भारत सरकार
जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय
केन्द्रीय भूमि जल बोर्ड

GOVERNMENT OF INDIA

MINISTRY OF WATER RESOURCES, RIVER DEVELOPMENT & GANGA REJUVENATION

CENTRAL GROUND WATER BOARD

Artificial Recharge Plan for the Over Exploited Jalgaon Jamod Taluka of Buldhana District

मध्य क्षेत्र, नागपुर

CENTRAL REGION, NAGPUR

जुलाई - 2016 / July - 2016

ARTIFICIAL RECHARGE PLAN AT A GLANCE

1.	Total Geographical Area of the Jalgaon-Jamod Block (Taluka)					618.70 km^2
	❖ Area occupied by Hard Rock (Basalt)					265.00 km^2
	❖ Area occupied by Soft Rock (Alluvium)					353.70 km^2
2.	Major land use pattern					Agriculture
3.	Average Annual Rainfall (mm)					677 mm
4.	Major Drainage					Purna River
5.	Area identified for Artificial Recharge *(considering average decadal (2005-14) post-monsoon water level more than 5 m bgl, long term post-monsoon water level trend, depth of weathering and lineaments)*					515.37 km^2
6.	Overall quality of groundwater					Suitable for domestic, industrial and irrigation use
7.	Availability of Surplus surface runoff (MCM)					12.30 MCM
8.	Surplus runoff considered for planning (MCM) *(70% of surplus surface runoff)*					8.61 MCM
9.	Runoff for RWH in Urban Household					0.097 MCM
10.	Sub-surface storage potential available (MCM)					167.72 MCM
11.	Proposed Artificial Recharge & Water Conservation Plan					
	Item	**Perco-lation Tank**	**Check Dam**	**Recharge shaft**	**Water Conser--vation Structure**	**Roof Top Rain Water Harvesting** (for 10% houses)
	❖ Proportionate Allocation of surplus runoff MCM)	1.90	0.68	5.90	0.14	0.097
	❖ Feasible number of structures	9	23	98	9	3386
	❖ Unit cost of structures (crores)	0.70	0.07	0.025	0.0025	0.0008
	❖ Estimated Cost (Crores)	6.30	1.61	2.45	0.0225	2.70
	❖ Expected Recharge (MCM) (considering 85 % efficiency)	1.61	0.58	5.01	0.12	0.082
12.	Total estimated cost (Crores)	13.08 crores				

Artificial Recharge Plan for the Over Exploited Jalgaon Jamod Taluka of Buldhana District

1. INTRODUCTION

Groundwater being most dependable source of water supply is under tremendous stress to meet the ever increasing demand of irrigation, industrial and domestic sector. The over exploitation of this resource has resulted in to decline in water levels in many part of the Country and many of the water assessment units are thus categorised as over-exploited blocks. The state of Maharashtra also faces the problem of groundwater over- development in some of the areas. Many talukas have been identified as Critical / Over-Exploited based on the ground water resources estimation based on GEC-97 Methodology. As per the latest groundwater resource assessment as on March 2011, 10 talukas have been identified as Over-Exploited.

Immediate remedial measures are therefore required to be taken up for converting these talukas into Critical / Semi-critical / Safe categories. The present artificial recharge plan has been prepared for the Jalgaon Jamod taluka of Buldhana district which will form the base for the future strategy.

2. LOCATION

Jalgaon Jamod Taluka is situated in the north of Buldhana district and lies between NL 20° 56' 54" to 21°01'47" and EL 76°34'07" to 76°34'37" near Satpura Hill ranges and spread over an area of 617.76 sq.km. The population of the taluka is 2,72,242persons as per 2011 census. There are 125 villages in the taluka (**Fig 1a and 1b**).

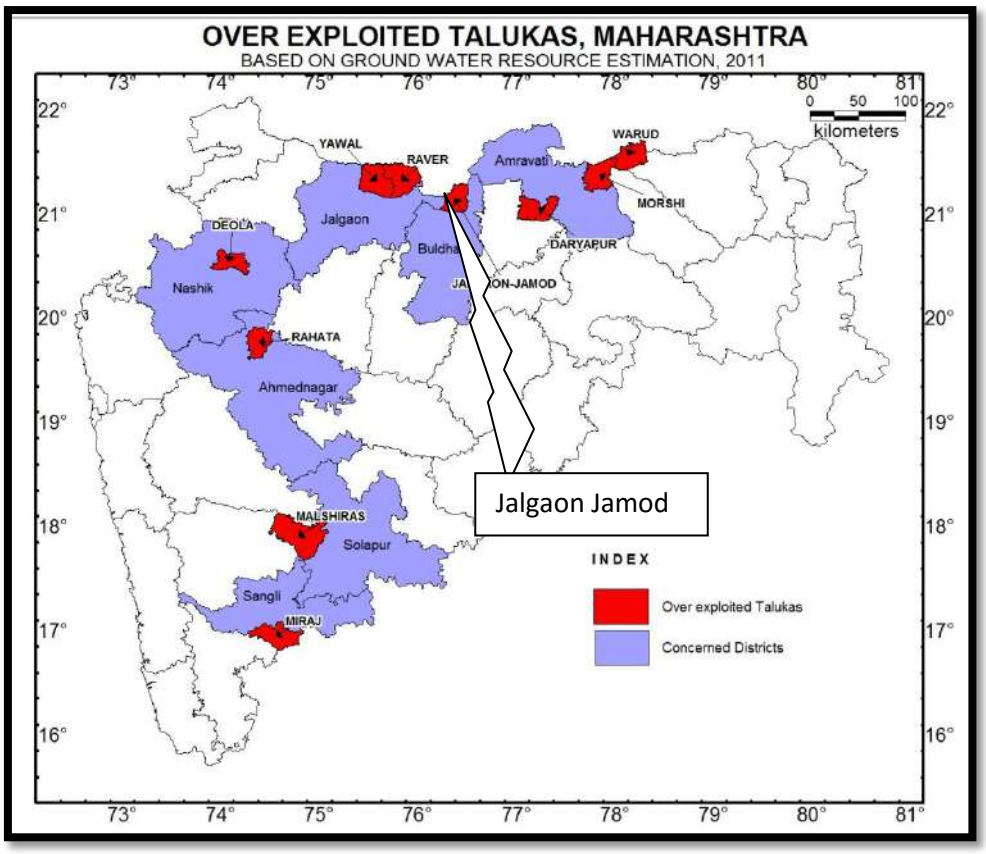


Figure1a: Location of Jalgaon Jamod Taluka, Buldhana District, Maharashtra

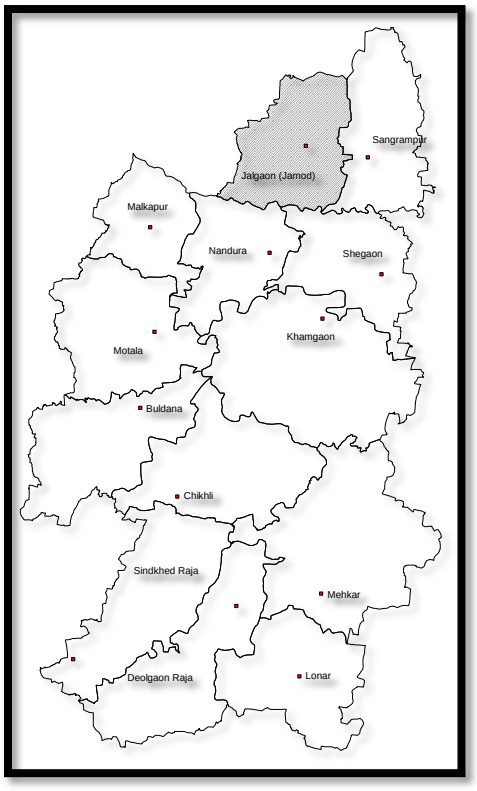


Figure1b: Location of Jalgaon Jamod Taluka, Buldhana District

3. PHYSIOGRAPHY & DRAINAGE

The taluka is broadly divided in to two physiographic units viz, the Satpura Hills in the north and the Purna alluvial plains in the central & southern part. The taluka is mainly drained by the Purna river (**Fig 2a)**. A digital elevation model of Jalgaon Jamod taluka indicating the village boundaries is shown in **Fig. 2b**.

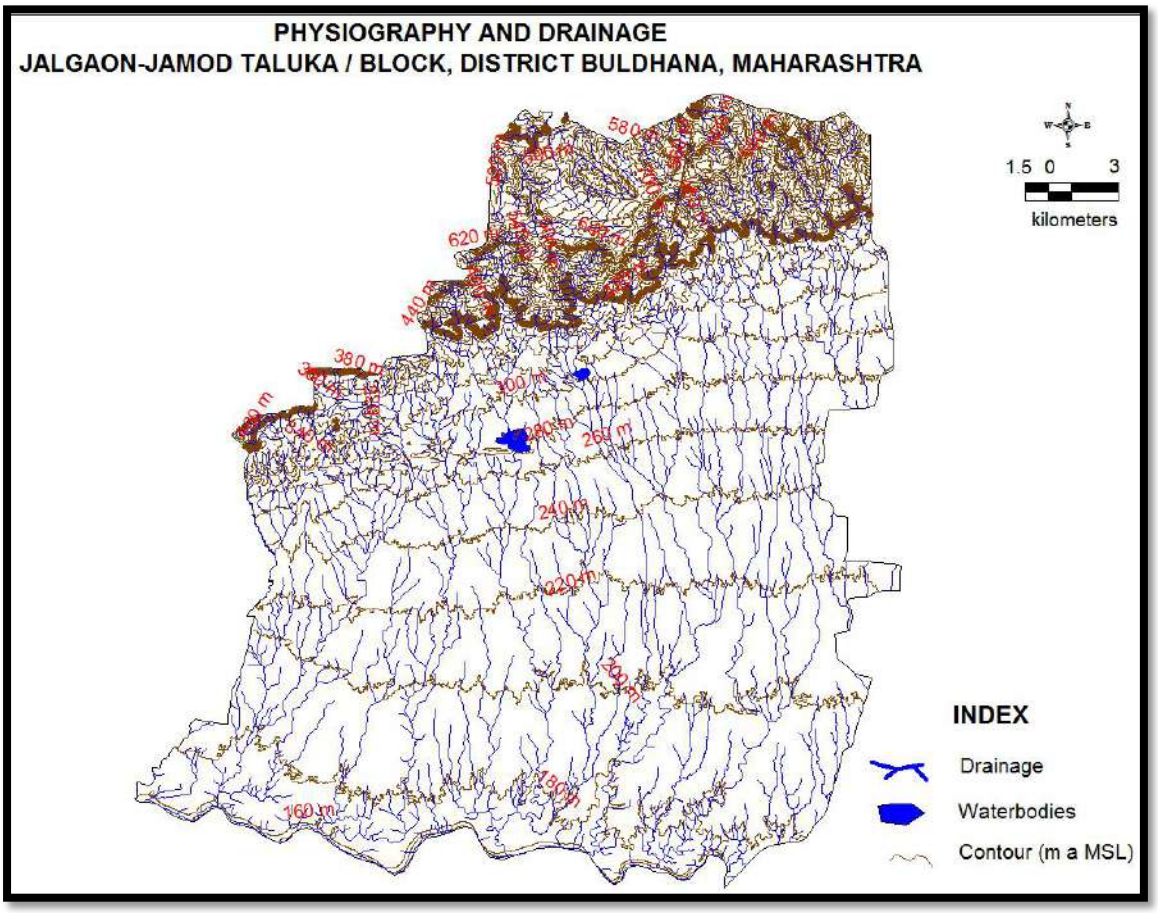


Figure2a: Physiography and Drainage, Jalgaon Jamod Taluka

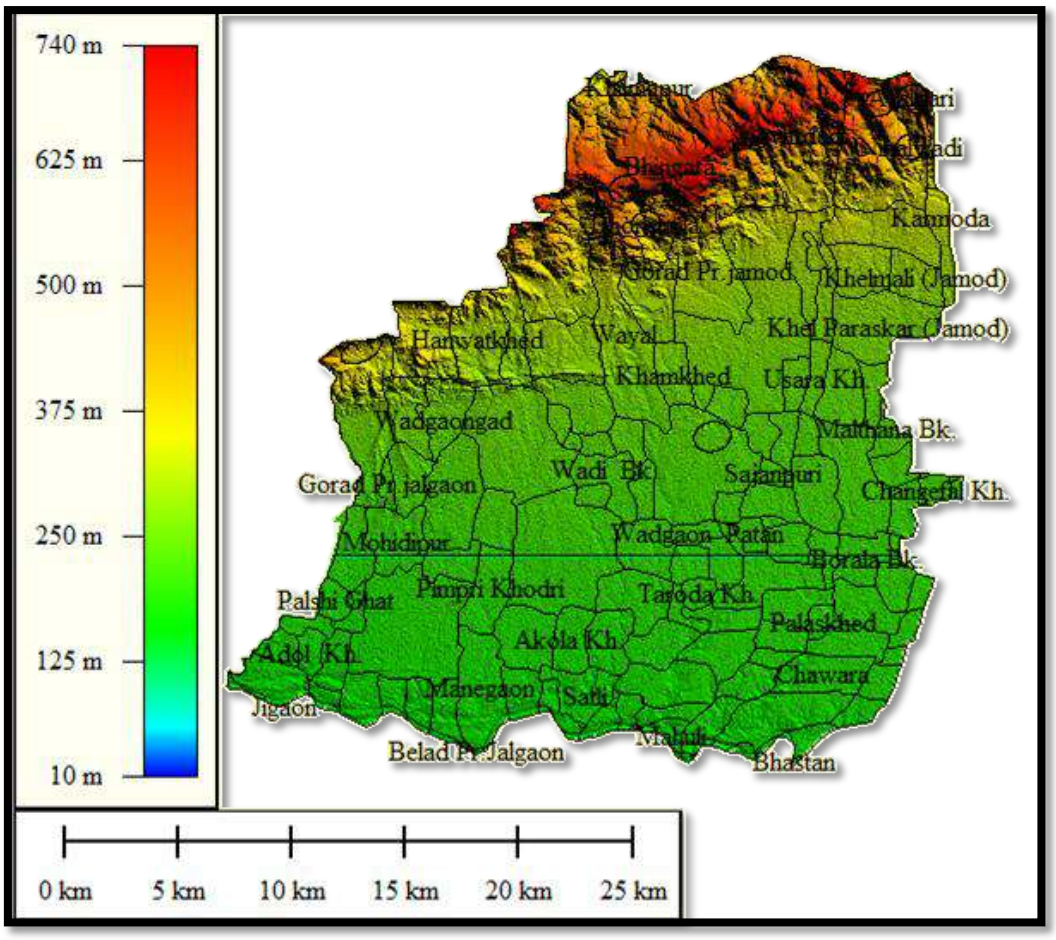


Figure2b: Digital Elevation Model, Jalgaon Jamod Taluka

4. RAINFALL

The area receives rainfall due to the south-west monsoon and about 90% of the rainfall takes place during the months of June to September. The Taluka has a long-term normal rainfall of 677 mm.

5. LAND USE PATTERN

The land use pattern of the area prominently reflects significance of agriculture activity with isolated scattered pockets of notified forest area and unmodified hilly forest. The double-crop (Kharif and Rabi) area is evenly distributed in the entire taluka.

6. HYDROGEOLOGY

The Alluvial deposits occupies major part of the taluka in eastern and southern parts and is termed as Purna Alluvial deposit, as it has been deposited in the Purna valley during Pleistocene to Recent period **(Fig. 3)**. The maximum alluvium thickness encountered in the taluka during ground water exploration was 130 m. The alluvium is divided into younger and older Alluvium with the younger one being more granular and the older more clayey. Ground water occurs under phreatic and semi-confined conditions down to a depth of 80 m i.e., in the younger Alluvium consisting of alternate beds of clay and sand. Two to five beds of coarse sand and gravel are encountered within the younger Alluvium, which form the productive aquifer. The older Alluvium is mostly clayey with only one or two thin beds of gravel at the base near the trap basement. In the deeper aquifers, ground water occurs in confined state. Younger Alluvium is lacustrine and older is marine in nature which has got inherent salinity and hence identified as 'saline ground water tract' (*Khar-Pan-Patta*").

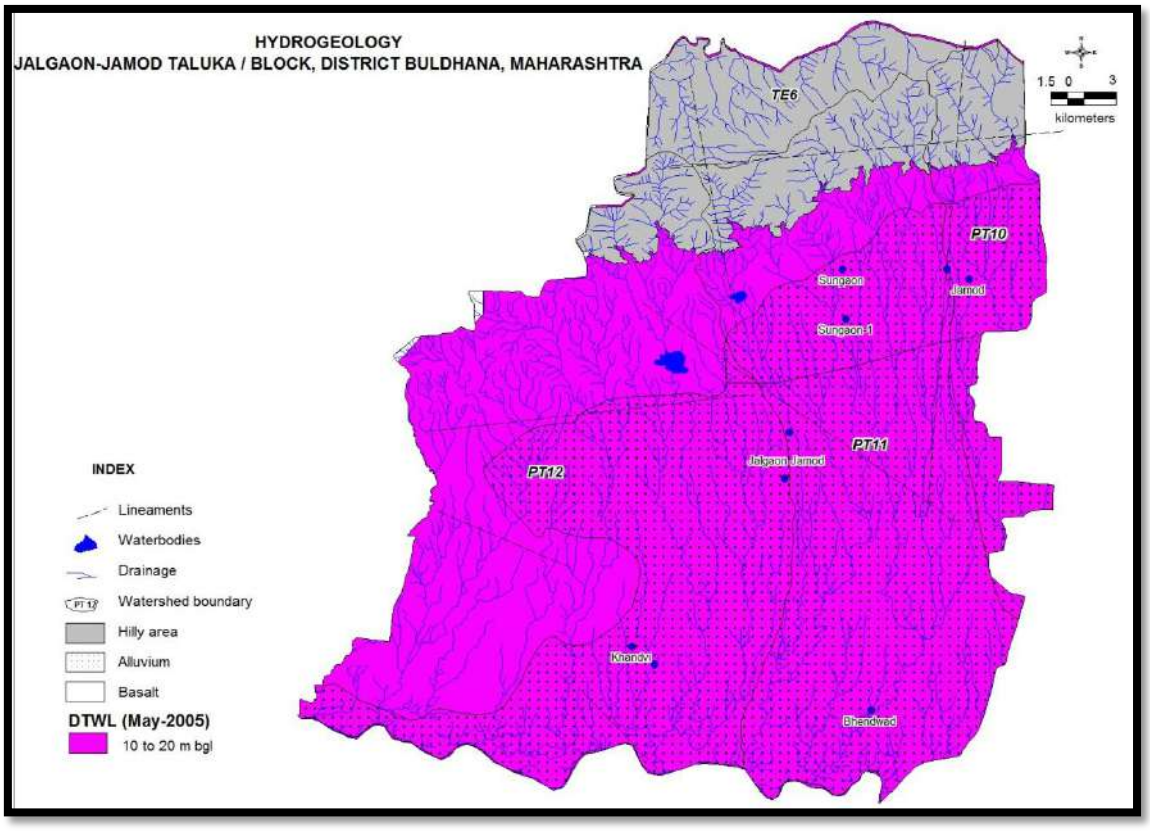


Figure 3: Hydrogeology, Jalgaon Jamod Taluka

Deccan Trap Basalt belonging to upper Cretaceous to lower Eocene age occurs in the northern and western part of the taluka where the ground water potential is not uniformly distributed due to inherent heterogeneity of the formation. The northern peripheral part is hilly and rugged terrain where basalt does not form potential aquifer due to limited thickness of weathered mantle. In Basalt, ground water occurs both in Vesicular and Massive Basalt as well as inter flow zones in weathered mantle, fractured zones. In general ground water occurs under water table conditions in shallow aquifer and semi-confined to confined conditions in deeper aquifer. The unconfined aquifer is developed due to the weathering and jointing of upper flow in Basalt down to depth of 15-20 mbgl (**Fig. 3**).

7. GROUND WATER LEVEL SCENARIO

CGWB regularly monitors ground water levels in the taluka 4 times in a year during May, August, November and January through its network of Ground Water Monitoring Wells (GWMW). The water levels recorded during the pre-monsoon season in May (2014), ranging from 4.9-15.35 m bgl. In major part of the taluka pre-monsoon water levels are ranging between 10 and 20 m bgl. Shallow water levels upto 10 m is observed in northern parts of taluka **(Fig 4).**

The water levels recorded in post-monsoon season (Nov. 2014) are ranging from 6.9-12.95 m bgl. In major part of the taluka water levels are ranging between 10 and 20 mbgl. Shallow water levels up to 10 m are observed in northern parts of taluka **(Fig 5).**

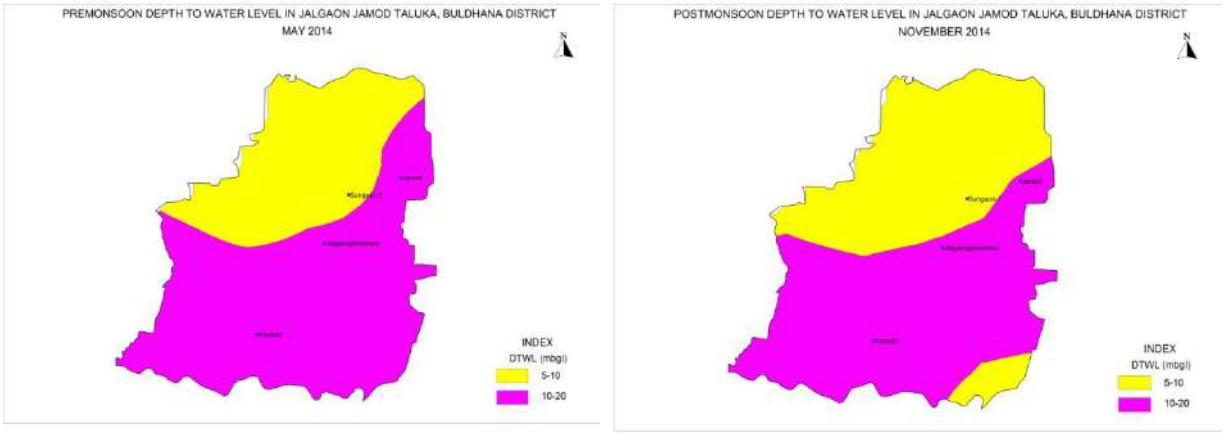


Fig 4 and 5: Pre and Post-monsoon (2014) Depth to Water Level, Jalgaon Jamod Taluka

8. DYNAMIC GROUND WATER RESOURCE

Ground Water Resources Assessment for the year 2011 indicates Net Annual Ground Water Availability of 6260.71ham, draft for all uses is 6488.10 ham with irrigation being the major consumer withdrawing 6296.97 ham and stage of ground water development is also high about 103.63%**(Table 1)**. The taluka is categorised as Over Exploited. The comparison of 2009 and 2011 ground water resource assessment indicates that the stage of ground water development has marginally reduced from 104.60% in 2009 to 103.63% in 2011. So far none of the taluka has been notified by CGWA/SGWA for ground water regulation.

Table 1: Dynamic Ground Water Resources of Jalgaon Jamod Taluka (As on March 2011)

S. No	Particulars	GW Resources (Ha.m)
1.	Net Annual Ground Water Availability	6260.71
2.	Existing Gross Ground Water Draft for irrigation	6296.97
3.	Existing Gross Ground Water Draft for domestic and industrial water supply	191.13
4.	Existing Gross Ground Water Draft for All uses	6488.10
5.	Provision for domestic and industrial requirement supply to 2025	262.30
6.	Net Ground Water Availability for future irrigation development	900.50
7.	Stage of Ground Water Development	103.63%
8.	Category of the Assessment Unit	Over-Exploited

9. NEED FOR ARTIFICIAL RECHARGE AND CONSERVATION MEASURES

Jalgaon Jamod taluka is one of the agriculture dominated area in Maharashtra. This has led to over-exploitation of groundwater resources in the alluvial area from both the shallow and deeper aquifers. These practices are being continued since last few decades and stage of groundwater development in the taluka even exceeded more than 100% of its natural recharge which lead to heavy depletion of ground water level. The over development of ground water has brought the taluka in over exploited category. Therefore there is an urgent need for taking up various artificial recharge and water conservation measures in the area.

10. JUSTIFICATION OF THE ARTIFICIAL RECHARGE PROJECT

The various State Government Agencies like department of Agriculture, Irrigation, Forest have already taken up some water conservation / artificial recharge measures in Jalgaon Jamod taluka. However, a robust consolidated plan for artificial recharge measures are also required for converting the entire Over-Exploited Jalgaon Jamod taluka into Critical / Semi-critical / Safe category.

11. FEASIBLE AREA FOR ARTIFICIAL RECHARGE OR CONSERVATION

The feasible area for artificial recharge to groundwater in Jalgaon Jamod taluka has been identified based on the following criteria's.

1. Long term average decadal post-monsoon depth to water level (2005-2014)
2. Long term post-monsoon water level trend (2005-14)
3. Depth of weathering in the taluka
4. Lineaments in the area

Thematic layers are prepared for all the above mentioned four criteria's and are superimposed on one another to generate the integrated map for identification of the feasible area for artificial recharge.

The long term post-monsoon depth to water level data for the period 2005-14 reveals the deepest water level of 17m bgl. Water level contour map is prepared wherein 4 categories of observed water levels are made i.e. 5-10 m 10-17 m bgl **(Fig. 6)**. The depth to water level map reveals that an area of 521.00 sq.km has depth to water level more than 5 m bgl.

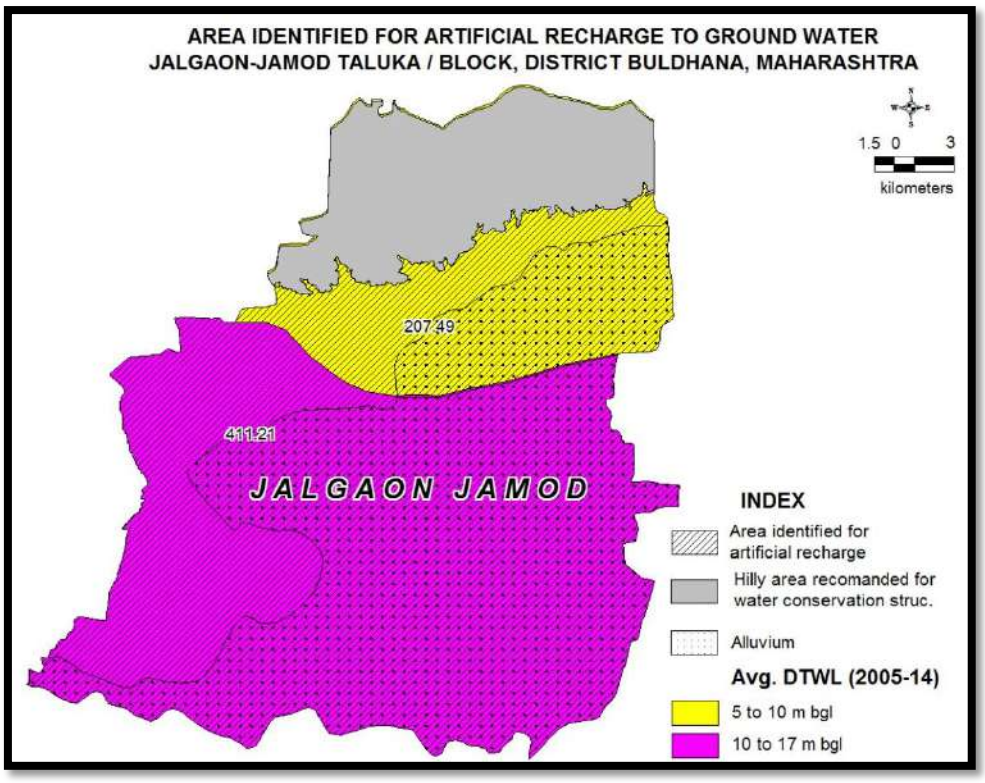


Fig 6: Average Decadal Post-monsoon depth to water level map of Jalgaon Jamod taluka

The long term water level trend map for the period 2005-2014 has been prepared and is shown in **Figure 7**. The water level trend map reveals both the rising water level trend between 0.0 to 0.20 m/year and the falling water level trend between 0.0 to 0.4 m/year. The area showing rising water trend has been excluded for taking up artificial recharge measures in the area and the area showing falling water level trend is only considered and recommended for artificial recharge to groundwater in Jalgaon Jamod taluka **(Fig 7).**

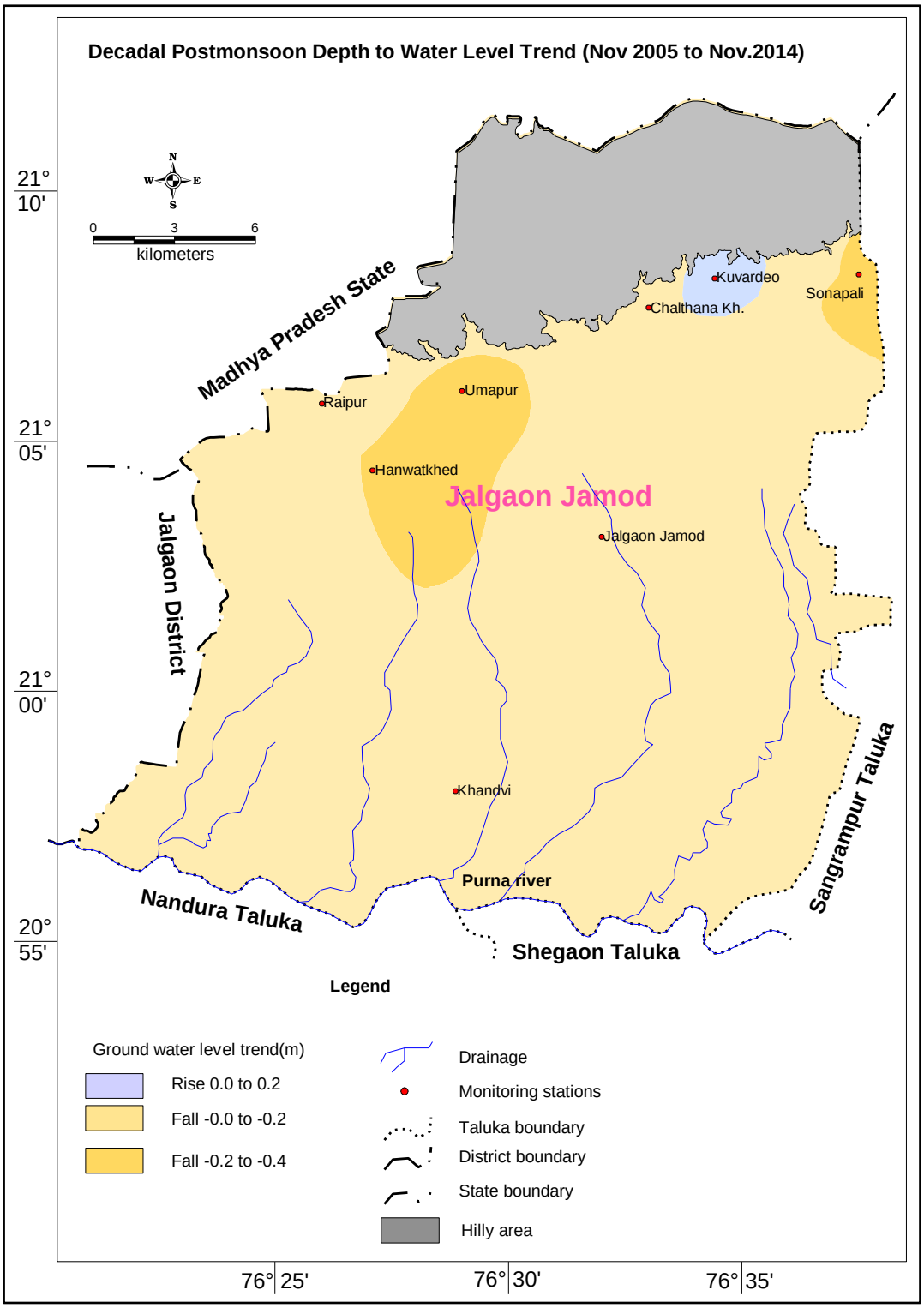


Figure 7: Map showing long term post monsoon water level trend (2005-14)

Based on the data available on depth of weathering form key wells established during the various hydrogeological studies in the area and also groundwater exploration data, a map

showing area under various categories of depth of weathering has been prepared and considered for preparation of artificial recharge plan **(Fig. 8)**. The map reveals that most of the area of Jalgaon Jamod taluka is having sufficient thickness of weathered zone varying from 10 to 30 m and therefore found feasible for artificial recharge to groundwater. Some of the area of Jalgaon Jamod taluka is also traversed by few lineaments (**Figure 9)** indicating promising scope for artificial recharge in that area.

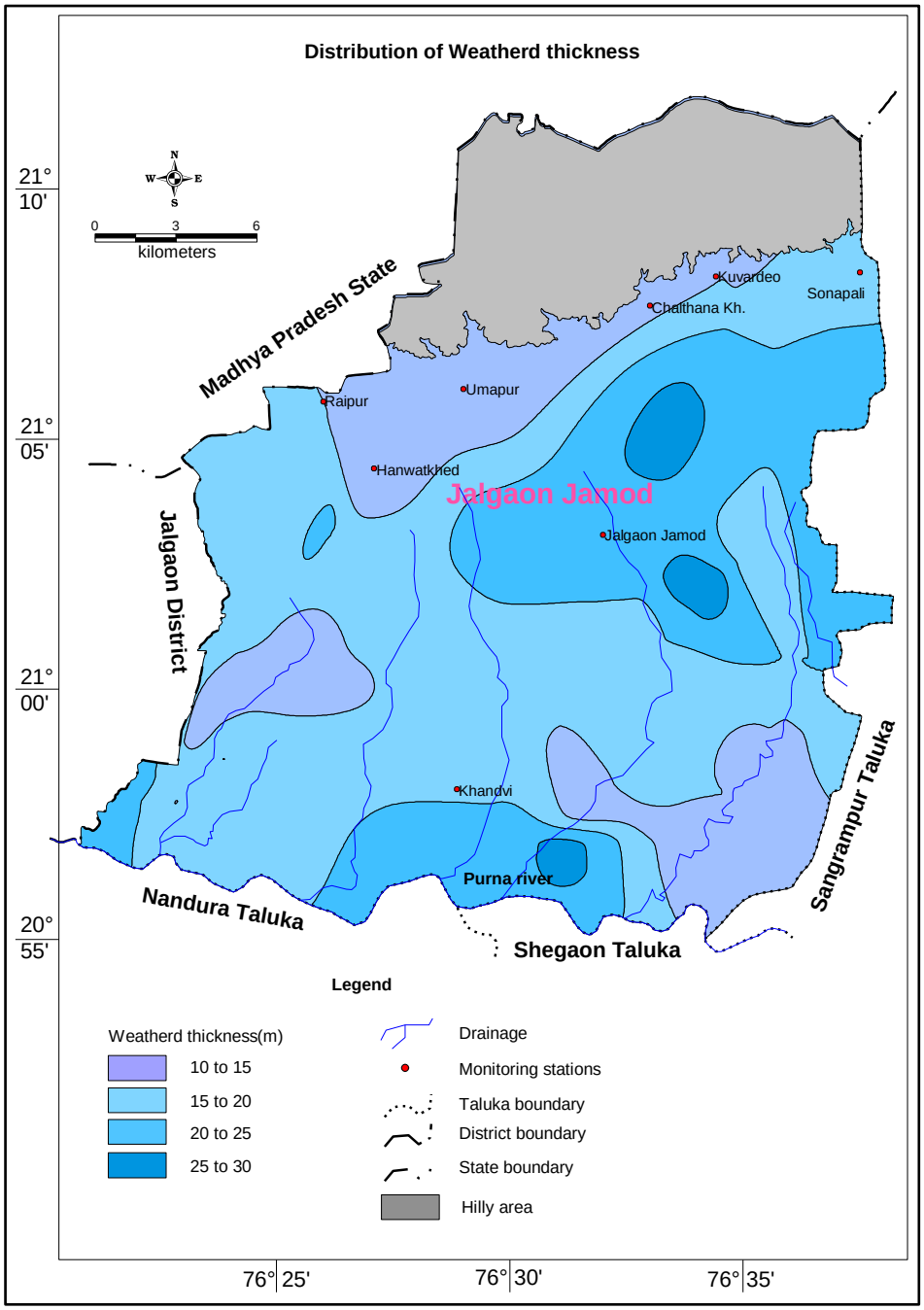


Figure 8: Map showing weathered thickness in Jalgaon Jamod taluka

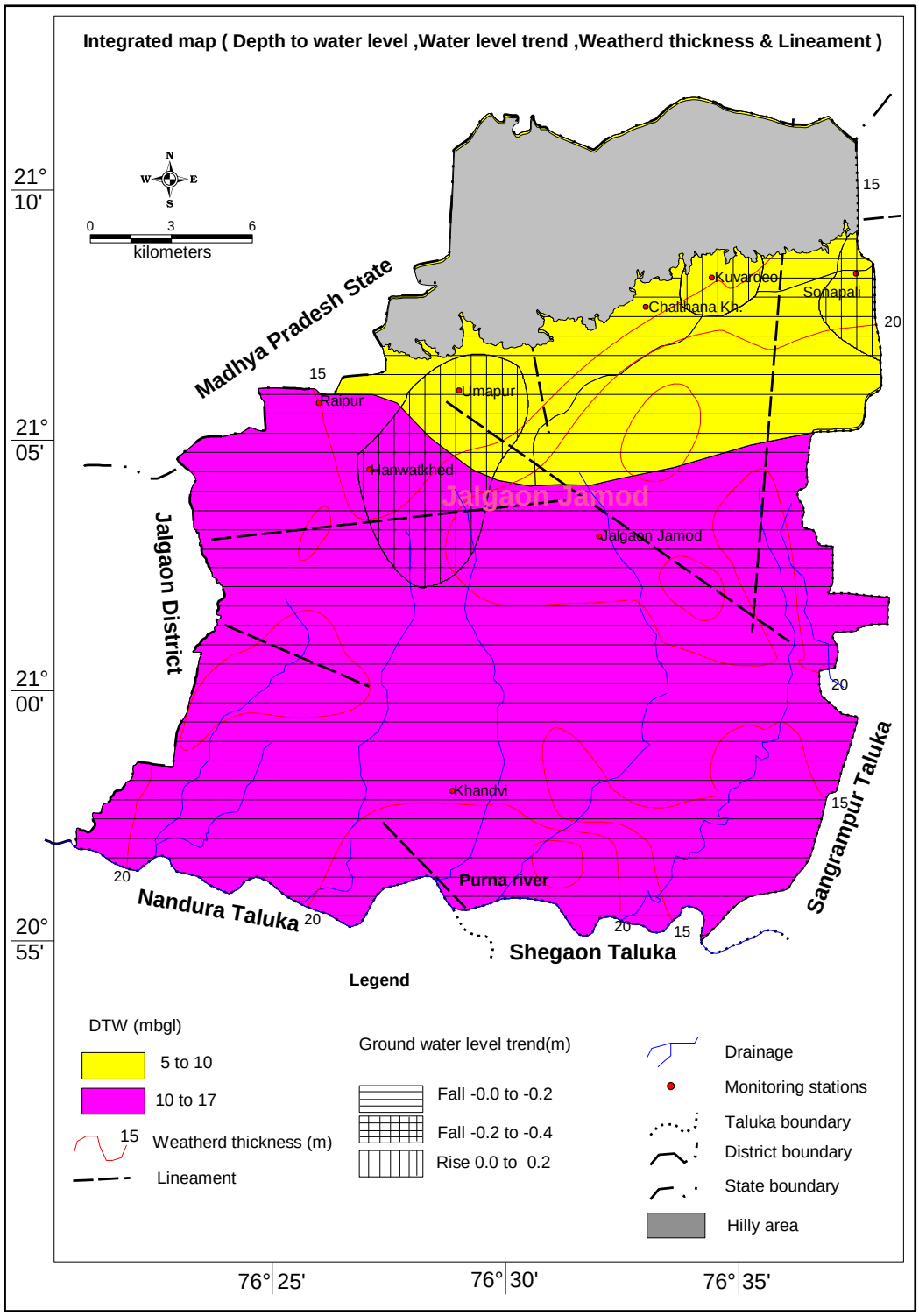


Figure 9: Integrated Map showing feasible area for artificial recharge to groundwater in Jalgaon Jamod taluka

An integrated map containing all the layers i.e. depth to water level, water level trend and weathered thickness, lineaments is prepared and is shown in **Figure 9**. Based on the map, an area of 515.37 sq.km is identified for artificial recharge to groundwater.

12. AVAILABILITY OF SURPLUS SURFCE WATER FOR ARTIFICIAL RECHARGE OR CONSERVATION

The availability of non-committed surplus runoff as source water is one of the main requirements for any artificial recharge scheme. In India in general and Maharashtra in particular, the monsoon rainfall is the chief source of water which can be utilized for artificial recharge. Normally the surplus / non-committed monsoon runoff can be utilized as source water for artificial recharge scheme.

The rainfall received during northwest monsoon between June and September is the principal source of water in the state of Maharashtra. The actual availability of surface water in the area depends upon the rainfall incidences, climate, Physiography, land use and hydrogeology. These components vary drastically in space and time and is not uniform in the state of Maharashtra. Therefore basin and sub-basin wise availability of water and its utilization status is considered to depict the realistic scenario of source water availability. For this purpose the hydrological data available with the state government was collected and compiled basin wise for Godavari, Krishna and Tapi basins.

Jalgaon Jamod taluka of Buldhana district falls in Tapi river basin. The data collected from Irrigation Department, Government of Maharashtra reveals that Tapi river basin covers an area of 51940 sq. km. The basin has surplus surface water runoff availability of 1240 MCM. Based on this data, it is estimated that the proportionate per sq.km. availability of surplus surface water runoff is 0.0239 MCM. Thus the proportionate surplus surface water availability for Jalgaon Jamod taluka comes out to be 12.30 MCM. For estimation of volume of water to be utilised for recharge, 70% of surplus water availability has been considered. Thus about 8.61MCM surplus surface water can be considered for preparation and implementation of master plan for artificial recharge in the over-exploited Jalgaon Jamod taluka and for estimation of number of structures required for augmentation of groundwater resource in the area. The proportionate surplus water availability in hard rock area is estimated to be 2.71 MCM where as in soft rock alluvial area it is 5.90 MCM. The estimated availability on surplus surface runoff in Jalgaon Jamod taluka is finalised in consultation with the State Government and hence confirmed for taking up artificial recharge measures in the taluka.

13. FEASIBLE ARTIFICIAL RECHARGE / CONSERVATION STRUCTURES

Hydrogeology, Physiography, climatic conditions and source water availability are the major factors which affect the selection of site, dimension of the artificial recharge scheme. The surface spreading techniques consisting of percolation tanks and cement plug/bund/check dam are most appropriate techniques in areas occupied by hard rocks. In alluvial areas i.e. alluvial part of Tapi and Purna basin, the percolation tanks in mountain fronts and recharge shaft in alluvial/bazada zone are the most feasible structures. Accordingly these structures have been recommended for artificial recharge to groundwater. Other structures like continuous contour trenches, gabion structures, nala bunds, village ponds etc. may also be taken up side by side which would be more appropriate for soil and moisture conservation. The underground bandharas or sub surface dykes are ground water conservation structures and hence can be taken up a site specific location to conserve the ground water. Beside this roof top rain water harvesting and storm water harvesting in public parks, play grounds are the most appropriate techniques as in urban areas most of the nala / river carries domestic sewage and non-availability of land for submergence.

Various artificial recharge studies on carried out by CGWB so far in the State of Maharashtra and the findings of the artificial recharges schemes implemented under Central Sector Scheme are highly helpful is preparation of plan for artificial recharge for any given area. The findings of these studies / schemes are considered in formulating the artificial recharge plan and are mentioned below.

- A percolation tank of 100 Thousand Cubic Metre (TCM) capacity (single filling) will actually store 200% more due to multiple fillings during monsoon. This will have gross storage capacity of 200 TCM. However, desilting of percolation tank on regular basis in 1-2 year before the onset of monsoon should be carried out for effective infiltration of stored water into the sub-surface.
- A check dam / cement plug of 10 TCM capacity (single filling) will actually store 300 % more due to multiple fillings in monsoon. This will provide gross storage of 30 TCM for check dam. However, it is also required to be desilted to maintain the storage capacity and recharge efficiency.
- A recharge shaft receiving a continuous water supply for recharge, on an average will recharge 1 TCM/day with 60 operational days during monsoon and post-monsoon.

- Unlike various water conservation schemes, percolation tank and check dam provide 85% recharge to ground water out of total storage.
- With regard to the amount of surface water considered for planning the artificial recharge in hard rock area, it can be considered that 70 % storage would be through percolation tank, 25% through check dams and remaining 5% through other water conservation/recharge structures.

The number of recharge structures required to store and recharge the ground water reservoir have been worked out as follows.

$$\text{No. Of structures} = \frac{\text{Total surface water considered}}{\text{Average gross capacity of Percolation Tank/Check Dam (considering multiple fillings)}}$$

Based on the above field findings, it is proposed to allocate 70% surplus water (i.e. 1.90 MCM) for construction of percolation tanks and about 25 % surplus water (i.e. 0.68 MCM) for construction of check dam. The remaining 5 % surplus available water 0.14 MCM is proposed for allocation for construction of various water conservation structures like loose boulder structures, gabbion structures etc. The average recharge efficiency of artificial recharge structure is considered as 85% on safer side.

The tentative locations of proposed artificial recharge structures are shown in **Figure 10** and the detail of these locations are given in **Annexure-I**. The design of percolation tank, check dam, recharge shaft are presented as **Annexure-II**. However, the final design of the individual structures will be site specific and will be prepared based on the hydrogeological survey in consultation with the implementing agency.

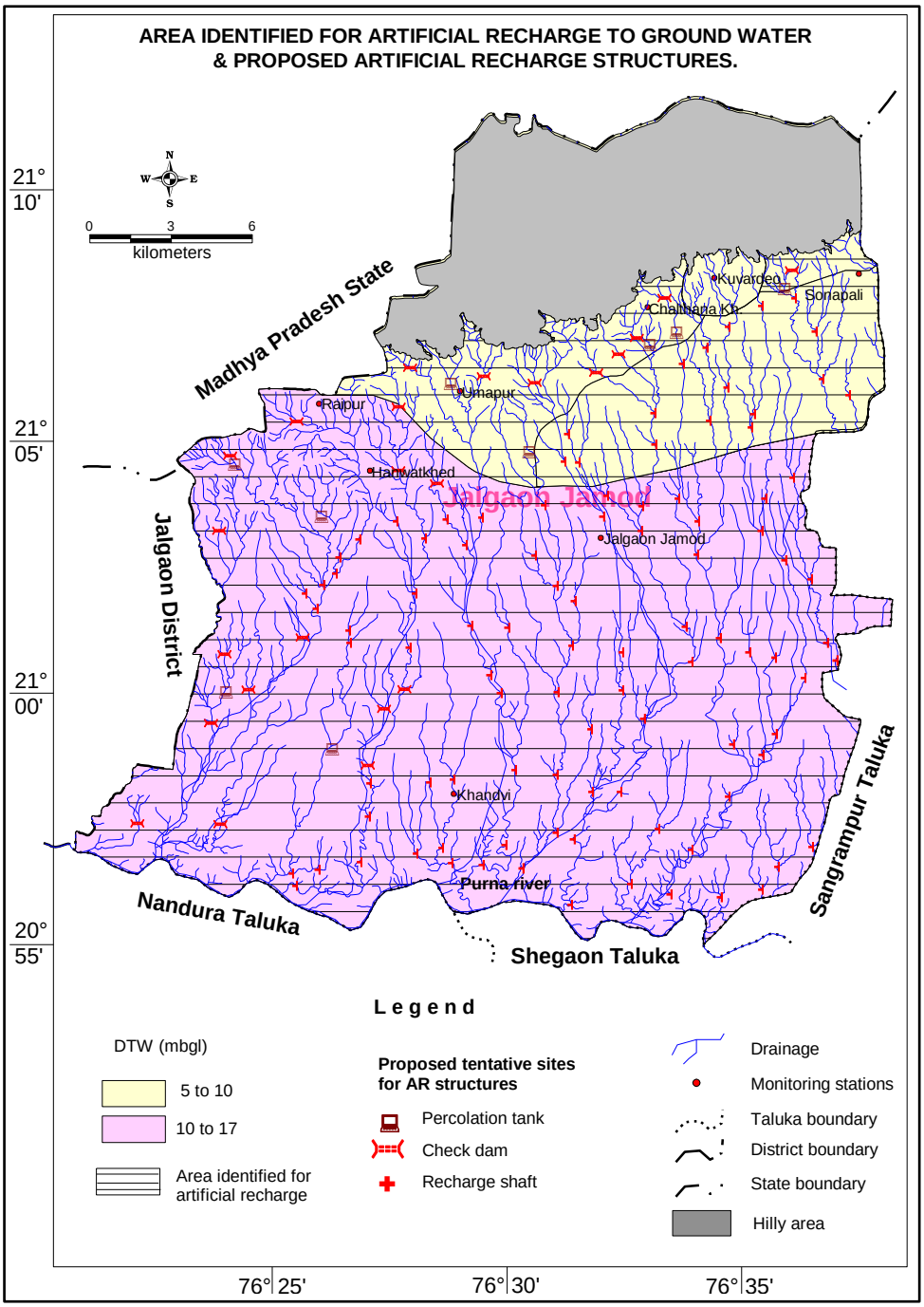


Figure 10: Tentative sites of Percolation Tank, Check Dam, Water Conservation Structures and Recharge Shaft, Jalgaon Jamod Taluka

14. TENTATIVE COST ESTIMATES

For estimating the tentative cost for construction of various types of artificial recharge and water conservation structures, schedule of rates **(**SOR) of Government of Maharashtra available for the year 2011 have been considered. In the state of Maharashtra, SOR of each district vary marginally from each other. It is estimated that the total expenditure to be

incurred for construction of various water conservation and recharge structures will be Rs. 13.08 crores (As per 2011 SOR). However, it is likely that the actual cost will vary depending upon the actual period of construction and location of sites which will be finalised after detailed hydrogeological consultation and survey by the implementing agencies.

Percolation Tanks

It is estimated that the total allocated surplus water for recharge through percolation tanks is 1.90 MCM. Thus about 9 percolation tanks shall be required to be constructed in Jalgaon Jamod taluka. Considering the recharge efficiency of 85 %, it is expected that about 1.61 MCM of surface water shall be recharged. As per the SOR available for the year 2011, it is estimated that for construction of one percolation tank with average gross capacity of 200 TCM, Rs. 70 lakh will be required. Therefore the total expenditure involved for construction of 9 percolation tanks will be Rs. 6.30 crores.

Check Dams

It is estimated that about 0.68 MCM of surplus was can be made available for recharge through check dams. Hence about 23 check dams can be constructed to recharge the proportionate allocated surplus water of 0.68 MCM. Considering the recharge efficiency of 85%, it is expected that about 0.58 MCM of surface water shall be recharged into sub-surface. The SOR available for the year 2011 indicate that for construction of one check dam with average gross capacity of 30 TCM, Rs. 7 lakh will be required. Therefore the total expenditure involved for construction of 23 check dams will be Rs. 1.61 crores.

Water Conservation Structures

After the allocation of surplus runoff water for the major structures like percolation tanks and check dams for the hard rock area of Jalgaon Jamod taluka, the remaining quantum of surplus water can be conserved by means of feasible water conservation structures for soil and water conservation. Thus about 0.14 MCM of surplus water can be made available for water conservation structures. The feasible water conservation structures in the area are loose boulder structure and gabbion structures. It is estimated that about 9 nos. water conservation

structures will be required to conserve the 0.14 MCM of surplus runoff water. These structures can be constructed on lower order streams i.e. streams of 1st and 2nd order. As per the SOR 2011, an approximate expenditure of Rs. 25000 will be required for construction of one water conservation structure. Therefore the total expenditure involved for construction of 9 water conservation structure will be Rs. 0.0225 crores.

Roof Top Rain Water Harvesting

In this first phase, it is proposed to take up roof top rain water harvesting measures in the urban households of Jalgaon Jamod Taluka. As per census 2011, there are about 33861 households in Jalgaon Jamod taluka. It is assumed that about 10 % of the households i.e. 3386 households may have the average roof area of about 50 sq.m. Therefore, considering the average annual rainfall of 677 mm, average roof area of 50 sq.m and runoff coefficient of 0.85, total rainwater harvesting potential generated in the urban households of Jalgaon Jamod taluka is about 0.097MCM.

For taking up roof top rain water harvesting and artificial recharge through individual household, it is proposed to recharge roof top runoff through a recharge pit having dimension of size 1 X 1m and having a depth of 1.50 m. The top 0.6 m portion of the pit will be open for pouring the harvested rainwater whereas the bottom portion of 0.90 m depth shall be filled with boulder, gravel and sand each having a thickness of about 0.30 m.

It is anticipated that the recharge efficiency of the recharge structure will be about 85%. Thus about 0.082 MCM water shall be recharged through adoption of rainwater harvesting in the urban households.

Recharge Shaft

The total area identified for artificial recharge to ground water in Jalgaon Jamod taluka is 515.37 sq.km. Based on the earlier studies carried out by CGWB in the State of Maharashtra, recharge shaft is the main suitable artificial recharge structures feasible in are underlain by the alluvium. The surface water availability for artificial recharge in alluvium area is 5.90 MCM. Thus about 98 nos. recharge shafts will be required to accommodate 5.90 MCM of water. Considering the 85% recharge efficiency, it is estimated that about 5.01 MCM water can be recharged into sub-surface. To get the continuous water supply to the recharge shaft, it is proposed to construct all recharge shafts either in the stream / nala bed or

along its bank. The SOR available for the year 2011 indicate that for construction of one recharge shaft 2.5 lakh will be required thus the total estimated cost for construction of 98 recharge shaft will be Rs. 2.45 crores.

15. TIME SCHEDULE

After the release of funds, the proposed plan can be implemented within a stipulated time of 2-3 years by the implementing agency of concerned State Department, Government of Maharashtra.

Time schedule	Activity to be carried out
0 To 3 months	Finalization of sites for construction of artificial recharge / water conservation structures by the Implementing Agency
4 To 6 months	Finalization of designs / specifications and budget Estimation as per the Schedule of Rates by the Implementing Agency
7 To 20 months	Implementation of the project by the Implementing Agency
20 To 24 months	Preparation of report and report submission by the Implementing Agency
25 To 36 months	Impact Assessment by the Implementing Agency

Annexure - I

Tentative Locations of Proposed Artificial Recharge Structures in Jalgaon Jamod Taluka of Buldhana District

SN	Village	Latitude	Longitude	Structures
1	Umapur	76.4657	21.1075	Check dam
2	Kahupatta	76.5101	21.1026	Check dam
3	Sungaon	76.5463	21.1174	Check dam
4	Sonbardi	76.6014	21.1398	Check dam
5	Kuvardeo	76.5708	21.1428	Check dam
6	Sungaon	76.5671	21.1282	Check dam
7	Gorad Pr.jamod	76.5319	21.1058	Check dam
8	Garpeth	76.4618	21.0946	Check dam
9	Raipur	76.4255	21.0898	Check dam
10	Wadwanal	76.4019	21.0784	Check dam
11	Garpeth	76.4616	21.0735	Check dam
12	Rajura Kh.	76.4754	21.0692	Check dam
13	Umapur	76.4919	21.1047	Check dam
14	Islampur	76.398	21.0536	Check dam
15	Mohidipur	76.4083	21.0009	Check dam
16	Karanwadi	76.3999	21.0127	Check dam
17	Karanwadi	76.3951	20.9899	Check dam
18	Palshi Supo	76.4276	21.0181	Check dam
19	Nimkarad	76.369	20.9566	Check dam
20	Pimpalgaon Kale	76.3985	20.9563	Check dam
21	Pimpri Khodri	76.4566	20.9946	Check dam
22	Asalgaon	76.4638	21.0011	Check dam
23	Pimpri Khodri	76.4508	20.9758	Check dam
24	Umapur	76.4799	21.1032	Percolation tank
25	Kahupatta	76.5077	21.0807	Percolation tank
26	Khelshirpur (jamod)	76.5986	21.1346	Percolation tank
27	Chalthana Kh.	76.5757	21.1331	Percolation tank
28	Sungaon	76.5505	21.1161	Percolation tank
29	Wadgaongad	76.434	21.0595	Percolation tank
30	Pimpalgaon Kale	76.4378	20.9824	Percolation tank
31	Karanwadi	76.4	21.0012	Percolation tank
32	Islampur	76.4031	21.0765	Percolation tank
33	Khelmali (jamod)	76.6119	21.1044	Recharge shaft
34	Khelmali (jamod)	76.6095	21.1202	Recharge shaft
35	Khelshirpur (jamod)	76.6023	21.1311	Recharge shaft
36	Khel Paraskar	76.6216	21.0991	Recharge shaft
37	Chalthana Siyam	76.5785	21.1215	Recharge shaft
38	Chalthana Kh.	76.5782	21.1015	Recharge shaft

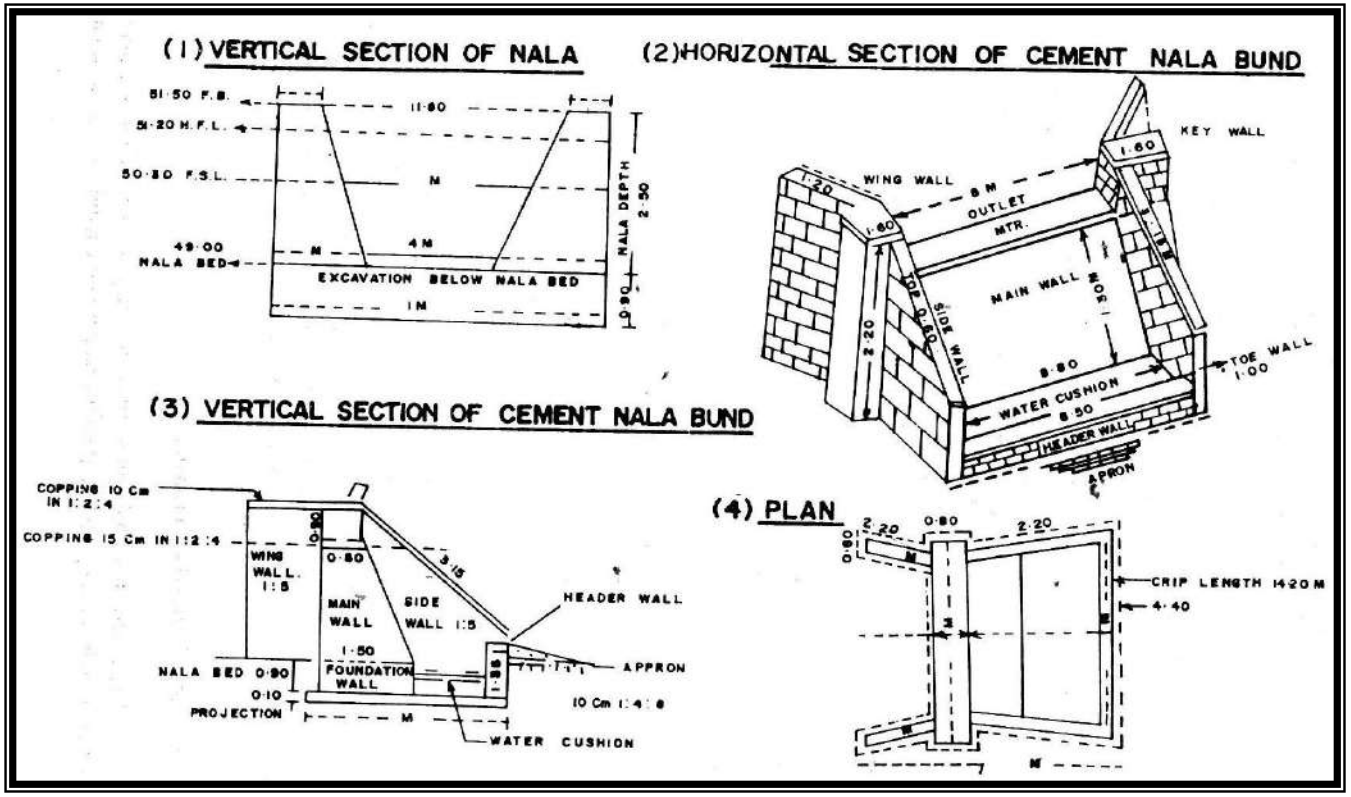
39	Sungaon	76.572	21.0906	Recharge shaft
40	Chalthana Kh.	76.5708	21.1147	Recharge shaft
41	Sungaon	76.5622	21.1094	Recharge shaft
42	Sungaon	76.5608	21.0649	Recharge shaft
43	Sungaon	76.5525	21.0826	Recharge shaft
44	Gorad Pr.jamod	76.5522	21.0931	Recharge shaft
45	Khel Paraskar	76.5867	21.0883	Recharge shaft
46	Khel Paraskar	76.5876	21.0927	Recharge shaft
47	Kahupatta	76.5214	21.0862	Recharge shaft
48	Khamkhed	76.5203	21.0772	Recharge shaft
49	Khamkhed	76.5253	21.0767	Recharge shaft
50	Sungaon	76.5355	21.0656	Recharge shaft
51	Kolkhed Pr.jamod	76.5479	21.0624	Recharge shaft
52	Kolkhed Pr.jamod	76.5476	21.0539	Recharge shaft
53	Wayal	76.5133	21.0626	Recharge shaft
54	JALGAON (JAMOD) (MA-1)	76.5174	21.0359	Recharge shaft
55	Tatarpur	76.51	21.046	Recharge shaft
56	Rajura Kh.	76.4853	21.0495	Recharge shaft
57	Rajura Kh.	76.4909	21.0586	Recharge shaft
58	Dautpur	76.4784	21.0577	Recharge shaft
59	Dhanora	76.4709	21.0516	Recharge shaft
60	Dhanora	76.4608	21.0571	Recharge shaft
61	Dhanora	76.4674	21.0335	Recharge shaft
62	Usara Bk.	76.5916	21.0648	Recharge shaft
63	Khelwardhe (jamod)	76.6015	21.0718	Recharge shaft
64	Usara Bk.	76.5902	21.0542	Recharge shaft
65	Akoli Bk.	76.6079	21.0382	Recharge shaft
66	Taroda Jamod	76.5674	21.0462	Recharge shaft
67	Wawadi Hardo	76.5678	21.0572	Recharge shaft
68	Palshi Supo	76.4403	21.0453	Recharge shaft
69	Dhanora	76.4475	21.0513	Recharge shaft
70	Palshi Supo	76.4392	21.04	Recharge shaft
71	Palshi Supo	76.4345	21.0362	Recharge shaft
72	Palshi Supo	76.4283	21.0334	Recharge shaft
73	Palshi Supo	76.4323	21.0281	Recharge shaft
74	Palshi Supo	76.4438	21.021	Recharge shaft
75	Palshi Supo	76.444	21.017	Recharge shaft
76	Asalgaon	76.4653	21.0153	Recharge shaft
77	Ahmadpur	76.4873	21.0227	Recharge shaft
78	Wadi Bk.	76.5003	21.0221	Recharge shaft
79	Asalgaon	76.4976	21.0003	Recharge shaft
80	Takli Khati	76.5179	21.0008	Recharge shaft
81	JALGAON (JAMOD)	76.523	21.0162	Recharge shaft

	(MA-1)			
82	JALGAON (JAMOD) (MA-1)	76.5239	21.0308	Recharge shaft
83	Nimbhora Bk.	76.5633	21.0223	Recharge shaft
84	Uti Bk	76.5654	21.0106	Recharge shaft
85	Parasharampur	76.5486	20.9917	Recharge shaft
86	Kherda Kh.	76.5859	21.0138	Recharge shaft
87	Kherda Bk.	76.5953	21.0121	Recharge shaft
88	Changefal Bk.	76.6136	21.0172	Recharge shaft
89	Changefal Bk.	76.6169	21.0112	Recharge shaft
90	Yengaon	76.5802	20.9832	Recharge shaft
91	Taaroda Kh.	76.5299	20.9884	Recharge shaft
92	Akola Kh.	76.4809	20.9716	Recharge shaft
93	Zadegaon	76.4679	20.9472	Recharge shaft
94	Pimpri Khodri	76.4514	20.9706	Recharge shaft
95	Manegaon	76.4507	20.9593	Recharge shaft
96	Manegaon	76.4478	20.9445	Recharge shaft
97	Dadulgaon	76.425	20.9365	Recharge shaft
98	Dadulgaon	76.4238	20.9407	Recharge shaft
99	Hingna Pr.balapur	76.433	20.9419	Recharge shaft
100	Satali	76.4802	20.9439	Recharge shaft
101	Golegaon Bk.	76.477	20.9493	Recharge shaft
102	Khandvi	76.4725	20.9708	Recharge shaft
103	Sukli	76.5301	20.9677	Recharge shaft
104	Gadegaon Bk.	76.5235	20.9521	Recharge shaft
105	Bhendwad Kh.	76.5537	20.9553	Recharge shaft
106	Chavra	76.5654	20.9485	Recharge shaft
107	Bhendwad Bk.	76.5579	20.9338	Recharge shaft
108	Pesoda	76.5904	20.9353	Recharge shaft
109	Pesoda	76.5961	20.9428	Recharge shaft
110	Kavthal	76.6083	20.9494	Recharge shaft
111	Kajegaon	76.5905	20.9799	Recharge shaft
112	Kajegaon	76.5954	20.9867	Recharge shaft
113	Gadagaon Kh.	76.5028	20.9748	Recharge shaft
114	Satali	76.4993	20.9499	Recharge shaft
115	Satali	76.4912	20.9436	Recharge shaft
116	Takli Khasa	76.5055	20.9424	Recharge shaft
117	Sukli	76.5174	20.9734	Recharge shaft
118	Gadegaon Bk.	76.5174	20.9541	Recharge shaft
119	Nimbhora Kh.	76.5439	20.937	Recharge shaft
120	Bhendwad Bk.	76.5758	20.9329	Recharge shaft
121	Mahuli	76.5228	20.9304	Recharge shaft
122	Khelshirpur (jamod)	76.5904	21.1286	Recharge shaft
123	Chinchkhed Kh.	76.5409	21.0137	Recharge shaft

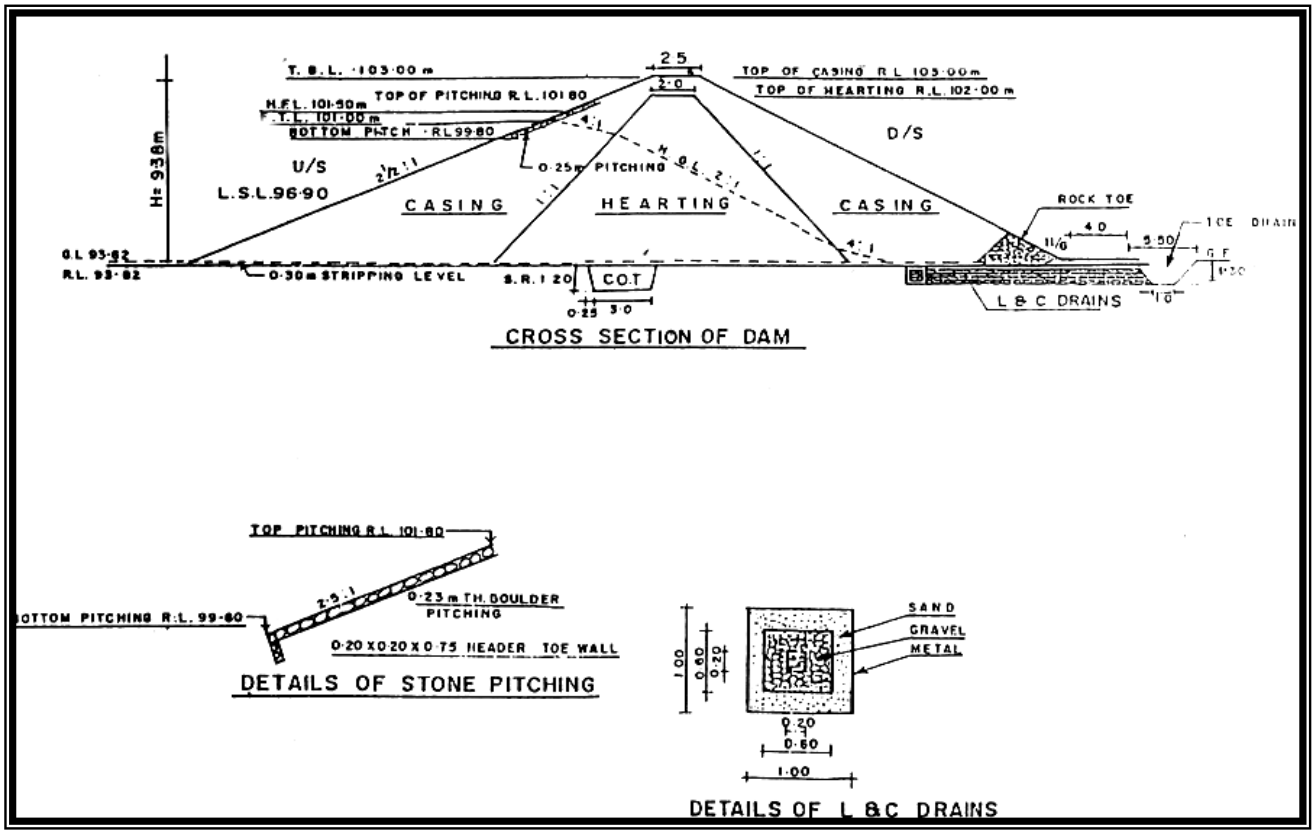
124	Kherda Kh.	76.5754	21.0186	Recharge shaft
125	Sungaon	76.5341	21.0587	Recharge shaft
126	Madakhed Bk.	76.5787	20.966	Recharge shaft
127	Borala Bk.	76.6056	21.0055	Recharge shaft
128	Kherda Bk.	76.5987	21.0442	Recharge shaft
129	Kurangad Bk.	76.5403	20.9677	Recharge shaft
130	Parasharampur	76.5409	21.0012	Recharge shaft

Annexure-II

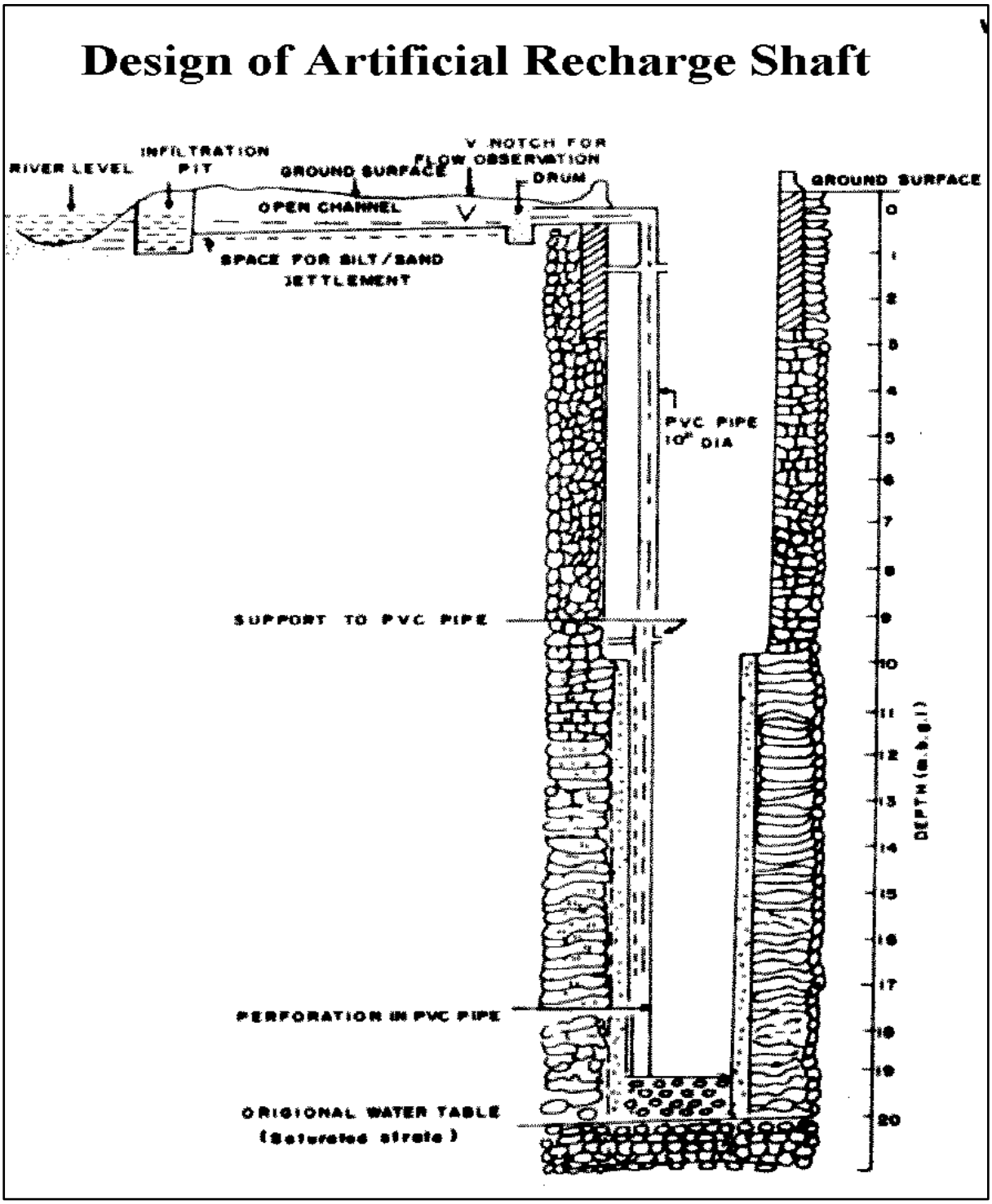
Design of Check Dam



Design of Percolation Tank

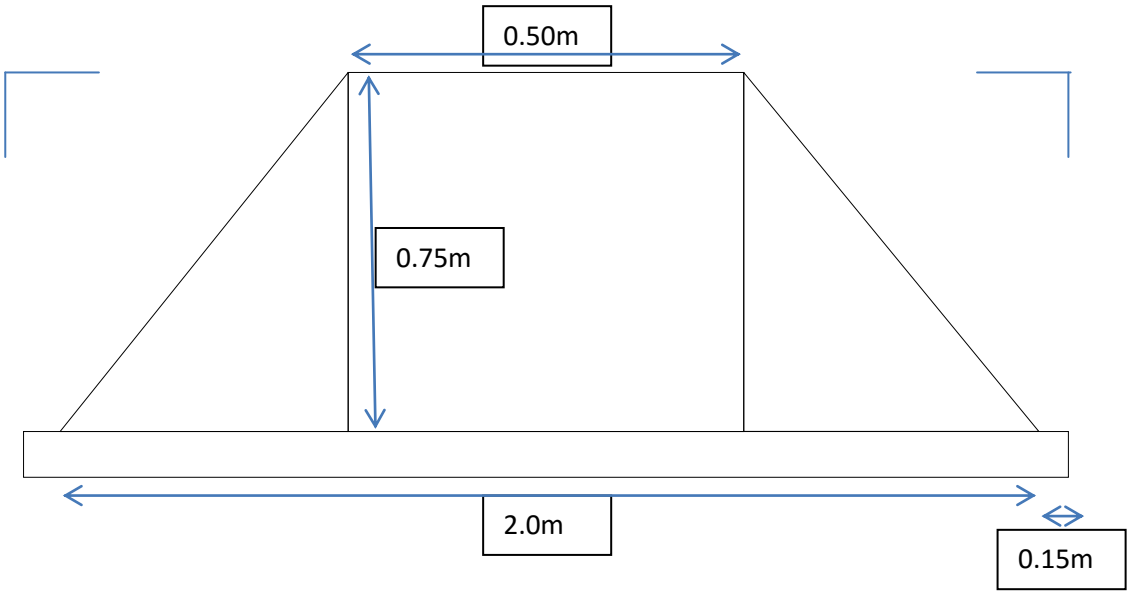


Design of Recharge Shaft



DESIGN OF WATER CONSERVATION STRUCTURES

Cross Section of Loose Boulder Structure



Cross Section of Gabbion Structure