SAVING THE OKAVANGO'S UNIQUE LIFE

RECONAFRICA FAILS TO PLACE A LEAK PROOF LINING SYSTEM IN THE DRILLING FLUID CONTAINMENT POND. DRILL SITE 6-2 KAVANGO NAMIBIA.

Introduction

ReconAfrica is a Vancouver based Canadian petroleum exploration company that has acquired an exploration licence for the PEL 73 area located in Kavango East and West in Namibia. Drilling of the first of two permitted exploration boreholes began in December 2020. The borehole referenced BH 6-2 is situated approximately 600m from the ephemeral river Omatako Omarumba, and all earthworks required to facilitate the drill rig have been completed. This includes a below ground level drill fluid containment pond.

Containment Pond

The pond is approximately 45m in length, 30m in width and some 3m in depth and capable of holding almost 4.2million litres of liquid waste It is not known if the capacity of the pond has been designed to contain at least 110% of the largest expected wastewater volume at any given stage as is standard practise. During the drilling process water-based drilling fluids are used to provide lubrication to the drill bit and to stabilise the borehole amongst other reasons. The drilling fluids are circulated down the borehole and pumped back to the surface for storage in the containment pond.

As drilling progresses the borehole will initially intersect shallow ground water aquifers that typically occur at a depth of 10 to 30m below ground level, with greater depth, at the base of the Kalahari beds and beyond into the underlying Karoo formations, highly saline groundwater will be intersected. This was revealed in the Environmental Impact Report prepared by Risk Based Solutions. As drill fluids circulate back to surface they bring rock cuttings and a quantity of groundwater which are stored in the containment pond built for the purpose. Due to the proposed ultimate borehole depths of 2500m, hypersaline fluid brine will be intersected in the deep Karoo sediments. The return drill fluids that will be placed in the containment pond will therefore contain drilling mud and rock cuttings from the Karoo sediments that are known to contain natural occurring radioactive materials (NORMS), and hypersaline brine – a cocktail that must be treated as hazardous liquid waste.

Technical Assumptions

The aeolian (wind blow) sand that occur in the vicinity of well 6-2 and throughout Kavango East and West are described as unconsolidated sand, with clay lenses and calcrete horizons that may occur in the immediate proximity of ephemeral water bodies such as pans and adjacent to the omuramba. Without having access to the site and without a detailed soil profile at hand, the assumption is that a typical soil profile beneath the containment pond may be described as follows:

NGL to -3m Containment pond

-3m to -5m Nodular to hardpan calcrete

-5m to -30m Loose to medium dense silty sand with occasional narrow clay lenses.

Information obtained from groundwater wells in the immediate vicinity of Well 6-2 provide the following data.

National BH Identification Number	33579	88554	22594	7912	8815	33577
Latitude	-18.34257	-18.34507	-18.35117	-18.37161	-18.40526	-18,37539
Longitude	20.01554	20.02117	19.84518	19.82956	19.87258	20,03563
Elevation (mamsl)	1094	1083	1138	1101	1148	1130
BH depth (m)	20.5	Na	110	57.6	61.6	52.5
Standing water level (m)	13.5	4	10	6.1	9.1	30.8

These data reveal that the depth to the groundwater table is in the range of 4m to 30.8m below ground level with an average depth of 12.3m. Using the assumed soil profile that is likely to occur beneath the containment pond, a range of typical values of hydraulic conductivity (the rate at which water is expected to flow vertically trough the ground) have been presented below These values have been used to determine the potential time in days that fluids emanating from the containment pond may take to reach the ground water table.

It must be borne in mind that these determinations are indicative only and are based on several assumptions. On site field testing and assessments would be required to determine actual parameters.

Depth	Description	Typical hydraulic conductivity cm/sec	Indicative flow rate	Time to reach water table	
				Best	Worst
NGL -3m	Containment pond	Not applicable	Not applicable	na	na
-3m -5m	Nodular to hardpan calcrete	10^{-4} to 10^{-6}	8.64 x 10^{-2}m/day 31.5m/year	160 days	16 days
-5m -12.3m	Loose to medium dense silty sand with occasional narrow clay lenses.	10^{-3} to 10^{-4}	0.864 m/day 315.4m/year	72 days	7.2 days
-12.3m	Water Table			**232 days**	**23.2 days**

As indicated previously the return drilling mud will include additives that ReconAfrica will use in the drill fluids as well as groundwater intersected within aquifers at various depths. The mud will also contain rock cuttings derived from the formations through which the borehole progresses.

Produced Water

The overlying aquifer that occurs at a depth of 4 to 30m in this region contains fresh potable water that is used for domestic and agricultural purposes by the adjacent communities. The deeper aquifers that are likely to be intersected near the base of the Kalahari Formation (about 900m) will be brine with a high salinity Deeper within the Karoo Group sediments, at unknown depths, the water will be hypersaline brine that will include chemical elements derived from the host rocks. Together with the added drilling fluids the water that returns to the surface to be stored in the containment pond is known as produced water which is water that comes out of the well during crude oil and gas exploration and production. Produced water contains soluble and non-soluble oil/organics, suspended solids, dissolved solids, and various chemicals used in the production process.

Typically, the salinity of the produce water may range in salinity from a few thousand to 463,000 ppm Total Dissolved Solids (TDS) particularly Na and Cl. Sea water has a typical salinity of 35 000 ppm.

Environmental Mitigation

An onsite visual assessment of the containment pond located adjacent to BH 6-2 has revealed that the containment pond has not been lined with an appropriate impermeable barrier system. Although not explicitly stated as a requirement in the Environmental Management Programme prepared by Risk Based Solutions, the requirements for a liner are implied. The report makes it a requirement of ReconAfrica to *"…Never allow any hazardous substance to soak into the soil*". Furthermore, the document also requires that upon completion of the drilling, ReconAfrica must *"… allow the pollution control dam to evaporate completely, scrape all waste that has collected in the pond and dispose of these and the **pond lining** at a suitable site"*

No lining or efforts to render the containment pond impervious have been made despite the implied requirement that there should be at least a single pond liner. As reported by National Geographic on 29th January 2021 a spokesperson for ReconAfrica indicated in a written reply in October 2020 that potentially toxic drill cuttings from the oil test wells *"will be managed in lined pits, cleaned, and disposed of offsite as per company and regulatory requirements."*

Canadian Guidelines and Regulations

Given the vulnerability of groundwater at this site, it would be expected that a double lining system would be required, coupled with monitoring of the pond lining, the interstitial pond fluid (i.e., the fluid between the two liners), the returned wastewater quality for selected parameters such as electrical conductivity (EC) and radioactivity. Regular monitoring of the groundwater quality in the immediate vicinity of the site must also be implemented.

Management guideline for saline fluids for hydraulic fracturing published by the British Columbia Oil and Gas Commission in April 2019 provide detailed requirements for the impoundment of saline flowback such as anticipated in Kavango East and West. Among the many design requirements specified in Canada some include:

- The primary synthetic liner must be a minimum of 60 mil (1.5 mm) thick, have hydraulic conductivity of 10-7cm/s or less and must have properties that are fit for the purpose intended and conditions and temperature extremes encountered.
- The secondary synthetic liner must be a minimum of 60 mil (1.5 mm) thick, have hydraulic conductivity of 10-7cm/s or less.
- The design must incorporate a leak detection system within the engineered seepage pathway leading to at least one leak detection well, vault, or port. This must allow for water sampling from the lowest point of the pond, positioned between the primary and secondary liners and be designed for accurate measurement of leakage rate.

The BC Oil and Gas Commission also provide guidelines for the management of containment ponds which include some of the following actions:

- The pond must be constructed and bermed in a manner that does not allow surface runoff from the site to enter the pond. A minimum of 1.0 m freeboard must be maintained within the containment pond at all times.
- The primary containment liner be regularly inspected for evidence of leaks and damage and that records of issues related to inspections and corrective actions be maintained.
- A groundwater monitoring program must be developed by a qualified professional to evaluate potential groundwater impacts that could be associated with the pond. Monitoring wells must be used to establish baseline conditions for groundwater levels and chemistry prior to use of the containment pond and the baseline monitoring.
- Samples from the leak detection system and sub-drain must be collected and analysed on a weekly basis.

In addition section 51 of Oil and Gas Activities Act , Drilling and Production Regulation (B.C. Reg. 286/2018 and B.C. Reg. 103/2019) provides an indication of the requirements for oil and gas exploration and production companies operating in British Columbia, Canada. As a Canadian registered company, it is apparent that there is no commitment from ReconAfrica to operate the site in Namibia to Canadian industry best practice standards.

Implications

Implications of not placing an impermeable lining system within the containment pond is that no barrier exists that will prevent potentially hazardous liquid waste generated by the drilling activity entering the upper groundwater aquifer.

The levels of toxicity and the concentrations of chemical elements and NORM's cannot be determined at this stage, however it is known from international oil and gas exploration activities that hazardous liquid waste is produced. To prevent potential contamination of groundwater resources it is essential that the containment pond is lined. This would be in line with the precautionary principal.

Oil and gas exploration could contaminate the groundwater, which would impact the livelihoods of adjacent communities. The groundwater in this area is especially vulnerable since the water tables are shallow (less than 30m deep) and therefore easily contaminated by surface activities. Aquifers in arid areas cannot be cleaned once contaminated. Because recharge of the shallow groundwater mainly occurs via the river systems, the groundwater would most likely be contaminated if the river course is contaminated.

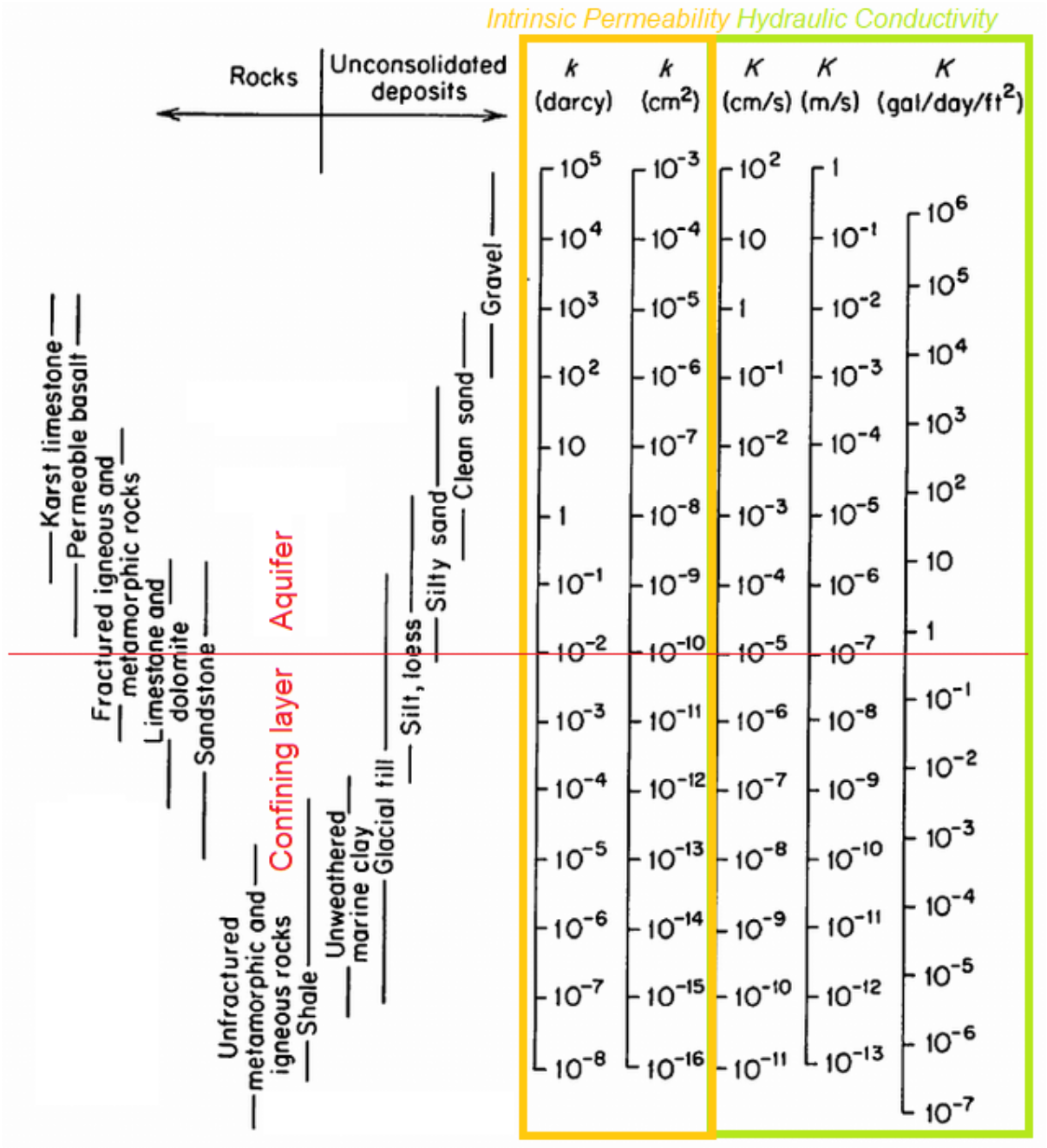
Also abstracting water from the local shallow aquifers for exploration and possible eventual oil and gas extraction can negatively affect the groundwater levels and if groundwater is abstracted from the deeper fractured bedrock aquifers, these would not be recharged.

Conclusions

Visual evidence obtained from the site indicate that ReconAfrica are not in compliance with their own declarations made in October 2020, and do not comply with the requirements of the EMPR. They are therefore in violation of the Environmental Compliance Certificate issue by the Ministry of Environment and Tourism. In addition, ReconAfrica have chosen to ignore Canadian industry approved guidelines issued by the Oil and Gas Commission in British Columbia, the state in which the companies head offices are located.

Despite the fanfare and extensive publicity that ReconAfrica have generated over the drilling of water wells adjacent to each exploration borehole will be made available to the communities once the exploration holes are completed - there will be no benefit accrued if the groundwater is contaminated by drilling effluent. The conclusions and inferences that can be drawn from the cavalier attitude of Recon Africa is that there is a lack of respect for the rural indigenous people of Kavango East and West who's livelihoods are total dependent on access to clean groundwater.

Further information can be obtained from :
Jan Arkert
jan@africaexposed.co.xa
+27836560900


Intrinsic Permeability Hydraulic Conductivity
Rocks
Unconsolidated deposits
k (darcy)
k (cm²)
K (cm/s)
K (m/s)
K (gal/day/ft²)
Karst limestone
Permeable basalt
Fractured igneous and metamorphic rocks
Limestone and dolomite
Sandstone
Unfractured metamorphic and igneous rocks
Shale
Unweathered marine clay
Glacial till
Silt, loess
Silty sand
Clean sand
Gravel
Aquifer
Confining layer