SECTION 2: THE CATCHMENTS OF THE TWEED AND THE EYE

2.3 Hydrology & Water Flows

Says Tweed tae Till
"What gars ye rin sae still ? "
Says Till tae Tweed
"Though you rin wi' speed,
An' I rin slaw,
Whaur ye droon ae man,
I droon twa,
Traditional

'The Lake ! oh let not that be made Still let it live in fancy's heart,
A thing of pipes and sluices; A haunt for happy faeries
Let something live for beauty's sake, And make no wretched reservoir
Unmixed with baser uses. Of lovely, lone, St. Mary's
J.B. S's "Appeal from Yarrow , 1900

(A) The River : The traditional source of the Tweed is at Tweed's Well (Grid Ref. NT 093 103) at an altitude of 385 m (1263 ft) but this seems to have been chosen so that it could be said that the Tweed, the Clyde and the Annan all rose off the same hill - the highest of the burns that runs down to Tweed's Well actually rises at 460m. The true, physical source of the Tweed lies in the headwaters of the Cor Water, which is much larger than the Tweed Burn when they join, and is either the top of the Powskein Burn which rises off the Crown of Scotland at NT 093 149 at 530m (1738 ft) or of the Whitehope Burn that rises on Whitehope Knowe at NT 094 145, also at 530 m. From its traditional source, the main channel flows for 156 kms (97.5 miles) to the sea at Berwick, joined by many tributaries along the way as shown in Diagram 2.3.1. The number and size of these tributaries mean that the Tweed is not so much a single channel as a collection of rivers that join together, giving its catchment a roughly rectangular shape as shown on Map 2.3.1 at the end of this section. The many branches of tributaries and their own tributary streams give the Tweed one of the highest Stream Order Numbers in the UK, shared with the Tay and the Yorkshire Ouse (First order streams - the smallest - are designated "1", when two of these join, the result is a second order stream, when two second order streams combine, they produce a third order stream, two third orders a fourth and so on). With a catchment area of almost 5000 square kilometres (1900 square miles) the Tweed is the fourth or fifth largest in the UK (depending on how the catchment of the Severn is defined) and in terms of total flow is third or fourth largest.

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Analysis of the Tweed system gives the following totals for lengths of different channel sizes :

Channels less than 2.5m (8 ft) wide :	1530 kms	950 miles
Channels 2.5 m to 20m (65 ft) wide :	1150 kms	718 miles
Channels over 20 m wide :	190 kms	119 miles
TOTALS	2870 kms	1787 miles

and a total wetted area of around 17.1 million square metres (20,450,000 square yards), representing about 15% of all the water available to Salmon in Scotland (Gardiner, 1988)

Probably the most significant feature of the course of the Tweed is that at Kelso, where the Teviot joins, it is only 25m above sea level and yet still has almost half its course to run. This gives the lower part of the river a very gentle gradient, as shown in Diagram 2.3.1.

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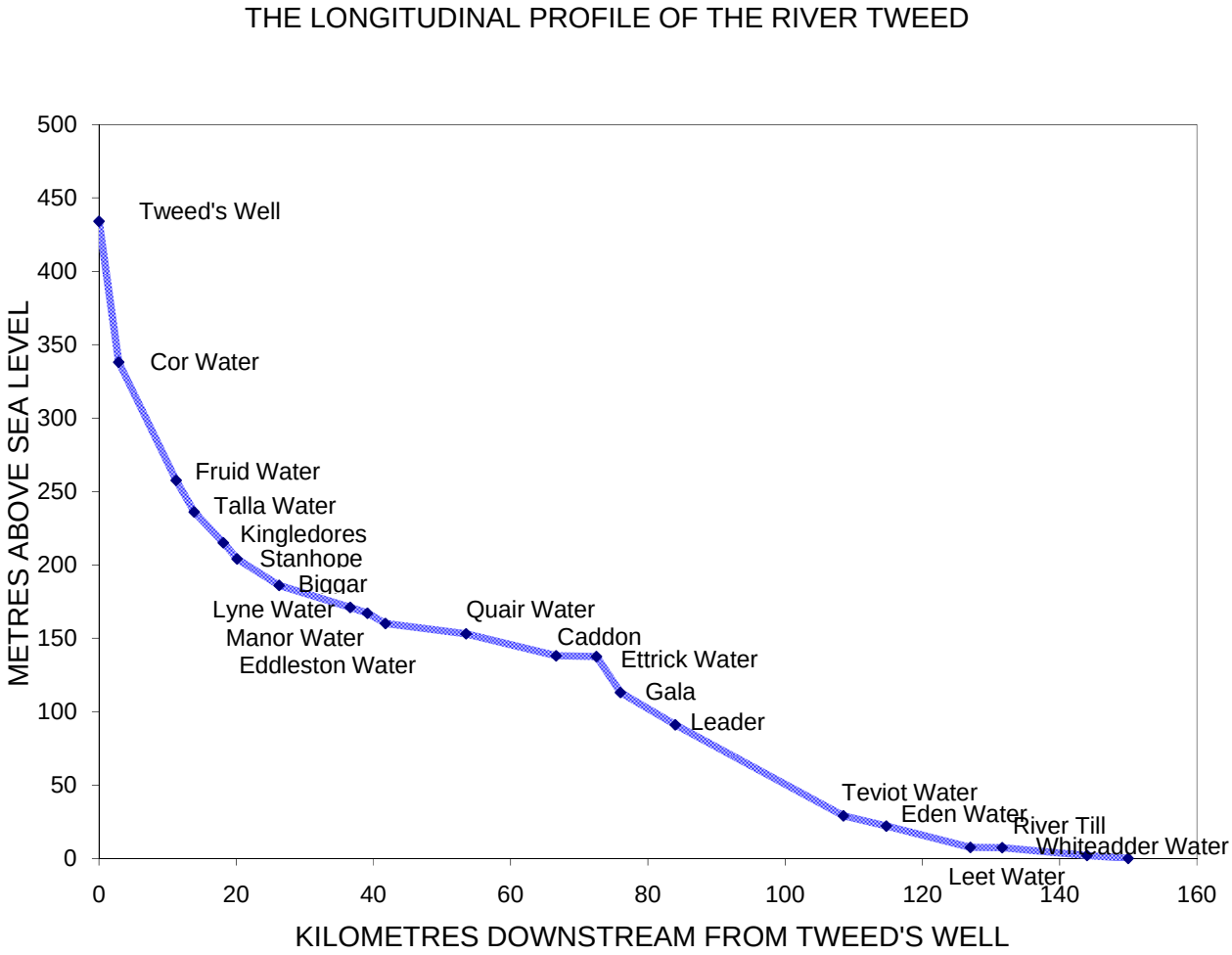
Diagram 2.3.1 : The profile of the river Tweed from the highest point feeding its traditional source at Tweed's Well to the sea at Berwick-upon-Tweed, and its confluences with its larger tributaries



(B) Water Velocity : The water velocity of the Tweed and tributaries has been analysed at 14 stations within the catchment and it was found that at flow levels other than in floods, velocities were highest at the lower, flatter, end of the system. During floods, velocities appeared to be much the same along the course of the river. Velocities seldom exceeded 3.0 m (9.75 ft) per second and most of those recorded lay between 0.25 and 1.00 m (10"and 3' 4") per second. (Ledger,1981).

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Intuitively, it would seem that the steepest lengths of channel, in the uplands, would have the fastest flows in a river system, but this is not in fact the case: An appearance of greater velocity is given by the characteristic turbulence of steep upland streams but in deeper, smoother water the flow is less affected overall by the friction with the channel bottom.

(C) Floods : An historical chronology of major floods for the Middle Tweed, Leader, Teviot and Whiteadder has been worked out using gauging station data for the period after 1948, and newspaper and other reports and data (such as the "*Tweedometer*" at Kelso) for the years back to 1750 (MacEwan, 1990). In this chronology the largest flood on the Middle Tweed was in August 1948, and the second greatest in February 1831. The 1948 flood may also have been the greatest since 1294: It was reported that 20,000 tons of gravel, "*a figure arrived at by direct measurement*", was deposited on 5 acres of haughlands around Allanton on the Whiteadder and 25,000 tons of material at Edrington. Government assistance was required by farmers to clear riverside land of stones and other materials deposited by the flood, which were put back in to the rivers or made into floodbanks (Scott, 1950). Along the Eye Water, where bankside space was limited, standing trees limited machinery access to the river so both standing and fallen trees, nearly 4,000 in all, were removed and the channel was "reformed". Similar treatments were carried out on the Leader, Gala, Eddleston, Blackadder, Ale, Leet, Kale, Bowmont, Eden, Teviot and Rule (and various tributaries of these). Disruption to the netting stations below Coldstream due to changes in the river channel and the deposition of debris also occurred and bulldozers and excavators had to be used to re-form banks and slopes. It was estimated that on August 12th 1948, almost 400 million tons of rain fell on the Tweed catchment (Glasspoole, 1949).

This flood chronology appears to show an increased frequency of moderate to extreme floods from the 1870's to the 1890's whilst the 1930's and 1970's had less frequent flooding than usual. Many of the most extreme flood events on the Middle Tweed occurred in August and were associated with Summer Frontal storms whilst April to July appears to be the least likely period for floods in general. The extreme flood of February 1831 had a large contribution from snowmelt and snowmelt was also a major contributor to many of the large flood events between 1850 and 1900, a period of long winters. In the 20th century however, snowmelt has rarely been a major contributor to floods (Smith & Bennett, 1994).

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(D) Droughts : No comparable chronology has been worked out for droughts : Those of 1972, 1974, 1976, 1984 and 1995 are still remembered: When the Experimental Committee of the RTC were netting fish for tagging in August 1864 in the lower river, they found large numbers of Brown-trout, which they attributed to the "*excessive drought*" having dried up the smaller streams, forcing the trout into the main river. They went on to say:

> "*Your Committee here wish to mention, from all the enquiries they have been able to make from the oldest inhabitant upon the banks of the river, that at no former period has the Tweed ever been known to be so low as this day, being lower by several inches than in 1826. This we ascertain from a portion of rock called 'Hud's Head", a little above the village of Hornecliffe, being several inches more above low-water mark than it was in that year. Since 1826 until now it has never been seen dry. In that year, "* J.P. 1826*" was cut upon it by a mason called John Park; all was worn out but the "*J*" and the "*8*". We have caused to be marked on it "*Richard Hodgson, Esq., M.P. ; George Smith, August 24th, 1864" (Anon, 1867)

There are references to a major drought of 1826 : "*The year 1826 was well-known in Rulewater as the "drouthy summer". The Rule nearly ceased to run, and water was scarce everywhere*" (Tancred, 1907) and the report on the Parish of Westruther in the New Statistical Account mentions that the crops failed due to drought in that same year. At the front of the book first published as "Highways and Byways in the Border" there is a note saying "*The artist wishes to call attention to the fact that his drawings were made during the long drought of 1911, when all the rivers were exceptionally low*". (Lang & Lang, 1911)

(E) Flow Patterns : Around the middle of the 19th century, complaints started to be made about the effect of land, and in particular, hill, drainage on the patterns of flow in the Tweed : Floods were said to have become more severe and to be of shorter duration due to the speeding up of the run-off by drains and the lack of wetlands in which water could be held for longer periods. Examples of such observations are:

1837 This change has been brought about by draining the sheep farms on the hills, the effect produced being that a little summer flood which took a fortnight or three weeks to run off previous to 1795 is now completely run out in eight hours. The rain which formerly filled the bogs or side of the hills, and which then kept giving a constant and regular supply to the river, is now carried off at once by these drains to the different feeders, causing sudden and violent floods, and short as they are sudden, so that the flood is all run off before the river has had time to clear itself ... the draining has affected the smaller streams as well as the Tweed itself. (Yarrell, 1841)

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THE Tweed FOUNDATION

A Tweed Foundation Paper

1843 ".....the effects of the furious spates which are continually taking place in the Tweed.....Before the hills were so well drained as at present, this was not so much the case; as the mosses gave out the water gradually, and the river continued full for a long time, to the great solace of the rod fisher. But now every hill is scored with little rills which fall into the burns, which suddenly become rapid torrents and swell the main river, which dashes down to the ocean with tremendous violence. Amid the great din, you may here the rattling of the channel stones , as they are borne downwards. Banks are torn away; new deeps are hollowed out, and old ones filled up....." (Scrope, 1843)

1857 "During the last twenty years a great decrease has taken place in the quantity of trout in our southern streams, and any angler who has been in the habit of frequenting regularly a particular stream during that time must have noticed an almost annual diminution in the number and still more in the size of its finny inhabitants. This is an alarming fact, and well worthy the attention of the angling community as some of the most fruitful causes of this disastrous result might be stopped.....the most prejudicial of these is the drainage of land, more particularly of the hill pastures for sheep....the water which used to find its way to the rivers gradually, keeping them large and full for a considerable time, is now conducted to them very soon after the rain falls, and runs off in a day or two, leaving them clear and dwindled till the next flood ..... " (Stewart, 1857)

1895 "It was worth while to be a boy then in the south of Scotland....even then, thirty long years ago, the old stagers used to tell us that 'the watter was owr sair fished' and they grumbled about system of draining the land, which makes a river a roaring torrent in floods, and a bed of gray stones with a few clear pools and shallows, during the rest of the year. In times before the hills were so drained, before the manufacturing towns were so populous, before pollution, netting, dynamiting, poisoning, sniggling and the enormous increase of fair and unfair fishing, the Border must have been an angler's paradise. Still, it was not bad when we were boys. We had Ettrick within a mile of us, and a finer natural trout-stream there is not in Scotland, though now the water only holds a sadly persecuted remnant.....There was one long pool behind Lindean.... where the trout literally seemed never to cease rising...They only averaged as a rule from three to two to the pound....one of my brothers one day caught three trout weighing over seven pounds, feat which nowadays sounds quite incredible." (Lang, 1895)

1896 4855 Evidence of Mr Walter Haddon, Hawick : "I have fished for trout in the River Teviot nearly every season since the year 1848. From that year on to about the year 1860, the trout fishing in the Teviot was very good, and even an ordinary angler could in the five mile stretch of water down from Hawick to Denholm fill a good basket of very fine trout, where now there is hardly such a thing as a live trout during the summer months.

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Above Hawick, the fishing has also fallen off very much. The trout are nothing like so numerous nor are they so large as they used to be previous to 1860. The following may be cited as the causes of deterioration:
1) The draining of the lands..... (Anon. 1896)

1912 *The Teviot* : On the 19th century in general :" it seems that a great reduction in numbers of trout took place.....brought about by netting.....and by the drainage of the land"...."many of the smaller burns, which are now roaring floods in time of rain and nearly dried up in drought, used, before the hills were drained, to carry a steady volume of water all year round." (Fernie, 1912)

The timings of these changes are rather vague - the 1836 remarks refer to a change haven taken place in the 1790's; the 1843 remarks to a period before the 1840's; the 1857 remarks to the 1830's and the 1895 remarks to the 1860's. However, it is clear from the New Statistical Account that there was a great deal of drainage work carried out well before the first government subsidies for drainage in the Land Drainage Act of 1847 as its reports, written in the 1830's, show:

Berwickshire

Parish of Earlston: "The wet arable has been generally dried by drainage and the extensive Moss ..... having been redeemed at an expense of from £1200 to £1400 affords now tolerable grazing for cattle"

Parish of Merton: "A good deal of ground has been drained"

Parish of Gordon: "In 1787, the then proprietor of Greenknow estate sold ... about 100 acres of his moor.... In marshy areas, draining also had to be resorted to; and some of these drains measure six feet wide and five feet deep. This helped to get rid of the stones."

Parish of Westruther: "The temperature of Westruther was considerably colder than that of the lower parts of the county. But this has been remedied in a great degree by the growth of wood, and especially by the extensive drains that have been cut in various parts of the Parish..... Formerly, in the most marshy places, rheumatism and a good deal of croup prevailed. But these have so entirely disappeared with the improving conditions of the parish, that there cannot now be said to be any distempers indigenous to the district.....On the Spottiswoode estate alone there is the astonishing number of thirty miles of drains interspersed, from 5,7 and 13 feet in depth. Besides there are some thousand roods (a Rood was a locally variable measurement of length : The standard Rood in later times was 16.5' / 5.03m) of open cuts , averaging from 10 to 20 feet wide (3m to 6m), and from 5 to 7 (1.5 m to 2m), which discharge a large body of water on the eastern side into the Blackadder and on the western side into one of the tributaries of the Leader. The advantages of this extensive system of draining are incalculable; it has brought into a state of tillage, pasture and thriving plantation many hundred acres which were formerly overflowing with water .... Forty years ago more than a third of the land was waste ... and if a similar interval pass before a third Statistical Account be demanded, such an

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inroad shall have been made on the few bogs and mosses that are still unimproved as will leave little to tell of the ancient condition of Westruther .. "

Parish of Swinton and Simprin: "The only improvement of any general importance which has recently been effected, is the deepening and widening of the bed of the Leet, which used to overflow its banks occasionally to the great injury of the contiguous grounds, as, from its being almost quite level, the water became stagnant upon it in many places."

Parish of Coldstream: "The improvements in agriculture, particularly the very extensive and efficient system of draining that has been carried on, have done much to ameliorate the climate, so that ague (= an intermittent fever, probably Rheumatism) which at one time was very prevalent, is now unknown in the parish ..... Many species of wildfowl, which formerly frequented the Tweed, have entirely disappeared - such as the Coot, Wild-duck, Diver and Teal. This is to be accounted ... partly from the drainage of those marshy lands in which these birds used to breed."

Parish of Duns: "Immediately to the southward of the town, there is a bog extending a considerable distance eastward and westward, which was formerly impassable ... The bog is now drained, and is excellent cow-pasture"

Selkirkshire

Parish of Galashiels: " Sheep-draining, as the mode of drying hill pastures by open furrows cut with the spade is termed, has been introduced, and is practised as far as needed, but not to any considerable extent.... There has not been a case of ague in the parish for the last ten years ... Many now living remember intermittent fever as a very common occurrence; but they remember also that wild ducks were frequently shot in many pools and marshes of the neighbourhood where wheat and clover now thrive"

Parish of Yarrow: "Of late years, however, the climate has been much ameliorated by draining ... Within the last forty years, too, the country has been thoroughly drained"

Peebleshire

Parish of Peebles: "The system of drainage has proved unfavourable to the run of salmon, for the heaviest rains are soon carried off, and a flood seldom lasts more than a few hours; wherease formerly, a heavy rain required some days to run off, and the river being thus kept full, the fish could ascend."

Parish of Broughton, Glenholm & Kilbucho: "Wild-swans, wild-geese and sea-mews (Seagulls) are not so plentiful as formerly, owing to the same cause which has banished the wild-ducks … the draining of the bogs and cultivation of the meadows"

Parish of Newlands: "In the bottom of this vale there is a moss, called Hallmyre bog, of about 60 acres (24 ha), along which a very deep and wide ditch was cut .... into which the bog has been drained by cross-drains, and is now all good arable land"

Parish of Eddleston: "Much has been done with respect to reclaiming waste land, draining, irrigation and embanking upon all the farms which have been let within the last twenty years. Almost every spot capable of irrigation has been irrigated, and wet land has been made dry"

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Roxburghshire

Parish of Jedburgh: "In draining bogs at Scarsburgh and Hunthill, hazelnuts, together with a few remnants of black oak, were found at the depth of ten feet (3 m)"

Parish of Lilliesleaf: "About forty years ago, ague was prevalent in the village, probably owing to the effluvia of a considerable morass and pool, or rather, loch which stood on the low-lying mossy ground to the south .... Upon the draining of that loch, accordingly, this distemper in a great degree disappeared. It may be notice that the morass here alluded to was formerly the resort of Sea-gulls or Mews, in such vast numbers that they are said to have fertilized a portion of an adjoining park still called Pick Maw Hill."

Parish of Bowden: "It appears, from the notice of climate in the former Statistical Account of this parish, that it has improved considerably from 1794. This may be owing to the draining of land and mosses....."

Parish of Melrose: "The ague, which was formerly very prevalent, owing to the damp exhalations of undrained marsh, has entirely disappeared...."

Parish of Southdean: "Diseases formerly prevalent in this district are now greatly mitigated .... Those arising from dampness of climate.... have almost disappeared, owing, no doubt, to the extensive drainage of sheep pasture"

Parish of Linton: "At one period, agues were not uncommon, but since the draining of the lakes and marshy lands, these have totally ceased..... Linton Loch is nearly circular in form, and contains fifty acres ....The whole surface of these fifty acres was formerly covered with water, it is now partially drained ....."

Parish of Yetholm: "In the vale of Cherrytrees are probably a hundred acres of moss, which, however, have been drained, and are now under cultivation"

Parish of Hownam: " Much of the surface water has been removed by draining...."

Parish of Eckford: "Ague, once an epidemic in the district, is now quite unknown. Its disappearance may be traced to the improved system of drainage, which is now so successfully pursued in this quarter...."

Parish of Oxnam: "By means of thorough draining, levelling and top-dressing, Scraesburgh Moss , which was formerly a watery waste, has been reclaimed and now produces luxuriant crops of grass."

Parish of Ashkirk: "But the climate has been much improved by the extent to which draining and plantations have been carried .... There were formerly a great many lochs in this parish but now only those of Essenside, Sheilswood, Headshaw and Ashkirk are of any considerable extent .... What is now called Synton Moss was at one time a considerable lake, but has been completely drained, in order to obtain the marl and peat with which it abounds .... There are four marl mosses on the estate of Synton, which have all been drained by the present proprietor..."

Parish of Kelso: "At one period, all the meadow-lands in the vicinity were filled with pools and marshes; and even in the memory of many persons still living the beautiful meadow to the north-east of the town which is now used as a race-course, formed the favourite resort of a colony of Sea-mews and wild ducks .... The last of these morasses has now disappeared under the ameliorating processes of draining and tillage; and intermittent fever, which was for centuries the scourge of the district has departed with it."

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> **Parish of Minto:** "Formerly, ague was so common a complaint that few in any condition of life escaped it, but now it has entirely disappeared, owing to the draining and other improvements of the land."
> **Parish of Cavers:** "The climate is upon the whole, cold and moist ..... Of late years, however, it has much improved, owing to the great extent of draining which has taken place."

These parish accounts from the 1830's have been quoted at length as they show that great changes to the hydrology of the Tweed were made in the early part of the 19th century. The storage capacity for water in bogs and hillsides must have been greatly reduced by this drainage, so the observations listed above of floods running off more quickly than in past times that were made in the middle and later 19th century will have been correct. It is of interest that the drainage was so thorough that ducks and other waterfowl disappeared from some areas as did human diseases associated with damp conditions.

The impact of 19th century drainage on the Tweed catchment cannot be underestimated. Before that time, the Tweed catchment must have been a very wet and watery place. The 10,000 or so chains (125 miles / 200 kms) of drains on Todrig, a mainly hill farm of 1500 acres (607 ha) in the Ale catchment which date from the mid-19th century are an example of the intensity of this drainage work (G. Easton of Todrig, *pers. comm.).* These great changes to the Tweed's hydrology must have played a large part in the sudden and dramatic collapse of catches of Salmon by Tweed nets in the 1850's, as indeed was suggested in the Eighth Annual Report of the Fishery Board for Scotland, 1890, though significant drainage was regarded as being a factor only after the Act of 1847 which these reports in the New Statistical Account show was not the case.

(F) Forestry Plantations and Flows : In more recent times, the advent of large scale plantations of conifers has also increased drainage of hill land - as can be seen in Section 2.4 these occupied 13% of the Scottish part of the catchment in 1986. Whilst the drainage associated with planting of conifers at first increases floods through speeding up the run-off, later on the consumption of water by the trees can reduce run-off during low-flow periods. A comparison of low flows in the Tima Water catchment (almost 100% plantation) with the upper Ettrick (then 70% moorland / grassland) showed that dry weather flows in the former were only around half of those in the latter. If this effect were extrapolated to the Tweed catchment as a whole, using the projected increase in plantations, the reduction in flows on the Tweed is "*likely to be somewhat greater than that due to reservoir*

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development in the Tweed system for public water supply purposes" (Badenoch, 1989).

(G) Reservoirs : The construction of large water supply reservoirs (Talla, 1890's: Fruid and Whiteadder,1960's and Meggat & St. Mary's Loch,1980's) has also changed the natural hydrology. Between them they export 3% of the water resources of the catchment but as this is water stored from the high rainfalls of autumn and winter it has no effect on low flows. In fact, the use of this stored water to provide compensation flows during low summer water levels can be regarded as something of an advantage: It has been estimated that low flows in the Tweed are nearly 50% higher now that they would have been if there were no reservoirs. It would, of course, have been a very different matter if these reservoirs had been for Hydro power – the erratic and sudden releases of water from such dams are known to have damaging impacts on fish populations. The freshet and compensation flows from reservoirs in the Tweed catchment are summarised in Table 2.3.1:

Table 2.3.1 : Summary of Compensation /Freshet Flow Arrangements for Tweed Reservoirs

SECTOR	Water	Reservoir	Supply	Compensation Flow		Freshet Flow	
				Summer	Winter	Weekly	Block
Upper Tweed	Talla	Talla	16.50	3.65	0.00	11.80	15.00
Upper Tweed	Fruid	Fruid	9.50	3.85	variable	11.80	15.00
Upper Tweed	Lyne	Baddinsgill	5.00	1.50	0.85	3.80	3.00
Upper Tweed	Lyne	West Water	5.00	1.50	0.85	3.80	3.00
Ettrick	Meggat	Meggat	22.50	9.00	3.00	none	30.00
Ettrick	Yarrow	St. Mary's Loch *	22.50	19.50	10.50	none	35.20
Whiteadder	Whiteadder	Whiteadder	6.50	2.50	0.50	none	20.00
Whiteadder	Watch	Watch Water	1.70	0.50	0.25	none	none
Middle Tweed	Caddon	Stantling Craig	0.00	1.00	1.00	none	none
Teviot	Ale	Alemoor	2.00	1.00	1.00	none	none

All flows in Million Gallons per Day (mgd)

* Level of the loch raised to store water

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"Supply" means the amount of water taken for use: Stantling Craig reservoir is shown as having a zero Supply as it is used for compensation flows rather than for direct supply. "Compensation Flow" is the minimum amount of water to be let through by the dam. The "Freshet Flow" is the amount that is let through weekly when required (usually during low flow periods in summer). The variability in the compensation and freshet arrangements comes from differences in the legislation for each reservoir. The Meggat Water Order also enables 300 million gallons to be released in an "emergency", defined as when low flows cause a situation of concern to the body responsible for the water quality of the Tweed.

(H) Climate change: This will alter the run-off patterns in the Tweed catchment, as winters are generally expected to get wetter and summers, drier - the 1980's were the wettest decade then on record for Britain due mainly to an increased number of days of westerly winds. Smith & Bennett (1994) found that the average maximum monthly run-off of the Teviot (upstream of the gauging station at Ormiston Mill) had significantly increased from 1970 to 1990, while the average minimum monthly flows had significantly decreased, showing that flows have got both higher and lower in recent years. It appears that the flows of the Tweed will become more extreme in future as rainfall becomes more concentrated in winter.

(I)Flow Measurements: Today, there is a network of gauging stations covering the Tweed and Eye catchments, run by SEPA and the EA. as shown on Map 2.3.1 at the end of this section and listed in Tables 2.3.2a & b (a is the metric version and b the imperial units). This shows the average flow at the sites and the levels below which there are flows for only 5% of the time (called the "Q95") and above which there are flows for only 10% of the time ("Q10"). The table also shows which stations are measuring purely natural flow patterns (to within 10% of completely natural) and which are measuring patterns modified by reservoirs holding up high winter flows and releasing the stored water as compensation flows during low flow periods in summer. As the data at many stations goes back to 1961, there is a good baseline from which changes over time and the effects of climate change can be measured.

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TABLE 2.3.2 a : FLOW GAUGING STATIONS IN THE TWEED CATCHMENT (Metric) : Data from the National River Flow Archive (www.ceh.ac.uk)

Ref No	River	Name	Grid Ref		Run by	Catchment Area (km^2)	Station altitude (m)	Max altitude in catchment (m)	Mean flow $m^3 s^{-1}$	Q 95 $m^3 s^{-1}$	Q 10 $m^3 s^{-1}$	Av Annual Rainfall (mm)	Flow Pattern				Operation Start	Operation Closed
21014	TWEED	Kingledores	109	285	SEPA	139	214	869	4.10	0.909	9.192	1569		RES	PWS		1961	
21001	Fruid W	Fruid	088	205	SEPA	23.7	277	808	0.66	0.122	1.775	1702		RES	PWS		1959	1968
21028	Menzion B	Menzion	092	234	SEPA	5.7	267	689	0.21	0.031	0.442	1468	Natural				1948	1952
21005	TWEED	Lyne Ford	206	397	SEPA	373	167	839	9.39	2.053	20.030	1259		RES			1961	
21018	Lyne W	Lyne Station	209	401	SEPA	175	168	562	3.07	0.694	6.569	945		(RES)			1968	
21019	Manor W	Cademuir	217	369	SEPA	61.6	197	818	1.64	0.309	3.464	1340				MA	1968	
21003	TWEED	Peebles	257	400	SEPA	694	155	839	15.62	3.358	34.010	1143		RES			1959	
21006	TWEED	Boleside	498	334	SEPA	1500	945	839	36.58	6.902	79.407	1133		(RES)			1961	
21013	Gala W	Galashiels	479	374	SEPA	207	120	651	3.66	0.515	8.074	930	Natural				1964	
21015	Leader W	Earlston	565	388	SEPA	239	103	528	3.38	0.454	7.420	853	Natural				1966	
21010	TWEED	Dryburgh	588	320	SEPA	2080	66.8	839	42.63	8.045	92.740	1079		RES	PWS		1960	
21021	TWEED	Sprouston	752	354	SEPA	3330	24.5	839	64.75	10.770	144.600	1015		(RES)	PWS		1969	
21023	Leet W	Coldstream	839	396	SEPA	113.1	12.1	223	0.90	0.024	2.082	671	Natural				1970	
21009	TWEED	Norham	898	477	SEPA	4390	4.3	839	78.94	14.160	169.500	955		RES	PWS		1962	
21017	Ettrick W	Brockhoperig	234	132	SEPA	3705	259	692	1.90	0.198	4.397	1733	Natural				1965	
21016	Tima	Deephope	278	138	SEPA	31	232	545	1.35	0.077	3.371	1497	Natural				1973	
21007	Ettrick W	Lindean	486	315	SEPA	499	99.1	839	15.05	1.975	34.654	1307		RES			1961	
21030	Meggat W	Henderland	231	232	SEPA	562	254	839	1.82	0.324	4.155	1671		RES			1968	
21034	Yarrow W	Craig Douglas	288	244	SEPA	116	239	839	3.80	0.737	8.386	1554		RES			1968	
21020	Yarrow W	Gordon Arms	309	247	SEPA	155	226	839	5.04	0.877	11.230	1459		RES	PWS		1967	
21001	Yarrow W	Philiphaugh	439	277	SEPA	231	128	839	6.57	1.120	14.828	1345		RES			1963	
21012	Teviot	Hawick	522	159	SEPA	323	90.1	608	8.69	0.991	20.000	1151	Natural				1963	
21024	Jed W	Jedburgh	655	214	SEPA	139	65.6	553	2.32	0.401	5.136	913	Natural				1971	
21025	Ale W	Ancrum	634	244	SEPA	174	61.2	445	2.69	0.222	6.544	926		RES	PWS		1972	
21008	Teviot	Ormiston Mill	702	280	SEPA	1110	43.2	608	19.97	2.845	44.430	939	Natural				1960	
21002	Whiteadder	Hungry Snout	663	633	SEPA	45.6	215	533	1.00	0.137	2.051	909		RES	PWS		1959	1968
21027	Blackadder	Mouth Bridge	826	530	SEPA	159	56.6	447	1.76	0.263	3.535	775	Natural				1973	
21022	Whiteadder	Hutton Castle	881	550	SEPA	503	29	533	6.39	1.111	13.140	815		RES	PWS		1969	

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21016	Eye	Eyemouth Mill	942	635	SEPA	119	2.9	414	1.25	0.130	2.703	730	Natural	1967	
21031	R. Till	Etal	927	396	EA	648	25.3	816	8.48	1.492	17.27	827	Natural	1956	1980
21032	R. Glen	Kirknewton	919	310	EA	198.9	54.3	816	2.90	0.286	6.391	876	Natural	1966	

Q95 The level at which flows are greater for 95% of the time i.e flow levels are only below this for 5% of the time **Q10** Flows are only greater than this for 10% of the time

RES = Flow pattern significantly modified by reservoirs, both by storage of winter high flows and release of compensation flows in summer. (RES) Minor modification

PWS = Flow pattern modified by abstraction for Public Water Supply MA = Flow pattern affected by minor water supply abstraction

Natural = Flow pattern modified by less than 10%

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TABLE 2.3.2 b : FLOW GAUGING STATIONS IN THE TWEED CATCHMENT (Imperial) : Data from the National River Flow Archive (www.ceh.ac.uk)

Ref No	River	Name	Grid Ref		Run by	Catchment Area (miles^2)	Station altitude (ft)	Max altitude in catchment (m)	Av. Flow (gallons / sec)	Q 95 (gallons / sec)	Q 10 (gallons / sec)	Av Annual Rainfall (ins)	Flow Pattern			Operation	
																Start	Closed
21014	TWEED	Kingledores	109	285	SEPA	53.67	702	2851	200.0	2022.0	61.8	1569		RES	PWS	1961	
21001	Fruid W	Fruid	088	205	SEPA	9.15	909	2651	26.8	390.5	67.0	1702		RES	PWS	1959	1968
21028	Menzion B	Menzion	092	234	SEPA	2.20	876	2260	6.8	97.2	57.8	1468	Natural			1948	1952
21005	TWEED	Lyne Ford	206	397	SEPA	144.02	548	2753	451.6	4406.1	49.6	1259		RES		1961	
21018	Lyne W	Lyne Station	209	401	SEPA	67.57	551	1844	152.7	1445.0	37.2	945		(RES)		1968	
21019	Manor W	Cademuir	217	369	SEPA	23.78	646	2684	68.0	762.0	52.8	1340			MA	1968	
21003	TWEED	Peebles	257	400	SEPA	267.95	509	2753	738.7	7481.3	45.0	1143		RES		1959	
21006	TWEED	Boleside	498	334	SEPA	579.15	3100	2753	1518.3	17467.4	44.6	1133		(RES)		1961	
21013	Gala W	Galashiels	479	374	SEPA	79.92	394	2136	113.3	1776.1	36.6	930	Natural			1964	
21015	Leader W	Earlston	565	388	SEPA	92.28	338	1732	99.9	1632.2	33.6	853	Natural			1966	
21010	TWEED	Dryburgh	588	320	SEPA	803.09	219	2753	1769.7	20400.4	42.5	1079		RES	PWS	1960	
21021	TWEED	Sprouston	752	354	SEPA	1285.71	80	2753	2369.1	31808.2	40.0	1015		(RES)	PWS	1969	
21023	Leet W	Coldstream	839	396	SEPA	43.67	40	732	5.3	458.0	26.4	671	Natural			1970	
21009	TWEED	Norham	898	477	SEPA	1694.98	14	2753	3114.8	37285.5	37.6	955		RES	PWS	1962	
21017	Ettrick W	Brockhoperig	234	132	SEPA	1430.50	850	2270	43.6	967.2	68.2	1733	Natural			1965	
21016	Tima	Deephope	278	138	SEPA	11.97	761	1788	16.9	741.5	58.9	1497	Natural			1973	
21007	Ettrick W	Lindean	486	315	SEPA	192.66	325	2753	434.4	7623.0	51.5	1307		RES		1961	
21030	Meggat W	Henderland	231	232	SEPA	216.99	833	2753	71.3	914.0	65.8	1671		RES		1968	
21034	Yarrow W	Craig Douglas	288	244	SEPA	44.79	784	2753	162.1	1844.7	61.2	1554		RES		1968	
21020	Yarrow W	Gordon Arms	309	247	SEPA	59.85	741	2753	192.9	2470.3	57.4	1459		RES	PWS	1967	
21001	Yarrow W	Philiphaugh	439	277	SEPA	89.19	420	2753	246.4	3261.8	53.0	1345		RES		1963	
21012	Teviot	Hawick	522	159	SEPA	124.71	296	1995	218.0	4399.5	45.3	1151	Natural			1963	
21024	Jed W	Jedburgh	655	214	SEPA	53.67	215	1814	88.2	1129.8	35.9	913	Natural			1971	
21025	Ale W	Ancrum	634	244	SEPA	67.18	201	1460	48.8	1439.5	36.5	926		RES	PWS	1972	
21008	Teviot	Ormiston Mill	702	280	SEPA	428.57	142	1995	625.8	9773.4	37.0	939	Natural			1960	
21002	Whiteadder	Hungry Snout	663	633	SEPA	17.61	705	1749	30.1	451.2	35.8	909		RES	PWS	1959	1968

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21027	Blackadder	Mouth Bridge	826	530	SEPA	61.39	186	1467	57.9	777.6	30.5	775	Natural			1973	
21022	Whiteadder	Hutton Castle	881	550	SEPA	194.21	95	1749	244.4	2890.5	32.1	815		RES	PWS	1969	
21016	Eye	Eyemouth Mill	942	635	SEPA	45.95	10	1358	28.6	594.6	28.7	730	Natural			1967	
21031	R. Till	Etal	927	396	EA	250.19	83	2677	328.2	3798.9	32.6	827	Natural			1956	1980
21032	R. Glen	Kirknewton	919	310	EA	76.80	178	2677	62.9	1405.9	34.5	876	Natural			1966	

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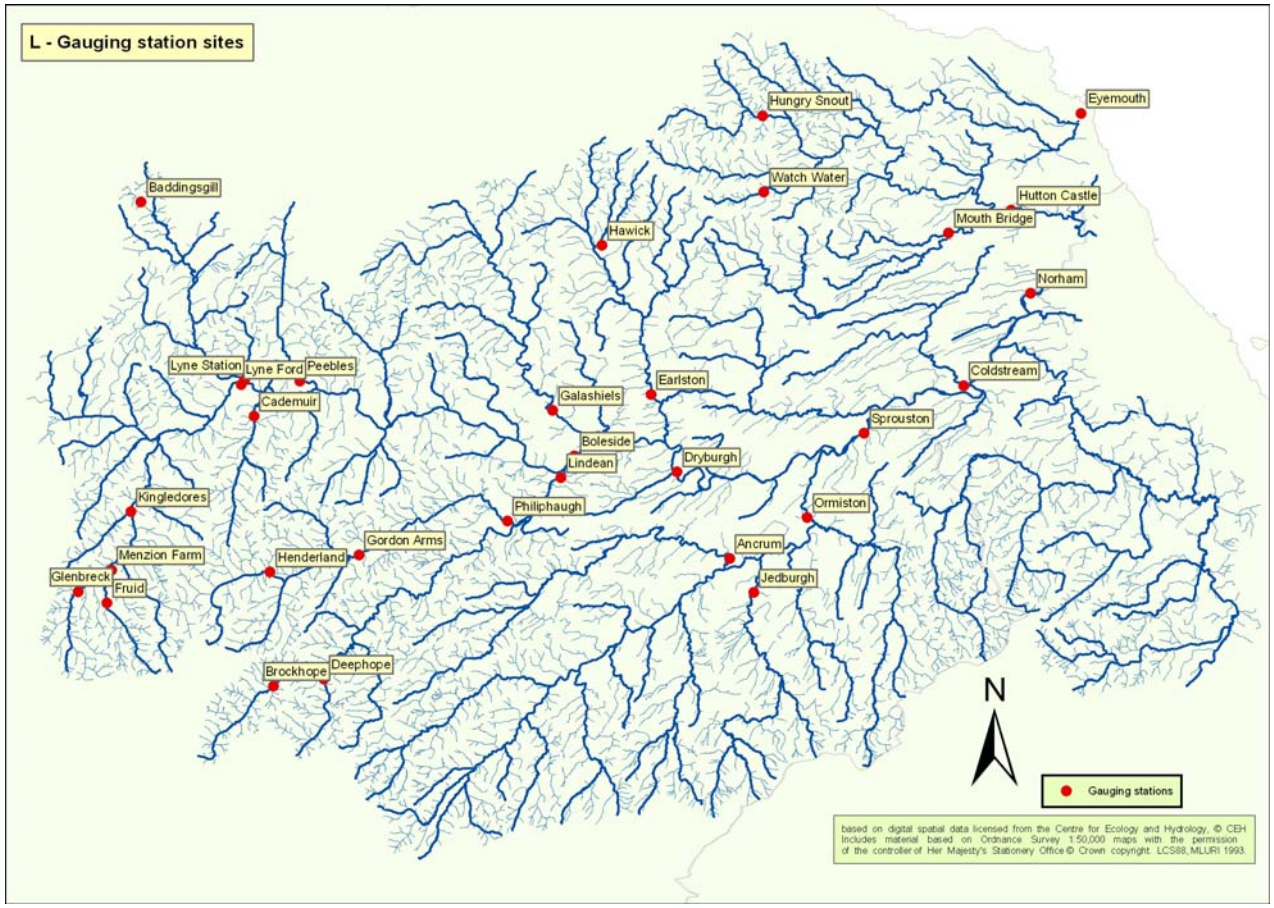

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