



बिहार सरकार

नगर विकास एवं आवास विभाग

**Model Estimate of Water
Supply for 500 Households**

पटना, बिहार |

Report

Name of Work:- Construction of MODEL ESTIMATE for 500 households of Urban Water Supply Scheme in different ULBs of Bihar.

This Model estimate has been framed in compliance to the direction received from Urban Development and Housing Department, Bihar, Patna. To provide "Har Ghar Nal Ka Jal" through Tap water is one of the important part of MUKHYAMANTRI SEVEN NISCHAY YOJANA. It is mandatory to provide House Service Connection to each and every household.

Hence, in compliance to the Nischay yojana , this Model Estimate has been framed to provide water supply through Tap in urban area of Bihar.

DESIGN PERIOD:-

Following design period has been adopted while designing the project:-

Source: -	15 Years
Electric Motor and Pump: -	15 Years
Distribution Main: -	30 Years

Population Forecast:-

The population is forecasted @ 2% per annum for the year 2033 based on population of 2011 Census taking base year 2018.

Demand: -

As per the CPHEEO manual on water supply and treatment published by Government of India, Ministry of Urban development, the per Capita water demand is taken as 135 Liters per day excluding 15% NRW.

Source :-

Since the most of the area of Bihar has good aquifer layer, the provision of High Yielding Tubewell has been made in this Estimate.

Details of Provision :-

1. Provision of 200mm X150mm X150 M deep High Yielding Tubewell
2. Provision of 5 HP Submersible Pump discharging 8.74 lps with 37 m head.
3. Provision for laying of 63mm, 90mm, 110mm and 160mm H.D.P.E (PE100-PN8) Distribution network has been made.
4. Provision of House service connection for every household has been made.

Rates :-

Schedule of rates effective from 17.10.2016 of Building Department and current Schedule Rate of PHED for scheduled items and prevailing market rates for non-scheduled items have been considered.

Specification :-

The standard specification of PWD & PHED will have to be followed during the execution of work.

This is a model estimate. Actual length of pipe line may vary substantially which has to be considered at the time of technical sanction after verification of actual site condition.

There may be some sites/habitations where high yielding tube well will not fruitful. For such sites/ habitations other source of water has to be considered necessitating separate water supply scheme.

For better planning and implementation of scheme, vetting from the nodal department of water supply field may be taken into consideration.

Life of HDPE pipes has been considered 30 years but for design purpose intermediate life (15 years) has been considered in this estimate.

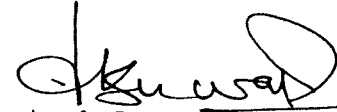
38,92,800.00

Estimated Cost:- The Estimated cost of this Estimate comes to Rs. ~~39,12,000.00~~
(Rs. ~~Thirty Nine Lakh Twelve Thousand~~ ^{Thirty Eight Lakh Ninety Two Thousand Eight Hundred}) only including 1.0% contingency.

Per Capita Cost:-

1557.00

The per capita cost comes to Rs. ~~1565.00~~ and per household cost comes to
^{7785.00} Rs. ~~7825.00~~ based on the population of 2011 Census.



Arvind Kumar
(Chief Engineer)

Bihar Rajya Jal Parshad

10.1.17

Model Estimate for 500 HH Water Supply Scheme
Population as per 2011 :- 2500
Projected Population at Intermediate (2031) stage:- 3250

General Abstract of Cost

S. N.	Particulars	Qty.	Unit	Rate	Amount
1	High Yielding Tubewell Cost for construction of 200mm x 150mm x 150m deep high yielding drilled tube well all complete as per direction of E/I. as per Sub estimate 1	1	Each	293216.44	293216.44
2	Pump motor with starter panel Supplying and installation of 7.5 HP Submersible pump and motor having discharge 8.74 lps against a total head of 37 m including doing power and light wiring S/F service wire extension of LT line (0.3Km) & suitable dia GI medium class column pipe, N/R Valve, flange etc all complete as per direction of E/I. as per Sub estimate 2	1	Each	110000.00	110000.00
3	Distribution Network Providing laying and jointing distribution pipes as per IS specifications from 63 mm dia to 160 mm dia HDPE pipe for distribution net works etc all complete as per direction of E/I. Total length of Pipe- 4950 m. as per Sub estimate 3	1	Each	2713393.70	2713393.70
4	House service connection House service connection with 15mm dia CPVC/MDPE pipe including fitting and fixing specials such as ferrule, bib cock etc all complete. as per Sub estimate 4	500	Each	1513.00	756500.00
	Total				3873110.14
	Contingency @ 1.0%				38731.10
	Grand Total				3911841.25
				Say	3912000.00

28,94,518.31

28,94,518.31

38,54,234.75
38,542.25
38,92,777.10

38,92,800/-

Note:

1. The length of distribution pipe may decrease or increase as per actual site condition. The carriage of materials is based on Patna town. It may decrease or increase as per the actual distance. The carriage may be calculated as per attached sheet. Road cutting cost may increase or decrease as per actuals. The technical sanction may be accorded after above consideration.
2. Strongly advised that pipeline should be laid before construction of Naali-Gali
3. This is a particular estimate, should not be universally adopted.

[Signature]
10/11/17

[Signature]
10/11/2017

[Signature]
10/11/17

Technically approved for ₹ 39,12,000/- (₹ Thirty Nine lakh twelve thousand only.)

[Signature]
10/11/17

Chief Engineer
Bihar Rajya Jal Parshad
PATNA

Vetted & corrected for estimated cost -
as Rs. 38,92,800/- (Rs. Thirty eight lakh ninety two thousand eight hundred only.)

[Signature]
10/11/17

[Signature]
10/11/17

[Signature]
10.10.17

[Signature]
10.1.17

[Signature]
10/11/17
10.1.2017

SUB-ESTIMATE 1

Estimate for construction of 200mm x 150mm x 150m Deep High Yeild Tubewell

S.No.	Description	QTY	Unit	Rate	Amount
1	Providing all materials, labour and equipment for drilling by Reverse Rotary rig Machine for following dia of bore hole in all kind of soil mixed with Kankar, sand stone including providing sample box and collection starta sample at every 3.0M depth of drilling for ascertaining proper aquifer for completing High Yielding Tube Well all complete as per IS:2800-1979 & PHED specification and direction of E/I				
24.1.1.3	(a) 400mm dia bore from G.L to 30.0m below GL.	30	PM	529.30	15879.00
24.1.1.2	(b) 350mm dia bore from 30.0m to 90.0m and beyond Below GL.	60	PM	413.50	24810.00
24.2.1.2	(b) 350mm dia bore from 90.0m to 160.0m and beyond Below GL.	70	PM	509.40	35658.00
2	Supplying, assembling, lowering and fixing in vertical position in bore well, unplasticized PVC medium well casing (CM) pipe of required dia, conforming to IS:12818, including required hire and labour charges, fittings & accessories etc. all complete, for all depths, as per direction of Engineer-in-charge.				
24.3.3	(a)200mm x 5mm thick pipe ISI mark.	30	PM	921.70	27651.00
24.3.2	(b)150mm x 5mm thick pipe ISI mark.	90	PM	615.30	55377.00
3	Supplying, assembling, lowering and fixing in vertical position in bore well unplasticized PVC medium well screen (RMS) pipes with ribs, conforming to IS: 12818, including hire & labour charges, fittings & accessories etc. all complete, for all depths, as per direction of Engineer-in-charge.				
24.4.2	150 mm dia and 1 mm slot.	30	PM	554.30	16629.00
4	Providing all tools and labour including supplying fitting & fixing the following accessories for aforesaid 150mm x 100mm T/W as per direction of E/I.				
LS	(i) 200mm x 150mm dia M.S Reducer	1	Each	500.00	500.00
LS	(ii)200mm dia M.S well cap.	1	Each	260.00	260.00
24.15.2	(iii)150mm dia M.S well shoe plug	1	Each	254.50	254.50
LS	(iv)Centre guide suitable for 200mm dia pipe	3	Each	150.00	450.00
LS	(v)Centre guide suitable for 150mm dia pipe	8	Each	100.00	800.00
24.14.3	(vi)MS clamp 200mm	1	P.Pair	1169.50	1169.50

5A/ 24.8	Providing all materials, labour and tools for providing and placing around tube well double washed pea gravel conforming to IS:8419-1977 of size 4mm to 8mm from dalbhumgarh of east singhbhum (JH) inclusive of loading, carriage, unloading & stacking in proper shape for measurement at site. (Stock measurement of clean and washed gravel shall be taken 13" as 12" in height to count void) as per direction of E/I.				
		12	PM ³	990.10	11881.20
5B	Carriage of Pea Gravel from Dhalbhumigarh (taken av distance 500km.)	12	PM ³	5450.77	65409.24
6/24.12	Development of tube well in accordance with IS : 2800 (part I) and IS: 11189, to establish maximum rate of usable water yield without sand content (beyond permissible limit), with required capacity air compressor, running the compressor for required time till well is fully developed, measuring yield of well by "V" notch method or any other approved method, measuring static level & draw down etc. by step draw down method, collecting water samples & getting tested in approved laboratory, i/c disinfection of tubewell, all complete, including hire & labour charges of air compressor, tools & accessories etc., all as per requirement and direction of Engineer-in-charge.				
		20	Per Hr	649.40	12988.00
7	Transportation and erection of drilling plants, developing equipments & all other required tools and M/C by and suitable mechanical means including all cost of loading, unloading, placing at work site and back after completion of work as per S/D of E/I.				
		1	Each	3000.00	3000.00
8	Supplying all materials and labours for arrangement for additional water required during the drilling period for 70 Hrs & site clearance & levelling etc and providing the soap duster etc to staff engaged in drilling etc all complete work as per specification & direction of E/I.				
		1	Each	20000.00	20000.00
9	Chemical and bacteriological testing of water sample including the cost of collection, carrying to designated PHE/other laboratories and submission of report in triplicate as per direction of E/I.				
		1	Each	500.00	500.00
Total-					293216.44

Installation of Pump & Motor with Panel

S.No.	Description	QTY	Unit	Rate	Amount
1	Supplying, installation, Testing and commissioning of 7.5 HP Submersible pump and motor having discharge 8.74 lps against a total head of 37 m including three phase connection with service wire extension of LT line (0.3Km) & suitable dia GI medium class column pipe, suitable dia N/R Valve, suitable dia flange, submersible flat cable, LT connection from control panel to starter etc all complete with floor mounted outdoor type L.T feeder pillar, three phase starter controll pannel operated on 440 V, 3 phase , 50 c/s made of MS sheet (minimum 2 mm thick) duly spray power coated painting with all accessories as per direction of E/I				
		1	Each	110000.00	110000.00
	Total :				110000.00

SUB-ESTIMATE 3

Water Supply Distribution System

S.No.	Description	Qty	Unit	Rate	Amount
1/2.8	Earth work in excavation in foundation trenches or drains(not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5 m. including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.				
	63mm	3450.0	0.46	0.5	798.68
	90mm	900.0	0.49	1.0	441.00
	110mm	400.0	0.51	1.0	204.00
	160mm	200.0	0.56	1.0	112.00
	5 % extra				77.8
Total-		1633.5	PM ³	230.50	376512.24
2/2.26	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20 cm in depth: consolidating each deposited layer by ramming and watering lead				
90% of item no 1		1470.1	PM ³	74.50	109523.41
3	Providing and supplying High Density Polyethylene pipe (HDPE pipe) of 20 mm to 225 mm OD and pressure 6.0 Kg/cm ² and 10 Kg/cm ² suitable for water supply which is available in all standard, like ISI-4984, ISO - 4427 DIN-8074 and various grades like PE-63, PE-80, PE-100 and newly invented PE 100+ materials				
HDPE pipe of materials grade PE100- PN8 (dia in mm)					
	63 mm dia			119.39	
	90 mm dia	3450.0	PM	121.70	419874.36
	110 mm dia	900.0	PM 248	249.82	224834.12
	160 mm dia	400.0	PM 263	370.99	148395.22
		200.0	PM	603.69	120738.87
4	Supplying labours and tools for lowering in trenches, laying and jointing H.D.P.E. pipes in trenches and making butt welded joint, supplying heating mirror, jack etc. including hydraulic testing and providing night guard, barrier and red light to safe guard against accident, all complete as per specification and direction of E/I			592.22	
HDPE pipe of materials grade PE100- PN8 (dia in mm)					

9,11,895.50
 2,90,583.40
 1,45,572.40
 1,18,444.40

	63 mm dia	3450.0	PM	21.32	73554.00
	90 mm dia	900.0	PM	38.16	34344.00
	110 mm dia	400.0	PM	53.33	21332.00
	160 mm dia	200.0	PM	84.09	16818.00
5	Providing all materials labours tools and tackles for fitting, jointing and testing to HDPE Standard specials confirming to IS specifications etc all complete.				
	10% of item No-3				77,803.25
6/ 18.31	Providing and fixing CI Sluice valves (with cap) Complete with bolts, nuts, rubber insertions etc.				79310.37
18.31.1.2	100mm dia Class II	1	Each	4046.30	4046.30
18.31.3.2	150mm dia Class II	1	Each	5890.00	5890.00
7/ 18.59	Providing and fixing CI double acting air valve of approved quality and bolts, nuts, rubber insertion etc. compete				
18.59.2	80mm dia	1	Each	6371.70	6371.70
8/ 18.35	Constructing masonry chamber 120 x 120 x 100cm inside in brick work in cement mortar 1:4 (1 Cement:4 coarse sand) for sluice valve, with CI Surface box 100mm top diameter, 160mm bottom diameter and 180mm deep (inside)with chained lid and RCC top slab 1:2:4 mix (1 Cement :2 Coarse sand: 4 graded stone aggregate 20mm nominal size), I/C necessary excavtion foundation concrete 1:5:10 (1 Cement:5 fine sand : 10 graded stone aggregate 40mm nominal size) and inside plastering with cement mortar 1:3 (1 Cement:3 Coars sand) 12mm thick, finished with a floating coat of neat cement complete as per standard design.				
		2	Each	14598.40	29196.80

9/ 18.36	Constructing masonry chamber 60 x 60 x 75cm inside in brick work in cement mortar 1:4 (1 Cement:4 coarse sand) for sluice valve, with CI Surface box 350x350mm top, 165mm bottom diameter and 180mm deep (inside)with chained lid and RCC top slab 1:2:4 mix (1 Cement :2 Coarse sand: 4 graded stone aggregate 20mm nominal size), I/C necessary excavtion foundation concrete 1:5:10 (1 Cement:5 fine sand : 10 graded stone aggregate 40mm nominal size) and inside plastering with cement mortar 1:3 (1 Cement:3 Coars sand) 12mm thick, finished with a floating coat of neat cement complete as per standard design.							
Road cutting and restoration					1	Each	5917.10	5917.10
10/ 15.24	Dismantling brick on edge soling in road including stacking serviceable materials in countable stacks within 15m lead and disposal of unserviceable materials with all leads etc all complete as per direction of E/I.							
	63mm dia	345	0.46	0.125	19.97			
	90 mm dia	90	0.49	0.125	5.51			
	110 mm dia	40	0.51	0.125	2.55			
	160 mm dia	20	0.56	0.125	1.40			
	Total-				29.43	PM ³	321.80	9470.37
11/ 11.73	Providing designation 100A one brick on edge soiling joints filled with local sand including cost of watering, taxes, royalty etc all complete as per building specification and direction of E/I.							
	63mm dia	345	0.46		159.74			
	90 mm dia	90	0.49		44.10			
	110 mm dia	40	0.51		20.40			
	160 mm dia	20	0.56		11.20			
	Total-				235.44	PM ²	407.00	95822.05
	Deduction for 80% Brick which are taken out during dismentaing work will be reused				11.54	P1000	-7019.25	-81015.94
12/ 15.2.1	Demolishing Cement concrete manually or by mechanical means including disposal of materials within 50m lead as per direction of E/I.							
	63mm dia	690	0.46	0.25	79.87			
	90 mm dia	180	0.49	0.25	22.05			

	110 mm dia	80	0.51	0.25	10.20			
	160 mm dia	40	0.56	0.25	5.60			
	Total-				117.72			
13/ 4.5.2	Providing and laying in position cement concrete 1:2:4(1cement:2coarse sand:4 graded stone chips 20mm nomina size)etc. all complete as per standard specification and direction of E/I.					PM ³	578.30	68076.03
	Quantity as per item no.13				117.72			
14/ 2.28	Providing local clean sand in filling in foundation trenches and in plinth including ramming and water in layers not exceeding 150mm thick with all leads and lifts including cost of all materials labours royalty and taxes all complete as per building specification and direction of E/I.					P.M ³	3850.50	453271.23
	63mm dia	690	0.46	0.15	47.92			
	90 mm dia	180	0.49	0.15	13.23			
	110 mm dia	80	0.51	0.15	6.12			
	160 mm dia	40	0.56	0.15	3.36			
	Total-				70.63			
15/ 11.72	Providing designation 100A brick one brick flat soling joints filled with local sand and as per direction of E/I.					PM ³	204.40	14436.87
	63mm dia	690	0.46		319.47			
	90 mm dia	180	0.49		88.20			
	110 mm dia	80	0.51		40.80			
	160 mm dia	40	0.56		22.40			
	Total-				470.87			
16/ Analysis attached	Carriage of the following materials from quarry to work site including loading, unloading and staking at work site as per specification & direction of E/I.					PM ²	253.80	119506.81
	(a). Bricks							
	(b). Coarse sand				17.94	P1000	607.00	10889.67
	(C) Stone chips				52.97	PM ³	485.81	25734.75
	(d). Local sand				105.95	PM ³	2796.69	296297.42
	Total				70.63	PM ³	343.28	24245.95
								2713393.70

26,94,518.31

House to House Service connection

S.N.	Particulars	Quantity	Unit	Rate	Amount
1A/ 2.8	Earth work in excavation in foundation trenches or drains(not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5 m. including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. For Pipe Laying (6 m X .3 m X 0.6m deep)	1.08	PM ³	230.50	248.94
1B/2.26	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20 cm in depth: consolidating each deposited layer by ramming and watering lead	1.08 1.03	PM ³	74.50	78.85 76.44
2/ PHED	Providing and fixing MDPE pipe (PE80) conforming IS: 15801/2008 and ISO 4427 with latest amendment PN12.5 (OD 20mm)	6	P/M	16.94 17.27	101.64 103.62
3/ PHED	Lowering, laying and jointing M.D.P.E. pipes in proper position including all specials by compression fitting/electrofusion and butt fusion jointing procedure including hydraulic testing as per relevant IS code complete with all materials for jointing procedures like Electrofusion machine, Electric mirror/heater, Butt fusion welding machine with hydraulic jack, top loading clamp, etc, pump and accessories for hydraulic testing and all labour as directed by Engineer-incharge as per IS-7634 Part II 2012 (amended up to date) Including Contractor's profit & Over head, water charge, labour cess but excluding trenching & refilling, road cutting and restoration the same.				
	20mm dia	6	P/M	3.03	18.18
4/ 18.7.1	Providing and fixing chlorinated polyvinyl chloride (CPVC) pipes, having thermal stability for hot and cold water supply, including all CPVC plain and brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes and fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge. Internal work (Exposed on wall) 15 mm nominal outer dia pipes.	1	P/M	138.70	138.70
5/ 18.20.1	Providing and fixing 15 mm brass ferrule with CI mouth cover including boring and tapping the main etc. all complete job.	1	Each	254.10	254.10
6/ LS	Providing and fixing HDPE electrofusion service saddle including all complete job as per direction of E/I.	1	Each	400.00	400.00
7/ 18.15.1	Providing and fixing brass bib cock of approved quality 15 mm nominal bore	1	Each	273.00	273.00
	Total :				1512.98
	Say Rs.:				1513.41

Rate Analysis Per Meter

S.N.	Particulars	Dia. Of Pipe	Rate including Excise Duty & CST	Cost without VAT	Amount of VAT	CP & Overhead Charges @ 15%	Total Cost including 1% Labour Cess
1.	2	3	4	5 (4/1.06)	6(4-5)	7 (5*0.15)	8(1.01*(4+7))
1	HDPE Pipe (PE100) PN8 conforming to IS 4984/1995 with latest amendment	63mm	105.56	99.58	5.98	14.94	121.70
2		75mm	150.82	142.28	8.54	21.34	173.88
3		90mm	216.68	204.42	12.26	30.66	249.82
4		110mm	321.78	303.57	18.21	45.53	370.99
5		125mm	417.95	394.29	23.66	59.14	481.86
6		140mm	523.62	493.98	29.64	74.10	603.69
7		160mm	523.62	493.98	29.64	74.10	603.69
8		180mm	682.28	643.66	38.62	96.55	786.62
9		200mm	861.66	812.89	48.77	121.93	993.43
10		225mm	1061.90	1001.79	60.11	150.27	1224.29
11		250mm	1345.32	1269.17	76.15	190.38	1551.05
12	HDPE Pipe (PE100) PN10 conforming to IS 4984/1995 with latest amendment	63mm	128.04	120.79	7.25	18.12	147.62
13		75mm	183.6	173.21	10.39	25.98	211.68
14		90mm	262.84	247.96	14.88	37.19	303.03
15		110mm	388.52	366.53	21.99	54.98	447.93
16		125mm	503.94	475.42	28.52	71.31	581.00
17		140mm	630.78	595.08	35.70	89.26	727.24
18		160mm	822.14	775.60	46.54	116.34	947.87
19		180mm	1044.44	985.32	59.12	147.80	1204.16
20		200mm	1288.04	1215.13	72.91	182.27	1485.01
21		225mm	1625.63	1533.61	92.02	230.04	1874.23
22	250mm	2001.26	1887.98	113.28	283.20	2307.30	
23	MDPE Pipe (PE80) PN 12.5 confirming to IS 15801/2008 and IS 4427 with latest amendment	20mm	14.98	14.13	0.85	2.12	17.27
24		25mm	20.16	19.02	1.14	2.85	23.24
25		32mm	32.48	30.64	1.84	4.60	37.45

Carriage Analysis for Patna Town

S.No.	Items	Rate (Rs.)	Remarks
1	Pea gravel		
	Carriage from Dalbhumgadh to work site (500 Km pakka and 5 Km unsurface road)		
	8/5 (500 x 6.50 + 5 x 7.90) + 133.60	5396.80	
	Including 1% Labour Cess	5450.77	per cum
2	Local Sand {Lead - 15 Km (14P + 1K)}		
	8/5 (14x6.50 + 1 x 15.80)	170.88	BCD SOR 2016
	Loading & Unloading	169.00	
		339.88	
	Including 1% Labour Cess	343.28	per cum
3	Bricks {Lead - 8 Km (7P + 1K)}		
	8/2 (7 x 6.50 + 1 x 15.80)	245.2	
	Loading & Unloading	355.79	
		600.99	
	Including 1% Labour Cess	607.00	per 1000 nos
4	Coarse Sand (Lead - 30 Km)		
	8/5 (30 x 6.50)	312	
	Loading & Unloading	169.00	
		481.00	
	Including 1% Labour Cess	485.81	per cum
5	Stone chips (Lead 250 Km)		
	8/5 (250 x 6.5)	2600.00	
	Loading & Unloading	169.00	
		2769.00	
	Including 1% Labour Cess	2796.69	Per cum

Design Parameter

1. No. of Households :- 500
2. Present Population Taking 5 Person per Households :- 2500
3. Projected Population (2033) taking 2% growth rate per annum :- 3250
4. Pumping hour :- 16 hours
5. Water Demand :-135 lpcd +15% UFW
6. Total Water Demand :- $3250 \times 135 = 554125$ Litre per day
7. Rate of Pumping :- $554125 / (16 \times 3600) = 8.74$ LPS
8. Head of Pump-motor:-

(a) Sub soil water level -	18 m
(b) Drawdown-	4.5 m
(c) Friction loss in pipes -	7.5 m
(d) Tail End pressure -	7 m
Total:-	37 m
9. Tubewell :-
 - (a) Discharge of tubewell is kept 1.5 times of the discharge of pump- $1.5 \times 8.74 = 13.11$ LPS
 $= 0.01311 \text{ m}^3/\text{s}$
 - (b) Velocity of flow in tubewell - 1.2 m/s
 - (c) Area of tubewell - $0.01311 / 1.2 = 0.0109 \text{ m}^2$
 - (d) Diameter of tubewell - $\sqrt{4 \times 0.0109 / 3.14} = 0.118 \text{ m}$, Say 150 mm
Hence provide 200mm x 150mm x 150m deep tubewell with 30 m screen pipe.
10. Distribution :- Total 4950 M distribution network has been assumed to cover 500 households.