

# UK Hydrological Bulletin: May – July 2012

2012 thus far has been remarkable in hydrological terms – the scale of the transformation from severe early spring drought conditions to widespread and sustained flooding through June and much of July is without modern parallel across much of the country.

Following two successive dry winters and the UK's lowest March rainfall since 1953, river flows and groundwater levels were exceptionally depressed over wide areas. There was considerable concern both for the water resources outlook and the drought's impact on agriculture and wildlife. Subsequently, with the Jet Stream now following a persistently southerly track, the wettest April on record initiated a dramatic hydrological transformation which, at a critical time in the drought's development, decisively reversed the normal seasonal decline in runoff and recharge rates.

Outflows from England & Wales for late April and early May were the highest in the 62-yr national series (Figure 1) and flood warnings were very common, particularly for the late spring. May was cool and cloudy with monthly rainfall totals generally in the normal range but, with modest evaporative demands and saturated soil conditions, the rainfall was unusually hydrologically effective. Exceptional runoff rates during the first fortnight helped replenish parched wetlands and extend the drainage network into the previously dry headwater reaches of many rivers, but they also presented further problems for wildlife (e.g. the inundation of nesting areas in the Ouse Washes and Fairburn Ings near Castleford). Flows declined through the latter half of the month but the previous maximum May outflow for England & Wales was still comfortably exceeded.

As a consequence of the abundant late-spring runoff, and contrary to the normal seasonal trend, reservoir stocks began a sustained recovery (Figure 2).

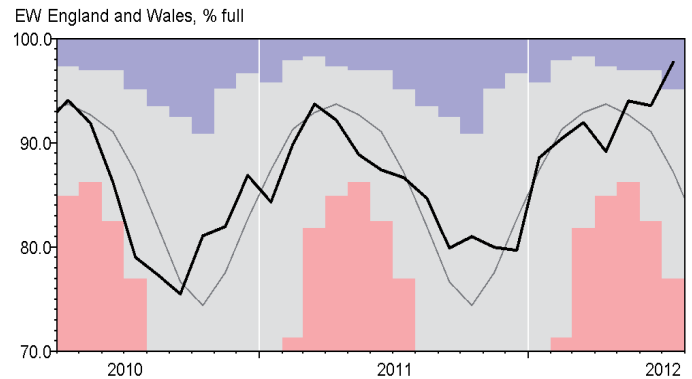


Fig 2 Estimated overall reservoir stocks for England & Wales with monthly max., min., and mean (based on the 1988–2011 record)

In addition, the very unusual extension of the recharge season well beyond the spring triggered a late recovery in groundwater resources — from an exceptionally low base in many areas. However, local differences in rainfall amounts, the depth to the depressed water-tables, and particularly, the storage characteristics of individual aquifer units made for markedly different timing in the onset and rate of recovery. Notable May increases in groundwater levels were recorded for the South Downs, with rises of more than 10m recorded, for example, at Compton (West Sussex). However, more muted responses typified most of the less-fissured Chalk outcrop and very low levels continued to typify some index boreholes in the North Downs, Dorset and parts of the Chilterns.

A continuing sequence of vigorous Atlantic frontal systems ensured that weather conditions

during June, and continuing into July, were aggressively autumnal. The Western Isles were an important exception: with rain-bearing low pressure systems diverted to the south, the notable spring rainfall deficiencies increased further and, with loch levels depressed, whisky production was interrupted (e.g. on Islay and Skye).

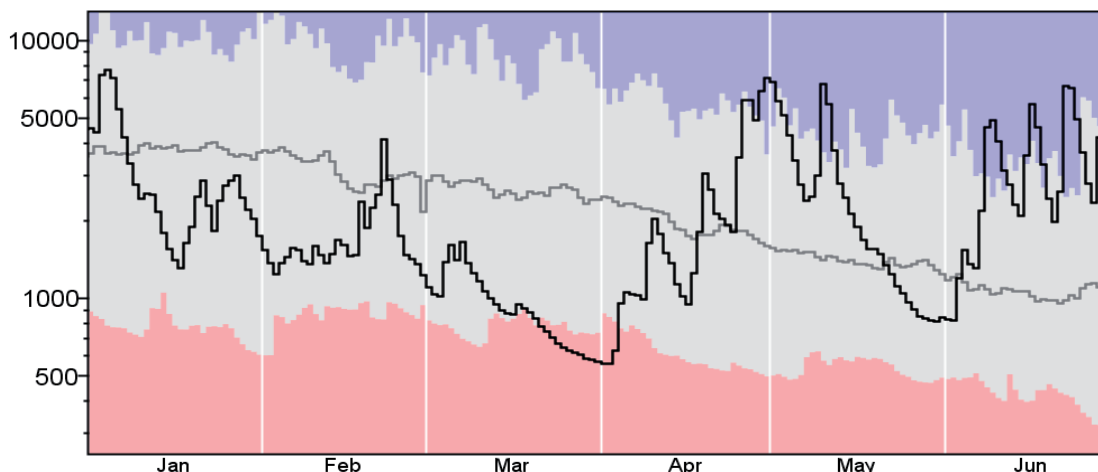
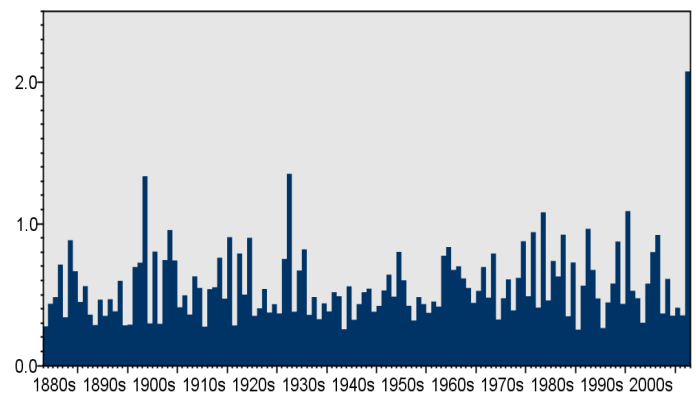


Fig 1 2012 daily outflows from England & Wales with daily max., min., and mean (based on the 1961–2011. record)

Elsewhere, many new maximum June rainfall totals were reported — in part reflecting the frequency of exceptional storm totals over a wide range of durations. A reported 48-hour total of 186 mm near Aberystwyth on the 8/9th resulted in the River Rheidol exceeding its previous maximum level by a wide margin; flows in the neighbouring Ystwyth closely approached the maximum in a series from 1963. With the flooding accentuated by high tide levels, approximately 1000 people were evacuated. Floodplain inundations were both widespread and frequent, necessitating the movement of livestock to higher ground. Flash flooding was particularly common during the third and fourth weeks and impacted most severely across northern England. On the 28th, both the east and west coast rail links to Scotland were closed due to landslides; a number of cliff slippages (e.g. in Dorset) were also reported.

Rivers registering new maximum June runoff totals showed a very wide distribution from the Clyde to the Exe and the Bush (Northern Ireland) to the Great Ouse. Unsurprisingly, estimated June outflows from Great Britain exceeded the previous June maximum by a wide margin. Across much of the major aquifers June rainfall totals were around twice the 1971–2000 average and with remarkably low soil moisture deficits for the time of year, groundwater level recoveries gathered momentum. However, the varying responsiveness of individual aquifer units meant that whilst new maximum June levels were reported in parts of the southern Chalk (and the Carboniferous Limestone in Derbyshire), levels in the Permo-Triassic sandstones at Heathlanes (Midlands) continued to track marginally below previous minima — in a 40-year series.

Exceptional rainfall and runoff rates continued into July, impacting severely on transport, agriculture and leisure pursuits. Convective activity produced some damaging hailstorms and a number of exceptional rainfall totals. In Ayrshire, on the 5th, a 90 mm total was recorded in three hours (including a 20.6 mm deluge in 15 minutes). Low pressure continued to dominate synoptic patterns and provisional data indicate that by mid-month, the previous maximum UK rainfall for April–July had been clearly eclipsed. Accordingly, levels in most reservoirs had risen close to capacity and overall stocks for England & Wales were at a level seldom reached even during wet winters. The remaining hosepipe bans in



**Fig 3** River Thames at Kingston: ratio of Apr–June to Jan–Mar runoff (based on naturalised flows)

southern England were lifted on the 9th.

Aquifer re-charge, normally very meagre in mid-summer, was substantial and the impact of locally intense rainfall contributed to an increased risk of groundwater flooding in some areas (e.g. in Dorset), serving as a warning of a possibly more widespread threat later in the year. By contrast, groundwater levels remain relatively depressed in a few slow-responding aquifers (in the Chilterns particularly where flows in spring-fed streams also remain below average). The full impact of the recent recharge will not be evident until the water currently in the unsaturated zone reaches the water tables.

The remarkable temporal contrast in synoptic patterns during 2012 is reflected in the comparison between the Jan–Mar and Apr–Jun rainfall totals for England. The ratio (1:2.6) has not been approached in the Met Office National Climate Information Centre series from 1910, and is probably unmatched in the last 230 years at least. The hydrological contrast is equally compelling, and is exemplified by the Thames where flows have been measured since 1883. Higher June runoff totals following a protracted drought episode were recorded in 1903 but, in 2012, the ratio between the April–June runoff and that for January–March was the highest in the 138-year record (Figure 3). Hydrological droughts very rarely terminate in the summer but the unprecedented late spring and early summer rainfall has dramatically transformed the water resources outlook.

*Terry Marsh*  
Centre for Ecology & Hydrology  
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