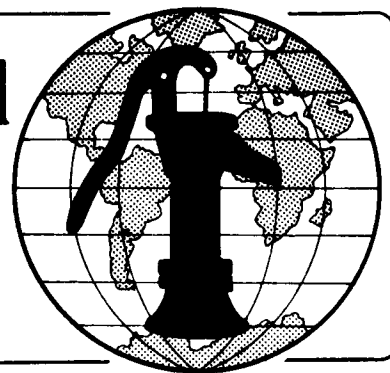


Water for the World



Conducting Sanitary Surveys to Determine Acceptable Surface Water Sources

Technical Note No. RWS. 1.P.2

A community interested in development of a community water supply may have several sources of surface water available to it. When a choice has to be made between sources, the quality of the water at the source and the quantity it produces must be considered. Methods for determining whether a surface source provides a sufficient quantity of water are discussed in "Selecting a Source of Surface Water," RWS.1.P.3. To determine water quality, a sanitary survey must be conducted.

A sanitary survey is a field evaluation of local health and environmental conditions. The goal of a sanitary survey is to detect all sources of existing and potential contamination, and to determine the suitability of the source for a community water supply. From information gathered in the survey, sources of contamination can be removed and water supplies protected. Information should be gathered through observation of local conditions, through sampling of water, and through interviews and conversations with local leaders, health officials and villagers. The following factors should be considered when doing the survey: (a) physical characteristics of the location which indicate potential contamination, (b) bacteriological quality of the water and (c) physical and chemical qualities of the water.

This technical note describes each of these factors and their importance in determining existing and potential sources of contamination of a water source. Worksheet A summarizes the questions to be answered by a sanitary survey.

Useful Definitions

ALGAE - Tiny green plants usually found floating in surface water; may form part of pond scum.

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

COLIFORM - Bacteria found in the large intestine; a coliform count is often used as an indicator of fecal contamination in water supplies.

E. COLI - A type of coliform bacteria present in the intestine of man and animals, the presence of which in water in sufficient quantity indicates fecal contamination.

FECAL BACTERIA - Organisms in human and animal waste associated with disease.

FILTRATION - Process by which bacteria are removed from water as it flows through tight soil or fine sand.

FISSURE - A narrow, deep crack in rock.

LIMESTONE - A white rock consisting of mostly calcium carbonate.

SCUM - Floating impurities found on top of liquids or bodies of water.

Worksheet A. Questions to be Answered by a Sanitary Survey

- | | | |
|--|-------|-------|
| 1. Do potential sources of surface contamination exist | Yes | No |
| a) above the site or in the watershed? | _____ | _____ |
| b) at the site? | _____ | _____ |

If yes, determine these sources and

- a) remove sources of contamination, and/or
- b) protect the water supply, or
- c) find a more acceptable water supply.

- | | | |
|--|-------|-------|
| 2. Do potential sources of fecal contamination exist | Yes | No |
| a) above the site or on the watershed? | _____ | _____ |
| b) at the site? | _____ | _____ |

If yes, determine these sources and

- a) analyze the water, or
- b) remove sources of contamination.

If level of coliform bacteria greater than 10 organisms per 100ml of water,

- a) water must be treated or
- b) alternative source must be found.

- | | | |
|--|-------|-------|
| 3. Does the water source have unacceptable chemical or physical qualities such as: | Yes | No |
| a) color? | _____ | _____ |
| b) turbidity (1) all the time? | _____ | _____ |
| (2) after a rainstorm? | _____ | _____ |
| c) unpleasant odor? | _____ | _____ |
| d) a lot of salt? | _____ | _____ |
| e) excessive algae? | _____ | _____ |
| f) excessive flourides? | _____ | _____ |
| g) hardness? | _____ | _____ |

If the answer is YES to any of these questions, study the water source carefully and analyze the water if possible. Generally, these conditions will make water unacceptable to the users and the source must either be treated or abandoned for a new one.

Physical Characteristics of the Location

Physical characteristics that contribute to the contamination of surface water can be recognized through a sanitary survey. To determine if a source is acceptable, a thorough study of the site and nearby areas must be done. If conditions indicate that contamination is likely, the water source should be tested to see if treatment is necessary. (See "Determining the Need for Water Treatment," RWS.3.P.1). Contaminants must either be removed or the water supply protected against them. If protection or removal is impossible, a more suitable source should be found. Physical conditions contributing to contamination of different types of surface sources are discussed below.

Springs. Springs can provide a very good source of water for a community supply. Generally, water from springs can be used without treatment if the source is adequately protected with a spring box. Not all water from springs is free from contamination. A sanitary survey of the spring site will help determine whether contamination is likely.

The first step in a sanitary survey of a spring site is to determine the physical conditions above the point where the water flows from the ground. If there are large openings or fissures in the bedrock above the spring, contamination of the spring from surface runoff may occur. Surface runoff enters the ground through the fissures and contaminates the spring water underground.

Find the true source of the spring. Many times, a small stream disappears into the ground through a fissure and emerges again at a lower elevation. What appears to be a spring actually may be surface water that has flowed underground for a short distance. The water is generally contaminated and may flow only during the wet season.

Determine if there are sources of potential fecal contamination. Livestock areas, septic tanks and other sewage disposal sites are sources of contamination. If they are located

above the source or closer than 100m to it, contamination may occur and disease-causing bacteria can enter the water.

The second step in a sanitary survey is to study the area at the spring site. The type of soil may indicate that contamination is likely. Filtration may be poor if permeable soil deeper than 3m is within 15m of the spring. Water passes quickly through coarse soils and impurities are not filtered out. If this condition exists, or if there is any suspicion of contamination, a water analysis must be done.

A spring flowing from limestone or highly fractured rock may be subject to contamination. Earth movements create fissures and cracks in limestone allowing surface run-off to enter the ground rapidly with little or no filtration of impurities. If a spring flows from a limestone bed, check the water after a heavy rain. If it appears turbid, suspect surface contamination and either analyze the water or choose a better site.

Community members must always be consulted during a sanitary survey. Information from local people should be added to the information collected through observation. They will know about spring yields and reliability and about other local conditions.

Ponds and Lakes. A study of the characteristics of the watershed must be done to determine whether there are potential sources of contamination of pond and lake water. The watershed is the area within which rainfall flows over the surface of the ground into rivers, streams, ponds and lakes. An acceptable watershed must be free from human and animal wastes. An area that has latrines, septic tanks or animals is not appropriate for a watershed feeding a drinking water supply. Such an area is a source of fecal contamination which may make water unsafe to drink. A study of the watershed should also determine that there are no contaminated streams entering ponds to be used as water sources. A contaminated stream flowing in the watershed could lead into the water supply and make the water unfit for drinking.

The watershed should not support farming. On some farms, pesticides and chemical fertilizers are used to increase crop production. Rainfall carries these elements from the fields into the water source and contaminates it. Find out if fertilizers and pesticides are used on farms in the watershed area before choosing the water source. If a watershed has farms that use fertilizers and pesticides, the water source fed by it will most likely be unsuitable without treatment. If there are farms, erosion is likely to occur. The soil that enters the pond or lake will settle to the bottom and may cause it to fill up rapidly. This reduces the amount of water available to the users and limits the life of the pond. A better site should be chosen or trees and grass should be planted in the watershed to prevent soil from entering the water supply.

Heavy growths of algae in water may indicate of possible contamination. Algae grow in water with a high concentration of organic material nitrates and phosphates. Water supporting excessive algal growth should not be used as a water source until its quality is determined.

Rivers and Streams. Like ponds and lakes, the quality of water in rivers and streams is dependent on the characteristics of the watershed. The major difference is that stream and river watersheds are more extensive and much more difficult to control. Above a river intake, the watershed may support sewage disposal, animal grazing and farming. People may use the river for laundry and bathing. Such practices will adversely affect the water quality downstream. Where an intake is located below an inhabited area, the water quality should not be trusted. Only where an intake is located above inhabited areas can efficient watershed management take place. If possible sources of contamination exist upstream, then treatment will be necessary.

Roof Catchments. A sanitary survey can indicate potential sources of contamination in catchment systems. The first step in the sanitary survey is to determine the roofing material available. Tile and corrugated metal make the best collectors for drinking water. Water from thatched, tarred or lead roofs is likely to be very contaminated and very dirty. Catchment systems should not be installed where houses have roofs made from these materials. Find out if a suitable cistern is available. The cistern should be clean and covered to protect the water quality.

Bacteriological Quality of Water

An untreated water source should be as free from bacteriological contamination as possible. The greatest and most widespread source of such contamination is human and animal wastes, which is called fecal contamination. A sanitary survey determines the degree to which water sources may be subject to fecal contamination. To find out if water contains fecal bacteria, it is necessary to take a water sample and have it analyzed. (See "Taking A Water Sample," RWS.3.P.2; "Analyzing a Water Sample," RWS.3.P.3; and "Determining the Need for Water Treatment," RWS.3.P.1).

Most fecal bacteria are members of a group called coliforms which include the organism E. Coli. The presence of E. Coli and other coliforms in water are indicators of fecal contamination. For an untreated water source to be acceptable, the level of fecal contamination must be low. The level of fecal contamination can only be determined by a laboratory analysis. The technical note "Analyzing a Water Sample," RWS.3.P.3, describes standards for acceptable amounts of coliforms in water and explains methods for testing water. Generally, standards are no more than three coliform organisms in a 100ml sample for piped systems and no more than 10 organisms in a 100ml

sample for nonpiped systems. Any source having over 10 coliform organisms per 100ml should be abandoned or the water treated.

Equipment for testing water may not be available and water analysis may be impossible. If so, observation can reveal characteristics that indicate bacteriological contamination. If there is a layer of scum on the water surface, suspect contamination. If excessive algae are growing in a pond or lake, there are organic impurities which may indicate the presence of fecal matter in the water. Speak to local health officials and village leaders to find out if there is a large number of cases of diarrheal illnesses. Many cases of diarrhea, especially among young children, may be an indication of contamination in the water source.

By simple measures such as removing obvious sources of contamination from a catchment area, fecal contamination can be controlled and eliminated. If contamination is not reduced, then the water source should be considered unacceptable.

Physical and Chemical Quality of Water

The bacteriological quality of water is the most important factor in determining the acceptability of a source. Many times, though, water is bacteriologically safe, it has physical or chemical characteristics that make it unpleasant or unattractive to the users. To determine the exact physical and chemical quality of water, laboratory analysis must be done. An evaluation of physical and chemical conditions can be made by doing a sanitary survey. A thorough sanitary survey can detect turbidity, color, odors, and tastes and help determine the acceptability of the water source.

Turbidity. Turbidity is the presence of suspended material such as clay, silt, organic and inorganic

material which clouds or muddies water. Turbid water may be potable but often it is aesthetically unacceptable to users. Turbidity may also indicate contamination. A laboratory analysis should be done, if possible.

Color. Dissolved organic material from decaying vegetation and some inorganic material cause color in water. An excessive algal growth may cause some color. Color in water is generally not harmful but it is objectionable and may cause users not to drink the water. Highly colored water needs treatment.

Odors and Tastes. Odors and tastes in water come from algae, decomposing organic material, dissolved gases, salts and chemicals. These may be from domestic, agricultural or natural sources. Water that has a bad odor or a disagreeable taste will be rejected by a community for a different source.

Certain chemical properties of water can make a source unacceptable to the users. The chemical quality of water can only be determined by an analysis in a well-equipped laboratory which is unlikely to be located in a rural area. Because an analysis may be impossible, it is important in the sanitary survey to recognize some chemical qualities of water which may make users reject a source.

Water that contains a high degree of calcium and magnesium carbonates is called "hard." Hard water requires a great deal of soap for cleaning and washing clothes because it does not lather. Extra soap, which is costly, must be purchased to clean with hard water. Extra time and work is involved in scrubbing with hard water. Pipes may even become clogged with deposits from the water. For basic economic reasons, people may reject hard water unless it is "softened."

Where algae are abundant, phosphates and nitrates are likely to be present.

These come from chemical fertilizer and sewage, and can be very dangerous to health. A high nitrate content in water may cause blood problems in infants being fed on reconstituted milk formulas. The babies become blue as oxygen in their blood is lost.

High concentrations of flouride in water cause dental problems. Flouride can cause teeth to become brown and mottled after several years. In severe cases, pitting occurs. If these dental problems exist, suspect high levels of flouride in the water and look for an alternative water source. Concentrations of 1-2 mg/liter of flouride are beneficial as the incidence of tooth decay is reduced by 65-70 percent.

Good quality water must be available to ensure the health of the people in a community. The bacteriological quality of water is especially important. Water used for drinking must be free from disease-causing fecal contamination. Fecal contamination can be prevented by the protection of water

sources, by the removal of sources of contamination, and by the treatment of water. A thorough sanitary survey must determine the potential sources of contamination of a water source so that measures to protect the source can be developed. If a need for treatment is apparent from the sanitary survey, a water analysis should be done (see "Determining the Need for Water Treatment," RWS.3.P.1).

The chemical and physical quality of water is important. The problem is that only some chemical and physical properties can be determined through a sanitary survey. Generally, competent laboratory testing is needed.

In many rural areas, access to a laboratory for water testing is impossible. The sanitary survey may be the only possible study of the suitability of a water source. Therefore, the survey must be thorough and must rely on very careful observation and on basic information collected from discussions with local villagers.