Business Plan

Irrigated Gardens

on the

Hout-river

Limpopo

Prepared by
Nicholas Papenfus
PhD MICT PrEng

Last revised in
May-2002

Dams for Africa, Suite 499, Private Bag X09, Weltevreden Park, 1715, Gauteng, South Africa.
Tel (011) 475-2764/4230, fax (011) 475 - 8381 e-mail : damsforafrica@worldonline.co.za

Background

On 23rd August a meeting was convened at the **Tribal authority** offices in Ga-Mabotsa, about 30 km to the NE of Pietersburg, attended by the chief, Kgosi Moloto, his uncle Mr S L Moloto, Municipal councillor Mr N L Malebana, Mr Jimmy Mabela and Mr David Semenya of **African Pathways**, and the writer of **Dams for Africa**.

It was agreed that a dam would be of great benefit to the community, as irrigated lands will allow for better paying crops. The farming and marketing activities will also create jobs and serve to eradicate poverty in the region.

After the meeting an inspection of various possible dam sites took place. However, this proved fruitless, the general topography in the area being unfavourable. As a final resort, the party went to an existing dam on the Hout river, which lies in the general tribal jurisdiction of the chief. This inspection revealed that the land downstream of the dam is not being cultivated at all. It was also observed that the level of water was within ½ meter of the overflow mark, and this is somewhat surprising, given that it was nearly the end of the dry winter season. The indication is that there is a substantial quantity of water (see figure 1) that could be made available for irrigation of the lands immediately downstream.

On 9th October 2001 a feasibility study for siphoning water over the dam wall to irrigate the downstream lands was proposed. This was circulated to the parties mentioned above, and an attempt was made to secure funding, but without success.

On 5th March, 2002, the writer again visited the dam, accompanied by Mr Washington Tunha of DWAF- Limpopo Provincial Offices. On this occasion the water was approximately 200mm from the top, see figure 2.

It appears that the only use that the dam is being put to is to feed a water treatment plant (observable in figure 7). The superintendent at the plant stated that:

- the dam was constructed in 1977
- it is being used to provide drinking water for 15 small villages in the region
- in the four years that he had been working at the plant the level of water in the dam has never been of any concern.

Irrigation Scheme at Hout-River Dam

Existing Infrastructure

Whereas the inspection carried out on 23/08/01 was carried out in some haste, as the sun was already setting when the party arrived at the dam, that done on 5/03/02 was unhurried and thorough. It became evident that there is a simpler alternative to siphoning the water over the dam. The intake tower (see figure 3) leads into a delivery tunnel beneath the dam (see figure 8). However, whereas the level of water in the intake tower is the same as that in the dam, the delivery tunnel was dry, except for some water that presumably originates from a leak. It is clear from figure 5 that there are two pipes that run in the delivery tunnel. The pipe seen on the LHS takes water to the purification plant; the pipe on the right terminates in a valve shortly after it exists the tunnel. It is further apparent that both these pipes have either gates or valves at their starting ends, which have long spindles, allowing them to be operated from the top of the intake tower (see figure 4).

DWAF additions

It is therefore possible to empty the pipe on the right side, and then insert a short flanged pipe at the front of the pipe before the valve (see figure 3). This fabrication should have a flanged off-take at the top for a close-off valve to be bolted on, followed by a water meter that will allow DWAF to monitor the quantity of water used by the scheme. This arrangement is proposed in figure 8. The water meter thus becomes the starting point for the irrigation pipes. Clearly this process is simpler and much more cost effective than siphoning water over the dam.

Irrigation pipes and layout of plots

The general layout is shown in figure 9 and is briefly described hereafter. A 100m x 110mm pipe, which is connected to the water meter, and which lies at an angle of 90^o to the delivery tunnel, has two 750m x 90mm pipes coming off it. The two pipes run down hill parallel to the stream. They have taps at regular intervals.

The ground on either side of each pipe is divided into 25m x 25m plots, and for an overall cultivation area of 7 hectares, there will need to be 28 plots in each of the four rows (i.e. 112 plots). Two taps are allowed for each plot. Furthermore, each entrepreneur has two hoses, 35m long, through which pressurised water flows. As no pumps are required this is a very cheap way of irrigation, but clearly the hoses will have to be moved regularly or even hand held. It is possible in this way to deliver water relatively quickly and easily to the exact location required, with a high degree of control.

It may be seen from table 3 that each of the 90mm pipes delivers 26,25 m^3/hr of water to 3,5 ha. This is equivalent to applying 6mm of water to 3,5 hectares in 8 hours (=210m^3). Assuming this quantity of water is delivered every day of the year through both pipes, this corresponds to 153300 m^3 of water, or 21900 m^3/ha. Clearly it is a high estimate, and makes no reduction for rain, or reduced irrigation rates in winter, and assumes that irrigation is done every day of the year. Nonetheless, even if this figure is assumed, it will only drop the level in the dam by 153mm over a period of a year (based on an estimated surface area of 1km^2 ,excluding evaporation losses or inflows from rain).

Business Plan

Table 1 below may be regarded as the heart of this business plan. It summarises the capital investment that is required, as well as the expenditure and income. It anticipates a distributable surplus of R672010 per annum, or R5081 for each of the 112 participating entrepreneurs. This analysis assumes that 3 crops of vegetables are grown annually (or see 'Income' in table 1), and sold in Pietersburg/Pretoria/Johannesburg at the prevailing market price. It assumes that the entrepreneur is only paid a fraction of the market price, to allow for transport and marketing costs. Beetroot, onions and cabbage were arbitrarily chosen for this analysis, although it is very probable that a wide variety of vegetables will be grown. The crops would typically be loaded on a truck at 5h00 and arrive in Johannesburg at 10h00.

An essential element of the business plan is the feasibility study. An amount of R36 510 is allowed for this, and is required so that the various preliminary estimates used in table 1 can be adjusted if need be, and the overall viability of the project can be confirmed. The various components of the feasibility study are shown in table 2. These include engineering aspects such as obtaining formal approval from DWAF to use the water; arranging for approval of the spacer-pipe/valve/meter; the detailed design of the irrigation system. There are also agricultural aspects. An agriculturist should arrange for the analysis of the soil to determine what types of crops may best be grown (other crops may be more profitable/suitable than lettuces). He should consider more closely the costs associated with fertilizing, planting, nurturing and harvesting, as well as the costs of storage, distribution, managing and marketing. Finally a facilitator will be required for discussions with the community, to get buy-in and commitment for the project. Kgosi Moloto has cautioned that this should only take place once the viability of the project has been confirmed, since it would be unwise to create expectancies that may not materialize.

Distributable surplus: Clearly the large number of participants (112) severely diminishes the return on an individual level (R5784). An employee working on the shop floor of a factory may expect to earn this in only three months.

However, before dismissing this return as totally unattractive, and judging the concept as not worthwhile, other considerations should be taken into account.

(1) R 5784 is much better than nothing, and it may be argued that it is in fact a good return for a piece of land that is only 1/16th of a hectare. In any case it may be the difference between starvation and survival, of being clothed rather than naked.

(2) The money is earned by the plot-holder, and this gives him/her a sense of worth, purpose, dignity and status – particularly in a rural society where jobs are very scarce and any form of income is welcome.

(3) Although as a migrant factory worker in a distant city the individual may earn much more in wages (if he is able to find work!) he/she has to commute daily to work, most probably from some form of rented accommodation in a township, which not only costs money but also takes perhaps 2 to 4 hours a day, whereas the garden plot is within walking distance, and the individual determines his own working hours. Especially for women with families, this allows them not only to be with their families, but to see the children off to school before they go to their plot.

A further point is that migrant factory workers are generally forced to stay in some form of rented accommodation, often substandard, whereas the garden worker is at home with their family. Not only is this another cost, but there are negative social consequences in a society where the children grow up without the love and care of their parents.

(4) A significant advantage of a garden is that by increasing the productivity by just a few percentage points (currently assumed to be 75%), the plot-holder can feed his family off the additional production (again a noteable saving) without reducing the saleable stock. Irrigated gardens thus represent the means to food security, and thus redress one of mankind's most primal fears.

(5) It is quite possible that there will be fewer than 112 participants. This can happen from a process of natural attrition whereby uncommitted/disinterested plot-holders are made to give their plots to good performers. If there are say only 28 people from the community that are willing to take on the related responsibilities and challenges of farming, each farmer could be allocate a quarter of a hectare in this case (rather than a sixteenth in the case of 112 participants). This has the potential for a 400% increase in the individual's surplus.

(6) After 5 years, the long term loan for such items as farm establishment, irrigation equipment, office/shed, underground ldpe pipes etc. will have been repaid, and these items will in all likelihood still be fully serviceable. This means that when a new long term loan is renegotiated, it will be for a smaller amount. (A new loan will be required for other items such as; to re-grade the road, purchase a new bakkie, repair/replace the fence, provide training at a more advanced level, etc.). By making these various adjustments to table 3, it is possible to show an 15% increase in the distributable surplus.

(7) By growing the correct quantities of the various types of vegetables, as well as other subtropical produce such as bananas, it may possible to dispose of the bulk of the produce to the surrounding villages. The associated savings in marketing and trucking of produce to far away metropolitan centres allow a higher price to be fetched by the grower, easily 50% more according to one study. If additional growing space is still available, then produce that is relatively insensitive to transport, such as coffee, should be considered. An increase of 50% in the selling price increases the surplus by 118%.

(8) Finally, it may be possible to find a donor that is prepared to grant the initial start up capital. It may be shown that this increases the distributable surplus by 34%.

Sectional Summary and Conclusion: The benefits mentioned in points (1), (2), (3), (4) are very important, but have not been quantified. On the other hand this *has* been done for points (5) through (8). The corresponding potential increases mean that the eventual average distributable income per quarter hectare holder increases by:

R 5784 x 4 x 1,15 x 2,18 x 1,34 = R 77 722 pa, and this is considerably *more* than what a migrant worker in a factory earns.

The financial and social benefits described above will reduce urban migration, and hence the level of unemployment in the cities, resulting in less crime. Ultimately this means fewer police, prisons and courts, which collectively currently cost the country R 31,8 billion. It also means well nourished children, who will have the mental energy to concentrate in the classroom and do well at school, getting good grades rather than fail, and this translates into savings in the education budget (currently R59 billion). Good nutrition also means fewer malnourished babies and healthier rural population, resulting in savings in the health budget (currently R33,5 billion).

If irrigated gardens as described here are able to reduce the budgets described above by as little as 0,1%, (i.e. R1 of every R1000) this will save the country R 124,3 million on an ongoing basis. It may therefore be argued that government should invest at least such an amount in garden projects of this nature, and this addresses the problem at source, leading to prevention rather than merely attempting to keep a problem at bay.

Conclusion

A business plan has been drafted in the interests of eradicating poverty in the Moletji district, and empowering some 112 entrepreneurs, both financially and in terms of new agricultural skills. It demonstrates the viability of using water from the dam on the Hout river for irrigating downstream lands.

To keep the analysis as simple as possible only onions, beetroot, and cabbage have been considered in the analysis, but clearly this may change once the soil has been assessed.

The fact that the dam is already there, that ample tribal ground is available immediately downstream for cultivation of 7 hectares (see figure 6), that no expensive mechanical equipment is required (e.g. water is gravity fed directly from an existing pipe = no pumps, tilling of the ground is done using simple hand tools = no tractors & ploughs), that entrepreneurs are only paid for the sale of their crops (= no labour costs), makes the scheme extremely viable. This is demonstrated by a ratio of 0,8 for the *annual net distributable surplus* **:** *capital expenditure*.

The proposed solution is ideal for rural Africa where simple methods that are unlikely to breakdown work well - the required water is available at the end of a hose, while hand cultivation tools preclude breakdowns of diesel/electrical powered machines/equipment.

It is therefore recommended that this business plan should be presented to a lending institution such as the Land Bank or DBSA, following which the community should be constructively engaged and the process started.

Alternatively funding should be sought from a donor, given that it meets a wide range of criteria such as food security, poverty alleviation, job creation, and development of entrepreneurial skills.

Table 1 - Business Plan [1]

Capital Expendature		unit	qty	unit cost	total	
				R	R	
Viability study (see table 2)		ea	1	36510	36510	
Spacer pipe [11]		ea	1	dwaf		
Valve [11]		ea	1	dwaf		
Meter [11]		ea	1	dwaf		
Pipelines (see table 3)		table 3	2	43193	86386	
90x3/4" clampsaddle, upstand, tap		ea	224	160	35840	
trenching costs		m	1560	2	3120	
Farm Establishment[9]		ha	7	5000	35000	
Equipment and Tools [10]		plot	112	1000	112000	
Storage shed/office/furniture		ea	1	60000	60000	
1.2 m high stock proof fence		m	1600	12.52	20028	
roadworks [12]		km	4	10000	40000	
Project management fees on farm development			12	267028	51466	
Start up capital [13]					135000	
Training [5]		persons	112	1000	112000	
bakkie		ea	1	110000	110000	714455
Income from Vegetable Crops						
Type	Selling Price [7]	Density/ha	months to maturity	Equivalent monthly return	Equivalent annual return	
	R			R	R	
cabbages	2.00	33333	3	22222	266667	
beetroot	0.25	250000	3	20833	250000	
onions	0.25	500000	6	20833	250000	
		average/ha for 100% utilization			255556	
		average/ha for 75% utilization [4]			191667	
Total		ha	7	191667	1341667	1341667
Expendature						
Production costs/ha [2]		ha x crops/yr	21	12000	252000	
Water usage [14]		m^3	153300	0.2	30660	282660
Overhead costs						
Marketer/manager/advisor					150000	
Assistant					40000	
Agricultural mentoring fees					20000	
Fascilitation Fees					20000	
Telephones/electricity/stationery					20000	
Vehicle maintenance & fuel					20000	270000
Cost of money						
Long term loan required after subsidy [8]			714455			
Short term loan for crop financing [15]			94220			
Interest at 12% on long term loan [3]		%		12	51441	
Repayment of long term loan		%		20	142891	
Interest at 15% on short term loan [3]		%		15	6784	
Repayment of short term loan		%		20	18844	219959
Distributable Surplus [6]						569047
[distributable surplus] / [capital expendature]						0.80

Notes

(1) It is assumed that seven hectares of land will be developed under irrigation, and that each hectare will be divided into 25m x 25m lots as indicated in figure 9. This allows for 16 entrepreneurs per hectare, totalling to 112 for the seven ha.
(2) A unit value for production costs of R12000 to R15000 for a single crop was obtained from the Agricultural Research Commission (Dr Finnie Niederwieser), and pertains to cabbage, beetroot and onion production. They include such aspects as ploughing, fertilizing, seeds, planting, insecticides, weeding, harvesting, labour, supervision, fuel. They exclude capital items such as tractors, irrigation systems, sheds, etc. The lower figure of R12000 is used since 'supervision' is budgeted for under overheads. Furthermore the 'labour' cost is taken as zero, since the participants are all entrepreneurs who are remunerated via their share of the surplus.
(3) Note that interest is calculated on the balance of the outstanding loan, which reduces by 20% each year as it is repaid over 5 years in 5 annual instalments at the end of each financial year. On this basis the total interest is 60% of the initial payment, and this is divided into 5 equal instalments.
(4) The 'utilization' is reduced to 75% to allow for some inefficiencies.
(5) Training will include the fundaments of cultivation, irrigation, productivity, business principles, etc.
(6) A record will be kept of each farmer's expenses and income to arrive at the distributable surplus that each farmer is entitled to.
(7) The selling prices used here may be regarded as conservative.
(8) The long term loan equates to the sum of all the 'capital' items.
(9) Farm establishment covers such aspects as clearing trees, ripping, etc.
(10) Equipment includes such items as spades, forks, hoes, sprayers, barrows, 2 x 30m x 3/4" hoses. Generally each entrepreneur will require one of each, except for the hoses, where 2 will make for much faster row irrigation.
(11) It is assumed that these items will be provided by DWAF; the spacer pipe is connected to the existing pipe from the dam, while the meter is required for DWAF to charge for the water used.
(12) Road works implies a simple scraping exercise with a grader, possibly with some shaping of the road's profile to get the water off. Thereafter each entrepreneur should maintain the road adjacent to his/her plot. A serviceable road is an important aspect of getting the produce to the market.
(13) Start up capital is taken as 50% of the overhead costs, and allows for 6 months of 'overhead costs', after which this expense will be paid by income that is generated from the sale of produce.
(14) Water usage is based on 6mm/day x 7 ha x 10000m2/ha x 365 days/yr. This is clearly conservative given that no irrigation is required when it rains, and that the projected production efficiency is only 75%, but it does allow for future expansion.
(15) The short term loan relates to financing production (listed in note 2) as well as the cost of the water. It is taken as 1/3 of the annual 'production' and 'water usage' costs (i.e. it covers 4 months). This loan is paid off after the crop is harvested, but a new loan is made for the next crop. Over a 5 year period, the amount required gradually reduces to zero as farmers become more proficient and financially independent.

Table 2: Proposed Feasibility Study to establish irrigable lands at Hout dam, near Ramakgaphola.

Step	Description	Feasibility hours	
		Main Person	Reporting to
1	Discuss with DWAF the possibility of using the water from the Hout dam for the proposed agricultural scheme[1]	8P	4F
2	Test and analyse the soil and water to determine what types of crops may be grown, considering the climate	12A	2P,2F
3	Budget for design, supply and installation of the irrigation system[1].	10E	
4	Determine the cost of fertilizing[1], and fencing off the lands[1]	4A, 1P	
5	Establish the cost of planting, nurturing and harvesting[1]	4A	2P,2F
6	Determine the cost of storage and distribution[1]	4A	1P,1F
7	Estimate the cost of managing and marketing[1].	4A	2P,2F
8	Determine overall viability of project, and draft a business plan for submission to a lending institution[1]	8P	2A,2F
9	Negotiations with community to get buy-in and commitment for the project	16F	
10	Management of feasibility process	4P	4F
11	Travelling time from Johannesburg (charge for one way only).		6A,9P
12	Total professional hours, including: agriculturalist(A) – outside consultant or government official engineer(E) – Dams for Africa facilitator(F) – African Pathways project engineer(P) – Dams for Africa	 28A 10E 16F 21P	 8A 0E 17F 16P
13	Total Professional Costs (Rands) Agriculturalist (A) = R 200/hr Engineer (E) = R 250/hr Facilitator (F) = R 200/hr Project Engineer (P) = R 200/hr	 36A 10E 33F 37P	 7200 2500 6600 7400
14	Travelling expenses (Rands) - 3 trips from Jhb to site and back @ 700km/trip - 6 trips from Pietersburg to site and back @ 80km/trip - Accomodation 4 nights @ R340		 5250 1200 1360
15	Soil tests		2000
16	Contingencies and sundries		3000
17	Sub total		36510

Note:
1. Preliminary investigations have been completed and budget prices obtained.
2. A brief written progress report is to be written by the 'main person' and circulated to all parties after each of steps 1 through 10 is completed. The report will give an overview of the work undertaken and what was accomplished, and will make recommendations on the way forwards.

Table 3 - Analysis of Pipelines and Costs

Pipeline Specifications		pipe 1	pipe 2
Length to endpoint [1]	m	800	800
Constant (roughness)		4.53E-10	4.53E-10
Area [2]	ha	3.5	3.5
Q/ha	m3/hr	7.5	2.5
Q total	m3/hr	26.25	8.75
Pipe ID	mm	90	90
Friction Loss [1]	m	11.5	1.6
Unit Cost of 90mm LDPE pipe - 6bar	R/m	27.6	27.6
90mm couplings	R	253	253
Unit cost of 90mmx1" clampsaddle, upstand, 2 taps	R/assem	256	256
Costs			
Total Cost of pipes	R	22080	22080
90mm couplings at 50m spacing	R	4048	4048
Cost of 90x1" tap assembly @8/ha	R	7165	7165
Sand filter and mesh filter	R	na	na
Installation excl trenching[3]	R	3900	3900
Delivery	R	2000	2000
Trenching [4]	R	4000	4000
Total	R	43193	43193

Notes

(1) Friction loss = constant x length x Q^1,77 / D^4,77. A friction loss of 1,6m over 800m is less that the fall of the pipe, and the hydraulic pressure is therefore likely to increase with distance away from the dam.
(2) It is assumed that there are 7 hectares of cultivated ground, and that these may be irrigated simultaneously. It is assumed that there are two 90mm pipelines running parallel to the stream, and spaced apart such that there is 25m of irrigable land on either side of each line. Using 800m as the length, the friction loss from an 800m long pipe calculates to 11,5m, for a flow rate of 26,25m3/hour. The actual loss however will be less, as water is taken off all along the line. (Note 3,5 ha x 10000m2/ha x 0,006m = 210m3/day = 7,5m3/hour/ha x 3,5ha (i.e. 26,25) x 8 hours. 26,25m3/hour overstates the loss, as the flow is constantly reducing along the length of the pipe. It is likely that the actual loss very closely follows the fall of the land.
(3) A specialist contractor will do the supervision and connection, but the price assumes the community will contribute the labour assist with unrolling and carrying, etc. The price includes accomodation and travelling.
(4) An amount is allowed for for using a backactor to dig, but filling after laying the pipes is assumed to be a community initiative.

Figure 1 - Over the dam – close-up of far side from intake tower.

Figure 2 - Spillway - close up of west side as seen from the top of the dam

Figure 3 – View of intake tower and catwalk

Figure 4 – Each pipe in the intake-tower/delivery-tunnel begins with a valve that can be opened or closed by means of a remote handle

Figure 5 - Pipes on the downstream side exiting the delivery tunnel. The pipe on the LHS delivers water to the water purification plant, while the RHS pipe terminates as shown

Figure 6 – Downstream view from the top of the dam, showing irrigable lands to the right of the stream. The pipe going to the purification plant may be seen exiting the delivery tunnel.

Figure 7 – Purification works near the dam. The foot of the embankment is observable in the lower right hand corner.

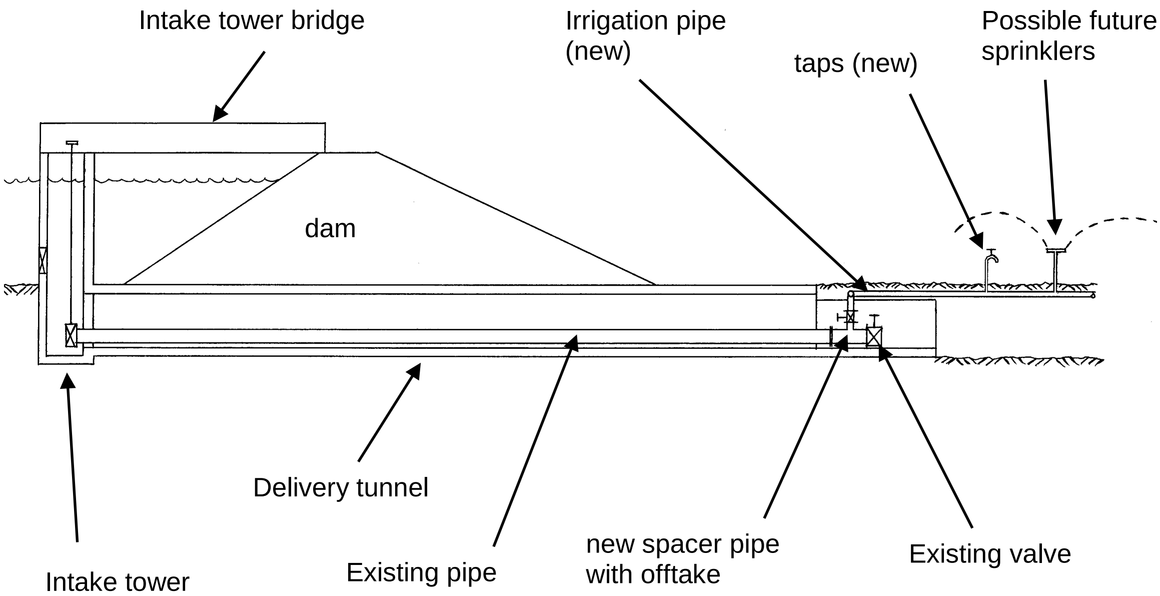

Figure 8 – Section through dam showing existing and new components of proposed irrigation system

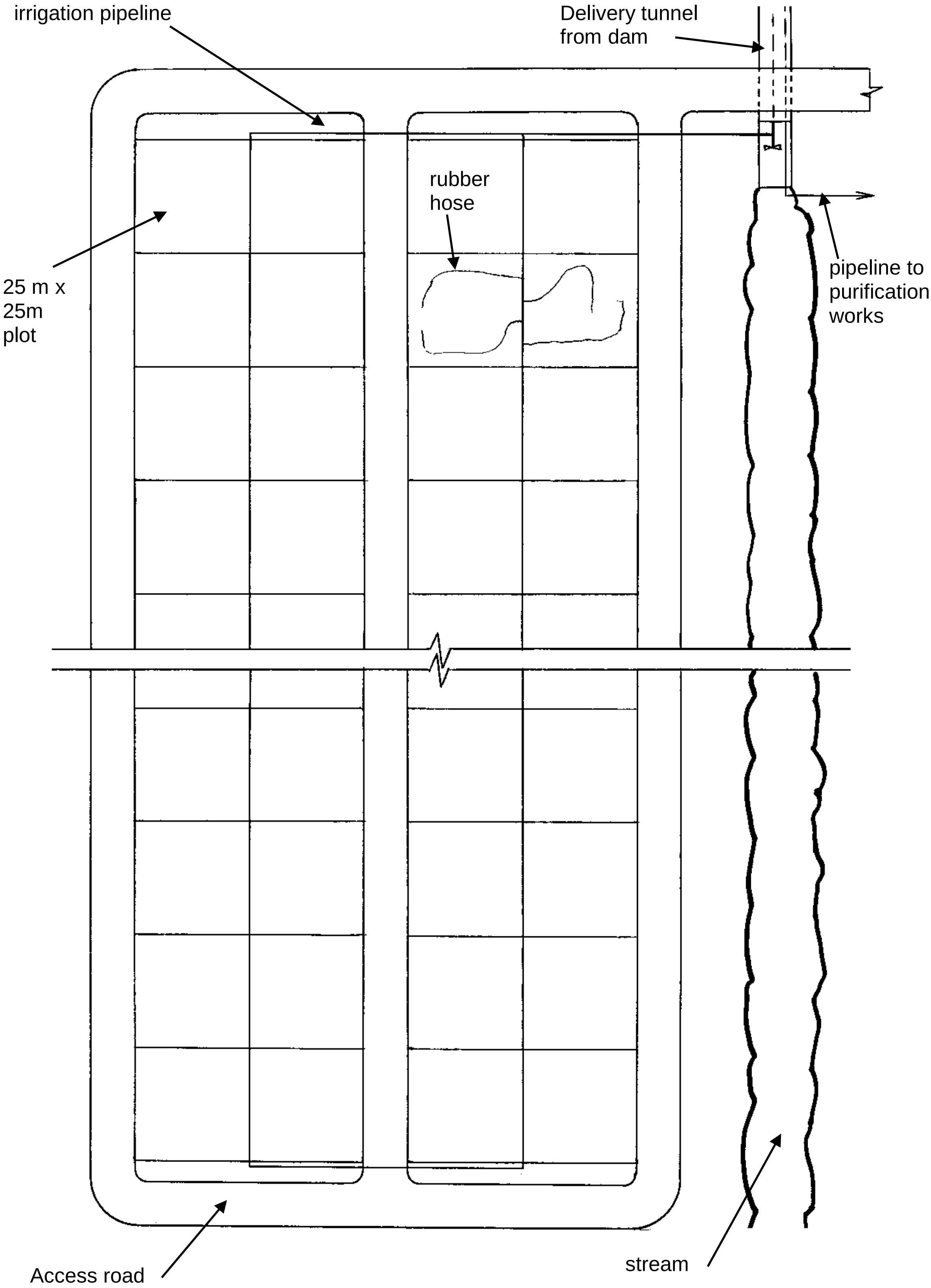
irrigation pipeline
Delivery tunnel
from dam
rubber
hose
25 m x
25m
plot
pipeline to
purification
works
Access road
stream

Figure 9 – Plan view of proposd irrigation/agricultural scheme

About Dams for Africa

Dams for Africa are turnkey project engineers committed to the **sustainable empowerment of communities** in remote rural areas by means of dam-construction/water-supply, for irrigation/agriculture as well as purification/reticulation.

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

The firm's contribution to a **typical project** would ideally be an initial feasibility study, followed by the design and supervision of the dam construction and related canals/pipes for irrigation to farms. The scope of the work may also extend to the construction of a water purification facility and related reticulation to houses.

Ideally **labour intensive** methods (that are at the same time cost effective) will be used in the construction process.

The firm 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 a dam.

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.

The firm 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* and /financial institutions.

The company 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 have a heart for ongoing mentoring if required.

The firm 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 dam and related works to good use for many years to come.

Tel 011 475 2764/4230
Fax 011 475 8381
Damsforafrica@worldonlne.co.za