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Experimental Design and Continuous monitoring of Costal Hydraulic study of Beach ground water table at Vellappatti Shoreline, Thooouthukudi District, Tamilnadu, India

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Abstract

The present is study focus field investigation, beach profile measurement, tidal water level and ground water level through water level pressure sensor and piezometers Well water level fluctuation supplemented by experimental design. Apart from these studies the passive characteristic features such as size, shape, roundness, porosity and permeability of beach sediment with different characteristic are accountable for this study. The hydraulic condition of the study area mainly composed on the elevation and beach groundwater table. The groundwater levels of all tube wells or piezometric wells at vellappatti beach are controlled by wave and tidal impact due to the subsurface condition of the soil deposition and evolution of Van Island. The above experimental data plotted time vs piezometric level is increase slowly, constant, fast, irregularly patterns used for the factors. The supporting of dumpy level data and 2D Electrical Resistivity imaging technique is used for the comparative study.

Key word: Hydraulics, beach, water level, Piezometric, Vellappatti.

Introduction

The study area is located in the latitude 8°51'07.6" Longitude 078°10'02.8. It is a coastal area of Thoothukudi District, located on the coastal tract of Gulf of Mannar, vellappati beach are selected for the study. The objective of the study is to monitor or analyses the formation of groundwater table and to detect the saltwater freshwater interface with help of experimental design to Continuous monitoring of salinity structures through 2d-electrical resistivity imaging study at Vellapatti Beach (figure- 1).

Geology of the study area: The study area mostly covered by beach sediments, such as sand, sandy clay, clay, beach sandstone, The recently formed Alluvium sediments were situtated near the study area.

The study area is experience in semiarid – tropical climate. Air temperature data indicate that May – August is the hottest months in the district and December – February is the coolest months in the district in the year. The mean annual temperature of the district is 28.30C. Mean annual precipitation is 675.71 mm. Major rainfall is received during the northeast monsoon period. The maximum rainfall is received during November.

Methodology of the study: To comprises field investigation, Beach profile measurement (figure-2), Tidal water level and ground water level through Piezometers and Geophysical studies. Passive characteristic features such as Sediment - size, shape, roundness, porosity and permeability with different gradient. The data collected from the different field viz. sedimentological, hydrological and oceanographic interactions will bring out a unified model of natural beach environments[1-4]. Automatic water level recorder is an micro processor based instrument to measure the water in the Piezometric wells based on the principle of hydrostatic pressure sensing. Automatic water level recorder is capable of taking measurements at programmable interval of 30 minutes (figure-3 and figure-4). It can store and transmit the data to laboratory at V.O. Chidambaram College, Tuticorin through telemetric GSM network. Data can also retrieved through hand held PC RS-232 port.

Material and Methods

The elevation data were collected with help of Auto level equipment. The subsurface condition were studied using CRM 500, steel electrode and multicore cable and Res2DINV software to prepare one 2D Electrical Resistivity Imaging pseudosection. The micro processor automatic water level recorder equipment made by IGIS, Hyderabad was used for beach ground water study. The tube wells piezometric water levels and bore water pressure were identified from this study. (figure 5a, 5b and 5c). The water and soil interaction with gravity act as major role in the peizometric study[5,6]. Dumpy level is most popular instrument for leveling. This is the combination with plane table and is useful for all ordinary purposes. The level section can be run, either along radial lines from a known point or run two sets of interacting parallel lines at right angle to each other, constituting a grid. The reduced levels of the several points are determined along this lines and the contour interpolated. In the beach and near shore region wind generated waves, tides and sea level fluctuations cause shoreline changes resulting in erosion and accretion along the shore, most of which can be explained with the parameters like wave steepness, sediment fall velocity and gradient of the beach[7]. The morphology of a beach depends on various parameters studied by Carter R.W.G[8]. At a particular time, the formation of a beach-state is the function of its sediment characteristics, the antecedent topography of the natural beach topography and the immediate and antecedent wave, tide and wind conditions and resistivity imaging changes (figure 2).

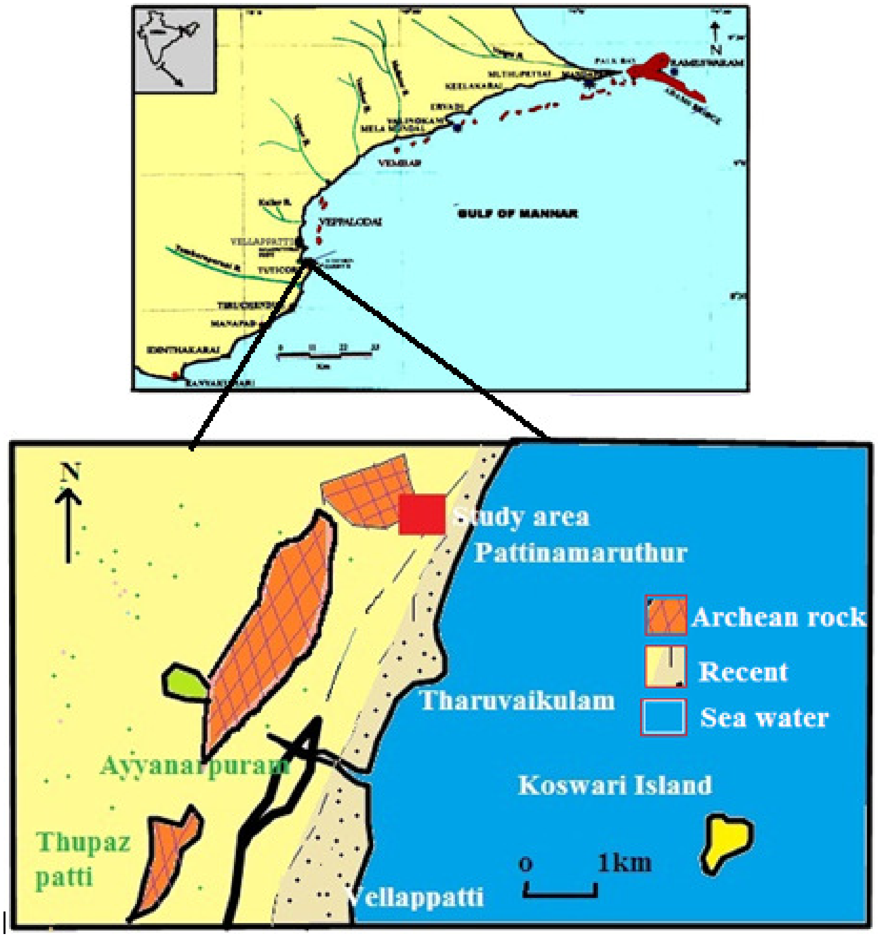

Figure.1
The study area Map

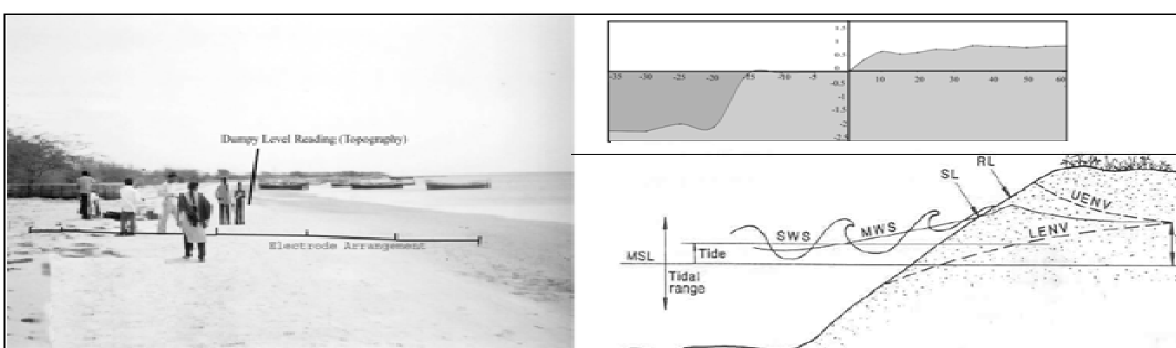

Figure-2
Schematic of the ocean forcing of coastal aquifers using dympy level
MSL = Mean Sea Level; SWS = Still Water Surface; MWS = Mean Water Surface, SL = Shoreline; RL = Run up Limit ; LENV and UENV are the lower and upper bounds of the water table oscillation envelope. $\eta+$ = water table over height above MSL generated by oceanic forcing.

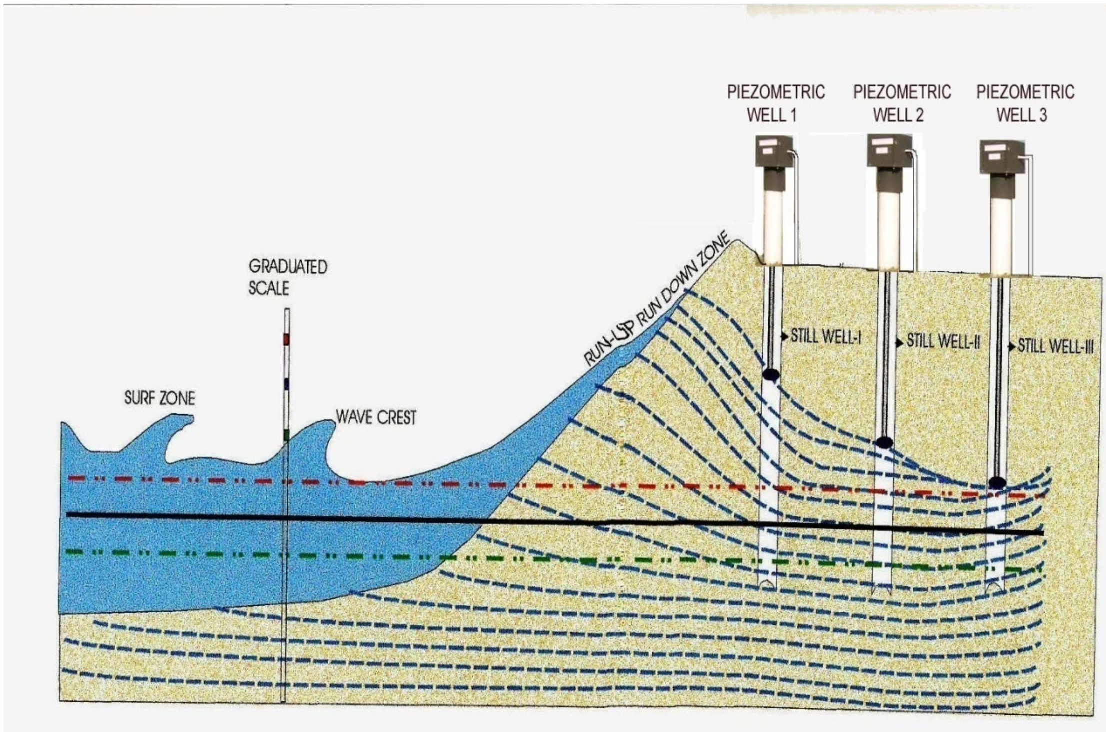

Figure-3
Schematic diagram of water table fluctuations in the coastal aquifer and in the surf zone

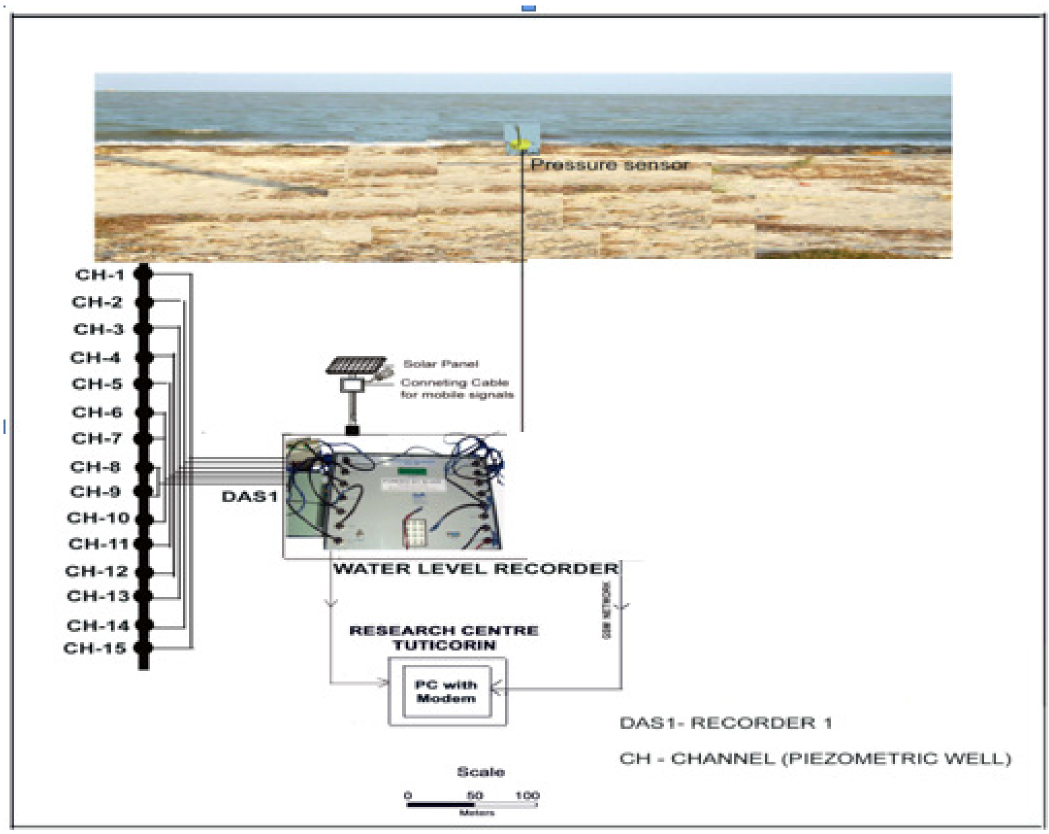

Figure-4
Shows water level piezometric well observation arrangement

Figure-5a
Shows water level piezometric well

Figure-5b
Seawater intrusion and it impact in palm trees in the nearest places

Figure-5c
Shows water level piezometric recorder and tidal recorder

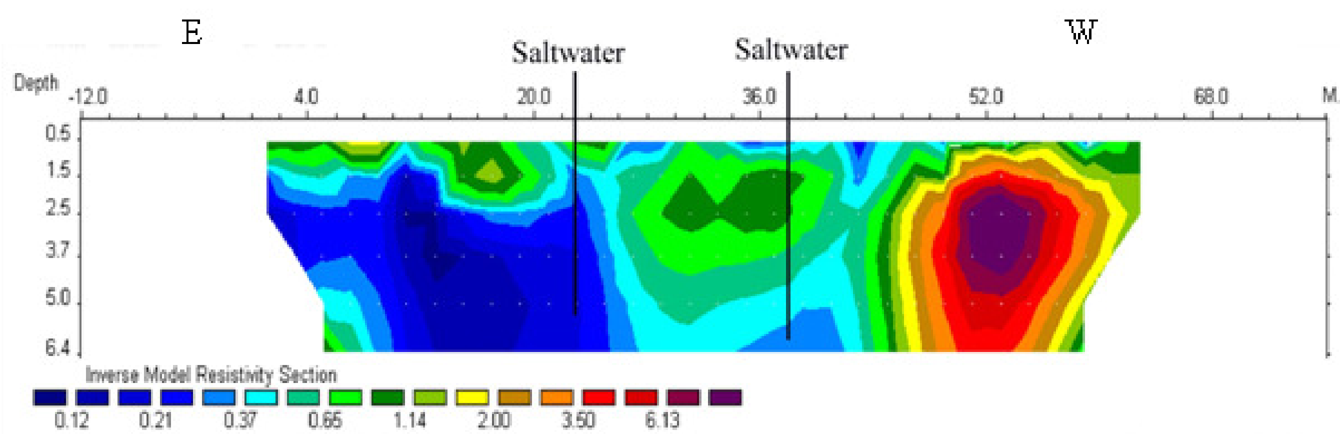

Figure-6
Shows the 2D ERI imaging section in the observatory wells

Results and Discussion

The comparison of tidal fluctuations with the beach groundwater fluctuations through piezometric wells establishes their close relationship in resistivity imaging pseudosections (figure 6). Further it is noted that the beach ground water table fluctuates with greater amplitude near the ocean and is inversely proportional with the distance from the ocean which indicates the dissipation of tidal energy along the beaches. The hydraulic study of beach groundwater table is depending upon the two factors such as gravity based groundwater flow and water flow movements in the sedimentary formations. Theoretical studies for such conditions of groundwater table have been carried out by Nielson[9-12]. Together with the tidal effect, the wave parameters also contribute to the beach water table fluctuation. Beach groundwater table fluctuation is compared with tidal fluctuation to determine the time lag with respect to the distance perpendicular from the beach face. The time of the occurrence of the high tide and low tides are noted and then compared with the time of occurrence of the high water level and low water level in the wells. The time difference between the occurrence of the high tide and the occurrence of the corresponding high water level in the wells is the time lag. Similarly time lag can be calculated from the time difference between the occurrence of piezometric water level change were used for the effect of hydraulic pressure due to the tidal impact were identified using the graphical interpretations. For example if the high tide has occurred at 6:00 AM and the corresponding high water level in the first well has occurred at 8:00 AM and in the second well at 10:00 AM then the time lag is 2 hours for the first well and 4 hours for the second well. If the time is kept fixed, then the variation is tidal level and the water levels in the wells are established (figure-7.1 to 7.11).

The time lag between the tidal crest and the corresponding water level crest at Well-II ranges from one hour to three hours where as it ranges between two hours to eight hours for the third well. The time lag between the tidal trough and the corresponding water level trough at Well-II ranges from one hour to 12 hours where as it ranges between 2 to 18 hours for the third well. The values of the crest and trough for the tides and water level at the still wells. These figures indicate that the overall beach groundwater flow is in the landward direction. This is very much evident from the field observation also. There is excess pumping of groundwater by the marine based industries in the adjacent areas of the beach.

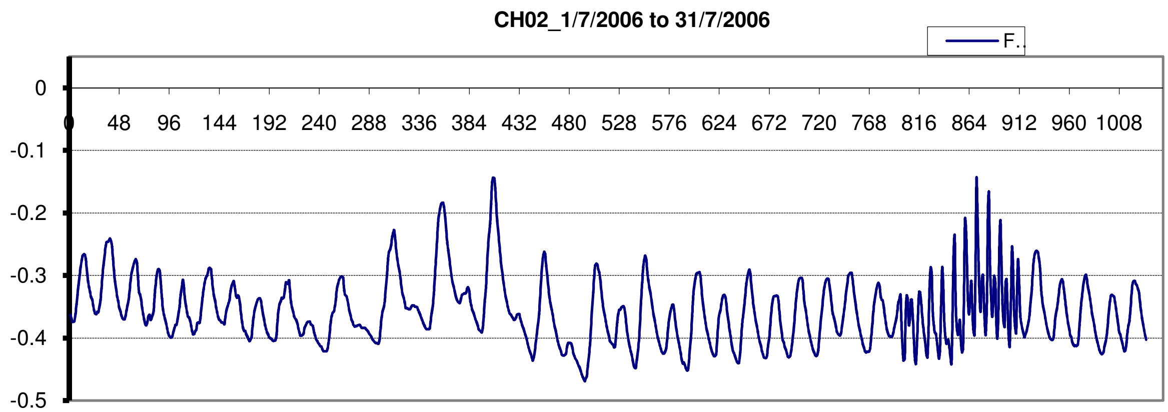

Figure-7.1
Piezometric water level vs time

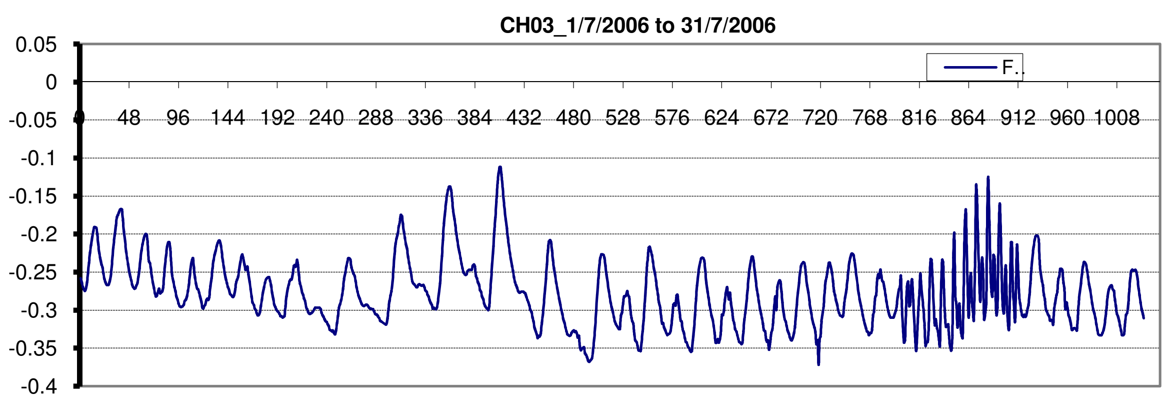

Figure-7.2
Piezometric water level vs time

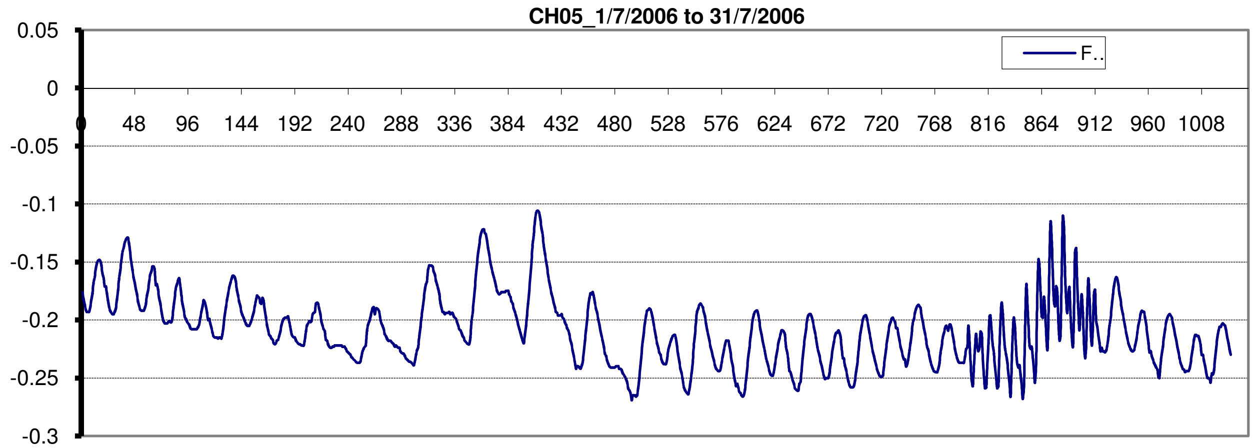

Figure-7.3
Piezometric water level vs time

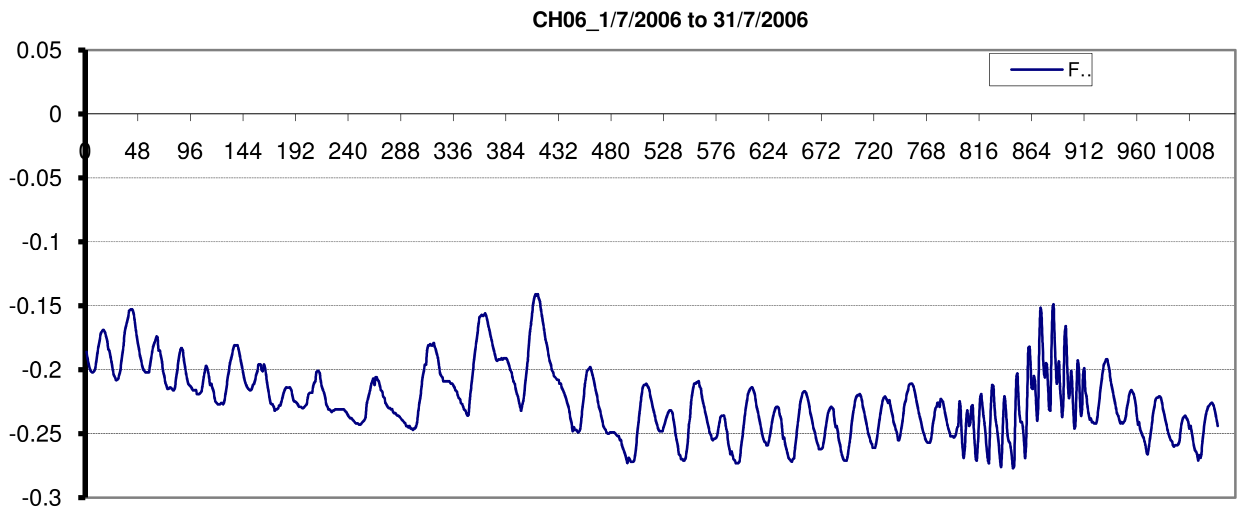

Figure-7.4
Piezometric water level vs time

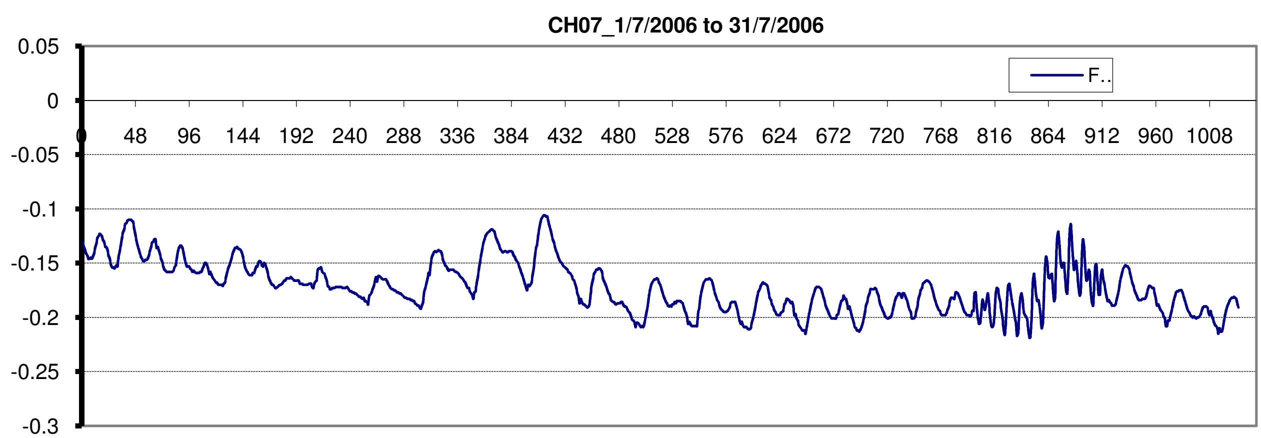

Figure-7.5
Piezometric water level vs time

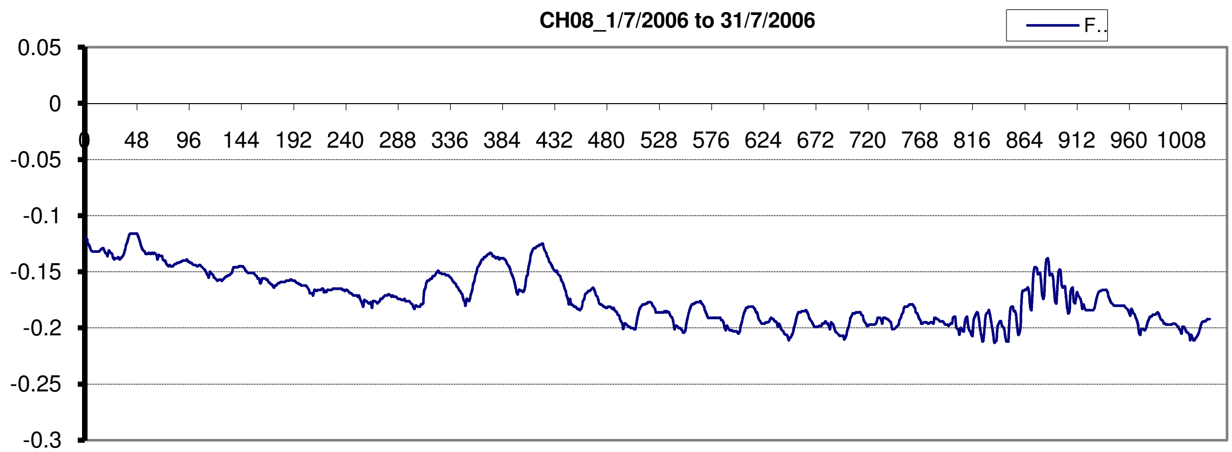

Figure-7.6
Piezometric water level vs time

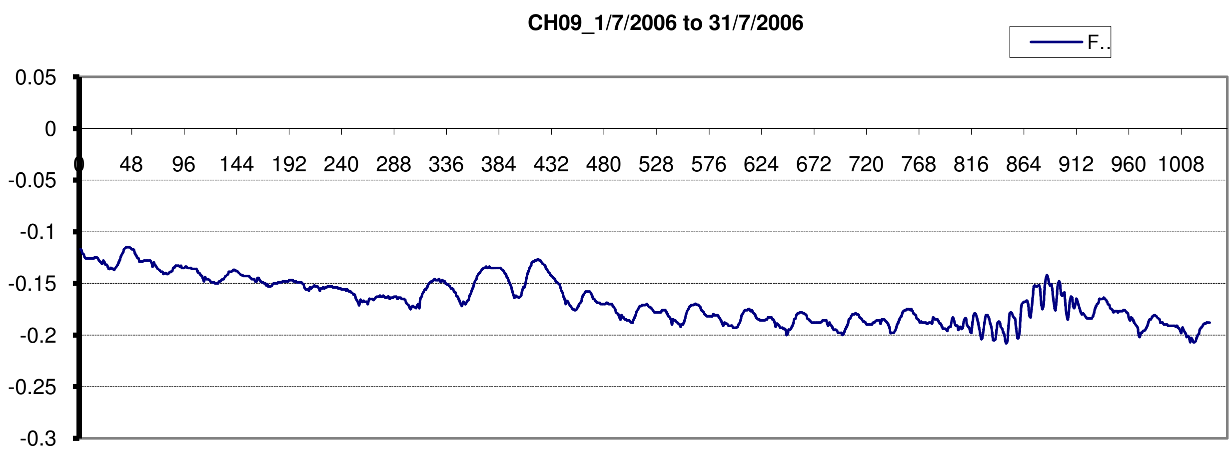

Figure-7.7
Piezometric water level vs time

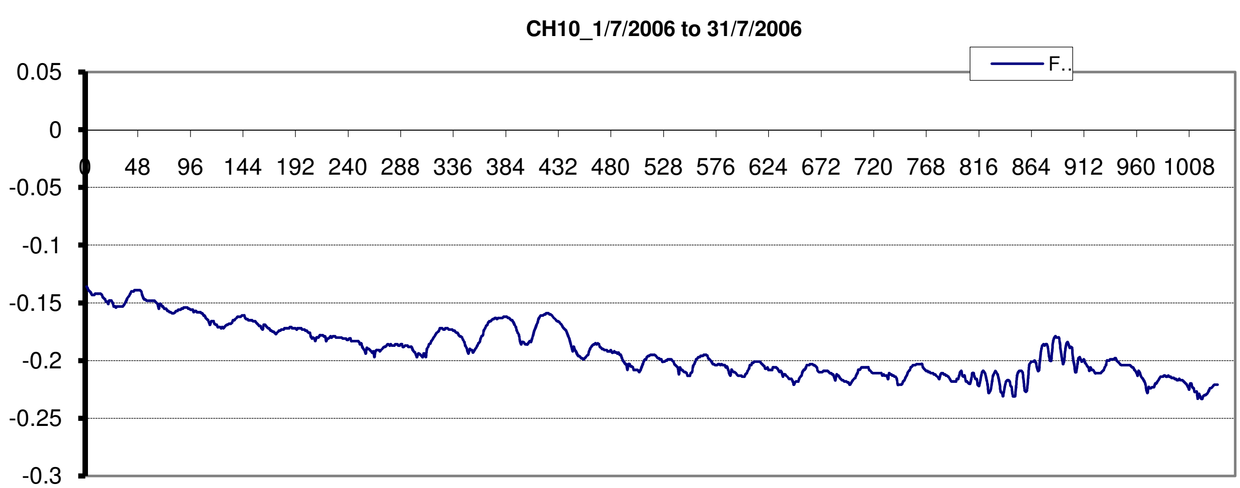

Figure-7.8
Piezometric water level vs time

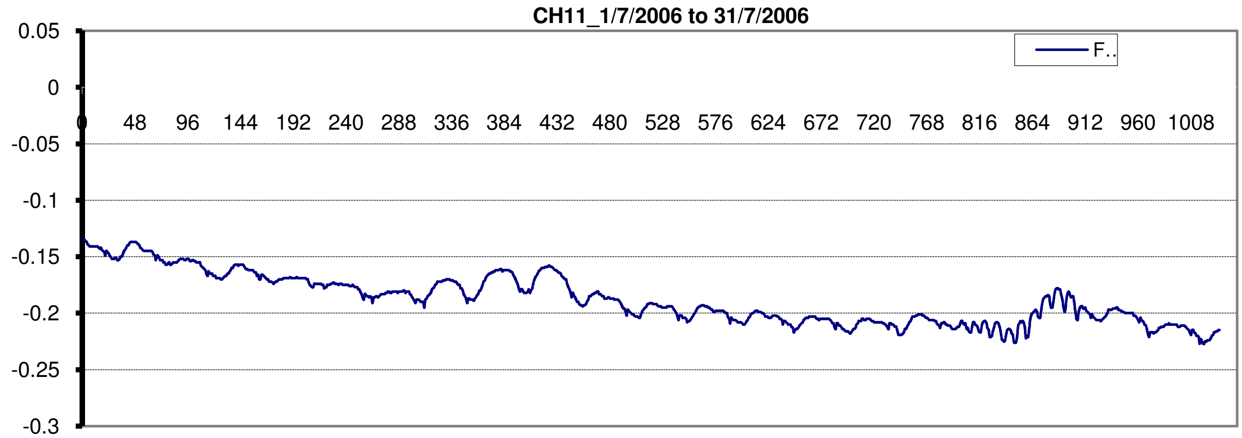

Figure-7.9
Piezometric water level vs time

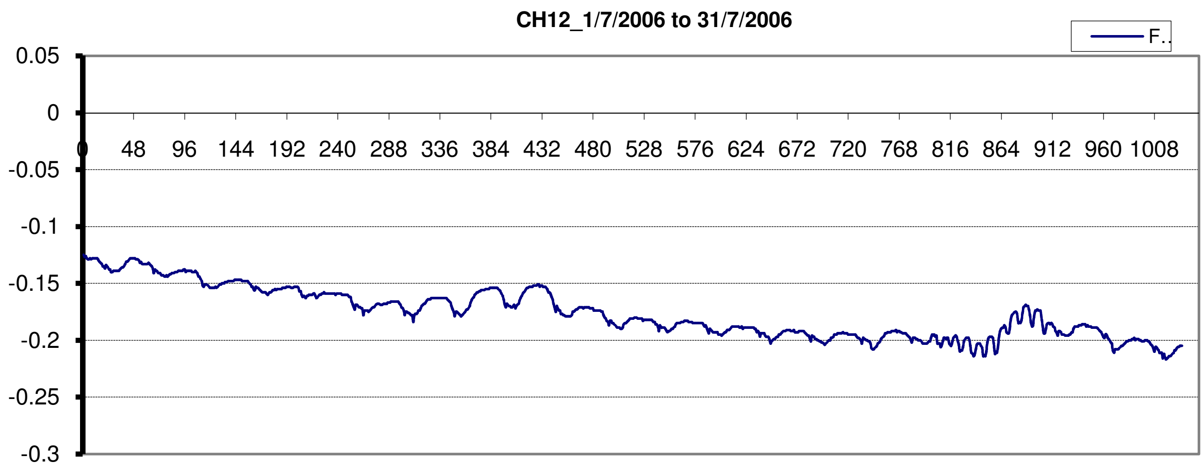

Figure-7.10
Piezometric water level vs time

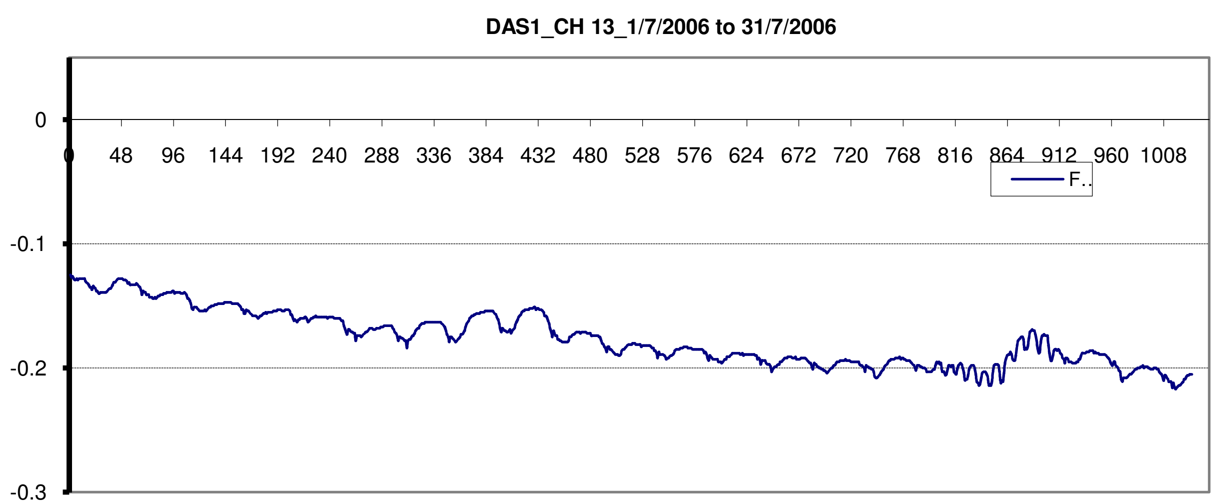

Figure-7.11
Piezometric water level vs time

Conclusion

Observation of beach groundwater fluctuations in the beaches of Vellappatti were continuously monitored from 1-7-2007 to 31-7-2007 which reveals that the coastal water table has been found is determined by the categories of tidal impact, beach gradient and geomorphology of the study area. The slope of the beaches at vellappatti is more ranging from 1^0 to 6^0. Water flows into the unsaturated part of the beach much more easily during sea level rise than it drains out into the sea during low sea level. This effect is quantified by our results of the piezometric experiments carried out in all the beaches of the study area. The comparison of piezometric water level with the tidal levels revel the impact of the tide on the beach groundwater table. The tidal range is more at ch02 to ch08 and low at ch09 to ch13 at vellappatti. The time lag for the first well at all the location is almost the same ranging from one hour to five hours. The study with respect to the time lag reveals that it is directly proportional to the distance of the well. The range of time lag varies from place to place. At Vellappatti the range of time lag is 2 to 6 hours for the second well and 2 to 10 hours for the third well. A clear decline of time lag is evident from Well ch02 to ch13 piezometric water level fluctuation formed due to the tidal impacts. The higher amplitude of water level fluctuation in the first wells of all the experimental sites is caused by the run-up effect. At Vellappatti there is no run-up effect thus the amplitude of water level fluctuation is less in the first well. In field situations the wave induced water table fluctuation is limited to 5 meters landwards from the high water line depending upon the hydrodynamic condition in the surf zone. It is found from the experimental studies that the study area formed in recent formation and tidal effect due to the Van Island. The experimental design is used to determine seawater intrusion and coastal environmental impact directly to affect the plants and aquifer system in the Vellappatti beach.

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