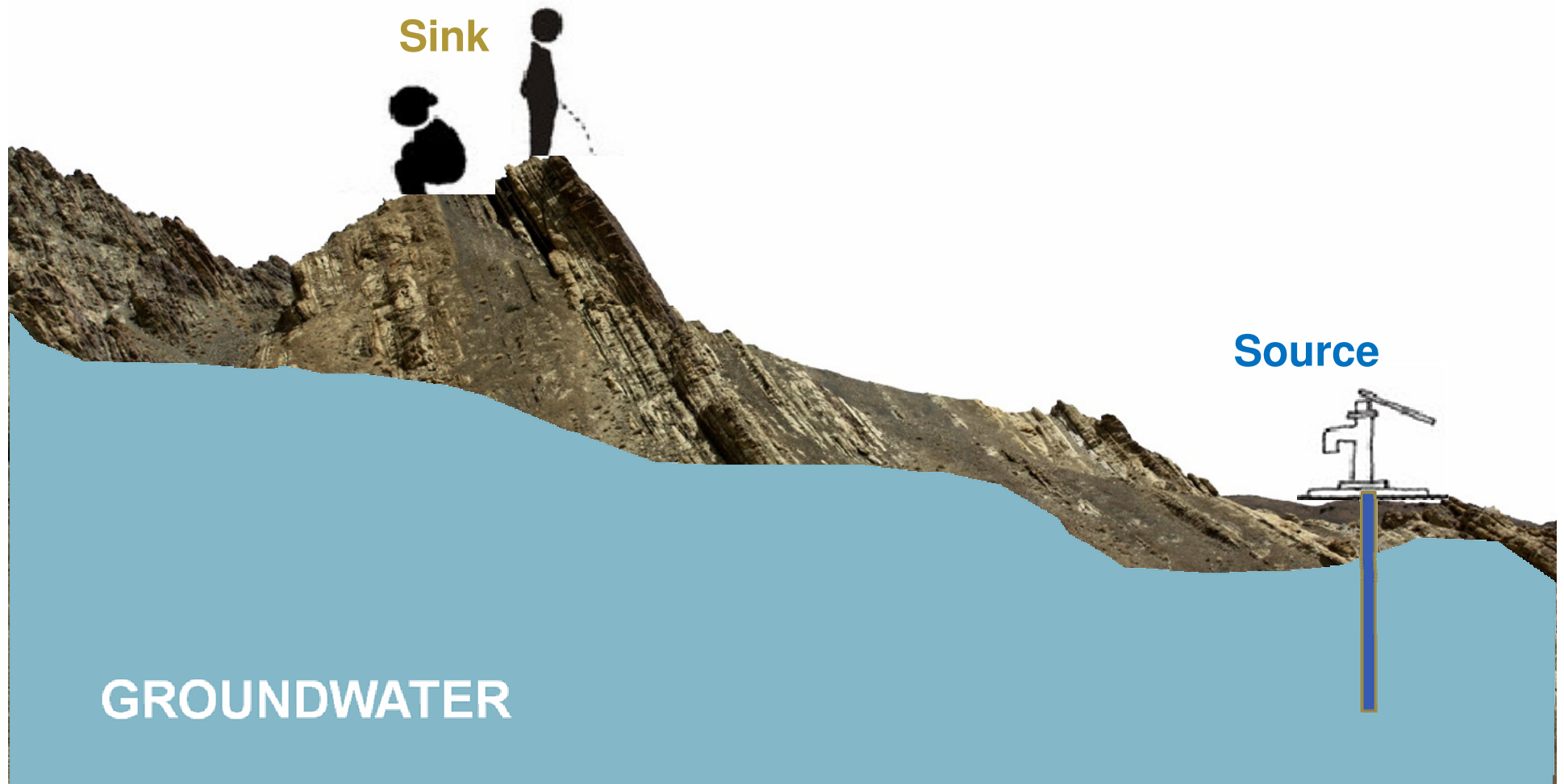


GROUNDWATER IN URBAN PLANNING



Himanshu Kulkarni

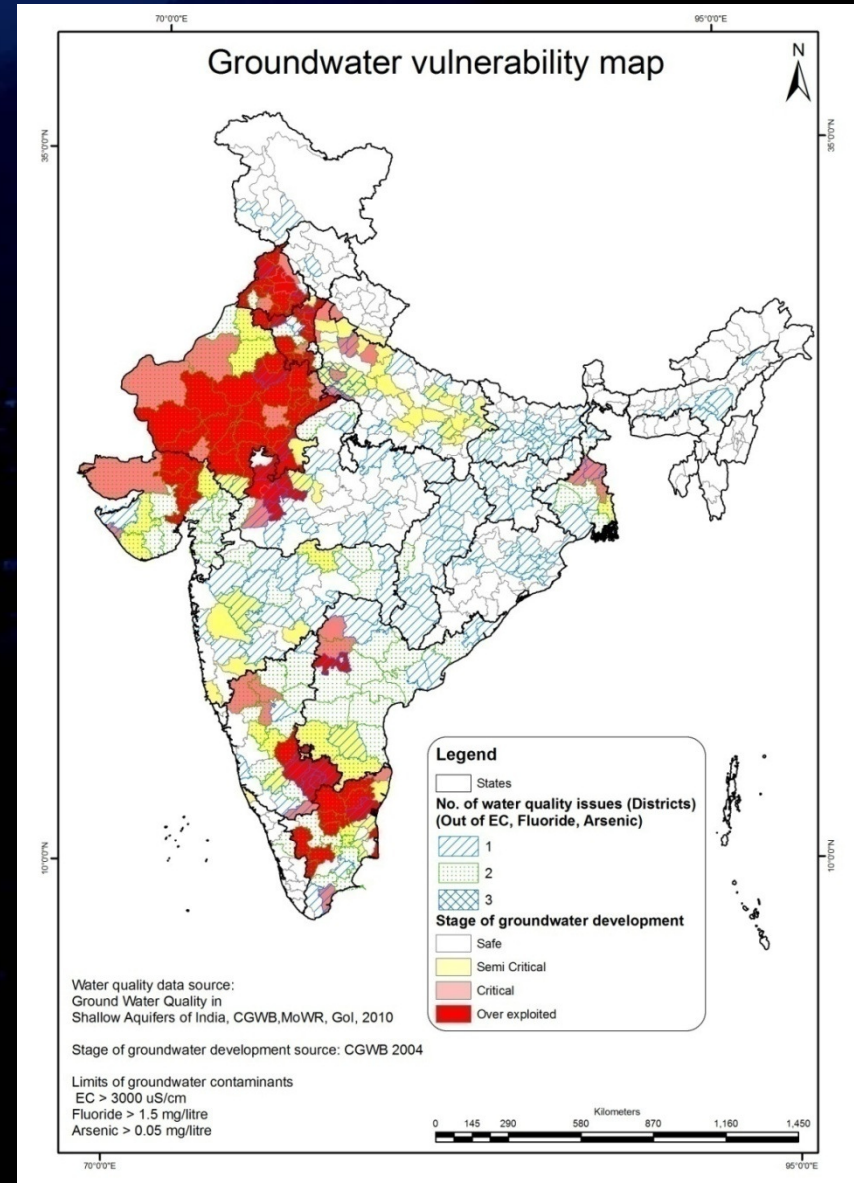
Groundwater: source & sink



The larger picture

- Global estimate: more than 1.5 billion urban dwellers rely on groundwater, currently
- Dependence on groundwater, especially in “developing cities”:
 - Population growth
 - Rapid urbanisation – city sprawl
 - Increased per-capita use
 - Higher ambient temperatures
 - Reduced reliability of intakes, especially from rivers
 - Demand & supply factors
 - Modest cost of water-wells (especially in India!)
- Conundrum of depleting groundwater and deteriorating quality (sanitation, solid and liquid wastes)

Hues of groundwater exploitation and contamination



Water sector, groundwater and urban WSS

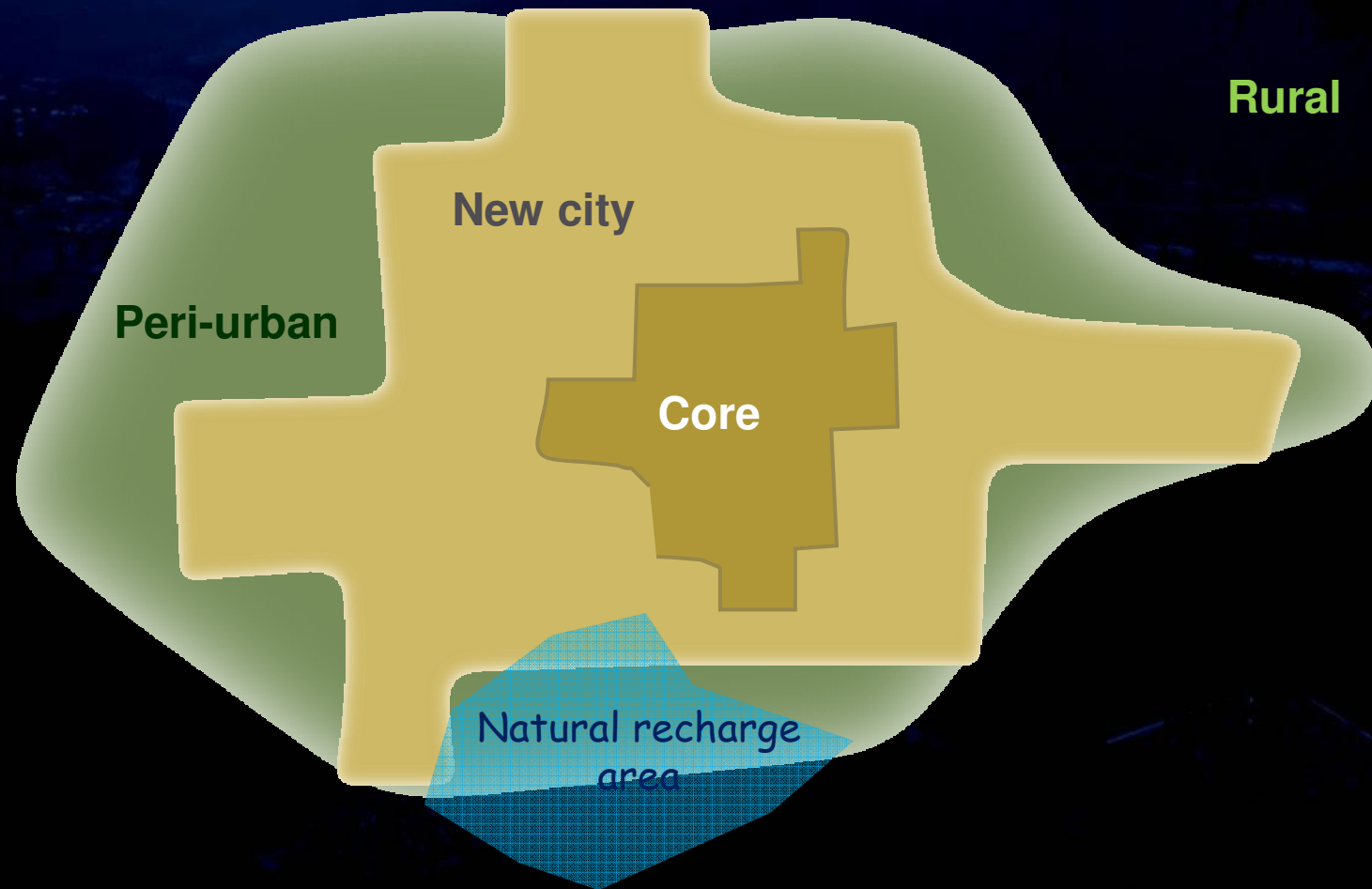
- OVERALL WATER SECTOR

- Changing approaches to WR Planning in India - significant inputs from a wider net of organisations on various aspects in the water sector
- Consideration to wide-ranging scales in attempting reform – major irrigation projects to Rural WSS (habitation level)

- URBAN WATER & SANITATION

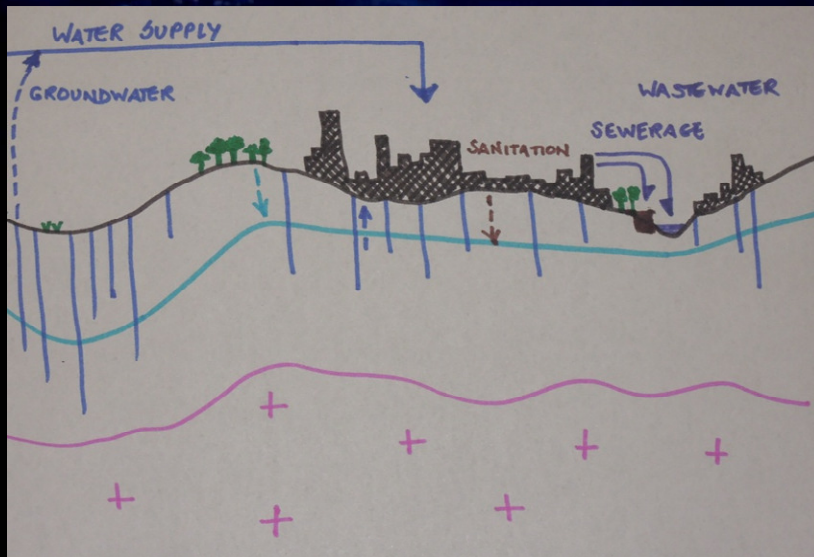
- Importance of water – sanitation, sewage, wastewater links
- Challenges with respect to water supply & sewerage system
- Dichotomy of equitability wrt to water and waste: *Water for all is more easily accepted but we are unable to deal with the waste-of-all*

Groundwater in the urban space

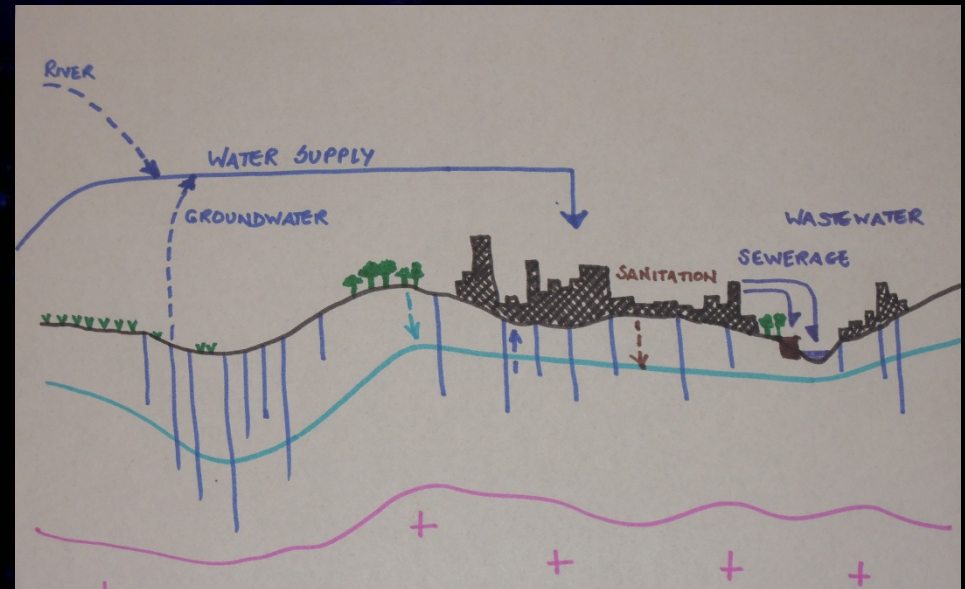


Urban groundwater – 2 scenarios

Fully groundwater dependent

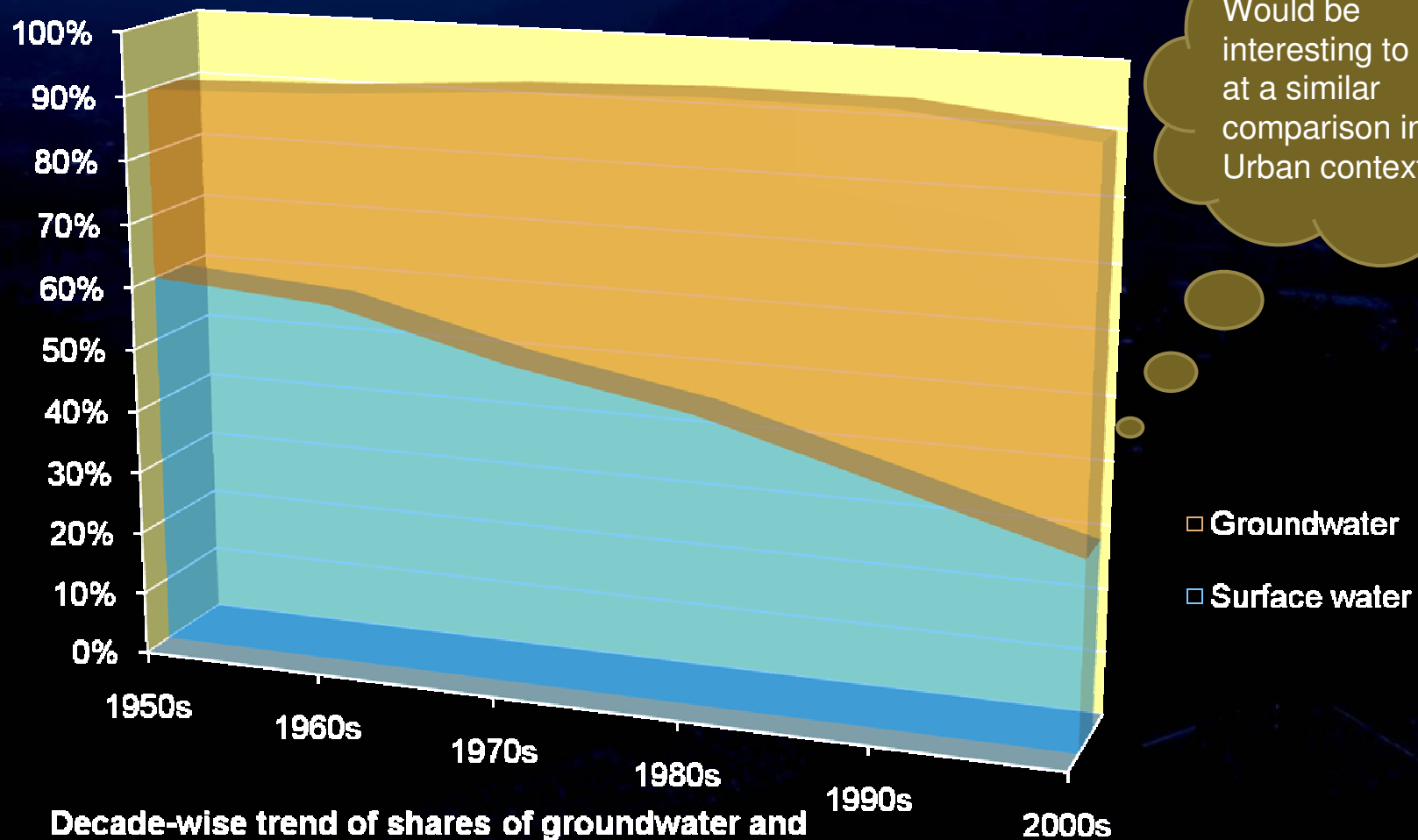


Groundwater supplements river imports



Groundwater use already *mainstreamed* in operation –
but seldom part of Urban Water Planning

NIA, surface water & groundwater



Decade-wise trend of shares of groundwater and surface water to NIA - an aggregated National Picture

Would be interesting to look at a similar comparison in the Urban context

Groundwater
Surface water

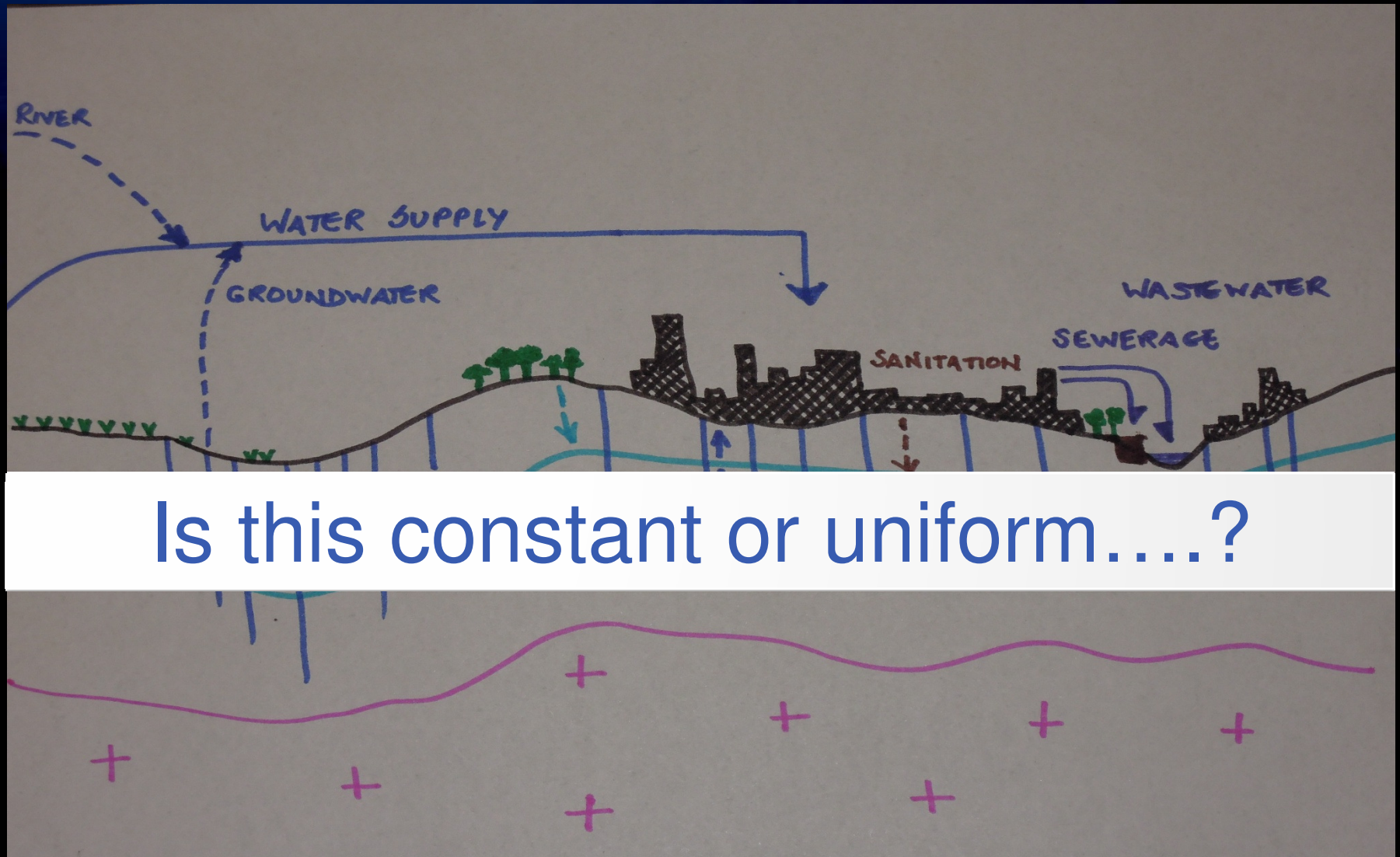
Source: Indian Agricultural Statistics, 2008

Urban groundwater: common issues

Foster et al, 2010: GW-MATE

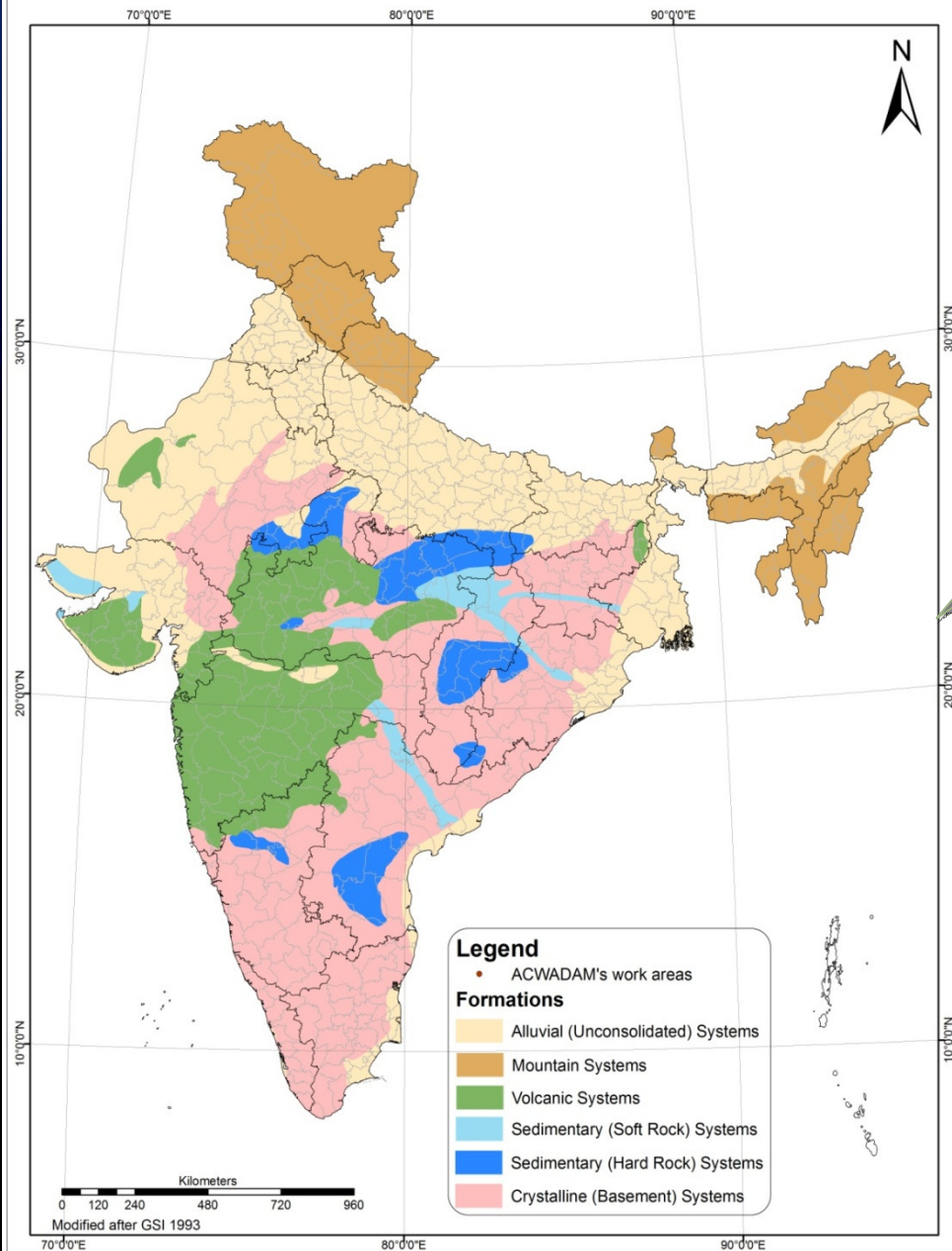
- Modification of groundwater cycle on account of urbanisation
- Many problems around groundwater are *predictable*, few are *predicted*
- Conceptual hydrogeological model not constant – needs continuous modification
- Two major consequences:
 - Paradox of urban recharge – tradeoff between reduction in infiltration-facilitative surfaces and leaking mains and sewers
 - Contaminant loading of sub-surface systems – improper sanitation, poor sewerage and haphazard waste-disposal

Aquifer setting – the missing dimension



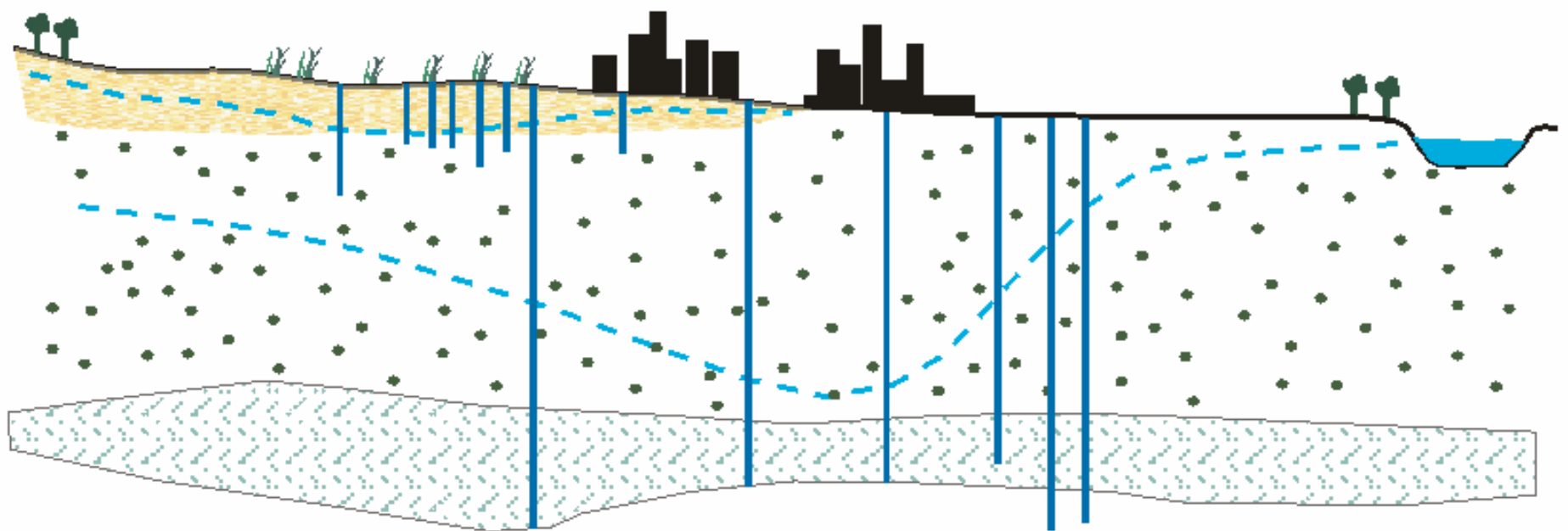
Is this constant or uniform....?

Overlay of generalised hydrogeological settings on administrative boundaries (Districts and states)

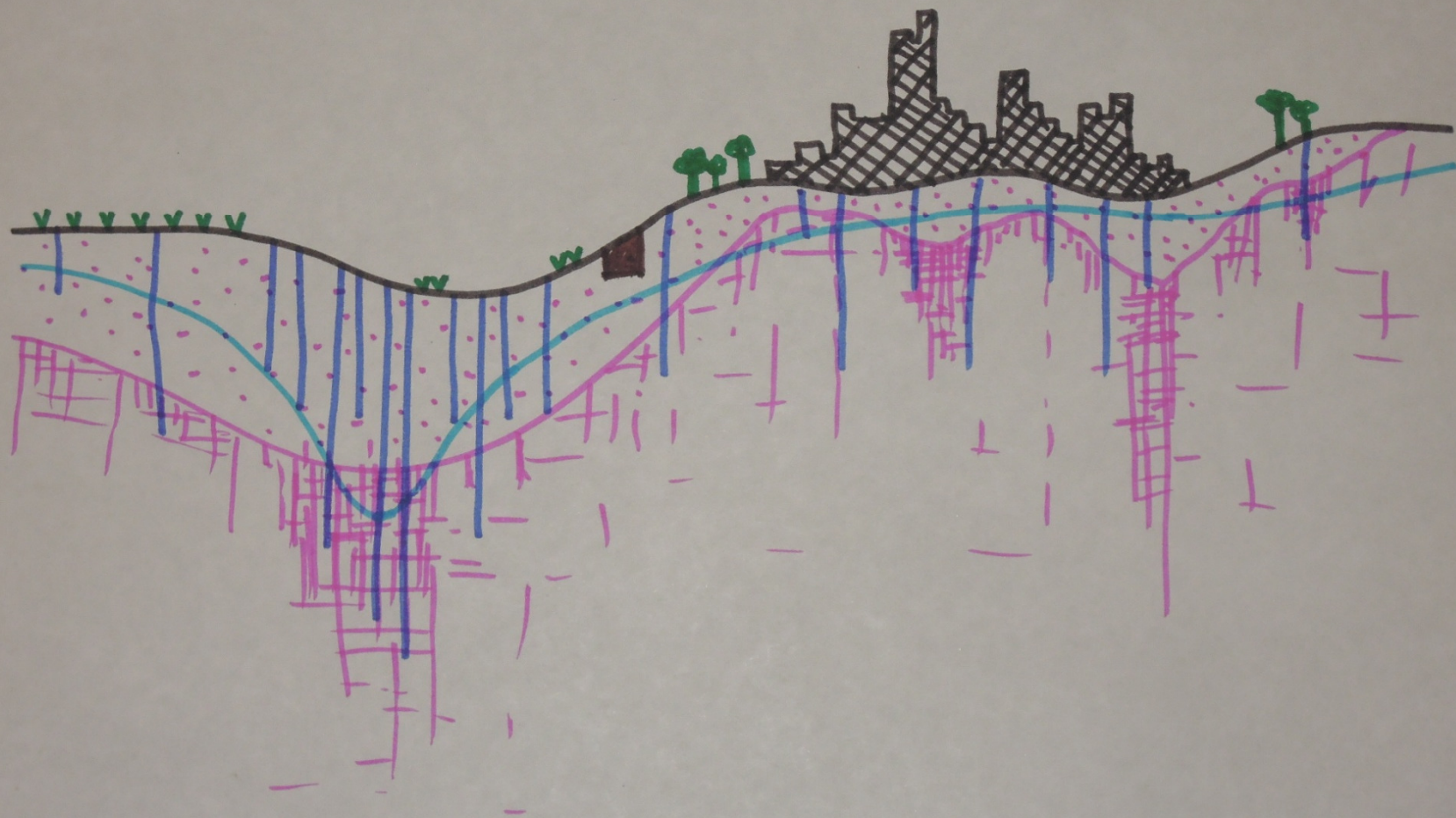


Diversity

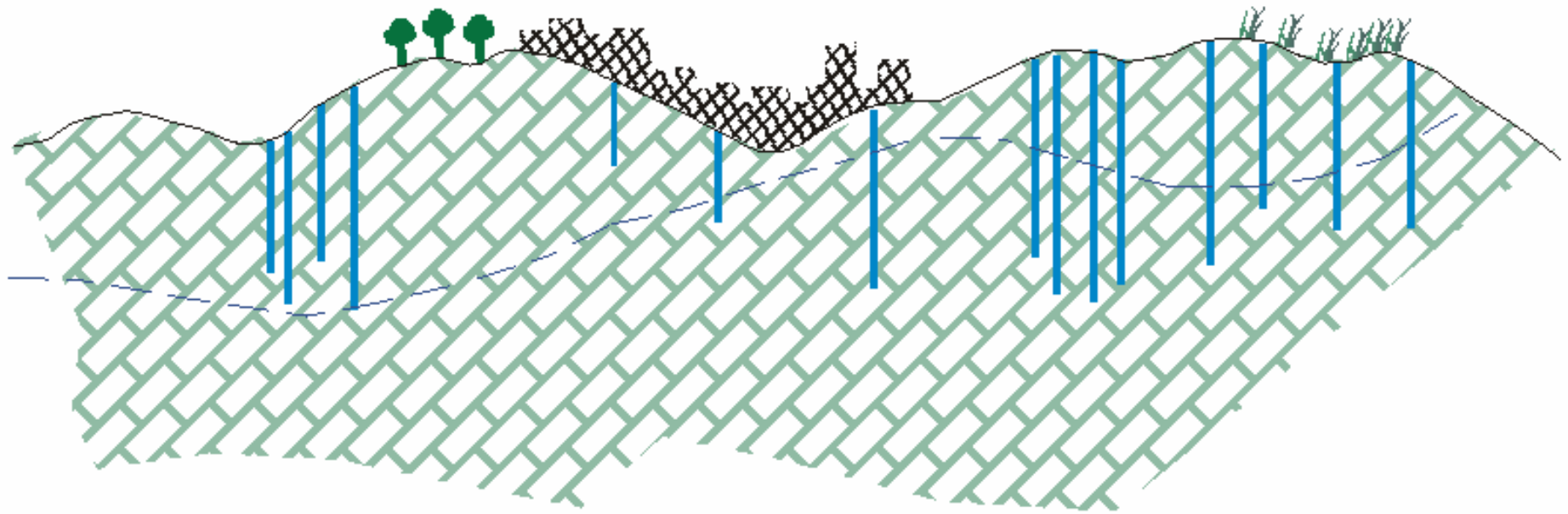
Alluvium



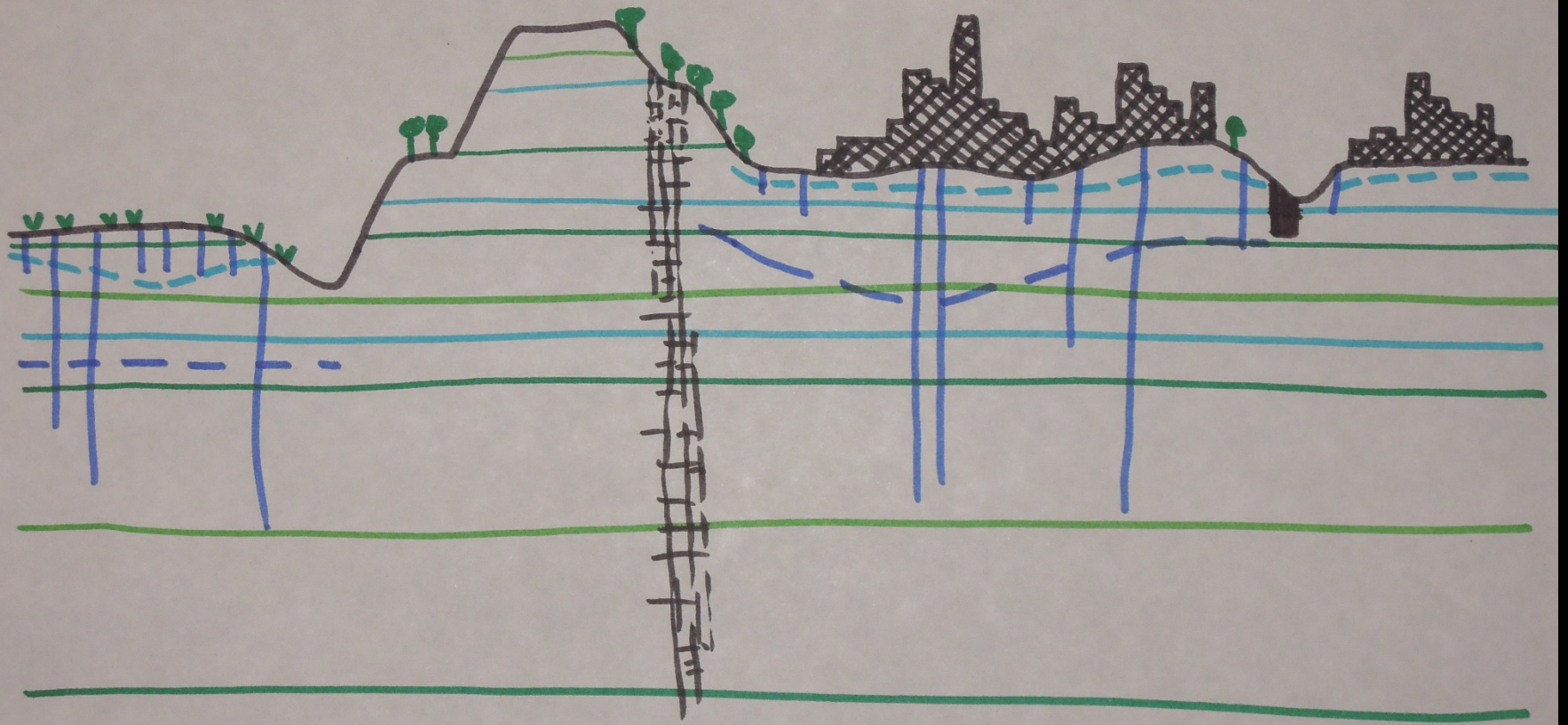
Crystalline / Basement Rocks



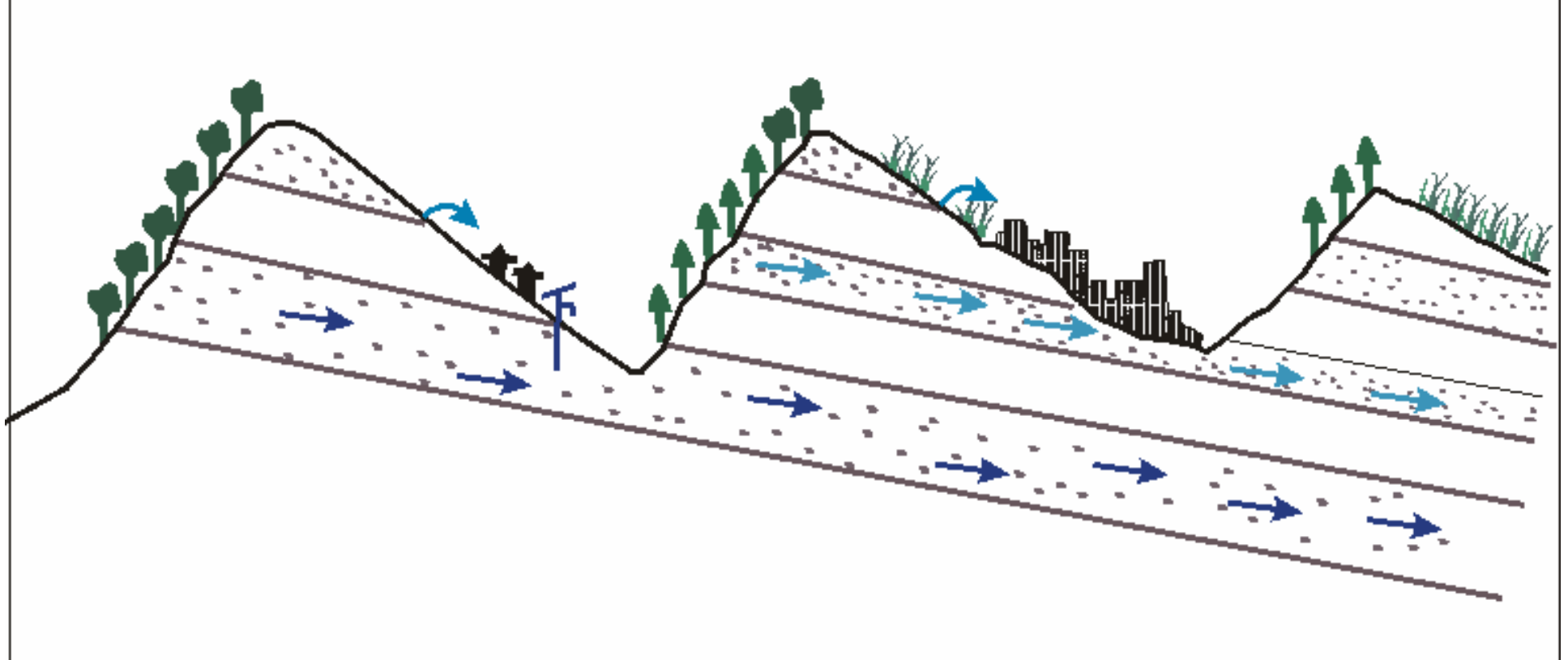
Limestone



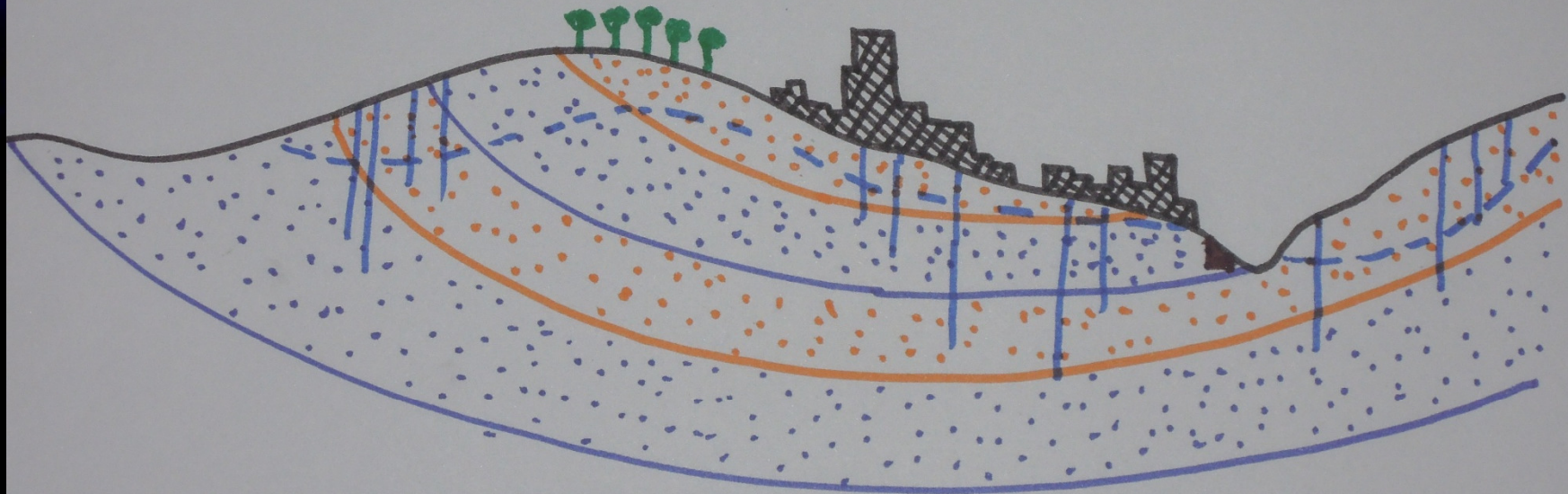
Volcanic rocks



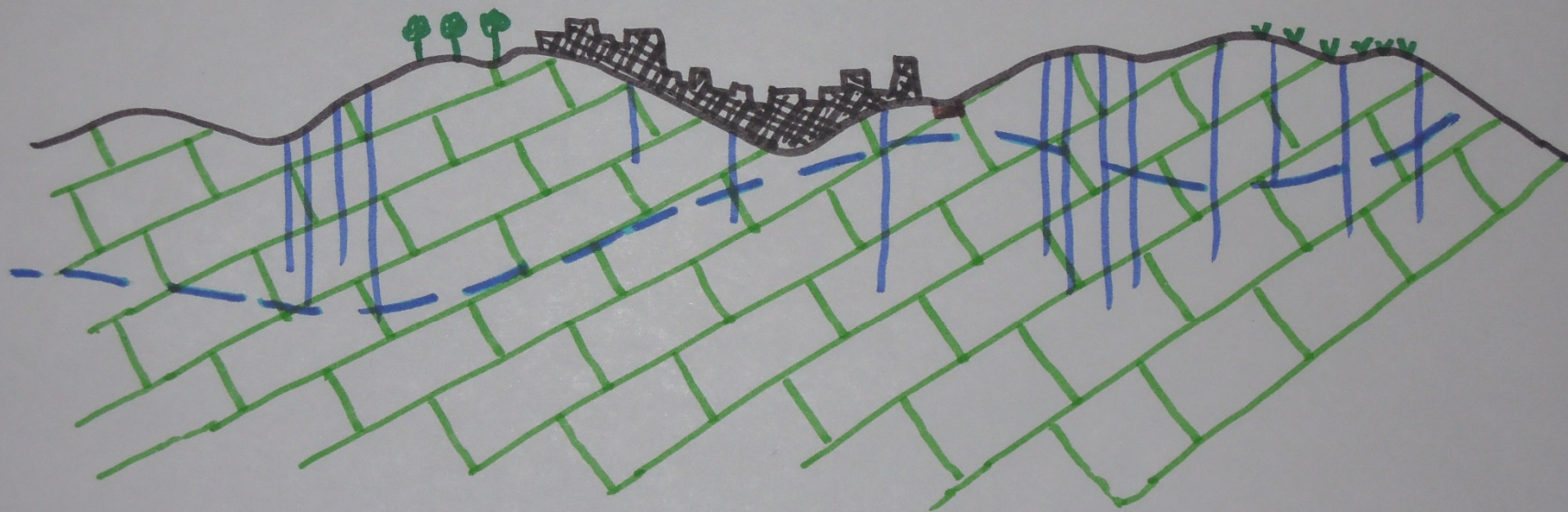
Himalayas



Consolidated sedimentary rocks



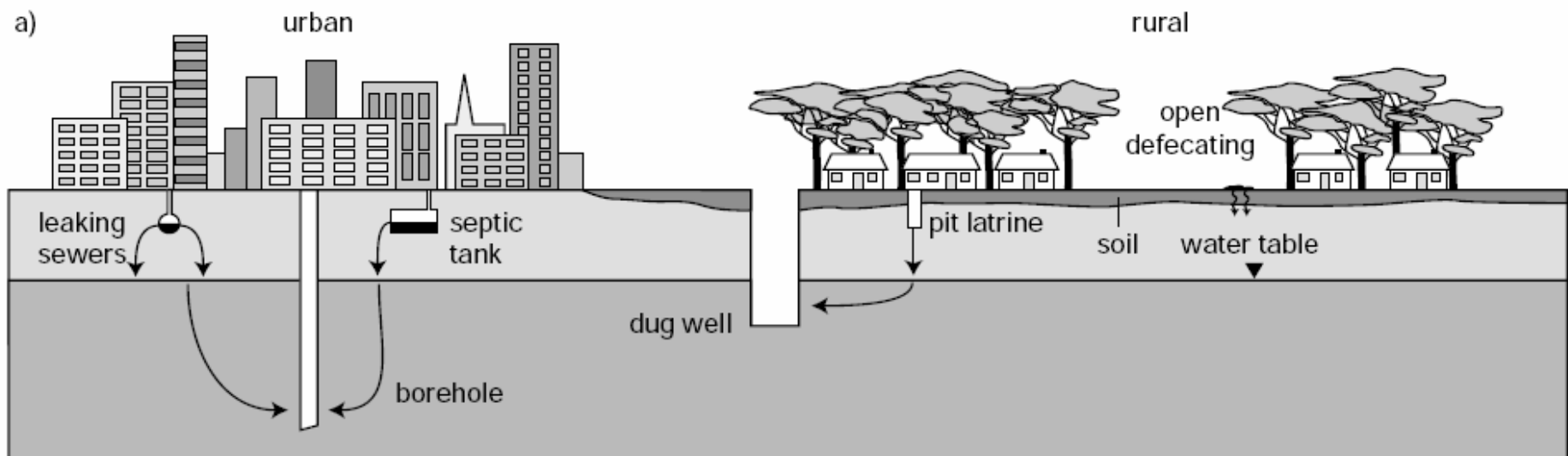
Carbonate rocks / limestones



Multiple / compounded



Urban – rural continuum



Mainstreaming

- Comprehensive understanding of groundwater resources (aquifers) required
- Information on sources, usage, impacts (especially recharge and quality)
- Logic of including groundwater in the *formal civic water supply system*
 - Examine whether such a move will take the pressure off individualistic access to groundwater
 - Link regulation and licensing to assured water supply and equitability
 - Without major improvements in sanitation, sewerage, recycling and treatment, one cannot assure security of water supply and sustainability of groundwater resources

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