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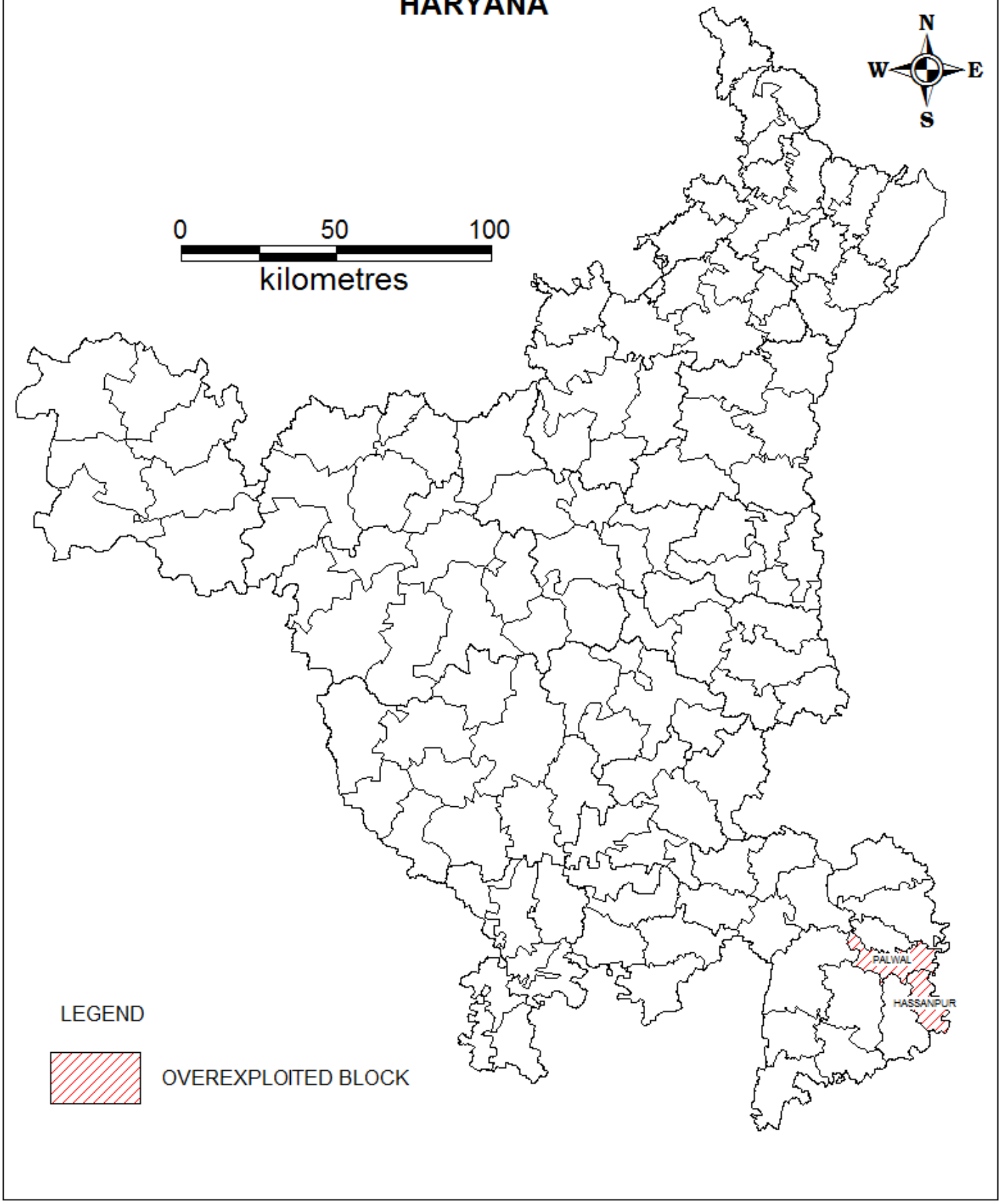
Government of India
Ministry of Water Resources,
River Development & Ganga Rejuvenation
Central Ground Water Board

PLAN ON

ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION IN OVEREXPLOITED BLOCKS OF PALWAL DISTRICT, HARYANA

Central Ground Water Board
North Western Region
Chandigarh

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



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

INTRODUCTION

Administratively, the district is divided into 3 sub-divisions/tehsils namely Palwal, Hodal and Hathin. Further, the district has been sub-divided into five development blocks i.e. Palwal, Hodal, Hathin, Hassanpur and Prithla. Palwal district has 6 towns and 280 villages with a total population of 10,40,493 as per 2011 census.

HYDROMETEOROLOGY

The climate of the district can be classified as tropical steppe, semiarid and hot which is mainly characterized by the extreme dryness of the Air except during monsoon months. The normal annual rainfall is about 542 mm which is spread over 27 rainy days. 85% of rainfall occurs during south-west monsoon.

GEOMORPHOLOGY

Soils of Palwal district are classified as tropical and brown soils, existing in major parts of the district. In Hathin block the organic content of soils ranging from 0.41 to 0.75 percent which is of medium category. In rest of the area organic contents is 0.2 to 0.4 percent and falls in Low category. The average conductivity of the soil is not more than 0.80 µmhos /cm and the average pH of the soil is between 6.5 and 8.7. The area comprises almost flat plains traversed by one ridge running N-S to NNE-SSW direction, divides the alluvium into two parts. The major river is Yamuna which is a perennial river.

HYDROGEOLOGY

The district is occupied by Indo-Gangetic alluvial plain of Quaternary age, and falls in Yamuna sub -basin of Ganga basin. The Central Ground Water Board has drilled 21 exploratory boreholes to delineate and determine potential aquifer zones, evaluation of aquifer characteristics. Out of 21 exploratory boreholes 13 boreholes were abandoned due to poor quality of ground water. The permeable granular zones comprising fine to medium grained sand and occasionally coarse sand and gravel. Their lateral and as well as vertical extent is

limited. The borehole data reveals that clay group of formations dominate over the sand group in the district area. Ground water occurs in alluvium and the underlying weathered/fractured quartzites. Alluvium comprises sands silt, Kankar and gravel. Which form the principal ground water bearing horizon. In Quartzite formation, occupying the north- western part of the district, ground water occurs in weathered and jointed fractured horizons. Weathering and fracturing has resulted in formation of semi-consolidated sand bads (BADARPUR SANDS) which form potential aquifer zones. This quartzite formation has not been explored for ground water occurrence. In alluvium, granular zones are evenly distributed in entire thickness which is negligible near the quartzite outcrops to over 350 m in the eastern parts near Yamuna River. The discharge of the wells ranges from 750 lpm to 900 lpm at a drawdown of5.5 to 7.00m. The transmissivity 'T' value ranges between 55 to 200 m^2 /day was determined. Shallow tube wells for irrigation use are generally constructed upto a depth of 40 m. The discharge of these shallow tubewells ranges are 360 -600 litres per minutes.

The depth to water level ranges from 2.00 m bgl to 10.75 m bgl during pre monsoon period, and 2 to 9.40 m. bgl during post monsoon period. The water level trend during pre monsoon period indicates average fall of 0.20m/year. The long term water level trend is show small decline and other places rise in district.

GROUND WATER QUALITY:

The shallow ground water of the district is alkaline in nature (pH 7.75 to 8.62) and is moderately to highly saline (EC 693 to 3600 mS/cm). Among anions, bicarbonate predominates at some places, whereas at other places either none of the anion dominates or chloride is dominant. Among cations, by and large, sodium is the dominant cation. At some places mixed cationic character has been observed. Comparing the concentration values of major ions with the recommended desirable and permissible concentration limits for drinking waters (Bureau of Indian Standards) It is found that more than half (75%) of the ground waters are not suitable for drinking purposes mainly due to fluoride

content that exceeds the maximum permissible limit of 1.5mg/1.

Salinity (EC), Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the parameters for ascertaining the suitability of ground water for irrigational uses. These parameters range from 693 to 3590 micromhos/cm at 25^0 C, 2.19 to 15.79 and -14.52 to 13.97 milli equivalents respectively. These waters are not suitable for customary irrigation as they may cause salinity and sodium hazards. It would be better if such waters are used for semi-salt tolerant to salt tolerant to salt tolerant crops along with appropriate amount of gypsum on well drained soils.

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 97%. The ground water development in two blocks (Hassanpur, Palwal) of the district has exceeded the available recharge and thus these two blocks have been categorized as "over exploited". Net ground water availability in this two blocks of the district is 254.42 million cubic meter (mcm), ground water draft for all users is 287.59 mcm, whereas net ground water availability for future irrigation development is -33.17 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.

Number of Irrigation tube wells with water distribution System

	Open Water Channel			
Sr.No	**District**	**Lined/pucca**	**Unlined/kutcha**	**Total**
1	**Faridabad and Palwal**	16381	2035	18416

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 x5mt x3mt 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 and 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.

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 Crores	Annual Recharge (MCM)
ROOF TOP RAIN WATER HARVESTING IN RURAL AND URBAN AREAS					
1	Artificial Recharge Plan For Urban Areas.	3051	0.25	763	0.209
2	Roof Top Rain Water Harvesting in Rural Areas	5173	0.25	1293	0.299
	Total	8224	0.25	2056	0.508
ARTIFICIAL RECHARGE IN FARMS					
3	Artificial Recharge Plan Through Recharge Pits.	2759	0.35	966	1.822
			Grand Total	3022	2.33

A-1 ARTIFICIAL RECHARGE PLAN FOR URBAN AREAS OF PALWAL DISTRICT							
Block	**Town Name**	**Total Households**	**Total Population of Town**	**Households taken for AR 10%**	**Total Roof Top Area (200 sqm) in cluster of 4-6 houses**	**Cost of recharge at @0.25 lacs (Crores)**	**Volume of water available for recharge (MCM)**
1	**3**	**2**	**3**	**4**	**5**	**6**	**7**
PALWAL	Palwal (M Cl + OG)	**23742**	**131926**	**2374**	**474840**	**5.94**	**0.161**
PALWAL	Baghola (44) (CT)	**931**	**5413**	**93**	**18620**	**0.23**	**0.006**
PALWAL	Palwal (Rural) (Part) (73) (CT)	**3982**	**23072**	**398**	**79640**	**1.00**	**0.027**
HASSANPUR	Hassan Pur (MC)	**1850**	**11569**	**185**	**37000**	**0.46**	**0.014**
		30505	**171980**	**3050**	**610100**	**7.63**	**0.209**

A-2 ROOFROP RAINWATER HARVESTING IN RURAL AREAS OF PALWAL DISTRICT								
Name of District	**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 each house)**	**Total recharge in MCM**	**Cost of Pit (crores) @Rs.0.25 lakh**
PALWAL	**1**	**Hassanpur**	**19847**	**7848**	**785**	**785**	**0.045**	**1.96**
	2	**Palwal**	**46196**	**43883**	**4388**	**4388**	**0.254**	**10.97**
		TOTAL	**66043**	**51731**	**5173**	**5173**	**0.299**	**12.93**

A3. ARTIFICIAL RCEHARGE PLAN THROUGH RECHARGE PITS IN OVER EXPLOITED BLOCKS OF PALWAL DISTRICT

Block Name	Total area of the village (in hectares rounded up to one decimal place)	5%of village area taken for farm recharge (sq.m)	Total number of recharge pits (1 recharge pit / hector) for 5% area	Annual recharge (MCM)= (Area*Runoff 15%*Rainfall in m/1000000)	Cost of Pit (crores) @Rs.0.35 lakh
Hassanpur	15183	7591500	759	0.550	2.66
Palwal	40000	20000000	2000	1.272	7.00
Total	**55183**	**27591500**	**2759**	**1.822**	**9.66**

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/ Cavity well (where top three meters is clay)

Total number of recharge pits (1 recharge pit / hector) for 5% area

QUANTITATIVE IMPACT

Sr. No	Total Draft (present) (mcm)	Overdraft (mcm)	Additional Recharge through proposed structures (mcm)	Draft Reduced due to Recharge (mcm)	Stage of development (present)	Stage of development after recharge	Reduction in stage of development after recharge
1	**287.59**	**-33.54**	**2.33**	**285.26**	**116.5%**	**112.12%**	**4.38%**

By the implementation of the proposed recharge structures there will be a reduction of 4.38% in stage of ground water development as tabulated below

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

QUANTITATIVE REDUCTION IN OVERDRAFT AFTER ENHANCING GROUND WATER USE EFFICIENCY IN WATER DISTRIBUTION SYSTEM

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)	Percentage of unlined channel	Wastage through unlined channel, (mcm) (Col 3 X Col5 X 0.25[#])/100	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 ((Col8/Col1) X100) (%)	Reduction in stage of development after constructing pucca canal (Col9-Col10) (%)
1	2	3	4	5	6	7	8	9	10	11
254.42	287.59	282.33	5.26	11.05	7.80	274.53	279.79	116.5 %	109.97%	6.53

#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 (ha)	Total cost @Rs.0.50 lack per hector(in cr) =Total irrigated area (by ground water scheme) of the block (Col5*0.5)	Total Cost in Rs. Cr. District wise
1	2	3	4	5	6	7
Palwal	Hassanpur	15141	11.05	1673	8.37	
	Palwal	46816	11.05	5173	25.87	34.23

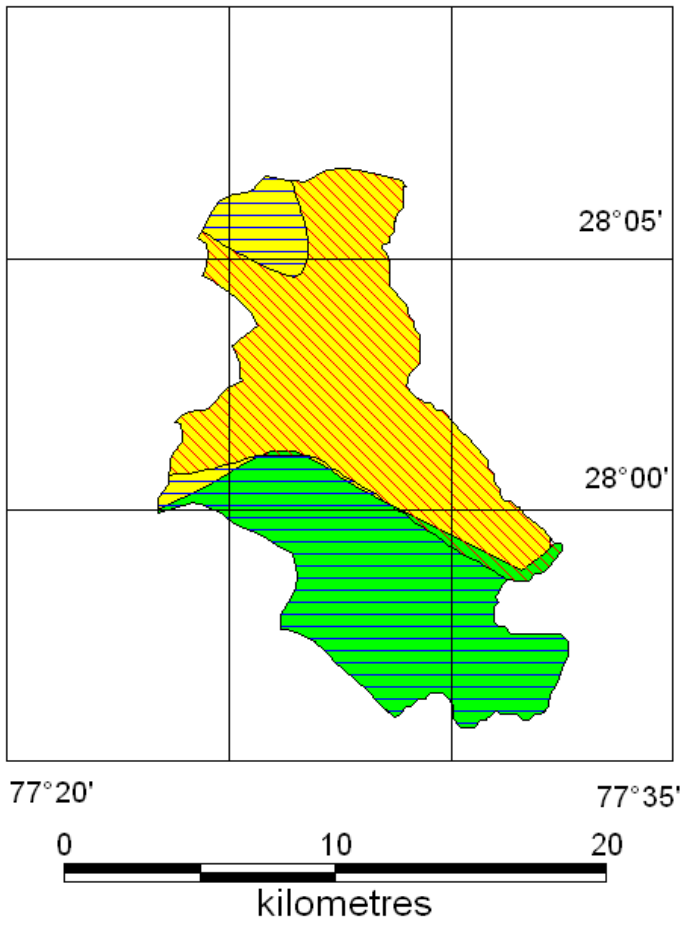
BLOCK WISE PLAN OF

DISTRICT PALWAL,

HARYANA

(2 BLOCKS)

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



LEGEND

Decadal Mean Water Level (m.bgl)

- 0.00 to 5.00
- 5.00 to 10.00

Decadal Mean Trend (m)

- -0.10 to 0.00
- 0.00 to 0.1114

785	No. of Recharge Structures in Rural Villages
185	No. of Recharge Structures in Urban Towns
759	No. of Recharge Pits in Agriculture land
18.5	Thickness of Sand

Ground Water Scenario of Block

Block Name:- Hassanpur **District :- Palwal** **State :- Haryana**		
1.	**GENERAL INFORMATION**	
`	**Geographical area (sq km)**	**202.04**
	Number of Villages inhabited **Un-inhabited**	**33** **0**
	Average Annual Rainfall (mm)	**596**
2.	**GEOMORPHOLOGY**	
	Major Physiographic	**Alluvium Plain**
	Major drainages **Basin** **Sub-Basin**	 **Ganga** **Yamuna**
3.	**LAND USE**	
	Current fallows (Sq.Km	**35**
	Net Area Sown (Sq.Km)	**161.92**
	Area Sown More than Once (Sq.Km)	**----**
	Total Irrigated Area (Sq.Km)	**161.92**
	Total UnIrrigated Area (Sq.Km)	**12.81**
4.	**PREDOMINAT GEOLOGICAL FORMATIONS**	**Younger alluvium**
5.	**HYDROGEOLOGY**	
	Major Water bearing Formation (Aquifer)	**Fine to coarse Sand**
	Avg. Depth to water level (decadal)	
	Pre- monsoon: (May 2015)	**2.02 to 17.52 (mbgl)**
	Post –monsoon: (Nov2014)	**1.53 to 17.95(mbgl)**

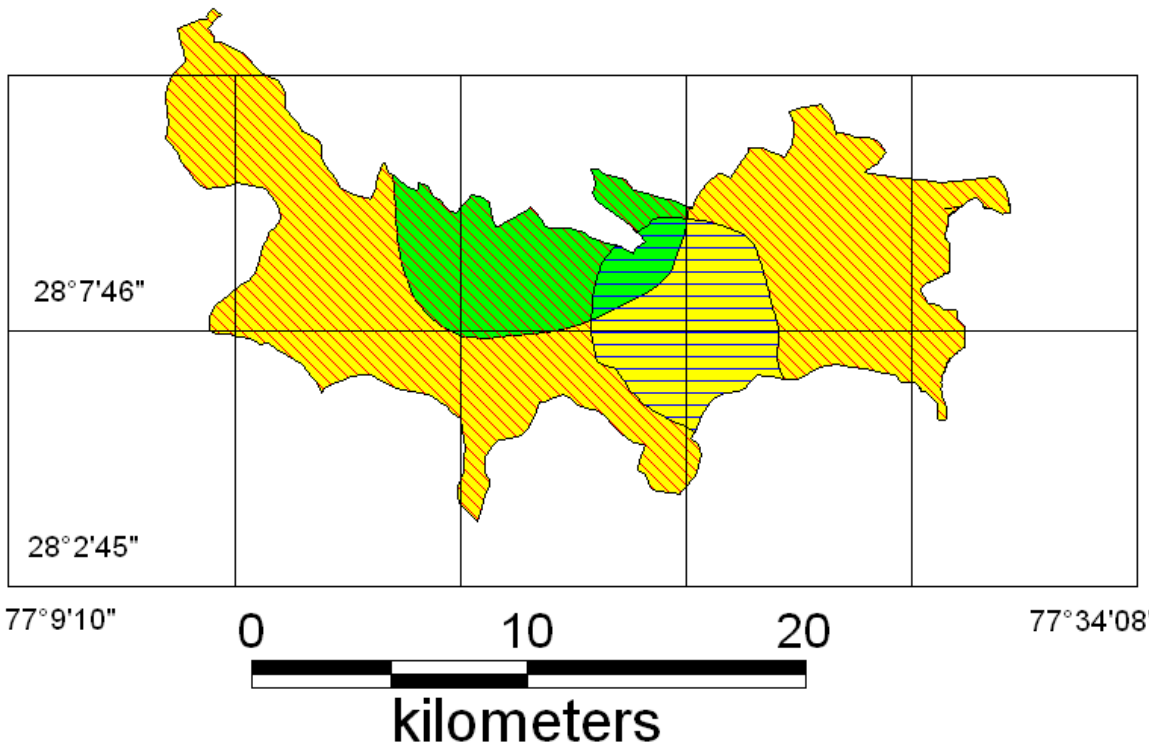
6.	**GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)**			
	No of wells drilled	**4**		
	Depth Range (m)	**174.4**		
	Discharge (Ipm)	**----------**		
	Aquifer Parameters			
	Transmissivity (m2/day)	**----------**		
	Storativity	**------**		
	Soil infiltration rate mm/ hour	**--**		
		Min	**Max**	**Avg.**
		--	**--**	**--**
7.	**GROUND WATER QUALITY**	**Min**	**Max**	
	EC in µS/cm at 25^0c	**---**	**3288**	
	NO3 (mg/l)	**---**	**104**	
	F (mg/l)	**---**	**0.17**	
	Fe (mg/l)	**---**	**0.12**	
	As (mg/l)	**---**	**0.0028**	
8.	**DYANMIC GROUND WATER RESOURCES in MCM**	**2011**		
	Net Ground Water Availability (MCM)	76.93		
	Existing Gross Ground Water Draft for Irrigation (MCM)	95.39		
	Existing Gross Ground Water Draft for Domestic and Industrial Water	1.81		

	Supply (MCM)		
	Existing Gross Ground Water Draft for all Uses (MCM)	97.20	
	Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	1.81	
	Net Ground Water Availability for Future Irrigation Development (MCM)	-20.27	
	Stage of Ground Water Development / Over Draft (%)	126	
	Category of Block	OE	
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	**Extensive Irrigation**	**Extensive Irrigation**
9.	**Percentage of sand thickness up to 50 m depth (Average)**	**Thickness(m) 18.50**	**Percentage % 37**
10	**Volume of unsaturated zone available for recharge (MCM)**	**98**	
11.	**Volume of water required for recharge (MCM)**	**131**	
12.	**Volume of surplus water available for recharge(MCM)**	**2.71**	

RECHARGE/ CONSERVATION STRUCTURES	**Total Number of Recharge Structures**	**Total Cost (Rs. in crores)**	**Total Recharge/ Water saving in MCM**

13	**Farm Recharge @Rs. 35000/-**	**759**	**3.80**	**0.55**
14	**RWH Rural @ Rs. 25000/-**	**785**	**3.93**	**0.045**
15	**RWH Urban@ Rs. 25000/-**	**185**	**0.73**	**0.014**
16	**Underground pipe line (area in hectares) @ Rs. 50000/-**	**1673**	**8.37**	**2.64**
TOTAL			**16.83**	**3.25**

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



LEGEND

Decadal Mean Water Level (m.bgl)

- 0.00 to 5.00
- 5.00 to 10.00

Decadal Mean Trend (m)

- -0.10 to 0.00
- 0.00 to 0.1114

- 4388 No. of Recharge Structures in Rural Villages
- 2865 No. of Recharge Structures in Urban Towns
- 2000 No. of Recharge Pits in Agriculture land
- 17 Thickness of Sand

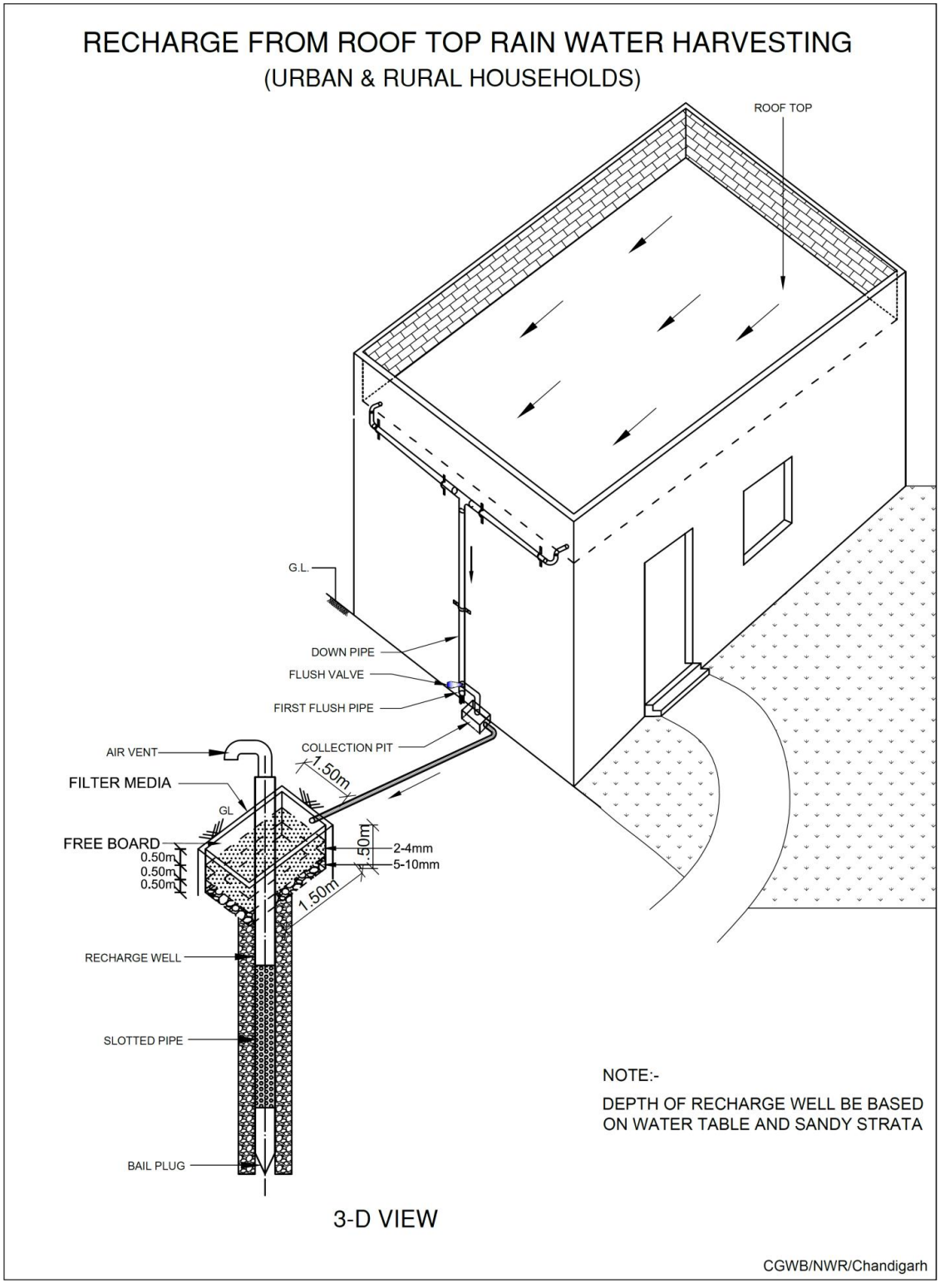
Ground Water Scenario of Block

Block Name:- Palwal **District :- Palwal** **State :- Haryana**		
1. **`**	**GENERAL INFORMATION**	
	Geographical area (sq km)	**498.56**
	Number of Villages inhabited **Un-inhabited**	**122** **0**
	Average Annual Rainfall (mm)	**596**
2.	**GEOMORPHOLOGY**	
	Major Physiographic	**Alluvium Plain**
	Major drainages **Basin** **Sub-Basin**	 **Ganga** **Yamuna**
3.	**LAND USE**	
	Current fallows (Sq.Km	**10**
	Net Area Sown (Sq.Km)	**396.83**
	Area Sown More than Once (Sq.Km)	**----**
	Total Irrigated Area (Sq.Km)	**396.21**
	Total UnIrrigated Area (Sq.Km)	**62**
4.	**PREDOMINAT GEOLOGICAL FORMATIONS**	**Younger alluvium**
5.	**HYDROGEOLOGY**	
	Major Water bearing Formation (Aquifer)	**Fine to coarse Sand**
	Avg. Depth to water level (decadal)	

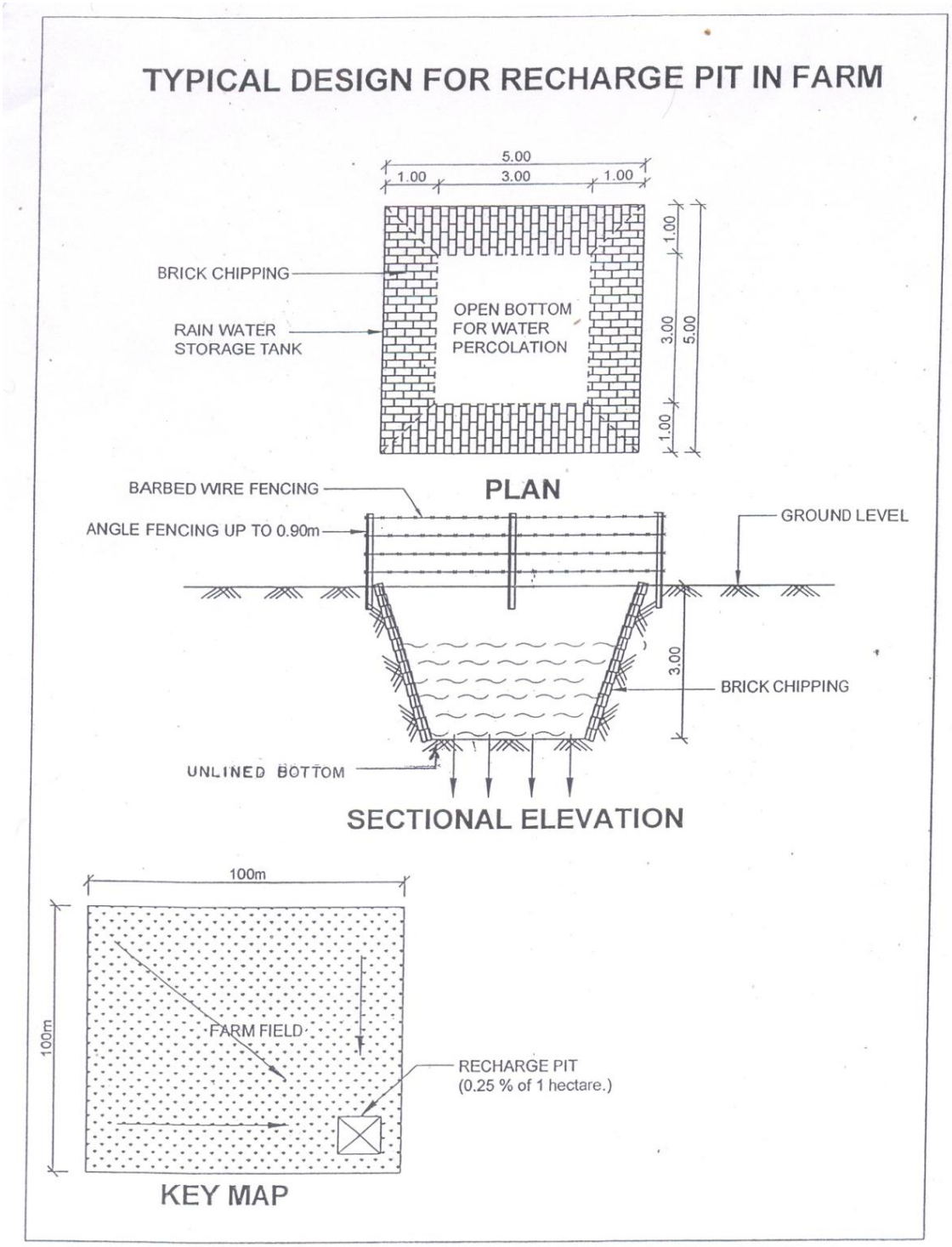
	Pre- monsoon: (May 2015)	2.02 to 17.52(mbgl)		
	Post –monsoon: (Nov2014)	1.53 to 17.95(mbgl)		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)			
	No of wells drilled	11		
	Depth Range (m)	250.03 to 355.56		
	Discharge (Ipm)	1500 to 2300		
	Aquifer Parameters			
	Transmissivity (m2/day)	878 to 3786		
	Storativity	1.73×10^{-5} to 2.22×10^{-5}		
	Soil infiltration rate mm/ hour	--		
		Min	Max	Avg.
		--	--	--
7.	GROUND WATER QUALITY	Min	Max	
	EC in µS/cm at 25^0c	2449	3870	
	NO3 (mg/l)	12.37	240	
	F (mg/l)	1.05	3.25	
	Fe (mg/l)	0	0.27	
	As (mg/l)	0.0036	0.0049	
8.	DYANMIC GROUND WATER RESOURCES in MCM	2011		
	Net Ground Water Availability (MCM)	177.49		
	Existing Gross Ground Water	186.94		

	Draft for Irrigation (MCM)			
	Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	3.45		
	Existing Gross Ground Water Draft for all Uses (MCM)	190.39		
	Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	3.45		
	Net Ground Water Availability for Future Irrigation Development (MCM)	-12.90		
	Stage of Ground Water Development / Over Draft (%)	107		
	Category of Block	OE		
	Any specific reasons for high stress on ground water leading to Overexploitation and decline in ground water level	Extensive Irrigation		Extensive Irrigation
9.	Percentage of sand thickness up to 50 m depth (Average)	Thickness(m) 17		Percentage % 34
10	Volume of unsaturated zone available for recharge (MCM)	242		
11.	Volume of water required for recharge (MCM)	322		
12.	Volume of surplus water available for recharge(MCM)	6.7		
		Total Number of Recharge	Total Cost (Rs. in	Total

RECHARGE/ CONSERVATION STRUCTURES		Structures	crores)	Recharge/ Water saving in MCM
13	Farm Recharge @Rs. 35000/-	2000	10.00	1.272
14	RWH Rural @ Rs. 25000/-	4388	21.94	0.254
15	RWH Urban@ Rs. 25000/-	2865	14.33	0.194
16	Underground pipe line (area in hectares) @ Rs. 50000/-	5173	25.87	5.16
TOTAL			72.14	6.88


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
1.50m
FILTER MEDIA
GL
FREE BOARD
0.50m
0.50m
0.50m
.50m
2-4mm
5-10mm
1.50m
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
1.00
3.00
5.00
1.00
BRICK CHIPPING
RAIN WATER STORAGE TANK
OPEN BOTTOM FOR WATER PERCOLATION
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