Using Web-Based GIS for 2019-2020 Bushfire Season Visualisation

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Aim and Objectives:

‘Using Web-Based GIS for 2019-2020 Bushfire Season Visualisation’ is a project which aims to deliver a web map that provides a clear visualization of data from the Victorian bushfires that burnt throughout the ”Black summer” from 2019-2020. More specifically, the web map will showcase a shapefile of all forests located within Victoria, a shapefile of all land burnt between the start of 2019 until the end of 2020, as well as a highly detailed “fire severity” raster dataset from satellite imagery of the “black summer”. In addition to those datasets, the web map will have widgets implemented to allow the user to have a deeper understanding of the black summer disaster.

Background:

The Australian summer that bridged 2019 to 2020 is commonly referred to as the “Black Summer” – a summer that followed a period of record-breaking drought and high temperatures (Filkov et al. 2020), leading to some of the worst fires the country has ever faced. With 12.6 million hectares of land and 8 million hectares of vegetation being burnt across the black summer (Wintle et al. 2020; Godfree et al. 2021). Despite this scale of devastation, the black summer is commonly misunderstood, and therefore an intuitive, publicly available web map covering the scale of the fires within Victoria could prove to be an invaluable educational tool.

Despite being around for decades, GIS is an ever-evolving field. Currently, most GIS work is shifting from the traditional desktop applications towards a cloud-based future. The shift towards cloud-based GIS is also bringing with it a change in mindset of most GIS professionals; where most have spent their career with and are most comfortable using “closed source software”, the shift to the cloud is also shifting their mindset to accepting open-source software more than ever (Coetzee et al. 2019). This is most likely due to the numerous benefits that open source, web based GIS has over traditional closed source, client based GIS, including; cost, speed, global scale, productivity, performance, reliability, and security.

Therefore, this project is going to be mapping and visualising the black summer through the use of open source, web-based GIS to create the publicly available web map.

Methodology:

Framework / Workflow overview:

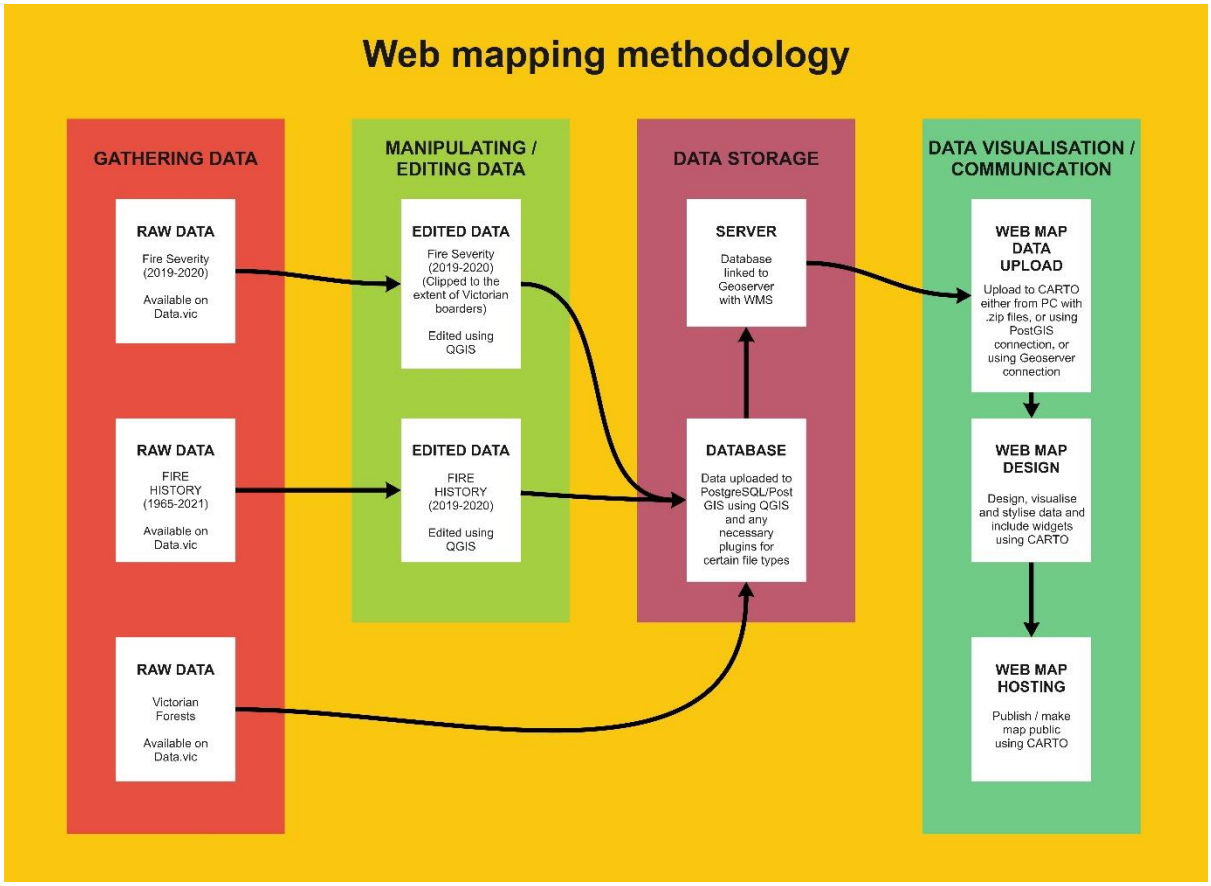

Figure 1.

Data collection:

This project started with the collection of all necessary data. As the web map will have the scope of the state of Victoria, and will be based upon fire data, data from DELWP (Department of Environment, Land, Water & Planning) would suffice. All data was therefore publicly available from the Data.vic website (https://discover.data.vic.gov.au/). Three primary datasets were used from Data.vic in order to create the web map; “Fire severity” – a raster dataset of burn intensity from the black summer fires in eastern Victoria, “Fire History” – a shapefile dataset of all known fires that have burnt since 1965, with additional embedded data like fire size, type, burn time, ect… , “Victorian Forests” – a shapefile dataset of all Victorian forestry.

Data Editing / Manipulation:

Once the three relevant datasets were obtained, the next step was to edit them in QGIS to meet the requirements to make the web map. The fire severity raster was clipped so that its extent was within the boundaries of Victoria (Figure 2). The fire history shapefile was also clipped so that its extent was within the boundaries of Victoria, but the temporal extent of the

data had to be limited from 1965-2021 to 2019-2020 so that only relevant fires were included (Figure 3). The Victorian forests dataset wasn't changed (Figure 4)

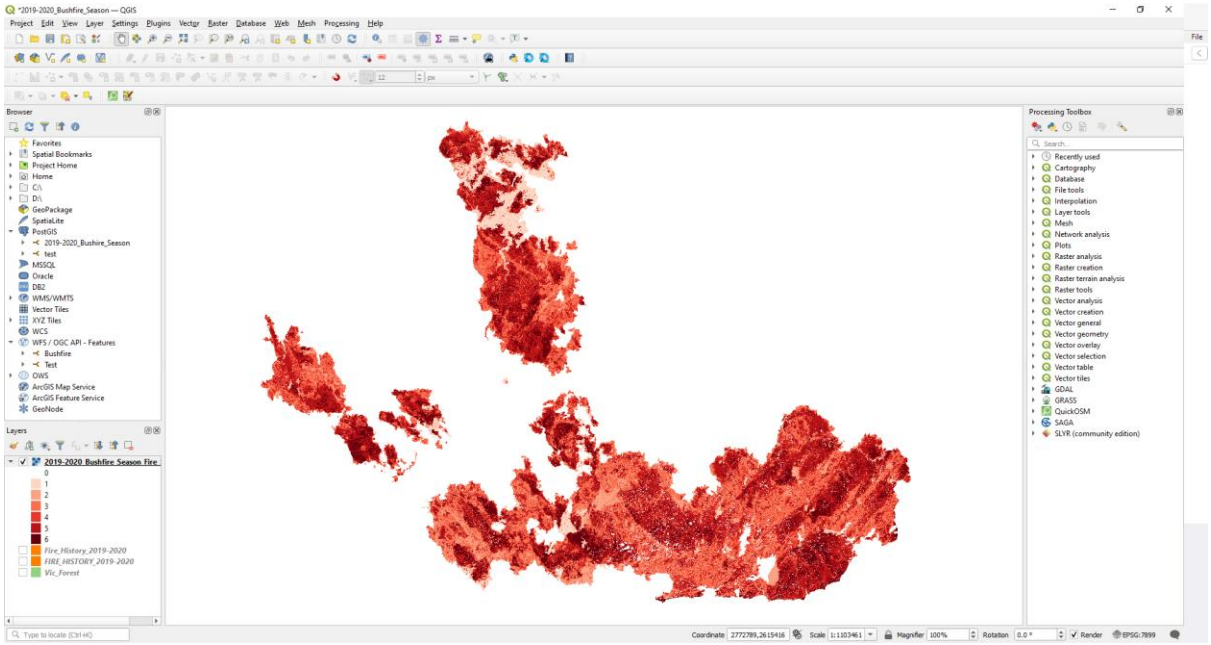

Figure 2. ("Fire Severity" raster after being edited in QGIS)

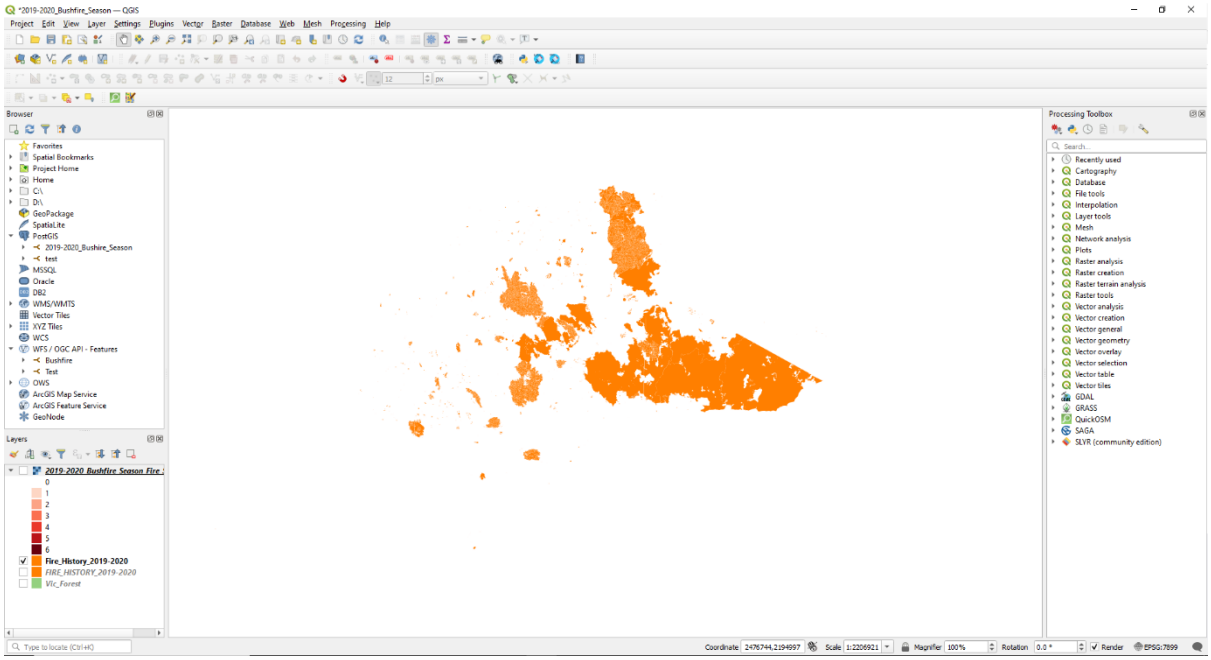

Figure 3. ("Fire History" shapefile after being edited in QGIS)

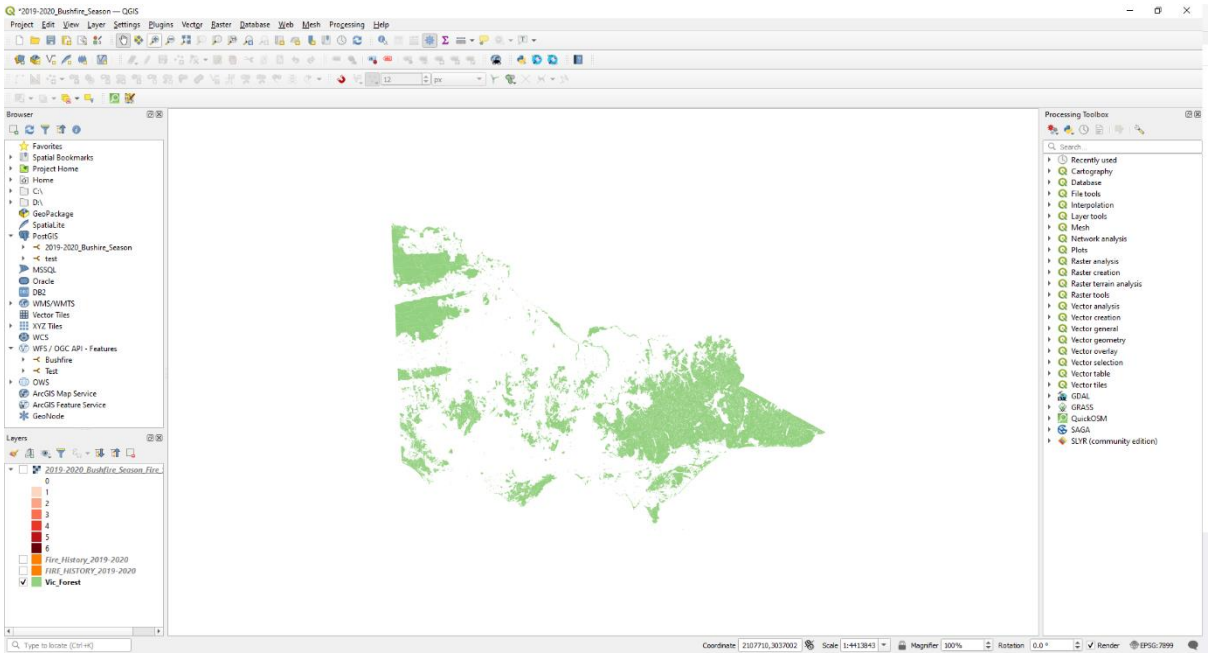

Figure 4. (“Victorian Forests” shapefile in QGIS)

Data Storage:

After the data had been manipulated in order to suit the project, it had to be stored in an appropriate database. The PostgreSQL extension PostGIS was used to create a spatial database for the storage of the three datasets for this project (Figure 5). Getting the two shapefiles onto the database had no issues, however PostGIS doesn’t natively support raster file types. In order to get the raster dataset onto the database however, required installing the “raster2postgis” plugin on QGIS, and importing the raster to the database through QGIS using the plugin.

The spatial database was then hosted on a client-side server using Geoserver (Figure 6). After getting the database onto Geoserver, it was noted that the raster dataset was once again not supported, however this time the solution was to just upload the raster directly to Geoserver instead of through the database connection.

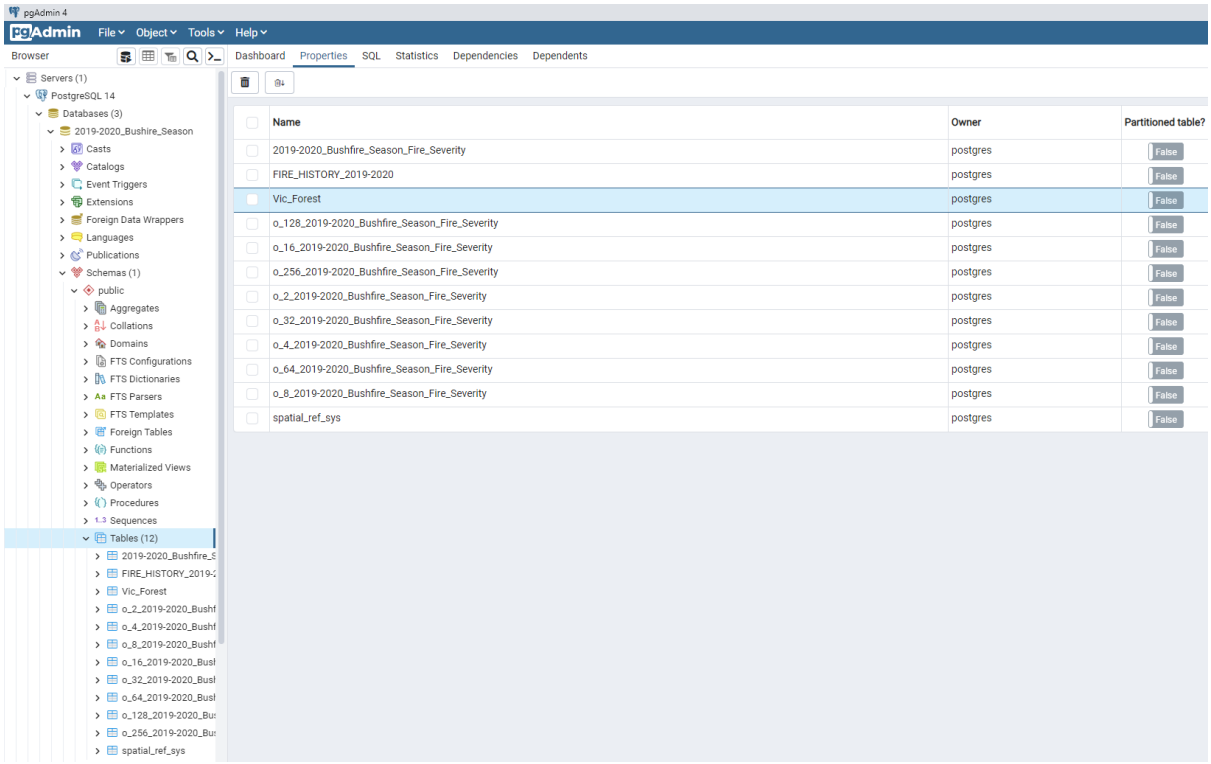

Figure 5. (PostGIS database with datasets uploaded)

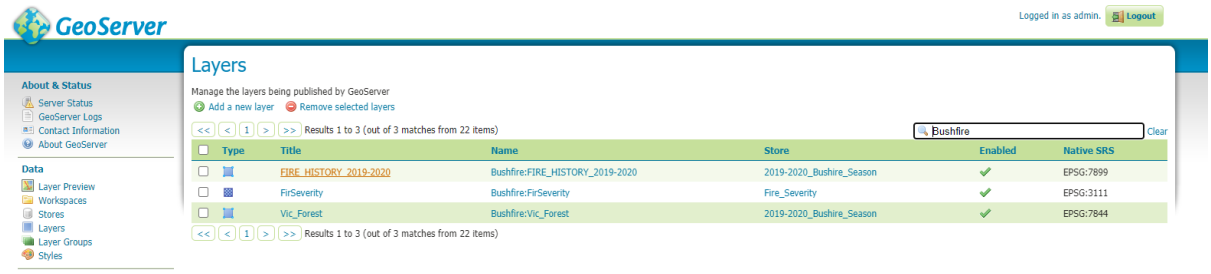

Figure 6. (Geoserver with datasets uploaded)

Data Visualisation and Communication:

After having the database hosted on geoserver, the final step was to actually create the visualisation and representation of the data as a publicly available web map. In order to do this, CARTO was used due to it being open-source and free for students.

After uploading the three datasets to CARTO, applying cartographic principals to the data and base map is essential for effectively communicating the data in an understandable, and aesthetically pleasing way (Figure 7). This was done through CARTOs web mapping and data visualising tools inbuilt on the website.

Unfortunately however, due to compatibility issues, the raster dataset was not able to make it onto the final map. Not only that, but also due to unforeseen complexities within the attribute tables of the datasets, CARTOs widget creation tools weren't able to be properly utilised, unfortunately

leading to widgets being excluded from the final web map as well (both of these shortcomings will be further discussed in the discussion section of this report).

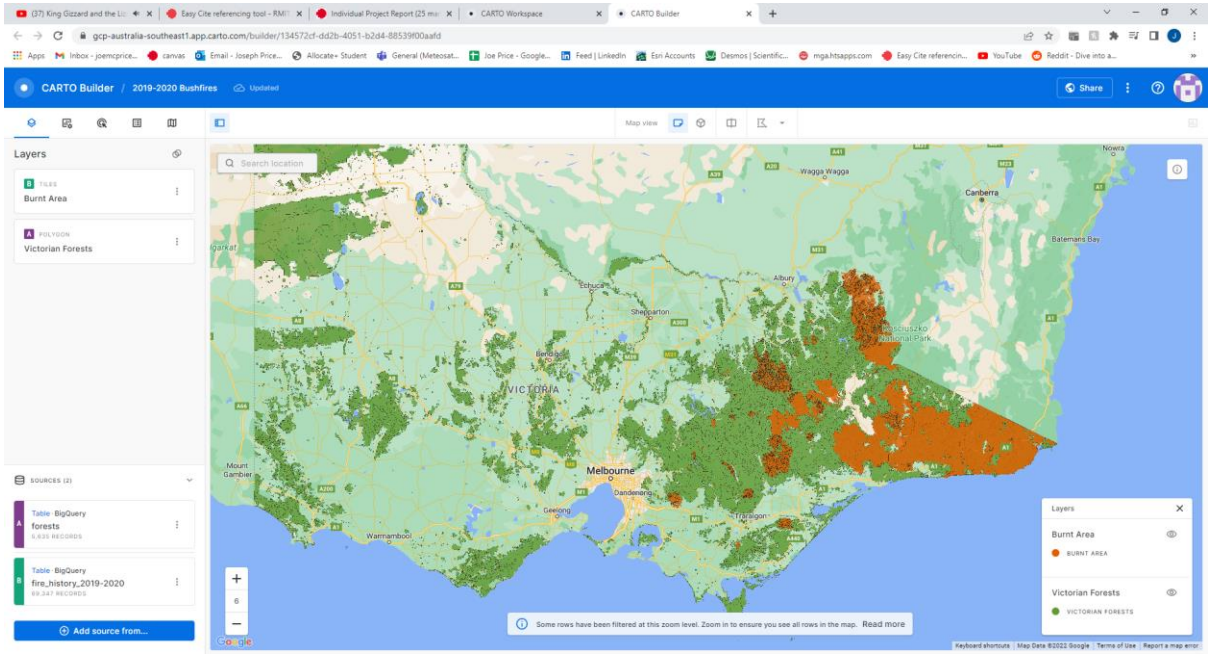

Figure 7. (CARTO data visualisation / web map creation https://gcp-australia-southeast1.app.carto.com/map/134572cf-dd2b-4051-b2d4-88539f00aafd)

Discussion:

Results:

Two publicly available datasets were effectively used in the creation of a publicly available web map, created entirely with open-source software, most of which being cloud based. This web map is successful in its data communication and visualisation in showcasing the scale and extent of the black summer bushfires within Victoria through an aesthetic and intuitive web map.

With respect to being publicly available, using free data, using open-source software, using cloud based technology, and visually communicating the scale and extent of the black summer fires within Victoria, this project was a success. However, one dataset and widget functionality had to be omitted from this web map due to some technical issues, and shortcomings in the creator's skillset.

Strengths / Limitations of Web Map:

Strengths:

- Intuitive to use
- Aesthetically pleasing
- Created with open-source software
- Web based
- Publicly accessible
- Created with free datasets

Limitations:

- No widgets
- Missing dataset
- Limited use cases

Reflection:

At the data collection stage of this project, there were no issues experienced. Obtaining good datasets needed from DELWP via the data.vic website was completed very smoothly, and everything went to plan at this stage.

In the data editing/manipulation stage, no problems occurred either. All three datasets could be opened by QGIS with no issues, and using skills learnt in the SIS classes, the datasets were edited and manipulated as such to meet the goals and objectives of this project.

The first major roadblocks of this project occurred in the data storage stage. When importing the datasets into the spatial database using PostGIS, there were incompatibility issues with the raster dataset. This problem was overcome by using the raster2postgis plugin for QGIS, and then connecting QGIS to the spatial database and importing the raster to PostGIS through QGIS using the plugin.

After then putting the datasets onto Geoserver using a PostGIS connection, another issue with the raster dataset came up. Geoserver didn't allow for a raster dataset to be uploaded via PostGIS. This was overcome by uploading the raster straight from a desktop to Geoserver (Which unfortunately is "Cheating" and goes against the philosophy of this assignment, but it was the only solution I could find)

When trying to connect CARTO to Geoserver to access the datasets, another roadblock arose. Since the Geoserver is being hosted client side, there isn't currently an option for CARTO to connect that way. Therefore, once again, the datasets once again had to be uploaded directly to CARTO (Unfortunately "Cheating" again).

The final roadblocks faced in this project were both issues faced involving CARTO. Firstly, no matter the approach / attempt, the raster dataset could not be uploaded to CARTO. Unfortunately, this resulted in the omission of the fire severity raster dataset from the final web map. Secondly, the attribute tables of the other two datasets relied on strings instead of integers or floats. This meant that CARTOs inbuilt widget creation tools couldn't read the data to easily display useful / relevant statistics / information about the datasets. Unfortunately, this resulted in the omission of widgets from the final web map as well.

Despite the above roadblocks however, this web map was successful in its data communication and visualisation for showcasing the scale and extent of the black summer bushfires within Victoria through an aesthetic and intuitive web map.

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