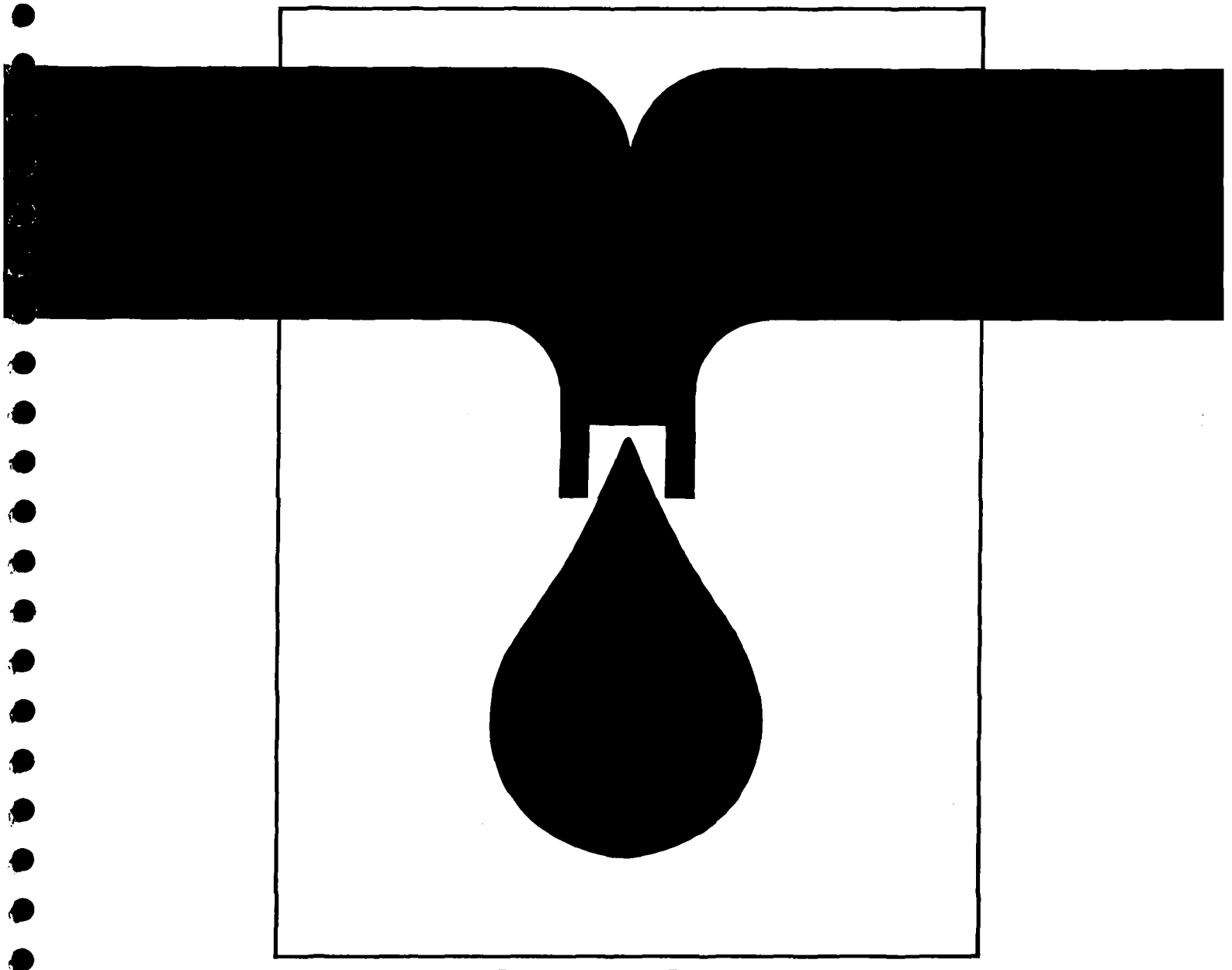
TRAINING MODULES
FOR
WATERWORKS PERSONNEL



Special Skills

3.9

Maintenance of water supply units
Inspection and action guide

Foreword

Even the greatest optimists are no longer sure that the goals of the UN "International Drinking Water Supply and Sanitation Decade", set in 1977 in Mar del Plata, can be achieved by 1990. High population growth in the Third World combined with stagnating financial and personnel resources have led to modifications to the strategies in cooperation with developing countries. A reorientation process has commenced which can be characterized by the following catchwords:

- use of appropriate, simple and – if possible – low-cost technologies,
- lowering of excessively high water-supply and disposal standards,
- priority to optimal operation and maintenance, rather than new investments,
- emphasis on institution-building and human resources development.

Our training modules are an effort to translate the last two strategies into practice. Experience has shown that a standardized training system for waterworks personnel in developing countries does not meet our partners' varying individual needs. But to prepare specific documents for each new project or compile them anew from existing materials on hand cannot be justified from the economic viewpoint. We have therefore opted for a flexible system of training modules which can be combined to suit the situation and needs of the target group in each case, and thus put existing personnel in a position to optimally maintain and operate the plant.

The modules will primarily be used as guidelines and basic training aids by GTZ staff and GTZ consultants in institution-building and operation and maintenance projects. In the medium term, however, they could be used by local instructors, trainers, plant managers and operating personnel in their daily work, as check lists and working instructions.

45 modules are presently available, each covering subject-specific knowledge and skills required in individual areas of waterworks operations, preventive maintenance and repair. Different combinations of modules will be required for classroom work, exercises, and practical application, to suit in each case the type of project, size of plant and the previous qualifications and practical experience of potential users.

Practical day-to-day use will of course generate hints on how to supplement or modify the texts. In other words: this edition is by no means a finalized version. We hope to receive your critical comments on the modules so that they can be optimized over the course of time.

Our grateful thanks are due to

Prof. Dr.-Ing. H.P. Haug
and
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for their committed coordination work and also to the following co-authors for preparing the modules:

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It is my sincere wish that these training modules will be put to successful use and will thus support world-wide efforts in improving water supply and raising living standards.

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Eschborn, May 1987

Title: Maintenance of water supply units
inspection and action guide

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MAINTENANCE OF WATER SUPPLY UNITS
INSPECTION AND ACTION GUIDE

0. Introduction

0.1 General

The terms "operation" and "maintenance" have been defined in Module 2.9. However, they are sometimes interchanged as if they were terms for the same thing. There is also some overlap in the activities. The following is intended to cover "maintenance". But certain aspects of "operation" will be included because of the overlap. "Maintenance" is used here normally to mean "Preventive Maintenance".

A maintenance programme should follow the same general procedure whether it is for a single water supply system or for several which may be situated in one or different parts of a country or province. The details of the programme and the logistics will be more involved, the greater the number of systems. Special arrangements will have to be made for the maintenance of water supply systems or units which are located in areas which are difficult to reach in the rainy season.

0.2 Urban and rural water supplies

Urban water supplies do receive better attention for their maintenance because they are in a more compact situation.

Rural water supplies are often technically simpler and relatively smaller in size. Bacause of this and the shortage of skilled manpower, the full time attention of skilled staff is neither necessary nor possible. As a result, maintenance staff will usually spend a large proportion of their time travelling. In this case, the availability of suitable vehicles is a major factor. It is also necessary to prepare a well planned and coordinated schedule for the work, in order to ensure that the time is effectively used on the job. This would mean taking spare parts which may be required at any of the weterworks to be visited as well as all necessary tools and equipment. Where possible, mobile workshops have to be used.

0.3 Presentation

The remedial and preventive actions are described in more details in the sections devoted to water tanks. It should be noted that the actions will apply analogously to other water retaining structures.

Certain components and appurtenances are common features of a number of different water supply units. The discussion of the maintenance of some typical units, does not include such common features. Instead, the maintenance of the components (such as structures, floors, walls, roofs, covers, and manhole covers) and appurtenances (such as inlet pipes, vents, ladders, valves, etx.) are discussed separately in order to avoid repetition and to save space. The same applies to drainage facilities, surrounding areas, and questions pertaining to sources of pollution/contamination.

1. Spring Protection

The overflow pipe must be cleared or repaired in order to prevent the possibility of back flow of water. It must be replaced if it does not discharge the maximum flow during the rainy season.

The screens should be checked to see if they are intact, and repaired or replaced as necessary.

The outlet pipe should be kept clear of stones, rubbish, frogs, etc.

Sediment in the silt trap and beyond (if any) should be removed promptly. In case there is sediment beyond the silt trap the cause should be investigated and removed. A report should be made and copies sent to the design and construction sections.

The chambers of spring protection systems should be inspected frequently to see whether cleaning is necessary. They should be emptied and cleaned regularly. The dry weather-flow must be determined and recorded.

The open stone wall must be checked and the necessary repairs carried out.

In the flow of water from the springs is blocked, e.g. water flows to the sides of the spring collection chamber or the filter material is washed out, the cause should be investigated and the necessary action taken.

The walls of the spring collection chamber should be checked to see if there are any cracks and whether seepage water enters; and repairs should be carried out as appropriate.

The access hole should be inspected to see whether surface water enters into the chamber. The necessary reconstruction should be carried out and/or the cover adjusted for a tight fit.

The flap of the drain pipe should be repaired, adjusted or replaced. Any frogs or other small animals should be removed from the drain pipe.

Deep cracks in the backfill must be repaired.

Plants in the very close vicinity of the spring, e.g. within 15 metres should be removed.

The surrounding area and the ground on which water is discharged from the overflow and drain pipes should be restored if they are eroded.

2. Hand Dug Wells

If solids have accumulated in the well or if the porous concrete rings are clogged the yield will be reduced. This should be checked regularly and the removal of waste build-up and the cleaning of the well must be carried out on time.

To prevent pollution, cracks in the shaft lining must be repaired, seepage-, surface- und split water must be prevented from entering the well.

A check should be made to determine if the well dries during or at the end of the dry period. The cause must be investigated. In case there are caison tubes which are left projecting into the main lining they should be lowered and the well deepened.

If the concrete in the shaft lining, the head wall, the cover, or the drainage apron is spalled it should be repaired.

The shaft lining, the head wall or the cover should be repaired where any reinforcement is exposed.

The well and its surroundings must be inspected to assess whether any improvements are necessary. If so, action should be taken following the guidelines given in Module 2.8 on the construction of hand dug wells and the improvement of existing wells. For example, if the well requires deepening and no caison tubes have been placed in advance for this eventuality, the maintenance (or construction) team should build and put caison tubes.

Open wells should be improved. However, until such time that this has been carried out any open well should be cleaned once a year in the dry season when the water level is low, and disinfected before being put into use again. This enables the clearance of rubbish, windblown dust or even dead animals which, apart from polluting the water, will reduce the yield and depth of the well or even block it up.

3. River Intake

The intake opening and screens must be kept free of vegetation or other matter which reduces the flow. If there is a weir and siltation is building up the silt should be removed. The frequency depends on the season and the nature of the river. In severe cases it would be necessary to construct a silt trap which should be cleaned regularly.

The banks and the bed of the river adjacent to the intake structure must be inspected after each flood and repaired as soon as possible if they are eroded or show signs of erosion.

The intake structure must be checked to see if it is intact, and repaired or reconstructed as necessary.

4. Impounding Reservoir (e.g. Earth Dam)

Burrows can create flow passages for the surface run-off and/or the impounded water. This will lead to slides thereby damaging the dam. Appropiate action should be taken to drive away burrowing animals.

The downstream face of the earth dam must be protected from erosion. Particular attention should be given to planting grass on footpaths.

The drains should work properly. If there are any unusual variations in the quantity of water discharged from the drainage system during the rainy season, if there are any signs of subsidence, if water appears in the "wrong" places, if there is increased flow from the drains or if there are signs of "springs" in places where none previously existed, the causes should be investigated and remedial actions taken.

In order to prevent or minimize insect breeding, the grass on the earth dam should be cut or trimmed at regular intervals.

The roots of trees and shrubs can cause fissures and cracks. They can also create flow passages and conceal leakages since they take up the water. Therefore, they should be removed and the ground made good after. If there are any fissures or cracks, the dam should be restored to avoid further damage.

The overflow weir should always be clear of debris and/or vegetation. This should be checked regularly and any obstructions must be removed promptly. The discharge ends of channels located near the downstream toe of the dam must be kept clear of obstructions. Any erosion at these points must be repaired as soon as possible.

Any vegetation growing at the edges of the reservoir area and in areas exposed by rapidly falling water levels should be cut and removed in order to discourage mosquito breeding. Weeds should be removed since they can provide suitable conditions for snails which transmit schistosomiasis. If the presence of such parasites is known or suspected, actions - including information to appropriate authorities - should be taken for ensuring protective measures for the workmen.

Cattle should be kept away from the reservoir area. They not only pollute the water, but they will also churn up the ground adjacent to the water where small pools can be formed which are ideal for mosquito breeding. Provision should be made for special cattle watering points away from the reservoir area. It is necessary to ensure that these watering points work properly and are used by herdsmen by making the necessary repairs and giving information through Public Relations.

5. Rainwater Catchment and Storage

The quality of rainwater is affected by the nature and the degree of maintenance of the collection surfaces and storage tanks.

For the purpose of this Module the subject is treated in four parts: Roof Catchment, Ground Catchment, Ancillary Works and Cisterns.

5.1 Roof Catchment

Before the beginning of the first rains the gutter, the downpipe and the screens must be checked to see if they are intact. They should then be cleaned, repaired or replaced as necessary.

Further the gutter should be inspected to ensure that it slopes uniformly towards the downpipe and no pools form in it. Otherwise it will be an ideal place for mosquito breeding. The gutter should be cleaned regularly, e.g. once every three months.

The screen must be kept free of leaves before the rains begin and thereafter respectively.

Before putting into operation the roof must be cleaned at the beginning of each rainy season in order to remove dust, bird droppings, etc...

5.2 Ground Catchment

Any source of pollution in the vicinity of the ground catchment must be removed, or appropriate action must be taken to prevent the pollution.

Before the beginning of the first rains the ground catchment and the troughs should be checked to see if they are intact. They should then be cleaned and repaired as necessary.

The troughs should be inspected to ensure that they slope evenly and that no pools form in them. They should be cleaned regularly, e.g. once every three months.

The ditch at the upper end of the catchment ground should be repaired if necessary and cleared of any rubbish or vegetation before each rainy season.

5.3 Ancillary Works

The diversion flap and screen must be intact and in working order. This should be checked before the first rains are due and after each rain.

At the beginning of the rains the screens must be cleaned of debris and leaves. There after they should be cleaned after each rain. Sediment in the sand trap and beyond (if any) should be removed at best immediately after the rainy season, and during the rainy season after each rain. In case sediment is found beyond the sand trap the cause should be investigated and removed. The design and construction sections ought to be informed.

5.4 Cisterns

The maintenance of cisterns is in general the same as for water tanks, or hand dug wells.

If the cistern has a filter, the filter material has to be cleaned or eventually replaced.

6. Water Tanks / Reservoirs

A reservoir could get cracks because of various causes. Therefore, a check should be made from time to time to see whether cracks have formed. The defective parts should be repaired.

The water tank, its connections and installtions must be watertight. Leaks should be detected and raepirs made to stop them.

Leaks in a reinforced concrete reservoir are detected visually if the reservoir is an elevated one. Otherwise the following method is used. The reservoir is filled up to a given level which is clearly marked. Then outlet and wash-out valves are tightly closed and kept closed during

the testing period of one or two days. An appreciable lowering of the water level indicates that the reservoir must have a leak.

A third method is used when the reservoir has under-drains. In this case the discharge through the under-drains is observed. The reservoir has a leak if the discharge is appreciable.

Any windows or openings must be blocked. All covers as well as passages of vents and pipes should be adjusted or rendered thight in order to prevent the entrance of light, surface water, rainwater, animals, dust and other impurities. Any algea should be removed.

Water tanks ought to be drained and cleaned every year and the walls disinfected with chlorine solution. The frequency depends on the characteristics of the water, the dispositions of the water tank and local conditions.

Sediment must not be allowed to accumulate in the water tank including the sump or outlet pipe. The dirt should be removed, the cause for its accumulations investigated and the necessary corrective measures taken.

The valves for the inlet, outlet, overflow, wash-out and by-pass pipes should be checked from time to time in order to determine their condition and whether they function properly.

Small animals such as rats, birds, bats, etc., should be removed. Their presence is an indication for defective vent screens or openings, which should be identified and replaced or repaired as the case may be.

The conditions and cleanliness of the entrance openings, vents, pipes, screens, etc., must be checked and the necessary repairs or replacements made.

The waste water from the overflow and/or wash-out pipe must always be drained and led to a soakaway. If this is not the case, the necessary facilities should be constructed.

The level indicator should be checked to see if it is in good conditon, functions and its readings are correct. It should then be repaired, adjusted, calibrated and painted as appropriate.

Any bushes or trees in the vicinity of the water tank and on the embankment should be removed.

7. Steel Water Tanks

Steel water tanks may be elevated or slightly above ground. They should be painted regularly to prevent corrosion. At best painting should be done before corrosion begins. The frequency depends on climatic and other local conditions. Under unfavourable conditions painting every three years is reasonable.

The surfaces to be painted are dried, cleaned and smoothened after the tank is drained. All dirt, scale and rust is removed by scraping or brushing. The internal and external surfaces of the water tank are then painted using paint which contains no substances that are deterimental to health or that impart bad taste or odor to the water.

The supporting steel structure must be painted too.

Leaks are detected visually. A steel plate which is slightly larger than the hole is cut and welded on the tank to cover the hole.

8. Wellhead Chambers for Boreholes

An inspection should be made regularly with regard to: leakages from the installations inside the wellhead chamber; the entrance of surface water into the well; the water tightness of the connections on the cover flange of the wellhead, for cable, water level indicator, observation pipe and air vents; the cleanliness of the floor; the conditions of the drainage grooves and sump; and cracks in the backfill.

Causes for damages should be investigated and repairs made to make them good. Dirt should be removed and surfaces cleaned.

The watermeter should be inspected. A note should be made when it was installed and/or last checked. If the watermeter does not work it should be dismounted and replaced. The defective watermeter should then be taken to the workshop checked, repaired and calibrated, and finally stored for re-use.

9. Structures, Floors, Walls and Roofs

Structures require regular maintenance in order to minimize damage. They should be inspected to determine if there are any signs of leakages, settlements or cracks. Cracks could be in the floor, walls, roof or plaster. A check should also be made to see if the reinforcement is exposed or if there is any spalling in the concrete or plaster.

Depending on the size of the structure and the magnitude of the repairs it would be necessary to prepare brief or detailed cost estimates together with a list of the work to be done, preferably in descending order of importance.

10. Covers

The covers must be checked to find out if they have any cracks or there are any signs of entry of water through them. It should also be ascertained that they have sufficient slope.

11. Manhole Covers (Access Hole Covers)

The security of access holes should be checked regularly. If there is no manhole cover one should be provided. If it is not intact it should be repaired. Adjustments should be made to make a tight fit. A check should be made to see whether there is a locking device or not. The locking device including key or opening device should either be provided, repaired, adjusted or replaced as deemed necessary.

12. Appurtenances

Inlet pipes, outlet pipes, overflow pipes, wash-out pipes, by-pass pipes, vents, screens, valves, watermeters, level indicators, etc., should be checked regularly to see if there are any signs of corrosion, blockage, breakage or rust formation, or whether they are functioning properly or not. They should then be cleaned, repaired, adjusted, caliberated, replaced or painted as appropriate. The safety of climbing irons and ladders should be checked frequently.

Pipes and other metal work including climbing irons and ladders should be painted to prevent corrosion. At best painting should be done before corrosion begins. The frequency depends on climatic and other local conditions. The basis for a successful painting in the thorough preparation of surfaces before they are painted.

13. Drainage

Drain pipes and channels should be kept clear of debris, vegetation, rubbish or stagnant water. The slopes must be adjusted if waterpools are noticed. The soakaway must be checked and put in working condition if necessary.

14. Surrounding Areas

The backfill close to the structure should be restored if there are any deep cracks in it. Drainage and diversion ditches should be kept clear of sediment, rubbish or vegetation; the major cleaning taking place before the rainy season starts.

Grass should be planted or stones laid as appropriate on those areas and on ditches which are eroded or likely to be eroded.

If the ridge on the downhill side of the ditch is eroded or otherwise damaged it should be repaired promptly.

Grass should be trimmed and weeds removed regularly.

The fence and the gate must be kept in good condition. If the locking device ist defective it should be repaired or changed.

The conditions of the access road, its culverts and fords (if any) must be checked particularly before the beginning of the rainy season. The maintenance team should do the repairs if this is the responsibility of the water supply "agency". Otherwise the appropriate authority should be informed and the matter followed up in order to ensure that the repairs are done in time.

15. Sources of Pollution / Contamination

All other works of operation and maintenance would be in vain if there are sources of pollution/contamination in the vicinity of the unit. If this is the case a record should be made and the appropriate authorities informed accordingly. Where legal enforcement is not possible public relations and education will be necessary.

16. Inspection and Action Guide

16.1 Introduction

The composition and formulation of the questions in the "Inspection and Action Guide" covers in part points which concern "operation" or information which would be required for inventory purposes. There are also some questions which relate to general administration matters with regard to operation and maintenance. It can also be said that some of the "actions" are general and not specific.

Following the principle that it is better to put down points for consideration first and strike them out later on if they do not apply to the particular local condition, and bearing in mind the fact that such inspection questionnaires are dynamic, a number of questions have been included in the Annex which consists of 15 parts.

An attempt was made to formulate all the questions in such a way that the ANSWER, "YES" for example, meant an "ACTION" IS NECESSARY. However, it has been found out that some questions cannot be easily formulated in this manner. (A Water Supply Service, any group or person preparing such a check list can formulate the questions to meet local needs).

16.2 Purpose

The Inspection and Action Guide is intended to serve a number of purposes. It can be used for purposes of training and can serve as an example and/or a model for the preparation of Inspection and Action Guides for individual water supply services.

It is a check list and a guide at the same time. The questions have been formulated in such a way that most of them can be answered with a "YES" or a "NO".

16.3 Use

The maintenance team inspects the unit using the Inspection and Action Guide as a check list. The observation is made and the question answered immediately by putting a cross ("x") in the appropriate box "II" in one of the ANSWER columns. When all the questions have been answered in this way, the team has automatically prepared a record of the deficiencies.

The next phase of the work is the execution of the remedial measure following the ACTION GUIDE and any detailed instructions such as those given in illustrative example b) 2. of Section 16.5 of Module 3.9.

The maintenance is completed when the remedial measures have been properly executed and the corresponding report has been written immediately thereafter.

For the purpose of training, the Inspection and Action Guide can be used on actual units in the field or on case studies in the class room.

16.4 Presentation

The guide is prepared in tabular form and has seven columns.

Column 1 is the Question No...

Column 2 is the QUESTION.

Columns 3, 4, 5 and 6 are devoted to the ANSWER:

- Column 3 has the small boxes "II" which will be crossed with an "x" if the ANSWER is "NO" for the cases where this answer means remedial action is NOT necessary.
- Columns 4 has the small boxes "II" which will be crossed with an "x" if the ANSWER is "YES" for the cases where this answer means remedial action is NOT necessary.

- Column 5 has the small boxes "II" which will be crossed with an "x" if the ANSWER is "NO" for the cases where this answer means remedial action IS necessary.
- Column 6 has the small boxes "II" which will be crossed with an "x" if the ANSWER is "YES" for the cases where this answer means remedial action IS necessary.

Column 5 and 6 are dark. All concerned will know that if the "cross" of the answer to the question is in the box "II" inside one of the dark columns, then remedial action will be necessary.

Column 7 gives the code of the remedial action. (The meanings of the letters and symbols used for this are given in Annex 3.9/00 "OBJECT: CODES FOR ACTIONS".)

16.5 Illustrative Examples

Two questions from Annex 3.9/01 "Object: 1. Spring Protection" (Questions Nos. 19 and 27) are used to illustrate the use of the Inspection and Action guide.

a) Question No. 19: "Does the outlet pipe have a screen?"

1. Answer = "NO"
   - the box "II" in the dark column 5 is crossed
   - remedial action IS necessary
   - code for action = M
     M = provide
   - Deficiency: The outlet pipe of the spring protection does not have a screen.
   - Remedial Action: Provide (install) a suitable screen.

2. Answer = "YES"
   - the box "II" in column 4 is crossed
   - remedial action is NOT necessary

b) Question No. 27: "Is there silt beyond the silt trap?"

1. Answer = "NO"
   - the box "II" in column 3 is crossed
   - remedial action is NOT necessary

2. Answer = "YES"
   - the box "II" in the dark column 6 is crossed
   - remedial action IS necessary
   - code for action = A + B + L; N + P; R + S; ?
     A = remove
     + = and
     B = clean
     + = and
     L = disinfect
     ; = separate action
     N = investigate cause
     + = and
     P = make good
     ; = separate action
     R = make a special record
     + = and
     S = write a special report
     ; = separate action
     ? = ask for advice
   - Deficiency: There is silt beyond the silt trap
   - Remedial Actions:
     ° remove the silt and clean, and disinfect before putting into operation;
     ° investigate the cause of silt accumulation beyond the silt trap, and take appropriate action to remove the cause;
     ° make a special record to see if this will recur, for example;
     ° make a special report, copies of which should be sent to the design and construction sections;
     ° ask for advice in case of doubt.

16.6 Common features of water supply units

Certain components and appurtenances are common features of a number of different water supply units. The examples given in the Annex for some typical units do not include questions regarding such common features. Instead, the components (such as structures, floors, walls, roofs, covers, and manhole covers) and appurtenances are dealt with separately,

in order to avoid repetition and to save space. The same applies to drainage facilities, surrounding areas, and questions pertaining to sources of pollution/contamination.

The questions for an actual Inspection and Action Guide for a particular water supply unit shall have to deal with all components and appurtenances of each typical unit that has to be attended to.

16.7 Modification and improvement of questionnaire

It has been stated that this Inspection and Action Guide can be used as an example and/or a model for preparing similar forms which will be used for particular cases. The given questions are neither complete nor exhaustive. They are intended to cause brain storming. The user is free to delete questions which have no relevance to the particular situation, and to add others as the need arises. This applies also to questions formulated by the user himself or herself.

16.8 Modification of the Inspection and Action Guide

The Inspection and Action Guide in the form in which it is presented is more suitable for purposes of training. The "ACTION" Column (column 7) can be left blank when the sheets are used for discussion, assignment or examination purposes.In these cases the Code for Actions (Annex 3.9/00) will not be given to the trainee.

When the Inspection and Action Guide or modifications thereof are used for actual maintenance, it is advisable to fully describe the remedial actions that are necessary. In this case remedial actions such as those given in the illustrative example b) 2. above will appear in column 7. Doing this will be worthwhile in spite of the greater amount of paper which will be required.

16.9 Remedial measures

The remedial measures include repairs, removal of waste build-up, application of protective paint, cleaning, disinfection and last but not least public relations and education. The maintenance of the general appearance of the waterworks is also necessary.

Accidents can occur on any maintenance work. Therefore, consideration should first be given to safety.

16.9.0 Safety

All employees should be properly trained in accident-prevention procedures and first aid. New employees should not start work before they receive such training.

The basic step towards the saftety is to make sure that all those involved understand what can go wrong and take preventive measures and use their common sense. They should also know what to do when accidents occur. Thus standard safety measures, even where they are not explicitly or legally required, must be adopted and enforced by all concerned.

Care should be taken when entering confined chambers and wells. Such places may be entered for many years without mishap, but one day they could become a source of danger because of poisonous air. A workman should never go down into a well except on a safety line and with someone up above who is strong enough to pull him out if he is overcome by foul air. The attention of all concerned must be drawn to this.

Special safety measures must be taken in order to protect the personnel involved in disinfection work. Working men must be equiped with protective clothing during the disinfection. If the disinfectant gets in contact with the eyes, the eyes must be washed immediately with clean water. When the disinfection is completed the workman must take a shower.

16.9.1 Repairs

The word repair is used to describe patching, restoration, remaking, and reconstruction.

One of the most important repairs is the repair to stop leaks in water retaining structures.

The structure is drained. The area about the crack is chiseled: width 2 - 2.5 cm; depth 2 - 2.5 cm; length slightly longer than the crack. The chiseled hole is cleaned and wetted. While it is still wet stiff cement mortar (1 part cement 2 parts sand) is applied. The mortar is allowed to set for 28 hours.

16.9.2 Removal of waste build-up

To check the accumulation of sediment the water level is first lowered to about 20 cm above the floor. The water is stirred up. If the bottom appears dirty and there are sediments, then cleaning is necessary.

The walls, floor and ladder are brushed to remove adhering dirt. The wash-out valve is opened to drain the dirty water to waste. In order to prevent the dirt particles from settling, the water is agitated by sweeping the floor towards the outlet while it is being drained.

16.9.3 Application of protective paint

The paint should be applied according to the manufacturer's instructions. Before the painting, the surfaces to be painted have to be dried, cleaned and smoothened. All dirt, scale and rust must be removed by scraping or brushing.

16.9.4 Cleaning

The amount of work involved in cleaning the units depends on their condition and the amount of the dirt to be removed.

In case of newly constructed units the construction team that will have carried out the improvement work should remove from the structure timber remaining from the formwork including pieces of wood, all debris and clean - dry - the structure with a broom. The longer the construction period the more thorough the cleaning shall be. The operation and maintenance team should then clean the chambers with water and make it ready for the inspection that will be made to ascertain that the structure is fit to be put into operation. By virtue of the nature of their work they should be more acquainted with the requirements as far as maintenance is concerned.

The surfaces shall be hosed down with clean water. All pipes connected to the units shall be cleaned. Where hosing down is not adequate the surfaces shall have to be scrubbed.

The units must also be thoroughly cleaned (and disinfected) after each work of maintenance or repair which is concerned with the surfaces that come into contact with the water.

16.9.5 Disinfection

a) General

The different units of water supply may be contaminated by workmen and equipment during construction, surface water, rubbish or animals. Contamination is also possible during cleaning or repairs.

Therefore, the units and their appurtenances should be disinfected before they are put into operation for the first time and immediately after each repair or cleaning activity. Disinfection is carried out with chemicals, usually chlorine.

The normal dosage for the disinfection of water supply units (whether newly constructed or repaired) is 50 mg/l at a contact time of 24 hours.

The disinfection methods are the same in principle. The procedures for different units are described below.

b) Disinfection of hand dug wells

All debris should be removed. The walls should be scrubbed with chlorine solution. Then the disinfectant is poured into the well and the water pumped until the odour of chlorine appears at the wellhead. The water is re-circulated for at least one hour. Another fresh solution is poured into the well and left for at least 24 hours. Finally water is pumped to waste until the odour of chlorine disappears.

c) Disinfection of spring collection chambers and spring boxes

All debris should be removed. The chlorine solution should be prepared. The walls are scrubbed with the solution. Chlorine solution is then poured into the spring collection chamber or the spring box.

d) Disinfection of storage tanks

All debris should be removed. The walls and floor should be scrubbed and washed. The walls and floor are scrubbed with cholorine solution. The tank is then rinsed out with clean water. Finally the tank is filled with water and the disinfecting solution poured in and left for at least 24 hours. The water drained out of the storage tank should be tested. There should be a distinct residual chlorine in the water.

16.9.6 Maintenance of the general appearance of the works

The waterworks should be kept tidy. Grass should be trimmed and weeds mown. Paths should be kept clear of weeds. The appearance of the works will be improved if shrubs and trees are planted in suitable positions. But care should be taken not to concentrate on the gardening work that the water supply has to be neglected. Trees should not be planted where their roots may reach structures or underground pipes.

The pathways and the sites of the waterworks generally should be swept and kept clean.

16.9.7 Public Relations and Education

Human action can not only upset maintenance work already carried out, but it can also cause unnecessary maintenance.

The solution to this problem lies in good public relations and education which should be regarded as important components of effective maintenance.

The following are examples where it would be necessary to implement good public relations and education.

It has been stated that damages caused to structures by human beings can be due to ignorance, carelessness, or abuse.

Where protected areas are not clearly defined, trees and bushes can be planted in wrong places.

Some appurtenances can be removed or damaged.

People (including children) may use dirty vessels to draw water, throw rubbish down wells or stand on the headwalls of hand dug wells.

Cattle may enter the reservoir area. Herdsmen may not use special cattle watering points. People may create footpaths on earth dams instead of using pathways which are provided.

It is possible that the wrong material is used for roofs which are employed for rainwater catchment.

There could be sources of pollution in the vicinity of water sources.

Divisersion ditches may be damaged intentionally or by accident.

People may carry out excavations which are dangerous for the water supply unit.

16.10 Discussion of some Questions in the Inspection and Action Guide

Some questions will now be discussed. In an attempt to encourage the reader to have a good look at the Annex, the questions will not be quoted.

1. Annex 3.9/01 Question 12

   This is an example of an inventory question. Once an appropriate action has been taken, it will not be necessary to include such a question for the periodic inspection.

2. Annex 3.9/02 Question 05

   This module which deals with the maintenance of water supply units is more concerned with the physical conditions of the structures and their surroundings. However, the question is related to operation and the suggested "actions" are not of structural nature. Details for such actions are in the scope of other modules.

3. Annex 3.9/03 Questions 04

   This concerns an inspection which, for example will have to be made after floods. But, it does not do any harm if it were made part of the routine inspection which occurs more frequently.

4. Annex 3.9/04 Question 20

It has to be considered whether a maintenance team or group would be able to perform the inspection and answer the question.

5.1 Annex 3.9/05-5.1 Question 01

The occurrence of roofs made of, for example, slates or lead in most developing countries may be none or on a small scale. However, these materials are mentioned in literatures (prepared also for developing countries; advice being given on what to use and not to use). The inclusion of such a question would be useful for an inventory, future work, as well as exchange of information and experience.

5.2 Annex 3.9/05-5.2 Question 09

The trees and shrubs would help in providing protection against wind blown dust. But, whether it would be possible to plant new trees or shrubs is a question which has to be looked into taking local conditions into consideration. In general the planting of trees or shrubs has been foreseen as an eventual action.

5.3 Annex 3.9/05-5.3 Question 08

For the action the instructions "make good" and "ask for advice" are included. This has to be specified from case to case. Advice can be obtained for example from the central or local Water Supply Service or Experts assigned by a bilateral assistance. In some cases, there will be no need to ask for advice.

5.4 Annex 3.9/05-5.4 Question 02

The action includes the instruction "eventually replace". The replacement refers to the filter material.

6. Annex 3.9/06 Question 20

Among others the question is put whether there are any mosquitoes. And the action is "investigate and make good". Whether such an item will be necessary has to be considered by the particular locality.

7. Annex 3.9/07 Questions 01 and 04

These two questions ask actually for the same thing. But, such a repetition would serve as a check on the assessment and judgement of the trainee who is carrying out the inspection or work on a case study.

8. Annex 3.9/08 Question 06

This question has been formulated in such a manner that the answer "YES" would mean that it is necessary to take action. This is included here for illustration purposes. However, a question such as "Is the floor clean?" would be more appropriate, because the floor is expected to be clean and that is what we are striving for.

9. Annex 3.9/09 Question 05

Simply covering the exposed reinforcement with mortar or concrete may not be adequate, depending on the condition of the exposed reinforcement and of the structure. Therefore, it is recommended to ask for advice. In some cases, there will be no need to ask for advice.

10. Annex 3.9/10 Question 01

This question is more suited for inventory. However, there is a point in including it in cases where implementation is a problem.

11. Annex 3.9/11 Question 01

This is also a question which is more suitable for inventory. However, the cover may have been removed, for example, by unauthorized persons after it had been provided following an inventory which was taken previously. It can also happen that the manhole cover my not have been put back in its place (by an inspection, repair, or operation team) and may be lying about on the ground.

12. Annex 3.9/12 Question 04

This question appears also under the particular unit where the item is very important for the unit. In the preparation of actual check lists care should be taken to avoid duplication.

13. Annex 3.9/13 Question 05

Normally if the answer to Question 03 and Question 04 is "NO" it will be expected that the answer to Question 05 will be "YES". However, this is again formulated in such a way in order to enlighten the work of the trainee or the person carrying out the inspection.

14. Annex 3.9/14 Questions 17 to 21

These questions are included not only to serve the purposes of inspection but as an example of the logic of how a number of questions can be made to follow one another. Again, if in a particular case the necessity of such a question is doubtful it is always very easy to discard it.

15. Annex 3.9/15

The distance of "30" metres is given as an example. Therefore, it is put in paranthesis. Depending on soil and other conditions the distance should be specified by taking into account local experience and results of relevant investigations (if any).

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Object: CODES FOR ACTIONS

Letters and symbols are used on the following pages in describing the remedial "ACTION" to be taken after the INSPECTION. The following codes are used for the purpose.

A = remove; dismount
B = clean
C = repair
D = restore
e = adjust, calibrate
F = replace
G = paint
H = install
J = reconstruct
K = construct
L = disinfect
M = provide
N = investigate cause
P = make good
Q = make a note
R = make a special record
S = write a special report
T = inform Public Relations
U = inform appropriate authority
V = check, test
W = store
X = take appropriate action
Y = plant
Z = cut or trim grass

\+ = and
\- = or
/ = if necessary
? = ask for advice
! = urgent
; = seperate action
()= eventually

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INSPECTION AND ACTION GUIDE

Object: 1. SPRING PROTECTION

For the ANSWER put an "x" in the appropriate box "II"

No.	QUESTION	ANSWER NO	ANSWER YES	TAKE ACTION NO	TAKE ACTION YES	ACTION
1	2	3	4	5	6	7
01	Does the area in the vicinity of the spring chamber slope away from the chamber ?		II	II		J + E
02	Is it eroded ?	II			II	D
03	Are there any plants within 15 metres ?					
	trees	II			II	A
	bushes	II			II	A
04	Is the ground on which water is discharged from the overflow and drain pipes covered with stones ?		II	II		J - K
05	Is it eroded ?	II			II	D
06	Does the flap of the drain pipe function ?		II	II		C - E - F
07	Are there any frogs or other small animals in the drain pipe ?	II			II	A; N + P
08	Does the overflow pipe function ?		II	II		C - B
09	Does the access hole have a raised edge ?		II	II		K
10	Does surface water run into the chamber ?	II			II	N + P
11	Are there any deep surface cracks in the backfill ?	II			II	D
12	Is the top of the chamber > 30 cm II (.....cm) = 30 cm II < 30 cm II (.....cm) above the ground ?					J
13	Does seepage water enter through the walls of the spring collection chamber ?	II			II	N + P
14	Is the open stone wall intact ?		II	II		C
15	Is the flow of water from the spring blocked ?	II			II	N + P
16	Is the filter material washed out ?	II			II	N + P
17	Is there a back flow of water ?	II			II	N + P
18	Does water from the spring flow to the sides of the collection chamber ?	II			II	N + P
19	Does the outlet pipe have a screen ?		II	II		M
20	Is the screen on the outlet pipe intact ?		II	II		C - F
21	Is the outlet pipe blocked ?	II			II	A + B; N + P
	by stones ?	II			II	A + B; N + P
	by rubbish ?	II			II	A + B; N + P
	by frogs ?	II			II	A + B; N + P
22	Does the overflow pipe discharge the maximum flow during the rainy season ?		II	II		F
23	Does the overflow pipe have a screen ?		II	II		M
24	Is the screen on the overflow pipe intact ?		II	II		C - F
25	Are there any frogs, etc., in the pipe ?	II			II	A; N + P
26	Is there silt in the silt trap ?	II			II	A + B + L
27	Is there silt beyond the silt trap ?	II			II	A + B + L; N + P; R + S; ?
28	What is the dry weather flow?					
29	.....					

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Object: 2. HAND DUG WELLS

For the ANSWER put an "x" in the appropriate box "II"

No.	QUESTION	ANSWER NO	ANSWER YES	TAKE ACTION NO	TAKE ACTION YES	ACTION
1	2	3	4	5	6	7
01	Have any solids accumulated in the well ?	II			II	A + J + L
02	Are the porous concrete rings clogged ?	II			II	B + L
03	Are there any cracks in the shaft lining ?	II			II	C + L
04	Does seepage water enter the well ?	II			II	N + P
05	Does the pump work ?		II	II		C - D - E - F
06	Are dirty vessels used do draw water ?	II			II	T
07	Is rubbish thrown down the well ?	II			II	A + L + T
08	Do people stand on the headwall ?	II			II	T + K
09	Is the cover missing ?	II			II	F + (T)
10	Does surface water enter the well ?	II			II	N + P
11	Does the well dry during the dry period ?	II			II	Q + S + J + L
12	Does the well dry at the end of the dry period ?	II			II	Q + S + J + L
13	Are there any caison tubes which are left projecting into the main lining ?		II	II		K + H + L
14	Is the head wall sufficiently raised above the ground (1 metre) ?		II	II		J - K
15	Does the well have a drainage apron ?		II	II		J - K
16	If yes is its width > 2 metres II (..... m) = 2 metres II < 2 metres II (..... m)					J
17	Does the drainage apron slope away from the well in all directions?		II	II		J + E
18	What is the yield of the well ?					Q
19	Does the surrounding ground slope away from the well ?		II	II		E
20	Is the concrete spalled ?					
	in the shaft lining	II			II	C + L
	in the head wall	II			II	C + L
	in the cover	II			II	C
	in the drainage apron	II			II	C
21	Is any reinforcement exposed ?					
	in the shaft lining	II			II	? + D + L
	in the head wall	II			II	? + D + L
	in the cover	II			II	D
22	.....					
23	.....					
24	.....					

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For the ANSWER put an "x" in the appropriate box "II"

Object: 3. RIVER INTAKE

No.	QUESTION	ANSWER				ACTION
		NO	YES	NO	YES	
				TAKE ACTION		
1	2	3	4	5	6	7
01	Is there any vegetation or other matter in the intake opening ?	II			II	A
02	Is there any vegetation or other matter in the screens in the bank of the river ?	II			II	A
03	Is any siltation building up behind the weir ?	II			II	A
04	Do the banks of the river adjacent to the intake structure show any signs of erosion ?	II			II	D
05	Does the bed of the river adjacent to the intake structure show any signs of erosion ?	II			II	D
06	Is the intake structure intact ?		II	II		C - J
07	.....					
08	.....					
09	.....					

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Object: 4. IMPOUNDING RESERVOIR (e.g. Earth Dam)

For the ANSWER put an "x" in the appropriate box "II"

No.	QUESTION	ANSWER NO	ANSWER YES	TAKE ACTION NO	TAKE ACTION YES	ACTION
1	2	3	4	5	6	7
01	Are there any signs of burrowings by animals into the dam ?	II			II	A; X
02	Is the downstream face of the earth dam covered by grass ?		II	II		Y
03	Are there any footpaths worn in the grass ?	II			II	D
04	Are there any usual variations in the quantity of water discharged from the drainage system during the wet season ?	II			II	( )
05	Are there any signs of subsidence ?	II			II	( )
06	Does water appear in the "wrong" places on the dam ?	II			II	(Q + R + S; ?; N + P)
07	Is there any increased flow from the drains ?	II			II	( )
08	Are there any signs of "springs" in places where none previously existed ?	II			II	( )
09	Is the grass on the downstream face of the earth dam trimmed ?		II	II		Z
10	Are there any shrubs on the dam ?	II			II	A + P
11	Are there any trees on the dam ?	II			II	A + P
12	Are there any cracks in the dam ?	II			II	D
13	Are there any fissures in the dam ?	II			II	D
14	Is the overflow-weir clear of debris or vegetation ?		II	II		A
15	Are the discharge ends of channels located near the downstream toe of the dam free of obstruction ?		II	II		A
16	Are there any signs of erosion at these points ?	II			II	D
17	Is there any vegetation growing at the edges of the reservoir area ?	II			II	A - Z
18	Are there any areas exposed by rapidly falling water levels ?	II			II	Q + R + S; ?
19	Is there any vegetation in these areas ?	II			II	Z
20	Are there any signs of mosquitoes ?	II			II	Q + R + S; ?
21	Are there any signs of snails amongst the weeds ?	II			II	Q + R + S + T + U + X
22	Has there been a check for schistosomiasis ?		II	II		U
23	Are there any protective measures for the workmen ?		II	II		U + X!
24	Does any cattle enter the reservoir area ?	II			II	T + U
25	Is the ground adjacent to the water churned up ?	II			II	D; N + P
26	Are there any small pools of water formed in it ?	II			II	D
27	Are there any special cattle watering points away from the reservoir area ?		II	II		M
28	Do these watering points work properly ?		II	II		C - D - J
29	Are they used by herdsmen ?		II	II		T
30	.....					
31	.....					

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For the ANSWER put an "x" in the appropriate box "II"

Object: 5. RAINWATER CATCHMENT AND STORAGE / 5.1 Roof Catchment

No.	QUESTION	ANSWER				ACTION
		NO	YES	NO	YES	
				TAKE ACTION		
1	2	3	4	5	6	7
01	The roof is made of					
	tiles		II	II		Q
	slates		II	II		Q
	aluminium		II	II		Q
	corrugated iron		II	II		Q
	thatch	II			II	Q + T + U
	lead	II			II	Q + T + U
	asbestos cement	II			II	Q + T + U
	.....					
02	Is the gutter intact ?		II	II		B + C
03	Is the downpipe intact ?		II	II		B + C
04	Does the roof gutter slope uniformly towards the downpipe ?		II	II		B + E
05	Do pools form in the gutter ?	II			II	A + B + C
06	Are there any leaves on the screens ?	II			II	A + B
07	Are the screens intact ?		II	II		C - F
08	.....					
09	.....					

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Object: 5. RAINWATER CATCHMENT AND STORAGE / 5.2 Ground Catchment

For the ANSWER put an "x" in the appropriate box "II"

No.	QUESTION	ANSWER				ACTION
		NO	YES	NO	YES	
				TAKE ACTION		
1	2	3	4	5	6	7
01	Is there a source of pollution in the vicinity of the ground catchment ?	II			II	Q + T + U; X
02	Is the ground catchment intact ?		II	II		C + D
03	Is the surface impervious ?		II	II		C + D
04	Is it clean ?		II	II		B
05	Are the troughs intact ?		II	II		B + C
06	Do they slope evenly ?		II	II		B + E
07	Do pools form in the troughs ?		II	II		A + B + C
08	Is the ditch at the upper end of the catchment ground intact ?		II	II		C
09	Are there any trees shrubs around the catchment area ?		II II	II II		(Y) (Y)
10	.....					
11	.....					

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Object: 5. RAINWATER CATCHMENT AND STORAGE / 5.3 Ancillary Works

For the ANSWER put an "x" in the appropriate box "II"

No.	QUESTION	ANSWER				ACTION
		NO	YES	NO	YES	
				TAKE ACTION		
1	2	3	4	5	6	7
01	Does the diversion flap work ?		II	II		C - E
02	Are there any debris on the screen ?	II			II	A + B
03	Are there any leaves on the screen ?	II			II	A + B
04	Is the screen clogged ?	II			II	A + B
05	Is the screen intact ?		II	II		C - F
06	Is the sand trap intact ?		II	II		C
07	Is there sediment in the sand trap ?	II			II	A + B
08	Is there sediment beyond the sand trap ?	II			II	A + B; ? - N + P
09	.....					
10	.....					

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Object: 5. RAINWATER CATCHMENT AND STORAGE / 5.4 Cisterns

For the ANSWER put an "x" in the appropriate box "II"

No.	QUESTION	ANSWER				ACTION
		NO	YES	NO	YES	
				TAKE ACTION		
1	2	3	4	5	6	7
01	Is there any sediment in the storage tank ?	II			II	A + B + L
02	Is the filter clean ?		II	II		B + (F)
03	Are the covers of the filter intact ?		II	II		C
04	Is there a slab on which the filter material can be cleaned ?		II	II		M
05	Is the slab intact ?		II	II		C
06	Is there adequate filter material in stock ?		II	II		M
07	.....					
08	.....					

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For the ANSWER put an "x" in the appropriate box "II"

Object: 6. WATER TANKS / RESERVOIRS

No.	QUESTION	ANSWER NO	ANSWER YES	TAKE ACTION NO	TAKE ACTION YES	ACTION
1	2	3	4	5	6	7
01	Does the reservoir have any windows ?	II			II	A + P
02	Does it have any openings ?	II			II	A + P
03	Is it tightly covered ?		II	II		E
04	Is there algae on the water ?	II			II	A + L; N + P
05	The inlet pipe is placed above the highest water level > 20 cm II (.... cm) = 20 cm II < 20 cm II (.... cm)					J
06	The outlet pipe is placed above the floor > 20 cm II (.... cm) = 20 cm II < 20 cm II (.... cm)					J
07	Is there any sediment in the water tank ?	II			II	A + B + L
08	Is the screen of the outlet pipe intact ?		II	II		C - F
09	Is there any sediment in the outlet pipe ?	II			II	A + B + L; N + P; S
10	Is the overflow pipe intact ?		II	II		C
11	Is the wash-out pipe intact ?		II	II		C
12	Is the waste water led to a soakaway ?		II	II		K
13	Is the by-pass pipe intact ?		II	II		C
14	Does the valve on the by-pass function ?		II	II		C - D - E
15	Does surface water enter at the vent ?	II			II	C - P
16	Does rainwater enter at the vent ?	II			II	C - P
17	Does a lot of dust enter through the vent ?	II			II	N + P
18	Is the screen of the vent strong enough ?		II	II		F
19	Is the screen intact ?		II	II		C
20	Are there any small animals in the tank ?	II			II	A + (B) + L; N + P
	rats	II			II	A + (B) + L; N + P
	birds	II			II	A + (B) + L; N + P
	bats	II			II	A + (B) + L; N + P
	mosquitoes	II			II	N + P
	.....	II			II	A + (B) + L; N + P
	.....	II			II	A + (B) + L; N + P
21	Are the tank, its connections and installations watertight?		II	II		C
22	Does the level indicator function ?		II	II		C - E
23	Are the readings of the level indicator correct ?		II	II		E
24	Is the sump clogged ?	II			II	A + B + L
25	Are there any bushes on the embankment ?	II			II	A + P
26	Are there any trees on the embankment ?	II			II	A + P
27	Is the waste water from the overflow pipe drained away ?		II	II		K
28	Is the waste water from the wash-out pipe drained away ?		II	II		K
29	.....					
30	.....					

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Object: 7. STEEL WATER TANKS

For the ANSWER put an "x" in the appropriate box "II"

No.	QUESTION	ANSWER				ACTION
		NO	YES	TAKE ACTION NO	TAKE ACTION YES	
1	2	3	4	5	6	7
01	Is the steel water tank rusty ?	II			II	B + G
02	Is the steel water tank corroded ?	II			II	B + C + G
03	Does it leak ?	II			II	B + C + G
04	Does it require to be painted ?	II			II	B + G
05	Is the supporting structure rusty ?	II			II	B + G
06	Does the supporting structure show any signs of corrosion	II			II	B + G
07	Is the supporting structure intact		II	II		C
08	.....					
09	.....					

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INSPECTION AND ACTION GUIDE

For the ANSWER put an "x" in the appropriate box "II"

Object: 8. WELLHEAD CHAMBERS FOR BOREHOLES

No.	QUESTION	ANSWER				ACTION
		NO	YES	NO	YES	
				TAKE ACTION		
1	2	3	4	5	6	7
01	Is there any leakage from the installations inside the wellhead chamber ?	II			II	N + P
02	Does the watermeter work ?		II	II		A + F; V + C + W
03	When was it checked ?					Q
04	Does surface water enter into the well ?	II			II	N + P
05	Are the connections, on the cover flange of the well-head, for					
	cable		II	II		N + P
	water level indicator		II	II		N + P
	observation pipe		II	II		N + P
	air vents		II	II		N + P
	water tight ?					
06	Is the floor dirty ?	II			II	B
07	Are the drainage grooves clogged ?	II			II	A + B
08	Is the sump clogged ?	II			II	A + B
09	Are there any deep cracks in the backfill ?	II			II	D
10	.....					
11	.....					

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INSPECTION AND ACTION GUIDE

For the ANSWER put an "x" in the appropriate box "II"

Object: 9. STRUCTURE, FLOOR, WALLS, AND ROOFS (COVERS)

No.	QUESTION	ANSWER NO	ANSWER YES	TAKE ACTION NO	TAKE ACTION YES	ACTION
1	2	3	4	5	6	7
01	Are there any leakages ?	II			II	N + P
02	Does the structure suffer from settlements ?	II			II	N; P; ?
03	Are there any cracks in the					
	floor	II			II	C - P + L
	walls	II			II	C - P + L
	roof (cover)	II			II	C - P + L
	plaster	II			II	C - P + L
	of the (water supply unit) ?					
04	Is the concrete spalled in the					
	floor	II			II	C - P + L
	walls	II			II	C - P + L
	roof (cover)	II			II	C - P + L
	of the (water supply unit) ?					
05	Is the reinforcement exposed in the					
	floor	II			II	?; C - P + L
	walls	II			II	?; C - P + L
	roof (cover)	II			II	?; C - P + L
	of the (water supply unit) ?					
06	Is the plaster spalled ?	II			II	C - P + L
07	.....					
08	.....					

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For the ANSWER put an "x" in the appropriate box "II"

Object: 10. COVER

No.	QUESTION	ANSWER NO	ANSWER YES	TAKE ACTION NO	TAKE ACTION YES	ACTION
1	2	3	4	5	6	7
01	Does the (water supply unit) have a cover?		II	II		M
02	Has the cover sufficient slope ?		II	II		J
03	Are there any cracks in the cover ?	II			II	C - P
04	Are there any signs of entry of water through the cover ?	II			II	N + P
05	.....					
06	.....					

MAINTENANCE OF WATER SUPPLY UNITS

ANNEX 3.9/11
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INSPECTION AND ACTION GUIDE

For the ANSWER put an "x" in the appropriate box "II"

Object: 11. MANHOLE COVERS (ACCESS HOLE COVERS)

No.	QUESTION	ANSWER				ACTION
		NO	YES	NO	YES	
				TAKE ACTION		
1	2	3	4	5	6	7
01	Does the (water supply unit) have a manhole cover ?		II	II		M
02	Is the manhole cover intact ?		II	II		C
03	Does it fit tightly ?		II	II		E
04	Does it have a lock or locking device ?		II	II		M
05	Does the lock or locking device work ?		II	II		C - E - F
06	Is there a key or opening device ?		II	II		M
07	Does it work ?		II	II		C - E - F
08	.....					
09	.....					

MAINTENANCE OF WATER SUPPLY UNITS

ANNEX 3.9/12

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INSPECTION AND ACTION GUIDE

For the ANSWER put an "x" in the appropriate box "II"

Object: 12. APPURTENANCES

No.	QUESTION	ANSWER NO	ANSWER YES	TAKE ACTION NO	TAKE ACTION YES	ACTION
1	2	3	4	5	6	7
01	Are the following appurtenances intact ?					
	inlet pipe		II	II		(
	outlet pipe		II	II		)
	overflow pipe		II	II		(
	wash-out pipe		II	II		)
	vent		II	II		(B + C + (E) + G
	climbing irons		II	II		)
	ladders		II	II		(
	valves		II	II		)
	.....		II	II		(
02	Are the connections of following appurtenances water-tight ?					
	inlet pipe		II	II		(
	outlet pipe		II	II		)
	overflow pipe		II	II		(
	wash-out pipe		II	II		) P
	vent		II	II		(
	.....		II	II		)
03	Are there any signs of corrosion on					
	inlet pipe	II			II	(
	outlet pipe	II			II	)
	overflow pipe	II			II	(
	wash-out pipe	II			II	)
	vent	II			II	(B + G
	climbing irons	II			II	)
	ladders	II			II	(
	valves	II			II	)
	.....	II			II	(
	of the (water supply unit) ?					
04	Are the (wire mesh) screens of the					
	inlet pipe		II	II		C - F
	outlet pipe		II	II		C - F
	intact ?					
05	.....					
06	.....					

MAINTENANCE OF WATER SUPPLY UNITS

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INSPECTION AND ACTION GUIDE

Object: 13. DRAINAGE (e.g. at public fountains or hand dug wells)

For the ANSWER put an "x" in the appropriate box "II"

No.	QUESTION	ANSWER				ACTION
		NO	YES	NO	YES	
				TAKE ACTION		
1	2	3	4	5	6	7
01	Is there a drain pipe ?		II	II		M
02	Is there a drain channel ?		II	II		M
03	Is the drain pipe or channel straight ?		II	II		E
04	Does it have a uniform slope ?		II	II		E
05	Are there any waterpools in it ?	II			II	A + B + N + P
06	Are there any sediments or debris in it ?	II			II	A
07	Is there a soakaway ?		II	II		K
08	Does the soakaway work ?		II	II		F - J
09	.....					
10	.....					

MAINTENANCE OF WATER SUPPLY UNITS

ANNEX 3.9/14

INSPECTION AND ACTION GUIDE

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Object: 14. SURROUNDING AREAS

For the ANSWER put an "x" in the appropriate box "II"

No.	QUESTION	ANSWER				ACTION
		NO	YES	NO	YES	
				TAKE ACTION		
1	2	3	4	5	6	7
01	Are there any deep cracks in the backfill close to the structure ?	II			II	D
02	Is the surrounding area drained ?		II	II		K
03	Is it eroded ?	II			II	D
04	Is it covered with grass ?		II	II		Y
05	Does the grass need cutting ?	II			II	Z
06	Are there any weeds ?	II			II	Z
07	Is there a diversion ditch ?		II	II		K
08	Has it a ridge on the downhill side ?		II	II		K
09	Is the diversion ditch filled with sediment ?	II			II	A
10	Is the diversion ditch eroded ?	II			II	D
11	Is the ridge intact ?		II	II		C
12	Is there a fence ?		II	II		K
13	Is the fence adequate ?		II	II		J
14	Is the fence intact ?		II	II		C
15	Does it have a gate ?		II	II		M
16	Is the gate intact ?		II	II		C
17	Can it be locked ?		II	II		E
18	Is there a lock ?		II	II		M
19	Does the lock work ?		II	II		C - E - F
20	Is there a key ?		II	II		M
21	Does the key work ?		II	II		C - E - F
22	Is the access road intact ?		II	II		C - U
23	Are the culverts intact ?		II	II		C - U
24	Are the fords (if any) crossable		II	II		C - U
25	.....					
26	.....					

MAINTENANCE OF WATER SUPPLY UNITS

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INSPECTION AND ACTION GUIDE

Object: 15. SOURCES OF POLLUTION/CONTAMINATION

For the ANSWER put an "x" in the appropriate box "II"

No.	QUESTION	ANSWER NO	ANSWER YES	TAKE ACTION NO	TAKE ACTION YES	ACTION
1	2	3	4	5	6	7
	Are there any sources of possible pollution/contamination within (30) metres of (the water supply unit) ?					
01	latrines	II			II	(
02	refuse dumps	II			II	(
03	manure piles	II			II	(
04	fertilizers	II			II	(
05	barns	II			II	) Q + R + S; T; U; X
06	.....	II			II	(
07	.....	II			II	(
08	.....	II			II	(

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TRAINING MODULES FOR WATERWORKS PERSONNEL

List of training modules:

Basic Knowledge

- **0.1** Basic and applied arithmetic
- **0.2** Basic concepts of physics
- **0.3** Basic concepts of water chemistry
- **0.4** Basic principles of water transport
- **1.1** The function and technical composition of a watersupply system
- **1.2** Organisation and administration of waterworks

Special Knowledge

- **2.1** Engineering, building and auxiliary materials
- **2.2** Hygienic standards of drinking water
- **2.3a** Maintenance and repair of diesel engines and petrol engines
- **2.3b** Maintenance and repair of electric motors
- **2.3c** Maintenance and repair of simple driven systems
- **2.3d** Design, functioning, operation, maintenance and repair of power transmission mechanisms
- **2.3e** Maintenance and repair of pumps
- **2.3f** Maintenance and repair of blowers and compressors
- **2.3g** Design, functioning, operation, maintenance and repair of pipe fittings
- **2.3h** Design, functioning, operation, maintenance and repair of hoisting gear
- **2.3i** Maintenance and repair of electrical motor controls and protective equipment
- **2.4** Process control and instrumentation
- **2.5** Principal components of water-treatment systems (definition and description)
- **2.6** Pipe laying procedures and testing of water mains
- **2.7** General operation of water main systems
- **2.8** Construction of water supply units
- **2.9** Maintenance of water supply units Principles and general procedures
- **2.10** Industrial safety and accident prevention
- **2.11** Simple surveying and technical drawing

Special Skills

- **3.1** Basic skills in workshop technology
- **3.2** Performance of simple water analysis
- **3.3a** Design and working principles of diesel engines and petrol engines
- **3.3b** Design and working principles of electric motors
- **3.3c** –
- **3.3d** Design and working principle of power transmission mechanisms
- **3.3e** Installation, operation, maintenance and repair of pumps
- **3.3f** Handling, maintenance and repair of blowers and compressors
- **3.3g** Handling, maintenance and repair of pipe fittings
- **3.3h** Handling, maintenance and repair of hoisting gear
- **3.3i** Servicing and maintaining electrical equipment
- **3.4** Servicing and maintaining process controls and instrumentation
- **3.5** Water-treatment systems: construction and operation of principal components: Part I - Part II
- **3.6** Pipe-laying procedures and testing of water mains
- **3.7** Inspection, maintenance and repair of water mains
- **3.8a** Construction in concrete and masonry
- **3.8b** Installation of appurtenances
- **3.9** Maintenance of water supply units Inspection and action guide
- **3.10** –
- **3.11** Simple surveying and drawing work

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