

# **TECHNICAL SPECIFICATION FOR TUBEWELL**

## **1 General**

The Contractor shall have to furnish in writing to the concerned Executive Engineer, GMC, a programme of drilling of wells within a week of handing over the pin pointed sites to the Contractor.

For the purpose of drilling approach road, water for drilling, crew, camp and other infrastructure, preparation of the site and placing the rig at the site etc, are to be arranged by the drilling contractor at his own cost.

Technical problems during drilling like jamming of drill string, damages to bits/ hammer/ drill rods/ stoppage of work due to unforeseen reasons etc would be the responsibility of the drilling contractor and no compensation of any kind would be paid by the department. In case the well could not be completed and had to be abandoned due to contractor's fault, no payment will be made for that well. In case the well is abandoned due to geological condition such as poor discharge, inadequate depth of good quality bearing formation, etc, duly certified by site officer and on approval of concerned authority, payment for executed works will be made. The decision of Executive Engineer will be binding on contractors in deciding whether the well is abandoned due to contractor's fault or due to geological formation.

Drilling Fluid / Bentonite Mud / Drilling Foam required for drilling and for efficient removal of cuttings, to reach the targeted depth and saving borehole from collapsing will be the responsibility of the contractor.

## **2 Scope of Work and Overview**

### **2.1 Scope of Work**

#### **(A) Alluvial Formations:**

The scope involves drilling of pilot hole; collection of samples including water samples for chemical analysis and preparation of litholog; electrical logging; preparation of composite log; design of well assembly; enlargement of hole size by reaming; lowering of well assembly; gravel shrouding; development and testing of exploratory and observation wells.

#### **(B) Hard Rock Formations:**

The scope involves drilling and casing of overburden; drilling in hard rock up to the targeted depth; identification of depth of each fracture; assessment of yield after encountering of each fracture; development and testing of exploratory and observation wells.

The contractor shall be required to carry out all of the following works:

**Exploratory Drilling:** Drilling and construction of exploratory wells/ observation wells as per Tables in Packages, conducting electrical logging, development and conducting preliminary yield of wells, conducting pumping test and data analysis, preparation of basic data reports along with site location map, and submission to GMC in prescribed format (Annexure- II to VIII ) intricate along with well diagram with complete details of reaming diameter, well assembly size and depth, gravel packing depth, cement sealing depth, clay packing depth etc.

The details of all the activities to be carried out by the contractor including methodology to be adopted and reporting formats are discussed in section 3.0 to 17.0.

### **3. Construction of Exploratory and Observation Wells**

The sizes of Pilot holes, reaming sizes, assembly designs, are to be strictly as per the actual requirements guided by BOQ. Formation strata samples should be collected after proper washing adopting standard procedure for sample collection for every 3 m or in the event of change in formation. The bottom of assembly should be provided with bail plug. The depth of blank pipe and slotted pipe with bail plug (well assembly) will be decided by the Engineer-In-Charge according to the formation encountered during drilling. After lowering the well assembly back washing should be carried out, the graded pea gravel of size 2 mm to 3.35 mm should be packed properly in the annular space between the well assembly and borehole up to the ground level. The bill of quantity should contain only the final reamed size of well and its depth and hence rate should be quoted for final reamed size and its depth only i.e. the final reamed rate deemed to cover the intermediate reaming sizes. The reaming with intermediate sizes should not be included in the bill of quantity. In case of higher consumption of gravel due to adverse geological formation like cavern formation, enlargement of reamed hole due to caving, the same should be certified by Engineer-In-Charge and it should be duly approved by authority concerned. A pair of clamps made of 75cm x 15cm MS plate of 9 mm thick should be provided and fixed around the casing with proper nuts and bolts which is finally reinforced in the cement concrete. Pumping tests such as Step Drawdown Test and Aquifer Performance Tests should be carried out using Submersible pump/ VT pump of adequate capacity creating sufficient drawdown. After carrying out test, analysis of data using approximate procedures based on geological formation and aquifer type should be carried for evaluating aquifer parameters such as Specific yield, Transmissivity, Storativity etc. Water sample should be collected during pumping test in 1 litre Teflon coated bottles using standard procedures. BDR along with litholog, logging data and report, pumping test data and report etc along with well diagram incorporating all details should be submitted. On completion of well, Mud pit should be filled up and hardened and brought to previous natural condition. The well should be provided with well cap using MS plate of minimum thickness 6mm and protection box made of 16-gauge GI sheet. A concrete platform should be provided around the well as per the specification given in the tender.

In respect of wells in Hard rocks, the Engineer In charge will decide the actual casing length at site based on overburden encountered. Lithology samples should be collected after proper washing adopting standard procedure for sample collection for every 3m or in the event of change in formation. Also Preliminary Yield Test (PYT) should be conducted as per instruction of site officer on encountering each fracture with substantial discharge. For conducting PYT, 75mm dia M.S Pipe (Eduction pipe) up to 1m above bottom level of drilling and 25mm dia airline should be lowered inside eduction pipe up to 1m above bottom level of eduction pipe. 20mm MS/ PVC pipe should be lowered for measuring water level and using water level sounders, the water level should be measured. Slug test has to be conducted on need based, on instruction of site engineer. Aquifer parameter test with full recovery should be conducted where EW and OW are constructed or as per instruction of site engineer. A pair of clamps made of 75cm x 15cm MS plate of 9 mm thick should be provided and fixed around the casing with proper nuts and bolts which is finally embedded in the cement concrete. In the well with discharge more than 3 litres per sec, pumping tests such as Aquifer Performance tests should be carried out. Pumping tests such as Step draw test and Aquifer Performance tests should be carried out using Submersible pump of adequate capacity creating sufficient draw down. After carrying out test, analysis of data using approximate procedures based on geological formation and aquifer type should be carried for evaluating aquifer parameters such as Specific yield, Transmissivity, etc. Water sample should be collected during pumping test and drilling in 1 litre Teflon coated bottle using standard procedures. BDR along with litho log, logging data and report, pumping test data and report etc should be submitted. Also well diagram with details such as overburden drilling dia and its depth, casing pipe lowered and its dia and depth, naked bore dia, depth at which fractures encountered, static water level, V notch discharge on encountering each fracture and depth, position of part assembly and its size and depth clay packing, cement sealing, concrete platform etc should be submitted. The well should be provided with well cap using M.S plate of minimum thickness 6mm and protection box made of 16-gauge GI sheet. A concrete platform should be provided around the well as per the specification given in the tender. Schematic diagram of well is given in Annexure I. On completion of well, the site around the well should be brought to previous natural condition.

## **4 Methodology / Approach**

### **4.1 Process /Methodology Involved in Construction of Wells In Soft Rock Up To 250 M Depth**

#### **Exploratory Wells**

- (i) Site selection and pinpointing of site
- (ii) Shifting of Rig
- (iii) Site preparation
- (iv) Pilot hole drilling (using 8½" RR Bit/ Drag Bit)
- (v) Sample collection & preparation of lithology
- (vi) Bore hole logging (Resistivity/Natural Gamma)

- (vii) Determining size of gravel packing
- (viii) Preparation of Composite log using data of (5) & (6) above
- (ix) Designing of Well assembly
- (x) Reaming of Bore hole ( by using appropriate size of RR bits based on recommended well assembly size, giving a margin for minimum 3" thickness gravel packing )
- (xi) Lowering of well assembly
- (xii) Back washing, shrouding of gravel and Clay packing (cement sealing, if required)
- (xiii) Verticality test of well
- (xiv) Development of well by air compressor/ pumping
- (xv) Pumping Test
  - a.SDT
  - b.APT
  - c.Water sample collection for analysis of Basic & Heavy metals under guidance ofsite Hydrogeologist/ Chemist.
- (xvi) Construction of platform, well capping and installation of protection box
- (xvii) Preparation of Basic Data Report & submission
- (xviii) Handing over of well

### **Observation Wells**

- (i) Pinpointing of site
- (ii) Shifting of Rig
- (iii) Site preparation
- (iv) Pilot hole drilling (using 8½" RR Bit/ Drag Bit)
- (v) Sample collection &Litholog
- (vi) Bore hole logging (Resistivity/Natural Gamma) (need based)
- (vii) Preparation of Composite log using data of (v) & (vi) above (need based)
- (viii) Designing of Well assembly
- (ix) Reaming of Borehole ( by using appropriate size of RR bits based on recommended well assembly size, giving a margin for minimum 100 mm thickness gravel packing )
- (x) Lowering of well assembly
- (xi) Back washing, shrouding of gravel and clay packing (cement sealing , if required)
- (xii) Development of well by air compressor
- (xiii) Construction platform, well capping and installation of protection box
- (xiv) Preparation of Basic Data Report
- (xv) Handing over of well

## **4.2 Process/ Methodology Involved In Construction Of Wells In Hard Rock Up To 250 M Depth**

### **Exploratory Wells**

- (i) Site selection and pinpointing of site
- (ii) Shifting of Rig

- (iii) Site preparation
- (iv) Overburden drilling (using Button Bit/ RR Bit)
- (v) Installation of casing pipe in the overburden and surface grouting.
- (vi) Telescopic Drilling using DTH method up to targeted depth
- (vii) Measurement of yield using V notch/ volumetric method after encountering each fracture zone and simultaneous water sample collection and quality analysis for individual fracture zone
- (viii) Sample collection and preparation of litholog
- (ix) PYT/ Slug test (need based)
- (x) Development by air compressor
- (xi) Verticality test of well
- (xii) Electrical logging/ calliper logging (need based)
- (xiii) Pumping Test if yield is more than 3 lps
  - a.APT
  - b.Water sample collection
- (xiv) Construction of platform, well capping and installation of protection box
- (xv) Preparation of Basic Data Report
- (xvi) Handing over of well

### **Observation Wells**

- (xvii) Pinpointing of site
- (xviii) Shifting of Rig
- (xix) Site preparation
- (xx) Overburden drilling (using Button Bit/RR Bit)
- (xxi) Installation of casing in the overburden and surface grouting.
- (xxii) Telescopic Drilling using DTH method up to target depth
- (xxiii) Measurement of yield using V notch/volumetric method after encountering each fracture zone and simultaneous water sample collection and quality analysis for individual fracture zone
- (xxiv) Sample collection and preparation of litholog
- (xxv) Development by air compressor
- (xxvi) Verticality test of well
- (xxvii) Pumping Test if yield is more than 3 lps
  - a.APT
  - b.Water sample collection
- (xxviii) Electrical logging/ calliper logging
- (xxix) Construction of platform, well capping and installation of protection box
- (xxx) Preparation of Basic Data Report
- (xxxi) Handing over of well

### **5 Casing**

- (i) M.S Casing pipes/ slotted pipe as specified in above should confirm to the specification given below.
- (ii) BIS marked steel tubes plain ended for water wells of type ERW conforming to Table No 3 of IS: 4270/2001 (third revision).
- (iii) A length of 0.50 m of casing pipe should be left above the ground level.
- (iv) MS Casing pipe should be installed perfectly vertical on the consolidated rock basement in such a manner that there should not be leakage of air during drilling. The annular space between the casing and the borehole wall should be grouted with cement slurry to avoid entry of local foreign material in the borehole in consolidated formations. The annular space above gravel pack may be filled with local clay in case of Soft rock formation.
- (v) Well cap should be securely sealed to the pipe after bore hole is checked by the Engineer-In Charge. The well cap should be fabricated as per the provided specifications by GMC.

## **6 Well Development**

In respect of borehole drilled in hard rock formations, well should be washed/ developed using compressor thoroughly after completion the drilling operation till clear water comes. In respect of tube wells constructed in the soft rock formations, well should be washed/ developed using compressor of minimum pressure of 1034 kPa (150 psi) and discharge of 17 cubic meter per minute (600 cfm) thoroughly after lowering of well assembly and gravel shrouding till clear water comes. hour meter reading of engine calibrated to 1500 rpm. Sufficient length of airline (minimum 25mm dia) should be lowered inside the eduction pipe so that the bottom of airline inside the eduction pipe is minimum 95m below static water level. No payment will be made if hour meter is not working.

## **7 Construction of Platform, Well Cap, Protection Box and Display BOARD**

After the completion of well in all respects described above, the contractor shall fabricate and install well cap using MS plate of minimum thickness 6mm, make platform around well, and install Display Board and Protection Box.

## **8 Data Collection**

Drilling contractor will

- (i) Maintain a drill time log for every meter of drilling for wells drilled in hard rock formation and every 3 m for wells drilled in soft rock formations
- (ii) Measure discharge over 90° V notch plate during drilling on every increase/ decrease of yield at various depths for wells drilled in hard rock formations.
- (iii) Collect formation samples of minimum 500 g mass at an interval of 3m or change of formation during drilling and properly pack in polythene bags and label with date/depth/ location.
- (iv) Collect 1 litre water sample during the following stages:
  - a. For every water-bearing zone encountered for wells drilled in hard rock formations.

b. After development is complete and during test for wells drilled in soft rock formations

Necessary arrangements are to be made for verification by Engineer-In-Charge for checking of depth of borehole, length of casing, static water level, discharge and any other requirement as shall be felt necessary from time to time. A guest tent should be pitched at the site during drilling/ testing and provided with table and chairs for the Engineer-In-Charge.

### **9 Gravel Packing of Tube well**

After the tube well assembly has been placed in position in soft rock formation/ boulder formation, the good quality gravel has to be shrouded in the annular space between the well pipe and the borehole. The gravel size shall be decided by the GMC (depending upon the grain size of formation) and gravel should be of rounded to sub-rounded shape and shall be supplied by the Contractor. Before shrouding, it must be got approved from Engineer-In-Charge. The annular spaces between assembly and bore hole wall shall be gravel packed (up to the designed cement seal, if required). After gravel packing (cement sealing is to be done, if required, and above the cement seal entire annular space shall be filled with local clay/drill cuttings). A check of the verticality of the housing pipe and necessary correction should be made at this stage.

### **10 Verticality Test**

The well assembly shall be placed vertically inside the borehole. Verticality test as per IS: 2800 (Part 2) -1979 must be arranged by the Contractor with standard equipments at his cost. In case of deviation beyond the permissible limit, the well will be treated as vertically out. In that case payment will be restricted to the cost of material used in well construction as per BOQ.

### **11 Successful and Unsuccessful Well**

Success of well will be decided by the Engineer-In-Charge. In case of non-availability of minimum thickness of aquifer capable of yielding expected discharge, the bore hole may be abandoned and payment based on actual work carried out will be made at quoted rates. The tube well abandonment committee will be constituted by concerned personnel from GMC.

### **12 Aquifer Performance Test (APT)**

The contractor has to carry out the APT in order to determine Transmissivity, Specific Yield/ Storativity in wells through pumping test method.

#### **12.1 "Blank"**

#### **12.2 Methodology/ Approach**

Transmissivity, Storativity may be determined by conducting APT in wells having discharge more than 3 lps.

**Method/Procedure for determining the aquifer parameters:**



### Conducting pumping test on existing wells tapping unconfined aquifer

- (i) This method is to be used for conducting test in predominantly unconsolidated and semi consolidated subject to availability of wells for the purpose. The test shall be conducted with main well (pumping well) having one pumping well and at least one observation well at a distance of 5 to 10 m from the pumping well.
- (ii) VT/ Submersible pump of adequate capacity should be lowered to desired depth (in consultation with the Engineer-In-Charge) and should create substantial drawdown.
- (iii) Pre-test trial pumping needs to be carried out to assess the sustainability of wells for long duration pumping (till pumping water level stabilizes or up to 1000 min whichever is earlier).
- (iv) Pre pumping water level is to be measured in the pumping well and all observation well(s)
- (v) The main well is to be pumped at a constant discharge for long duration and water level in both pumping and observation wells are measured periodically (Annexure-III a and III b)
- (vi) Recovery water level is to be recorded as per data sheet (Annexure-III c and III d) after stopping of the pump until the pumped water level reaches static water level or 90% of the static water level.

The data recorded shall be analysed by using suitable methods for unconfined, semi confined and confined aquifers like Jacob's straight line, Theis' method and Curve matching method.

### 12.3 Technical Specifications

Area/ Method	Details
For Alluvial/ Sedimentary areas, subject to availability (Pumping test method)	(i) Pre-test trial pumping needs to be carried out to assess the sustainability of wells for long duration pumping. Wells that can sustain long duration pumping should only be selected. Lowering of suitable capacity submersible pump.
	(ii) Water level of nearby dug wells (if available) should be similar to pumping and observation wells.
	(iii) The main well should be pumped at a constant discharge continuously for a long duration till the third segment of type curve is attained or 10000 min whichever is earlier.
	(iv) The test has to be repeated after 24 hrs in the event of any breakdown/ interruption of

	pumping during test.
	(v) Analysis by suitable method.

#### **12.4 Submission of reports in the prescribed formats**

The following reports are required to be submitted by the contractor in the format prescribed in relevant Annexure in hard as well as soft copies:

For Alluvial/Sedimentary areas

- (i) Test Site details – (Annexure-VIII)
- (ii) Raw Pumping data sheet in case of Alluvial/Sedimentary areas- (Annexure-III a to III d)
- (iii) Processed graph sheet
- (iv) Calculation details and results
- (v) Consolidated statement of test (Annexure IIIa)

For hard rock areas

- (i) Well inventory data in original
- (ii) Processed graph sheet
- (iii) Calculation details and results
- (iv) Consolidated statement of test (Annexure- IVb)

#### **13 Preliminary yield Test (PYT)**

The contractor has to carry out the PYT in order to determine aquifer parameter (Transmissivity, Specific capacity) in wells having discharge more than 1 lps and less than 3 lps.

##### **13.1 “Blank”**

##### **13.2 Methodology/ Approach**

Transmissivity may be determined by conducting Preliminary Yield Test in wells having discharge more than 1 lps and less than 3 lps.

#### Method/ Procedure:

- (i) For conducting PYT, 75mm dia GI/ MS/ PVC Pipe (Eductor pipe) up to 1m above bottom level of drilling and 25mm dia airline should be lowered inside eduction pipe up to 1m above bottom level of eductor pipe. 20 mm GI/ MS/ PVC pipe should be lowered for measuring water level and using water level sounders, the water level should be measured.
- (ii) Pre pumping water level is to be measured in the pumping well.
- (iii) The well is to be pumped at a constant discharge for long duration (100 min) and water level during recuperation (recovery) should be measured periodically (Annexure-III e). The discharge should be measured using 90° V Notch
- (iv) Recovery water level is to be recorded as per data sheet (Annexure-III e) after stopping the pump until the pumped water level reaches static water level or 90% of the static water level.

The data recorded shall be analysed by using Jacob straight line method.

#### 14 Slug Test

The contractor shall conduct slug test in existing bore wells/ tube wells

##### 14.1 “Blank”

##### 14.2 Methodology/ Approach

Slug tests is to be conducted in low-yielding bore wells/tube wells (having well diameter  $\leq 254\text{mm}$ ), where conventional aquifer performance tests cannot be conducted due to constraints of yield. The contractor shall identify the wells for conducting the slug tests in a grid pattern in consultation with CGWB. In this method, a known volume or Slug of water (maximum 20 litre) is instantaneously injected into the well and the water level is measured at periodic intervals till the pre-injection water level returns to the pre-injection level or for a pre-determined period, whichever is less.

#### Procedure for conducting slug test:

- (i) Collect and record all available information (depth, diameter, yield, aquifer type, lithology etc.) about the tube well / bore well to be tested
- (ii) Measure the static water level before the injection of slug.
- (iii) Inject a known volume (slug) of water (not more than 20 litres) into the bore well/tube well.
- (iv) Measure the water level at closely spaced intervals (once every minute up to 10 minutes, once every 2 minutes up to 20 minutes and then on once every 5 minutes till completion).
- (v) Continue recording depth/time measurements until the water level returns to preinjection level or a sufficient Number of Readings have been made to clearly show a trend on a plot of water level recovery versus the logarithm of time.

- (vi) Estimate the value of change in head ( $H_0$ ) in response to injection of slug ( $H_0$ ). Compute also the change in water levels ( $H$ ) for each subsequent measurement.
- (vii) Compute the values of  $H/H_0$  for each measurement.

#### Analysis of Data

Field data generated need to be analysed using standard methods

- (i) For Unconfined aquifer - Hvorslev method (1951)/Bouwer and Rice method (1976).
- (ii) For confined aquifers - Cooper et al (1967) method

#### 14.3 Technical Specifications

- (i) Slug test is to be conducted in borewells/tubewells (having well diameter  $\leq 254\text{mm}$ ) in grid pattern.
- (ii) Conducting test with slug injection (20 litres)
- (iii) Slug injected should be of potable water quality.
- (iv) Recording water level data in periodic time steps (minute recording up to 10 min, 2 minute recordings upto 20 minutes and then on 5 minute recordings till completion)

Analysis of data generated using following method for unconfined aquifer by

- (i) Hvorslev method (1951) and
- (ii) Bouwer and Rice method (1976)

For Confined aquifer by - Cooper et al (1967)

Submission of report in prescribed format (Hard and Soft copy) containing

- (i) Site location details – (Annexure-V)
- (ii) raw data sheet - (Annexure-VI)
- (iii) Processed graph sheet
- (iv) Calculation details and results
- (v) Consolidated statement of slug test (Annexure-VII)

#### 15 Mode of Measurement

The Contractor shall be paid on actual measurement of finished work on the basis of quoted rates. The Contractor shall be eligible for payment of full length drilling of bore hole irrespective of the design of tube well assembly provided the more drilling necessitated in search of a suitable aquifer and as per the advice of Engineer- In-Charge.

#### 16 The Surrounding Area After Well Completion

The area surrounding the well site has to be levelled, pits to be filled and the area to be restored to the original condition i.e. as before start of drilling operation.

## 17 Handing Over of Tubewell

The tube well must be properly handed over to the GMC on completion.

## 18 Monitoring and Measurement of Work

18.1 The monitoring and measurement of different activities for exploratory drilling shall be as specified in below table

Sr. No.	Parameter	Monitoring Mechanism / Measurement Criteria
1)	Location of site	site selection report(s) duly signed by the representatives of contractor, and Engineer in charge.
2)	Depth/ Diameter of pilot hole	Sounding should be carried out in the presence of the Engineer-In-Charge
3)	Inspection of assembly pipes, screen pipes, gravel etc. as per specification	Pipes used for assembly, screen pipes, gravel etc. should be pre-inspected and approved by Engineer-In-Charge
4)	Litholog/ Electrical log/ Composite log/ Well Design	Verification/ validation by the GMC
5)	Installation of well assembly and gravel shrouding	Should be carried out in the presence of Engineer-In-Charge
6)	Development of well	Actual measurement of time should be based on engine Hour running/ sand content of water, will be verified by Engineer In-Charge
7)	Testing of well	Actual measurement of time/ water levels should be carried out by the contractor in the presence of Engineer- In-Charge. Analysis and Aquifer parameters evaluation report to be prepared by the contractor and to be validated by the Regional office
8)	Well capping/ construction of platform and installation of protection box	Physical inspection by the Engineer- In-Charge

PS: The contractor will report to the Engineer-In-Charge at specific time of 1100 hours via email/ phone the daily progress at each site and submit status report on weekly basis to Executive Engineer and Regional Director.

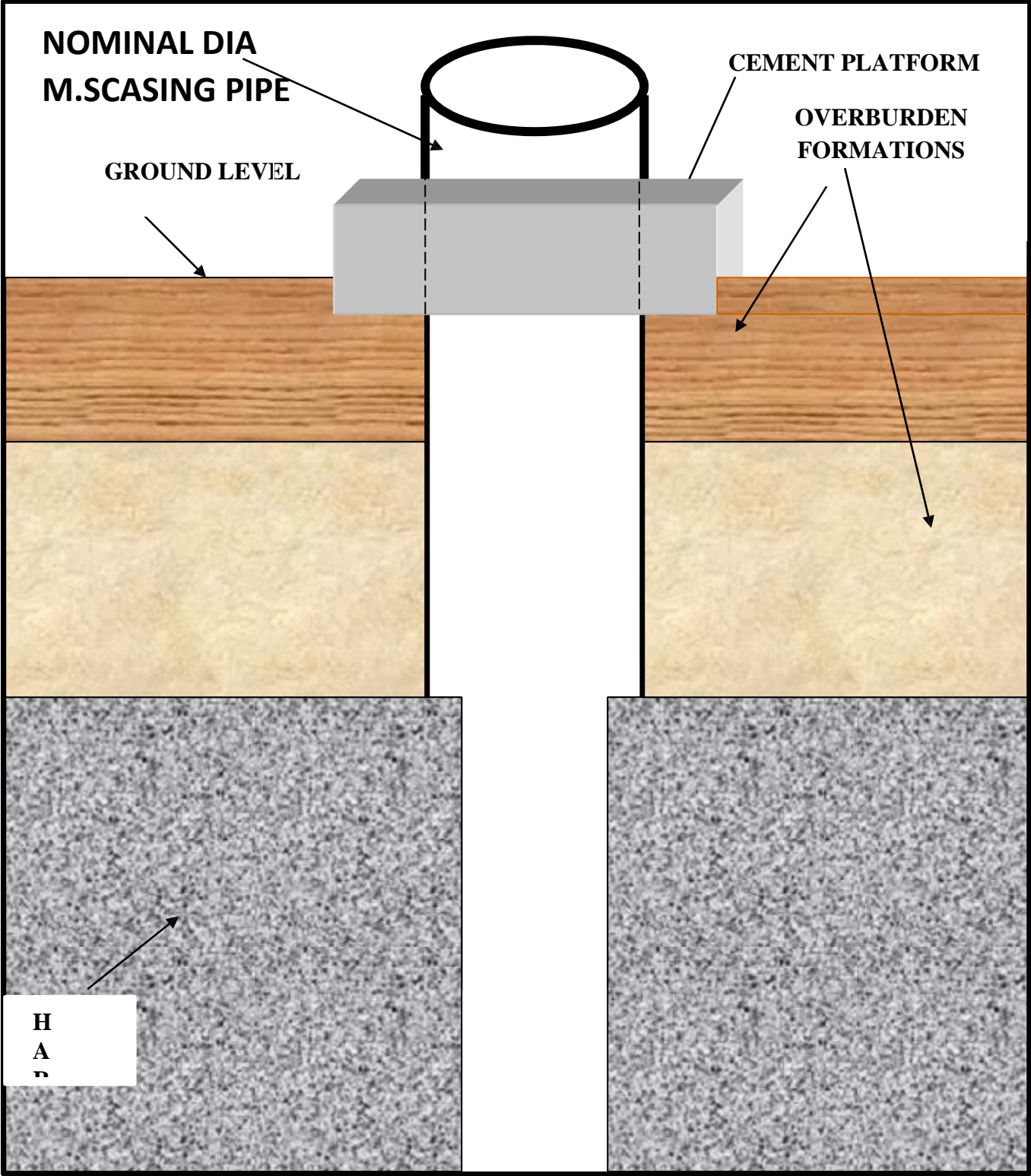
#### 18.2 Preparation and Submission of BDR

The contractor is required to prepare the basic data report (BDR) for all the wells. The BDR for each of the well shall be submitted to GMC in softas well as hard copy (in triplicate).

#### 18.3 Specification and Drawings

The specifications for drilling and construction of wells shall be as specified in the bill of quantities.

(ANNEXURE I)



**(ANNEXURE II)**

**LOGGING DATA (NATURAL GAMMA LOGGING)**

Unique ID	
Location	
Site plan and RL(m amsl)	
Date/Year	
Depth Drilled (m bgl)	
Depth Logged (m bgl)	
Bore hole dia.	

**Unique ID**

Depth range (m bgl)		Thickness (m)	Natural Gamma counts (CPS)	Inferred Lithology
From	To			

**Signature and stamp of Authorized signatory**



(ANNEXURE III-A)

PUMPING TEST DATA SHEET – PUMPING WELL

Site name with coordinates				
Location details				
Type of Well Pumping well				
Date of Test & Start time				
Diameter of well (mm)				
Distance from the observation well (m)				
Capacity of the pump				
Discharge (lps)				
Measuring Point (m)				
SWL in m below measuring point				
Clock Time (HH/MM)	Time since pump started (min)	Water level (m bmp)	Drawdown (m)	Remarks
Interval for Recording of data.				
1 minute interval upto 10 min				
2 minute interval upto 20 min				
5 minute interval upto 50 min				
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	12			
	14			
	16			
	18			
	20			

	25			
	30			
5 min recording upto 60 min				
10 min recording upto 100 min				
20 min recording upto 200 min				
50 min recording until 500 min				
100 min recording until completion of the test.				

**(ANNEXURE III-B)**

**PUMPING TEST DATA SHEET – OBSERVATION WELL**

Site name with coordinates				
Location details				
Type of Well Pumping well				
Date of Test & Start time				
Diameter of well (mm)				
Distance from the observation well (m)				
Capacity of the pump				
Discharge (lps)				
Measuring Point (m)				
SWL in m below measuring point				
<b>Clock Time (HH/MM)</b>	<b>Time since pump started (min)</b>	<b>Water level (m bwp)</b>	<b>Drawdown (m)</b>	<b>Remarks</b>
Interval for Recording of data.				
1 minute interval upto 10 min				
2 minute interval upto 20 min				
5 minute interval upto 50 min				
	1			
	2			
	3			
	4			
	5			

	6			
	7			
	8			
	9			
	10			
	12			
	14			
	16			
	18			
	20			
	25			
	30			
5 min recording upto 60 min				
10 min recording upto 100 min				
20 min recording upto 200min				
50 min recording until 500 min				
100 min recording until completion of the test.				

**(ANNEXURE III-C)**

**RECOVERY TEST DATA SHEET – PUMPING WELL**

Site name with coordinates				
Location details				
Type of Well Pumping well				
Date of Test & Start time				
Diameter of well (mm)				
Distance from the observation well (m)				
Capacity of the pump				
Discharge (lps)				
Measuring Point (m)				
SWL in m below measuring point				
Time since pump started	Time since Stopping of	Water level (m bmp)	Residual Drawdown RDD	t/t'

(min)	pumping (min) (t')		(m)	
<b>Interval for Recording of data.</b>				
<b>1 minute interval upto 10 min</b>				
<b>2 minute interval upto 20 min</b>				
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	12			
	14			
	16			
	18			
	20			
	25			
	30			
<b>5 min recording upto 60 min</b>				
<b>10 min recording upto 100 min</b>				
<b>20 min recording upto 200min</b>				
<b>50 min recording until 500 min</b>				
<b>100 min recording until completion of the test.</b>				

**(ANNEXURE III-D)**

**RECOVERY TEST DATA SHEET – OBSERVATION WELL**

<b>Site name with coordinates</b>		
<b>Location details</b>		

Type of Well Pumping well				
Date of Test & Start time				
Diameter of well (mm)				
Distance from the observation well (m)				
Capacity of the pump				
Discharge (lps)				
Measuring Point (m)				
SWL in m below measuring point				
Time since pump started (min)	Time since Stopping of pumping (min) (t')	Water level (m bmp)	Residual Drawdown RDD (m)	t/t'
Interval for Recording of data.				
1 minute interval upto 10 min				
2 minute interval upto 20 min				
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	12			
	14			
	16			
	18			
	20			
	25			
	30			
5 min recording upto 60 min				
10 min recording upto 100 min				
20 min recording upto 200 min				
50 min recording until 500 min				

**100 min recording until completion of the test.**

**(ANNEXURE III-E)**

**RECOVERY TEST DATA SHEET – PRELIMINARY YIELD TEST**

<b>Site name with coordinates</b>				
<b>Location details</b>				
<b>Type of Well Pumping well</b>				
<b>Date of Test &amp; Start time</b>				
<b>Diameter of well (mm)</b>				
<b>Distance from the observation well (m)</b>				
<b>Capacity of the pump</b>				
<b>Discharge (lps)</b>				
<b>Measuring Point (m)</b>				
<b>SWL in m below measuring point</b>				
<b>Time since pump started (min)</b>	<b>Time since Stopping of pumping (min) (t')</b>	<b>Water level (m bmp)</b>	<b>Residual Drawdown RDD (m)</b>	<b>t/t'</b>
<b>Interval for Recording of data.</b>				
<b>1 minute interval upto 10 min</b>				
<b>2 minute interval upto 20 min</b>				
	<b>1</b>			
	<b>2</b>			
	<b>3</b>			
	<b>4</b>			
	<b>5</b>			
	<b>6</b>			
	<b>7</b>			
	<b>8</b>			
	<b>9</b>			
	<b>10</b>			
	<b>12</b>			

	<b>14</b>			
	<b>16</b>			
	<b>18</b>			
	<b>20</b>			
	<b>25</b>			
	<b>30</b>			
<b>5 min recording upto 60 min</b>				
<b>10 min recording upto 100 min</b>				
<b>20 min recrodingupto 200min</b>				
<b>50 min recording until 500 min</b>				
<b>100 min recording until 90% recuperation to static water level.</b>				

**(ANNEXURE IV-A)**

## CONSOLIDATED STATEMENT OF PUMPING TEST CONDUCTED

[illegible]



**(ANNEXURE IV-b)**

### CONSOLIDATED STATEMENT OF RESULT OF TEST CONDUCTED IN HARD ROCK

[illegible]

**(ANNEXURE V)**

Well no: \_\_\_\_\_ Date of test \_\_\_\_\_

Location:

District: \_\_\_\_\_ State \_\_\_\_\_

Latitude (Degree Decimal): \_\_\_\_\_ Longitude (Degree Decimal): \_\_\_\_\_

**Well Details:**

Type of Well: BW/TW Owner: Govt/Private. Well usage: Irrigation/Domestic Well status: In use/Abandoned

Geologic formation \_\_\_\_\_ Depth of the well: \_\_\_\_\_ (m). Diameter of Well : \_\_\_\_\_ (mm) Casing length \_\_\_\_\_ (m) Reported discharge \_\_\_\_\_ lps.

Alluvial area/Hard rock area: Zones tapped/Fractures encountered from \_\_\_\_\_ to \_\_\_\_\_ (m).

***Test Reading***

Measuring point (MP) \_\_\_\_\_ (m) Static WL \_\_\_\_\_ (m) Slug Quantity (Injection) \_\_\_\_\_ litre.

*Time of start of test* \_\_\_\_\_ *Time of Completion of test* \_\_\_\_\_ Length of test \_\_\_\_\_ (Minutes)

**Results:**

**Analysis method**

Type of aquifer: Unconfined/Confined. Method used for Analysis:

\_\_\_\_\_

**Aquifer parameters:**

Transmissivity \_\_\_\_\_  $\text{m}^2/\text{d}$  and Hydraulic Conductivity (K) \_\_\_\_\_  $\text{m}/\text{d}$ .

Name of personnel conducted test

Signature

Date

(ANNEXURE VI)

SLUG TEST DATA SHEET

Site name				
Location details				
Volume of Slug injected (litres)				
Date of Test				
Diameter of well (mm)				
Distance from the observation well (m)				
Height of M.P. (m.agl)				
SWL in m below measuring point				
Time(min)	Time (sec)	Water level (H in m)	Change in Water level (Ho in m)	H/Ho
Interval for Recording of data.				
1 minute interval upto 10 min				
2 minute interval upto 20 min				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
12				
14				
16				
18				
20				
25				
30				
35				
40				
45				

<b>50</b>				
<b>55</b>				
<b>60</b>				
<b>65</b>				
<b>70</b>				
<b>75</b>				
<b>80</b>				
<b>85</b>				
<b>90</b>				
<b>95</b>				
<b>100</b>				

(ANNEXURE VII)

CONSOLIDATED STATEMENT OF SLUG TEST

Sr. No.	Location	Depth of well	Geological formation	K value (m/d)		
				Hvorslev method	Bouwer and rice method	Cooper et al
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

(ANNEXURE VIII)

**WELL INVENTORY DATA SHEET**

Well no: \_\_\_\_\_ Date of inventory \_\_\_\_\_

Location:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Administrative Block: \_\_\_\_\_ District: \_\_\_\_\_ State \_\_\_\_\_

Name of the Watershed \_\_\_\_\_ Area of the Watershed \_\_\_\_\_ km<sup>2</sup>

Geologic formation \_\_\_\_\_

Type of Well: DW/DCB/BW\* Owner: Govt/Pvt. Well usage: Irrigation/Domestic.

Depth of the well: \_\_\_\_\_ (m). Diameter of Well: \_\_\_\_\_ (mm)

Casing length/ Curbing depth (m) \_\_\_\_\_ (m) Reported discharge \_\_\_\_\_ lps.

Weathering thickness) \_\_\_\_\_ m Fractures encountered from \_\_\_\_\_ to \_\_\_\_\_ (m).

Measuring point (MP) \_\_\_\_\_ (m) Static WL \_\_\_\_\_ (m) Type of Pump-  
Submersible/Centrifuge/JET

Pump Capacity \_\_\_\_\_ (HP) Hours of pumping \_\_\_\_\_ hrs/day.

Number of pumping days \_\_\_\_\_ days /year. Total estimated draft  
\_\_\_\_\_ m<sup>3</sup>/year.

Cropping pattern \_\_\_\_\_

Command area of the well \_\_\_\_\_ ha.

Any \_\_\_\_\_ other \_\_\_\_\_ Salient  
feature: \_\_\_\_\_

Name of officer