

Groundwater of the Cuvelai-Etосha Basin

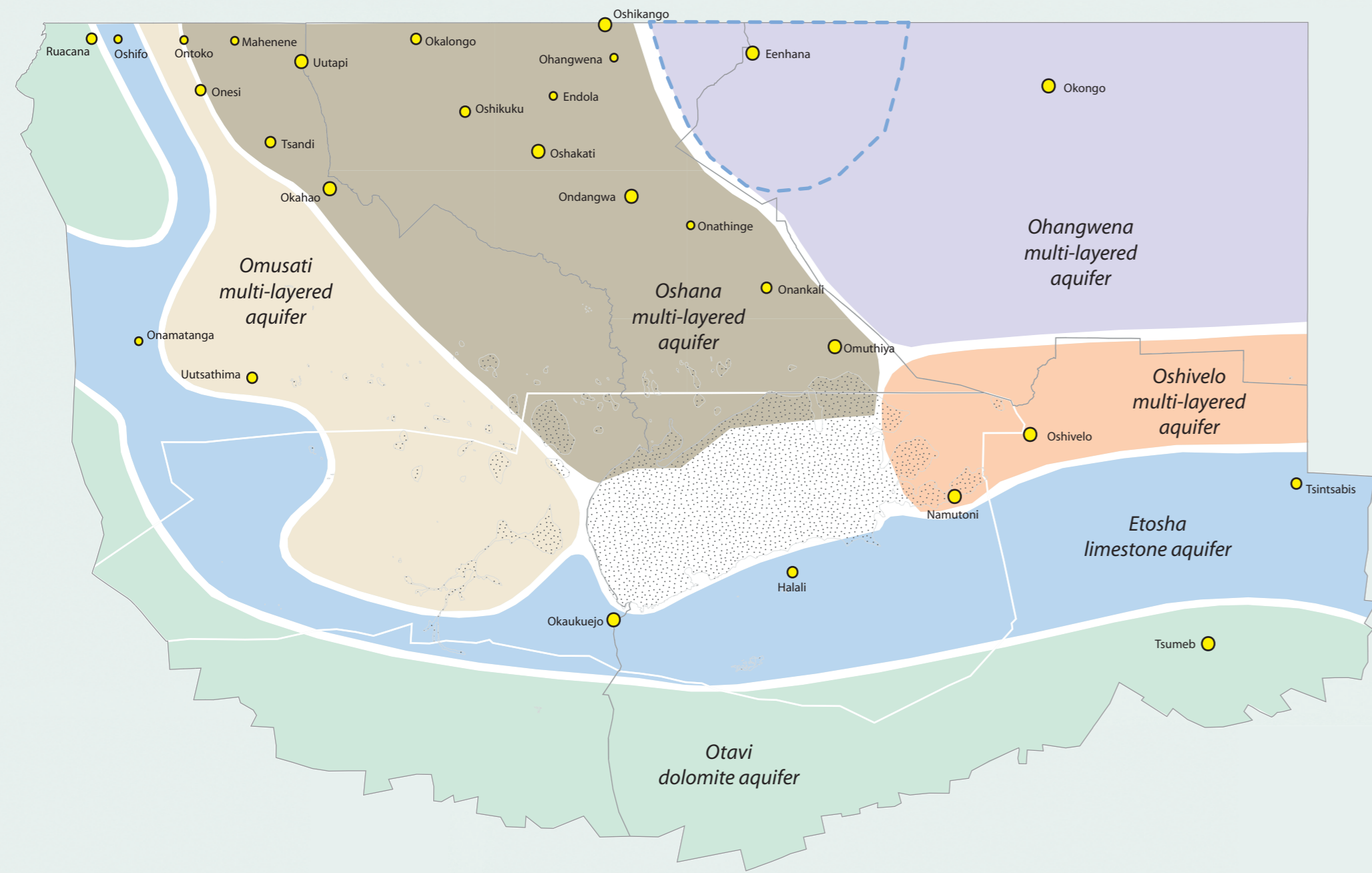
Groundwater is the main source of water for people and livestock in much of the Basin, especially in the west, north-east and the south-east. In areas where groundwater is of sufficient quantity and quality, boreholes have been drilled to

supply water. A canal and pipelines supply water from the Kunene River to areas which don't have suitable groundwater resources. Groundwater is rainwater that has seeped into the ground and has been stored in water-bearing layers known as aquifers.

The six main aquifer systems

The four multi-layer zones have water in different layers. The dotted line shows a separate deep aquifer of fresh water in the Ohangwena zone.

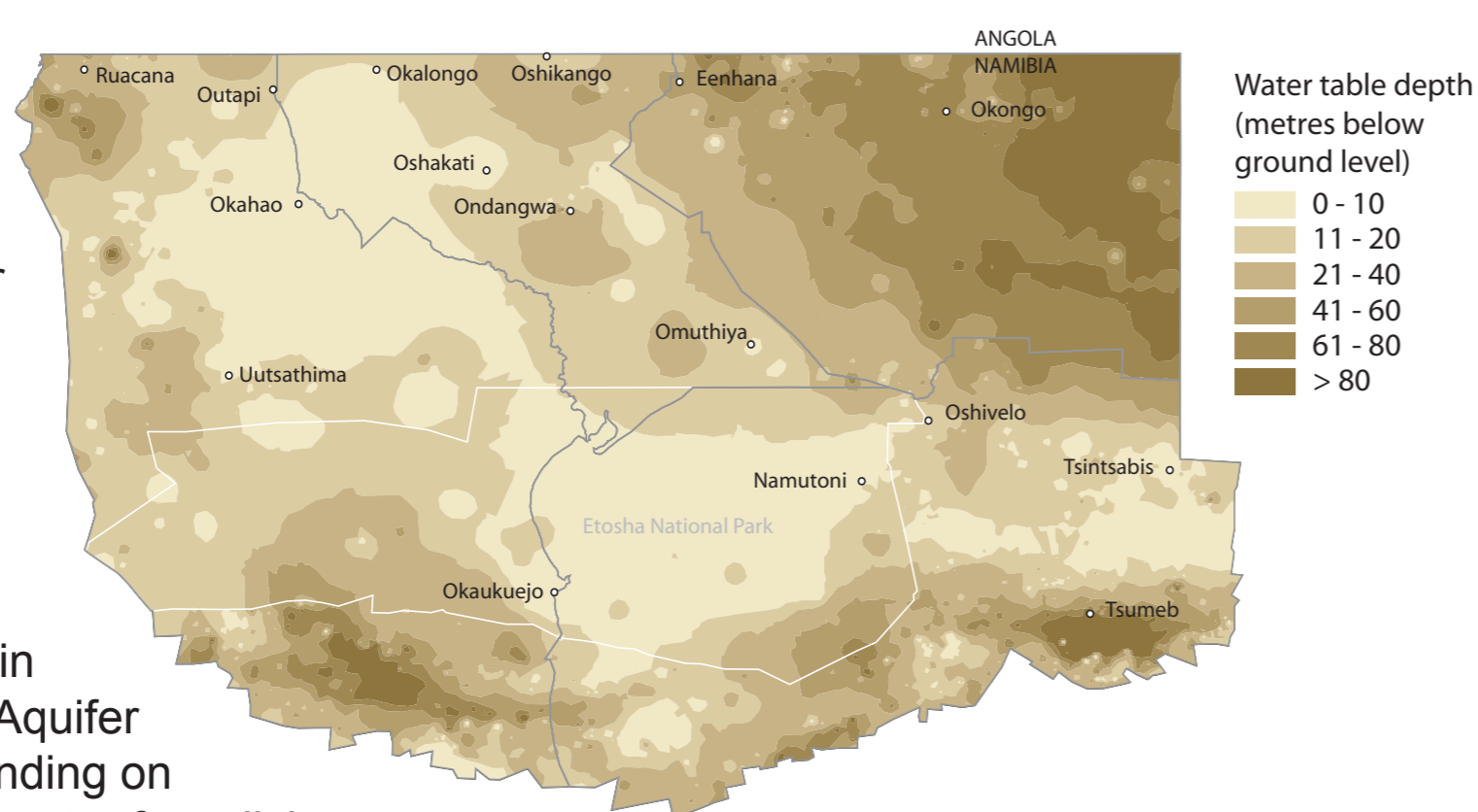
The Otavi and Etosha aquifer systems have most of their water in single layers of limestone or dolomite rock.



Aquifer system	Rock type	Depth (m)	Quality	Yield (m ³ /h)
Ohangwena multi-layered aquifer	Sand, sandstone	60-300	Fresh to brackish	1-50
Oshivelo multi-layered aquifer	Conglomerate, sandstone, sand, dolocrete, calcrete	30-150	Fresh to brackish	5-100
Etosha limestone aquifer	Dolocrete, calcrete, sand	10-100	Fresh, locally high Nitrates	3-100
Oshana multi-layered aquifer	Sand, calcrete/limestone	10-80	Saline to hyper saline	1-30
Omusati multi-layered aquifer	Sand, clay and calcrete, dolocrete	20-100	Brackish, fresh in places	1-30
Otavi dolomite aquifer	Dolomite	20-250	Fresh	>50

Water table depth

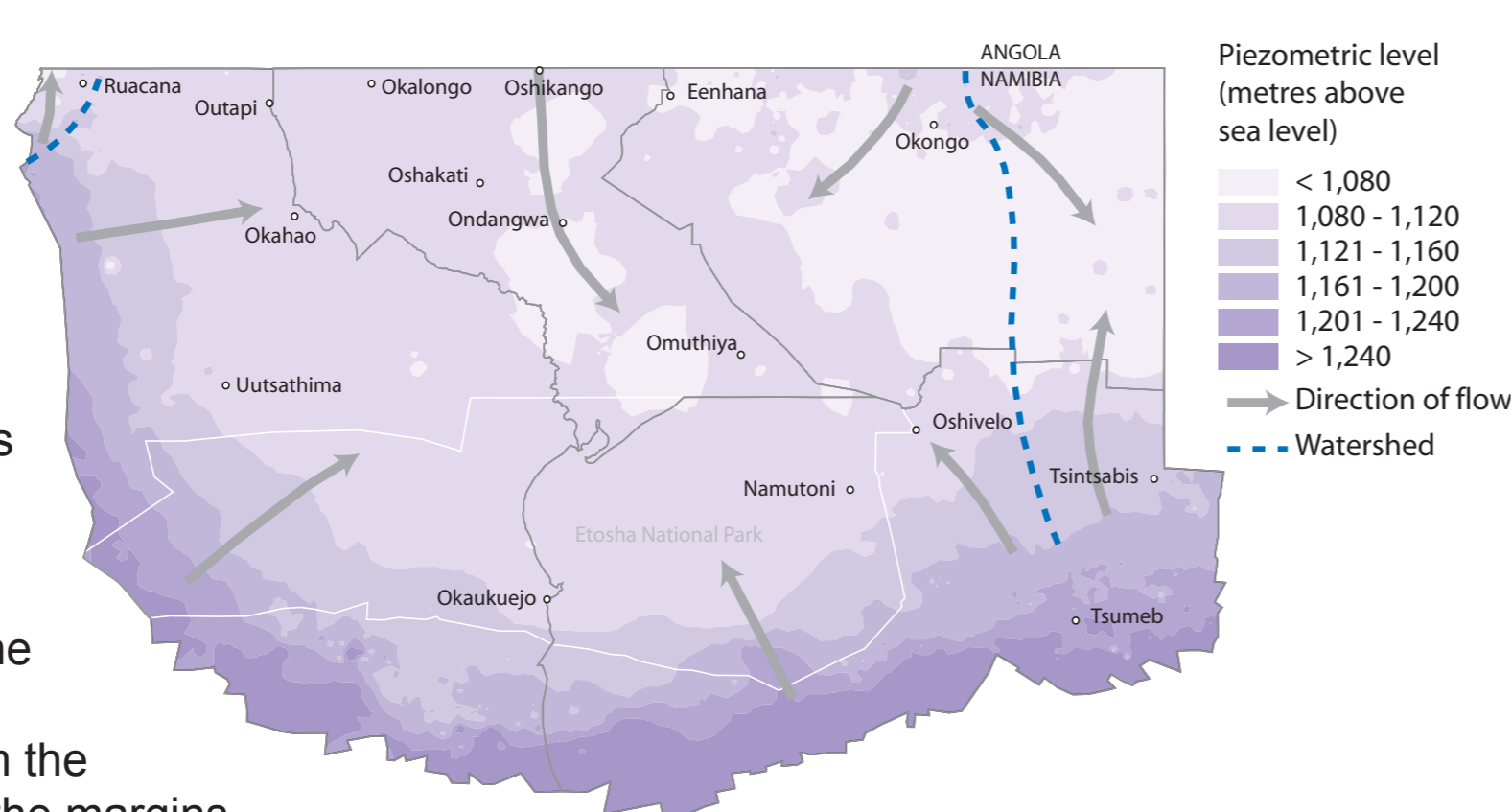
The deepest groundwater is in the north-east where most boreholes are deeper than 100 metres. Water levels in the south and west may be as deep, but there is greater variation from one local area to another.



The depth of the water in the Oshana Multi-level Aquifer varies seasonally depending on rainfall and seepage of water from *iishana*.

Groundwater flow

The altitude of the groundwater (called the piezometric level) provides information on the direction of flow beneath the ground. Just as on the surface, water at higher altitudes flows to lower levels.



All groundwater flows towards the centre of the Basin. In the south and west, the flows are from the high-lying areas along the margins towards and below Etosha Pan. Flows of groundwater from the north into the centre are due to the higher elevations along the northern border and in Angola.



Most information in this poster is about deep underground water pumped from boreholes. However, people in the Basin have used hand-dug wells to harvest shallow water for hundreds of years. Most of the *omifima* wells are just a few metres deep, but some may be 10 or 20 metres deep, such as in this cluster of *eendungu* wells at a cattle post.

this area of the Basin. This was long before piped water became available and many people, especially those in the Angolan Cuvelai, still depend entirely on water from shallow wells.

In areas where all the groundwater lies deep below the surface, windmills, engines and solar power are used to pump water to the surface. Water levels rise in years of good rainfall, bringing the water closer to the surface.

It is access to sweet water on top of the Oshana Multi-level Aquifer that first enabled so many people to settle and live in



Borehole water quality

Water quality is measured by its content of total dissolved solids (TDS). Any water with a TDS value of 2,600 milligrams per litre or more is not fit for humans, while values above 5,000 are detrimental to livestock. The dissolved solids consist mainly of salt, calcium, phosphates, nitrates, fluorides and sulphates.

The best borehole water is in the eastern and far western areas and south and east of Etosha Pan. By contrast, water of poorest quality is in the central areas of the Basin which is where the great majority of people live. However, most of these people use piped water or fresh water from shallow hand-dug wells.

These maps show the chemical properties of deep water pumped from boreholes. People may suffer detrimental effects from high concentrations of fluorides (which affect teeth and the development of childrens' bones), sulphates (act as a laxative) and nitrates (affect oxygen transport in the body).

