

# A3

## Global overview

### IN THIS APPENDIX:

- Regions, countries and localities where sand-abstraction systems are in use and where the possibility exists for small-scale sand-abstraction technology
- Review of further localities where sand-abstraction may not be used but where the possibility may exist to establish developed sand-abstraction systems

Sand-abstraction in the manner and systems described has been primarily developed in southern Africa although the technology is in widespread use in several countries and in particular in North America where it is used in collector wells and driven well-points. Systems generally similar to sand-abstraction are also used in streambed abstraction in perennial rivers in temperate zones and include sea water intakes through infiltration galleries that are installed into beach sand. The abstraction technology is thus well established and in one way or another sand-abstraction is used almost anywhere on the globe that there is free moving water in sediment. However, it is dryland areas to which sand-abstraction is particularly suited.

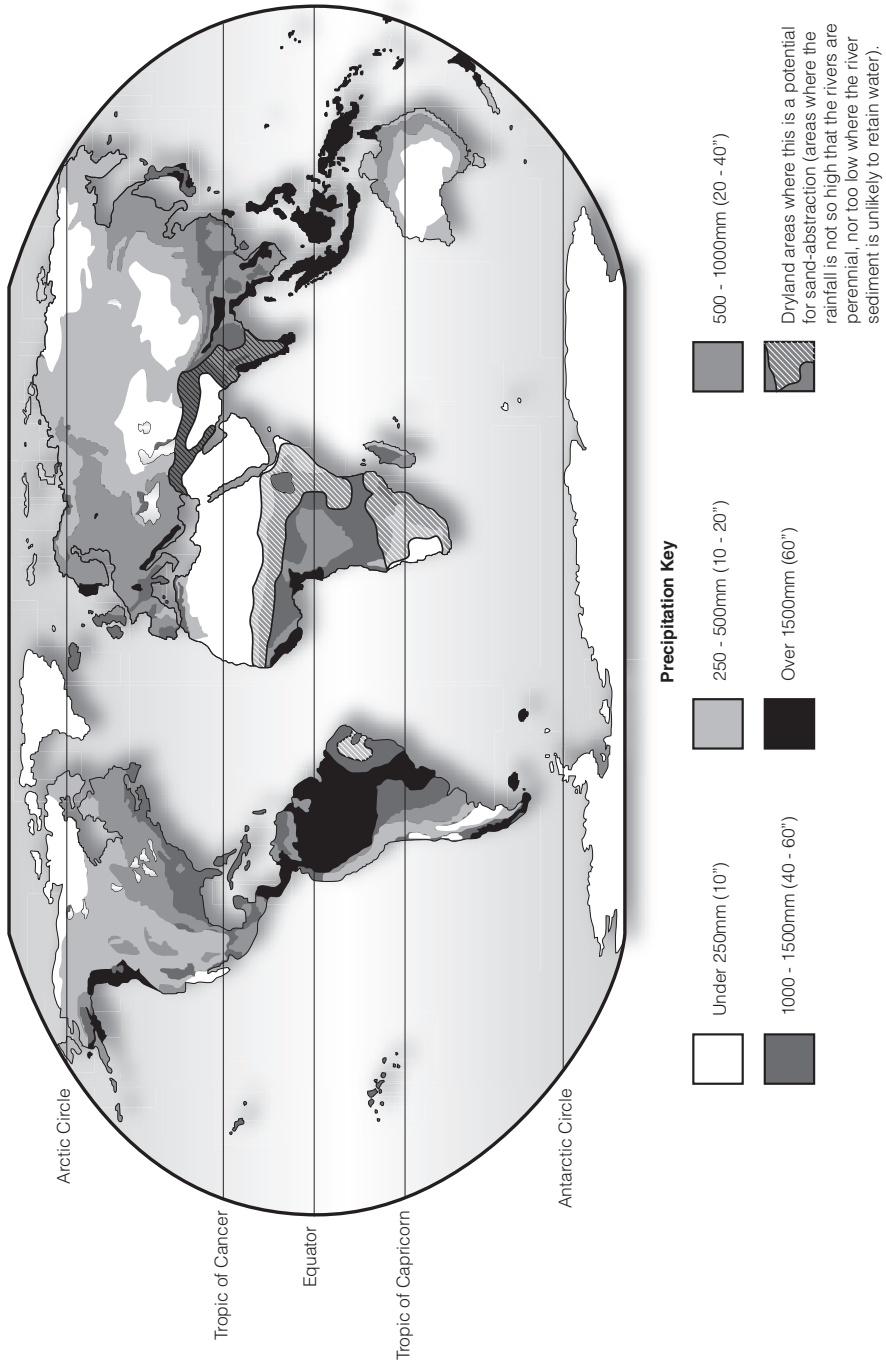
Approximately one third of the world described as arid or semi-arid lies between latitudes 30° north and 30° south of the equator. On the basis of climate, dryland regions occupy 36% of the earth's land surface with many of the countries within the region categorized as water deficit. The most extensive arid area of the world is the desert region of the Sahara and Sahel that stretches across north Africa. Other desert areas in the region are the Danakil which occurs in Eritrea and northern Ethiopia, the Ogaden in Somalia and south east Ethiopia, the Chalbi in northern Kenya and the Didi Galgalu desert in eastern Kenya. In southern Africa there are the Kalahari and the Namib Deserts. In the Middle East the desert regions are the Arabian Desert, the Indo-Iranian deserts of Iran, Afghanistan and Pakistan and the Thar Desert of India.

The desert regions of central Asia primarily occur in Turkmenistan, Uzbekistan, Kazakhstan and Tibet together with the Taklimakan and Gobi deserts of China. The desert regions of South America are the Patagonia and Atacama Deserts. Much of the continent of Australia is designated as desert as are parts of the south east of North America. Whilst sand-abstraction is only possible at a few localities in the arid areas of deserts there are generally extensive possibilities in the semi-arid areas of the desert margins.

Figure A3.1 indicates global precipitation and the regions that are most likely to be suitable for small-scale sand-abstraction development.

Documented evidence exists of developed sand-abstraction systems for community, small-scale irrigation, commercial agriculture and mining use in the dryland areas of Zimbabwe, Botswana, Namibia, Swaziland and South Africa. A wide range of abstraction technology has been used in these countries from the basic, small-scale hand operated to sophisticated, large high-tech automated schemes. Reliable reports of either developed or traditional sand-abstraction systems have also been received from south west Zambia (Barotseland), northern and western Kenya, Somaliland, southern and western Sudan, northern Nigeria and isolated parts of Morocco. The schemes have been mainly small-scale and for the benefit of rural communities.

There is also documented evidence of the seasonal use of riverbed sand wells in India in the Kerala, Rajasthan and Orissa States. Although these wells are generally not perennial as the riverbed alluvium does not accrue to a depth sufficient to retain water for year round use there is greater opportunity for water supplies from tube-wells installed in alluvial riverbanks, sand or gravelbeds. Where appropriate tube-well technology is used extensively throughout Pakistan, India and Bangladesh. Temporary wells are also dug into the dry rocky beds of fast flowing rivers in arid or semi-arid mountainous countries such as Tibet, Nepal and Mongolia, as well as into seasonal riverbeds in the rural areas of western China and the former Soviet Republics of Kazakhstan, Turkmenistan and Uzbekistan. In the Andes nations of Bolivia and Peru the gradients of riverbeds are typically high. Consequently the sediment is very coarse with high rates of transport so that water abstraction is more likely to be from riverbed intakes than sand-abstraction. Isolated schemes have been reported in New Mexico and Arizona in the USA where there are seasonal rivers. However the rivers there generally have an insufficient depth of river channel sediment for reliable sand-abstraction use.



**Figure A3.1.** Dryland regions that have a potential for sand-abstractation

Other areas where there are possible applications for sand-abstraction related systems are north east Brazil, where run-off water harvesting from seasonal river flow is directed into unlined pits to recharge riverbank aquifers. The Middle East and parts of the Indian sub-continent have also established water harvesting traditions. Research and documented reports indicate possibilities in parts of other countries in Latin America.

Apart from well-points and tube-wells, infiltration galleries are widely used in Iraq, Iran and Afghanistan as well as in Algeria, Northern Mexico, California and Hawaii. They are also widely used in Oceania, particularly Tonga but also in Samoa and Fiji where they are used to abstract the islands' shallow groundwater supplies and to reduce the risk of excessive saltwater intrusion. Infiltration gallery systems installed in the sand or gravelbeds below perennial river systems is an established practice in both the United States and the United Kingdom.

Sand 'spears' are used to abstract shallow groundwater from sand and gravelbeds in and around Cape Town, South Africa as well as parts of West Australia and Queensland in Australia and in Ohio, Iowa, Michigan, Wisconsin, Minnesota, New York State, Georgia and Florida in the United States.

Many of the incidents recorded are traditional open wells which are dug into dry streambeds. With suitable site identification and possible development and selection of an appropriate abstraction technology there is ample opportunity for greater utilisation of the water reserves in sand rivers, sand and gravelbeds.