Rainwater harvesting for Aquifer Storage and Recovery - Case Studies in Goa

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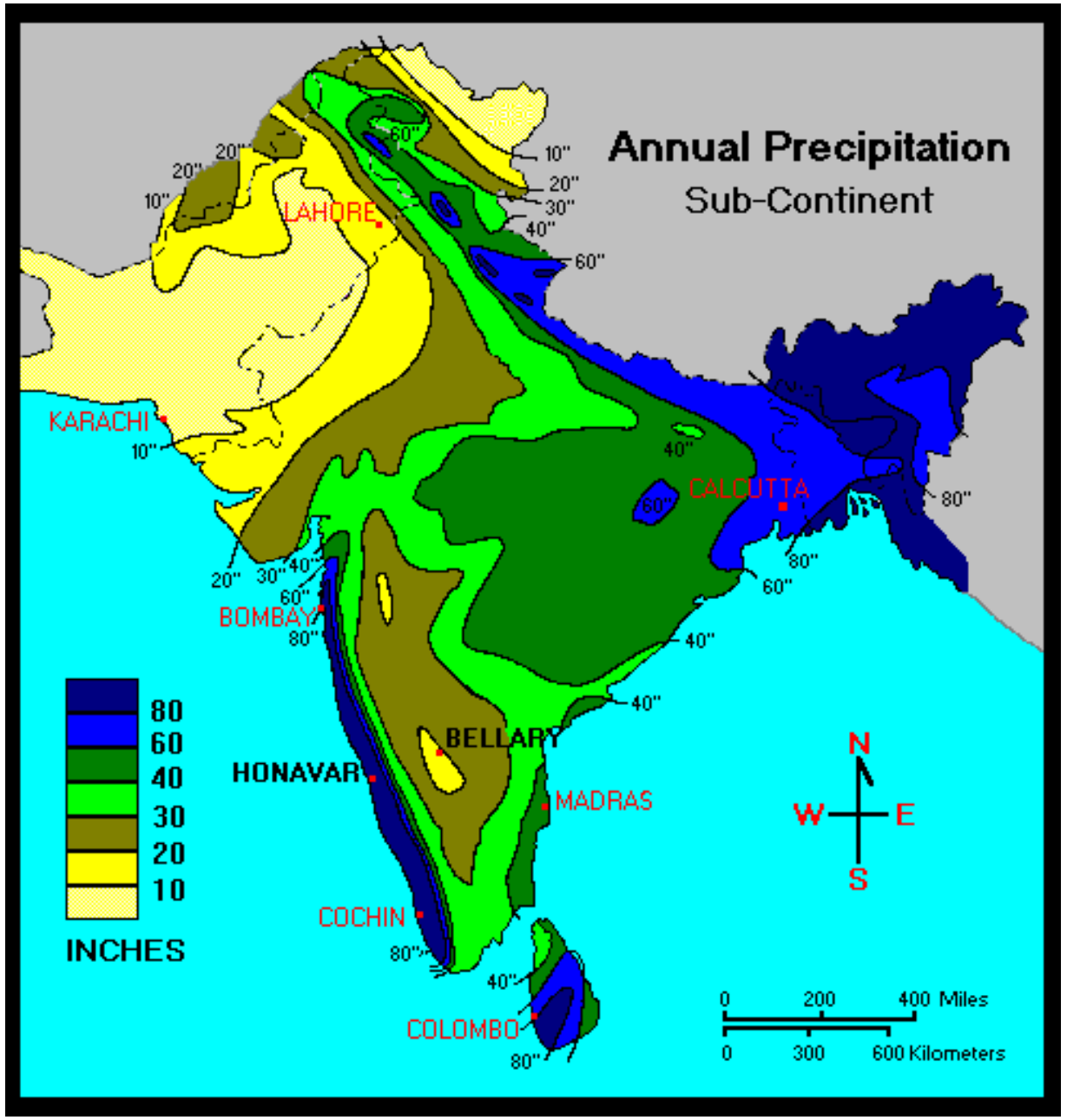
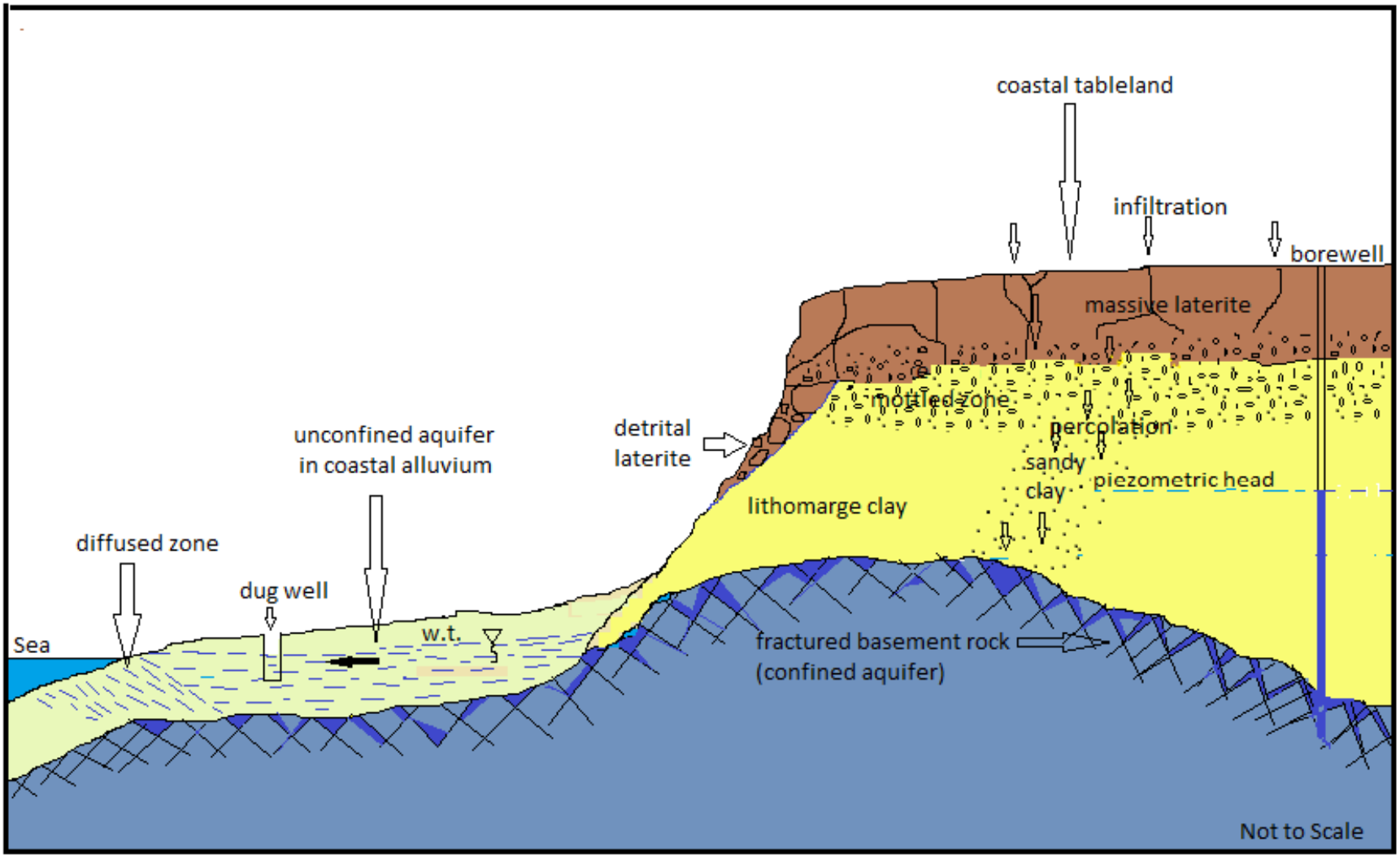
CSE workshop on Energy and Resource Efficiency in Urban Water management, 27-09-2013 at ICG Goa


Annual Precipitation
Sub-Continent
LAHORE
KARACHI
BOMBAY
CALCUTTA
BELLARY
HONAVAR
MADRAS
COCHIN
COLOMBO
80
60
40
30
20
10
INCHES
N
W
E
S
0 200 400 Miles
0 300 600 Kilometers

Objectives of the Groundwater Recharging project are;

1. To arrest declining groundwater levels and increases groundwater storage to maintain sustainable groundwater availability in the Campus
2. To develop and test a scientific technique suitable to the local geological conditions for groundwater recharging
3. To provide a platform for awareness and learning about groundwater conservation methods for various stakeholders



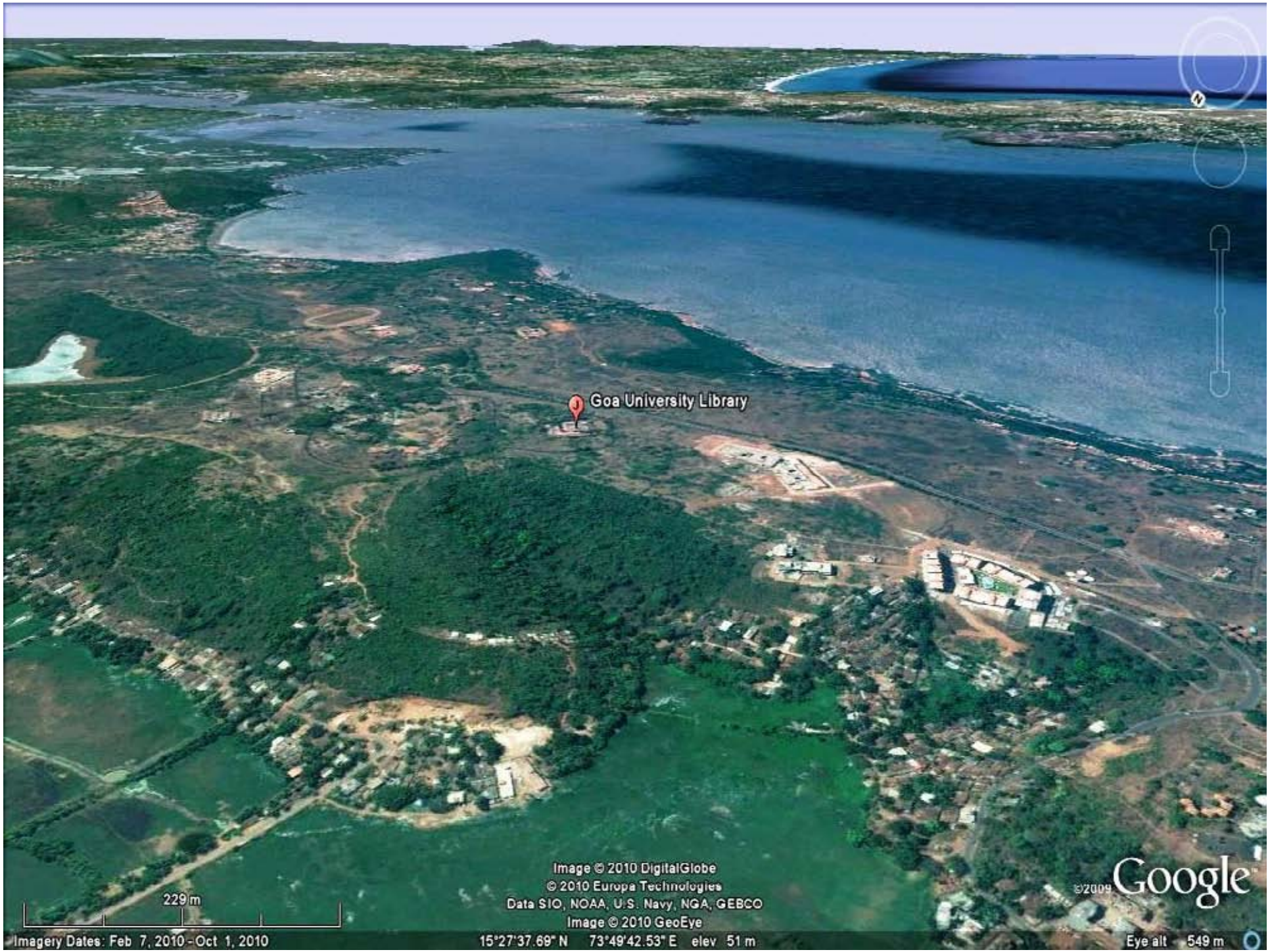
A schematic vertical section showing unconfined aquifer in coastal alluvium and confined aquifer in fractured basement rock below coastal tableland

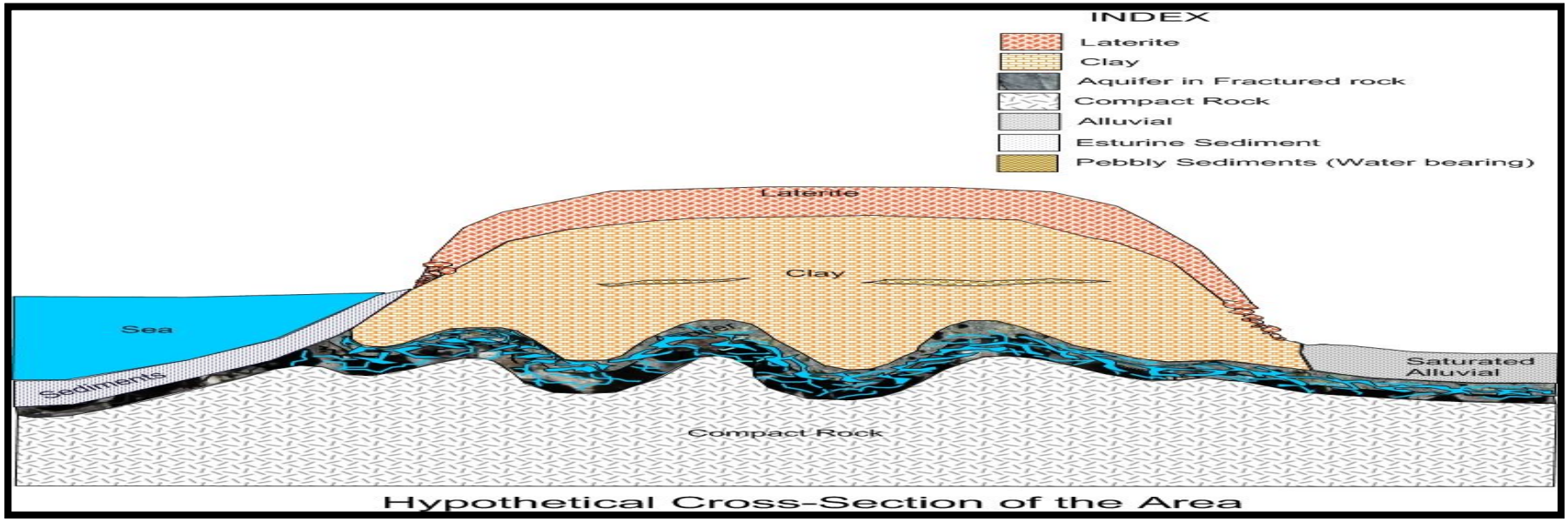
Hard laterite on the surface in Goa

Rainwater harvesting for Groundwater Recharging in Goa

Case study - 1

Surface runoff water harvesting at Goa University started from June 2007


Goa University Library
Image © 2010 DigitalGlobe
© 2010 Europa Technologies
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2010 GeoEye
©2009 Google
229 m
Imagery Dates: Feb 7, 2010 - Oct 1, 2010
15°27'37.69" N 73°49'42.53" E elev 51 m
Eye alt 549 m



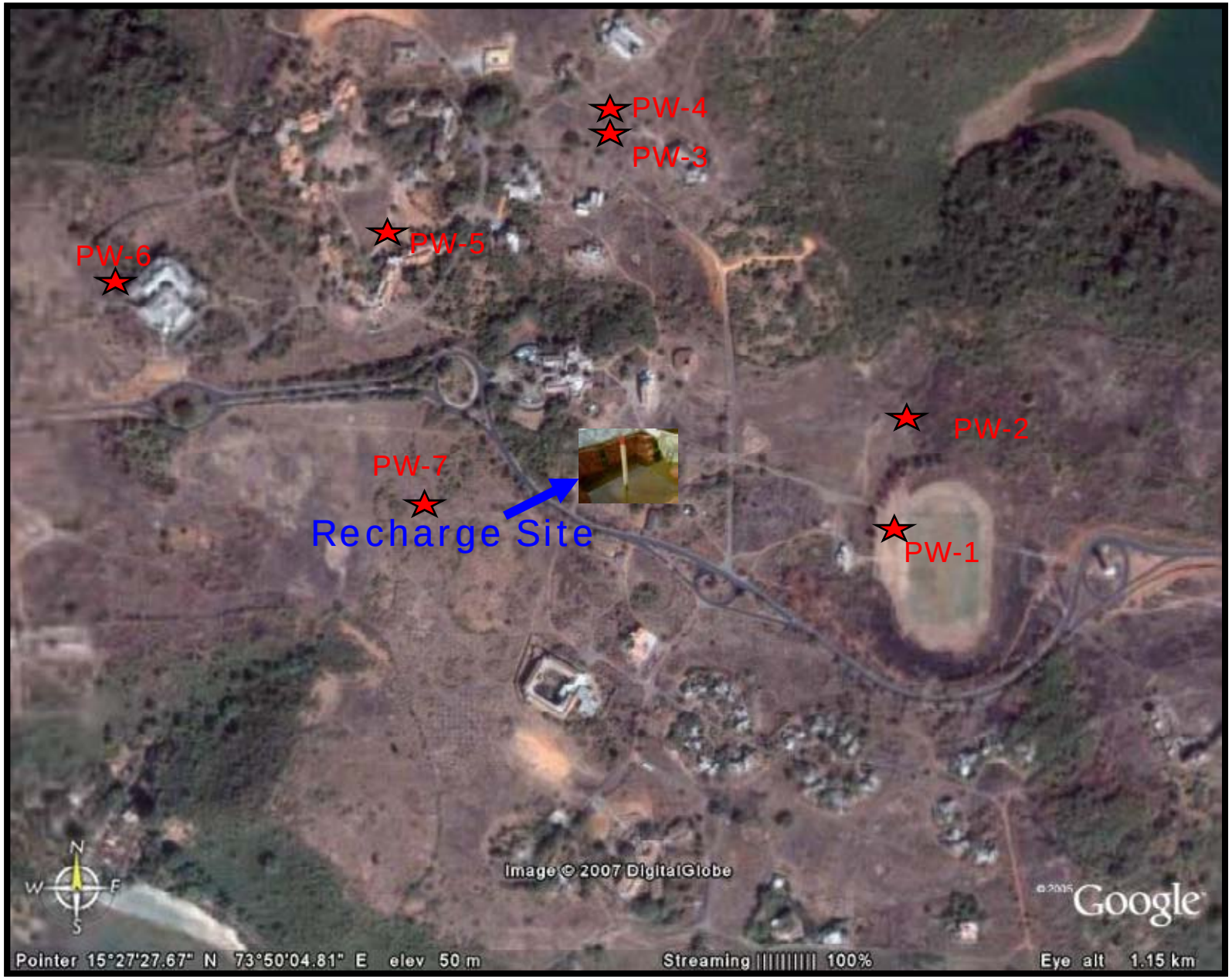
Hypothetical Cross-Section of the Area

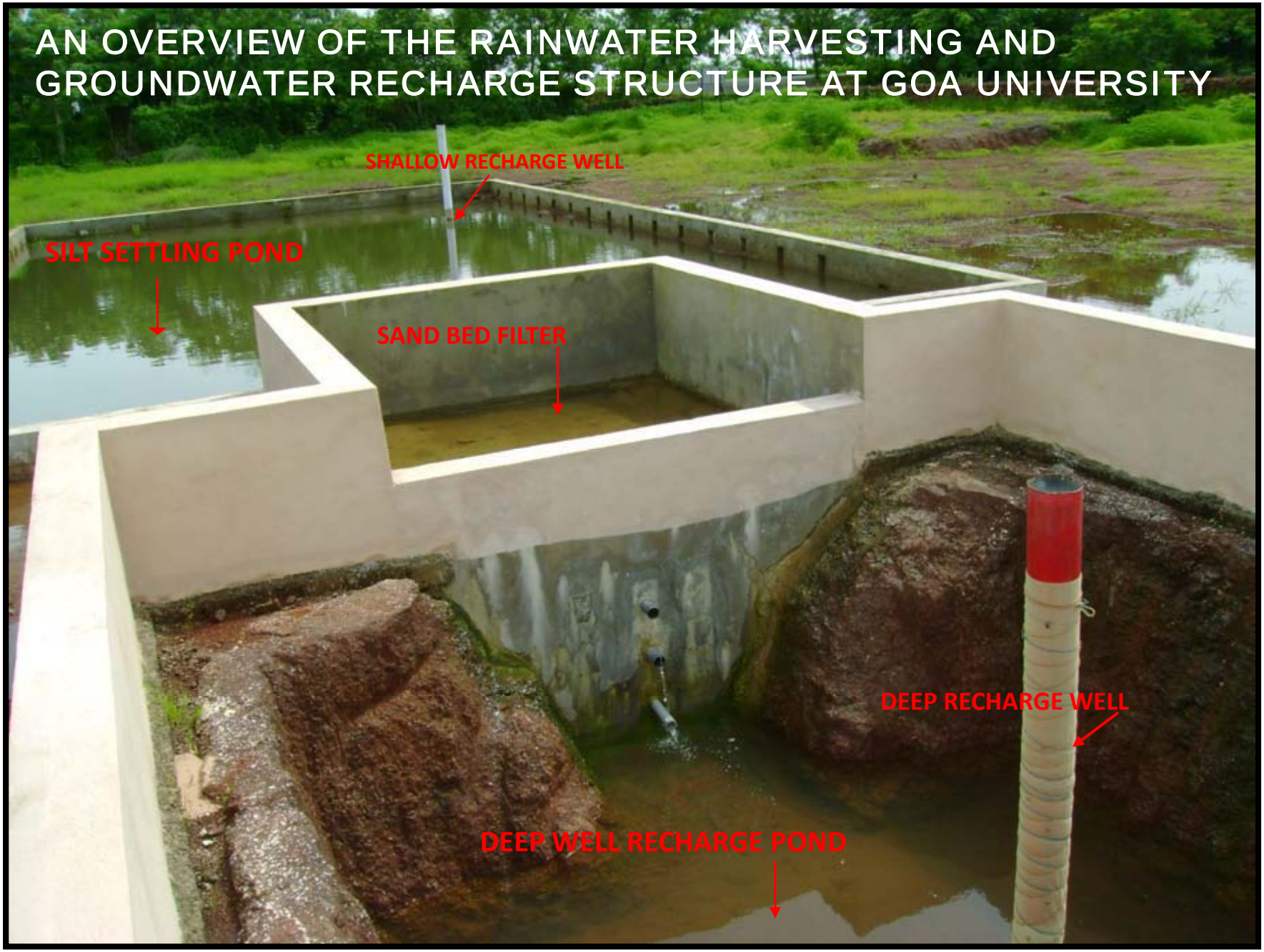
Catchment area at the surface water harvesting site -1

Deep recharge bore well close up

Shallow recharge bore well

Satellite image showing the rain harvesting site



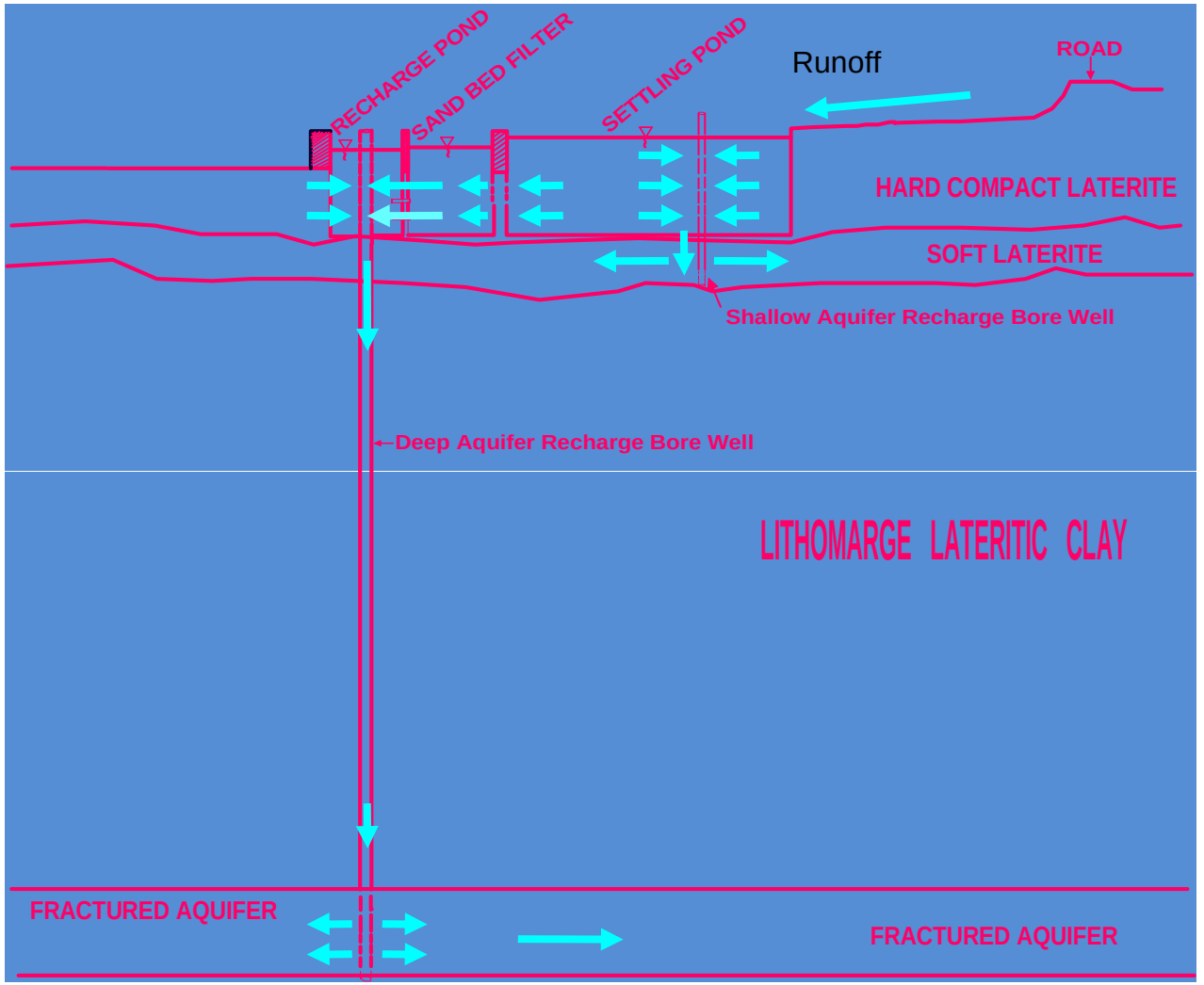

AN OVERVIEW OF THE RAINWATER HARVESTING AND GROUNDWATER RECHARGE STRUCTURE AT GOA UNIVERSITY
SHALLOW RECHARGE WELL
SILT SETTLING POND
SAND BED FILTER
DEEP RECHARGE WELL
DEEP WELL RECHARGE POND

Silt settling pond

Close up view of site -1

STUDENTS LEARNING FROM THE SITE

DIAGRAMATIC VIEW OF THE GROUNDWATER RECHARGE MODEL



Update on Surface Runoff Water Harvesting and Groundwater Recharging 2010

The equation of recharge contribution per year from the rainwater harvesting structure

1) Total drainage area contributing surface runoff = 15000 m^2

2) Monsoon rainfall during 2010 = 3.7m

3) Surface runoff collected = 55.5 million liters.

4) Estimated recharge (70%) to sub surface through recharge bore well = 38 million liters

The total groundwater recharge during 2010 from this structure amounts to about 38 million liters. The average campus water utilization is about 0.5 million liters per day. Therefore the groundwater recharged volume during 2010 would account for about 76 days of campus utilization . Under normal rainfall years the recharge will be about 25 million litres.

Case study - 2

Roof water harvesting at Goa University started from July 2008

Roof water coming down through special PVC pipes

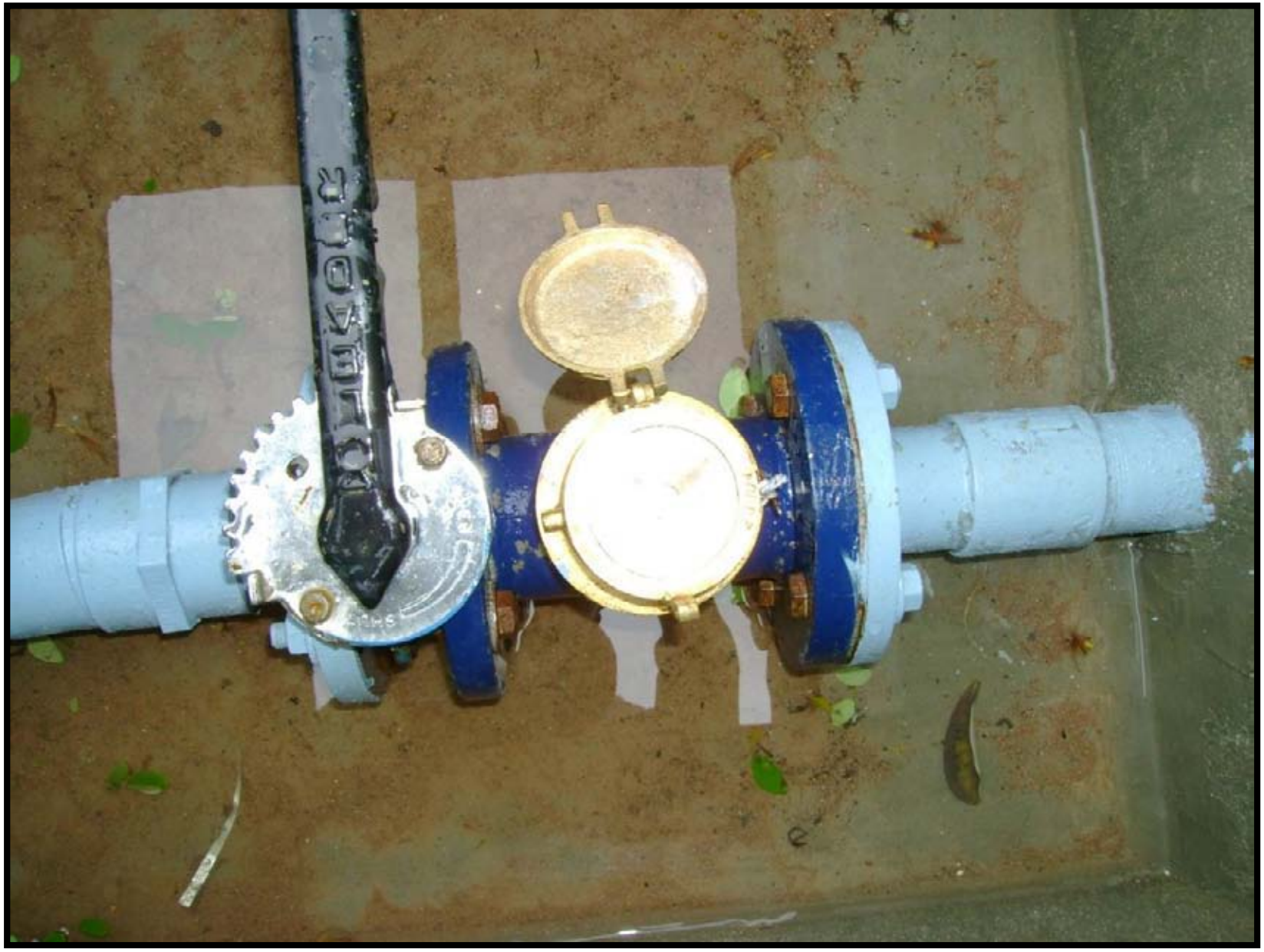
Valves being opened to allow roof water to collection tank

Synoptic view of the roof, tank and the groundwater recharge wells, Goa University

Air ventilation for roof water tank, Goa University

Inside view of the storage tank

Devise to measure the rate of groundwater recharge



View of the PVC pipe inside the bore well. Roofwater stored in the tank comes through this pipe and falls into the bore well and recharges the groundwater

Field study by the students

Update on Rooftop Rainwater Harvesting and Groundwater Recharging as on 2010

The roof area of about 400 m^2 is presently tapped at this site and the roof water harvested and recharged into the groundwater regime through bore well during last three years is:

2008: 260000 liters

2009: 180000 liters

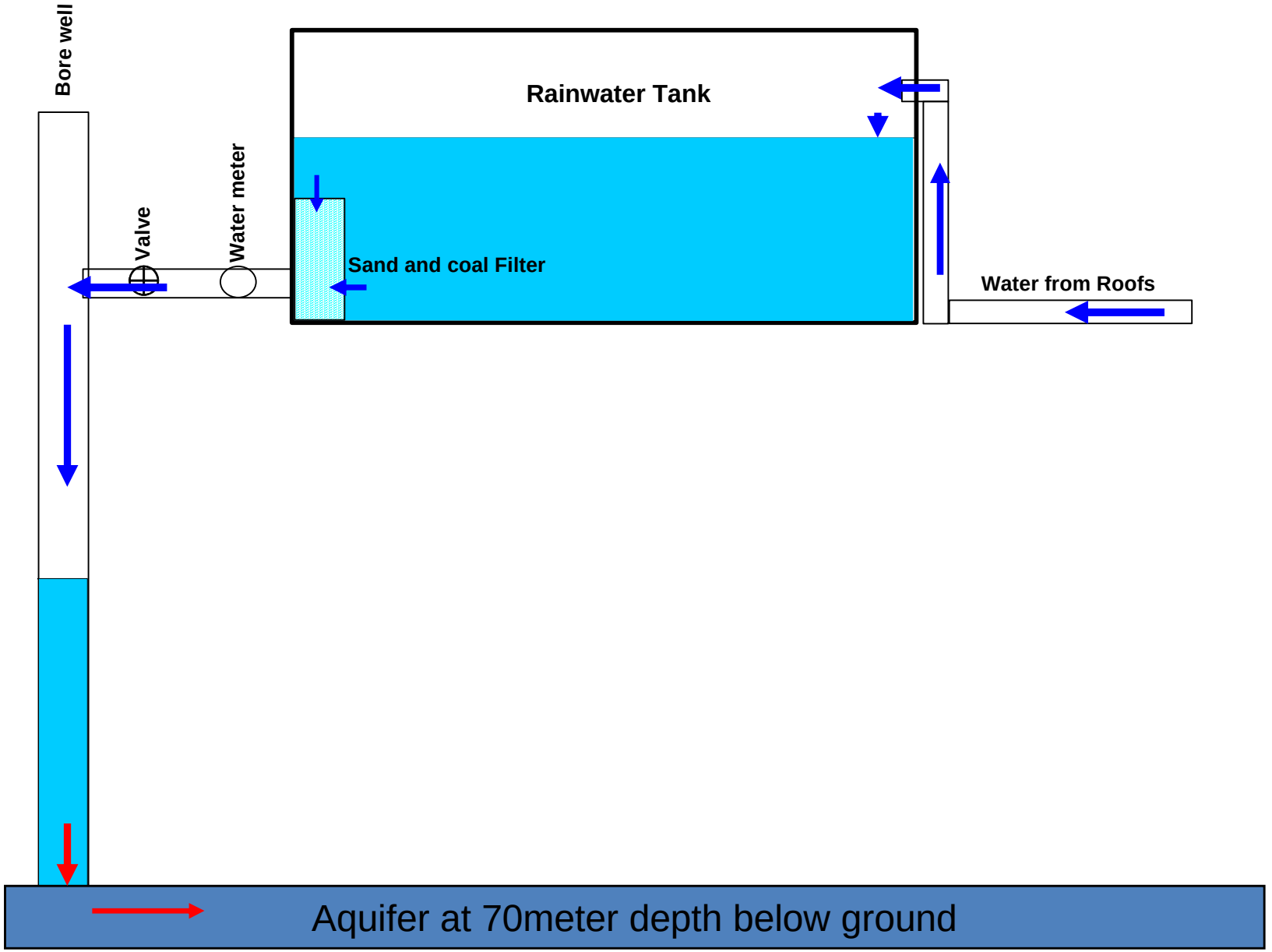
2010: 934000 liters till 11/11/10

There is record recharge this year due to heavy rainfall of 3.7m and increased collection efficiency. This facility need to be augmented by connecting roofs of other buildings which is under progress

Case study - 3

Design and implementation of roof water harvesting and groundwater recharging at ICG Donapaula Goa


THE INTERNATIONAL CENTRE GOA
RAIN WATER HARVESTING &
GROUNDWATER RECHARGING PROJECT
Supported by
Bisleri
The sweet taste of purity
Designed by : Earth Sciences Department - Goa University
This Project will harvest 25 Lakh litres
of rain water every year
Inaugurated on : JULY 9th 2011

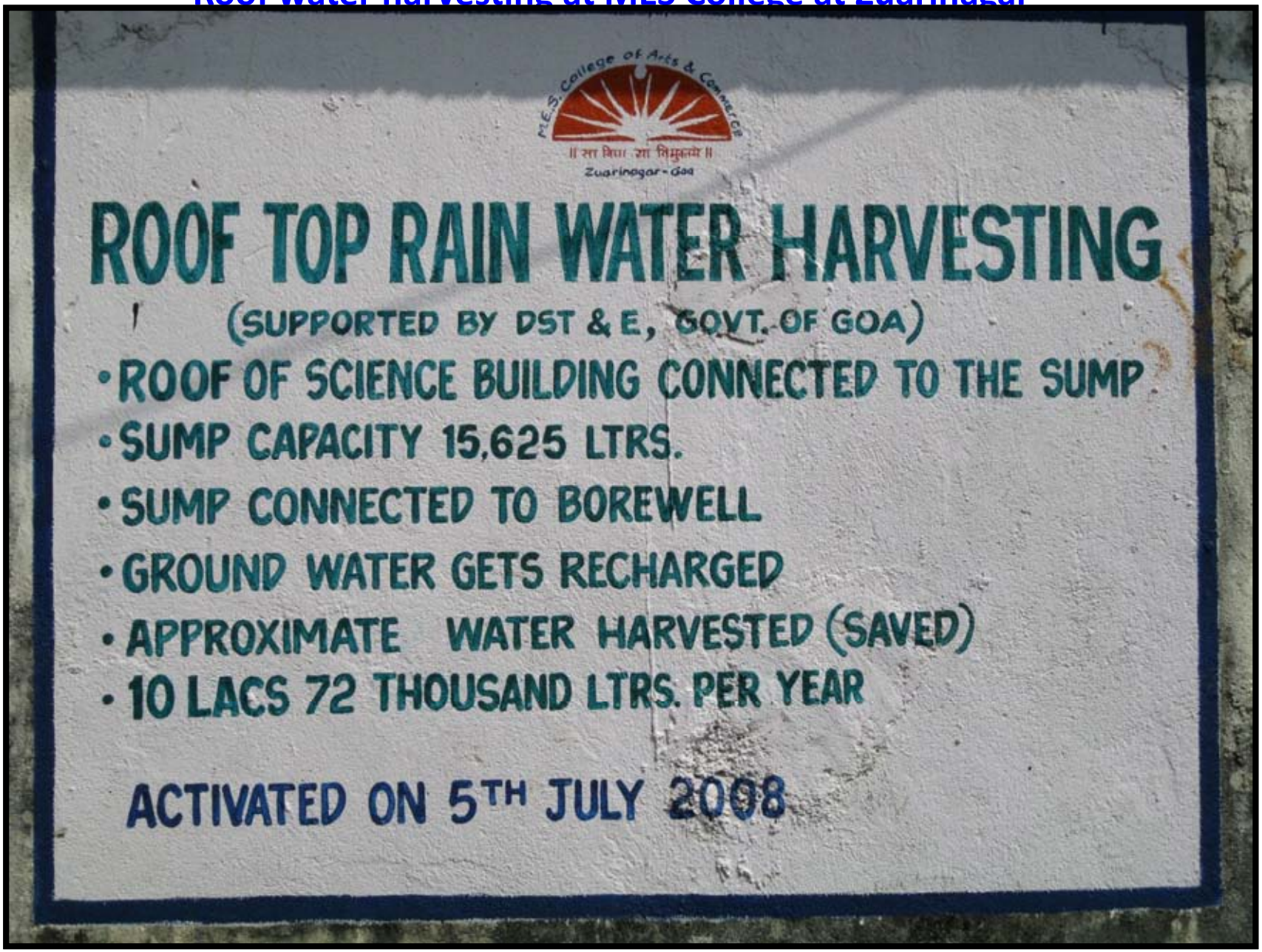

Bore well
Rainwater Tank
Water meter
Valve
Sand and coal Filter
Water from Roofs
Aquifer at 70meter depth below ground

Case study -4

Roof water harvesting and groundwater recharging at MES College, Zuarinagar 2008


MES College, Zuarinagar
N
293 m
©2010 Europa Technologies
©2010 Google
Image ©2010 GeoEye
©2009 Google
Imagery Date: Mar 9, 2010
15°23'31.24" N 73°51'51.92" E elev 76 m
Eye alt 1.08 km

Roof water harvesting at MES College at Zuarinagar



Case study - 5

Roof top rainwater harvesting and groundwater recharging at Birla Fiber Optics factory, Verna Industrial Estate, Goa, 2010

Total Three projects in this plot have been installed

Roof water harvesting site at Birla Optic Fiber Industry at Verna Industrial Estate- 2010

Case Study -7

RECHARGE ESTIMATION FOR A RESIDENTIAL AREA IN PORVORIM PLATEAU

Shallow recharge well

Recharge test in progress

Open pit in laterite for recharge test

Recahrge measurement in pit site

Results of Recharge rates

Borehole No. 1 = 952.6 m3 per day
Borehole No. 2 = 749.50 m3 per day
Borehole No. 3 = 736.7 m3 per day
Borehole No. 4 = 494.1 m3 per day
Borehole No. 5 = 460.4 m3 per day
In Laterite = 32.47 m3 per day

It is seen from the experimental results that the recharge rates for the boreholes range from 460 m^3/day to about 953 m^3 /day which are considered to be significant for laterites. The average recharge rate is estimated to be 678 m^3 per day.

A New Concept of Artificial aquifer to harvest rainwater from backfilled mine pits in Goa

Rainwater Percolation through mine reject dump


18 05 2012


10 05 2012


11 05 2012


14.05.2012


29.05.2012

The inflow rate tested during 1st June 2012 is 4176 m^3/day for this artificial aquifer well

Model demonstration to villagers

Awareness to students from high schools

Participation by the villagers


THANKS
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