



Enhancing Straightened River Channels

3.3 Stone riffle

RIVER SKERNE

LOCATION - DARLINGTON, Co DURHAM, NZ301160

DATE OF CONSTRUCTION - AUGUST 1996

LENGTH - 60M

COST - £2,000

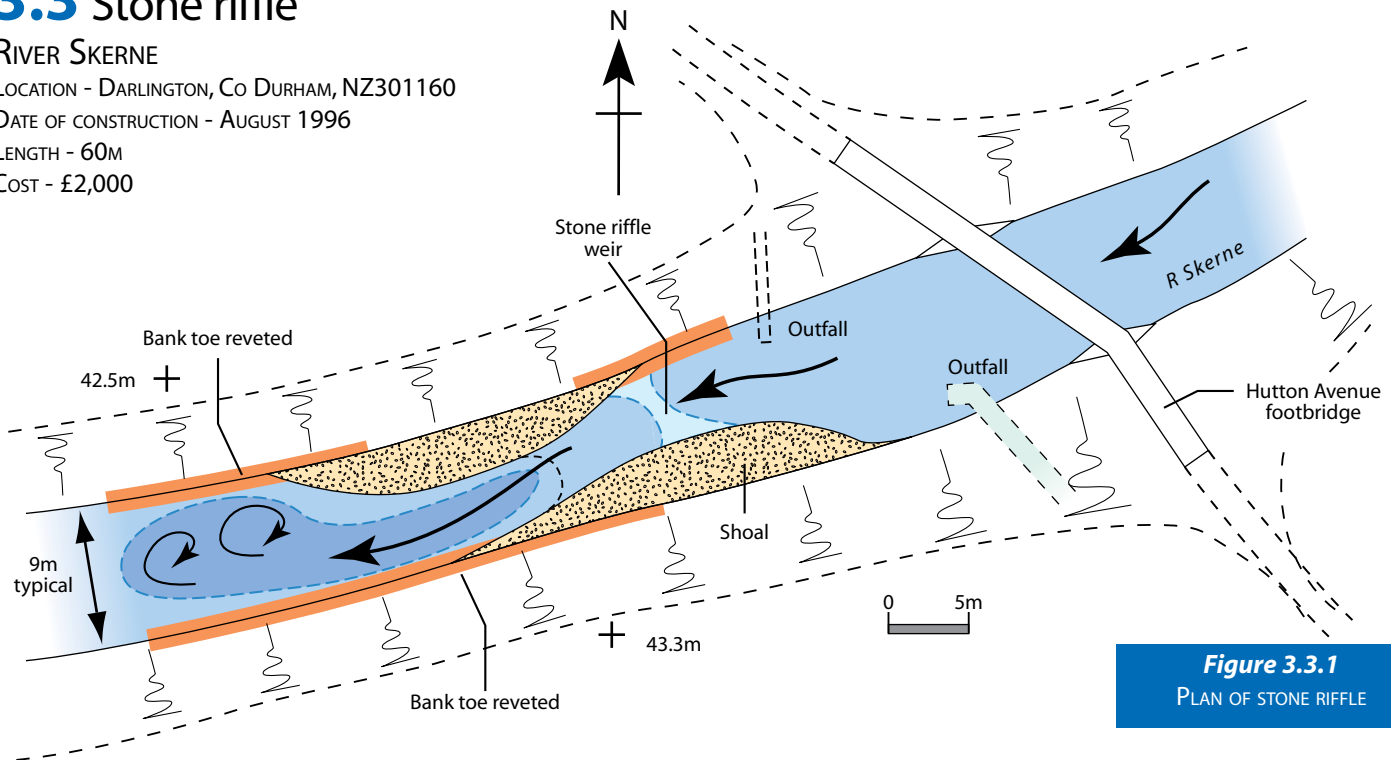


Figure 3.3.1
PLAN OF STONE RIFFLE

Description

The Skerne has no natural gravel sediments in the restoration reach, so the introduction of a stone riffle feature needed to be entirely artificial and self sustaining. A riffle located just downstream of Hutton Avenue footbridge afforded several benefits within what was a featureless, straight reach of river (see *Techniques 3.1 and 3.2*) for other enhancements in the same reach).

Firstly, the sight and sound of water cascading over the riffle is enjoyed by people using the footbridge. Also, the regulation of normal water levels upstream has helped in introducing stable marginal planting ledges where water birds and mammals can always be seen. Two surface water outfall pipes just upstream (one 900mm diameter) are always submerged because of the riffle (see *Technique 9.1*). Children regularly paddle in the shallow flow over the riffle. In anticipation of this the design needed to be as intrinsically safe as possible.

Stone Riffle downstream of Hutton Avenue footbridge



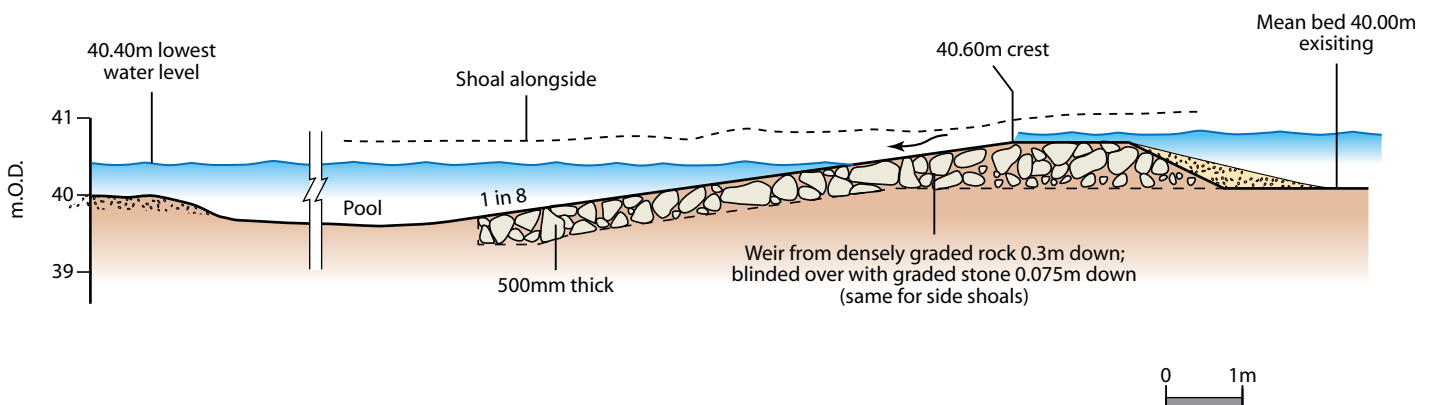
Design

Although described as a riffle, the structure was designed as a low weir. Scour of the structure, as well as the river bed and banks downstream, were primary considerations.

The riffle is configured as two semi-elliptical shoals, diagonally opposite each other, that are linked by a shallow sloping weir, such that the whole is a single, homogeneous structure. During low flows, only the weir is submerged but the shoals quickly drown as flows increase. The configuration sustains a deep faster flow of water around the downstream shoal that noticeably

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eddies as the currents merge with the lower river. These variations in the speed, depth and direction of flow all sustain habitat diversity. The river banks alongside each shoal are graded as flat as practical to make access to the water's edge easy and safe. The toes of the river banks are reveted with stone where river flows are accelerated during passage over the structure and beyond.

The stone used for construction was a densely graded crushed rock mixture sized 300mm down to 5mm. The dominant size (at least 50%) was in the range 125-300mm to ensure that the structure would not wash away during floods, albeit some adjustment to form would inevitably occur. As a final measure, the entire structure was covered in a layer of smaller crushed stone to simulate gravel. This mixture was sized 75mm down. Its purpose was to smooth out the irregularities in the core rock surfaces improving appearance. Much of this material would be washed away by floods, but was expected to settle out in desirable niches close downstream.



The riffle allows easy access down to the river
– November 1996

At normal water levels the new structure is free flowing, but spates of floodwater cause downstream levels to rise more quickly than those upstream such that the structure is 'drowned out' at an early stage; an important flood defence and fishery requirement. Weed growth downstream of the structure also causes seasonal rises in normal water level that partially submerge the structure.

Subsequent performance 1995 – 2001

The new riffle/weir has performed well and adds greatly to the amenity of this well visited location. The river has scoured away much of the smaller sized stone, as anticipated, but a stable structure has evolved in the form required. The slope of the weir has steepened significantly (from 1 in 8 built to perhaps 1 in 4).

It was anticipated that washed out stone would lead to the formation of a smaller, secondary riffle close downstream but this has not occurred. Consideration has been given to building this in order to stabilise normal water levels at the bottom of the main weir, whilst adding an additional element of diversity.

Of particular note is the popularity of this spot with children who can gain safe access to the river and paddle in the shallow water, where the bed is firm and stoney.

