MTIGT1003: 4 Credits

GIS BASED 3D VISUALIZATION IN GEOTECHNOLOGY

Unit:4 - 3D Visualization of Subsurface Lithology

For 6 Year Integrated M.Tech. Geoinformatics and Geotechnology programme

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MTIGT1003: GIS BASED 3D VISUALIZATION IN GEOTECHNOLOGY 4 Credits

Unit-1: Principles of 3D Visualization: Data Input (x, y, z) – TIN – Vertical Exaggeration – DEM based visualization – Concepts of Shaded Relief mapping. **12 Hrs.**

Unit-2: 3D Visualisation of Topographic Data: Generation of x, y, z data – 3D visualization of topography – DEM based topographic analysis – shaded relief – applications. **12 Hrs.**

Unit-3: 3D Visualisation of Geophysical Data: X, Y, Z data from different sources – Generation of DEM, Different processed outputs of DEM, Shaded relief maps of Gravity, Magnetic and Resistivity data – Its applications. **16 Hrs.**

Unit-4: 3D Visualisation of Subsurface Lithology: Collection of borehole data – working out lithology and lithotop of various horizons – DEM of shaded relief of thickness of various formations, Depth of various formations and litho top of various formation – their interpretations. **12 Hrs.**

Unit-5: 3D Visualisation of Groundwater: Collection of water level and other aquifer variables (Transmissivity, Permeability, Storage co-efficient, etc.) – Generation of x, y, z – Generation of DEM and shaded relief of groundwater systems and interpretation. **12 Hrs.**

References

- Burrough, P.A Principles of Geographical Information Systems for Land Resources Assessment, Clarandone Press, Oxford, 1986.
- Graeme F.Bonham-Carter, Geographic Information Systems for Geoscientists: Modelling with GIS, Pergamon Publications, 1994.
- Sabins, F.F.Jr., Remote Sensing Principles and Interpretation, Freeman, Sanfrancisco. 1978.
- Lillisand, T.M. and P.W.Kiefer, Remote Sensing and Image Interpretation, John Wiley & Sons, New York, 1986.

MTIGT1004: PRACTICAL – GEOTECNOLOGY AND 3D VISUALIZATION
2 Credits

1.Generation of DEM and 3D visualization. **6 Hrs.**

2.DEM based topographic analysis. **6 Hrs.**

3.Satellite Image wrapped DEM based topographic analysis **6 Hrs.**

4.Shaded relief of topographic data and its interpretations. **6 Hrs.**

5.3D visualization, DEM and shaded relief of gravity data and its interpretation. **6 Hrs.**

6.3D visualization of DEM and shaded relief of magnetic – airborne magnetic data and its interpretation. **6 Hrs.**

7.3D visualization of DEM and shaded relief of muti depth gravity data and its interpretations. **6 Hrs.**

8.3D visualization of DEM and shaded relief of bore hole depth and subsurface lithology and interpretations 10 Hrs.

9.3D visualization of DEM and shaded relief of Ground water levels and interpretations. **6 Hrs.**

10.3D visualization of DEM and shaded relief of Aquifer variables (T, K & S). **6 Hrs.**

Monoscopic methods of Depth Perception

Distances to objects, or depth can be perceived monoscopically on the basis of

- **Relative sizes of objects**
- **Hidden objects**
- **Shadows and**
- **Differences in focusing of the eye for viewing objects at varying distances.**

Concepts of Shaded Relief mapping

Initially, to create shaded Relief map, slope and aspect are to be calculated based on the plane defined for each triangle.

Slope can be written in degrees by specifying degree and Aspect is always reported in degrees. Zero is north, and values increase clockwise like a compass. Flat triangles will be assigned an aspect value of -1.

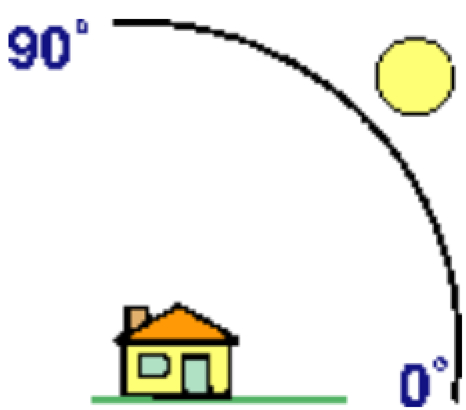
Optionally, a hillshade field can be written containing a brightness value for each triangle. Values range from zero to 255.

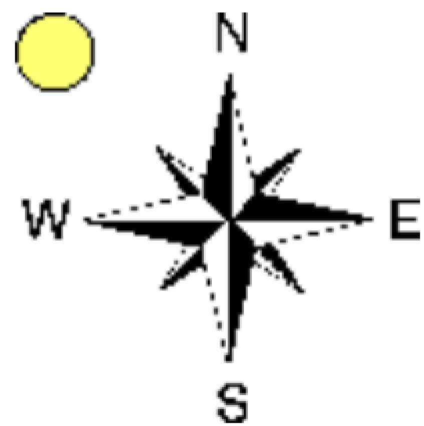
The brightness value is based on the relation between the plane defined by each triangle and a **light source**. The position of the light source defaults to the northwest, with an azimuth of 315 degrees (compass-based with 0 north, positive clockwise) and an altitude of 45.

For Hill shade, it is necessary to obtain the hypothetical illumination of a surface by determining illumination values for each cell in a raster.

It should be done by setting a position for a hypothetical light source and calculating the illumination values of each cell in relation to neighboring cells.

It can greatly enhance the visualization of a surface for analysis or graphical display, especially when using transparency.





Depiction of Water Level data

- Data Collection – For 2 seasons in a year and/or for 30 to 50 years – to understand the historic changes that had happened
- Pre-monsoon (March to June of previous year) and Post-Monsoon (Dec.–same year, Jan. & Feb. of next year) – Make a separate list of maxima values for each well for both Pre- & Post- monsoon periods for each year and calculate Natural Recharge by calculating the difference between two monsoons,
- i.e., **NR = (Pre-monsoon WL – Post-monsoon WL)**

- Calculate average NR and/or WL values for each well for the entire 30 to 50 years data collected along with Decimal Degree Longitude & Latitude for each well.
- Plot the well locations in GIS and generate DEM for NR and / or WL separately
- Every year NR values can plotted, generate DEM and stack them one below the other to understand the spatial changes of NR happened over a period of several years, for e.g. 50 years.

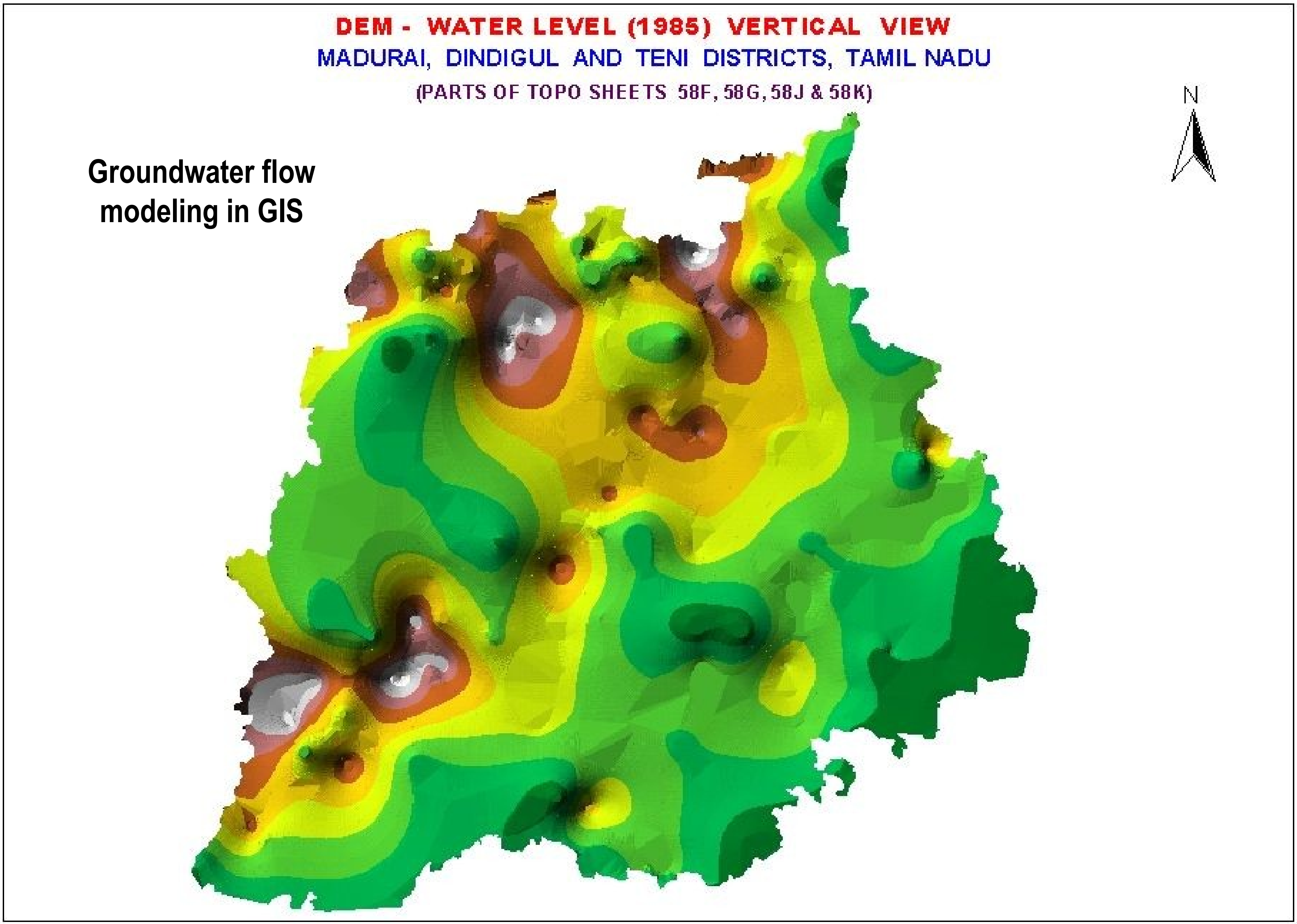

DEM - WATER LEVEL (1985) VERTICAL VIEW
MADURAI, DINDIGUL AND TENI DISTRICTS, TAMIL NADU
(PARTS OF TOPO SHEETS 58F, 58G, 58J & 58K)
Groundwater flow modeling in GIS
N

FIG. 1.8

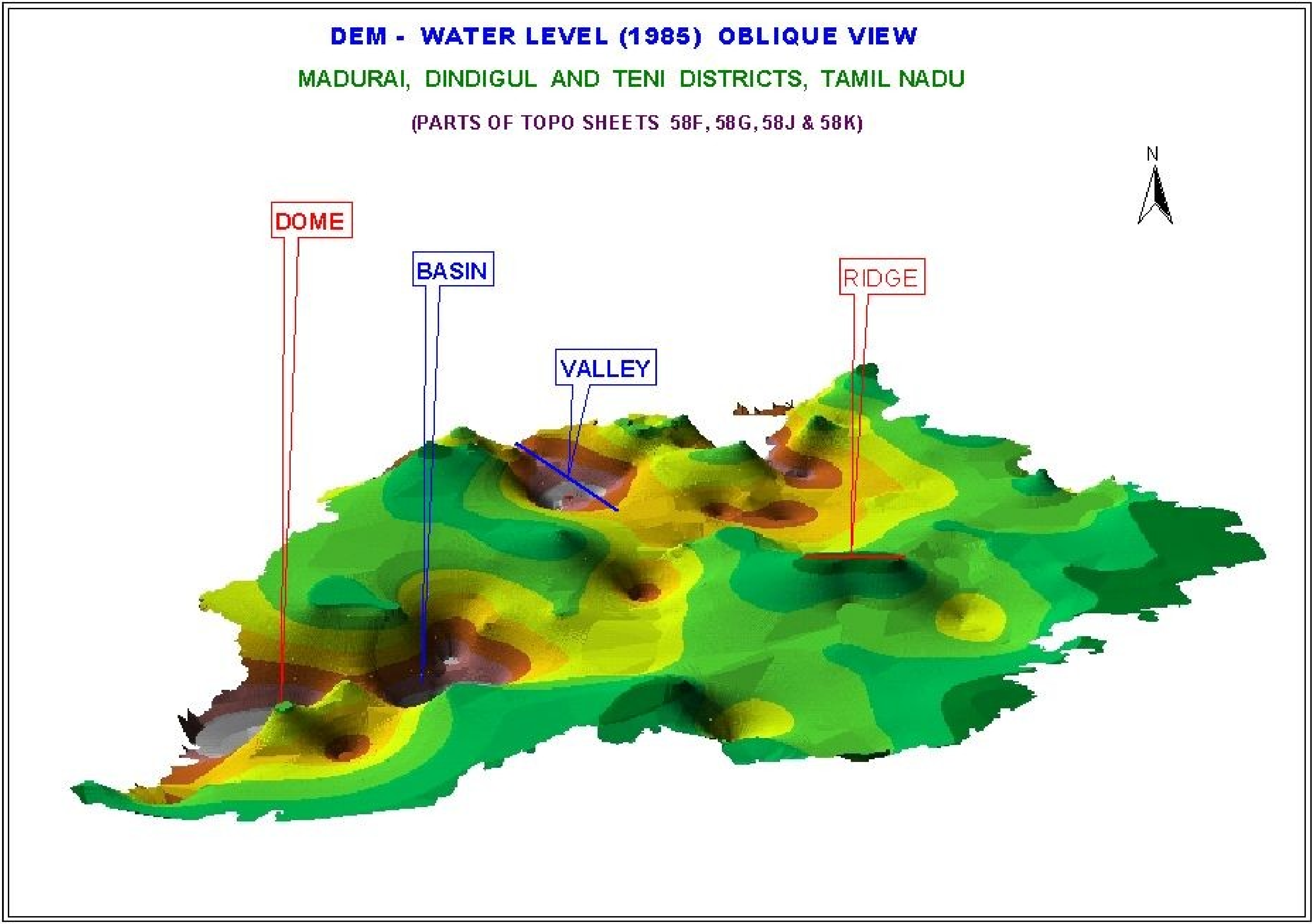
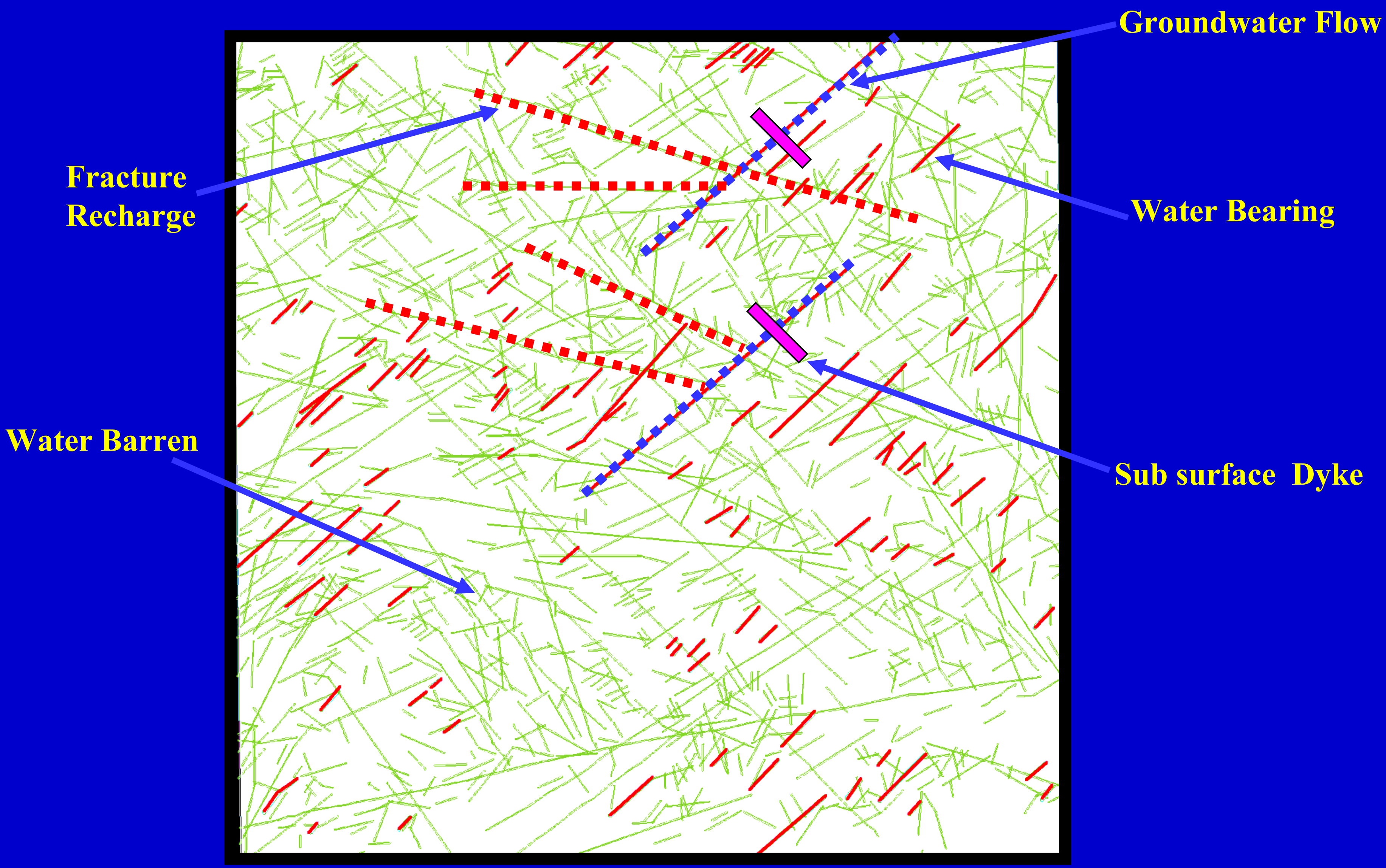

DEM - WATER LEVEL (1985) OBLIQUE VIEW
MADURAI, DINDIGUL AND TENI DISTRICTS, TAMIL NADU
(PARTS OF TOPO SHEETS 58F, 58G, 58J & 58K)
N
DOME
BASIN
VALLEY
RIDGE

FIG. 1.9

RECHARGE THROUGH FRACTURES



Quantification of Allowable Recharge

- Determination of size of the Aquifer / GW Reservoir / Container by Geophysical methods
- Calculation of Water level changes during a period of 30 – 50 years of pre- and post-monsoon seasons
- WR Budgetting – Estimation of available surface water resources for various purposes
- Quantification of available SW for Recharge of the container

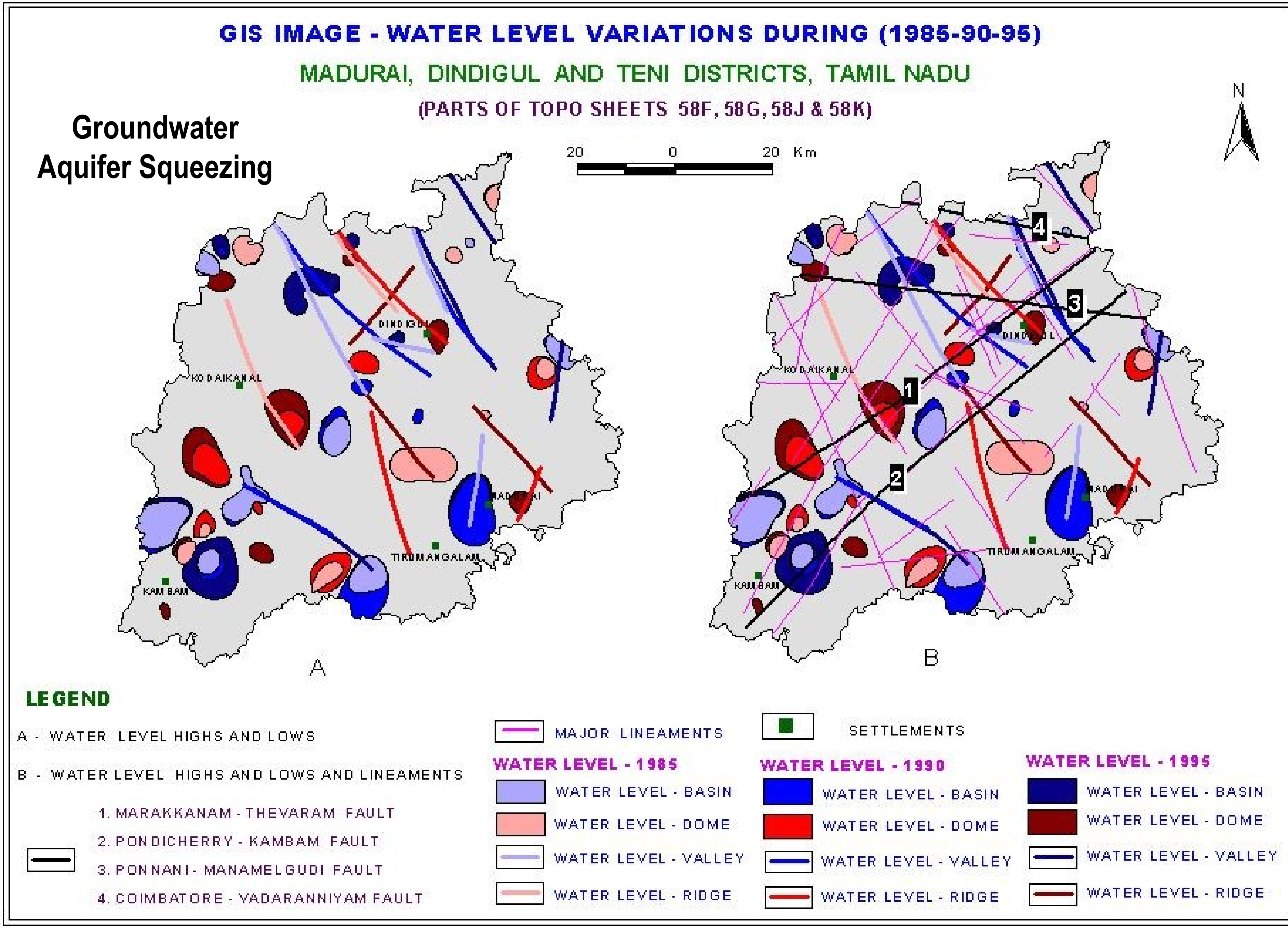

GIS IMAGE - WATER LEVEL VARIATIONS DURING (1985-90-95)
MADURAI, DINDIGUL AND TENI DISTRICTS, TAMIL NADU
(PARTS OF TOPO SHEETS 58F, 58G, 58J & 58K)
Groundwater
Aquifer Squeezing
20 0 20 Km
N
DINDIGUL
KODAIKANAL
MADURAI
TIRUMANGALAM
KAMBAM
A
B
1
2
3
4
LEGEND
A - WATER LEVEL HIGHS AND LOWS
B - WATER LEVEL HIGHS AND LOWS AND LINEAMENTS
1. MARAKKANAM - THEVARAM FAULT
2. PONDICHERRY - KAMBAM FAULT
3. PONNANI - MANAMELGUDI FAULT
4. COIMBATORE - VADARANNIYAM FAULT
MAJOR LINEAMENTS
SETTLEMENTS
WATER LEVEL - 1985
WATER LEVEL - 1990
WATER LEVEL - 1995
WATER LEVEL - BASIN
WATER LEVEL - DOME
WATER LEVEL - VALLEY
WATER LEVEL - RIDGE

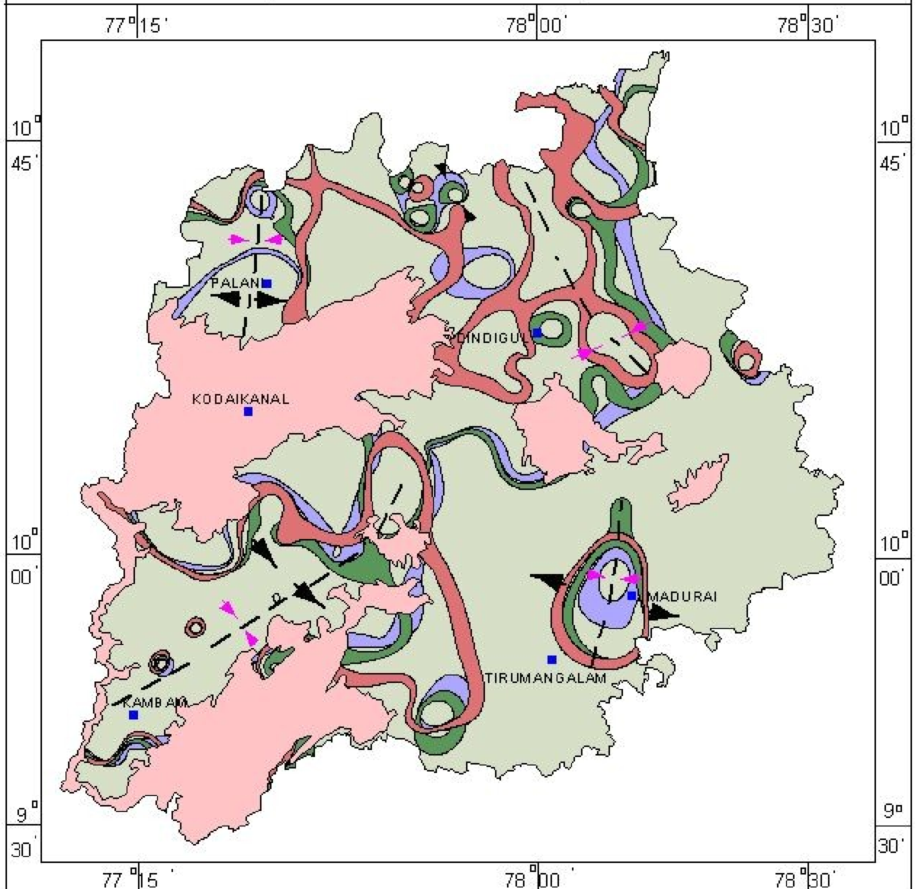
FIG. 2.4

SPATIAL DISTRIBUTION OF WATER LEVEL DURING 1985-90-95

MADURAI, DINDIGUL AND TENI DISTRICTS, TAMIL NADU

(PARTS OF TOPO SHEETS 58F, 58G, 58J & 58K)

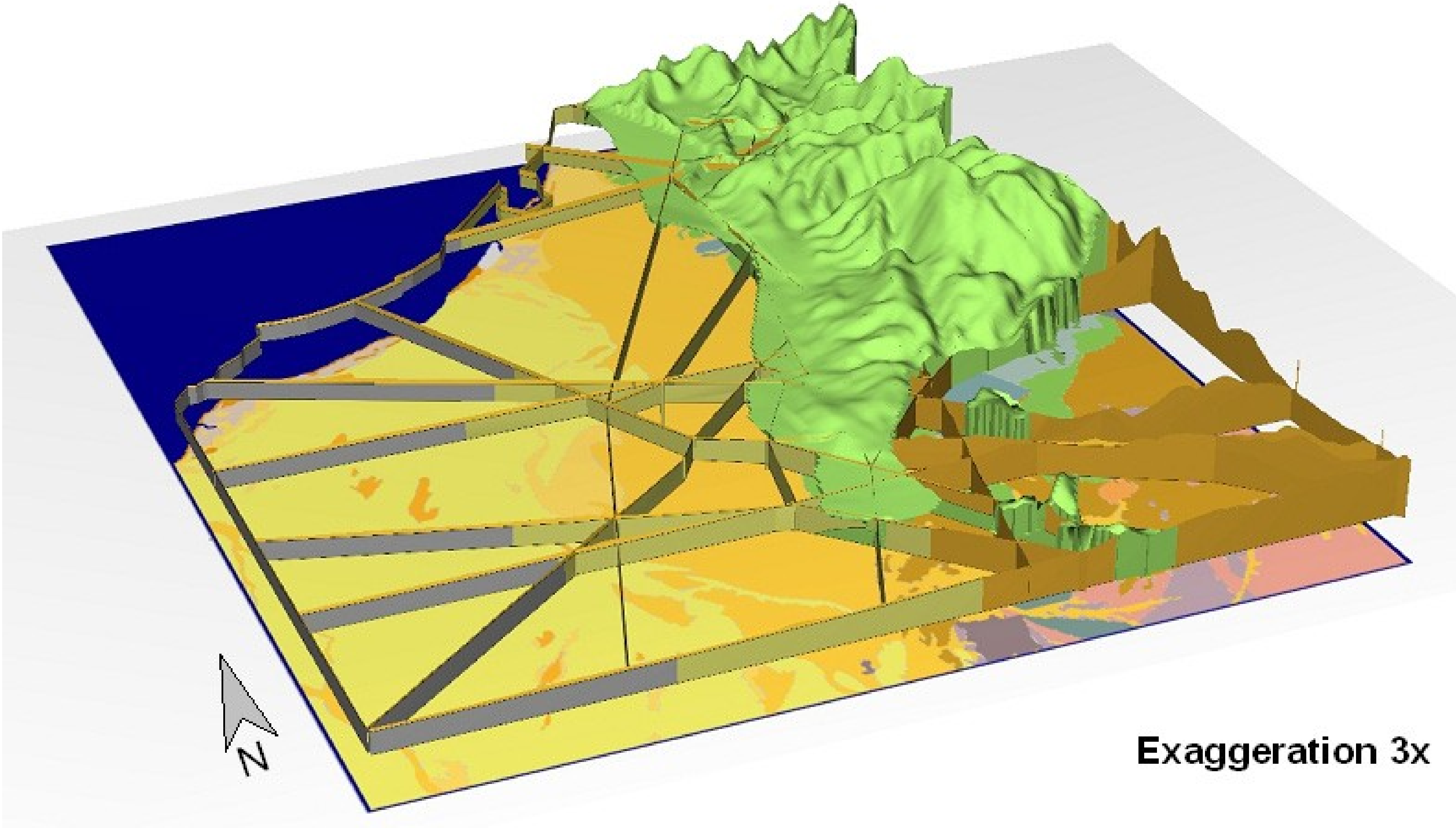
20 0 20 Km



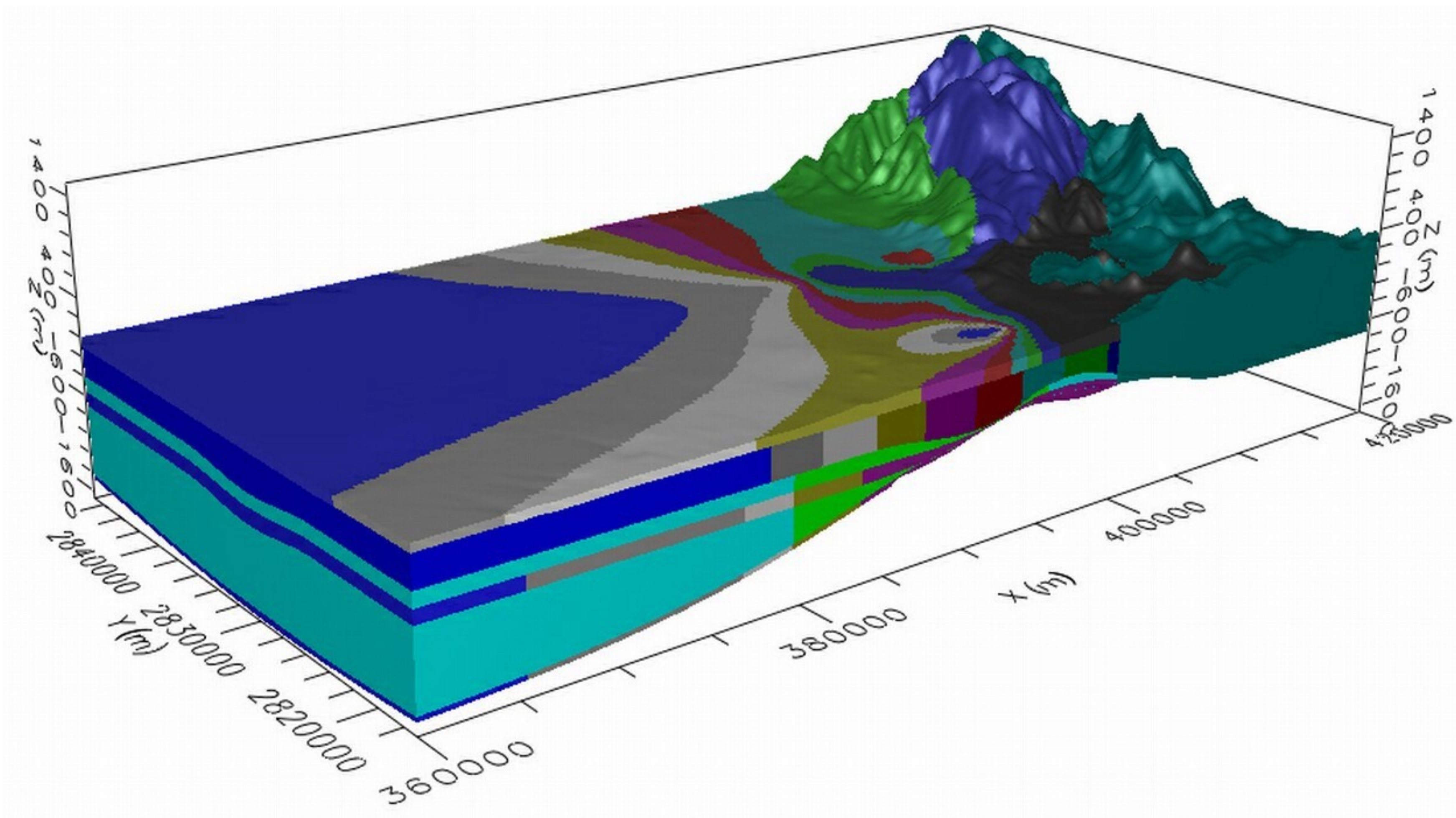
LEGEND

- HILLS
- SETTLEMENTS
- AXES OF WATER LEVEL DEEP
- DIRECTION OF WATER LEVEL BASIN WIDENING / SHIFTING
- 9M WATER LEVEL - 1995
- 9M WATER LEVEL - 1990
- 9M WATER LEVEL - 1985

Fig. 2.5



Constructed 3D-geological model for Khatt Springs area



Conceptual model of Khatt springs area in which the subsurface stratigraphy is approximated into six layers model based on the variations in the vertical hydraulic conductivities