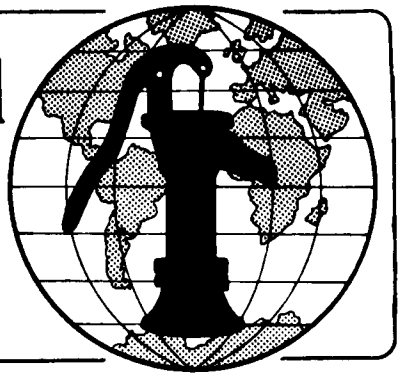
Water for the World



Choosing Where to Place Intakes
Technical Note No. RWS. 1.P.4

Intakes are pipes, canals, wells, collection boxes or other openings through which water from springs, streams and ponds enters a water supply system. From the intake, water goes either to storage, treatment, or, in some cases, directly to the user. Intakes are necessary for the development of most surface water sources. This technical note describes the general characteristics of intakes and discusses important considerations for their placement in surface sources.

Useful Definitions

BACTERIA - One-celled micro-organisms which multiply by simple division and which can only be seen through a microscope.

CONVEX - Curving outward like the surface of a sphere.

PUDDLED CLAY - A mixture of clay and water used to make a watertight seal.

RESERVOIR - A natural or artificial lake where water is stored for use.

SPRING EFFLUENCE - The point or opening where spring water flows from the ground.

Purpose of Intakes

Intakes serve as an entrance for water into community water supplies. They make water available and more accessible to the users. For example, the installation of an intake in a source such as a pond or lake located far from a community gives the users access to the water supply without having to walk long distances and carry heavy loads. If water is delivered close to the community, or if house connections are made available, people will use more water than they did when water had to be carried. Increased water availability should result in improved hygienic conditions and practices.

Water quality is affected by the installation of intakes. Structures built to collect water from springs protect the source from contamination by surface run-off and from contact with animals and people. Infiltration galleries and collecting pipes installed in filter beds improve water quality by filtering out sediment and debris. In many cases, harmful bacteria are also filtered from the water as it passes from the source through the soil and into the galleries or collection pipes.

The type of source and the conditions found determine the type of intake that can be installed. Intakes should provide the maximum amount of good quality water at a cost affordable to the community.

Intakes for Springs and Seeps

There are two basic types of intakes for collecting water from springs and seeps. The first, and easiest to install, is the spring box. For springs that flow from a spot on level ground, an open-bottomed spring box should be placed over the opening to capture all available flow. For springs on a hillside, a box with an open back should be placed against the hillside and the water should be channeled into the collection boxes. See Figures 1 and 2 for examples of these types of spring collection.

Intakes for seeps and some springs are perforated plastic or concrete pipe placed in trenches or collection ditches. The trenches are deep enough so that the saturated ground above them acts as a storage reservoir during

times of dry weather. Generally, the trenches should be 1m below the water level. Collection pipes are placed in the trenches which are lined with gravel and fine sand so that sediment is filtered out of the water as it flows into the pipes. Clean, clear water flows from the collection pipes to the storage or collection box. See Figure 3 for an example of a spring box with collection pipes. For spring flows that cover a wide area, a concrete wall should be installed to collect all flow.

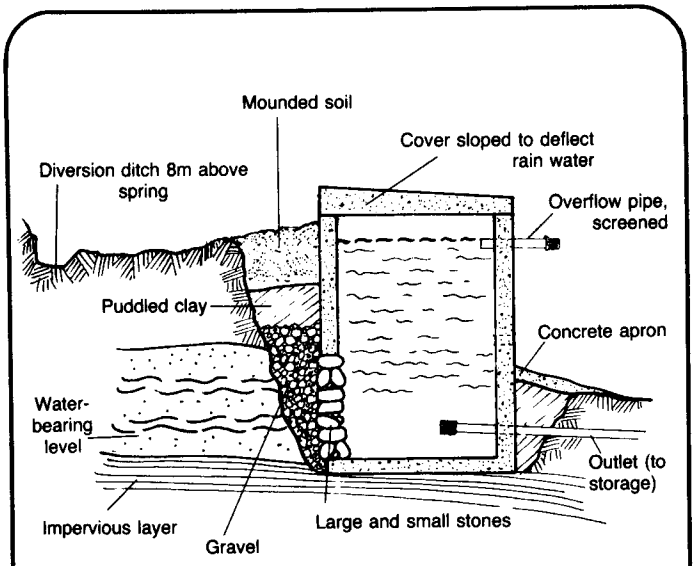


Figure 1. Spring Box with Pervious Side

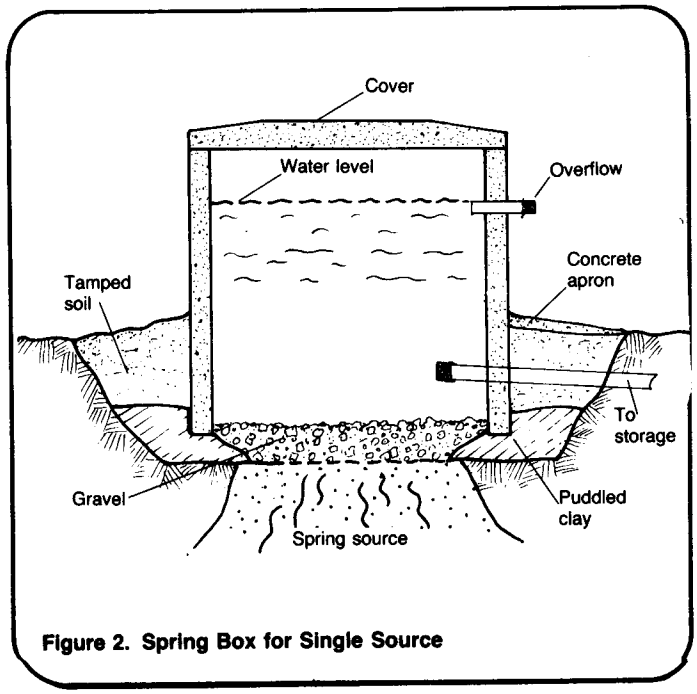


Figure 2. Spring Box for Single Source

In horizontal wells, the intake is a pipe which has been driven, jetted or augured and driven through the ground above a spring effluence. The water reaches the surface by flowing from the tapped aquifer through the installed pipe. Horizontal well intakes must be located in an area with a sloping water table in order to have adequate discharge. The pipe must also enter the aquifer far enough to ensure the required minimum flow throughout the year. See Figure 4 for an example of intake placement for horizontal wells.

Intakes for Ponds and Lakes

The location of intakes for ponds and lakes depends on the size and depth of the source, the quality and condition of the water, and the cost of delivering water to the community. An intake should be placed near or in the deepest part of the pond or lake. At this point, the intake will make maximum use of stored water and will generally be far enough away from the shore to prevent contamination by people and animals. In larger water bodies, the quality of water should improve greatly as distance from the shore to the intake increases.

The depth of the intake in the water is another important consideration. For ponds and medium-sized lakes, a general rule is that the intake should be 0.30-0.50m below the surface. If the intake is placed closer than 0.30m to the surface, floating debris, algae and aquatic plants may clog the intake screen and pipe. Constant maintenance would be required to keep the intake in operation. Another problem is that water containing plant life and organic matter may have an unacceptable taste and odor.

An intake placed too near the bottom of a pond or lake may draw in very turbid water or water containing a large quantity of suspended solids. Sediment and solids will clog the system and increase maintenance costs. Turbid water, if not treated, will be unacceptable to the users.

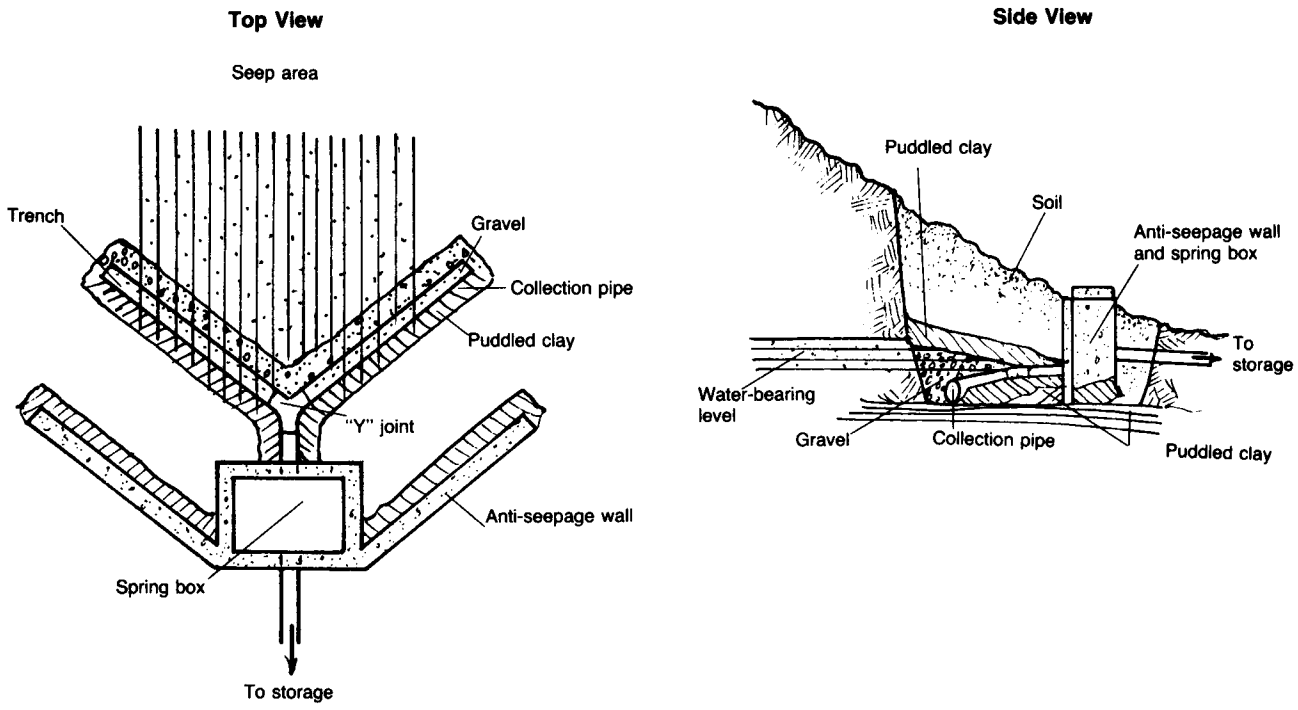


Figure 3. Seep Collection System

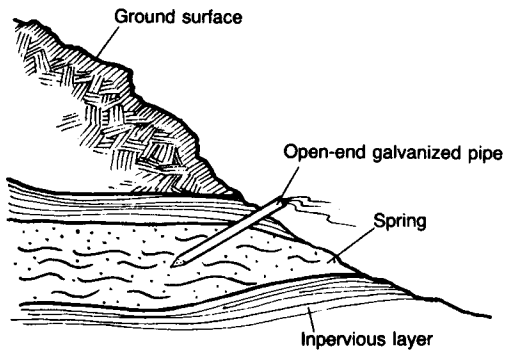


Figure 4. Horizontal Well Driven into Artesian Spring

A floating intake of flexible pipe can be installed to ensure that water is drawn from the same level regardless of changes in the water level. The intake is secured to a float so that it is suspended 0.30-0.50m below it. The float rises and falls with the water level but the intake position remains the same. The floating intake will supply water of uniform quality throughout the year. Figure 5 shows how a floating intake works.

In a newly dug reservoir or in a pond where a dam is to be built, a screened concrete intake box can be located on the floor of the reservoir next to the dam embankment. The water is deepest near the embankment and thus will be free from organic material as it enters the intake. A 10mm screen on

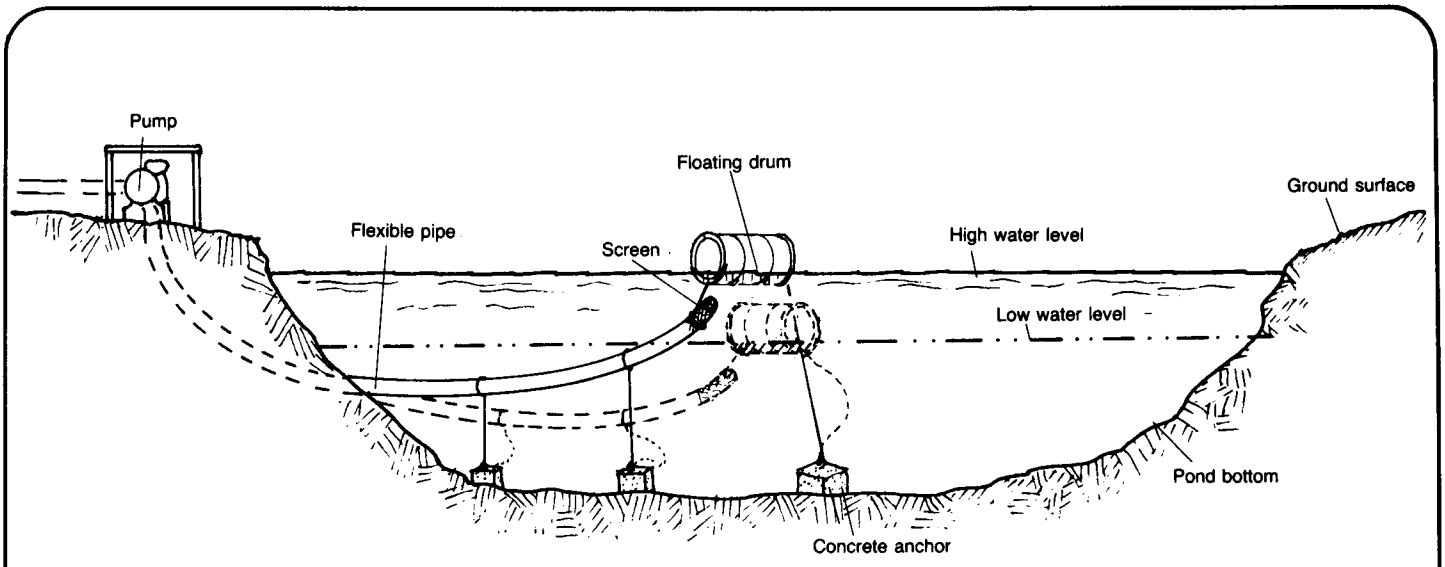


Figure 5. Floating Intake in Pond or Lake

the top of the box filters out any suspended matter or debris drawn to the intake. This type of intake is permanent, quite expensive, and can only be constructed in a newly-excavated reservoir. Floating intakes, which are usually cheaper to build, should be installed under most conditions.

Pond and lake intakes should be located so that the best quality water enters the system. Their location must prevent the drawing of water contaminated by contact with humans and animals, or by organic material and suspended matter. Proper location of the intake will help ensure that suitable water is available to the community.

Generally, developing intakes for ponds and lakes is expensive. The further away the users are from the source, the more expensive the system. Where possible, the source and intake should be located near the community.

Intakes for Rivers and Streams

Intakes will be needed if rivers and streams are to be used for water supply. They can provide sufficient water to a water supply system but there are special considerations which must be recognized for effective planning. Rivers and streams generally have a wide seasonal variation that will affect the location of intakes and the quality of water drawn by them. During the wet season, water is abundant. However, flooding may occur which could destroy the intake and measures must be taken to protect it in this case. In the dry season, water flow will lessen and may even disappear completely. In this case, a community dependent on a river as a water source would have to find an alternative. In faster flowing streams and rivers, erosion along the riverbanks can be a problem. To prevent erosion, a flat stable section of the stream rather than a windy section should be chosen for the intake site. Efficient planning is necessary to ensure a year-round supply of water from a river or stream. There are two types of intakes for rivers and streams: infiltration systems and direct intakes.

Infiltration Systems. A well near a riverbank can be an excellent intake for a stream or river. An infiltration well can provide potable water from a surface source during the entire year if it is excavated below the stream bed level.

Water quality is good because as water is pumped from the well, the stream water is drawn through the

ground into the well. As the water passes through the ground, suspended particles and bacteria are removed and the stream water is considerably purified.

The purification process depends on the makeup of the soil in the river bank and the distance of the well from the stream or river. If the soil is made up of large particles, the water will pass through it quickly. Soil containing finer particles of sand and silty clay slows the movement of water. The slower the water moves, the less distance it must travel for filtration to take place. In fine or compacted soils, the well could be placed as close to the river as 2 or 3m. In coarser soils, the well may have to be 20 or 25m from the stream so that the water will flow underground long enough to be purified. In semicoarse soils, a distance of 10-15m from the stream should be sufficient. Be sure that the soil is not a highly compacted clay. Water movement through compacted clay is very slow and the replenishment of the well could also be very slow.

Another advantage of an infiltration well is that water is usually available even in seasons when the river dries up. Water is stored in the soil and in the well. If the river is likely to dry up and no other suitable source is available, be sure to dig lower than the bed of the stream and plan a well with a large storage capacity. Figure 6 shows the process of infiltration at a riverside well.

Infiltration galleries are developed in basically the same way as infiltration wells, except that collecting pipes are installed. Riverbanks with firm soil that does not contain a lot of clay are good for infiltration galleries. Some infiltration galleries are built in the bank parallel to the stream. Trenches are dug to a depth below the water level and collecting pipes are installed as shown in Figure 7. The pipes run into a clear water well which provides some storage and settling. Their distance from the river or stream depends on the soil makeup. Filtration is usually very good because each collection pipe

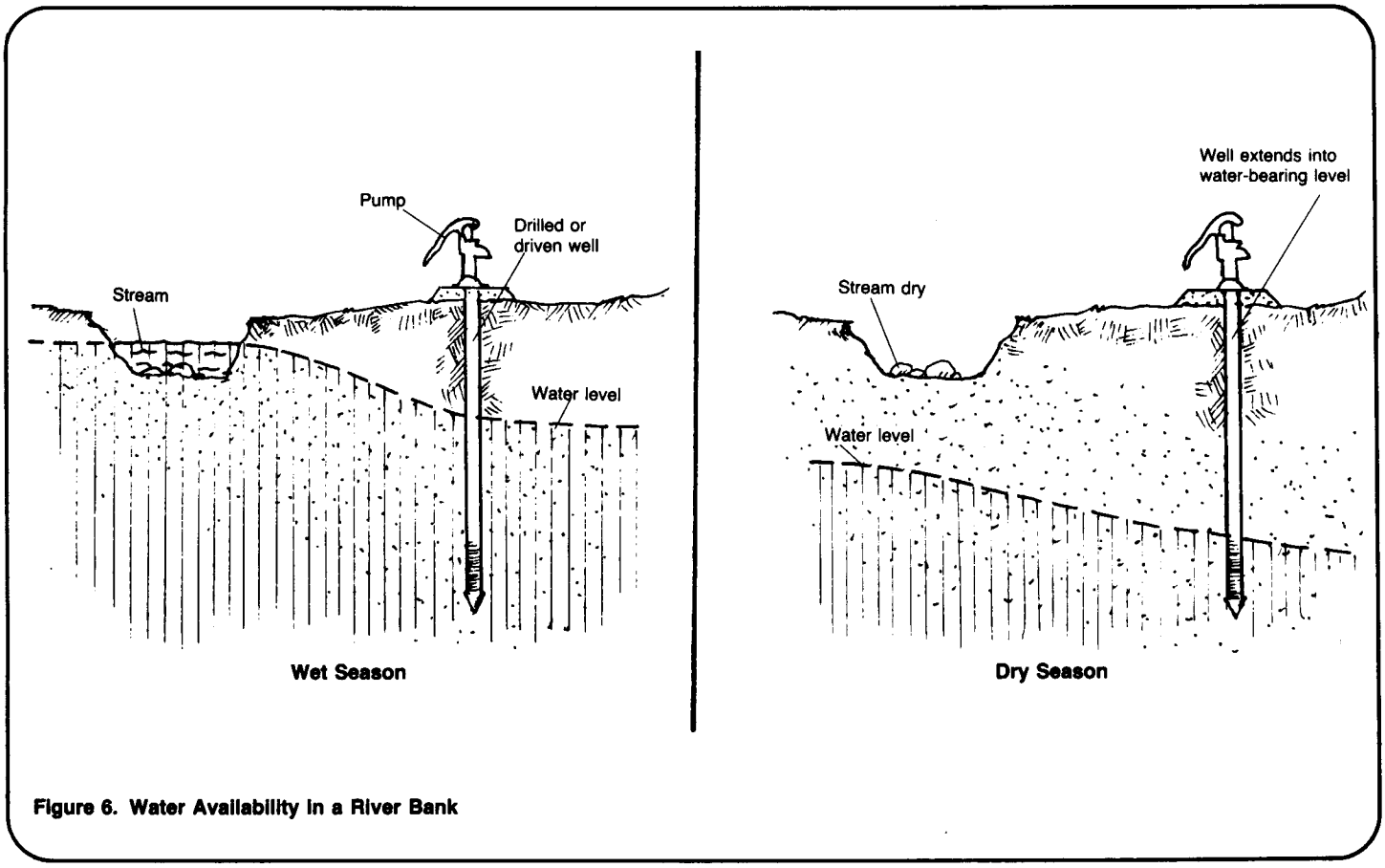


Figure 6. Water Availability in a River Bank

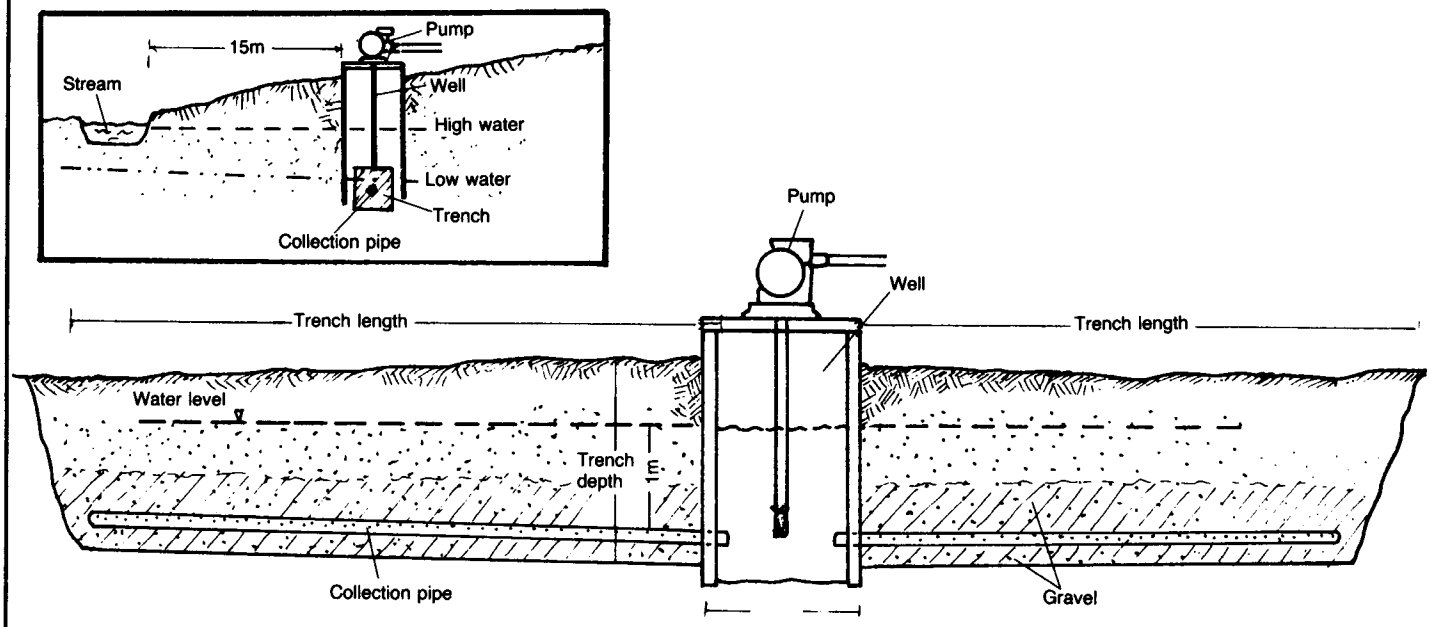


Figure 7. Infiltration Gallery

is protected by a layer of sand and gravel which filters out sediment. As the water moves from the stream to the trenches, bacteria are filtered from it. If soil is sandy this type of infiltration gallery may not work. The sand may clog the collection pipes and cut off the flow of water. Sandy soil is not firm which makes deep excavation dangerous due to cave-ins. Where there are sandy river banks, another alternative should be found.

In some streams, the collection pipes can be laid directly in the stream bed as shown in Figure 8. The stream can be bailed out or have its flow diverted and a trench 0.5-0.7m deep dug out. A collection pipe surrounded by gravel can be placed in the trench and connected by another pipe to a clear well on the shore. This type of infiltration gallery is best installed during the dry season.

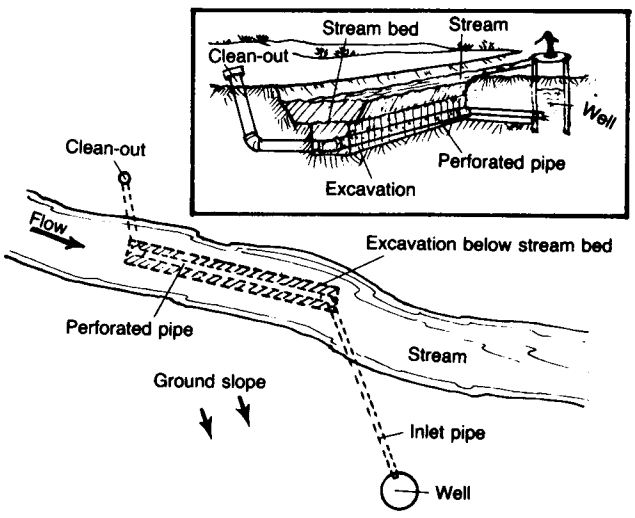


Figure 8. Infiltration Gallery in Stream Bed

Another possibility is to place the pipes under the stream bed, perpendicular to the stream as shown in Figure 9. This technique requires that the pipes be driven into the stream bed. This type of infiltration gallery is much more difficult to build, but is useful when the other two methods cannot be used. With infiltration galleries, often times it is best to use fine filtering materials to slow the velocity of water entering the system. Lower velocity provides clearer water, but less quantity. To maintain the quantity desired, infiltration galleries can be made longer in order to collect water over a larger area.

Infiltration galleries can provide large quantities of good quality water because water is collected over a large area. Infiltration wells generally serve only a few users, while infiltration galleries can serve entire communities.

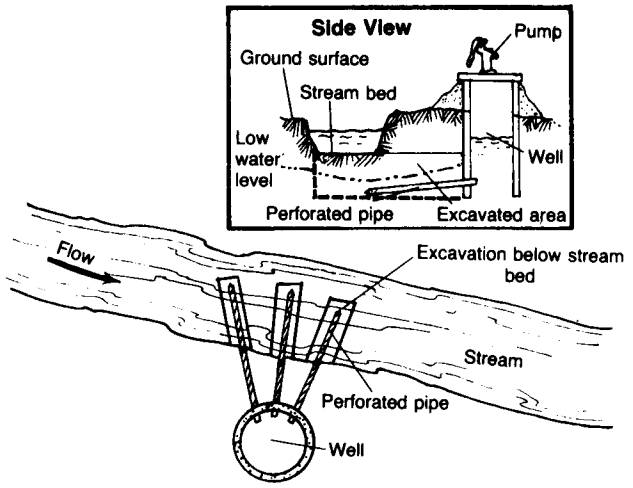


Figure 9. Multiple Pipe Infiltration System

Direct River Intakes. River water quality can be assured by locating the intake above inhabited areas and sources of contamination. There is little chance of fecal contamination by people or animals in areas where few people live.

Direct intake structures should be located either on a straight, stable section of a river bank or else near the convex side of the bank as shown in Figure 10. Be sure that the bank is stable when choosing the location. The intake should be located so that it is submerged all year long. Before attempting to install an intake in a specific location, determine the low water level during the dry season. The intake should be low enough to collect water all year but not too close to the bottom where sediment or rock could enter and clog it.

Many times streams are not very deep and, especially for gravity flow intakes, it will be necessary to introduce techniques which ensure a constant flow through the intake. A weir or submerged dam can be built across the river to raise the water level enough to provide the necessary flow. The intake must be submerged at all times.

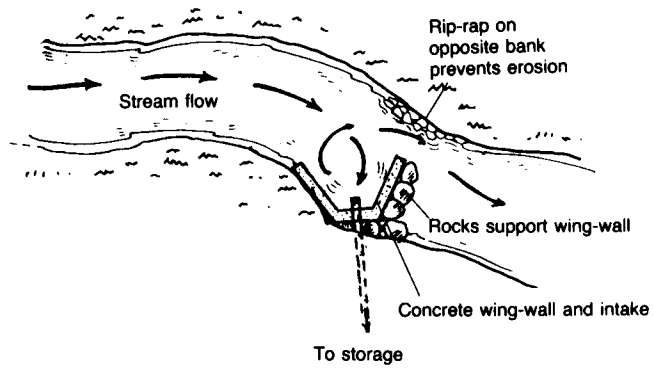


Figure 10. Direct Intake for River or Stream

In a deeper and faster stream, the intake can be located in a concrete ring attached to the shore by a catwalk. The ring is placed in the stream and protects the intake from damage from debris and the force of the water.

The catwalk is attached to the ring from the shore to provide access for maintenance. The intake is connected to a mechanical pump. This type of intake is generally expensive to construct, operate and maintain, and skilled people must be available for its construction.

Intakes for rivers and streams should be located as close as possible to the users. The expense of piping water over long distances must always be considered when planning to use a source. Where possible, a river intake should take advantage of the purification process that accompanies an infiltration system so treatment can be avoided. If the installation of a gravity system is possible, the costs of pumping water to the users will not be a burden.

Summary

The choice of location for an intake depends upon the type of source to be developed and the conditions present at the potential source. Intakes should be placed so they collect the maximum amount of water available. Their placement should ensure that the best possible quality of water enters the system. Intakes installed in ponds, lakes and rivers should be located so that sediment and organic material do not enter them. Another important consideration is that the intake be located so that the required minimum supply of water is available to the users during the entire year. Finally, if possible, the source should be located close to the community to avoid the cost of installing expensive pipe for a distribution system.

Technical Notes are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.