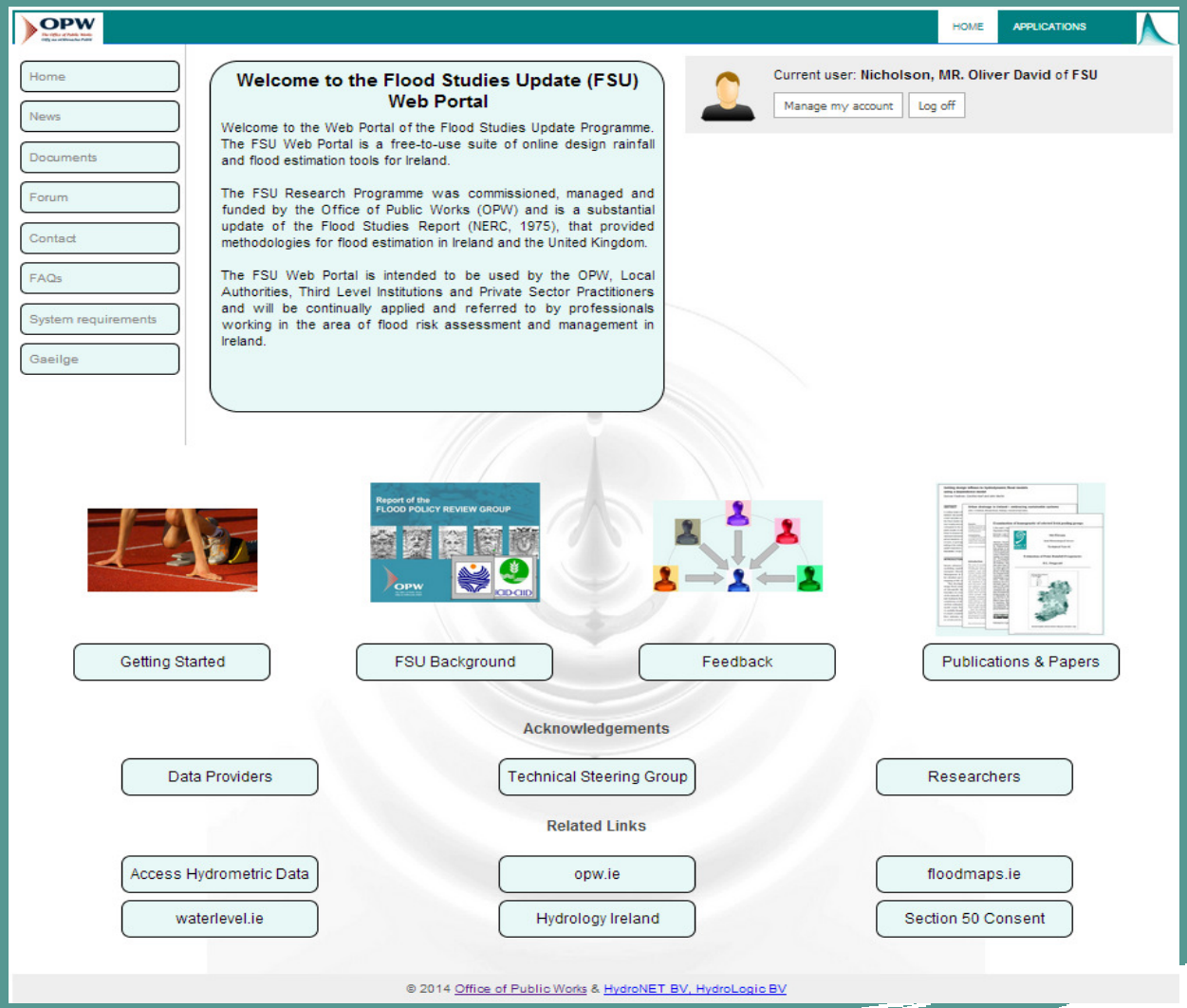
Introductory Lectures on the FSU Methodologies November/December 2014



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Introductory Lectures on the FSU Methodologies
November/December 2014

01 – Introduction to the FSU Web Portal Datasets

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Presentation Structure

- Background & Objective
- Datasets used in the FSU Methodologies
- Hydrological Datasets
- Spatial Datasets
- Physical Catchment Descriptors (PCDs)
- Basis of the FSU Methodologies

Background & Objective

Background

- 1975 Flood Studies Report (FSR) – UK & Ireland
- 1999 Flood Estimation Handbook (FEH) – UK Only
- IHP/ICID recommendation & Report of the Flood Policy Review Group (2004)
- 2014 Flood Studies Update (FSU) – Ireland Only

Objective of the FSU Research

- Provide improved methods of extreme rainfall and flood estimation at both gauged and ungauged locations in Ireland

Background & Objective

Why was an update to the FSR required?

- 40 more years of data
- Advances in hydrology research
- Advances in GIS – Improvements in mapping
- Advances in ICT – PCs and the Internet
- Changes to catchments and climate

Background & Objective

Data Availability FSR Vs FSU

Description	FSR	FSU
Meteorological (rainfall) data:		
Number of daily station locations	330	577
Number of station years	3300	25800
Number of sub-daily station locations	12	47
Hydrometric (flow) data:		
Number of stations used	112	215
Number of station years of Amax flows	1700	6725
Other data:		
No. of Physical Catchment Descriptors	<10	30
Mapping scale (precision)	Coarse scale	DTM based
Index flood equation (FSE)	1.50	1.37

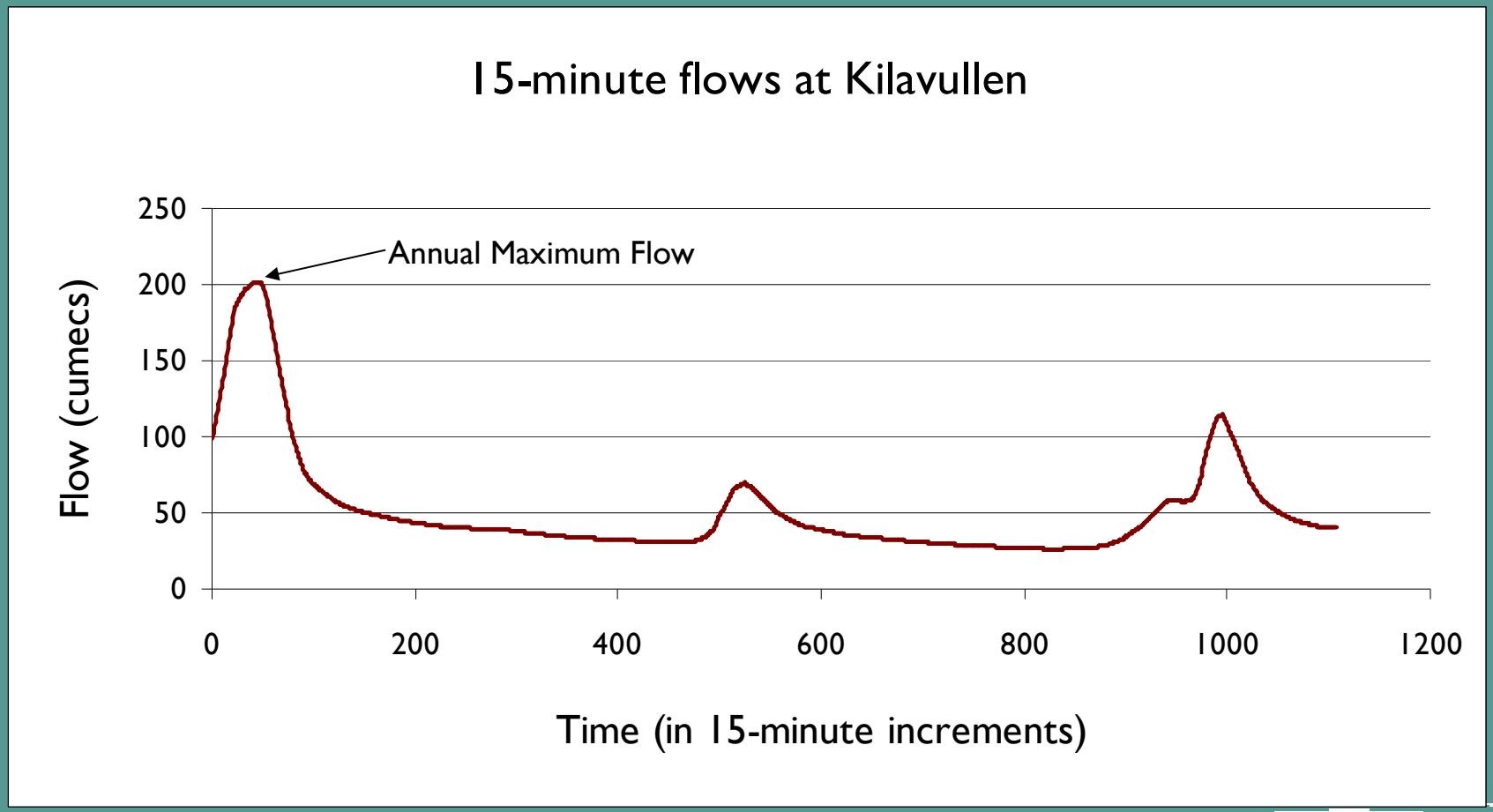
Datasets Used in the FSU Methodologies

Types of Datasets used in the FSU Research

- Hydrological Datasets – River Flow
- Meteorological Datasets – Rainfall Depths
- Spatial Datasets – Topographical & Land Use Mapping
- All the above were used to derive Physical Catchment Descriptors (PCDs)

Hydrological Datasets

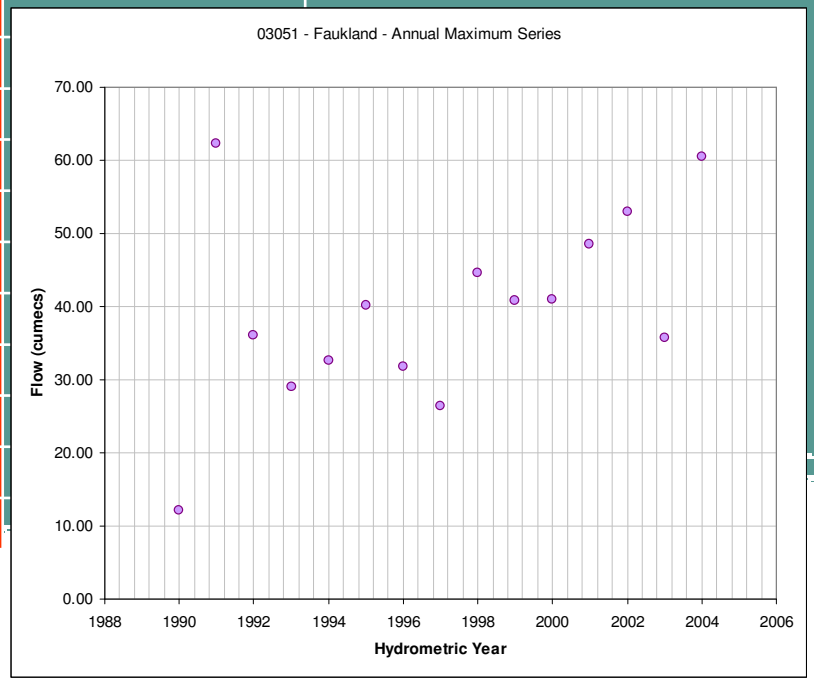
15-minute Flow Data (Used for Hydrograph Analysis)



Hydrological Datasets

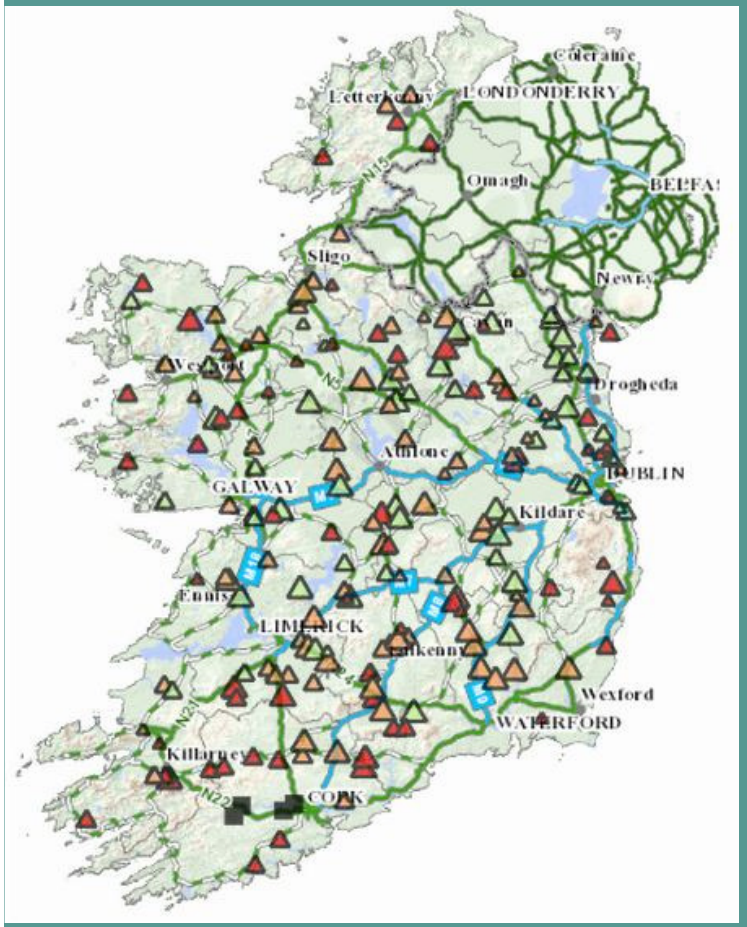
Annual Maxima (Amax) Series

Annual Maximum Series of Recorded Levels and Estimated Flows						
Hydrometric	Date		Staff Gauge	Estimated	FSU Station	Notes
Year			Reading (m)	Flow (m^3/s)	Class.	
1990	28/10/1990		0.88	12.10	B	Lowest Flow
1991	21/12/1991		2.01	62.30	B	Highest Flow
1992	15/01/1993		1.55	36.10	B	
1993	26/02/1994		1.40	29.00	B	
1994	31/01/1995		1.48	32.70	B	
1995	29/11/1995		1.63	40.10	B	
1996	19/02/1997		1.46	31.80	B	
1997	18/11/1997		1.37	26.40	B	
1998	01/10/1998		1.72	44.60	B	
1999	03/03/2000		1.64	40.80	B	
2000	08/12/2000		1.65	41.00	B	
2001	20/02/2002		1.79	48.60	B	
2002	22/10/2002		1.86	52.90	B	
2003	20/03/2004		1.55	35.80	B	
2004	08/01/2005		1.98	60.50	B	
Median of the Amax Series (QMED)				40.10		



Hydrological Datasets

Classification of FSU Stations



216 FSU Stations

- 54 A1-Stations
  HGF/Qmed > 1.3
- 85 A2 Stations
  1.3> HGF/Qmed > 1.00
- 77 B-Stations
  1 > HGF/Qmed > 0.95
- C and U Stations
  Not Used

Record length indicated by size of triangles

Spatial Datasets

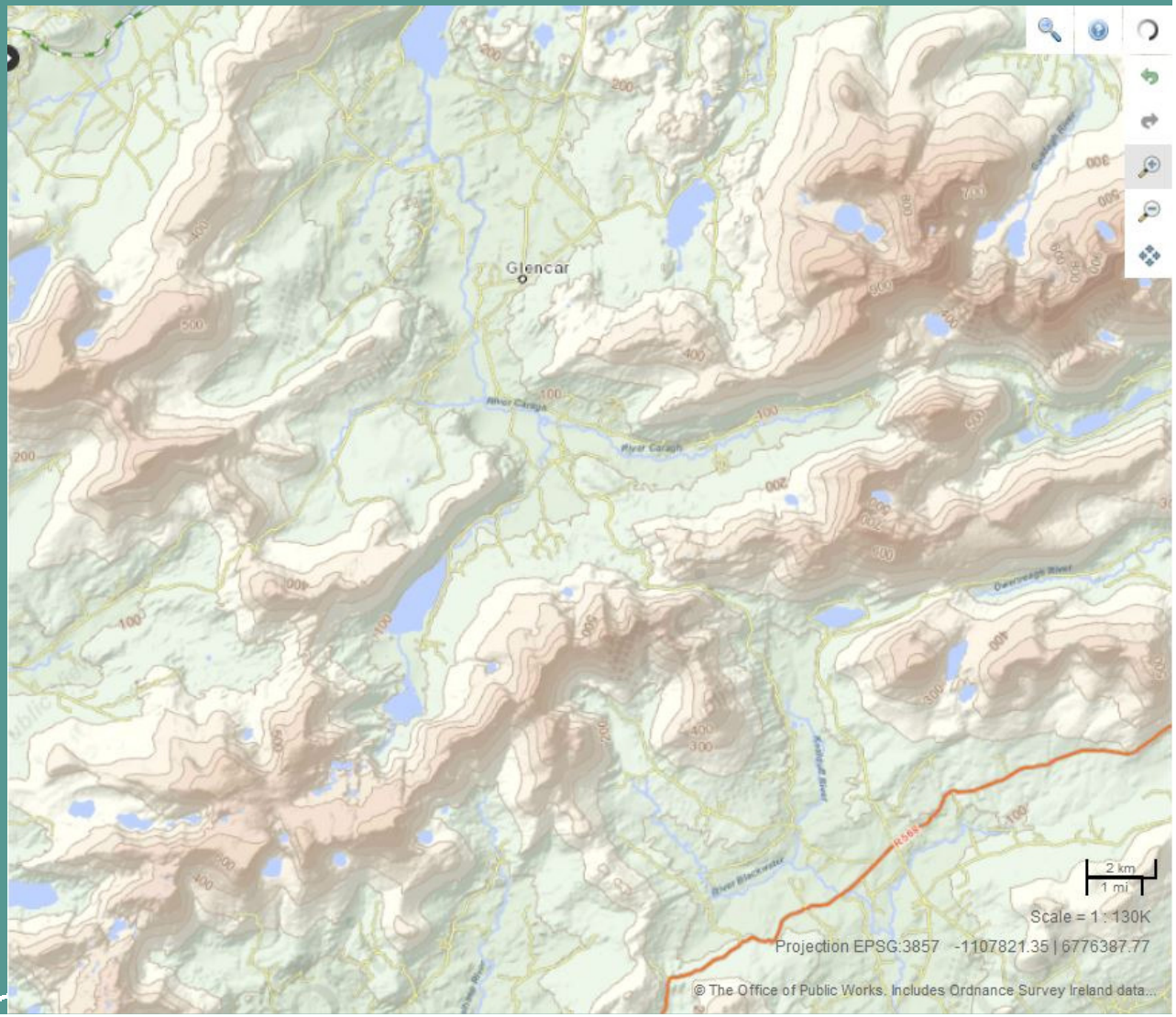
Spatial Datasets used in the FSU Research

- OSi Digital Elevation Model (DEM)
- EPA Blueline River Network (BRN)
- FSU Node and FSU Station Locations
- Gauged and Ungauged Catchment Outlines
- Physical Catchment Descriptors (PCDs)

Spatial Datasets

OSi Digital Elevation Model (DEM)

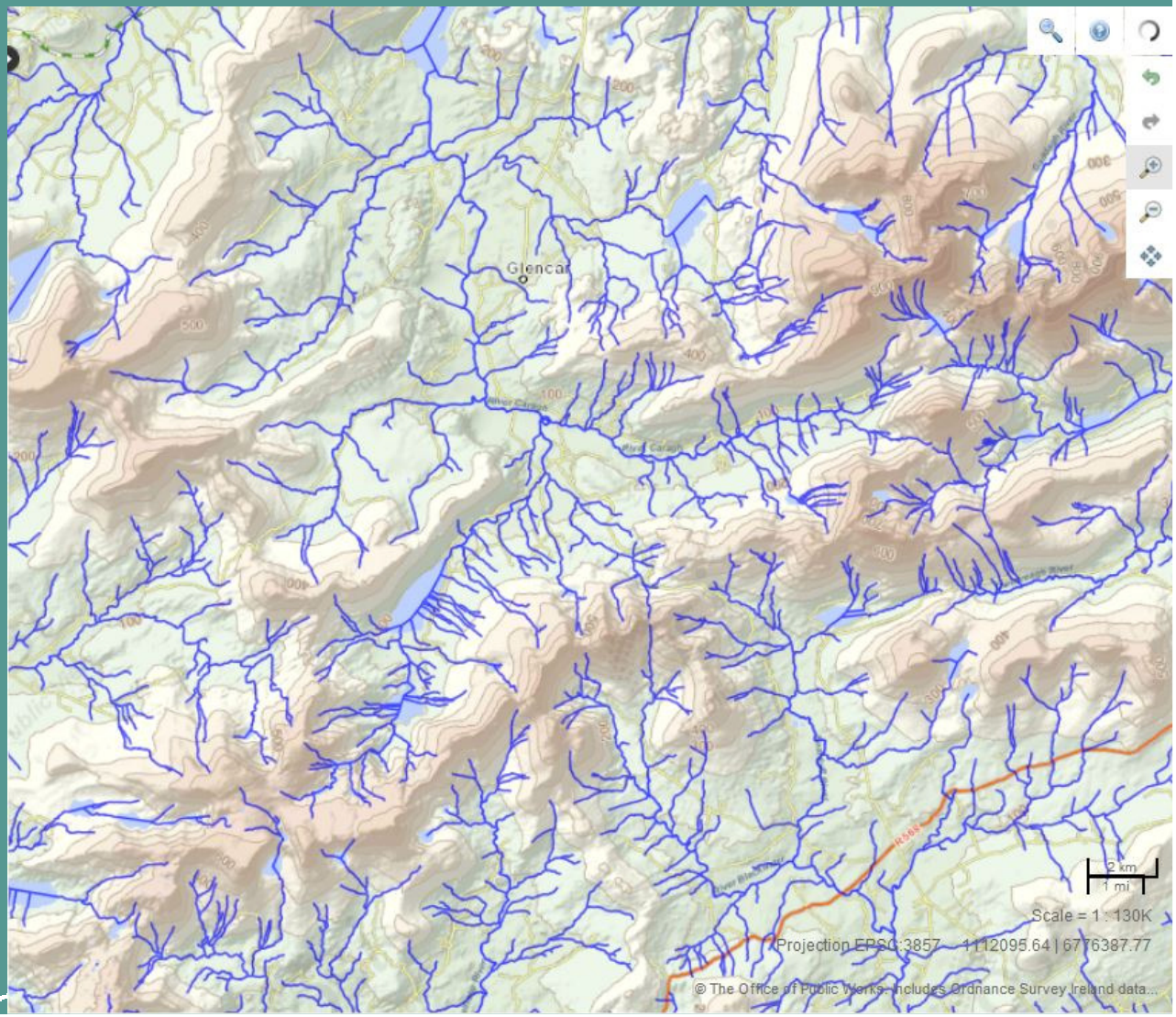
- 10 metre grid
- Vertical acc. +/- 2 m
- Effectively a contoured map of Ireland
- Start point for all FSU spatial datasets



Spatial Datasets

OSi/EPA Blueline River Network (BRN)

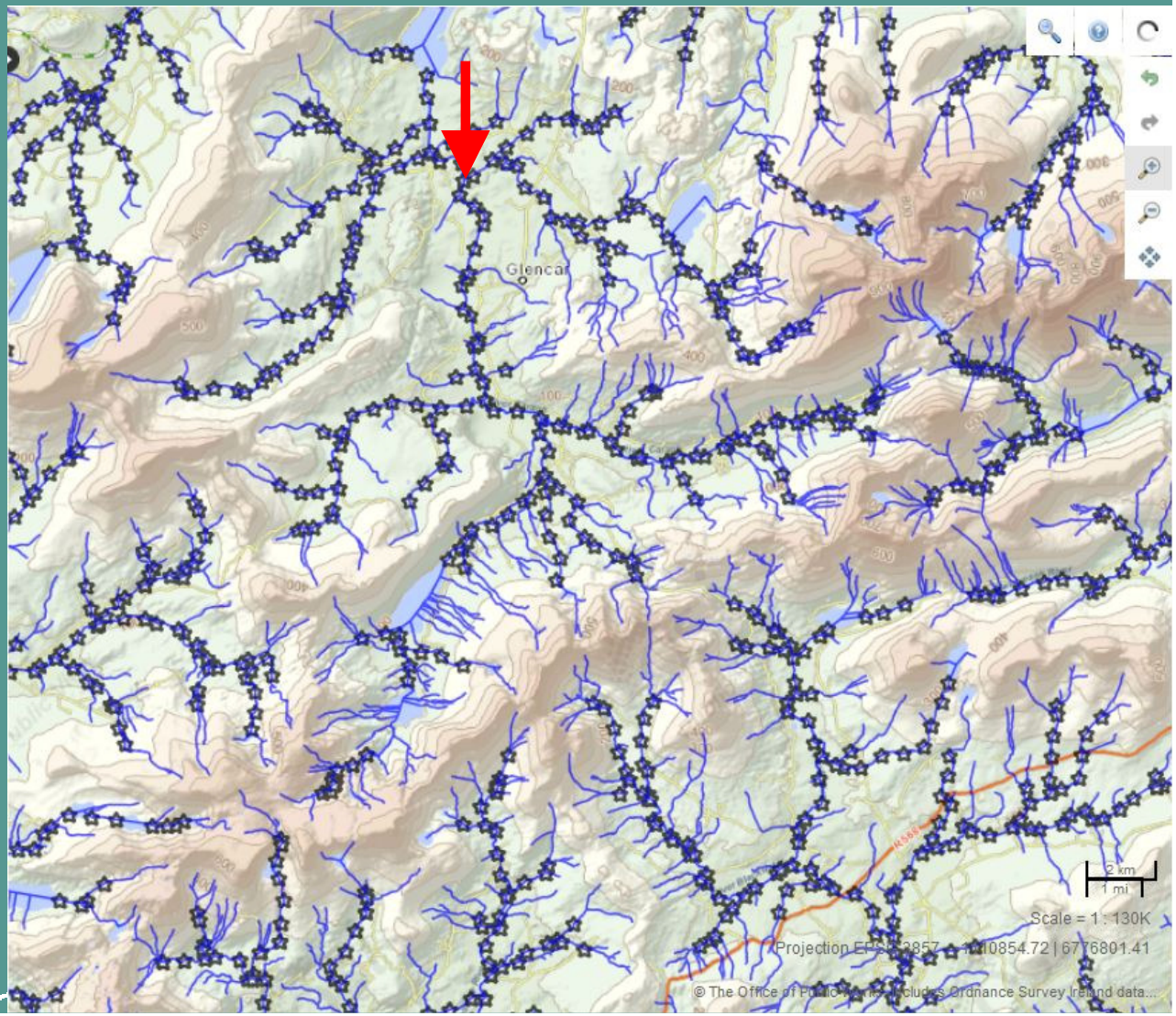
- OSi Map of all watercourses
- Hydrologically corrected by EPA
- Each line has an associated flow direction



Spatial Datasets

FSU Node and FSU Station Locations

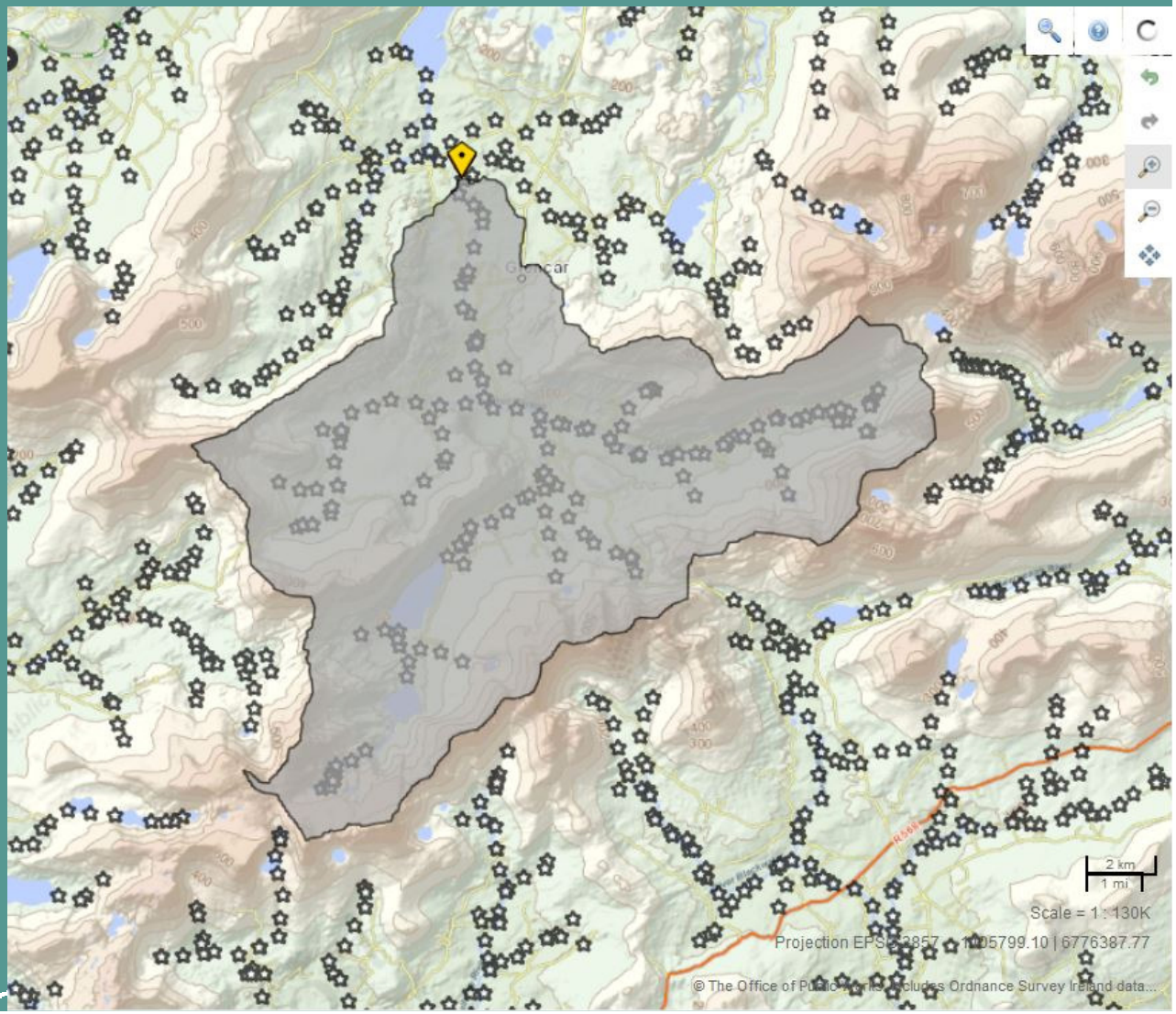
- Spaced at 500m centres
- Unique Labels e.g. 22_3419_2
- Catchment outlines were derived for each node and FSU Station



Spatial Datasets

Gauged and Ungauged Catchment Outlines

- Catchment outline derived from the OSi DEM
- Overlayed onto other spatial mapping to derive Physical Catchment Descriptors (PCDs)



Spatial Datasets

Physical Catchment Descriptors (PCDs)

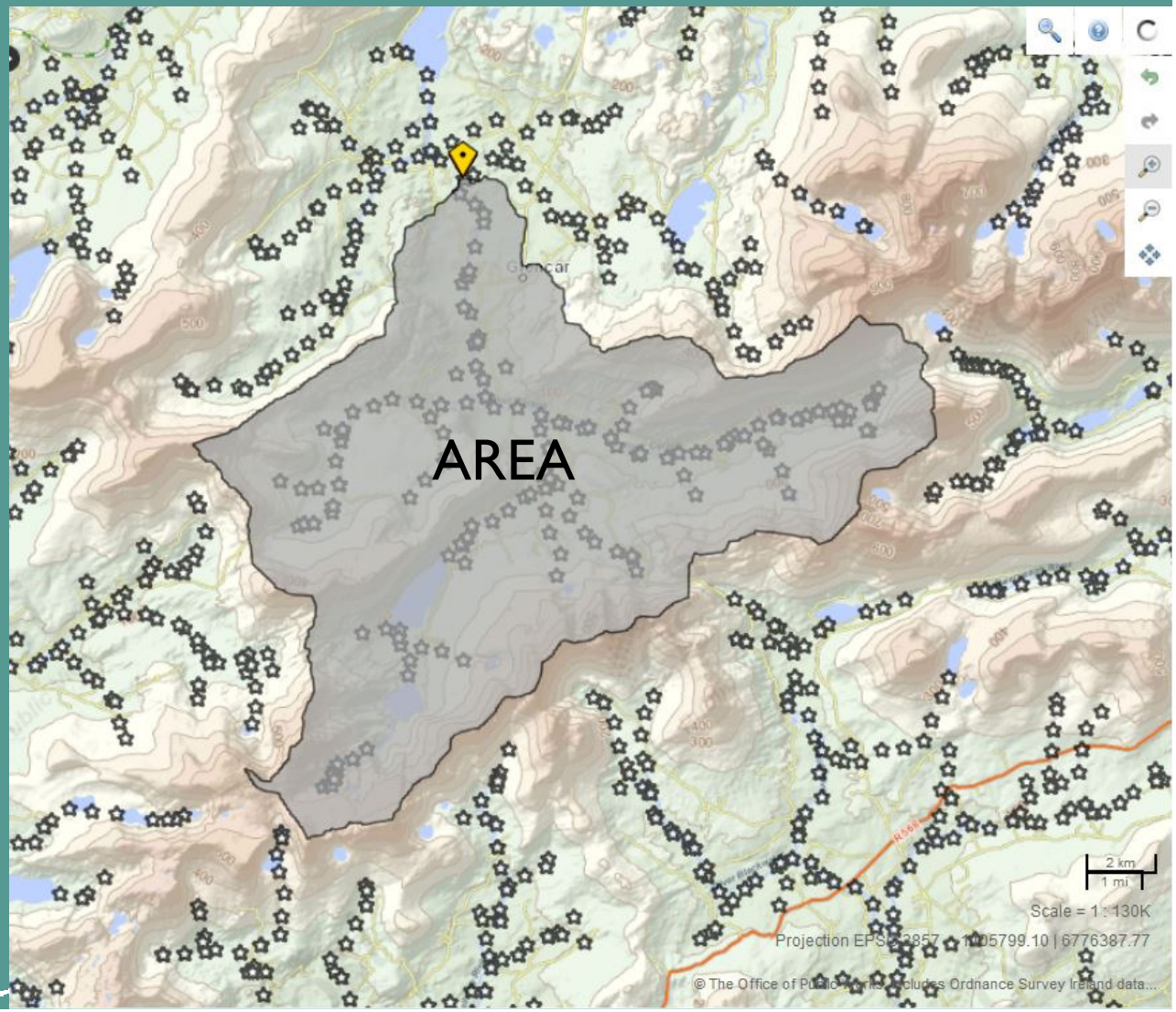
Describe the physical characteristics of a catchment in numerical form

- Catchment Area *(AREA)*
- Standard Period Average Annual Rainfall (*SAAR*)
- Baseflow Index derived from Soils (*BFIsoil*)
- Flood Attenuation from Reservoirs and Lakes (*FARL*)
- Drain Density (*DRAIND*)
- Mainstream Slope (*S1085*)
- Arterial Drainage Index (*ARTDRAIN2*)
- Proportion of Urban Landcover Extent (*URBEXT*)

Physical Catchment Descriptors

1. Catchment Area *(AREA)*

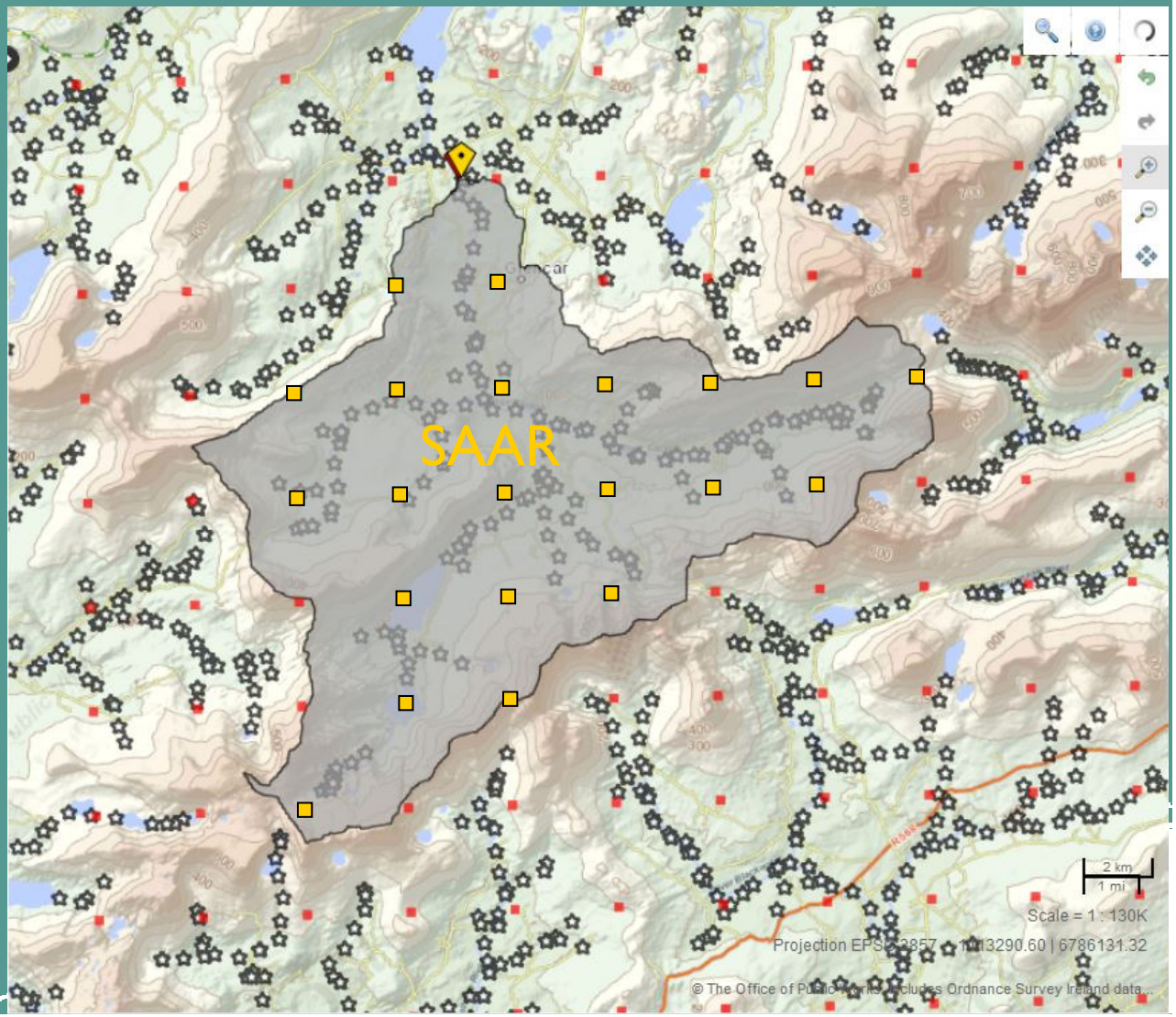
- Area within the catchment outline
- Units in km^2



Physical Catchment Descriptors

2. Standard Period Average Annual Rainfall *(SAAR)*

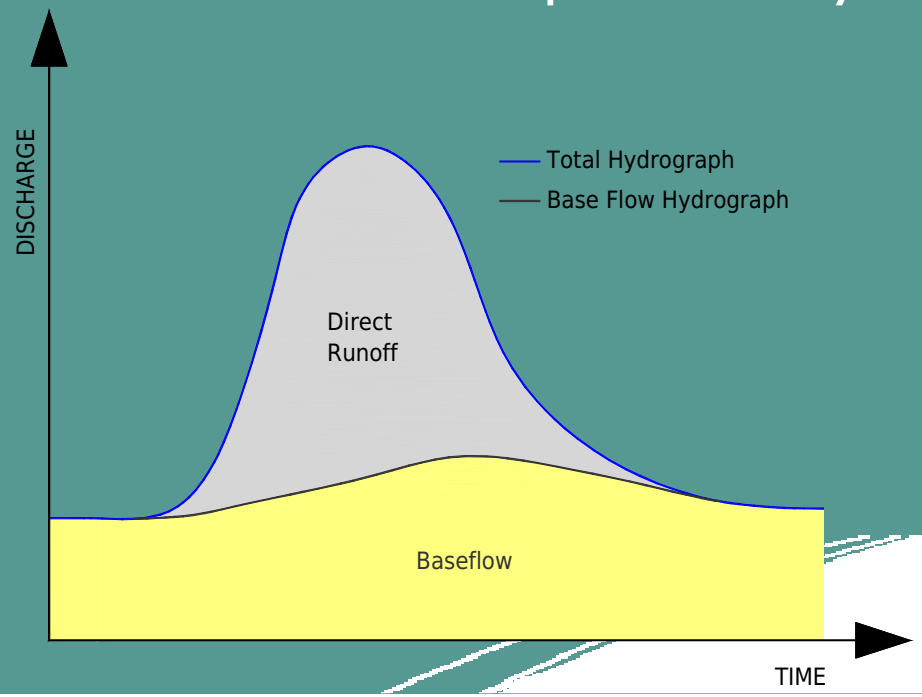
- Average of the gridded values of SAAR contained within the catchment
- Units in mm/year

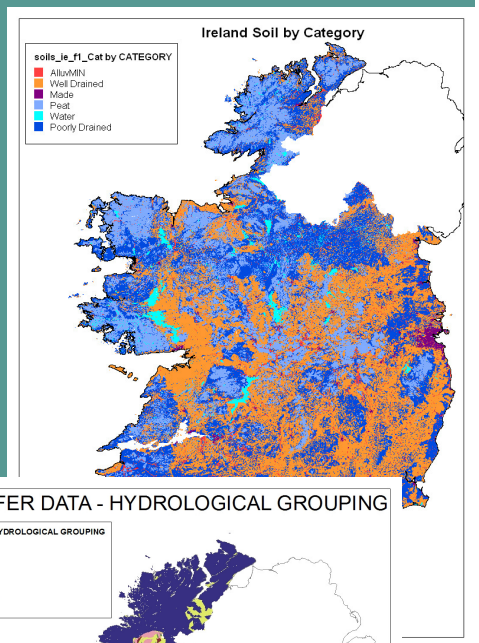


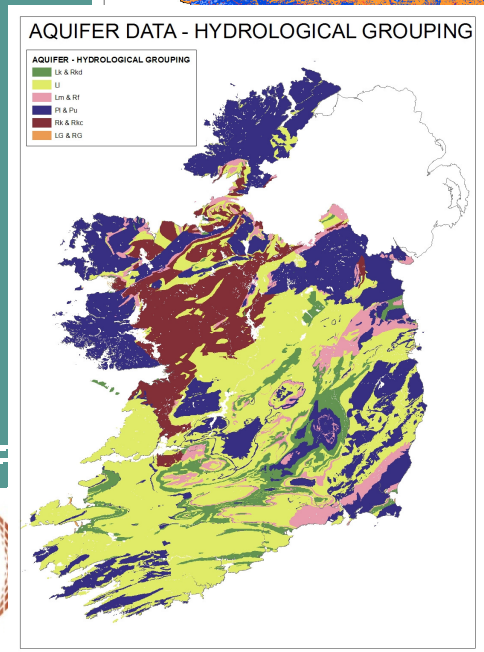
Physical Catchment Descriptors

3. Baseflow Index derived from soils *(BFIsoil)*

- Baseflow Index (at a gauge) = Baseflow/Total Flow (with a range from 0 → 1)
- Using Soils, Subsoils, and Aquifer maps, BFI was derived for all ungauged locations
- Indicator of catchment permeability



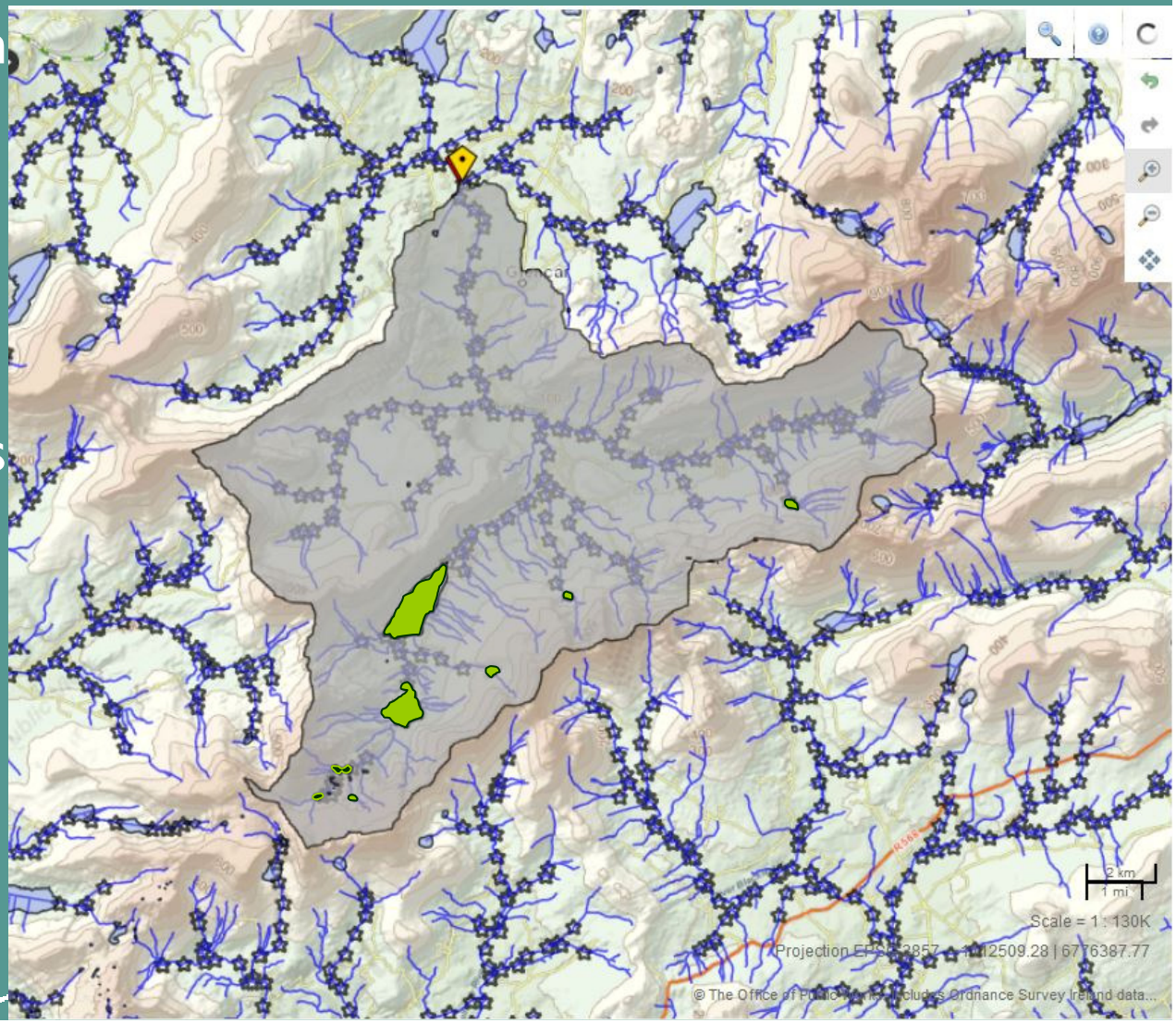




Physical Catchment Descriptors

4. Flood Attenuation from Reservoirs and Lakes *(FARL)*

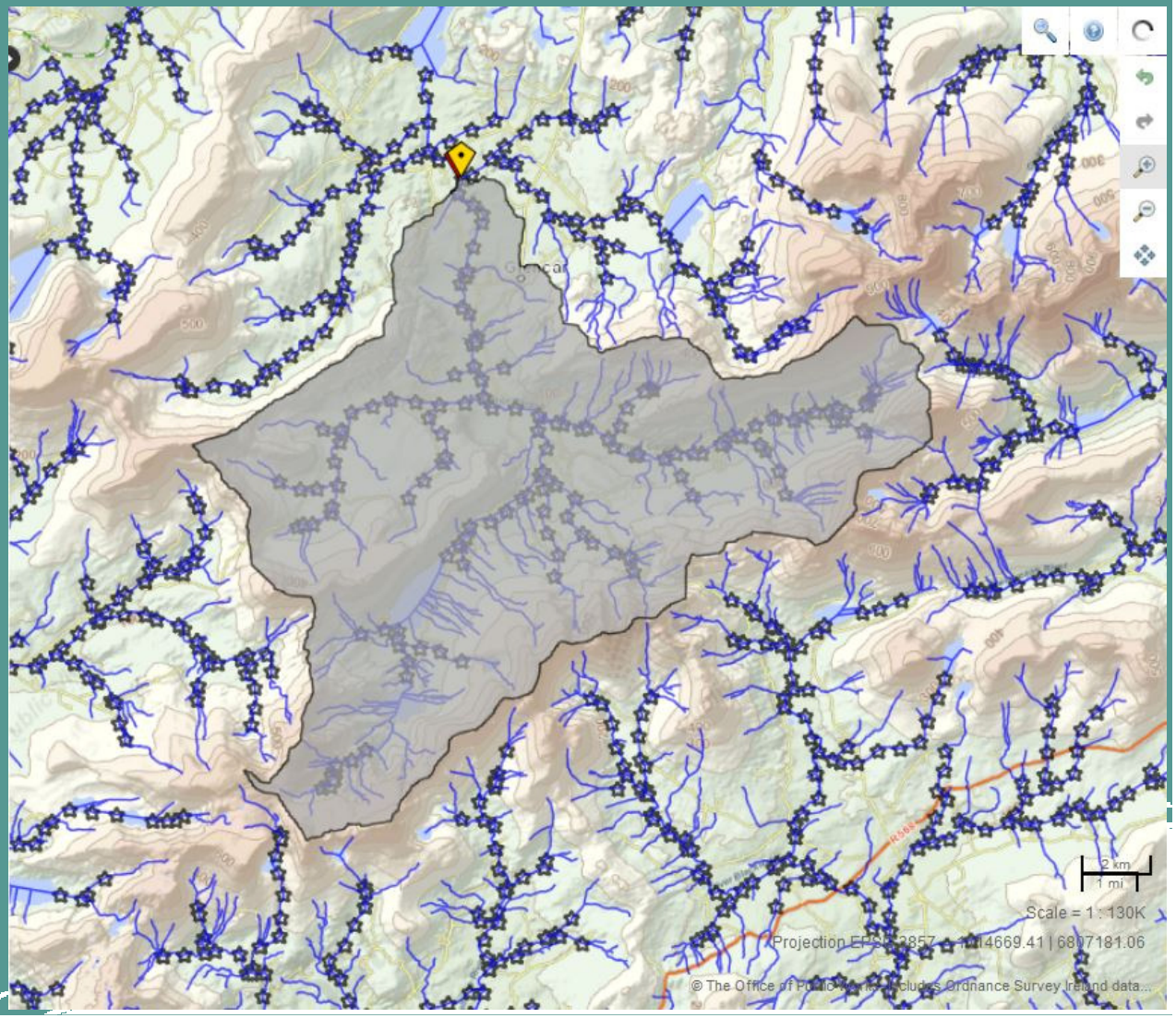
- Indicates proportion of lakes in a catchment
- Indicator of the attenuating effects of large waterbodies
- Range 0 → 1
- FARL=1 (no lakes)
- FARL≈0.6 (extensive lake coverage)



Physical Catchment Descriptors

5. Drain Density *(DRAIND)*

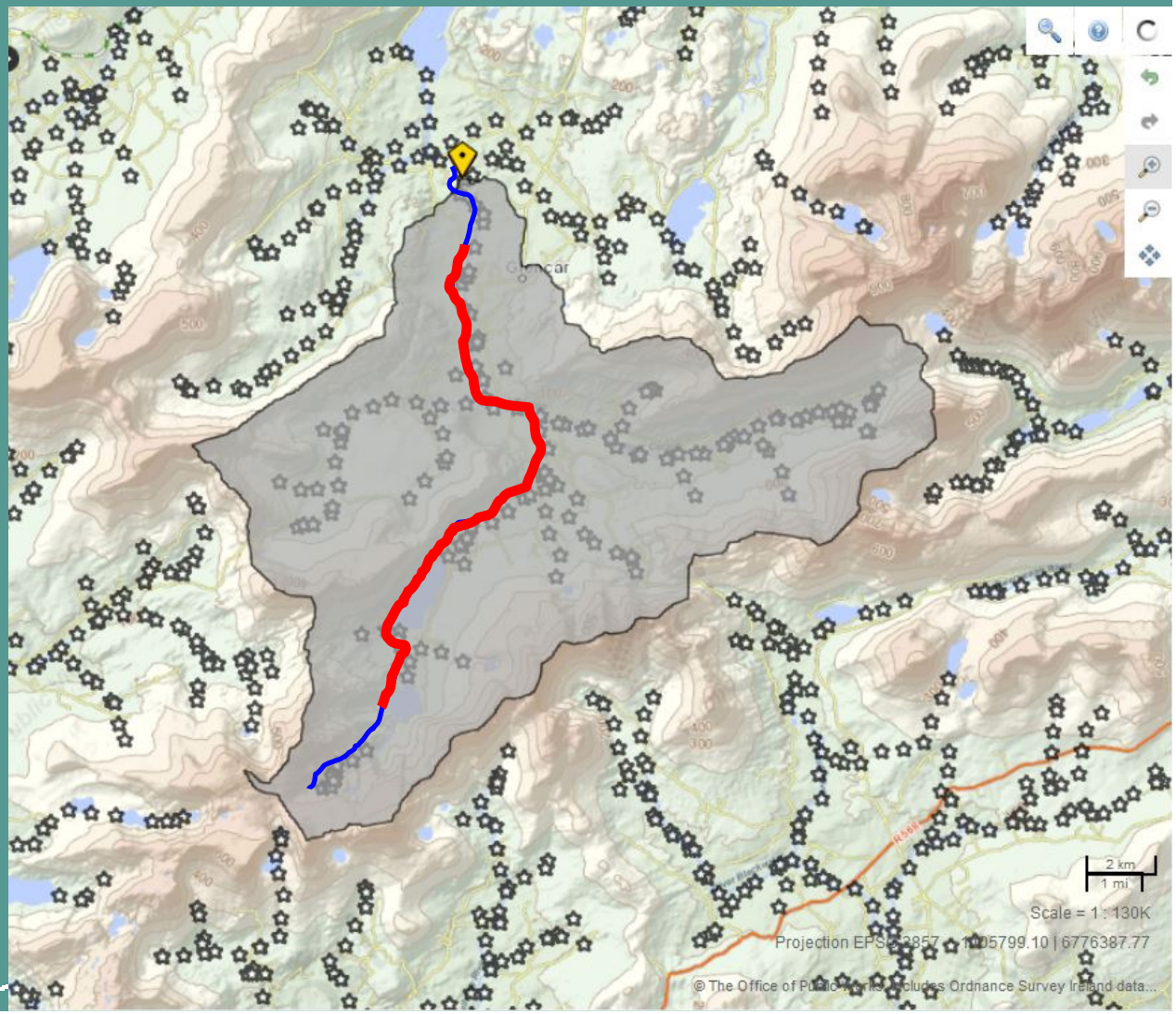
- DRAIND is an index that relates the <u>length</u> (km) of the upstream hydrological network and the <u>area of the catchment</u> (km^2)
- Units in km^{-1}



Physical Catchment Descriptors

6. Mainstream Slope *(S1085)*

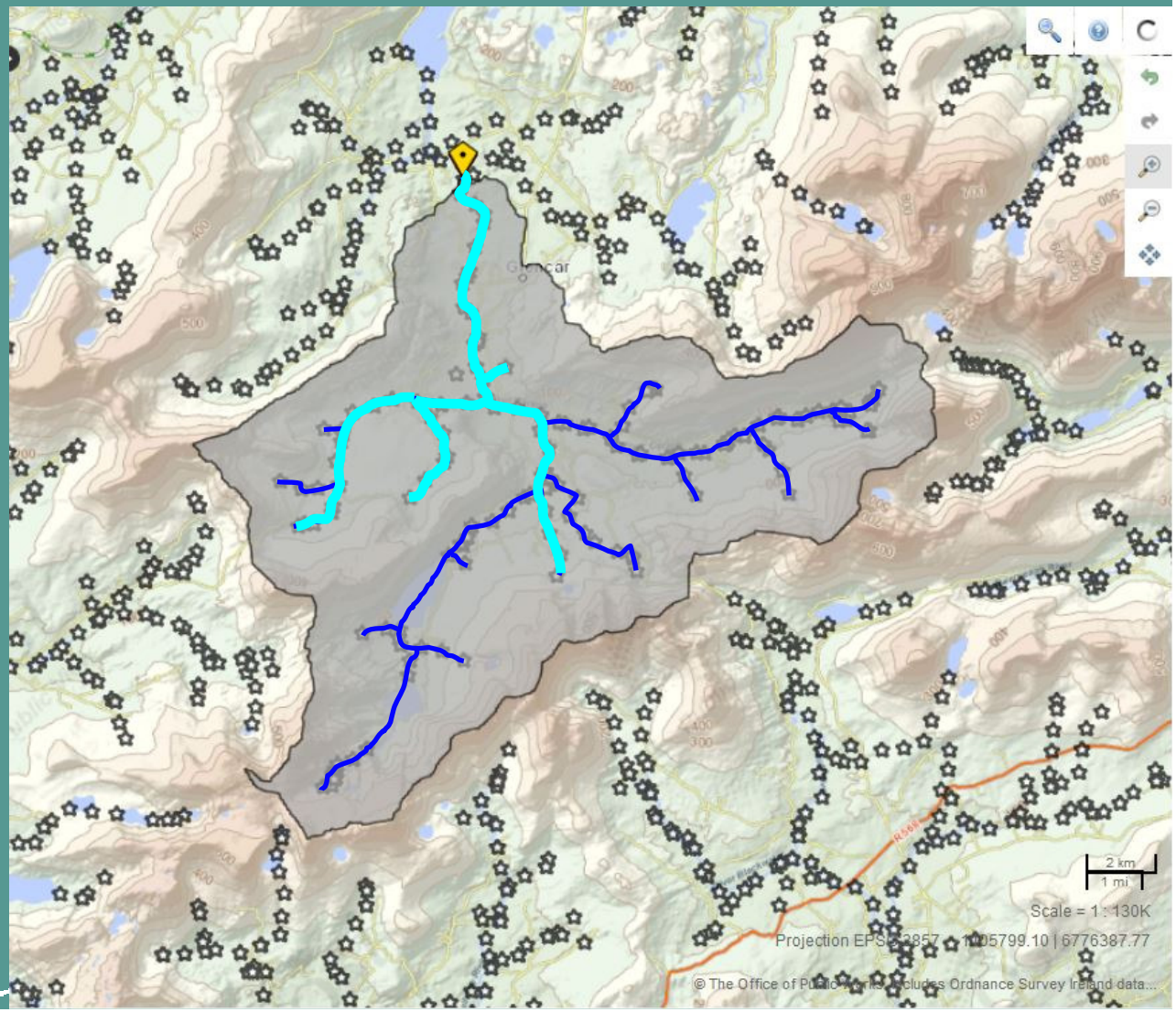
- Slope of the River main stream when the upper 15% and the lower 10% are discarded
- Units in m/km



Physical Catchment Descriptors

7. Arterial Drainage Index *(ARTDRAIN2)*

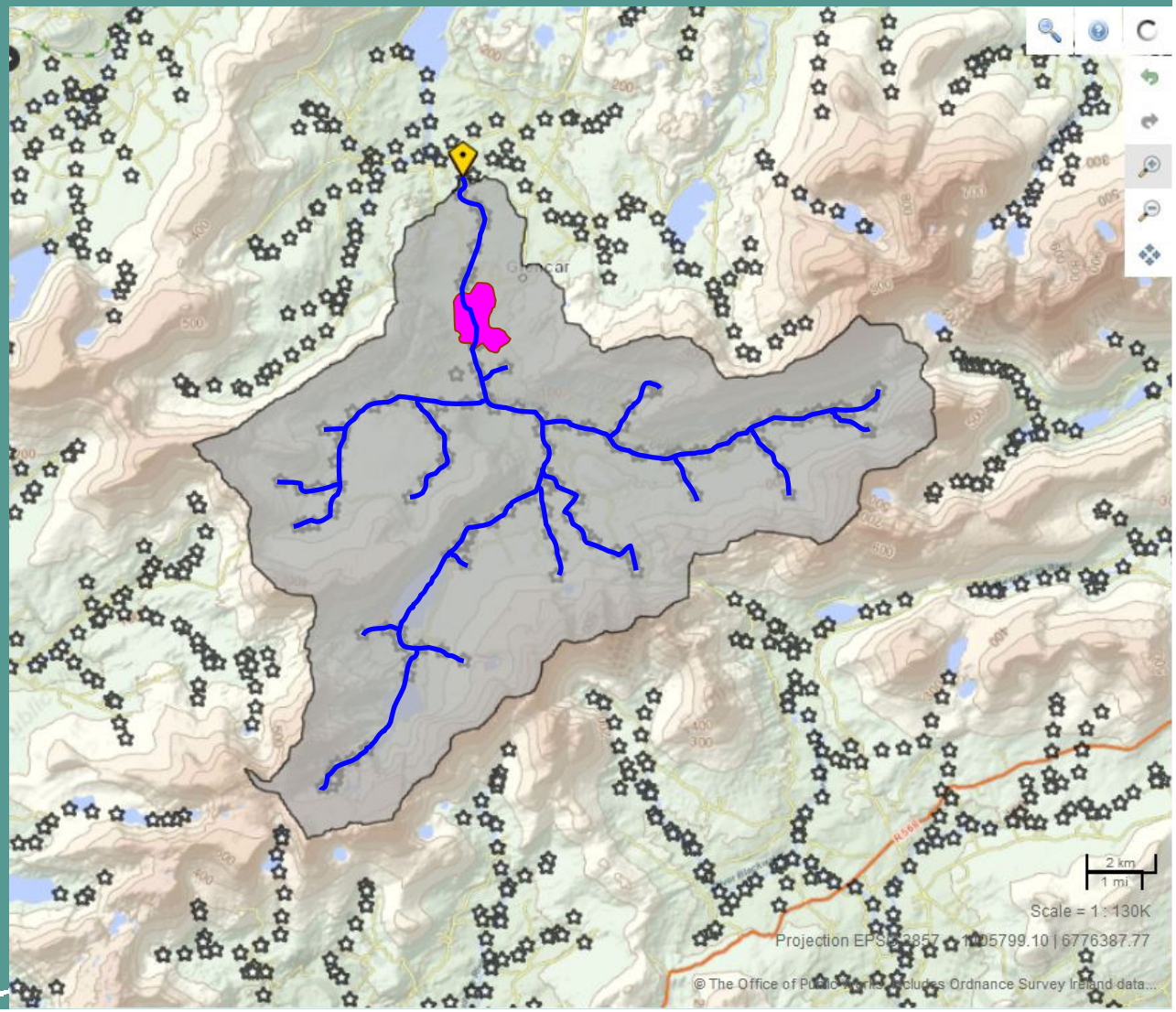
- Proportion of the upstream river network that has been included in drainage schemes (km/km)
- Expressed as a proportion from 0 → 1



Physical Catchment Descriptors

8. Proportion of Urban Landcover Extent *(URBEXT)*

- Proportion of the catchment that is urbanised
- Based on Corine Land Cover data
- Expressed as a proportion from 0 → 1



Basis of the FSU Methodologies

How are Flood Variables Derived in the FSU Research?

- The variable of interest (e.g. QMED) is chosen
- Measured values of that variable are collected for gauged catchments
- Physical Catchment Descriptors (PCDs) are derived for the same gauged catchments
- A relationship between the variable of interest (e.g. QMED) and PCDs is derived
- This is used to generalise a method for calculating the variable of interest for ungauged catchments/locations

Basis of the FSU Methodologies

Using PCDs to derive QMED at ungauged locations

Get QMED values at gauged locations

↓

Derive PCDs for those gauged catchments

↓

Derive relationship between QMED and PCDs (equation)

↓

Calculate QMED at ungauged locations using the equation

↓

Use other information to adjust the equation estimate