Impact of Urban Waste on Quality of Ground Water and its Modeling Using Visual Mod Flow - A Critical Review

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Abstract: Nowadays, solid waste handling, disposal and management of ground water is one of the most important tasks in various countries. Urbanization and disposal of solid wastes leads to contamination of ground water and surface water sources. Ground water is one of the natural resources on the earth and is the only source of drinking water in all the regions. It is clearly distinct from the ground water monitoring that the Leachate generated from the land fill site is affecting the ground water quality in the nearby areas through percolation in the sub soil. The present study is focused on urban waste and its impact on groundwater in various cities. Ground water modeling has become an important tool to support planning and decision-making. The models provide an analytical framework for obtaining and understanding the mechanism involved in the ground water systems. Modflow software is very useful for developing models for the study in different areas. It is a simplified representation of the site to be modeled, including the process that influences their quality caused by human intervention. In the present scenario, the visual Mod flow modeling is an effective way to deal with this challenge.

Keywords* — *Contamination, Landfill, Leachate, Modelling, Solid Waste, Visual modflow

I. INTRODUCTION

In recent days, ground water has become an important and indispensable source for all living beings. Groundwater plays a vital role in meeting the ever-growing demand for domestic, agricultural, and industrial usage. There is a universal tendency to tap the ground water, which has resulted in serious falls in water level in many parts of the world. Solid waste is the unwanted part of animal and human activities which are basically solid in nature. The solid waste is generated from residential, industrial, commercial, construction, demolition, hospital and agriculture sectors and it is disposed in land fill sites. Due to the changes in consumption pattern of human beings, the quantity of solid waste generation and its toxicity is also increasing. Meanwhile, ecological problems such as air pollution, soil and ground water contamination due to leachate have become a major problem to the ecology. Many geo-ecological problems and the discharge of salts and nutrients in soils have direct or indirect impact on groundwater. The solid waste is rich with complex effluents such as dissolved ammonium, calcium, magnesium, sodium, potassium, iron, sulphate, chlorides and heavy metals like cadmium, chromium, copper, lead, zinc, nickel and plant constituents. Municipal solid waste management is one of the major problems in urban areas if the site is not designed systematically or not lined properly for disposal or dumping of waste. Furthermore, if no environmental impact assessment (EIA) has been carried out prior to the selection of site, it may result in continuous groundwater contamination. Many researchers studied groundwater contaminant transport by using mathematical models. Ground water investigation by modeling has been known to scientists for a long time, since assessment and monitoring of the underground water are difficult exercises. Usually, the impact of type of contaminant is neglected or only qualitative assessment is made in most cases. Mathematical models provide a framework for understanding the physical, chemical, and biological processes that find out the cycling of elements and compounds through the

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environment. This software consists of input, run and output parts. First, characteristics of soil, ground water and also boundary conditions are assigned by software. Run section is designed to translate input section into the standard input to simulate.

II. Mechanism Of Ground Water Contamination Due To Leachate

Nowadays, the hydrologists deals with the mechanism of ground water flow, contaminant transport, bio-degradation and sorption, pure phase impacts in source areas and

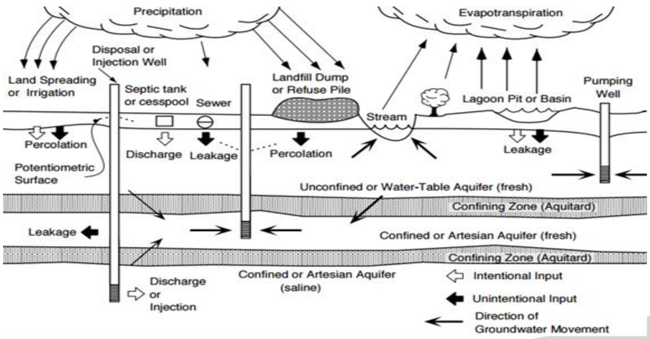

Fig-1 Mechanism of Ground Water Flow

Nowadays, the hydrologists deals with the mechanism of ground water flow, contaminant transport, bio-degradation and sorption, pure phase impacts in source areas and plumes, and remediation schemes. The ground water flow study in the subsurface, including well mechanics, is required before one can make any progress towards explaining or processes predicting contamination.

III. Modeling Of Ground Water And Leachate Flow

- To understand the physical, chemical, and biological processes controlling the fate and movement of contaminants in the subsurface environment.
- To present the mathematical representation in the transport models that predicts the contaminant movement.
- To determine the different model parameters in the field and the laboratory using different methods
- To develop the transport models to predict contaminant movement if they are introduced.
- To develop the management models to control and/or prevent the introduction of contaminants in the aquifer and to determine the methodology for the safe disposal of hazardous wastes, and for the removal of contaminants effectively to protect the biosphere.
- To investigate and predict the key features of ground water its movement and behaviour under specified conditions, modelling has become an effective tool . It became an integral part in the management of water resources, protection of surface and sub-surface water bodies, leachate migration studies and for saltwater intrusion studies. If the models are properly constructed, they will give effective results.

3.1 Types :

As per Reference[36],the models are classified based on the order of increasing complexity is:

(a) Basic model- It only gives the basic structure of the selected area but is not suitable for complex conditions.

(b) Impact assessment model – it is suitable for predicting the developments in the water bodies and helpful in decision making. But it requires more data.

(c)High complexity model – To study the drastic changes in the geohydrology it is suitable. It is also called as

an acquirer simulator.

3.2 The sequential development of the model includes[36]:

1. Model objectives - It is defined as the purpose of the model.

2. Hydro-geological Characterization - It plays a prominent role in the development of a reliable model.

3. Model conceptualization - Field conditions have to be assembled in a systematic way.

4. Modeling software selection -The selected model should be capable of simulating the existing site conditions.

5. Model design - It includes model grid size, spacing, layer elevations, boundary conditions, hydraulic conductivity, recharge, dispersion coefficients, and degradation rate coefficients etc.

6. Model calibration - Proper characterization of site conditions is required for calibration. In this, changing the input parameter to match with field conditions has to be done to get an acceptable model.

7. Sensitivity analysis - It is the process of varying model input parameters within a reasonable range to observe the relative changes in model response

8. Model verification - The process of model verification may result in the further calibration or refinement of the model has to be done to match the field conditions.

9. Predictive simulations - A model is used to predict the future groundwater flow, contaminant transport conditions, and to evaluate different remediation alternatives.

10. Performance monitoring plan – Continuous monitoring of performance is necessary for predicting future field

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conditions.

3.3 Basic guidelines :

(a) Modeling approach

(b) Development of conceptual model

(c) Model calibration and prediction

(d) Uncertainty analysis

(e) Model reporting and reviews

3.4 Challenges of groundwater flow model

Modeling is a sequential procedure through which rational assumptions and simplifications are made, which would possibly lead to pragmatic representation of a system. There are assumptions in the conceptual model development phase, not to over complicate the environment, which is difficult to comprehend. There is relinquishment during discretization, to avoid excessive heterogeneity. Artificial boundary conditions are created with degree of unreliability, to give the model a certain level of variable quantity. These proposals are simply intrinsic to any modeling practice which can never be avoided. However, additional simplifications on top of all these unreliability , through improper model calibration procedures, lead, to unfeasible simulation of the reality. This issue is well defined by considering the time variant fluxes and water levels in the Upper Awash basin. A groundwater table mapped using groundwater level records collected over significant time periods, cannot realistically procedure a water table or potentiometric surface. Unless it is proved, the head remains constant for many years is too much of an assumption. Hence, it leads to simplification of the groundwater model, which in turn results in the groundwater system responding to time-dependent stresses, SWL records of sequential years can be used to calibrate transient conditions. Numerous calibrations of the same system can yield multiple combinations of boundary conditions and aquifer properties due to ambiguous features of the calibrated models. The assumptions made at the beginning regarding aptness of the models, in terms of conceptualization, discretization and definitions of boundary conditions should always be seen solemnly.

IV. REVIEW OF LITERATURE

Some of the regional groundwater flow modeling methodologies and special issues are discussed below:

Modflow is an effective software for water resource management that can be integrated with GIS[1]. The North China plain in China is facing a severe water shortage and pollution problem. MAP GIS which is a powerful GIS tool is used to prepare the model by co-relating the available geological and hydrological data. Reference[1], selected the simulation period from 1 January 2002 to 31 December 2003 to study the above area and concluded the discharge as $49374X10^6m^3$ and the total discharge as $56530X10^6m^3$.

Reference[3], used visual modflow 2.8.1 version to study an area of 320sq.km for analyzing the impact of bleaching and dying units at the downstream of Amaravati River of Karur town. He divided the area into 4572 cells with a grid size of 350mX200m in two layers. The model is simulated to find the quality of water under 5 scenarios. For this, he used the available data from PWD, CGWB, survey of India, and IMD data to simulate the model. Through the model, he concluded that even if the effluent meets the discharge standards in another 10 years, groundwater quality may not be changed. But if the operating 487 units with an effluent discharge of $14600m^3$/day, maintains zero discharge, then there will be an improvement in the quality of water over a period of time.

Reference[8] compared the model output prepared with Visual modflow with a land surface model prepared with 3d arc-second resolution. He selected a combined Rhine-Meuse basin and estimated the groundwater recharge and river discharge values. He used an offline procedure to simulate both the models separately and compared the model data with the field observations. He concludes and proposed a novel approach to building large-scale groundwater models by using the available global data.

Reference[9], estimated groundwater recharge at 12 identified locations in the Sonar sub-basin in the drought porn region of Bundelkhand in Madhya Pradesh using visual modflow. He concluded that even if the basin receives good rainfall, it is facing severe drought due to the uneven distribution of rainfall. To prepare the model, he used the available soil profile data, vegetation information, and weather data for simulation of the model. He found that the groundwater recharge at the identified locations varies between 157 to 349 mm/year. The data identified is very useful for the local authority for effective planning management.

Reference[11], selected Thirukkazhukundram taluk in Tamilnadu and studied about lowering of groundwater levels due to continuous pumping and how it creates a way for saltwater intrusion in the selected block. He applied GIS to study the groundwater levels and simulated the GIS data to prepare the model using visual modflow.

V. STUDIES ON LARGE SCALE GROUND

WATER MODELING.

Reference[13], used visual modflow version 4.2 and MT3D to simulate flow, contaminants path and to evaluate the increase in concentration of contaminants in ground water, due to the construction of sewage treatment plant and an accidental pool near the Gaunting reservoir, which is a prime water source for Beijing city. The waste water

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generated due to the construction project near the reservoir is domestic waste water that contains COD,BOD,NH3-N etc. The study area consists of 40 Sq.km and it is divided into 144 rows and 177 columns with a cell size of 10mx10m near the pool and at outwards 20mx20m, 50mx50m, 100mx100m in succession. The reservoir was considered as a constant head boundary whereas the study area as a second order flow boundary. By considering two accidents in a one month interval in the sewage plant, he analysed the rise of NH3-N concentration in the ground water.

By adopting absorption and degradation as model parameters, he studied the NH_3-N leakage volume by using

Q leakage= A Ks (d + h max/ d)

Were,

A - Area of the bottom of the accidental pool

K_s - Co-efficient of permeability of the pool base

d - Thickness of the pool base

h_{max} - Maximum depth of the waste water in the pool

(For accidental pool h max>>d)

So,

Q leakage= A Ks (d + h max/ d)

Q leakage= A (Ks h max/ d)

Q leakage= Ks(A h max/ d)

Q leakage= Ks (V max/d)

V_{max} = volume of the wastewater in the accidental pool

After the study, he discovered that, after the first accident in the pool, first layer the concentration of NH3-N was reduced from $8x10^{-5}$ mg/l on the third day to $2.5x10^{-5}$ mg/l on the thirtieth day. Whereas after the second accident the concentration is $1.1x10^{-4}$ mg/l on the thirtieth day and it became stable after 200 days. It is because of dilution, absorption and degradation the concentration becomes stable. He also concluded that with proper assumptions and simplifications the visual modflow will give accurate results about the transportation of physical and chemical substances in the ground water.

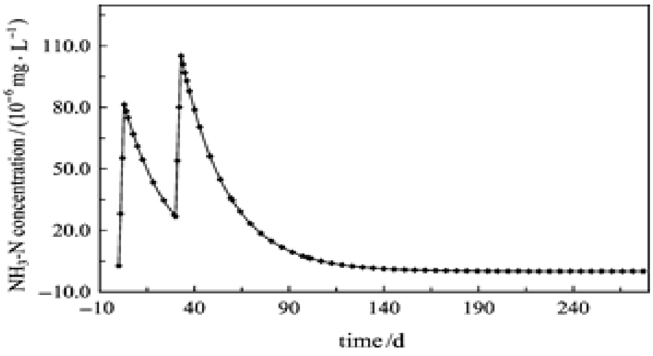

Fig.2NH$_3$-N concentration varies with time observed under the accident pool.

It is concluded that the NH_3-N concentration declined gradually with the increase in distance from the pool. The concentration declined to about one-sixth of that in the center at a distance of about 20m from the accidental pool. The model demonstrates that the NH_3-N concentration increase was little and the impact on the environment was small, due to the effect of dilution of ground water, adsorption by soil and degradation. This paper indicates that the transport of the physical and chemical reactive substances of the ground can be simulated well with Visual Modflow through proper assumptions and simplifications.

Nutrients such as phosphate, phosphorous, nitrate, nitrite etc. are termed as pollutants which have an adverse effect on the human body and the ecosystem in the short term and in the longer span, eutrophication in ponds, lakes,odor, and high turbidity in the water body are some of the examples.

Reference[16], used Visual modflow version 4.2 to predict the fate and transport of phosphorous and to know the amount of contamination spreading within a span of 10 years due to Seri Petalling landfill in Selangor, Malaysia.The study area is in the southwest of KualaLumpur, having a slope range from 25m to 43m above M.S.L. The average annual rain fall of the study area is 2900 mm and the aquifer consists of silty clay. The layer is known as the Kenny Hill formation. [17],[18].The aquifer, is considered as isotropic and heterogeneous.

The parameters used as input in software includes, Effective porosity, specific yield, specific storage and dispersivity of phosphorous in soil are bought from the literature whereas the other parameters which are used for simulation includes hydraulic conductivity, porosity, thickness, and type of soil are gathered between 1999 and 2001[19].

The formula that is used to predict the flow is:

$$\frac{\partial}{\partial x}\left(K_{xx}\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_{yy}\frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_{zz}\frac{\partial h}{\partial z}\right)-W=S_s\frac{\partial h}{\partial t}$$

MT3DMS is a three dimensional multispeciescontaminant transport for simulating of solute transport processes[20],was used to simulate advection, dispersion and chemical reactions of phosphorus contamination in ground water.

The formula that is used to predict the flow is[21]:

$$\frac{\partial(\omega C^k)}{\partial t}=\frac{\partial}{\partial x_i}\left(\omega Dij\frac{\partial C^k}{\partial x_j}\right)-\frac{\partial}{\partial x_i}\left(\omega v_i C^k\right)+q_s C_s^k+\sum R_n$$

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Constant head boundary, Evapotranspiration boundary, recharge boundary and river boundary are used to define the boundaries in the model.The recharge and Evapotranspiration values assigned in the software are 288 mm/year and 1550 mm/year respectively. The developed model has a root mean square (RMS) value of 0.081mg/L and the standard error of estimation (SEE) is 0.058mg/L, whereas the normalized RMS for the model was 3.992%.

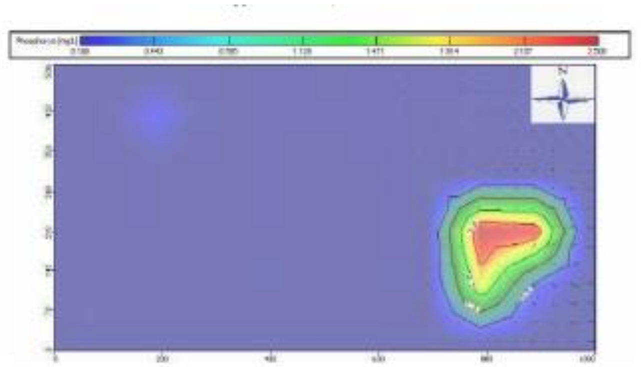

Fig.3 Migration of contamination after 1 year

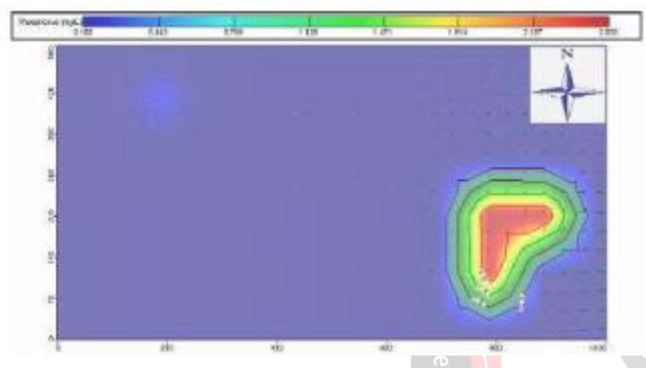

Fig.4 Migration of contamination after 10 years

The study confirms that the study area (unconfined aquifer) is highly contaminated with phosphorous, which is 2.38mg/l where the Malaysia department of Environment standards are 0.35mg/L[22]. The model was run at a steady state for 1 and 10 years. As a matter of fact, phosphorous cannot leach and move with ground water in a shorter time because of the high absorption capacity of the soil[23]. The results show phosphorous has not migrated widely along the ground water flow, but after 10 years the pollution plume is moving towards the river. Ground water flow and solute transport modeling was effective in assessing and predicting the phosphorous concentration in subsurface zone in the landfill area.

A flow model and solute transport model was prepared for Auja-Tamaseeh basin in Tulkarem area-west bank by [12] using visual modflow. The selected area is about 246km2 with carbonate rocks[24],[25]. The area is defined as a three-dimensional two layer with a grid size of 500mx500m and analyzed for a stress period of 10 years.The upper layer which is having ground water varies in thickness from 494 m in the north-western part to 294 m in different places in the study area. A steady state calibration flow model as well as a solute transport model was developed based on the SUSMAQ[26] model and SABBAH[27] model.The model area boundary conditions were fixed based on the water levels calculated by SUSMAQ. The base map was prepared by using arc GIS, then it was exported to DXF-Format to be incorporated into Modflow software.

The conceptual model was developed initially with an emphasis on boundary conditions, geometry etc. After the conceptual model using MT3D package under visual modflow software numerical model was developed for a stress period of 10 years with specified initial concentrations. The conceptual model was prepared assuming the region was under a steady state and transient conditions. The ground water wells are located in the upper aquifer, hence the area is described as three-dimensional two layer model. The boundary conditions for the model were defined based on the ground water levels performed by SUSMAQ. The grid coordinates are interpolated using the field interpolator package under the Modflow software, the hydraulic conductivity values are taken based on the spatial distribution of the calibrated hydraulic conductivity done by SUSMAQ and it is taken as 0.1m/d for horizontal hydraulic conductivity and for vertical it is assumed as 1/10 of the horizontal value [26].

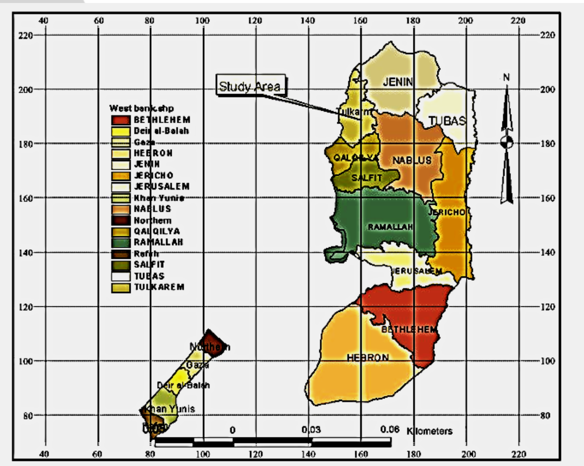

Fig.5 Location map of the study area

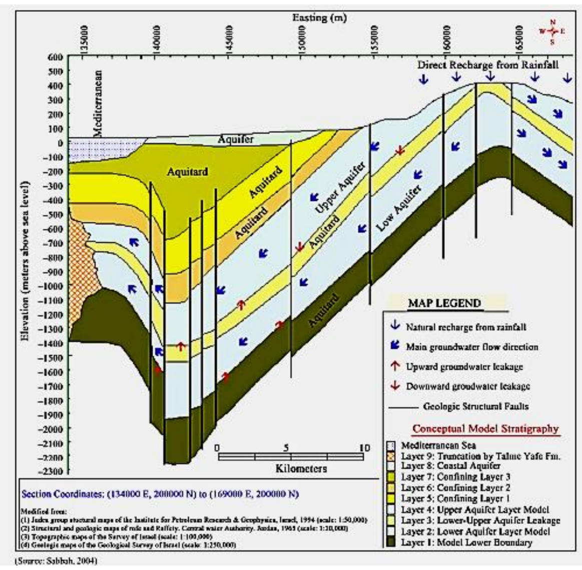

Fig.6 Location map of the study area

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The recharge from rainfall for the selected area is calculated by using the relationship derived by Goldschmidt and Jacoub (1958) based on the annual rain fall quantities from 1943/44 to 1953/54.

$$R_{red} = 0.9x\,(P_{red} - 360) \text{ in mm/year}$$

Reference [28], developed a relationship between rain fall and recharge, and it is used to develop the linear relationship, which is divided into three segments.

$$R = 0.8 \times (P-360) \qquad P > 650\text{mm/year}$$

$$R = 0.534 \times (P-216) \qquad 650 > P > 300 \text{ mm/year}$$

$$R = 0.15 \times (P) \qquad P < 300 \text{ mm/year}$$

Where,

R = Recharge from rainfall in mm/year

P = annual rainfall in mm/year

By knowing the average precipitation for the study area as 611.82 mm/year, he estimated the recharge as

$$R = 0.534 \times (611.82-216)$$

$$= 211.37 \text{ mm/year}$$

$$= 0.00058 \text{ m/day}$$

WAB (northern area) - East west hydro geological cross section

The pumping of ground water for each well in the study area was assumed as (0.07-1) mcm/year.

The conclusions are, the ground water head starts at an elevation of 110m a.s.l in the south east of the area, 70m a.s.l. in the north east of the model, and it indicates a flow direction towards north-western parts. The model output also indicates that the tendency of contamination and pollutant spreading occurs due to dispersion and there is a gradual increase in chloride concentration with time during the time of simulation.

Reference[29] , conducted studies on assessment of water ground contamination in sandy soils of Umunwanma in Umuahia – South, Abia State,Nigeria , because of its low adsorption property sandy soils permits leachate easily hence the area is highly vulnerable to ground water pollution. The area is a good source for drinking water because of its low iron content, but it is highly polluted by the septic tanks and bore holes through the inter connection of the lower confined aquifer with the upper unconfined aquifer.There have been many studies that have correlated polluted groundwater with septic tanks[30].One of the pits made for land filling for a road project laid in 2003 was selected for the study. The selected pit has an aerial extent of 321sq.m and depth varies from about 5.08m - 6.81m. , which is very close to the city. The other reasons for the selection of the pit is, it is nearer to a waste generating unit(cattle market/abattoir) and the suck-out waste from the septic tanks, all types of waste generated in the city is also discharged to the same pit.All these are done without taking into consideration the impact on the environment.

The present study is aimed mainly at deriving the relationship between the point source (sewage and solid waste disposal) and temporal variation of groundwater quality in the area.The soil immediately beneath the pit is of semi-permeable silty clay type with a thickness of 1m to 4.67m.The uppermost saturated unconfined aquifer varies from 35m to 45m approximately while the thickness of the lower aquifer is about 45m.The hydraulic conductivity of the unsaturated zone is about 9m/d and it is assumed as constant in the model calibration for all the layers. Ground water is available at a depth of 30m in the area.The thickness of the aquifer is considered as unconfined with a stratigraphy of 7 layers with alternating finer and coarser unconsolidated sediments.

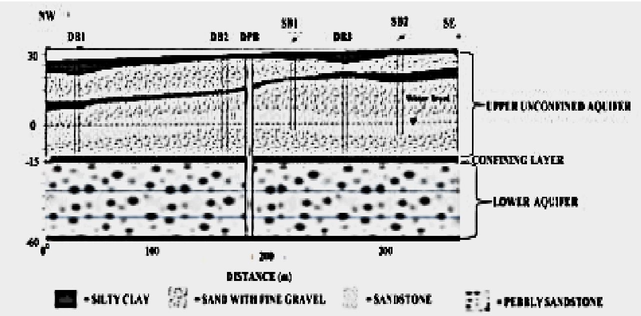

Fig.7 Geological / Hydro geological cross-section (NW-SE), of boreholes and infiltration test ponds.

DB = Deep borehole

SB = shallow borehole

DPB = deepest borehole.

By centring the discharge pit, the model domain is fixed as in a square shape with 0.2km on both sides. The cell size is 2m, having 100 columns and 100 rows and the model domain encloses a square area of 0.2km x 0.2km with an unconfined aquifer, centered on the effluent discharge pit (infiltration ponds). In the first layer, the flow is in a vertical direction where as in the second layer it is in horizontal direction, hence the vertical conductivity was set to 10% of the horizontal hydraulic conductivity. The finite difference method is applied to find flow rate, direction and for particle tracking.

It is concluded that with the model if the dumping continuous further the unconfined nature of the upper aquifer will increase the leachate significantly. Moreover, within a span of 15 years, the plume will reach the lower confined aquifer also.

Reference[31]), studied about the contaminants migration and mixing with ground water in an ex-landfill site. Despite the closure and restoration of the landfill, due to the rainwater leachate is generated in the ex-landfill site. The

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ex-landfill site measures about 30 hectares[32] surrounded by granite, Meta-sedimentary of Hawthorne and Kenny Hills formations and particularly KualaLumpur limestone.The aquifer in the site is a shallow sand type of about 5-10 m thickness including deep fractured limestone bedrock. The study area is modelled using three layers, namely sandy silt at the top of 5m thick, silty sand in the middle with15m thickness and finally, silty clay at the bottom with 10m thickness[33]. The available drilling investigations information was also used to conceptualize the ground water model.The information about the geological strata was collected from the borehole report produced. Two boreholes were drilled in the study area to a maximum depth of 30m, which provides adequate information about the upper geologic strata of the study area and also the movement of groundwater.

The total model area has a dimensions of approximately 694m wide and 678m long. The model grid was prepared with 30 rows and 30 columns and spaced evenly 55x54m approximately. The surrounding ponds in the site are used to represent the horizontal extent of the model domain. The surface top elevation is obtained from the elevation survey conducted at this site and from Google earth. The GPS reading,elevation from Google earth and borehole data[33] is used to find the middle and bottom elevation at the site. The hydraulic conductivity for all the three layers was estimated based on the soil type and with the help of existing data.The total recharge of groundwater is estimated on the basis of annual precipitation and it is about 15% (375mm/year) of the total annual precipitation. The water table is available 2-3 m below the ground surface.The top Sandy silt layer is modeled as impermeable, the middle silty sand layer acts as a confined aquifer and the bottom layer is considered as another impermeable layer. The study focused on shallow aquifers of silty sand formation only to prepare the model. The limestone formation which underlines the land fill site is not included in the model and the borehole drilled at this site has failed to reach this limestone formation because it is located far deeper. More than 30m depth is estimated. The field hydraulic head values used in the study area were based on field-measured values reported by [34]

The model was developed based on the following assumptions:

- The groundwater flow and recharge are assumed as steady state and uniformly distributed.
- Hydraulic conductivity is assumed as uniform and isotropic in the horizontal plane and for the vertical plane it is one-tenth for all the three layers.
- The base of the model is assumed as no flow boundary.
- The ground water velocity is high in the top layer; hence the leachate quantity is also more. This is not surprising because the middle one is a confined aquifer with a hydraulic conductivity of $1x10^{-5}$ m/sec. In the bottom layer the groundwater velocity is much smaller due to the low flow properties (i.e. Clay). This layer acts as an impermeable zone and protects the deeper aquifer formation against groundwater pollution because of its low hydraulic conductivity.

The MODFLOW model provides an excellent representation of the groundwater flow of the landfill site. It is concluded, River Jingjang and Nanyang Pond are hydraulically connected with the same aquifer beneath the landfill. The model also indicated that rivers and water bodies are more vulnerable to contaminant migration from the middle layer to the aquifer, where the ground water velocity is high relative to the top layer.

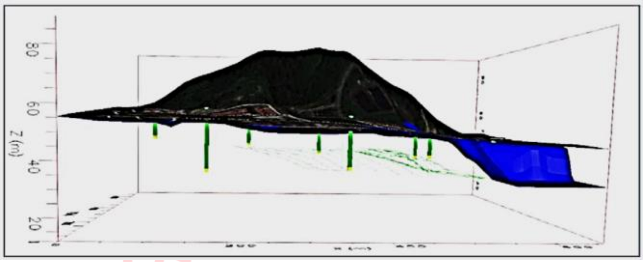

Fig.8 Taman Beringin Landfill 3D View

Three-dimensional view of the Taman Beringin Landfill indicating the movement of groundwater towards the eastern side towards Sg. Jingjang and Nanyang Pond (Blue colour represents the water body of Jingjang river and Nanyang Pond.

In most cities in developing countries, municipal solid waste is dumped in open areas without proper lining, which leads to environmental problems such as land pollution, air pollution and water pollution. It also leads to formation of leachate during rains, which may seep and contaminate the ground water. Reference [35], used Visual Modflow to evaluate the hydraulic conductivity, geotechnical properties of contaminated soil and properties of leachate to estimate and predict the fate of contaminants that has occurred in the selected site at Dundigal village of the Telangana in India.

The total area of the study area is about 11.6 Km^2, it has weathered and fractured formation. The study area consists of granite and rock formations. The soil samples are collected by using a core cutter at a depth of 0.5m and 1.0m, In the vicinity of the study area, a solid waste dumping site is available. The annual rain fall in the study area is about 1347mm, and the recharge in the study area is from rain fall infiltration during the monsoon periods.

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The visual Modflow software package includes three different software and many support modules. The calculation of volume, quality and distribution of ground water flows can be done by using MODFLOW software., similarly, to calculate direction and speed of flow in the aquifer, MODPATH software is used. The MT3D software is used to calculate diffusion and transportation processes with chemical reaction of solutes in the ground water flow system.

The index properties along with the environmental properties such as, pH, EC organic content in the study area are determined. MODFLOW simulates three-dimensional ground water flow by using a cell entered finite difference method. It is used to trace the path lines, based on the assumption of the adjective transport only. The contaminant migration is highly influenced by ground water flow direction and hydraulic conductivity of the considered aquifer. The study area map was digitized using Arc GIS 9.2 software and imported into visual MODFLOW software. The model domain was discredited into 100x100 grids with a cell dimension of 35mx65m. Further, finer grids are adopted around the selected well locations.

The samples are collected within a 500m radius and concluded that the time taken to contaminate the soil and to contaminate the ground water is 1645 days (4.5 years) and 7300 days (20 years) respectively as per visual MODFLOW with the assumptions.

VI. CONCLUSIONS

Based on a review of modeling studies on ground water contamination, it is concluded that their presence and their concentrations vary from one place to another.Solid waste handling, controlling and monitoring techniques in major cities must be geared towards achieving quality environmental conditions to protect natural resources such as water that are degraded by these solid wastes. From this work, it is possible to articulate a position on thorough environmental management procedures to protect groundwater resources at ground level. Solid waste should be recycled instead of dumped at sites, unless, if otherwise, waste collection and management authority, the Ministry of Environment and Waste Management Board should be properly reorganized.

Water quality parameters in solid waste were assessed to evaluate the level and degree of purity of the water quality.The review was carried out during the dry and wet season, it was observed that there was some level of contamination in the ground water within the solid waste dump site. This paper suggests the need for an effective disposal mechanism for households, since the earth's surface itself acts as an effective filtrate to filter out particulate matters like leaves, bugs, dissolved chemicals.There is a need to have a programme of effective monitoring of ground water quality.

From the review, it is clear that there is a strong linkage between poor SWM and environmental/health issues. The rapid increase in population, economic growth, urbanization and industrialization improve the generation of SW at global level, boosting environmental contamination when such SW is not managed. Indeed, in many developing countries, waste is scattered in urban centres or disposed of in open dump sites. The lack of infrastructure for collection, transportation, treatment and final disposal, management planning, financial resources, know-how and public attitude reduces the chances of improvement, as pointed out also by other authors.

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