



Hydrology Project in India to Monitor Water Levels

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Declining water levels and the drying up of open wells over a period of time has been observed throughout India and has caused prolonged droughts along with pumping and utilization. In many states throughout India, this has become an impediment to monitoring water levels and quality since many open wells have become dry. In order to overcome this lack of monitoring locations, deep bore wells (piezometers) were constructed under the World Bank Aided Hydrology Project, which started in the year 1995 and ended in March 2002.

As part of the project, funding was provided to each State in India to obtain and install modern digital water level recorders for the accurate measurement of groundwater levels. For over 2,200 sites, In-Situ's TROLL data loggers were selected due to their ease of use, reliability and accuracy of data. The TROLL data loggers include sensors to monitor temperature and water level, an internal data logger and power supply all inside a single, fully submersible unit. Installation and support of the equipment is performed by our distributor SWAN Environmental from their multiple offices around India.

The main objectives of the Hydrology Project

- 1) To construct a network of observation wells and to install modern digital water level recorders for the accurate measurement of groundwater levels.



- 2) To upgrade the collection of hydrological data and improve the processing of it.
- 3) To develop a sophisticated, user-friendly database for the dissemination to various agencies including voluntary and non-governmental organizations engaged in related studies.

Advantages of an Automatic Water Level Recording System or AWLR (TROLL data logging system):

- Aquifer behavioral characteristics can be easily noticed
- Identification of aquifer characteristics from a group of known influences—rainfall, canal seepage, etc.
- Magnitude and lag time effects of precipitation on the groundwater
- Determination of multi-aquifer systems and the establishment of aquifer controls
- Date wise division of the hydrograph to study the pumping influence on the aquifer
- Easy to store data at well and office sites



A.P. State Ground Department manages water monitoring locations throughout the Andhra Pradesh State in Southeast India.

Joint inspections with members from A.P. State Ground Water Department, SWAN Environmental and In-Situ at one site where a miniTROLL was deployed to monitor long-term water level trends.

- Easy to transfer data from piezometer / AWLR to office using Pocket PC computers
- Easy transfer and usage of data from the district level to the state level and the national level by means of an Internet facility
- Water level fluctuations can be studied at any required interval by programming the AWLR as needed

Moinabad Case Study

Moinabad in the Rangareddy District is situated at about 23 Km west of Hyderabad in Andhra Pradesh State in Southeast India and has an area of 193.4 Km².

The Moinabad area has medium to rugged terrain with a general slope towards the east. The highest and lowest altitudes in this area are 620m and 542m respectively. The drainage is sub-den-

driftic in nature and is marked by a number of gullies with eroded sides. There are a number of granite outcrops and hillocks in the area.

The area receives 723 mm of mean annual rainfall; 80% of the rainfall is contributed by the southwest monsoon.

The area of Moinabad is underlain by pink and grey granites of Achaean age and a basaltic flow 3-6m thick can also be observed in the north part of Kethireddipalle and Sajanpally villages. The host rock is traversed by a few dolerite dykes, pink feldspathic veins and quartz reefs. The granite is medium to coarse grained, equigranular and porphyritic in texture.

Groundwater occurs under water table conditions and is confined to weathered and fractured portions of the host rock. The depth of the weathered zone varies from 6 to 25m below ground. Groundwater presently is being extracted by means of bore wells



Two separate water level monitoring sites in the Rangareddy district about 23 Km west of Hyderabad.

because of the depletion of water levels beyond the weathered zone of the host rock.

There are 2522 bore wells in this area, out of which 125 are hand pumped, 93 are used for drinking water, and the remainder are used for irrigation.

As part of the Hydrology Project, a piezometer was drilled in the premises of the Moinabad Development Office to a depth of 40m in 1996. PVC casing was inserted to a depth of 14.75m and the yield of the bore is 600Lph. Water is encountered at a depth of 18m. An Automatic Water Level Recorder was installed in the piezometer during 1998 and is programmed for hourly sampling. Data is retrieved every month and analyzed to identify remedial measures to the district and local administration. Analysis of the water level data vs. rainfall data is shown in the composite hydrograph of Moinabad (figure 1).

Monitoring and analysis of water level data

- Groundwater monitoring systems are a scientific means of surveillance to observe the periodic changes in groundwater levels. The data collected over a period of time provide

information about changes in the groundwater levels.

- The depths of the water levels in observation wells in the district are monitored six times in a year (May, July, August, September, November and January).
- 48 piezometer monitoring stations are measured every month where piezometers fixed with AWLRs are programmed for 1-6 hour sampling and the data is retrieved monthly.
- The depth of the water levels are measured in 83 observation wells during the months of May (Pre-monsoon) and November (Post-monsoon). The collected data is compared, impact studies are carried out, and depth to water table contour maps are being drawn.
- Piezometers fixed with AWLRs are programmed for 1-6 hour sampling and the data is retrieved monthly. The data obtained is combined on a hydrograph together with the rainfall of the area.
- Comparative analysis of the water levels with the collected data and the water levels of open wells (phreatic) with bore well (semi confined / fractured).

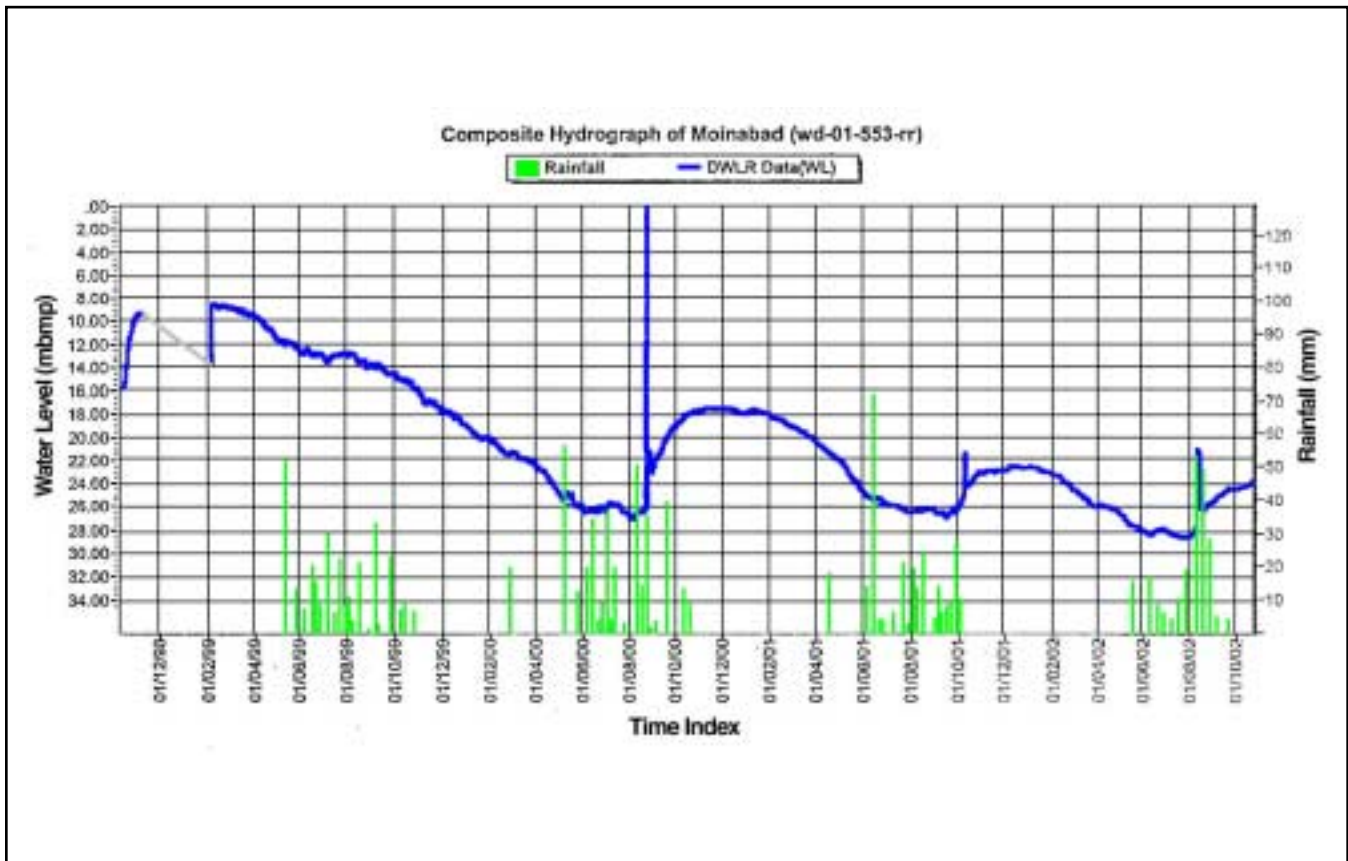


Figure 1: Hydrograph from Moinabad comparing the water level and rainfall data over a four year period. Water level data is provided by the TROLL data logger.

Problems encountered at some well sites

Many of the well sites were constructed by inserting a heavy duty Machined Steel (MS) casing into the ground while the bottom of the casing is generally left open without any filtering materials or a screened interval. Due to this method of construction, water flow is restricted and/or clogged over time causing the water to become stagnant inside the casing. Over time the well casing materials begin to degrade showing heavy signs of rust. It can fall into the water and over time attach and build up on the stainless steel housing of the TROLL monitoring instruments (see image below). Rusted material from the well casing can build

up inside the sensor inlets and on the sensor itself causing the sensor to become rigid to respond to water fluctuations.

Proper well design and construction materials combined with routine well flushing and maintenance could help to improve these sites. Alternatively, use of a Water Barrier Kit would create a fresh water barrier around the unit protecting it from chemical reactions with the rusted materials.

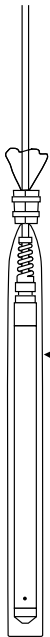
Acknowledgment: Information and illustrations for this Application Note were generously supplied by the Andhra Pradesh Ground Water Department and SWAN Environmental Pvt. Ltd.



The well casing materials used at this site have begun to degrade showing heavy signs of rust.



Heavy deposits of rusted well casing material on the TROLL's stainless steel sensor housing can cause damage to the sensor.



Use of a Water Barrier Kit creates a fresh water barrier around the unit, protecting it from chemical reactions with the rusted materials.



A Multi-Parameter TROLL 9000 is used to assess the water quality of the site.

