7. Typical Scenarios

7.1 Introduction

This Section presents seven scenarios which are broadly representative of the majority of emergency water and sanitation situations faced by relief personnel. It also indicates the particular considerations that need to be taken into account in these situations.

The principal benefit of such an approach is that information can be conveyed in a way which is more accessible to non-specialists than would be possible using a more generalised approach. However, there are drawbacks to the approach and it is important that readers should be aware of them. First, a few 'typical' scenarios cannot cover all possible types of situation likely to be faced by field staff. Second, scenarios which are typical are not necessarily mutually exclusive. However, it is hoped that readers may be able to find information relevant to their own circumstances which will help them to participate in discussions on the design and implementation of emergency water and sanitation programmes.

7.2 Population displacement into arid areas

Water Characteristics. Arid regions often pose the greatest difficulty for emergency water supply to displaced populations, for by definition the areas are dry. The long-term options are either to move the camp closer to a reliable water source or to develop an independent water source close to the camp. Both are likely to be slow processes. The short-term options may include bringing the water to the camp by lorry (water tankering) and maximising the use of local sources found in the area.

Section 5.2, under the heading *Creating New Sources*, discussed the technical complexities associated with developing a borehole supply. Nevertheless, borehole sources can and, all around the world, do provide good quality and reliable quantities of water in emergency situations. However, some other issues arise from the use of boreholes, which can be particularly important for the resident population. An illustration from the Twareg refugee programme in Mauritania in 1992 illustrates this point very well (see Box 10).

Box 10

Borehole Sources in Mauritania

In a very arid area the only option for supplying water to the refugees was from deep boreholes. The boreholes were 125m deep. Near to Fassala Nere camp, there were some traditional hand-dug wells of 60m depth, which were used by the local population. Within a few months of the boreholes being operational, locals within a few kilometres radius of them started to complain about their wells drying up. This was almost certainly as a direct consequence of the rate of borehole extraction. In such instances, the volume of water being drawn from the aquifer is greater than the rate at which it is recharging. This inevitably leads to the water level dropping. Hence, the local wells were drying up. The only thing that can be done to the wells is to deepen them. At 60m below ground level, this is a complicated task

Establishing a high volume water source in an arid area can also interfere with local agricultural systems and cultural practices. Again in Mauritania, local nomadic practices were interrupted by the borehole water. The opportunity of reliable volumes of water all the year round acted like a magnet drawing large herds of livestock to the area. This had disastrous effects on the vegetation. Animals were grazing the same area for prolonged periods and, whereas previously, grasses would be grazed to ground level, roots were now being eaten, with direct consequences on soil erosion and stability. By relying on a single water source, people were jeopardising their future ability to sustain their traditional agricultural practices.

Sanitation characteristics. Much of the discussion in sections 6.1 AND 6.2 will be relevant here. From the point of view of sanitation, arid areas are well suited as space is not usually such a limiting factor and hot, dry climates are naturally better at inhibiting the transmission of faecal-oral diseases when open defecation habits are practised. Unless the soils are rocky and/or shallow, the scope for digging pit latrines is also good. If it is a desert environment, it is probable that construction materials such as wood, sand, gravel and cement will be in short supply. Reliable sources for the supply of these materials will need to be found.

7.3 Population displacement into hilly or mountainous areas

Water characteristics. Very often in mountainous or hilly terrain the issue is not so much where the water is to come from, but how to get it to the population. As always, it is very important to consider the proximity of water when choosing a camp site.

Water is usually found in the valley bottom in the form of a river, lake or as groundwater. Sometimes it will surface through a spring-line, i.e. above ground level where it is forced out of the hill side because an impermeable layer prevents further downward flow. If luck is on your side, a spring-line may exist above the level of the camp site. This will allow the water to flow by gravity through pipes to the camp. However, such a situation should by no means be taken for granted and every effort should be made to identify a reliable water source before the site is chosen.

If a hilly area is populated, it is the valley bottoms that will be either cultivated or inhabited. In either case, there will be enormous competition for land, and it is unlikely that land for a camp site will be able to be negotiated with the local inhabitants. This will dictate that the site is either on the slopes of the hill or at the top. Its exact location will depend on the slope, which is important because if it is very steep people will not be able to live there, and access for agency vehicles might be difficult.

When people are living at a significant height above a water source the agency is faced with a major decision: should it pump the water up to the people or ask the people to walk down to the water? Before making this decision, what is entailed in taking water to the camp should be clearly understood, as significant pumping will be required. It is not impossible to pump water to considerable heights but the system is difficult and expensive, and it does take a long time to install. The running costs are also high and generous budgets should be allowed for this.

On the other hand, asking people to walk long distances down steep slopes to collect their water is also far from ideal. The extent to which this can be expected of them will depend upon how they usually collect their water. If they are from a region where they normally walk downhill for their water, this will be nothing new to them; if they are not, then problems will be encountered when trying to persuade them to collect sufficient water on a daily basis.

If people are being asked to collect their water from difficult access points, it is more important than in other situations to ensure that they have adequate means of transporting it. The emphasis is always on increasing the amount of water used and so, if people are to walk long distances for their water, it should be worth their while. In the same way, means should be made available for storing water within the shelter so that there is always the opportunity to have one vessel available just for transporting water, whilst another is used for storage. This usually means providing jerry cans and they may not be readily available in the particular country or region. Local alternatives, such as clay pots, will be in use and may be available on a reasonably large scale. Narrow-necked containers are preferred as they help prevent the ingress of air- or hand-borne contamination.

Obviously the decision about pumping water a long way uphill will be influenced by a number of factors, including the predicted length of stay and the number of camps being considered. In Rwanda, for example, during the Burundese refugee influx in October 1993, there were up to 30 camps needing water. Funding for this was limited and would not have met the full cost of

Box 11

The Central African states of Rwanda and Burundi have a topography and population densities which typify all that is difficult about providing water to displaced and resident populations in hilly conditions. Since February 1993 and until the outbreak of civil war in April 1994, a great deal of effort has been devoted to providing water to hundreds of thousands of internally displaced and refugee populations in Rwanda. There is virtually no free land available for displaced persons' camps in the most densely populated country in Africa. The problem was always how to get water to the people and almost always the answer was to provide better collection and distribution points close to the spring site, whilst encouraging increased use and collection of water. Important in this context is the role of hygiene awareness amongst the population. There needs to be a valid reason in their own minds as to why they are being asked to expend huge amounts of time and energy collecting more water than they may have been used to.

pumping water into all the camps. This gives rise to another question. If there are large numbers of people and providing water is going to be a problem, is it better to leave people in small settlements near to water sources such as springs, or to gather them into a large camp where substantial expenditure on a water system can be justified? If small settlements are preferred, this may mean that the provision of other services such as health care may be more complicated than in a large camp, but note should be taken of the fact that people have to collect water daily and the effort required to do this should, where possible, be kept to the minimum.

Sanitation issues relate to the slope of the ground and the influence latrine siting can have on water quality, and also the depth of soil.

Digging a hole for a pit latrine can be a more complicated procedure on a slope than on flat ground. The ground needs to be levelled off so that a squatting plate can be installed, and care must be taken to ensure that the risk of pit collapse is minimal; good drainage around the latrine structure is also essential. Water must be diverted away from the pit, not only to prevent pit collapse, but also to ensure that rainwater does not prematurely fill the pit and cause it to overflow.

The depth of the soil is another important factor. The sides and tops of hills often have very little soil cover. This will cause problems, as it will not be possible to dig sufficiently deep pits. Alternative sites can be identified, but other local constraints may limit the possibilities. In this case, engineering solutions need to be explored. The most readily achievable solution will probably be to dig the pit as deep as possible and then to add extra storage capacity by extending the structure above ground level. In other words to create a sealed chamber above ground level. Another option might be the regular emptying of shallow pits – known as desludging – and transportation of the material to other disposal sites.

If defecation areas are to be used during the first stages of the camp's development, consideration must be given to the relationship of the areas to the camp and water source. If a defecation area is sited above a camp, when it rains all the faecal matter will be washed into the camp. Similarly, if an area is above an open water source, such as a river or lake, the excreta will be washed directly into the water that people are collecting for domestic use. This will severely affect the health status within the camp. During the Burundese refugee influx into Rwanda in 1993, at the very early stages of the development of one camp, open defecation was the practice both inside and around the camp. The camp was on a very steep slope. The only water source nearby was a marshy area immediately below the camp, which in itself offered a poor and polluted source of water. The rainy season had just started and every time it rained, excreta were washed directly into the marsh. This camp was to have the highest incidence of dysentery amongst all the refugee camps.

Care must also be taken when siting latrines if the camp is above a spring or springs which are being used for the provision of water. Just as excreta can be washed down a hill and into an open source, so they can move through the soil and into spring water. Exactly how water will move below ground level in any given area is very difficult to predict. However, to minimise the risk of contamination, the maximum possible distance should be maintained between the latrines and the spring. It is difficult to be more specific than this. Text books always say that latrines should not be sited uphill of a water source and should be at a minimum linear distance of 30m. This allows a margin for natural sub-surface filtration and bacteriological activity to act on the liquid from the latrine.

7.4 Population displacement into areas of abundant surface water

Water Characteristics. Surface water sources can offer good scope for supplying large quantities of water of acceptable quality very quickly. However, it needs to be recognised that introducing a technology aimed at treating a surface water source will make the system fragile, vulnerable to disruption and reliant upon expensive chemicals. It is highly improbable that a community will be able to sustain a water supply from such a source once the emergency is over or after the relief agencies have left the area. As such, notions of providing a resident population with a water supply after the emergency has ended are unrealistic. If local conditions allow, it may be appropriate to look at the options for a two- or even three-phase water supply programme.

The first phase may be tankering water from a good quality source. This can be done, whilst second-phase surface water installations are being developed closer to the camp or settlement. The third phase might involve developing alternative sources such as hand-dug wells or tubewells for a long-term water supply. The ability to move on to the third phase will be totally dependent upon the nature of the soil and the groundwater in the area.

If water is to be drawn from a river, it is very important that it is drawn upstream of the nearest centre of population. This will reduce the chance of high levels of human contamination in the raw water.

The methods discussed above can apply equally to lake water. In Burundi water from lake and marsh sources is currently supplying refugees and returnees.

As discussed in Section 5.2 under *Treatment*, infiltration galleries can be very effective at cleaning a turbid lake or river source. However, this is a time-consuming operation and caution needs to be used when planning the exercise, as experience in Rwanda in 1993 illustrated. It was only after the work had been completed and water was flowing into the collection gallery that it was realised that the gravel which had been used as the filtering medium had a very high iron content and was affecting the taste of the water, making it unpalatable. This was not crucial at the time as there were alternative sources of water available to the camp of 80,000 people and the fall-back option was to flocculate the river water. As stated earlier, experimentation should be encouraged.

Box 12

Slow Sand Filtration (SSF) was used on the Rohinga refugee programme during 1992 in Bangladesh, where its use was of particular interest because the normal method of water supply in the region was via tubewells. The geology around the Dumdumia camps prohibited tubewells and so alternative surface water sources had to be used. SSF provided water to one of the camps whilst sedimentation and flocculation of water drawn from behind a purpose-built dam supplied another camp. The dam was constructed to capture the flow of a small stream and additional flood waters and illustrates how the maximum use can be derived from a small flow of water if the surrounding topography permits.

Water supply systems will always require maintenance and therefore management. The more complicated a system is, the more management it will require. Treating surface waters is a complicated means of providing water and demands considerable managerial and logistical support. This must be recognised before responsibility for the construction and operation of such a system is accepted. Efforts should be made to standardise the equipment. For example, if diesel-powered centrifugal pumps are being used, the type and specification should be standardised as much as possible across the programme. This will assist with maintenance programmes as central workshops can be established for a number of camps, and when ordering spare parts. A record should be kept of engine and pump serial numbers to help with spares orders, and a record of each pump's service history will assist when planning replacements. Whenever possible, the preference should always be to standardise on equipment that is installed and available locally. This may mean that equipment which was initially imported for the emergency will be replaced by local purchases.

Box 13

An extreme example of the problems created by a high watertable dictated a very complicated latrine design for the Bhutanese refugee camps in South-Eastern Nepal. In a number of the camps the watertable was less than 1m below groundlevel during the wet season. Latrines were to be provided at a ratio of 1 latrine for every two families. Space was limited in the camps and so it was not possible to gain the required storage capacity by making wide shallow pits. One suggestion was to install a piped sewage system which would deliver waste to treatment ponds, but this was considered inappropriate in the circumstances.

The solution adopted was to provide fully lined twin-pit latrines. Each of the two pits under every latrine was designed to contain storage capacity for the number of users adequate for one year's use. The principle was to use one pit for a year, seal it over and use the other the next year. During the time when the first pit was sealed, the sludge was to be rendered safe for handling and at the end of the second year was to be emptied; the first pit was then reused for the third year and so on, in theory indefinitely. In order to provide the capacity for one year's storage whilst keeping the pit out of the watertable, it was necessary to raise the pit lining above ground level. This is the key to gaining additional storage capacity for pit latrines when either high watertables or shallow soils limit the depth to which the pit can be dug.

Sanitation Characteristics. In areas where surface water is prolific, the position of the watertable below ground level is of special relevance. If the watertable is close to the surface, work on a sanitation programme may have to pay particular regard to this. Clearly if the watertable is 4m below ground level, digging pits for pit latrines to this depth will contaminate the groundwater; this must be avoided. As a guideline figure, 1.5m between the bottom of the pit and the highest level of the watertable should be sufficient to prevent contamination of the groundwater in fine soils. These limitations will reduce the storage capacity of the pit and hence its design life. This in turn may have implications for the design of latrine to be used, as consideration may need to be given to the possibility of resiting latrines or regular desludging because of lack of capacity.

7.5 Population displacement into existing settlements

Water Characteristics. When there is a movement of people into an existing settlement there will inevitably be an additional burden on the existing water supply. The capacity of the system to cope with this demand will determine the need for assistance measures. The most obvious intervention is to look at ways of expanding the existing system or obtaining the maximum yield from it. In the case of a pumped water supply, this may simply mean increasing the hours that the pump is run. If it is a gravity flow piped system, it may be possible to consider additional storage to capture flow that is wasted. Simply providing extra collection points will have the effect of reducing waiting time, particularly during peak demand hours. If the regular supply is from wells, there may be wells in the area that have fallen into disrepair; it is not uncommon for open wells to become redundant simply because stones have fallen, or been thrown, into them. If this is the case, simply clearing the obstacles could make the well serviceable again.

If the existing system clearly cannot cope with the additional numbers of people, it will be necessary to find short- and medium-term alternatives. Tankering water can provide an immediate response, whilst medium-term options are being surveyed and installed. In the situation of an existing settlement, there is an even stronger case than elsewhere for making the emergency water system as appropriate as possible so that it can offer the resident population new opportunities once the emergency is over. Thus, for example, if a village is dependent upon wells, providing additional wells would be an appropriate and, and it is to be hoped, sustainable solution. The opportunity can be taken to