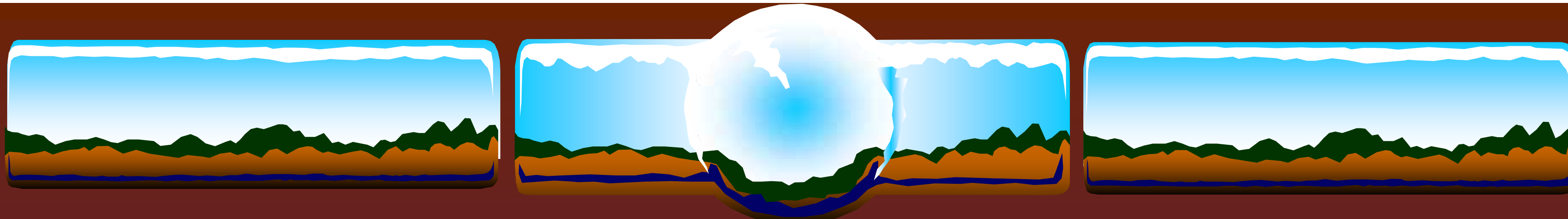


IMPACT OF COAL MINING ACTIVITIES ON GROUND WATER REGIME IN PARTS OF RANIGANJ COAL FIELD AREA

BARDDHAMAN DISTRICT

WEST BENGAL

INTRODUCTION

MINING ACTIVITIES AFFECT

- TOPOGRAPHY & SOIL
- SURFACE WATER & ITS QUALITY
- GROUND WATER & ITS QUALITY
- HUMAN HEALTH

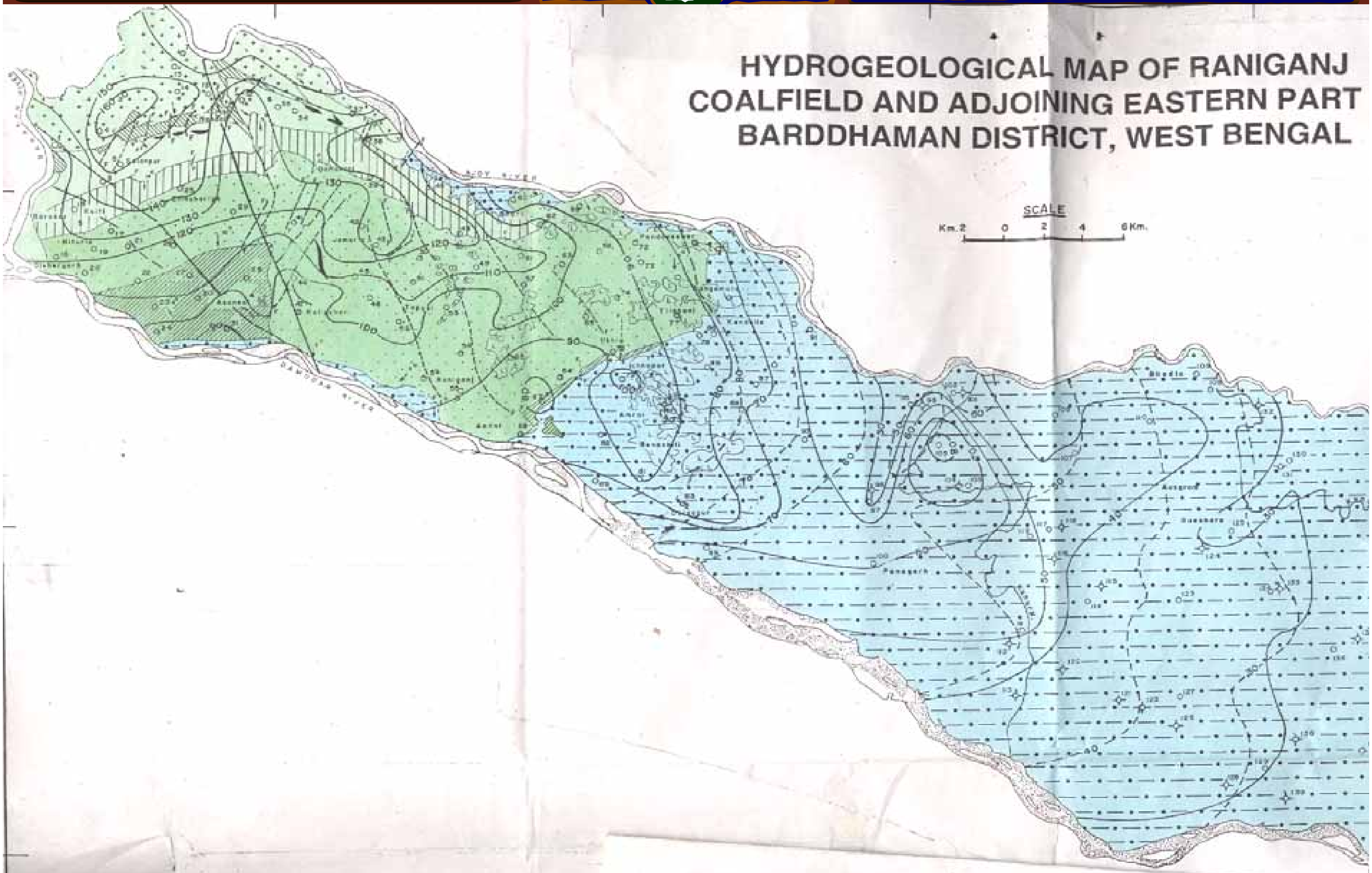
IN ORDER TO ASSESS THE IMPACT OF COAL MINING ON GROUND WATER REGIME, A PART OF RANIGANJ COAL FIELD AREA IN THE INTERFLUVE OF AJOY-DAMODAR SUB-BASIN IN BARDDHAMAN DISTRICT WAS SELECTED FOR STUDY.

GEOLOGY

- LOWER GONDANA GROUP OF ROCKS MAINLY COMPRISE THE AREA, UNDERLAIN BY ARCHAEAN METAMORPHICS WHICH ARE EXPOSED IN THE NORTH WESTERN PART OF THE AREA.
- 2 SETS OF MAJOR FAULTS TRENDING NNE-SSW IN THE WESTERN PART & NNW-SSE IN THE EASTERN PART TRAVERSE THE AREA. THE LATTER ONE HAVE BETTER GROUND WATER POTENTIAL.

HYDROGEOLOGY

- MODE OF OCCURRENCE OF GROUND WATER IN:
- WEATHERED RESIDUUM DOWN TO ABOUT 20 MBGL UNDER UNCONFINED CONDITION BEING HARNESSED BY DUG WELLS.
- FRACTURES GENERALLY DOWN TO 100 MBGL UNDER CONFINED CONDITION BEING EXPLOITED THROUGH DUG-CUM BOREWELL/BOREWELL.


HYDROGEOLOGICAL MAP OF RANIGANJ
COALFIELD AND ADJOINING EASTERN PART
BARDDHAMAN DISTRICT, WEST BENGAL
SCALE
Km. 2 0 2 4 6 Km.

	AGE-GROUP	LITHOLOGY	HYDRO-GEOLOGICAL CONDITIONS	GROUNDWATER POTENTIAL	TYPES OF GROUNDWATER STRUCTURES FEASIBLE	QUALITY OF GROUNDWATER
Unconsolidated formations	Quaternary Upper Tertiary	Older Alluvium and Laterite, silt, sand, ferruginous concretions, lithomergic clay. Gravels, Pebbles, Cobbles, etc.	Moderately thick. regionally extensive confined to un-confined aquifers down to 50m. but thickness increases towards east.	Limited yield prospects below 50 M^3/hour.	Shallow tubewell about 50m depth	Fresh Groundwater
Semi-consolidated formations (Lr. Gondwana Group)	Mesozoic Upper-Paleozoic		FISSURED FORMATIONS			
1. Panchet Formation	Lr. Triassic	Coarse grained, greenish yellow to greenish grey, micaceous, Sandstone, silty shale, coarse grained, yellow, felspathic, cross bedded sandstone and thick bright red clay with calcareous concretions		Large yield prospects above 20 M^3/hour.		
2. Raniganj Formation	Upper Permian	Medium to fine grained, grey cross bedded, micaceous, felspathic sandstne with calcareous clayey matrix, variety of siltstone and shales with coal seams.				Fresh Groundwater but shows biogenic pollution at places due to coal mining and presence of abandoned pits and shafts.
3. Ironstone Shale Formation	Middle Permian	Thick black, laminated, fissile shale and fine grained sandstone with ferruginous laminae and thin bands of hard crypto-crystalline clay Ironstone.	Groundwater restricted to weathered residium, fracture zone having secondary porosity.	Moderate yield prospects 5 to 20 M^3/hour.	Large diameters open wells, shallow bore wells fitted with hand pump and deep bore wells about 100 m. deep fitted with pump.	
4. Barakar Formation	Lower Permian	Very coarse grained conglomeratic sandstone, very coarse to medium grained arkosic, quartzo-felspathic and quartzitic sandstone, variety of shales and siltstone, fire clay lenses and coal seams.				
5. Talchir Formation	Upper Carboniferous	Tillite with sandy and or clayey matrix at the base followed by alternation of sandstone and shale.				
Consolidated formation	Archaean	Granite gneiss with migmatitic gneiss, pegmatites, quartz veins etc.		Limited yield prospects. below 5 M^3/hour.		Fresh Groundwater.

HYDROGEOLOGICAL FEATURES

Exploratory Well	Outcrop of coal seams	Dolerite dykes
Jhanjra Coal Mine	Faults (F)	Dip 5°

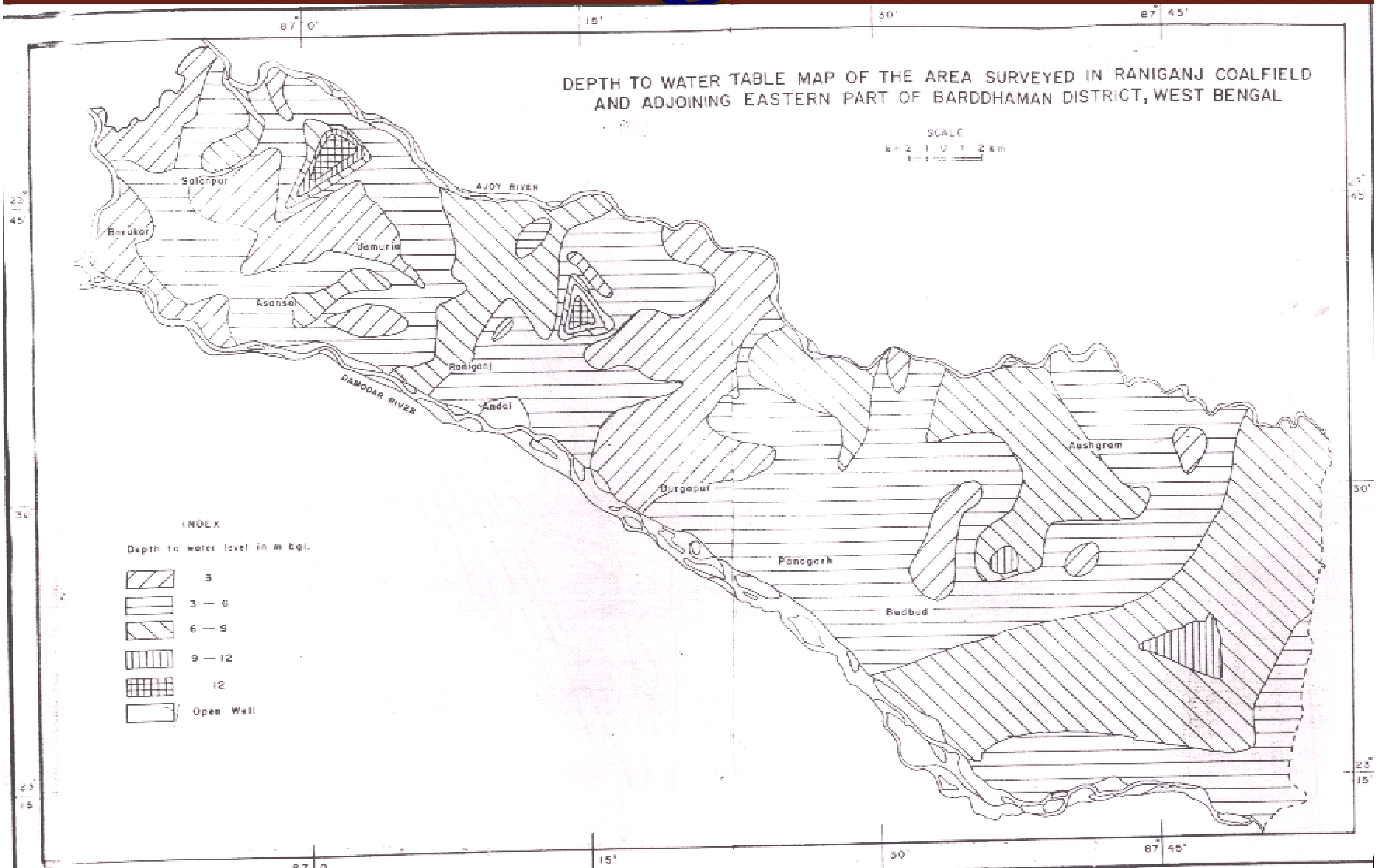
60 Water table contour (m)

40 Piezometric contour (m)

YIELD OF THE WELLS: 0.5-38 M^3/HR

TRANSMISSIVITY: 50-200 M^2/DAY

- DEPTH TO WATER LEVEL DURING PRE-MONSOON PERIOD: IN GENERAL 3-6 MBGL & AS HIGH AS 18 MBGL.



DEPTH TO WATER TABLE MAP OF THE AREA SURVEYED IN RANIGANJ COALFIELD AND ADJOINING EASTERN PART OF BARDDHAMAN DISTRICT, WEST BENGAL
SCALE
km 2 1 0 1 2 km
AJOY RIVER
DAMODAR RIVER
Salanpur
Barakar
Jamuria
Asansol
Raniganj
Andal
Durgapur
Panagarh
Budbud
Aushgram
INDEX
Depth to water level in m bgl.
3
3 — 6
6 — 9
9 — 12
12
Open Well

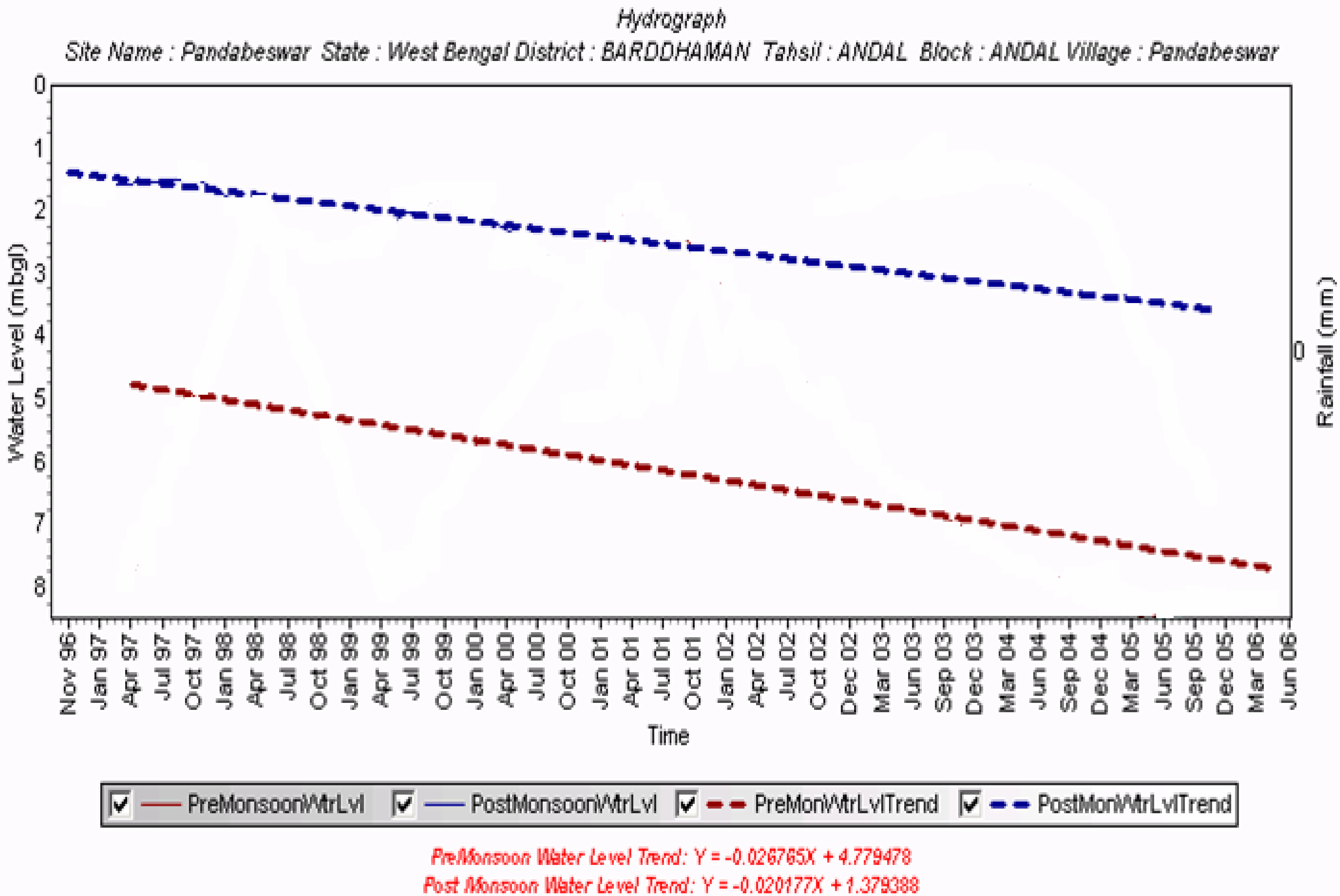
GROUND WATER RESOURCE POTENTIAL

- NET GW AVAILABILITY: 18739 HAM
- EXISTING GROSS GW DRAFT FOR ALL USES: 2132 HAM
- ADDITIONAL GW DRAFT DUE TO MINING ACTIVITIES: 5622 HAM
- STAGE OF GW DEVELOPMENT: 41%

IMPACT OF COAL MINING ON GW REGIME

❖ HYDROGEOLOGICAL ASPECTS:

- DTW VARIES FROM 7-18 MBGL AROUND ACTIVE MINE ESTABLISHMENTS.
- DUE TO SEEPAGE OF GW INTO MINES DTW DECLINES CONSIDERABLY IN WELLS & EVEN WELLS GET DRY DURING SUMMER IN THE VICINITY OF COAL MINES.



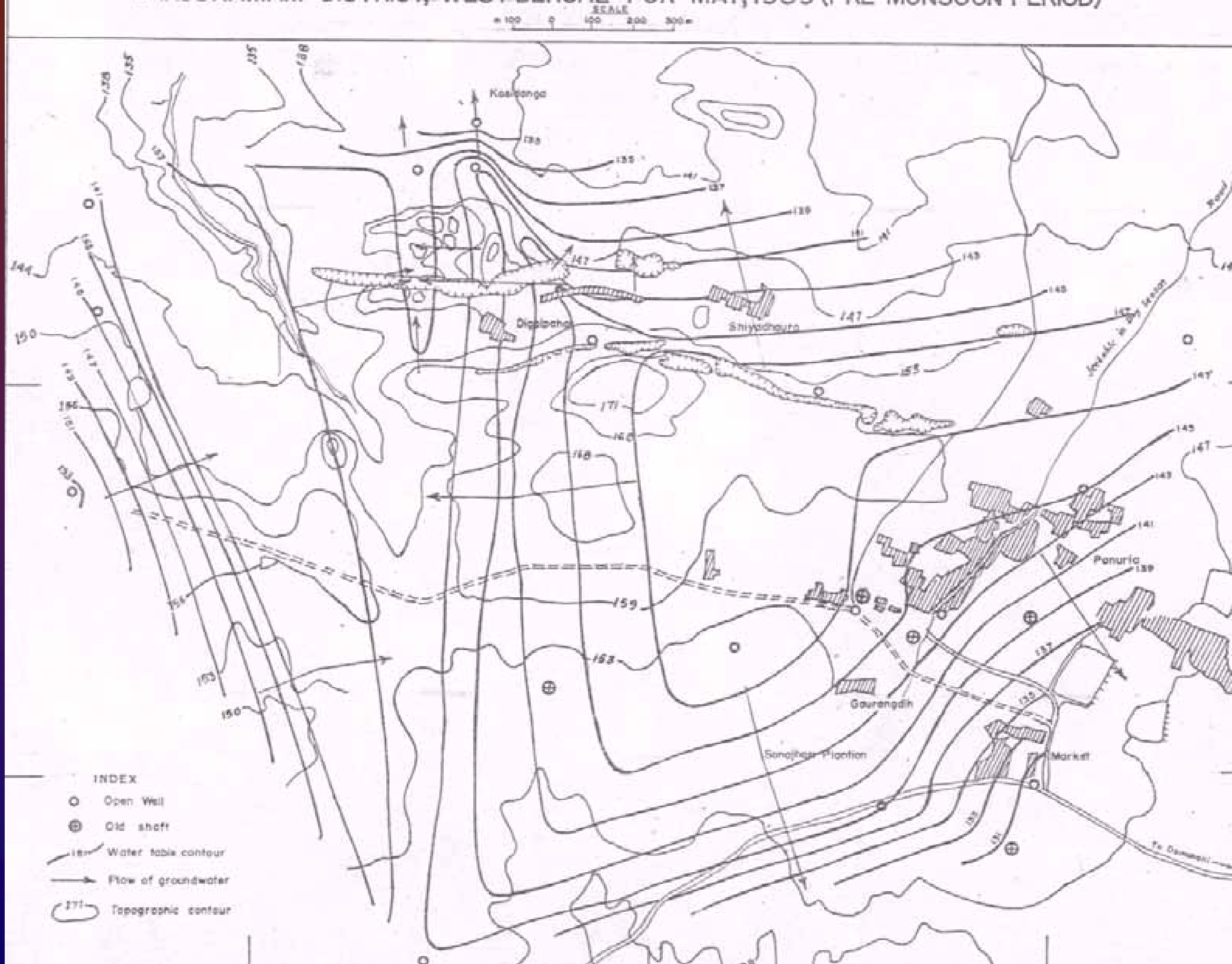
Hydrograph
Site Name : Pandabeswar State : West Bengal District : BARDDHAMAN Tahsil : ANDAL Block : ANDAL Village : Pandabeswar
Water Level (mbgl)
0
1
2
3
4
5
6
7
8
Rainfall (mm)
0
Nov 96 Jan 97 Apr 97 Jul 97 Oct 97 Jan 98 Apr 98 Jul 98 Oct 98 Jan 99 Apr 99 Jul 99 Oct 99 Jan 00 Apr 00 Jul 00 Oct 00 Jan 01 Apr 01 Jul 01 Oct 01 Jan 02 Apr 02 Jul 02 Oct 02 Dec 02 Mar 03 Jun 03 Sep 03 Dec 03 Mar 04 Jun 04 Sep 04 Dec 04 Mar 05 Jun 05 Sep 05 Dec 05 Mar 06 Jun 06
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.026765X + 4.779478
Post Monsoon Water Level Trend: Y = -0.020177X + 1.379388

- GROUND WATER FLOW PATTERN IS INFLUENCED BY MINING ACTIVITY, MAINLY DURING PREMONSOON PERIOD.
- HUGE AMOUNT OF GROUND WATER (ABOUT 108.33 MCM ANNUALY) DISCHARGES INTO THE MINES FROM THE ZONE OF WEATHERING, THE SECTIONS OF ALTERNATING JOINTED, FISSURED SANDSTONES, THINELY LAMINATED SHALES, INTERCEPTED IN THE SHAFTS & GALLERIES DURING MINING ACTIVITIES.
- THE GRADIENT OF WATER TABLE VARIES FROM 4 M/KM TO 10-20 M/KM.

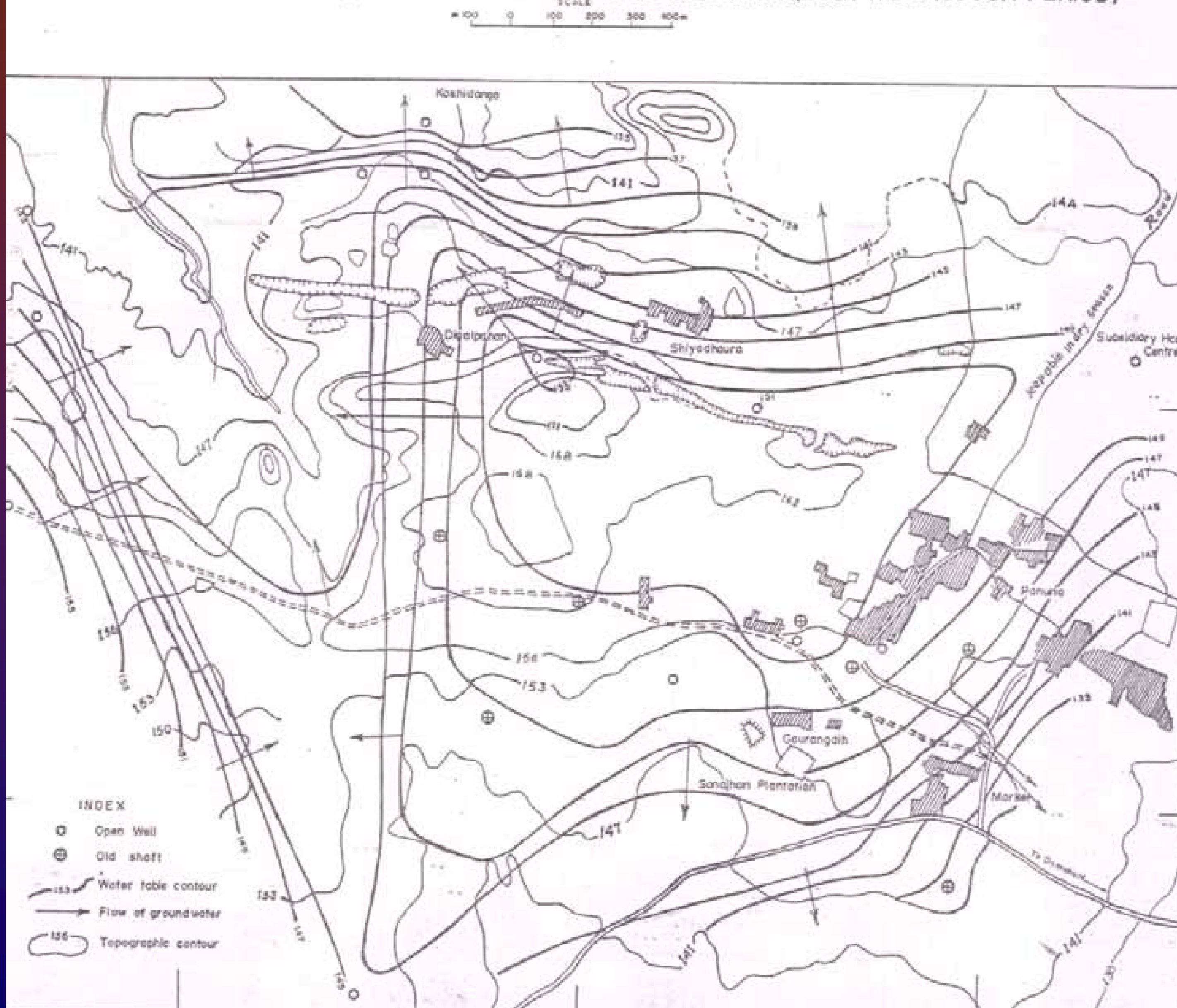
- SUBSTANTIAL QUANTITY OF WATER PUMPED OUT FROM VARIOUS COLLIERIES OF CMPDIL, ASANSOL IS ESTIMATED TO BE 0.25 MCM/DAY IN DRY PERIOD & 0.39 MCM/DAY DURING MONSOON.

PUMPED OUT WATER IF CONTAMINATED MAY POLLUTE THE NEARBY SURFACE WATER AND NEAR SURFACE AQUIFER.

WATER TABLE CONTOUR MAP OF GOURANDIH COAL MINES AREA (A-OCP), ASANSOL, BARDDHAMAM DISTRICT, WEST BENGAL FOR MAY, 1989 (PRE-MONSOON PERIOD)

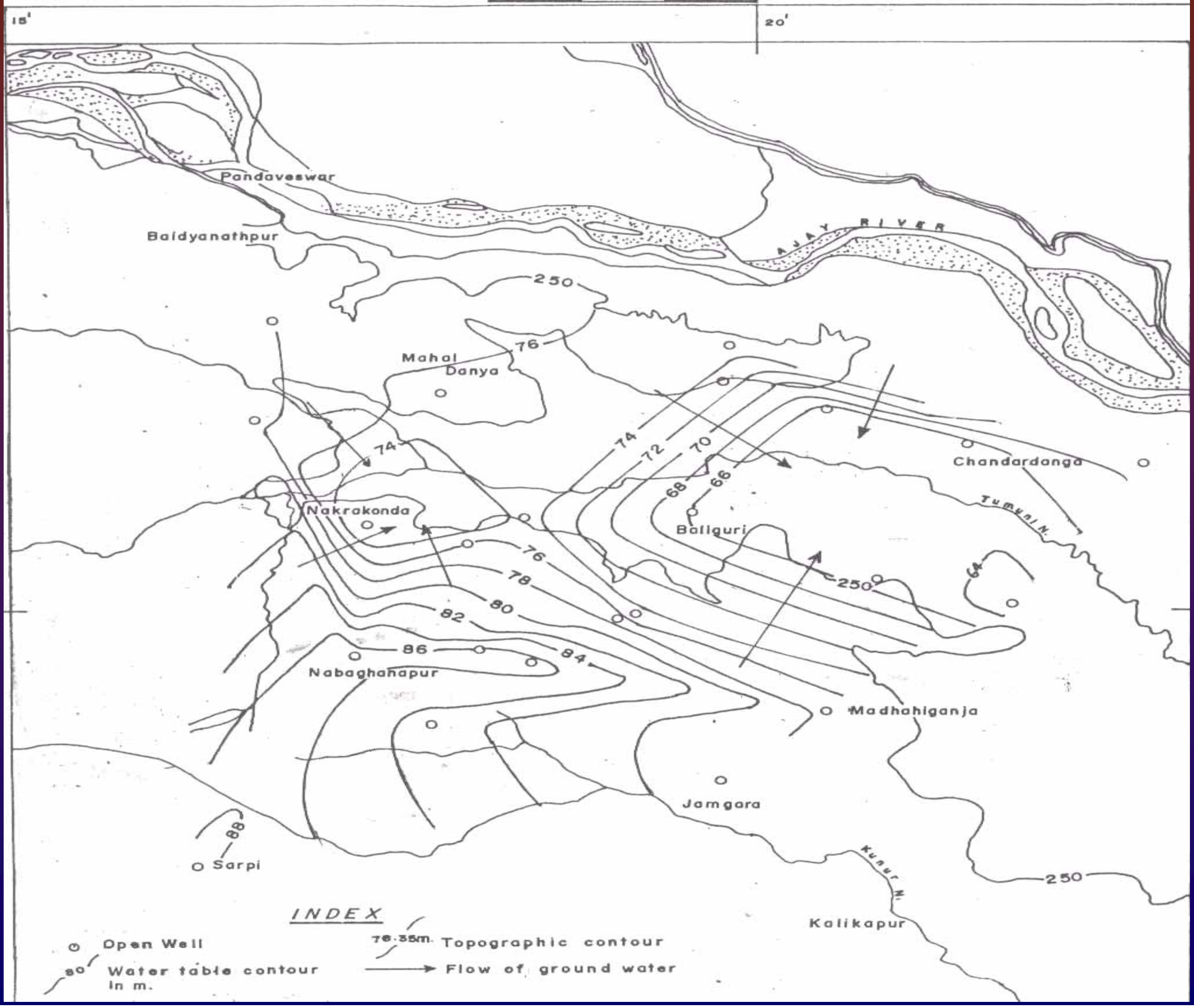


WATER TABLE CONTOUR MAP OF GOURANDIH COAL MINES AREA (A-OCP), ASANSOL, BARDDHAMAN DISTRICT, WEST BENGAL FOR DECEMBER 1988 (POST MOONSOON PERIOD)

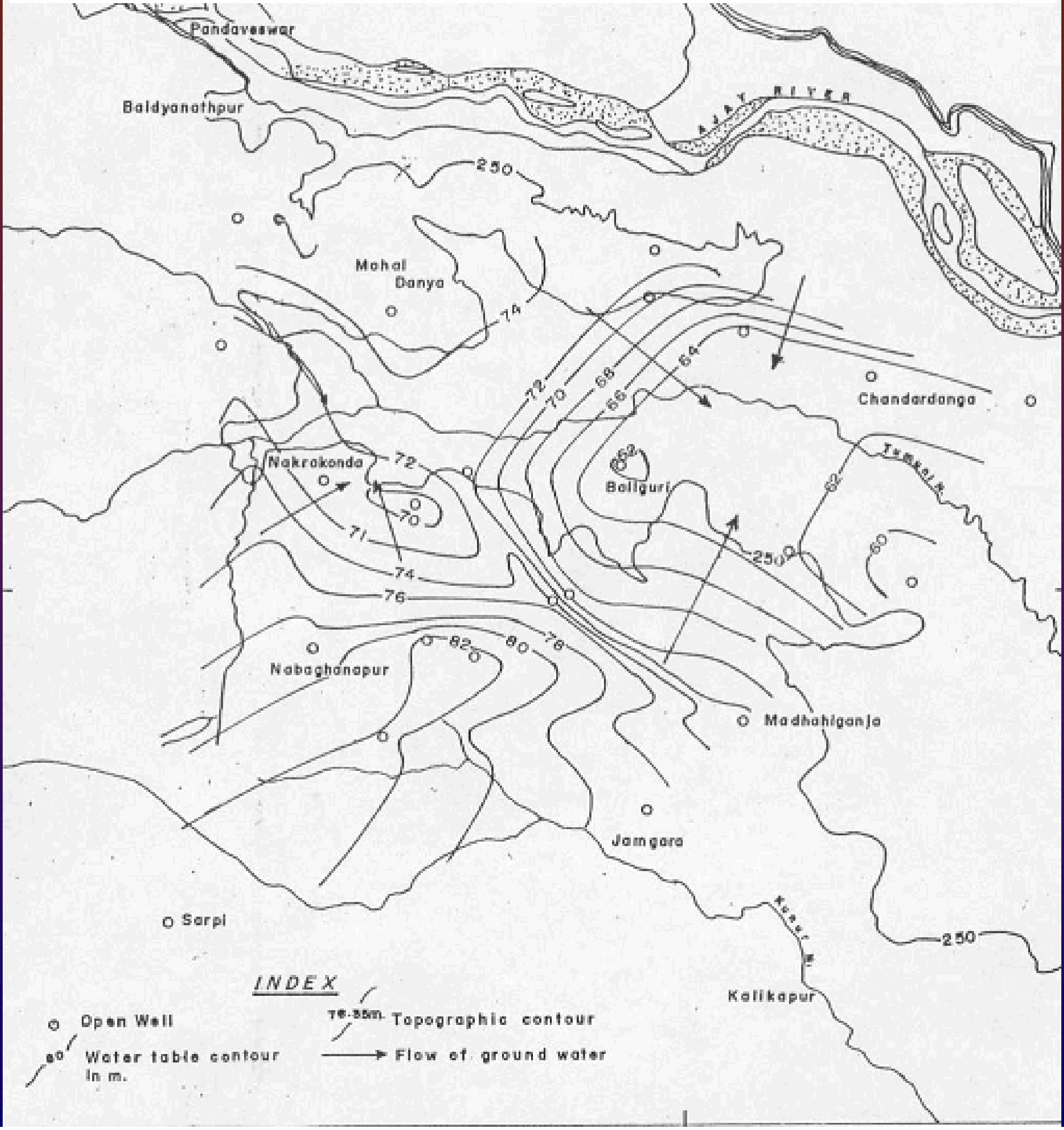


WATER TABLE CONTOUR MAP OF JHANJRA COAL MINE AREA BARDDHAMAN DISTRICT, WEST BENGAL, FOR DECEMBER 1988 (Post-monsoon period)

SCALE: Km. 0 1 2 3 Km.



WATER TABLE CONTOUR MAP OF JHANJRA COAL MINES BARDDHAMAN DIST PRE MONSOON 1999



❖ HYDROCHEMICAL ASPECTS:

❖ QUALITY IN OPEN WELL

Chemical constituents	Range in ppm
Silica	6.8-8.4
Calcium	< 1-44
Sodium	1.2-100
Magnesium	4-302
Potassium	<1—144
Bicarbonate	24-549

❖ CONSTITUENTS	RANGE
Sulphate	<0.1-590
Fluoride	0.04-1.3
Iron	<0.01-1.9
Nitrate	<1- 180
Total Hardness as $CaCo_3$	20-910
Sp Conductance in micromhos/cm	97-2570

COMPARISION OF QUALITY

Parameters in ppm)	Open wells	Mine water	Surface water
(1)	(2)	(3)	(4)
pH	6.5-8.2	7.1-8.7	7.1-8.7
Total solids	260-656	436-4218	484-886
Suspended	0-8	0-746	0-24
Alkanility	26-300	-	174-252
Total Hardness	28-470	30-535	38-184
BOD	8-14	10-619.20	10-32
COD	28-56	18-940.20	32-78
Phenolic compound	Nil	Nil-0.125	Nil-0.3
Total cyanides	Nil	Nil	Nil-0.78

(1)	(2)	(3)	(4)
Oil and greases	Nil	Nil-78.80	Nil-4.0
Chloride	36-58	36-62	56-114
Amonical Nitrogen	Nil-0.20	Nil-1.64	Nil-8.65
Sulphate	Trace	Trace	Trace
Nitrate	Nil-Trace	Nil-Trace	Trace
Copper	Nil	Nil-0.12	Nil
Hexavalent Chromium	Nil	Nil	Nil
Nickel	Nil	Nil-0.13	Nil

THE DATA INDICATES THAT BOD IS HIGH

IN CASE OF GROUND WATER, SURFACE

WATER AND MINE WATER. COD IS HIGH

IN GROUND WATER AND SURFACE WATER

AND VERY HIGH IN MINE WATER.

RECOMMENDATION

- GROUND WATER DEVELOPMENT NEED TO BE DONE BY
  - LARGE DIA OPEN WELLS PREFERABLY IN TOPOGRAPHIC LOW AND AWAY FROM COAL MINES.
  - BORE WELLS AFTER DELINEATING WATER BEARING FRACTURES & ITS EXTENSION BY PHOTOGEOLOGICAL AND GEOPHYSICAL SURVEY.
- LARGE SCOPE FOR GW DEVEOPMENT PROVIDED, MINE SEEPAGE COMPONENT IS MINIMISED ADOPTING SUITABLE MEASURES.
- JUDICIOUS WITHDRAWAL OF WATER
  - LEFT IN ABANDONED MINES MAY HELP AVERTING HAZARDS LIKE UNDERGROUND FIRE ETC.
  - WITHDRAWAN WATER CAN BE USED AFTER PROPER TREATMENT IN DOMESTIC AND INDUSTRIAL SECTOR

- SCOPE FOR CONJUCTIVE USE OF SURFACE AND GROUND WATER:
  - BY DAMODAR RIVER/CANAL WATER IN THE UPPER REACHES
  - BY GROUND WATER IN TAILEND PORTION
- SCOPE FOR RAINWATER CONSERVATION :

  CONSIDERING ANNUAL RAINFALL 1271 MM

  AND AREA OF 1500 SQ.KM.

  - GROSS QUANTITY OF RAINWATER 1906.50 MCM
  - NET QUANTUM OF RAINWATER FOR DOMESTIC CONSUMPTION(CONDIDERING 30% OF GROSS FOR EVAPORATION AND SURFACE RUNOFF) 1334.55 MCM