



FROM RAINWATER HARVESTING TO AQUIFER RECHARGE



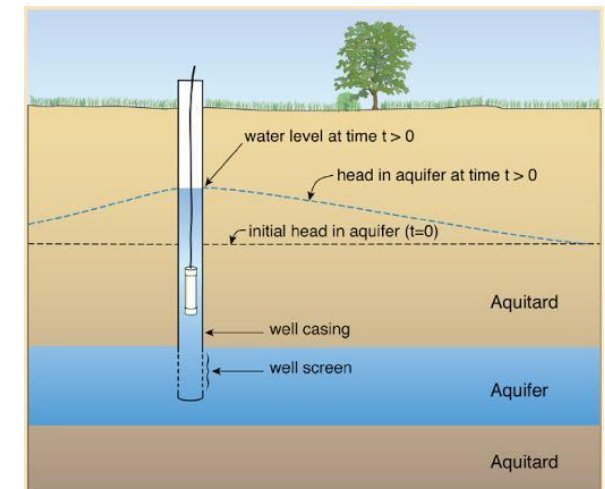
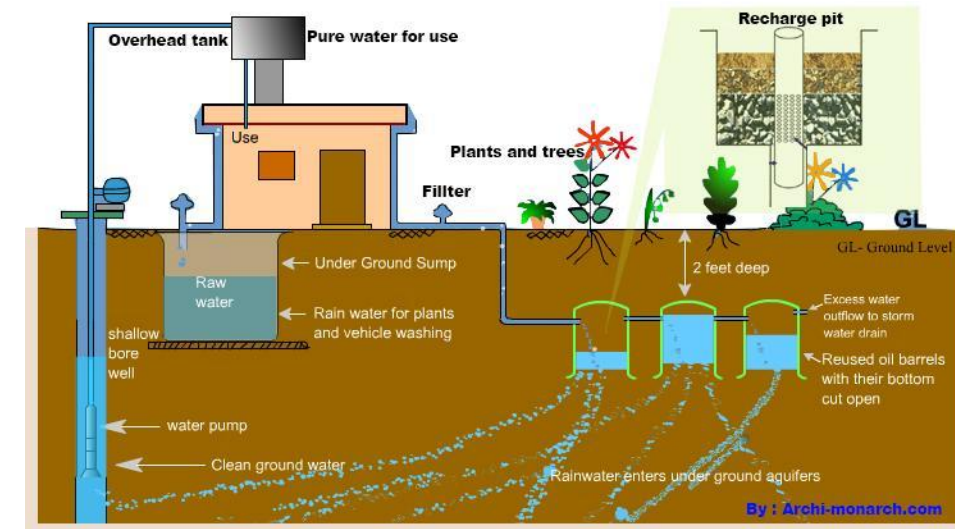
**LOCATION: KIRLOSKAR
BUNGALOW, PUNE**

DATE:- SEPTEMBER 23, 2020

As part of Bhujal Abhiyan and ACWADAM's partnership regarding building Groundwater Literacy through public participation in Pune city

CONCEPT AND OBJECTIVES OF A SURVEY

- Rainwater harvesting (RWH) means tapping the rainwater where it falls and is a most effective method for conservation of water in city areas.
- The **objective of the survey** is to understand the technical feasibility for artificial groundwater recharge. And to understand the recharge capacity of the existing borewell through tapping rainwater or the storm water within the premises.
- The **aim of the study** is to decide the location-specific RWH measures by which the rainwater from roof/s as well as the surface runoff from open plot can be diverted using appropriate filter media into aquifer/s or to a specially designed collection chamber.
- The **methodology** involves estimating the potential rainwater available and conducting a slug injection test for the recharge borewell for gauging its intake potential based on the underlying aquifer geometry and properties



Observations

1. Good rainwater catchment area (around 200 sq mts) available on terrace.
2. Terrace catchment area exclusively has a reasonable annual surface runoff availability (around 1.5 lakh litres). However, the existing drainage outlets are small and without netting thereby resulting in rainwater flooding the terrace and entering the bungalow.
3. The bungalow lawn has large open grass area which is good at reducing the surface runoff and facilitating infiltration.
4. Based on the aquifer map of Pune City it appears that the borewell has encountered the Aquifers 1 (deepest), 2 and a small, lower part of 3 (shallowest) (as shown in Annexure 1.
5. Rainwater recharge by means of borewell recharge and rainwater storage in an underground tank are feasible options.
6. Drainage lines for rainwater and grey water merge into common chamber which is joined to municipal line.

Technical Feasibility - Terrace Section

Rainfall Details of Pune City (<https://en.wikipedia.org/wiki/Pune>)

Normal annual Rainfall of Pune City	803 mm
Average Annual Rainy days	48.7
Monsoonal Avg. rainfall (June to Sept)	722 mm
Monsoonal Avg. Rainy days	39.7
Annual rainfall for 2019	1000 mm
No. of rainy days	74
A rainy day is 2.4 mm/day rainfall	

Estimation of Rainwater available from Roof Top for artificial recharge through borewell – Using good year data of 2019 & 2020

Average annual rainfall	1000 mm
Variation from average rainfall	20 to 22%
Total number of rainy days	74 days
Rooftop area	180 sq mts
Runoff coefficient	0.8
Total volume of water generated	144 cum (i.e. 1.44 lakh liters)
Per day avg. volume of water generated	1.95 cum/day (~2000 liters in a day)
Per hour volume of water generated	61 liters/hour
Maximum volume of water that has been generated in an hour	10000 liters/hour (Maximum intensity - 70 mm in an hour during 2020)
Acceptance capacity of borewell (as per Slug Test)	3600 liters/hour
Maximum water that can be artificially recharged in an hour	3500 to 4000 liters/hour

NOTE: Pavement area, Garden area & landscaping area, open area has not been considered as it is not feasible to divert this storm water for recharging through bore well.

Slug Test and Pumping Test Results

Slug Test		
Pump capacity	1*	Hp
Filling rate	48	liters/mins
Filling rate	2880	liters/hr
Initial WL	4.28	m
Final WL	4.18	m
Test time	68	minutes
Test Start	12:42	pm
Test End	13:50	pm
Diameter	6	inch
	0.15	meters
Rise in WL	0.1	m
Volume of water filled	3264	liters
Intake capacity	1	liters per second

Pumping Test		
Pump capacity	3*	Hp
Discharge rate	80	liters/min
Initial WL	4.18	m
Final WL	4.14	m
Test time	15	minutes
Test Start	13:57	pm
Test End	14:12	pm
Specific capacity	34	liters/min/meters of drawdown
* HP Capacity to be confirmed		

- Diagnosis:
- The discharge of borewell is more than what the aquifer can sustain through a limited aquifer transmissivity. Hence the pump is running intermittently during summer months.
 - To maintain the steady state condition pump discharge should be lesser than the aquifer response to the borewell..
 - For safe yield the maximum permissible discharge is 50 to 55 liters/minutes – estimated through specific capacity values.

Recommendations

- After ascertaining the intake capacity of the borewell and establishing its relation to the average expected rainwater from the terrace, a filter pit of 2.0m (L) x 2.0m (B) x 2.0m (D) around the existing borewell is suitable for recharging aquifer/s. Design enclosed.
- Considering the limitations of intake capacity of the borewell for artificial groundwater recharge, excess roof top water available can be stored in the artificially constructed pond in the open space of lawn. Around 20000 to 25000 liters of rainwater can be stored in the underground tank. This tank can be constructed underground using ferrocement technology with dimensions 5m x 5m x 1m.
- Mesh to be put at terrace pipe to arrest initial leaves and other garbage.
- The roof water from the first rainfall spell should be let out on the lawn and should never be used for borewell recharge. This may contaminate the groundwater.
- The filter bed should necessarily be cleaned after every monsoon. Cleaning of sand, gravel & pebbles, within the filter should be done after two years.
- Putting gunny bag below inlet pipe to capture un-arrested leaves and other waste.
- Every year the chemical and bacteriological water quality testing should be carried out to understand the effect of artificial groundwater recharge.
- Grouting of borewell (putting cement slurry around casing up to a depth of 6 mts below ground) should be checked before construction of filter pit. If it is not done at the time of drilling then before construction of filter pit grouting should be done.

Annexures

1. Satellite map showing Borewell location



Annexures

2. Recharge area map

Borewell Point source Recharge potential identification map

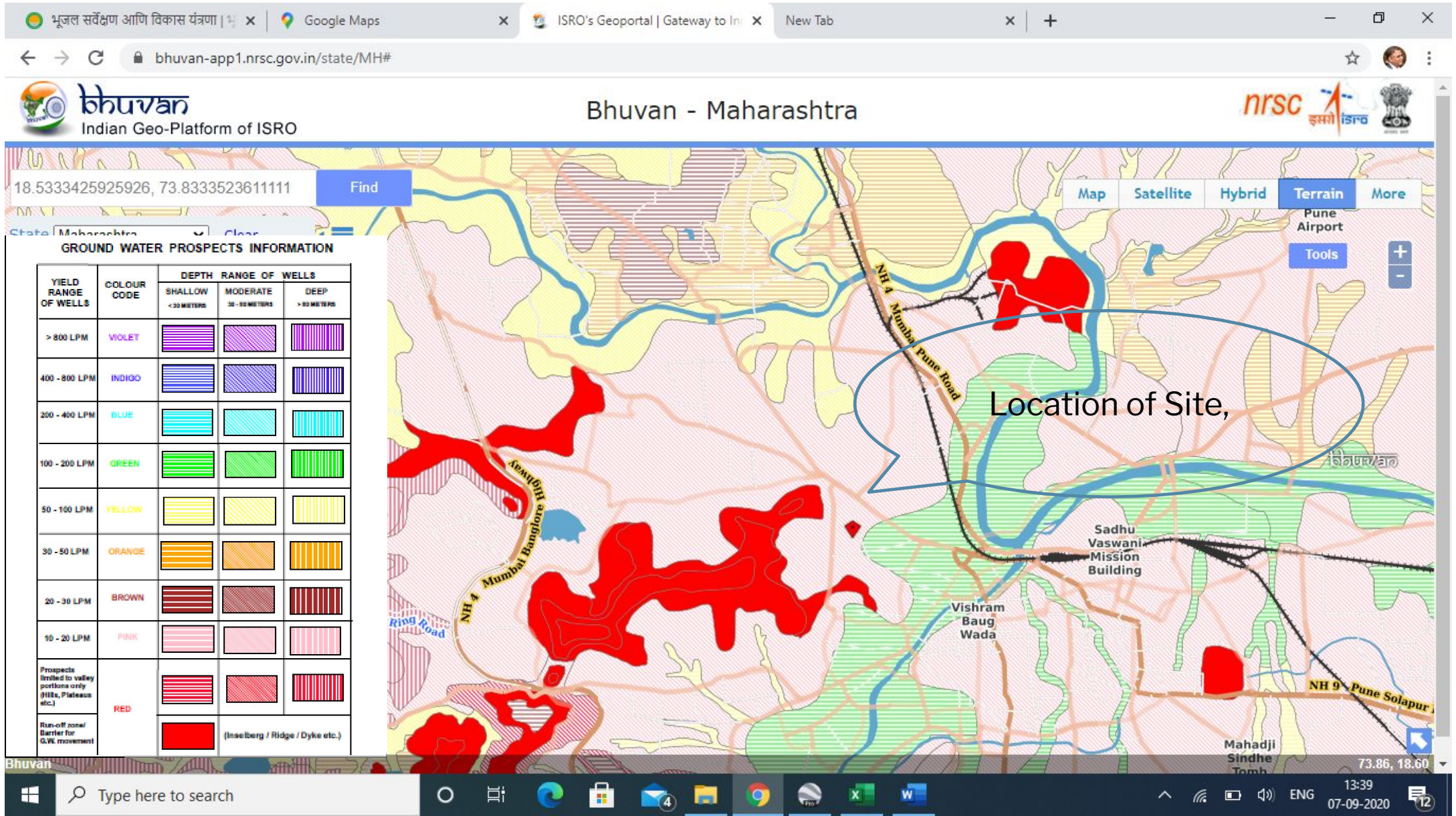
Map exhibiting the location of borewell tapping confined Aquifer -1 and its disposition on a two dimensional recharge area map of phreatic Aquifer.



Depth from MSL	Narrative Geological log	
576	Soil	
575		
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569	Hard rock	
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547	Weathered basalt	
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Annexures

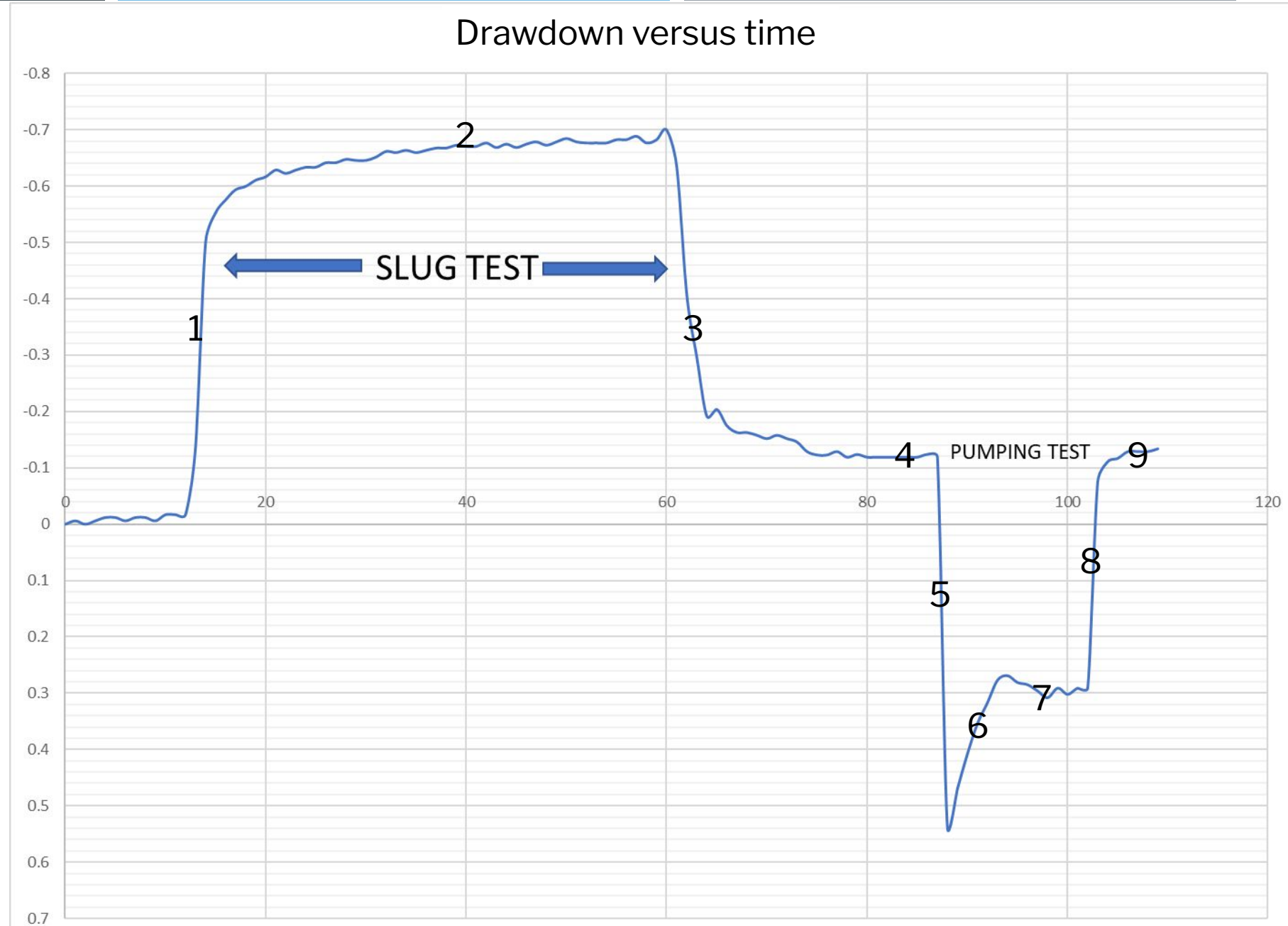
3. Groundwater Potential Map



Annexures

4.1. Slug test data

1. Rise in the water level indicating injection of slug into the borewell
2. Line showing continuous intake of slug for 68 minutes – stabilised intake even during injection
3. Intake continues after slug injection ceases and water is entering at least two of the three aquifers, with a rapid drawdown indicating this intake (including the water column building a pressure that compensates the hydrostatic pressure in aquifers 1 and 2 (both are confined)).
4. Stabilisation with very small intakes as the pressure in aquifer 1 and 2 stabilises to a new potentiometric level.
5. Pumping begins from the borewell leading to a quick drawdown in the potentiometric level. Stabilizing level with respect to pumping rate
6. Stopped pumping, leading to rapid recovery and then progressively slower recovery responses from the two aquifers (6,7) and (8,9).



4.2. Slug test data

Sr No	Date Time	Time interval (minutes)	WL (meters)	Drawdown
1	9/15/2020 12:30	0	4.28	0
2	9/15/2020 12:31	1	4.286	-0.006
3	9/15/2020 12:32	2	4.28	0
4	9/15/2020 12:33	3	4.286	-0.006
5	9/15/2020 12:34	4	4.292	-0.012
6	9/15/2020 12:35	5	4.292	-0.012
7	9/15/2020 12:36	6	4.286	-0.006
8	9/15/2020 12:37	7	4.292	-0.012
9	9/15/2020 12:38	8	4.292	-0.012
10	9/15/2020 12:39	9	4.286	-0.006
11	9/15/2020 12:40	10	4.297	-0.017
12	9/15/2020 12:41	11	4.297	-0.017
13	9/15/2020 12:42	12	4.297	-0.017
14	9/15/2020 12:43	13	4.418	-0.138
15	9/15/2020 12:44	14	4.781	-0.501
16	9/15/2020 12:45	15	4.833	-0.553
17	9/15/2020 12:46	16	4.856	-0.576
18	9/15/2020 12:47	17	4.874	-0.594
19	9/15/2020 12:48	18	4.88	-0.6
20	9/15/2020 12:49	19	4.891	-0.611
21	9/15/2020 12:50	20	4.897	-0.617
22	9/15/2020 12:51	21	4.909	-0.629
23	9/15/2020 12:52	22	4.903	-0.623
24	9/15/2020 12:53	23	4.909	-0.629
25	9/15/2020 12:54	24	4.914	-0.634
26	9/15/2020 12:55	25	4.914	-0.634
27	9/15/2020 12:56	26	4.922	-0.642
28	9/15/2020 12:57	27	4.922	-0.642
29	9/15/2020 12:58	28	4.928	-0.648
30	9/15/2020 12:59	29	4.926	-0.646
31	9/15/2020 13:00	30	4.926	-0.646
32	9/15/2020 13:01	31	4.932	-0.652
33	9/15/2020 13:02	32	4.942	-0.662
34	9/15/2020 13:03	33	4.94	-0.66
35	9/15/2020 13:04	34	4.944	-0.664
36	9/15/2020 13:05	35	4.94	-0.66
37	9/15/2020 13:06	36	4.944	-0.664
38	9/15/2020 13:07	37	4.948	-0.668
39	9/15/2020 13:08	38	4.948	-0.668
40	9/15/2020 13:09	39	4.953	-0.673
41	9/15/2020 13:10	40	4.951	-0.671
42	9/15/2020 13:11	41	4.951	-0.671

Sr No	Date Time	Time interval (minutes)	WL (meters)	Drawdown
43	9/15/2020 13:12	42	4.957	-0.677
44	9/15/2020 13:13	43	4.949	-0.669
45	9/15/2020 13:14	44	4.955	-0.675
46	9/15/2020 13:15	45	4.949	-0.669
47	9/15/2020 13:16	46	4.955	-0.675
48	9/15/2020 13:17	47	4.959	-0.679
49	9/15/2020 13:18	48	4.953	-0.673
50	9/15/2020 13:19	49	4.959	-0.679
51	9/15/2020 13:20	50	4.965	-0.685
52	9/15/2020 13:21	51	4.959	-0.679
53	9/15/2020 13:22	52	4.957	-0.677
54	9/15/2020 13:23	53	4.957	-0.677
55	9/15/2020 13:24	54	4.957	-0.677
56	9/15/2020 13:25	55	4.963	-0.683
57	9/15/2020 13:26	56	4.963	-0.683
58	9/15/2020 13:27	57	4.969	-0.689
59	9/15/2020 13:28	58	4.957	-0.677
60	9/15/2020 13:29	59	4.963	-0.683
61	9/15/2020 13:30	60	4.98	-0.7
62	9/15/2020 13:31	61	4.915	-0.635
63	9/15/2020 13:32	62	4.688	-0.408
64	9/15/2020 13:33	63	4.577	-0.297
65	9/15/2020 13:34	64	4.472	-0.192
66	9/15/2020 13:35	65	4.484	-0.204
67	9/15/2020 13:36	66	4.455	-0.175
68	9/15/2020 13:37	67	4.443	-0.163
69	9/15/2020 13:38	68	4.443	-0.163
70	9/15/2020 13:39	69	4.438	-0.158
71	9/15/2020 13:40	70	4.432	-0.152
72	9/15/2020 13:41	71	4.438	-0.158
73	9/15/2020 13:42	72	4.432	-0.152
74	9/15/2020 13:43	73	4.426	-0.146
75	9/15/2020 13:44	74	4.409	-0.129
76	9/15/2020 13:45	75	4.403	-0.123
77	9/15/2020 13:46	76	4.403	-0.123
78	9/15/2020 13:47	77	4.409	-0.129
79	9/15/2020 13:48	78	4.399	-0.119
80	9/15/2020 13:49	79	4.404	-0.124
81	9/15/2020 13:50	80	4.399	-0.119
82	9/15/2020 13:51	81	4.399	-0.119
83	9/15/2020 13:52	82	4.399	-0.119

Sr No	Date Time	Time interval (minutes)	WL (meters)	Drawdown
84	9/15/2020 13:53	83	4.399	-0.119
85	9/15/2020 13:54	84	4.399	-0.119
86	9/15/2020 13:55	85	4.399	-0.119
87	9/15/2020 13:56	86	4.404	-0.124
88	9/15/2020 13:57	87	4.4	-0.12
89	9/15/2020 13:58	88	3.743	0.537
90	9/15/2020 13:59	89	3.81	0.47
91	9/15/2020 14:00	90	3.872	0.408
92	9/15/2020 14:01	91	3.926	0.354
93	9/15/2020 14:02	92	3.963	0.317
94	9/15/2020 14:03	93	4.003	0.277
95	9/15/2020 14:04	94	4.011	0.269
96	9/15/2020 14:05	95	3.999	0.281
97	9/15/2020 14:06	96	3.995	0.285
98	9/15/2020 14:07	97	3.984	0.296
99	9/15/2020 14:08	98	3.972	0.308
100	9/15/2020 14:09	99	3.989	0.291
101	9/15/2020 14:10	100	3.978	0.302
102	9/15/2020 14:11	101	3.989	0.291
103	9/15/2020 14:12	102	3.989	0.291
104	9/15/2020 14:13	103	4.356	-0.076
105	9/15/2020 14:14	104	4.391	-0.111
106	9/15/2020 14:15	105	4.397	-0.117
107	9/15/2020 14:16	106	4.409	-0.129
108	9/15/2020 14:17	107	4.409	-0.129
109	9/15/2020 14:18	108	4.409	-0.129
110	9/15/2020 14:19	109	4.414	-0.134

Annexures

5. Recharge Pit Design

IS 15797 : 2008
भारतीय मानक
छतों पर वर्षा जल संग्रहण — मार्गदर्शी सिद्धान्त
Indian Standard
ROOF TOP RAINWATER
HARVESTING — GUIDELINES

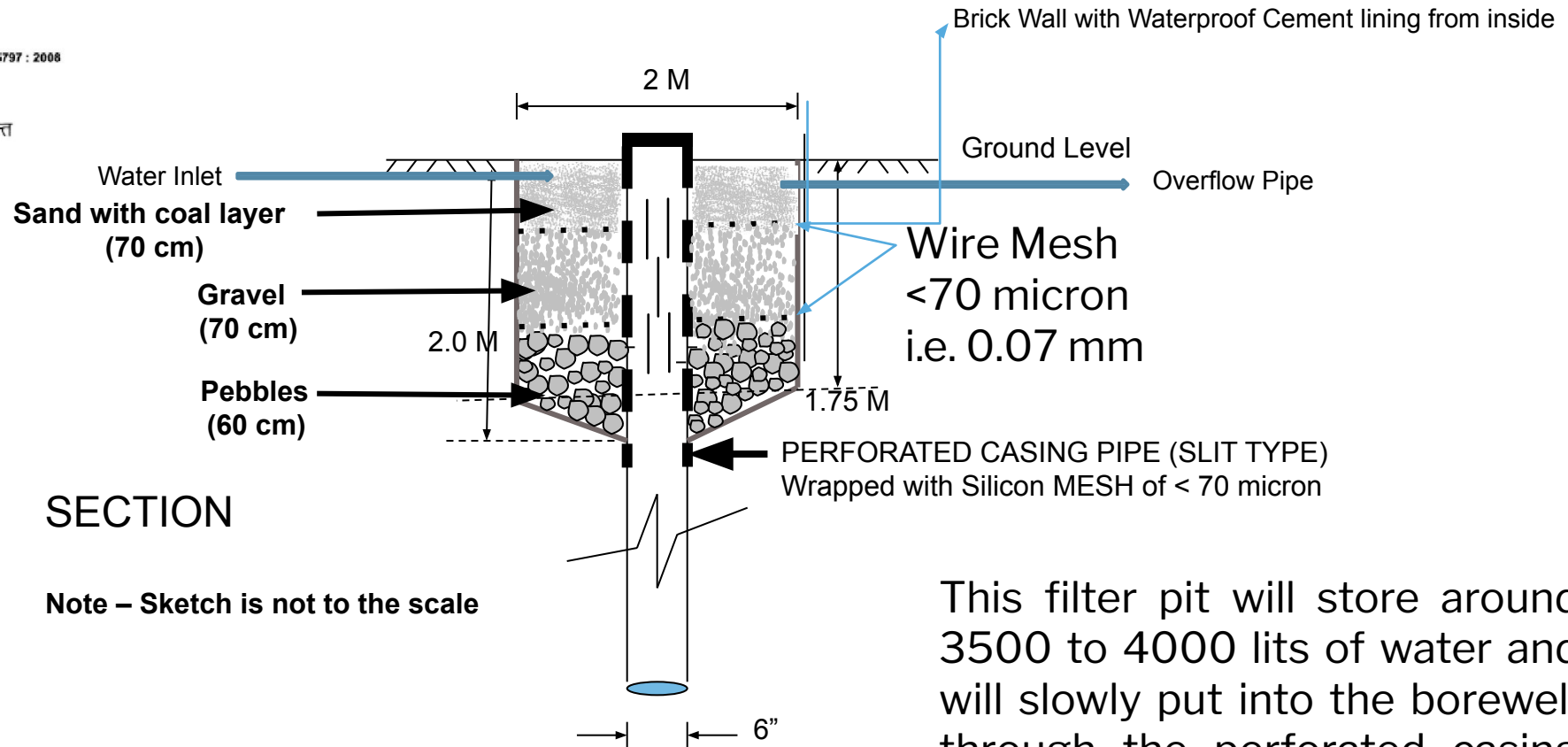
ICS 13.060.10

IS
15797:2008

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

May 2008

Price Group 7



This filter pit will store around 3500 to 4000 lits of water and will slowly put into the borewell through the perforated casing pipe.



Type Design for
the underground
ferrocement
storage tank



Thank you