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Space for Societal Resilience, Transformation and Intelligence

DATE: 20 – 22 August 2025

VENUE: CSIR ICC, Tshwane, South Africa

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Integrating GIS and Remote Sensing for Sustainable Grid in Hydrologically Sensitive Areas of South Africa's Central Grid

Sixolise Melapi
Snr Advisor GIS (NTCSA)

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National Transmission Company of South Africa (NTCSA

The National Transmission Company of South Africa (NTCSA) was established as part of a larger effort to restructure Eskom and promote a competitive electricity market. This unbundling process, first proposed in 1998, aims to divide Eskom into three separate entities: generation, distribution, and transmission (NTCSA). The NTCSA is specifically responsible for managing the national electricity grid and transmitting power from generation sources to distribution networks.

- **NTCSA Mandate**: Develop and maintain South Africa's national electricity grid.
- **Current Network**: +33,000 km of high-voltage powerlines.
- **Future Plans** : +14,000 km under the 2022–2035 Transmission Development Plan (TDP).

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Land Management Mandate and Role

NTCSA Is required to ensure that its infrastructure and assets are secured and safeguarded during planning, construction and operation ensuring its network function efficiently and safely.

- Ensure that all servitudes registered to NTCSA business, both vacant and built, are fully monitored for threat, using technology.
- together with physical monitoring methods.
- Guard against illegal occupation of the servitudes and land by applying land invasion preventative measures.
- Responding to illegal encroachment.
- Maintaining an effective and accurate land assets register and GIS (data analytics).

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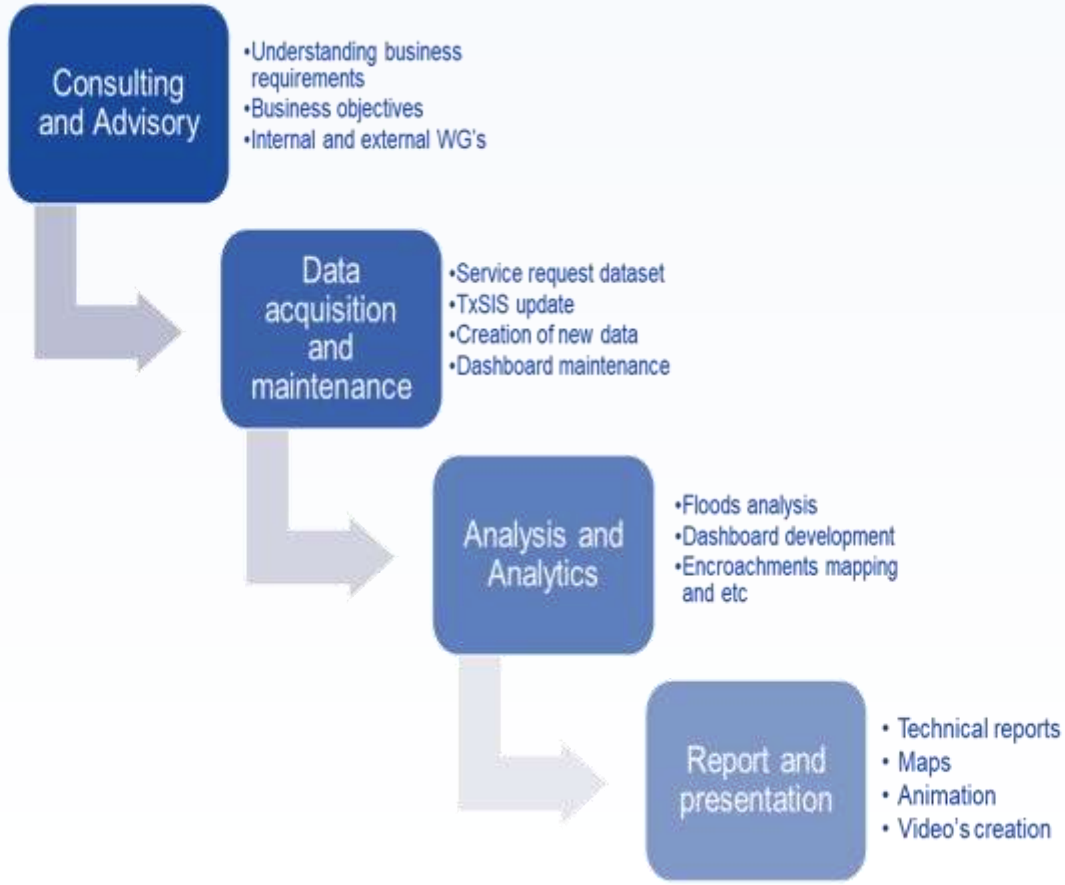
Geospatial Intelligence CoE Value Chain



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Role of Geospatial Science

- Enhances **asset resilience** through Remote Sensing & GIS analysis.
- Provides **scientific evidence** to mitigate risks.
- Balances infrastructure needs with **ecological protection**.

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Regulatory Context

Governed by **National Environmental Management Act (NEMA), No. 107 of 1998**.

- Emphasis on:
  - Proactive **spatial planning**
  - **Environmental stewardship**
- Supports compliance with statutory permits:
  - Water use licenses
  - NEMA authorizations

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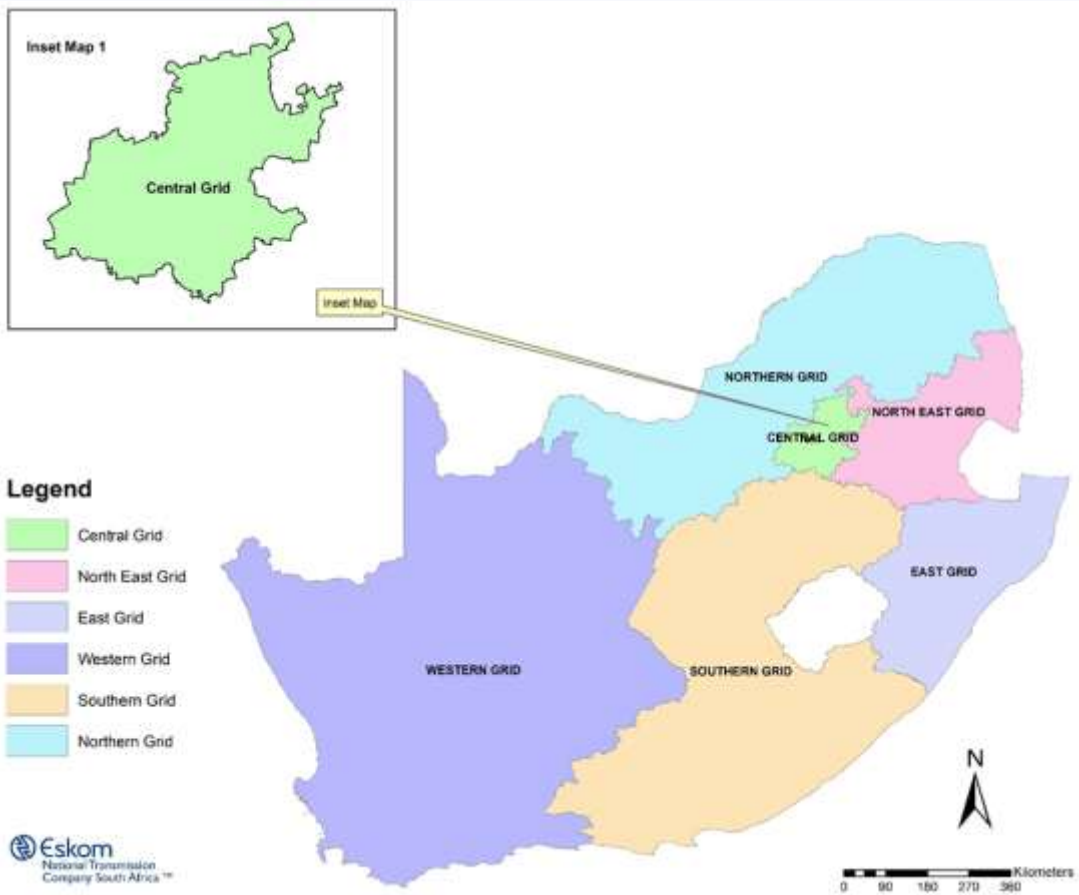
Study Area



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Methodology

- Applied 500-meter buffer around waterbodies.
- Generated polygons representing influence zones
- Conducted **select-by-location query** to extract towers within buffer
- Exported selected towers to new layer & table
- Ensured no duplication of tower records
- Created subset of towers for analysis
- Used Random Selection tool to choose towers for fieldwork
- Exported results to CSV & KML formats
- Locations applied in ground truth verification

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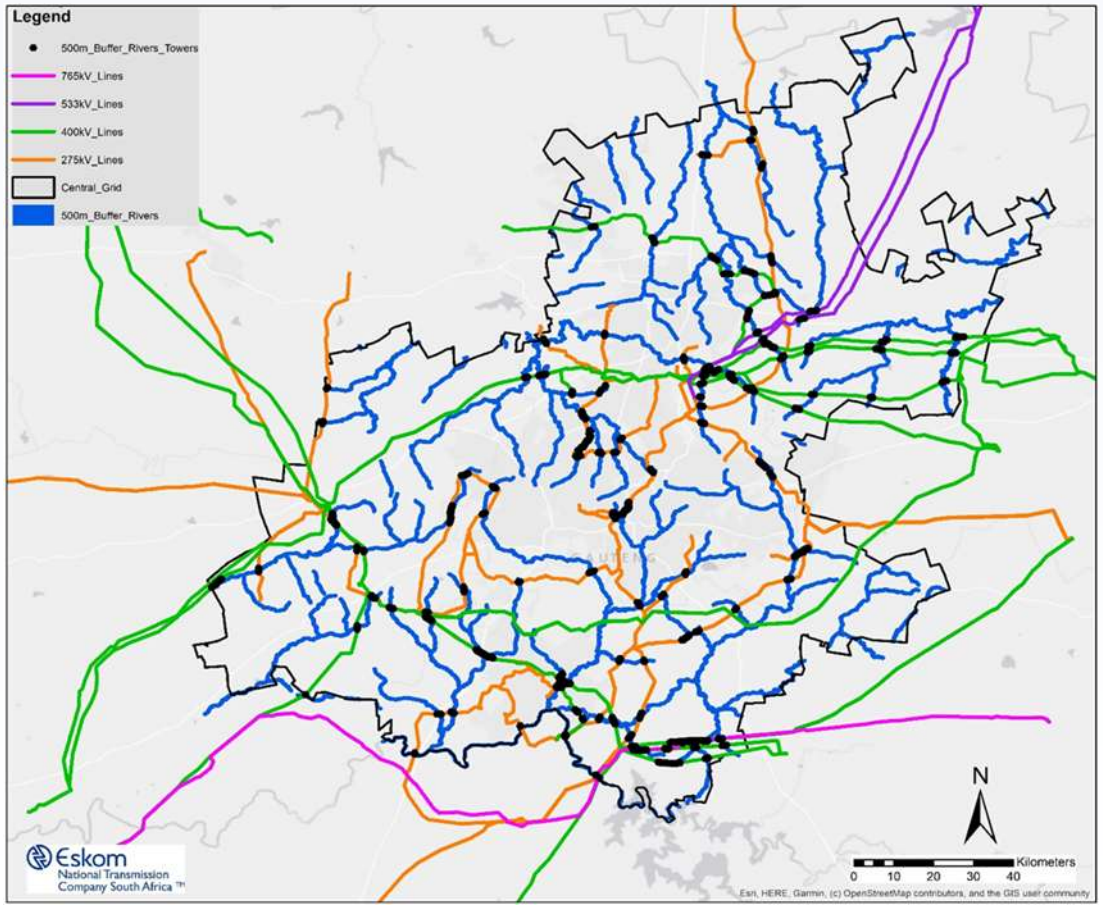
Towers within 500m buffer of Rivers



Number of affected towers within 500m buffer of Rivers are 2911.

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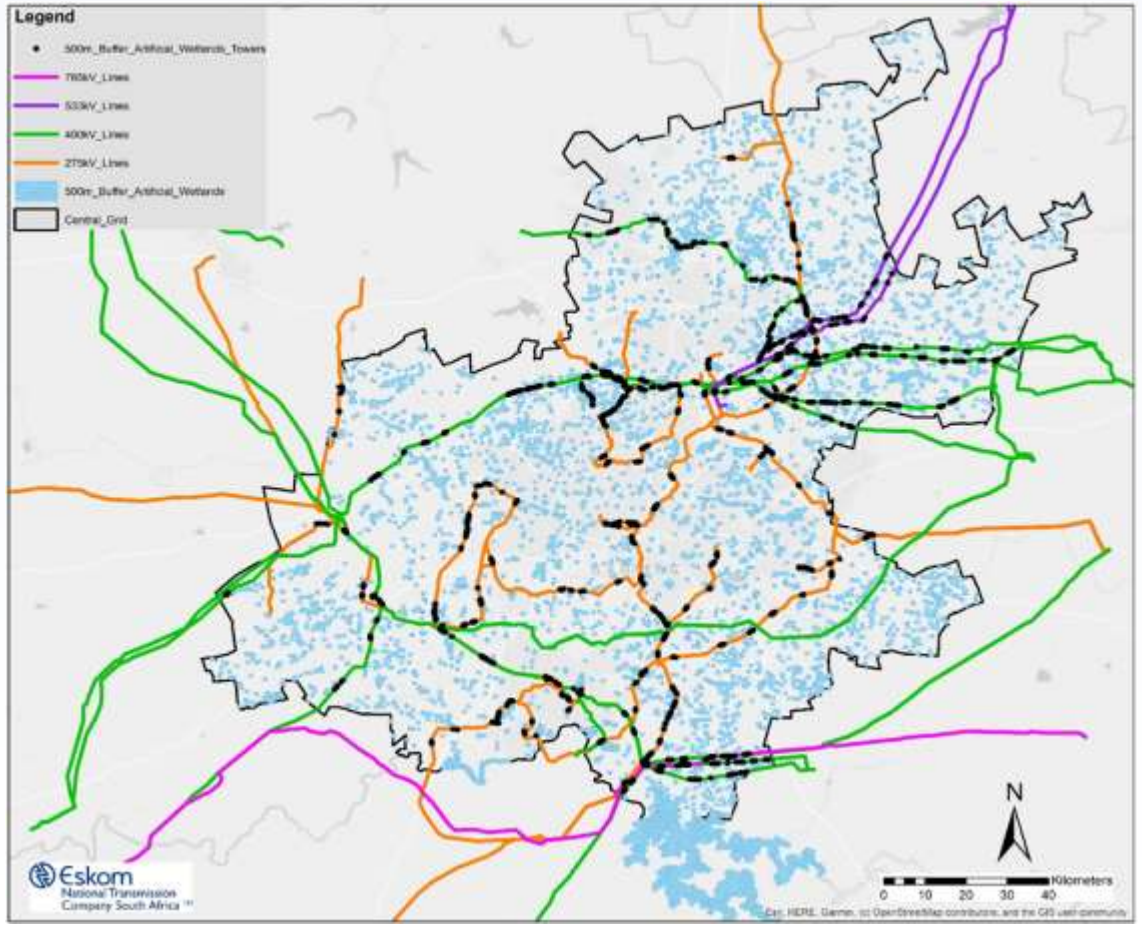
Towers within 500m buffer of Artificial Wetlands



Number of affected towers within 500m buffer of Artificial wetlands are 4501.

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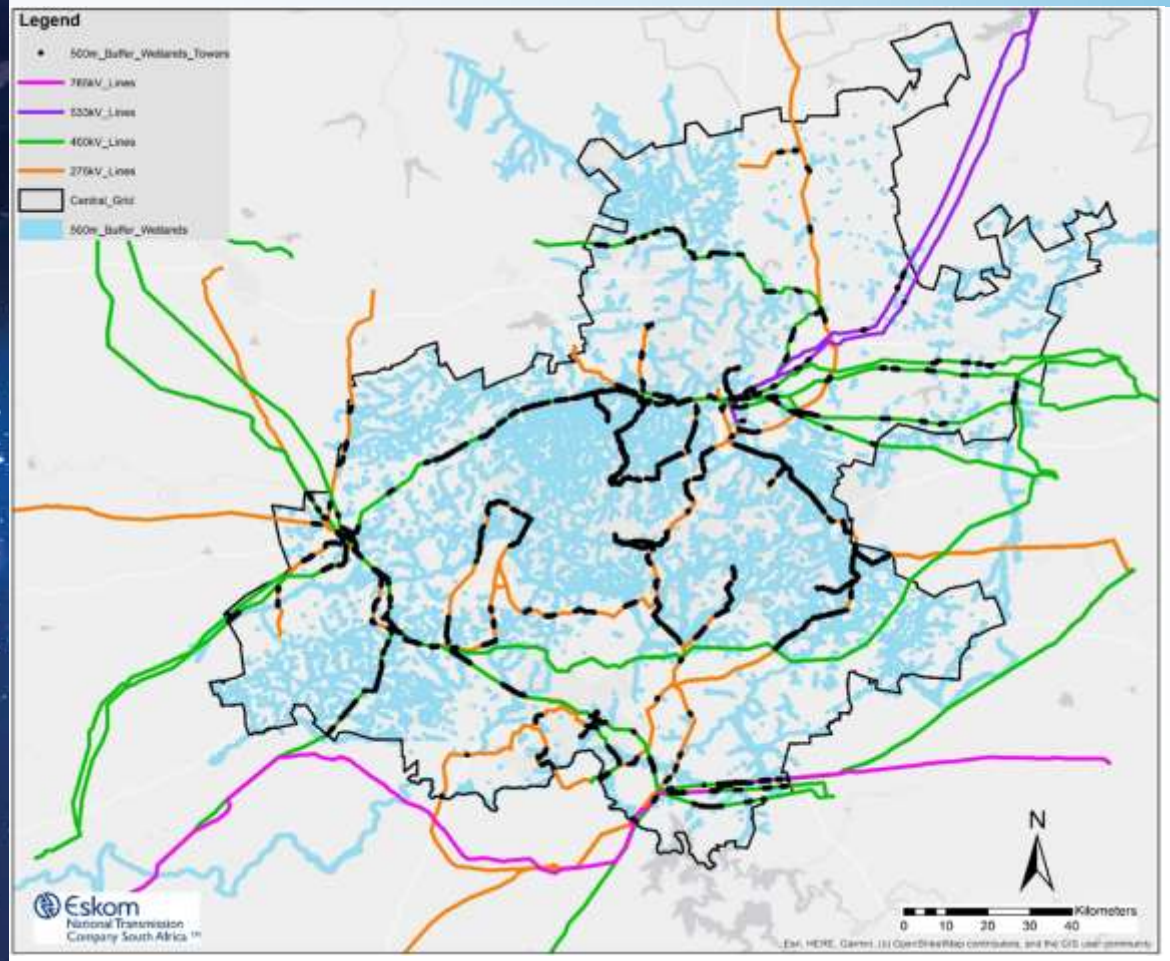
Towers within 500m buffer of Natural Wetlands



Number of affected towers within 500m buffer of Natural wetlands are 8730.

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Field Verification

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The Normalized Difference Water Index (NDWI)

- The Normalized Difference Water Index (NDWI) was used for detecting water bodies using Sentinel-2 satellite imagery.
- Sentinel-2 Level-2A (surface reflectance) imagery was obtained from: **Copernicus Open Access Hub.**
- **Formular used : NDWI**=(Green+NIR) / (Green−NIR)
- Water features: positive NDWI values (0 to +1)
- Non-water (built-up, soil, vegetation): negative values (-1 to 0)
- Calculate NDWI for each pixel using ArcGIS Raster Calculator
- NDWI raster map (continuous values between -1 and 1).

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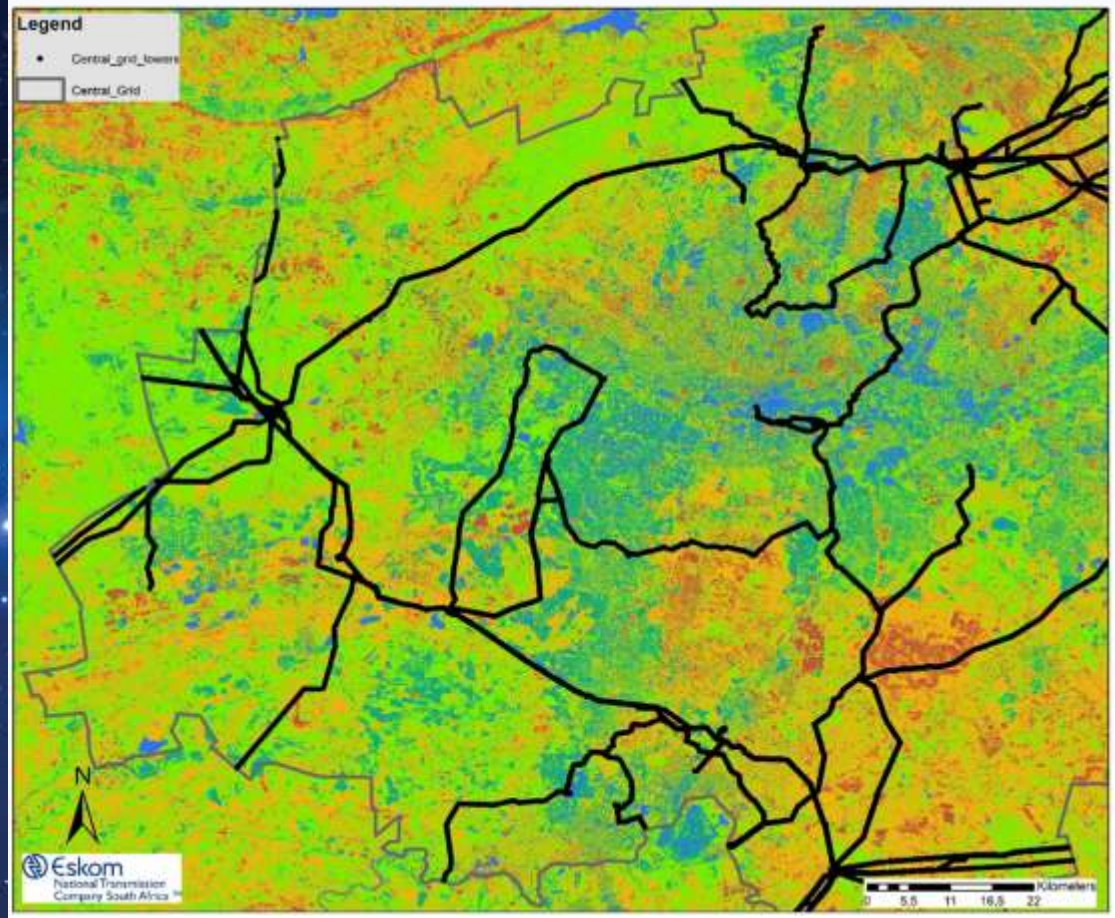
NDWI Map



Assisting with Infrastructure planning and maintainance.

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Conclusion

- **Waterbody Monitoring Near Infrastructure**
- **Early Flood Risk Detection**
- **Environmental Compliance & Planning**
- **Cost-Effective & Frequent Monitoring**
- **Support for Infrastructure Planning**
- **Climate Change & Drought Monitoring**
- **Subsidence monitoring**

➢ NDWI time-series analysis detects drying or expanding water bodies over time.

➢ Assists NTCSA in long-term climate resilience planning.

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