**Module 1**

**UNICEF Principles for the Planning, Contracting and Management of Borehole Drilling Projects**





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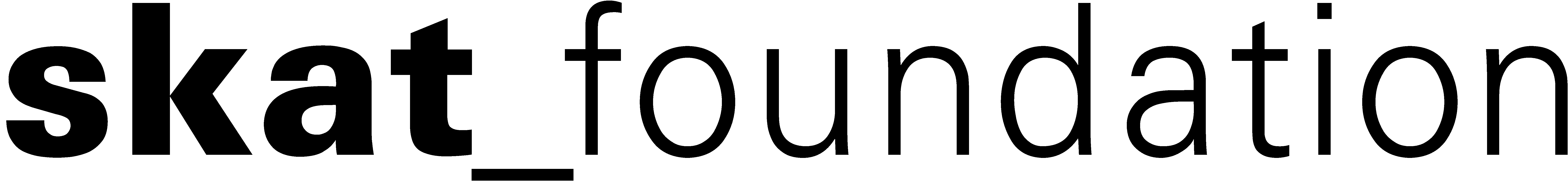
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# 1.1 Background

The **UNICEF Toolkit for Borehole Drilling – Planning, Contracting and Management (**subsequently referred to as the **Toolkit**) has been developed to bring uniformity to practices and to guide UNICEF staff involved in borehole procurement and the supply of equipment, as well as contracting consultancy services for borehole siting and supervision. The Toolkit comprises five modules (see cover page).

Module 1 sets out the responsibilities for key stakeholders and presents eight principles for the planning, contracting and management of borehole drilling projects. These principles are applicable to all borehole projects in which UNICEF is involved, either directly as the contracting Client or in support of the National Government or other agencies. The principles are to be used to develop appropriate contracts for borehole projects and are applicable to all boreholes fitted with handpumps. The principles aid decision-making and streamline the procurement process.

# 1.2 Responsibilities of Key Stakeholders

Borehole drilling projects require the collaboration of many different stakeholders. Clarifying the respective responsibilities for everyone involved and making adjustments where necessary is an essential part of the planning process and will improve the chance of the successful completion of the project. The responsibilities of key stakeholders in borehole projects are set out in Table 1.1.

Table 1.1 Stakeholder definitions and responsibilities for borehole drilling projects

| Stakeholder | Responsibilities |
| --- | --- |
| Community  (including community representatives and community drilling trackers) | The **community** members are the end users of the water supply as identified by the responsible government agency and UNICEF. The responsibilities of the community are:   * Appoint **community representatives** to liaise with local government, UNICEF, the Supervisor and the Contractor in the entire process (i.e. planning, project meetings, siting, mobilization, construction and completion of the works). * Participate in the borehole siting activities including agreement on the exact placement of the borehole site. * Appoint two literate and numerate individuals as **community** **drilling monitors** to support drilling supervision by tracking the drilling process and recording select information as requested by the supervisor. Note that the community is not responsible for technical or contractual details. * Establish a water committee.   Should any problems arise, the community should inform the supervisor. In case the problem concerns the supervisor, the community should inform the Consultant or the UNICEF Designated Representative. |
| Local government or authority | Representatives of the **local government or authority** should:   * attend the pre-mobilization meeting between UNICEF and the Drilling Contractor, * attend the introduction meeting with the community, * participate in the handing over ceremony.   Local government or authority representatives may also support drilling supervision by:   * conducting spot checks to monitor progress, * conducting spot checks to ensure that supervision is taking place, * attending site meetings, * participating in the inspection of works at the site on the dates they are substantially completed, * participating in the final inspection.   The local government or authority usually has the responsibility of post-construction monitoring of water facilities comprising   * checking functionality * checking yield and testing water quality * supporting the communities in the maintenance.   However, local governments often do not have the resources for adequate monitoring. |
| UNICEF as Client/ contracting Client | **The client** is the organization or agency that is contracting out the borehole construction. In the case of boreholes that are directly contracted by UNICEF, the Client is the UNICEF Country Office and has the following responsibilities:   * Identifying the specific communities in which the siting and borehole construction will take place. * Ensuring that community representatives for the project have been selected and providing their names and contacts to the consultant and driller. * Ensuring that all regulatory requirements for the borehole are met. Legal requirements should be established by the Client early on to avoid delays. * Managing the contract with the drilling contractor. * Managing the contracts with the consultant responsible for siting and supervision **or** ensuring that supervising staff have clear Terms of Reference and the required equipment and resources to undertake siting and supervision. * Ensuring that siting of the borehole is undertaken as per contract. * Ensuring that the mobilisation and borehole construction process are supervised according to the contract. * Ensuring that any defects are corrected within the defects liability period. |
| Government or NGO as Client/ contracting Client | **The Client** is the organization or agency that is contracting out the borehole construction. In cases where UNICEF supports National Government or an NGO to contract boreholes, the National Government or NGO has the following responsibilities:   * Identifying the specific communities in which the siting and borehole construction will take place. * Ensuring that community representatives for the project have been selected and providing their names and contacts to the consultant and driller. * Ensuring that all regulatory requirements for the borehole are met. * Managing the contracts with the drilling contractor * Managing the contracts with the consultant responsible for siting and supervision **or** ensuring that supervising staff have clear Terms of Reference and the required equipment and resources to undertake siting and supervision. * Ensuring that siting of the borehole is undertaken as per contract. * Ensuring that the mobilisation and borehole construction processes are supervised according to the contract. * Ensuring that any defects are corrected within the defects liability period. |
| Consultant | The **Consultant** is the person or company that has been engaged or whose bid has been accepted by the Client to carry out services such as the design of the project, borehole siting, drilling supervision and final inspection of the works. The Consultant’s responsibility is to ensure that the drilling contractor adheres to the technical specification, makes all the required measurements, keeps all records accurately and ensures that health and safety procedures are adhered to. |
| Contractor | The **Contractor** (or drilling contractor) is a private company or NGO with a procurement contract to engage in the drilling of boreholes. It is the responsibility of the Drilling Contractor to drill the borehole as specified in the contract. |
| Regulator | The **Regulator** issues permits or licences for drilling or abstraction. |
| Supervisor | The **Supervisor** is the on-site representative of the Client. The Supervisor may either be a UNICEF staff or a nominated representative of the consultant. It is the responsibility of the Supervisor to ensure that the Drilling Contractor adheres to the technical specification, makes all the required measurements, keeps all records accurately and ensures that health and safety procedures are adhered to. |
| UNICEF Designated Representative | The **UNICEF designated representative** is the UNICEF officer designated as representing UNICEF as in the contract. |

# 1.3 Principles

UNICEF has eight principles for the planning, contracting and management of borehole projects. These define the minimum standards expected and the procedures to be followed. Table 1.2 explains each principle, and breaks it down into a set of recommendations.

**Table 1.2 UNICEF principles for the planning, contracting and management of borehole drilling**

|  |  |
| --- | --- |
| Principle | Explanation and sub principles |
| Principle 1  Professionalization of Borehole Drilling | **All persons and organizations to be engaged in borehole drilling projects either as drilling contractors, consultants or equipment suppliers should be certified or registered with the recognised professional bodies.**  Recommendations:   * The siting, supervision and construction of boreholes and installation of pumps should be carried out by private sector companies or NGOs which are registered nationally. Government agencies should not be engaged to carry out such works except where Government is the only competent agency available. * All drilling contractors engaged should be licensed by the national government to engage in the drilling of boreholes and/or be members of the national drillers association. In countries where there is no licensing of drilling contractors or no national drillers association, the contractors shall be selected based on a shortlist from a prequalification exercise that establishes the technical and financial capacity of the contractors to carry out the works. Where there is no licensing of drilling contractors, UNICEF should work with the Government to establish such licensing system. * Hydrogeologists and groundwater consultants engaged for siting, supervision and monitoring of boreholes should be licensed by the national government and/or be members of the relevant national association. All consultants should be proven to have the requisite knowledge, skills and experience. The consultants should be selected through an evaluation process with clearly defined evaluation criteria. Where there is no licensing of drilling contractors, UNICEF should work with the Government to establish such licensing system. |
| Principle 2  Technology choice in borehole construction | **The choice of technology for the construction is the most economical for the borehole purpose and is aligned with national standards and community demand. National procurement guidelines shall be followed.**  Recommendations:   * Borehole dimensions, i.e. depth, diameter, requirements for development and time for pumping test, should be realistic; they should not be over- or under-specified. The borehole design may be modified during drilling based on field realities and hydrogeology. * A stepped approach to technology choice should be followed. If feasible, low-cost methods such as manual drilling should be considered first before mechanized drilling. The use of small drilling rigs should be considered first before larger drilling rigs if the borehole requirements can be met. * Every completed borehole should have some form of physical identification marker or plate with a number which conforms to the national borehole numbering system. Where there is no national borehole numbering system, UNICEF should support the Government to initiate such numbering system. * Where national/sub-national water point databases exist, UNICEF should ensure that all constructed boreholes are included in the database. |
| Principle 3  Borehole siting practice | **Siting of boreholes should be professionally and scientifically carried out by competent and experienced groundwater consultants who also have social/community development competence. On projects where more than five boreholes are drilled, and those in difficult groundwater terrains, a hydrogeologist/groundwater specialist should be engaged to carry out the siting. On small projects (i.e. where up to five boreholes are drilled) which are located in areas where the groundwater is easily accessible, the responsibility for siting may be given to the Drilling Contractor.**  Recommendations:   * The selection of the siting procedure to be used should be based on a conceptual model of groundwater conditions in the project area developed from a desk study of the terrain from maps and other remote sensing tools, aquifer types, groundwater chemistry, climate and recharge potential. * From the conceptual model, the risks of drilling a dry borehole should be evaluated and the appropriate siting techniques recommended. It is not in every terrain that the use of geophysical methods should be specified or deemed necessary in siting boreholes. In proven regional, unconsolidated aquifers, the use of geophysics may not be necessary. Geophysical methods should only be specified where they enhance the chances of drilling a successful borehole and are cost-effective. In compacted sediments and crystalline rock terrains, the use of geophysics will often be appropriate. * The community, represented by the water users committee, must be involved in the location of the borehole site, and their preference should be given first priority. Where the location selected by the community is inappropriate for technical reasons, the reasons should be clearly explained to them and recorded. Alternative locations should be proposed for consideration by the community. * The consultants responsible for the siting of the borehole should be paid even if the boreholes are dry. * The ownership of the land selected must be determined. The consent of the owners to use the land for the borehole and allow access perpetually must be set down in writing. If compensations are agreed on, they must be settled before commencement of any work. * Sites selected for borehole drilling should not be those that are likely to be polluted or contaminated by potential sources of pollution nor interfere with natural groundwater discharges and other existing wells and boreholes. |
| Principle 4: Supervision | **Effective supervision is essential for sustainable boreholes. The quality of the product is as good as the quality of the supervision. All borehole projects should be supervised by competent personnel who are well trained and experienced in borehole supervision. Supervisors should be properly equipped and have adequate facilitation to undertake the job without dependency on logistics by the drilling contractor.**  **The Client (i.e. UNICEF, National Government or NGO) should aim at providing full-time supervision for the drilling process. In full-time supervision, the Supervisor stays with the drill team from the pre-drilling inspection to demobilization. Where there are insufficient/inadequate resources for full-time supervision, part-time supervision may be considered in which the Supervisor witnesses critical milestones of the drilling process. The critical milestones must have been stated in the contract document as well as the consequences of not abiding by them. The levels of supervision are defined in the Toolkit Module 1, section 1.3.**  Recommendations:   * Supervision of borehole drilling ensures that the boreholes are drilled as specified, safety of the public and drilling personnel are guarded and all the data collected during drilling are accurately recorded and reported to the relevant agency. * Supervision of borehole drilling requires professional, experienced and qualified personnel. UNICEF should ensure that there are competent personnel to carry out the supervision of borehole projects, and that they are adequately facilitated. Where such personnel are not available in-country, UNICEF will work with the Government to train and develop the capacity of local personnel to carry out drilling supervision prior to the commencement of the project, may arrange mentoring support and will lobby for adequate facilitation. UNICEF may also enter into a contract with a consultancy firm to carry out the supervision. |
| Principle 5: Water quality and safety | **Delivering water that is safe for human consumption is a key accountability for UNICEF. Safety is a measure of the potential risk for humans of drinking water that is harmful to their health. The risk is related to both microbial and chemical contamination.**  **All completed boreholes will comply with national standards on water quality, or, in the absence of national standards, with WHO guidelines.**  Recommendations:   * All boreholes will be sited to minimize the risk of microbial and chemical contamination. * Following completion of the borehole, drillers (or the designated agency) will facilitate water sample collection, following national standards or recommendations for sampling. * Water quality tests, both bacteriological and chemical tests, will be carried out by independent institutions, and results will be compared against national drinking water quality standards (or WHO international guidelines, should there be no national standards). * Should initial tests highlight microbiological contamination above national standards, the driller will be responsible for shock chlorination of the water point. If subsequent tests still detect microbiological contamination, appropriate measures should be implemented by the relevant authorities. * If tests highlight chemical contamination related to geological conditions (e.g. fluoride or arsenic contamination) beyond national standards, then the Supervisor and the competent authorities will decide on the temporary or definitive closure of the water point. * Payment for boreholes which result in poor water quality depends on the measures taken by the driller to minimize the risk of contamination. Unless there is evidence that poor water quality is a direct result of the driller’s actions, boreholes should be paid for. This is further elaborated in Principle 6. |
| Principle 6  Payment for boreholes | **Groundwater exploration is an inexact science, and in some terrains there are risks of drilling a dry borehole or encountering groundwater of poor quality irrespective of the experience and qualification of the hydrogeologist who sited the borehole.**  **Payment for completed boreholes will be according to a bill of quantities based on the recommendations from the siting exercise and the preliminary borehole design, i.e. the probable borehole depth, diameter and lining materials and conditions of geological formations. Payments will be made as per the actual works done and quantities of materials used (rather than as a lump sum).**  **Where boreholes are declared unacceptable on completion of drilling through inadequate water either in quantity or quality but through no fault of the driller, the driller will be paid according to the measureable quantities of items of work completed up to the point of the borehole being declared unacceptable. This includes boreholes where geophysical surveys have been conducted and where boreholes do not have sufficient yield or safe water quality.**  Recommendations:   * The risks of drilling a dry borehole should be evaluated from the desk study and classified as either high, moderate or low (see **Toolkit** Module 1, section 1.4). In areas of high and moderate risks, particular care must be taken in the siting of the boreholes and in the supervision of drilling. * Where the risks of drilling a dry borehole become apparent during the drilling, particularly from the output during hammer drilling, and the recommended depth has been attained and possibly surpassed, the Supervisor may elect to stop the drilling and declare the borehole unacceptable without installing casing and screens in the borehole. In such circumstances, the driller should be paid for items of work expended until the borehole was declared unacceptable, based on the bill of quantities. * If the borehole is declared unacceptable due to poor water quality as a result of wrong drilling technique or poor gravel pack, then the driller will not be paid for such boreholes and should be asked to drill another one at their own expense. * The quantities in the bill of quantities are only indicative. The Contractor will only be paid for the quantities expended. * All contracts should have a defects liability period of a specified duration as prescribed in the national procurement guidelines. A retention fee will be held by the Client for the duration of the defects liability period. The client (i.e. UNICEF, Government or the NGO) will sensitize users on the need for timely reporting of defects during the liability period. * Criteria for a successful borehole include: completion of all drilling operations, installation of casing and screen, development works and test pumping, including lowering of borehole assembly with PVC casing, screen and end cap, gravel pack at appropriate intervals and back fill, close near surface water table aquifer, cleaning and development, pumping test, chlorinate borehole, pump installation, construction of apron with drainage and soak away pit and water quality testing, both chemical and biological. * Where the risks of drilling a borehole that is contaminated by chemical contaminants originating from geological processes (such as arsenic and fluoride) and the recommended depth has been attained and possibly surpassed, the Supervisor may elect to stop the drilling and declare the borehole unacceptable without installing casing and screens in the borehole. |
| Principle 7 Selection and installation of pumps[[1]](#footnote-1) | **Selection of pumps to be installed on the boreholes must adhere to national standards or guidelines. Where there are no national standards, the pump selected must be robust and not corrode.**  Recommendations:   * Where countries have published or accepted national standards or guidelines for handpumps or standardized particular types of handpump, the Supervisor must ensure that the right tools and procedures for assembling the pump are used, as using the wrong tools and shortcuts can damage the pumps as well as compromise the safety of the installation team. * In the case of corrosive water (i.e. pH < 6.5), specific measures need to be taken. Galvanised iron (GI) riser pipes must not be installed in water where the pH is less than 6.5. In cases where the pH is close to 6.5, UNICEF and the respective line ministry will provide guidance on what should be installed. * Handpump installation must be coordinated with the pad construction, and one team will be responsible for the handpump and pad. * Handpump mechanics or pump minders must be identified and trained in the installation and repair of the particular handpump on the project. Training may be conducted as part of the handpump installation contract or as a separate initiative. The training should be extended to cover individuals involved in any other service delivery models being considered. * A separate contract for head works construction and handpump installation may be considered on large multiple borehole projects apart from the drilling contract to ease the installation of the handpumps |
| Principle 8  Monitoring functionality and water safety and quality over time | **The functionality and the safety of the water of the completed boreholes shall be monitored on a regular basis and the findings published.**  Recommendations:   * Monitoring of the borehole functionality and water safety should be formalized and the facilities inspected at least twice a year by the designated government agency. * Packages to monitor functionality may include work for more than one year. * Post-construction monitoring of borehole functionality and water safety and qualityis often the responsibility of local government, the communities and the private sector. But often local governments and communities do not have the resources for the monitoring. UNICEF should work with government and other partners to set in place the necessary arrangements for the monitoring process. * UNICEF and its partners should work with governments and communities to address the underlying causes of poor functionality and poor water quality through e.g.: * appropriate service delivery models for the water points, * water safety planning and implementation, * operational monitoring of water safety measures (=barriers developed to reduce risks of contamination, as per water safety plans) and * water quality surveillance systems (independent spot checks on water quality). * The report of the monitoring visits (which provides information on the functionality of the borehole, water quality and safety) and the required actions should be shared with the communities and all other relevant entities at the national and local government levels. |

# 1.3 Levels of Supervision and End of Contract Inspection

There are three different levels of supervision, as described in Table 1.3. The supervisor needs to be properly equipped in all cases, but a borehole camera is particularly important for part-time milestone supervision and end-of-contract inspection.

Table 1.3 Levels of drilling supervision

|  |  |
| --- | --- |
| **Level** | **Description** |
| **Full time supervision** | Supervisor stays with the drilling team throughout the drilling process, from inspection of the equipment and materials to demobilization. On large drilling programmes with multiple rigs, several Supervisors are deployed. While this supervision level is ideal, the resources needed are not always available |
| **Part-time milestone supervision** | One Supervisor is responsible for the supervision of several drilling sites and may only witness crucial stages (milestones) of the drilling. The stages that must be carried out in the presence of the Supervisors need to be specified in the contract documents of the Drilling Contractor and Supervisor and the consequences of not abiding by them stated. However, the Supervisor is expected to be promptly on site and should not cause undue delays. The milestones are:   * mobilization * site selection (if this is part of the Drilling Contract) * termination of drilling * lining of the borehole * borehole development * pumping test * demobilization * platform construction * pump installation (may be delegated depending on the contract)   The designated ‘Record Keeper’ in the drilling contractors’ team plays a very important role. He/she is designated to collating the measurements and preparing the forms at all stages of the process set out in the milestones above. This role should be specified in the contract documents.  The role of identified community members as monitors to track the drilling construction process can also be very useful for milestone supervision. |

**End-of-contract inspection** is not supervision but rather a visit to the works in order to verify that all specifications have been adhered to and that the works are in their proper condition. On completion of the Works by the Drilling Contractor, the Supervisor will inspect the boreholes, pads, pumps and surroundings and identify any defects that need to be corrected during the defects liability period. These defects are to be attached to the Certificate of Substantial Completion. A Certificate of Final Completion is only issued if all defects have been corrected.

# 1.4 Categorisation of Risk of Dry Borehole

In a particular country, or region, it may be possible to classify the drilling potential into three (or more) categories as set out in Table 1.3. Appropriate contracts and payment should be defined for each category. It should be noted that this model is not intended to be prescriptive, but that it illustrates a way of dealing with one of the key challenges of borehole drilling: the risk of dry wells. Ideally, the Client should take responsibility for the siting and pay the contractor for successful and dry holes according to a Bill of Quantities (BoQ) (See Module 4, Annex 4.1).

Table 1.4 Categorisation of dry boreholes

|  |  |  |
| --- | --- | --- |
| Category | Success Rate\* | Actions |
| A  High Success | >75% | No need for geophysical survey. Drilling at any site has a high chance of success. First preference of community is likely to be successful. |
| B  Moderate Success | 50-75% | Survey required and may be done by the Contractors within the community preferred area following government guidelines.  In some cases, it is advisable to specify minimum drilling depth in the Contract. |
| C  Low Success | <50% | Client to commission independent siting including use of geophysics (resistivity depth sounding and electromagnetic profiling). Sites selected and designed by the consultant should be drilled by the Contractor. |

1. Concerning the pumps to be installed, recommendations throughout the toolkit have specifically been formulated for handpumps. [↑](#footnote-ref-1)