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

PLAN ON

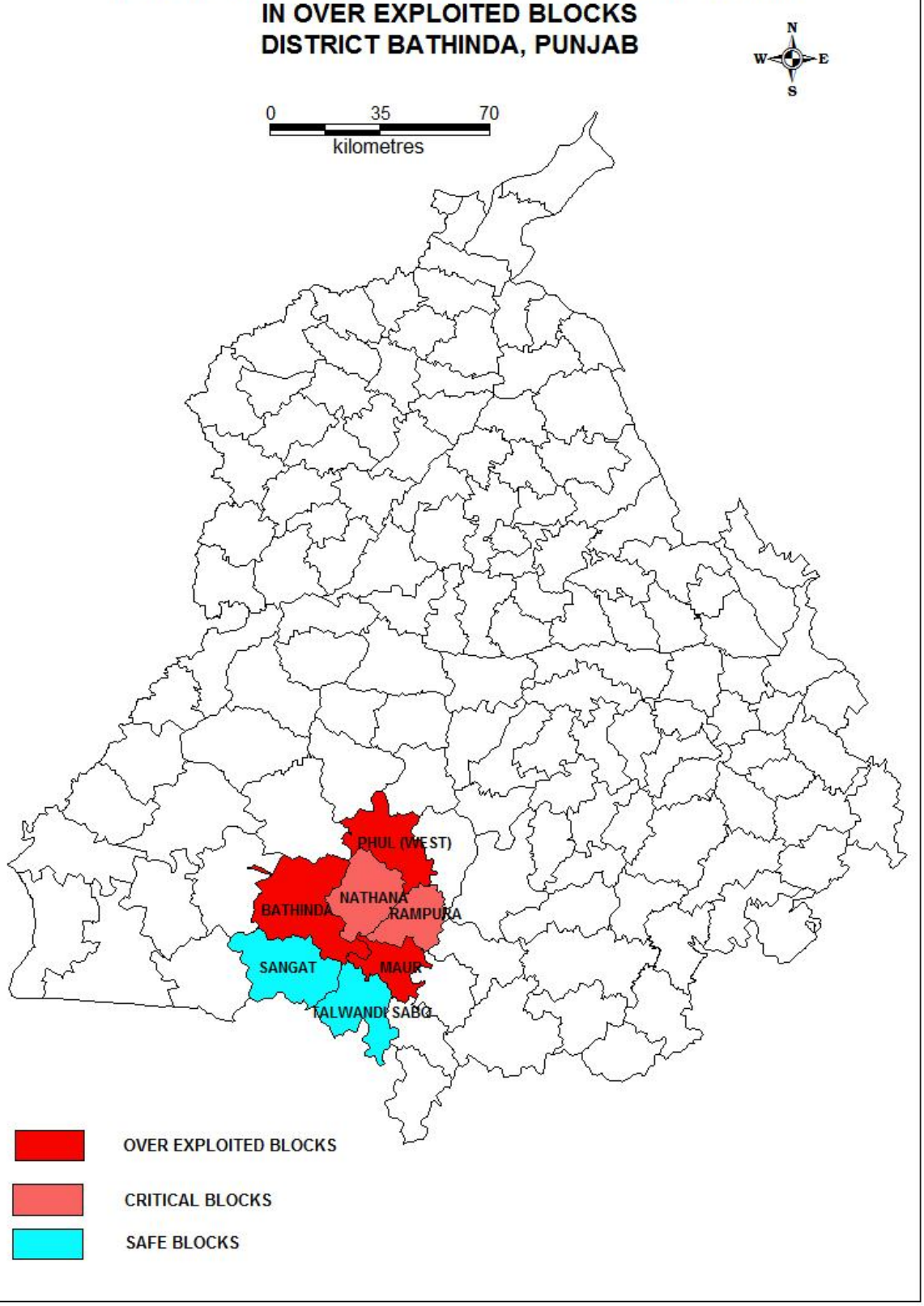
ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION

IN

OVEREXPLOITED BLOCKS OF BATHINDA DISTRICT, PUNJAB

Central Ground Water Board
North Western Region
Chandigarh

PLAN OF ARTIFICIAL RECHARGE TO GROUND WATER IN OVER EXPLOITED BLOCKS DISTRICT BATHINDA, PUNJAB



PLAN OF ARTFICIAL RECHARGE TO GROUND WATER IN OVER EXPLOITED BLOCKS, DISTRICT BARNALA PUNJAB

INTRODUCTION

Bathinda district is situated in the southern part of Punjab State. It lies between 29^{o} $33^{'}$ and 30^{o} $36^{'}$ North latitude and 74^{o} $38^{'}$ and 75^{o} $46^{'}$ East longitude. . It falls in Survey of India Topo sheets No. 44J, 44K, 44N, and 44O It covers an area of 3367 Sq. Km. The district is surrounded by Sirsa and Fatehabad district of Haryana State in the south, Sangrur and Mansa districts in the East, Moga in the North-East and Faridkot and Muktsar districts in North-West. The Bathinda district has 3 Sub-Divisions, Bathinda, Rampura phool, Talwandi sabo. It has Seven blocks named Bathinda, Nathana, Rampura, Phool, Talwandi sabo, Sangat, Maur. The district has a good network of canals for irrigation and domestic purposes. The main canals in the area which feed the various distributaries and minor canals are the Bathinda branch and Kotla branch canal originated from Sirhind canal

RAINFALL & CLIMATE

The district lies in the South-western region of the State and in far away from the Shivalik ranges in the North of the state. It is the nearest to the Thar Desert of Rajasthan and also far away from the Major rivers lines that run through the state. Therefore, climatically, the district has a very hot in summer and frequently scorching heat is in full swing. The climate of Bathinda district can be classified as tropical steppee, semi arid and hot which is mainly dry except in rainy months and characterised by intensely hot summer and cold winter. The normal annual rainfall of Bhatinda District is 408 mm in 20 days which is unevenly distributed over the district. The southwest monsoon sets in last week of June and withdrawn towards end of September and contributes about 82% of annual rainfall. July and August are the rainiest months. Rest 18% of the annual rainfall occurs during non of the year in the form of thunder storm and western disturbances. Rainfall in the district increases from southwest to northeast.

GEOMORPHOLOGY AND SOIL TYPES

The district area is occupied by Indo-Gangetic alluvium. There is no surface features worth to mention. The maximum elevation of the area is 220.6 m. amsl. and the minimum elevation is 197.5 m.amsl. The master slope of the area is towards Southwest. The Southern part contains isolated sand dunes of various dimensions. The soil in the district is mostly sandy. Being sandy Plain region is dotted with scattered sand dunes which have a tendency to shift towards eastern side. But with the development of latest Technology and machinery the topography is under vast change with respect to various aspects connected with green revolution. The district has two types of soils, the arid brown soils and siezoram soils. The arid

brown soils are calcareous in nature, these soils are imperfectly to moderately drained. Salinity and alkalinity are the principal problems of this soil. In siezoram soils the accumulation of calcium carbonate is in amorphous or concretionary form (kankar). Presence of high amount of calcium carbonate and poor fertility is the main problem of this soil. The arid brown soils are found in mostly eastern parts of the district and siezoram soils are found in the western part of the district.

Hydrogeology

The district is occupied by Indo-Gangetic alluvial plain of Quaternary age. The Central Ground Water Board has drilled 5 exploratory borehole to delineate and determine potential aquifer zones, evaluation of aquifer characteristics etc. The area has both unconfined and confined aquifers. In alluvium thin granular zones exist down to a depth of 450m. The top aquifer ranges from 40 to 56 m. The depth of the top aquifer in the North is upto 56 m, in the south it is upto 58 m, in the East it is 38 m. and in the west it is 40 m. The top granular zone is interspersed by 2 to 3 thin clay lenses. A thick clay bed of thickness from 15 to 35 m. present beneath the granular zone. The granular zones are more in comparision to the clay beds in the Central and Northern parts of the district. And clay beds are more dominant than the granular zones in the South and western parts of the district. The fresh water granular zones exist upto 300 m in the North, upto 200 m in the Central and upto 50 m. in the Southwestern parts of the district. The exploratory wells at Khaliwale and Gulabgarh were tested at discharge of 1006 and 1500 lpm. The transmissivity values were low in the order of 1300 and 2724 m2/day respectively. The hydraulic conductivity value varies from 1.6 to 19.17m/day. The value of storage coefficient was computed as 2.6×10^{-2}.

During the Premonsoon the depth to water level in the district varies from 20.39 m bgl (western and southern part) to 16.50 m.bgl (Northern part). It is shallow and around 4 m in the west and southern parts and water level are deep above 12 m in Northern parts of the district. In the south and western part of the district, the water levels range from 6 to 12 m. and gradually increase towards North where the water level ranges from 14 to 1 m. The shallowest water level recorded was 3.43 m.bgl at Raike Kalan in Bathinda block and the deepest water level recorded was 20.39 at Dialpural in Bagtha Baika block. During the Post-monsoon, the depth to water level is in the same pattern as in pre-monsoon. The water level varies from 2.24 to 20.76 m.bgl. Seasonal fluctuation of the water level varies from –0.03 to 2.5 m. Water level rise of above 1 m. occurs in a small area. Remaining area shows either constant or decline in water level. Maximum water level decline is seen at Phulla, Dialpura and Dialpur mirza sites located in the North central part of the district.

The long-term (10 years) water level trend during premonsoon period indicates that maximum decline is seen in the northern part of the district, at Dialpur mirza and Dhapali the

decline is of around 0.30 to 0.77 m/yr. In the southern part of the district Jajjal and Bagi bander are showing a maximum rise in water level around 0.05 to 0.13 m/yr. In the western part of the district. Kalla Bander and Rai ke kalan are showing the maximum rise in the range of 0.0.87 to 4.30m. In general, a rise in water level is seen in the southern part of the district and decline in water level is seen in the Northern part of the district

The elevation of the water table in the district ranges between 189.14 to 209.25 m amsl. The general slope of the water table is towards SW from North, NE, East and SE. The hydraulic Gradient is gentle being of the order of 0.18 m/km in the NE – SW direction with the slope towards SW. In the SE – NW direction the hydraulic Gradient is 0.22 m/km with the slope towards NW.

Ground Water Resources

The block wise ground water resource potential in the district has been assessed as per GEC-97. The stage of ground water development ranges between 67% (block-Sangat) to 255% (block- Phul). The net annual ground water availability in Bathinda district is 101681 Ham out of this 4500 Ham has been kept reserved for domestic and industrial purposes upto 2025 years. The present net ground water draft in the district is 121452 Ham. The average level of ground water development in the district is 119% and falls in Over Exploited category.

Ground Water Quality

The ground water of the district is alkaline in nature with pH values ranging from 7.54 (Dhapoli) to 8.0 (Dera Tappa). Well waters in the area are generally medium to highly saline. However, pockets of fresh water are also found. EC of waters show wide variations, it ranges from 288 μS/cm at Dhapoli Tappa to 3490 μS/cm at 25°C at Ghuda . The ground water is moderately hard in nature with total hardness expressed as $CaCO_3$ ranging from 40 to 1451 mg/l. Among cations, the concentration of calcium ranges from 11 mg/l at Rampur Phulla to 216 mg/l at Raike Kalan whereas magnesium concentration ranges between 3.8 mg/l at Rampur Phulla and 228 mg/l at Ghuda. Calcium content is within the permissible limit of 200 mg/l (BIS). Likewise, magnesium, in most of the waters, is below 100mg/l. Sodium concentration varies widely from 12 mg/l at Dera Tappa to 570 mg/l at Bhagi Bhandar, whereas potassium concentration ranges from 3.2 mg/l at Dhapali to 325 mg/l at Dial purmirza. In majority of the samples, the potassium content is less than 100 mg/l.

Among cations, sodium is the predominant cation in 62% of waters; Ca+Mg in 28% and no single cation is dominant in 10% of ground waters in the area. Among anions, HCO_3 is the predominant anion in 76% of water samples and in the remaining 24% samples mixed anionic character is observed. Occurrence of Na - HCO_3 type in 48% wells show that at some places,

the ground waters have under gone cation exchange phenomenon while wells having Na-HCO_3 + Cl type water indicates that the process of base exchange is still going on.

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

Distribution of Shallow Tubewells According to Owner's holding Size

No. of shallow tube wells by size class of individual owner							
Sr.no	district	Marginal (0-1 ha)	Small (1-2 ha)	Semi-Medium (2-4 ha)	Medium (4-10ha)	Big (>=10 ha)	Total
1	**Bathinda**	**757**	**5504**	**14796**	**17364**	**2798**	**41219**

Distribution of Deep Tubewells According to Owner's Holding Size

No. of deep tube wells by size class of individual owner							
Sr.no	district	Marginal (0-1 ha)	Small (1-2 ha)	Semi-Medium (2-4 ha)	Medium (4-10ha)	Big (>=10 ha)	Total
1	**Bathinda**	**93**	**1125**	**2380**	**1595**	**360**	**5553**

Distribution of Shallow Tubewells According to Depth of tube well

No. by the depth of shallow Tube well							
Sr.no	district	(0-20 mts)	(20-40 mts)	(40-60 mts)	(60-70 mts)	(>70 mts)	Total
1	**Bathinda**	**39679**	**909**	**493**	**138**	**0**	**41219**

Number of Ground Water Schemes and Potential Utilized by water distribution device

Ground Water Schemes according to water Distribution System				
	Open Water Channel			
Sr.no	**District**	**Lined/Pucca**	**Unlined/kutcha**	**Under-ground pipe**
1	**Bathinda**	**19383**	**15647**	**116**

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.

Sr.no.	Type of Structure	No. of structures	Unit cost in Lakhs	Total cost of structure in Lakhs	Annual Recharge (MCM)
ROOF TOP RAIN WATER HARVESTING IN RURAL AND URBEN AREAS					
1	**Artificial Recharge Plan For Urban Areas.**	**4465**	0.25	**11.162**	**0.272**
2	**Roof Top Rain Water Harvesting in Rural Areas**	**7940**	0.25	**19.850**	**2.994**
	Total	12405	**0.25**	**31.012**	**3.266**
ARTIFICIAL RECHARGE IN FARMS					
1	**Artificial Recharge Plan Through Recharge Pits.**	**11990**	0.35	41.965	6.765
			Total	**41.965**	**6.765**

By the implementation of the proposed recharge structures there will be a reduction of 0.54% in stage of ground water development as tabulated below

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	**1214.52**	**-212.66**	**10.031**	**1204.489**	**119%**	**118.46 %**	**0.54 %**

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

Block Name	**Total area of the village (in hectares)**	**10%of village area taken for farm recharge (in hectares)**	**Total number of recharge pits**	**Annual recharge (MCM)= (Area*Runoff 15%)**	**Cost of Pit @Rs.35000/- (crores)**
Phul	**27608**	**2761**	**2761**	**1.45**	**9.66**
Maur	**28285**	**2829**	**2829**	**1.667**	**9.90**
Bathinda	**24627**	**6400**	**6400**	**3.648**	**22.40**
			11990	**6.765**	**41.96**

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 BATHINDA DISTRICT OF PUNJAB								
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 Rs.25000/- /structure (crores)**
BATHINDA	1	**Phul**	**27608**	**13730**	**1373**	**1373**	**0.585**	**3.43**
	2	**Bhagta Bhai Ke**	**63996**	**36296**	**3630**	**3630**	**1.655**	**9.08**
	3	**Bathinda**	**24627**	**14554**	**1455**	**1455**	**0.055**	**3.64**
	4	**Maur**	**28285**	**14815**	**1482**	**1482**	**0.699**	**3.71**
		Total	**144516**	**79395**	**7940**	**7940**	**2.994**	**19.86**

ARTIFICIAL RECHARGE PLAN FOR URBAN AREAS OF DISTRICT BATHINDA PUNJAB

District	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 @Rs.25000/-/structure (crores)
BATHINDA	BATHINDA	Bathinda (Mcorp)	60301	285788	3000	600000	0.182	**7.5**
	BATHINDA	Kot Fatta (MCI)	1457	7412	146	29140	0.009	**0.37**
	BATHINDA	Bhisiana (CT)	1170	4890	117	23400	0.007	**0.29**
	BATHINDA	Mehna (CT)	5767	27733	577	115340	0.035	**1.44**
	MAUR	Maur (M Ci)	6250	31849	625	125000	0.039	**1.56**
		TOTAL	**74945**	**357672**	**4465**	**892880**	**0.272**	**11.16**

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 Punjab, particularly in overexploited blocks. There are around 41219 operated by farmers for irrigation through unlined/Katcha (33.45%) open channel system in Bathinda 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 Bathinda district is estimated at 1184.46 MCM. It is expected that around 9.38% 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 99.84 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 Bathinda Districts. The measure if implemented will bring down the ground water overdraft from 119% to 109.62 %. 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 Punjab**. 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, BATHINDA DISTRICT

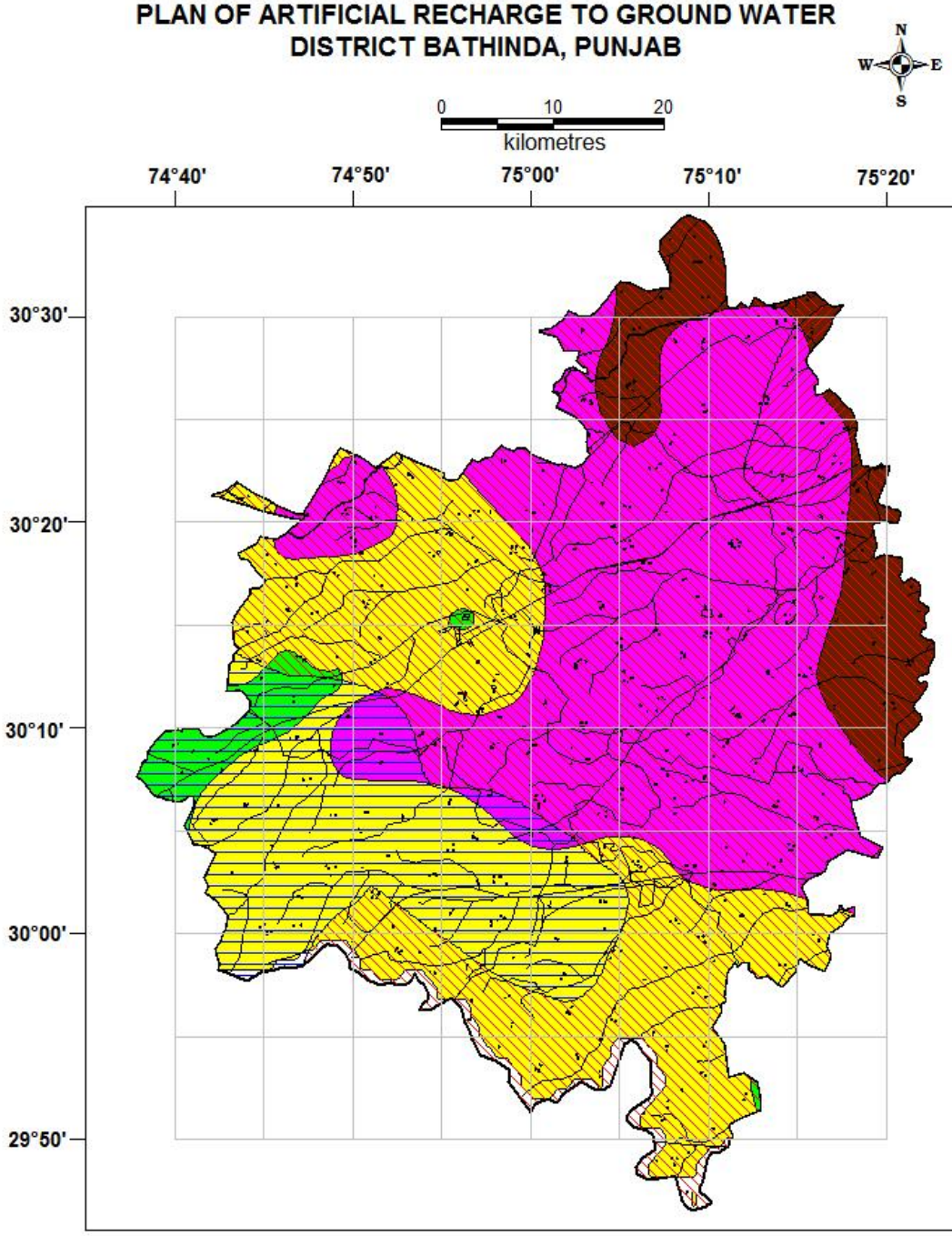
Net Annual Ground Water Availability (mcm)	Total Draft (present) (mcm)	Gross Irrigation Draft (present) (mcm)	Gross Ground Water Draft for Domestic and industrial supply (mcm)	Pecentage of unlined channel	Wastage through unlined channel, (mcm) (Col 3 X Col5 X 0.30#)	Potential of Reduced irrigation overdraft (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
1016.81	1214.52	1184.46	30.05	33.45	99.84	1084.62	1114.67	119	109.62	9.38

 # Losses from open kuchha channel are around 30%.

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 lack per hector(in cr) =Total irrigated area (by ground water scheme) of the block *0.5 *Col4	Total Cost in Rs.Cr. District wise
BATHINDA	Bhagta Bhaika	8557.8	33.45	2863	14.3	**81.40**
	Phul	9417	33.45	3150	15.7	
	Rampura	9690.8	33.45	3242	16.2	
	Nathana	9390.4	33.45	3141	15.7	
	Bathinda	6014	33.45	2012	10.1	
	Sangat	1150	33.45	385	1.9	
	Talwandi Sabo	810.9	33.45	271	1.4	
	Maur	3625	33.45	1213	6.1	

PLAN OF ARTIFICIAL RECHARGE TO GROUND WATER
DISTRICT BATHINDA, PUNJAB



Legend

Refer Salient Features of Hydrogeology

Decadal mean water level trend (m)

	0.00 -- 0.1114
	-0.20 -- -0.10
	-0.10 -- -0.00

SALIENT FEATURES OF HYDROGEOLOGY OF DISTRICT BATHINDA

Wells Feasible	Rigs Suitable	Depth of Well (m)	Discharge (lpm)	Suitable Artificial Recharge Structures
Tube Wells	Direct and Reverse Rotary	40 - 100	1300 - 2500	Recharge Shaft And Recharge Trench
Tube Wells	Direct and Reverse Rotary	40 - 250	1000 - 1300	Recharge Shaft And Recharge Trench
Tube Wells	Direct and Reverse Rotary	20 - 50	800 - 1000	Recharge Shaft And Recharge Trench

DEPTH TO WATER LEVEL NOVEMBER 2014		
0.00 - 5.00 mbgl	National Highway	International Boundary
5.00 - 10.00 mbgl	Canals	State Boundary
10.00 - 20.00 mbgl	Water Bodies	Block Boundary
20.00 - 40.00 mbgl	Major Drainage	Block Headquarters

OTHER INFORMATION

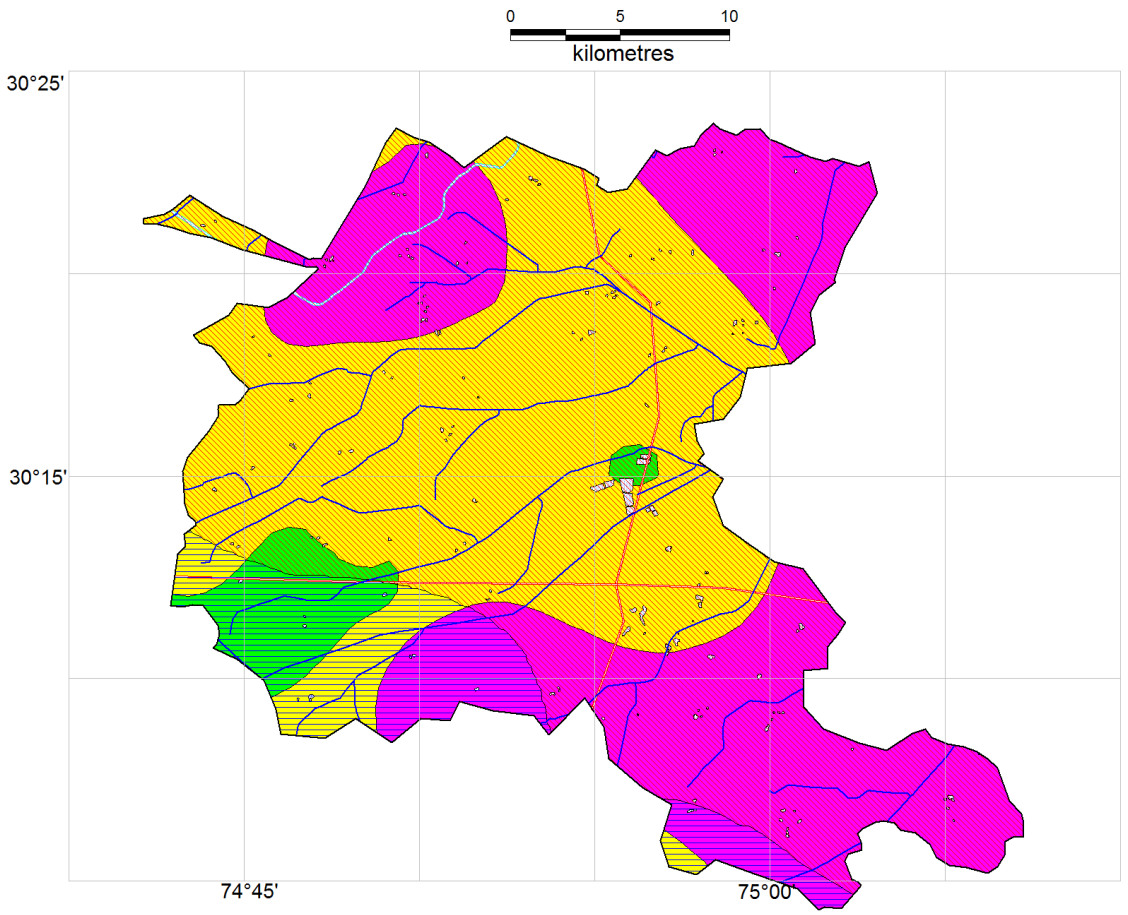
Name of State	Punjab
Name of District	Bathinda
Geographical Area	3367 sq.km
Major Geological Formation	Alluviam
Major Drainage System	Sutlej and Ghaggar
Population (as on 2011)	13,88,859
Total Number of Blocks	7
Existing Major/Medium Irrigation Projects	Sirhind Canal
Utillizable Ground Water Resources 2011	1016.81 (mcm)
Net Ground Water Draft	1214.52 (mcm)
Stage of Ground Water Development	119 %
Average Annual Rainfall	404 mm
Range of Mean Daily Temperature	3.9° - 42° C
Over Exploted Blocks	PHUL MAUR BATHINDA

BLOCK WISE PLAN OF DISTRICT BATHINDA PUNJAB

(3 OE BLOCKS)

BLOCK: BATHINDA DISTRICT: BATHINDA STATE: PUNJAB

DEPTH TO WATER LEVEL BATHINDA, DECADAL MEAN POST MONSOON Vs DECADAL MEAN TREND POST MONSOON (2004-2013)



LEGEND

Decadal Mean Water Level (m.bgl)

- 0.00 to 5.00
- 5.00 to 10.00
- 10.00 to 20.00

Decadal Mean Trend (m)

- -0.10 to 0.00
- 0.00 to 0.1114

1455	No. of Recharge Structures in Rural Villages
3840	No. of Recharge Structures in Urban Towns
6400	No. of Recharge Pits in Agriculture land
28	Thickness of Sand

NH Road Canals River/Drain Water Bodies

Ground Water Scenario of Block Bathinda

Block Name:- Bathinda **District:- Bathinda**		**State:- PUNJAB**
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*739.5*
	• Number of Villages inhabited • Un-inhabited	*65* *0*
	ii) Average Annual Rainfall (mm)	*382*
	iii) Area feasible for Artificial Recharge	*739.5*
	iv) Village identified under scarcity of Water?	*54*
	v) Village covered under water supply?	*54*
	vi) Water Tank exists in the village?	*36*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	 *Satluj 90%* *Ghaggar 10%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	600.79
	• Net Area Sown (Sq.Km)	504.55
	• Area Sown More than Once (Sq.Km)	446.82
	• Total Cropped Area (Sq.Km)	951.37
	• Cropping Intensity	189
	• Area under Thur and Sem (Sq.Km)	--

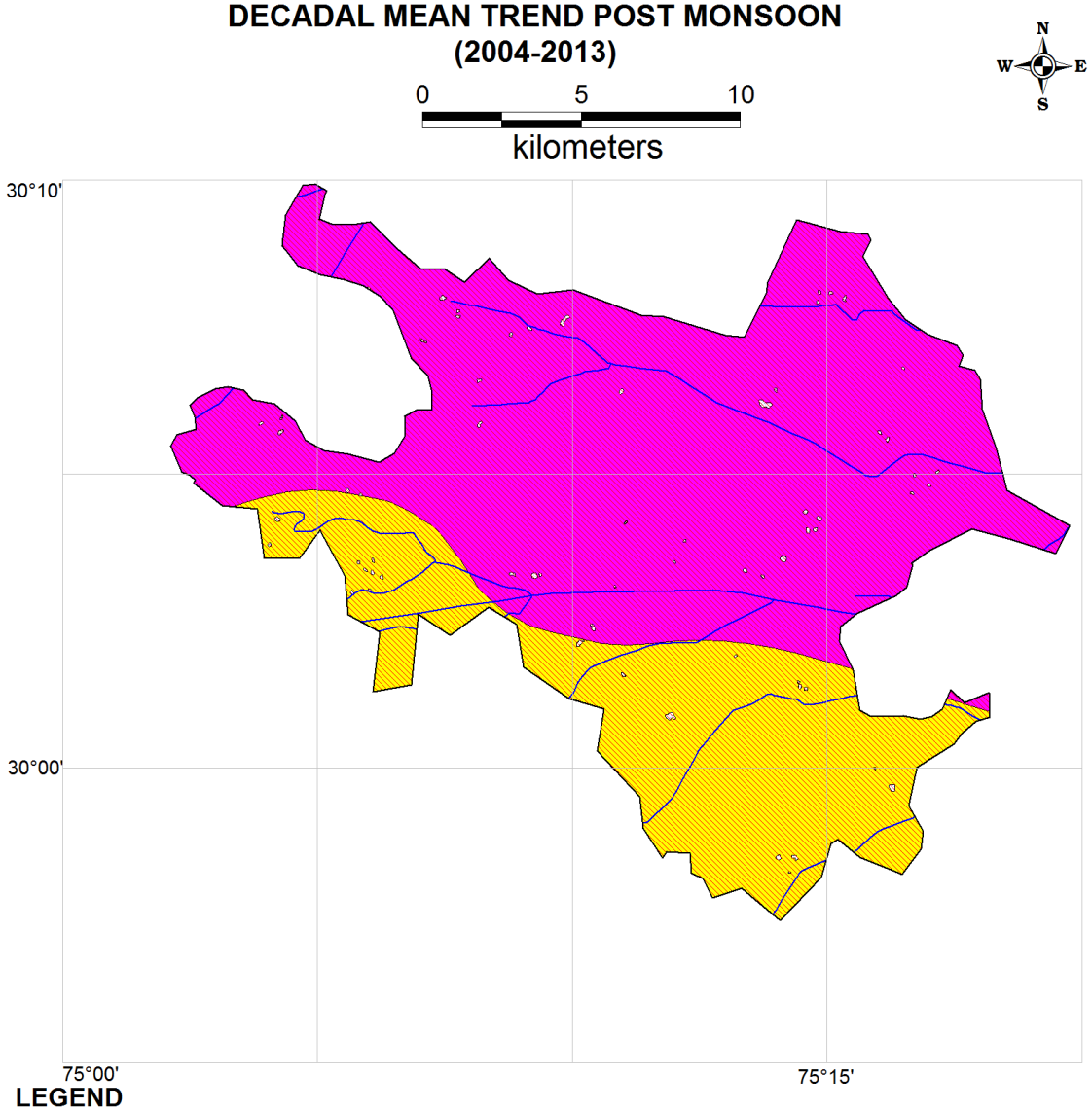
4.	PREDOMINAT GEOLOGICAL FORMATIONS	*Recent alluvium*	
5.	HYDROGEOLOGY		
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand	
	Avg. Depth to water level (decadal)	Depth to water level (May-2015)	
	• Pre- monsoon: (May 2015) 5.97-20.80(mbgl)	5.00-20.00mbgl	
	• Post –monsoon: (Nov2014) 4.55-17.79 (mbgl)		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	*4*	
	• Depth Range (m)	*250.0-545.0*	
	• Discharge (Ipm)	*1006-1500*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*79-1300*	
	• Storativity	*$2.8*10^{-2}$ to $3.8*10^{-4}$*	
	• Specified yield	*0.072*	
7.	GROUND WATER QUALITY	Min	Max
	• EC in µS/cm at 25^0c	*646*	*1064*
	• NO3 (mg/l)	*7.5*	*30*
	• F (mg/l)	*0.08*	*0.43*
	• As (mg/l)	0.0009	0.0032
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (MCM)	212.42	
	• Existing Gross Ground Water Draft for Irrigation (MCM)	215.24	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	10.44	
	• Existing Gross Ground Water Draft for all Uses (MCM)	225.68	

	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	15.65	
	• Net Ground Water Availability for Future Irrigation Development (MCM)	-18.47	
	• Stage of Ground Water Development / Over Draft (%)	106	
	• 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)* *28*	Percentage % 56
10	Volume of unsaturated zone available for recharge (MCM)	616.91	
11.	Volume of water required for recharge (MCM)	820.39	
12.	Volume of surplus water available for recharge(MCM)	6.69	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@rS. 35000/-	6400	22.40	3.648
14	RWH Rural @ Rs. 25000/-	1455	3.63	0.055
15	RWH Urban@ Rs. 25000/-	3840	9.60	0.233
16	Underground pipe line (area in hectares) @ Rs. 50000/-	6014	10.10	18.14
	TOTAL		**45.73**	**22.076**

BLOCK: MAUR DISTRICT: BATHINDA STATE: PUNJAB

DEPTH TO WATER LEVEL MAUR, DECADAL MEAN POST MONSOON
Vs
DECADAL MEAN TREND POST MONSOON
(2004-2013)



LEGEND

Decadal Mean Water Level (m.bgl)

- 5.00 to 10.00
- 10.00 to 20.00

Canals

Decadal Mean Trend (m)

- -0.10 to 0.00

Water Bodies

1482	No. of Recharge Structures in Rural Villages
625	No. of Recharge Structures in Urban Towns
2829	No. of Recharge Pits in Agriculture land
16	Thickness of Sand

Ground Water Scenario of Block

Block Name:- Maur **District:- Bhatinda**		**State:- PUNJAB**
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*356.1*
	• Number of Villages inhabited • Un-inhabited	*34* *0*
	ii) Average Annual Rainfall (mm)	*395*
	iii) Area feasible for Artificial Recharge	*356.1*
	iv) Village identified under scarcity of Water?	*33*
	v) Village covered under water supply?	*33*
	vi) Water Tank exists in the village?	*31*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	*Ghaggar100%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	282.93
	• Net Area Sown (Sq.Km)	266.86
	• Area Sown More than Once (Sq.Km)	254.78
	• Total Cropped Area (Sq.Km)	530.33
	• Cropping Intensity	191
	• Area under Thur and Sem (Sq.Km)	--
5.	HYDROGEOLOGY	

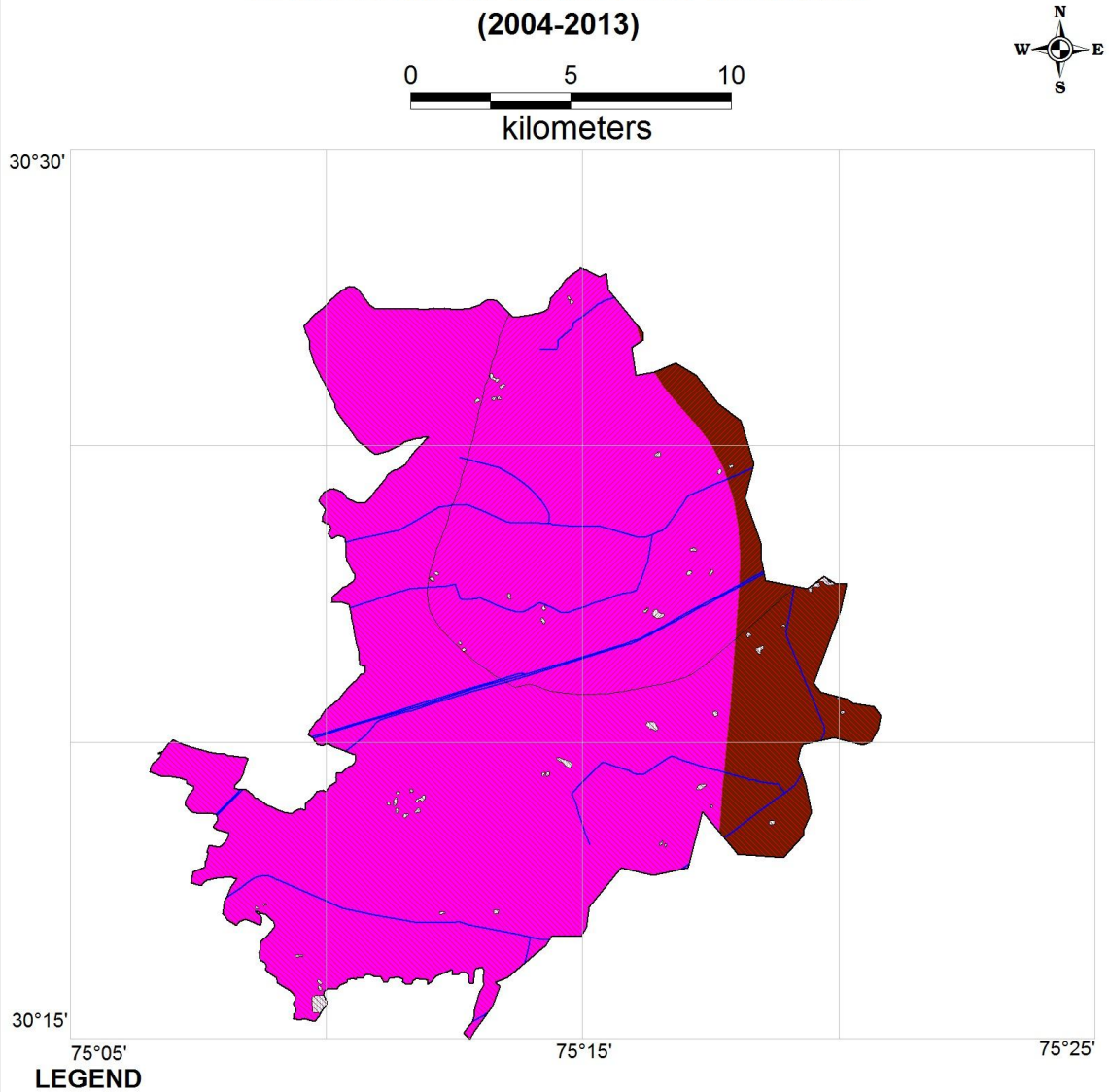
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand	
	Avg. Depth to water level (decadal)	Depth to water level (May-2015)	
	Pre- monsoon: (May 2015) *7.70-13.65(mbgl)*	*5.00-20.00 mbgl*	
	Post-monsoon (nov.2015) *7.85-13.52 (mbgl)*		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	--	
	• Depth Range (m)	*250.0-545.0*	
	• Discharge (Ipm)	*1006-1500*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*79-1300*	
	• Storativity	*$2.8*10^{-2}$ to $3.8*10^{-4}$*	
	• Specified yield	*0.072*	
7.	GROUND WATER QUALITY	Min	Max
	• EC in µS/cm at 25^0c	---	---
	• NO3 (mg/l)	---	---
	• F (mg/l)	---	---
	• As (mg/l)	0.001	0.001
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (MCM)	84.81	
	• Existing Gross Ground Water Draft for Irrigation (MCM)	171.88	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	2.51	
	• Existing Gross Ground Water Draft for all Uses (MCM)	174.38	
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	3.76	

	• Net Ground Water Availability for Future Irrigation Development (Ham)	-90.83	
	• Stage of Ground Water Development / Over Draft (%)	206	
	• 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)* *16*	Percentage % 32
10	Volume of unsaturated zone available for recharge (MCM)	297.07	
11.	Volume of water required for recharge (MCM)	395.05	
12.	Volume of surplus water available for recharge(MCM)	3.22	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@rS. 35000/-	2829	9.90	1.667
14	RWH Rural @ Rs. 25000/-	1482	3.70	0.699
15	RWH Urban@ Rs. 25000/-	625	1.56	0.039
16	Underground pipe line (area in hectares) @ Rs. 50000/-	3625	6.10	14.49
	TOTAL	**21.26**		**16.895**

BLOCK: PHUL DISTRICT: BATHINDA STATE: PUNJAB

DEPTH TO WATER LEVEL PHUL, DECADAL MEAN POST MONSOON
Vs
DECADAL MEAN TREND POST MONSOON
(2004-2013)



LEGEND

Decadal Mean Water Level (m.bgl)

- 10.00 to 20.00
- 20.00 to 40.00
- Water Bodies

Decadal Mean Trend (m)

- -0.20 to -0.10
- -0.10 to 0.00
- Canals

- 1373 — No. of Recharge Structures in Rural Villages
- 24 — Thickness of Sand
- 2761 — Recharge Pits in Agricultural Lands

Ground Water Scenario of Block

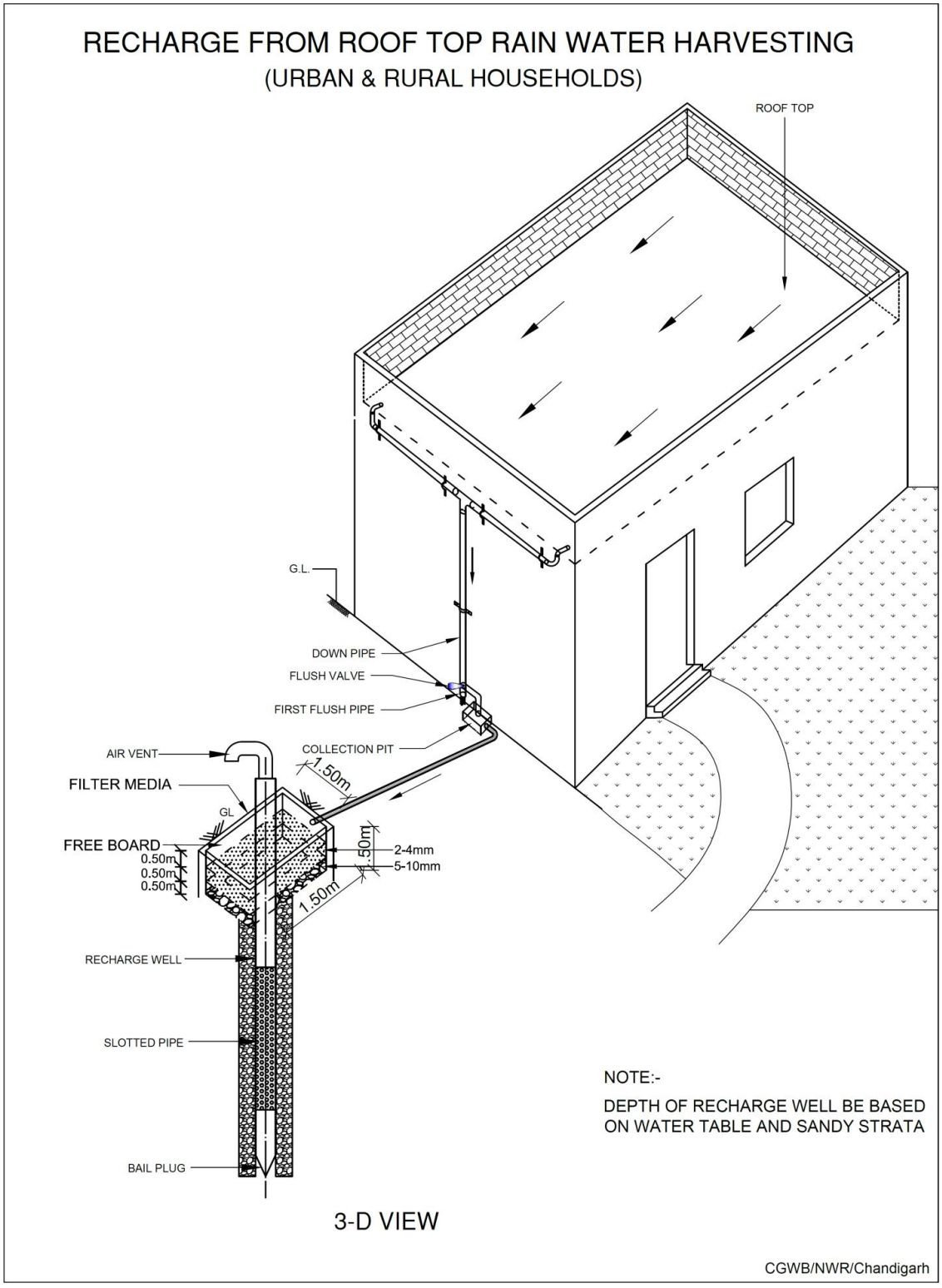
Block Name:- Phul **District:- Bhatinda**		**State:- PUNJAB**
1.	GENERAL INFORMATION	
	i) Geographical area (sq km)	*522.3*
	• Number of Villages inhabited • Un-inhabited	*27* *0*
	ii) Average Annual Rainfall (mm)	*354*
	iii) Area feasible for Artificial Recharge	*522.3*
	iv) Village identified under scarcity of Water?	*13*
	v) Village covered under water supply?	*14*
	vi) Water Tank exists in the village?	*9*
2.	GEOMORPHOLOGY	
	Major Physiographic	Alluvium Plain
	Major drainages Basin Sub-Basin	*Sutluj 100%*
3.	LAND USE	
	• Area According to Village Papers (Sq.Km)	146.80
	• Net Area Sown (Sq.Km)	119.11
	• Area Sown More than Once (Sq.Km)	107.05
	• Total Cropped Area (Sq.Km)	226.16
	• Cropping Intensity	190
	• Area under Thur and Sem (Sq.Km)	--
4.	PREDOMINAT GEOLOGICAL	*Recent alluvium*

	FORMATIONS		
5.	HYDROGEOLOGY		
	Major Water bearing Formation (Aquifer)	Fine to coarse Sand	
	Avg. Depth to water level (decadal)	Depth to water level (May-2015)	
	• Pre- monsoon: (May 2015) 8.85 – 27.64 (mbgl)	10.00- 40.00(mbgl)	
	• Post –monsoon: (Nov2014) 19.49 – 28.70 (mbgl)		
6.	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2015)		
	• No of wells drilled	*3*	
	• Depth Range (m)	*250.0-545.0*	
	• Discharge (Ipm)	*1006-1500*	
	Aquifer Parameters		
	• Transmissivity (m2/day)	*79-1300*	
	• Storativity	*$2.8*10^{-2}$ to $3.8*10^{-4}$*	
	• Specified yield	*0.072*	
7.	GROUND WATER QUALITY	Min	Max
	• EC in µS/cm at 25^0c	*991*	*5605*
	• NO3 (mg/l)	*12*	*246*
	• F (mg/l)	*0.4*	*3.37*
	• As (mg/l)	---	*0.0033*
8.	DYANMIC GROUND WATER RESOURCES in MCM	**2011**	
	• Net Ground Water Availability (MCM)	126.56	
	• Existing Gross Ground Water Draft for Irrigation (MCM)	317.59	
	• Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (MCM)	5.03	
	• Existing Gross Ground Water Draft for all Uses (MCM)	322.63	
	• Allocation for Domestic and Industrial Requirement Supply up to next 25 years (MCM)	7.53	

	• Net Ground Water Availability for Future Irrigation Development (MCM)	-198.57	
	• Stage of Ground Water Development / Over Draft (%)	255	
	• 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)* *24*	Percentage % 48
10	Volume of unsaturated zone available for recharge (MCM)	435.72	
11.	Volume of water required for recharge (MCM)	579.43	
12.	Volume of surplus water available for recharge(MCM)	4.72	

RECHARGE/ CONSERVATION STRUCTURES		Total Number of Recharge Structures	Total Cost (Rs. in crores)	Total Recharge in mcm
13	Farm Recharge@Rs. 35000/-	2761	9.66	1.45
14	RWH Rural @ Rs. 25000/-	1373	3.43	0.585
15	RWH Urban@ Rs. 25000/-	-	-	-
16	Underground pipe line (area in hectares) @ Rs. 50000/-	9417	15.70	26.77
	TOTAL		**28.79**	**28.805**

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