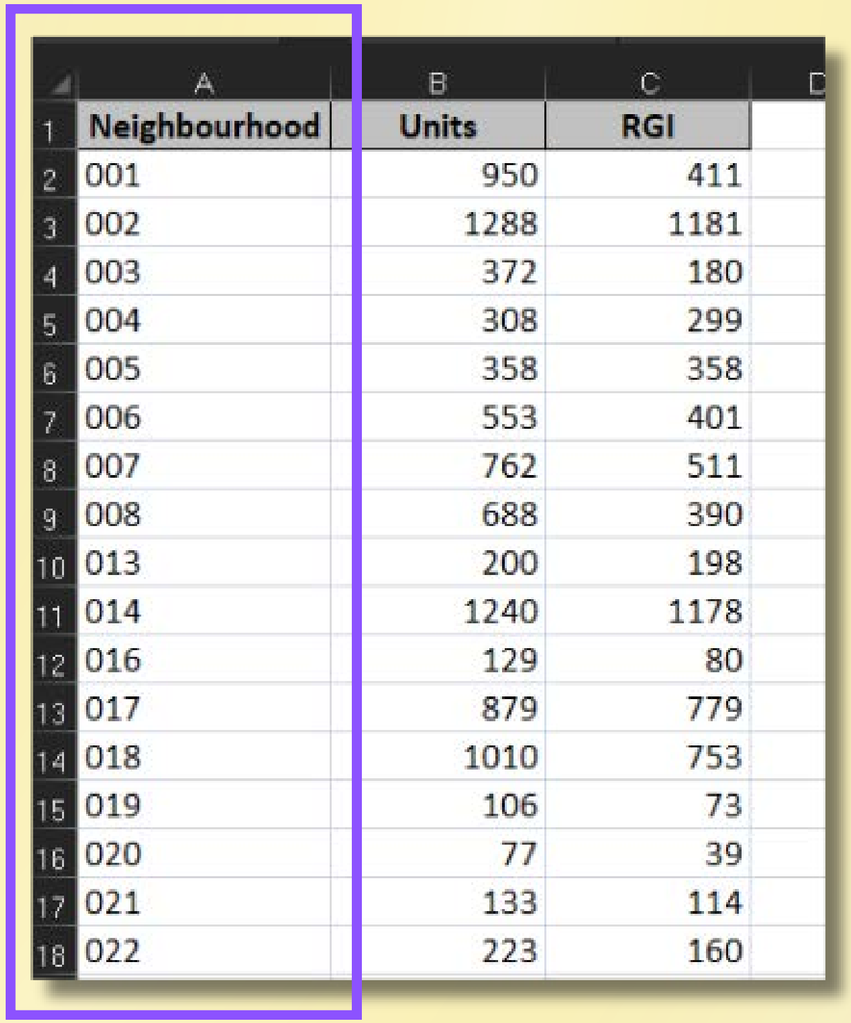


- Result: the software will attempt to look up locations for each address provided.



Add data from a spreadsheet: Attribute Join

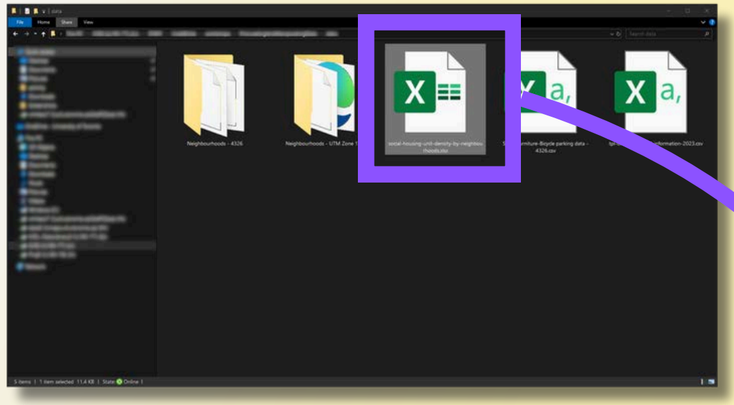
- Review the **socialhousing.csv** file in the sample data folder.
- This dataset details social housing unit density exist **per Toronto neighbourhood**. Neighbourhoods are identified by a **unique ID number**.
- It also lists how many of these units are geared-to-income (RGI).

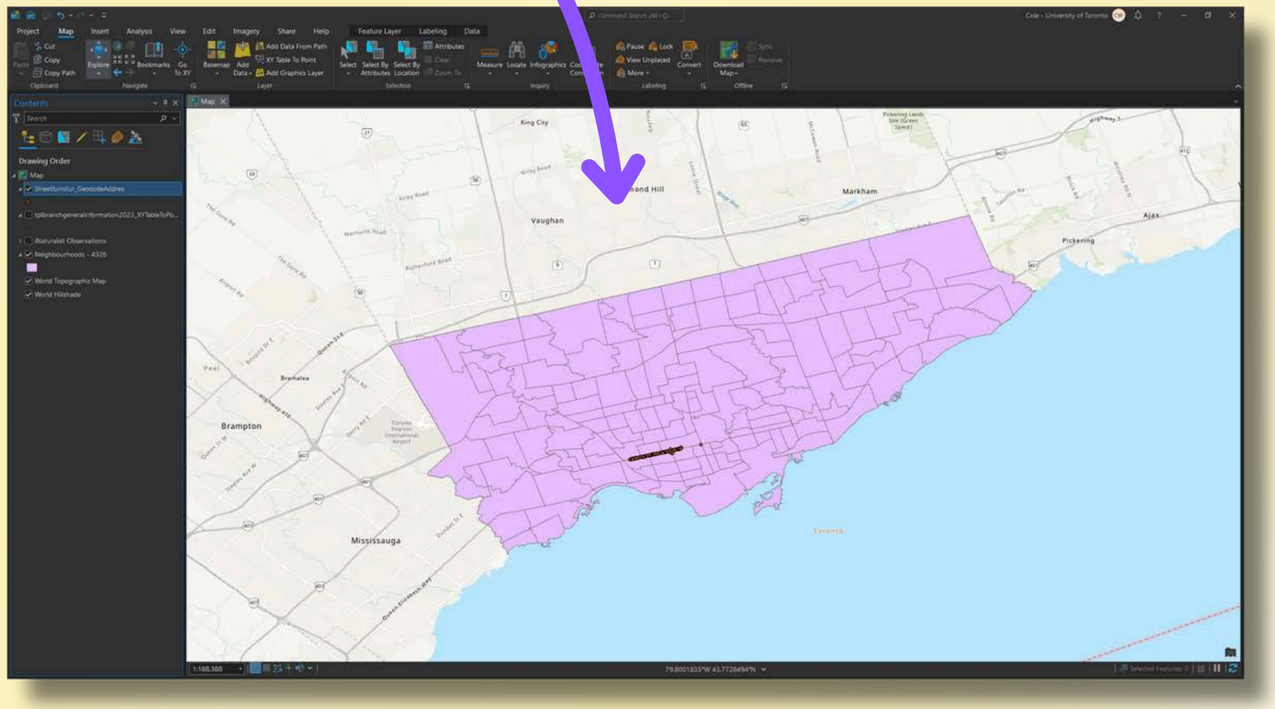


	A	B	C
1	Neighbourhood	Units	RGI
2	001	950	411
3	002	1288	1181
4	003	372	180
5	004	308	299
6	005	358	358
7	006	553	401
8	007	762	511
9	008	688	390
10	013	200	198
11	014	1240	1178
12	016	129	80
13	017	879	779
14	018	1010	753
15	019	106	73
16	020	77	39
17	021	133	114
18	022	223	160

Add data from a spreadsheet: Attribute Join

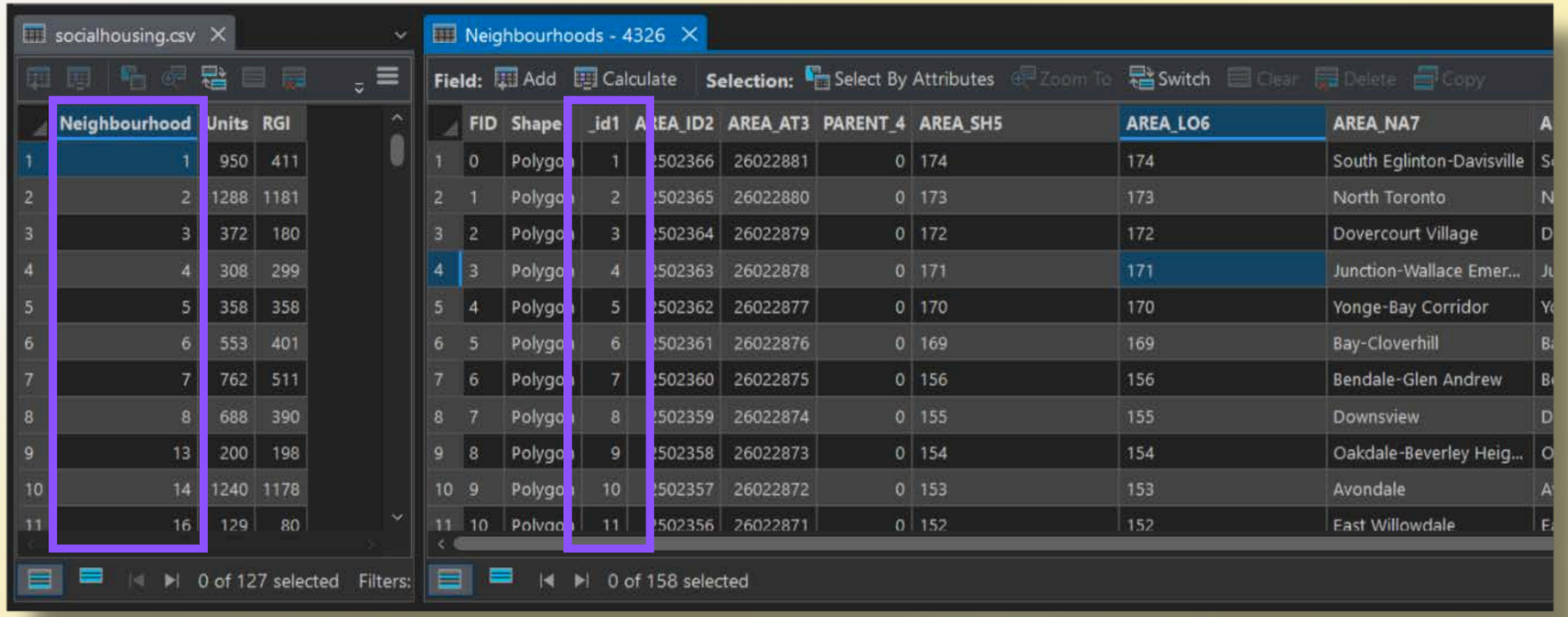
- Add the **socialhousing.csv** file to the map.
- Use the **Add Data** button, or simply **drag and drop** the file from Windows Explorer into the map view.





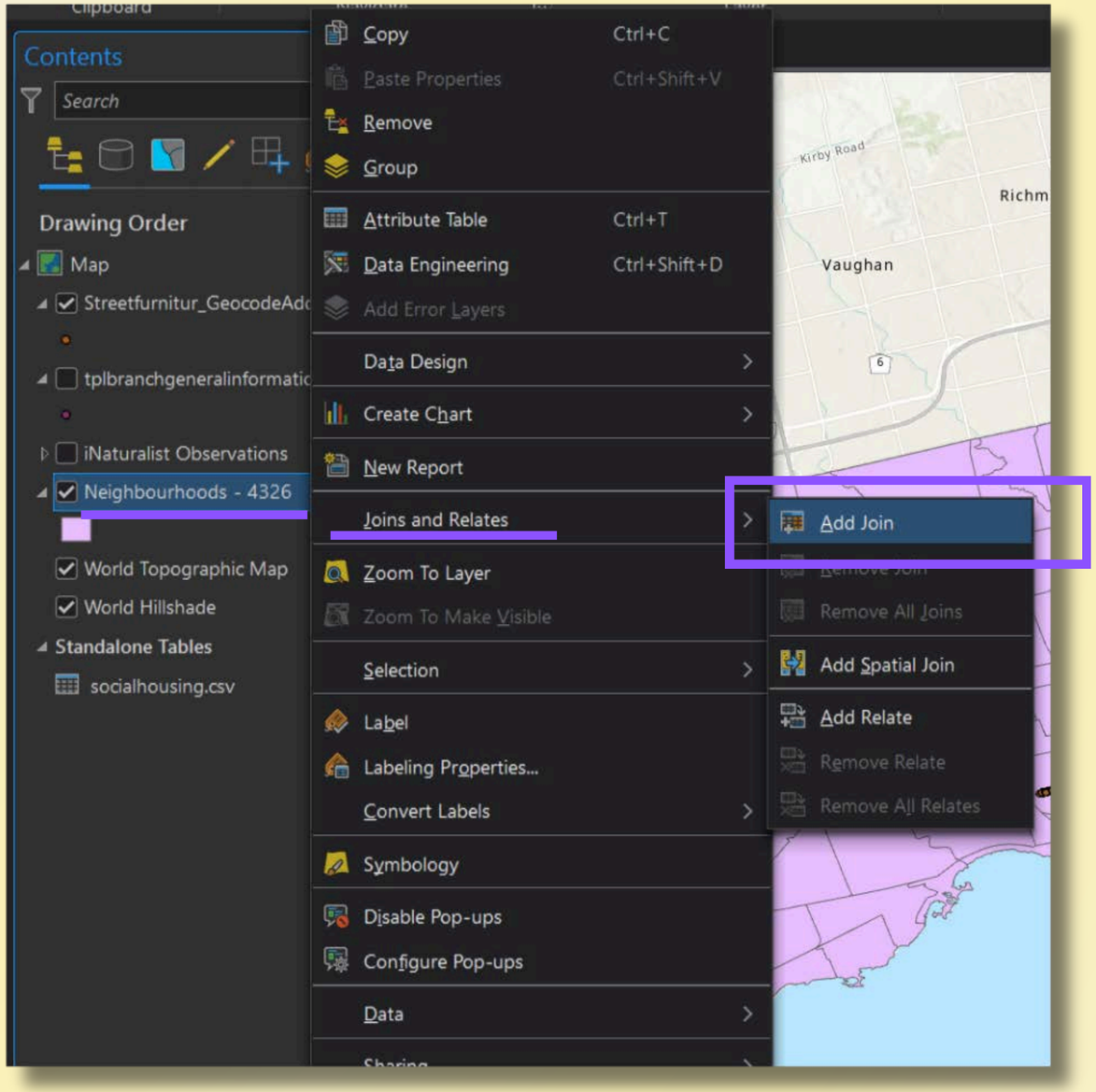
Add data from a spreadsheet: Attribute Join

- Recall that the Neighbourhoods layer also contains an ID for each neighbourhood in its attribute table.
- We can **join** the housing data to the neighbourhood polygons by matching these IDs.



Add data from a spreadsheet: Attribute Join

- Right-click the **Neighbourhoods** layer in the Contents pane.
- Choose **Joins and Relates -> Add Join**

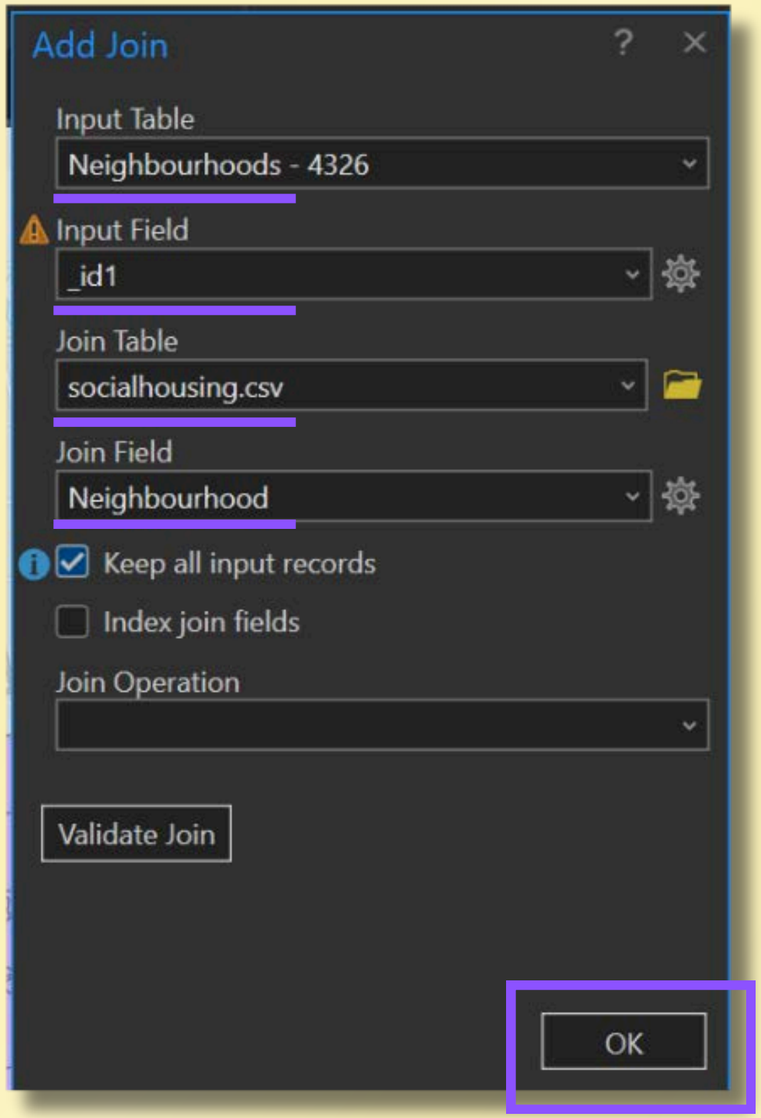


Add data from a spreadsheet: Attribute Join

Specify the following:

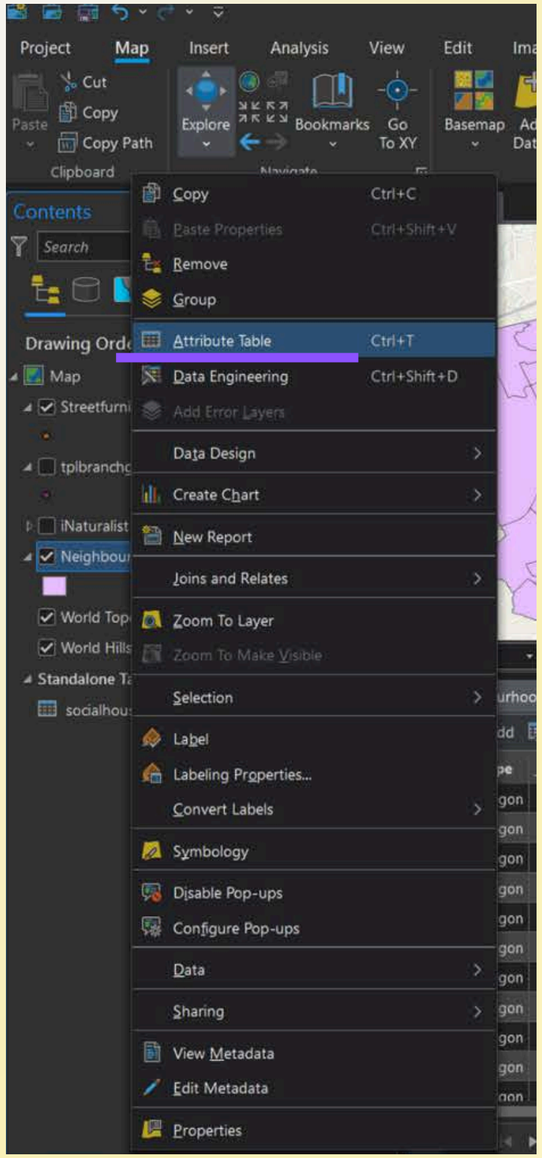
- Input Table: **Neighbourhoods - 4326**
- Input Field: **_id1**
- Join Table: **socialhousing.csv**
- Join Field: **Neighbourhood**

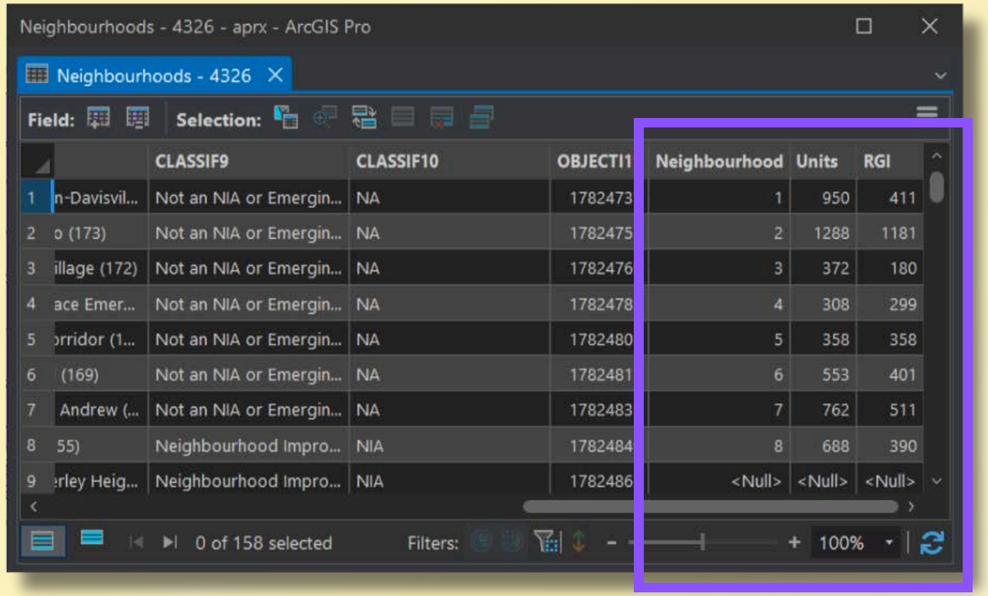
Click **OK**.



Add data from a spreadsheet: Attribute Join

- Open the Neighbourhoods layer's attribute table.
- Scroll to the far right.
- **Data from the csv has successfully been joined to the polygon layer.**



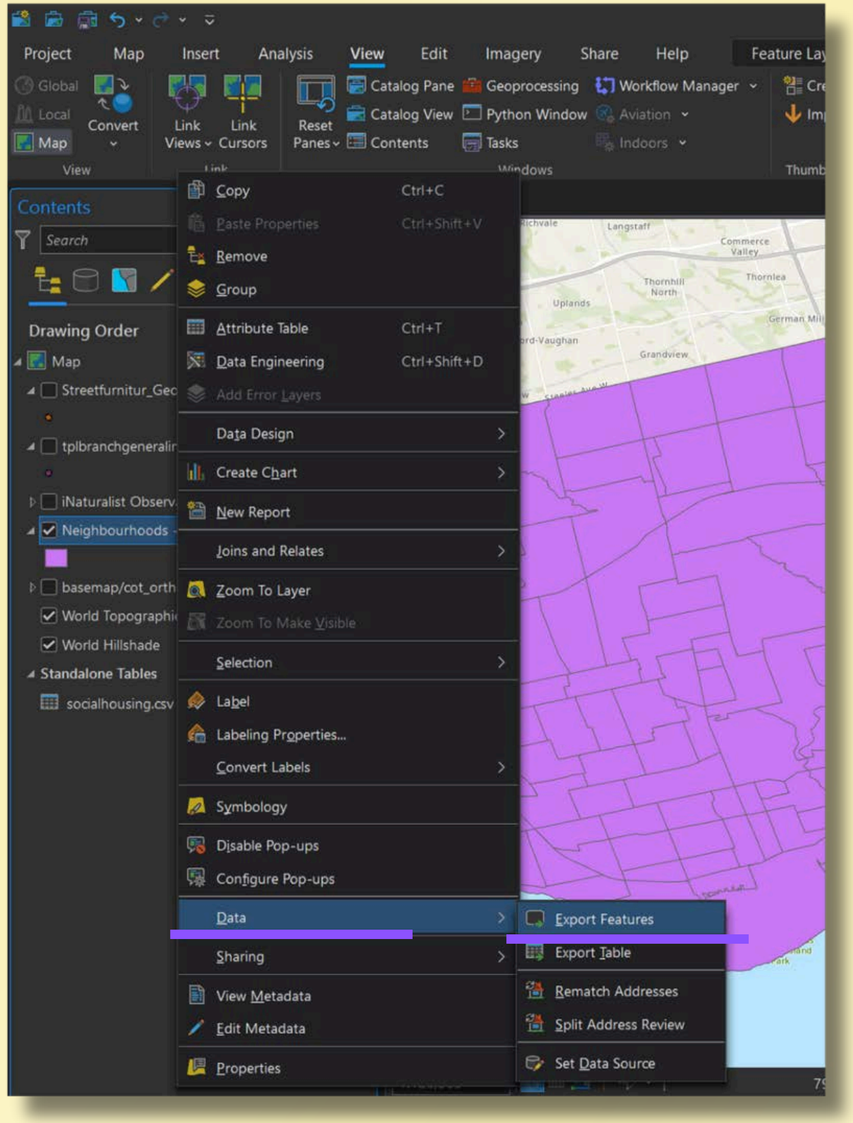


Joined data!

Add data from a spreadsheet: Attribute Join

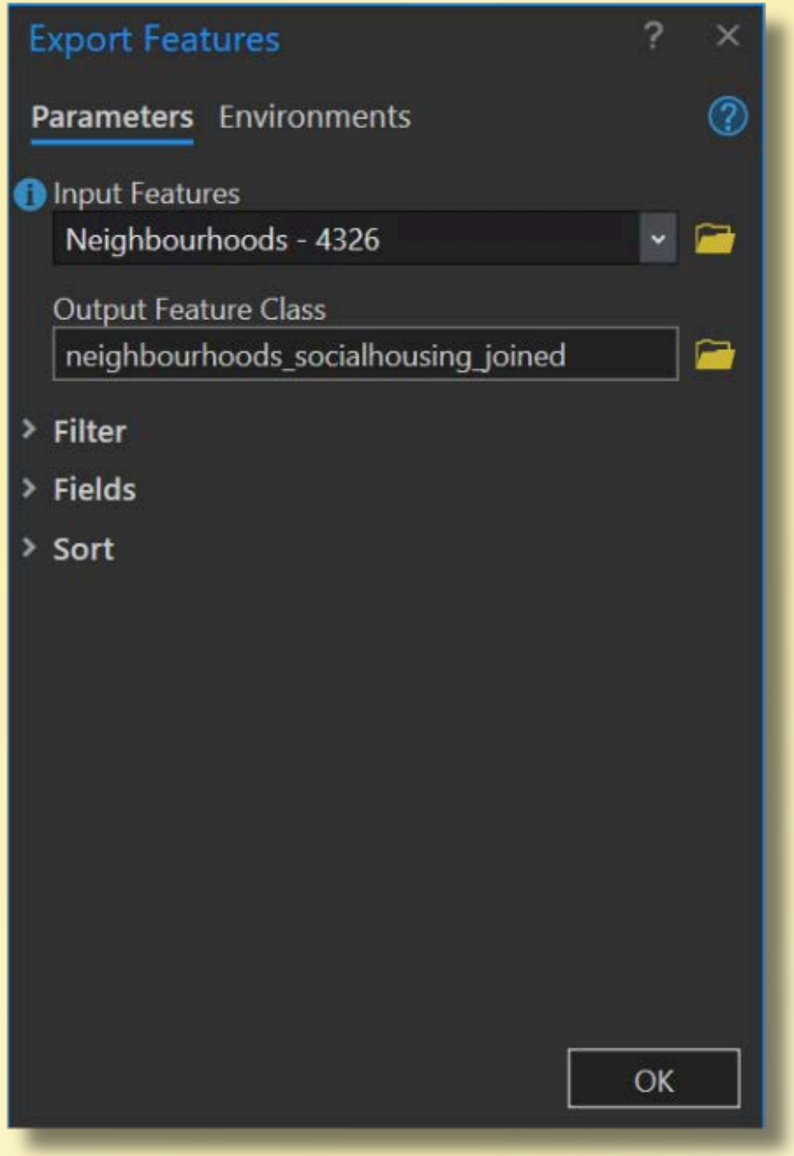
Export the layer to save a permanently-joined version of the data

- Right-click the layer name in the Contents pane
- From the menu, choose **Data -> Export Features**



Add data from a spreadsheet: Attribute Join

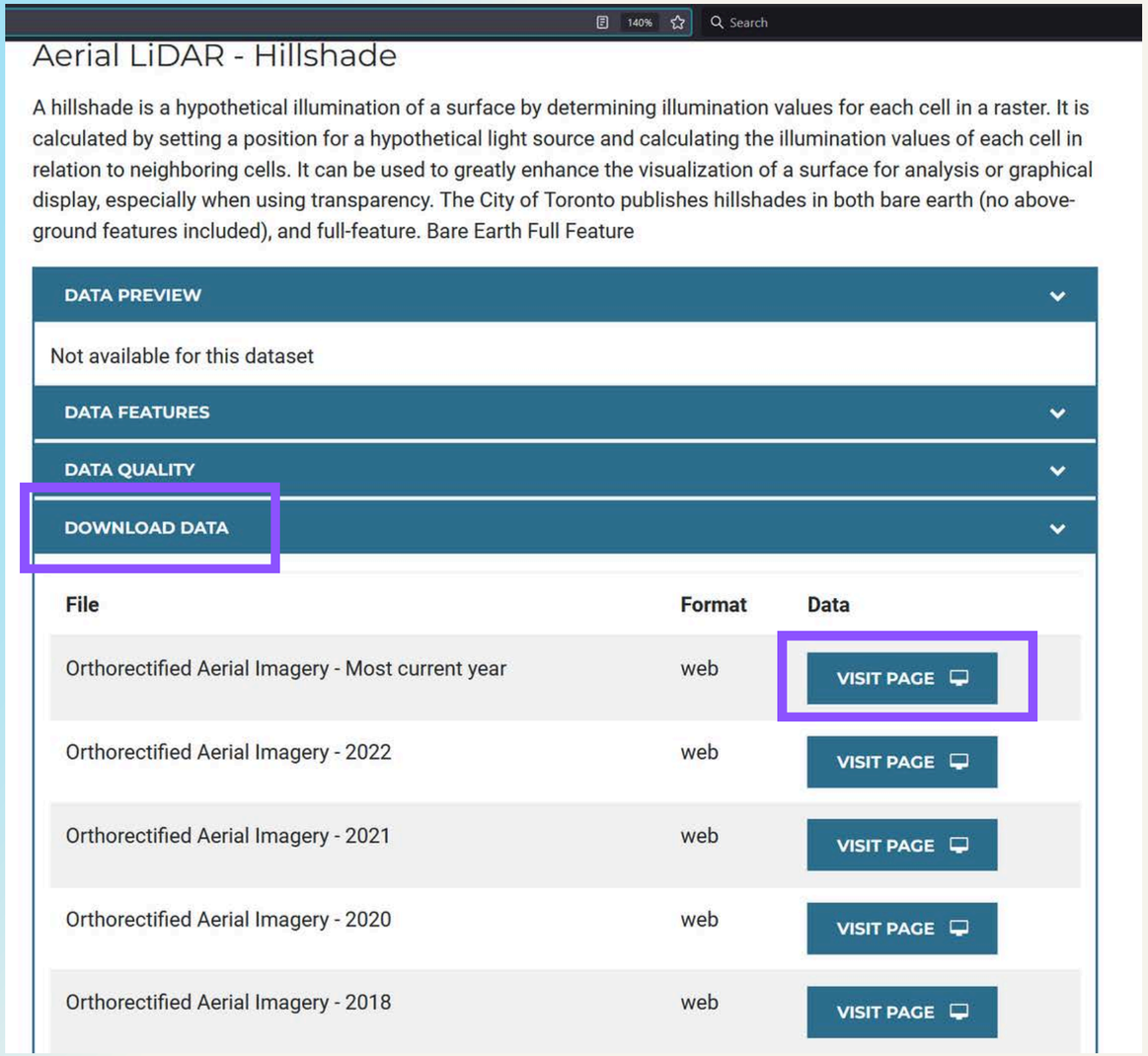
- The output layer will be saved in the project geodatabase by default.



Add data from a Web Service

Web services allow data to be shared from the internet.
To add a web service layer to Pro:

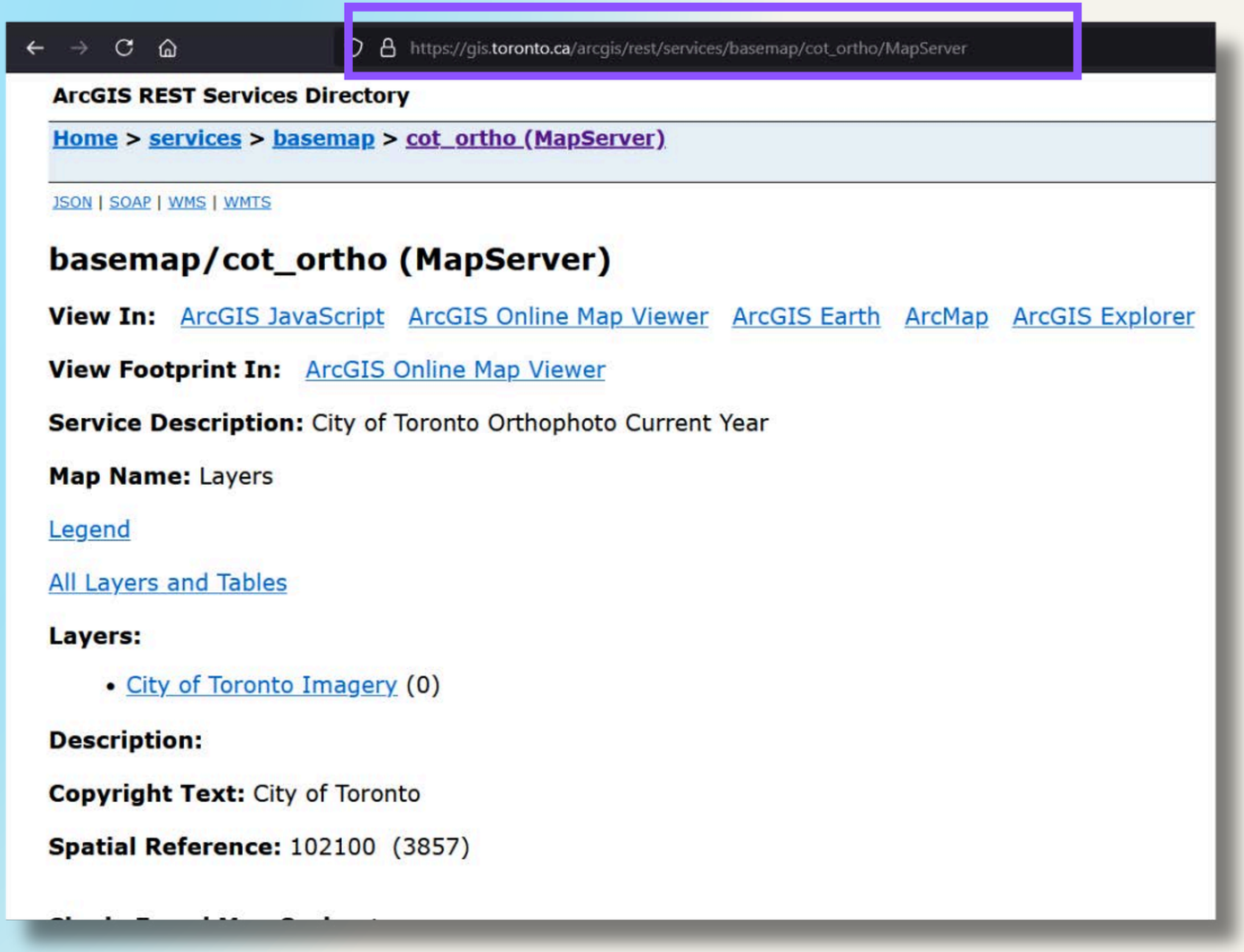
- Visit https://open.toronto.ca/dataset/web-map-services/
- Expand the **Download Data** section
- Click the **Visit Page** button next to the **Orthorectified Aerial Imagery - Most current year** item



Add data from a Web Service

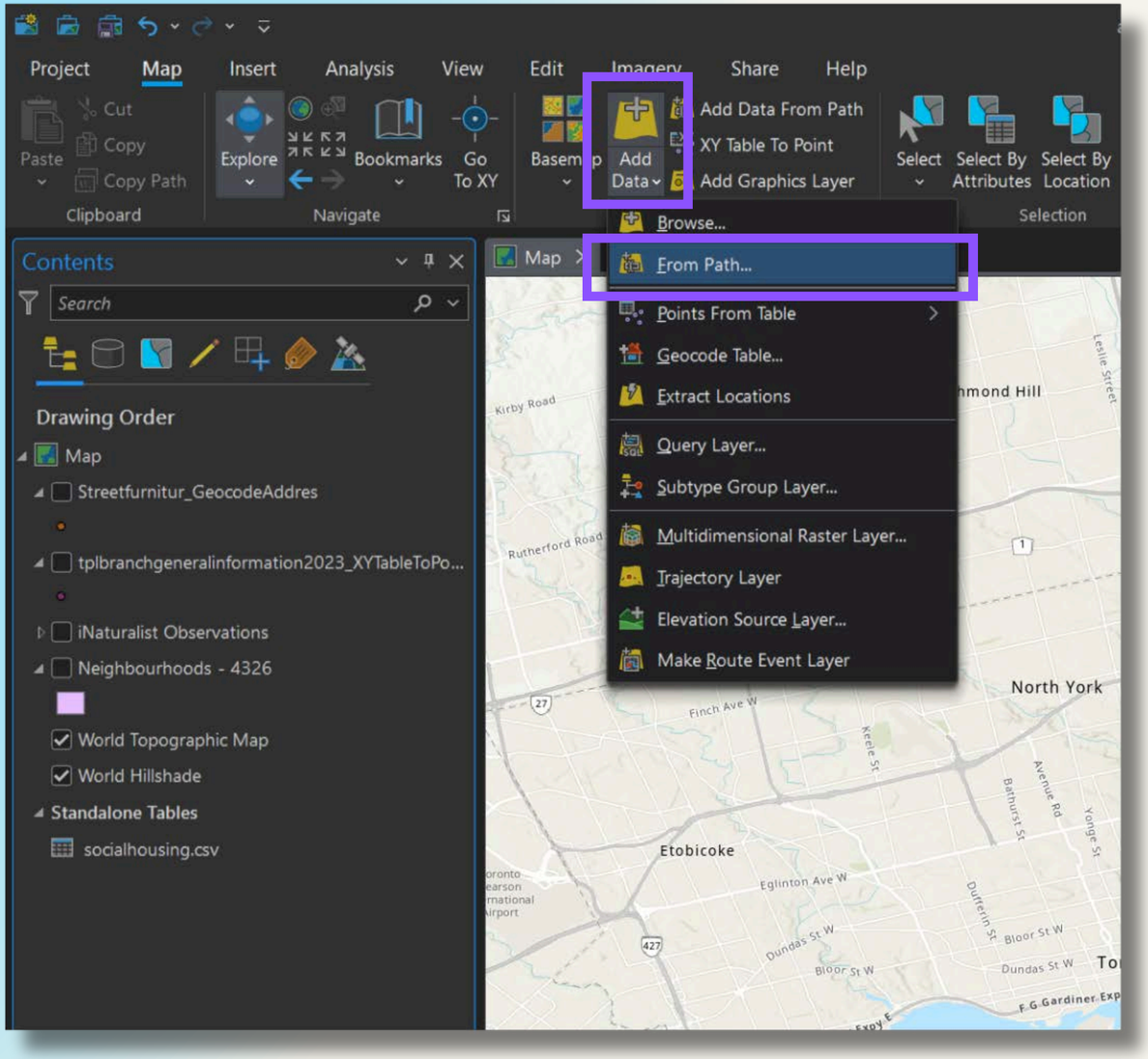
- Copy the URL (Ctrl + C)

https://gis.toronto.ca/arcgis/rest/services/basemap/cot_ortho/MapServer



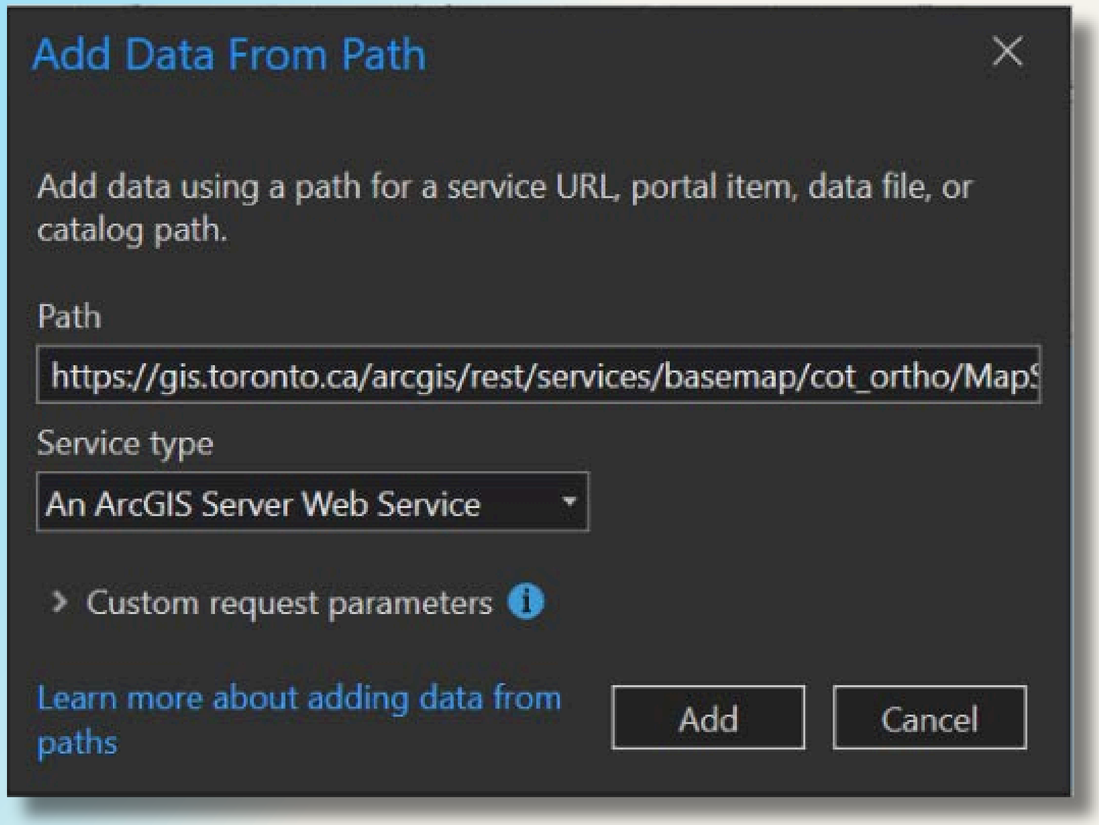
Add data from a Web Service

- In Pro, click the **Add Data** button (Map tab)
- Select **From Path...**



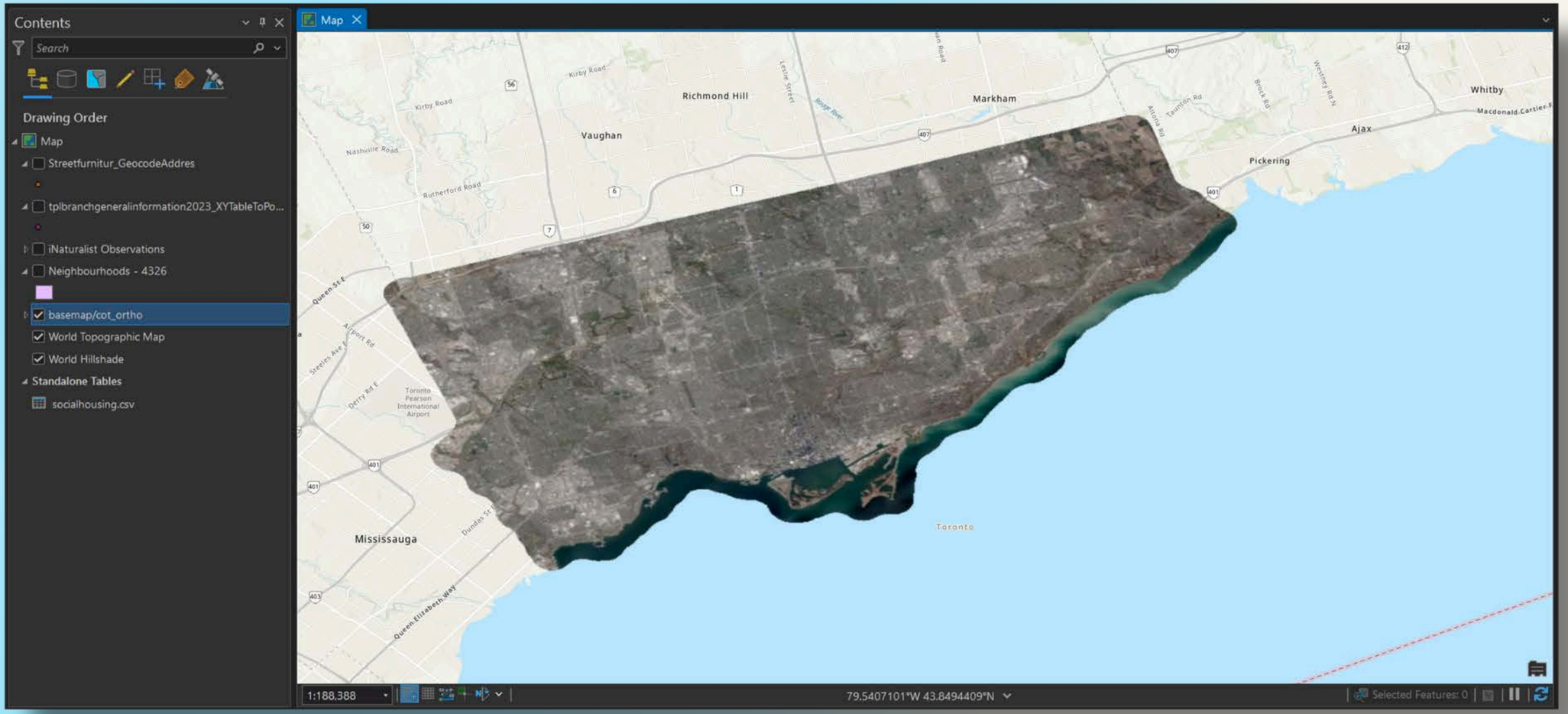
Add data from a Web Service

- Paste in the web service URL.
- Click Add.



Add data from a Web Service

- Result:



Symbology in ArcGIS Pro

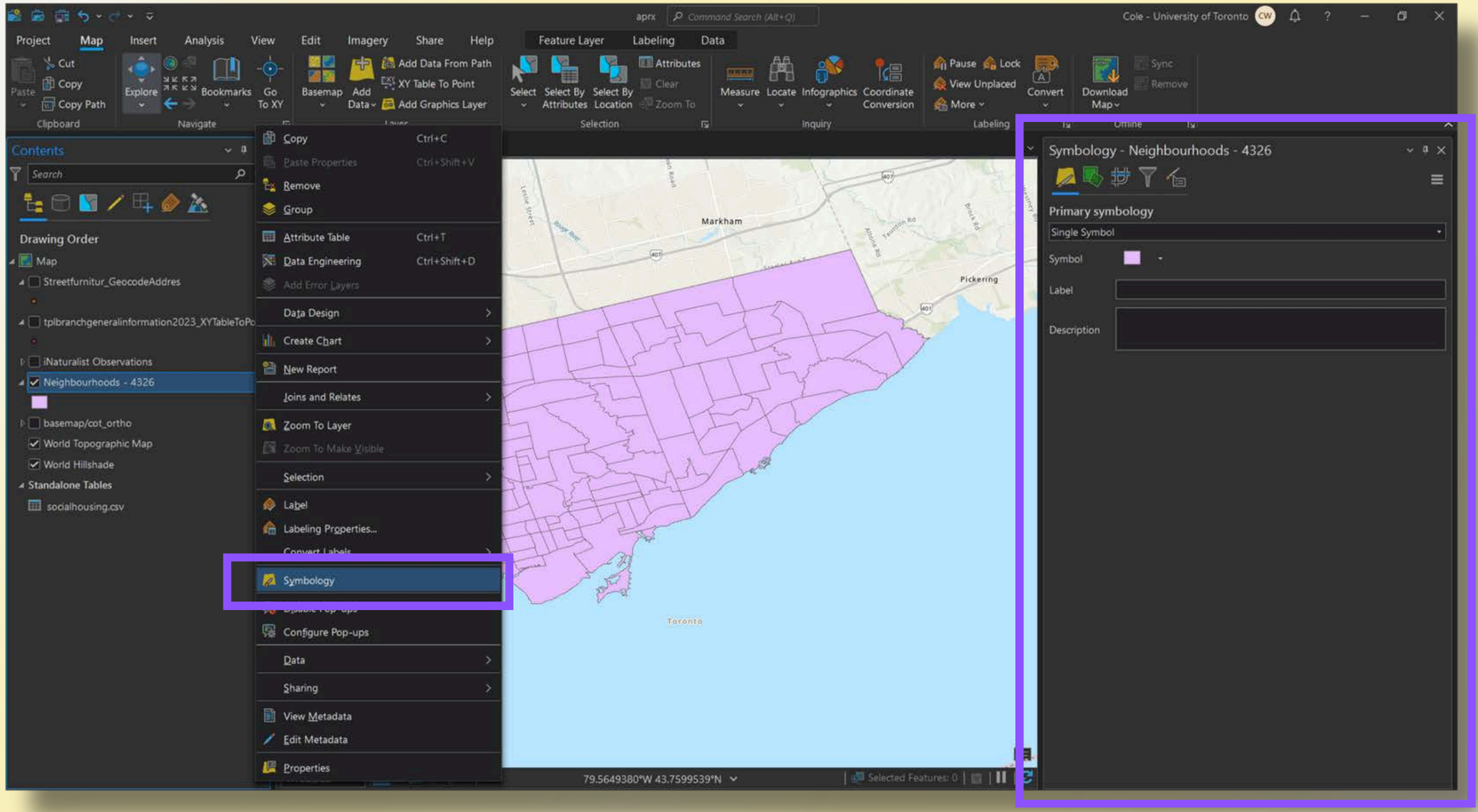
- Symbology involves the use of symbols to represent geographic features (and their attributes) on the map

- Effective symbology makes it easier for viewers to understand complex information.

Symbology in ArcGIS Pro

Access Pro's symbology options:

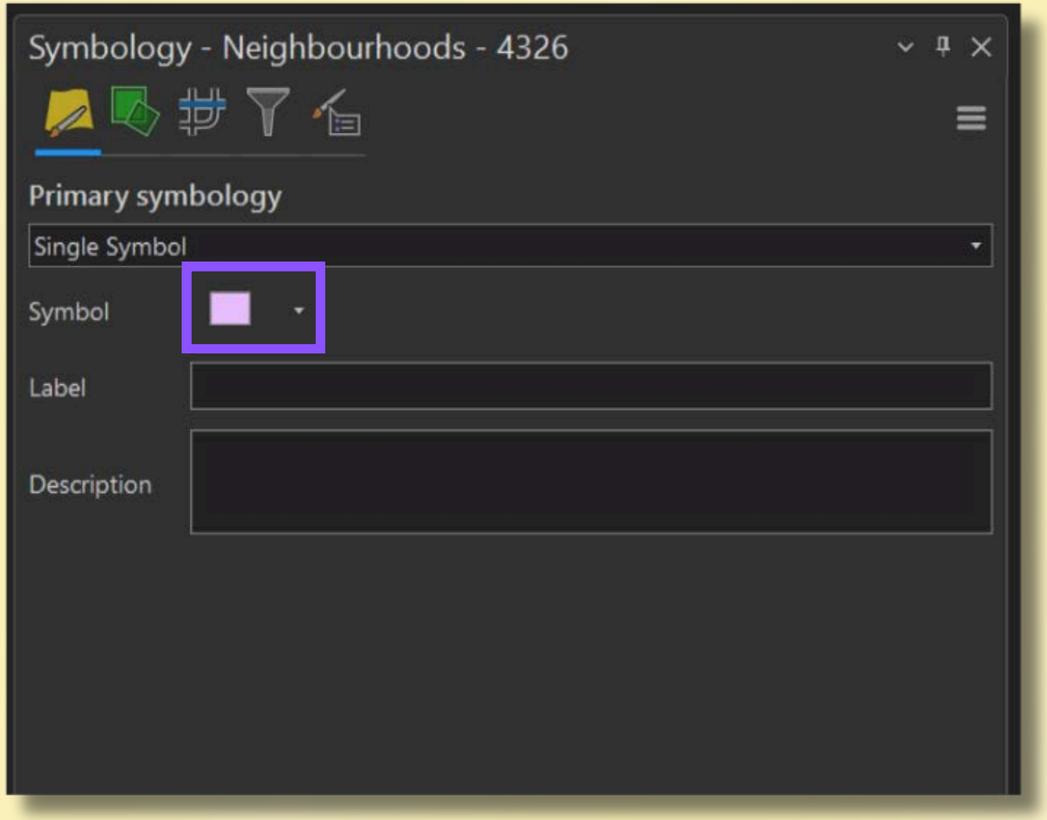
- Right-click on the **neighbourhoods_social housing_joined** layer in the Contents Pane
- Select **Symbology** from the pop-up menu
- The **Symbology Pane** will appear.



Symbology in ArcGIS Pro
Types of Symbology: Single Symbol

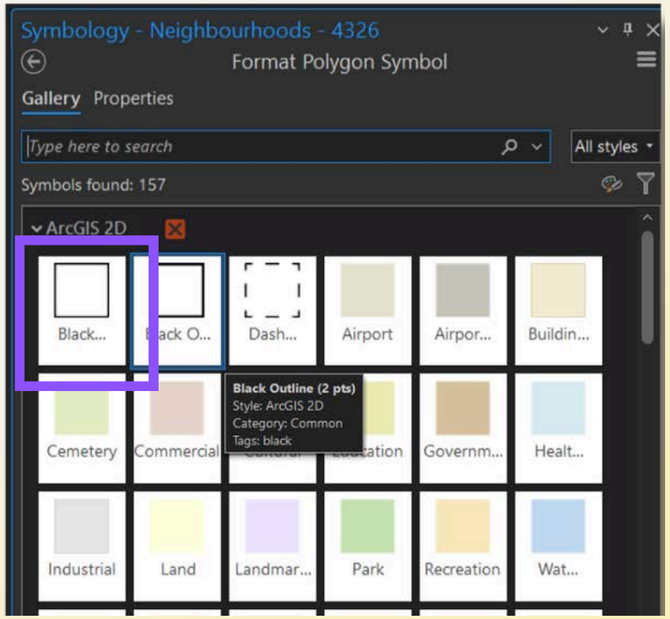
Single Symbol: All features in a layer are represented with the same symbol. Ideal for displaying features of the same type.

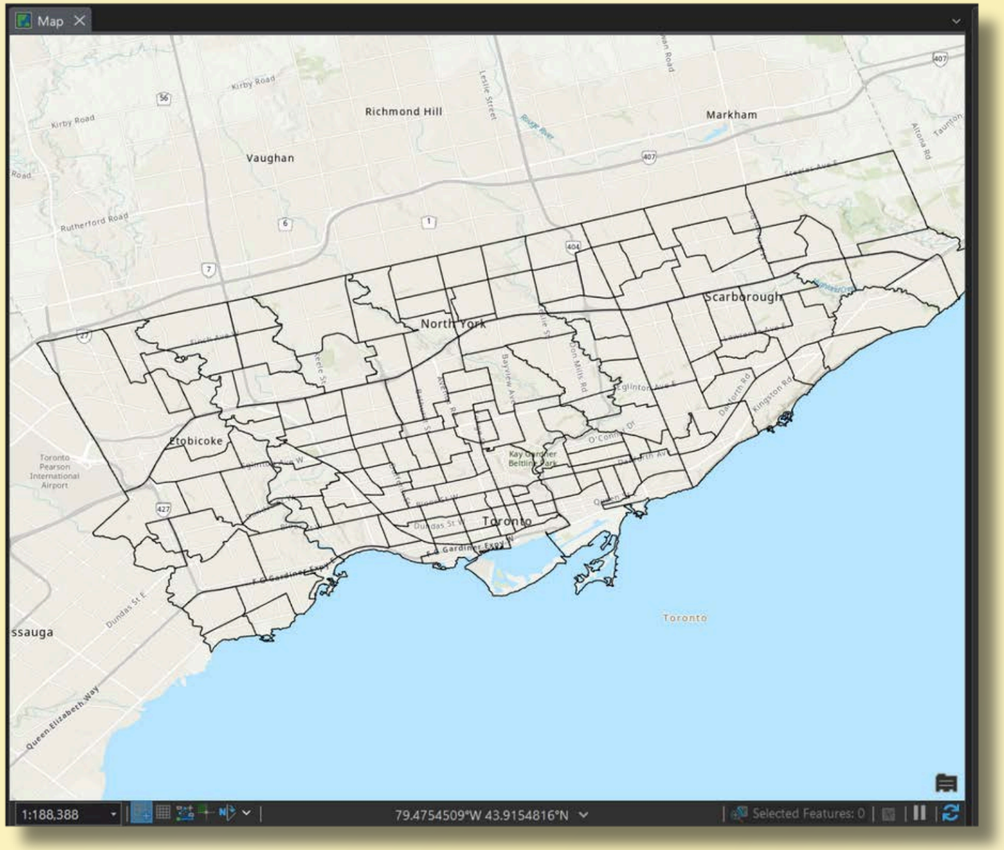
- The Neighbourhoods layer has this symbology style by default.
- To customize the symbology, click the symbol swatch on the Symbology pane.



Symbology in ArcGIS Pro
Types of Symbology: Single Symbol

- Choose **Black Outline** from the Gallery.

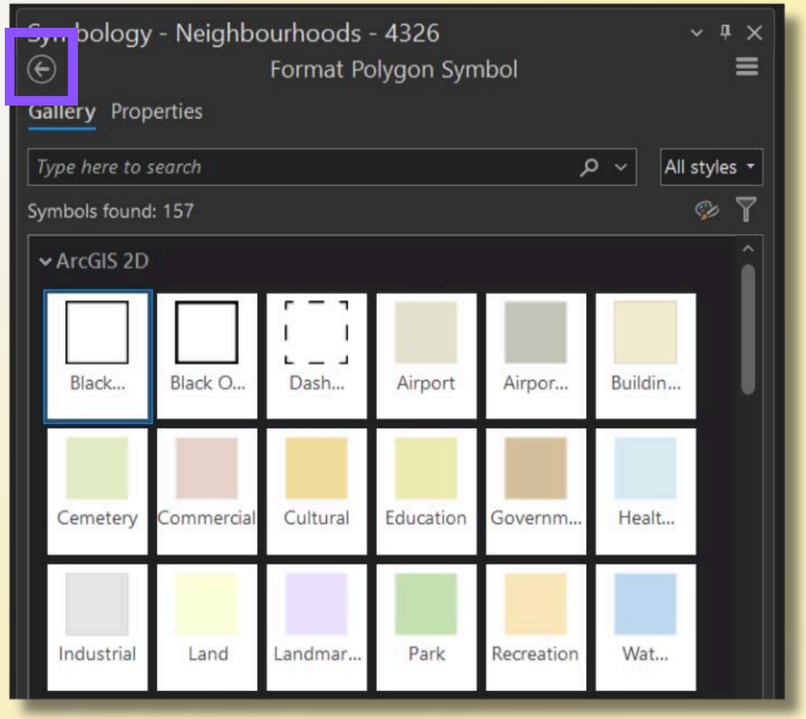


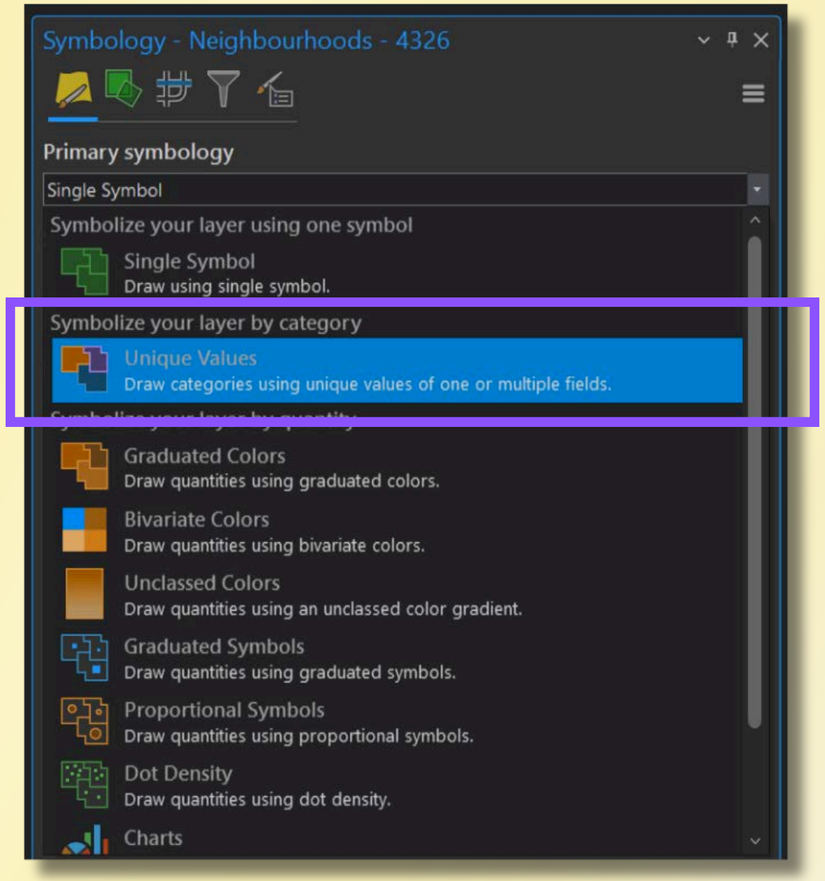


Symbology in ArcGIS Pro
Types of Symbology: Unique Values

- Click the Back button to return to the main symbology options for the Neighbourhoods layer

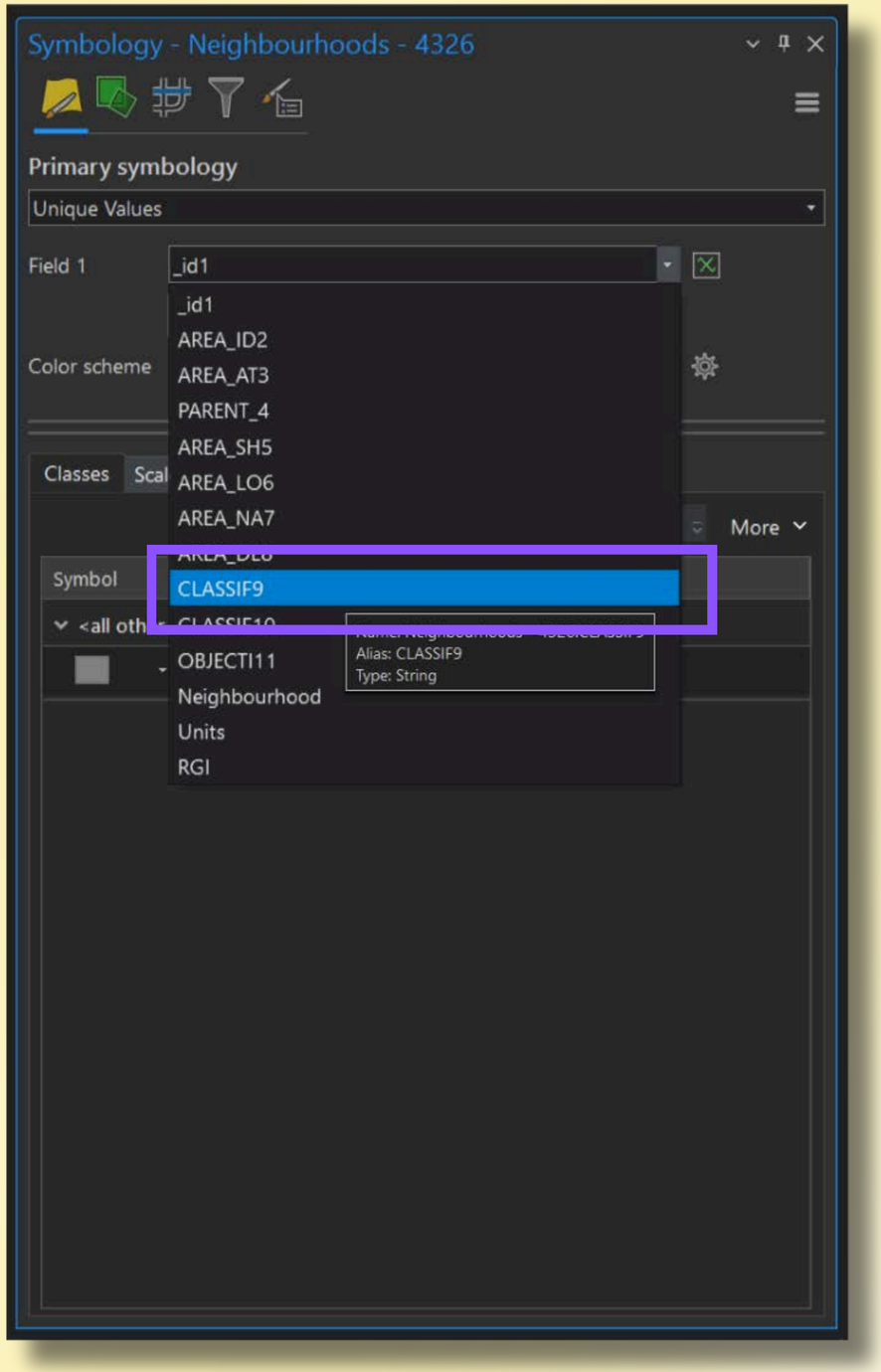
- Choose **Unique Values** from the Primary symbology dropdown



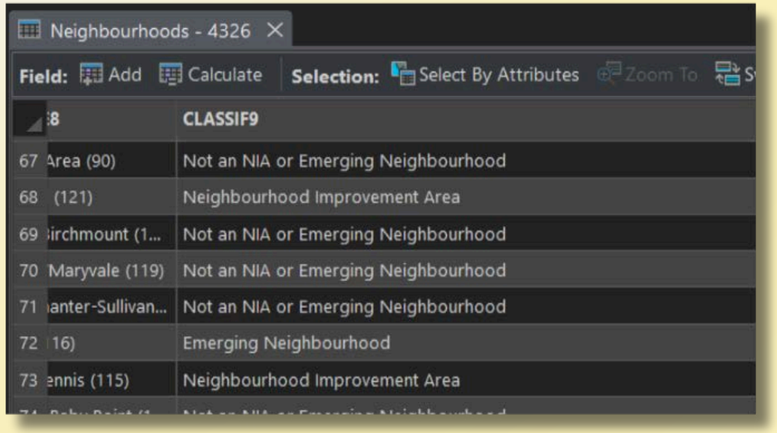


Symbology in ArcGIS Pro
Types of Symbology: Unique Values

- Choose **CLASSIF9** from the **Field 1** dropdown menu.

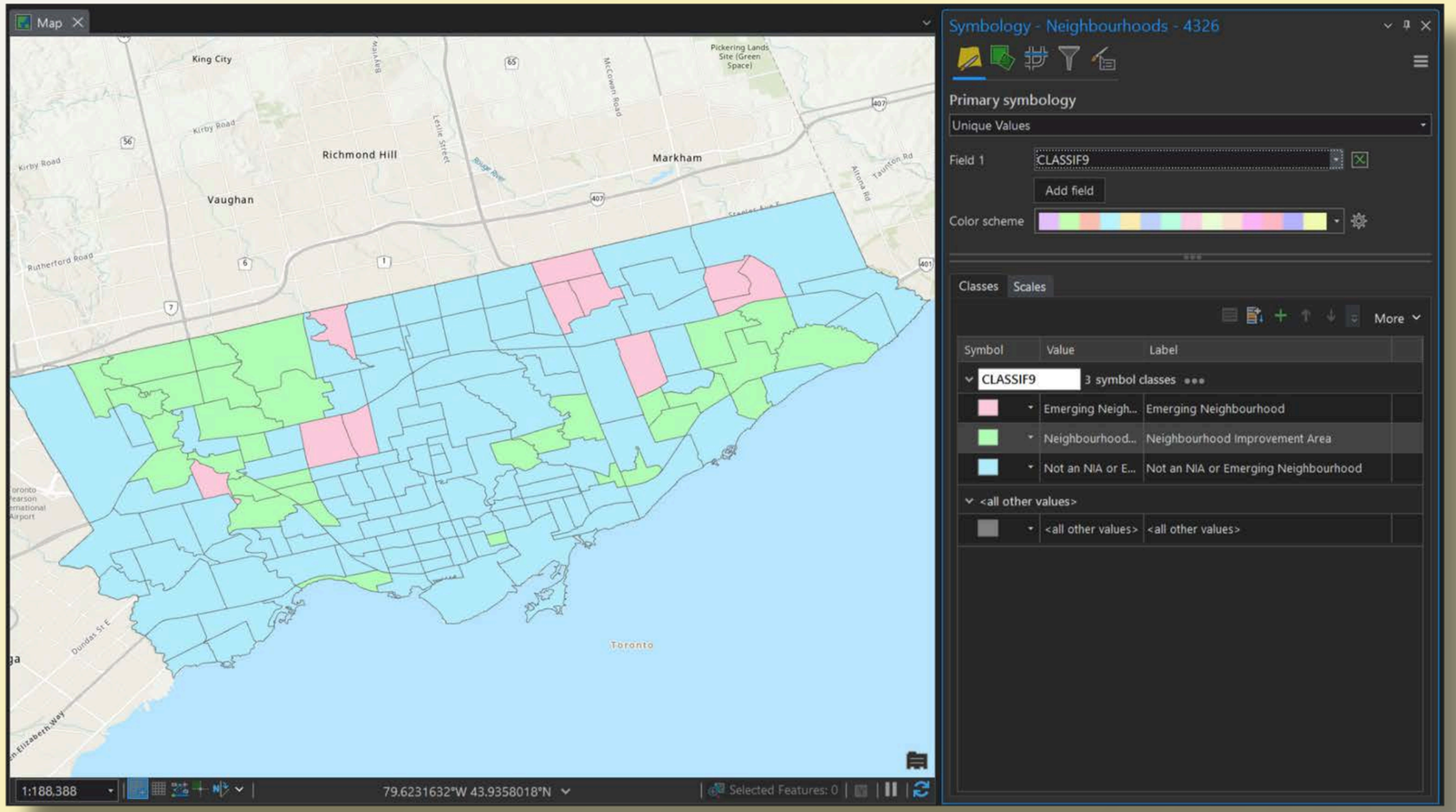


Note: This field is not very well-named, but a review of the attribute table shows that it specifies each neighbourhood's Emerging Area or NIA status.



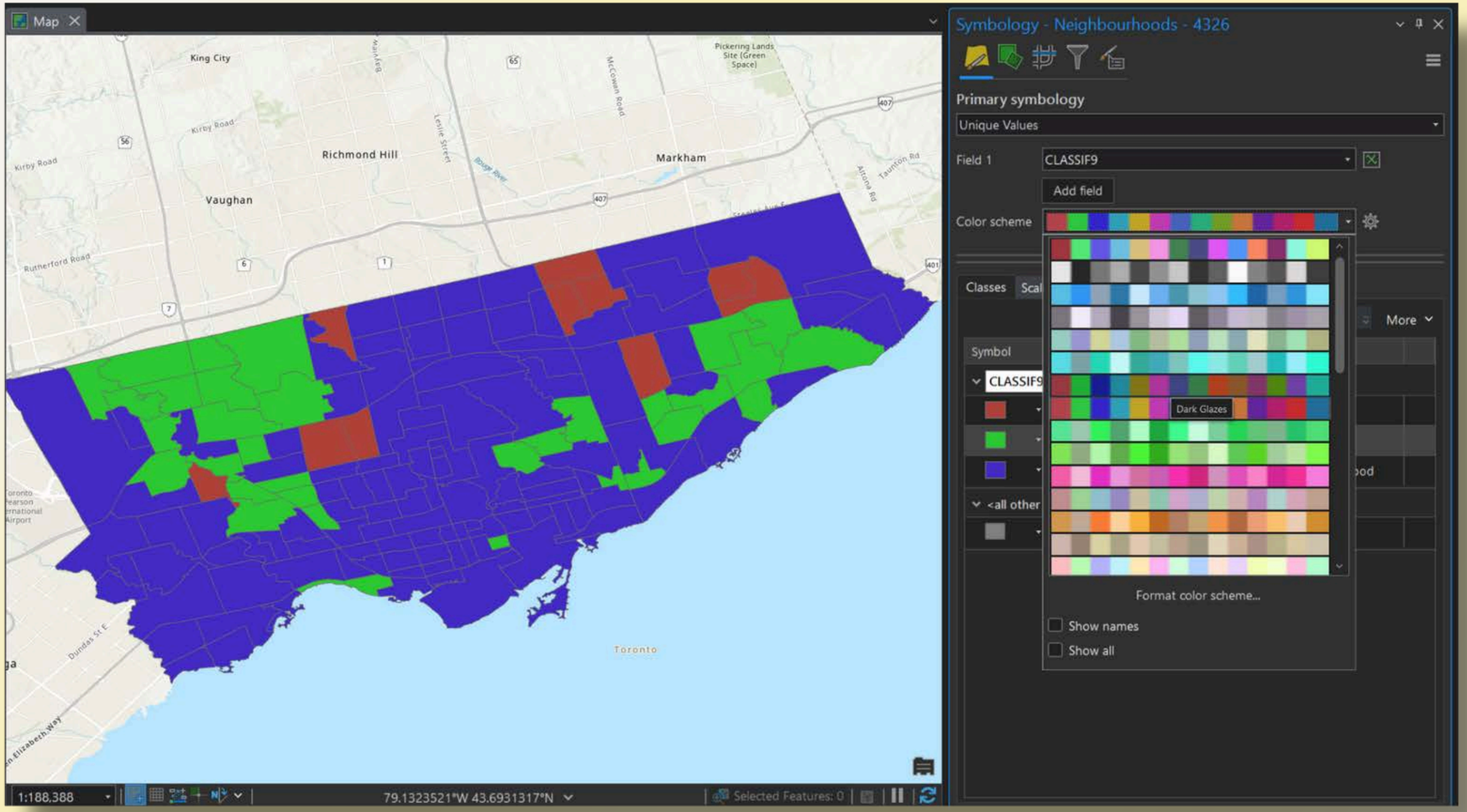
Symbology in ArcGIS Pro
Types of Symbology: Unique Values

- Each polygon is now styled to reflect the attribute value in the CLASSIF9 field.



Symbology in ArcGIS Pro
Types of Symbology: Unique Values

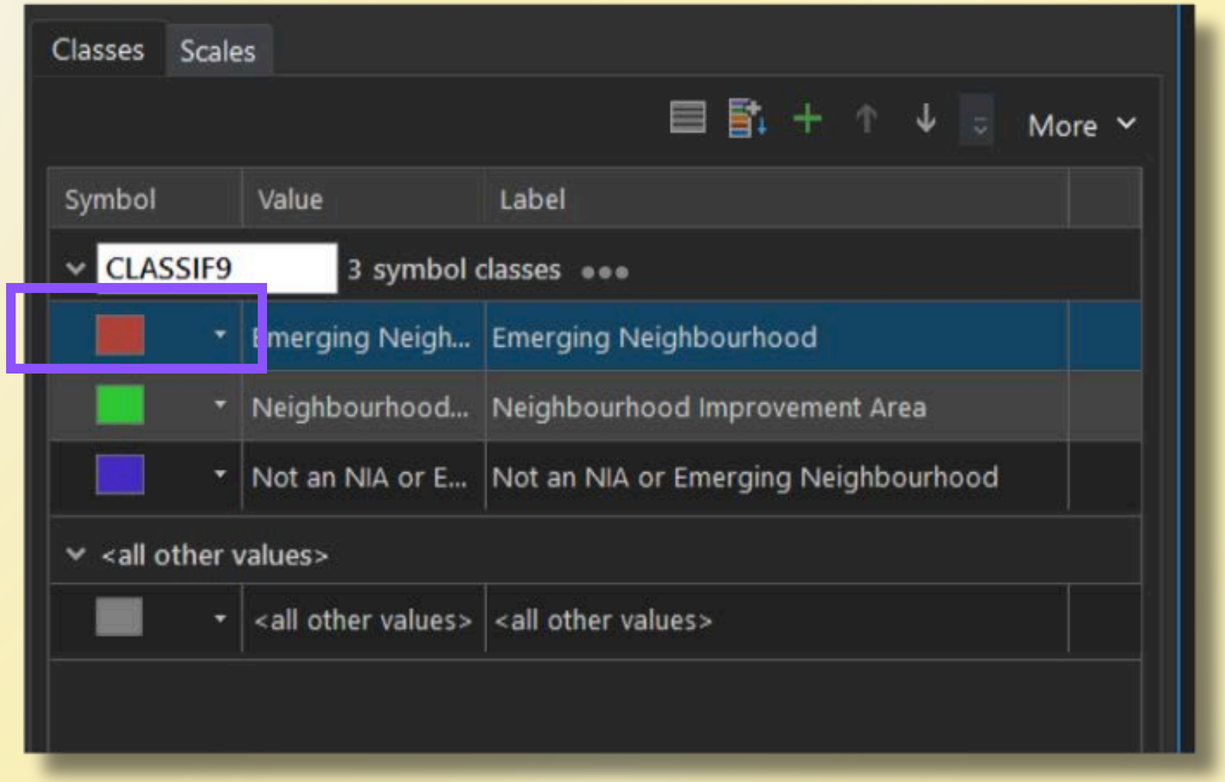
- Various colour schemes can be selected from the **Color scheme** dropdown.



Symbology in ArcGIS Pro
Types of Symbology: Unique Values

Customize individual symbols:

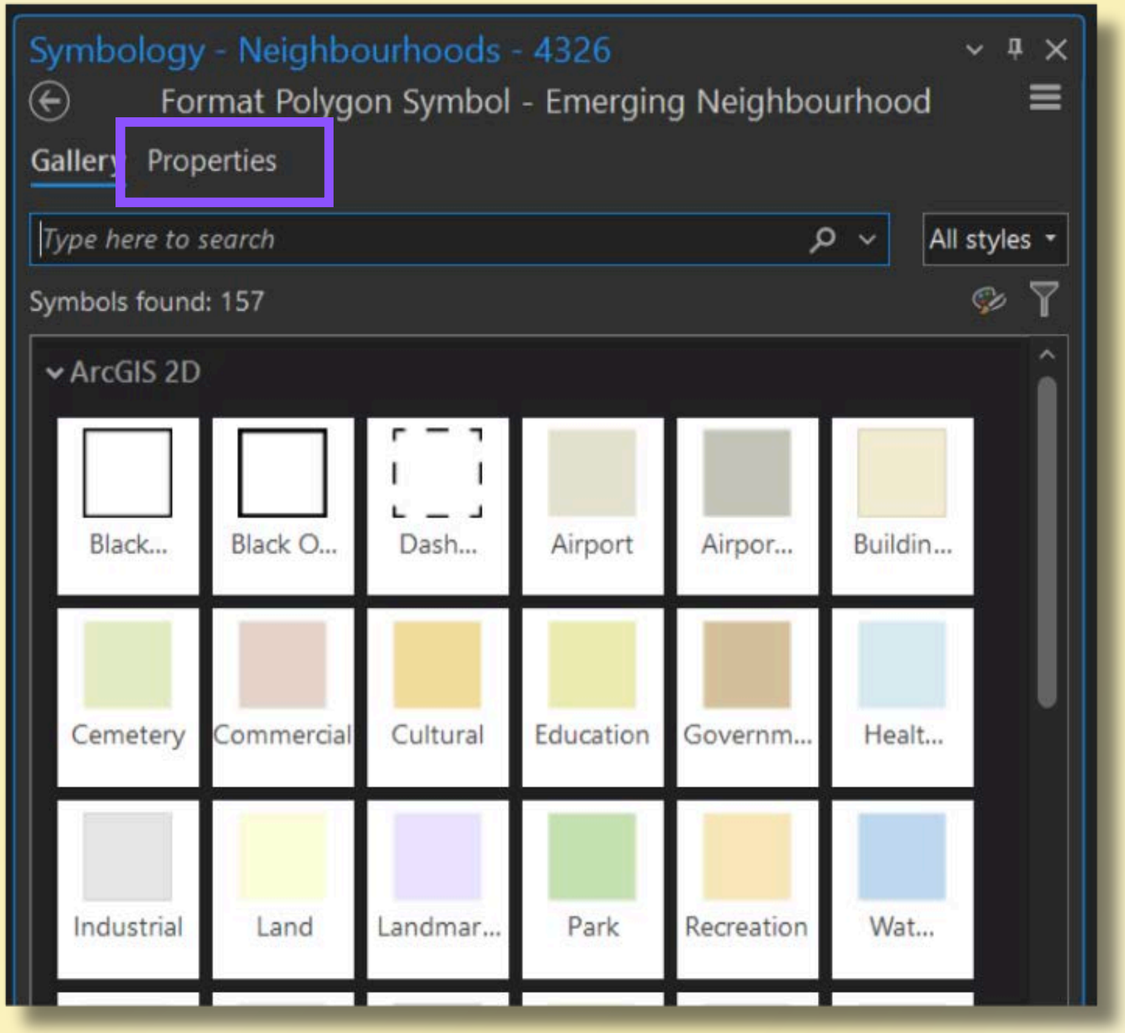
- Click the swatch next to the Emerging Neighbourhood category.



Symbology in ArcGIS Pro
Types of Symbology: Unique Values

Customize individual symbols:

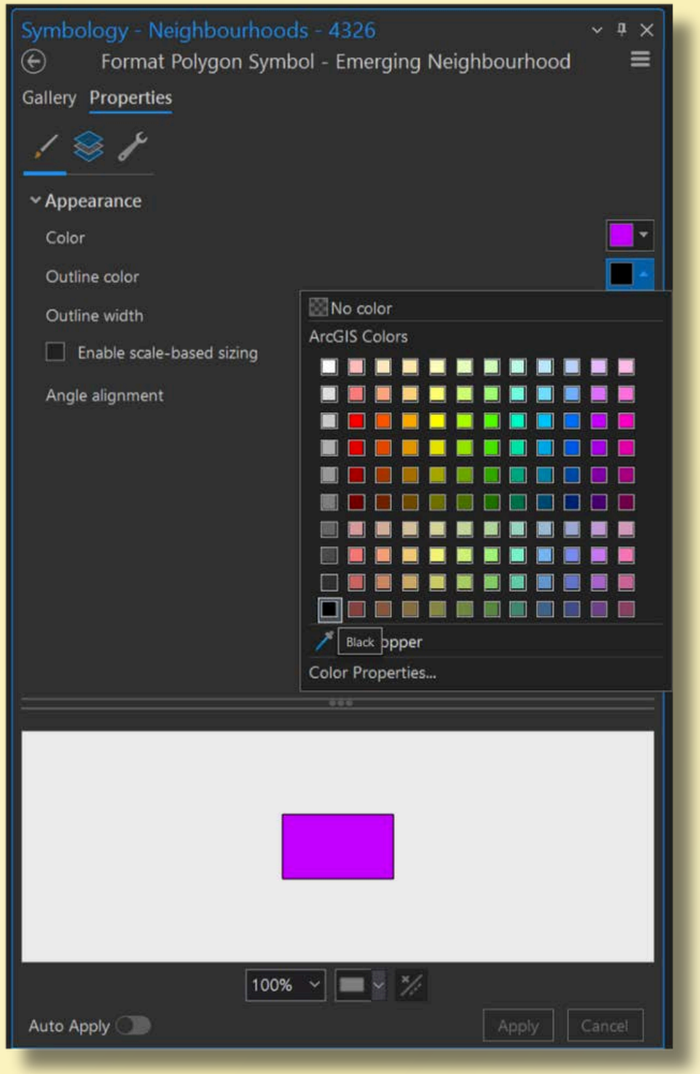
- Click **Properties**.



Symbology in ArcGIS Pro
Types of Symbology: Unique Values

Customize individual symbols:

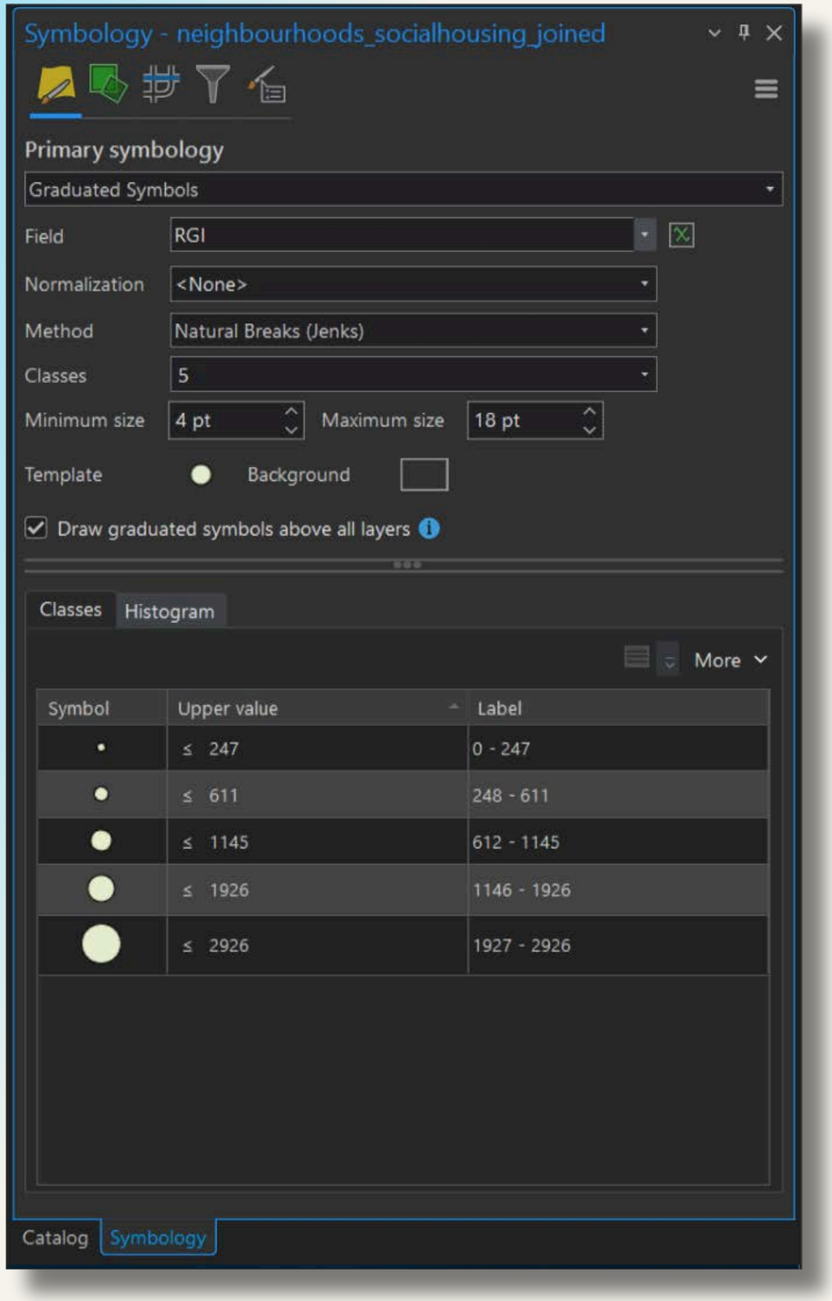
- Adjust the **Fill Color**, **Outline Color**, and **Outline Width** settings.



Symbology in ArcGIS Pro
Types of Symbology: Graduated Symbols

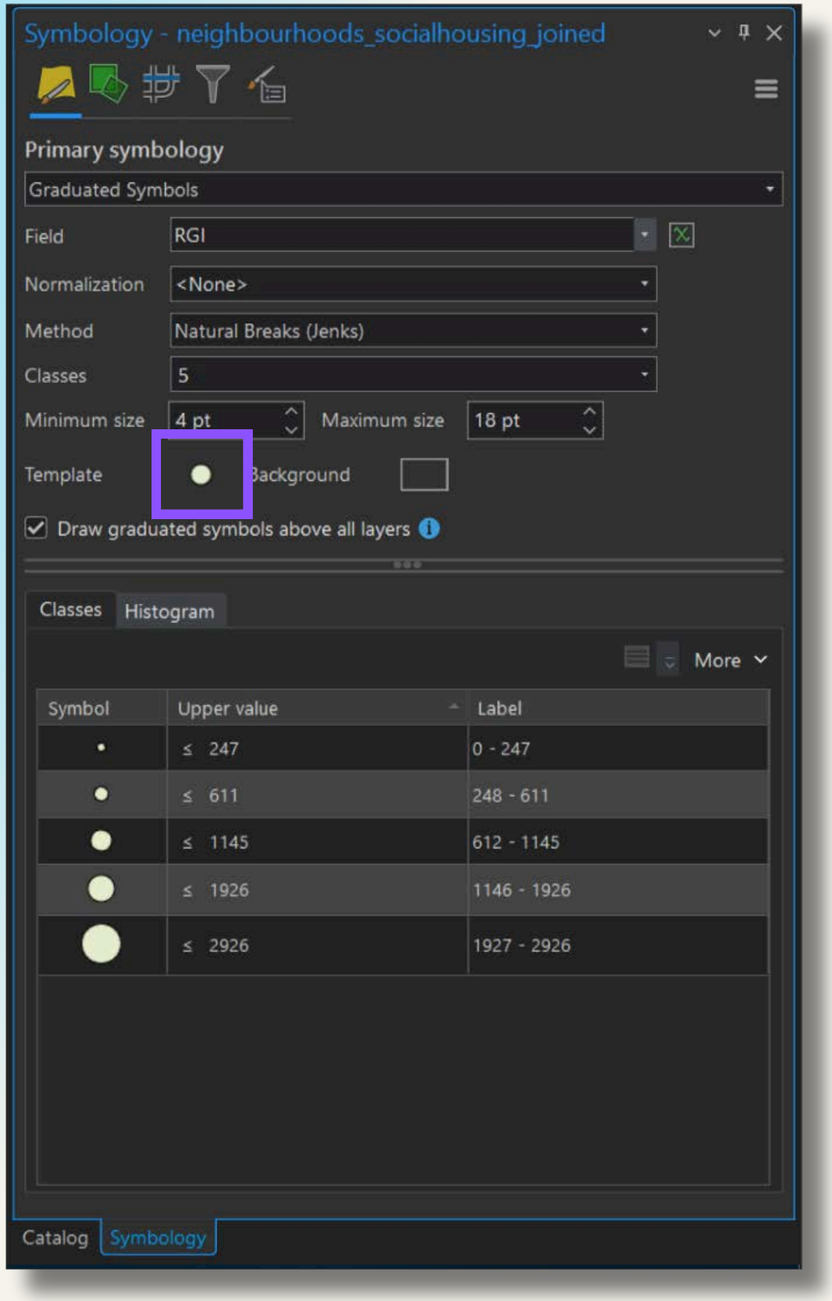
- Return to the primary symbology view and select **Graduated Symbols**.

- Choose **RGI** for the field.



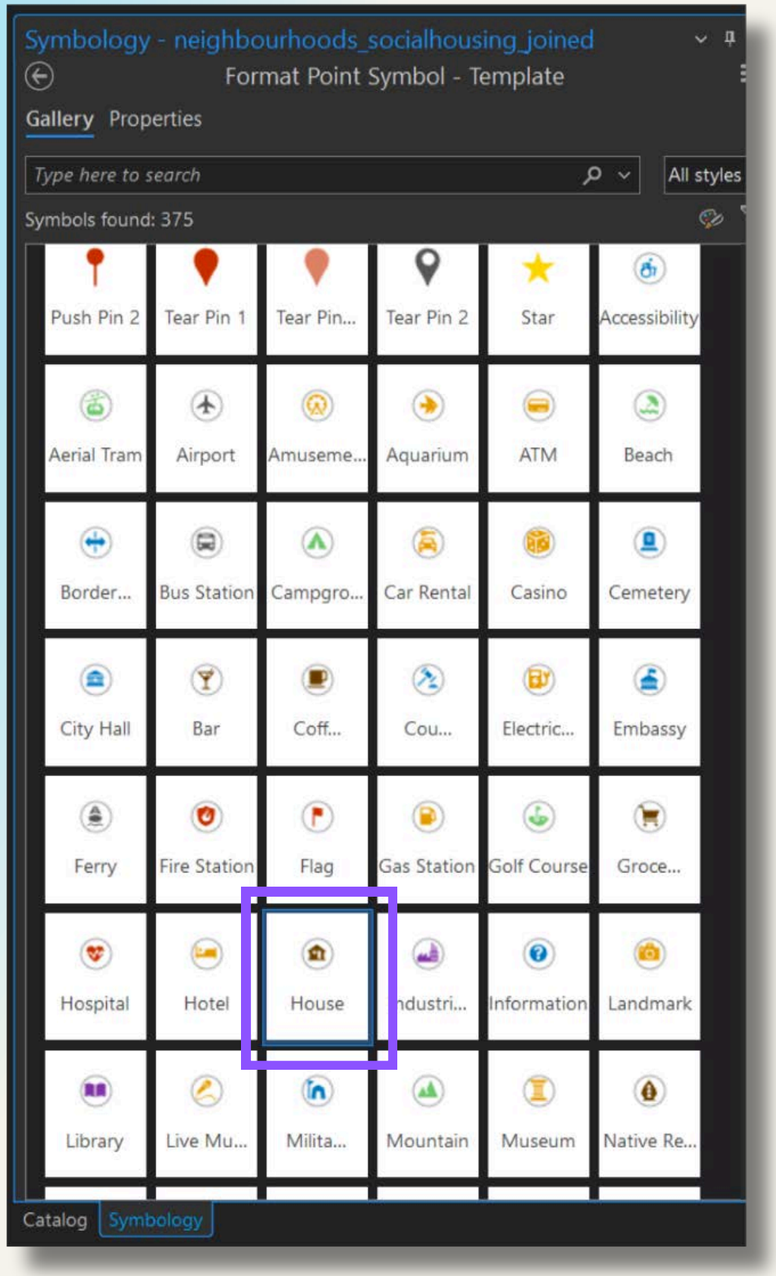
Symbology in ArcGIS Pro
Types of Symbology: Graduated Symbols

- Click the symbol to change the template



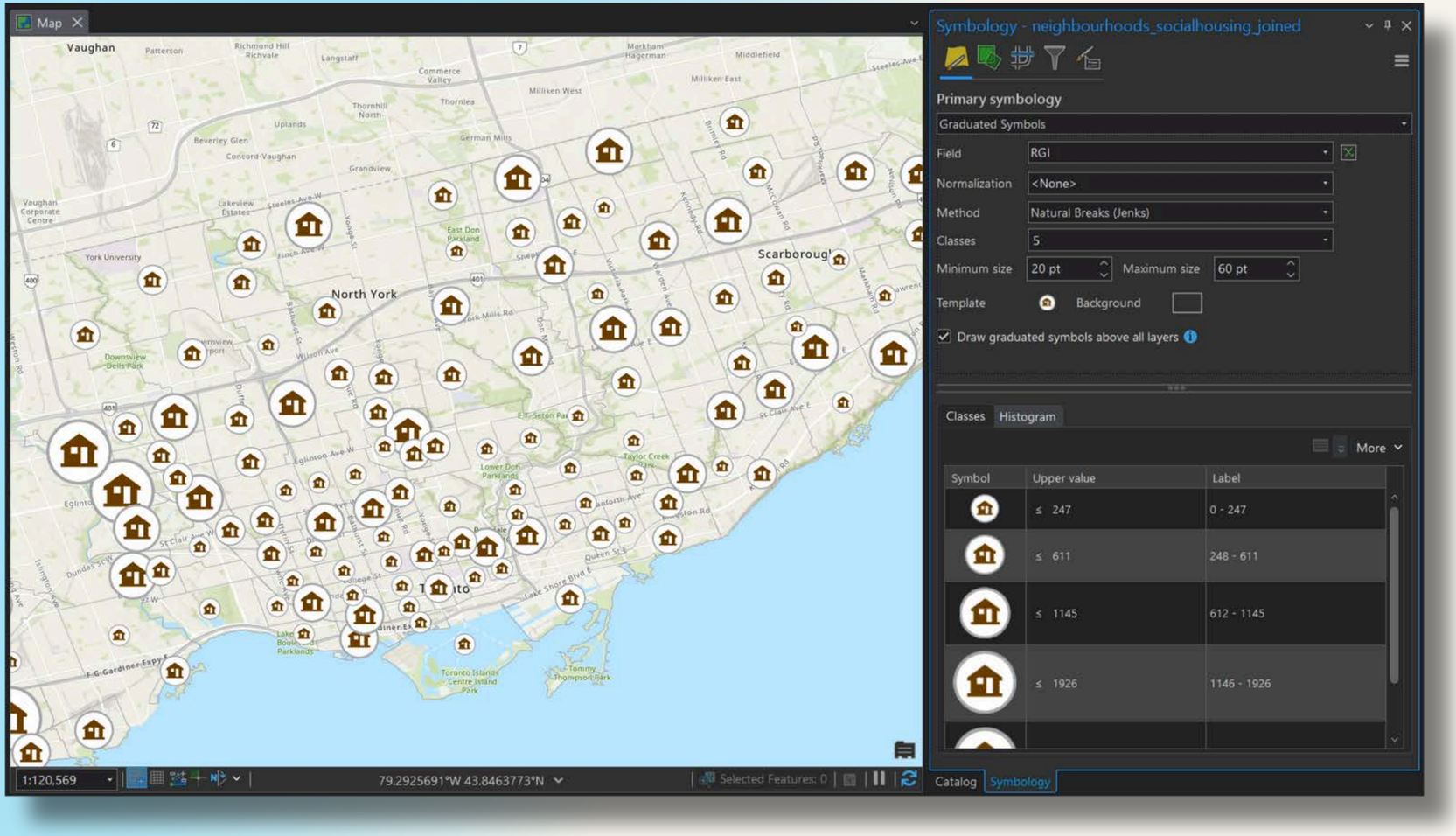
Symbology in ArcGIS Pro
Types of Symbology: Graduated Symbols

- Choose a symbol from the Gallery.



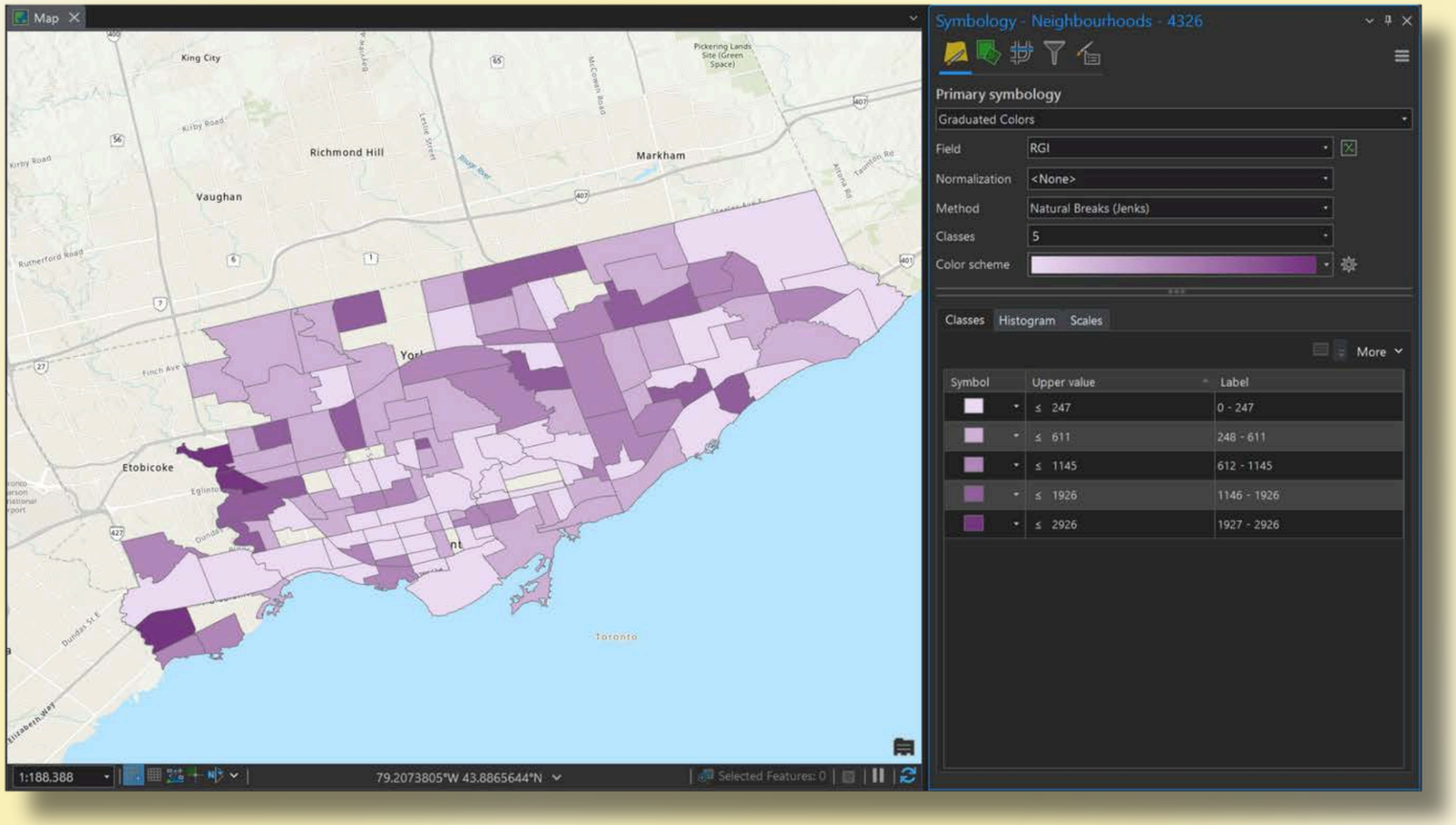
Symbology in ArcGIS Pro
Types of Symbology: Graduated Symbols

- Adjust Minimum and Maximum symbol sizes.
- Result: Attribute information is visualized by symbol size.



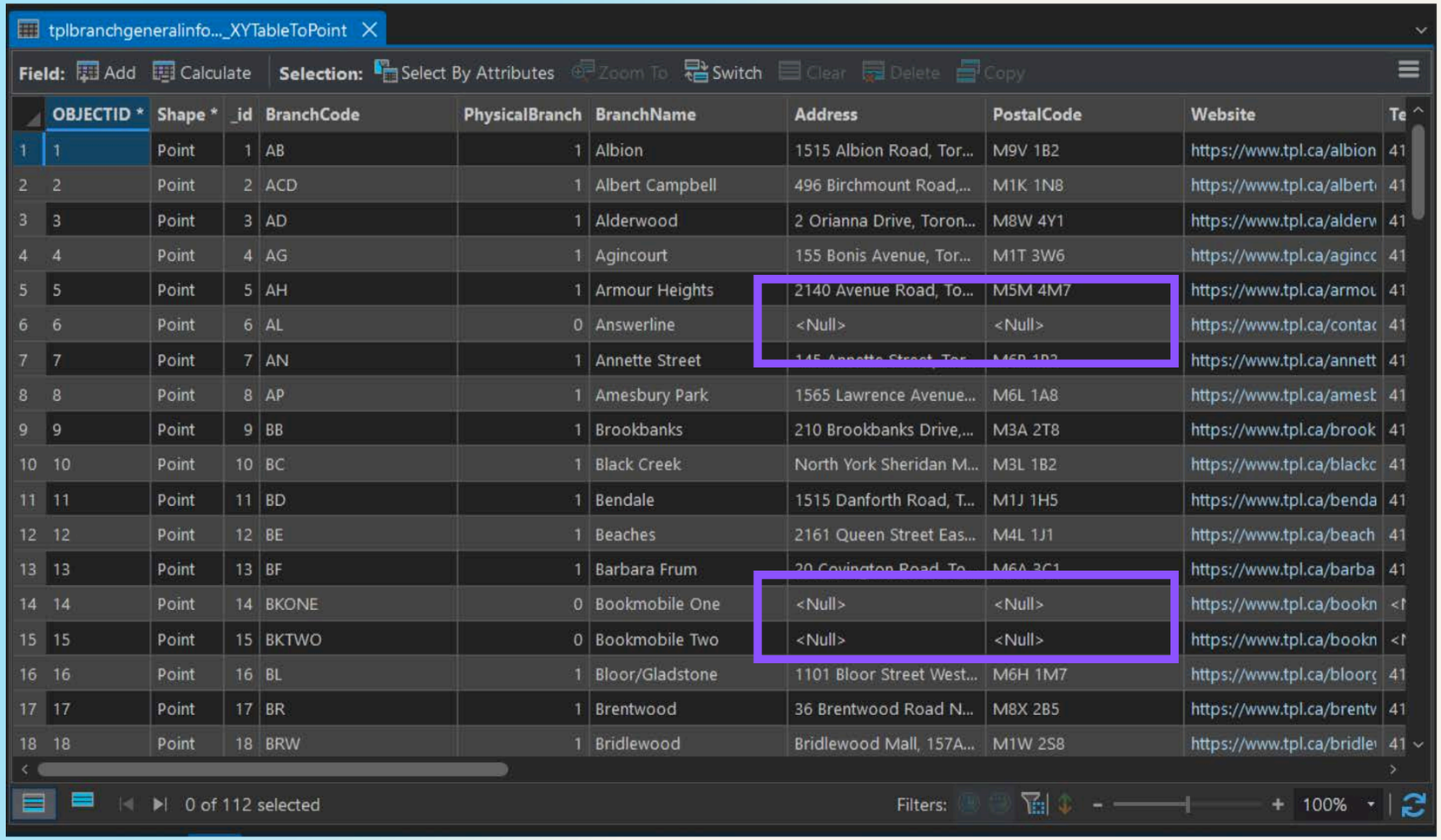
Symbology in ArcGIS Pro
Types of Symbology: Graduated Colours

- Return to the primary symbology view and select **Graduated Colors**.
- Choose **RGI** for the field.
- Choose a **colour ramp**.
- The map symbology now communicates information re: the quantity of rent geared to income housing per neighbourhood.



Filter Data using Definition Queries

- Open the **Attribute Table** of the libraries layer:
  - Right-click the layer name and select **Show Attribute Table**, or select the layer name and press Ctrl + t.
- Note that some records have **<Null>** for their address

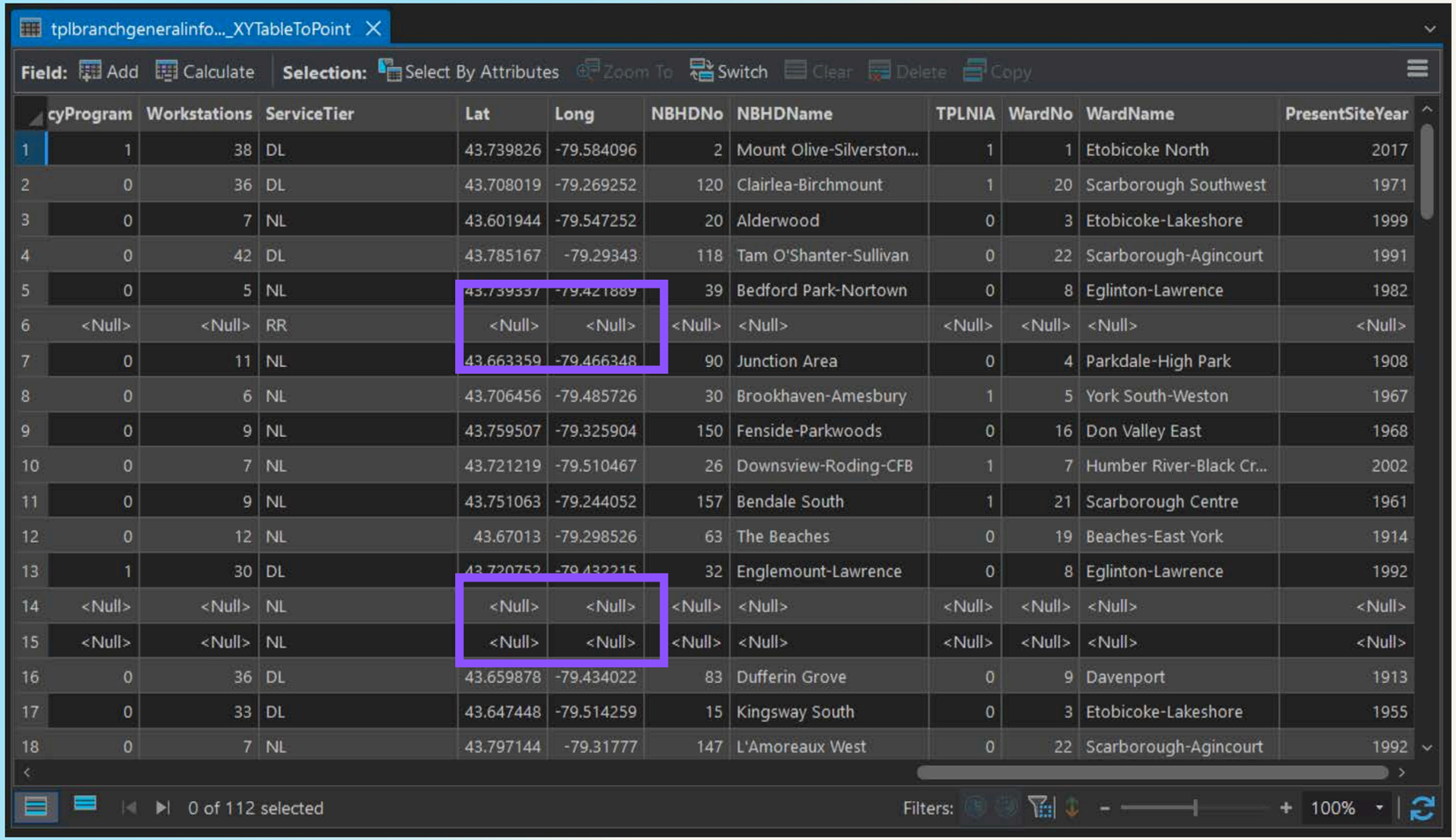


	OBJECTID *	Shape *	_id	BranchCode	PhysicalBranch	BranchName	Address	PostalCode	Website	Te
1	1	Point	1	AB	1	Albion	1515 Albion Road, Tor...	M9V 1B2	https://www.tpl.ca/albion	41
2	2	Point	2	ACD	1	Albert Campbell	496 Birchmount Road,...	M1K 1N8	https://www.tpl.ca/albert	41
3	3	Point	3	AD	1	Alderwood	2 Orianna Drive, Toron...	M8W 4Y1	https://www.tpl.ca/alderw	41
4	4	Point	4	AG	1	Agincourt	155 Bonis Avenue, Tor...	M1T 3W6	https://www.tpl.ca/agincc	41
5	5	Point	5	AH	1	Armour Heights	2140 Avenue Road, To...	M5M 4M7	https://www.tpl.ca/armou	41
6	6	Point	6	AL	0	Answerline	<Null>	<Null>	https://www.tpl.ca/contac	41
7	7	Point	7	AN	1	Annette Street	145 Annette Street, Tor...	M6P 1P3	https://www.tpl.ca/annett	41
8	8	Point	8	AP	1	Amesbury Park	1565 Lawrence Avenue...	M6L 1A8	https://www.tpl.ca/amesb	41
9	9	Point	9	BB	1	Brookbanks	210 Brookbanks Drive,...	M3A 2T8	https://www.tpl.ca/brook	41
10	10	Point	10	BC	1	Black Creek	North York Sheridan M...	M3L 1B2	https://www.tpl.ca/blackc	41
11	11	Point	11	BD	1	Bendale	1515 Danforth Road, T...	M1J 1H5	https://www.tpl.ca/benda	41
12	12	Point	12	BE	1	Beaches	2161 Queen Street Eas...	M4L 1J1	https://www.tpl.ca/beach	41
13	13	Point	13	BF	1	Barbara Frum	20 Covington Road, To...	M6A 3G1	https://www.tpl.ca/barba	41
14	14	Point	14	BKONE	0	Bookmobile One	<Null>	<Null>	https://www.tpl.ca/bookn	<N
15	15	Point	15	BKTWO	0	Bookmobile Two	<Null>	<Null>	https://www.tpl.ca/bookn	<N
16	16	Point	16	BL	1	Bloor/Gladstone	1101 Bloor Street West...	M6H 1M7	https://www.tpl.ca/bloorg	41
17	17	Point	17	BR	1	Brentwood	36 Brentwood Road N...	M8X 2B5	https://www.tpl.ca/brentv	41
18	18	Point	18	BRW	1	Bridlewood	Bridlewood Mall, 157A...	M1W 2S8	https://www.tpl.ca/bridle	41

Filter Data using Definition Queries

- These records also lack latitude and longitude information, and are not displayed anywhere on the map

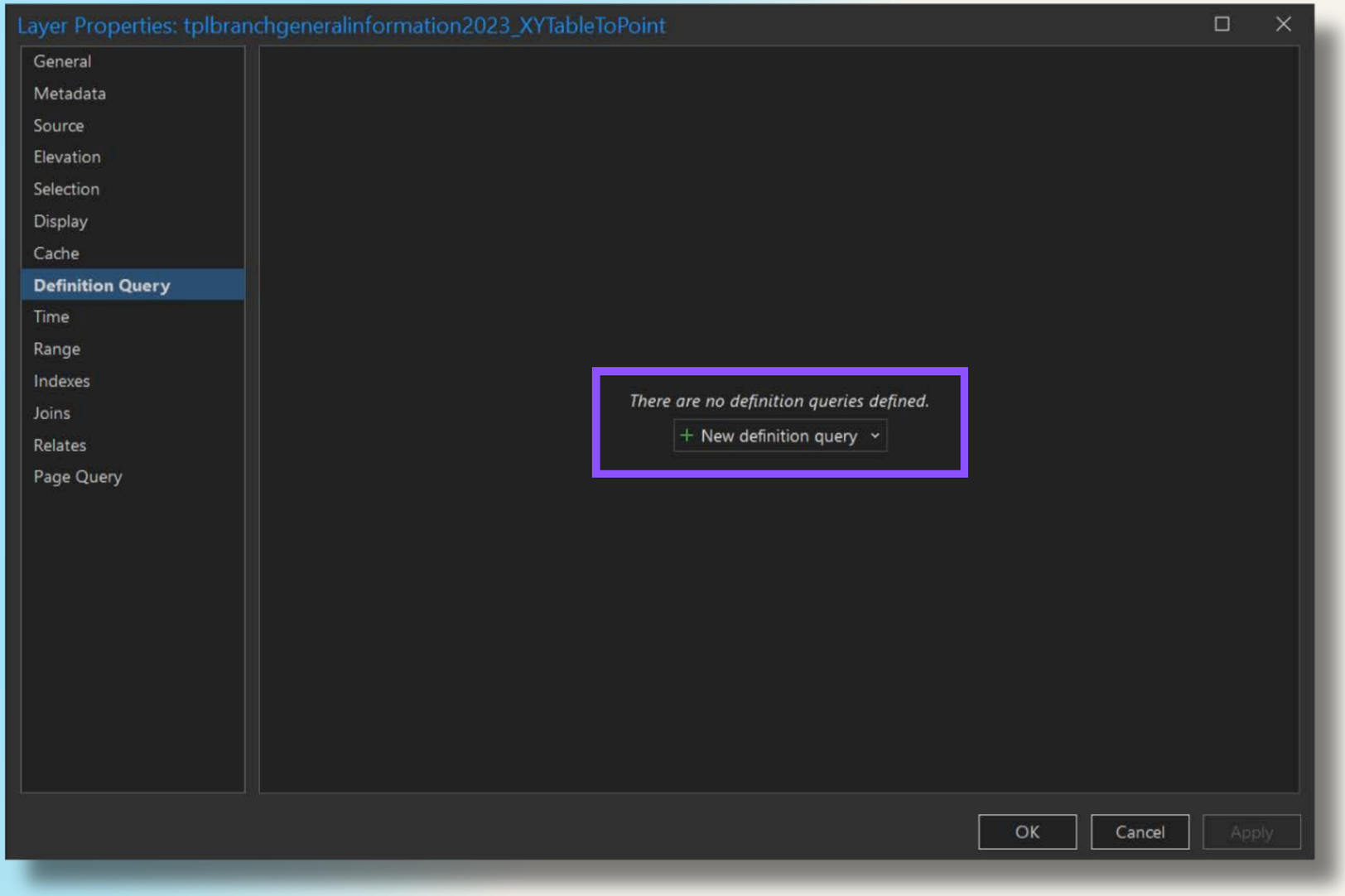
- Let’s filter out these layers to exclude them from further analysis



	cyProgram	Workstations	ServiceTier	Lat	Long	NBHDNo	NBHDName	TPLNIA	WardNo	WardName	PresentSiteYear
1	1	38	DL	43.739826	-79.584096	2	Mount Olive-Silverston...	1	1	Etobicoke North	2017
2	0	36	DL	43.708019	-79.269252	120	Clairlea-Birchmount	1	20	Scarborough Southwest	1971
3	0	7	NL	43.601944	-79.547252	20	Alderwood	0	3	Etobicoke-Lakeshore	1999
4	0	42	DL	43.785167	-79.29343	118	Tam O'Shanter-Sullivan	0	22	Scarborough-Agincourt	1991
5	0	5	NL	43.739337	-79.421889	39	Bedford Park-Nortown	0	8	Eglinton-Lawrence	1982
6	<Null>	<Null>	RR	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
7	0	11	NL	43.663359	-79.466348	90	Junction Area	0	4	Parkdale-High Park	1908
8	0	6	NL	43.706456	-79.485726	30	Brookhaven-Amesbury	1	5	York South-Weston	1967
9	0	9	NL	43.759507	-79.325904	150	Fenside-Parkwoods	0	16	Don Valley East	1968
10	0	7	NL	43.721219	-79.510467	26	Downsview-Roding-CFB	1	7	Humber River-Black Cr...	2002
11	0	9	NL	43.751063	-79.244052	157	Bendale South	1	21	Scarborough Centre	1961
12	0	12	NL	43.67013	-79.298526	63	The Beaches	0	19	Beaches-East York	1914
13	1	30	DL	43.720752	-79.432215	32	Englemount-Lawrence	0	8	Eglinton-Lawrence	1992
14	<Null>	<Null>	NL	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
15	<Null>	<Null>	NL	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
16	0	36	DL	43.659878	-79.434022	83	Dufferin Grove	0	9	Davenport	1913
17	0	33	DL	43.647448	-79.514259	15	Kingsway South	0	3	Etobicoke-Lakeshore	1955
18	0	7	NL	43.797144	-79.31777	147	L'Amoreaux West	0	22	Scarborough-Agincourt	1992

Filter Data using Definition Queries

- Open the layer's Properties and select the **Definition Query** tab.
- Definition queries allow you to display only the subset of data that meets the conditions you set.
- Click **New Definition Query**.



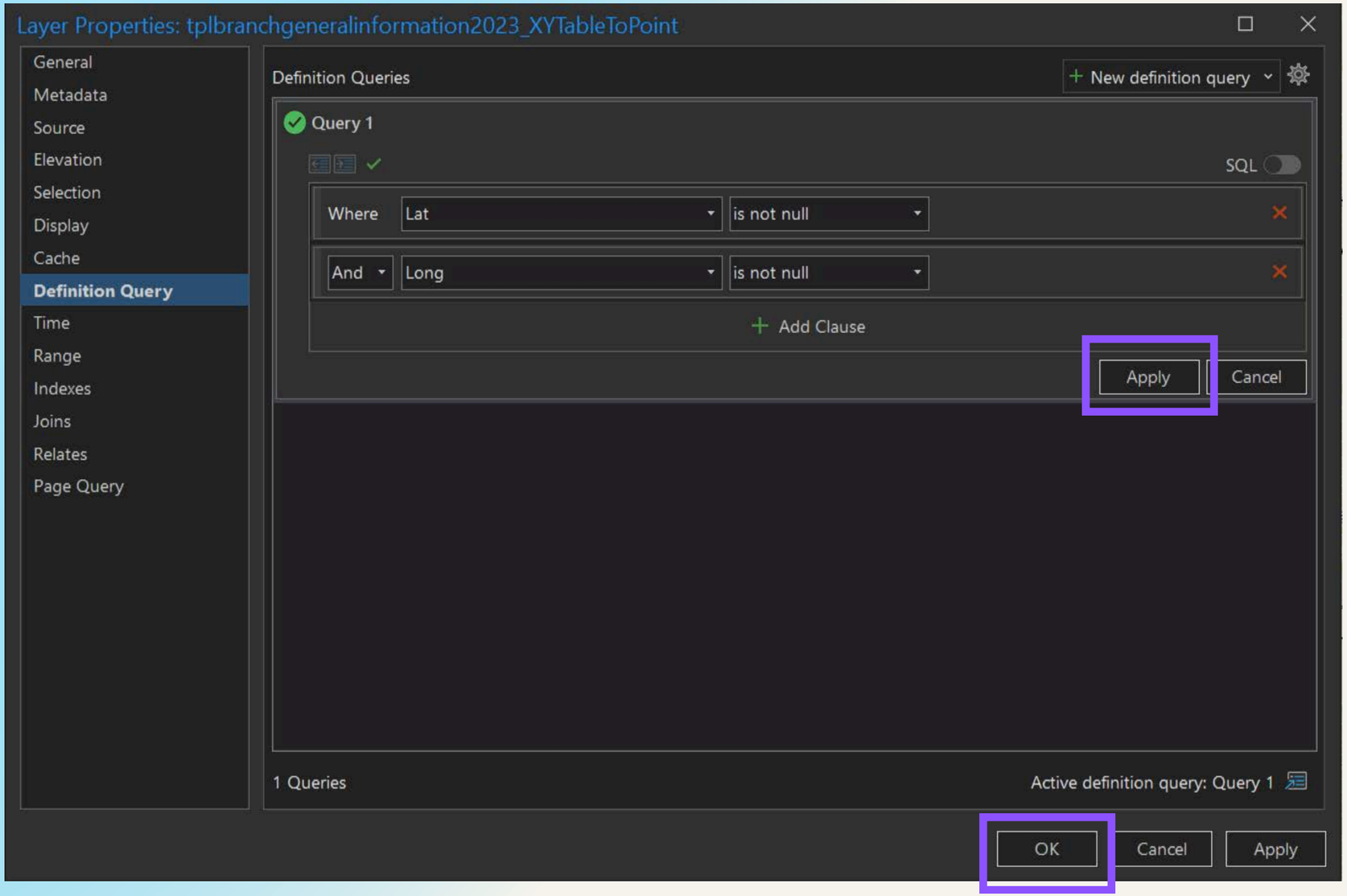
Filter Data using Definition Queries

- Create the query:

```
Where Lat is not null And Long is not null
```

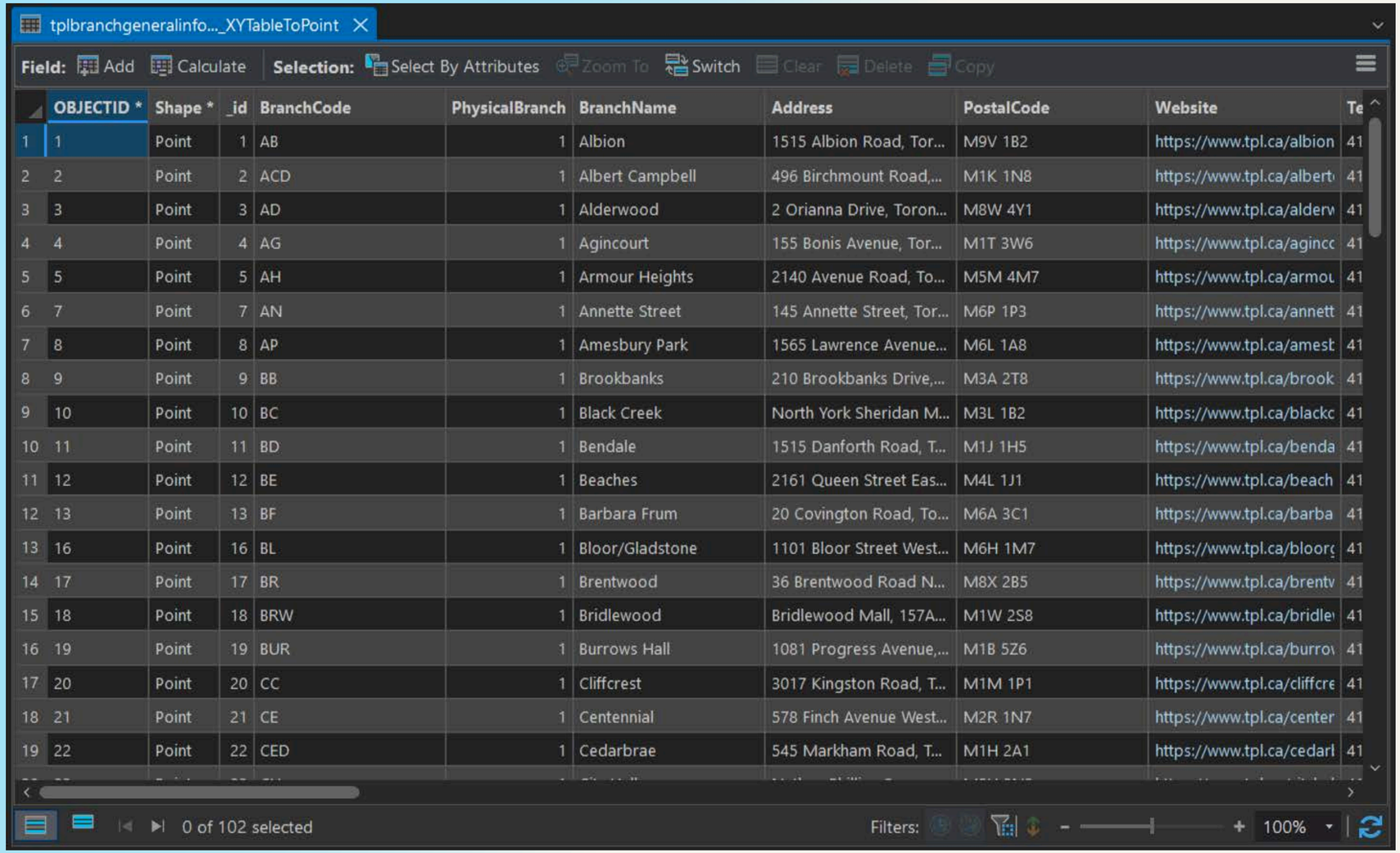
- Click **Apply**.

- Click **OK**.



Filter Data using Definition Queries

- Only the records that are associated with a physical location remain



	OBJECTID *	Shape *	_id	BranchCode	PhysicalBranch	BranchName	Address	PostalCode	Website	Te
1	1	Point	1	AB	1	Albion	1515 Albion Road, Tor...	M9V 1B2	https://www.tpl.ca/albion	41
2	2	Point	2	ACD	1	Albert Campbell	496 Birchmount Road,...	M1K 1N8	https://www.tpl.ca/albert	41
3	3	Point	3	AD	1	Alderwood	2 Orianna Drive, Toron...	M8W 4Y1	https://www.tpl.ca/alderw	41
4	4	Point	4	AG	1	Agincourt	155 Bonis Avenue, Tor...	M1T 3W6	https://www.tpl.ca/agincc	41
5	5	Point	5	AH	1	Armour Heights	2140 Avenue Road, To...	M5M 4M7	https://www.tpl.ca/armou	41
6	7	Point	7	AN	1	Annette Street	145 Annette Street, Tor...	M6P 1P3	https://www.tpl.ca/annett	41
7	8	Point	8	AP	1	Amesbury Park	1565 Lawrence Avenue...	M6L 1A8	https://www.tpl.ca/amest	41
8	9	Point	9	BB	1	Brookbanks	210 Brookbanks Drive,...	M3A 2T8	https://www.tpl.ca/brook	41
9	10	Point	10	BC	1	Black Creek	North York Sheridan M...	M3L 1B2	https://www.tpl.ca/blackc	41
10	11	Point	11	BD	1	Bendale	1515 Danforth Road, T...	M1J 1H5	https://www.tpl.ca/benda	41
11	12	Point	12	BE	1	Beaches	2161 Queen Street Eas...	M4L 1J1	https://www.tpl.ca/beach	41
12	13	Point	13	BF	1	Barbara Frum	20 Covington Road, To...	M6A 3C1	https://www.tpl.ca/barba	41
13	16	Point	16	BL	1	Bloor/Gladstone	1101 Bloor Street West...	M6H 1M7	https://www.tpl.ca/bloorg	41
14	17	Point	17	BR	1	Brentwood	36 Brentwood Road N...	M8X 2B5	https://www.tpl.ca/brentv	41
15	18	Point	18	BRW	1	Bridlewood	Bridlewood Mall, 157A...	M1W 2S8	https://www.tpl.ca/bridlev	41
16	19	Point	19	BUR	1	Burrows Hall	1081 Progress Avenue,...	M1B 5Z6	https://www.tpl.ca/burrov	41
17	20	Point	20	CC	1	Cliffcrest	3017 Kingston Road, T...	M1M 1P1	https://www.tpl.ca/cliffcre	41
18	21	Point	21	CE	1	Centennial	578 Finch Avenue West...	M2R 1N7	https://www.tpl.ca/center	41
19	22	Point	22	CED	1	Cedarbrae	545 Markham Road, T...	M1H 2A1	https://www.tpl.ca/cedarl	41

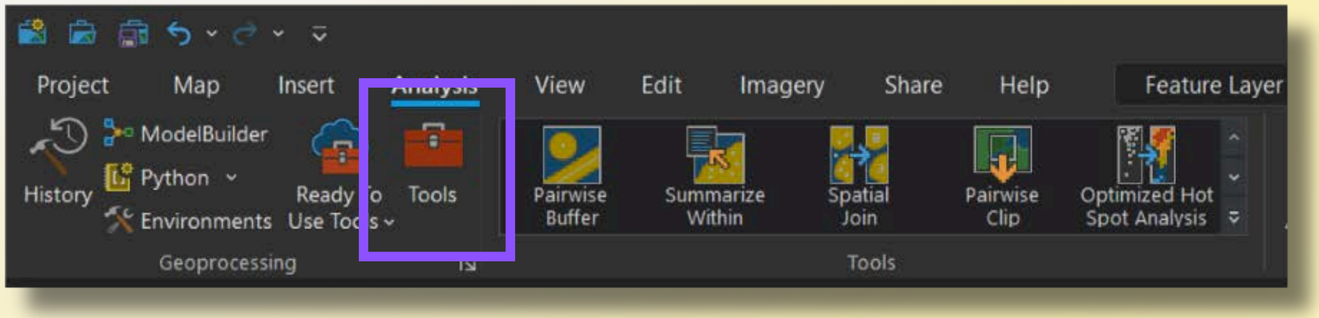
Geoprocessing

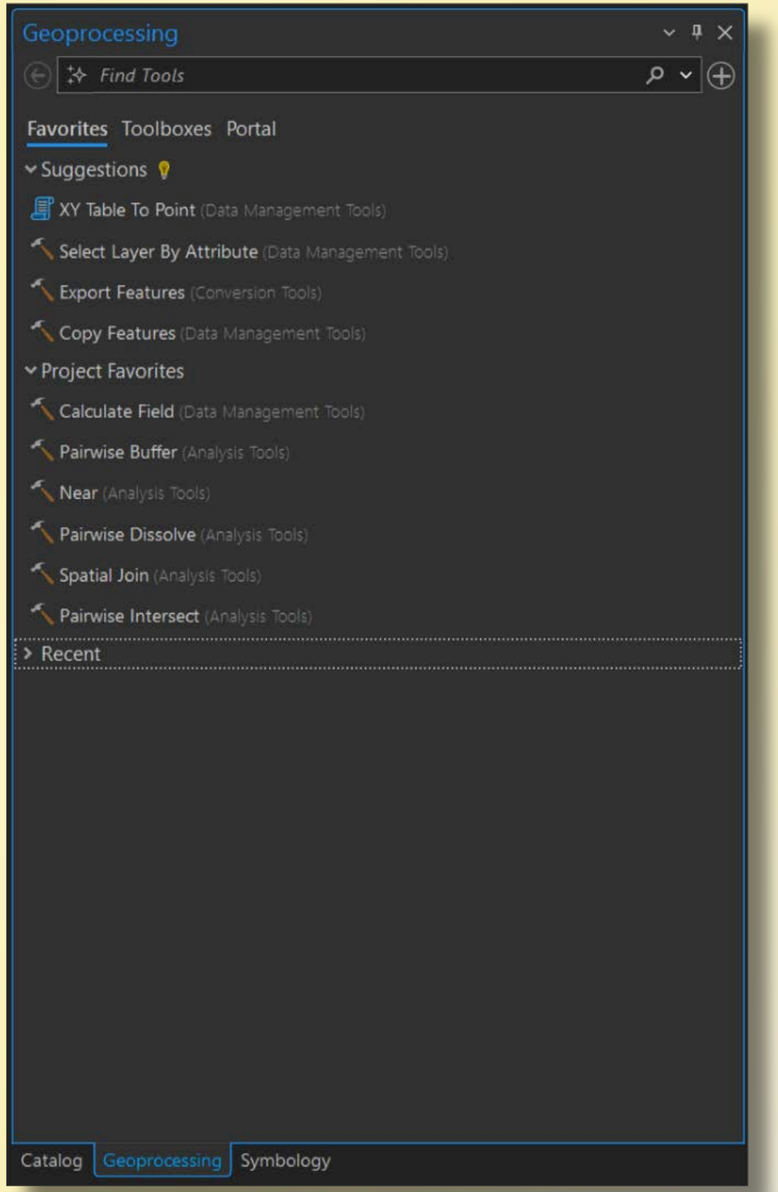
- **Geoprocessing tools** allow users to transform spatial layers and related data
- Typically accept input layer(s) along with other parameters, and output a new layer.
- ArcGIS Pro includes hundreds of geoprocessing tools

Geoprocessing Example: Buffer

- From the Analysis Tab/ Geoprocessing group, click the **Tools** button.

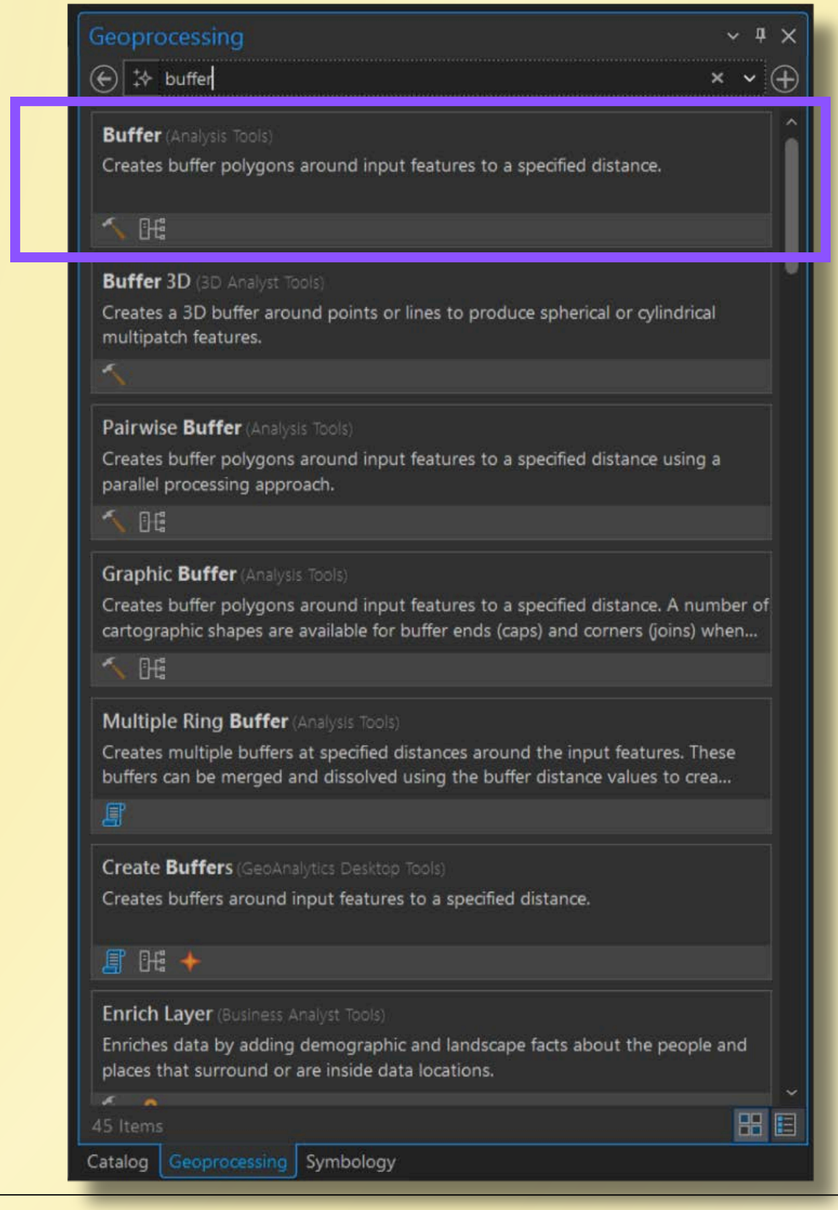
- The Geoprocessing Pane will appear.





Geoprocessing Example: Buffer

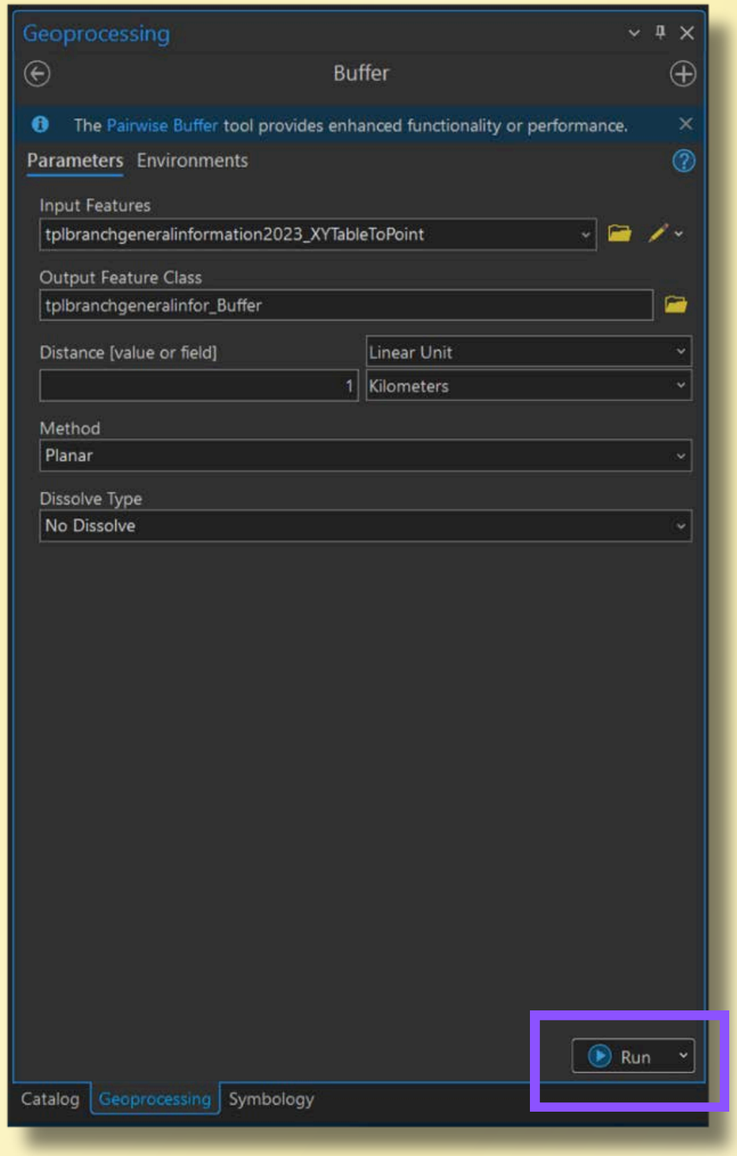
- Search for **Buffer** and click the first result.



Geoprocessing Example: Buffer

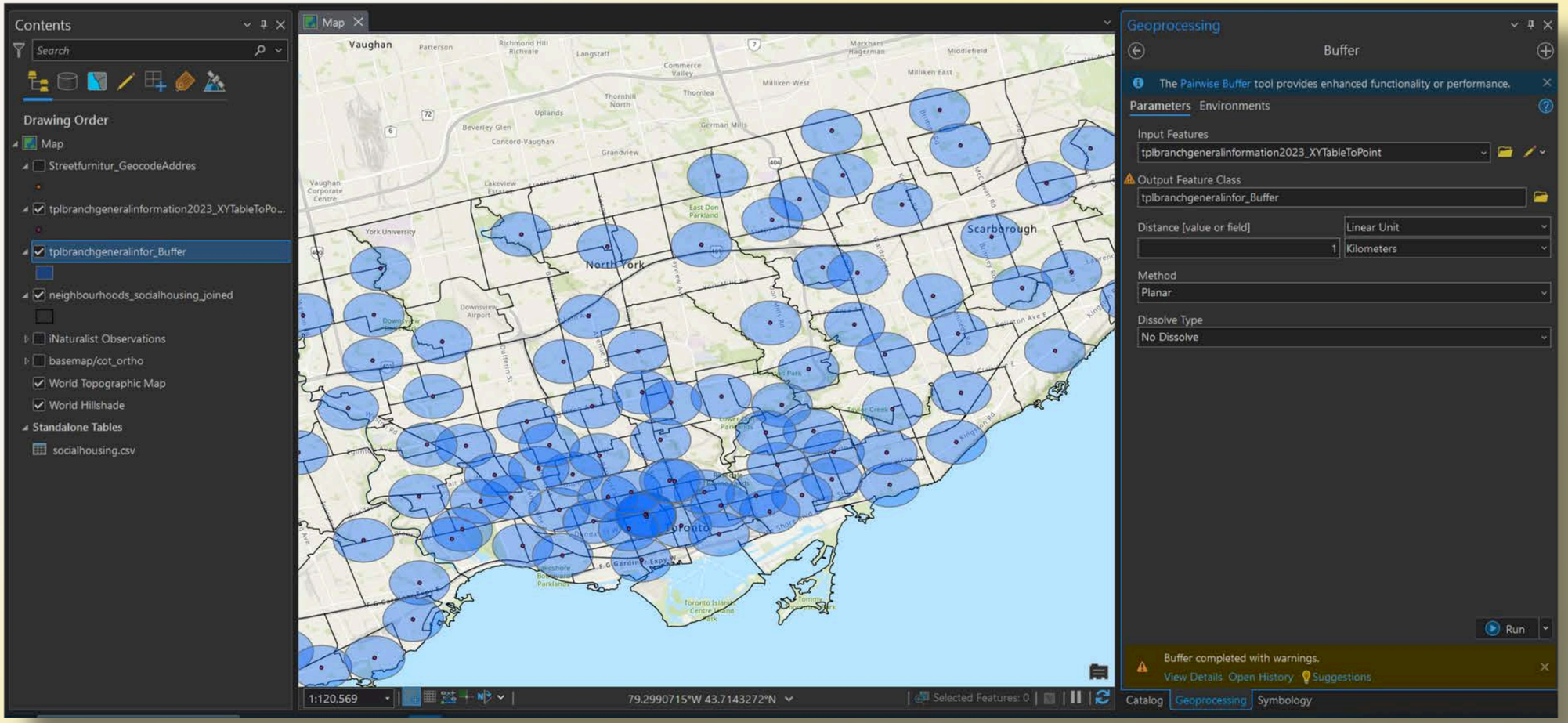
Parameters:

- Input Features: **Libraries**
- Distance: **1 kilometre**
- Click **Run**.



Geoprocessing Example: Buffer

Result:



Working with Raster Data

Raster data

- Geographic information expressed as a grid of pixels (also called ‘cells’).

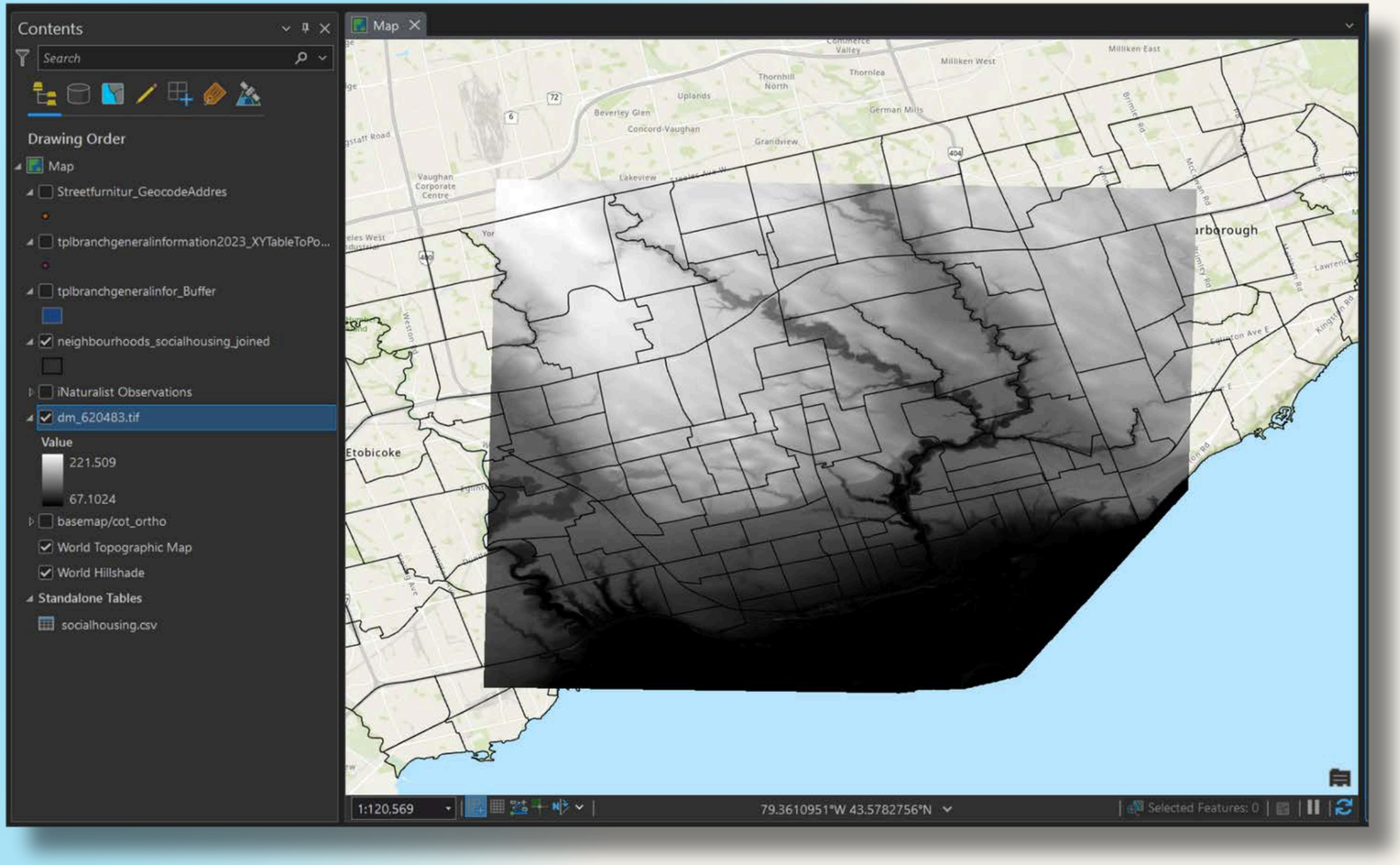
- Each pixel represents a specific value, such as elevation, temperature, or land cover class.

- Common file formats:
  - **TIFF/GeoTIFF** - Very common in desktop publishing and GIS
  - **Esri Grid** - Proprietary ArcGIS format
  - **NetCDF** - Multidimensional raster data

Working with Raster Data

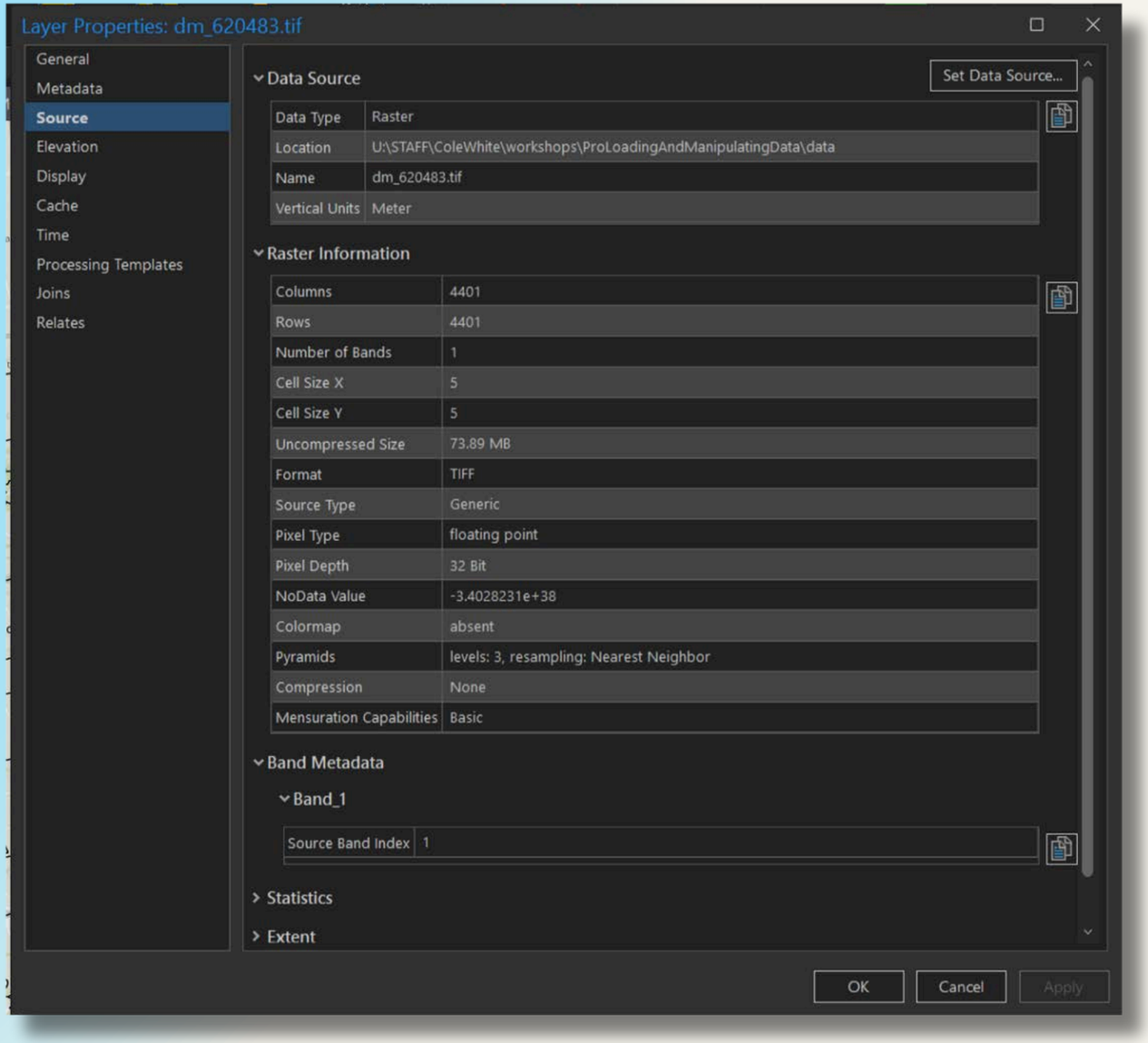
- Add the **dm_620483.tif** file from the workshop data to the map

- Double click on the layer name in the Contents pane to view the layer's properties.



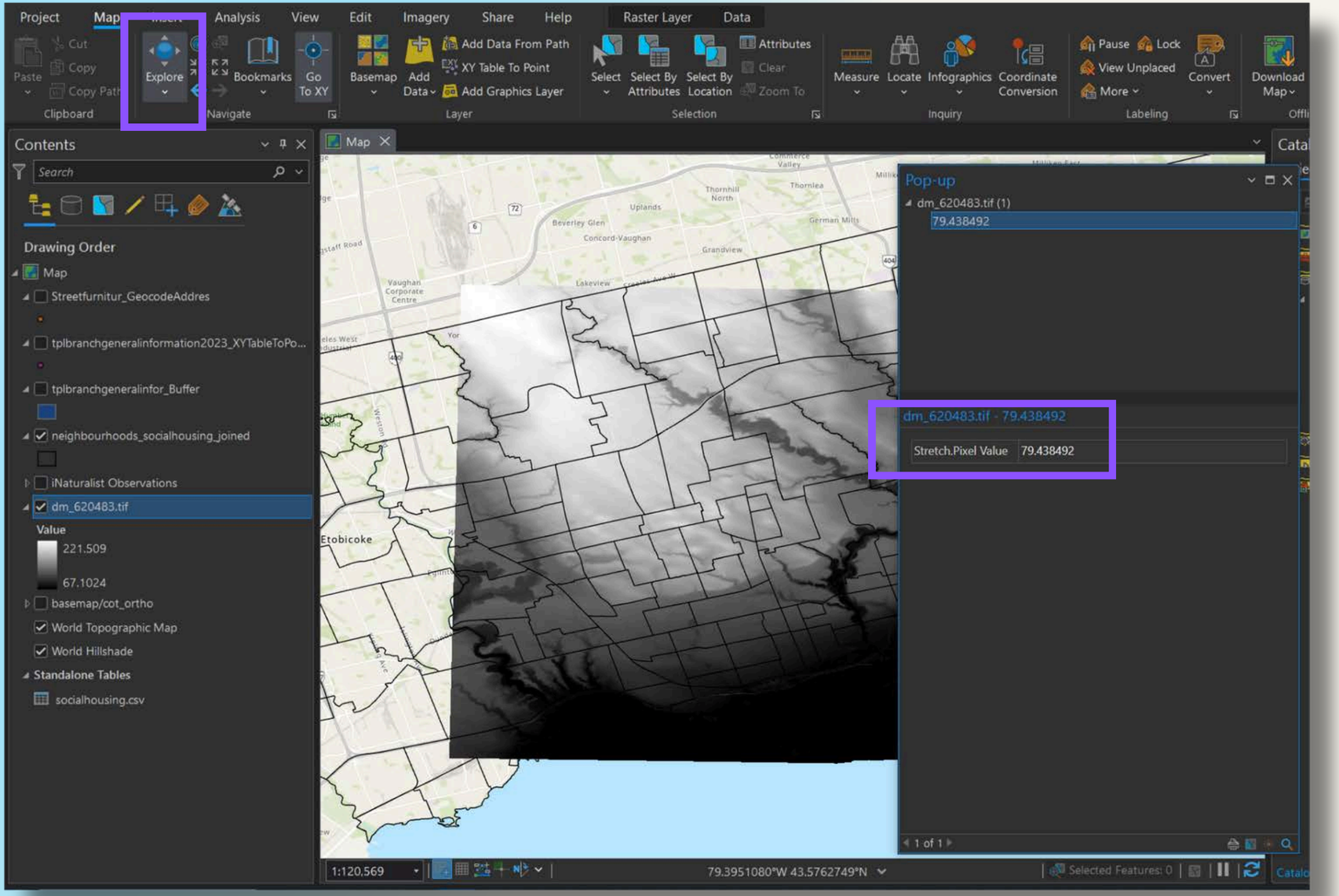
Working with Raster Data

- Note the number of **columns** and **rows**, number of **bands**, **cell size**, and **spatial reference**.



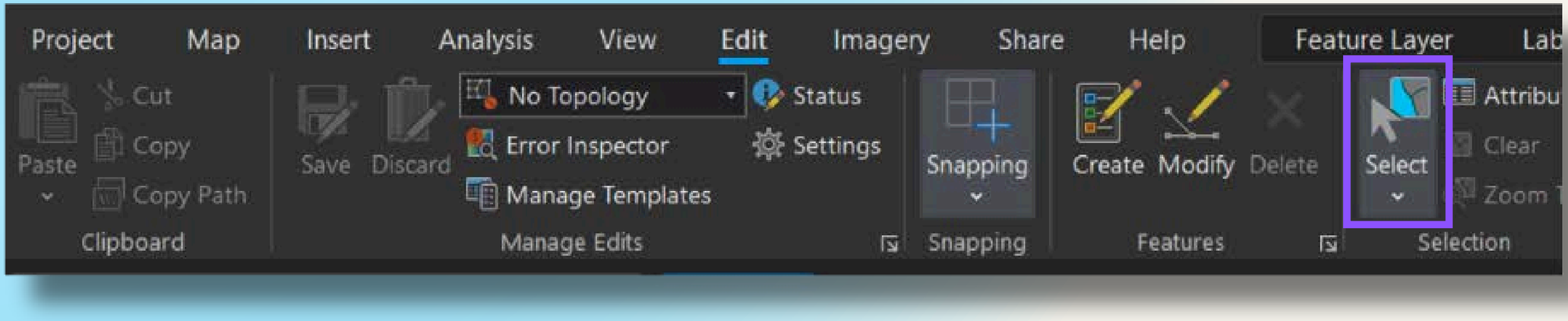
Working with Raster Data

- The **Explore** tool can be used to query pixel (elevation) values



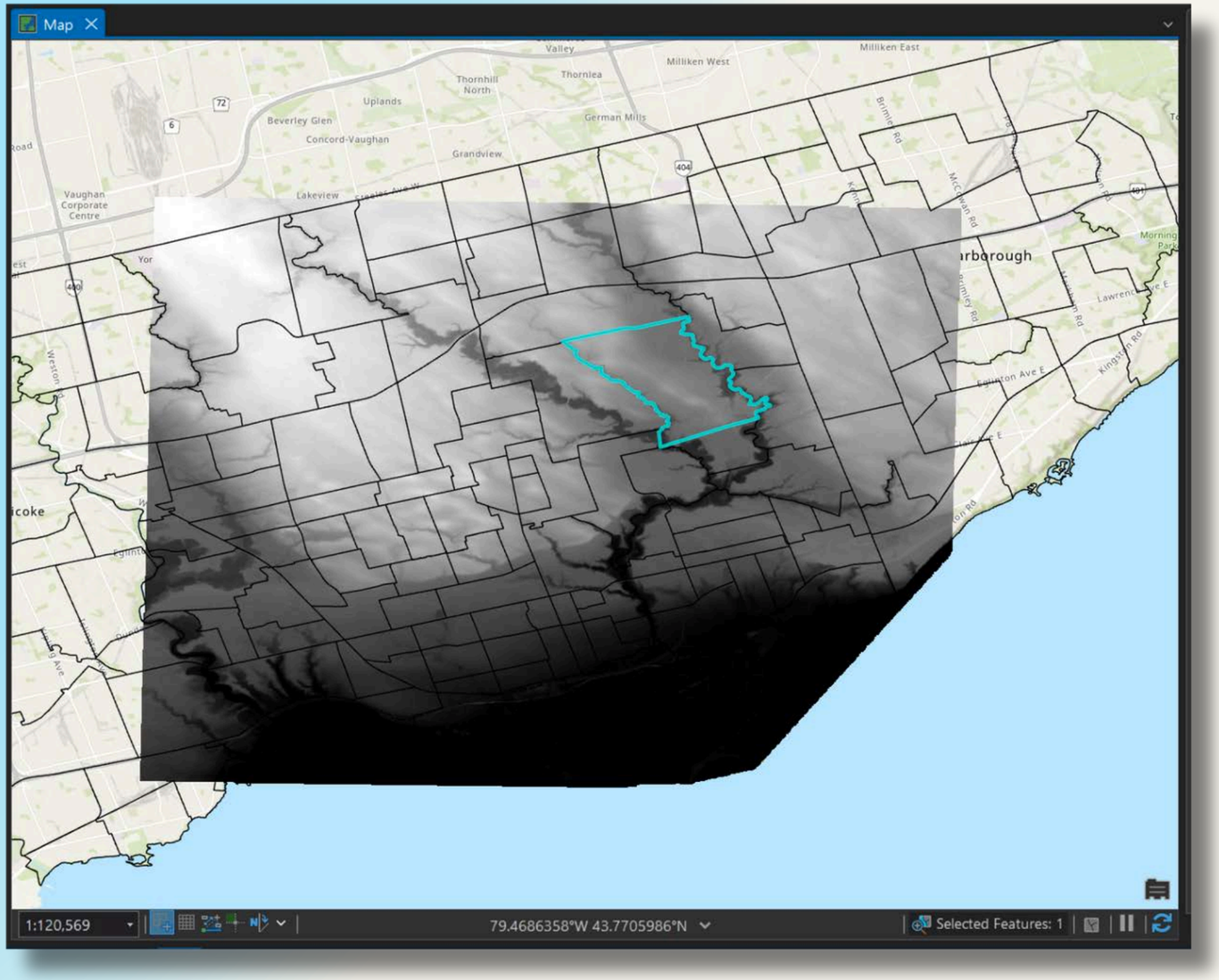
Working with Raster Data: Geoprocessing

- From the Edit tab/Selection group, choose the **Select** tool.



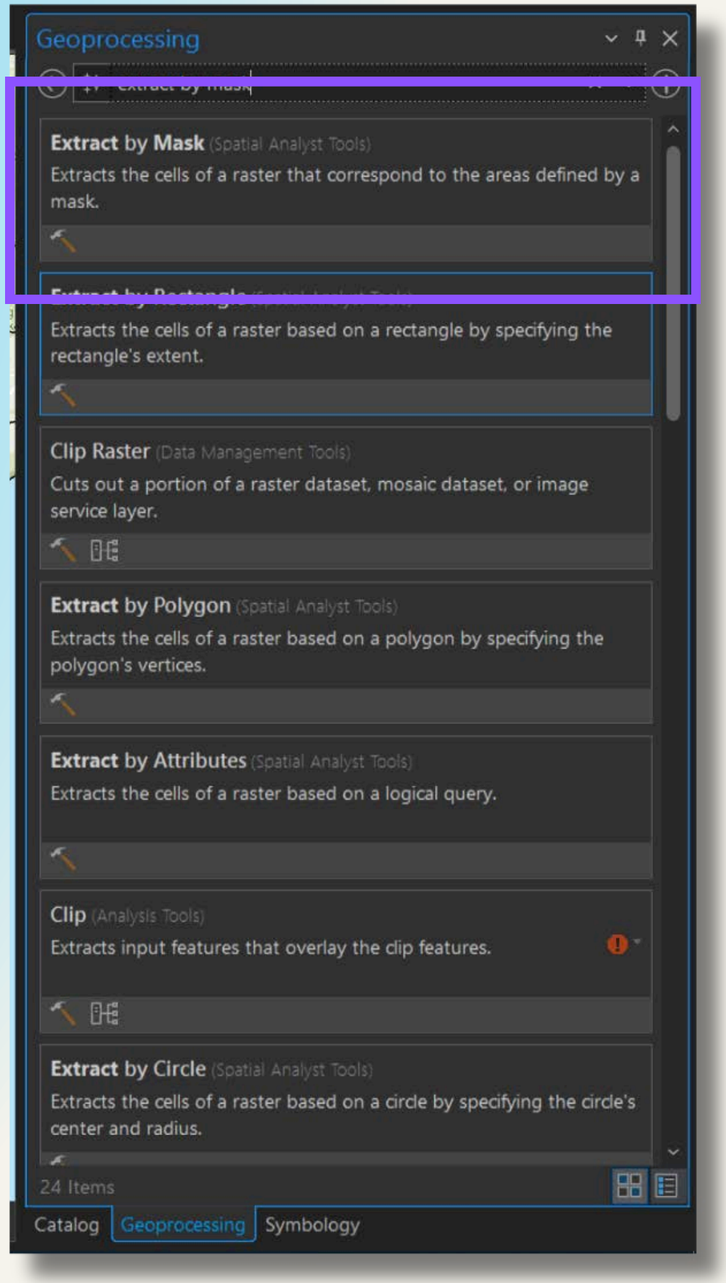
Working with Raster Data: Geoprocessing

- Click within the map view to select one of the neighbourhood polygons.



Working with Raster Data: Geoprocessing

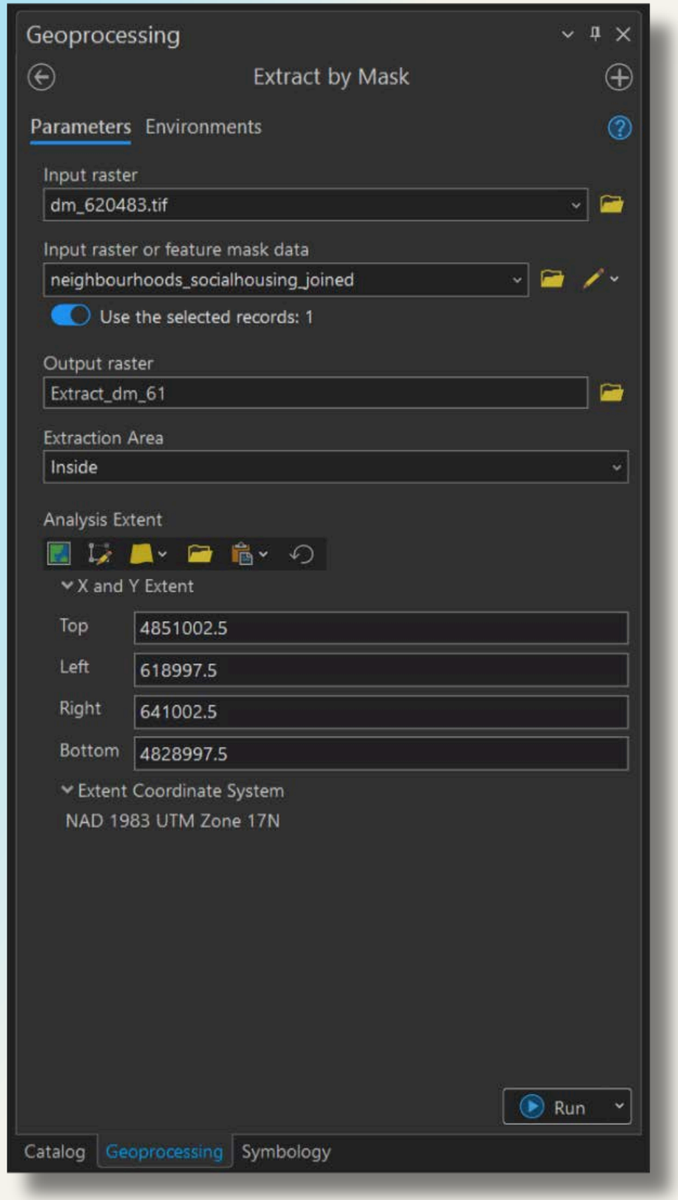
- From the **Geoprocessing** pane, open the **Extract by Mask** tool.



Working with Raster Data: Geoprocessing

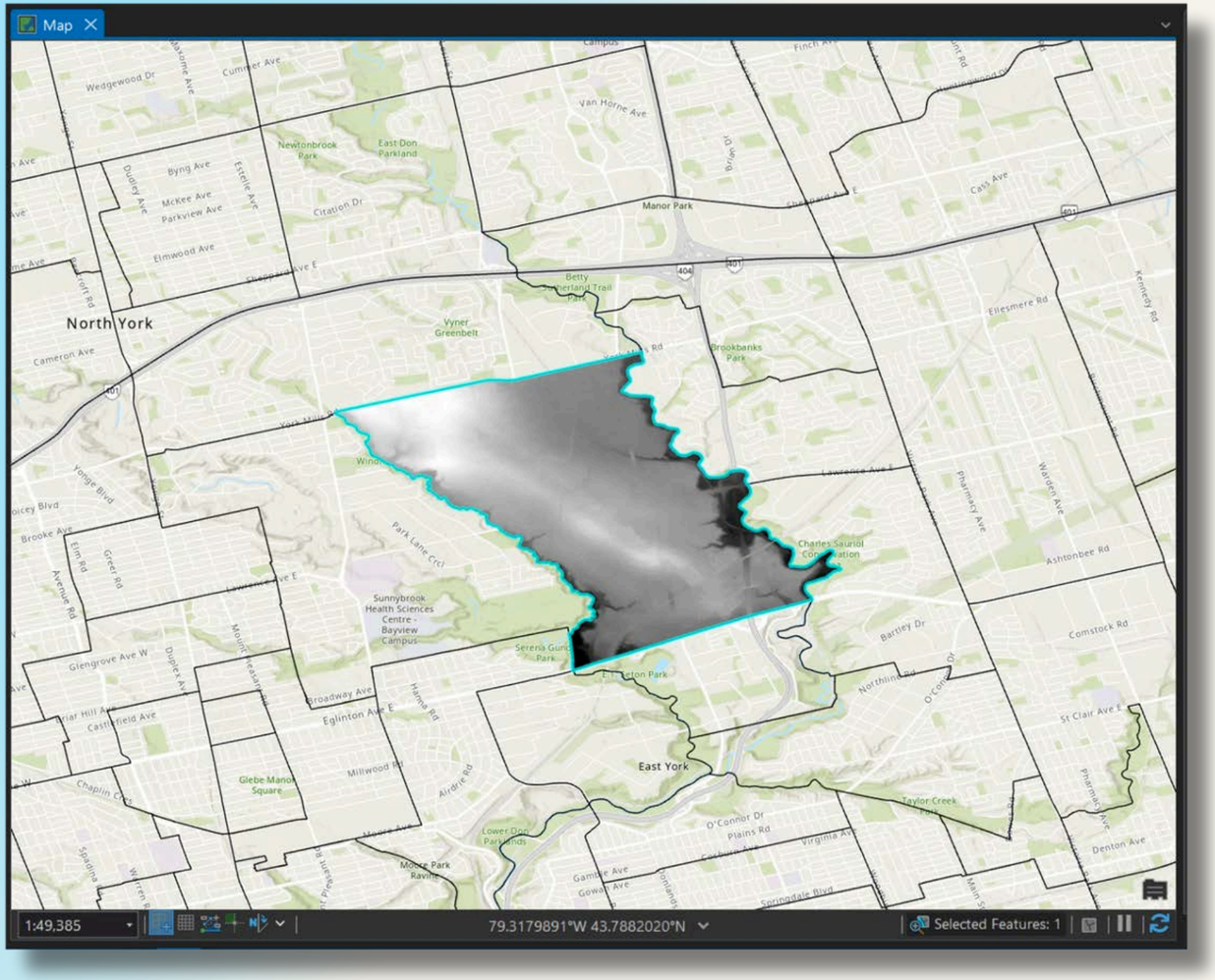
Input Parameters:

- Input raster: DEM
- Input raster or feature mask data: The neighbourhoods layer
- Note that the tool honours the layer selection
- Click Run.



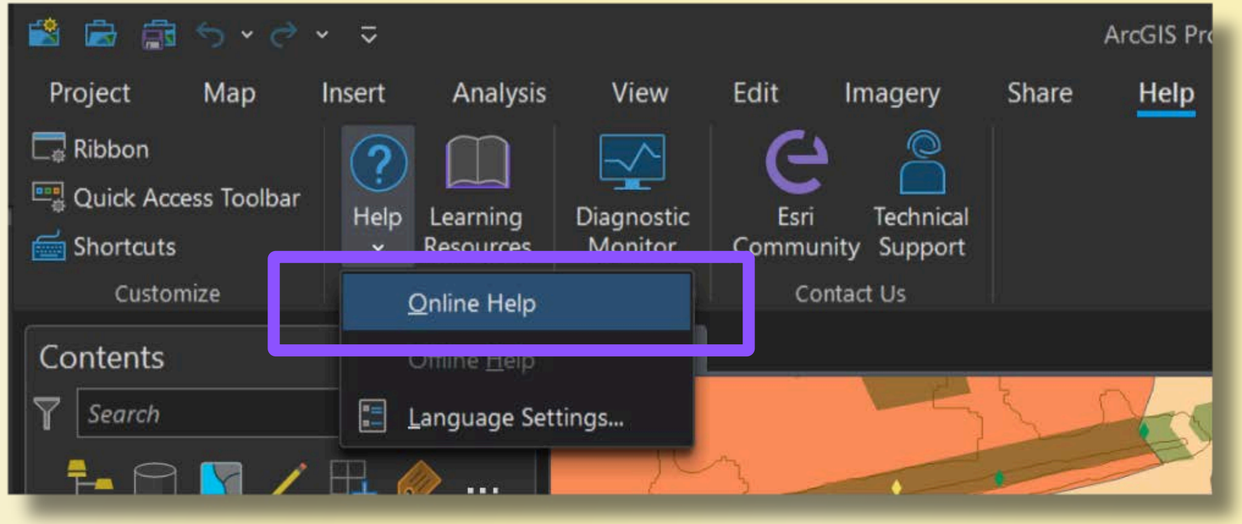
Working with Raster Data: Geoprocessing

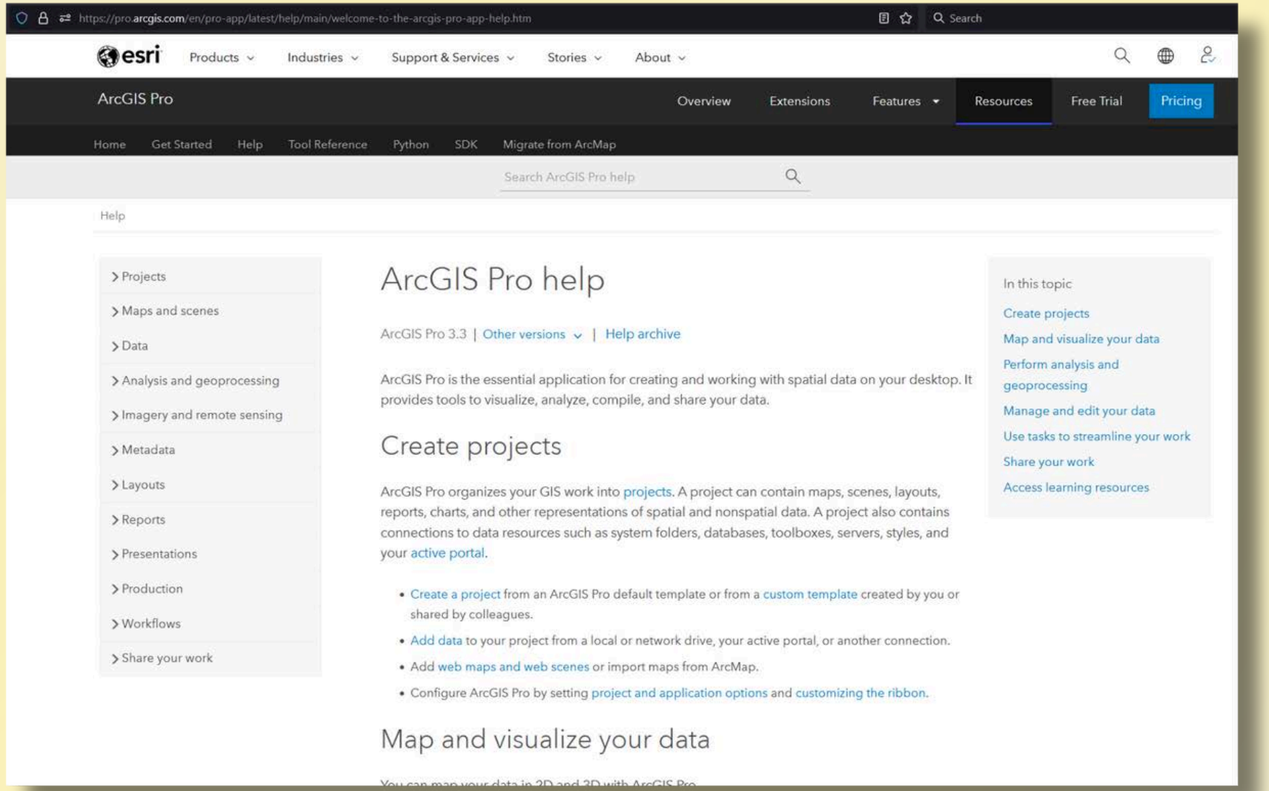
Result:



Getting Help

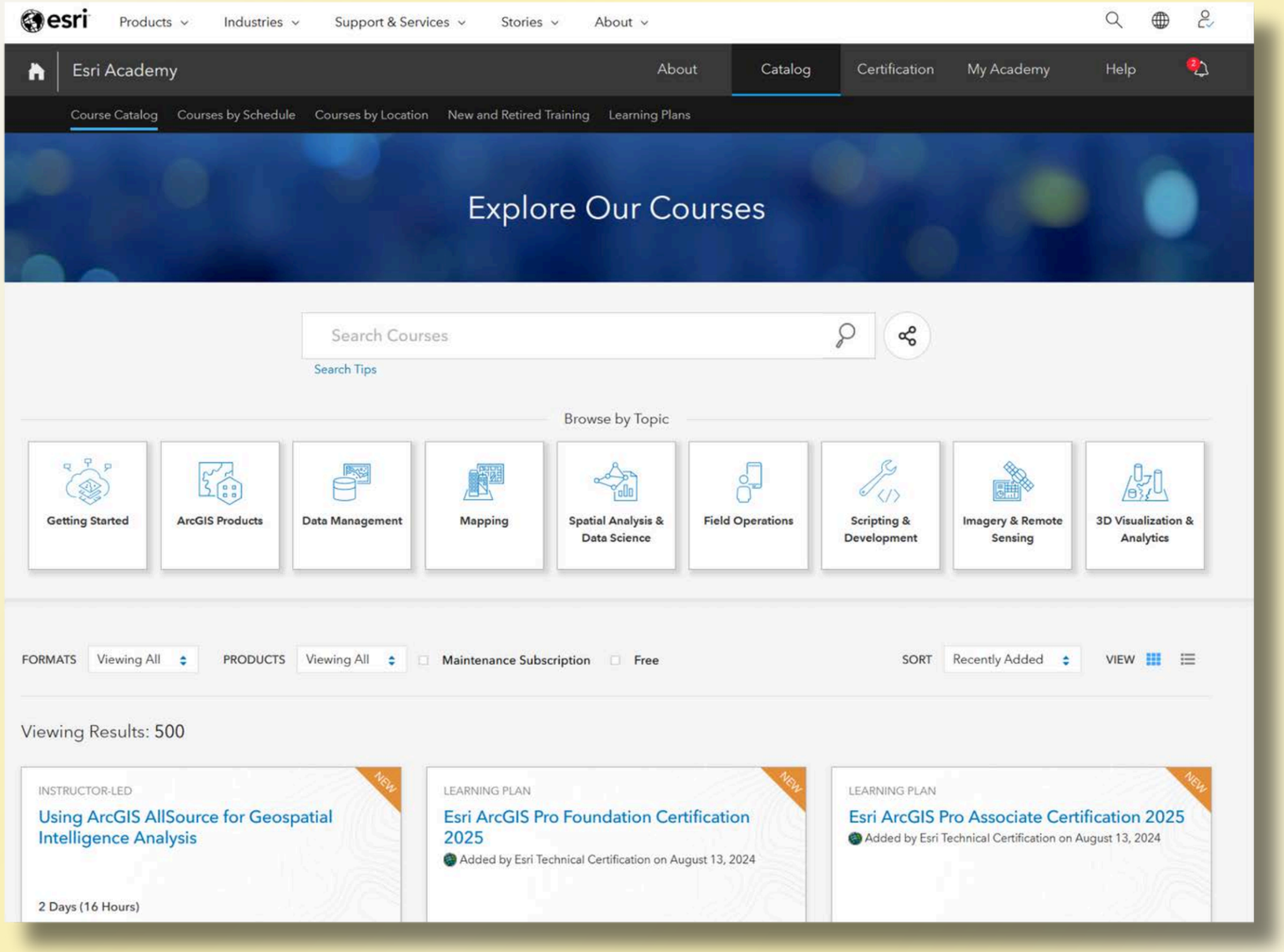
- From the **Help** tab in Pro, choose **Help -> Online Help**
- A website will be launched where you can access detailed documentation for the latest version of Pro.





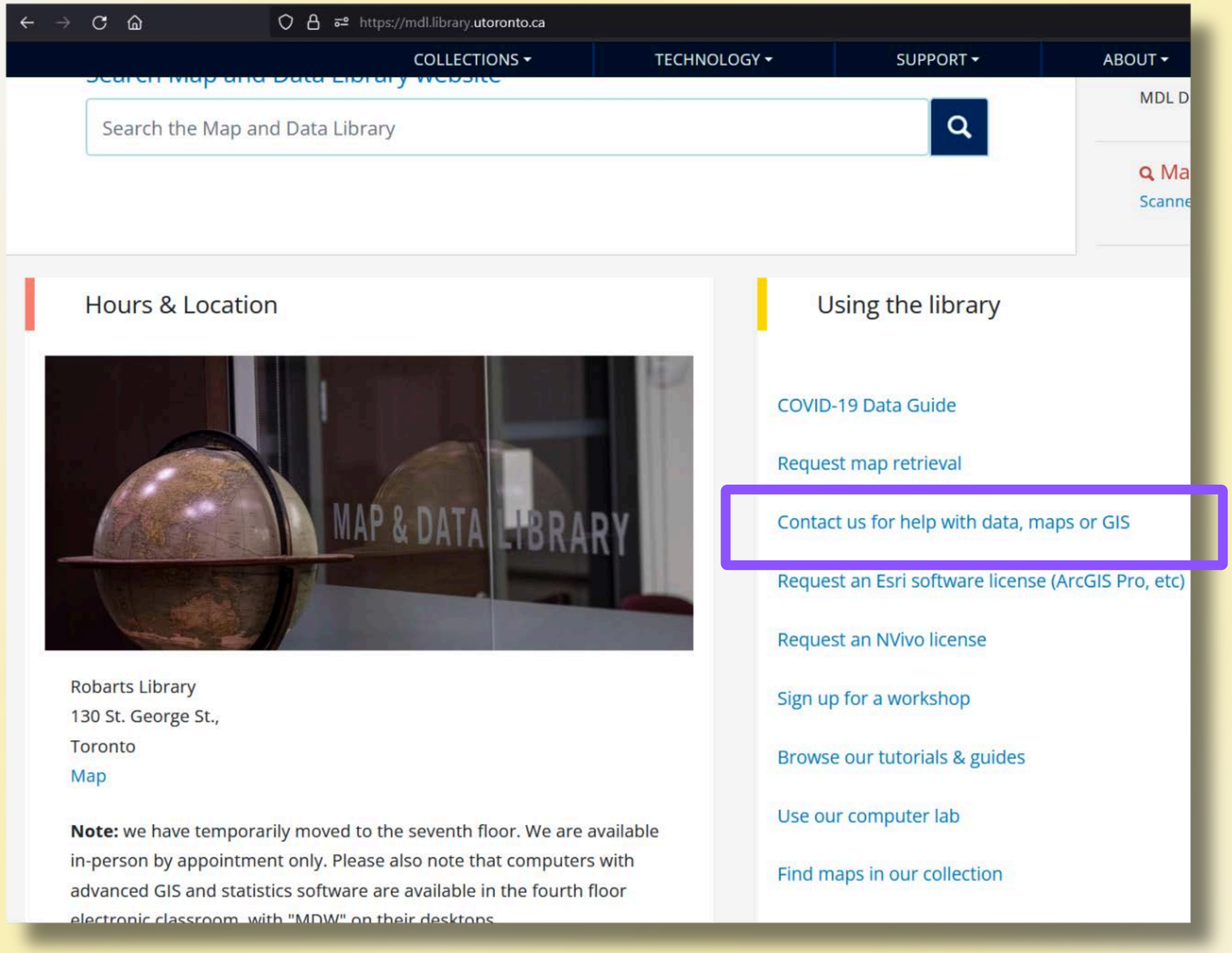
Getting Help

- Visit https://www.esri.com/training/ and log in with your UTORid.
- The **Course Catalog** contains many helpful, beginner-friendly tutorials.



Getting Help

- Contact the Map and Data Library



Next Steps

- Layout creation
- Analysis
- Working with raster data
- Automation
- Artificial Intelligence/Machine Learning

Resources: Finding Spatial Data

MDL Geospatial Data Collection
https://mdl.library.utoronto.ca/collections/geospatial-data

Scholars GeoPortal
https://geo.scholarsportal.info

Natural Earth Data
https://www.naturalearthdata.com/

Open Street Map
https://www.openstreetmap.org

City of Toronto Open Data
https://open.toronto.ca/

Ontario GeoHub
https://geohub.lio.gov.on.ca/

Toronto and Region Conservation Authority Open Data
https://data.trca.ca/

GIS at NASA
https://www.earthdata.nasa.gov/learn/gis

ArcGIS Hub
https://hub.arcgis.com/search

Living Atlas
https://livingatlas.arcgis.com/en/home/

USGS EarthExplorer
https://earthexplorer.usgs.gov/

Thank you!