Report # 1

Possible Dam at Mohlaletsi, Limpopo Province

Submitted to Prof. R McCutcheon (Wits) and Mr Filip Taylor-Parkins (LITE)

Prepared by Nicholas Papenfus

PhD(WITS), MSAICE, MICT, Pr Eng

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Summary

This report considers the possibility of constructing a dam on a tributary of the Mohlaletsi river near the town of Mohlaletsi, Sekhukhuniland., Limpopo Province, for the purposes of supplying domestic water for the inhabitants of the town, for the irrigation of plots on the downstream side of the proposed dam site, and to control chronic soil erosion on the upstream side.

Background and Purpose

On 27th November 2003, Nicholas Papenfus and Antony Maakana of Dams for Africa together with Alfred Schuphof and Vanessa Veenstra (two students from The Netherlands representing LITE/Wits) visited a rural town in Sekhukhuneland, Limpopo Province. The purpose of the visit was to explore the area with a view to identifying possible sites for a dam that would serve the community in three ways:

1. As a source of domestic water - currently only a limited amount of borehole water is available in the town for human consumption. This is supplemented by water taken out of a tributary of the Mohlaletsi river, where a hole is dug into the sand on the banks so that a degree of filtration takes place. While this may reduce the murkiness of the water, it is doubtful that harmful bacteria are eliminated.

   Therefore the presence of a storage dam in conjunction with a purification plant would ensure an increased supply of safe drinking/domestic water.

2. To increase the amount of land that can be cultivated – clearly a dam means more water available for irrigation.

3. To reduce the amount of soil erosion – no erosion of soil takes place below the surface of the water as it has virtually no velocity once impounded.

Breached Dam

Figure 1 shows a view of a dam that is situated near to the town, but which at some stage completely silted up, and subsequently was breached. (It is not known when the dam was built, or breached). It is possible that the breach started at the concrete/embankment interface as a result of an incorrect slope in the lower section of the concrete abutment. If the concrete at the interface slopes away from the embankment – as it does near the bottom - this allows a gap to develop as subsequent consolidation of the earth takes place. It is also possible that the spillway's capacity was inadequate, allowing overtopping followed by swift erosion.

One possibility would be to make the necessary repairs to the existing dam. However in order to have a useful storage volume, it would be necessary to remove the sediment, which would likely cost more that the construction of a new dam!

Alternatively the sand could be left, and the dam used as a sand dam. However, from appearances (see figure 3), the voids in the sand mass are unlikely to exceed 10%, and it is therefore unlikely that the cost of the repairs will be justified in terms of R/m^3 of useful stored water.

Figure 1 – View of breach in dam

Figure 2 – Downstream view showing the degree of sedimentation and the incorrect slope in the bottom section of the concrete abutment

Figure 3 – Apart from a narrow channel where the river flows, the entire reservoir is filled with sediment. Interestingly the various flood events can be seen in the distinctive layers.

Site for New Dam

Approximately 1,0 km upstream of the existing dam there is a site (see figure 5 and 7) that appears to have many features that are ideal for siting a storage dam. These may be described as follows:

1. the gradient upstream from the proposed site is relatively small – this allows increased storage capacity (notice distance between contours in figure 4)
2. the river is flanked by two hills that are relatively near to each other at this point – this reduces the length of the structure and hence the cost
3. approximately 100m upstream of this site the topography changes from a relatively narrow gorge to a basin that is approximately 2,5km wide and 1.2 km long – this greatly increases the storage capacity
4. there appears to be suitable bedrock (see figure 7) for the construction of a central spillway. Hard rock resists erosion and undermining, and is ideal for founding rigid structures e.g. structures made from random-rock masonry (RRM).
5. the dam has a relatively small but still workable catchment of 59 km^2
6. the hills flanking the river are sufficiently high (see figure 5 and 7) to allow the construction of a high dam if required – again this greatly increases the storage capacity
7. there is a track, which with some minor grading will permit access by construction vehicles all the way to the proposed site

8. the basin that will be inundated is largely uninhabited so that there will be virtually no relocation costs. The basin is significantly eroded and vegetation is sparce and there are no ploughed lands (see figure 5). This means that inundation will not represent a serious loss of income to the local inhabitants.
9. Inundation will put an end to erosion below the water surface as clearly no erosion can take place in stationary water.

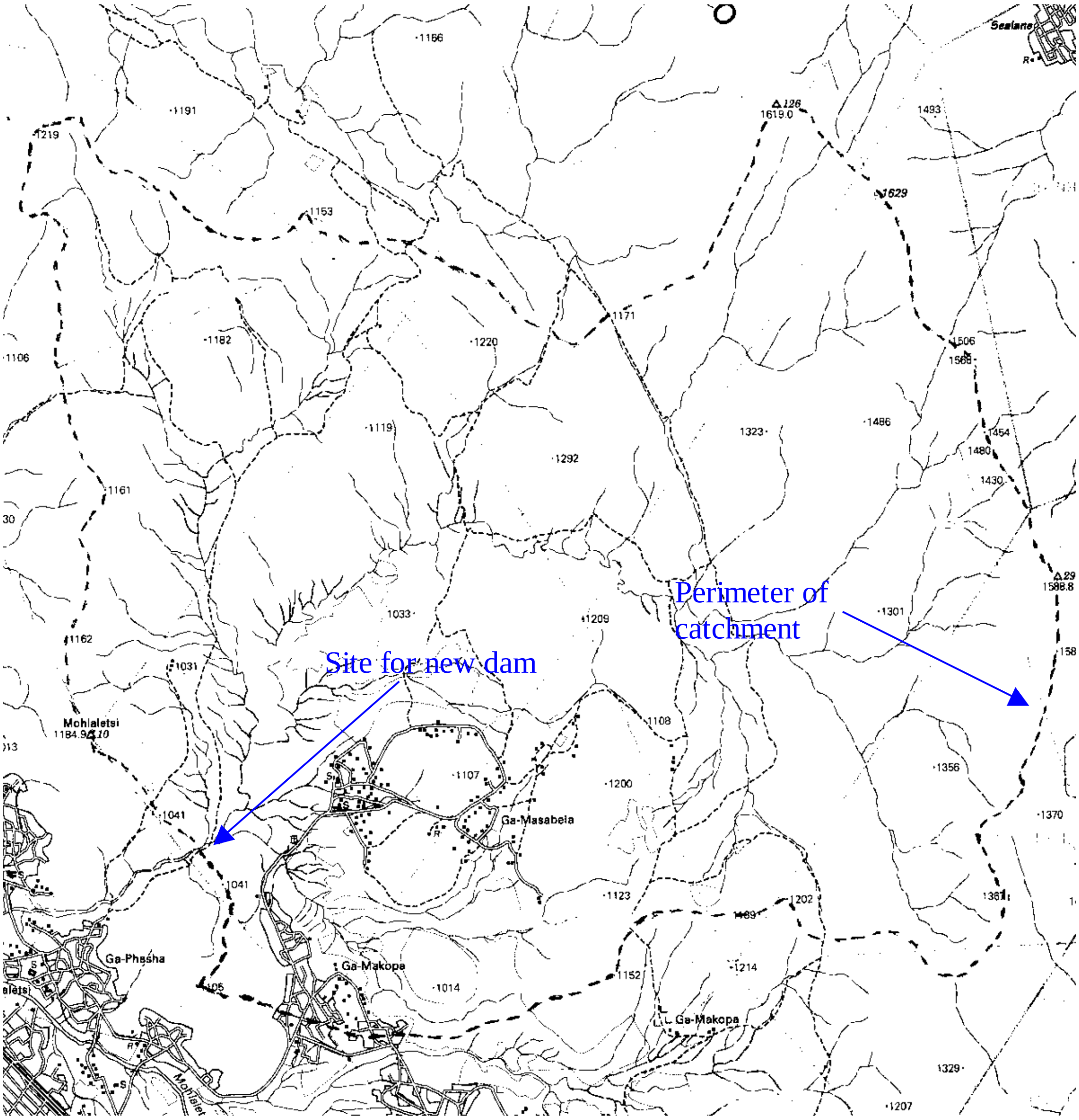

Figure 4 – Extract of 1:50000 topographical map of the Mohlaletsi area, showing the site of the proposed dam, and the perimeter of the corresponding 59 km^2 catchment (see dotted line).

Figure 5 – The river can be seen to flow through two hills (the first can be seen in the foreground, the second on the lhs of the pic). Upstream of the two hills there is a wide basin which is substantially eroded.

Dam Design

The visible presence of bedrock at the level where the river flows (see figure 7) allows the incorporation of a central spillway. This structure with its sidewalls and buttresses (see figure 6) could ideally be made from random-rock masonry. Earth embankments (which have a degree of flexibility) on either side of the central spillway (see figure 6) may be the best solution if the two hills on either side of the river that comprise the abutments do not have a hard subsurface stratum, which appears to be the case (see figure 7). The sloping sidewalls that confine the embankment need to be stiffened as shown in figure 6, and these walls create a useful stilling basin on the downstream side.

On the other hand if suitable hard and impervious founding material is discovered at a relatively shallow depth on the respective slopes, then a *multiple buttress arch dam* would work well, which could be made entirely of random-rock masonry. An example of such a structure is shown in figure 8.

The *height* of the dam clearly has a major influence on both the storage capacity and the cost. There is however no point in making the dam so high that it is never or seldom filled. On the other hand the greater the stored volume the better the dam will serve to supply the inhabitants and farmers of Mohlaletsi with domestic and irrigation water respectively. Furthermore a high water level means that the inundated basin (currently badly eroded is protected). The pertinent factors in determining the height are: (1) catchment size, (2) rainfall runoff, (3) expected demand (4) erosion prevention (5) available funding.

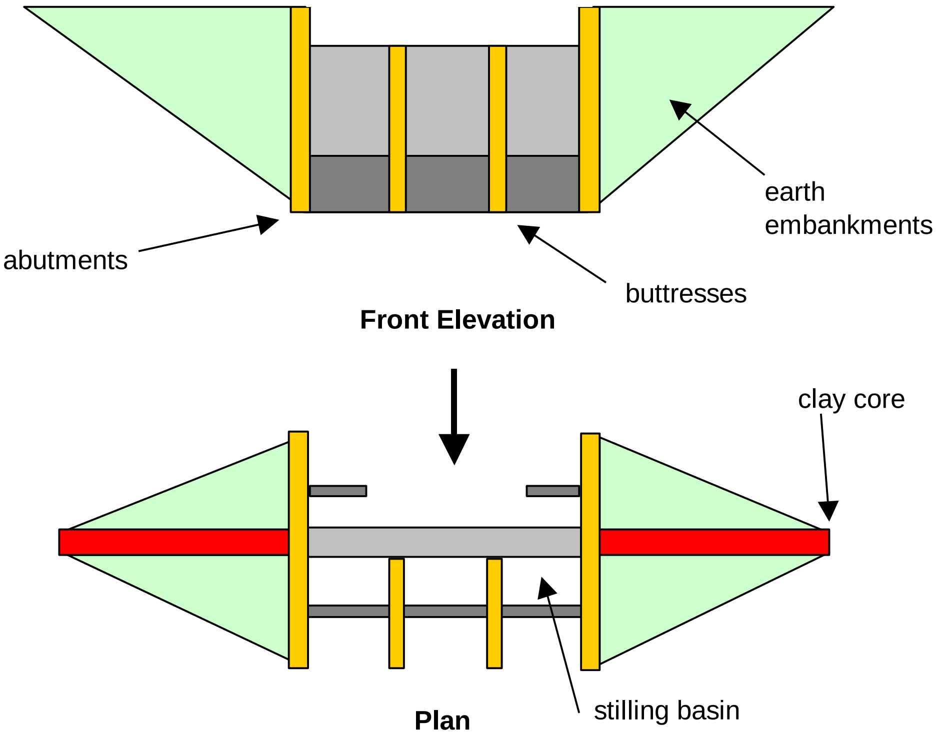

Figure 6 – Plan and Front Elevation of proposed design

Figure 7 – The rock formations at the level of the river appear to be overlain with softer materials higher up. In this picture Alfred is 30m upslope from Antony who is 30m upslope from Vanessa standing in the river.

Figure 8 – Example of a multiple buttress arch dam

Funding Strategy

Possible sources of funding could be:

1. Government – at national, provincial,or local level.
2. A delegation headed by Prof McCutcheon may open the door to minister Ronnie Kasrils (DWAF), on the grounds that we have a novel community project that is aimed at upliftment, something close to the minister's heart.
3. Environmental Affairs may be interested in contributing to the reduction of soil erosion.
4. The Limpopo Department of Agriculture may be willing to particitpate, on the grounds that the dam provides irrigation to hdi farmers. Nicholas can make this approach as he has good contacts here – up to MEC level.
5. LITE may be in a position to source funding from the Netherlands – Filip to consider.

Funding may be easier to obtain on the grounds that this project covers a number of bases: (a) Supply of domestic water (DWAF, Public Works, Local Government can all be approached) (b) Water for irrigation crops (Limpopo dept of Agriculture), (c) Reduction of erosion (Environmental Affairs), (d) Labour intensive construction (LITE), (e) Poverty alleviation (NDA, Anglo American) (f) Educational (student involvement – Wits etc.).

Funding should be on two levels.

1. Funding should be obtained for an investigative phase where the feasibility of the project is considered in sufficient detail to come to a reasonably accurate estimate of costs, and what the returns and benefits are likely to be.

2. If the above is promising, funding for implementation will be easier to find and should be vigorously pursued at that stage.

Recommendation and Conclusion

This report attempts to show that there is merit in funding a more in depth investigation into building a dam which will serve the community on a number of levels such as the provision of domestic water, water for irrigation of crops, water for control of soil erosion, development of skills in rock masonry, etc.

About Dams for Africa

Dams for Africa (Pty) Ltd design/construct/rehabilitate water related infrastructure to **empower communities** in remote rural areas. Typical projects include dam rehabilitation, canal, weir and reservoir construction, installation of storage tanks, pipelines and irrigation systems etc.

DFA recognises the need to be **flexible** and will tailor its involvement according to each need, from minor consultations to relatively large turnkey projects.

DFA's contribution to a **typical project** may take the form of an initial feasibility study, followed by design and/or construction.

Whenever practical **labour intensive** methods will be used in the construction process, sourced from local community.

DFA is also in a position to provide the necessary hydrological, topographical, geological, ecological and social impact **studies**, and attend to the technicalities and legalities associated with water related infrastructure.

Dams for Africa fully appreciates the need to **network** and co-operate with partners such as:

1. *Community based organizations* that are in touch with the needs of the resident population.

DFA is aware of the importance of *community involvement* and is, if required, prepared to participate in all stages of this process. This would include a response-to-need request as the first step, assistance with visualization, participation in negotiations, recruitment and training of local residents for the construction stage, facilitation of training in subsequent agriculture and irrigation, and ongoing mentoring as may be required.

2. *Donors/funders* including government and financial institutions.

DFA is prepared to participate in *fundraising* for worthwhile projects, and in the production of 'bankable' documentation.

3. *Training organizations* who teach on farming methods, produce marketing, and who know the value of ongoing mentoring.

DFA would like to know that its engineering contribution is placed in the hands of a motivated community that has been *equipped* with the necessary skills to put the water infrastructure to good use for many years to come.

Tel 011 475 2764
Fax 011 475 8381
Damsforafrica@worldonlne.co.za