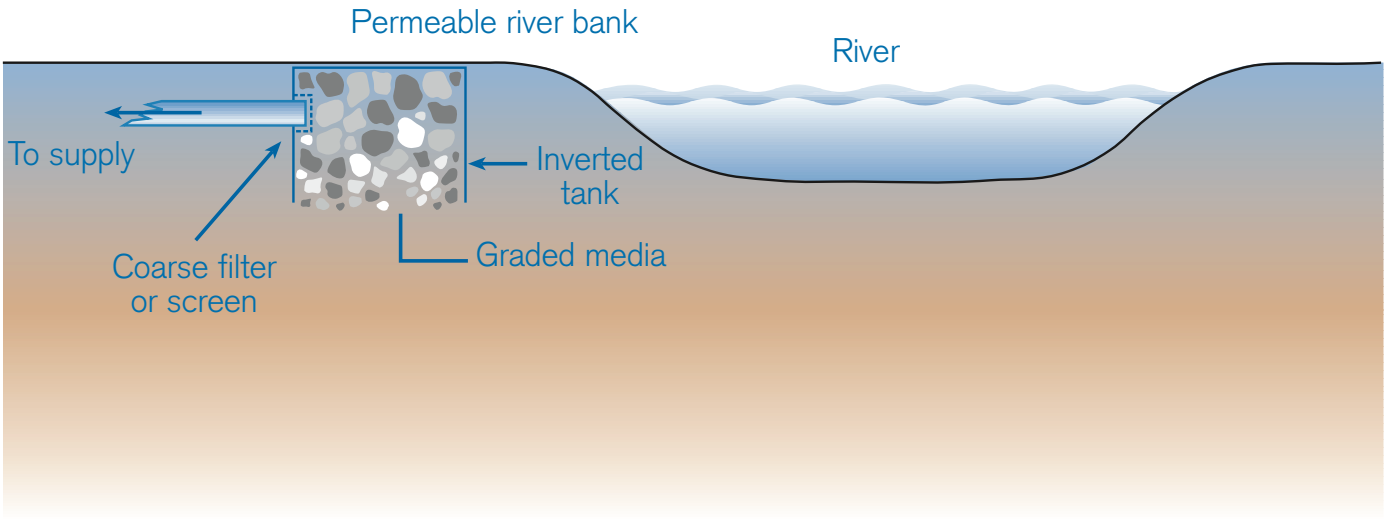
3.4 Source protection

3.4.1 Streams and rivers

Pollution and natural variations in water quality are the main problems associated with stream and river sources that need to be considered when siting and constructing an intake. Water may be pumped directly from the stream or river or it may be collected from the ground in the immediate vicinity of the stream or riverbank. The advantage of the latter is that where the strata have suitable transmissive properties, supplies taken in this way are naturally filtered and of better quality than the river water itself.

The intake should be located away from any features that might create turbulence during periods of heavy rainfall and increase the turbidity of the water. This means that intakes should not be situated on bends in the stream or river or at places where sudden changes in level occur. Most commonly, intake pipes are situated in the stream or river protected by a strainer to prevent the ingress of debris, fish and vermin. The inlet pipe feeds a settlement tank that allows particulate material to settle. The outlet of the tank, fitted with a strainer, should be situated above the floor of the tank to prevent contamination by sediment. The tank must be built of a material that will not impair water quality and designed to prevent entry of vermin and debris. An example of a slightly more sophisticated intake is shown in Figure 3.7. The inlet pipe is situated in a small gravel-filled tank buried upside down in the stream or riverbank (alternatively, the tank may be buried in the stream or river bed). The water enters the tank through a substantial thickness of riverbank material. This type of infiltration gallery will only be appropriate where the riverbank is sufficiently permeable to allow water to enter the tank at an adequate rate. The intake may suffer a gradual loss of permeability through siltation.

Figure 3.7 River source



3.4.2 Springs

Spring water can be of good quality but it must be protected from possible contamination once it has reached ground level. In particular, it is necessary to consider the possibility of pollution from septic tanks or from agricultural activities. A small chamber built over the spring, for example as shown in Figures 3.8 and 3.9, will protect it from pollution, provide storage for periods of high demand and serve as a header tank. The collection chamber should be built so that the water enters through the base or the side. The top of the chamber must be above ground level and it should be fitted with a lockable watertight access cover. An overflow must be provided appropriately sized to take the maximum flow of water from the spring. The outlet pipe should be fitted with a strainer and be situated above the floor of the chamber.

The chamber should be built of a material that will not impair water quality and be designed to prevent the entry of vermin and debris. The area of land in the immediate vicinity of the chamber should be fenced off and a small ditch dug upslope of the chamber to intercept surface run-off.

Figure 3.8 Spring source – schematic

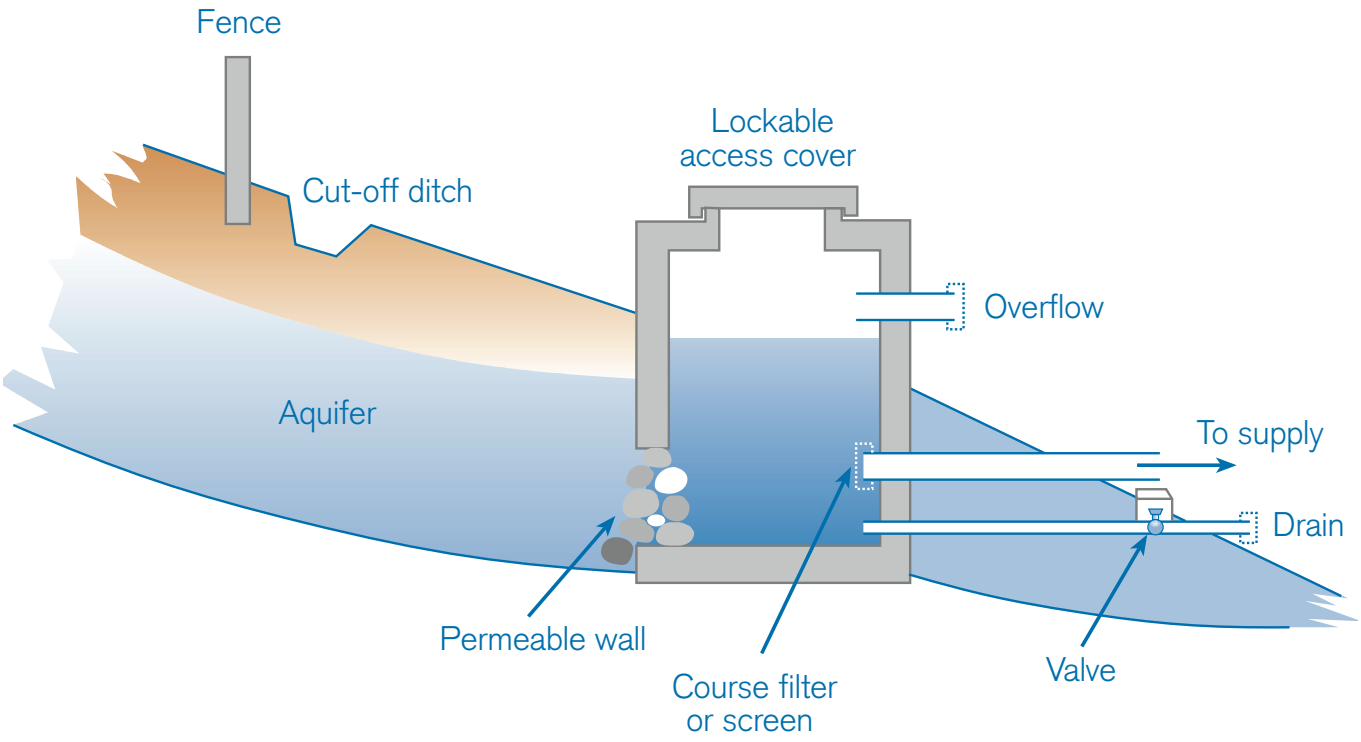
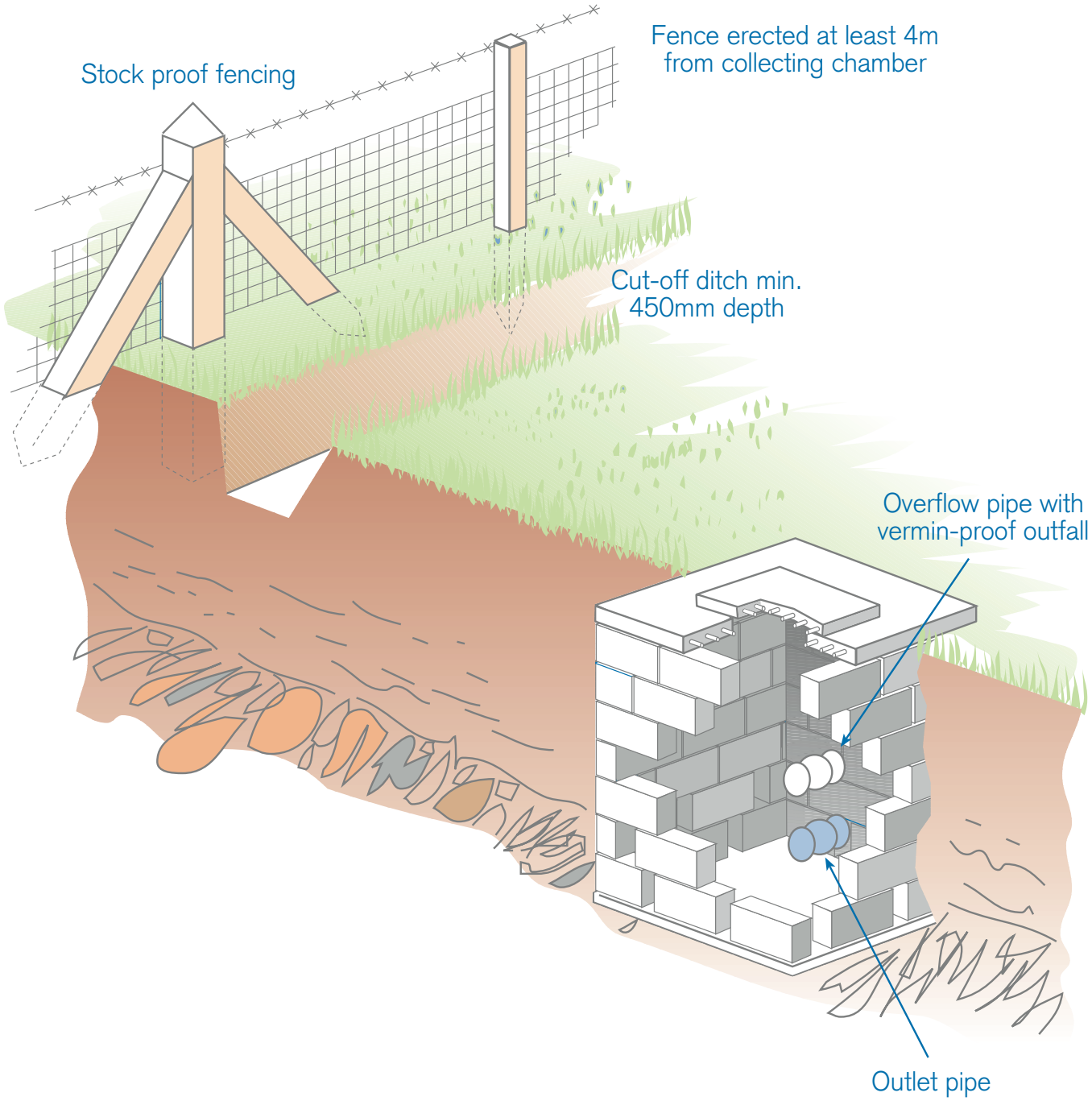


Figure 3.9 Spring collection chambers



3.4.3 Wells and boreholes

Shallow wells and boreholes are more at risk from contamination than deep wells and boreholes but if built and sited correctly, both may provide good quality water. Similar measures may be taken to protect both sources.

The upper section of the shaft must be lined and sealed against the surrounding material to exclude surface water ingress and, in the case of shallow wells and boreholes, water from the upper layer of the aquifer. Such sanitary seals range from 6 to 30 m in depth and must extend above ground level. Wells are often lined with masonry or concrete pipes and boreholes with steel, plastic or glass-reinforced plastic casings and sealed into the ground by a cement grout injected into the annular space between the casing and the surrounding ground. The shaft lining material should not affect water quality.

Where boreholes are drilled through a perched aquifer into lower water bearing strata, highly variable water quality may be obtained. Use of such boreholes as sources of potable water should be avoided unless the area through the perched aquifer is sealed.

The borehole lining may extend some depth into the aquifer if the bottom section requires support. Slotted or perforated linings are inserted which allow the ingress of groundwater. A gravel packing may be necessary if the borehole penetrates unconsolidated sand or sand and gravel to prevent fine material being drawn into the well during pumping.

At ground level, the well or borehole should be covered by a watertight chamber with a lockable cover. A concrete apron should slope away from the chamber to drain surface water. The well or borehole should be sited up-hill of, and at least 30 m away from, potential sources of pollution which include septic tanks, sewer pipes, cess pools and manure heaps. Typical arrangements for wells and boreholes are shown in Figures 3.10 to 3.13.

Figure 3.10 Well or borehole source – schematic

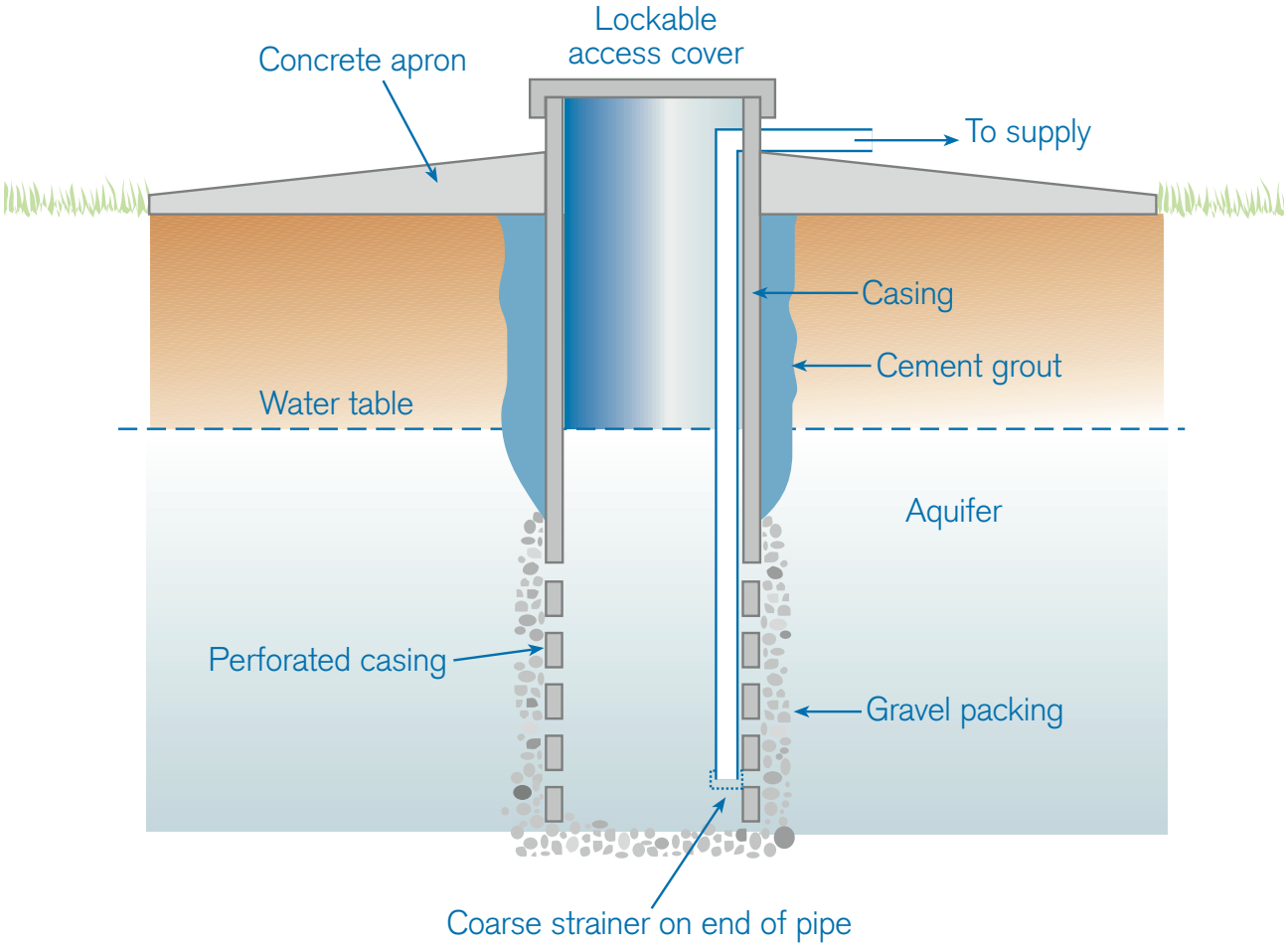


Figure 3.11 Well and submersible pump installation – typical arrangement

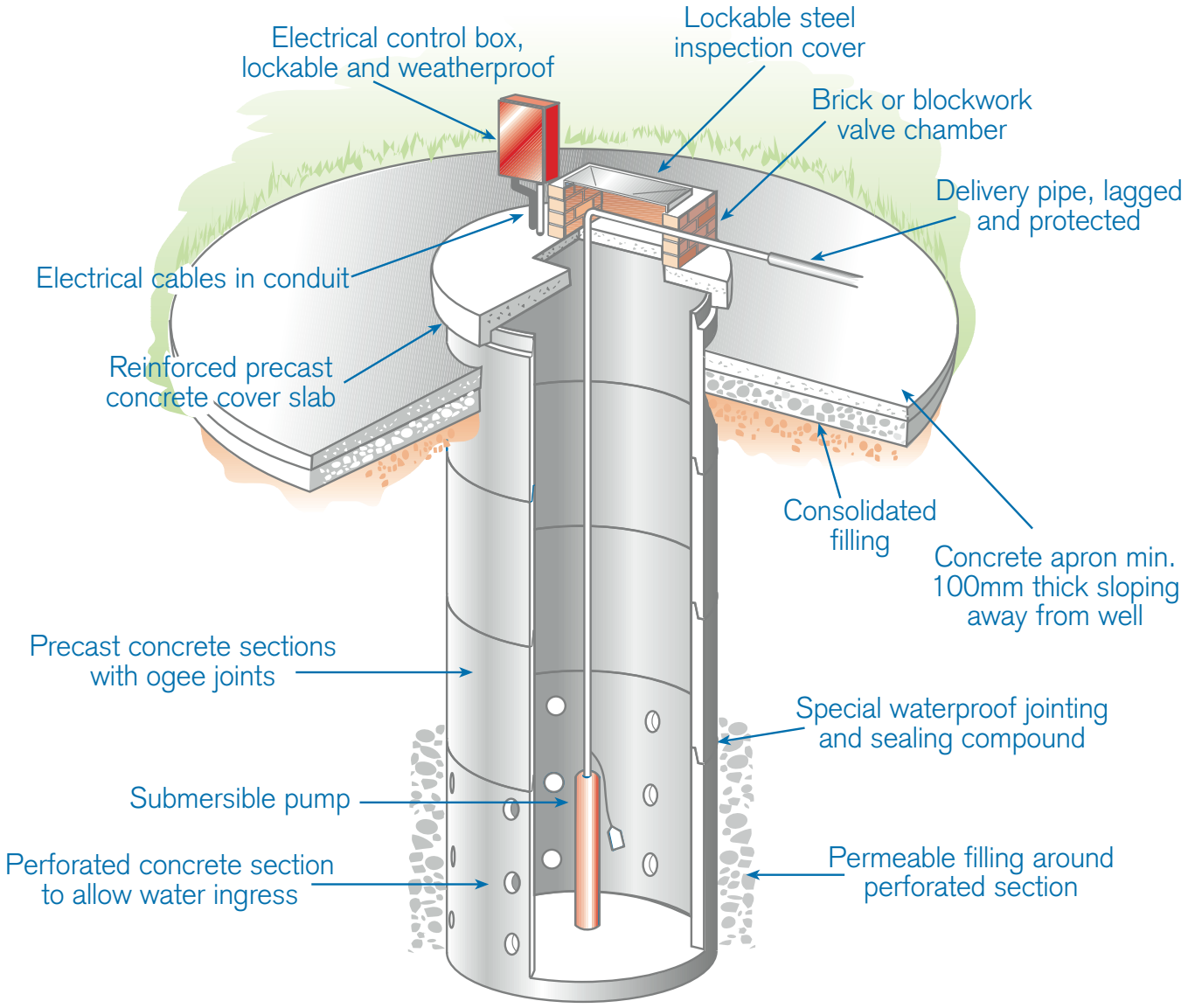


Figure 3.12 Well and pump installation – typical arrangement

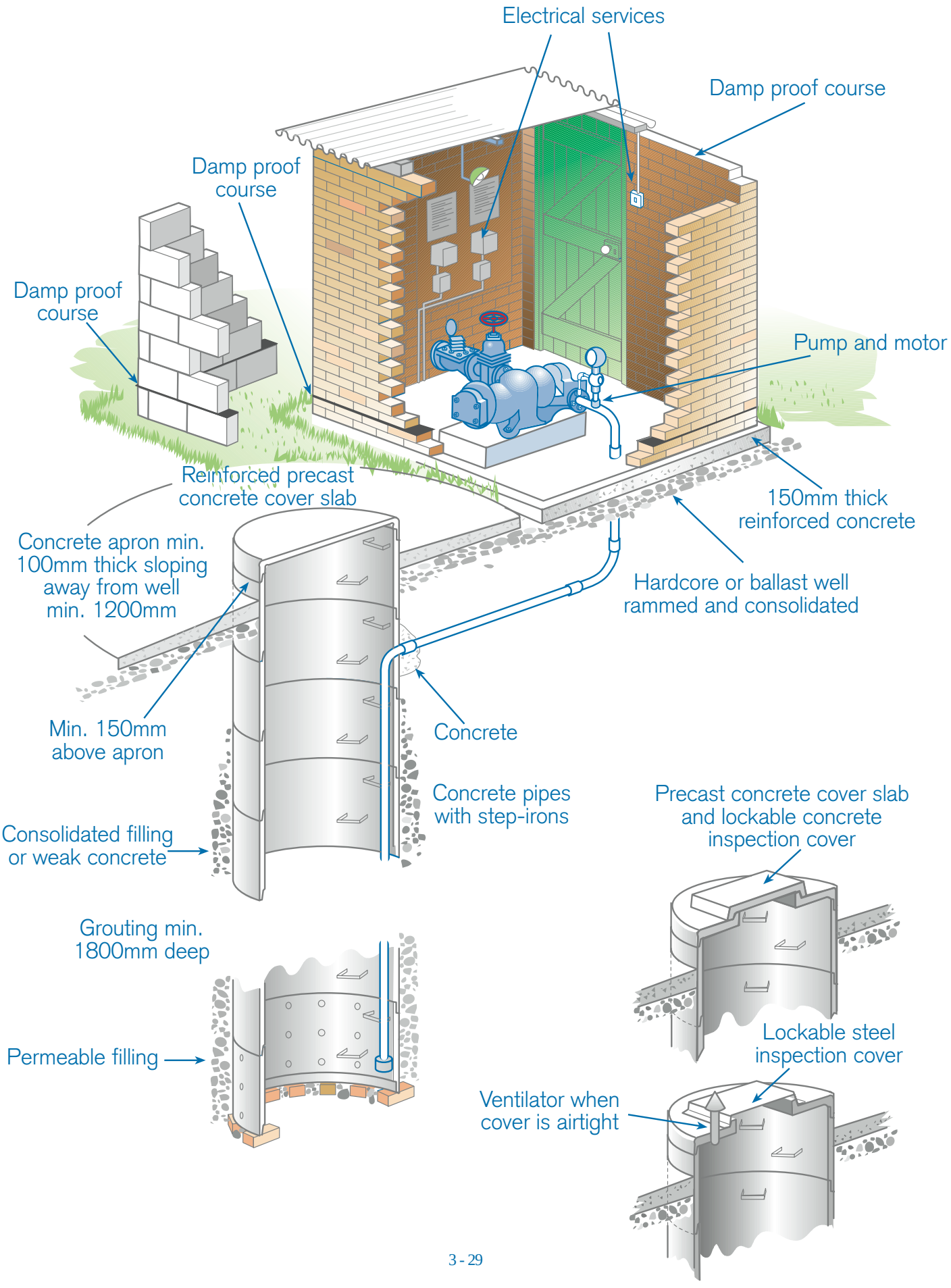


Figure 3.13 Borehole headworks

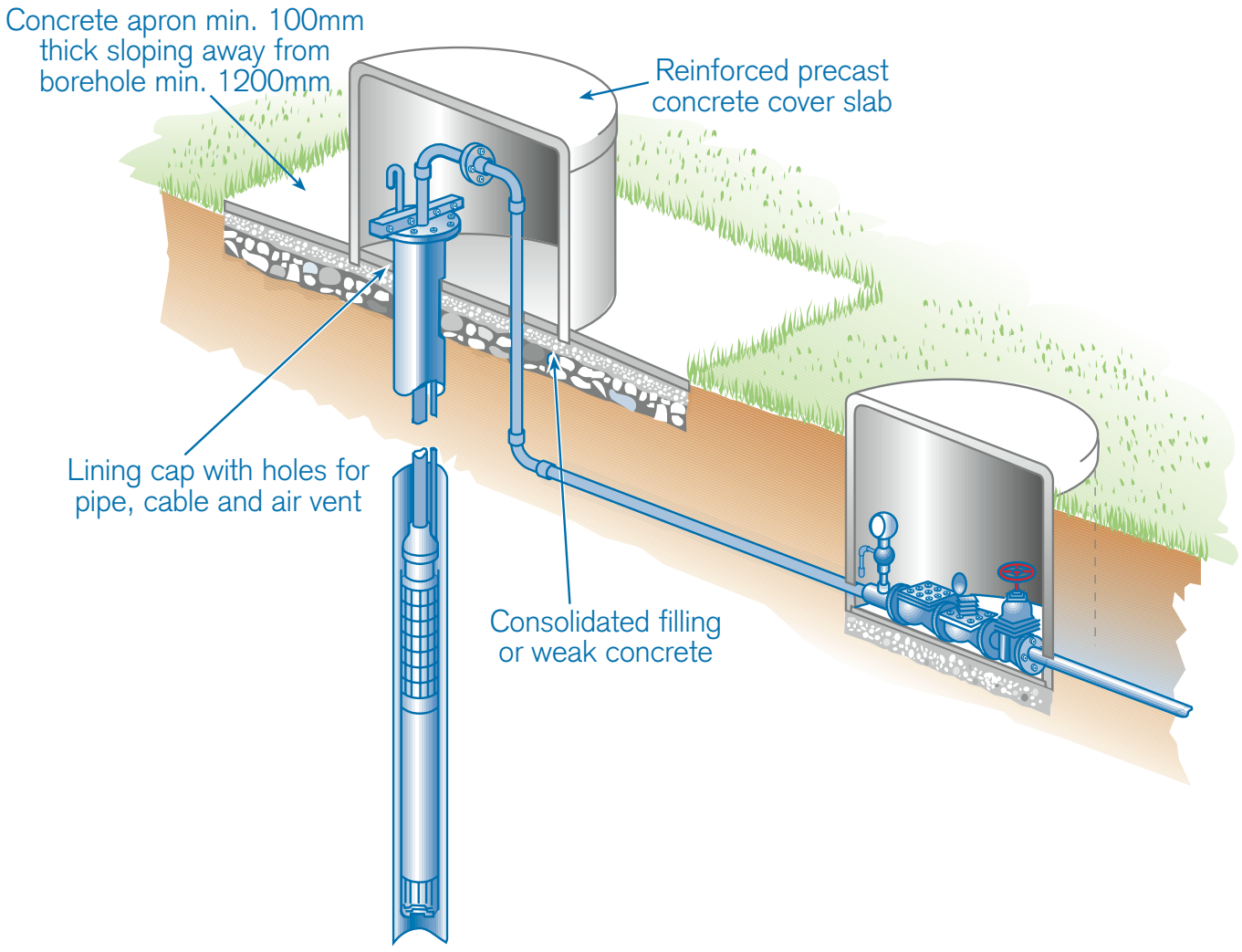


Figure 3.13 Borehole headworks (cont'd)