



Lusaka and Surroundings

-Vulnerability of Groundwater-

1 : 75,000

VULNERABILITY OF GROUNDWATER*

The PI-Map is the product of the P-Factor and the I-Factor based on the PI-Method after N. Goldscheider, M. Kluge, S. Sturm & H. Wastl (2000): The PI-Method – a GIS-based Approach to Mapping Groundwater Vulnerability with Special Consideration of Karst Aquifers. – Z. angew. Geol., 46 (2000) 3: 157-166; Hannover.

The numbers in brackets express the final value for vulnerability.



The explanation of the map's compilation and guidance for interpretation can be found in the accompanying brochures to this map. (Nick et al., 2012; Blumie et al., 2012).

AREA WITH INCREASED RISK OF GROUNDWATER QUALITY DETERIORATION*

Landuse	Sanitation system
industrial and commercial area	pit latrine
commercial agriculture	septic tank
landfill	waterborne sewer system
graveyard	trickling filter
quarry	stabilization pond

GROUNDWATER FEATURES

Used production borehole of the Lusaka Water and Sewerage Company (LWSC) with name

single appearance	grouped appearance
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Springs

perennial	intermittent or seasonal
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HYDROLOGY

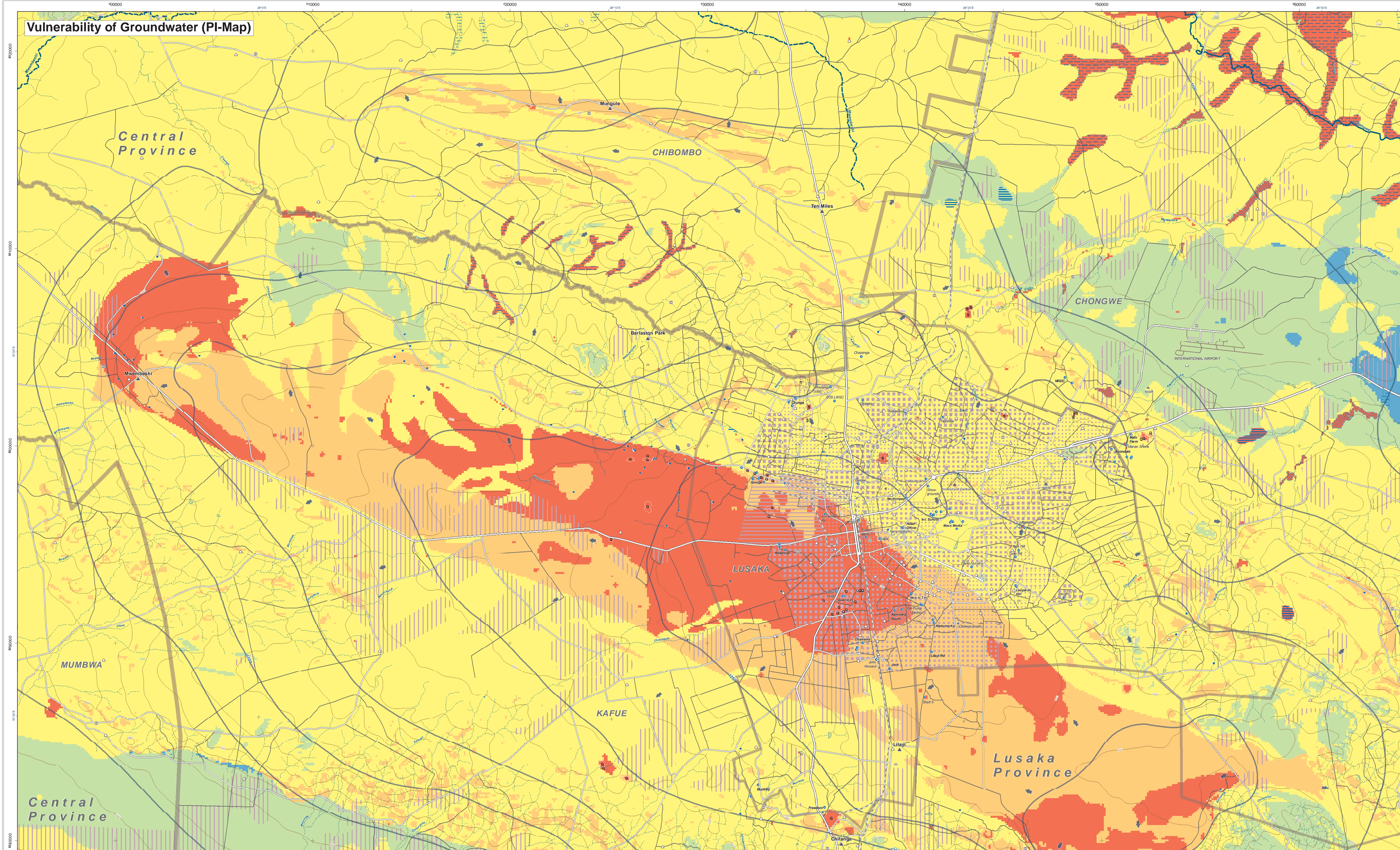
dam	pan
swamp or marsh	pond
dambo (type of shallow wetland)	
large river with perennial / seasonal or intermittent runoff	
river or large stream with perennial / seasonal or intermittent runoff	
stream with perennial / seasonal or intermittent runoff	
small stream or creek with seasonal or intermittent runoff *	
regional groundwater flow direction *	

Piezometric surface, contour line in meters [a.s.l.], contour interval 50m *

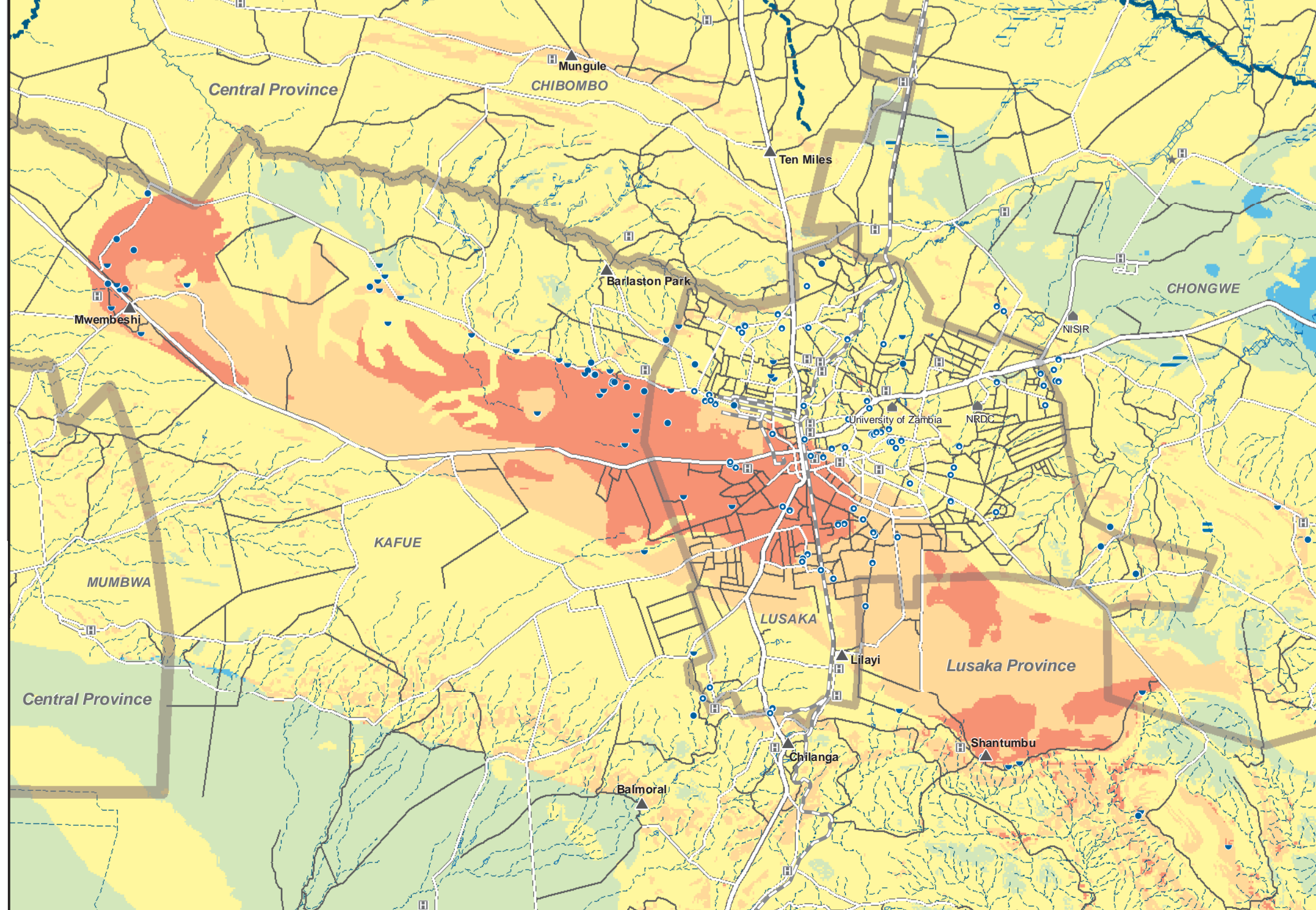
validated	tentative
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Prepared as a technical cooperation project between the Governments of Zambia and the Federal Republic of Germany.
References and Data Source:
- A. Nick & M. Kluge & H. Wastl (2002): Groundwater Resources of the Mueemba and Chongwe catchments, including the Lusaka region – A Manual with Explanations for the Use of the Hydrogeological Maps and Vulnerability Map. Ministry of Lands, Energy and Water Development, Department of Water Affairs and Federal Institute for Geosciences and Natural Resources, Lusaka.
- B. Blumie, A. Nick, B. Shamboko-Mukale, C. Chisala (2012): Groundwater Resources of the Mueemba and Chongwe catchments, including the Lusaka region. – A Brief Description of Physiography, Climate, Hydrology, Geology and the Groundwater Systems of the Area. Ministry of Lands, Energy and Water Development, Department of Water Affairs and Federal Institute for Geosciences and Natural Resources, Lusaka.
- IRI International Corp., Nippon Koei Co. Ltd. & Japan Engineering Consultants (2009): The Study on Comprehensive Urban Development Plan for the City of Lusaka in the Republic of Zambia. Final Report (March 2009), Volume II Chapter 2: Water supply and sewerage/drainage. Ministry of Local Government and Housing, Lusaka City Council and Japan International Cooperation Agency (JICA) (Modified).
- K. Hahnke, B. Shamboko-Mukale (2010): Development of a Groundwater Information & Management Program for the Ministry of Energy and Water Development, Department of Water Affairs, Lusaka & Federal Institute for Geosciences and Natural Resources, BGR, Hannover; 77 pages, Lusaka.
- Department of Water Affairs, Groundwater Database: Groundwater Resources for Southern Province and Lusaka Province; Project (GRASP), December 2011.
TOPOGRAPHY
- Topographic Map 1:50,000, Survey Department Lusaka, sheet numbers and publication date: 1520B1 (1973), 1520B2 (1974), 1520B3 (1974), 1520B4 (1974), 1520B5 (1974), 1520B6 (1974), 1520B7 (1974), 1520B8 (1974), 1520B9 (1974), 1520C1 (1983), 1520C2 (1976), 1520D1 (1989).
- Topographic Map 1:250,000, Survey Department Lusaka, sheet numbers and publication date: SD-35-15 (1988), SD-35-16 (1991).
- LUKASAT 5TM, Resolution 30m, date 2007/02/08, WGS 1984 UTM Zone 35, Datum D.WGS_1984.
- LUKASAT 10M, Resolution 30m, date 2007/02/08, WGS 1984 UTM Zone 35, Datum D.WGS_1984.
- DEM grid resolution is approximately 90m by 90m (3 arcsec).
Geometry: Transverse Mercator Projection, Zone 35, Spheroid: Modified Clarke 1880

Vulnerability of Groundwater (PI-Map)



Effectiveness of Protective Cover (P-Map)



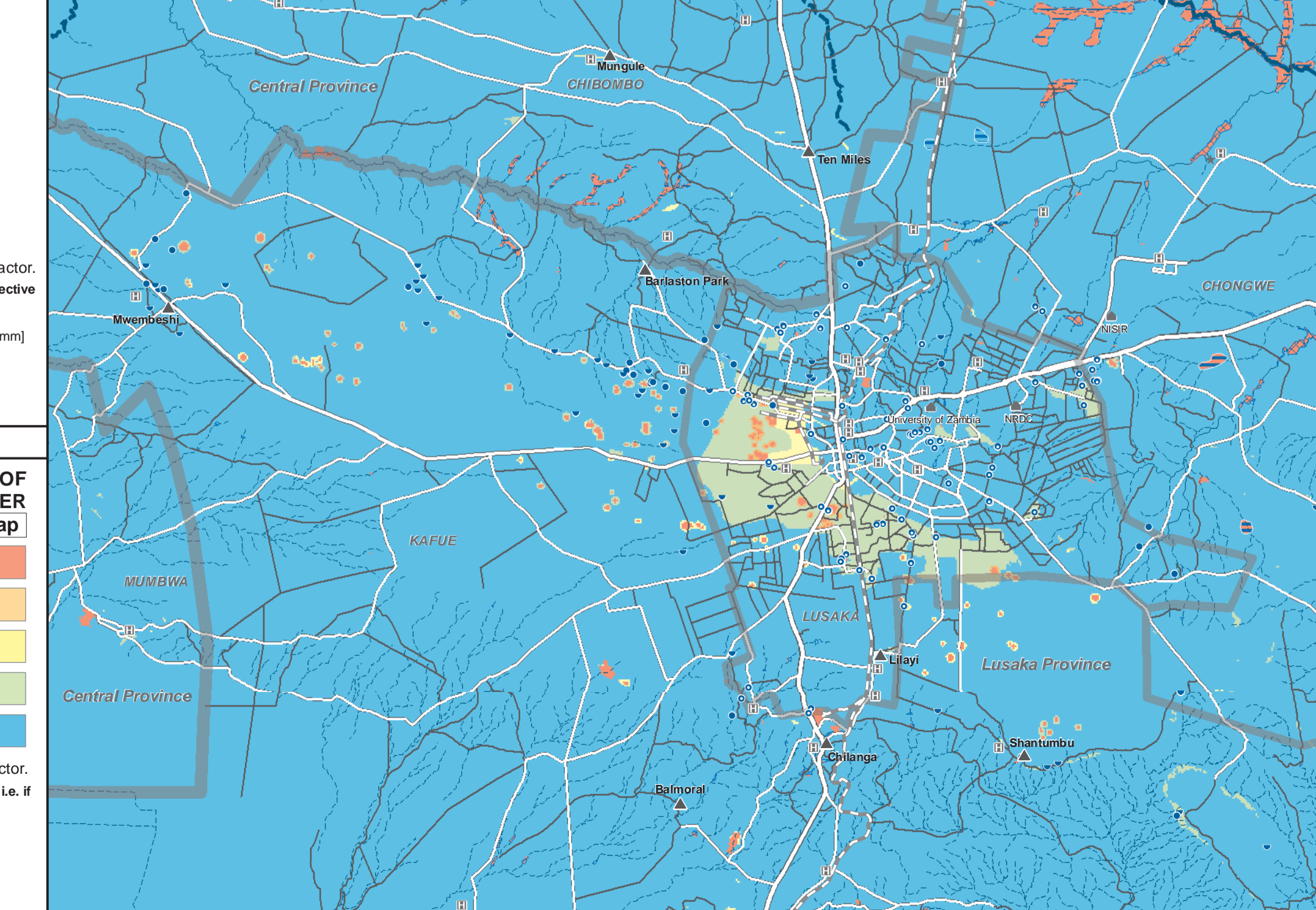
EFFECTIVENESS OF PROTECTIVE COVER (P-Map)

very low (1)
low (2)
moderate (3)
high (4)
very high (5)

The numbers in brackets express the P-Factor. The P-Map shows the effectiveness of the protective cover which is compiled from the following parameters:
- effective field capacity (available water content) [mm]
- annual groundwater recharge [mm]
- grain size distribution of subsoil
- lithology
- fracturing
- thickness of each stratum [m]

Scale: 1 : 250,000

Degree of Bypassing of Protective Cover / Infiltration Map (I-Map)



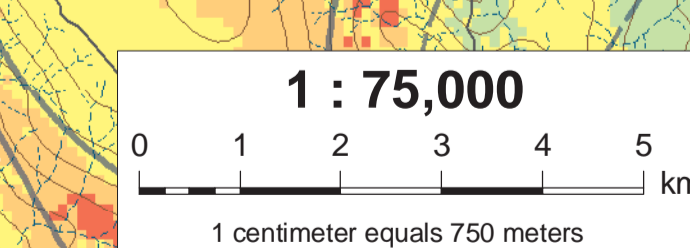
DEGREE OF BYPASSING OF PROTECTIVE COVER (I-Map)

very high (0.2)
high (0.4)
moderate (0.6)
low (0.8)
very low (1.0)

The numbers in brackets express the I-Factor. The I-Map illustrates the infiltration properties, i.e. if the protective cover is bypassed or not. It takes into account the following parameters:
- depth to top permeable layer [cm]
- saturated hydraulic conductivity [m/s]
- slope [%]
- bind size classes
- surface catchment, e.g. swallow holes or spring streams

TOPOGRAPHY

hut, village	trunk road
point of interest (mission, agricultural station)	main road
research institute	district road
school *	street, motorable track or farm road
health facility	track *
contour line in meter [a.s.l.], contour interval 20m *	railway



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KAFUE
district boundary with name

Central
provincial boundary with name

Map Names:
1 Lusaka and Surroundings
2 Lusaka Catchment
3 Kafue Flats & Southern Tributaries
4 Southern Kafue Lake & Kafue
5 Northern Kafue Lake & Kafue Gorge
6 Mueemba & Chongwe

* Features not presented in P-Map and I-Map