

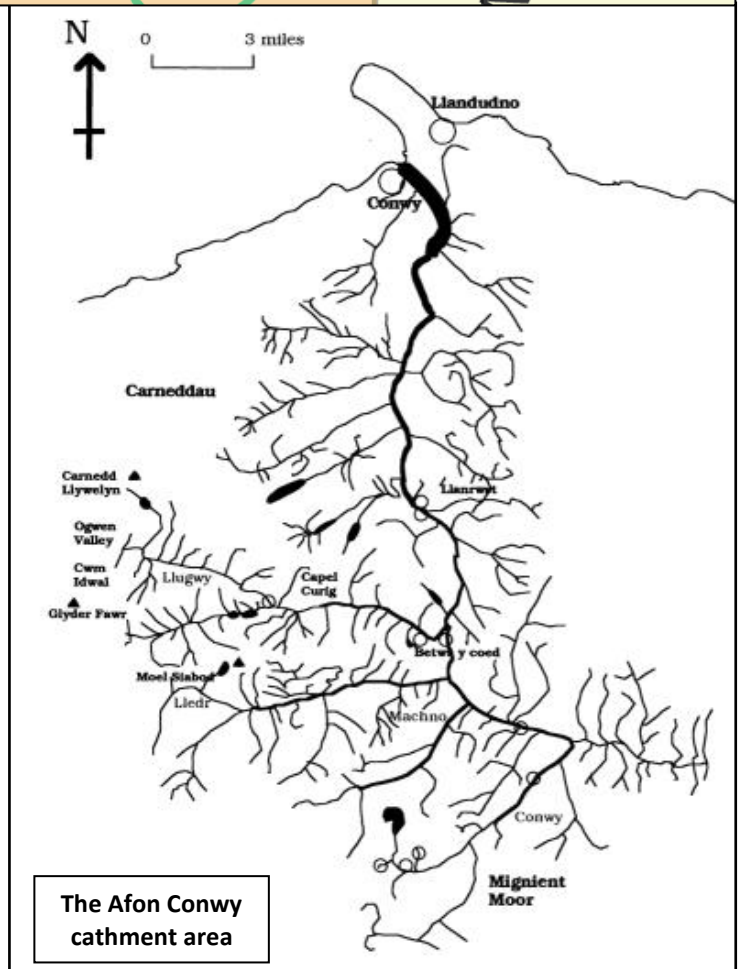
The Afon Conwy, or River Conwy, is 55km long and is one of the major drainage systems in North Wales. The river begins up on the moorland plateau of Migneint Moor to the south of Rhyd-y-creuau field centre. Its source is Llyn Conwy, a reservoir 450 metres above sea level (GR 782 457)



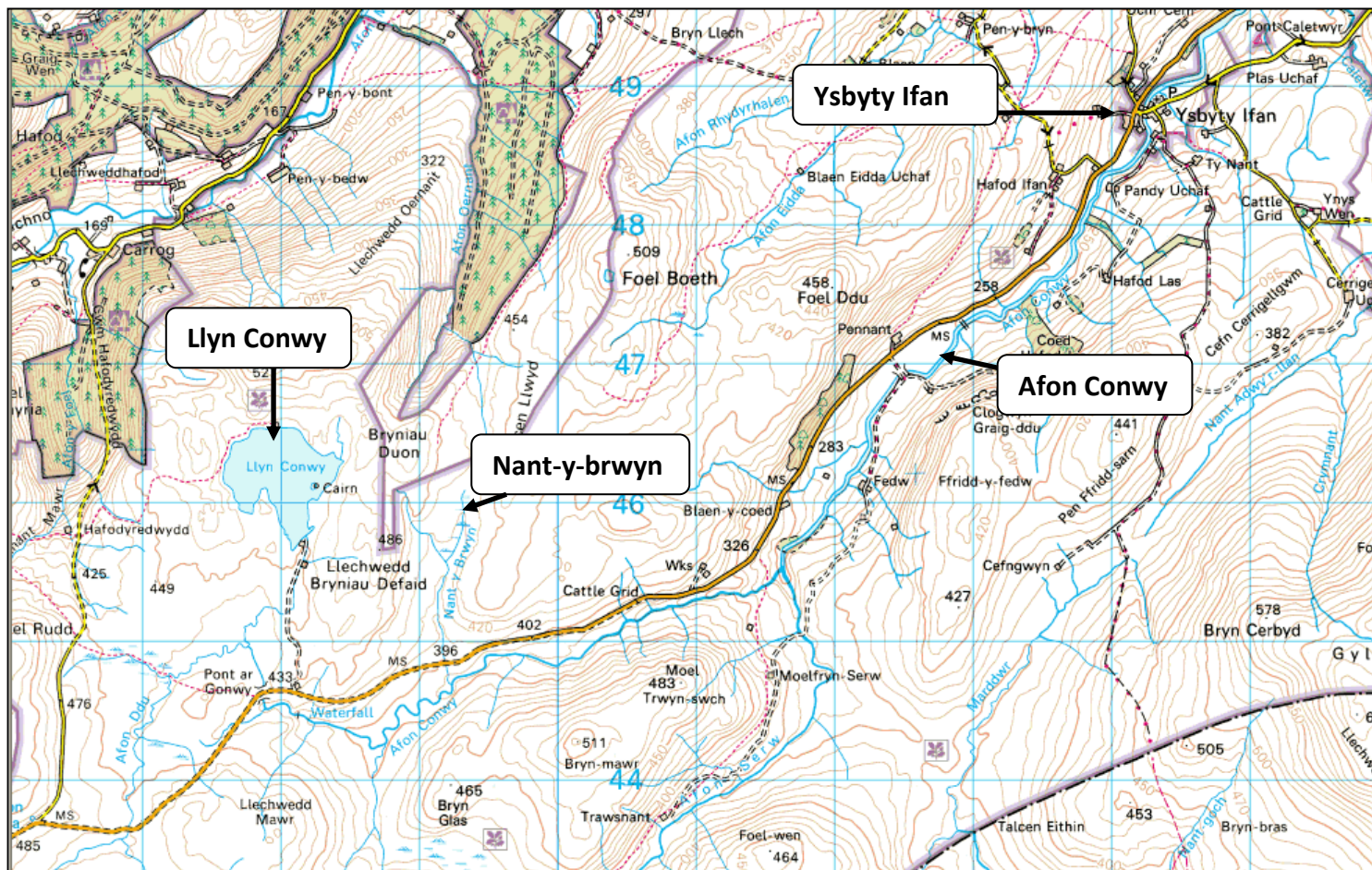
North Wales and the Afon Conwy

The river flows North-east from the Migneint Moors before turning sharply North-West after the small village of Ysbyty Ifan. The Conwy then continues North, cascading down the Conwy falls, flowing past the settlements of Betws-y-coed and Llanrwst and eventually reaching the sea as a large estuary near the castled town of Conwy on the North Wales coast (GR 774 795).

The Afon Conwy has a relatively large drainage basin of approximately 590 km² which drains some of the highest mountains in the UK. Given the high rates of precipitation in the area, the catchment has a high channel density with many large tributaries including the Afon Machno, the Afon Lledr and the Afon Llugwy.



The Afon Conwy catchment area



OS map extract of the upper courses of the Afon Conwy in the Migneint Moors. The main channel flows South-West to North-East

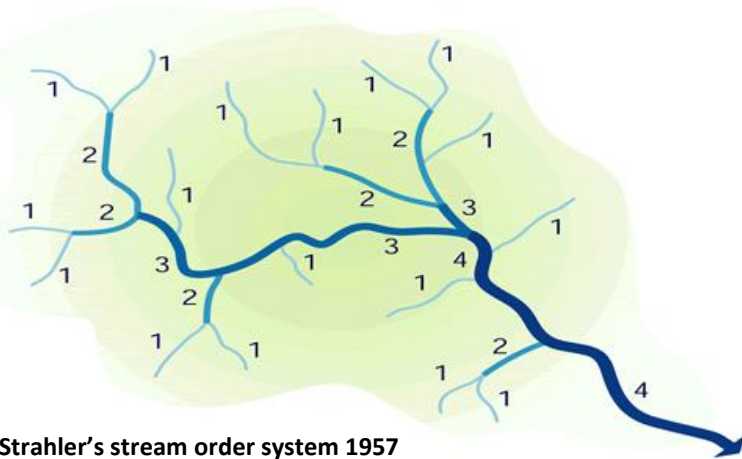
Geology and soils on the Migneint Moor

Migneint Moor consists mainly of siltstones and mudstones from the Nant Ffrancon subgroup (Upper Ordovician), some of which have been metamorphosed into slate. This bedrock is of an acidic, impermeable character, directly influencing catchment dynamics.

The cold conditions at this altitude and the saturated soils encourage the development of peat soils, especially after the large scale deforestation of the area. Peat soil is characterised by large accumulations of partially decayed plant matter due to a lack of oxygen in the soil, delaying decomposition at that location. A report by the International Union for the Conservation of Nature (IUCN) has estimated that the UK's peatlands and peatbogs lock in about 3 billion tonnes of CO₂, and are a far more significant carbon store than the UK's forests.

The impermeable bedrock of the Migneints causes an increased rate of soil saturation in since water cannot percolate further down The saturated peat soils mean that infiltration rates are very low, increasing the amount of overland flow and reducing the lag time for the river. The geology and soil combined with high rainfall and a lack of trees means that river levels of the Conwy in this upper catchment area can change very quickly after rainfall events.

A stratified sampling strategy is commonly used on the Afon Conwy to select sites for investigations. This sampling strategy uses Strahler's stream order classification to choose successive sites downstream.



Strahler's stream order system 1957

Strahler's (1957) stream order system is a simple method modified from Horton's classification system (1945). Stream sections are classified based on the number of tributaries upstream.

A stream with no tributaries is considered a first order stream. When two stream orders of n meet they are then categorised as stream order $n+1$.

The Nant y brwyn

The first data normally collected by students is at approximately 400m above sea-level on the small tributary called Nant y Brwyn with stream orders 1 & 2 (GR 792 453). This series of small tributaries lie at the bottom of a small v-shaped notch and displays some characteristics typical of an upland stream including the v-shape of the valley, narrow valley bottom with no developed floodplain, interlocking spurs, turbulent water with step-pool sequences, steep channel gradient and large, angular bedload.

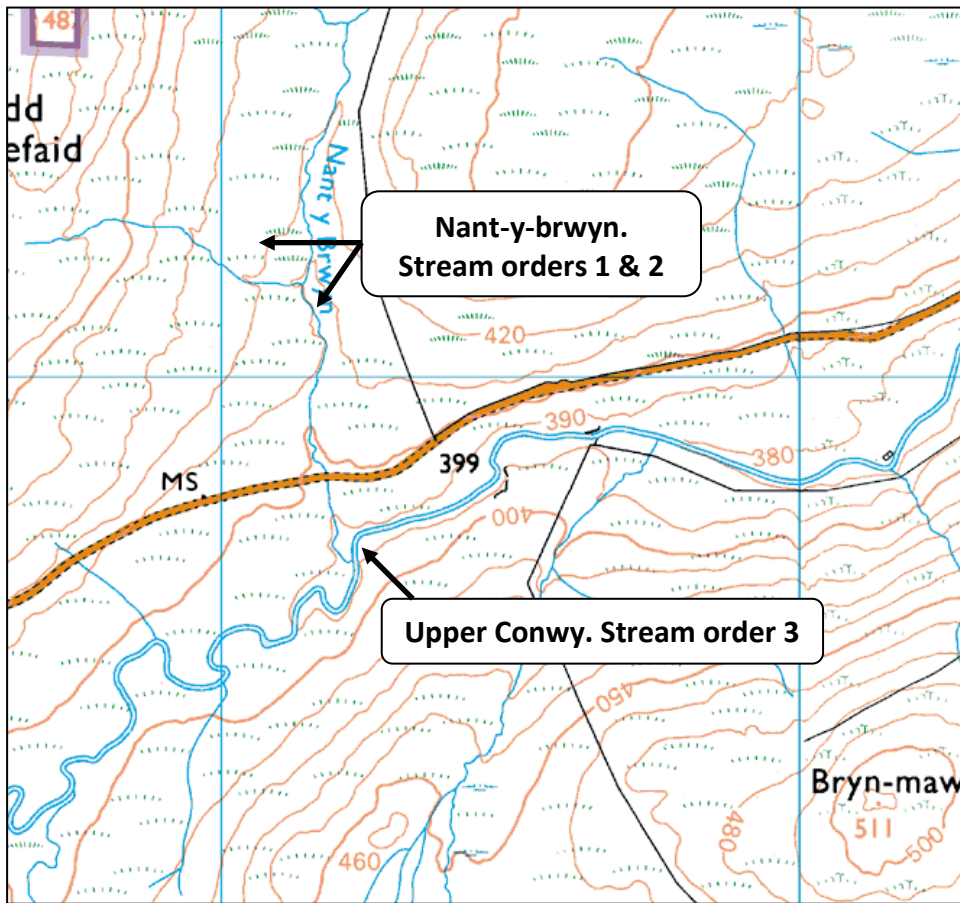
These sites have good opportunities to observe the bedrock geology with clear exposures left behind after the down cutting of the river. In addition to the slate, white Quartz, an abundant mineral commonly found in Wales, is easily identifiable. The Quartz mineral constituents (mainly Silica and Oxygen) were carried into the rock weaknesses in a heated liquid solution where they crystallised to form veins along joints or bedding planes.



First order channel on the Nant y brwyn



Second order channel on the Nant y brwyn



OS map extract of the Migneint Moor with the Nant y brwyn and Afon Conwy

The next site for data collection is usually located at approximately 380 metres above sea-level just downstream of the confluence between the Nant-y-brwyn and the Afon Conwy with a stream order of 3 (GR 793 447).

This site is unusual for the upper course of a river as it displays characteristics you would more likely expect in a rivers middle to lower course, such as a small but developed floodplain and relatively large, regular and sinuous meanders with river cliffs and graded slip-off slopes.

This can be in part explained by the areas relatively recent past when large accumulations of glacial ice built up to form an ice cap centred over the Migneint Moors.

This ice cap spilled outwards in all directions filling a number of glacial troughs in the area. Previously, scientists believed this ice cap was large enough to overtop the mountains to the North but further study has refuted this theory. Enough ice accumulated in the mountain cwms to account for the ice features in these areas.



Confluence between the Nant y brwyn and the Afon Conwy

However given the significant accumulation of ice, relatively uniform siltstone geology and the lack of resistant peaks in the Migneints it is likely that the area was completely covered during the last glacial maximum giving the flattened, rolling appearance seen today with associated river features.



Students on Migneint Moor sampling on the upper Afon Conwy



Graded deposition on a slip-off slope. Afon Conwy



Meander on the Afon Conwy. Note the river cliff and slip-off slope

Even though the features of the upper Conwy are curiously located they do possess great potential for observing key river landforms such as well developed meanders.

After heavy rain and deposition, slip-off slopes display excellent grading showing how river energy and sediment size interact to organise or 'sort' deposits in a fluvial environment.

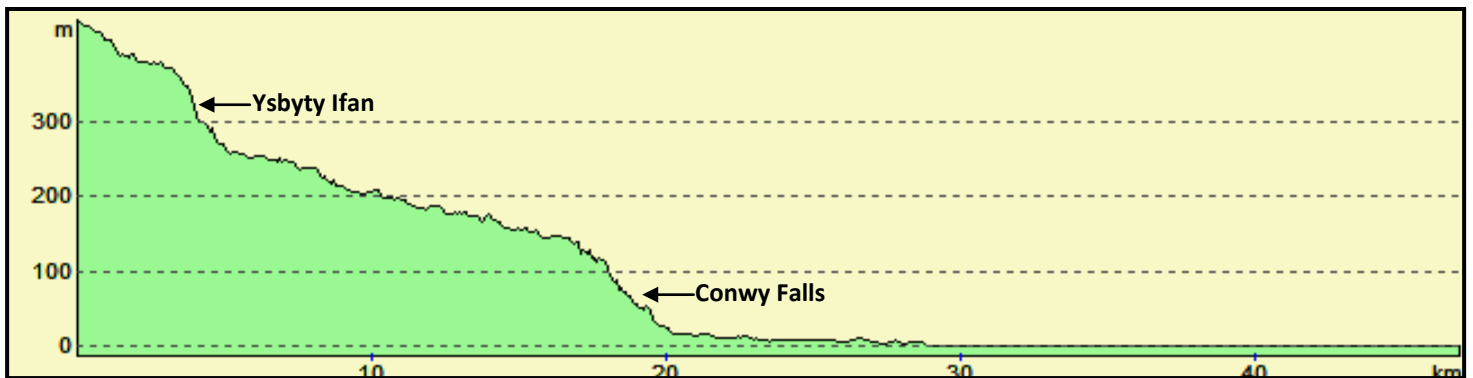
'Grading' or 'sorting' refers to sediment of similar size being deposited in the same location due to available energy. Further up the slip-off slope nearest the channel bank, water velocity is low due to friction. Only small calibre sediment can be transported and deposited in this low energy environment. Lower down the slip-off slope, towards the channel centre, friction decreases and velocity increases as the water gets deeper. Given the greater amount of available energy, larger bedload can be transported and deposited in this location.



Part of the first knick point on the Afon Conwy

The Afon Conwy differs from a theoretical long profile showing two distinct 'knick points' along its course, the first is located 2-3km upstream of the village Ysbyty Ifan and the second is located 3-4km upstream of Betws-y-coed at Conwy Falls.

These knick points are believed to have formed after large glaciers met from connecting valleys in each location, rapidly scouring deeper troughs at those points due to an abrupt increase in ice volume. Consequently, steps were left in the channel profile 'rejuvenating' the river at these points.



Long profile of the Afon Conwy showing two distinct 'knickpoints' at Ysbyty Ifan and Conwy Falls. Source: MemoryMap

Other factors may well have influenced the creation of these steps such as differences in geology (Conwy Falls cuts through a volcanic ash flow tuff surrounded upstream and downstream by siltstone and mudstone) and changes in base level caused by absolute sea-level (Eustatic) changes or rebound of plates after glacial melt (Isostatic rebound).

Both knick points are in a state of recession, with a series of waterfalls and rapids slowly moving upstream.



Conwy Falls – second knick point on the Afon Conwy

Ysbyty Ifan



The bridge over the Conwy at the village of Ysbyty Ifan

Ysbyty Ifan is the first settlement of any significance moving from source to mouth on the Afon Conwy. By this point the river has been joined by a number of tributaries making it much larger.

Ysbyty Ifan is normally the third site at which students sample on the Afon Conwy.

The river at this location is of stream order 4 (GR 842 488).

Until 1189, the village was known as Dôl Gynwal. Then, it came to the attention of the Knights of St John, who set up a hospice. The church marks the spot where the old hospice stood.

Upstream of Ysbyty Ifan the river channel becomes significantly steeper for a short section before flattening out back up onto Migneint Moor.

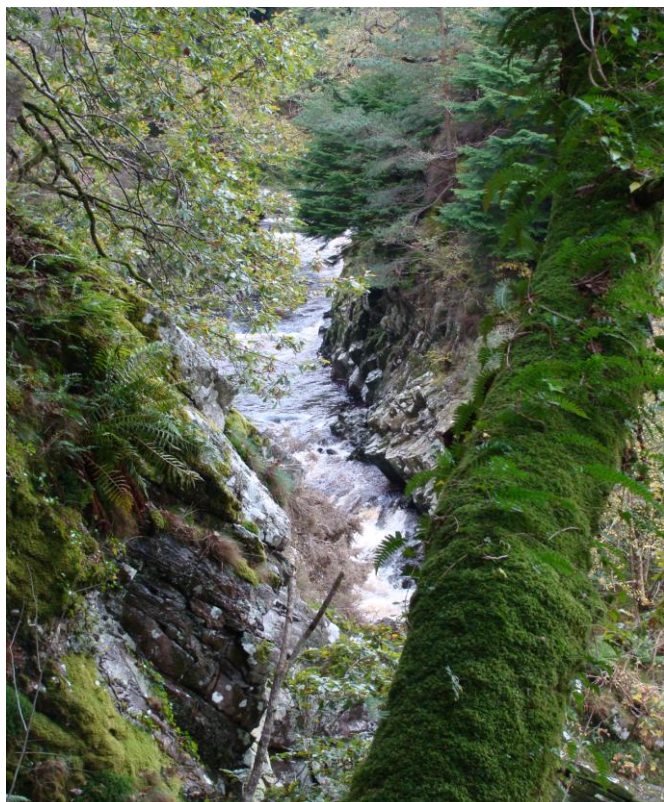
This is the Conwy's first 'knick point', likely to have been caused by the meeting of two large glaciers in the Devensian glacial event, gaining erosive energy and subsequently carving a step in the landscape. This step or 'knick point' has been receding ever since and today you can see a small gorge as you drive to or from the Migneint Moors.



National Trust properties are protected by reinforced banks

The renewal of a rivers potential energy and vertical erosion is called **rejuvenation**.

Other points of interest at Ysbyty Ifan are the small floodplain, a river bar forming in the low energy environment behind the bridge and the first signs of river defences including reinforced banks.



Conwy Falls with a steep-sided gorge.
Created as the knickpoint retreated over time

The Conwy Falls is the largest series of rapids and waterfalls on the river course falling approximately 40m in height over a distance of approximately 800m (GR 808 535)

The area is classified as a Site of Special Scientific Interest (SSSI) for its rare flora and fauna.

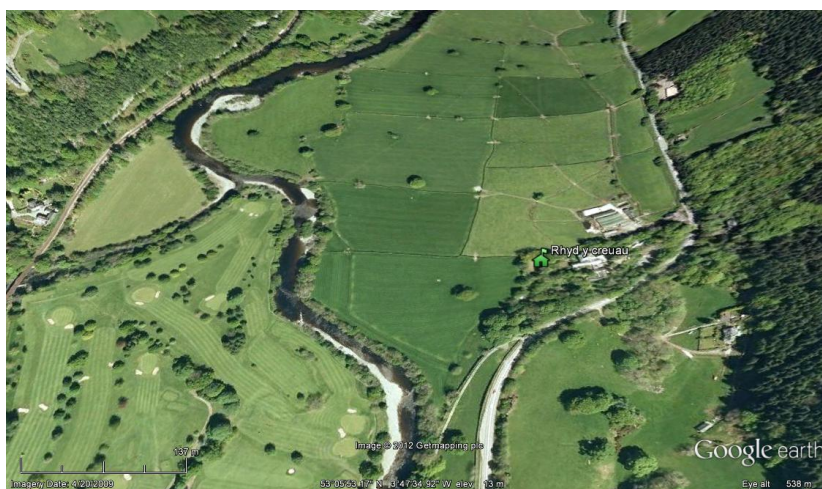
Formation of the gorge and knickpoint has been suggested to originate from the large quantities of ice meeting at this point. Valley glaciers from the Lledr and Llugwy valley joined the Conwy valley glacier around Betws-y-Coed causing aggressive glacial erosion deepening the valley.

Hanging valleys were created as a result higher upstream along the Lledr and the Conwy.

Since the the last glacial event, rejuvenation has been taking place with the rivers trying to regrade themselves. So far, the Conwy has cut back around a kilometre leaving a deep gorge downstream towards Betws-y-Coed. The original valley floor is at the height of the viewing platform and the café.

Rhyd-y-creuau

By the time the Afon Conwy passes the Field Studies Centre it has been joined by two major tributaries, the Afon Machno and the Afon Lledr and will soon be joined by the Afon Llugwy, it's third major tributary. All three of these channels join the Conwy within approximately 4km of each other. The Conwy only has 44m to descend between Rhyd-y-Creuau the sea; a distance of approximately 30 kilometres.



The Afon Conwy passing Rhyd-y-creuau and

River features typical of lower courses are evident here including channel braiding and developed pool-riffle sequences.



Pont Fawr bridge in Llanrwst

Llanrwst

The town of Llanrwst is the largest settlement so far on the Afon Conwy. At this point the river is flowing along the bottom of the large Conwy Valley glacial trough where a large floodplain has developed after the last glacial maximum.

The Conwy has a very 'flashy' response, meaning it responds very quickly to rainfall events with a high peak discharge.



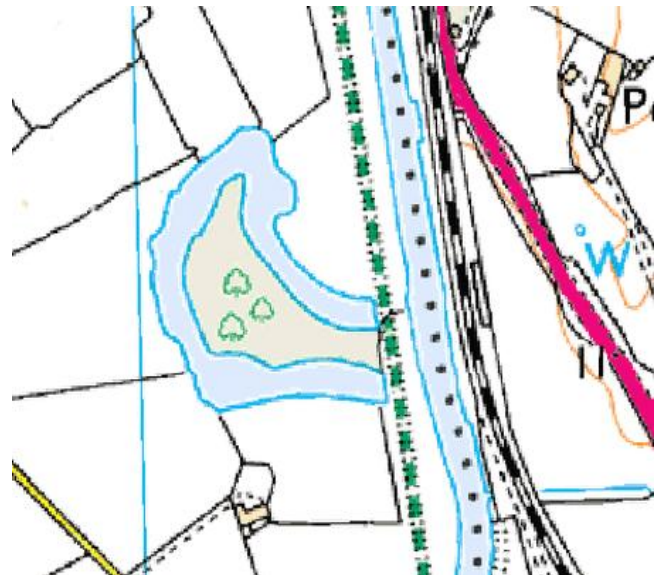
Pont Fawr in flood - Llanrwst

Being so close to the river means the settlement is vulnerable to flooding. Flood defences are very much in force here as the river often overflows its banks.

Since 2004, approximately £7million has been spent trying to protect properties in the area. Defences include an artificial flood culvert, a new system of levees and mountable flood gates.

Flood risk is elevated in Llanrwst as the river is tidal until half a kilometre downstream. This means that damming of river water can occur at high tides.

A fine example of an oxbow lake can be seen immediately downstream from Llanrwst. The lake was formed when the meander became so sinuous that it was cut off at some point, probably during a flood event.



Oxbow lake near Llanrwst

Conwy Estuary

This site is the mouth of the Conwy, 55km from the source. The river here is an estuary with mudflats and salt marsh.

The estuary is a kilometre wide in places. The sediment has been broken into smaller pieces and is now predominantly silts and fine estuarine muds.



The town of Conwy overlooking the Conwy estuary



Looking upstream from the mouth of the Afon Conwy

The reserve area would have been reclaimed and grazed had it not been for the RSPB and the local council. Now it is a thriving wildlife haven.

Summary:

Length – 55 km

Source – Llyn Conwy, 450m asl

Mouth – Conwy estuary

Major tributaries – Afon Machno, Afon

Lledr, Afon Llugwy



The Conwy estuary seen from the Great Orme