

# Geography 222

## Laboratory 4

### Introduction

The following lab will introduce you to the power of buffers and overlay tools for conducting spatial analysis projects.

Simply put, a buffer is a polygon created around a feature. An overlay is the combination of two data layers used to identify which features (points, lines, or polygons) are over top of the other features. Overlays can be visual or topological. A topological overlay combines the spatial, and attribute, data of two (or more) layers to create another map layer.

In today's laboratory you will learn how to conduct:

- Point, Line, and Polygon buffers
- Intersect, and Erase overlays

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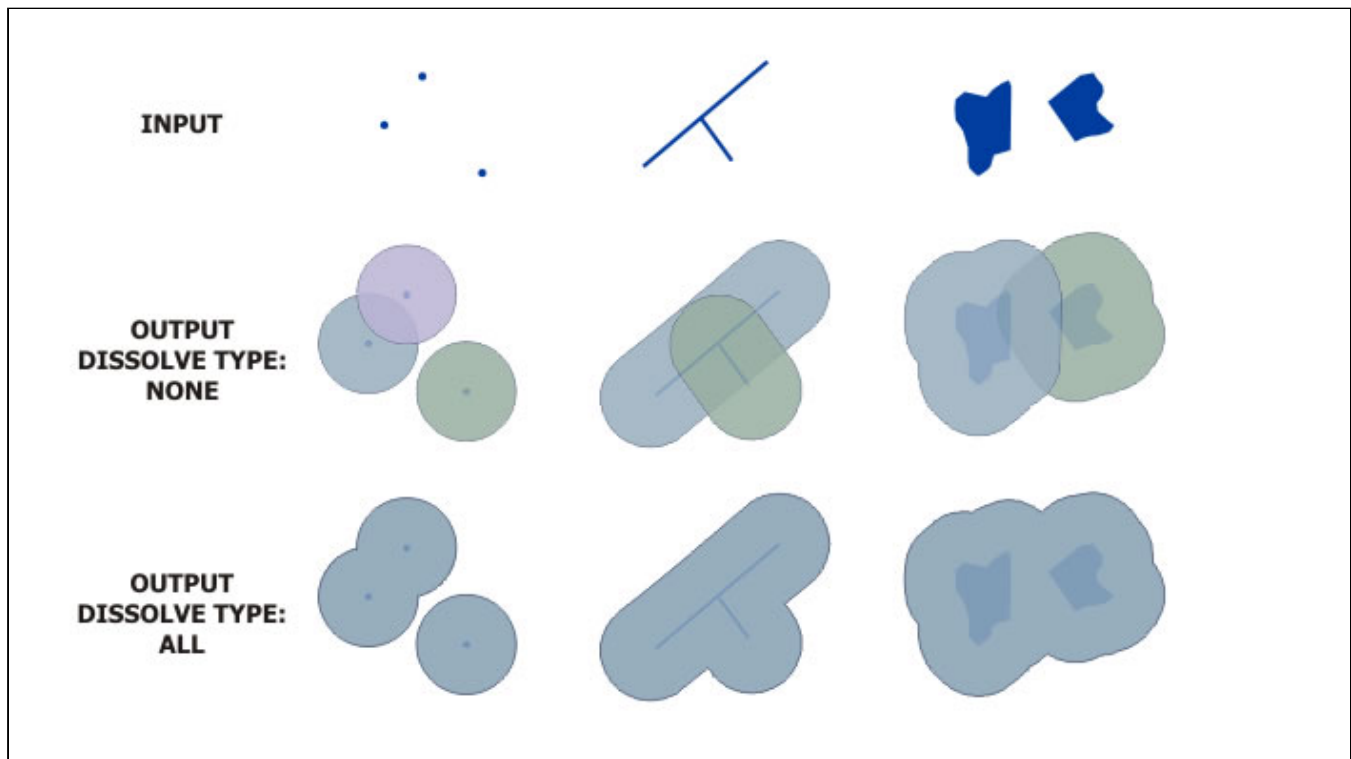
### Exercise

#### Buffers

Polygons generated from buffers are used to determine spatial proximity. You generate them when the analysis calls for identifying areas or zones surrounding geographic features (points, lines, or polygons). Polygons are the only features that can have a buffer *outside or inside* the feature.

The buffer geoprocessing tool will generate a new feature class (i.e., new file), consisting of polygons (one or more), surrounding one or a set of existing features. They can be dissolved (no overlap) or undissolved (overlapping).

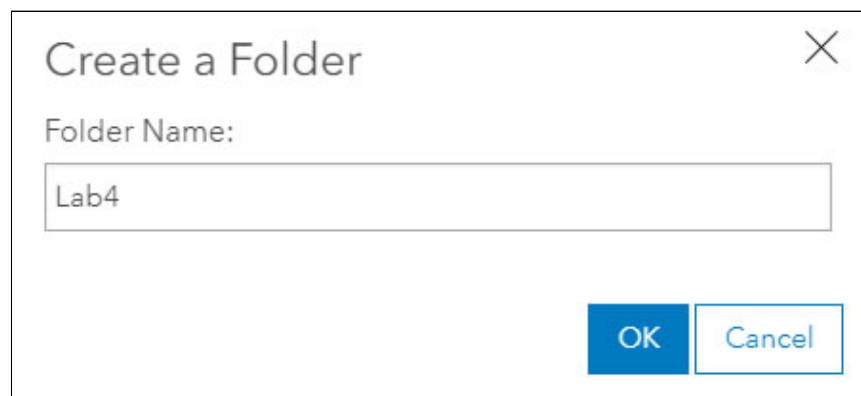
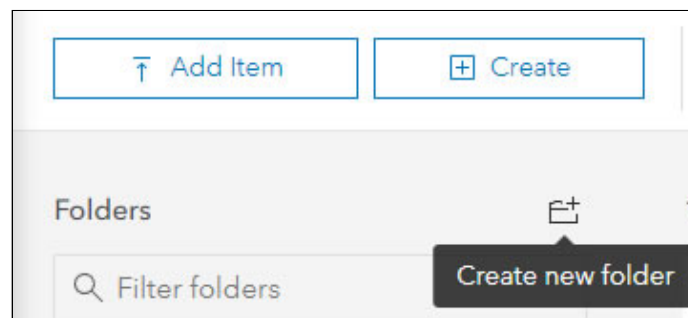
Examples of buffer analysis questions include: identifying all homes within 1 km of a grocery store (point), identifying all invasive plant species within 1 km of a river (line), or all crimes within 1 km of a census tract (polygon).



Source: <http://pro.arcgis.com/en/pro-app/tool-reference/analysis/buffer.htm>

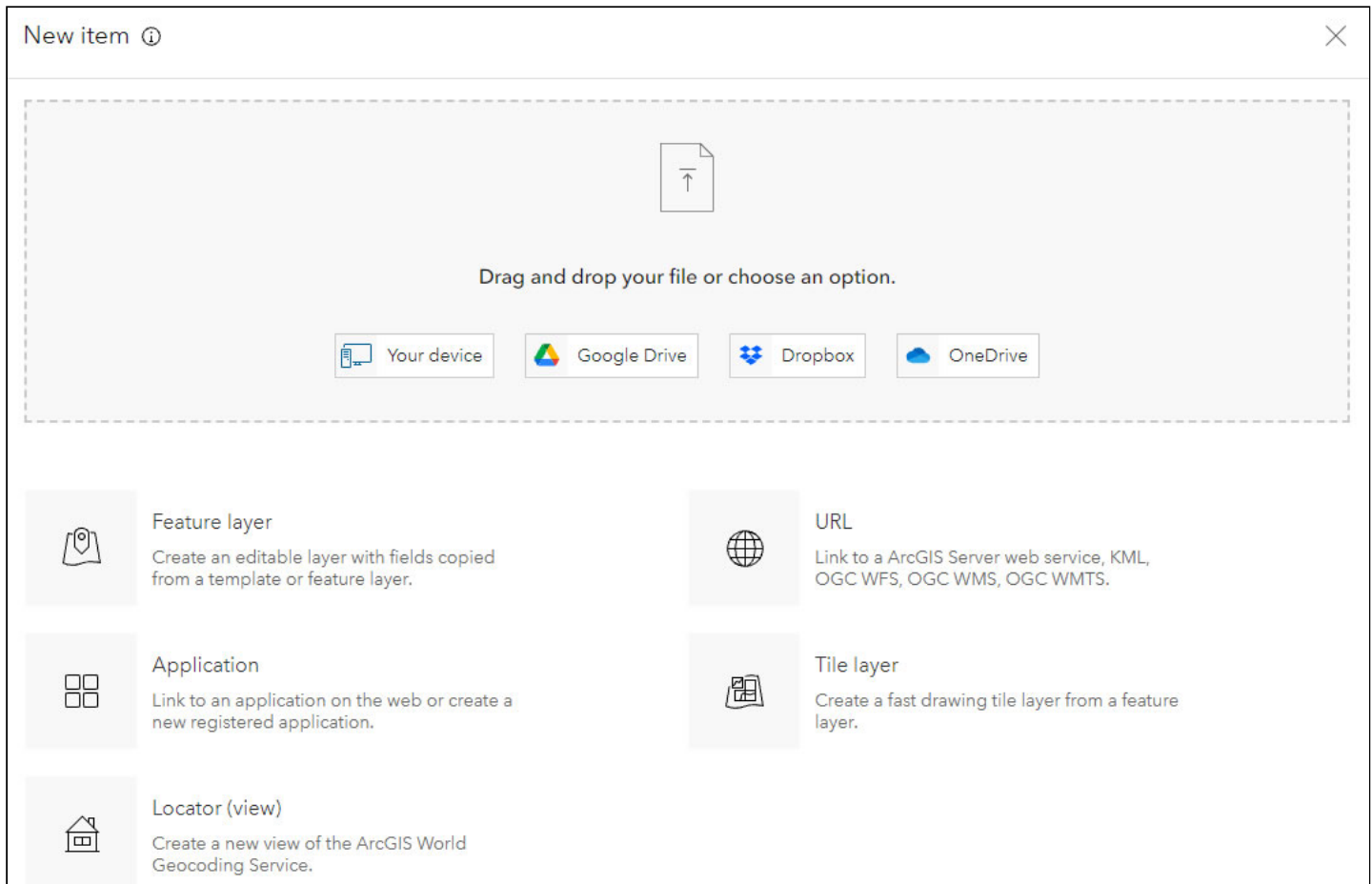
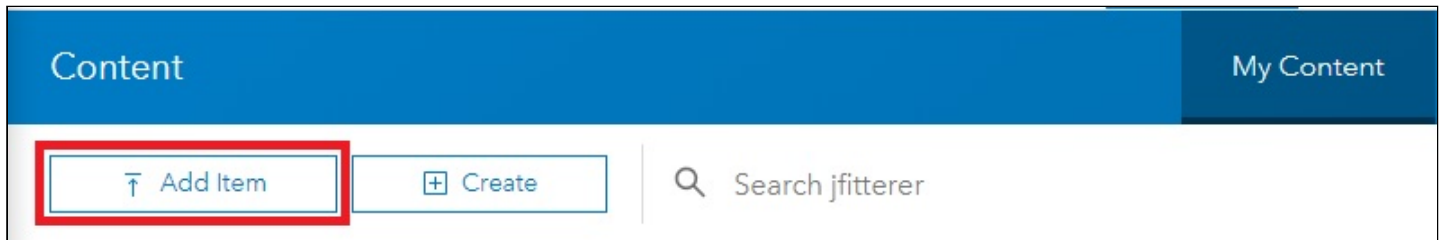
Let's use ArcGIS Online to explore buffer creation.


1. Login to [ArcGIS Online](#)
2. Download the [Lab Data](#) to your Lab 4 folder
3. In ArcGIS Online go to the Content tab and select "Create New Folder"



- Press **OK**

From the **Lab4** folder, select **Add Item** → From your computer




- Drag and drop the **CensusSubdivision** layer into the **Add Item** box  **CensusSubdivision**
- Add the Feature as a **hosted feature layer** → press **Next**

New item ⓘ

File  
CensusSubdivision.zip

Item type  


**Shapefile**  
A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.

How would you like to add this shapefile?

☒ **Add CensusSubdivision.zip and create a hosted feature layer**  
A shapefile with location information is the source for a hosted layer that displays as points on a map. A shapefile without location information displays as a table that can be viewed, charted and joined with other layers.

☐ **Add CensusSubdivision.zip only**  
Add shapefile without publishing. File can be shared and downloaded by others or published at a later date.

Back
Cancel
Next


- Change the file name to include your netlink ID and add tags and summary as set below:

New item ⓘ

File  
CensusSubdivision.zip

Title  
CensusSubdivision\_jlaura

Folder  


Lab4

Tags  
Census Subdivision × Add tags

Summary  
Census Subdivision

Characters left: 2030

- Press **Save**


4. Go back to the **Content** tab → select the **Lab4** folder → **Add Item**

- Drag and drop the CRD\_Roads.zip layer
- Choose: **Add "CRD\_Roads.zip" and create a feature hosted layer** → Next

New item ⓘ

File  
CRD\_Roads.zip

Item type  


**Shapefile**  
A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.

How would you like to add this shapefile?

☒ Add CRD\_Roads.zip and create a hosted feature layer  
A shapefile with location information is the source for a hosted layer that displays as points on a map. A shapefile without location information displays as a table that can be viewed, charted and joined with other layers.

☐ Add CRD\_Roads.zip only  
Add shapefile without publishing. File can be shared and downloaded by others or published at a later date.

Back
Cancel
Next


- Change the file name to include your netlink ID and add tags and summary as set below:

New item ⓘ

File  
CRD\_Roads.zip

Title

Folder  


Lab4

Tags  

CRD Roads × Add tags

Summary

Characters left: 2039

- Press Save

5. Go back to the **Content** tab → select the **Lab4** folder → **Add Item**

- Drag and drop the Hospital.zip layer
- Choose: **Add "Hospital.zip" and create a feature hosted layer** → Next

- Set the summary and tags as:

New item ⓘ

File  
Hospitals.zip

Title  
Hospitals\_jlaura

Folder  
Lab4

Tags  
Hospitals x Add tags

Summary  
Hospitals

Characters left: 2039

- Press **Save**

6. Go back to the **Content** tab → select the **Lab4** folder → **Add Item**

- Drag and drop the **Malls.zip** layer
- Choose: **Add "Malls.zip" and create a feature hosted layer** → Next
- Set the summary and tags as:

New item ⓘ

File  
Malls.zip

Title  
Malls\_jlaura

Folder  
Lab4

Tags  
Malls x Add tags

Summary  
Malls

Characters left: 2043

- Press **Save**

7. Go back to the **Content** tab → select the **Lab4** folder → **Add Item** → From your computer

- Drag and drop the **Vic\_Census\_Join.zip** layer

- Choose: **Add "Vic\_Census\_Join.zip" and create a feature hosted layer** → Next
- Set the summary and tags as:

New item ⓘ

File  
Vic\_Census\_Join.zip

Title  
Vic\_Census\_jlaura

Folder  
Lab4

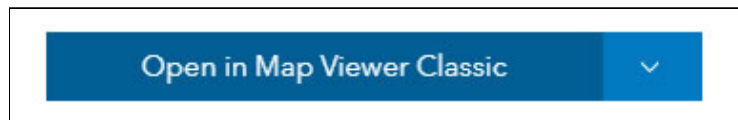
Tags  
Vic Census × Add tags

Summary  
Vic\_Census

Characters left: 2038

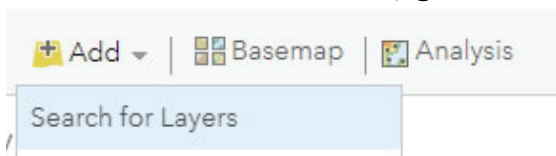
- Press **Save**

8. Once you have added the Census Tracts, use the Open in Map Viewer button to create an active map.

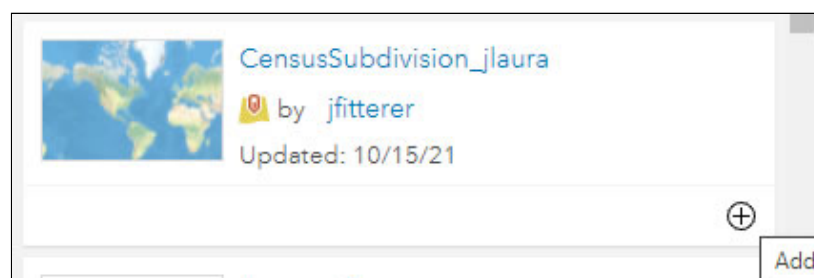


- Set symbology to "show location only" and press Done

9. From the details menu, go to **Add** data  and **search for layers**



to add to the map:





## Point Buffer

**HYPOTHETICAL SITUATION:** The Capital Regional District (CRD) has commissioned a study to reduce noise levels around each hospital. They propose creating a one kilometre 'quiet' zone around all hospitals and they need to know the area ( $m^2$ ) that will be affected for each hospital.

1. Open the **Analysis** menu, and select the **Create Buffers** tool



2. Enter the buffer size: 1 kilometer



1
Choose layer containing features to buffer

Hospitals

2
Enter buffer size

Distance

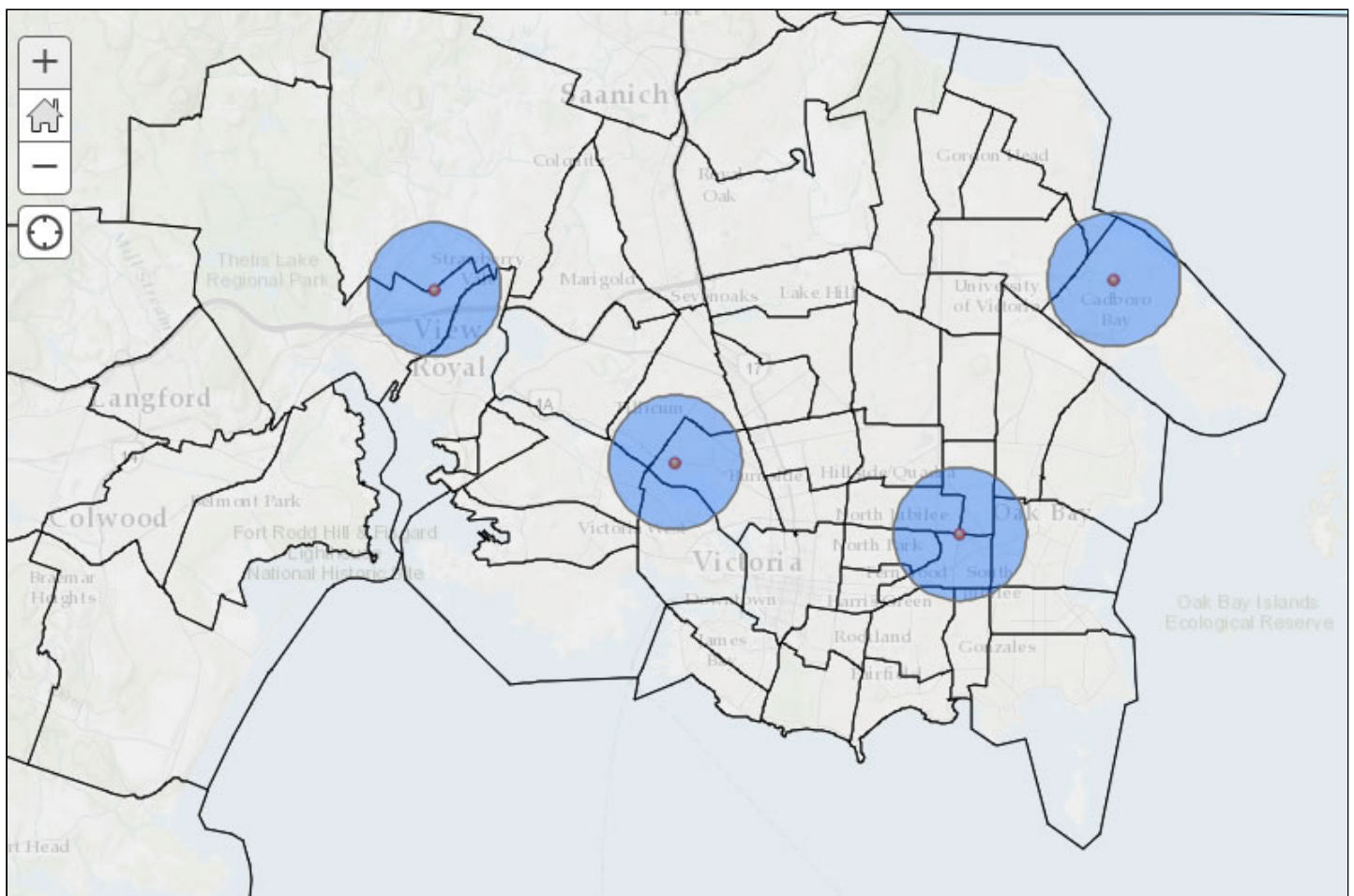
Field

Enter buffer size

1
Kilometers

- Uncheck ☐ Use current map extent

Press **Run Analysis**

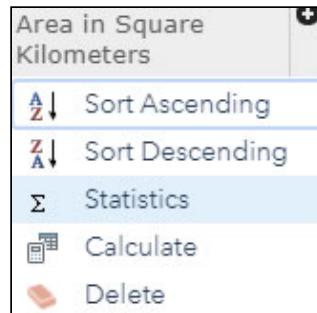


2. Open the Buffer of Hospitals Attribute Table

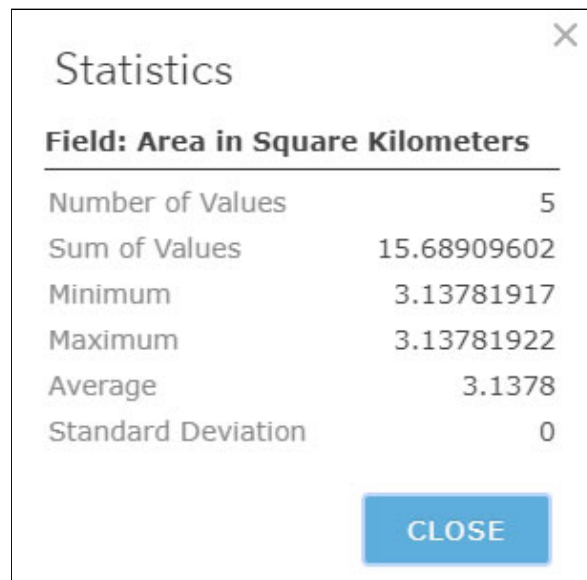


3. Scroll to the "**Area in Square Kilometers**" column

4. Calculate Statistics:



5. Read the sum of the statistics to get the **Total Area**:



The total area is: 15.69km<sup>2</sup>

## Line Buffer

HYPOTHETICAL SITUATION: The CRD is proposing a 100 meter no garbage zone around the Patricia Bay highway and they need to know how much land will be affected by this new policy (km<sup>2</sup>).

Before you can begin to create the new buffer, you have to select 'Patricia Bay' from CRD\_Roads layer (if you need a refresher on attribute queries, revisit Lab 3).

1. Select the Analysis  button

2. Navigate to the "**Find Existing Locations**" and enter the following query:

**Find Existing Locations**

**1 Choose layer containing features you want to find using attribute and spatial queries**

CRD\_Roads

**2 Build a query to find features**

CRD\_Roads where NAME is 'Patricia Bay'

and

CRD\_Roads where TYPE is 'HWY'

**ADD EXPRESSION**

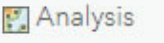
**3 Result layer name**

Patricia Bay Hwy in CRD\_Roads

Save result in jfitterer

- Uncheck ☐ Use current map extent
- Press **Run Analysis**

With the highway selected, you will create a 100m no garbage zone.

3. Select the Analysis  button → Use Proximity → Create Buffers → set the parameters as follows:

Choosing the Patricia Bay highway from the drop down, you can create the 100m buffer around the road.

**Create Buffers**

**1 Choose layer containing features to buffer**

Patricia\_Bay\_Hwy\_in\_CRD...

**2 Enter buffer size**

**Distance** **Field**

Enter buffer size

100 Meters

To create multiple buffers, enter distances separated by spaces (2 3 5).

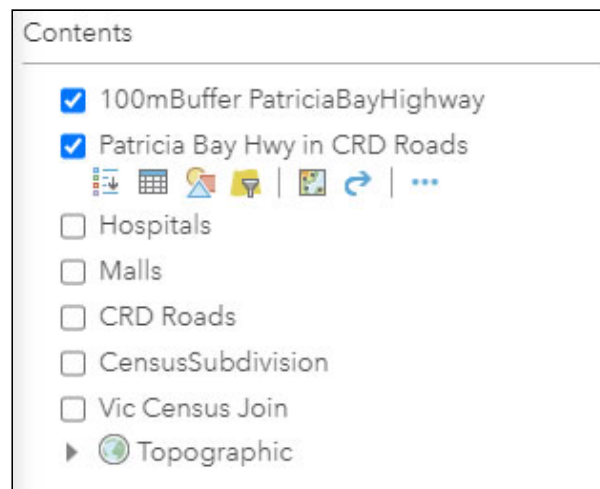
+ Options

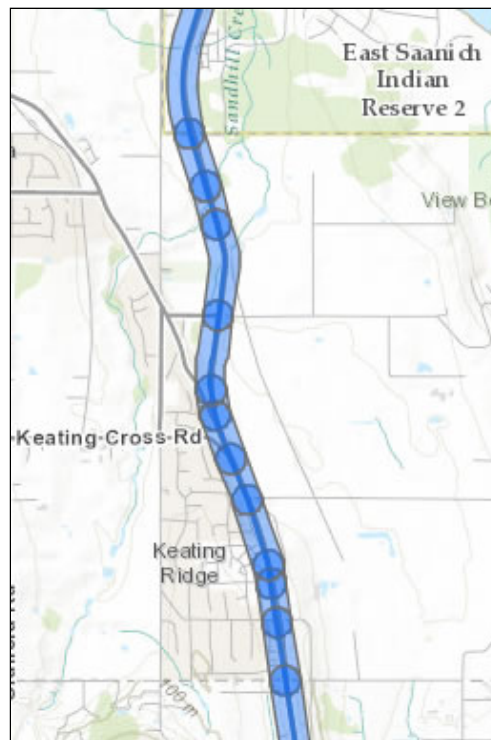
**3 Result layer name**

100mBuffer\_PatriciaBayHighway

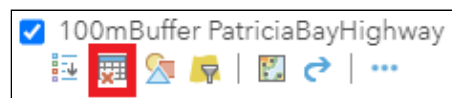
- Uncheck ☐ Use current map extent
- Press **Run Analysis**

If you uncheck the other layers, you will notice that the buffer created overlapping polygons.





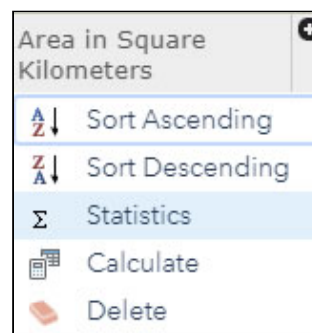
Also, if you open the layer's attribute table



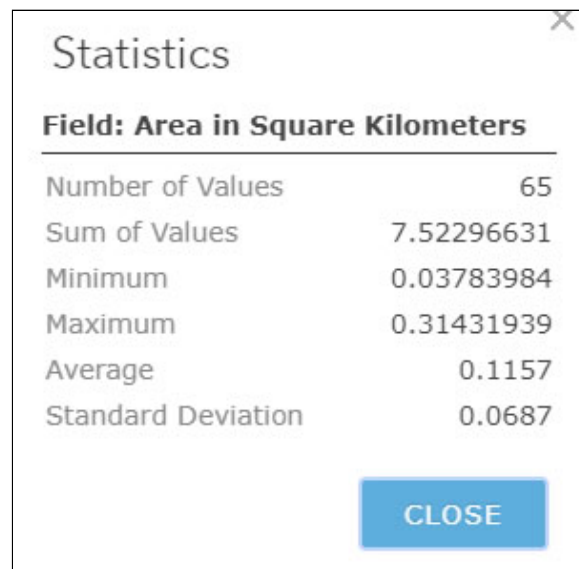
You will see the **Area in Square kilometers** column:

Area in Square Kilometers
0.04
0.04
0.04
0.05

- Right click → choose statistics:



Read the **Sum of the Values** to get the total area (7.53km<sup>2</sup>)




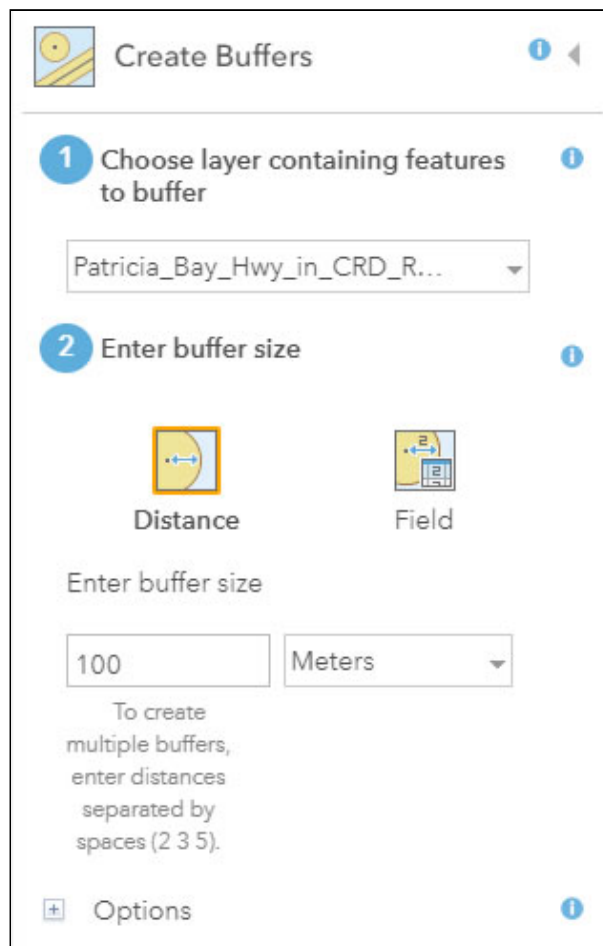
A dialog box titled "Statistics" with a close button (X) in the top right corner. It displays statistical data for a field named "Area in Square Kilometers".

Field: Area in Square Kilometers	
Number of Values	65
Sum of Values	7.52296631
Minimum	0.03783984
Maximum	0.31431939
Average	0.1157
Standard Deviation	0.0687

A blue "CLOSE" button is located at the bottom right of the dialog box.

Now you will want to create a dissolved buffer around the road:

4. Select the Analysis  Analysis button → Use Proximity → Create Buffers → set the parameters as follows:





A dialog box titled "Create Buffers" with a close button (X) in the top right corner. It contains two numbered steps for configuring a buffer.

**1 Choose layer containing features to buffer**

Patricia\_Bay\_Hwy\_in\_CRD\_R... ▼



**2 Enter buffer size**

 Distance  Field

Enter buffer size



100 Meters ▼

To create multiple buffers, enter distances separated by spaces (2 3 5).

 Options 




Options

Buffer type





OverlapDissolve

Side type



AroundLeftRight

End type



RoundFlat

3 Result layer name

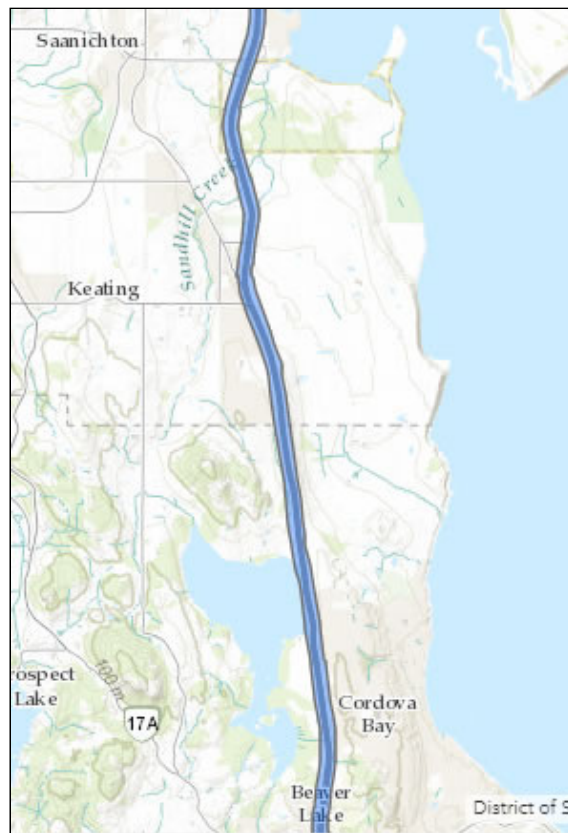
Buffer of Patricia\_Bay\_Hwy\_in\_CRD\_

Save result in jfitterer

☐ Use current map extent [Show credits](#)

RUN ANALYSIS

- Press **Run Analysis**



5. Open the **Attribute Table** for the **Dissolved 100m Buffer for the Patricia Bay Highway**



View the dissolved area:

Buffer of Patricia Bay Hwy in CRD Roads (Features: 1, Selected: 0)	
Buffer distance in Meters	Area in Square Kilometers
100.00	5.52

## Polygon Buffer

**HYPOTHETICAL SITUATION:** The Langford Association is considering a 'parking-free' zone around the downtown core to encourage people to shop there. Census tract 9350151.04 has been chosen, and they are contemplating a 250m zone outside that region. They need to know how much area  $\text{km}^2$  will be affected.

1. Select the Analysis  button

2. Navigate to the **"Find Existing Locations"** and enter the following query:



**Find Existing Locations**

**1** Choose layer containing features you want to find using attribute and spatial queries

Vic\_Census\_Join

**2** Build a query to find features

Vic\_Census\_Join where GUID is 9350151.04

**ADD EXPRESSION**


**3** Result layer name

Find Locations in Vic\_Census\_Join

Save result in jfitterer

- Uncheck ☐ Use current map extent
- Press **Run** Analysis

Now that the Langford census tract has been selected you can create the 250m parking-free zone.



1. Select the Analysis  Analysis button → Use Proximity → Create Buffers → set the parameters as follows:

**Create Buffers**

**1 Choose layer containing features to buffer**

Find\_Locations\_in\_Vic\_Cen...

**2 Enter buffer size**

Distance Field

Enter buffer size

250 Meters

To create multiple buffers, enter distances separated by spaces (2 3 5).

**Options**

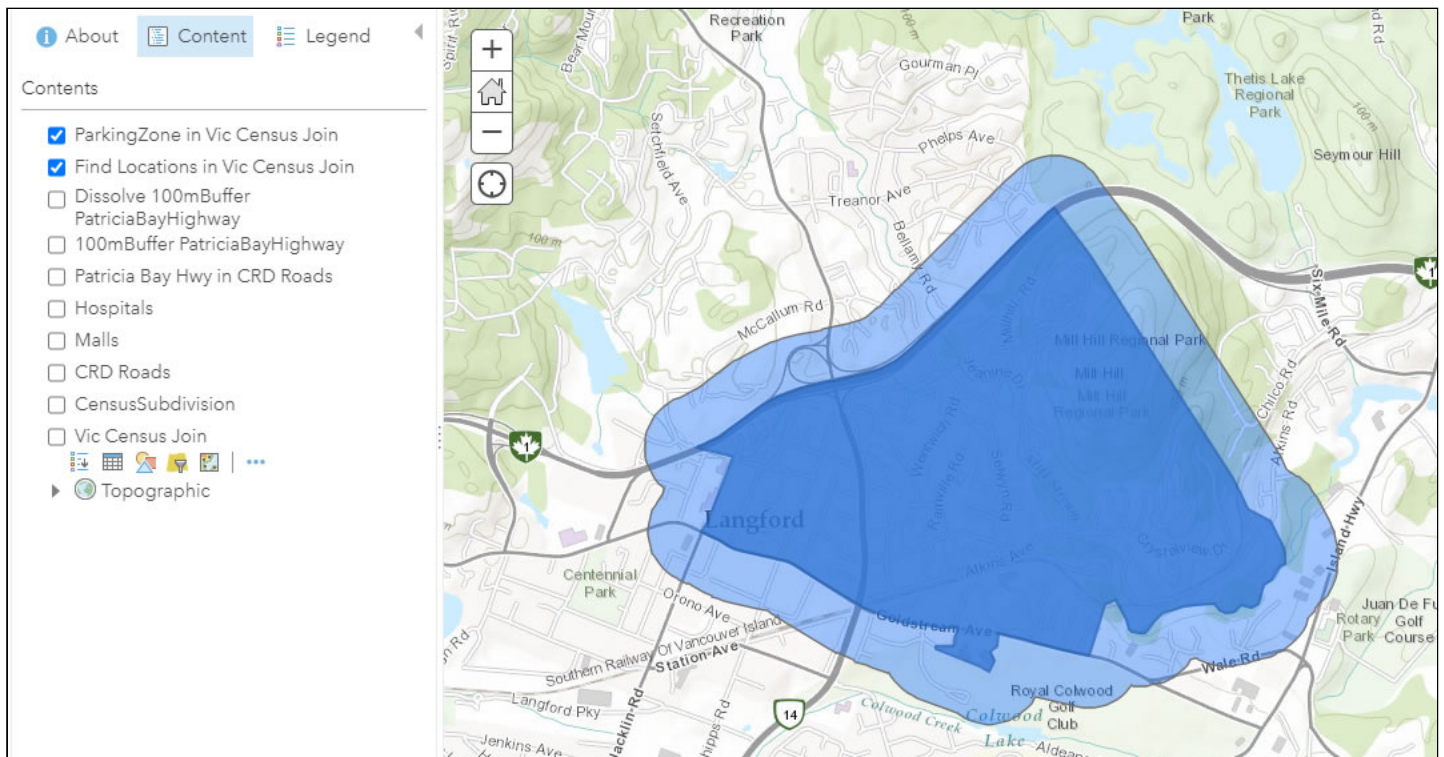
**3 Result layer name**

ParkingZone\_in\_Vic\_Census\_Join

Save result in jfitterer

- Uncheck ☐ Use current map extent
- Press **Run Analysis**

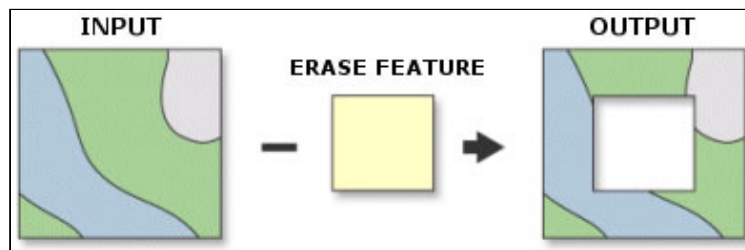
This will create a polygon that expands 250m around the 9350151.04 census tract

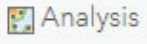


## Overlay Types

Now you will need to remove the Langford census tract area from the buffer using the **Erase** Overlay tool.

The Erase tool "creates a feature class by overlaying the input features with the polygons of the erase features. Only those portions of the input features falling outside the erase features outside boundaries are copied to the output feature class" <https://pro.arcgis.com/en/pro-app/tool-reference/analysis/an-overview-of-the-overlay-toolset.htm>



1. Select the Analysis  button → Manage Data → Overlay Layers → set the parameters as follows:

**Overlay Layers**

1 Choose input layer

ParkingZone\_in\_Vic\_Census\_...

2 Choose overlay layer

Find\_Locations\_in\_Vic\_Censu...

3 Choose overlay method

Intersect Union Erase

4 Result layer name

Erase ParkingZone\_Vic\_Census

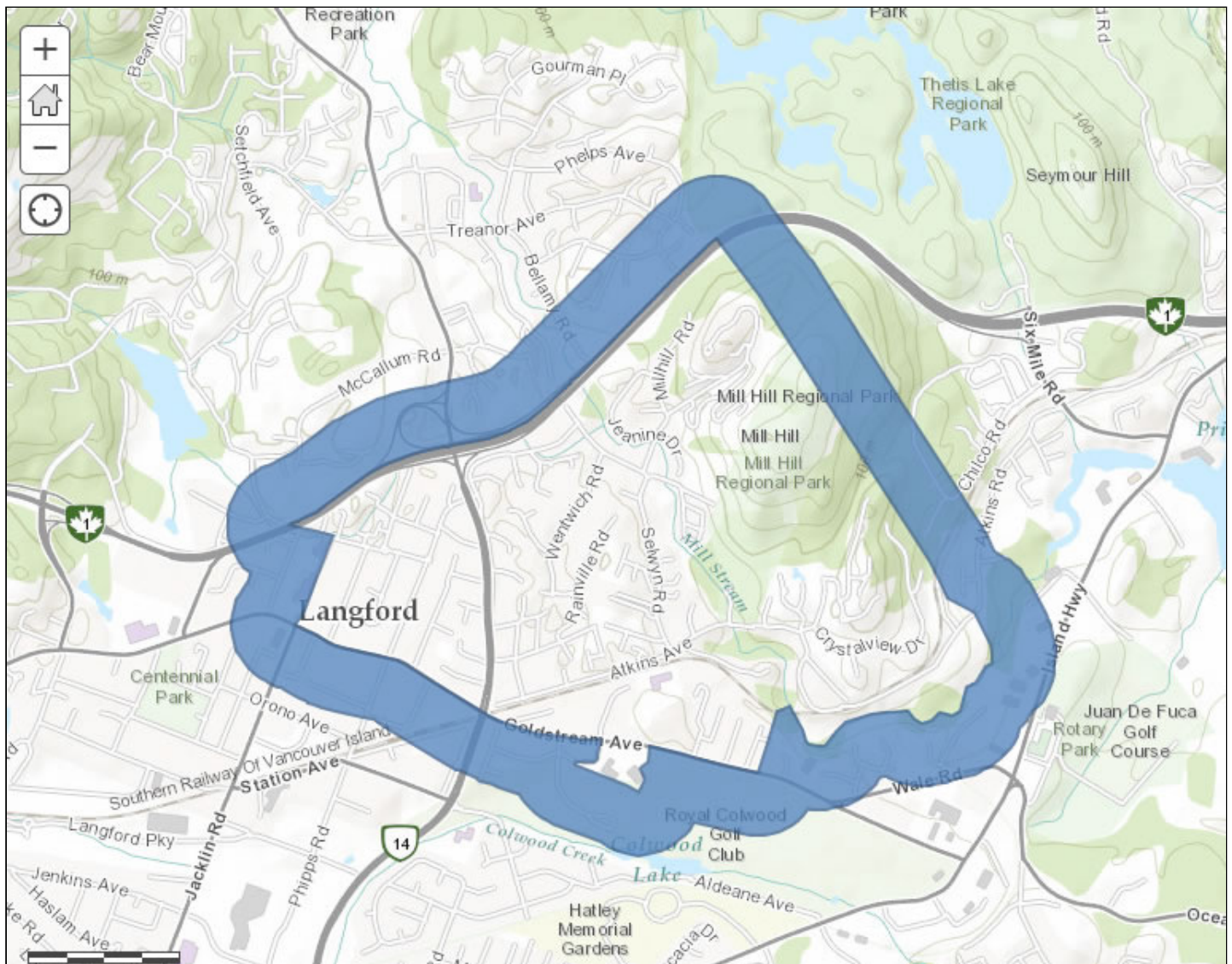
Save result in jfitterer

☐ Use current map extent [Show credits](#)

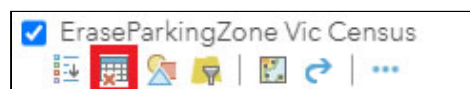
**RUN ANALYSIS**

- Press **Run Analysis**

2. You are left with the erased feature, which is the 250m buffer around the Langford census tract.



3. Now you can open the **EraseParkingZone Vic Census** layer to view the total area

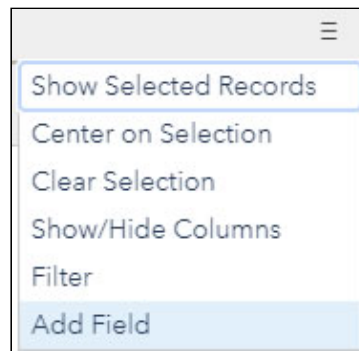


Area in Square  
Kilometers

2.21

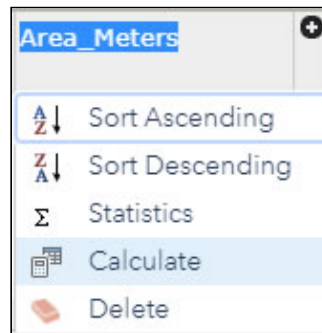
What happens if you want to know the Square Area of the polygon in meters or another unit?

1. First you will create a new **Area** column, by using the **Add Field** to the attribute table.

The 'Add Field' dialog box is shown. It has a title bar with a close button (X). Inside, there are four input fields: 'Field Name' with the value 'Area\_Meters', 'Display Name' with the value 'Area\_Meters', 'Type' with a dropdown menu showing 'Double', and 'Default Value: (Optional)' with the value '0'. At the bottom, there are two buttons: 'ADD NEW FIELD' in blue and 'CANCEL' in light blue.

- Press "Add New Field"

3. In the **Attribute Table** scroll to the new **Area\_Meters** column and use the drop down to calculate the Area.



- Choose the **Arcade**



## Calculate Field : Area\_Meters

Which language do you want to use?

### Arcade

Ideal For:

- Calculations that require more functionality than SQL including spatial operations
- Improved troubleshooting

**Arcade**

### SQL

Ideal For:

- Fastest performance
- Calculations that can be expressed using SQL
- Layers with Sync or Keep track of created and updated features enabled

**SQL**

[Learn more](#)

- Select **"Functions"** and choose **AreaGeodetic**
- **AreaGeodetic(\$feature, 'square-meters')**
- Press **OK**

## Arcade Calculator: Area\_Meters

Expression Test

1 `Area($feature, 'square-meters')`

Globals Functions Constants

Filter by Name

Abs	i
Acos	i
Angle	i
Area	i
AreaGeodetic	i
Asin	i
Atan	i
Atan2	i
Attachments	i

**OK** Cancel

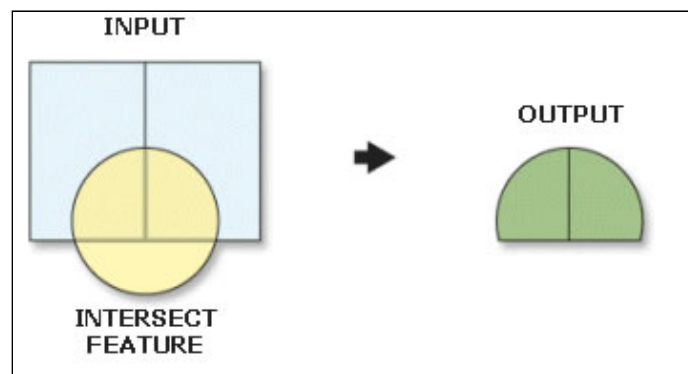
## Intersect

Intersect computes an intersection of the input layers. Features or portions of features which overlap in all feature classes/layers will be written to the output feature class. The input and overlay layers can be points, lines or polygon geometry.

If the inputs have different geometry types (line on polygon, point on line, etc), the output geometry type will default to the same as the Input features with the lowest dimension geometry. For example, if one of more of the inputs are points, the default output will be a point; if one or more of the inputs are lines, then the output will be a line; if all outputs are polygon, then the output will be polygon.

Use intersect when you want a resulting layer that:

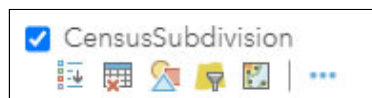
- A. has the combined attribute data of the features in the input and overlay layers, and
- B. only contains features that fall within the spatial extent of the overlap.



Source: <http://pro.arcgis.com/en/pro-app/tool-reference/analysis/an-overview-of-the-overlay-toolset.htm>

Let's revisit the example above but this time you want to isolate the malls within the Victoria census subdivision. The resulting output will only contain the malls within the Victoria region.

1. Turn the **CensusSubdivision** layer on in the content menu to identify the **Victoria** region from the **CensusSubdivision** layer






2. To identify the **Victoria** region from the **CensusSubdivision** file, select the Analysis



button → Find Existing Locations → set the parameters as follows:

**Note, that you have to use the unique value options to search for the Victoria title from the CSDName column when creating the query.**



 Find Existing Locations  

1

Choose layer containing features you want to find using attribute and spatial queries

1

CensusSubdivision






2

Build a query to find features

1

CensusSubdivision where  
CSDNAME is 'Victoria'

ADD EXPRESSION



3

Result layer name

1

Victoria in CensusSubdivision


Save result in

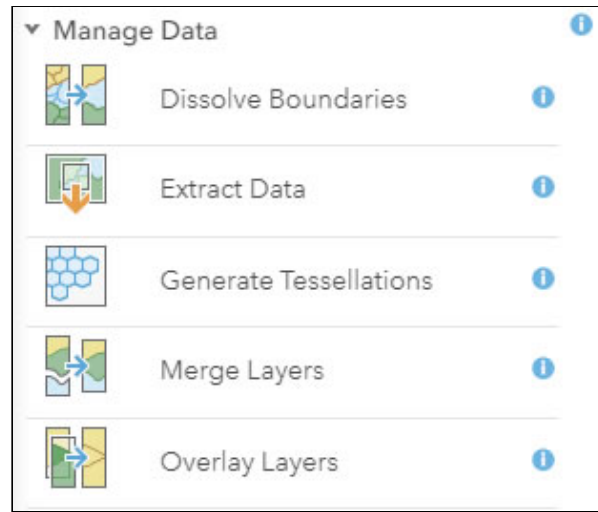
jfitterer

- Uncheck ☐ Use current map extent
- Press **Run Analysis**

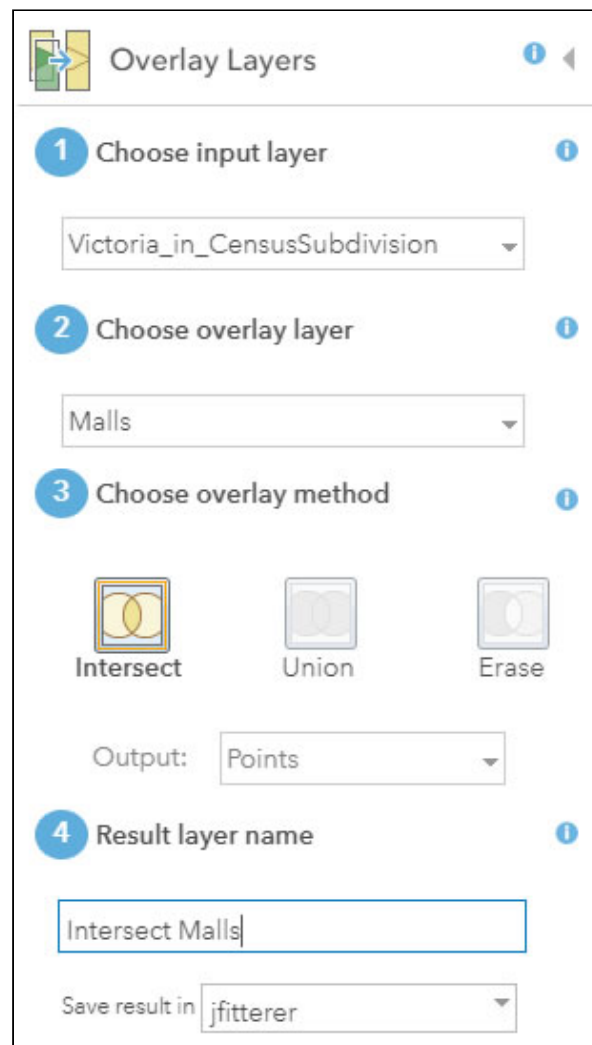
The output region will be the Victoria Census Area:



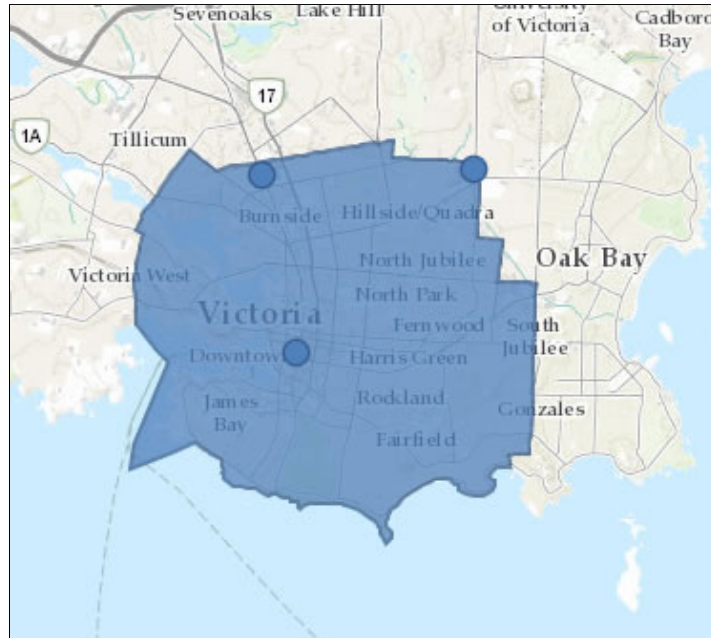
3. To run the intersect, go to the Analysis  Analysis button → Manage Data → Overlay Layers



- Set the parameters as follows:

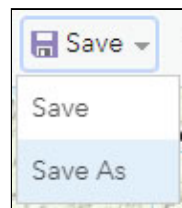


- Uncheck ☐ Use current map extent
- Press **Run Analysis**



Now you have identified the malls within the Victoria census region.

If you would like to save the map, select Save from the dropdown menu and then select Save As



×

Save Map

Title:

Tags: 

lab4 ×

[Add tags](#)

Summary:

Save in folder:

SAVE MAP

CANCEL

## Assignment

