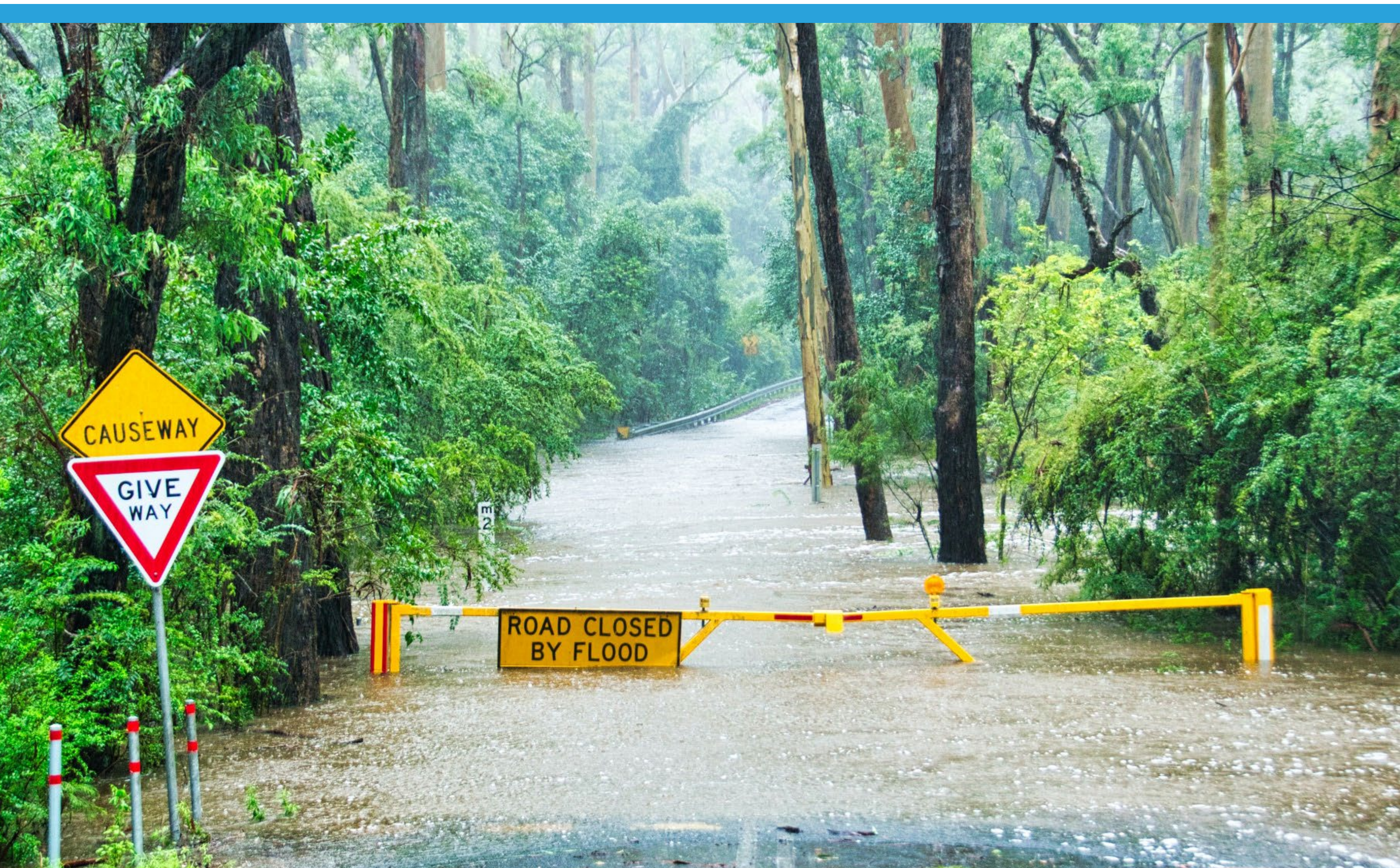
# Asset Vulnerability Assessment Project

## Stage 1 – Worked Example User Guide

Prepared for: South East Councils Climate Change Alliance (SECCCA)

**Final**

17/11/2021



# About This Document

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## Disclaimer



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# Table of Contents

# 1. This Document

This worked example user guide has been provided to Council to assist in viewing data within a QGIS environment as part of the SECCCA AVA project.

Section 2 of this user guide provides a schematic representation of the Data Handover structure, with simple explanations for the various folders and the data they contain.

Section 3 provides background notes on the AVA outputs, including links to QGIS video recordings of the Climate Viewer, and definitions of key climate terms used throughout the project.

Section 4 outlines the structure and basic use of the QGIS Climate Viewer.

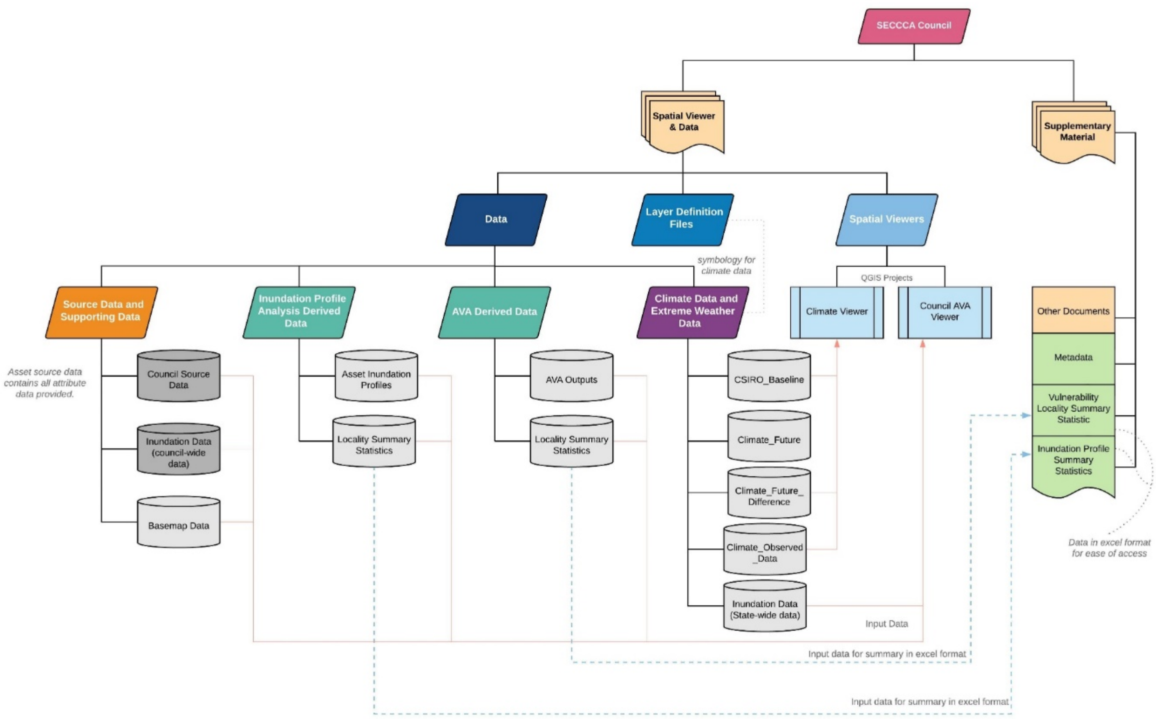
Section 5 provides step-by-step instructions for four worked examples on key user questions that the QGIS viewers can answer.

Note that Section 5 uses the Bass Coast AVA Viewer as the example (screenshots, etc.). However, the instructions presented in this User Manual are transferrable across all councils and any other QGIS project.

For further information regarding QGIS application, please refer to the provided QGIS training material (training notes, training data and recording), or access additional information here: [https://qgis.org/en/docs/index.html](https://qgis.org/en/docs/index.html).

# 2. Data Handover File Structure

The figure below presents a schematic representation of the data handover file structure. Each of the folders are described in Section 2.1.



## 2.1. Handover Structure Folder Explanation

### Source Data and Supporting Data

The Source Data and Supporting Data folder contains the un-analysed data provided to Spatial Vision by the Council.

### Inundation Profile Analysed Derived Data

This folder contains the outputs of the inundation profile analysis. The Asset Inundation Profiles contain the feature classes that identify the assets impacted by the three inundation scenarios:

'_FLD' = 1 in 100 year flooding event

'_SLR' = 82 cm Sea Level Rise

'_STM; = Storm Surge on 82 cm Sea Level Rise

The *Locality Summary Statistics* geodatabase contain geodatabase tables that identify the number of assets (per asset type) in each locality within the LGA impacted by the three inundation scenarios.

### AVA Derived Data

This folder contains the outputs of the vulnerability assessment. The *AVA Outputs* geodatabase contains feature classes that identify the vulnerability of the assets (per asset type) to the climate variables. The table below identifies the climate variables for which vulnerability was determined for each asset type.

| Asset Type | Unit |
|---|---|
| **Buildings** | Extreme Rainfall, Extreme Temperature, Standard Precipitation Index (SPI) |
| **Roads** | Extreme Rainfall, Extreme Temperature, Standard Precipitation Index (SPI) |
| **Drainage (Pits and Pipes)** | Extreme Rainfall, Standard Precipitation Index (SPI) |

The *Locality Summary Statistics* geodatabase contains geodatabase tables that present the 'average asset vulnerability' score for a particularly climate model, RCP future, and time fame (e.g. ACCESS 1.0 RCP 8.5 2050 climate future) (%) for all assets that intersect locality.

### Climate and Extreme Weather Data

This folder contains all climate and extreme weather-related data for the case study. The Sub-folders include:

1. CSIRO Baseline Data – 5 km gridded climate data that the projections are based on. The baseline period is from 1981 to 2010.
2. Climate Future Data - 5 km gridded climate projection data (absolute values) for the climate variables. This data is not presented in the QGIS Climate Viewer, but is provided as part of the data package.

3. Climate Future Difference Data - 5 km gridded climate projection data, showing the change in values from the baseline for the climate variables.
4. Historic Climate Data – this contains the 5 km gridded observed climate data (source: SILO) for the same variables mentioned above. These datasets contain observed historical climate data for the decades: 1970, 1980, 1990, 2000, 2010.
5. Inundation Data (state-wide) – this folder contains data of the different inundation scenarios (Flooding Scenarios; storm surge at the different sea level rise increments) from various state-wide sources.

### Layer Definition Files

The Layer Definition Files folder contains Layer files that can be brought directly into a QGIS environment, that refers to the data within the *Climate Data and Extreme Weather Data* folder, and has all symbology set.

### Spatial Viewers

This folder contains the QGIS Projects that relate to:

1. The Council AVA viewer, with symbolised layers
2. Climate projected and observed polygrids, with symbolise layers

The purpose of these projects with pre-symbolised layers is to allow the user easy viewing of the data.

# 3. First Pass AVA Project Outputs Background Notes

In delivering the Asset Vulnerability Project, the Spatial Vision team have packaged the data outputs from the first pass assessment process into a spatial data viewer. The viewer used is QGIS.

The data outputs are aimed at assisting asset managers better understand the likely climate change under various climate futures, and the likely impacts.

The data is packaged in two separate viewers:

- one that displays climate information prepared by the CSIRO (and sponsored by the Victorian Department of Environment, Land, Water, and Planning under the Victorian Climate Futures Project (VCF19)); This viewer also includes historical climate observation data. This is referred to as the *Climate Viewer.*

- second that presents the inputs and outputs from the first pass asset vulnerability assessment (AVA) for building, roads and drains. This second viewer includes both the inundation profile for assets under various inundations scenarios, in addition to the full vulnerability assessment for assets based on three different climate models and futures, two carbon emission scenarios, and four different time points. This is referred to as the *AVA Council Viewer.*

## 3.1. Reference Videos

*Note: the reference videos may show the QGIS viewer with slight variances to the final viewer.*

### Intro to QGIS

"This video is a brief overview and introduction to the council-specific QGIS viewer that presents the inundation profile and vulnerability analysis outputs.
This video was produced as part of the SECCCA Asset Vulnerability Assessment Project in May 2021.

See: *Intro to QGIS*: https://youtu.be/NKZ0Z073cuk

### Climate Viewer

"This video presents an exploration of the QGIS climate data viewer (baseline, projected and historic climate data) for the SECCCA region, including how to compare views of different climate future models and timeframes.
This video was produced as part of the SECCCA Asset Vulnerability Assessment Project in May 2021.

See: *Climate Viewer:* https://youtu.be/IxF9--U7iNk

## 3.2. Key Climate Data Explanations

### Inundation Climate Change Events

The overall first pass Asset Vulnerability Assessment will include consideration of the following three inundation events:

- Sea Level Rise of 82 cm
- Sea Level Rise of 82 cm with 1% Annual Exceedance Probability (AEP) Storm Surge Event
- 1 in 100 year Flood Event based on historical data

### General Circulation Models (GCM) selected

1. ACCESS 1.0 - CSIRO and BoM – representing a maximum consensus future
2. HadGEM2-CC - Met Office Hadley Centre – representing a hotter and drier future
3. NorESM1-M - Norwegian Climate Centre – representing a warmer and wetter future

### Representative Concentration Pathway (RCP) emissions scenarios

The carbon emission future scenarios used are RCP 4.5 and RCP 8.5 that represent low and high carbon emissions scenarios.

### Time Frames

The time frames selected are those available in the VCP2019 projections and include the years of 2030, 2050, 2070 and 2090. This projection data is based on a baseline climate represented by the period from 1981 to 2010.

### Project Climate Change and Climate Change Related Events

The first pass asset vulnerability assessment will include consideration of the following projected climate change variables that will be derived from the most recent climate modelling prepared by CSIRO and made available as part of the Victorian Climate Projections 2019 Project:

- Number of annual hot days (defined as days with a max temp greater than 35°C)
- Degree increase of annual extremely hot days (defined as change that occurs to top 1% of events)
- Number of annual heat waves (defined as three or more consecutive days greater than 35°C)
- Percentage change of annual extremely wet days (defined as change to events that occur top 1%)
- Number of months in a given year in which a dryness index measure falls below a threshold value (based on a Standard Precipitation Index approach)
- Percentage change in annual rainfall

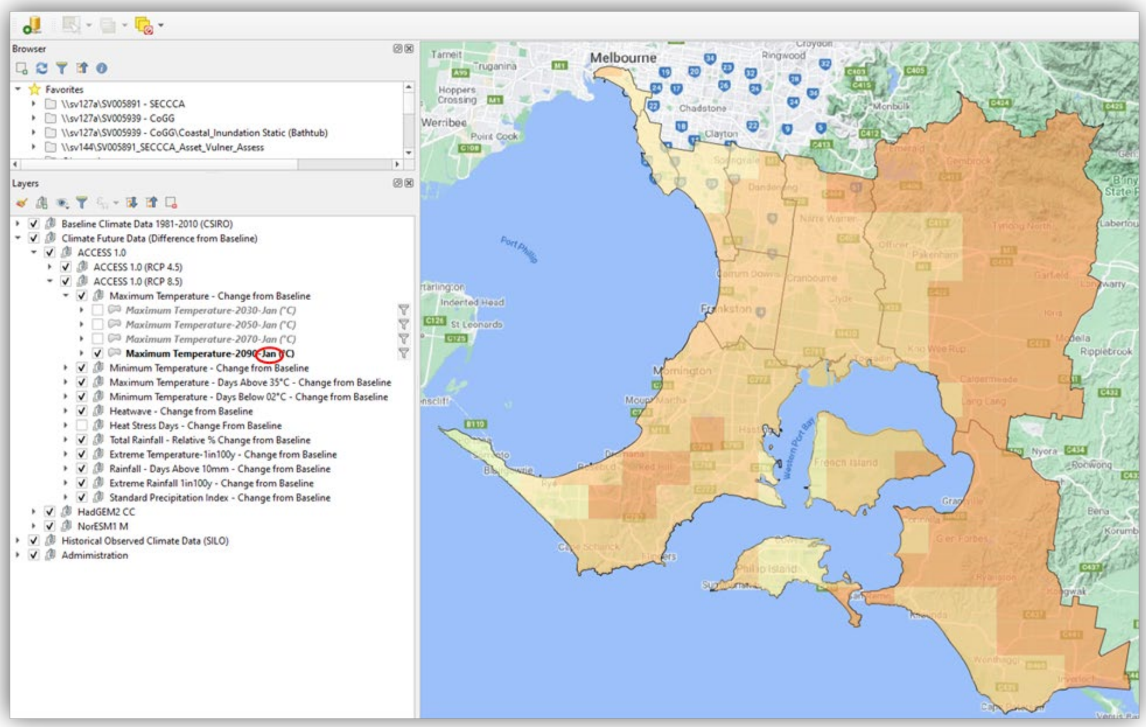
# 4. Climate Viewer - QGIS Environment

This section provides an understanding on the structure, navigation and use of the Climate Viewer, including instructions on changing the symbology for monthly data variables.

## 4.1. Structure

The figure below outlines the data presentation structure within the Climate Data QGIS viewer.

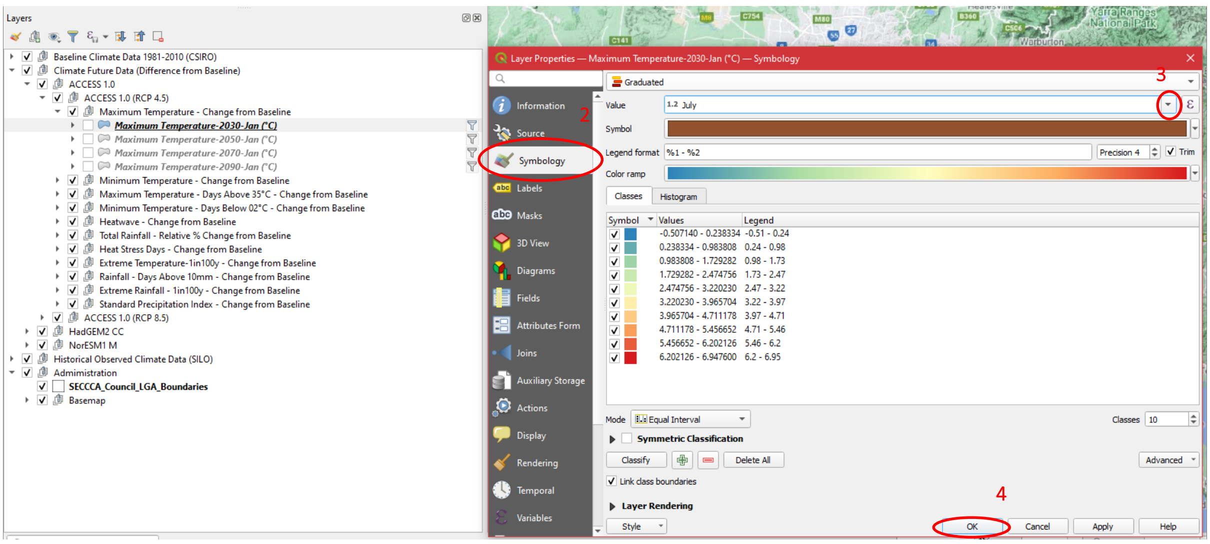
- The climate variables (e.g. "Maximum Temperature", "Rainfall – Days above 10mm", etc.) are presented and symbolised for the baseline data, the projected data (for all models, RCP 4.5 and RCP 8.5, and all timeframes) and the historical data.
- For consistency, the Climate Viewer defaults monthly data to 'January' (see red circle in figure below). This can be changed by the user to any other month.
- For the climate future data, symbology for each climate variable is consistent across all climate future models, RCPs and timeframes. This allows for visual comparison of these different factors to assist decision making.




## 4.2. Changing Symbology for Monthly Data

Monthly climate variables are presented for January as the default, but can be altered to another month. Follow the instructions below on how this is done.

1. Identify the climate variable of interest, and right click to access 'Properties'
2. Navigate to the 'Symbology' tab in the pop-up Layer Properties box that appears
3. Change the month by navigating to the 'Value' dropdown and selecting the appropriate month.
4. Click 'OK' to reflect the change on the map view.




*Note: The layer name in the Layers tree will not automatically change from 'Jan' to the correct month, despite the change being reflected on the map view. Ensure you manually change the layer name to the correct month* *to avoid confusion.*

***Note**: The attribute tables have all data in the attribute table for quick reference.*

# 5. Worked Examples

It is suggested that viewers familiarise themselves to the Asset Vulnerability Assessment Project First Pass Methods Report prior to applying these worked examples to ensure they understand the concepts, definitions and data underpinning the examples.

***Note**: These worked examples are using a specific asset or focus area in Bass Coast to demonstrate the process involved, however the methodologies can be applied across any other asset or focus area.*

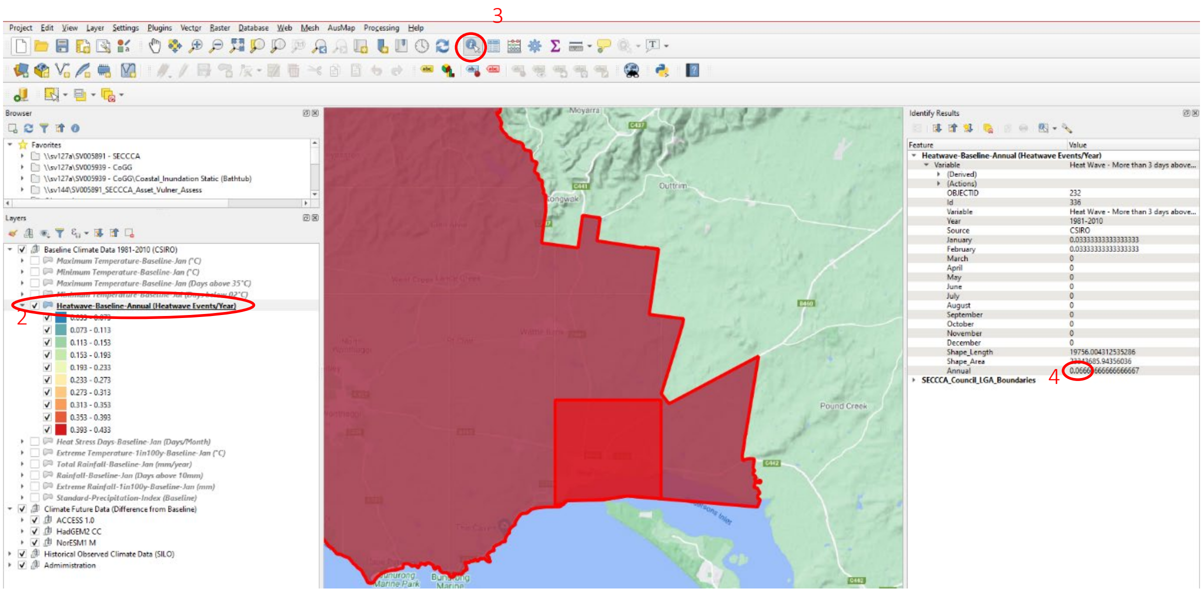
## 5.1. Climate Viewer – Worked Example #1

### Worked Example Question

*"What's the relative change in the number of heatwaves per year in Inverloch expected to be over time?"*

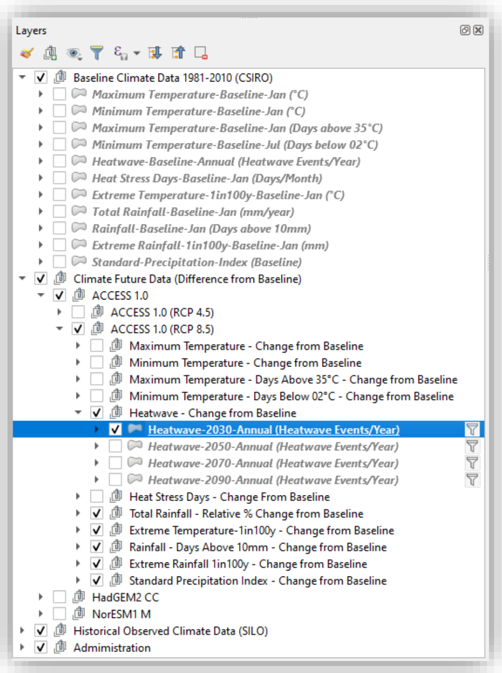
### Steps

1. Navigate to the area of interest (in this example, Inverloch) in the map view.
2. Turn on the Heatwave layer in the Baseline grouping to determine what the current number of annual heatwaves are in the focus area.
3. Use the identify tool and click the area of interest to get the attribute information pop-up box ('identified' objects will be highlighted in red).
4. From the pop-up box that appears, note down the annual heatwave value. In this example, it is ~0.07 heatwaves per year.




5. Decide which climate model and RCP scenario you will initially look into. In this worked example, the Maximum Consensus Model (ACCESS 1.0) will be used, for an RCP scenario of 8.5.
6. Navigate to the appropriate layer grouping in the Layers tree, and turn on the layer for 2030 heatwaves. Use the identify tool again to click the area of interest and note down the annual heatwaves (change from baseline) from the pop-up box that appears.

*Hint*: make sure that you're noting down the value from the correct layer in the identify pop-up box that appears. The identify pop-up box will show results for all layers that are currently turned on in the Layers tree.




7. Repeat Step 6 for the other timeframes (2050, 2070 and 2090) to see how the number of annual heatwaves is expected to change over time from the baseline for the focus area.
   *Note*: This worked example can also be repeated for the other climate models and RCP scenarios to see how the outputs vary.
   The outputs for this worked example would be:

| Timeframe | Annual Heatwaves (ACCESS 1.0 RCP 8.5) (change from baseline) |
|---|---|
| Baseline (1981-2010) | 0.07 heatwave events |
| 2030 | +0.13 |
| 2050 | +0.2 |
| 2070 | +0.67 |
| Drainage (Pits and Pipes) | +1.27 |

## 5.2. Council AVA Viewer - Worked Example #1

### Worked Example Question

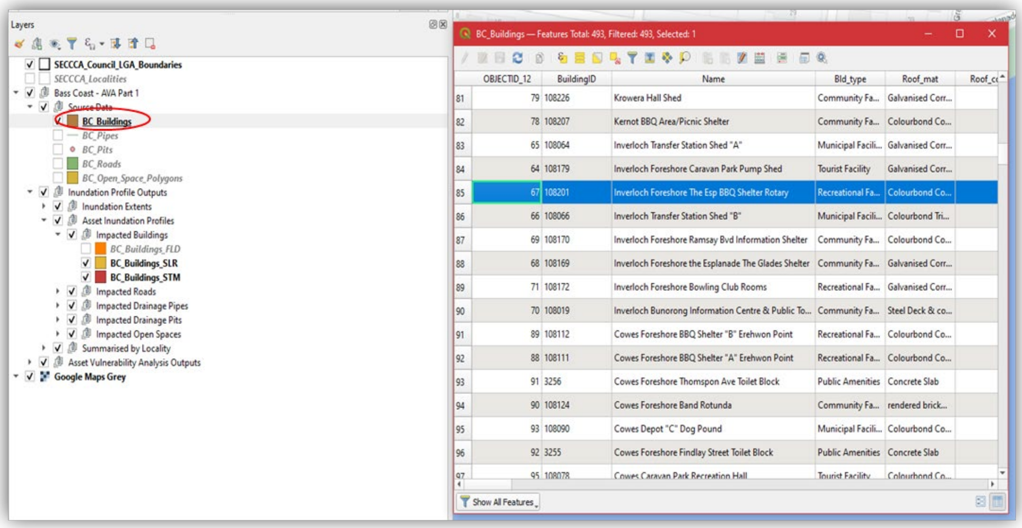
*"Will Building 'X' be impacted by different inundation scenarios?"*

*Note: This worked example will use the Inverloch Foreshore The Glades BBQ Shelter building in Inverloch, Bass Coast, but the method can be applied to any building or individual asset.*

### Steps

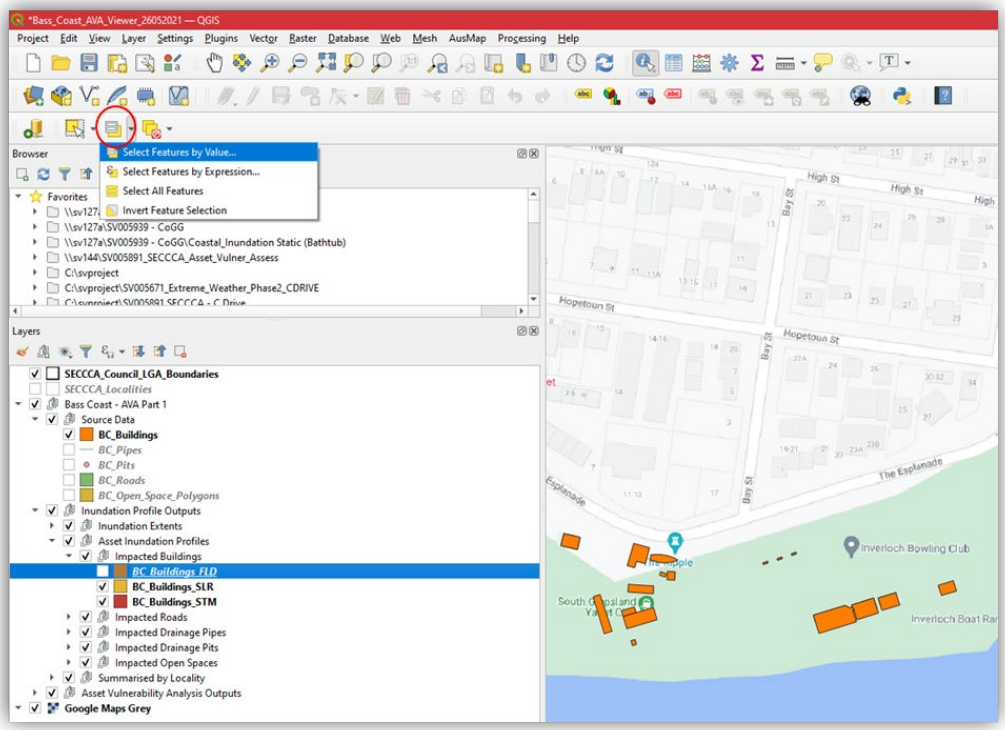
1. Open the attribute table for 'Buildings' in the Source Data to find and identify the

building of interest (in this example – "I*nverloch Foreshore The Glades BBQ Shelter*"). Note down the BuildingID key (or AssetID/etc.).
***Note***: *Assets within these Inundation Profile Output layers are those that ARE impacted by the inundation scenario. If the asset is not in the layer, then it is not impacted by the inundation scenario.*

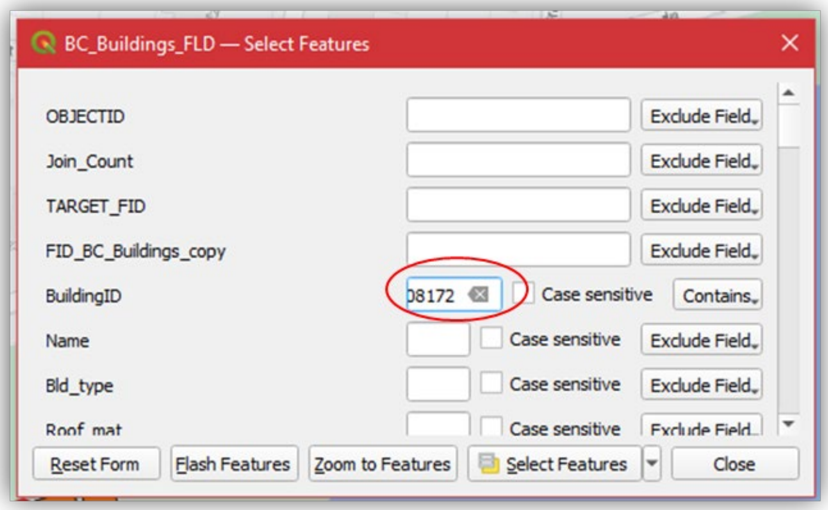



***Hint***: *right click feature in attribute table and select "zoom to feature" to navigate to the building on the map view.*
***Hint***: *Turn on the BC_Building_FLD layer to visually see whether the building is impacted by a 1 in 100 year flood event.*

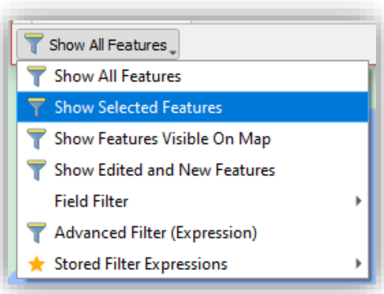
2. Ensure the *BC_Building_BC* layer is highlighted in the Layers tree, then click the 'Select Features by Value' symbol in the main toolbar.



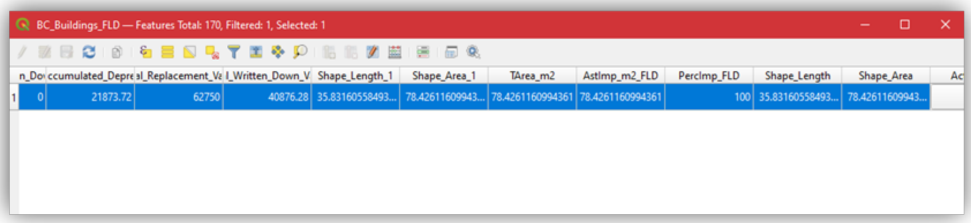

3. In the popup box that appears, input the BuildingID number of the focus building, then click 'Select Features'.



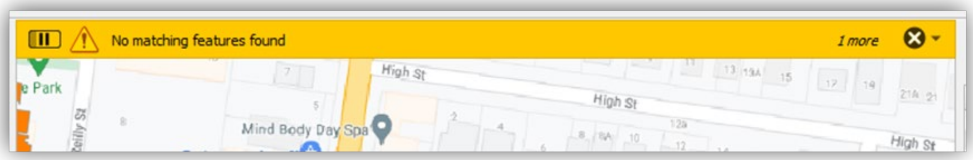

4. Open the *BC_Building_FLD* attribute table and select the 'Show All Features' drop-down box in the bottom left corner to then select 'Show Selected Features'. This will change the attribute table to only present the selected asset




*Hint: the information in the attribute table includes useful statistics such as the total absolute area of the asset impacted, and the percentage of the total asset impacted.*




5. Repeat this step for the other two inundation scenarios (82cm Sea Level Rise = SLR; Storm Surge on 82cm Sea Level Rise = STM) to see whether the asset is impacted.
*Hint: If the asset is not impacted by an inundation scenario, an error like the screenshot below will appear when doing the 'Select Feature by Value' step (Step 4).*



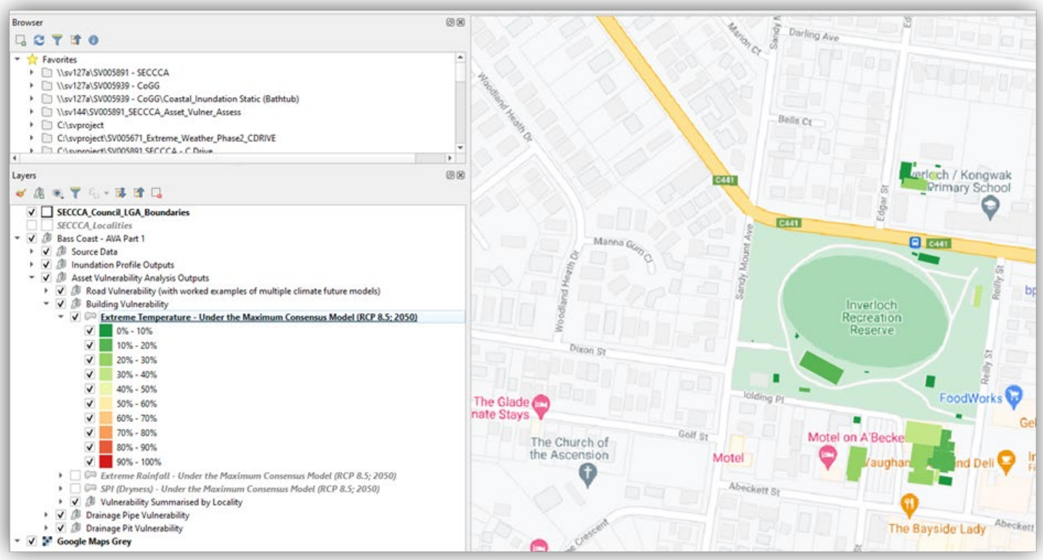
## 5.3. Council AVA Viewer – Worked Example #2

### Worked Example Question

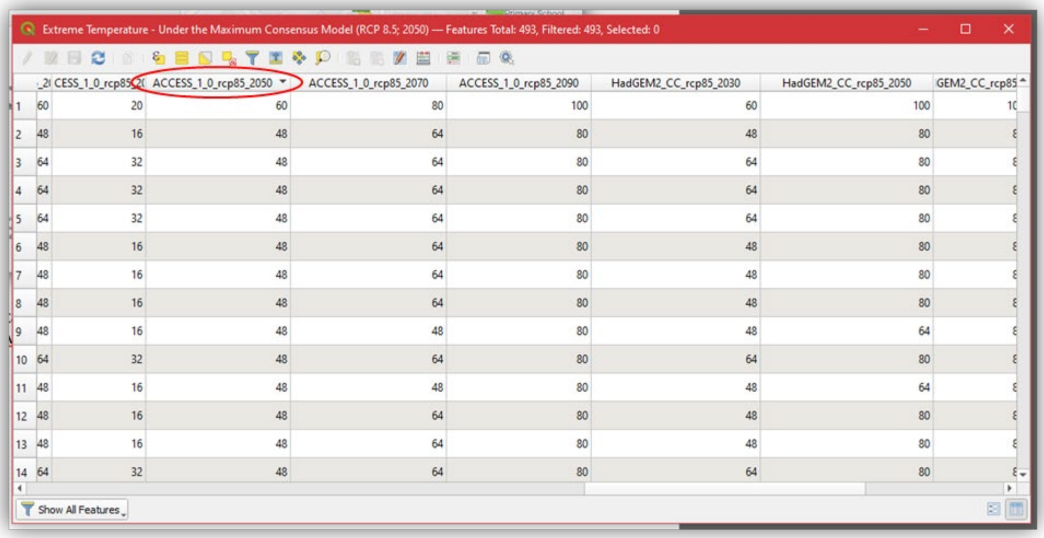
*"Which building assets are the most vulnerable to extreme temperature in my LGA?"*

### Steps

1. Locate the outputs for building vulnerability to extreme temperature in the Layers tree and tick the box to view in the map area.
   *Note: the default future scenario in the QGIS viewer is set at the Maximum Consensus Model (ACCESS 1.0) RCP 8.5 for 2050.*

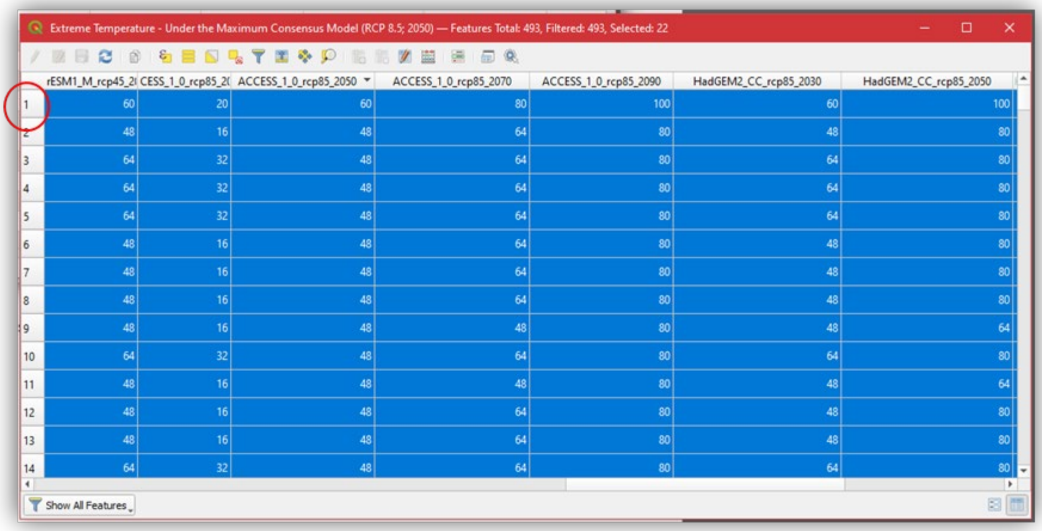



2. Open the attribute table of this layer and navigate to the future scenario field you are interested in. Click the field name twice to automatically sort from high-low.

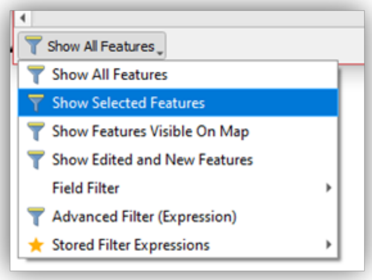



| | | 2( CESS_1_0_rcp85_2( | ACCESS_1_0_rcp85_2050 | ACCESS_1_0_rcp85_2070 | ACCESS_1_0_rcp85_2090 | HadGEM2_CC_rcp85_2030 | HadGEM2_CC_rcp85_2050 | GEM2_CC_rcp85 |
|---|---|---|---|---|---|---|---|---|
| 1 | 60 | 20 | 60 | 80 | 100 | 60 | 100 | 10 |
| 2 | 48 | 16 | 48 | 64 | 80 | 48 | 80 | [illegible] |
| 3 | 64 | 32 | 48 | 64 | 80 | 64 | 80 | [illegible] |
| 4 | 64 | 32 | 48 | 64 | 80 | 64 | 80 | [illegible] |
| 5 | 64 | 32 | 48 | 64 | 80 | 64 | 80 | [illegible] |
| 6 | 48 | 16 | 48 | 64 | 80 | 48 | 80 | [illegible] |
| 7 | 48 | 16 | 48 | 64 | 80 | 48 | 80 | [illegible] |
| 8 | 48 | 16 | 48 | 64 | 80 | 48 | 80 | [illegible] |
| 9 | 48 | 16 | 48 | 48 | 80 | 48 | 64 | [illegible] |
| 10 | 64 | 32 | 48 | 64 | 80 | 64 | 80 | [illegible] |
| 11 | 48 | 16 | 48 | 48 | 80 | 48 | 64 | [illegible] |
| 12 | 48 | 16 | 48 | 64 | 80 | 48 | 80 | [illegible] |
| 13 | 48 | 16 | 48 | 64 | 80 | 48 | 80 | [illegible] |
| 14 | 64 | 32 | 48 | 64 | 80 | 64 | 80 | [illegible] |

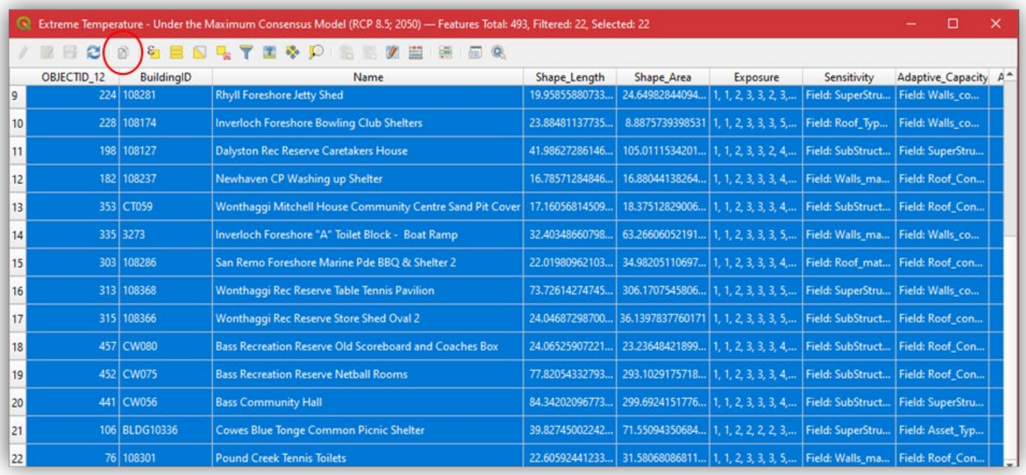
3. Highlight the assets with the highest vulnerability by clicking the row '1' and dragging down to desired number.




4. Click the 'Show All Features' drop-down option and select the 'Show Selected Features' to only view these selected high-vulnerability assets in the attribute table.




5. Scroll back to the left in the attribute table to view asset information for each highly-vulnerable asset (i.e. Building ID, Building name, etc).
*Note: This information can be copied across to an excel/text document by selecting the 'Copy selected rows to clipboard' option in the toolbar*




You have now identified the buildings with the highest vulnerability to extreme temperature for the future scenario of 'ACCESS 1.0 RCP 8.5, for 2050'. These steps can be repeated for any other climate future model, RCP scenario, or timeframe.

## 5.4. Council AVA Viewer – Worked Example #3

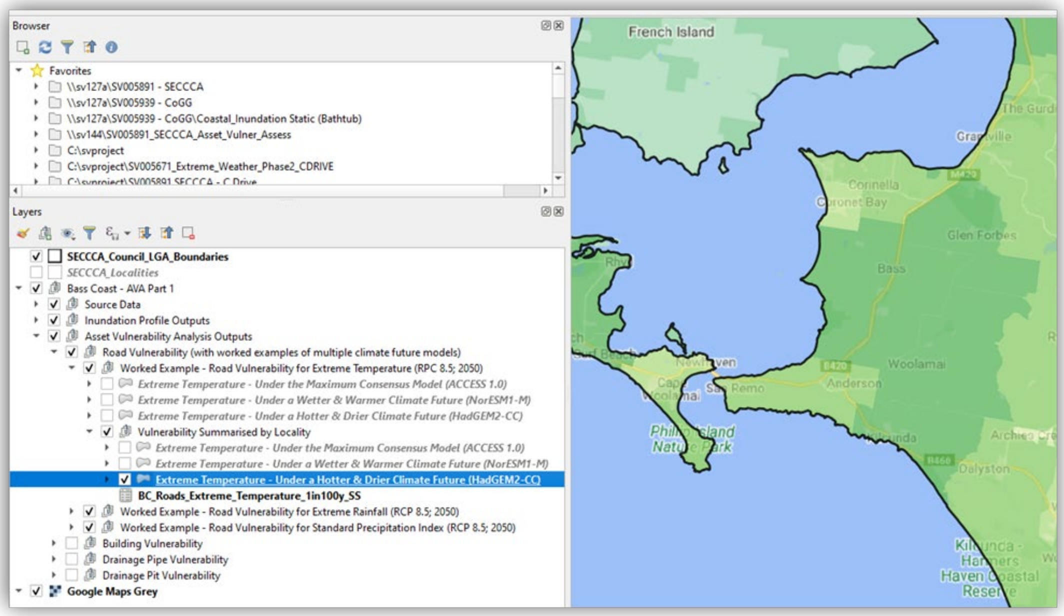
### Worked Example Question

*"Which localities in my LGA should I be most concerned about in regards to the vulnerability of roads to extreme temperature?"*

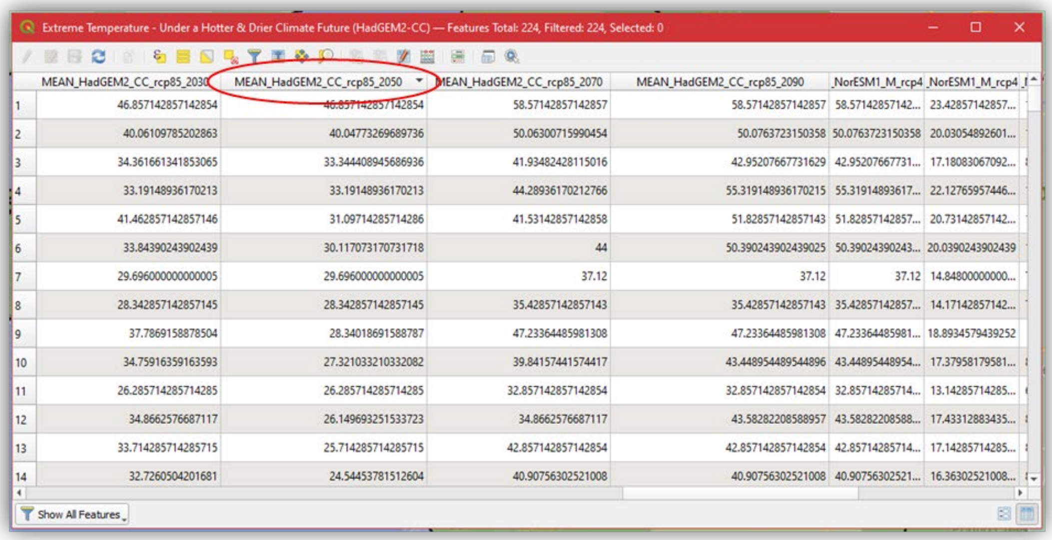
***Note***: *This question can also be answered by referring to the Vulnerability Locality Summary MS excel document.*

### Steps

1. Locate the outputs for road vulnerability (summarised by locality) to extreme temperature in the Layers tree and tick the box to view in the map area. Decide which model you want to view the results for.
   ***Note***: *This worked example will focus on the HadGEM2-CC Climate Future Model, RCP 8.5 for 2050.*




2. Open the attribute table and use the scroll bar to navigate to the desired climate future scenario (in this case – "MEAN_HadGEM2_CC_rcp85_2050"). Click the field name twice to automatically sort from high-low.




| | MEAN_HadGEM2_CC_rcp85_2030 | MEAN_HadGEM2_CC_rcp85_2050 | MEAN_HadGEM2_CC_rcp85_2070 | MEAN_HadGEM2_CC_rcp85_2090 | _NorESM1_M_rcp4 | _NorESM1_M_rcp4 |
|---|---|---|---|---|---|---|
| 1 | 46.857142857142854 | 46.857142857142854 | 58.57142857142857 | 58.57142857142857 | 58.57142857142... | 23.42857142857... |
| 2 | 40.06109785202863 | 40.04773269689736 | 50.06300715990454 | 50.0763723150358 | 50.0763723150358 | 20.03054892601... |
| 3 | 34.361661341853065 | 33.344408945686936 | 41.93482428115016 | 42.95207667731629 | 42.95207667731... | 17.18083067092... |
| 4 | 33.19148936170213 | 33.19148936170213 | 44.28936170212766 | 55.319148936170215 | 55.31914893617... | 22.12765957446... |
| 5 | 41.462857142857146 | 31.09714285714286 | 41.53142857142858 | 51.82857142857143 | 51.82857142857... | 20.73142857142... |
| 6 | 33.84390243902439 | 30.117073170731718 | 44 | 50.390243902439025 | 50.39024390243... | 20.0390243902439 |
| 7 | 29.696000000000005 | 29.696000000000005 | 37.12 | 37.12 | 37.12 | 14.84800000000... |
| 8 | 28.342857142857145 | 28.342857142857145 | 35.42857142857143 | 35.42857142857143 | 35.42857142857... | 14.17142857142... |
| 9 | 37.7869158878504 | 28.34018691588787 | 47.23364485981308 | 47.23364485981308 | 47.23364485981... | 18.8934579439252 |
| 10 | 34.75916359163593 | 27.321033210332082 | 39.84157441574417 | 43.448954489544896 | 43.44895448954... | 17.37958179581... |
| 11 | 26.285714285714285 | 26.285714285714285 | 32.857142857142854 | 32.857142857142854 | 32.85714285714... | 13.14285714285... |
| 12 | 34.8662576687117 | 26.149693251533723 | 34.8662576687117 | 43.58282208588957 | 43.58282208588... | 17.43312883435... |
| 13 | 33.714285714285715 | 25.714285714285715 | 42.857142857142854 | 42.857142857142854 | 42.85714285714... | 17.14285714285... |
| 14 | 32.7260504201681 | 24.54453781512604 | 40.90756302521008 | 40.90756302521008 | 40.90756302521... | 16.36302521008... |

3. Repeat steps 3 to 5 from *Council AVA Viewer – Worked Example #2* to highlight required assets and copy out into excel/text format.

Spatial Vision