MODELING THE BUILT ENVIRONMENT AS A SURROGATE FOR HUMAN-CAUSED WILDFIRE IGNITION SOURCES

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Summary

Human activity through accidents, negligence, or arson is a common source of wildfire ignition. According to Silva et al. (2010)[1] researchers in Europe studying wildfire activities in the southern Mediterranean countries found 98% of human-caused fires initiate within 2 km of the nearest road or trail. The following workflow (1) classifies roads based on travel frequency (2) calculates proximity to the nearest road or trail, and models human-caused ignition to support development of a wildfire hazard model.

Data

The data required to complete this workflow include a comprehensive and current:

- Railroad layer
- Road centerline layer
- Trails layer
- Structures layer

Server

To complete this workflow for your area of interest (AOI), we recommend first replicating each step as we have done at Idaho State University's GIS TREC. To do that, you will need a connection to the Bannock County GIS server, as it contains the road centerline and railroad layers described in this exercise. To establish a connection to this server, open an ArcGIS Pro project, then:
Right-click the `Servers` folder from the Catalog pane

1. Select NEW ARCGIS SERVER.
2. In the URL text box, enter the following address: https://maps.bannockcounty.us/server/rest/services/Roads/FeatureServer
3. After you have successfully connected, expand the Bannock County GIS server and you should see entries for both Roads and Railroads

Add Data to your Map

4. In the Bannock county GIS server, expand Railroads and select the Feature Layer located inside it. Add this layer to the current map.

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[1] Silva, J. S., Rego, F., Fernandes, P., & Rigolot, E. (2010). *Towards Integrated Fire Management Outcomes of the European Project Fire Paradox* (Vols. 1238–8785). European Forest Institute. URL = https://www.researchgate.net/publication/232092221_Towards_Integrated_Fire_Management-Outcomes_of_the_European_Project_Fire_Paradox visited 20260715

5. Next, expand the Roads folder, then add the CENTERLINES SIMPLE feature layer to the map

The CENTERLINES SIMPLE layer contains more than just paved roads. It includes dirt roads, four-wheel-drive roads, and hiking trails. The distinction will be important in later steps of the exercise. While this layer may not be perfect it is easily the best available source of these data for Bannock County. It is likely, the county or city GIS department for your Area of Interest (AOI) will have similar data available.

Data Exploration

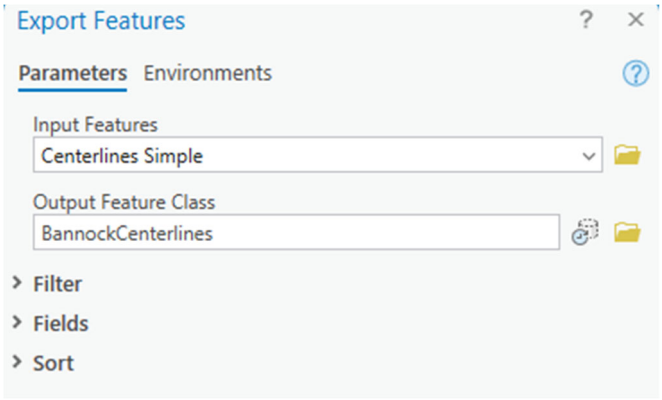
6. Open the attribute table for Bannock County Roads, and take a few minutes to become familiar with it, paying particular attention to the `Asset Owner` field. This is the field we will use to estimate the frequency of human activity on that road, trail, etc.

Alternative data sources for your AOI will likely use other attributes. You will need to spend some time identifying a similar attribute(s) that can be used to estimate the frequency of human activity. For example, you may find a MTFCCS[2] (MAF/TIGER Feature Class Code) field, if available this will be very useful.

Make a Working Copy of the Data

You are not allowed to make edits to the CENTERLINES SIMPLE layer on the Bannock County server. To complete the next step, you need to have a local copy of these data. To do this:

7. From the Contents pane in ArcGIS Pro, right click the CENTERLINES SIMPLE layer and choose DATA—EXPORT FEATURES
8. Complete the Export Features tool as shown below



9. Click OK
10. Repeat this for the railroads layer naming the exported layer `RailroadCenterlines`

Add Field

11. Before proceeding further, remove the web service roads and railroads layers from your current map.
12. Next, with the roads attribute table open, click the Add Field button.

[2] https://giscenter-sl.isu.edu/AOC/AOC_Research/SPARC/MTFCCS.zip

13. Build a new field using the following settings:
    Field Name: `PotentialIgnition`
    Alias: `Potential Ignition Rating`
    Data Type: `Short`

Classification of Roads and Trails

This step is one of the most important parts of this workflow. Here, we classify the different roads and trails based on how frequently they are traveled day to day. The assumption is roads with more traffic have a greater likelihood of human-caused wildfire ignitions, since increased human activity raises the chance of a fire being ignited due to negligence or by accident.

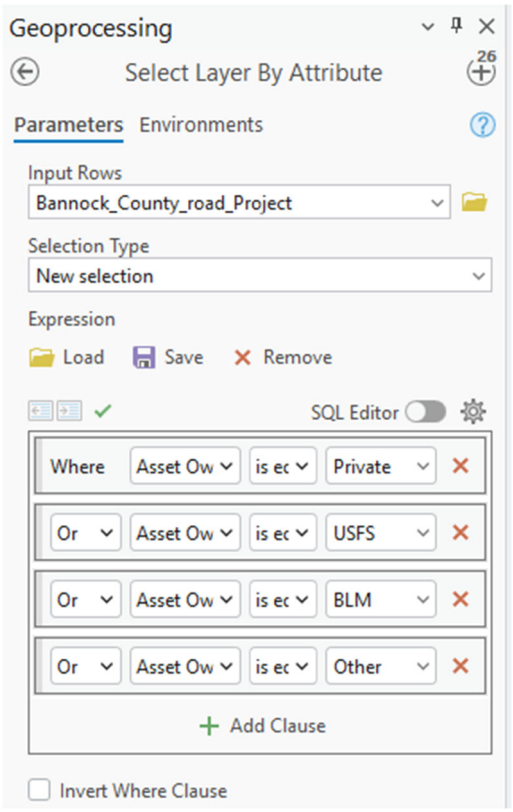
14. In the `Asset Owners` field, you will see various road owners like state, county, cities, and BLM, to name but a few. This information along will be used to apply classification values using a scale of 1-4 scale with 4 designating roads with the highest traffic (e.g., interstate and state highways) (**Table 1**).

Table 1. Travel frequency values relative to potential human-caused wildfire ignition

Potential Ignition value	Ownership examples
1	BLM, USFS, private, and other trails
2	City roads
3	County roads and highways
4	State and Interstate highways

To populate the new `Most Traveled` field, we will iteratively use the `Select by Attribute` tool and `Calculate fields` tool.

15. Start by opening the `Select by Attribute` tool.
    a. Input the `BannockCenterlines` layer
    b. Set Selection Type to `New selection`
    c. Build the SQL expression as shown in the figure below being careful to use the OR operator between each part of the SQL expression.
    d. Click `Apply` (do not click OK)



16. Without closing the Select by Attributes window, open the `Calculate Field` tool by right-clicking the `Potential Ignition Rating` field and choosing calculate fields.
17. When the `Calculate field` window opens, you should see there are (approximately) 1,400 records selected (which is good). Do NOT turn off the selected records slider.
    a. Set the Field Name to: `Potential Ignition Rating` (this should have been done for you automatically)
    b. Set the Expression type to: `Python` (this is the default)
    c. In the `Potential Ignition Rating Roads` text box, enter: `1`
    d. Click Run to apply the calculation.

    In the Attribute table you should see the selected roads and trails now listed as a 1 under `Most Traveled Roads`. These roads are the least traveled in Bannock county.

18. Continue populating all records for ratings 2-4 based on Table 1 (above).
19. We will repeat these same steps for the railroads layer starting with adding a new field.

    Field Name: `PotentialIgnition`
    Alias: `Potential Ignition Rating`
    Data Type: `Short`

20. Assign a value of one (1) to all railroad records using the `Calculate Fields` tool.

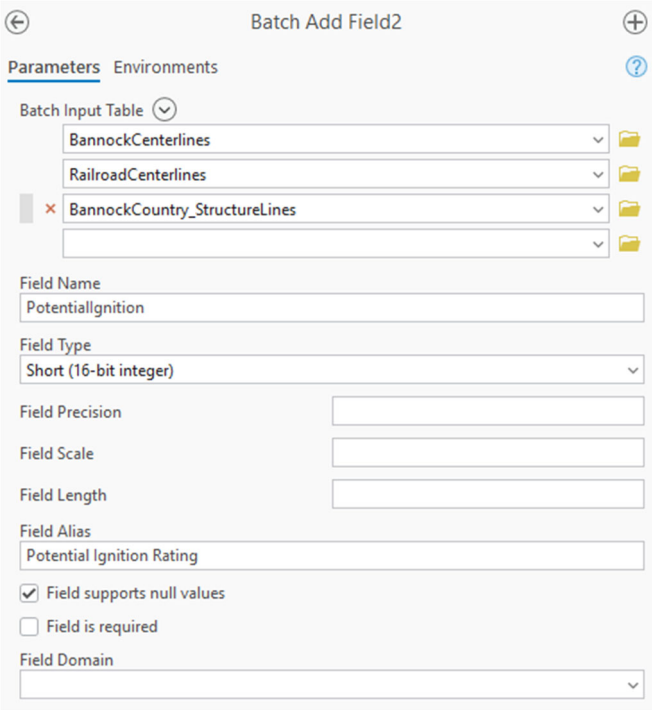
21. Add the `BannockCounty_StructureLines` layer to the current map (NOTE: This layer was produced in the previous workflow exercise).

22. If necessary, repeat these steps starting with adding a new field.
    Field Name: `PotentialIgnition`
    Alias: `Potential Ignition Rating`
    Data Type: `Short`

23. Assign a value of four (4) to all structure lines records using the `Calculate Fields` tool.

Did you know you can add the identical new field to several layers simultaneously? We can do this using the `Add Field` geoprocessing tool in batch mode. To use this capability:

24. From the Geoprocessing pane's search box find the `Add Field` tool
25. Right-click the `Add Field` tool entry and choose `Batch`
26. From the first page of the `Batch Add Field` pane, set the batch parameter to `Input Table` (this should be the default setting).
27. Click `Next`
28. Complete the tool dialog like that shown below



29. Click Run

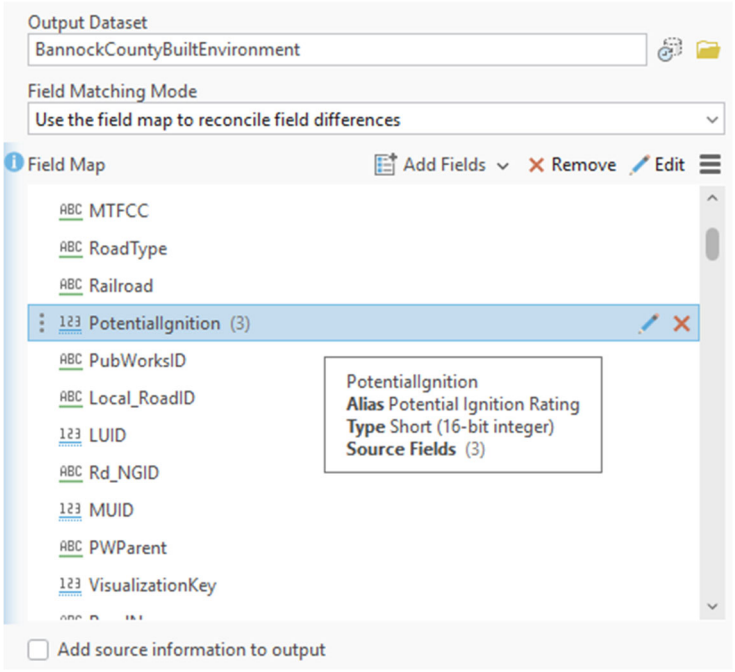
The advantage of using this tool in batch mode is not only is it faster but it also ensures the field is created identically. The latter point is critical when using the upcoming merge tool.

Create a Single Built Environment Layer

Now that the potential ignition fields have been populated for the roads, trails, railroads, and structures features we need to combine each of the discrete layers into a single layer that we will call the Built Environment layer. To do this we will use the `Merge` tool.

30. Open the `Merge` geoprocessing tool
31. Add the three individual layers into this tool as `Input Datasets`

32. Name the Output Dataset `BannockCountyBuiltEnvironment`
33. The next parameter is important. We need to choose `Use the Field Map to reconcile field differences`.
    a. Once this selection has been made you will be able to view all the fields that could be added to the new built environment layer. For our wildfire hazard model, the only field that is necessary is the `PotentialIgnition` field.
    b. You will see three (3) in parenthesis following the name of this field. This tells us all three of the input datasets contain this field.
    c. You can delete all other fields by clicking the red X on the far-right side of each unnecessary field.



    d. Click `Run`

At this point, all necessary data has been created to support producing a human-caused wildfire hazards component model. You may need to complete these steps again using data specific to your area of interest (AOI). The way these data are used within the wildfire hazards model is explained in the subsequent document.

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