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BUREAU OF PLANNING AND ECONOMIC DEVELOPMENT AMHARA NATIONAL REGIONAL STATE

DEPARTMENT OF INTERNATIONAL DEVELOPMENT COOPERATION

THE RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME, AMHARA REGION

RURAL WATER SUPPLY DESIGNS COMPLIATION REPORT DESIGNED BY RWSEP PHASE II OF ITS IMPLEMENTATION PERIOD

A PERIOD COVERING FROM 1998 to 2002

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GENERAL

The Rural Water Supply and Environmental Programme in Amhara Region (RWSEP) is a regional development programme supported by the Government of Ethiopia and Finland (GOF) operating in the Amhara Regional State since 1994. Phase I (1994 –1998) focussed on capacity building at woreda and regional level while Phase II (1998 –2002) shifted the focus to woreda and zone level

The overall objective of the programme is that " Communities have the capacity to plan, manage, and implement their own aims for sustainable development". This is to be reached through the programme purpose, which is stated as " Communities have a strengthened capacity to initiate, plan, implement and manage water supply and sanitation, environmental and related schemes and services".

In its two phases of operation in the region, the programme has operated in 18 woredas of the region located in four adjacent zones.

As water in an entry point of the programme, in the two phases the programme has financed the construction of nearly 1422 water points for communities, schools and health institutions. The technological mixes of water points in their order of their abundance are hand dug wells with hand pumps, spring developments and pipe laying from the near by water distribution point mainly for schools and health institutions.

In its operation period the programme together with the experts of the Regional Water Bureau and Zonal Water Departments has developed and implemented different designs for water points, prepared training manuals and guidelines which have contributed a lot in the achievement of the programme objectives. In order that such materials to be available to any body involved in the sector, compilation of the different designs and guidelines, which have been used by the programme was one of the assignments given to the programme water expert in the 2001/2002 year as June 30/2002 is the end of the phase II of the programme.

This report entitled **"Report on the Compilation of Water Point Designs Implemented by RWSEP** "has the following objectives:

1. To show clearly to what extent the programme has gone in collaboration with its partners in making its designs as practical as possible (considers women in community water point design and children in school water point design).
2. To make the designs available for usage for those interested and involved in the sector.
3. To be a basis for estimating required materials and costs for water points construction by the government offices, NGO, other bi lateral and multilateral programmes which are/will be involved in the financing of water points mainly hand dug wells and spring development.

At last but not the least it is necessary to emphasize that these designs and also the corresponding analysis made on the designs are not final and not to use them as a blue print designs by others, but needs to be seen as good start, which needs to be refined in the future by incorporating comments observed when applying those designs at the practical/field level.

1. BRIEF DESCRITPTIONS OF THE DESIGNS/TECHNOLOGIES

1.1 Spring Development

Spring is ground water, which comes out to the surface through cracks of bedrock. In order to utilize the spring water for drinking and washing purposes it has to be well developed and the surrounding sanitation condition should be well kept.

Spring can be developed on the spot without collection chamber if the springs is located at reasonable distance to the community and the yield of the spring is sufficient to supply the daily demand of the community within a maximum of 10 hours flow.

Spring with collection chamber is to be constructed when the yield of the spring is not sufficient to supply the daily demand of the community within maximum of 10 hours and the capacity of the collection chamber should be determined through calculation of demand of the community versus the supplying capacity of the spring during the driest season of the year.

The shape and area of the spring capping structure depends on the nature and location of the spring, and shall be designed each by each according to the reality. Anyhow in both cases the spring needs to be well protected and should be comfortable for women in using the source (have safe entrance and exit to women during fetching water from the source).

The most widely constructed spring in most of the programme woredas is a spring capping with 2 mcu capacity collection chamber and almost all the discussions in this report deals on this.

The plan, section and details of the spring development with collection chamber design exercised by the programme are shown from **Drawing No. SPD 001 to SPD 003** in the list of the drawings.

1.2 Hand dug well for community use

Depending on their depth and technology requirement wells are classified in to two types, namely shallow and deep wells. Generally wells with less than 50 meters depth are referred to as shallow, while those above 50 meters depth are named deep wells. Hand dug wells are found under the shallow well category. Their depth rarely exceeds 30 meters. According to the information provided from the regional BWMERD the average hand dug well depth for the whole region is around 15 meters.

Hand dug wells are the most suitable types of wells for small rural village/community level development. They supply water to the community by pumps or by rope and bucket depending on their depth and available technology.

The hand dug well design used by the programme is most commonly known by the name **"gender sensitive design"** because it takes in to consideration the need of women. Its superstructure is high enough and has properly designed pot rest in order to ease carrying of the pots by one woman (without the help of other people for operating the pump and lifting the pot for carrying).

More than 95% of the hand dug wells financed by the programme are equipped with Afridev hand pump due to its ease of operation and maintenance at village level or 'VLOM" nature. The remaining 5% are equipped either with Indian Mark II or direct action pumps.

The plan, section and details of the hand dug well design for community use exercised by the programme are shown from **Drawing No. SHD 001 to SHD 003** in the list of the drawings.

1.3 Hand dug well for school use

School water points have been financed by RWSEP since 1999. The hand dug well design, which had been practised by the programme was designed to suit for community water supplies. Hence the need for preparing a suitable design for schools was recommended in the year 1999/2000 annual meeting of the programme.

Some of the comments given on the hand dug well design which had been used for schools water point were:

- It does not allow number of students to get water from the pump outlet at a time.
- It does not encourage hygienic use of water i.e., hand washing. Drinking is not simple as many students are waiting to get water from the pump at a time and the design will not allow enough time for one student wash his/her hands before drinking.
- Since it does not have storage on the ground other than the well itself, it requires students to operate the pump at any time when they are in need of water and it is difficult especially for students of lower ages. In other words it does not allow one student to drink by himself/herself at a time and needs somebody else to operate the pump for her/him.

Because of the above comments, the previous design was not highly appreciated by the school community hence the RWSEP experts prepared two alternative designs. The designs have also provisions for communal use of water points both by community and students with the same well.

The two alternative designs are to be used in the following two cases:

1. **Design alternative No.1** – This alternative design is to be used for schools where the soil around the well is not black cotton soil and the well did not show sign of collapse during digging. In this alternative design the structure for students use will be constructed attached with the well head.

The plan, section and details of the design are shown from **Drawing No. SHD 001 to SHD 003** in the list of the drawings.

2. **Design alternative No.2** – This alternative design is to be used for schools where the soil around the well is black cotton soil and the well showed sign of collapse during digging. In this alternative design the structure for students use will be constructed separated from the well head.

The plan, section and details of the design are shown from **Drawing No. SHDB 001 to SHDB 004** in the list of the drawings

The main features of the alternative designs are:

- Have some storage tank (concrete ring or masonry made) so that once water filled in the tank number of students can freely get water without operating the pump at the time of drinking.
- Have more than one outlet (minimum three) so that number of students can drink at same time and students can practice hand washing before drinking.
- Communal usage of water point with the community when the need arises is possible.

2. COST ESTIMATE OF THE DESIGNS

This section is the part of the report that deals with the estimated cost of the different water point designs which have been used by the programme. Especially in case of hand dug wells the cost of construction depends on the depth of the well and the hardness of the formation to dig in. Hence selecting some fixed depths is required to estimate and the cost of other depths can be roughly estimated based on the depths whose cost and material requirements are estimated here below. Therefore, this section of the report deals with on the following types of water points.

1) For the case of spring development.
1.1) Spring development with 2 mcu capacity collection chamber.

2) For hand dug wells of community and/or school use.
2.1) Well of target depth 10 meters and excavated well diameter of 1.5 meters, lined with concrete cylinder of 116/100 centimeters external and internal diameter respectively.
2.2) Well of target depth 15 meters and excavated well diameter of 1.5 meters, lined with concrete cylinder of 116/100 centimeters external and internal diameter respectively.
2.3) Well of target depth 20 meters and excavated well diameter of 1.5 meters, lined with concrete cylinder of 116/100 centimeters external and internal diameter respectively.
2.4) Well of target depth 15 meters and excavated well diameter of 2 meters, lined with concrete cylinder of 166/150 centimeters external and internal diameter respectively.

2.1 Labor Cost.

2.1.1 Artisans Labor Cost /Semi Skilled Labor Cost/

Water point constructions financed by the programme have been undertaken by artisans (people trained for hand dug well and spring construction for two months). These artisans are trained for each woreda and their number depends on the number of water points to be constructed in each woreda yearly and the training is both in theory and practice. The trainees construct one hand dug well and one spring during the two months training.

These trained artisans take labor contract from the community by signing tripartite agreement with the WCC and community. The woreda and the programme office provide the materials for the construction and the artisans are paid only for their labor.

The artisan labor payment guideline which the programme using recently is the one revised in December 2000 or Thisas 1993.

In order to calculate the labor cost first calculating the quantity of each work item as per the designs prepared is necessary and done for each design.

After calculating the quantity of work for each activity, the estimate of the labor cost for each design on the basis of the guideline are made from Table 2.1 to Table 2.9.

Table 2.1: Artisans labor cost for spring development with 2 mcu capacity masonry collection chamber.

No	Description of activities	Unit	Qty	Unit price in Birr	Total price in Birr
Spring eye					
1	Site clearing	M2	25	6	150
2	Excavation for basement	M3	7	8.5	59.5
3	Concrete work for foundation below masonry work if necessary	M3	0.54	110	59.4
4	Spring eye spring box masonry work	M3	5	33	165
5	Three coats plastering of the capping structure from inside	M2	2.84	5.5	15.68
6	Filling the spring box with stones and river gravel	M3	5	10	50
7	Casting concrete on the top of the spring eye	M2	6	11	66
8	Pointing the walls of spring capping structure from outside	M2	1.05	5.5	5.78
9	Making the manhole and necessary plumbing works	Sum	Sum	44	44
10	Fencing the spring eye (5m x5 m) and making flood protection ditches	Sum	Sum	77	77
2 m3 collection chamber					
11	Site clearing	m2	25	2.2	55
12	Excavation for basement	m3	4	8.5	34
13	Excavation of trench for pipe laying	m3	12	8.5	102.5
14	Basement masonry works	m3	4	33	132
15	Hard core filling	m3	2,4	8.8	21.12
16	5cm thick lean concrete above the hardcore	m2	7.36	7	51.52
17	Water tight basement, 10 cm reinforced concrete work	m3	0.6	110	66
18	Collection chamber with 50cm thick masonry walls	m3	5	44	220
19	Three coats plastering the collection chamber from inside	m2	6	5.5	33
20	Concrete casting of 12 cm reinforced concrete slab to cover the collection chamber	m3	0.6	220	132
21	Pointing the collection chamber masonry walls from outside.	m2	7.08	5.5	38.94
22	Manhole and all plumbing works including the connection pipe from the spring eye	Sum	Sum	77	77
23	Fencing around the collection chamber (8m x8m), necessary steps and drainage works and support to lift the insera.	Sum	Sum	77	77
TOTAL					**1734.44**

Table 2.2: Artisans labor cost for community hand dug well of diameter 1.5 meters and target depth 20 meters.

It. No.	Description of the activity	Unit	Quantity	Unit price in Birr	Total price in Birr	Remark
1	SITE CLEARING	m^2	25	2.2	55	
2	DIGGING (1,5 m diameter)					
	Digging from 1 up to 3 meter	m	3	13	39	Ordinary soil
	Digging from 3 up to 6 meter	m	3	17	51	Ordinary soil
	Digging from 6 up to 9 meter	m	3	40	120	Hard soil
	Digging from 9 up to 12 meter	m	3	57	171	Hard soil
	Digging from 12 up to 15 meter	m	3	74	222	Hard soil
	Digging from 15 up to 17 meter	m	2	110	220	Hard soil
	Digging from 17 up to 20 meter	m	3	220	660	Rocky
	Dewatering from 15 to 20 meter	m	5	40	200	Dewatering
3	MAKING 1 m diameter concrete rings	No	41	12.5	512.5	
4	INSTALLING 1 m diameter concrete rings and filling river gravel, soil and stones	No	41	15	615	
5	FILLING 25 cm thick basement hard core	m2	8.91	9	80.19	
6	MAKING 7 cm thick lean concrete above the hard core including drainage ditches	m2	8.91	7	62.37	
7	MAKING 64 cm high masonry work including steps	m3	1.95	44	85.8	
8	MAKING the plastering of the masonry work and shaping work	m2	6.8	7	47.8	
9	MAKING 12 cm thick reinforced concrete slab including pump stand and manhole	m3	0.5	110	55	
10	MAKING 8 m x8 m fence	Sum	1	44	44	
11	MAKING a cattle through and a wash basing with concrete cylinder(the price includes cylinder production)	No	2	28	56	
12	DISINFECTION of the well	Sum	1	44	44	
13	PUMP installation					
	Depth from 15 m up to 20 m	Sum	1	77	77	
	Total				**3417.66**	

Table 2.3: Artisans labor cost for community hand dug well of diameter 1.5 meters and target depth 15 meters.

It. No.	Description of the activity	Unit	Quantity	Unit price in Birr	Total price in Birr	Remark
1	SITE CLEARING	m^2	25	2.2	55	
2	DIGGING (1,5 m diameter)				0	
	Digging from 1 up to 3 meter	m	3	13	39	Ordinary soil
	Digging from 3 up to 4.5 meter	m	1.5	17	25.5	Ordinary soil
	Digging from 4.5 up to 6 meter	m	1.5	24	36	Hard soil
	Digging from 6 up to 9 meter	m	3	40	120	Hard soil
	Digging from 9 up to 12 meter	m	3	57	171	Hard soil
	Digging from 12 up to 13 meter	m	1	74	74	Hard soil
	Digging from 13 up to 15 meter	m	2	220	440	Rocky
	Dewatering from 10 to 12 meter	m	2	20	40	Dewatering
	Dewatering from 12 to 15 meter	m	3	30	90	Dewatering
3	MAKING 1 m diameter concrete rings	No	31	12.5	387.5	
4	INSTALLING 1 m diameter concrete rings and filling river gravel, soil and stones	No	31	15	465	
5	FILLING 25 cm thick basement hard core	m2	8.91	9	80.19	
6	MAKING 7 cm thick lean concrete above the hard core including drainage ditches	m2	8.91	7	62.37	
7	MAKING 64 cm high masonry work including steps	m3	1.95	44	85.8	
8	MAKING the plastering of the masonry work and shaping work	m2	6.8	7	47.8	
9	MAKING 12 cm thick reinforced concrete slab including pump stand and manhole	m3	0.5	110	55	
10	MAKING 8 m x8 m fence	Sum	1	44	44	
11	MAKING a cattle through and a wash basing with concrete cylinder(the price includes cylinder production)	No	2	28	56	
12	DISINFECTION of the well	Sum	1	44	44	
13	PUMP installation				0	
	Depth up to 15 m	Sum	1	66	66	
	Total				**2484.16**	

Table 2.4: Artisans labor cost for community hand dug well of diameter 1.5 meters and target depth 10 meters.

It. No.	Description of the activity	Unit	Quantity	Unit price in Birr	Total price in Birr	Remark
1	SITE CLEARING	m^2	25	2.2	55	
2	DIGGING (1,5 m diameter)				0	
	Digging from 1 up to 3 meter	m	3	13	39	Ordinary soil
	Digging from 3 up to 4.5 meter	m	1.5	17	25.5	Ordinary soil
	Digging from 4.5 up to 6 meter	m	1.5	24	36	Hard soil
	Digging from 6 up to 9 meter	m	3	40	120	Hard soil
	Digging from 9 up to 10 meter	m	1	132	132	Rocky
	Dewatering from 6 to 10 meter	m	4	30	120	Dewatering
3	MAKING 1 m diameter concrete rings	No	21	12.5	262.5	
4	INSTALLING 1 m diameter concrete rings and filling river gravel, soil and stones	No	21	15	315	
5	FILLING 25 cm thick basement hard core	m2	8.91	9	80.19	
6	MAKING 7 cm thick lean concrete above the hard core including drainage ditches	m2	8.91	7	62.37	
7	MAKING 64 cm high masonry work including steps	m3	1.95	44	85.8	
8	MAKING the plastering of the masonry work and shaping work	m2	6.8	7	47.8	
9	MAKING 12 cm thick reinforced concrete slab including pump stand and manhole	m3	0.5	110	55	
10	MAKING 8 m x8 m fence	Sum	1	44	44	
11	MAKING a cattle through and a wash basing with concrete cylinder(the price includes cylinder production)	No	2	28	56	
12	DISINFECTION of the well	Sum	1	44	44	
13	PUMP installation				0	
	Depth up to 15 m	Sum	1	66	66	
	Total				**1654.16**	

Table 2.5: Artisans labor cost for community hand dug well of diameter 2 meters and target depth 15 meters.

It. No.	Description of the activity	Unit	Quantity	Unit price in Birr	Total price in Birr	Remark
1	SITE CLEARING	m^2	25	2.2	55	
2	DIGGING (2 m diameter)				0	
	Digging from 1 up to 3 meter	m	3	17	51	Ordinary soil
	Digging from 3 up to 4.5 meter	m	1.5	29	43.5	Ordinary soil
	Digging from 4.5 up to 6 meter	m	1.5	40	60	Hard soil
	Digging from 6 up to 9 meter	m	3	57	171	Hard soil
	Digging from 9 up to 12 meter	m	3	74	222	Hard soil
	Digging from 12 up to 13 meter	m	1	110	110	Hard soil
	Digging from 13 up to 15 meter	m	2	220	440	Rocky
	Dewatering from 10 to 12 meter	m	2	30	60	Dewatering
	Dewatering from 12 to 15 meter	m	3	40	120	Dewatering
3	MAKING 1 m diameter concrete rings	No	31	16.5	511.5	
4	INSTALLING 1 m diameter concrete rings and filling river gravel, soil and stones	No	31	20	620	
5	FILLING 25 cm thick basement hard core	m2	11.3	9	101.7	
6	MAKING 7 cm thick lean concrete above the hard core including drainage ditches	m2	11.3	7	79.1	
7	MAKING 64 cm high masonry work including steps	m3	2.6	44	114.4	
8	MAKING the plastering of the masonry work and shaping work	m2	8.1	7	56.7	
9	MAKING 12 cm thick reinforced concrete slab including pump stand and manhole	m3	0.72	110	79.2	
10	MAKING 8 m x8 m fence	Sum	1	44	44	
11	MAKING a cattle through and a wash basing with concrete cylinder(the price includes cylinder production)	No	2	28	56	
12	DISINFECTION of the well	Sum	1	44	44	
13	PUMP installation				0	
	Depth up to 15 m	Sum	1	66	66	
	Total				**3105.1**	

Table 2.6: Artisans Labor cost for school water point from hand dug well where the soil around the well is not black cotton, the well has diameter of 1.5 meters & target depth 20 meters.

It. No	Description of the activity	Unit	Quantity	Unit price in Birr	Total price in Birr	Remark
A	Well Digging and Construction					
1	SITE CLEARING	m^2	25	2.2	55	
2	DIGGING (1,5 m diameter)					
	Digging from 1 up to 3 meter	m	3	13	39	Ordinary soil
	Digging from 3 up to 6 meter	m	3	17	51	Ordinary soil
	Digging from 6 up to 9 meter	m	3	40	120	Hard soil
	Digging from 9 up to 12 meter	m	3	57	171	Hard soil
	Digging from 12 up to 15 meter	m	3	74	222	Hard soil
	Digging from 15 up to 17 meter	m	2	110	220	Hard soil
	Digging from 17 up to 20 meter	m	3	220	660	Rocky
	Dewatering from 15 to 20 meter	m	5	40	200	Dewatering
3	MAKING 1 m diameter concrete rings	No	41	12.5	512.5	
4	INSTALLING 1 m diameter concrete rings and filling river gravel, soil and stones	No	41	15	615	
5	FILLING 25 cm thick basement hard core	m2	13.61	9	122.49	
6	MAKING 7 cm thick lean concrete above the hard core including drainage ditches	m2	13.61	7	95.27	
7	MAKING 64 cm high masonry work including steps as shown in the drawing.	m3	3.03	44	133.32	
8	MAKING the plastering of the masonry work and shaping work	m2	9.23	7	64.61	
9	MAKING 12 cm thick reinforced concrete slab including pump stand and manhole	m3	0.7	110	77	
10	MAKING 8 m x8 m fence	Sum	1	44	44	
11	MAKING a cattle through and a wash basing with concrete cylinder(the price includes cylinder production)	No	2	28	56	
12	DISINFECTION of the well	Sum	1	44	44	
13	PUMP installation					
	Depth up to 15 m	Sum	1	66	66	
14	MAKING 120/100cm x 50cm high R.C cylinder to be used as water storage tank in 1:2:3 concrete mix, plaster its inside walls, and cement screed its floor slab. The cover slab is 8cm thick RC in 1:2:3 mix ratio.	No.	1	55	55	
15	Installation of all the necessary pipes and fittings.	Sum	1	50	50	
	Total Labor Cost				**3673.19**	

Table 2.7: Artisans Labor cost for school water point from hand dug well where the soil around the well is not black cotton, the well has diameter of 1.5meters & target depth 15 meters.

It. No.	Description of the activity	Unit	Quantity	Unit price in Birr	Total price in Birr	Remark
A	Well Digging and Construction					
1	SITE CLEARING	m^2	25	2.2	55	
2	DIGGING (1,5 m diameter)					
	Digging from 1 up to 3 meter	m	3	13	39	Ordinary soil
	Digging from 3 up to 4.5 meter	m	1.5	17	25.5	Ordinary soil
	Digging from 4.5 up to 6 meter	m	1.5	24	36	Hard soil
	Digging from 6 up to 9 meter	m	3	40	120	Hard soil
	Digging from 9 up to 12 meter	m	3	57	171	Hard soil
	Digging from 12 up to 13 meter	m	1	74	74	Hard soil
	Digging from 13 up to 15 meter	m	2	220	440	Rocky
	Dewatering from 10 to 12 meter	m	2	20	40	Dewatering
	Dewatering from 12 to 15 meter	m	3	30	90	Dewatering
3	MAKING 1 m diameter concrete rings	No	41	12.5	512.5	
4	INSTALLING 1 m diameter concrete rings and filling river gravel, soil and stones	No	41	15	615	
5	FILLING 25 cm thick basement hard core	m2	13.61	9	122.49	
6	MAKING 7 cm thick lean concrete above the hard core including drainage ditches	m2	13.61	7	95.27	
7	MAKING 64 cm high masonry work including steps as shown in the drawing.	m3	3.03	44	133.32	
8	MAKING the plastering of the masonry work and shaping work	m2	9.23	7	64.61	
9	MAKING 12 cm thick reinforced concrete slab including pump stand and manhole	m3	0.7	110	77	
10	MAKING 8 m x8 m fence	Sum	1	44	44	
11	MAKING a cattle through and a wash basing with concrete cylinder(the price includes cylinder production)	No	2	28	56	
12	DISINFECTION of the well	Sum	1	44	44	
13	PUMP installation					
	Depth up to 15 m	Sum	1	66	66	
14	MAKING 120/100cm x 50cm high R.C cylinder to be used as water storage tank in 1:2:3 concrete mix, plaster its inside walls, and cement screed its floor slab. The cover slab is 8cm thick RC in 1:2:3 mix ratio.	No.	1	55	55	
15	Installation of all the necessary pipes and fittings.	Sum	1	50	50	
	Total Labor Cost				**3025.69**	

Table 2.8: Artisans Labor cost for school water point from hand dug well where the soil around the well is black cotton, the well has a diameter of 1.5 meters and target depth 20 meters.

It. No.	Description of the activity	Unit	Quantity	Unit price in Birr	Total price in Birr	Remark
A	**Well Digging and Construction**					
1	SITE CLEARING	m^2	25	2.2	55	
2	DIGGING (1,5 m diameter)					
	Digging from 1 up to 3 meter	m	3	13	39	Ordinary soil
	Digging from 3 up to 6 meter	m	3	17	51	Ordinary soil
	Digging from 6 up to 9 meter	m	3	40	120	Hard soil
	Digging from 9 up to 12 meter	m	3	57	171	Hard soil
	Digging from 12 up to 15 meter	m	3	74	222	Hard soil
	Digging from 15 up to 17 meter	m	2	110	220	Hard soil
	Digging from 17 up to 20 meter	m	3	220	660	Rocky
	Dewatering from 15 to 20 meter	m	5	40	200	Dewatering
3	MAKING 1 m diameter concrete rings	No	41	12.5	512.5	
4	INSTALLING 1 m diameter concrete rings and filling river gravel, soil and stones	No	41	15	615	
5	FILLING 25 cm thick basement hard core	m2	8.91	9	80.19	
6	MAKING 7 cm thick lean concrete above the hard core including drainage ditches	m2	8.91	7	62.37	
7	MAKING 64 cm high masonry work including steps	m3	1.95	44	85.8	
8	MAKING the plastering of the masonry work and shaping work	m2	6.8	7	47.8	
9	MAKING 12 cm thick reinforced concrete slab including pump stand and manhole	m3	0.5	110	55	
10	MAKING 8 m x8 m fence	Sum	1	44	44	
11	MAKING a cattle through and a wash basing with concrete cylinder(the price includes cylinder production)	No	2	28	56	
12	DISINFECTION of the well	Sum	1	44	44	
13	PUMP installation					
	Depth from 15 m up to 20 m	Sum	1	77	77	
	Sub Total				**3417.66**	
B	**Construction of Students Drinking Area**					
1	SITE CLEARING	m^2	12	2.2	26.4	
2	FILLING 25 cm thick basement hard core	m2	7.05	9	63.45	
3	MAKING 7 cm thick lean concrete above the hard core including drainage ditches	m2	7.05	7	49.35	

4	MAKING 64cm high masonry work for supporting the cylindrical water tank in 1:4 mortar mix	M^3	1.26	44	55.44	
5	MAKING 3cm thick cement screeding for smoothening the top of the masonry in 1:3 mortar mix	M^2	1.96	7	13.72	
6	MAKING two coats of 12.5mm thick plastering of the masonry work in 1:4 mix ratio.	M^2	3.75	7	26.25	
7	MAKING 120/100cm x 50cm high R.C cylinder to be used as water storage tank in 1:2:3 concrete mix, plaster its inside walls, and cement screed its floor slab. The cover slab is 8cm thick RC in 1:2:3 mix ratio.	No.	1	55	55	
8	MAKING average of 1.5meters high (including the foundation) trapezoidal masonry wall for supporting the pipe from the pump to the R.C cylinder as shown in the drawing if necessary.	M^3	0.3	44	13.2	
9	MAKING 76cm high (above the ground) 40x40cm masonry made pot rest for women carrying pot in hand dug wells serving both school and community.	M^3	0.12	44	5.28	
10	Installation of all the necessary pipes and fittings.	Sum	1	50	50	
	Sub Total				**358.09**	
	Total Labor Cost				**3775.75**	

Table 2.9 : Artisans labor cost for school water point from hand dug well where the soil around the well is black cotton, the well has a diameter of 1.5 meters and target depth 15 meters.

I.No.	Description of the activity	Unit	Quantity	Unit price in Birr	Total price in Birr	Remark
A	**Well Digging and Construction**				2484.16	
B	**Construction of Students Drinking Area**				358.09	
	Total Labor Cost				**2842.25**	

2.1.2 Community Labor Cost /Unskilled Labor Cost/

The unskilled labor for the programme work is covered by the community through participation. The number of community members/individuals/ which participate per day for hand dug well and spring construction depends on the type of work to be done daily and ranges from 5 to 15 people. For cost estimating purpose we can take 8 people per day on an average.

In order to calculate the monetary value of the community contribution, it is better to estimate the number of working days required to complete the well digging of different depths and construction of spring with collection chamber. Also the average labor cost of one unskilled labor if it was paid to the laborers needs to be known. Based on some data collected from woredas the average daily payment of unskilled labor in the programme woredas is estimated to be 5 Birr/day.

It is also important to fix the average number of working days required for construction in order to estimate the unskilled labor cost. It is known that the number of days required to perform a hand dug well or spring construction will depend mainly on the depth of the well to be dug, the hardness of the formation to be dug, the area of the spring capping structure to be capped, the rate of community participation, the timely supply of construction materials to the site, the efficiency of the supervisor to regularly supervise the site and give solutions to problems timely.

Based on some data collected , the average number of working days required to complete spring development, hand dug wells for community use and hand dug well for school use are shown in Table 2.10 below.

Table 2.10: Average number of working days required to complete the construction of spring development and hand dug well.

It No.	Description	Required number of working days for construction	Remark
1	Construction of spring capping structure with 2 mcu capacity masonry made collection camber.	40	
2	Digging and construction of 1.5 meters diameter and 10 meters deep hand dug well for community or school use	40	
3	Digging and construction of 1.5 meters diameter and 15 meters deep hand dug well for community or school use	50	
3	Digging and construction of 1.5 meters diameter and 20 meters deep hand dug well for community or school use	60	
4	Digging and construction of 2 meters diameter and 15 meters deep hand dug well for community or school use	65	

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Based on the above table and the average unskilled labor cost of 5 Birr/day in most of the programme woredas, the total estimated cost of unskilled labors required for construction of spring development and hand dug well are shown in Table 2.11 below.

Table 2.11:The total estimated cost of unskilled labors required for construction of spring development and hand dug well.

It. No.	Description	Unit	Quanuty	Daily labor cost (Birr)	Total labor cost	Remark
1	Construction of spring capping structure with 2 mcu capacity masonry made collection camber.	Mandays	40 days x 8 people/day = 320	5	1600	
2	Digging and construction of 1.5 meters diameter and 10 meters deep hand dug well for community or school use	Mandays	40 days x 8 people/day = 320	5	1600	
3	Digging and construction of 1.5 diameter and 15 meters deep hand dug well for community or school use	Mandays	50 days x 8 people/day = 400	5	2000	
4	Digging and construction of 1.5 meters diameter and 20 meters deep hand dug well for community or school use.	Mandays	60 days x 8 people/day = 480	5	2400	
5	Digging and construction of 2 meters diameter and 15 meters deep hand dug well for community or school use.	Mandays	65 days x 8 people/day = 480	5	2600	

2.2 Material Cost

2.2.1 Determination of Material Requirement

In order to calculate the material cost first calculating the quantity of each work item as per the designs prepared is necessary. The quantity of work used in the calculation of the artisan labor cost is used also for this purpose. In order to calculate the quantity of reinforcement bars required for construction of the water points, the reinforcement bar schedules shown from **Annex 1 to Annex 6** are used.

After calculating the quantity of work for each activity, the type and quantity of materials for each activity are calculated. For this calculation a guideline prepared by the former Building Construction Authority with some adjustment made on the basis of field experience are used. The detail calculation is made so that the procedure to be used in the future for other related works. The summarized quantity of materials required for spring development, hand dug well for community use and hand dug well for school use are shown from Table 2.12 to Table 2.18.

2.2.1.1 Quantity of materials required for a spring capping structure with 2 mcu capacity collection chamber.

1) Spring Eye

1.a) Mass concrete work below masonry foundation
Volume of concrete = 0.54 mcu
Concrete mix ratio 1:3:6
1.a.1) Cement = 4.2 bags/mcu x 0.54 mcu = 2.3 bags = 3 bags
1.a.2) Sand = 0.41 mcu/mcu x 0.54 mcu = 0.25
1.a.3) Coarse aggregate = 0.82 mcu/mcu x 0.54 mcu = 0.5

1.b) Masonry work for the box of spring eye
Total volume of masonry = 5 mcu
Mortar mix ratio 1:3
1.b.1) Cement = 3.3 bags/mcu x 5 mcu = 16.5 bags = 17 bags
1.b.2) Sand = 0.32 mcu/mcu x 5 mcu = 1.6 mcu
1.b.3) Stone =1.4 mcu/mcu x 5 mcu = 7 mcu

1.c) Plastering the internal walls of capping structure (1:3)
Area to be plastered = 2.84 msq.
Mortar mix ratio 1:3
1.c.1) Cement = 0.36 bags/msq x 2.84 msq = 1 bag
1.c.2) Sand = 0.04 mcu/msq x 2.84 msq = 0.11 mcu

1.d) Filling the spring box with stone or gravel
Total volume of river gravel = 5 mcu

1.e) Casting 10 cm thick mass concrete on the top of the spring eye
Total volume of concrete = 0.1 mx6 msq = 0.6 mcu
Concrete mix ratio 1:3:6
1.e.1) Cement = 4.2 bags/mcu x 0.6 mcu = 2.5 bags
1.e.2) Sand = 0.41 mcu/mcu x 0.6 mcu = 0.25 mcu
1.e.3) Coarse aggregate = 0.82 mcu/mcu x 0.6 mcu = 0.5 mcu

1.f) Reinforced concrete for manhole cover
Total volume = 0.1 m x 0.8 m x 0.8 m = 0.064 mcu
Concrete mix ratio 1:2:4
1.f.1) Cement = 6 bags/mcu x 0.064 mcu = 0.5 bags
1.f.2) Sand = 0.39 mcu/mcu x 0.064 mcu = 0.03 mcu
1.f.3) Coarse aggregate = 0.78mcu/mcu x 0.064 mcu = 0.05 mcu
1.f.4) Reinforcement bar ϕ 10mm = 4.3Kg **(see annex-1)**
1.f.5) 1.5 mm black wire = 0.01 kg/kg x 4.3 kg = 0.05 kg

1.g) Pointing external walls of spring capping structure
Area to be pointed = 1.05 msq.
Mortar mix ratio 1:3
1.g.1) Cement = 0.06 bags/msq x 1.05 msq = 0.06 bags
1.g.2) Sand = 0.006 mcu/msq x 1.05 msq = 0.01 mcu

2) Collection Chamber of 2mcu capacity

2.a) Basement masonry works
Total volume of masonry = 4 mcu
Mortar mix ratio 1:3
2.a.1) Cement = 3.3 bags/mcu x 4 mcu = 13.2 bags = 14 bags
2.a.2) Sand = 0.32 mcu/mcu x 4 mcu = 1.28 mcu
2.a.3) Stone = 1.4 mcu/mcu x 4 mcu = 5.6 mcu

2.b) 25 cm thick hard core filling
Total area to be filled = 7.36 msq
2.b.1) Stone = 0.35 mcu/msq x 7.36 msq = 2.7 mcu

2.c) 5 cm thick lean concrete above hardcore
Volume = 0.05 m x 7.36 msq = 0.4 mcu
Concrete mix ration 1:3:6
2.c.1) Cement = 4.2 bags/muc x 0.4 mcu = 1.7 bags = 2 bags.
2.c.2) Sand = 0.41 mcu/mcu x 0.4 mcu = 0.16 mcu
2.c.3) Coarse aggregate = 0.82 mcu/mcu x 0.4 mcu = 0.32 mcu

2.d) 12 cm thick reinforced concrete watertight floor slab
Total volume of concrete = 0.6 mcu
Concrete mix ratio 1:2:3
2.d.1) Cement = 7 bags/mcu x 0.6 mcu = 4 bags
2.d.2.) Sand = 0.46 mcu/mcu x 0.6 mcu = 0.25 mcu
2.d.3) Coarse aggregate = 0.7 mcu/mcu x 0.6 mcu = 0.4 mcu
2.d.4) Reinforcement bar ϕ10 = 36.5 kg **(see annex -1)**
2.d.5) 1.5 mm black wire = 0.01 kg/kg x 37 kg = 0.4 kg

2.e) 50 cm thick masonry work for the collection chamber wall.
Total volume of masonry = 5 mcu
Mortar mix ratio 1:3
2.e.1) Cement = 3.3 mcu/mcu x 5 mcu = 16.5 bags = 17 bags
2.e.2) Sand = 0.32 mcu/mcu x 5mcu = 1.6 mcu
2.e.3) Stone = 1.4 mcu/mcu x 5 mcu = 7 mcu

2.f) 25 mm thick three coats plastering the inside wall of the collection chamber
Total area to be plastered = 6 msq
Mortar mix ratio 1:3
2.f.1) Cement = 0.36 bag/msq x 6 msq = 2.2 bags = 3 bags
2.f.2) Sand = 0.04 mcu/msq x 6 msq = 0.24 mcu

2.g) 12 cm thick RC cover slab for the collection chamber
Total volume of concrete = 0.6 mcu
Concrete mix ratio 1:2:4
2.g.1) Cement = 6 bags/mcu x 0.6 mcu = 3.6 bags = 4 bags
2.g.2) Sand = 0.41 mcu/mcu x 0.6 mcu = 0.25 mcu
2.g.3) Coarse Aggregate = 0.82 mcu/mcu x 0.6 mcu = 0.5 mcu
2.g.4) Reinforcement bar ϕ10 mm =45.4 kg **(see annex –1)**
2.g.5) 1.5 mm black wire = 0.01 kg/kg x 45.4 kg = 0.5 kg

2.h) Pointing the external walls of the collection chamber
Area to be pointed = 7.08 msq
Mortar mix ratio 1:3
2.b.1) Cement = 0.06 bags/mcu x 7.08 msq = 0.5 bags.
2.b.2) Sand = 0.006 mcu/msq x 7.08 msq = 0.05 mcu

2.i) 25mm thick cement screeding above the floor slab of the collection chamber.
Area to be screeded = 2 msq
Mortar mix ratio 1:3
2.i.1) Cement = 0.36 bags/msq x 2 msq = 1 bag.
2.i.2) Sand = 0.04 mcu/msq x 2msq = 0.1 mcu

2.f) Pipes and fittings work (required pipes and fittings are shown in Table 2.12).

The total estimated requirement for each material for a spring capping structure with 2 mcu capacity collection chamber as per the attached drawings is summarized and shown in Table 11 below.

Table 2.12: The total estimated material requirement for a spring capping structure with 2 mcu capacity collection chamber.

It. No.	Description of Material	Unit	Quantity of materials required for spring development	
			With collection chamber	**Without collection chamber**
1	Cement	Bags	3+17+1+2.5+0.5+0.06+14+2+4+17+3+4+0.5 +1 = 70	3+17+1+2.5+0.5+0.06 = 24
2	Sand	Mcu	0.25+1.6+0.11+0.25+ 0.03+0.01+1.28+0.16+0.25+ 1.6+0.24+0.25+0.05+0.1 = 6	0.25+1.6+0.11+0.25+0.03+0.01= 2.3 = 3
3	Coarse aggregate	Mcu	0.5+0.5+0.05+0.32+0.4+0.5 = 2.27 = 2.5	0.5+0.5+0.05= 1
4	Stone	Mcu	7+5.6+2.7+7 = 22.3mcu = 23	7
5	River gravel	Mcu	5	5
6	ϕ10 mm reinforcement bar	Pcs	0.5+5+5.5 = 11	11
7	ϕ 1.5 mm black wire	Kg	0.05 + 0.4+0.5 = 1	0.05
9	4 m long x 20 cm high x 2.5 cm thick form work timber	Pcs	4	2
10	Nails	Kg	5	3
11	6-10 mm diameter eucalyptus poles	Pcs	72 (for formworking and fencing around the water point).	52 (for formworking and fencing around the water point).
12	G-30 CIS	Pcs	2	1
13	Burned oil	Liter	1	1
8	Pipes and fittings			
8.1	2” G.I pipe	Pcs	5	2
8.2	2” Gate valve	Pcs	1	
8.3	2” Nipples	Pcs	2	
8.4	2” Union	Pcs	4	
8.5	2” Tee	Pcs	1	
8.6	2” Plug	Pcs	2	1
8.7	2” Coupling	Pcs	2	1
8.8	2” Elbow	Pcs	7	3
8.9	¾” G.I pipe	Pcs	1	
8.10	¾” Coupling	Pcs	4	
8.11	¾” Faucet	Pcs	4	

NB. 1. The material requirement may be higher if wastage of materials is more than 10%.

2. For ease of procurement and practical purposes materials are adjusted to the nearest full mcu, bag, liters or Kg.

3. If the area of the capping structure and the size of the collection chamber increased above the design prepared, poor foundation is encountered in the spring capping structures which need R.C foundation beam construction & the distance of the collection chamber is above 24 meters from the spring capping structure, the quantity of construction materials such as cement, sand, coarse aggregate, 6 mm diameter bar, 10 mm diameter bar, 1.5 mm black wire and 2” G.I pipe will increase.

2.2.1.2 Quantity of materials required for hand dug wells for community use.

Quantity of materials required for a well of 1.5 meters diameter and 20 meters deep.

a) Production of 0.5 meters high, 1 meters internal diameter and 1.2 meters external diameter R.C cylinder
Total volume of concrete $=3.14(0.6^2 - 0.5^2) \times 0.5\ m = 0.17$ mcu
Concrete mix ratio 1:2:4

a.1) Materials required for one cylinder:
a.1.1) Cement = 6 bags/mcu x 0.17 mcu = 1 bag
a.1.2) Sand = 0.39 mcu/mcu x 0.17 mcu = 0.07 mcu
a.1.3) Coarse aggregate = 0.78 mcu/mcu x 0.17 mcu = 0.14 mcu
a.1.4) Reinforcement bar ϕ 6mm = 2.63 kg **(see annex - 3)**
a.1.5) Black wire ϕ 1.5mm = 0.01kg/kg x 2.63 kg = 0.03 kg
a.1.6) Burned oil = 0.1 lit./msq x 3.5msq (area of mould to be painted for 1 cylinder) = 0.35 lit.

a.2) Total number of cylinders required = 43 pcs (including one for cloth washing basin and one for cattle trough)
a.2.1) Cement = 1 bag/cylinder x 43 cylinders = 43 bags
a.2.2) Sand = 0.07 mcu/cylinder x 43 cylinders = 3 mcu
a.2.3) Coarse aggregate = 0.14 mcu/cylinder x 43 cylinders = 6 mcu
a.2.4) Reinforcement bar ϕ 6 mm = 2.63 kg/cylinder x 43 cylinders = 113 kg
a.2.5) Black wire ϕ 1.5 mm = 0.03 kg/cylinder x 43 cylinders = 1.3 kg = 1.5 kgs
a.2.6) Burned oil = 0.35 liters/cylinder x 43 cylinders = 15 liters

b) Filling 25 cm thick basement hardcore
Area to be filled = 8.91 msq
b.1) Stone = 0.35 mcu/msq x 8.91 msq = 3.1mcu

c) Making 7 cm thick lean concrete above the hard core including drainage ditch
Volume = 0.07m x 8.91msq = 0.62 mcu
Concrete mix ratio 1:3:6
c.1) Cement = 4.2 bags/mcu x 0.62 mcu = 2.6 bags = 3 bags
c.2) Sand = 0.41 mcu/mcu x 0.62 mcu = 0.25 mcu
c.3) Coarse aggregate = 0.82 mcu/mcu x 0.62 mcu = 0.5 mcu

d) Making 64 cm high masonry work for well head including steps
Volume of masonry = 1.95 mcu
Mortar mix ratio 1:4
d.1) Cement = 2.7 bags/mcu x 1.95 mcu = 5.3 bags = 6 bags
d.2) Stone = 1.4 mcu/mcu x 1.95 mcu = 2.7 mcu
d.3) Sand = 0.34 mcu/mcu x 1.95 mcu = 0.7 mcu

e) Making two coats plastering (25mm thick) of the masonry work and shaping work.
Area to be plastered = 6.8 msq
Mortar mix 1:3
e.1) Cement = 0.36 bag/msq x 6.8 msq = 2.5 bags = 3 bags
e.2) Sand = 0.04 mcu/msq x 6.8 msq = 0.3 mcu

f) Making 12 cm thick R.C well head slab including pump stand and manhole cover
Volume of concrete work = 0.5 mcu
Concrete mix ratio 1:2:4
f.1) Cement = 6 bags/mcu x 0.5 mcu = 3 bags
f.2) Sand = 0.39 mcu/mcu x 0.5 mcu = 0.2 mcu
f.3) Coarse aggregate = 0.78 mcu/mcu x 0.5 mcu = 0.4 mcu
f.4) Reinforcement bar ϕ10 mm = 27.9 kg **(see annex –2).**
f.5) Black wire ϕ1.5 mm = 0.01 kg/kg x 27.9 kg = 0.3 kg

g) River gravel for filling the annular space between the well and the cylinder (assuming water strike level is at 10 meters and river gravel is to be filled to this level starting from the bottom of the well).
g.1) Volume of river gravel = $3.14(0.75^2 - 0.6^2)$ x 10 meters = 7 mcu

h) Materials for formworking of the construction of drainage ditch and well head.
Form work area = 4 msq
h.1) 4 meters long x 25 cm high and 2.5 cm form work timber = 4 pcs
h.2) Nails = 0.3 kg/msq x 4 msq = 1.2 kgs. = 1.5 kgs.
h.3) 6-10 mm diameter eucalyptus poles = 2 meters/msq x 4 msq = 8 meters or 2 Pcs
h.4) Burned oil for painting formwork panels = 0.1 liters/msq x 4 msq = 0.4 liters = 0.5 liters
h.5) G- 30 CIS for formwork of well head interior = 1 Pcs

i) Fencing the well area (wood is to be provided by the community)
i.1) Nails = 4 kgs
i.2) G-30 corrugated iron sheet = 1 Pcs
i.3) Eucalyptus poles of different size = 50 Pcs

j) For some activities such as jointing cylinders by mortar, preparation of cemented platform for cylinder production and for mixing concrete or mortar and for other unforeseen activities 2/two/ bags of cement are proposed to be added above & over the above quantities.

The total estimated requirement of each material for a well of 1.5 meters diameter and 20 meters deep is summarized and shown in Table 2.13 below.

Table:2.13 The total estimated material requirement for a well of 1.5 meters diameter and 20 meters deep.

Item No.	Description of Material	Unit	Quantity	Remark
1	Cement	Bags	43+3+6+3+3 + 2 = 60	60
2	Sand	Mcu	3+0.25+0.7+0.3+0.2 = 4.45	5
3	Coarse aggregate	Mcu	6+0.5+0.4 = 6.9	7
4	Stone	Mcu	3.1+2.7 = 5.8	6
5	River gravel	Mcu	7	7
6	ϕ10 reinforcement bar	Pcs	4	4
7	ϕ 6 reinforcement bar	Kg	113	113
8	ϕ 1.5mm black wire	Kg	1.5+0.25 =1.75	2
9	4m long x 20cm high x 2.5cm thick form work timber	Pcs	4	4
10	Nails	Kgs	1.5+3.5 = 5 kgs	5
11	6-10 mm diameter eucalyptus poles	Pcs	52	For well fencing and form working and be supplied by the community.
12	G-30 CIS	Pcs	2	2
13	Burned oil	Liters	15 + 0.5 = 15.5 liters	16
14	Afridev hand pump with all its accessories.	Set	1	1

NB. 1. The material requirement may be higher if wastage of materials is more than 10%.

2. For ease of procurement and practical purposes materials are adjusted to the nearest full mcu, bag, liters or Kg.
3. If the well diameter is more than 1.5 meters and the larger diameter cylinder is used, the quantity of cement, sand, coarse aggregate, 6mm diameter bar, 1.5mm black wire and burned oil will increase.

Quantity of materials required for a well of 1.5 meters diameter and 15 meters deep.

In this case the only difference from the well of 20 meters deep is the quantity of materials required for cylinder production and may be the amount of river gravel to be filled in the well but other materials for the well head remains unchanged because the well head design to be used in both cases is a standard design suitable for different well depths of the same diameter.

Therefore the differences in materials are calculated as follows:
Number of cylinders required = 33 (including cloth washing basin and cattle trough).

- Cement = 1 bag/cylinder x 33 cylinders = 33 bags
- Sand = 0.07 mcu/cylinder x 33 cylinders = 2.3 mcu
- Coarse aggregate = 0.14 mcu/cylinder x 33 cylinders = 4.6 mcu
- Reinforcement bar ϕ 6mm = 2.63 kg/cylinder x 33 cylinders = 87 kg
- Black wire ϕ 1.5 mm = 0.03 kg/cylinder x 33 cylinders = 0.9 kg = 1 kgs
- Burned oil = 0.35 liters/cylinder x 33 cylinders = 11.5 liters =12 liters

For river gravel determination assuming water strike level is at 7 meters and river gravel is to be filled to this level starting from the bottom of the well.

- Volume of river gravel = $3.14(0.75^2 - 0.6^2)$ x 8 meters = 5 mcu

Table 2.14 The total estimated material requirement for a well of 1.5 meters diameter and 15 meters deep.

Item No.	Description of Material	Unit	Quantity	Remark
1	Cement	Bags	33+3+6+3+3 +2 = 49	50
2	Sand	Mcu	2.3+0.25+0.7+0.3+0.2 = 3.75	4
3	Coarse aggregate	Mcu	4.6+0.5+0.4 = 5.5	6
4	Stone	Mcu	3.1+2.7 = 5.8	6
5	River gravel	Mcu	5	5
6	ϕ10 mm reinforcement bar	Pcs	22	3.5
7	ϕ 6 mm reinforcement bar	Kg	87	87
8	ϕ 1.5 mm black wire	Kg	1+0.25 =1.25	1.5
9	4 m long x 20 cm high x 2.5 cm thick form work timber	Pcs	4	4
10	Nails	Kgs	1.5+3.5 = 5 kgs	5
11	6-10 mm diameter eucalyptus poles	Pcs	52	For well fencing and form working and be supplied by the community..
12	G-30 CIS	Pcs	2	2
13	Burned oil	Liters	12 + 0.5 = 12.5 liters	13
14	Afridev hand pump with all its accessories.	Set	1	1

Table 2.15 The total estimated material requirement for a well of 1.5 meters diameter and 10 meters deep.

Item No.	Description of Material	Unit	Quantity	Remark
1	Cement	Bags	23+3+6+3+3 +2 = 40	40
2	Sand	Mcu	1.7+0.25+0.7+0.3+0.2 = 3.2	4
3	Coarse aggregate	Mcu	3.4+0.5+0.4 = 4.3	5
4	Stone	Mcu	3.1+2.7 = 5.8	6
5	River gravel	Mcu	3	3
6	ϕ10 mm reinforcement bar	Pcs	4	4
7	ϕ 6 mm reinforcement bar	Kg	61	61
8	ϕ 1.5 mm black wire	Kg	1+0.25 =1.25	1.5
9	4 m long x 20 cm high x 2.5 cm thick form work timber	Pcs	4	4
10	Nails	Kgs	1.5+3.5 = 5 kgs	5
11	6-10 mm diameter eucalyptus poles	Pcs	52	For well fencing and form

				working and be supplied by the community..
12	G-30 CIS	Pcs	2	2
13	Burned oil	Liters	8 + 0.5 = 8.5 liters	9
14	Afridev hand pump with all its accessories.	Set	1	1

Materials quantity required for a well of 2 meters diameter and 15 meters deep.

Excavated diameter well of 2 meters is usually required when the soil where the well is to be dug is soft formation and sensitive for collapse. The external and internal diameter of the R.C cylinder, which is to be installed in such well, is 170 centimeters and 150 centimeters respectively.

a) Production of 0.5meters high, 1.5 meters internal diameter and 1.7 meters external diameter R.C cylinder
Total volume of concrete =$3.14(0.85^{2} – 0.75^{2})$ x 0.5 m = 0.25 mcu
Concrete mix ratio 1:2:4

a.1) Materials required for one cylinder:
a.1.1) Cement = 6 bags/mcu x 0.25 mcu = 1.5 bag
a.1.2) Sand = 0.39 mcu/mcu x 0.25 mcu = 0.1 mcu
a.1.3) Coarse aggregate = 0.78 mcu/mcu x 0.25 mcu = 0.2 mcu
a.1.4) Reinforcement bar ϕ 6mm = 3.88 kg (see annex - 3)
a.1.5) Black wire ϕ 1.5mm = 0.01kg/kg x 3.88 kg = 0.04 kg
a.1.6) Burned oil = 0.1 lit./msq x 4.74 msq (area of mould to be painted for 1 cylinder) = 0.47 lit.

a.2) Total number of cylinders required = 33 pcs (including one for cloth washing basin and one for cattle trough)
a.2.1) Cement = 1.5 bag/cylinder x 33 cylinders = 50 bags
a.2.2) Sand = 0.1 mcu/cylinder x 33 cylinders = 3.3 mcu
a.2.3) Coarse aggregate = 0.2 mcu/cylinder x 33 cylinders = 6.6 mcu
a.2.4) Reinforcement bar ϕ 6 mm = 3.88 kg/cylinder x 33 cylinders = 128 kg
a.2.5) Black wire ϕ 1.5 mm = 0.04 kg/cylinder x 33 cylinders = 1.32 kg = 1.5 kgs
a.2.6) Burned oil = 0.47 liters/cylinder x 33 cylinders = 15.5 liters = 16 liters

b) Filling 25 cm thick basement hardcore
Area to be filled = 11.3 msq
b.1) Stone = 0.35mcu/msq x 11.3 msq = 4 mcu

c) Making 7 cm thick lean concrete above the hard core including drainage ditch
Volume of concrete = 0.07 m x 11.3 msq = 0.8 mcu
Concrete mix ratio 1:3:6
c.1) Cement = 4.2 bags/mcu x 0.8 mcu = 3.4 bags = 4 bags
c.2) Sand = 0.41 mcu/mcu x 0.8 mcu = 0.4 mcu
c.3) Coarse aggregate = 0.82 mcu/mcu x 0.8 mcu = 0.7 mcu

d) Making 64 cm high masonry work for well head including steps
   Volume of masonry = 2.6 mcu
   Mortar mix ratio 1:4
   d.1) Cement = 2.7 bags/mcu x 2.6 mcu = 7 bags
   d.2) Stone = 1.4 mcu/mcu x 2.6 mcu = 3.7 mcu
   d.3) Sand = 0.34 mcu/mcu x 2.6 mcu = 0.9 mcu

e) Making two coats plastering (25mm thick) of the masonry work and shaping work.
   Area to be plastered = 8.1 msq
   Mortar mix ratio 1:3
   e.1) Cement = 0.36 bag/msq x 8.1 msq = 3 bags
   e.2) Sand = 0.04 mcu/msq x 8.1 msq = 0.32 mcu

f) Making 12 cm thick R.C well head slab including pump stand and manhole cover
   Volume of concrete = 0.72 mcu
   Concrete mix ratio 1:2:4
   f.1) Cement = 6 bags/mcu x 72 mcu = 4.3 bags = 5 bags
   f.2) Sand = 0.39 mcu/mcu x 0.72 mcu = 0.3 mcu
   f.3) Coarse aggregate = 0.78 mcu/mcu x 0.72 mcu = 0.6 mcu
   f.4) Reinforcement bar ϕ10 mm = 44 kg
   f.5) Black wire ϕ1.5 mm = 0.01 kg/kg x 44 kg = 0.44 kg

g) River gravel for filling the annular space between the well and the cylinder (assuming water strike level is at 7 meters and river gravel is to be filled to this level starting from the bottom of the well).
   g.1) Volume = $3.14(0.75^2 - 0.6^2)$ x 8 meters = 7 mcu

h) Materials for formworking of the construction of drainage ditch and well head.
   Form work area = 5 msq
   h.1) 4 meters long x 25 cm high and 2.5 cm formwork timber = 4 Pcs
   h.2) Nails = 0.3 kg/msq x 5 msq = 1.5 kgs.
   h.3) 6-10 mm diameter eucalyptus poles = 2 meters/msq x 5 msq = 10 meters or 2 Pcs
   h.4) Burned oil for painting formwork panels = 0.1 liters/msq x 5 msq = 0.5 liters
   h.5) G- 30 CIS for formworking of well head interior = 1 Pcs

i) Fencing the well area (wood is to be provided by the community)
   i.1) Nails = 4 kgs
   i.2) G-30 corrugated iron sheet = 1 Pcs
   i.3) Eucalyptus poles of different size = 58 Pcs

j) For some activities such as jointing cylinders by mortar, preparation of cemented platform for cylinder production and for mixing concrete or mortar and for other unforeseen activities 2/two/ bags of cement are proposed to be added above & over the above quantities.

The total estimated requirement of each material for a well of 2 meters diameter and 15 meters deep is summarized and shown in Table 2.16 below.

Table 2.16 The total estimated material requirement for a well of 2 meters diameter and 15 meters deep.

Item No.	Description of Material	Unit	Quantity	Remark
1	Cement	Bags	50+4+7+3+5 +1 = 70	70
2	Sand	Mcu	3.3+0.4+0.9+0.32+0.3 = 5.22	6
3	Coarse aggregate	Mcu	6.6+0.7+0.6 = 7.9	8
4	Stone	Mcu	4+3.7 = 7.7	8
5	River gravel	Mcu	7	7
6	ϕ10 mm reinforcement bar	Pcs	6	6
7	ϕ 6 mm reinforcement bar	Kg	128	128
8	ϕ 1.5 mm black wire	Kg	1.5 + .44 =1.94	2
9	4 m long x 20 cm high x 2.5 cm thick form work timber	Pcs	4	4
10	Nails	Kgs	1.5+3.5 = 5 kgs	5
11	6-10 mm diameter eucalyptus poles	Pcs	60	For well fencing and form working and be supplied by the community.
12	G-30 CIS	Pcs	2	2
13	Burned oil	Liters	15.5 + 0.5 = 16	16
14	Afridev hand pump with all its accessories.	Set	1	1

2.2.1.3 Quantity of material requirement for school water point design from hand dug well source.

The difference of the school water point from the community water points is that the school water point has additional structure to support the concrete water tank and also to create suitable drinking facility for students. The difference of the material requirement of the school water point as compared to community water point of the same depth and diameter is only due to materials required for the construction of the students drinking area and also the construction of the cylindrical water tank.

Therefore, the additional materials required for the students drinking area to be made in school water point is shown below and the total materials required for school water point of the same depth to that of the community water point will be the respective materials calculated earlier for community water point plus the additional materials required for the students drinking area construction as shown below.

The additional material required for the construction of students drinking area and cylindrical water tank for the **alternative design No.2** i.e, where the soil around the well is black cotton is shown in detail as follows.

a) 25 cm thick hardcore filling
Total area to be filled = 7.05 msq
a.1) Stone = 0.35 mcu/msq x 7.05 msq = 2.5 mcu

.b) 7 cm thick lean concrete filling above the hardcore
Total volume of concrete = 0.07 m x 7.05 msq = 0.5 mcu
Concrete mix ratio 1:3:6
b.1) Cement = 4.2 bags/mcu x 0.5 mcu = 2 bags
b.2) Sand = 0.41 mcu/mcu x 0.5 mcu = 0.21 mcu
b.3) Coarse Aggregate = 0.82 mcu/mcu x0.05 mcu = 0.42 mcu

c) 64 cm high masonry work for supporting the cylindrical water tank.
Total volume of masonry = 1.31 mcu
Mortar mix ratio 1:4
c.1) Cement = 2.7 bags/mcu x 1.31 mcu = 3.6 bags = 4 bags
c.2) Sand = 0.34 mcu/mcu x 1.31 mcu = 0.45 mcu
c.3) Stone = 1.4 mcu/mcu x 1.31 mcu = 1.85 mcu

d) 3 cm thick cement screding above the masonry work for placing the water tank.
Total area to be screeded = 1.96 msq
Mortar mix ratio 1:3
d.1) Cement = 0.3 bags/msq x 1.96 msq = 0.6 bag = 1 bag
d.2) Sand = 0.04 mcu/msq x 1.96 msq = 0.1 mcu

e) Two coats plastering of the masonry work supporting the cylindrical water tank.
Total area to be plastered = 3.75 msq
Mortar mix ratio 1:4
e.1) Cement = 0.36 bags/msq x 3.75 msq = 1.5 bag
e.2) Sand = 0.04 mcu/msq x 3.75 msq = 0.15 mcu

f) 1.5 meters high masonry made pipe support.
Total volume of masonry = 0.3 mcu
Mortar mix ratio 1:4
f.1) Cement = 2.7 bags/mcu x 0.3 mcu = 0.81 bag = 1 bag
f.2) Sand = 0.34 mcu/mcu x 0.3 mcu = 0.1 mcu
f.3) Stone = 1.4 mcu/mcu x 0.3 mcu = 0.42 mcu

g) 0.75 meters high masonry made pot rest for women carrying (in the case of communal use of the water point by the school and community).
Total volume of masonry = 0.12 mcu
Mortar mix ratio 1:4
g.1) Cement = 2.7 bags/mcu x 0.12 mcu = 0.32 bag = 0.5 bag
g.2) Sand = 0.34 mcu/mcu x 0.12 mcu = 0.05 mcu
g.3) Stone = 1.4 mcu/mcu x 0.12 mcu = 0.2 mcu

h) Production of 120 cm external and 100 cm internal diameter cylindrical water tank
Volume of concrete work = Volume of the cylindrical concrete cylinder + volume of floor slab of the tank + volume of roof slab of the tank
Total volume of concrete work = 0.17 mcu + 0.08 mcu + 0.11mcu = 0.36 mcu.
Concrete mix ratio 1:2:3
h.1) Cement = 7 bags/mcu x 0.36 mcu = 2.52 bags = 3 bags

h.2) Sand = 0.46 mcu/mcu x 0.36 mcu = 0.2 mcu
h.3) Coarse aggregate = 0.7 mcu/mcu x 0.36 mcu = 0.25 mcu
h.4) 10 mm diameter reinforcement bar = 17.3kg **(see annex-6).**
h.5) 6 mm diameter bar = 2.63kg
h.6) 1.5 mm diameter black wire = 0.01 kg/kg x 20 kg = 0.02 kg

i) Pipes and fittings

i.1) For molds where 1" diameter hole is made to be used for pipe installation during cylinder production.
i.1.1) 2" G.I pipe = 6 meters or 1 Pcs.
i.1.2) 2" coupling = 1 Pcs.
i.1.3) 2" elbow = 1 Pcs.
i.1.4) 2" union = 1 Pcs.
i.1.5) 1" G.I pipe = 1 meters
i.1.6) 1" tee joint = 2 Pcs
i.1.7) 1" x ¾" reducer = 4 Pcs
i.1.8) ¾" G.I pipe = 1 meters
i.1.9) ¾" coupling = 4 Pcs
i.1.10) ¾" faucet = 4 Pcs

i.2) For moulds no hole is made on it (pipe will be installed after boring the concrete cylinder produced).
i.2.1) 2" G.I pipe = 6meters or 1 Pcs.
i.2.2) 2" coupling = 1 Pcs.
i.2.3) 2" elbow = 1 Pcs.
i.2.4) 2" union = 1 Pcs.
i.2.5) ¾" G.I pipe = 3 meters.
i.2.6) ¾" coupling = 4 PCs
i.2.7) ¾" faucet = 4 Pcs

By the same procedure the additional materials required for **alternative design No.1** i.e., when the soil around the well is not black cotton is calculated and used in the summarization of materials required shown in Table 2.17 & Table 2.18 below.

Table 2.17: Summary of materials for different alternative school water point designs for a well of diameter 1.5 meters and target depth 20 meters.

It. No.	Description of material	Unit	Quantity of materials required for different alternative designs			
			Alternative 2.1	Alternative 2.1	Alternative 1.1	Alternative 1.2
1	Cement	Bags	73	73	69	69
2	Sand	Mcu	6	6	6	6
3	Coarse aggregate	Mcu	8	8	8	8
4	Stone	Mcu	11	11	10	10
5	River gravel	Mcu	7	7	7	7
6	ϕ10 reinforcement bar	Pcs	6	6	6	6
7	ϕ 6 mm black wire	Kg	116	116	116	116
8	ϕ 1.5mm black wire	Kg	2	2	2	2
9	4m long x 20cm high x	Pcs	4	4	4	4

	2.5cm thick formwork timber					
10	Nails	Kg	5	5	5	5
11	6-10 mm diameter eucalyptus poles	Pcs	72	72	72	72
12	G-30 CIS	Pcs	2	2	2	2
13	Burned oil	Lit.	16	16	16	16
14	Pipes and fittings					
14.1	2" G.I pipe	M	6	1	6	1
14.2	2" coupling	Pcs	1	1	1	1
14.3	2" elbow	Pcs	1	1	1	1
14.4	2" union	Pcs	1	1	1	1
14.5	1" G.I pipe	M	1		1	
14.6	1" tee joint	Pcs	1		1	
14.7	1" x ¾" reducer	Pcs	4		4	
14.8	¾" G.I pipe	M	1	3	1	3
14.9	¾" coupling	Pcs	4	4	4	4
14.10	¾" faucet	Pcs	4	4	4	4
14.11	¾" elbow for bending the overflow pipe downward	Pcs	1	1	1	1
14.12	¾" nipples (optional)	Pcs		4		4
14.13	¾" coupling (optional)	Pcs		8		8
15	Afridev hand pump with all its accessories.	Set	1	1	1	1

The explanations of the alternative designs are as follow.

Design alternative 1.1 The soil around the well is black cotton and the mould has holes for 1' pipe installation during concrete cylinder water tank production

Design alternative 1.2 The soil around the well is not black cotton and the mould does not have holes for pipe installation during concrete cylinder water tank production

Design alternative 2.1 The soil around the well is black cotton and the mould has holes for 1' pipe installation during concrete cylinder water tank production

Design alternative 2.2 The soil around the well is not black cotton and the mould does not have holes for pipe installation during concrete cylinder water tank production

Table 2.18: Summary of materials for different alternative school water point designs of 1.5 meters diameter and target depth 15 meters.

It.No.	Description of material	Unit	Quantity of materials required for different alternative designs			
			Alternative 2.1	Alternative 2.1	Alternative 1.1	Alternative 1.2
1	Cement	Bags	73	73	69	69
2	Sand	Mcu	6	6	6	6
3	Coarse aggregate	Mcu	8	8	8	8
4	Stone	Mcu	11	11	10	10
5	River gravel	Mcu	7	7	7	7
6	ϕ10 reinforcement bar	Pcs	6	6	6	6
7	ϕ 6 mm black wire	Kg	90	90	90	90
8	ϕ 1.5mm black wire	Kg	2	2	2	2
9	4m long x 20cm high x 2.5cm thick form work timber	Pcs	4	4	4	4
10	Nails	Kg	5	5	5	5
11	6-10 mm diameter eucalyptus poles	Pcs	72	72	72	72
12	G-30 CIS	Pcs	2	2	2	2
13	Burned oil	Pcs	12	12	12	12
14	Pipes and fittings					
14.1	2” G.I pipe	M	6	1	6	1
14.2	2” coupling	Pcs	1	1	1	1
14.3	2” elbow	Pcs	1	1	1	1
14.4	2” union	Pcs	1	1	1	1
14.5	1” G.I pipe	M	1		1	
14.6	1” tee joint	Pcs	1		1	
14.7	1” x ¾” reducer	Pcs	4		4	
14.8	¾” G.I pipe	M	1	3	1	3
14.9	¾” coupling	Pcs	4	4	4	4
14.10	¾” faucet	Pcs	4	4	4	4
14.11	¾” elbow for bending the overflow pipe downward	Pcs	1	1	1	1
14.12	¾” nipples (optional)	Pcs		4		4
14.13	¾” coupling (optional)	Pcs		8		8
15	Afridev hand pump with all its accessories.	Set	1	1	1	1

2.2.2 Estimation of Material Cost.

The procurement of the construction materials is made in two levels i.e. at regional level by the Project Facilitation Office and at woreda level by Woreda Coordinating Committee. The major materials procured at regional level and distributed to woredas are reinforcement bars, pipes and fitting, hand pumps, timber formworks. corrugated iron sheets and the like.

The local materials to be procured at woreda level are cement, sand, river gravel, nails and the like.

The community supplies other local materials such as stone and eucalyptus poles (for formworking and fencing of water points)..

The material cost used in this estimate for those procured at regional level is the unit price quated by the winner supplier of the year 2001/2002 i.e. December 2001. The cost of these materials does not include the transport of such materials to the woredas.

The materials cost procured at woreda level is estimated based on the average cost of these materials used in the year 2001/2002 work plan preparation. Except cement the cost of other local materials is the cost to dump these materials at site level

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Based on the quantity of materials determined with the detailed procedure shown in section **2.2.1** above, the cost of the materials required for the different types of water points are shown below.

2.2.2.1 Material cost estimate for spring development with 2 mcu capacity collection chamber.

Table 2.19: Material cost for a spring development with 2 mcu capacity masonry made collection chamber.

It. No.	Description of material	Unit	Quantity	Unit Price	Total Price	Remark
1	Cement	Bags	70	50	3500	
2	Sand	Biago	1	1480	1480	
3	Coarse aggregate	Mcu	3	80	240	
4	Stone	Mcu	23	15	345	
5	River gravel	Biago	1	1310	1310	
6	ϕ10 mm reinforcement bar	Pcs	11	28	308	
7	ϕ 6 mm reinforcement bar	Kg		4		
8	ϕ 1.5 mm black wire	Kg	1	6	6	
9	4 m long x 20 cm high x 2.5 cm thick form work timber	Pcs	4	40	160	
10	Nails	Kgs	5	10	50	
11	6-10 mm diameter eucalyptus poles	Pcs	72	4	288	
12	G-30 CIS	Pcs	2	44	88	
13	Burned oil	Liters	1	3	3	
14	Pipes and fittings					
14.1	2” G.I pipe	Pcs	6	170	1020	
14.2	2” Gate valve	Pcs	1	42	42	
14.3	2” Nipples	Pcs	2	6	12	

14.4	2" Union	Pcs	4	11	44	
14.5	2" Tee	Pcs	1	7	7	
14.6	2" Plug	Pcs	2	5	10	
14.7	2" Coupling	Pcs	2	6	12	
14.8	2" Elbow	Pcs	7	7	49	
14.9	¾" G.I pipe	Pcs	1	53	53	
14.10	¾" coupling	Pcs	4	1	4	
14.11	¾" faucets	Pcs	4	15	60	
	Total				**9091**	

N.B. 1. In case of coarse aggregate, out of the 80 Birr unit price, 15 Birr is for cost of stone /mcu as the aggregate is made by crushing of stones and 65 Birr /mcu is for the cost of crushing 1 mcu of stone to aggregate (13 Birr/barrel or 13 Birr/200 liters).

2. One Biago sand is estimated to be 7 mcu.

2.2.2.2 Material cost estimate of hand dug well for community use.

The material cost of hand dug wells of different target depths for community use are shown from Table 2.20 to Table 2.23.

Table 2.20: Material cost for a hand dug well of 1.5 meters diameter and 20 meters depth for community use.

It. No.	Description of material	Unit	Quantity	Unit Price	Total Price	Remark
1	Cement	Bags	60	50	3000	
2	Sand	Biago	1	1480	1480	
3	Coarse aggregate	Mcu	7	80	560	
4	Stone	Mcu	6	15	90	
5	River gravel	Biago	1	1310	1310	
6	ϕ10 mm reinforcement bar	Pcs	4	28	112	
7	ϕ 6 mm reinforcement bar	Kg	113	4	452	
8	ϕ 1.5 mm black wire	Kg	2	6	12	
9	4 m long x 20 cm high x 2.5 cm thick form work timber	Pcs	4	40	160	
10	Nails	Kgs	5	10	50	
11	6-10 mm diameter eucalyptus poles	Pcs	52	4	208	
12	G-30 CIS	Pcs	2	44	88	
13	Burned oil	Liters	16	3	48	
14	Afridev hand pump with all its accessories.	Set	1	3200	3200	
	Total				**10770**	

N.B. 1. In case of coarse aggregate, out of the 80 Birr unit price, 15 Birr is for cost of stone /mcu as the aggregate is made by crushing of stones and 65 Birr /mcu is for the cost of crushing 1 mcu of stone to aggregate (13 Birr/barrel or 13 Birr/200 liters).

2. One Biago sand is estimated to be 7 mcu.

Table 2.21: Material cost for a hand dug well of 1.5 meters diameter and 15 meters depth for community use.

It. No.	Description of material	Unit	Quantity	Unit Price	Total Price	Remark
1	Cement	Bags	50	50	2500	
2	Sand	Baigo	1	1480	1480	
3	Coarse aggregate	Mcu	6	80	480	
4	Stone	Mcu	6	15	90	
5	River gravel	Biago	1	1310	1310	
6	ϕ10 mm reinforcement bar	Kg	4	28	112	
7	ϕ 6 mm reinforcement bar	Kg	87	4	348	
8	ϕ 1.5 mm black wire	Kg	1.5	6	9	
9	4 m long x 20 cm high x 2.5 cm thick formwork timber	Pcs	4	40	160	
10	Nails	Kgs	5	10	50	
11	6-10 mm diameter eucalyptus poles	Pcs	52	4	208	
12	G-30 CIS	Pcs	2	44	88	
13	Burned oil	Liters	13	3	39	
14	Afridev hand pump with all its accessories.		1	3200	3200	
	Total				**10074**	

N.B. 1. In case of coarse aggregate, out of the 80 Birr unit price, 15 Birr is for cost of stone /mcu as the aggregate is made by crushing of stones and 65 Birr /mcu is for the cost of crushing 1 mcu of stone to aggregate (13 Birr/barrel or 13 Birr/200 liters).

2. One Biago sand is estimated to be 7 mcu.

Table 2.22: Material cost for a hand dug well of 1.5 meters diameter and 10 meters depth for community use.

It. No.	Description of material	Unit	Quantity	Unit Price	Total Price	Remark
1	Cement	Bags	40	50	2000	
2	Sand	Baigo	1	1480	1480	
3	Coarse aggregate	Mcu	5	80	400	
4	Stone	Mcu	6	15	90	
5	River gravel	Biago	1	1310	1310	
6	ϕ10 mm reinforcement bar	Kg	4	28	112	
7	ϕ 6 mm reinforcement bar	Kg	61	4	244	
8	ϕ 1.5 mm black wire	Kg	1.5	6	9	
9	4 m long x 20 cm high x 2.5 cm thick form work timber	Pcs	4	40	160	
10	Nails	Kgs	5	10	50	
11	6-10 mm diameter eucalyptus poles	Pcs	52	4	208	
12	G-30 CIS	Pcs	2	44	88	
13	Burned oil	Liters	9	3	27	
14	Afridev hand pump with all its accessories.		1	3200	3200	
	Total				**9378**	

N.B. 1. In case of coarse aggregate, out of the 80 Birr unit price, 15 Birr is for cost of stone /mcu as the aggregate is made by crushing of stones and 65 Birr /mcu is for the cost of crushing 1mcu of stone to aggregate (13Birr/barrel or 13Birr/200 liters). One Biago sand is estimated to be 7 mcu.

Table 2.23: Material cost for a hand dug well of 2 meters diameter and 15 meters depth for community use.

It. No.	Description of material	Unit	Quantity	Unit Price	Total Price	Remark
1	Cement	Bags	70	50	3500	
2	Sand	Baigo	1	1480	1480	
3	Coarse aggregate	Mcu	8	80	640	
4	Stone	Mcu	8	15	120	
5	River gravel	Biago	1	1310	1310	
6	ϕ10 mm reinforcement bar	Pcs	6	28	168	
7	ϕ 6 mm reinforcement bar	Kg	128	4	512	
8	ϕ 1.5 mm black wire	Kg	2	6	12	
9	4 m long x 20 cm high x 2.5 cm thick form work timber	Pcs	4	40	160	
10	Nails	Kgs	5	10	50	
11	6-10 mm diameter eucalyptus poles	Pcs	60	4	240	
12	G-30 CIS	Pcs	2	44	88	
13	Burned oil	Liters	16	3	48	
14	Afridev hand pump with all its accessories.		1	3200	3200	
	Total				**11528**	

N.B.1. In case of coarse aggregate, out of the 80 Birr unit price, 15 Birr is for cost of stone /mcu as the aggregate is made by crushing of stones and 65 Birr /mcu is for the cost of crushing 1 mcu of stone to aggregate (13 Birr/barrel or 13 Birr/200 liters).

2. One Biago sand is estimated to be 7 mcu.

2.2.2.3 Material cost estimate of hand dug well for schools use

As seen in the material cost estimate there are four different alternatives of school hand dug wells based on the nature of the soil around the well and whether the cylinder mold we use for producing the water tank has hole made (there are some woredas where the mold is prepared for this purpose). For the estimate of the material cost, the one which consumes more material is used (alternative design where the soil around the well is black cotton and a 1" diameter hole is made in the mould which produces the water tank).

Based on the above analysis the materials cost for school water point design with a target depth of 20 meters and 15 meters are shown in Table 2.24 and 2.25 respectively.

Table 2.24: Material cost for a school water point where the soil around the well is black cotton and the mould for the concrete water tank production is prepared for installation of 1" pipe during cylinder production. The diameter of the well is 1.5 meters & target depth 20 meters.

It.No.	Description of material	Unit	Quantity	Unit Price	Total Price	Remark
1	Cement	Bags	73	50	3650	
2	Sand	Biago	1	1480	1480	
3	Coarse aggregate	Mcu	8	80	640	
4	Stone	Mcu	11	15	165	
5	River gravel	Biago	1	1310	1310	
6	ϕ10 mm reinforcement bar	Kg	6	28	168	

7	ϕ 6 mm reinforcement bar	Kg	116	4	464	
8	ϕ 1.5 mm black wire	Kg	2	6	12	
9	4 m long x 20 cm high x 2.5 cm thick form work timber	Pcs	4	40	160	
10	Nails	Kgs	5	10	50	
11	6-10 mm diameter eucalyptus poles	Pcs	52	4	208	
12	G-30 CIS	Pcs	2	44	88	
13	Burned oil	Liters	16	3	48	
14	Pipes and fittings					
14.1	2" G.I pipe	Pcs	1	170	170	
14.2	2" coupling	Pcs	1	6	6	
14.3	2" elbow	Pcs	1	7	7	
14.4	2" union	Pcs	1	11	11	
14.5	1" G.I pipe	Pcs	1	80	80	
14.6	1" tee joint	Pcs	1	5	5	
14.7	1" x ¾" reducer	Pcs	4	2	8	
14.8	¾" G.I pipe	Pcs	1	53	53	
14.9	¾" coupling	Pcs	4	1	4	
14.10	¾" faucet	Pcs	4	15	60	
15	Afridev hand pump with all its accessories	Set	1	3200	3200	
	Total				**12047**	

N.B. 1. In case of coarse aggregate, out of the 80 Birr unit price, 15 Birr is for cost of stone /mcu as the aggregate is made by crushing of stones and 65 Birr /mcu is for the cost of crushing 1 mcu of stone to aggregate (13 Birr/barrel or 13 Birr/200 liters).

2. One Biago sand is estimated to be 7 mcu.

Table 2.25: Material cost for a school water point where the soil around the well is black cotton and the mould for the concrete water tank production is prepared for installation of 1" pipe during cylinder production. The target depth of the well is assumed to be 15 meters.

It.No.	Description of material	Unit	Quantity	Unit Price	Total Price	Remark
1	Cement	Bags	59	50	2950	
2	Sand	Biago	1	1480	1480	
3	Coarse aggregate	Mcu	7	80	560	
4	Stone	Mcu	10	15	150	
5	River gravel	Biago	1	1310	1310	
6	ϕ10 mm reinforcement bar	Pcs	6	28	168	
7	ϕ 6 mm reinforcement bar	Kg	90	4	360	
8	ϕ 1.5 mm black wire	Kg	2	6	12	
9	4 m long x 20 cm high x 2.5 cm thick form work timber	Pcs	4	40	160	
10	Nails	Kgs	5	10	50	
11	6-10 mm diameter eucalyptus poles	Pcs	52	4	208	
12	G-30 CIS	Pcs	2	44	88	
13	Burned oil	Liters	13	3	39	

14	Pipes and fittings					
14.1	2" G.I pipe	Pcs	1	170	170	
14.2	2" coupling	Pcs	1	6	6	
14.3	2" elbow	Pcs	1	7	7	
14.4	2" union	Pcs	1	11	11	
14.5	1" G.I pipe	M	1	80	80	
14.6	1" tee joint	Pcs	1	5	5	
14.7	1" x ¾" reducer	Pcs	4	2	8	
14.8	¾" G.I pipe	Pcs	1	53	53	
14.9	¾" coupling	Pcs	4	1	4	
14.10	¾" faucet	Pcs	4	15	60	
15	Afridev hand pump with all its accessories	Set	1	3200	3200	
	Total				**11139**	

N.B. 1. In case of coarse aggregate, out of the 80 Birr unit price, 15 Birr is for cost of stone /mcu as the aggregate is made by crushing of stones and 65 Birr /mcu is for the cost of crushing 1mcu of stone to aggregate (13Birr/barrel or 13Birr/200 liters).

2. One Biago sand is estimated to be 7 mcu.

2.2.3 Estimated Material Transport Cost at Woreda Level

The major construction materials, tools and equipment to be transported from woreda level to the water points under construction after they are bought at woreda level or transported from the PFU to the woreda are cement, reinforcement bars, tools and equipment, pipes and fittings etc. In order to calculate the estimated cost of transport of these materials from the woreda capital to the site are the following.

- Maximum of 6 quintals of cement is transported per trip, hence for 30 quintals of cement 5 trips are required.
- Cylinder moulds, other tools and equipment to be transported once.
- Reinforcement bars and pipes to be transported once.
- Upon completion of the work some tools and equipment including cylinder molds will be demobilized form the site once. Hence the total of **8 single trips** are required for materials transport for construction other than 10 meters deep well. For a well of 10 meters **7 single** trips are requires.

The other assumptions used in the estimate are:

- The site is located at 50 kms round trip from the woreda.
- Th fuel consumption of the woreda cars to the water points site to be 5 liters/Km.
- Fuel cost at the woreda level to be 3 Birr/km.
- The driver do not spent the night in the field and his perdiem to be 0.6x47 Birr/day = 28.2 Birr/day.

Based on the above assumptions the estimated perdiem and fuel cost required for transportation of the construction materials, equipment and tools to the water point construction sites is shown in Table 2.26 below.

Table 2.26: Estimated material transport cost from woreda capital to water point construction other than 10 meters deep hand dug well.

It. No.	Description of cost component	Unit	Quantity	Rate/Unit (Birr)	Total Cost (Birr)	Remark
1	Perdiem of driver during materials transport to water point construction site	Mandays	8	28.2	225.6	
2	Fuel cost for transport of materials to water point sites under construction	Liters	10 liters/trip x 8 trips = 80 liters	3	240	50kms divided by 5 lit/km = 10 liters/trip
	Total materials transport cost				465.6	

For 10 meters deep well the perdiem required is Birr 197.4 and for fuel cost Birr 210 is required making the total material transport cost to Birr 407.4.

2.2.4 Community Labor in Material Transport.

There are water points where the community transport industrial materials such as cement, reinforcement bars, cylinder molds from the woreda capital or from some place far from the water point construction site to the water point under construction. This is common especially when the site is not accessible by car or when the woreda car is not functioning due to various reasons. In some water points almost all the industrial materials are transported by community using mainly donkeys and on their backs. To consider this cost component to the community contribution the following estimate shown in Table 27 is used to show at least such costs are common in some water points.

Table 2.27: Estimated industrial materials transport cost by community from the woreda capital or nearby place to the water point under construction.

It. No.	Description of cost component	Unit	Quantity	Rate/Unit (Birr)	Total Cost (Birr)	Remark
1	Labor cost for transporting industrial materials from the woreda capital or near by place to the water point under construction.	Mandays	4 days x 5 people/day = 20 mandays.	5	100	

2.3 Supervision Cost

2.3.1 Estimating the Number of Supervision Days.

Supervision of any construction project at different stages of construction is believed to be very decisive in the sustainability of the project by ensuring its construction quality.

In the case of RWSEP financed water points frequent supervision by woreda experts such as woreda programme coordinators, water desks and sanitarians have been made during water point constructions. And also supervision by zonal experts and the programme water expert have been made.

The minimum frequency of supervision and number of supervision days required by the near by supervising body (in the RWSEP case by woreda experts) for ensuring acceptable quality of construction are shown in Table 2.28 and Table 2.29.

Table 2.28: Minimum frequency of supervision and number of supervision days required during hand dug well construction.

It. No.	Description of activity	Minimum frequency of supervision	Estimated Number of supervision days	Remark
1	**Supervision at well digging stage**			
1.1	Supervision when the well digging starts	1	1	
1.2	Supervision at some stages when well digging is progressing (may be to give solutions to problems encountered during digging)	1	1	
1.3	Decide the water adequacy and order cylinder production when well digging is nearing to completion.	1	1	
2	**Cylinder production and lowering stage.**			
2.1	Ensure the quality of cylinders produced.	1	1	
2.2	Ensure that cylinders are lowered to the well properly.	1	1	
3	**Well head construction stage**			
3.1	Ensure that construction of the well head is progressing with good quality of construction including proper utilization of construction materials as per the specification.	1	1	
3.2	Ensure the well is completed properly and approve payment to the artisan.	1	1	
	Total number of full supervision days		**7**	

N.B. The frequency of supervision and the number of supervision days required for school water point construction is taken almost the same as that of the community use hand dug well.

Table 2.29: Minimum frequency of supervision and number of supervision days required during spring development with 2 mcu capacity collection chamber.

It. N.	Description of activity	Minimum frequency of supervision	Estimated Number of supervision days	Remark
1	**Capping Structure construction stage.**			
1.1	Ensure the spring eyes are properly cleaned and decide how the capping structure to look like.	1	1	
1.2	Ensure that the excavation of the capping structure is done to the required depth & good foundation for the wall of the capping structure is encountered) and decide on the foundation type and construction to be started.	1	1	
1.3	Ensure that the foundation (masonry and /or concrete) constructed well and decide or check if already done the locations of the drainage pipe, outlet pipe and the overflow pipe in the capping structure.	1	1	
1.4	Ensure that river gravel is packed properly and decide on how the spring head cover and other activities such as retaining walls to look like if required.	1	0.5	Assuming that the collection chamber construction started and supervision of the capping structure is made in parallel with the collection chamber.
1.5	Ensure that the construction work of the spring capping structure completed as per the recommendations/ comments given by the supervisor.	1	0.5	Ditto
2	**Construction of collection chamber.**			
2.1	Ensure that the site for the collection chamber is located in appropriate place and the site is cleared well and agree on how to proceed with the next activities.	1	0.5	Assuming that some construction activities of the capping structure are progressing in parallel with this construction activity of the collection chamber.
2.2	Ensure that the hard core and lean concrete properly filled. Ensure also the floor slab properly cured to start the masonry work and agree on how to proceed with the next activities.	1	0.5	Ditto
2.3	Ensure that the construction of the masonry wall of the collection chamber progressing well. Check also the proper installation of the drainage, inlet, outlet and over flow pipes of the chamber and agree on how to proceed with the next activities.	1	1	
24	Ensure that the plastering and /or pointing of the masonry walls and also screeding	1	1	

	of the floor slab progressing well and the form work for the roof slab done well, and agree on how to proceed with the next activity.			
25	Ensure that the collection chamber well completed, pipe from the capping structure to the collection chamber well laid and the scheme functions satisfactorily.	1	1	
	Total number of full supervision days		**8**	

2.3.2 Estimating the Supervision perdiem payment for woreda experts.

Assuming that the supervisor will not spend the night in the field, more than one site can be visited in a day and there is also a possibility of the supervisor to go on foot or by motor bike and also that the supervisor will go for supervision with the driver when transporting materials to site will be compensated by the full day perdiem considered for the supervisor. With the above justifications fuel cost during supervision by woreda experts is not considered.

Table 2.30 Estimated perdiem required for one woreda expert for supervision of hand dug well and spring development with 2 mcu capacity collection chamber.

It. No	Description	Unit	Estimated no of mandays for supervision.	Daily perdiem	Total perdiem	Remark
1	Supervision of Construction of spring capping with 2 mcu capacity-collection camber.	Mandays	8	58	464	
2	Supervise the construction of hand dug well 15 meters deep and 1.5 meters diameter for community or school use.	Mandays	7	58	406	
3	Supervise the construction of hand dug well 20 meters deep and 1.5 meters diameter for community or school use.	Mandays	7	58	406	

2.4 Tools and Equipment Cost

Costs of tools and equipment such as hand tools, cylinder moulds, nylon ropes, chain blocks, pipe trader, pipe wrenches etc. are required for the construction of more than one hand dug well and/or springs. Hence it is not simple to calculate the cost contribution of these equipment and tools to one water point. Of course there are methods for estimating the deprecations of these equipment and tools when used for one water point but needs more assumptions. The simplest methods used in small construction works for estimating the cost of tools and equipment is to take nearly 3% of the total of other cost components. But especially in hand dug wells the use of relatively expensive tools and equipment (cylinder molds and chain blocks) as compared to the total cost of the water point are common. Therefore, it is proposed to estimate the cost of tools and equipment for rural water points construction to be about 6% of the sum of other costs i.e. material, labor and transport.

2.5 Total Estimated Construction Cost of Water Points.

The major cost components required for the construction of spring development with collection chamber, hand dug well for community use for target depths of 10, 15 and 20 meters, hand dug well for school use of target depth 15 and 20 meters are calculated above. Hence in this section I would like to summarize the costs required for the different types of water points.

2.5.1 Estimated total cost with respect to cost components.

The estimated total construction cost of the different types of water points with respect to their cost component (labor, materials, supervision and the like) are shown in the following Table from 2.31 to Table 2.33

Table 2.31: Total estimated cost of spring development with 2 mcu capacity collection chamber in terms of major cost components.

It.No	Description of cost component	For spring development with 2 mcu capacity collection chamber		Remark
		Amount in Birr	Amount as % out of the total cost	
1	**Labor Cost**	**3334.44**	**23.4**	
1.1	Artisans labor cost for construction	1734.44		
1.2	Unskilled (community) labor cost for construction	1600		
2	**Material Cost**	**9647.6**	**67.7**	
2.1	Materials procurement cost	9091		
2.2	Materials transport cost	465.6		
2.3	Transport of some materials by community from the woreda capital or nearby place to the water point under construction.	100		
3	**Supervision Cost**	**464**	**3.3**	
3.1	Perdiem for supervision by woreda experts	464		
4	**Equipment and tools cost = 6% of (sum of 1+2+3) costs**	**807**	**5.6**	
	Total Construction cost.	**14253.04**	**100**	

Table 2.32: Total estimated cost of hand dug wells of diameter 1.5 meters for community use in terms of major cost components.

It. No	Description of cost component	For a well of target depth 20 meters		For a well of target depth 15 meters		For a well of target depth 10 meters	
		Amount in Birr	Amount as % out of the total cost	Amount in Birr	Amount as % out of the total cost	Amount in Birr	Amount as % out of the total cost
1	**Labor Cost**	**5817.66**	**31.3**	**4484.16**	**27.3**	**3254.16**	**23.8**
1.1	Artisans labor cost for construction.	3417.66		2484.16		1654.16	
1.2	Unskilled (community) labor cost for construction	2400		2000		1600	
2	**Material Cost**	**11335.6**	**60.9.**	**10639.6**	**64.6**	**9230.4**	**67.5**
2.1	Materials procurement cost	10770		10074		8723	
2.2	Materials transport cost	465.6		465.6		407.6	
2.3	Transport of some materials by community from the woreda capital or nearby place to the water point.	100		100		100	
3	**Supervision Cost**	**406**	**2.1**	**406**	**2.5**	**406**	**3**
3.1	Perdiem for supervision by woreda expert	406		406		406	
4	**Equipment and tools cost = 6% of (sum of 1+2+3) costs**	**1054**	**5.7**	**932**	**5.6**	**777**	**5.7**
	Total Construction cost.	**18613.26**	**100**	**16461.76**	**100**	**13667.56**	**100**

Table 2.33: Total estimated cost of hand dug well of diameter 2 meters for community use in terms of major cost components.

It. No	Description of cost component	For a well of target depth 15 meters		For a well of target depth 20 meters	
		Amount in Birr	Amount as % out of the total cost	Amount in Birr	Amount as % out of the total cost
1	**Labor Cost**	**5505.1**	**28.8**	**7417**	**29.7**
1.1	Artisans labor cost for construction.	3105.1		4417	
1.2	Unskilled (community) labor cost for construction.	2400		3000	
2	**Material Cost**	**12093.6**	**63.4**	**15682**	**62.8**
2.1	Materials Procurement Cost	11528		15000	
2.2	Materials Transport Cost	465.6		582	
2.3	Transport of some materials by community from the from the woreda capital or nearby place to the water point.	100		100	
3	**Supervision Cost**	**406**	**2.1**	**464**	**1.9**
3.1	Perdiem for supervision by woreda expert	406			
4	**Equipment and tools cost = 6% of (sum of 1+2+3) costs**	**1092.3**	**5.7**	**1414**	**5.6**
	Total Construction cost.	**19297**	**100**	**24977**	**100**

Table 2.34 Total estimated cost of hand dug wells for school use in terms of major cost components.

It. No	Description of cost component	For a well of target depth 20 meters		For a well of target depth 15 meters		Remark
		Amount in Birr	Amount is % out of the total cost	Amount in Birr	Amount is % out of the total cost	
1	**Labor Cost**	**6073.19**	**30**	**4839.25**	**27**	
1.1	Artisans labor cost for construction	3673.19		2839.25		
1.2	Unskilled (community) labor cost for construction.	2400		2000		
2	**Material Cost**	**12612.6**	**62.3**	**11704.6**	**65**	
2.1	Materials procurement cost	12047		11139		
2.2	Materials transport cost	465.6		465.6		
2.3	Transport of some materials by community from the woreda capital or nearby place to the water point.	100		100		
3	**Supervision Cost**	**406**	**2**	**406**	**2.3**	
3.1	Perdiem for supervision by woreda expert	406		406		
4	**Equipment and tools cost = 6% of (sum of 1+2+3) costs**	**1145**	**5.7**	**1017**	**5.7**	
	Total Construction Cost.	**20236.79**	**100**	**17966.85**	**100**	

2.5.2 Estimated total cost with respect to source of finance (contribution).

As RWSEP is a bi lateral programme between the Ethiopian and Finland governments and also there is great involvement of the community in the different stages of the project, the construction cost of the water points are covered/financed from the Ethiopian government, the Finland government and the beneficiaries.

When we come to the construction cost, the Ethiopian government mainly covers the fuel, lubricant and maintenance of cars up to five hundred Birr, as well as the salaries of the GOE staff. The salary of GOE staff anyhow is not included here as direct construction cost.

The beneficiaries of the water points contribute in labor, and provision of local construction materials mainly stone and eucalyptus (for fencing of the water point, form working during slab construction, water lifting support and support for cylinder lowering).

Therefore, the following four tables show the estimated contribution of each source of finance for the water point construction of different types.

Table 2.35 Total estimated cost of spring development with 2 mcu collection chamber in terms of source of finance.

It. No.	Source of finance	Spring development with 2 mcu collection chamber		Remark
		Amount in Birr	Amount in % out of the total cost	
1	**Government of Finland & Ethiopia**	**11875.04**	**83.3**	
1.1	Artisans labor Cost for construction	1734.44		
1.2	Labor cost for crushing aggregate	195		
1.3	Procurement of major construction materials other than stone and eucalyptus	8209		
1.4	Perdiem payments for supervision and materials transport to water points under construction.	689.6		
1.5	Equipment and tools for the construction of water points.	807		
1.6	Fuel cost for supervision and transportation of materials for water point under construction.	240		
2	**Community Contribution**	**2378**	**16.7**	
2.1	Community contribution in labor during construction.	1600		
2.2	Community contribution for supplying stone and eucalyptus.	678		
2.3	Community contribution in material transport from the woreda capital or nearby area to the water point.	100		
	Total Construction Cost.	**14253.04**	**100**	

NB. 1. From cost items 1.1 to 1.6, are mainly covered by the Finland Government.
2. Cost item 1.6 is covered by the Ethiopian Government.

Table 2.36: Total estimated cost of hand dug wells of 1.5 meters diameter for community use in terms of source of finance.

It. No.	Source of finance	For a well of target depth 20 meters		For a well of target depth 15 meters		For a well of target depth 10 meters	
		Amount (Birr)	Amount in % out of the total cost	Amount (Birr)	Amount in % out of the total cost	Amount (Birr)	Amount in % out of the total cost
1	**Government of Finland & Ethiopia**	**15710.26**	**84.3**	**13973.76**	**84.9**	**11624.56**	**84.8**
1.1	Artisans labor cost for construction.	3417.66		2484.16		1654.16	
1.2	Labor cost for crushing aggregate	455		390		325	
1.3	Procurement of major construction materials other than stone and eucalyptus	9912		9296		8025	
1.4	Perdiem payments for supervision and materials transport water to points under construction.	631.6		631.6		603.4	
1.5	Equipment and tools for the construction of water points.	1054		932		777	
1.6	Fuel cost for supervision and transportation of materials for water point under construction.	240		240		210	
2	**Community Contribution**	**2903**	**15.7**	**2488**	**15.1**	**2073**	**15.2**
2.1	Community contribution in labor during construction.	2400		2000		1600	
2.2	Community contribution for supplying stone and eucalyptus.	403		388		373	
2.3	Community contribution in material transport from the woreda capital or nearby area to the water point.	100		100		100	
	Total Construction Cost.	**18613.26**		**16461.76**	**100**	**13667.56**	**100**

NB. 1. From cost items 1.1 to 1.6, are mainly covered by the Finland Government.
2. Cost item 1.6 is covered by the Ethiopian Government.

Table 2.37: Total estimated cost of hand dug well of 2 meters diameter for community use in terms of source of finance.

It. No.	Source of finance	For a well of target depth 20 meters	
		Amount (Birr)	Amount in % out of the total cost
1	**Government of Finland & Ethiopia**	**16095**	**84.3**
1.1	Artisans labor cost for construction.	3105.1	
1.2	Labor cost for crushing aggregate	520	
1.3	Procurement of major construction materials other than stone and eucalyptus	10518	
1.4	Perdiem payments for supervision and materials transport water to points under construction.	631.6	
1.5	Equipment and tools for the construction of water points.	1080.3	
1.6	Fuel cost for supervision and transportation of materials for water point under construction.	240	
2	**Community Contribution**	**2990**	**15.7**
2.1	Community contribution in labor during construction.	2400	
2.2	Community contribution for supplying stone and eucalyptus.	490	
2.3	Community contribution in material transport from the woreda capital or nearby area to the water point.	100	
	Total Construction Cost.	**19085**	**100**

NB. 1. From cost items 1.1 to 1.6, are mainly covered by the Finland Government.
2. Cost item 1.6 is covered by the Ethiopian Government.

Table 2.38 Total estimated cost of hand dug wells for school use in terms of source of finance.

It. No.	Source of finance	For a well of target depth 20 meters		For a well of target depth 15 meters		Remark
		Amount (Birr)	Amount in % out of the total cost	Amount (Birr)	Amount in % out of the total cost	
1	**Government of Finland & Ethiopia**	**17243.79**	**85.2**	**15403.85**	**85.7**	
1.1	Artisans labor cost for construction	3673.19		2839.25		
1.2	Labor cost for crushing aggregate	520		455		
1.3	Procurement of major construction materials other than stone and eucalyptus	11034		10221		
1.4	Perdiem payments for supervision and materials transport to water points under construction.	631.6		631.6		
1.5	Equipment and tools for the construction of water points.	1145		1017		
1.6	Fuel cost for supervision and transportation of materials for water point under construction.	240		240		
3	**Community Contribution**	**2993**	**14.8**	**2563**	**14.3**	
2.1	Community contribution in labor during construction.	2400		2000		
2.2	Community contribution for supplying stone and eucalyptus.	493		463		
2.3	Community contribution in material transport from the woreda capital or nearby area to the water point.	100		100		
	Total Construction Cost.	**20236.79**	**100**	**17966.85**	**100**	

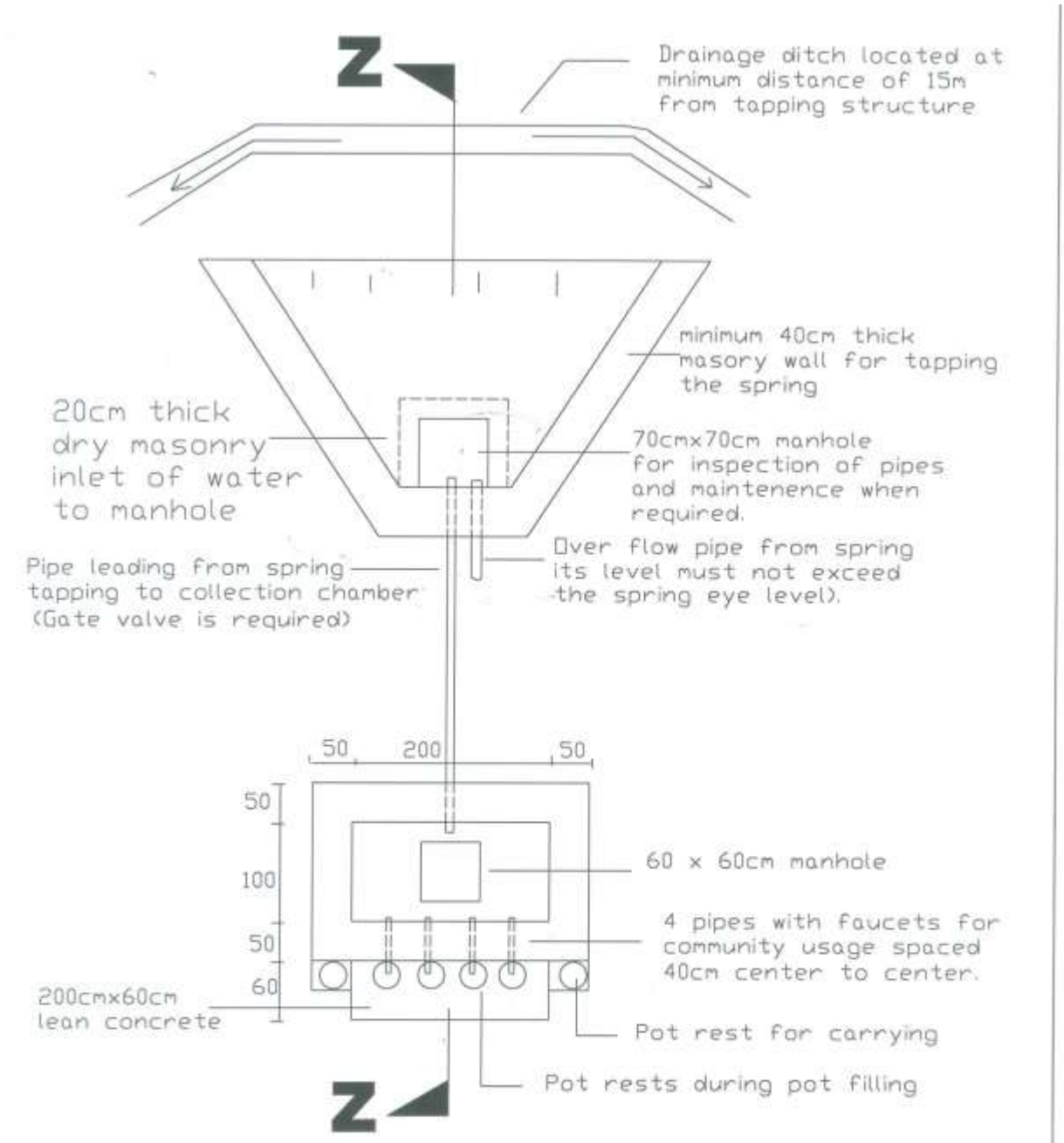
NB. 1. From cost items 1.1 to 1.6, are mainly covered by the Finland Government.
2. Cost item 1.6 is covered by the Ethiopian Government.

In using Tables from 2.35 to 2.38, the following remarks are necessary.

1. Although there are indirect costs necessary for the completion of the water points such as, the salaries of the GOE staff only these direct costs are considered in the cost estimate.
2. The cost estimate for the water points is applicable only when the water points are to be construction by artisans. For water points to be constructed by purely private contractors there is a need to increase the estimate by some percentage may be by 25% to account for profit and overhead.
3. When using the above cost estimates for budget preparation in the planning stage, increasing the estimates by minimum of 10% is necessary in order to accommodate the expected changes in unit price of materials due to various reasons.

LIST OF DRAWINGS

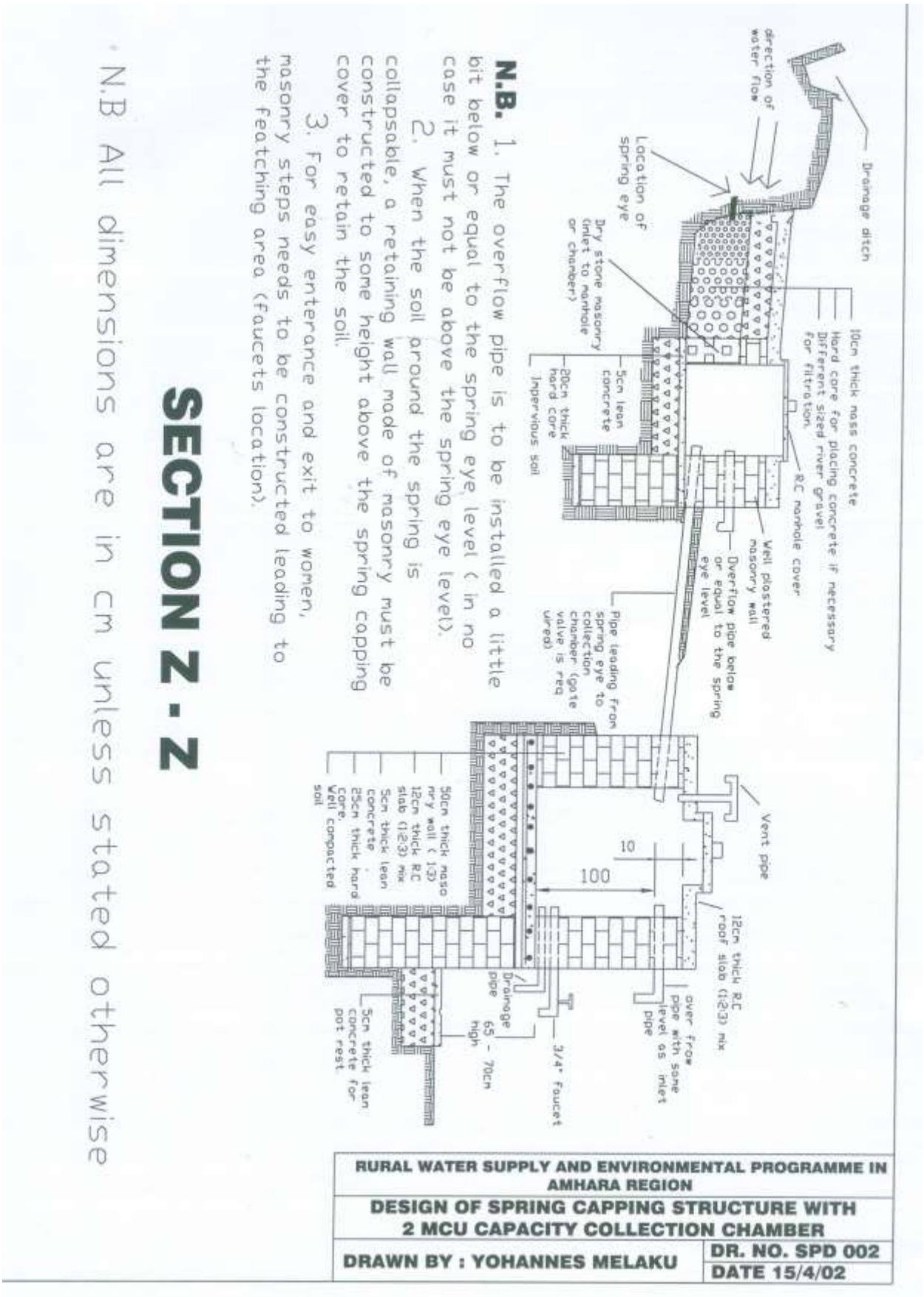
DRAWING No. SPD 001 To SPD 003 DESIGN Of SPRING CAPPING STRUCTURE WITH 2 MCU CAPACITY COLLECTION CHAMBER



PLAN OF SPRING CAPPING STRUCTURE WITH 2 MCU CAPACITY COLLECTION CHAMBER

N.B All dimensions are in cm unless stated otherwise

RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
DESIGN OF SPRING CAPPING STRUCTURE WITH 2 MCU CAPACITY COLLECTION CHAMBER	
DRAWN BY : YOHANNES MELAKU	DR. NO. SPD 001
	DATE 15/4/02



N.B. 1. The overflow pipe is to be installed a little bit below or equal to the spring eye level (in no case it must not be above the spring eye level).

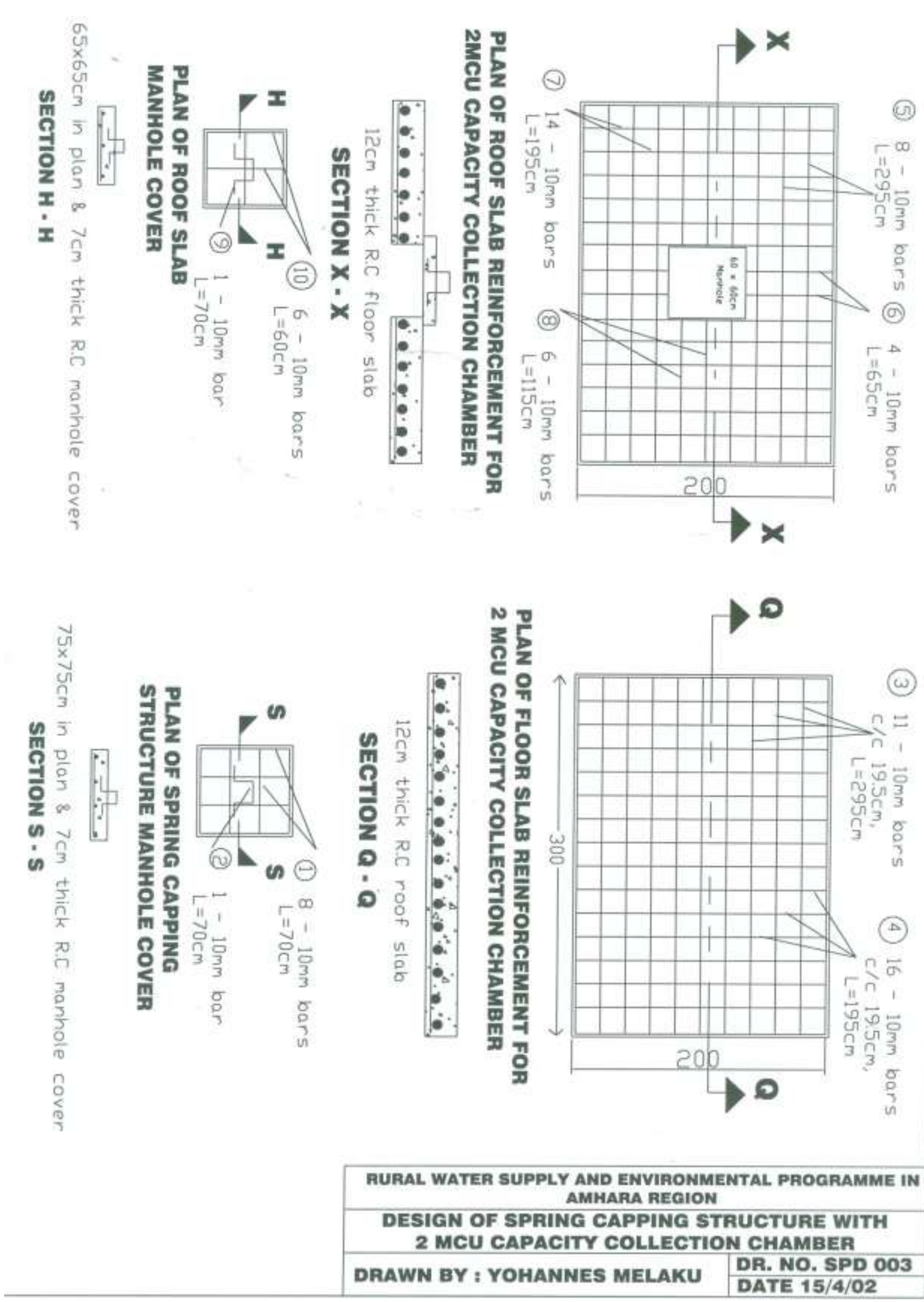
2. When the soil around the spring is collapsable, a retaining wall made of masonry must be constructed to some height above the spring capping cover to retain the soil.

3. For easy entrance and exit to women, masonry steps needs to be constructed leading to the featching area (faucets location).

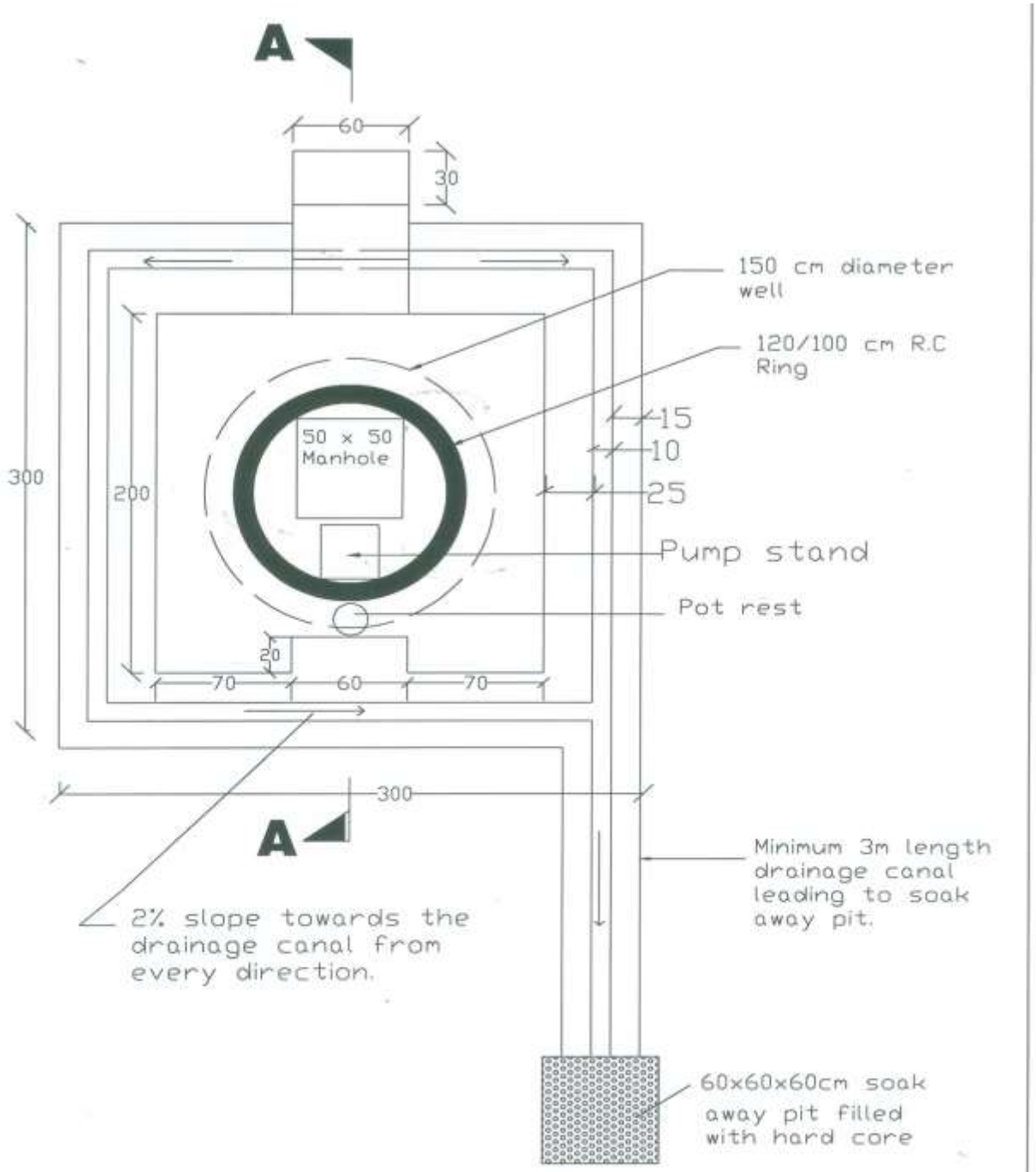
SECTION Z - Z

N.B All dimensions are in cm unless stated otherwise

RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
DESIGN OF SPRING CAPPING STRUCTURE WITH 2 MCU CAPACITY COLLECTION CHAMBER	
DRAWN BY : YOHANNES MELAKU	DR. NO. SPD 002
	DATE 15/4/02


PLAN OF ROOF SLAB REINFORCEMENT FOR
2MCU CAPACITY COLLECTION CHAMBER
⑤ 8 - 10mm bars
L=295cm
⑥ 4 - 10mm bars
L=65cm
⑦ 14 - 10mm bars
L=195cm
⑧ 6 - 10mm bars
L=115cm
60 x 60cm
Manhole
200
X
SECTION X - X
12cm thick R.C floor slab
PLAN OF ROOF SLAB
MANHOLE COVER
⑩ 6 - 10mm bars
L=60cm
⑨ 1 - 10mm bar
L=70cm
H
SECTION H - H
65x65cm in plan & 7cm thick R.C manhole cover
PLAN OF FLOOR SLAB REINFORCEMENT FOR
2 MCU CAPACITY COLLECTION CHAMBER
③ 11 - 10mm bars
c/c 19.5cm,
L=295cm
④ 16 - 10mm bars
c/c 19.5cm,
L=195cm
300
200
Q
SECTION Q - Q
12cm thick R.C roof slab
PLAN OF SPRING CAPPING
STRUCTURE MANHOLE COVER
① 8 - 10mm bars
L=70cm
② 1 - 10mm bar
L=70cm
S
SECTION S - S
75x75cm in plan & 7cm thick R.C manhole cover
RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN
AMHARA REGION
DESIGN OF SPRING CAPPING STRUCTURE WITH
2 MCU CAPACITY COLLECTION CHAMBER
DRAWN BY : YOHANNES MELAKU
DR. NO. SPD 003
DATE 15/4/02

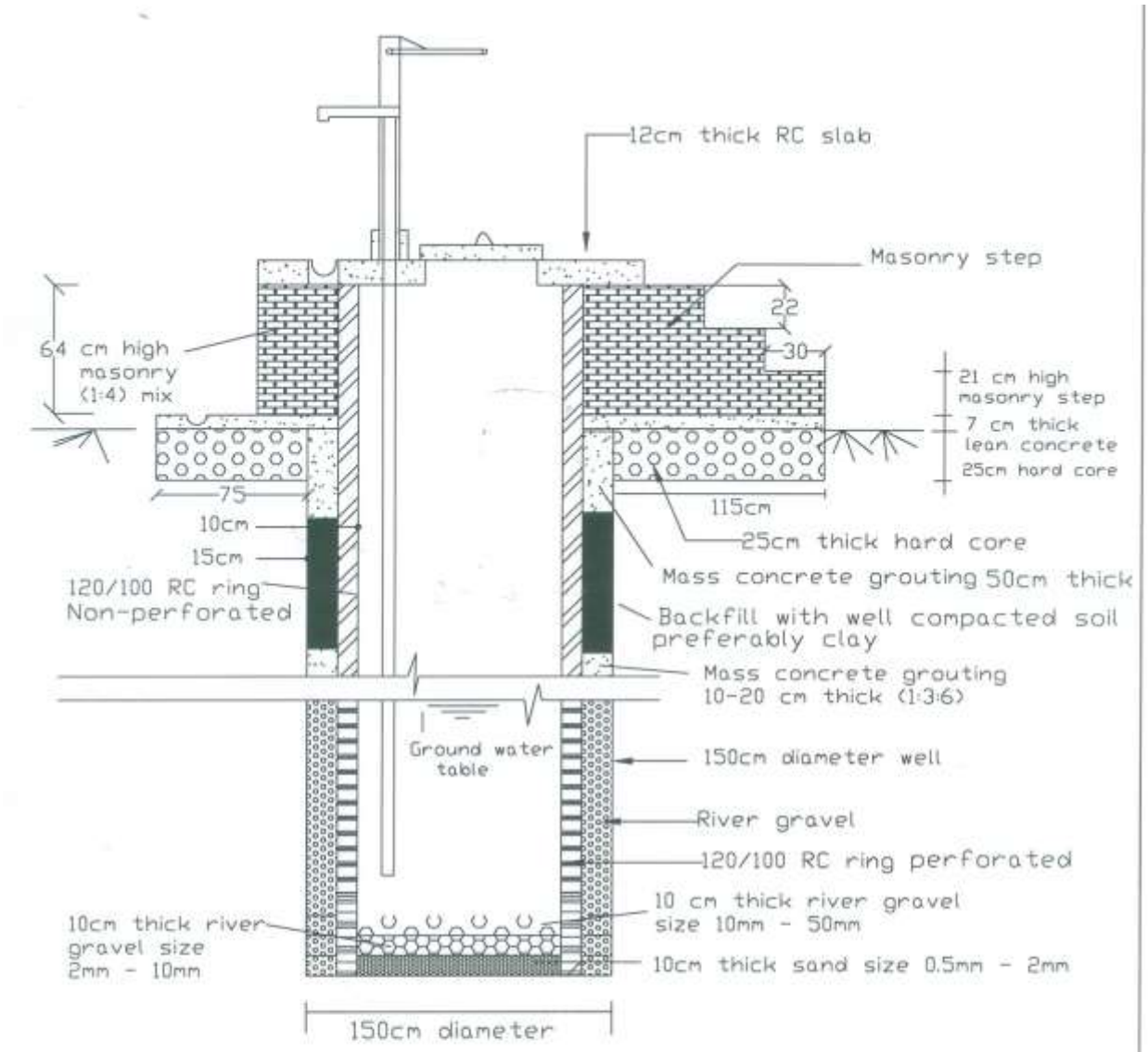
DRAWING No. CHD 001 To CHD 004 DESIGN Of COMMUNITY HAND DUG WELL



PLAN OF HAND DUG WELL FOR COMMUNITY USE

N.B All dimensions are in cm unless stated.

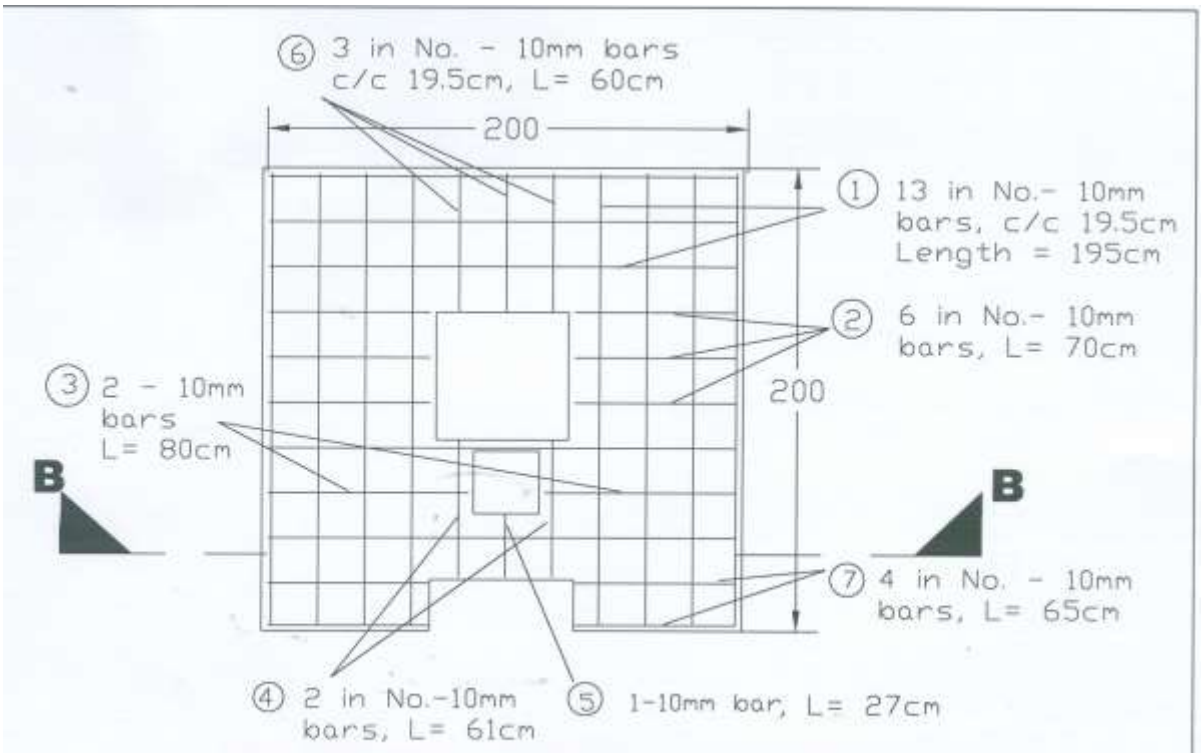
RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
COMMUNITY HAND DUG WELL DESIGN	
DRAWN BY : YOHANNES MELAKU	DR. NO. CHD 001 DATE 15/4/02



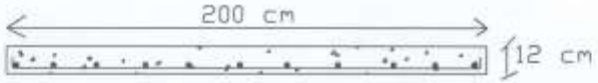
SECTION A-A OF HAND DUG WELL DESIGN FOR COMMUNITY USE

N.B. All dimensions are in cm unless stated otherwise

RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
COMMUNITY HAND DUG WELL DESIGN	
DRAWN BY : YOHANNES MELAKU	**DR. NO. CHD 002** **DATE 15/4/02**

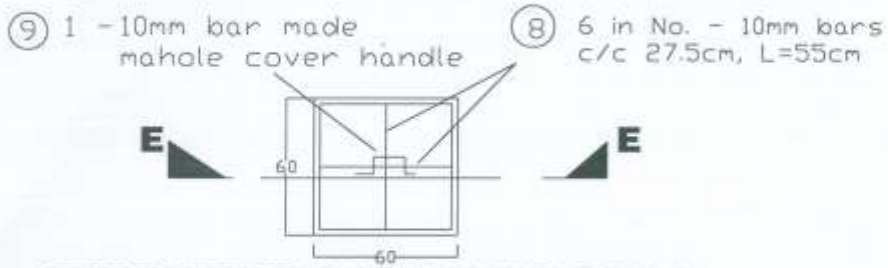


REINFORCEMENT PLAN OF WELL HEAD OF HAND DUG WELL FOR COMMUNITY USE



12 cm thick R.C well head reinforced with 10mm bars spaced c/c 19.5 cm bothways.

SECTION B-B



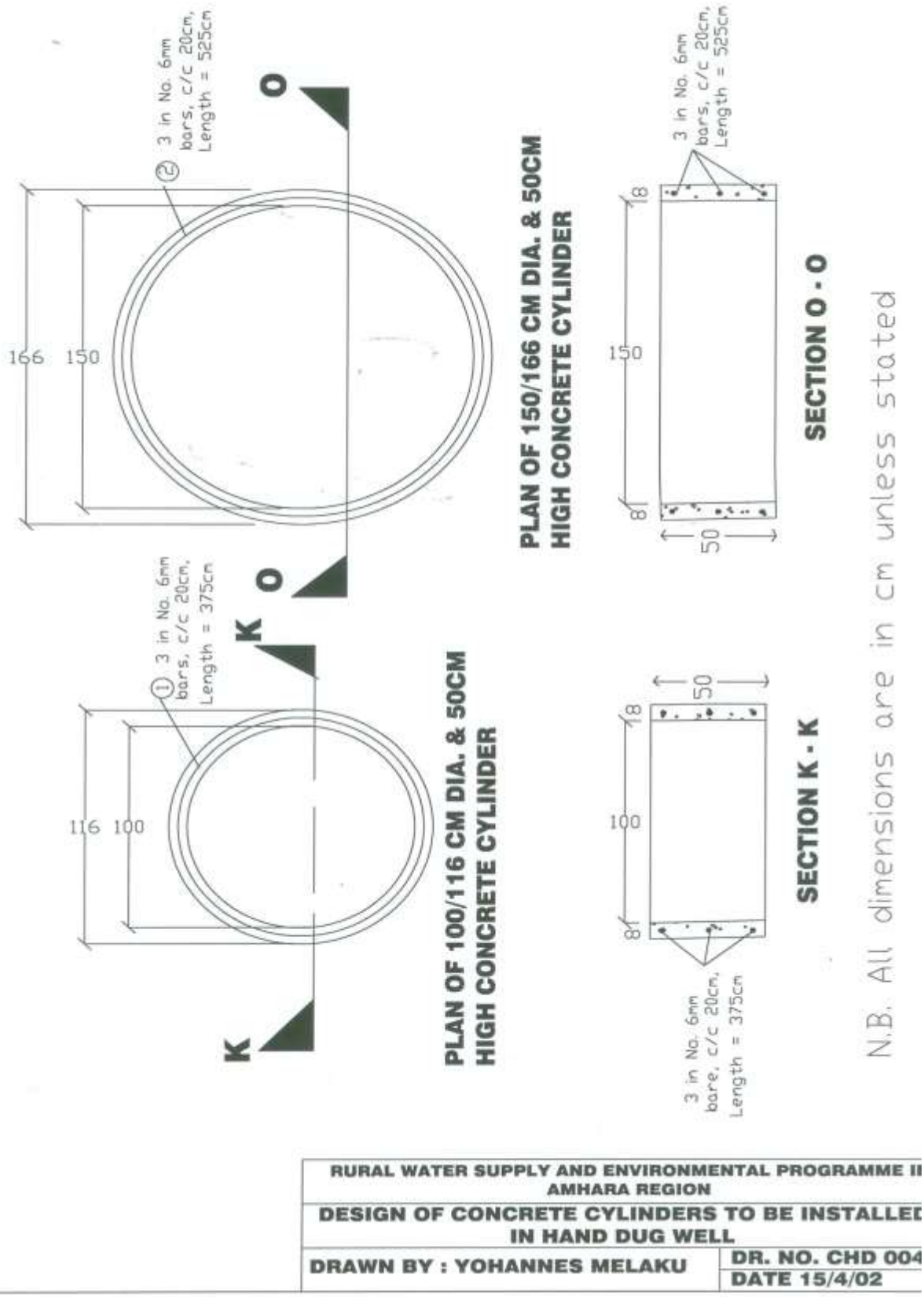
REINFORCEMENT PLAN OF MANHOLE COVER

7cm thick R.C manhole cover
Dimension 60 x 60cm.

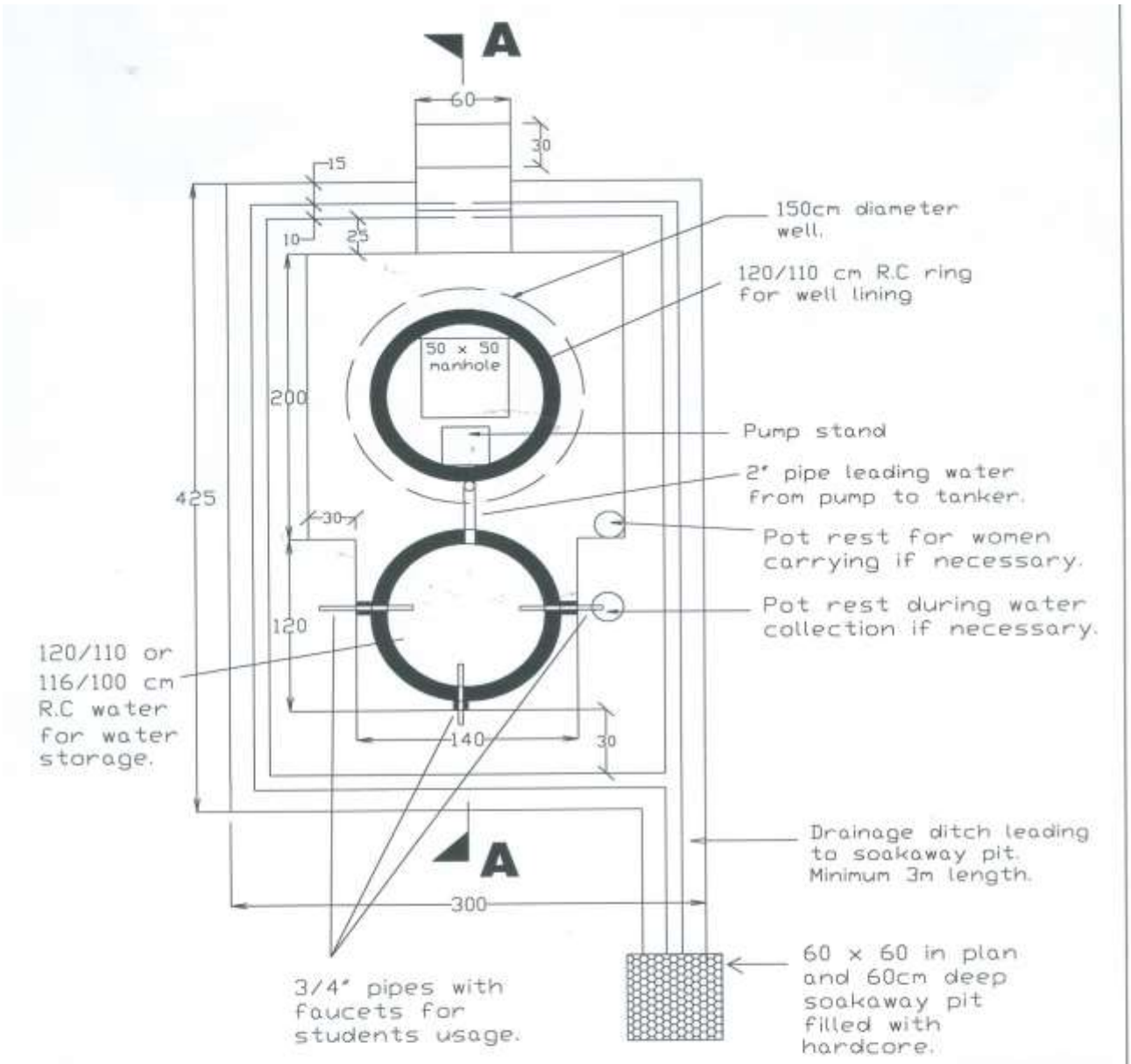
SECTION E-E

NB. All dimensions are in cm.

RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
COMMUNITY HAND DUG WELL DESIGN	
DRAWN BY : YOHANNES MELEKU	**DR.NO. CHD 003**
	DATE 15/4/02


3 in No. 6mm bars, c/c 20cm, Length = 525cm
166
150
O
O
PLAN OF 150/166 CM DIA. & 50CM HIGH CONCRETE CYLINDER
3 in No. 6mm bars, c/c 20cm, Length = 525cm
18
150
8
50
SECTION O - O
3 in No. 6mm bars, c/c 20cm, Length = 375cm
116
100
K
K
PLAN OF 100/116 CM DIA. & 50CM HIGH CONCRETE CYLINDER
50
18
100
8
SECTION K - K
3 in No. 6mm bare, c/c 20cm, Length = 375cm
N.B. All dimensions are in cm unless stated
RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME II
AMHARA REGION
DESIGN OF CONCRETE CYLINDERS TO BE INSTALLED
IN HAND DUG WELL
DRAWN BY : YOHANNES MELAKU
DR. NO. CHD 004
DATE 15/4/02

DRAWING No. SHD 001 To SHD 003 DESIGN Of SCHOOL HAND DUG WELL FOR NON-BLACK COTTON SOIL



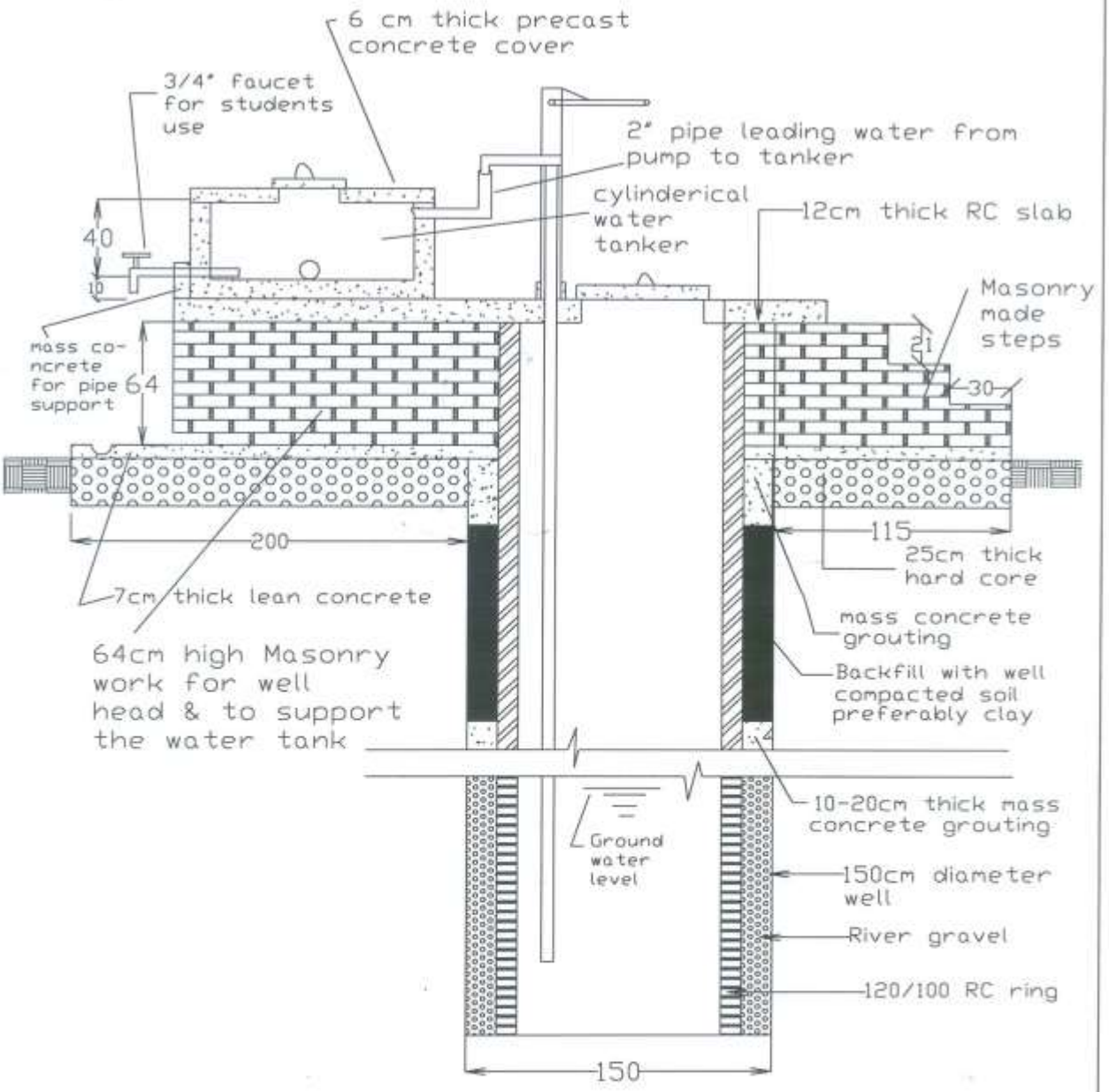
PLAN OF HAND DUG WELL FOR SCHOOLS WHERE THE SOIL AROUND THE WELL IS NON-BLACK COTTON

N.B. 1. 3/4" over flow pipe at 3cm from the top of the tank & bended downward by elbow can be used to know that the tank is full when operating the pump.

2. In case of communual usage of the well by schools and community, one of the 3/4" pipe where the pot rest is located can be changed by higher diameter pipes for community use.

3. All dimensions are in cm unless stated

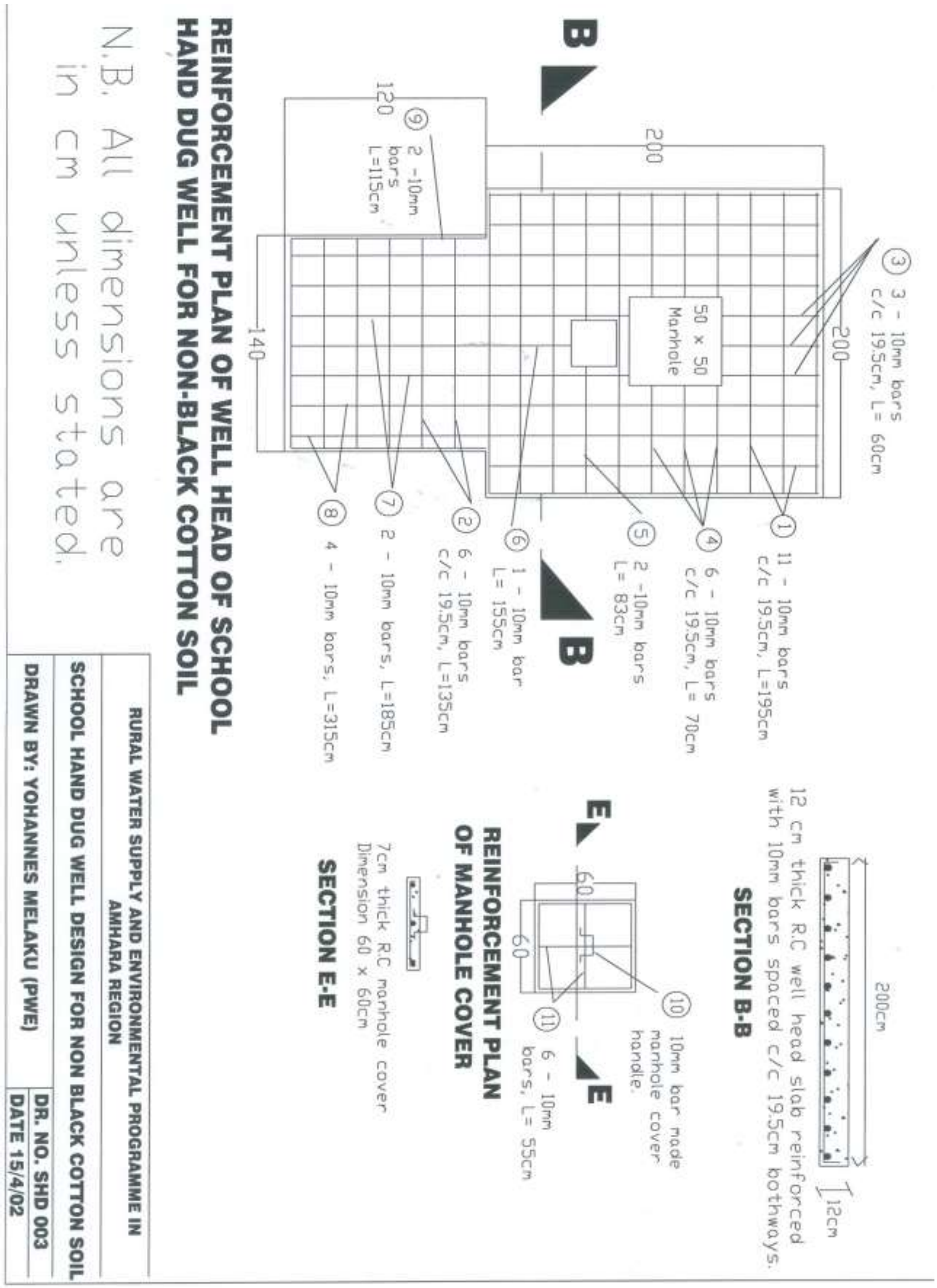
RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
SCHOOL WATER POINT DESIGN FOR NON BLACK COTTON SOIL	
DRAWN BY: YOHANNES MELAKU (PWE)	DR. NO. SHD 001
	DATE 15/4/02



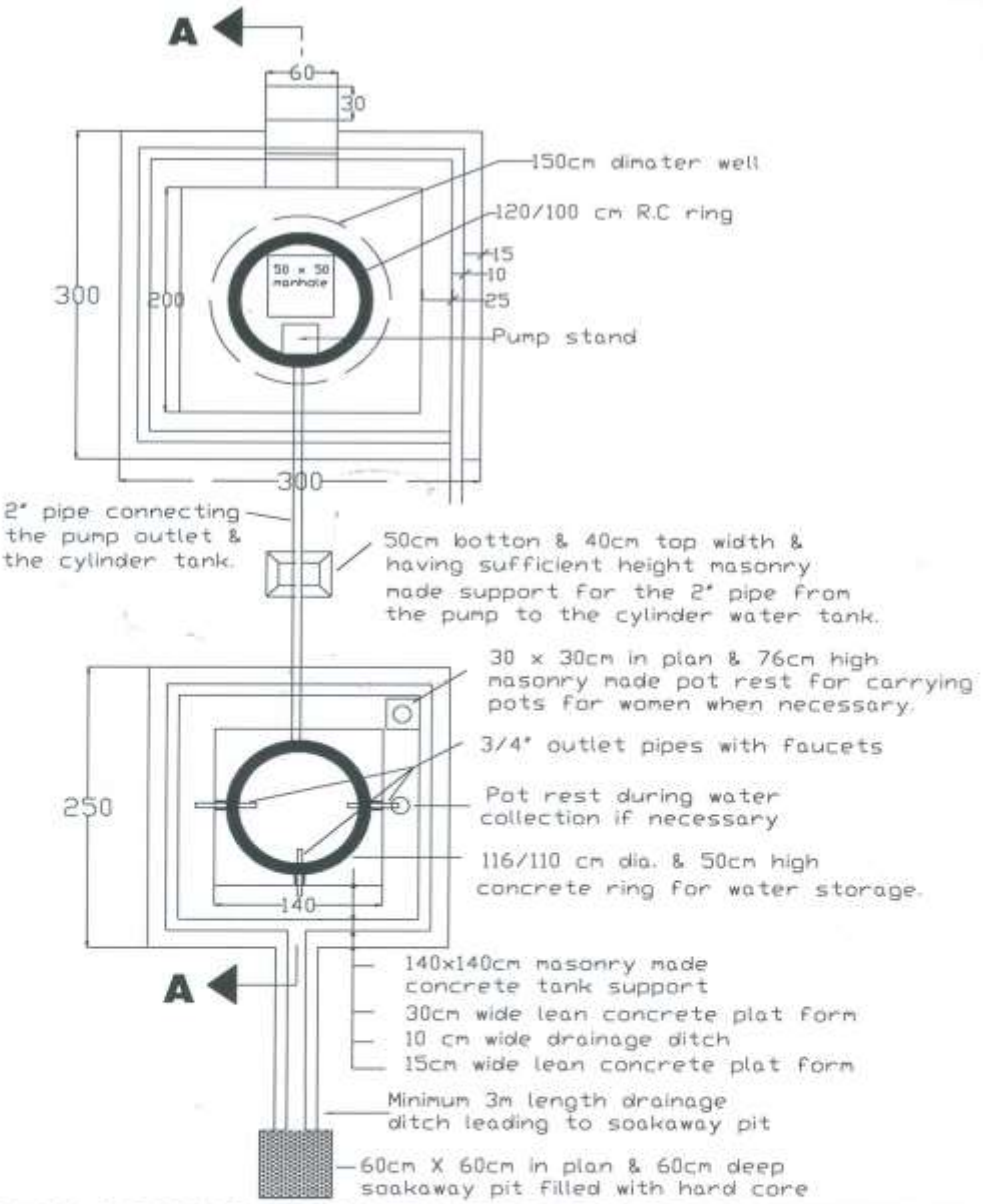
SECTION A - A OF HAND DUG WELL FOR SCHOOL WHEN THE SOIL AROUND THE WELL IS NOT BLACK COTTON

N.B All dimnsions are in cm unless stated

RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
SCHOOL WATER POINT DESIGN FOR NON-BLACK COTTON SOIL	
DRAWN BY: YOHANNES MELAKU (PWE)	DR. NO. SHD 002 DATE 15/4/02


REINFORCEMENT PLAN OF WELL HEAD OF SCHOOL HAND DUG WELL FOR NON-BLACK COTTON SOIL
B
B
200
200
120
140
50 x 50 Manhole
(1) 11 - 10mm bars c/c 19.5cm, L=195cm
(2) 6 - 10mm bars c/c 19.5cm, L=135cm
(3) 3 - 10mm bars c/c 19.5cm, L= 60cm
(4) 6 - 10mm bars c/c 19.5cm, L= 70cm
(5) 2 -10mm bars L= 83cm
(6) 1 - 10mm bar L= 155cm
(7) 2 - 10mm bars, L=185cm
(8) 4 - 10mm bars, L=315cm
(9) 2 -10mm bars L=115cm
200cm
12cm
12 cm thick R.C well head slab reinforced with 10mm bars spaced c/c 19.5cm bothways.
SECTION B-B
E
E
60
60
(10) 10mm bar made manhole cover handle.
(11) 6 - 10mm bars, L= 55cm
REINFORCEMENT PLAN OF MANHOLE COVER
7cm thick R.C manhole cover Dimension 60 x 60cm
SECTION E-E
N.B. All dimensions are in cm unless stated.
RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION
SCHOOL HAND DUG WELL DESIGN FOR NON BLACK COTTON SOIL
DRAWN BY: YOHANNES MELAKU (PWE)
DR. NO. SHD 003
DATE 15/4/02

DRAWING No. SHDB 001 To SHDB 003 DESIGN Of SCHOOL HAND DUG WELL FOR BLACK COTTON SOIL



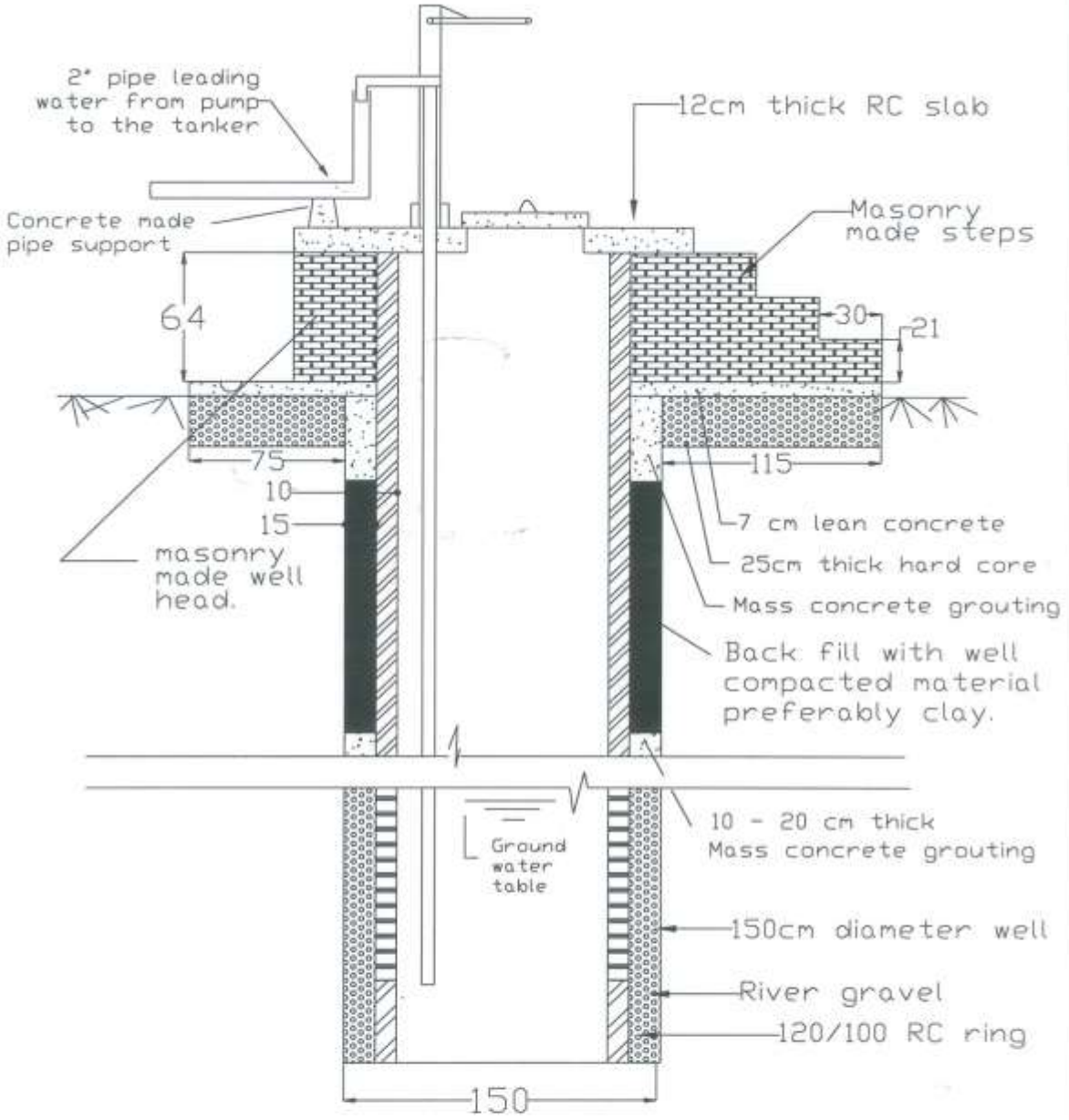
PLAN OF HAND DUG WELL FOR SCHOOLS WHERE THE SOIL AROUND THE WELL IS BLACK COTTON

N.B 1. 3/4" overflow pipe at 3cm from the top of the tank and bended downward by elbow can be used to know that the tank is full when operating the pump.

2. In case of communual usage of the well by schools and community, one of the 3/4 " pipe where the pot rest is located can be changed by higher diameter pips for community use.

3. All dimensions are in cm unless stated.

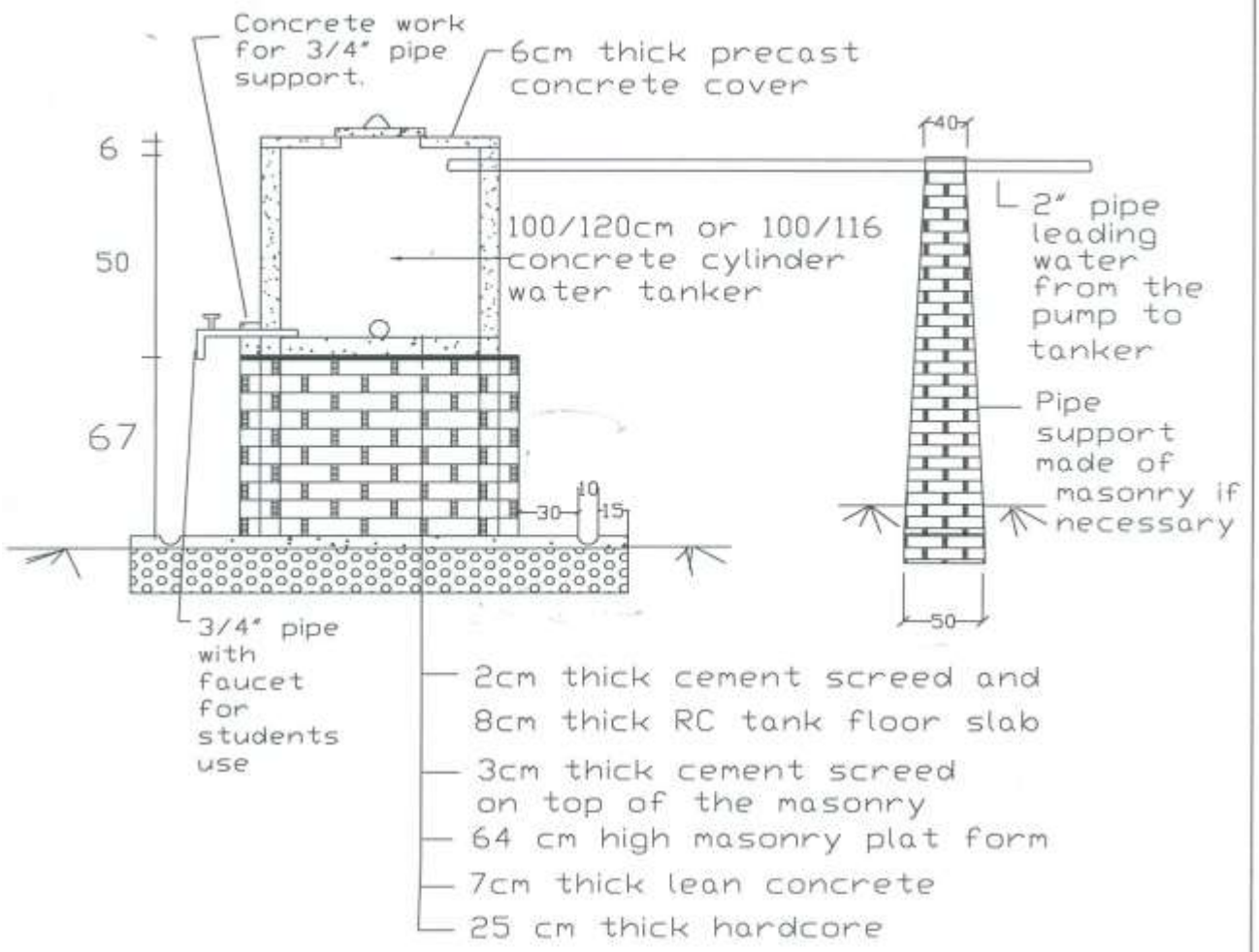
RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
SCHOOL HAND DUG WELL DESIGN FOR BLACK COTTON SOIL	
DRAWN BY : YOHANNES MELAKU (PWE)	DR. NO. SHDB 001
	DATE 15/4/02



SECTION A-A OF HAND DUG WELL DESIGN FOR SCHOOL WHERE THE SOIL AROUND THE WELL IS BLACK COTTON

N.B All dimnsions are in cm unless stated

RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
SCHOOL HAND DUG WELL DESIGN FOR BLACK COTTON SOIL	
DRAWN BY : YOHANNES MELAKU (PWE)	**DR. NO. SHDB 002**
	DATE 15/4/02



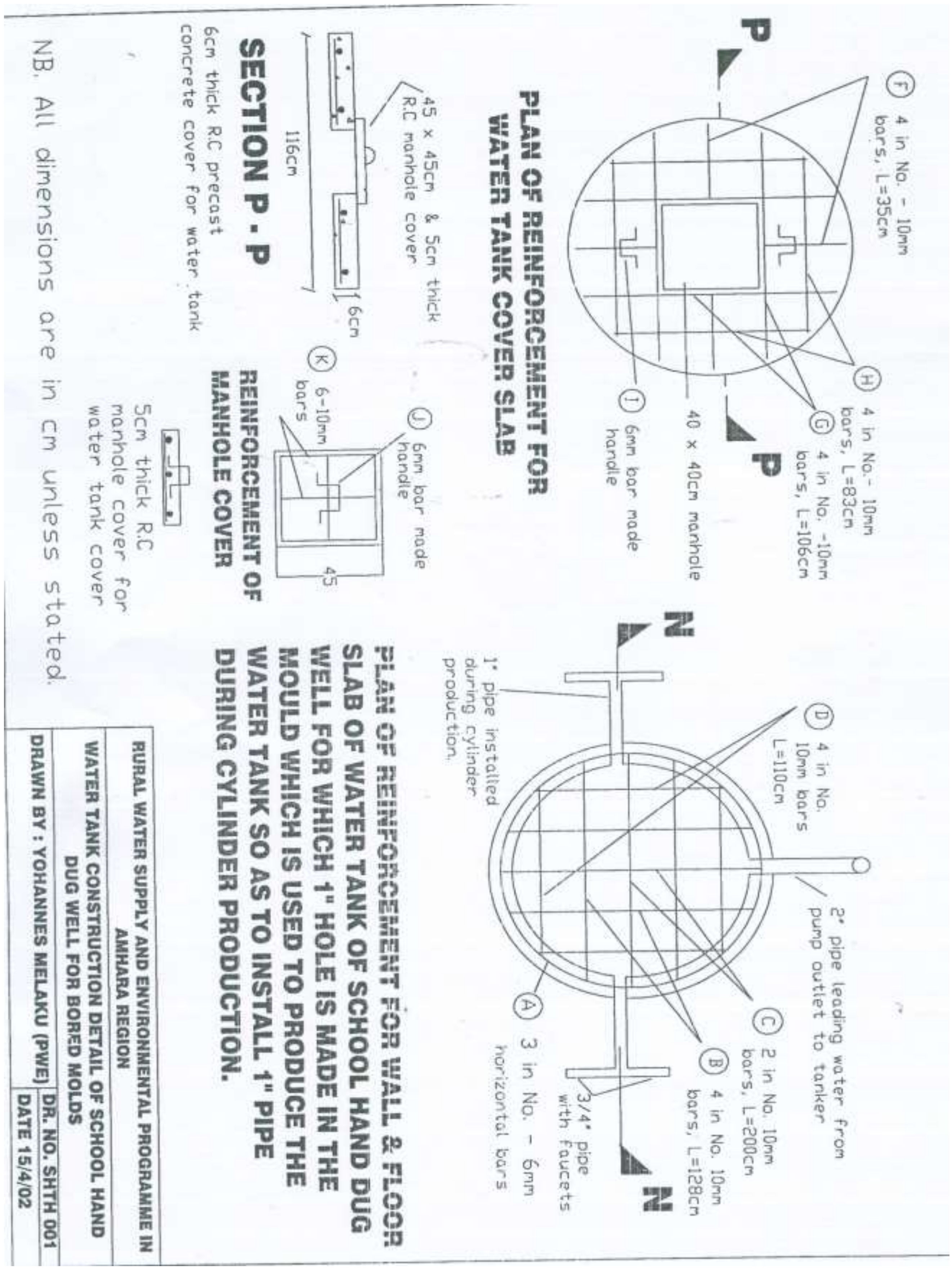
CONTINUATION OF SECTION A-A OF HAND DUG WELL FOR SCHOOL WHEN THE SOIL AROUND THE WELL IS BLACK COTTON.

N.B. 1. 3/4" overflow pipe at 3cm from the top of the tank and bended dawnward by elbow can be used to know that the tank is full when operating the hand pump.

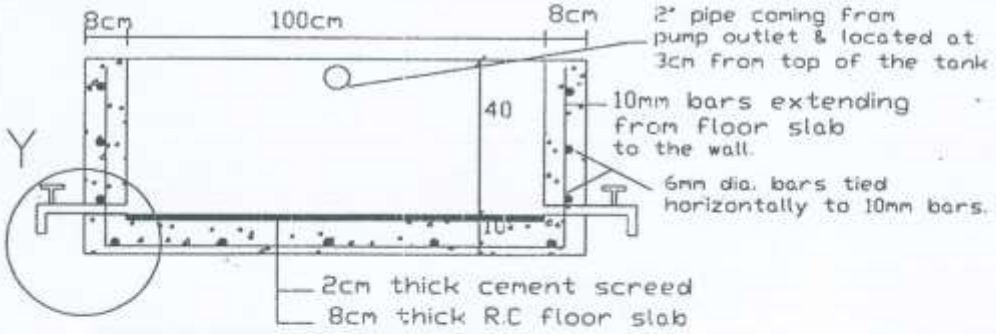
2. All dimensions are in cm unless stated.

RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
SCHOOL HAND DUG WELL DESIGN FOR BLACK COTTON SOIL	
DRAWN BY : YOHANNES MELAKU (PWE)	DR. NO. SHDB 003
	DATE 15/4/02

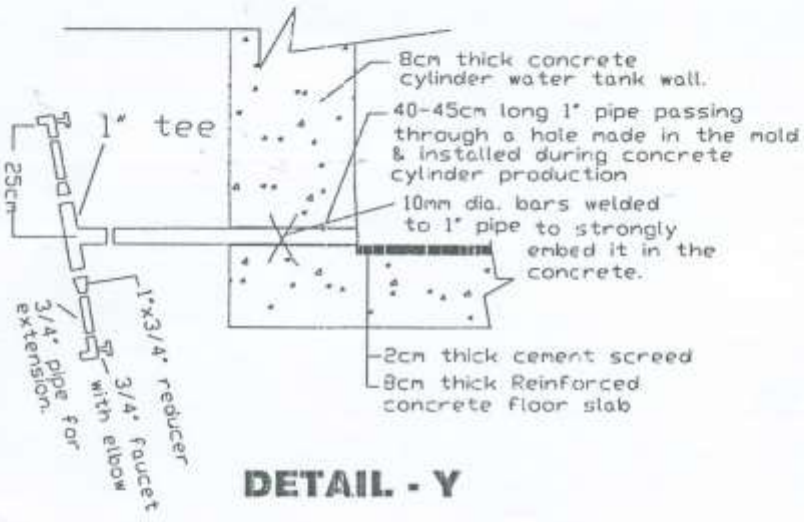
DRAWING No. SHTH 001 To SHTH 002 WATER TANK CONSTRUCTION DETAIL Of SCHOOL HAND DUG WELL FOR BORED MOLDS



P
F 4 in No. - 10mm bars, L=35cm
H 4 in No. - 10mm bars, L=83cm
G 4 in No. -10mm bars, L=106cm
40 x 40cm manhole
I 6mm bar made handle
P
PLAN OF REINFORCEMENT FOR WATER TANK COVER SLAB
45 x 45cm & 5cm thick R.C manhole cover
6cm
116cm
SECTION P - P
6cm thick R.C precast concrete cover for water tank
J 6mm bar made handle
K 6-10mm bars
45
REINFORCEMENT OF MANHOLE COVER
5cm thick R.C manhole cover for water tank cover
NB. All dimensions are in cm unless stated.
N
D 4 in No. 10mm bars L=110cm
1" pipe installed during cylinder production.
2" pipe leading water from pump outlet to tanker
C 2 in No. 10mm bars, L=200cm
B 4 in No. 10mm bars, L=128cm
A 3 in No. - 6mm horizontal bars
3/4" pipe with faucets
N
PLAN OF REINFORCEMENT FOR WALL & FLOOR SLAB OF WATER TANK OF SCHOOL HAND DUG WELL FOR WHICH 1" HOLE IS MADE IN THE MOULD WHICH IS USED TO PRODUCE THE WATER TANK SO AS TO INSTALL 1" PIPE DURING CYLINDER PRODUCTION.
RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION
WATER TANK CONSTRUCTION DETAIL OF SCHOOL HAND DUG WELL FOR BORED MOLDS
DR. NO. SHTH 001
DRAWN BY : YOHANNES MELAKU (PWE)
DATE 15/4/02



SECTION N - N



DETAIL - Y

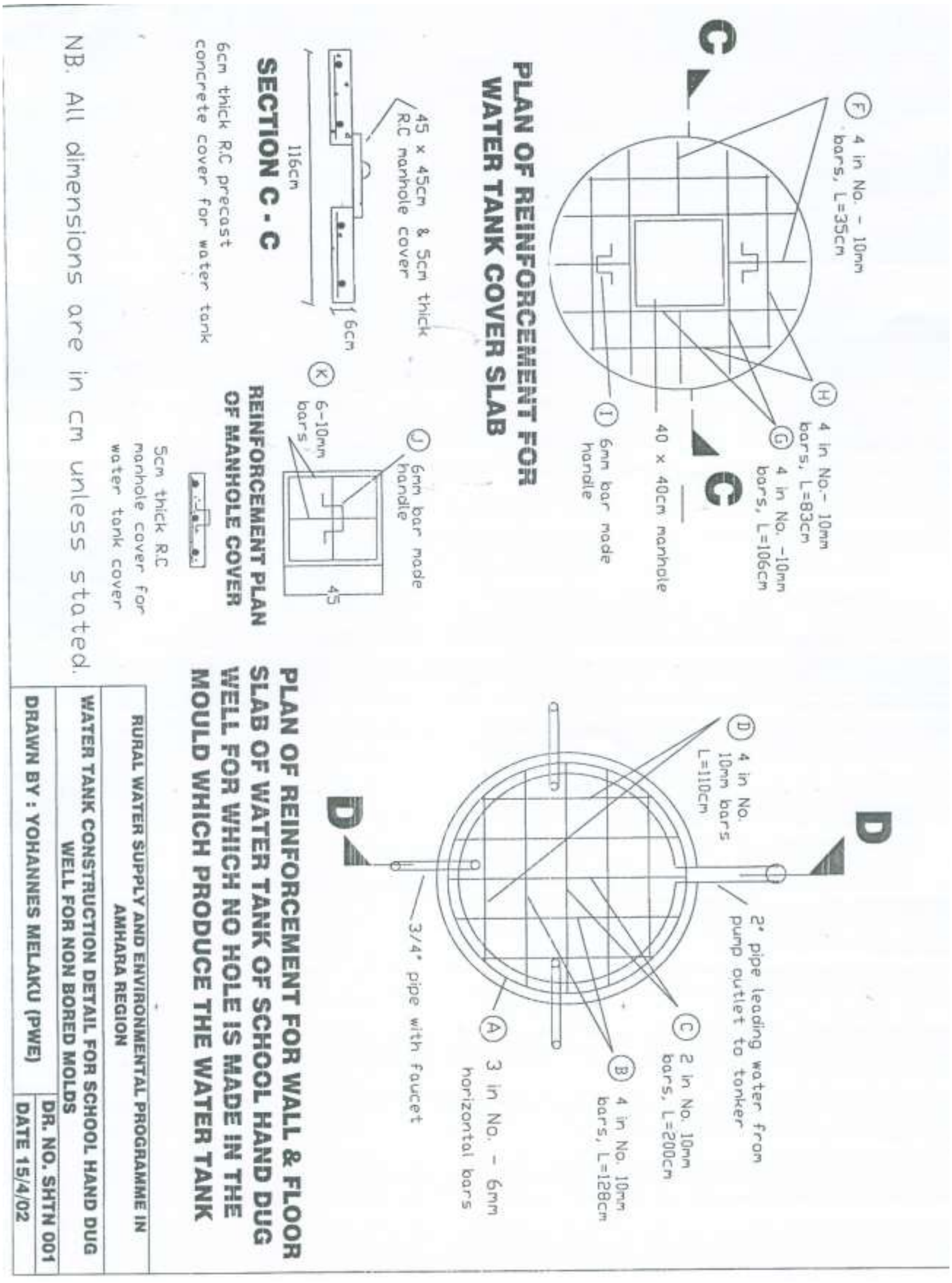
In this alternative design 1" pipe having 40-45cm length will be installed through the holes made in the mold during cylinder production. At 4cm from one end of the pipe, 10mm bars will be welded as cross to make the pipe strongly embeded in the concrete. After the concrete is cured, other fittings and pipes will be connected as shown in the detail.

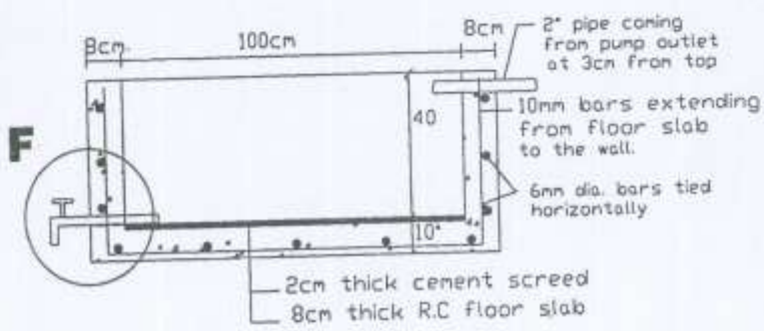
NB. All dimensions are in cm unless stated.

WATER TANK CONSTRUCTION DETAIL OF SCHOOL HAND DUG WELL FOR BORED MOLDS

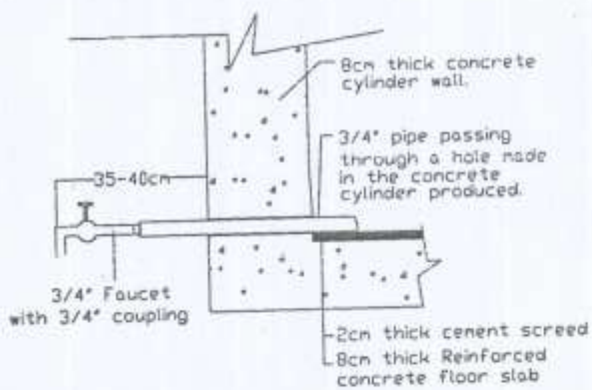
RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
WATER TANK CONSTRUCTION DETAIL OF SCHOOL HAND DUG WELL FOR BORED MOLDS	
DRAWN BY : YOHANNES MELAKU (PWE)	DR. NO. SHTH 002
DATE 15/4/02	

DRAWING No. SHNH 001 To SHNH 002 WATER TANK CONSTRUCTION DETAIL Of SCHOOL HAND DUG WELL FOR NON - BORED MOLDS


PLAN OF REINFORCEMENT FOR WATER TANK COVER SLAB
C
C
(F) 4 in No. - 10mm bars, L=35cm
(H) 4 in No.- 10mm bars, L=83cm
(G) 4 in No. -10mm bars, L=106cm
40 x 40cm manhole
(I) 6mm bar made handle
SECTION C - C
45 x 45cm & 5cm thick R.C manhole cover
116cm
6cm
6cm thick R.C precast concrete cover for water tank
(J) 6mm bar made handle
(K) 6-10mm bars
45
REINFORCEMENT PLAN OF MANHOLE COVER
5cm thick R.C manhole cover for water tank cover
NB. All dimensions are in cm unless stated.
D
D
(D) 4 in No. 10mm bars L=110cm
2" pipe leading water from pump outlet to tanker
(C) 2 in No. 10mm bars, L=200cm
(B) 4 in No. 10mm bars, L=128cm
(A) 3 in No. - 6mm horizontal bars
3/4" pipe with faucet
PLAN OF REINFORCEMENT FOR WALL & FLOOR SLAB OF WATER TANK OF SCHOOL HAND DUG WELL FOR WHICH NO HOLE IS MADE IN THE MOULD WHICH PRODUCE THE WATER TANK
RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION
WATER TANK CONSTRUCTION DETAIL FOR SCHOOL HAND DUG WELL FOR NON BORED MOLDS
DR. NO. SHTN 001
DRAWN BY : YOHANNES MELAKU (PWE)
DATE 15/4/02

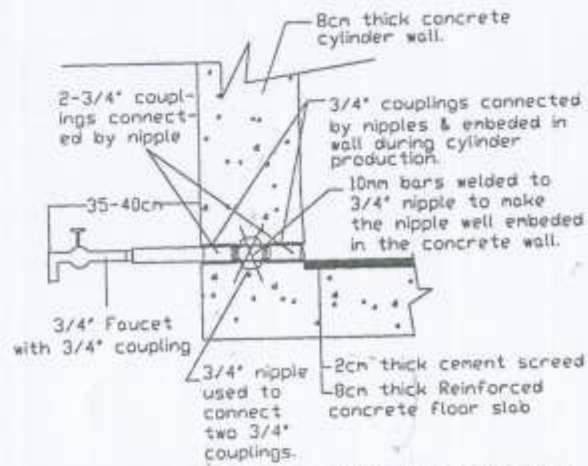


SECTION D - D



FIRST ALTERNATIVE DETAIL - F

In this alternative design 3/4" pipe with faucets will be installed by boring the cylinder after it is produced.



SECOND ALTERNATIVE DETAIL - F

In this alternative, two 3/4" couplings will be connected by one 3/4" nipple, 10mm cross bars will be welded to the nipple. The connected couplings with the nipple will be put between the inner & outer cylinder molds during cylinder production. After the produced cylinder is cured, the 3/4" pipe with faucet will be connected to the 3/4" coupling which is located on the outer side of the concrete cylinder.

NB. All dimensions are in cm unless stated.

WATER TANK CONSTRUCTION DETAIL FOR NON BORED HOLES

RURAL WATER SUPPLY AND ENVIRONMENTAL PROGRAMME IN AMHARA REGION	
WATER TANK CONSTRUCTION DETAIL FOR SCHOOL HAND DUG WELL FOR NON BORED MOLDS	
DRAWN BY : YOHANNES MELAKU (PWE)	DR. NO. SHTN 002
	DATE 15/4/02

LIST OF ANNEXES

ANNEX – 1

Reinforcement Bar Schedule Spring Development with 2mcu Capacity Collection Chamber (Drawing No. SPD 003)

Location	Bar No.	Shape	Dia. (mm)	Length (m)	No. of bars	Total Length (m)	
						ϕ6	ϕ10
Manhole cover of the spring capping structure.	1	70	10	0.7	8		5.6
	2	10 / 15 / 15	10	0.7	1		0.7
Floor slab of the collection chamber	3	295	10	2.95	11		32.45
	4	195	10	1.95	16		21.2
Roof slab of the collection chamber	5	295	10	2.95	8		23.6
	6	65	10	0.65	6		3.9
	7	195	10	1.95	14		27.3
	8	115	10	1.15	6		6.9
Manhole cover of collection chamber	9	10 / 15 / 15	10	0.7	1		0.7
	10	60	10	0.6	8		4.8
		Total length in meters				11.25	127.15
		Weight Kg/m				0.222	0.618
		Total Weight in kg				2.5	78.58
		Waste (10%) in Kg				0.25	7.86
		Total weight including waste in Kg				2.75	86.44

NB: The lengths shown in bar shapes are in centimeters (cms).

ANNEX - 2

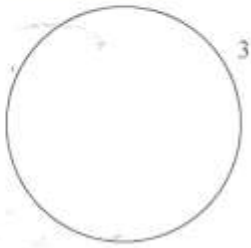
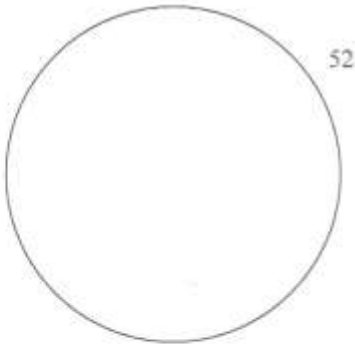
Reinforcement Bar Schedule for Well Head of Community Hand Dug Well (Drawing No. CHD 003)

Location	Bar No.	Shape	Dia. (mm)	Length (m)	No. of bars	Total Length (m)	
						ϕ6	ϕ10
Slab of well Head	1	195	10	1.95	13		25.35
	2	70	10	0.70	6		4.2
	3	80	10	0.80	2		1.6
	4	61	10	0.61	2		1.22
	5	27	10	0.27	1		0.27
	6	60	10	0.60	3		1.8
	7	65	10	0.65	4		2.6
Manhole cover of well head	8	55	10	0.55	6		3.3
	9	10 / 15 / 15	10	0.7	1		0.7
		Total length in meters					41.04
		Weight Kg/m				0.222	0.618
		Total Weight in kg					25.40
		Waste (10%) in Kg					2.54
		Total weight including waste in Kg					27.94

NB: The lengths shown in bar shapes are in centimeters (cms).

ANNEX – 3

Reinforcement Bar Schedule of Reinforced Concrete Cylinders to be installed in hand dug well (Drawing No. CHD 004)

Location	Bar No.	Shape	Dia. (mm)	Length (m)	No. of bars	Total Length (m)	
						ϕ6	ϕ6
RC cylinder for 116 cm outside diameter, 110 cm inside diameter and 50 cm high cylinder.	1		6	3.75	3	11.25	
RC cylinder for 166 cm outside diameter, 150 cm inside diameter and 50 cm high cylinder	2		6	5.25	3		15.75
		Total length in meters				11.25	15.75
		Weight Kg/m				0.222	0.222
		Total Weight in kg				2.50	3.5
		Waste (5%) in Kg				0.13	0.35
		Total weight including waste in Kg				2.63	3.85

NB: The lengths shown in bar shapes are in centimeters (cms).

ANNEX - 4

Reinforcement Bar Schedule for Well Head of Hand dug well for schools where the soil around the well is not black cotton (Drawing No. SHD 003)

Location	Bar No.	Shape	Dia. (mm)	Length (m)	No. of bars	Total Length (m)	
						ϕ6	ϕ10
Slab of well Head	1	195	10	1.95	11		21.45
	2	135	10	1.35	6		8.1
	3	60	10	0.6	3		1.8
	4	70	10	0.70	6		4.2
	5	83	10	0.83	2		1.66
	6	155	10	1.55	1		1.55
	7	185	10	1.85	2		3.7
	8	315	10	3.15	4		12.6
	9	115	10	1.15	2		2.3
Manhole Cover of Well Head	10	10 / 15 / 15	6	0.7	2		1.4
	11	55	10	0.55	6		3.3
		Total length in meters					62.06
		Weight Kg/m				0.222	0.618
		Total Weight in kg					38.4
		Waste (10%) in Kg					3.84
		Total weight including waste in Kg					42.24

NB: The lengths shown in bar shapes are in centimeters (cms).

ANNEX - 5

Reinforcement Bar Schedule for Well Head of Hand dug well for schools where the soil around the well is black cotton (Drawing No. SHDB 004)

Location	Bar No.	Shape	Dia. (mm)	Length (m)	No. of bars	Total Length (m)	
						ϕ6	ϕ10
Slab of well Head	1	195	10	1.95	15		29.25
	2	70	10	0.70	6		4.20
	3	80	10	0.8	2		1.60
	4	79	10	0.79	2		1.58
	5	47	10	0.47	1		0.47
	6	60	10	0.60	3		1.80
Manhole Cover of Well Head	7	55	10	0.55	6		3.30
	8	10 / 15 / 15	10	0.7	1		0.70
		Total length in meters					42.90
		Weight Kg/m				0.222	0.618
		Total Weight in kg					26.5
		Waste (10%) in Kg					2.65
		Total weight including waste in Kg					29.15

NB: The lengths shown in bar shapes are in centimeters (cms).