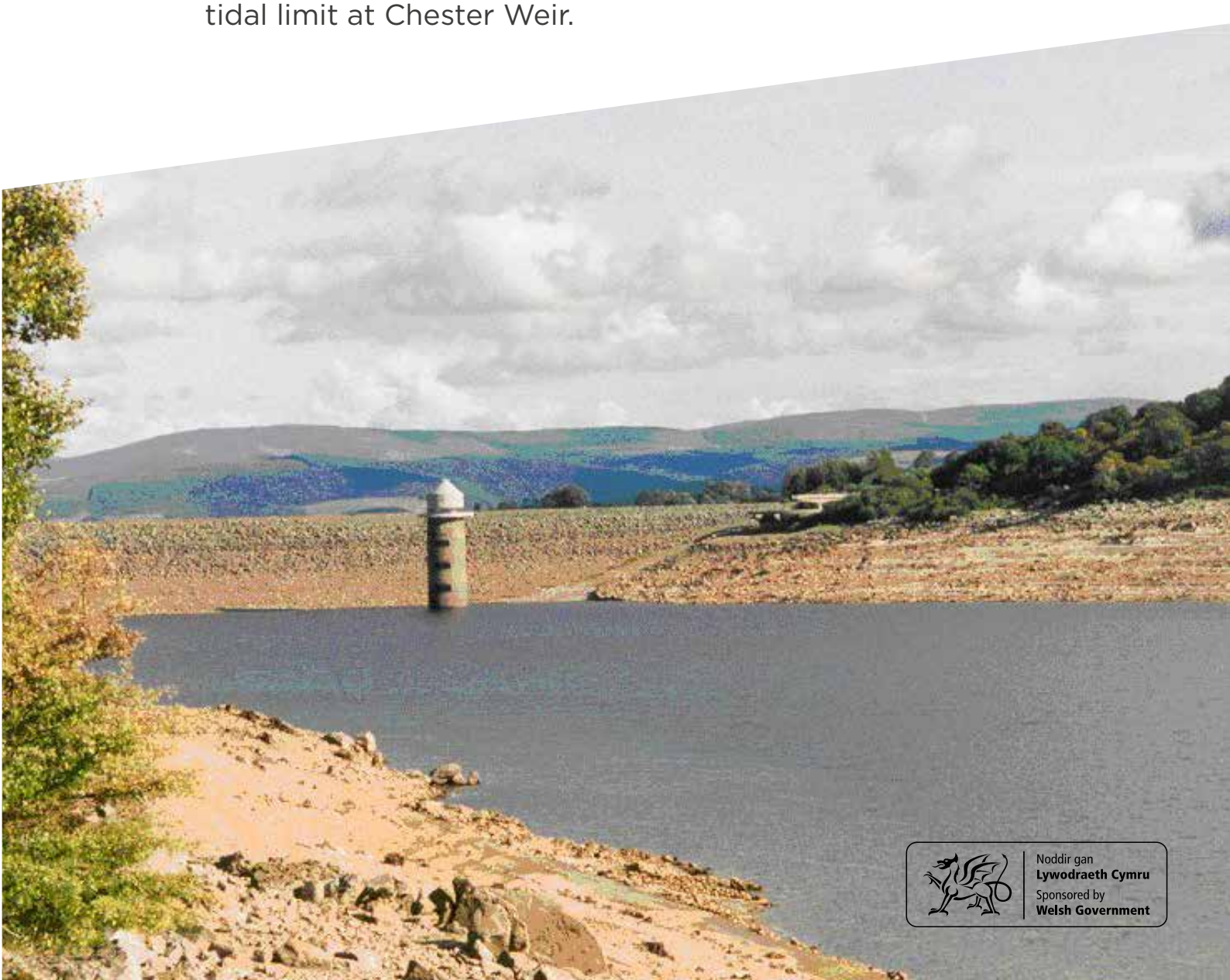
Cyfoeth Naturiol Cymru
Natural Resources Wales

# The Dee Regulation Scheme - in a nutshell

The River Dee (Afon Dyfrdwy) rises in the mountains of Snowdonia National Park, to the west of Bala Lake (Llyn Tegid).

After flowing through a broad valley to Corwen, it tumbles eastwards through the spectacular Vale of Llangollen before breaching the Welsh foothills, near Bangor-on-Dee and meandering northwards through the Cheshire plain to its tidal limit at Chester Weir.



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**The River Dee is an internationally famous example of river basin management. Through the Dee Regulation Scheme, the river system is managed in a sustainable way to meet many different functions, uses and needs. For example:**

- **water abstracted in its lower reaches for public supply exceeds the combined supply of the reservoirs of the Lake District in England;**
- **the low lying land alongside the river below Bala floods less frequently;**
- **the fishery is preserved and fully considered;**
- **recreational activities have been developed at appropriate locations;**
- **hydro-electric power is generated at Llyn Celyn.**

# Historical developments

During dry summer weather, the natural flows of the River Dee are not enough to sustain significant abstractions of water. But, if excess flood flows can be stored in reservoirs, this water can be released in dry weather to boost the low river flows. This can enable continuous water abstraction from the river.

Low-flow regulation, as this is called, was used by Telford at the beginning of the 19th Century to guarantee a supply of water to the Shropshire Union Canal. Telford built sluices at the outlet of Bala Lake, and the water released through the sluices was abstracted into the canal at its start point, at Horseshoe Falls.

Over 150 years after Telford's original scheme, the principle of river regulation had been re-established on the Dee.

The next development was Llyn Celyn, a new 81,000,000 $m^3$ capacity reservoir in the Bala Lake catchment area. Completed in 1965 by Liverpool Corporation, and designed to operate in conjunction with the Bala Lake Scheme, this supported additional water abstractions from the Dee of 327 Ml/d. It also meant extra

## Bala sluices

The Industrial Revolution and public health problems due to polluted rivers led to more demand for water. As a result, numerous reservoirs were built in natural valleys during the latter half of the 19th Century. These were based on the direct supply principle, with the relatively clean upland reservoir water, following basic treatment, being piped to the area of supply. The Alwen Reservoir, in the Dee catchment, was built in the 1920's to supply water to Birkenhead.

Many rivers in industrial areas became too polluted to be used for water supply, and the relatively small amount of water drawn down to the rivers from reservoirs was not enough to redress the situation. But, the City of Chester provided a notable exception. It abstracted water from the Dee since the first Chester Waterworks Company was formed in 1826 because of the relatively few troublesome effluents in the Dee

flood storage, a near-trebling of the dry weather flow for most of the length of the river, storage for special releases to the river for water quality or fisheries purposes, a 65% increase in the minimum flow over Chester Weir to the Dee Estuary, and a four Megawatt Hydro-electric station at the dam.

In 1973, the Dee and Clwyd River Authority built another major regulating reservoir in the Brenig valley. Stage One of the Brenig project was completed when it was first filled with 60,000,000 m3 in 1979. This increased the potential for water abstraction from the river to around 860 Ml/d.

In 1989, following the privatisation of the water industry, the regulation of the River Dee came under the control of the National Rivers Authority, which was succeeded by Environment Agency Wales in 1996. In 2013 the management of flows came under the joint control of Natural Resources Wales and the Environment Agency.

In 2016 the authorised abstractions by the three statutory undertakings and Canal and River Trust were:

| | |
|---|---|
| United Utilities | 666.4 Ml/d |
| Dee Valley Water | 78.0 Ml/d |
| Canal and River Trust | 28.3 Ml/d |
| Dwr Cymru Welsh Water | 34.0 Ml/d |

In addition, a residual flow of at least 364 Ml/d is maintained over Chester Weir, in all but the most testing of droughts. This safeguards migratory fish and limits the amount of saline water over Chester Weir during high tides.

In the late 1950's, the Dee and Clwyd River Board constructed the Bala Lake Scheme. The natural lake outlet was lowered (bypassing Telford's original sluices), and new sluice gates were built downstream of the confluence with the Afon Tryweryn, a short distance from the lake exit.

This provided around 18,000,000 cubic metres ($m^3$) of controllable stored water in Bala Lake to support continuous water abstraction from the Dee totalling 235 Ml/d (Megalitres per day) by six Statutory Water Undertakings and British Waterways. In also provided short-term detention of flood run-off from the Bala Lake catchment, greatly reducing the frequency and extent of flooding in the Dee Valley downstream of Bala. Alongside this development, more stringent standards were imposed on effluents which discharged to the Dee upstream of Chester Weir.

# Operating the Regulation Scheme

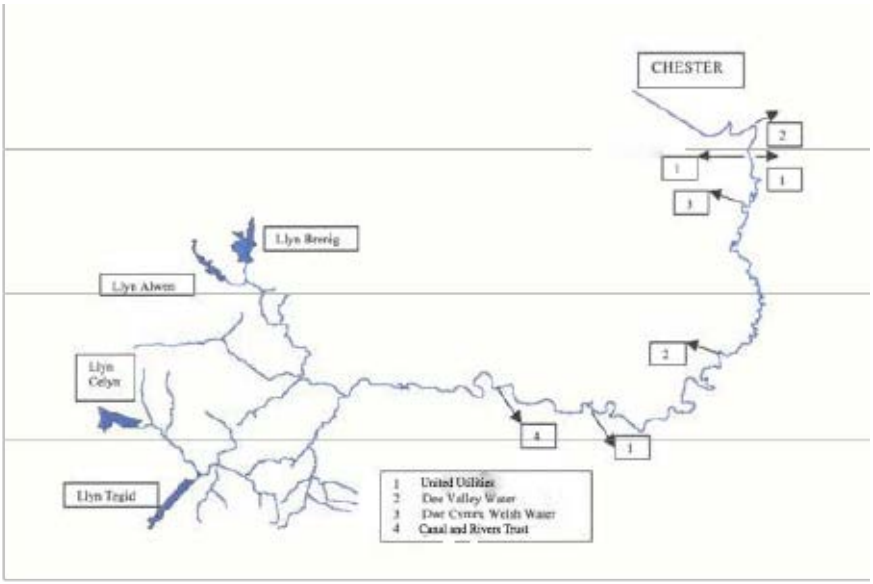
Managing the multi-purpose Dee river system must keep a fair balance between many interests and groups of users.

Major abstractors and river interests are represented on a Consultative Committee, set up under the Dee and Clwyd River Authority Act 1973. The complex rules used to operate the scheme are prepared with this Committee's advice, and the special conditions for operation in severe droughts must be approved by all members of the Committee.

When constructed in 1955, the sluice gates in Bala were operated manually by operators who changed the position of the gates by manually winding them to achieve the desired flow. In 2000 the gates were automated allowing duty officers flexibility in operating them remotely. It also provides a far more accurate target flow under six distinct modes of operation. There is still a failsafe that allows the gates to be operated manually if required.

The telemetry systems , which collect information from reservoirs, river flow measurements and rain gauges are now widely accessible. Weather radar and satellite pictures are also received to help Natural Resources Wales's Duty Officers to decide on the most appropriate releases of water from the reservoirs.

During low flows, water released from the reservoirs takes almost two days - during which rain may occur- to reach the major abstraction points near Chester. Yet, the accuracy of the measurement and forecasting system is such that less than 5% of the water released in a dry summer is eventually surplus to requirements down river.




| Reservoir | Catchment Area ($km^2$) | Surface Area (ha) | Capacity ($m^3 \times 10^6$) | Average $m^3$/sec | Run-off mm/yr |
|---|---|---|---|---|---|
| Llyn Celyn | 60 | 325 | 81 | 3.90 | 2051 |
| Bala Lake | 262 | 400 | 18 | 13.64 | 1642 |
| Llyn Brenig | 23 | 370 | 60 | 0.65 | 893 |
| Alwen Reservoir | 26 | 150 | 15 | 0.36 | 438 |

The catchment area to Chester Weir is 1816 $km^2$ with an average natural run-off of 36.8 $m^3$/sec (639mm/yr). Sixteen per cent of this catchment area and 33% of this run-off is controlled by the regulating reservoirs.