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Demarcation of Groundwater Potential Zones Using Remote Sensing, GIS and MIF Techniques in Theni District, Tamil Nadu

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Abstract: ***In the groundwater research, favourable groundwater potential zones are identified using integrated remote sensing (RS) and geological information system (GIS) by any researchers all over the World. The present study was carried out to assess the groundwater potential zones using remote sensing and geological information system and Multi Influencing Factor (MIF). The information such as geology map, geomorphology, landuse / landcover map, soil map, slope map, lineament density map were generated and converted to the raster data base using ArcGIS. Multi influencing factor (MIF) is used for distribute fixed score and weight of the features. Finally, all the individual thematic layers are weighted mathematically and generated to the groundwater potential zones. Based on the interpretation, the study area Theni district is classified into four potential categories, viz., very poor, poor, good and very good. The information can provide the better ideas to planning and management in the study area.***

Keywords: Groundwater potential zones, Multi influencing factor (MIF), Thematic layer

1. Introduction

Groundwater is a one of the dynamic natural resource of human being. Generally hard rock terrains to meet ever-increasing groundwater demand for domestic and agricultural activities. Remote sensing and geological information system is widely used for targeting groundwater potential zones (Jyotisarup et al. 2011). Several author used to remote sensing and GIS tools for identification groundwater potential zones based on different factor apart from geology, geomorphology, slope, landuse/landcover, soil texture, drainage density and lineament density (N.S Magesh et al. 2012; Sivakumar et al. 2015; Manikandan et al. 2014; Suresh et al. 2015). Interpreting satellite imaginary and aerial photographs to prepare land use, geomorphological structural maps etc., to suggest an overall view of potential zones for targeting groundwater resources.

2. Study Area

Physiographically, the entire district has an undulating terrain dotted with hillocks on the north and southern parts. Western Ghats hill range are the major hilly regions which is run parallel north to south, and other smaller hillocks are found scattered in Theni district. This district has a total geographical extent of 2871.31 square kilometers and lies between 9°53' and 10°22' north latitude and 77°17' and east longitude (Fig. 1). Theni district enjoyed with salubrious climatic condition, the maximum temperature ranges from 20℃ to 40℃. Annual normal rainfall is 950 mm from four distinct periods, monsoon viz., South West North East, winter and hot climate period. SuruliAr and Vaigai River are major seasonal rivers drain into this district. Geologically the area lying with in this district can be broadly classified into hardrock terrain occupied by chornockite and hornblende biotite gneiss.

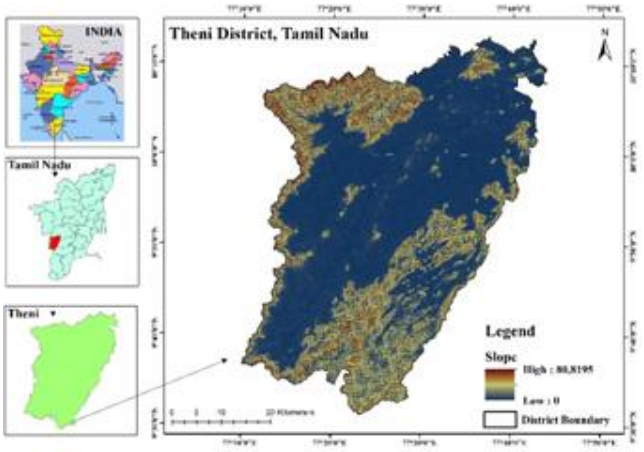

Figure 1: Study area map

3. Methodology

The methodology used for identification groundwater potential zone using integrated study of remote sensing and GIS is showing in Fig. 2. Scanned Survey of India (SOI) topo sheets was used for preparation of base map of the study area. Drainage network of the study area digitised from SOI topo sheets using ArcGis 10.3. Slope map of the study area mapped from SRTM dem data using spatial analyst tool. Lineament density and drainage map was prepared using line density tool of ArcGis 10.3. IRS – 1C, LISS – III geo coded (1:50000 Scale) satellite image used for preparation of various thematic layers such as lamduse/landcover, geomorphology, soil and lineament. Geology map collected from Geological Survey of India (GSI). These thematic layers processed into 30m resolution raster layer format. Order of thematic layers were processed into weighted overlay analyst tool for create a groundwater potential map, during the process of weighted overlay analysis, rank was providing all individual parameter of every thematic layers, weight were allocated based on multi influencing factor (MIF).

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4. Multi Influencing Factor (MIF)

Basis of influencing factor, viz., geology, geomorphology, landuse/landcover, soil, drainage density, lineament density and slope have been used for identification of groundwater potential zone. These potential zones are variation is based on the weightage value, higher weightage value showing best impact of groundwater potential zone. The groundwater potential zone is derived from following term

$$GWP = W_{Geo}R_{Geo} + W_{Geom}R_{Geom} + W_{LULC}R_{LULU} + W_{Soil}R_{Soil} + W_{Dden}R_{Dden} + W_{Lden}R_{Lden} + W_{Slope}R_{Slope}$$

Where
W_{Geo} is weight of geology and R_{Geo} is rank on the theme;
W_{Geom} is weight of geomorphology and R_{Geom} is rank on the theme;
W_{LULC} is weight of landuse/landcover and R_{LULU} is rank on the theme;
$W_{Soil}$is weight of soil and R_{Soil} is rank on the theme;
W_{Dden} is weight of drainage density and R_{Dden} is rank on the theme;
W_{Lden} is weight of lineament density and R_{Lden} represents rank on the theme;
W_{Slope} is weight of slope and R_{Slope} is rank on the theme;

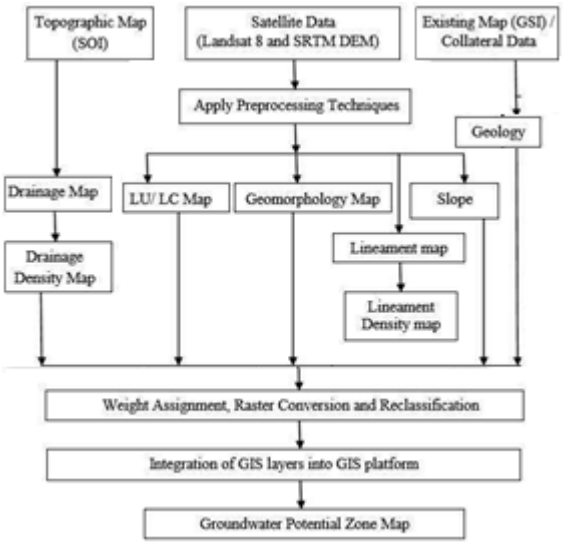

Figure 2: Flow Chard used for groundwater potential zone

5. Results and Discussion

All the thematic layers were integrated using weighted overlay analysis, assigned for weight for all the individual parameters for every layer, values are showing in table 1. The origin, occurrence and movement of groundwater are controlled by geological setup of a terrain. Hence, clear understandings of the subsurface geological conditions are of primary importance. Geologically, the area lying with in this district can be broadly classified into hard rock terrain (Fig. 3), most of the study area covered by chornockite rock followed by hornblende biotite gneisses. Geomorphological map (Fig. 4) helps to identify the various geomorphic units and to target the groundwater potential areas in each of units. Theni district is bounded by Western Ghats (structural hills). Composite slopes and the pediment zones associated with these structural hills. Valley fills area noticed in southern part of the study area. Even though the hydro geomorphic are demarcated, based on remote sensing technique and are the subsequent field checks, the geomorphological map prepared by 1:50000 scale. The study area landuse/landcover map (Fig. 5) derived from satellite imaginary based on tone, texture, pattern, size, shapeand etc., using image processing technique and final output made up ArcGis technique.

Table 1: Classification of weighted factors influencing the potential zones

Theme	Sub-Classes	Rank	Influence (weight) %
Geology	Chornockite	3	25
	Gneiss	8	
	Quartzite	10	
Geomorphology	Denudational hill	2	22
	Pediment	4	
	Structural hills	1	
	Valley	8	
	Water Bodies	9	
Landuse/ Landcover	Agricultural land	8	8
	Build-up land	2	
	Forest	6	
	Waste land	3	
	Water Bodies	9	
Soil	Older alluvium	2	16
	Red gravelly	6	
	Red loamy	1	
	Younger alluvium	4	
Slope	0 - 15	16	15
	15 - 30	12	
	30 - 45	8	
	45 - 50	4	
	50 - 65	2	
	65 - 80	1	
Drainge Density	0 - 0.5	21	6
	0.5 - 1.0	17	
	1.0 - 1.5	13	
	1.5 - 2.0	9	
	2.0 - 3.5	7	
	3.5 - 4.5	5	
	4.5 - 5.5	2	
Lineament density	0 - 0.6	1	8
	0.6 - 1.2	5	
	1.2 - 1.8	9	

Theni district mainly occupied for agricultural lands followed by forest area. Water bodies, agricultural lands and forest area are good groundwater potential zones based on theme of landuse/landcover.

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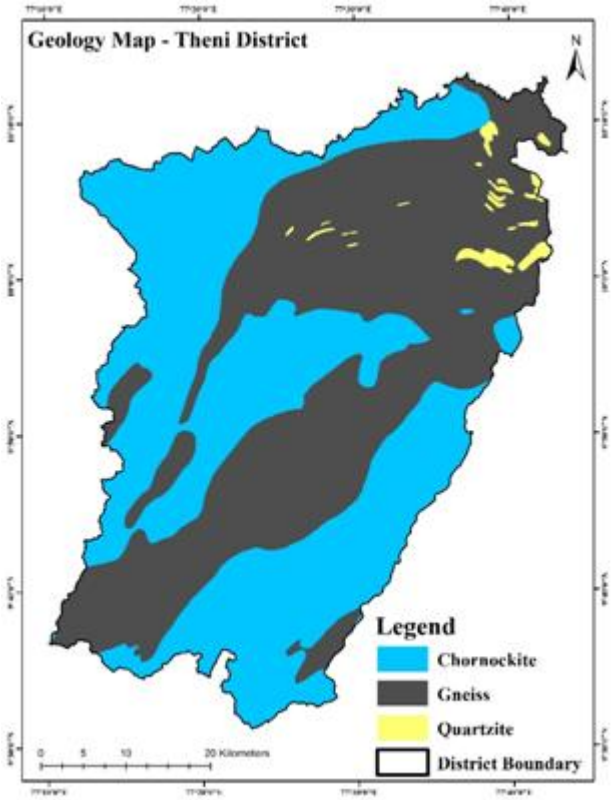

Figure 3: Geology Map

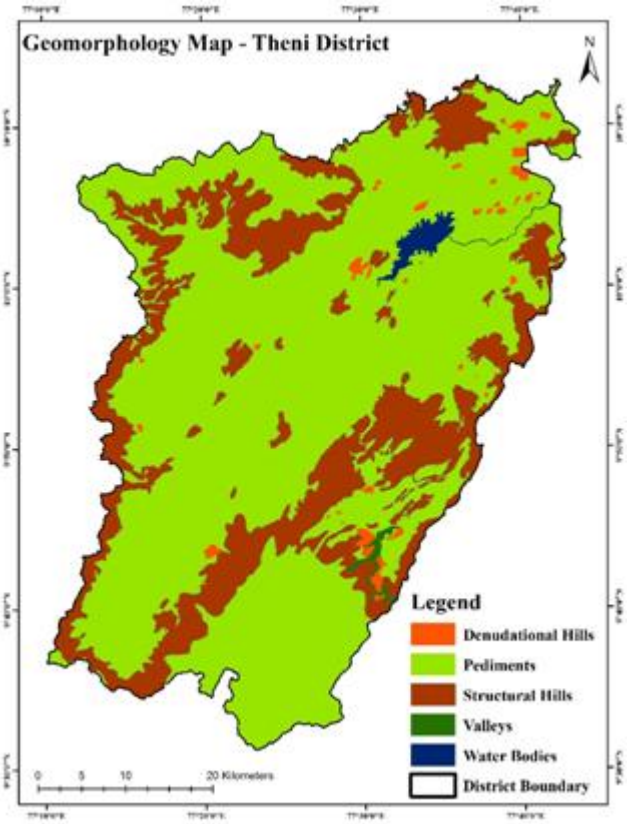

Figure 4: Geomorphology Map

Natural soil is the formed by a physical and chemical weathering of host rock and their properties is formed during the course of the formation and the subsequent existence is depending upon the topography, hydro meteorological condition and human interference. Soil characteristics of a terrain are more important aspect since they play major role in groundwater recharge. Four major group viz. alluvium, younger alluvium, red loamy and red gravelly soil is broadly identified in this district and their distribution is indicated in the soil map (Fig. 6).

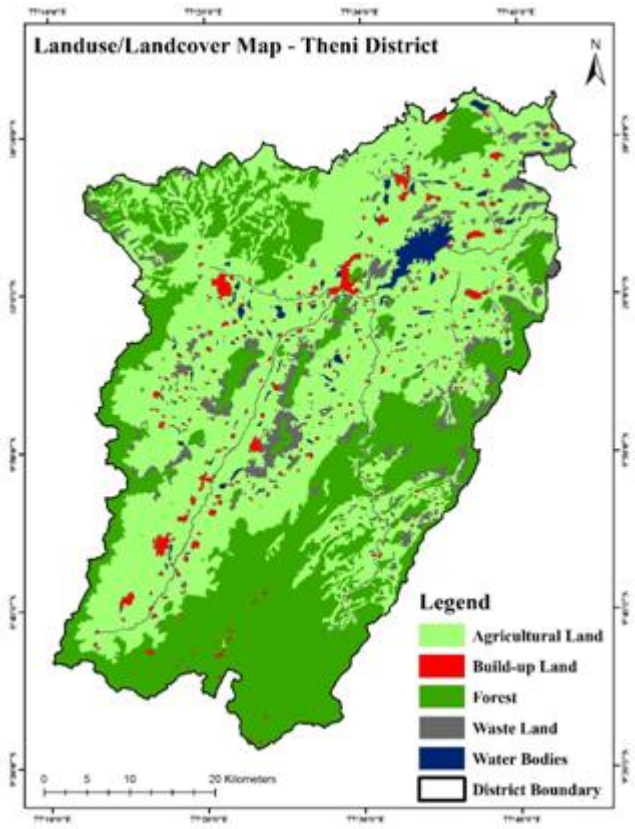

Figure 5: Landuse/Landcover Map

Generally, lineaments are weaker zones, which have been formed due to crustal movements of the earth. Lineaments occur as linear lines and are identified in satellite imaginaries. There is may be in the earth form of fault or geological contact or shear or major joints. There is important source of groundwater in hard rock terrains. Lineament density map (Fig. 7) of Theni district has been prepared from landsat and IRS imageries scale of 1:50000 by visual interpretation. Field investigation also carried out in the district and subsequently confirmed by existing boreholes of the study area. Most of the boreholes, nearby lineament zones giving a good yield condition in this district. Drainage density is most important parameter, to identification groundwater potential zones. The drainage density map is showing in Fig. 8. Higher amount of drainage density value are indicating the runoff zones and lower value indicating the recharge zones of the study area. Generally, recharge zones are good for groundwater potential zones, central part of the study area are showing in low value of drainage density, there is favourable zones of groundwater potential consider to drainage density. Slope played important role for identification groundwater potential zone. In the study area slope (Fig. 9) various from 0 to 80.8195°, recharge condition is various from amount of slope range. Most of the minimum values of slope are identified in middle part of the study area there is good area for surface water infiltration.

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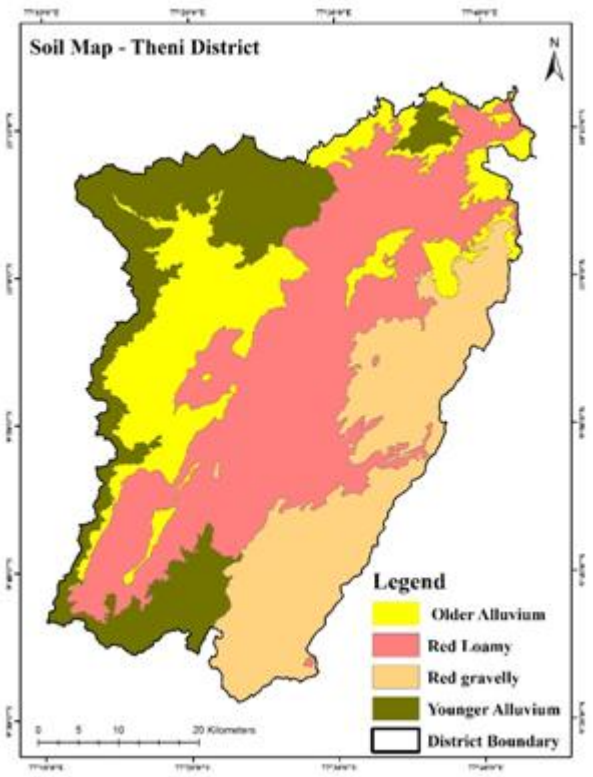

Figure 6: Soil Map

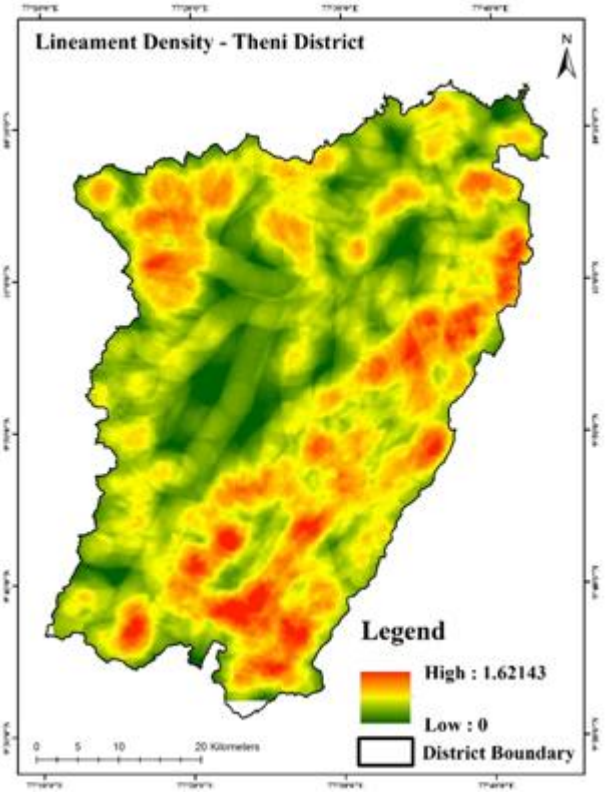

Figure 7: Lineament density Map

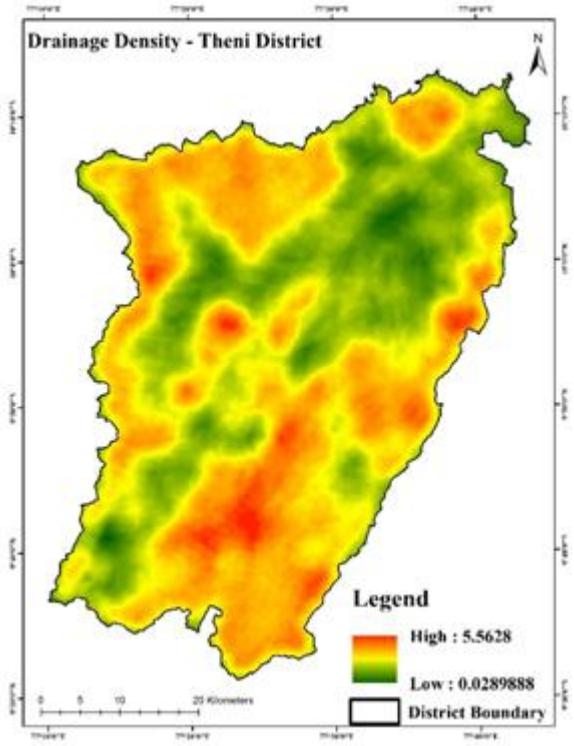

Figure 8: Drainage density Map

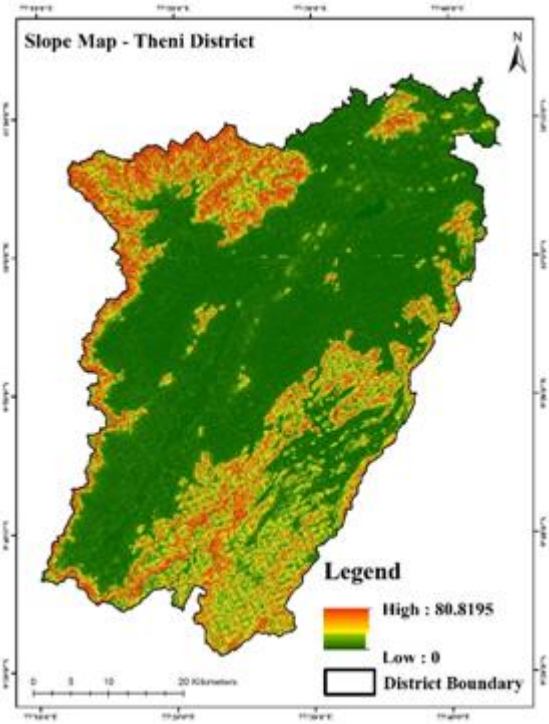

Figure 9: Slope Map

6. Conclusion

Remote sensing techniques, using satellite imageries and aerial photographs, are effective modern tool, for terrain analysis and for evaluation of groundwater potential zones. These techniques are applied to study the thematic layers of geology, geomorphology, landuse/landcover, soil, lineament density, drainage density and slope; these thematic layers are processed by weighted overlay analysis in ArcGis using MIF technique. The output of groundwater potential zones (Fig. 10), Theni district is classified for very poor, poor, good and

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very good categories. Present study can be used for target favourable groundwater resource in macro and microlevel.

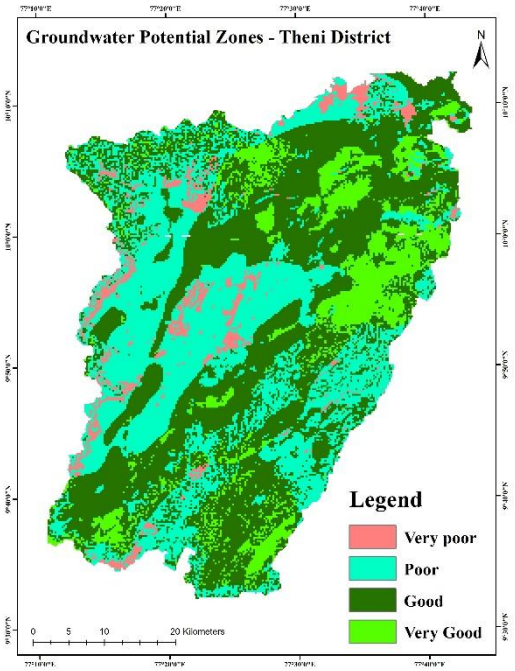

Figure 10: Groundwater potential zones map

References

[1] Jyoti sarup, Manish K. Tiwari and Vardichand Khatediya. Delineate Groundwater Prospect Zones and identification of Artificial Recharge Sites using Geospatial Technique, International Journal of Advance Technology & Engineering Research (IJATER), Vol. 1,Issue 1,2011.

[2] N. S. Magesh, Chandrasekar and John prince soundranayagam. Delineation of Groundwater potential zones in Theni district, Tamil Nadu using remote sensing, GIS and MIF techniques, Geoscience Frontiers, (1) 3 (2) (2012) 189 – 196, 2012.

[3] J. Manikandan, A.M. Kiruthika and S.Sureshbabu, Evaluation of groundwater potential zones in Krishnagiri District, Tamil Nadu using MIF Technique, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, Issue 3, p10524 – 10534, 2015.

[4] S. Sivakumar, C. Lakshumanan, J. Rajesh, and P. Karthick. Identification of groundwater potential zones in hard rock terrain of Thiruvannamalai Tamilnadu, India – a geomatics based approach, International Journal of Remote Sensing & Geoscience (IJRSG), Volume 4, Issue 1, p1 – 6, 2015.

[5] D. Suresh, J. Colins Johnny, and B. K. Jayaprasad. Identification of artificial recharge sites for Neyyar river basin, International Journal of Remote Sensing & Geoscience (IJRSG), 2015, Volume 3, Issue 1, p20 – 27, 2015

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