22. Intakes from rivers

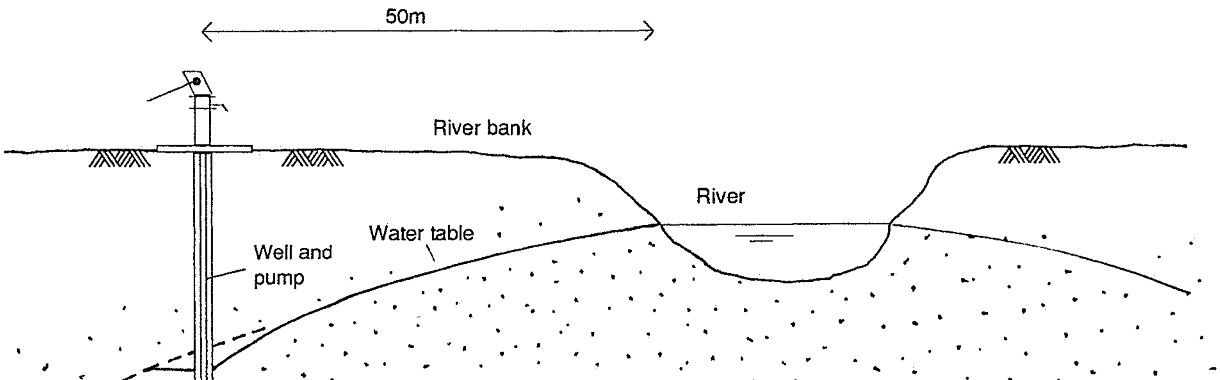
Introduction

A typical small water supply system requires less than about 200,000 litres per day, which is well within the capacity of small streams and alternative water sources, other than rivers. Indeed a river is not the ideal source of domestic water in many situations and an intake would normally be constructed only if there is no satisfactory alternative source such as groundwater (handpump), rainwater (catchment tank), or a spring (spring box). In contrast to these sources, water from rivers is liable to be polluted, and many rivers in the tropics and subtropics provide difficult conditions under which to construct an intake, for instance:

- They have awide range of water levels between high and low flows, threatening to damage the intake at high flows, and leave it dry at low flows, and the intake has to operate satisfactorily over the whole range.
- They have a high sediment load (‘silt’), especially at peak flows, which may block the intake.
- Scour and deposition can cause frequent changes to the bed and banks of the river channel, and may damage the intake or alternatively cut it off from the river.

Despite these problems, there are many circumstances where river water has to be used. The most suitable solution for village water supplies will often be a well or a series of wells along the river bank, provided that permeable materials of sand or gravel link the river and the well, without clay lenses to impede the flow. Water seeps to the well by sub-surface flow, and a distance of 50m from the river to the well should provide enough filtration to make the water safe to drink. Such wells also avoid problems of siltation and flood damage, and may still operate satisfactorily when the river is dry, by drawing on sub-surface water.

The wells can be drilled, jetted, augered or hand-dug and must extend some distance below the river bed level to give maximum year-round discharge. The top of the well should be above flood level, or sealed to prevent surface floodwater entering the well and filling it with silt.



The remainder of this technical brief describes other types of intakes, for use when the above solutions are not suitable or would not deliver enough water. These intakes generally provide higher discharges, as would be required for large communities (or for small-scale irrigation schemes, where intakes are designed on similar principles). The illustrations show examples of the intakes, not standard designs.

Selection of an intake site

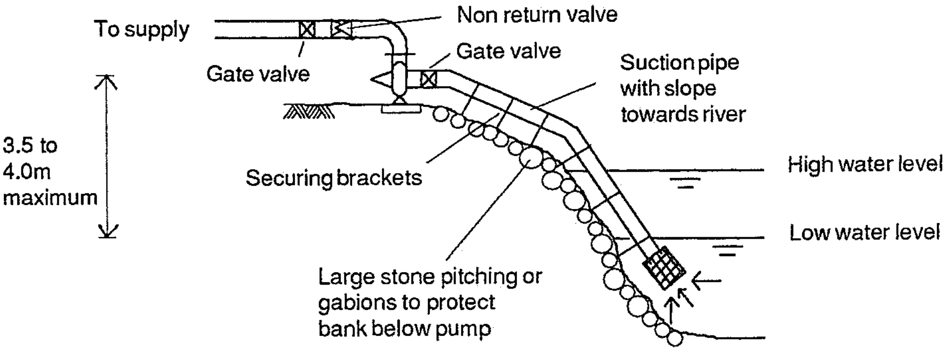
For all types of intake it is necessary to examine possible sites on the river and select a suitable protected, stable site on a stable, confined length of river, preferably upstream of a natural control section. Sites on the inside of bends should be avoided, to reduce sediment deposition and inflow, and side intakes should not be located where the river is wide and shallow, because of difficulties abstracting water at low flows without the expense of a long weir.

Intakes from rivers

Exposed intakes

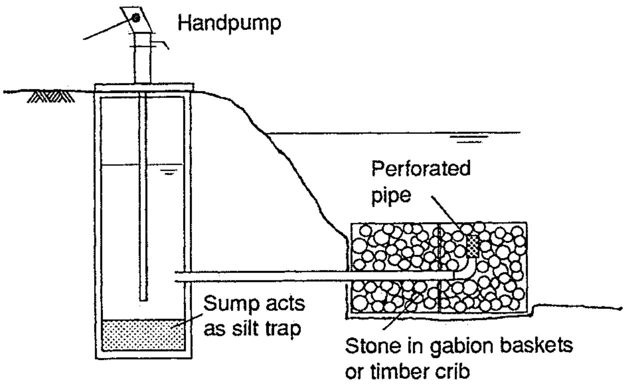
Pump with suction intake

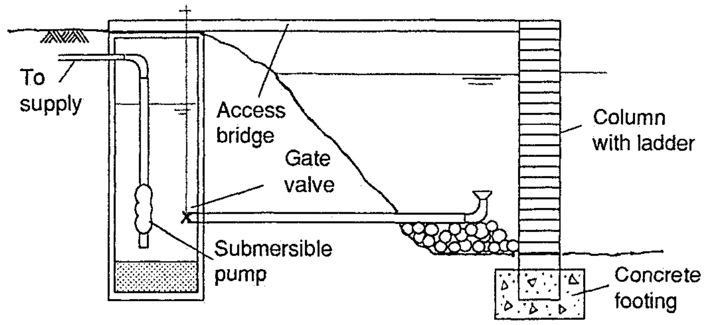
On rivers with a stable bed and little variation between high and low water level, a pump may be set up on the bank, with its suction pipe down the bank ending in a screened intake below low water-level. Because of the suction limit of the pump, the difference in level between the mouth of the intake and the pump must be less than 3.5 to 4m.



Intake with sump

For deeper intakes, a well-type pump may be set in a sump, with the inlet pipe through the river bank. In a simple intake, the pipe can be surrounded with a protective stone covering. In larger intakes a pier can be used to provide access to the intake, for instance to operate a valve or clean the screen. The pier also provides some protection, and could be fitted with a bar screen to exclude debris from the intake. A duplicate inlet pipe, sump and pump may be provided to make it easier to desilt the sump and maintain the pump.

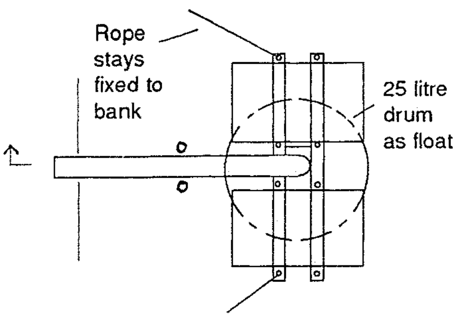




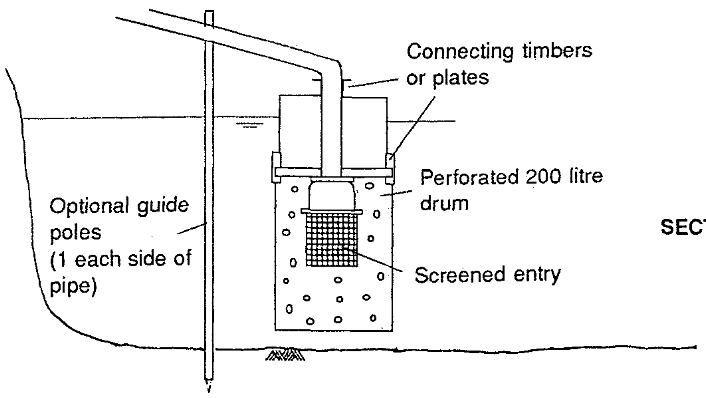
Problems can arise with all of the above intakes if the river bed is unstable (for example, gravel), or the river is very shallow at low flows. It can be difficult to set the intake level to be safe from silting up during floods, but still able to abstract water at low flows. A weir can assist with this (see opposite) or a floating intake can be used.

Floating intake

A floating intake has the advantage that it abstracts water from near the surface of the river, thereby avoiding the heavier silt loads carried on the river bed during floods. The danger with this type of intake is that children at play or floating debris such as tree trunks can damage the floats or cause the securing cables to break, making the intake inoperative. The example below shows a floating intake used as a temporary installation.

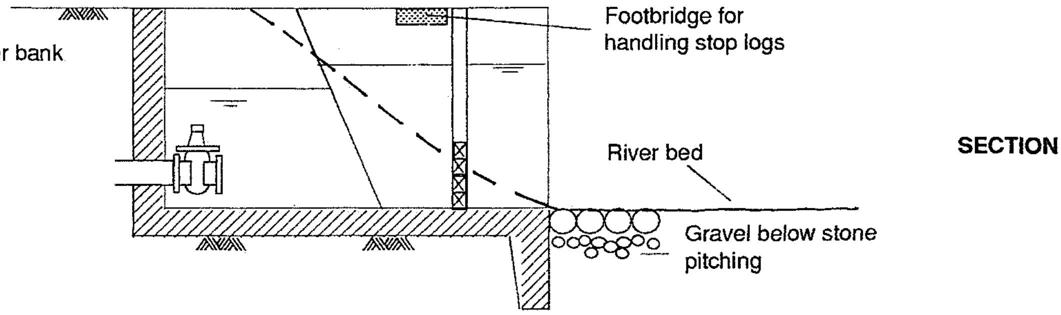


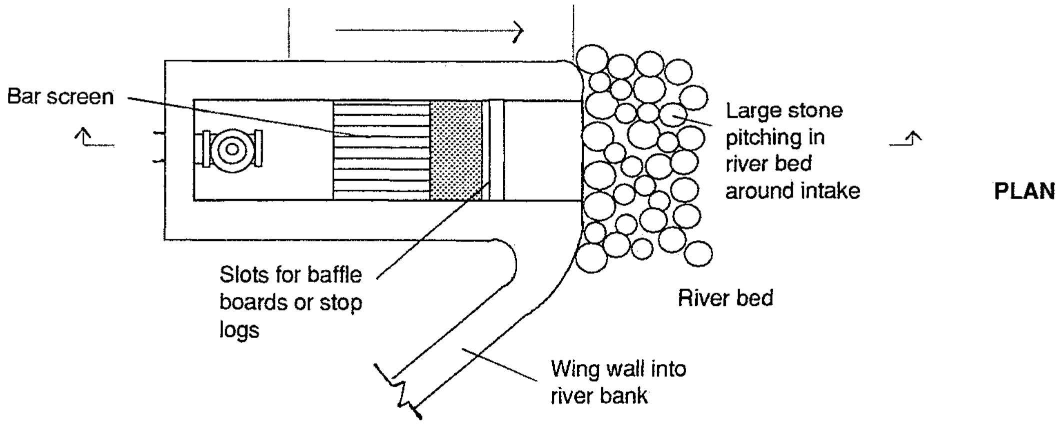
PLAN



SECTION

Protected side intake





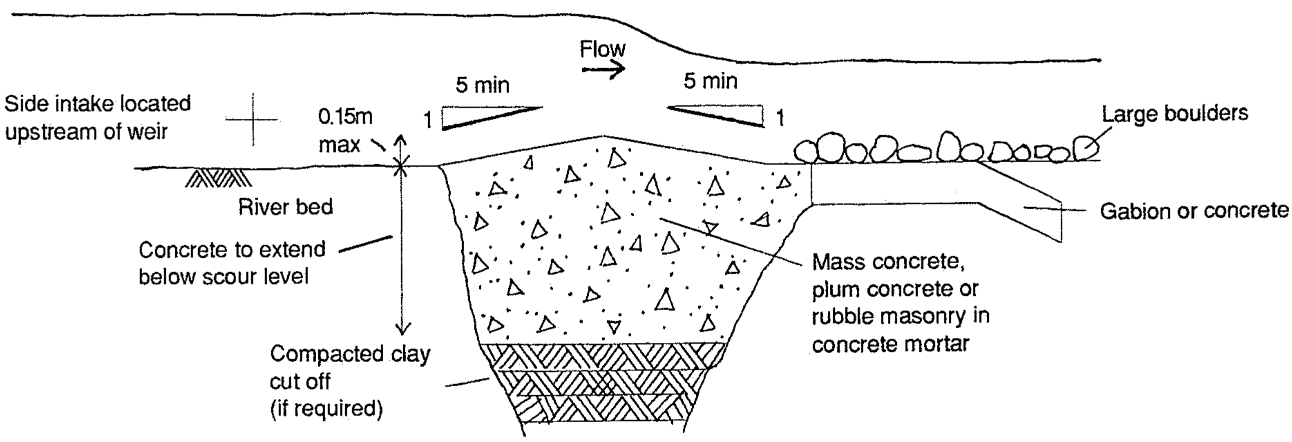
In the side intake the water is abstracted through an intake built in the river bank. The example includes wing walls into the bank and large stone pitching to protect the intake against floods and scour. A duplicate intake may be provided to facilitate maintenance.

Screens are used to prevent debris and large stones from entering the intake. A screen consists of a row of vertical steel bars, inclined at an angle of about 60 degrees to allow the screen to be cleaned by raking from above. A typical design uses bars of 25mm in diameter with a spacing of about 100mm, sized to give a velocity through the screen of about 0.5 to 0.7 metres per second.

The most important operation and maintenance tasks on this type of intake are:

- **To check the screens and rake them clear**
- **To clear any sediment which is deposited at the intake or its approach channel**

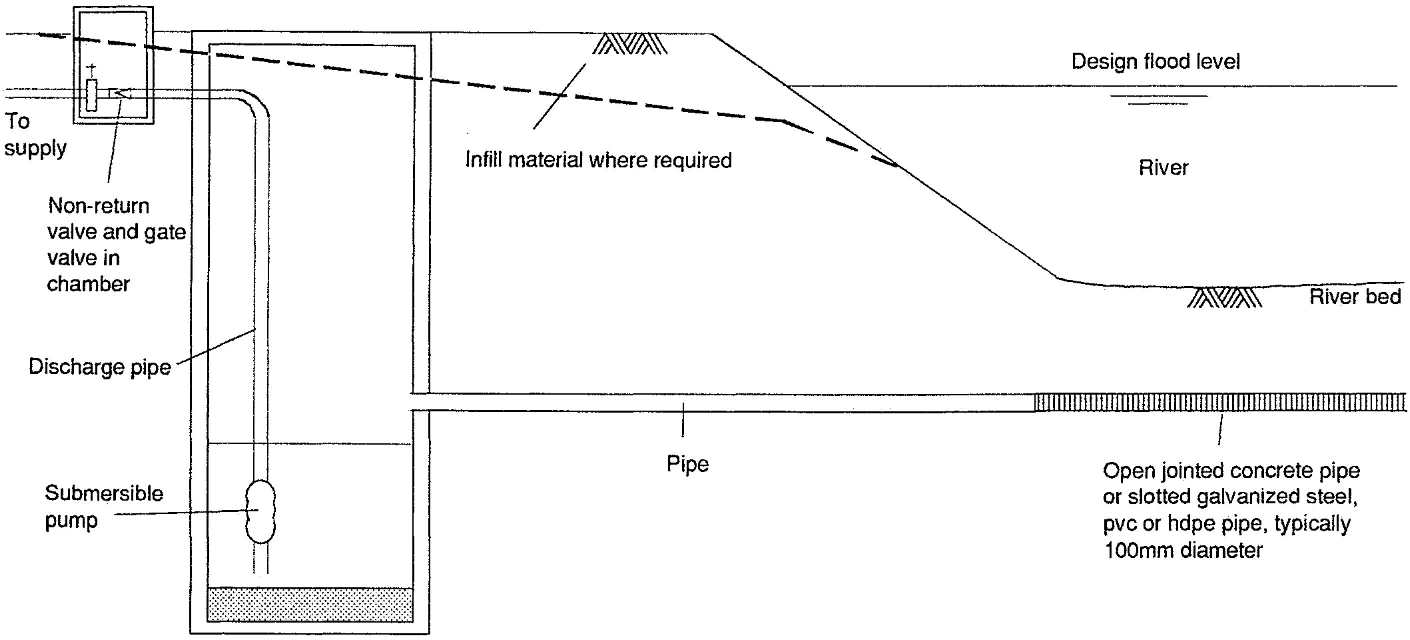
If the abstracted flow is a significant proportion of the dry season river flow, then it may be necessary to build a low weir across the river to divert the required flow to the intake.This could be a temporary boulder and brushwood weir, preferably combined with existing boulders on site. However, if the bed is unstable and liable to scour down, then a permanent low weir or sub-surface dam may be needed to maintain the water level above the intake. A possible design is shown below, suitable for rivers with a gravel bed.



Intakes from rivers

Infiltration galleries

The infiltration gallery draws on sub-surface flow, like the well on the river bank, and provides some filtration of the water. However, infiltration galleries are more difficult to design and construct than wells.



The infiltration gallery comprises an open jointed or slotted pipe laid below the river bed at a depth where it is safe from damage by scour. It is most suitable for use in river beds of medium to coarse sand, and in stable or degrading river sections where no sediment accumulation occurs. It is important to create and maintain an effective graded gravel filter around the slotted pipe, to prevent blockage of the filter or the pipe; for long life intakes, the filter should be designed in detail (see *Design of Small Dams,* p. 235). Blockage problems have led to the failure of some infiltration galleries, particularly in rivers carrying fine sediment. Construction involves excavation of a deep trench in the river bed which may be difficult and dangerous, and normally a de-watering pump is required. Alternatively, pipe jacking techniques can be used to drive the pipe horizontally through the bed, but without the safeguards of a filter. Infiltration galleries can also be constructed in the river bank, in a similar way.

A typical yield is said to be more than 15 litres per minute per metre length of gallery, but this depends on the difference in water level between river and sump. In dry river beds, this can be increased by constructing a sub-surface dam.

Another approach is to construct a sand storage dam on the river bed, incorporating an abstraction pipe and graded filter. As sediment is trapped behind the dam, the bed level rises and the pipe gradually comes to act as an infiltration gallery.

For further information:

Hofkes, E H (Ed), *Small Community Water Supplies,* IRC Technical Paper No 18, 1983.

Nilsson, Ake, *Groundwater Dams for Small-scale Water Supply,* IT Publications, 1988.

US Bureau of Reclamation, *Design of Small Dams, 2nd Edition,* 1979.

Technical Brief No.24, *Groundwater dams.*

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