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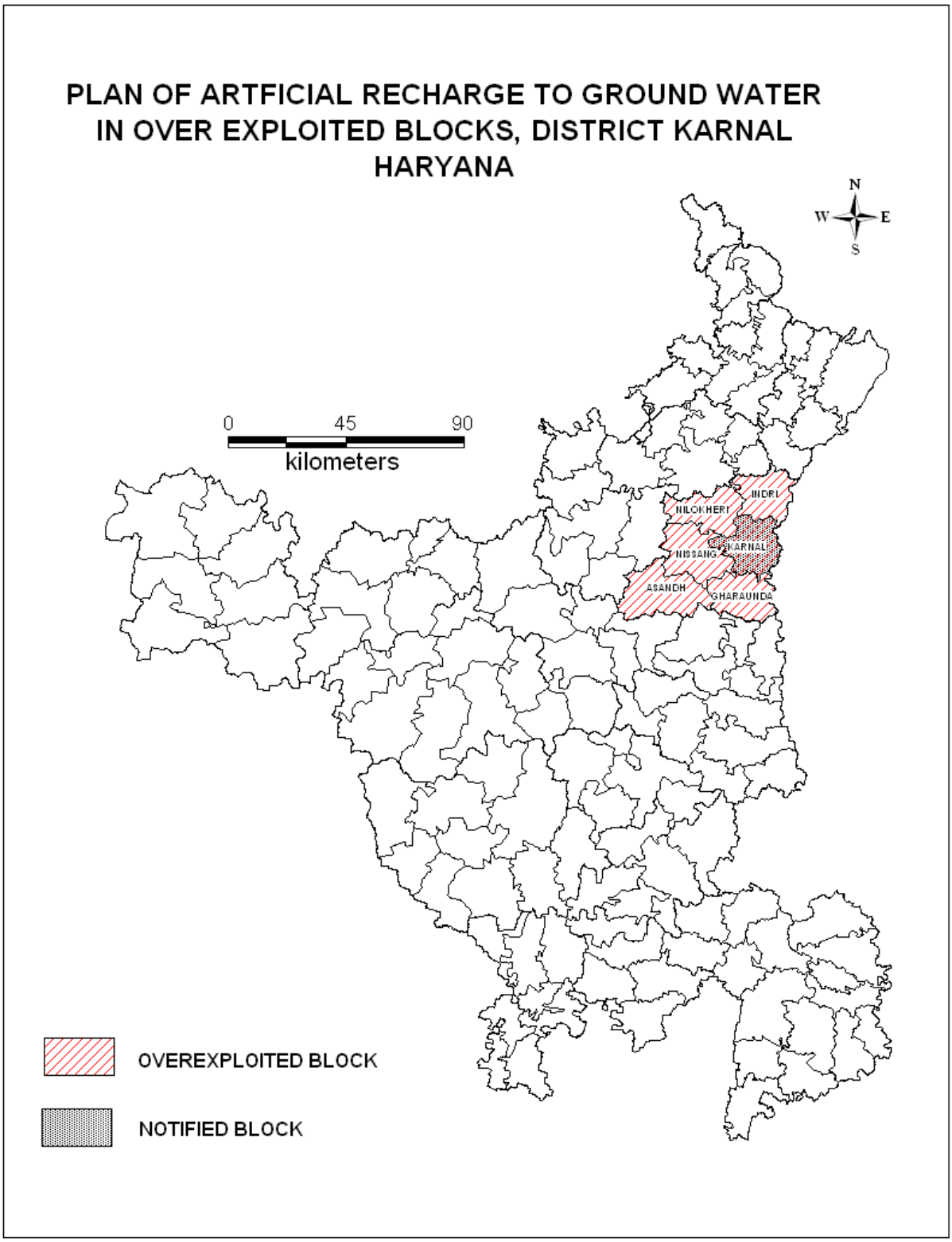
Government of India
Ministry of Water Resources,
River Development & Ganga Rejuvenation
Central Ground Water Board

PLAN ON

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION IN OVEREXPLOITED BLOCKS OF

KARNAL DISTRICT, HARYANA

Central Ground Water Board
North Western Region
Chandigarh


PLAN OF ARTFICIAL RECHARGE TO GROUND WATER
IN OVER EXPLOITED BLOCKS, DISTRICT KARNAL
HARYANA
N
W
E
S
0
45
90
kilometers
INDRI
NILOKHERI
KARNAL
NISSANG
ASANDH
GHARAUNDA
OVEREXPLOITED BLOCK
NOTIFIED BLOCK

PLAN OF ARTFICIAL RECHARGE TO GROUND WATER IN OVER EXPLOITED BLOCKS, DISTRICT KARNAL HARYANA

INTRODUCTION

Administratively, the district is under control of Rothak division and is divided into 3 sub-divisions Karnal, Assandh and Indri. Karnal, Indri, Assandh, Nilokheri and Gharaunda are 5 tehsils of district Moga. Further, the district has been sub-divided into six development blocks i.e. Karnal, Indri, Assandh, Nissing Nilokheri and Gharaunda. Karnal district has 8 towns and 434 villages with a total population of 17,42,815 as per 2011 census.

HYDROMETEOROLOGY

The climate of the district is characterized by the dryness of the air with an intensely hot summer and a cold winter. The normal annual rainfall is about 582 mm which is spread over 32 rainy days. 82.39% of rainfall occurs during south-west monsoon.

GEOMORPHOLOGY

The area represents almost an alluvial plain without any conspicuous topographical features and forms a part of the vast Indo-Gangetic plain. The elevation of the area above mean sea level ranges from 256 m amsl in the north to 245 m amsl in the south with an average elevation of 240m.amsl.The general slope of the area is southwards. In the north western part of the district the land slopes south west wards. There are many topographical depressions in the area of which the most pronounced is at Daha, south of Karnal. The river Yamuna which marks the eastern boundary of the Haryana State as well as Karnal district provides the major drainage in the area. The river Yamuna emerges from Yamnotri off the Bansur-Punch glacier in Tehri Garhwal district of Uttarakhand at an elevation of 6330 meters. It emerges into the plains from the foothills at Kalesar just north of Tajewala. The Chantang Nala is the other drainage line and flows from north to southwest in the western part of the district and disappears near Assandh. The soils in Gharaunda and SE half of Karnal blocks are young, stratified with no profile development. They are sandy to fine sandy loams. The soils in SE half of Nilokheri, SW extremity of Karnal block touching Nilokheri, eastern portion of Nissang, Western half of Gharaunda block are heavily textured varying from sandy loam at the surface to clayey loam at about one meter depth.

HYDROGEOLOGY:

The area falls in the Upper Yamuna Basin and the principal ground water reservoir in the area is unconsolidated alluvial deposits of Quaternary age. Ground water in near surface zone occurs under water table conditions and occurs under semi confined to confined conditions in deeper aquifers. Rain fall and seepage from the river Yamuna, canal networks and irrigation is the principal source of ground water recharge in the area. The study of exploratory boreholes drilled in the district during the Upper Yamuna Project of Central Ground Water Board indicated presence of three tier aquifer groups upto 463 m depth below ground level.

Aquifer Group-I: The Aquifer group I is composed of different sand and clay lenses and extends from surface downwards to different depth varying down to 90m to 180m at different places and occurs all over the area. This is composed of relatively coarser sediments. This group of aquifers is underlain by a clayey horizon 10-15m thick which is regionally extensive. The average transmissivity of this group was calculated by the Upper Yamuna Project of CGWB to be of the order of 2200 m^2/day, lateral permeability of the order of 24m/day and average storativity as 0.12.

Aquifer Group-II: This group is composed of different sand and clay lenses and lies below aquifer group-I and occurs at varying depths ranging between 115m and 195 m to 215m and 285m. The sediments of this group are less coarse and are mixed with some kankar. This group is underlain by another clayey horizon, which is considerable thick at places and appears to be regionally extensive. The average transmissivity of this group is 700m^2/day, the average lateral permeability is 7.2m/day and the average storativity is $1x10^{-3}$.

Aquifer Group-III: The aquifer group III is composed of thin sand layers alternating with thicker clay layers and occurs at variable depths ranging between 314 m to 405m.bgl. The granular material of this group is generally finer and more so in the southerly direction. This group has an average transmissivity value of 525m^2/day, and average lateral permeability and average storativity values of the order of 7.1m/day and $4.5x10^{-4}$ respectively.

GROUND WATER QUALITY:

Data of chemical analysis of water samples from shallow aquifers indicates that ground water is alkaline in nature and is fresh to moderately saline. The electrical conductivity (EC) values ranges from 346 µs/cm, to 2213 µs/cm at 25^0C, Nitrates from 1.9 to 498 mg/l, fluoride from 0.14 to 4.94 mg/l, and iron from 0.03 to 1.64 mg/l.arsenic in the district ranges from 0.0011 to 0.0655 mg/l.

The suitability of groundwater for irrigational uses is generally ascertained by considering salinity (EC), Sodium Adsorption ratio (SAR) and Residual Sodium Carbonate (RSC). The ground water is fresh to saline with low RSC values. The US Salinity Laboratory Classification of irrigation water indicates that ground water falls under C_2S_1, C_3S_1, C_3S_2 and C_3S_3 Classes and therefore suitable for customary irrigation on well – drained soils on which semi – salt tolerant suitable crops such as wheat, gram and rice etc are grown without any fear of sodium hazards.

Type of water:
Nearly all type of waters are available viz. Ca+ Mg – mixed anion, $NaHCO_3$, Mixed cation – bicarbonate type or mixed cation and mixed anion type.

GROUND WATER RESOURCES:

Ground Water Resources estimation of the district was done as on 31.03.2011 as per GEC-1997 for each individual block. Stage of ground water development in the district is 148%. The ground water development in all the blocks of the district has exceeded the available recharge and thus all the blocks have been categorized as "over exploited".

Net ground water availability of the district is 822.31 million cubic meter (mcm), ground water draft for all users is 1218.91 mcm, whereas net ground water availability for future irrigation development is -396.60 mcm.

GROUND WATER IRRIGATION SCENARIO

As per the data available from minor irrigation census 2006-07 the detailed number of shallow, deep, tubewells, lined, unlined water distribution system, land holdings of wells are given below for reference

Total Distribution of Tubewells According to Owner's Holding Size

Sr.no	District	Marginal (0-1 ha)	Small (1-2 ha)	Semi-Medium (2-4 ha)	Medium (4-10ha)	Public	Group of Farmers	Total
1	**Karnal**	**66**	**743**	**5903**	**5805**	**930**	**32975**	**46422**

Distribution of Tubewells According to Depth of tube well

No. by the depth of Tube well						
Sr.no	**District**	**40-60 mts**	**60-70 mts**	**70-90 mts**	**90-110**	**Total**
1	**Karnal**		**37018**	**4137**	**4290**	**46422**

Number of Irrigation tube wells with water distribution System

Ground Water Schemes according to water Distribution System				
	Open Water Channel			
Sr.no	District	Lined/pucca	Unlined/kutcha	Total
1	Karnal	41320	5102	46422

PLAN OF THIS REPORT

In this plan 2 types of the recharge structures are proposed such as Roof Top Rain water harvesting in rural & urban areas and Recharge pits in agriculture lands of 5mt x 5mt x 3mt size. The pit will be surrounded by angle irons and barbed fencing. The size and depth depend on the availability of the land. The extra water available on the field will be stored in the pit and that will also be recharged to the ground water. **A summery outline of the artificial recharge plan for the entire district of each block is given at the beginning in tabular forms. This is followed by the salient features of each block along with the detailed structure-wise recharge plan and cost estimates.**

Details of the block wise type of suitable recharge structures and volume of water assured for annual recharge for each block, schematic design of recharge structures are annexed at annexure I & II.

This plan is focusing on the technical aspects of the ground water recharge through various means so that various implementing agencies may get the appropriate technical guidelines. The existing/ongoing schemes of the central or state govt. like MANERGA, IWSP, PMKVY, NABARD funded schemes, Urban Development schemes, departmentally funded projects etc. may be benefitted from the recharge plan by incorporating the input in the operational guidelines/ design and for locating the specific sites.

Agriculture university, engineering Collages, Academic and Research Institution, NGO may also take up the pilot or demonstrative projects in the blocks suitable to them to plan at local level as per local conditions.

A. POTENTIAL FOR REDUCTION IN OVERDRAFT AFTER RAINWATER HARVESTING AND ARTIFICIAL RECHARGE

Sr.no.	Type of Structure	No. of structures	Unit cost in Lakhs	Total cost of structure in Lakhs(IN CRORE)	Annual Recharge (MCM)
ROOF TOP RAIN WATER HARVESTING IN RURAL AND URBEN AREAS					
1	**Artificial Recharge Plan For Urban Areas.**	6185	0.25	**15.46**	**0.245**
2	**Roof Top Rain Water Harvesting in Rural Areas**	19860	0.25	**49.65**	**1.068**
	Total	**26045**	**0.25**	**65.11**	**1.313**
ARTIFICIAL RECHARGE IN FARMS					
1	**Artificial Recharge Plan Through Recharge Pits.**	23930	0.35	83.76	16.081
			Total	**148.87**	**17.394**

By the implementation of the proposed recharge structures there will be a reduction of 1.88% in stage of ground water development as tabulated below

Sr.no.	Total Draft (present) **(mcm)**	Recharge through different proposed structures **(mcm)**	Draft Reduced due to Recharge **(mcm)**	Stage of development (present) (Average value of three OE Blocks)	Stage of development after recharge	Reduction in stage of development after recharge
1	**1218.91**	**17.394**	**1201.52**	**148%**	**146.12%**	**1.88%**

ARTIFICIAL RCEHARGE PLAN THROUGH RECHARGE PITS IN OVER EXPLOITED BLOCKS OF KARNAL DISTRICT

DISTRICT NAME	Block Name	Total area of the village (in hectares rounded up to one decimal place)	10%of village area taken for farm recharge(sq m)	Total number of recharge pits (1 recharge pit / hector) for 10% area	Annual recharge (MCM)= (Area*Runoff 15%*Rainfall in m/1000000)	Cost of Pit @Rs.0.35 lakh (In Crore)
KARNAL	Assandh	49430	49430000	4943	3.322	17
	Gharaunda	36567	36567000	3657	2.457	13
	Indri	34410	34410000	3441	2.312	12
	Karnal	38640	38640000	3864	2.597	14
	Nilokheri	39329	39329000	3933	2.643	14
	Nissang	40919	40919000	4092	2.750	14
	Total	239295	239295000	23930	16.081	84

Number of Recharge pits are based on following factors:

Availability of Irrigation wells In the farmer land

Area of sandy strata at shallow depth identified

Type of structure will be recharge pit/ Recharge well (where top three meters is clay)

ROOF TOP RAINWATER HARVESTING IN RURAL AREAS OF KARNAL DISTRICT OF HARYANA

Sr.No.	Name of CD block	Total area of the village (in hectares rounded up to one decimal place)	Number of households (2011 census)	No of Houses taken for Artificial Recharge (10% of total households)	Total No of AR Structures (one structure for 10 house holds)	Total rechaerge in MCM	Cost @0.25 lack (In Crore)
1	Assandh	49430	33617	3362	3362	0.181	8
2	Gharaunda	36567	36442	3644	3644	0.196	9
3	Indri	34410	27100	2710	2710	0.146	7
4	Karnal	38640	39566	3957	3957	0.213	10
5	Nilokheri	**39329**	**32027**	3203	3203	0.172	8
6	Nissang	40919	29842	2984	2984	0.160	7
	Total	**239295**	**198594**	**19860**	**19860**	**1.068**	49

ARTIFICIAL RECHARGE PLAN FOR URBAN AREAS OF KARNAL DISTRICT, HARYANA

District	Name of CD Block	Town Name	Total Households	Total Population of Town	HousholdS taken for Atificial Recharge (10%)	Total Roof Top Area (sqm)	Vol of water available for recharge (MCM)	Cost @0.25 lack (In Crore)
KARNAL	NILOKHERI	Nilokheri (MC)	3908	17938	391	39080	0.020	1
	NILOKHERI	Taraori (MC)	5240	25944	524	52400	0.026	1
	INDRI	Indri (MC)	3546	17487	355	35460	0.016	1
	KARNAL	Karnal (M Cl + OG)*	63280	302140	3164	316400	0.118	8
	NISSING	Nissing (MC)	3361	17438	336	33610	0.013	1
	KARNAL	Uncha Siwana (CT)	1807	8922	181	18070	0.007	0
	ASSANDH	Assandh (MC)	5081	27125	508	50810	0.018	1
	GHARAUNDA	Gharaunda (MC)	7267	37816	727	72670	0.028	2
	TOTAL				**6185**		**0.245**	15

B. POTENTIAL FOR REDUCTION IN OVERDRAFT BY ENHANCING THE GROUND WATER USE EFFICIENCY OF IRRIGATION TUBE WELLS

The micro level transformation in the ground water management have vast impact potential to counter extensive ground water depletion faced by the state of Haryana, particularly in overexploited blocks. There are around 5102 operated by farmers for irrigation through unlined/Katcha (10.95%) open channel system in Karnal district where water from the tubewell is discharge to the agricultural field. In this process huge quantity of ground water is wasted in soil moisture and evaporation losses.

Dynamic ground water resources (2011) indicate that Gross ground water draft for irrigation in Karnal district is estimated at 1206.47 MCM. It is expected that around 3.79% of over draft can be brought down by switching over to underground/surface pipeline based distribution from the prevailing unlined open channels. Thereby gross draft will be reduced to the tune of 33.03 MCM assuming there is no crop diversification by the farmers.

The benefit will lead to saving of precious ground water resources in overexploited blocks of Karnal Districts. The measure if implemented will bring down the ground water overdraft from 148% to 144 %. The category of the blocks will also improve drastically resulting in boosting of agriculture and industrial development otherwise not sustainable in majority of the blocks in the state.

The tubewells also consume enormous electricity which is subsidized and government incurs significant revenue on this account. The measures therefore will result in saving of energy and money. Pollution impact will be reduced whenever diesel engines are used by the farmers. The environmental and ecological condition in the irrigated land will improve. Unwanted weed growth will also be controlled inside the farm land. This will also be useful in the waterlogged/ shallow water table areas as the seepage losses in these areas also aggravate the water logging. **Government should make/launch a mission mode program for installing the underground pipe lines instead of having *katcha* channel in the entire Haryana**. Heavy ground water overdraft can be reduced by these efforts. This will ensure **more crop per drop**.

POTENTIAL FOR REDUCTION IN OVERDRAFT BY ENHANCING THE GROUND WATER USE EFFICIENCY IN IRRIGATION TUBEWELLS, KARNAL DISTRICT

Net Annual Ground Water Availability (mcm)	Total Draft (present) (mcm)	Gross Irrigation Draft (present) (mcm)	Gross Ground Water Draft for Domestic and industrial supply (mcm)	Pecentage of unlined channel	Wastage through unlined channel, (mcm) (Col 3 X Col5 X 0.25#)	Potential of Reduced irrigation overdraft (Col3-col6) (mcm)	Gross draft after saving of water (mcm) (Col 7+Col4)	Present Stage of development (%)	Stage of development afterwards((Col 8/Col1)X100) (%)	Reduction in stage of development after constructing pucca canal (Col9-Col10) (%)
1	2	3	4	5	6	7	8	9	10	11
822.31	1218.91	1206.47	12.44	10.95	**33.03**	1173.4	1185.88	**148**	144	3.79

#losses from open kuchha channel are around 25%.

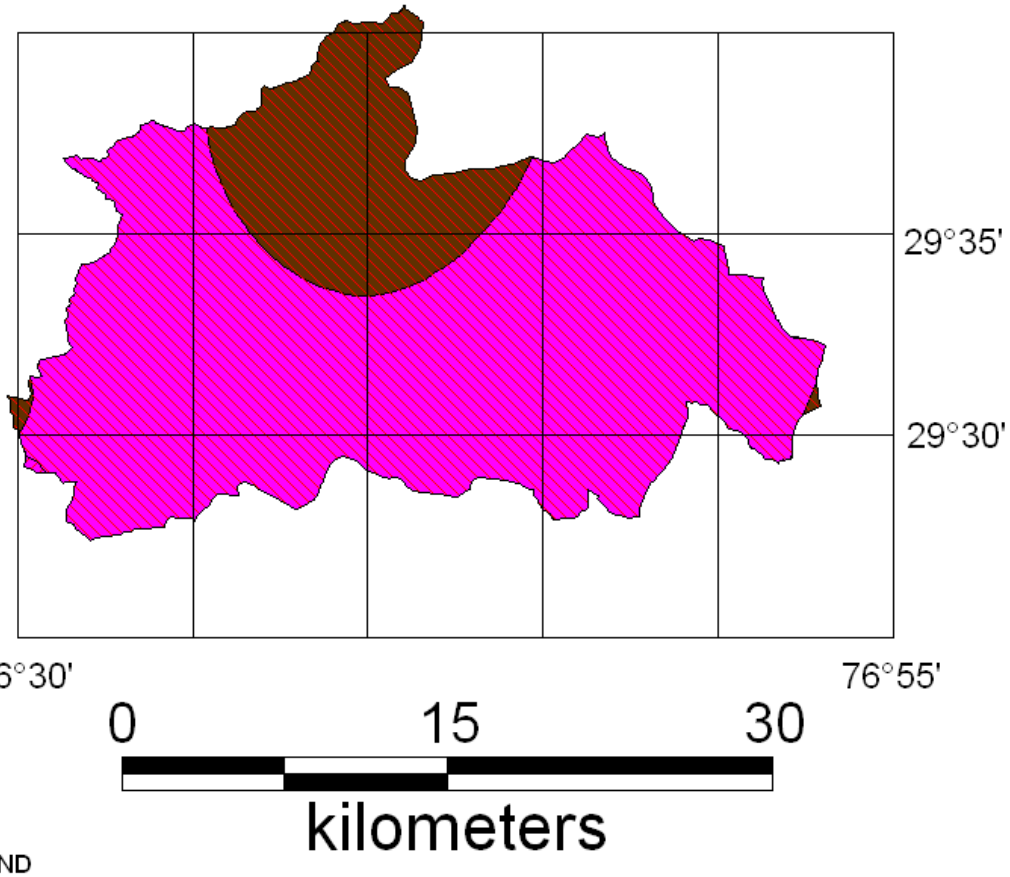
COST ESTIMATE OF UNDERGROUND PIPE LINE

District	Block	Irrigated area by ground water scheme (ha)	Percentage of Unlined Channel (%)	Area under unlined Channels	Total cost @Rs.0.50 lakh per hector(in cr) Area *0.50/100 = Crores	Total Cost in Rs.Cr. District wise
Karnal	**Assandh**	21023	10.95	2302	12	**92**
	Gharaunda	29746	10.95	3257	16	
	Karnal	30585	10.95	3349	17	
	Indri	28571	10.95	3129	16	
	Nilokheri	28590	10.95	3131	16	
	Nissing	26905	10.95	2946	15	

BLOCK WISE PLAN OF DISTRICT KARNAL HARYANA

(6 OE BLOCKS)

BLOCK-ASSANDH DISTRICT-KARNAL STATE-HARYANA
DEPTH TO WATER LEVEL ASSANDH, DECADAL MEAN POST MONSOON
Vs
DECADAL MEAN TREND POST MONSOON
(2005-2014)



LEGEND

Decadal Mean Water Level (m.bgl)

- 10.00 to 20.00
- 20.00 to 40.00

Decadal Mean Trend (m)

- -0.10 to 0.00

3362	No. of Recharge Structures in Rural Villages
508	No. of Recharge Structures in Urban Towns
4943	No. of Recharge Pits in Agriculture land
20	Thickness of Sand

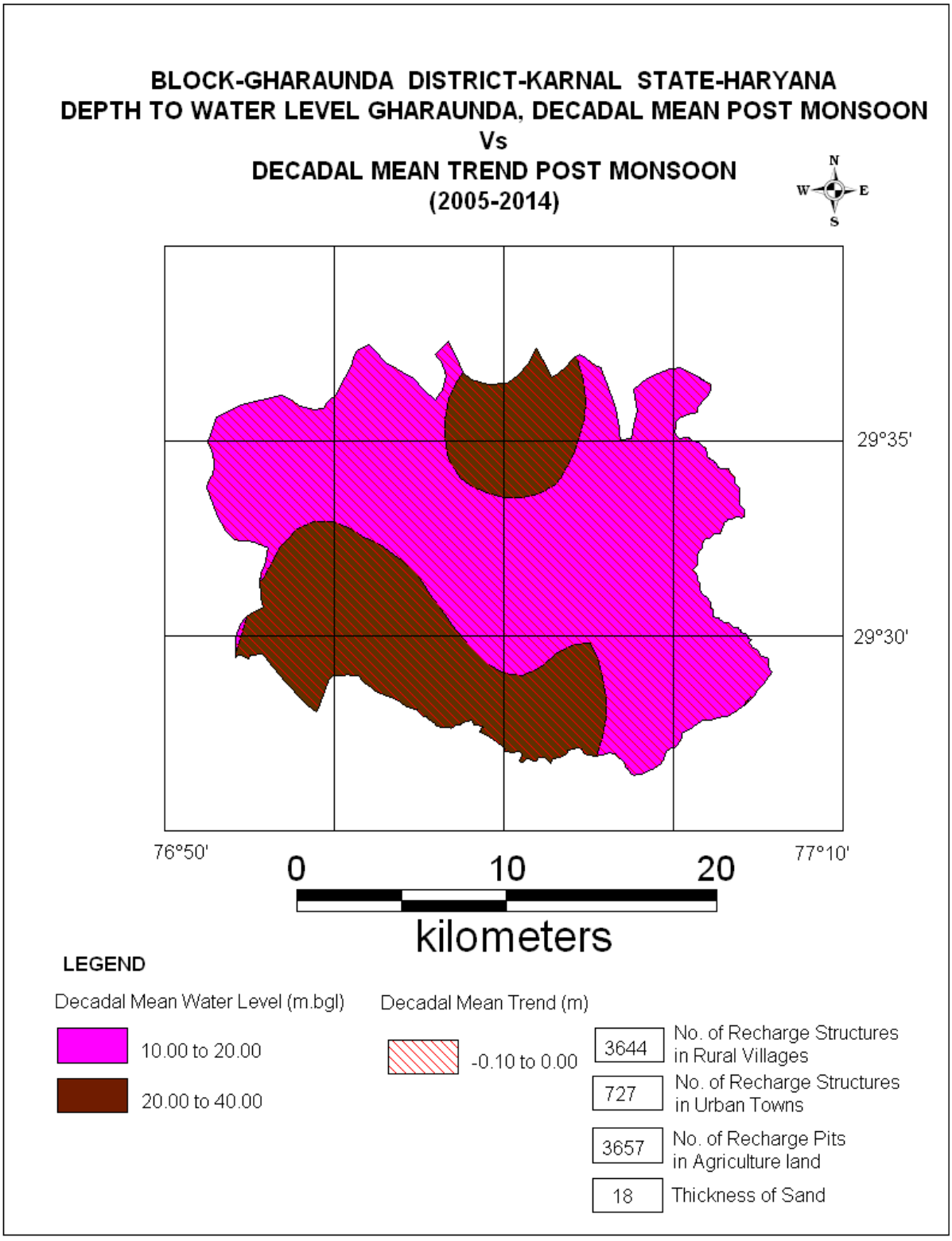
Ground Water Scenario of Block

Block Name :- Assandh **District :- Karnal** **State :- Haryana**		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*504.85*
	• Number of Villages inhabited • Un-inhabited	*48* *0*
	ii) Average Annual Rainfall (mm)	*582*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Ganga* *Yamuna*
3.	LAND USE	
	• Current fallows (Sq.Km	--
	• Net Area Sown (Sq.Km)	448.55
	• Area Sown More than Once (Sq.Km)	--
	• Total Irrigated Area (Sq.Km)	448.55
	• Total UnIrrigated Area (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Younger alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Depth to water level	
	• Pre- monsoon: (May 2015)	*2414-24.14 (mbgl)*
	• Post –monsoon: (Nov2014)	*24.02-29.70(mbgl)*
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	*11*
	• Depth Range (m)	*64.0-464.08*

	• Discharge (Ipm)	--		
	Aquifer Parameters			
	• Transmissivity (m2/day)	*2200*		
	• Storativity	*0.12-1*10^{-3}-4.5*10^{-4}*		
	• Soil infiltration rate mm/ hour	--		
		Min	*Max*	*Avg.*
		--	--	--
7.	GROUND WATER QUALITY	Min	Max	
	• EC in µS/cm at 25^{0}c	*564*	*2213*	
	• NO3 (mg/l)	*1.9*	*498*	
	• F (mg/l)	*0.36*	*4.94*	
	• Fe (mg/l)	*0.03*	*1.64*	
	• As (mg/l)	*0.0028*	*0.0105*	
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**		
	• Net Ground Water Availability (MCM)	104.70		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	216.40		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	0.52		
	• Existing Gross Ground Water Draft for all Uses (MCM)	216.92		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	0.52		
	• Net Ground Water Availability for Future Irrigation Development MCM	-112.22		
	• Stage of Ground Water Development / Over Draft (%)	207		

	• Category of Block	OE	
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*	
9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *20*	Percentage % 40
10	Volume of unsaturated zone available for recharge (MCM)	642	
11.	Volume of water required for recharge (MCM)	853	
12.	Volume of surplus water available for recharge(MCM)	6.18	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	4943	17.3	3.32
14	RWH Rural @ Rs. 25000/-	3362	8.4	0.18
15	RWH Urban@ Rs. 25000/-	508	1.27	0.018
16	Underground pipe line (area in hectares) @ Rs. 50000/-	2302	11.51	5.92
	TOTAL		38.48	9.438


BLOCK-GHARAUNDA DISTRICT-KARNAL STATE-HARYANA
DEPTH TO WATER LEVEL GHARAUNDA, DECADAL MEAN POST MONSOON
Vs
DECADAL MEAN TREND POST MONSOON
(2005-2014)
N
W
E
S
29°35'
29°30'
76°50'
77°10'
0
10
20
kilometers
LEGEND
Decadal Mean Water Level (m.bgl)
10.00 to 20.00
20.00 to 40.00
Decadal Mean Trend (m)
-0.10 to 0.00
3644
No. of Recharge Structures in Rural Villages
727
No. of Recharge Structures in Urban Towns
3657
No. of Recharge Pits in Agriculture land
18
Thickness of Sand

Ground Water Scenario of Block

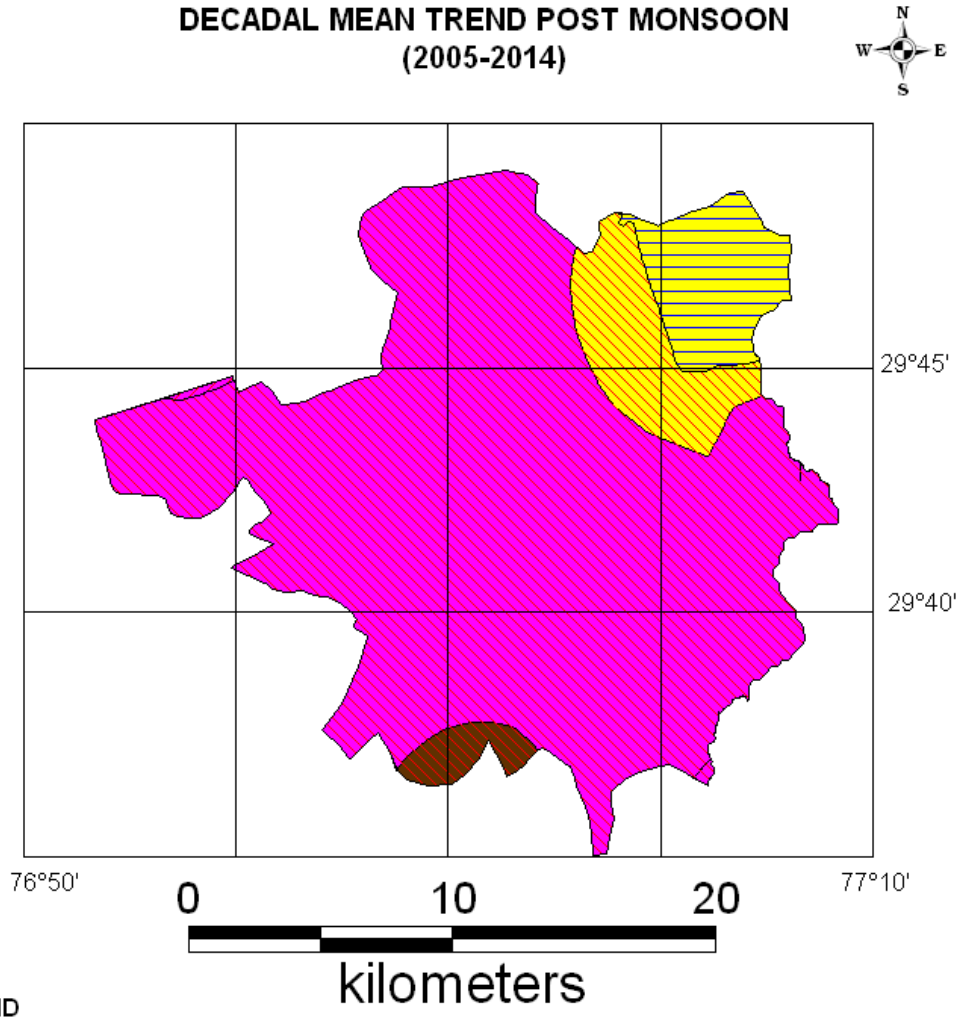
Block Name :- Gharaunda **District :- Karnal** **State :- Haryana**		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*395.53*
	• Number of Villages inhabited • Un-inhabited	*65* *0*
	ii) Average Annual Rainfall (mm)	*582*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Ganga* *Yamuna*
3.	LAND USE	
	• Current fallows (Sq.Km	0
	• Net Area Sown (Sq.Km)	314.00
	• Area Sown More than Once (Sq.Km)	--
	• Total Irrigated Area (Sq.Km)	314.00
	• Total UnIrrigated Area (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Younger alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
6.	Depth to water level	
	• Pre- monsoon: (May 2015)	*11.13-25.41 (mbgl)*
	• Post –monsoon: (Nov2014)	*17.23-35.34(mbgl)*
	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	*23*

	• Depth Range (m)	*64.0-464.08*		
	• Discharge (Ipm)	--		
	Aquifer Parameters			
	• Transmissivity (m2/day)	*2200*		
	• Storativity	*0.12-1*10^{-3}-4.5*10^{-4}*		
	• Soil infiltration rate mm/ hour	--		
		Min	*Max*	*Avg.*
		--	--	--
7.	GROUND WATER QUALITY	Min	Max	
	• EC in µS/cm at 25^{0}c	*723*	*1088*	
	• NO3 (mg/l)	*0*	*19*	
	• F (mg/l)	*0.14*	*1.03*	
	• Fe (mg/l)	--	--	
	• As (mg/l)	*0.0011*	*0.0505*	
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**		
	• Net Ground Water Availability (MCM)	111.79		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	155.42		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	2.01		
	• Existing Gross Ground Water Draft for all Uses (MCM)	157.43		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	2.01		
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-45.64		
	• Stage of Ground Water Development / Over Draft (%)	141		
	• Category of Block	OE		

	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*	
9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *18*	Percentage % 36
10	Volume of unsaturated zone available for recharge (MCM)	501	
11.	Volume of water required for recharge (MCM)	667	
12.	Volume of surplus water available for recharge(MCM)	4.83	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	3657	12.8	2.457
14	RWH Rural @ Rs. 25000/-	3644	9.11	0.196
15	RWH Urban@ Rs. 25000/-	727	1.82	0.028
16	Underground pipe line (area in hectares) @ Rs. 50000/-	3257	16.29	4.25
	TOTAL		40.02	6.931

BLOCK-KARNAL DISTRICT-KARNAL STATE-HARYANA
DEPTH TO WATER LEVEL KARNAL, DECADAL MEAN POST MONSOON
Vs
DECADAL MEAN TREND POST MONSOON
(2005-2014)



LEGEND

Decadal Mean Water Level (m.bgl)

- 5.00 to 10.00
- 10.00 to 20.00
- 20.00 to 40.00

Decadal Mean Trend (m)

- -0.10 to 0.00
- 0.00 to 0.1114

3957	No. of Recharge Structures in Rural Villages
3345	No. of Recharge Structures in Urban Towns
3864	No. of Recharge Pits in Agriculture land
12	Thickness of Sand

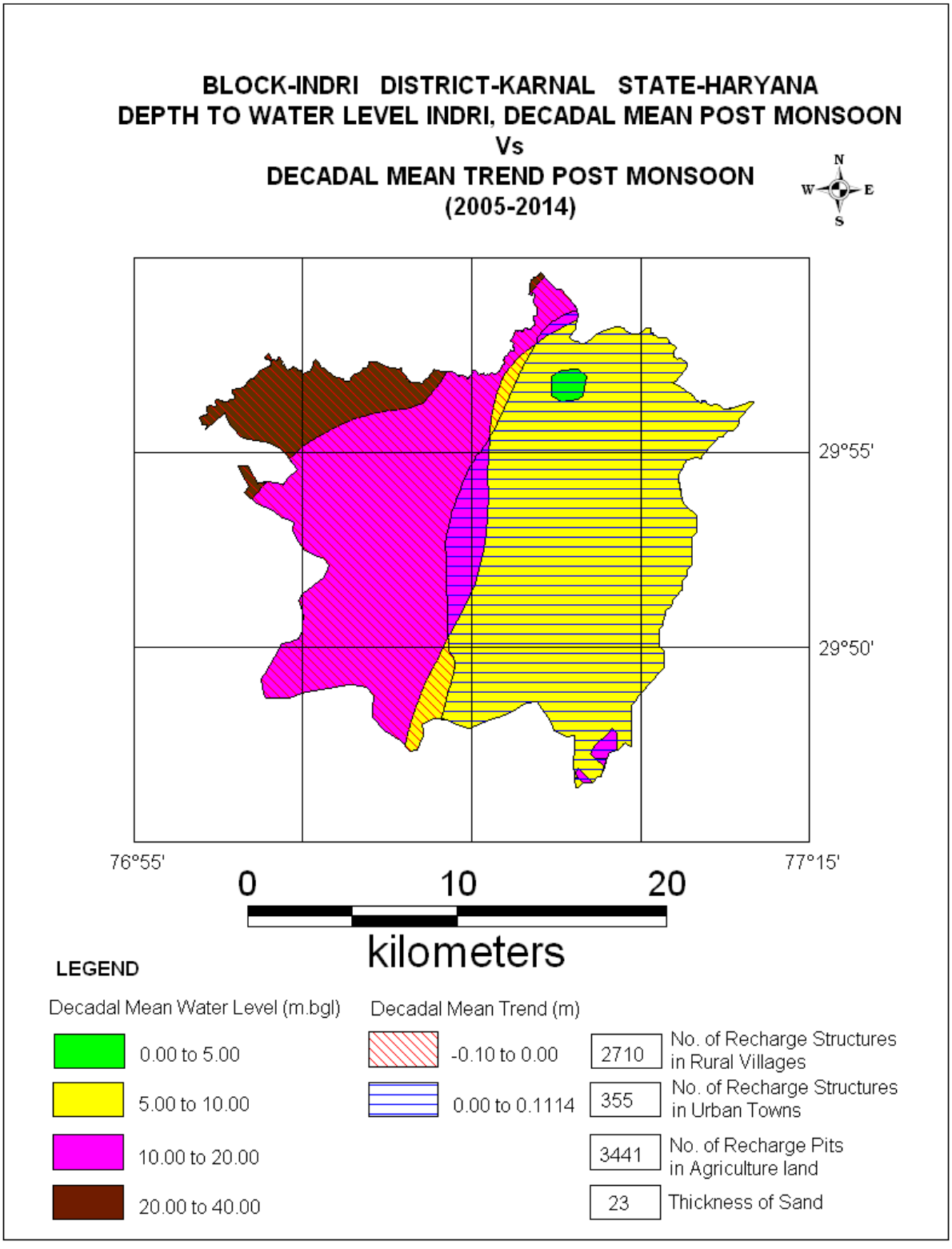
Ground Water Scenario of Block

Block Name :- Karnal **District :- Karnal** **State :- Haryana**		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*402.73*
	• Number of Villages inhabited • Un-inhabited	*84* *0*
	ii)Average Annual Rainfall (mm)	*582*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Ganga* *Yamuna*
3.	LAND USE	
	• Current fallows (Sq.Km	0
	• Net Area Sown (Sq.Km)	317.72
	• Area Sown More than Once (Sq.Km)	--
	• Total Irrigated Area (Sq.Km)	317.72
	• Total UnIrrigated Area (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Younger alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
6.	Depth to water level	
	• Pre- monsoon: (May 2015)	---------- *(mbgl)*
	• Post –monsoon: (Nov2014)	*6.60-15.53 (mbgl)*
	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	*18*
	• Depth Range (m)	*64.0-464.08*

	• Discharge (Ipm)	--		
	Aquifer Parameters			
	• Transmissivity (m2/day)	*2200*		
	• Storativity	*0.12-1*10^{-3}-4.5*10^{-4}*		
	• Soil infiltration rate mm/ hour	--		
		Min	*Max*	*Avg.*
		--	--	--
7.	GROUND WATER QUALITY	Min	Max	
	• EC in µS/cm at 25^{0}c	*346*	*508*	
	• NO3 (mg/l)	*0*	*2.2*	
	• F (mg/l)	*0.2*	*0.57*	
	• Fe (mg/l)	--	--	
	• As (mg/l)	*0.0028*	*0.0655*	
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**		
	• Net Ground Water Availability (MCM)	160.51		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	206.46		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	5.03		
	• Existing Gross Ground Water Draft for all Uses (MCM)	211.46		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	5.03		
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-50.95		
	• Stage of Ground Water Development / Over Draft (%)	132		
	• Category of Block	OE		

	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*	
9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *12*	Percentage % 24
10	Volume of unsaturated zone available for recharge (MCM)	517	
11.	Volume of water required for recharge (MCM)	688	
12.	Volume of surplus water available for recharge(MCM)	4.99	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	3864	13.52	2.597
14	RWH Rural @ Rs. 25000/-	3957	9.89	0.213
15	RWH Urban@ Rs. 25000/-	3345	8.36	0.125
16	Underground pipe line (area in hectares) @ Rs. 50000/-	3129	15.65	5.65
	TOTAL		47.42	8.585


BLOCK-INDRI DISTRICT-KARNAL STATE-HARYANA
DEPTH TO WATER LEVEL INDRI, DECADAL MEAN POST MONSOON
Vs
DECADAL MEAN TREND POST MONSOON
(2005-2014)
N
W
E
S
29°55'
29°50'
76°55'
77°15'
0
10
20
kilometers
LEGEND
Decadal Mean Water Level (m.bgl)
0.00 to 5.00
5.00 to 10.00
10.00 to 20.00
20.00 to 40.00
Decadal Mean Trend (m)
-0.10 to 0.00
0.00 to 0.1114
2710
No. of Recharge Structures in Rural Villages
355
No. of Recharge Structures in Urban Towns
3441
No. of Recharge Pits in Agriculture land
23
Thickness of Sand

Ground Water Scenario of Block

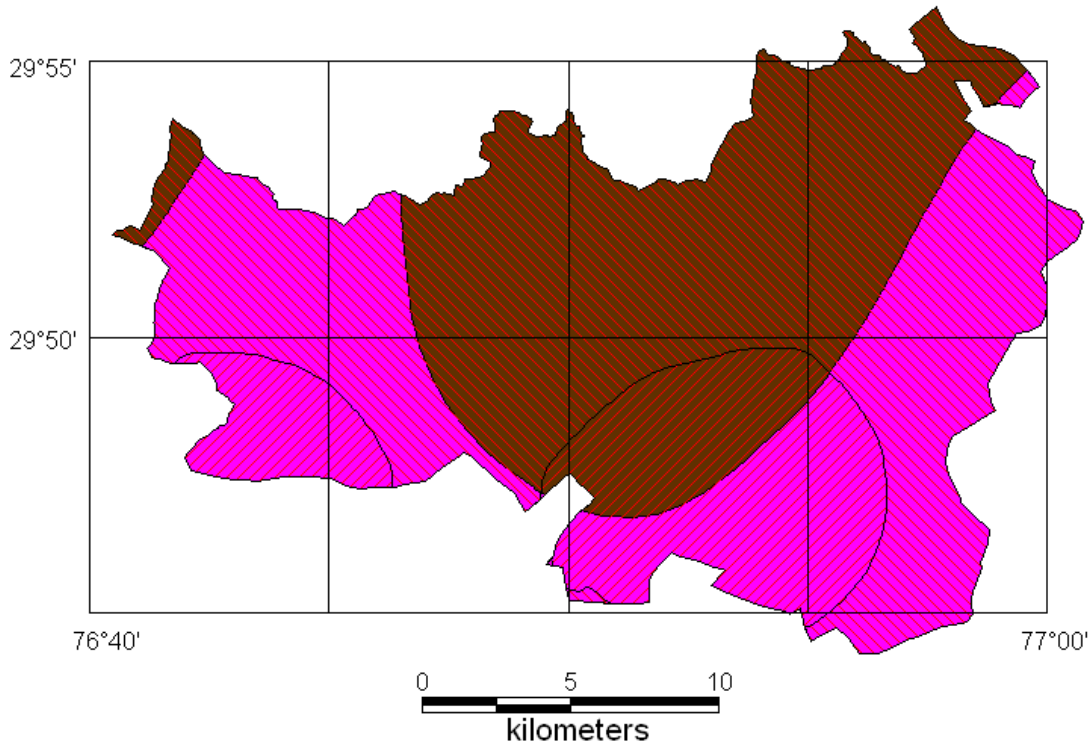
Block Name:- Indri **District :- Karnal** **State :- Haryana**		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*353.03*
	• Number of Villages inhabited • Un-inhabited	*65* *0*
	ii)Average Annual Rainfall (mm)	*582*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Ganga* *Yamuna*
3.	LAND USE	
	• Current fallows (Sq.Km	0
	• Net Area Sown (Sq.Km)	314.00
	• Area Sown More than Once (Sq.Km)	--
	• Total Irrigated Area (Sq.Km)	314.00
	• Total UnIrrigated Area (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Younger alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Depth to water level	
	• Pre- monsoon: (May 2015)	*3.56-7.75 (mbgl)*
	• Post –monsoon: (Nov2014)	*2.31-10.14 (mbgl)*
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	*12*
	• Depth Range (m)	*64.0-464.08*

	• Discharge (Ipm)	--		
	Aquifer Parameters			
	• Transmissivity (m2/day)	*2200*		
	• Storativity	*0.12-1*10^{-3}-4.5*10^{-4}*		
	• Soil infiltration rate mm/ hour	--		
		Min	*Max*	*Avg.*
		--	--	--
7.	GROUND WATER QUALITY	Min	Max	
	• EC in µS/cm at 25^{0}c	*357*	*473*	
	• NO3 (mg/l)	--	*1.08*	
	• F (mg/l)	*0.38*	*0.48*	
	• Fe (mg/l)	*0.13*	*0.86*	
	• As (mg/l)	*0.0073*	*0.019*	
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**		
	• Net Ground Water Availability (MCM)	192.46		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	216.44		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	1.34		
	• Existing Gross Ground Water Draft for all Uses (MCM)	217.78		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	1.34		
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-25.32		
	• Stage of Ground Water Development / Over Draft (%)	113		
	• Category of Block	OE		

	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*	
9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m) 23*	Percentage % 46
10	Volume of unsaturated zone available for recharge (MCM)	449	
11.	Volume of water required for recharge (MCM)	597	
12.	Volume of surplus water available for recharge(MCM)	4.32	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	3441	12.04	2.312
14	RWH Rural @ Rs. 25000/-	2710	6.78	0.146
15	RWH Urban@ Rs. 25000/-	355	0.89	0.016
16	Underground pipe line (area in hectares) @ Rs. 50000/-	3349	16.75	5.93
	TOTAL		36.46	8.404

BLOCK-NILOKHERI DISTRICT-KARNAL STATE-HARYANA
DEPTH TO WATER LEVEL NILOKHERI, DECADAL MEAN POST MONSOON
Vs
DECADAL MEAN TREND POST MONSOON
(2005-2014)



LEGEND

Decadal Mean Water Level (m.bgl)

- 10.00 to 20.00
- 20.00 to 40.00

Decadal Mean Trend (m)

- -0.20 to -0.10
- -0.10 to 0.00

3203	No. of Recharge Structures in Rural Villages
915	No. of Recharge Structures in Urban Towns
3933	No. of Recharge Pits in Agriculture land
12	Thickness of Sand

Ground Water Scenario of Block

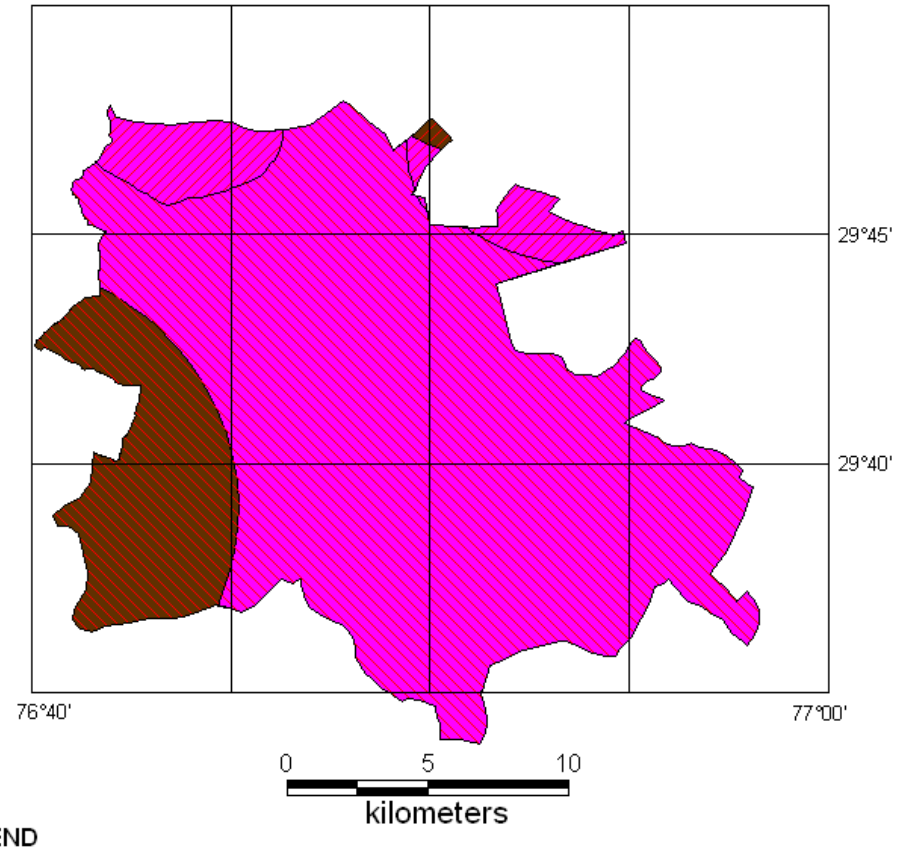
Block Name:- Nilokheri **District :- Karnal** **State :- Haryana**		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*394.91*
	• Number of Villages inhabited • Un-inhabited	*80* *0*
	Ii)Average Annual Rainfall (mm)	*582*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Ganga* *Yamuna*
3.	LAND USE	
	• Current fallows (Sq.Km	0
	• Net Area Sown (Sq.Km)	344.50
	• Area Sown More than Once (Sq.Km)	--
	• Total Irrigated Area (Sq.Km)	344.50
	• Total UnIrrigated Area (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Younger alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Depth to water level	
	• Pre- monsoon: (May 2015)	*16.00-16.00 (mbgl)*
	• Post –monsoon: (Nov2014)	*13.09-29.03 (mbgl)*
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	*6*
	• Depth Range (m)	*64.0-464.08*
	• Discharge (Ipm)	--
	Aquifer Parameters	

	• Transmissivity (m2/day)	*2200*		
	• Storativity	*0.12-1*10^{-3}-4.5*10^{-4}*		
	• Soil infiltration rate mm/ hour	--		
		Min	*Max*	*Avg.*
		--	--	--
7.	GROUND WATER QUALITY	Min	Max	
	• EC in µS/cm at 25^{0}c	--	--	
	• NO3 (mg/l)	--	--	
	• F (mg/l)	--	--	
	• Fe (mg/l)	--	--	
	• As (mg/l)	--	--	
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**		
	• Net Ground Water Availability (MCM)	112.82		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	170.54		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	2.06		
	• Existing Gross Ground Water Draft for all Uses (MCM)	172.60		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	2.06		
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-59.78		
	• Stage of Ground Water Development / Over Draft (%)	153		
	• Category of Block	OE		
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*		
9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *12*	Percentage % 24	

10	Volume of unsaturated zone available for recharge (MCM)	502
11.	Volume of water required for recharge (MCM)	667
12.	Volume of surplus water available for recharge(MCM)	4.84

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	3933	13.77	2.64
14	RWH Rural @ Rs. 25000/-	3203	8.0	0.17
15	RWH Urban@ Rs. 25000/-	915	2.29	0.046
16	Underground pipe line (area in hectares) @ Rs. 50000/-	3131	15.66	4.67
	TOTAL		39.72	7.526

BLOCK-NISSANG DISTRICT-KARNAL STATE-HARYANA
DEPTH TO WATER LEVEL NISSANG, DECADAL MEAN POST MONSOON
Vs
DECADAL MEAN TREND POST MONSOON
(2005-2014)



LEGEND

Decadal Mean Water Level (m.bgl)

- 10.00 to 20.00
- 20.00 to 40.00

Decadal Mean Trend (m)

- -0.20 to -0.10
- -0.10 to 0.00

2984	No. of Recharge Structures in Rural Villages
336	No. of Recharge Structures in Urban Towns
4092	No. of Recharge Pits in Agriculture land
19	Thickness of Sand

Ground Water Scenario of Block

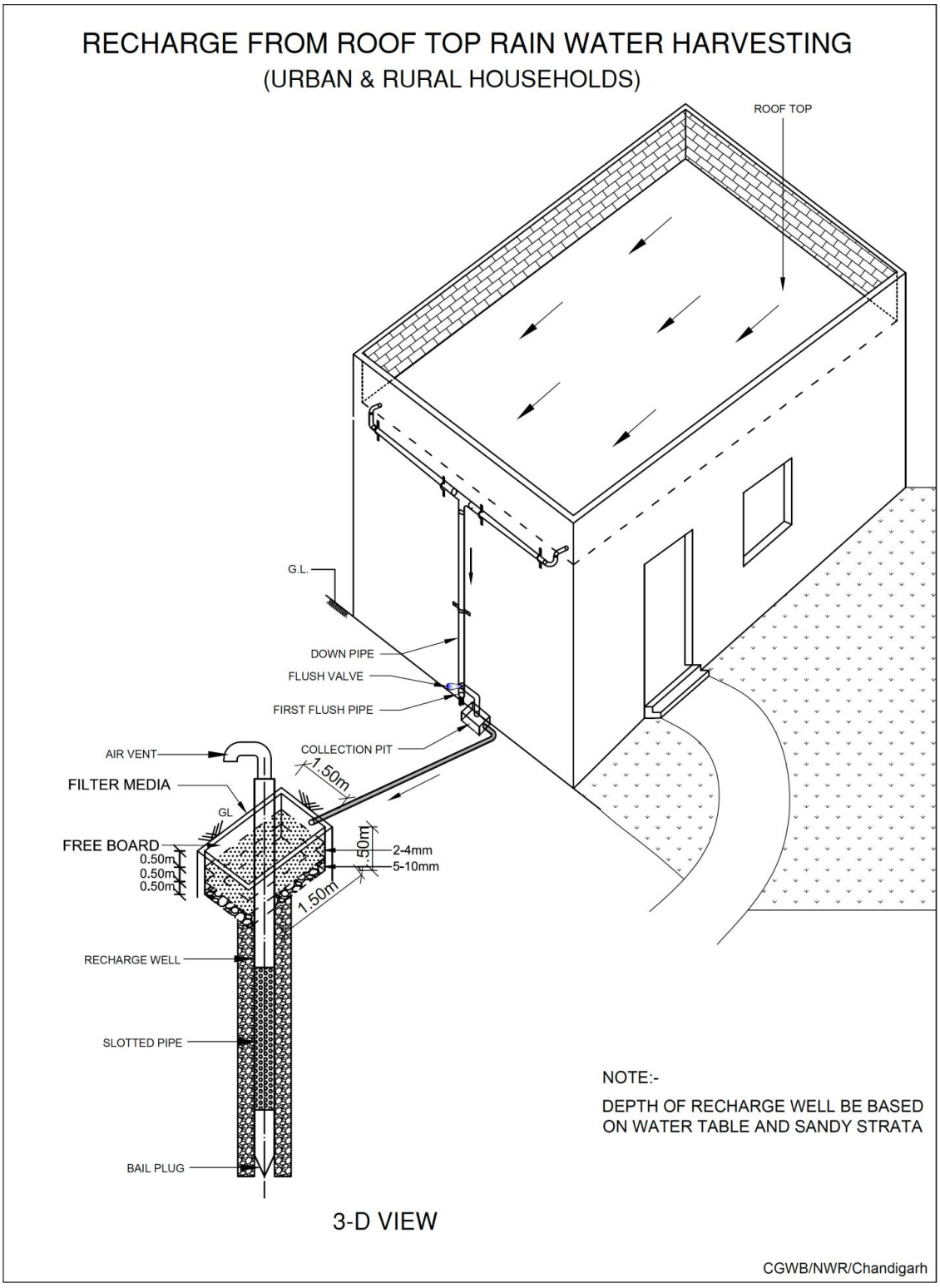
Block Name :- Nissang **District :- Karnal** **State :- Haryana**		
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*416.57*
	• Number of Villages inhabited • Un-inhabited	*49* *0*
	ii)Average Annual Rainfall (mm)	*582*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Ganga* *Yamuna*
3.	LAND USE	
	• Current fallows (Sq.Km	0
	• Net Area Sown (Sq.Km)	365.14
	• Area Sown More than Once (Sq.Km)	--
	• Total Irrigated Area (Sq.Km)	365.14
	• Total UnIrrigated Area (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Younger alluvium*
5.	HYDROGEOLOGY	
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand
	Depth to water level	
	• Pre- monsoon: (May 2015)	*18.52-22.27 (mbgl)*
	• Post –monsoon: (Nov2014)	*20.77-21.81 (mbgl)*
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)	
	• No of wells drilled	*2*
	• Depth Range (m)	*64.0-464.08*
	• Discharge (Ipm)	--
	Aquifer Parameters	
	• Transmissivity (m2/day)	*2200*

	• Storativity	*0.12-1*10^{-3}-4.5*10^{-4}*		
	• Soil infiltration rate mm/ hour	--		
		Min	*Max*	*Avg.*
		--	--	--
7.	GROUND WATER QUALITY	Min	Max	
	• EC in µS/cm at 25^{0}c	*605*	*1495*	
	• NO3 (mg/l)	*8.3*	*19*	
	• F (mg/l)	*0.34*	*0.34*	
	• Fe (mg/l)	*0.22*	*0.4*	
	• As (mg/l)	*0.0029*	*0.0036*	
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**		
	• Net Ground Water Availability (MCM)	140.03		
	• Existing Gross Ground Water Draft for Irrigation (MCM)	241.24		
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	1.48		
	• Existing Gross Ground Water Draft for all Uses (MCM)	242.72		
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	1.48		
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-102.69		
	• Stage of Ground Water Development / Over Draft (%)	173		
	• Category of Block	OE		
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	*Extensive Irrigation*		
9.	Percentage of sand thickness up to 50 m depth (Average)	*Thickness(m)* *19*	Percentage % 38	
10	Volume of unsaturated zone available for recharge (MCM)	529		
11.	Volume of water required for recharge (MCM)	704		

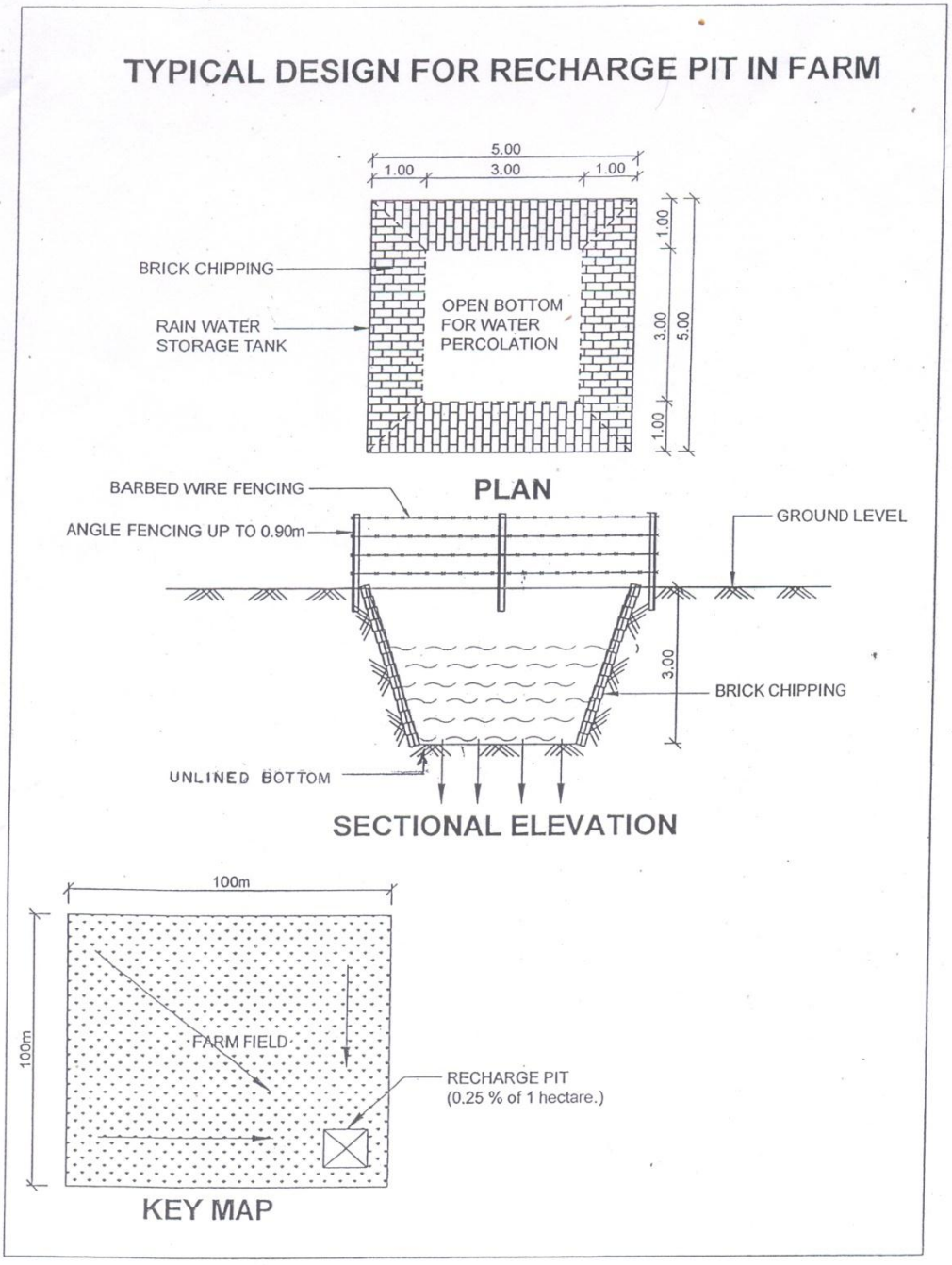
12.	Volume of surplus water available for recharge(MCM)	5.1

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	4092	14.32	2.75
14	RWH Rural @ Rs. 25000/-	2982	7.46	0.16
15	RWH Urban@ Rs. 25000/-	336	0.84	0.013
16	Underground pipe line (area in hectares) @ Rs. 50000/-	2946	14.73	6.60
	TOTAL		37.35	9.523

Annexure I


RECHARGE FROM ROOF TOP RAIN WATER HARVESTING
(URBAN & RURAL HOUSEHOLDS)
ROOF TOP
G.L.
DOWN PIPE
FLUSH VALVE
FIRST FLUSH PIPE
COLLECTION PIT
AIR VENT
FILTER MEDIA
GL
FREE BOARD
0.50m
0.50m
0.50m
1.50m
1.50m
2-4mm
5-10mm
RECHARGE WELL
SLOTTED PIPE
BAIL PLUG
NOTE:-
DEPTH OF RECHARGE WELL BE BASED ON WATER TABLE AND SANDY STRATA
3-D VIEW
CGWB/NWR/Chandigarh

Annexure II


TYPICAL DESIGN FOR RECHARGE PIT IN FARM
5.00
1.00
3.00
1.00
BRICK CHIPPING
RAIN WATER
STORAGE TANK
OPEN BOTTOM
FOR WATER
PERCOLATION
1.00
3.00
5.00
1.00
PLAN
BARBED WIRE FENCING
ANGLE FENCING UP TO 0.90m
GROUND LEVEL
3.00
BRICK CHIPPING
UNLINED BOTTOM
SECTIONAL ELEVATION
100m
100m
FARM FIELD
RECHARGE PIT
(0.25 % of 1 hectare.)
KEY MAP