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Cities in war : thirsty cities

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Kabul Water Supply: Evolution since the 1992-94 Civil War

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Introduction

Violent conflicts and frequent political change have disastrous consequences on public infrastructure. Among other services necessary for a normal life, the disruption of power supply and difficult access to water have immediate consequences on the public health status of the entire population of a town. Without electricity and water, economic activity is disrupted with obvious consequences on the income of the inhabitants. People living in cities are particularly vulnerable to the effects of war and war has affected Afghanistan during the last 30 years, with most of the cities being caught in the middle of the hostilities. The capital of Afghanistan, Kabul, has been the theatre of many violent combats and the scars of the war are still visible, with some suburbs almost entirely destroyed.

Availability of water in Kabul was never been a problem as its underground was and is quite rich, with several productive aquifers fairly easy to harvest. In the late seventies almost 70% of the population had decent access to water and many households were connected to the network, with new developments planned and in a stage to be constructed, with the assistance of foreign donors. Instability and war had a tremendous impact on any development and access to water has become quite precarious during and after the end of the civil war, which affected the country between 1992-1994.

The development of new schemes or the rehabilitation of older ones are more necessary than ever, as many people are now returning home to restart a new life and to seek new opportunities, which will increase the demand of water. In this paper we will describe how the inhabitants have managed to maintain a minimum access to water, with the assistance of international NGOs and institutions. Many projects carried out during the aftermath of the civil war were not sustainable under the prevailing circumstances but the recent political developments may have led to a different situations. More than ever stability is now essential as modern distribution schemes cannot be planned and brought to an end in volatile situations.

Sources of water

The three main sources of water in Kabul city are:

- The open wells
- The wells equipped with hand pumps
- The networks

They are not listed here according to their importance as all of them are used, even if for different purposes. From the end of the civil war until now people have managed to draw water from at least one of these sources. The quantity of water available per household is in principle not a problem, even if some discomfort may occur occasionally. The quality of the water, however, is of some concern as several surveys have shown a significant degree of contamination of the upper layers of the aquifer, most probably linked with the poor waste disposal practices of the inhabitants. The need to improve the piped water supply was acknowledged by all the organisations present in the country, as it would be the only way to cope with the increased needs linked with the establishment of a more peaceful situation, with refugees returning to the capital and with the resumption of normal economic activity.

This paper briefly describes the main characteristics of these sources and highlights some of the problems observed during the recent events.

The open wells

Majority of the 120,000 houses in Kabul have a water well in their courtyard, at least those located on the plains (around 1800 m a s/l). A number of 100,000 to 120,000 wells is generally admitted. Most of these wells are contaminated, as their protection is poor. In the recent year, UNICEF has carried out a massive regular chlorination campaign and some results have been observed, although such programmes are difficult to monitor. What is known is that majority of the people consider this water unfit for consumption and collect daily drinking water either from the hand-pumps, or, whenever possible, from the network and use this source for general domestic use such as cleaning and washing. Less educated and very poor people may have no choice but to continue using water from these contaminated wells.

1 Geneva Foundation, consultant, on assignment for the ICRC in Kabul from November 2001 to February 2002
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4 Consultants on assignment for short missions. M. Elliot was previously assigned to Kabul for OXFAM

Wells equipped with hand-pumps

People not connected to the network and looking for a better source of water other than drawing water from the courtyard well, can gain access to the commodity from more than 2,600 hand-pumps that have been installed by different NGOs during their involvement in Afghanistan. A little over 20% of these wells are hand-dug and the remaining are tube-wells, drilled at depths of between 5 to 25 metres. Most of these wells are equipped with hand-pumps of different types (DACAAR, INDIA MK II, Ariantech, etc.) HABITAT[5] has drilled about 1,100 of these wells and equipped them with hand-pumps. Solidarité (about 500) and UNICEF (about 400) have also made large contributions. Other organisations have also contributed to increase the coverage in different areas.

A large number of hand-pumps were not functioning due to poor maintenance or, recently, due to the effects of a prolonged drought, which has decreased the water level. Repairing and deepening wells will be an important activity in the following years. The pumps can be purchased from different manufacturers but the quality varies. When a poor quality is chosen, the breakdown frequency is high and, consequently, so are the necessary maintenance problems. Maintenance was performed by small private enterprises, equipped with spare parts and trained to carry out the necessary job with the support of the users community of the particular well. Several problems have been observed. Due to the movement of the population, the normal funding mechanisms have been disturbed and many communities are not able to pay for the maintenance.

Network

Brief history of its development

The Kabul water supply network is quite complex and is composed of 11 interconnected networks, 14 independent networks and 6 apartment blocks with their own water supply. These networks are supplied by an important number of deep wells. A few well fields are producing a large part of the water. Many are managed by the Central Authority for Water Supply and Sewerage (CAWSS)[6]. Other boreholes supply smaller networks and are in principle managed separately. Some of them are under the responsibility of the Public Maintenance Department, which depend on different ministries, such as those supplying the Micro-rayon complex. Smaller networks are managed by small communities organised in “fora”, under a programme funded and implemented by UNCHS (Habitat) together with the Rural Rehabilitation Department. From these networks people can access water through a total of about 43,000 house connections and through more than 1,600 public stand-posts. Not all these wells are in working condition. In December 1999, only 33 out of 81 wells were operational and of the 1,600 stand-posts, only 54% were distributing water.

Recent data on wells equipped with hand-pumps

Hand-pumps surveys in Kabul

The problem of the hand-pumps has been addressed by several organisations. Two main studies have been carried out relatively recently by ACF[7] in 1996 and by MEDAIR[8] in conjunction with the Ministry of Public Health. These two reports describe quite extensively the situation of one of the main sources of drinking water for the inhabitants of Kabul. The first report addresses the problem of the contamination of the ground water and the possible links with the deterioration of the health status of the population. 1,400 samples taken in wells distributed across the city were examined and a survey was conducted to investigate how people were using the water among 4,560 households. Faecal contamination, nitrate and nitrite, and phosphates were measured.

Bearing in mind the poor waste water and faecal matter evacuation systems prevailing in Kabul, it is not surprising that faecal contamination was found important with 80% of the samples exceeding the value of < 5 F.C./100 ml (Faecal Coliforms)[9] considered as acceptable by the authors. This level differs from WHO standards (0 F.C. in drinking water) but it is generally admitted that in such contexts the zero tolerance level used in piped water may not be applicable.

Distinctions were made between acceptable quality of water (< 5-10 F.C /100 ml), intermediate quality (10 – 100 F.C./100 ml) and high level of contamination (> 100 F.C./100ml). Results were expressed as percentages and therefore are of limited interpretation. Nevertheless, it was quite clear that the water of the hand-pumps was less contaminated than that of the open wells, with 45% of the samples showing less than 5 F.C/100 ml compared to 79% of the samples for the second ones. Surprisingly, the percentage of the samples collected from the network showing values higher than 5 F.C./100 ml was slightly higher than those obtained from the hand-pumps. A few districts showed a significant higher percentage of samples with more than 5 F.C./100ml, up to 71% for district 7 and to 58% for district 8.

[6] UNCHS (Habitat) United Nations Centre for Human Settlements (Nairobi)
[6] CAWSS, Central Authority for Water Supply and Sewerage

7 Nigel Timmins, Assessment of water and sanitation in Kabul city, Afghanistan, June September 1996. ACF
8 Martine van Bijlert, Handpumps in Kabul city, MEDAIR for UNCHS-Habitat Afghanistan, October 1997.
9 The F.C. count/100 ml (Faecal coliforms) is an indicator for faecal contamination and it is considered that their presence may reflect the presence of pathogens responsible for faecal-oral transmission of diseases.

Several areas showing a high level of F.C./100 ml were identified and tentatively mapped. They are probably linked with areas of very high levels of the water table and prone to easier contamination than deeper ones, even if these reasons have not been specifically mentioned by the authors. Nitrate concentrations were found, on average, higher than 60-70 mg/l, with several areas with significant higher levels reaching values up to 140 mg/l, attributed to source contamination from poor confined latrine or septic tanks. The levels of phosphate and nitrite did not allow for any specific interpretation, being either higher than the maximum readable value of the method for phosphate or correlated to the nitrate levels for the nitrite.

This study is of enormous value for future evaluation of the impact of the ongoing programmes in the sanitation field. A lot of work has been devoted by several agencies to the improvement of the human waste evacuation, with about 45,000 latrines built or improved by the ICRC in several districts located in the northern part of Kabul, where the population density is at its highest[10] and with other agencies carrying out similar programmes in several southern districts. It is expected that the above-mentioned contamination of the upper aquifer may drastically decrease and, consequently, the faecal contamination of the water together with the levels of the nitrate. The coverage in the northern district is now reaching values close to 80-90% and there must be an impact on the water quality and probably on the patterns of the diseases among the population. A similar study will have to be conducted to monitor the evolution of the quality of the water used as drinking water by a large proportion of the Kabul inhabitants.

The second study (MEDAIR / Habitat) has focused more on the evaluation of the hand-pumps. Their condition, how they were working, how they were installed and maintained were assessed in order to formulate recommendations for their use, being an important water source. Finally, the habits of the inhabitants, in relation to the access to water from this source, were also evaluated. The installation of the hand-pumps was triggered in 1992 to provide water to those who had lost their water supply from the networks, when the city's electricity supply was cut down, with the aim to improve the safety of the collection from the existing shallow wells.

Unfortunately, many pumps were installed in a hurry, on wells not drilled or dug sufficiently deep, thus drawing their water from the most contaminated top layer of the aquifer and prone to run dry in case of lack of recharge of the aquifer due to poor rains or snowfalls. But many hand-pumps are not operational due to the lower water table linked with the years of drought. It is also clear that many wells have not been drilled sufficiently deep, as many programmes have a privileged number of wells instead of a number of good wells. The decrease in the level of the water table is a problem, but the extent of the problems would not be so severe if some precautions would have been applied.

Existing database on wells equipped with hand-pumps

The number of wells drilled or surveyed has changed since the last survey carried out by MEDAIR. In the following table the recent changes have been introduced. The results have been gathered during a survey carried out by the ICRC in consultation with other agencies in order to improve the information on this essential source of drinking water for the inhabitants of Kabul. The database now includes information on 2,677 wells, upgraded up to the end of the year 2000, and is accessible using GIS (geographical information systems). It has not been updated since and does not include the last UNCHS survey carried out at the beginning of 2001.

At the beginning of 2001, the information available at ICRC WAT/HAB was the following: well code, agency involved, type of well (hand-dug or tubewell), state of functioning of the hand-pump, district. For the wells built by the ICRC, a complete log book was available containing the most useful hydro-geological parametres like the static water level and the total depth of the well, thus allowing to monitor the variation of the depth of the water table and gain some hints on the extent of the recharge of the aquifer due to the 2002 snowfall and rains.

Other agencies did have similar information in their files but it was impossible to determine to what extent their files were affected by the recent events. A complete survey will have to be undertaken and shared among the agencies, in order to harmonise and update the database. In the following, all the discussions will be based on this database. For the wells built by the ICRC, where more data are available, and some initial findings on the effects of the drought will also be presented.

As far as the ICRC wells are concerned, 90% were operational before the recent war against "terror". Unfortunately their number is limited to 300, as drilling was never a priority for this institution. By the beginning of 2002, out of an estimate of 3,200 hand-pumps installed in Kabul, it was assumed that only about 1,300 to 1,400 were in working condition,

[10] P.Jansen, J.F.Pinera, O. Bernard, J. P. Dross and R. Conti. Strategic Response to Urban Sanitation in a war-torn city. ICRC. Proceedings of the 26th WEDEC conference, Dhacca, 4-11 November 2000

Table I *Number and type of wells equipped with hand-pumps per district beginning of 2001. Evolution since 1997 (MEDAIR survey) according to ICRC database. No. and percentage of pumps in working conditions.*

District no.	Techn. survey[1] Wells equipped with HP	ICRC database Wells equipped with HP	Factor of change	Type Hand dug	Type Tube wells	No. of pumps functioning Beginning of 2001	% of pumps in working conditions
1	93	117	1.25	32	85	65	55
2	65	74	1.13	56	18	30	40
3	70	93	1.33	17	76	52	55
4	120	388	3.23	43	345	271	70
5	141	198	1.40	66	132	104	53
6	182	362	1.99	37	325	289	80
7	59	159	2.69	29	130	120	75
8	152	197	1.29	114	83	74	37
9	218	243	1.11	55	188	192	79
10	121	275	2.27	44	231	216	79
11	67	84	1.25	52	32	38	45
12	64	--		--			
15	200	316	1.58	40	276	173	55
16	113	171	1.51	38	133	108	63
Total	**1683**	**2677**	**1.59**	**623**	**2054**	**1732**	**65**

which means less than 50%. All the others will either be in need of repair or will need to be removed and installed in a new borehole. A survey is underway in the five south-western districts (3, 5, 6, 7, 8) to select where any specific intervention will be needed or where it may be necessary to drill a new borehole. Coordination is more than necessary, but better policies will also have to be enforced.

Out of 2,677 wells used for drinking water, 623 are hand-dug wells and the remaining are tube wells. The proportion of hand-dug well versus tube wells at the beginning of 2001 is illustrated in the next figure. With a few exceptions almost all the recent wells are tube wells. Tube wells are easier and faster to build, and are considered safer as they are, in principle, less prone to contamination. But they have to be equipped with hand-pumps and the latter need a minimum of regular maintenance. The quality of the hand-pump is also critical, as the MEDAIR report has pointed out.

The number of wells equipped with a hand-pump has increased dramatically in some districts since the last survey. The number of wells equipped with a hand-pump

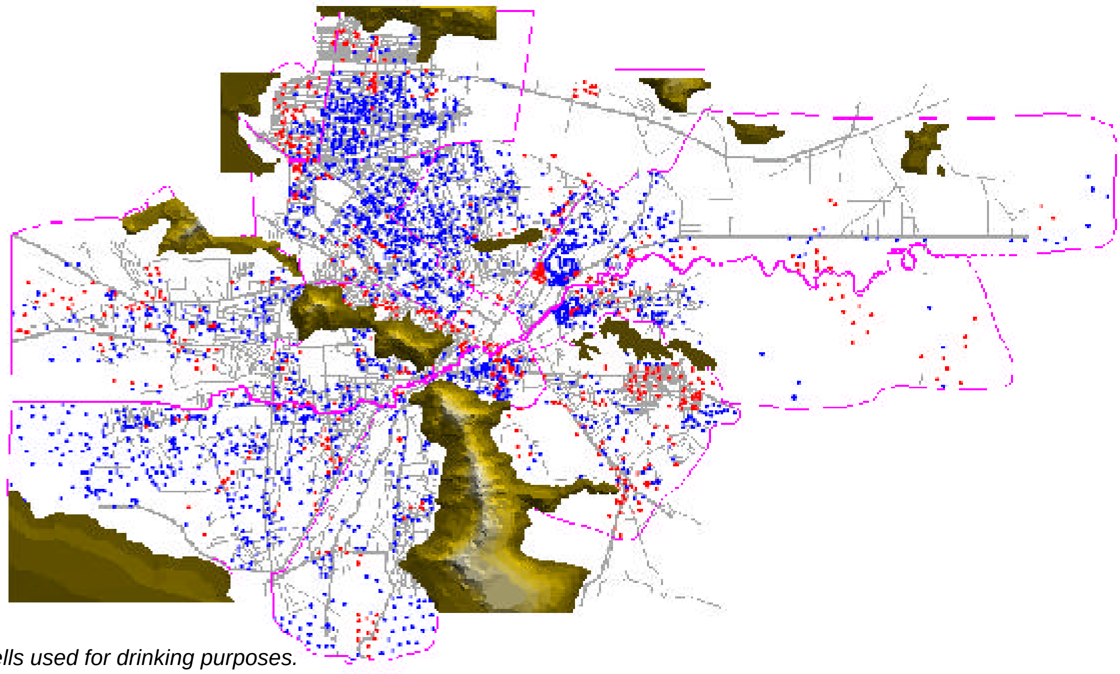

Figure 1 *Type of wells used for drinking purposes.*
Hand dug wells: red dots, Tube wells: blue dots (ICRC Database: update beginning of 2001).

has increased by a factor of 3.23 in district 4, by 2.69 in district 7 and by 2.27 in district 10, reflecting probably the movement of the population between 1997 and 2001, or just an oriented targeting by some organisations. A better update cannot be excluded either, but we believe that the work carried out by MEDAIR was quite complete and the increase really reflects an increased coverage, due to specific programmes. For instance, since 1999 the ICRC has drilled about 300 wells in the north-western areas of the town. Other agencies have carried out similar programmes.

All of these wells have been, at a given time, equipped with a hand-pump. It is considered that one hand-pump meets the needs of about 500 people. As far as coverage is concerned the main problem is obtaining reliable population data. In this paper, data obtained from UNCHS[11] has been used, which gives population data per “gozar”, based on surveys undertaken between September 1995 and December 1996 and completed with ICRC data, gathered during the initial house-to-house surveys for the latrine programme[12]. However, the patterns of the population density may have significantly changed since 2001, particularly during the last events, when a significant number of returnees made their journey back to Kabul.

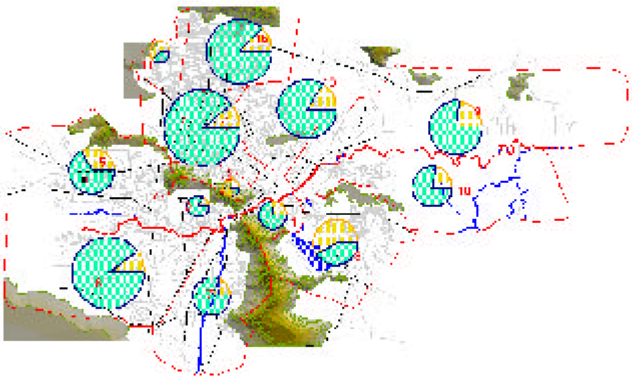

Figure 2 *Proportion of hand dug wells (yellow) versus tube wells (pale blue) per district ICRC database updated beginning of 2001.*

The results outlined below will have to be taken with the necessary care. If the main causes of problems were clearly identified, the number of hand-pumps not operational was still quite high. Habitat estimated that the replacement rate was as high as 10% with a similar repair rate (10% of the hand-pumps for SOLIDARITE and for HABITAT). A new approach for maintenance was slowly introduced with the aim to hand it over to the users of the hand-pumps, with quite an impressive success rate. Private caretakers of the pumps were trained and cheap fast running spare parts were made available. Users got used to addressing the problems they were facing with the hand-pumps to these private micro enterprises and most of the agencies were gradually able to drop this activity, maintaining their support in case of more complex problems.

The number of hand-pumps not operational per district, outlined in table I is shown graphically in the next figure. 30% to 40% of the pumps were not in working condition in most of the districts, with the exception of districts 2, 8 and 11, where the number of pumps out of order was close to 60%. The reasons for these significant differences are not clear. All of these wells have been, at a given time, equipped with a hand-pump, but the poor operational state of the hand-pumps does affect the access to water. The mean number of people per hand-pump, if all the pumps are in working condition, varies from 300 to 500 for most of the districts. A striking exception is in district 2, where the number of people/hand-pump exceeds a 1,000 and in district 11, where the number is close to 800.

Unfortunately the data shows that quite a given number of pumps were not operational, particularly in the above mentioned districts, already affected by poor coverage. In the figure below, we have reported the variation in coverage if we consider the state of the pumps. The coverage per district, expressed by the number of inhabitants/hand-pump is worsening, with only a few districts close to 500, considered to be the upper acceptable value, if the wells equipped with hand-pumps are the only source of water. Coverage as high as 700 is common, with a few districts in quite poor situations, due to a few wells being equipped with hand-pumps but also to due to a high rate of pumps being out of order or not delivering water due to low water table. The problem of the depth of the wells has been identified and a future policy will certainly address this issue.

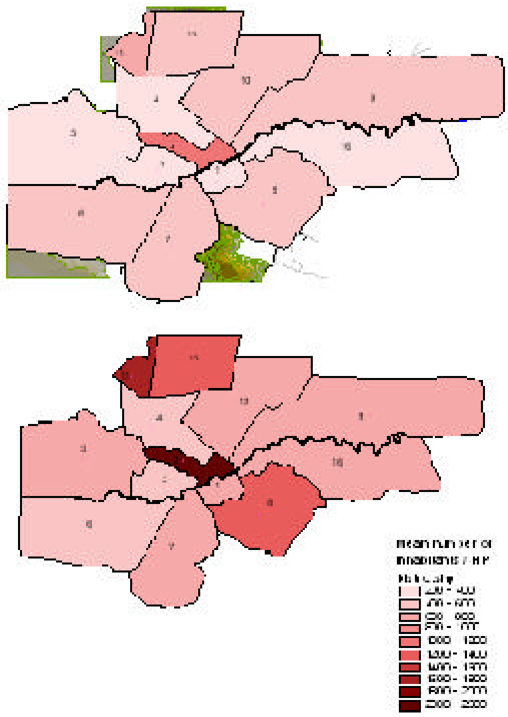

Figure 3 *Access to Water from wells equipped with hand pumps. Evolution of the number of people per hand pump due to misfunctioning or damage. Only the state of the pump is taken into account. Movement of populations are not included.*

[11] MEDAIR survey
[12] UNCHS (Habitat) Urban rehabilitation programme, September 1995 to December 1996

The above-mentioned survey, conducted by UNCHS, was carried out between December 2002 and May 2001. Geo-referenced electronic maps were not available. The results are somehow different as the number of wells equipped with hand-pumps is larger, up to 3,258 (May 2001). A distinction was made between non-functioning wells due to technical reasons and those not operational due to low water table.

The overall proportion of the functioning hand-pumps is close to 59% and is slightly lower than what has been computed from the ICRC database, up to 65%. The proportion of wells not operational due to low water table is close to 22% and the remaining hand-pumps were not working because of technical problems. The difference in the total number most probably reflects the decrease of interest by the ICRC in this particular sector, taken up by other organisations and outlines the difficulty of maintaining an updated database in these circumstances. It shows how important it is to share a common approach on metadata definition allowing for comparisons from time to time.

The UNCHS survey presents interesting information on the change of the static levels of the water table, to be used to quantify the present status of the "drought" in Kabul.

Effects of the drought

Climatic data for Kabul shows that the annual potential evapo-transpiration vastly exceeds rainfall[13]. Direct recharge of precipitation to groundwater is considered low and recharge occurs between March and May, when the snow accumulated during the winter melts. Kabul aquifers, as most of the aquifers in the plains surrounding the mountains, are likely to be recharged in foothills by rivers and streams descending from the mountains and infiltrating into coarse-grained alluvial deposits.[14] The recharge is highly dependent on quantities of winter snowfalls.

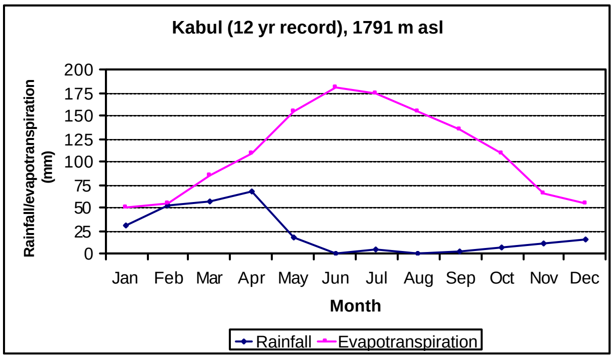

Figure 4 *Mean monthly rainfall and evapotranspiration in Kabul area*

[13] Data in Shobair SS (2001) Effects of deep wells on groundwater resources in Afghanistan. Unpublished paper
ref. AFG/96/004 Food and Agriculture organisation of the United Nations (FAO), Peshawar, August 2000.
[14] D.Banks, Norvegian Church Aid, Guidelines for sustainable use of groundwater in Afghanistan, September 2001.

Rainfall and snow have been scanty during the last 3-4 years throughout the whole country. Some provinces have been dramatically affected, like those of the whole south-west and some in the north-western areas. The mean rainfall for Kabul varies from 300 to 600mm/y. Kabul has been affected by the drought too, even if to a lesser extent, at least as far as water supply is concerned. Nevertheless, the drop of the water table has been constant and the effects were quite important, affecting particularly the tube wells equipped with hand-pumps. According to local engineers, the water table has dropped by 4 –5m in the past 2 years in Kabul city, by 5-8m in Kandahar and by 2-4m in Herat[15]. Boreholes have been less affected, being drilled deeper. On a few cases, lowering of the submersible pump was sufficient to maintain an adequate water supply, like in a couple of wells of the Afshar well field and in other locations.

UNCHS (Habitat) survey of the hand-pumps

Data collected by UNCHS between December 2000 and May 2001, to monitor the evolution of the water table in Kabul were compiled by UNCO[16]. The mean drop per district has been monitored and the monthly drop rate estimated. A mean value of 0.24m per month was computed for the whole city. It is generally assumed that for the many tube wells drilled in a hurry and not sufficiently deep, the number of "dry" wells has steadily increased until 2002. It is considered that this year the recharge of the aquifer has been close to normal but data will have to confirm it.

In an attempt to quantify the extent of the problem and to understand why a given hand-pump was not working, an initial survey was carried out at the end of 2001 in the southern districts of Kabul. The aim of the survey was not just to study the problems, but to repair the most used hand-pumps, according to the priority of the community. While they were dismantled the exact reason of the failure to deliver water was identified. The problems were divided using the same categories as the UNCHS survey, that is, low water table or mechanical problems. A detailed list of spare parts needed to resume the functioning of every hand-pump surveyed was established and steps were taken to immediately implement the repairs.

Approximately, 90% of the hand-pumps of the southern districts were considered out of order or affected by the drop of the water table, a figure much higher than that quoted in our previous 2001 analysis, when the number of functioning hand-pumps was much higher than 50%, with the exception of district 8, which had the lowest record with 37% of the pumps being operational.

[15] Eng. Ehsanallah, NPO, Kabul, quoted by D.Banks as personal communication
[16] Eng. Salim Qayum, UNCO, reported in D.Banks report, appendix4

Not all the hand-pumps have been surveyed. Only 220 have been included in this survey and they were chosen by the community's representatives (wakils, elders, etc) according to criteria such as proximity to a school, to a health post, to a market or to a highly populated area. Of the 220 pumps surveyed, 50 were in working condition and had only minor problems, 50 were not operational because of low water table and the remaining 120 had mechanical problems, probably reflecting poor maintenance and damage caused during the recent war against terror. Percentages cannot be compared, as the choice was oriented.

A mean drop of the water table of 3m was observed. Almost at the same time, a similar survey was launched to monitor the situation of the wells built by the ICRC between 1999 and 2000. 252 wells were drilled during this period and detailed information was still available through the "well passports" established during the construction, reflecting all the necessary information such as location, static water level, total depth, diameter, geological layers, type of pump, depth of cylinder, number of users, etc.

These data can be used to quantify the drop of the water table, due to the drought, but were collected mainly to understand the problem of the hand-pumps and to find a solution to solve it. They may allow to monitor the eventual recharge which will take place during the rainy season and when the snow melts usually at the end of April and in May. Data collected by UNCHS can also be used, and the results are shown in the following table. Not all the districts have been surveyed and in some the number of wells drilled by the ICRC is low. As far as the UNCHS data is concerned, only the mean drop per district is given. To compare we have used the same approach, by computing the mean value below ground level (BGL) of the static water level per district, even if this way of proceeding is biased, as the district boundaries do not necessarily match the behaviour of the aquifer and we may find wells with a relatively different static level in different areas of a district. Despite this bias the results are interesting.

If ICRC data are used, in districts 4, 10 and 15 the drop of the water table has reached 2.7, 4.8 and 1.6 metres respectively. This suggests that a mean drop between 2-3 metres in these three northern districts, confirming what has been outlined previously. Unfortunately, the ICRC database does not provide data for the other districts as the majority of the wells drilled by this institution were located in the northern areas of the town. Comparison with UNCHS data is difficult for the above-mentioned reasons, and also because in this case mean values have limited validity. The only way to gather consistent results is to compare the static water levels for the same wells, considering that the values at the beginning of 2001 are those measurable in "normal" situations.

	UNCHS			ICRC		
District	**Mean well depth (m)**	**Water table 21.04.2001 m below ground level**	**Water table 21.05.2001 m below ground level**	**No. of wells included**	**Water table January 2001 m below ground level**	**Water table January 2002 m below ground level**
1	9.3	8.21	8.45			
2	9.26	7.87	8.13	2		5.7
3	5.88	4.74	4.81	23		4.3
4	7.49	5.80	6.10	41	4.0	6.7
5	12.24	9.20	9.45	24		8.6
6	10.07	8.51	8.80	13		6.6
7	9.30	7.60	7.83	7		10.9
8	13.60	11.35	11.55	10		5.8
9	7.20	4.91	5.11			
10	8.96	7.36	7.97	52	2.0	6.8
11	21.87	21.04	21.00			
12	12.36	11.90	12.02			
15	15.68	14.22	14.55	33	6.4	8.0
16	10.38	7.95	8.24			

Table II *Change in water table, measured in wells in Kabul City. ICRC data: end of 2000 and February 2002, UNCHS data April/May 2001.*

Usefulness of 3D models and GIS database

3D topographic models, built from geo-referenced topographic maps, allow for a global appreciation of the situation and can be used to explain to non-technical decision makers the problems related to the access to water, particularly if the latter occurs underground. They help to immediately locate which areas may need specific attention and are particularly suited to visualise the drop in the water table, well by well.

A crude 3D model has been built using ARCVIEW 3D analyst. Elevation data from 50 metre contour lines, digitised over the Kabul topographic map have been used. The results are shown in the next figure, where the main hills of the town can be seen and where other important features, like main roads, the secondary roads and the rivers of Kabul can be easily recognised. Any spatial feature can then be displayed on the surface, like wells, public standpoints, boreholes, etc. and every parametre associated with it. Of particular interest are, among others, the parametres showing a variation along the z-axis, like depth, depth of the water table, elevation of the building, etc. and any changes associated with, and here, those linked with the drought.

The model is quite crude as it considers the alluvial plains at the same height (1,800 m asl), which is certainly not correct. Nevertheless, graphic evidence of the decrease of the level of the ground water, expressed in metres below the ground surface, using data obtained from the above mentioned surveys and databases, can be easily observed. Bearing in mind the scale of the map, a vertical exaggeration factor of 100 has been chosen to improve the visual recognition of the effect. Only the wells for which we had precise data were used, that is those reported in ICRC's well's passports and those obtained for the very same ones, gathered during the survey carried out at the beginning of 2002. Districts 4, 10 and 15 are considered. The results are shown in the following figures with different angles of view.

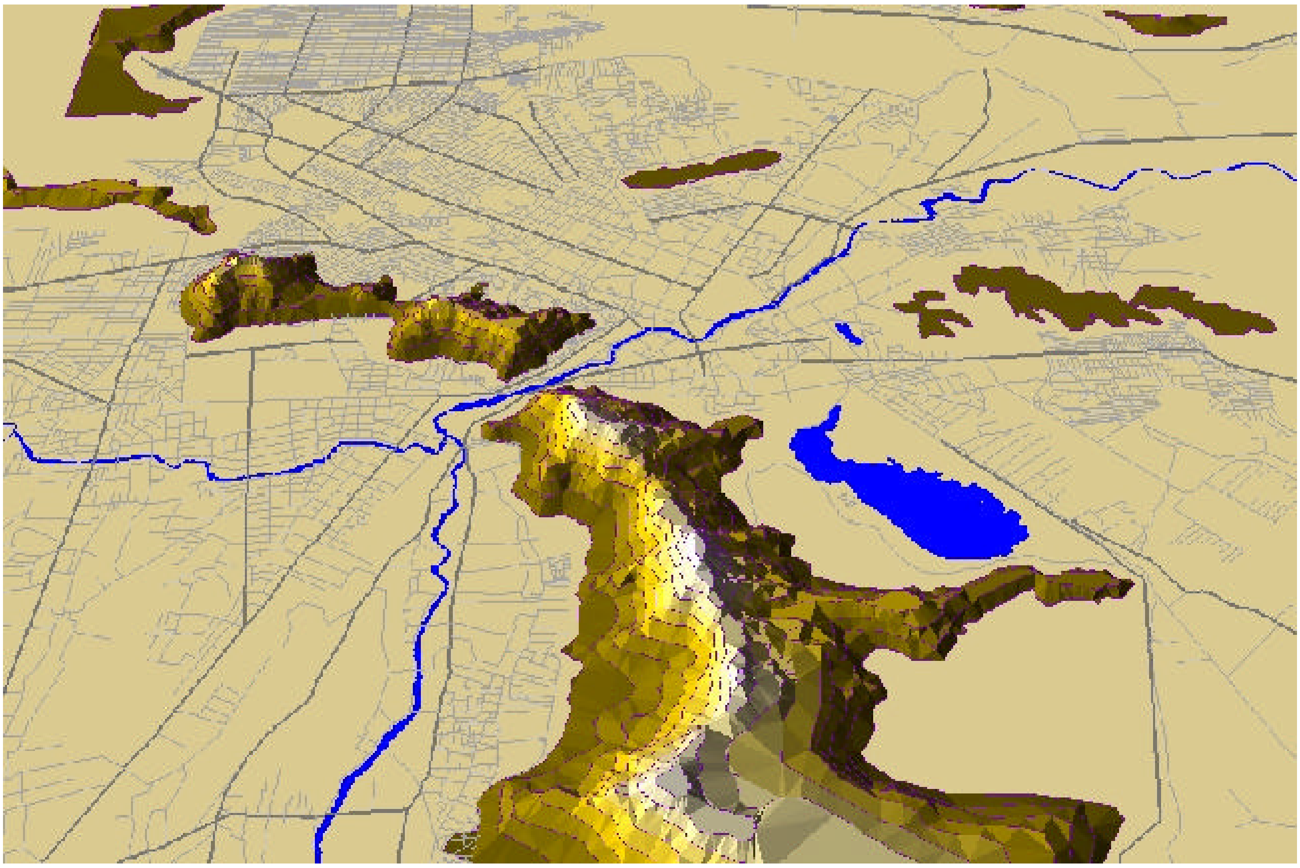

Figure 5 *3D model of the town of Kabul, showing the main topographic features. S-E view.*

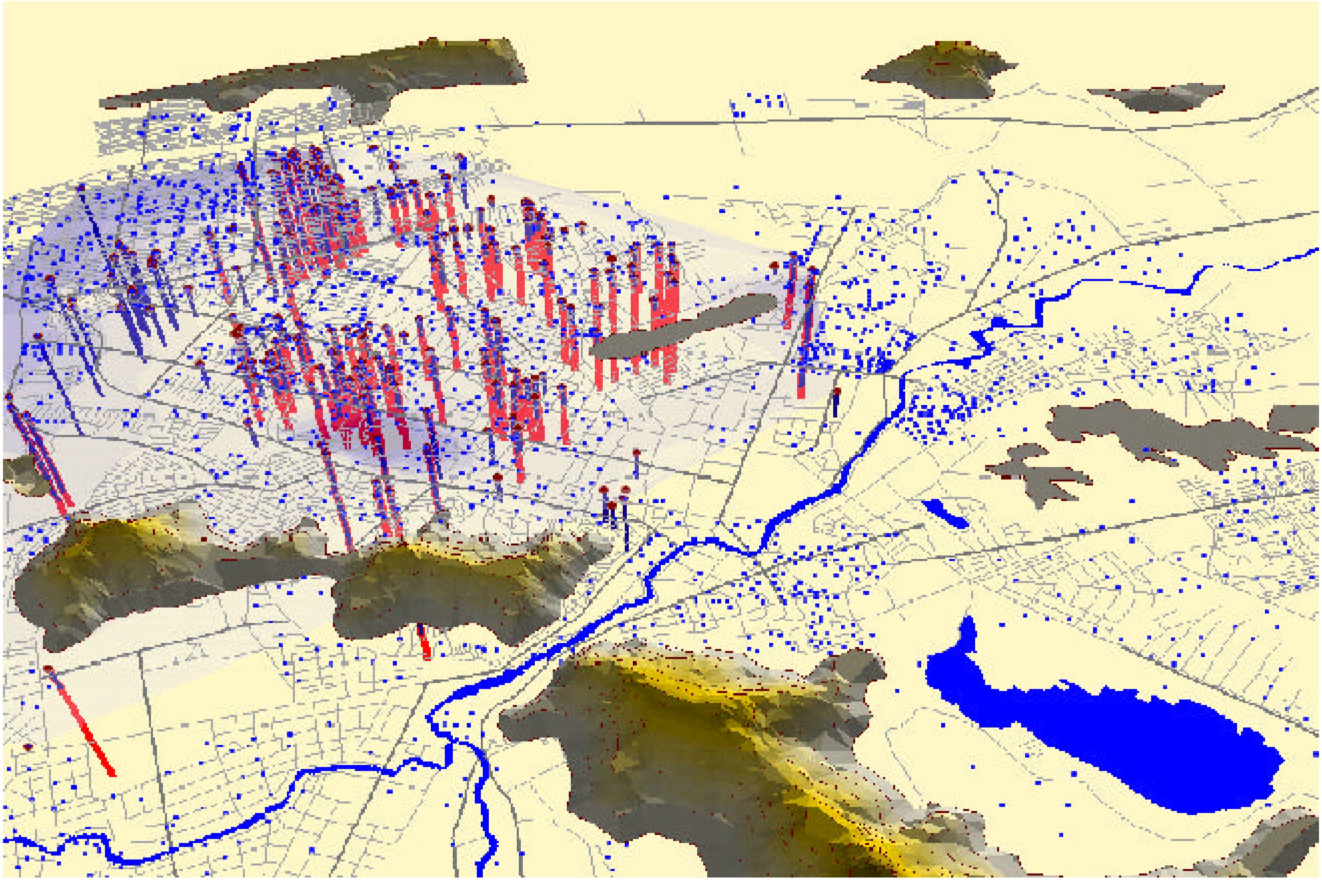

Figure 6a

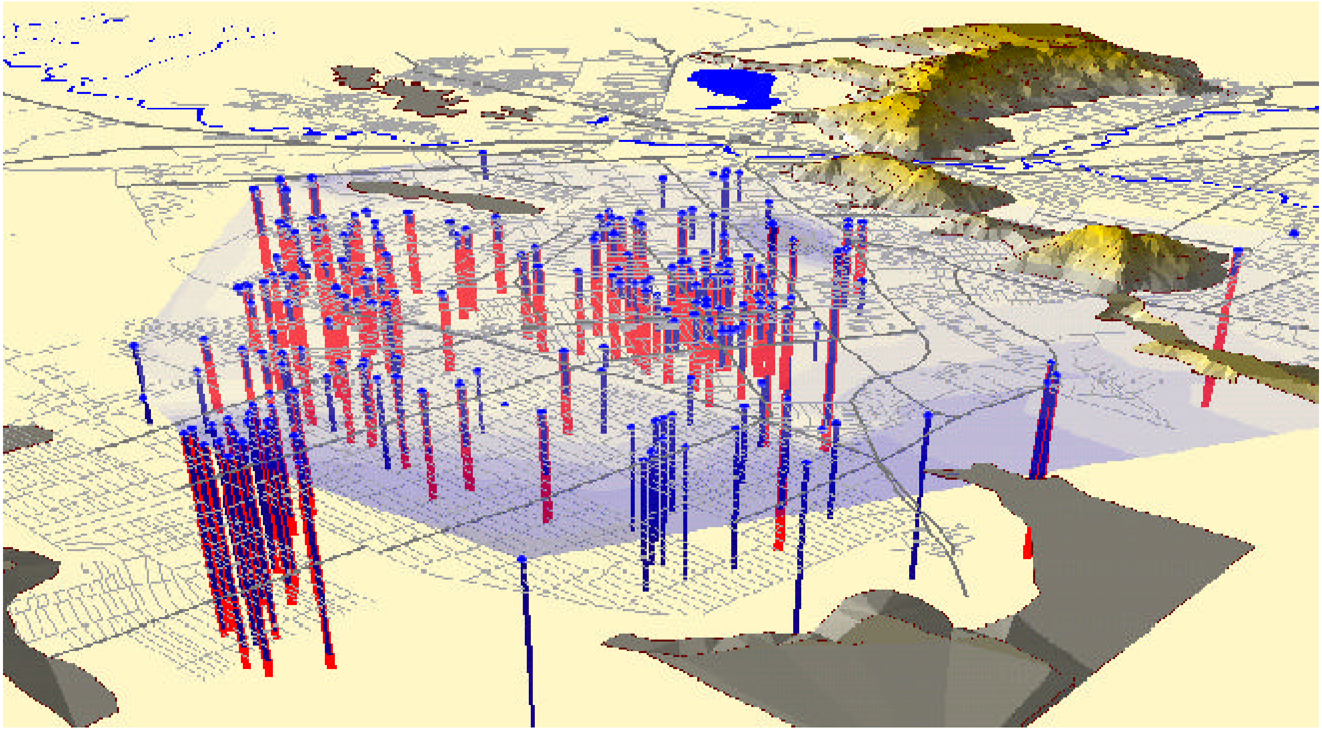

Figure 6b

Figure 6a and 6b *Changes in the static water level in wells drilled by the ICRC between end of 1999 and 2002 in the northern districts. Blue bars represent the depth of the water table in a normal rainfall period and the red bars the levels measured beginning of 2002. The blue surface is representing the iso-depths of the water table, from the ground level, assumed to be at 1800 m asl. View from N-W. Vertical exaggeration factor x 100.*

Out of a total of 196 wells, only 122 wells had data which could be used. As a first conclusion, it seems that for those wells drilled or built in areas where the water table is close to the surface, the drop has been more important. This means a higher proportion of the length of the red bars compared to the blue ones. Where the wells had to be drilled deeper, like in district 10, the drop is relatively low. In principle, the drop does not affect the access to water as majority of the wells have been drilled sufficiently deep, to avoid a decrease of the water level below the pump cylinder.

In the following figure, the water table level (static water levels) measured in the southern districts are shown. In these areas we do not have access to individual records and any comparison is biased, as pointed out previously. But, according to the experience of the technicians involved in the survey/repair, a drop of about 2-3 metres was common.

The results may give other hints on the recharge behaviour of the water table. It has been proposed that the recharge of the water table is taking place at the mountain's foothills, where the coarser sediments are deeper and where the hydraulic conductivity is relatively high[17] (estimated between30-60 m/d). This conductivity is expected to be lower away from the mountain areas, where the proportion of fine-grained layers is increasing. The water table may consequently be deeper at the foothills, but also its recharge is more likely to occur and particularly during drought situations. The lateral recharge of the more fine layers does not normally take place and the water table levels of these areas are deeply affected, as it can be observed in the northern area. For instance, in Shar-I-Now and Wazir, the water table was quite close to the surface in the beginning of the year 2000 and dropped for about 3m, by the beginning of 2002. The recharge from the river is considered low because of the poor conductivity of the fine grained layers.

The results outlined here are based on a limited number of wells. The situation now allows to harmonize the existing databases and, eventually, to carry out a more in-depth survey to define which pumps will have to be maintained in operation and in which area. It is also of paramount importance to define where new wells will have to be drilled and how, in order to avoid mis-management of the available resources and to orient the effort where people may desperately be in need of water, like in the district areas close to the airport, where the drilling of new boreholes is still not officially allowed, for understandable reasons, linked with the soil occupation, yet to be solved. The effects of the undergoing improvement of the distribution of water through the network will have to be integrated, even this is not likely to occur before 2003. Areas not likely to be covered in the near future may be supplied from tube wells equipped with hand pumps, at least temporarily.

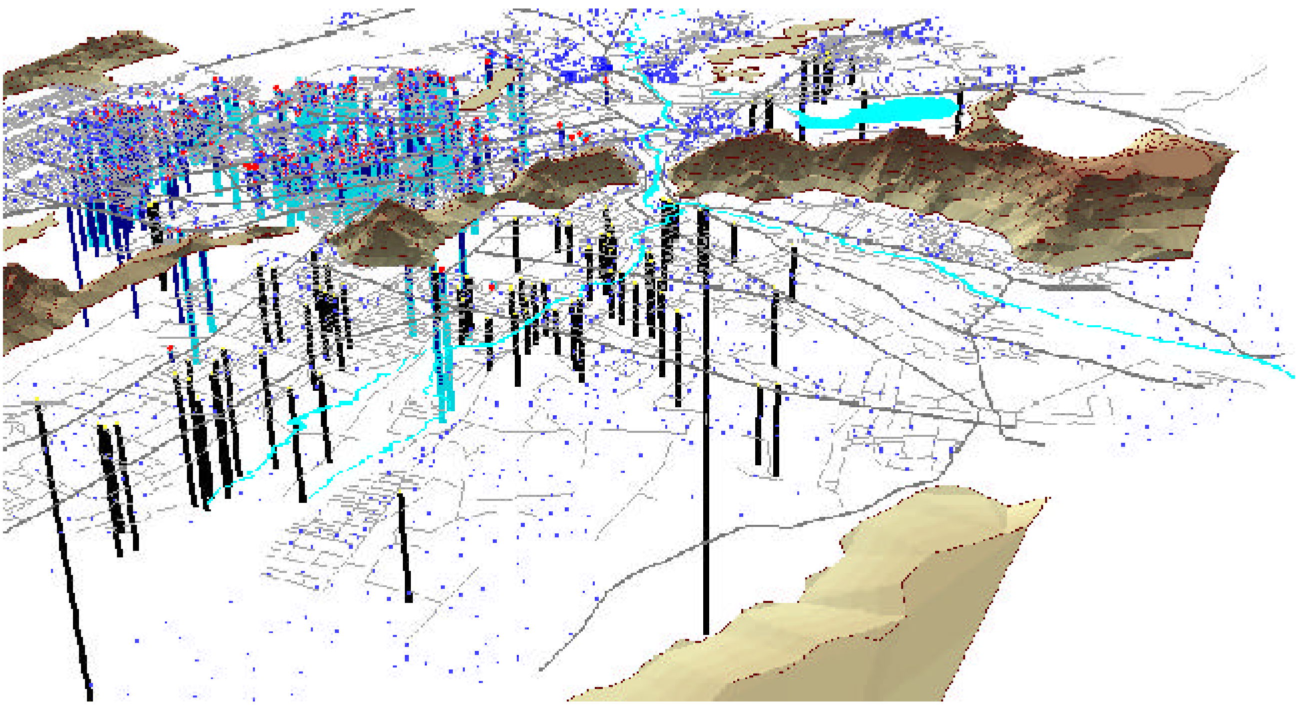

Figure 7 *In black: static water level of the wells repaired in the southern districts. Exaggeration factor x 100.*

[17] D.Banks, op. cit.

Water distribution through the network.

Historical background[18].

The first piped system of Kabul was built at the beginning of the century, supplying the Palace of the King and part of central Kabul. Technical assistance, provided by the Japanese and the German governments, led to the completion of the Alludin borehole scheme in 1965. A few other schemes were added in the 1970's as the Qargha gravity system. In 1972, a Canadian consultancy firm (PRIL) began to work on a Master Plan for water supply and sewerage.

The Logar project was planned in two phases with a sewerage network to be built in the second phase, when more boreholes would be drilled in the Logar aquifer. Construction began in 1978 and was completed in August 1984. Other schemes were considered by the Master Plan. The major ones are listed in the table below, with their rated potential and actual capacities. The Micro-rayon apartment building scheme, built as part of Soviet Aid, not included in the master Plan, was supplied independently from the city system and had its own piped sewerage system and sewage treatment station.

At the completion of Logar, the town water supply would have been about 85,000 m3/day. In Kabul, the number of connections reached 55,000 with about 33,000 individual house connections and some 850 standpipes linked to the Logar scheme only. All the systems were powered by electricity and were in principle operational 24 h/day up to 1992, when the civil war disrupted the supply of power and damaged many transmission pipelines.

The public utility (CAWSS)[19]

The present Central Authority for Water Supply and Sewerage (CAWSS) also called Abrasani was established in 1975 as a result of an early recommendation of the consultant in charge to establish the Master Plan.

Abrasani (Central Authority for Water Supply and Sewerage, CAWSS), the para-statal utility, was responsible for the water supply systems for 10 major urban centres country wide. Kabul was the central base, where the best expertise was available and from where the other centres were assisted. Mazar, Kandahar, Herat, Jalalabad, Pul-I-Kumri, and other areas had their own authorities, organised in a similar way.

In the seventies and until the soviet intervention any new capital investment was paid for by the central government, which was funded by the World Bank or by other donors, mainly the Germans, the Japanese, and USAID. The revenue collected by water sales was left to cover operation and maintenance costs of the systems, though even this was subsidised by the government. Until 1979, the amount of subsidy was quite small, with Abrasani almost self-sustainable, at least for meeting operation and maintenance costs.

The utility still has the same responsibilities but the civil war has "decimated the effectiveness of Abrasani and they have lost many key people". According to Salem Karimi, former senior water engineer within the utility, out of 8 senior water engineers who were employed by the utility, only he is still working in Kabul. Like many other engineers, he has joined an international NGO or institution as it happens so often in such situations. The others have left the country and are working abroad.

Figure 8 *Workshop team in December 2001.*

The utility was employing about 260 people in Kabul and another 590 in the provinces. Formerly dependent from the Ministry of Water and Energy, it has been placed, after the civil war, under the responsibility of the Ministry of PublicWorks, with no major improvements. In Kabul, Abrasani had specialisations in a number of areas including engineering design, planning, vehicle workshop, system maintenance, water metre repairing, testing, administration and revenue collection.

Since 1995 several International NGOs were involved in programmes aimed to support water supply projects: OXFAM, CARE and SOLIDARITE. With the Water Management Team (WMT), the objective of OXFAM was to strengthen the utility, but CARE and SOLIDARITE developed different approaches on how to manage projects and used different elements of the utility to pursue their objectives. The role of the WMT was finally limited to the Logar project and, as a result, instead of

[18] This information is based on J.Cosgrave report, Making omelettes: an evaluation of the Logar Water Project, 1999, OXFAM, unpublished internal report and Solidarité , Report on water supply, S.Ahmadi, December 1998, personal communication to J.F.Pinera
[19] This section is based on notes put at the disposal by R.Luff, OXFAM, December 2001

strengthening the operational capacity of the utility, the final result was that it became more fragmented than ever. The ICRC did nothing else when it became involved in water projects in 1999, taking up the role of SOLIDARITE and lately, that of OXFAM. The WMT was dead or dormant for better times.

Unfortunately, for OXFAM it was just too early for such a "thing" such as a WMT. Despite some obvious criticism, the approach chosen by the International NGO's allowed at least to maintain some of the systems in operation. It would certainly have proven useless to invest in a utility already in a poor state without a strong commitment of the government to support it. More or less, the dispersion of the systems allowed for their functioning and for their support by the NGO's. This is of course not the case for the Logar project, which is far too complex to be handled as a relatively small system.

All the efforts of OXFAM were aimed to create at least three essential functions within the utility: the workshop, the operation and maintenance and the revenue/finance functions. One objective was achieved: funds for a workshop were obtained and the workshop was eventually achieved. But again, no clear medium or long term objectives were set for its operation neither how it would operate apart from the daily emergencies. At the end of 2001 everything was in place but these questions remained unanswered. As for the other functions, they were there too, but unfortunately, only on the paper. The situation is more or less the same but there is now a new opportunity to enforce this approach with the involvement of KfW, who has committed itself to tackle the institutional development of the utility, in close co-operation with the Ministry of Public Works.

Tariffs

The information in this field is scanty. In principle, the tariffs outlined in the next table were applied until 1998. A comprehensive review was felt necessary and proposals were submitted to the government. In principle the utility was employing 4/5 people to collect revenues in every water zone (5), with reading of water "metres " carried out every 3 months. Houses without metred connections and communal water points were charged with a flat rate. These rates were collected through a municipality charge, which included other services and it was difficult for the utility to recover its own part. A ten-fold increase of the charges has been proposed, but even that would not compensate for the devaluation of the Afghani. As a reminder, the exchange rate went from 1 US $ = 50'000 Afgh. at the end of November to about 1 US $ = 25'000 Afgh. by early January, thus obliging some international NGOs to price everything in US dollars. Already in 1998, the need for a better way of charging for the delivery of water was considered urgent. It was also recognised that standard policies were needed, to be applied to all the networks, communal water points and community schemes, regardless of which agency had supported these. The problem remains to be solved.

Table III *Tariff structure*

Type of connection	Aghanis/month [1]
Domestic monthly charge	70
Government offices/business charges	140
½ inch pipe connection	1000
¾ inch pipe connection	2000
1 inch pipe connection	4000

[1] 1998 1 US $ =50 Afgh. Jan. 2002: 1 US $ = 25'000 Afgh.

Assistance from different International NGO

Between 1994 and 1998, SOLIDARITE[20] assisted CAWSS to run and rehabilitate most of the network schemes. Its involvement allowed CAWSS to maintain the distribution of water through the network, either by supplying diesel to run the power generators which were not supplied by the different ministries, "owners" of the schemes, like in Micro-rayon or in other apartment blocks, or by repairing the electrical connections to the pumping stations when the electricity was restored in the concerned areas. The Micro-rayon sewage treatment stations I and II, were working almost round the clock when they were operated with assistance from SOLIDARITE. Their operation was then reduced to 6-8 hours a day due to lack of fuel, even if everything was in fairly good working condition. When the connection to the electrical grid was finally completed their operation remained poor as only about 10% of the required personnel reported. Untreated sewage was discharged into the Kabul river, almost without any treatment.

At the end of 1998, when SOLIDARITE decided to stop its support, a decrease in the operating hours was observed in almost all the wells where diesel generators were used. For instance, the operation of wells No.1, No.2 and 2a of the Afshar well field decreased from 8 hours daily to 4 hours when assistance to the Ministry of Public Works stopped. Accurate data were not available and it is quite difficult to estimate the amounts of water produced at the well fields and pumped into the network. They were probably close to those measured in February 2001, at about 20,000 m3/d.

[20] Afghanistan, NGOs run Kabul water supply, HYDROPLUS 75, 1997, July-August, pg 23.

Table IV Kabul town: major networks*, potential capacity and capacity end of 1999, end of 2001 in m3/day and power supply. Data based on mean daily hours of pumping and nominal capacity of the pumps. [1] Well 6A is included here but was not operated regularly. [2] Reported to produce at this level from Solidarité, but currently not working due to the drought.[3] Data from Solidarité. Working hours under their support. N.A. Not applicable due to lack of data.*

Scheme	Potential m3/day 24/24 h	Before 1998[3]	End of 1999 m3/day	February 2001 m3/day	July 2001 m3/day	December 2001 m3/day	Power supply *
Afshar (1997-1982)	13'600	6'260	11'000	8'500	8'430	10'838 2'592 [1]	24h/day electricity
Qargha [2]	4'500	4'500	N.A.	N.A.	N.A.	N.A.	Gravity scheme for district 4 and 5
Alludin	9'500	?	9'500	630	864		Operated by gensets/fuel
Pul-e Artal Nesaji	3'500 9'072	3'500 ?	3'600 1'100	3'600 1'300	1'800 1'300	2'340 1'620	24h/day Operated by gensets/fuel
Logar (1978-984)	31'100	0	0	0	0	0	No fuel
Microrayon …………	15'600	6'840	?	3'115	3'115	3'955	24h/day electricity
Total	86'872	NA	NA	17'145	15'509	18'853	

Damage to the water infrastructure in Kabul during the recent air-strike

Several transmissions and distribution lines have been damaged, leaving formerly supplied suburbs or districts without access to safe water. Damage was considered "collateral" as it is not yet clear if it was caused by attacks on legitimate targets, for instance in case of the presence of military installations, or if it was just a problem linked to the precision of the delivery. Damage was observed at several locations, as described in table V below.

Table V
Major damage to the water transmission and distribution lines, problems and number of people affected.

Location	Date of the damage No. impacts	Problem	Estimated population affected	Days without water
Afshar road to Ghazni	11 October 2 bombs (1 UXO[1])	Burst of 600 mm dia cast iron pipe	350'000	20
Micro-rayon apt. blocks	13, 14 October 2 bombs	Burst of a 250 and 100 mm dia pipe on 610 meters and destruction of the valve box	150'000	10
Karthe Parwan	10-11 October	Electricity damage Circuits damaged, pumps out of operation for 2 weeks	50'000	10
Sarai Shamali		400 mm line from a 10'000 m3 reservoir to the 5000 m3 supplying Kheir Khana damaged on 2-4 meters		20

The main consequences of the destruction of the pipes was the interruption of the distribution of water from the Afshar well field to the Kheir Khana area (350,000 inhabitants) and the cut-off of the supply of the Micro-rayon apartment buildings, hosting an estimated 150,000 to 180,000 people. The inhabitants of Kabul could rely on alternative sources, by collecting water from hand-pumps installed by many organisations during the recent years.

The data outlined in table IV gives the production of the major well fields and does not include all the 87 facilities (84 deep wells and 3 booster stations). Only a few networks were operating to about ¾ of their capacity, that is, Afshar, Poli Ortal and most probably the Qargha gravity scheme. For the last one we may assume that it was supplying the scheme at its normal capacity, but daily capacities varied from 4,000 to 4,500 m3. By the beginning of 2002, the Qargha Karez scheme was not operational due to the effects of the drought. The information collected during 2001 did not include the production of this gravity scheme, as data were focused on borehole's operation. What is evident is the huge unused potential of the Logar well field, which represents about 40% of the available total capacity and the poor operation of the Alludin and Nasaji well fields, powered by fuel generators. The low operation rate of the Microrayon wells is related to lack of electricity but also to damage of the waste water lifting stations of the complex, not able to cope with higher amounts of water to evacuate. The figure below shows the transmission lines and the primary network of the major schemes.

Figures 9 & 10 *Damage to the distribution line at the main road leading to Micro-rayon apartment complex and to the 600 mm asbestos/asphalt coated cast iron pipe at the Ghazni road and makeshift repairs (November 2001/P.G Nembrini).*

Evolution of the boreholes production after the recent war

At the end of 2001, a regular survey of the operational capacities of all the wells was initiated. All the 87 facilities were surveyed again when the activities of the ICRC were resumed, by the end of November. The production figures, recorded at a weekly basis, are based on operating hours and computed using the nominal capacity of the pumps. To allow for comparison a mean daily production has been computed. The results are shown in figure 12 on the following page.

The quantities produced have increased since August 2001. For week 48, the difference is due to the operation of two wells at the Afshar well field, 6b (30) and 7(28), to the Micro-rayon well no. 4 (17), to the third Alludin well, operated with the assistance of CARE (32), and, to the two Project Jadid wells (86 and 87). The

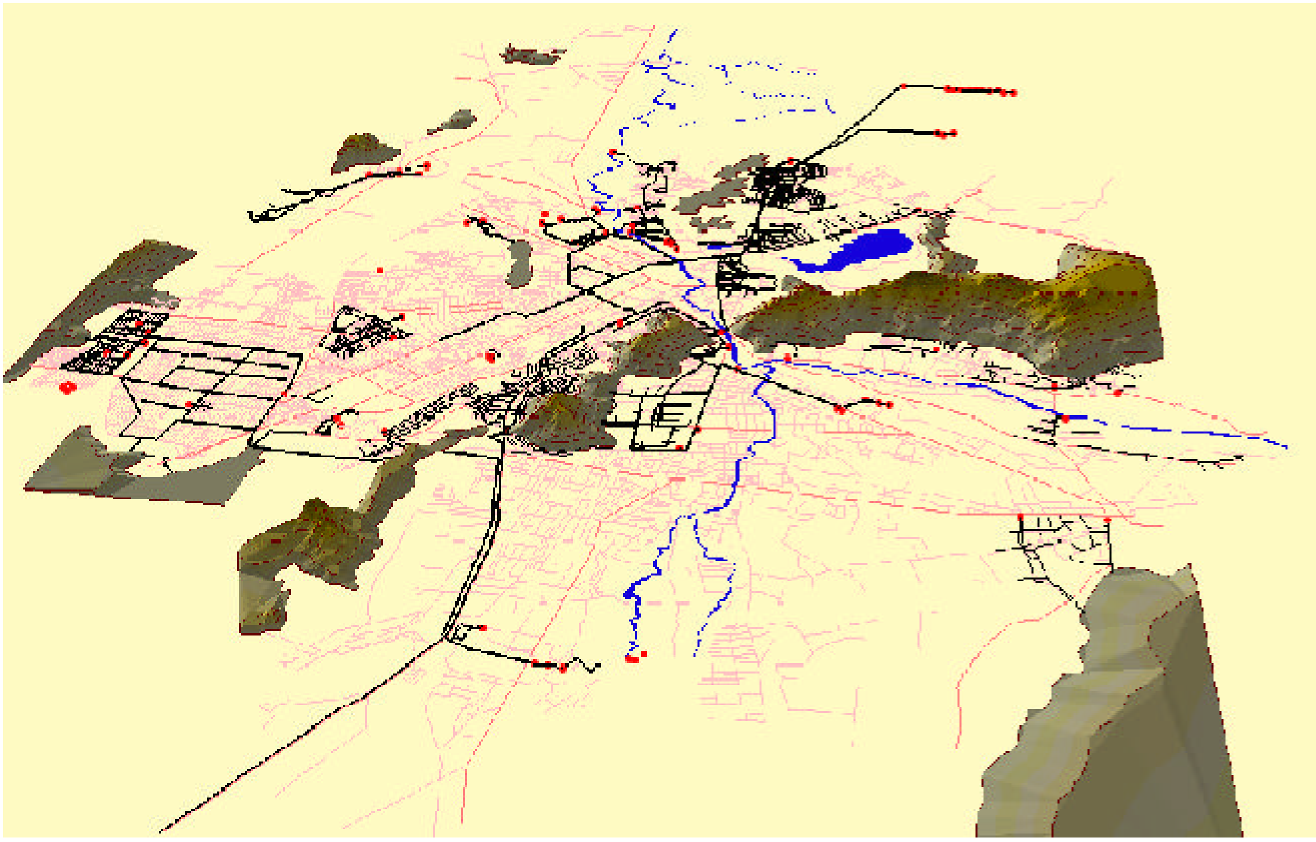

Figure 11 *Location of major network schemes*

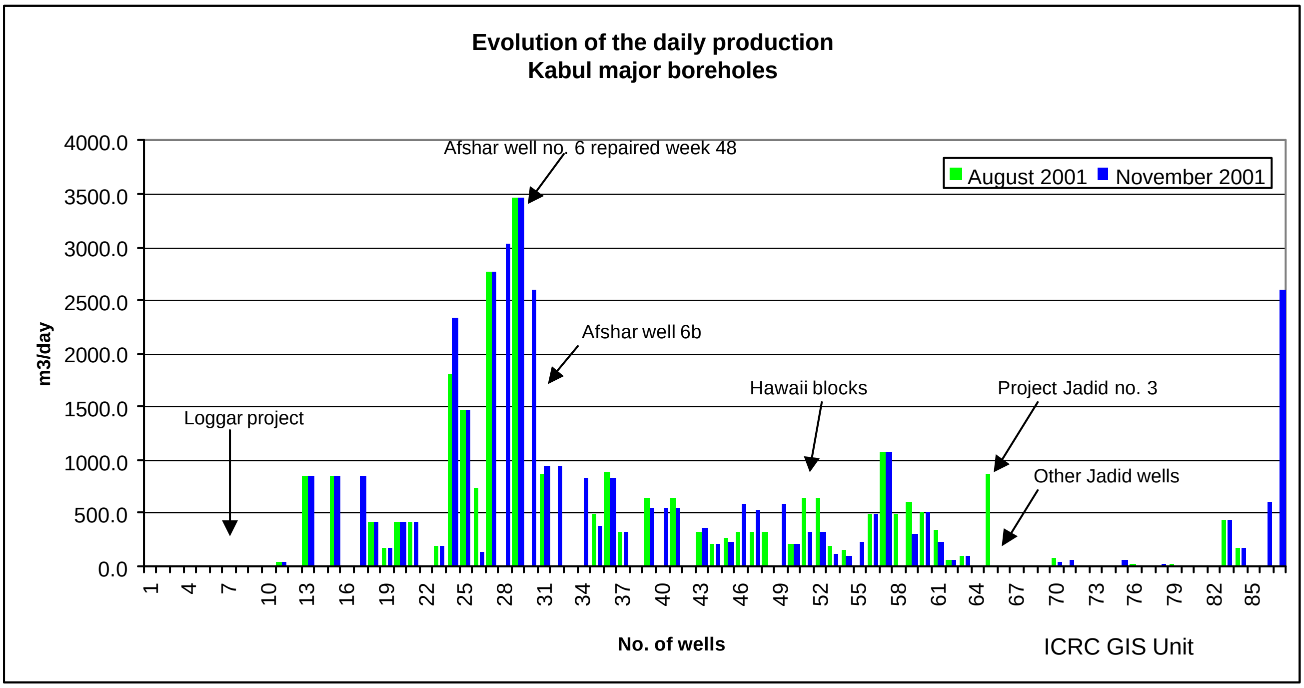

Figure 12 *Mean daily production of the wells depending from different entities (CAWWS : Central authority for Water Supply and Sewerage, PMD: Public Maintenance Department, RRD: Rural Rehabilitation Department). All the wells are included.*

situation was apparently improving even if was too early to draw any conclusions about the sustainability of the operation. Data collected in the following weeks show that the performance of week 48 was unique. The mean daily total production fell from a maximum close of 40,000 m3/day to about 30,000 m3/day during week 49, but increased regularly in the following weeks when ordinary problems linked with the distribution of power could be solved and with the resumption of the operation of other deep wells (Debory University borehole). In the specific case of Micro-rayon apartment blocks, ICRC assisted the public maintenance department to replace or rewind several electrical motors operating the sewage lifting pumps, in order to avoid regular flooding due to the increased pumping, thus increasing the security of the whole waste water evacuation of this huge apartment complex.

Figure 13 *Replacement of the electrical motor of one of the sewage lifting pump in Micro-rayon*

Figure 14 shows the evolution of the production between week 48 (first week of December 2001) until the end of January 2002, when the production is still quite low, if compared to the total potential production of all the wells, close to 50,000 m3/day (Logar and Qargha Karez are not included). Many wells are not operated 24 hours a day due to power or fuel problems and some must be stopped, as the water level in the wells decreases.

The data can be analysed more in depth as it was done for a few weeks for the Afshar well field, where the production decreased for unknown reasons. The production reached its maximum during week 49 but decreased regularly for all the wells except well no. 9, during week 50 to 51, due to general lack of power, used preferentially in other areas. The poor production of well no. 9 is related to the draw-down of the well, with the dynamic level reaching its lowest possible level in about two hours of pumping.

The normal power supply to Afshar well field was eventually restored in the following week, restoring its important production, supplying about 170,000 people of the Kheir Khana area. A proposal to lower the pump in well no. 9 has been prepared and submitted to the ICRC water team. Most of the other wells showed similar problems related to power, fuel, and to technical failures, but the global production was on the increase, as is illustrated in the former graph. Several control panels had to be changed and could be found locally. Spare submersible pumps were also purchased by the ICRC, allowing CAWSS to react rapidly in case of failure of a specific type of pump.

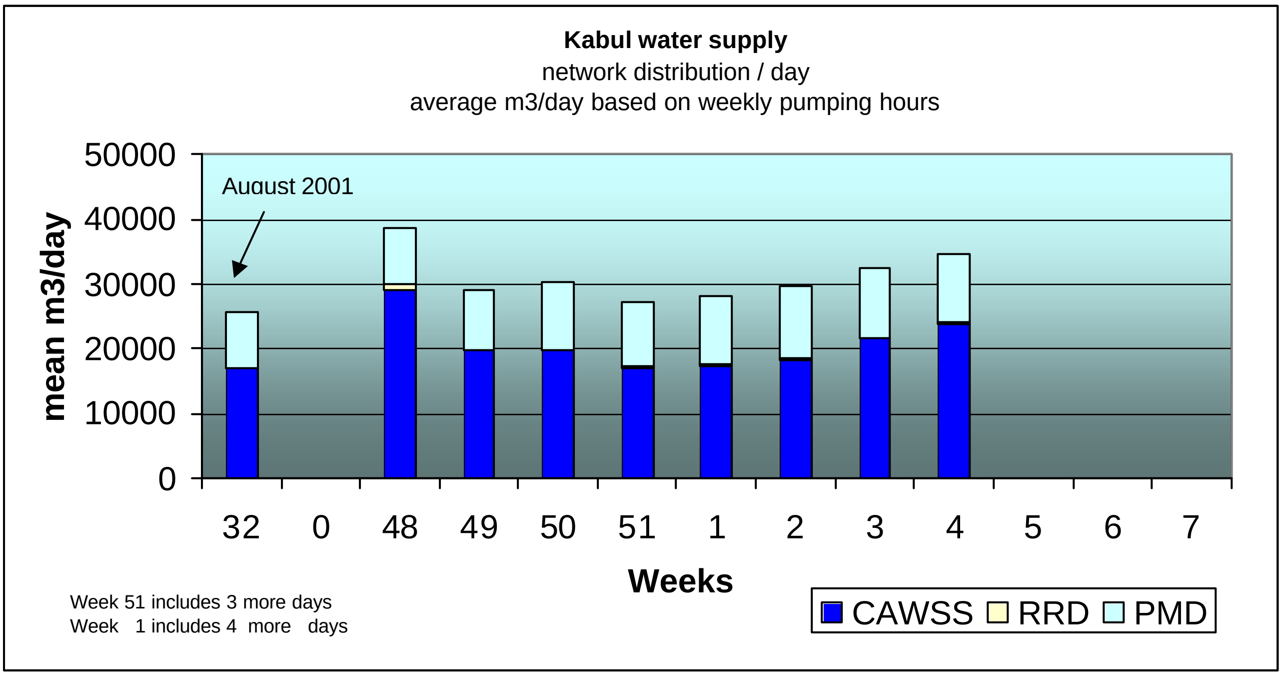

Figure 14 *Weekly total production of all the boreholes. Average cubic metres based on weekly pumping hours*

Access to a reliable electrical power supply was nevertheless one of the major worries of all the agencies involved in any assistance programme. By early 2002, the town was becoming more and more active from one week to the other, stretching the capacities to supply and distribute electricity of the MoWE, to its maximum. The foreseen returnees from Pakistan together with an increase in economic activity, would put a further burden on the supply of power. It was therefore of paramount importance to focus on this aspect of the problem.

In the following paragraphs the situation of the electricity supply of Kabul will be described in general and its link with the future extensions of the network will be commented upon.

Figure 15b *Afshar well field. Pumping Station.*

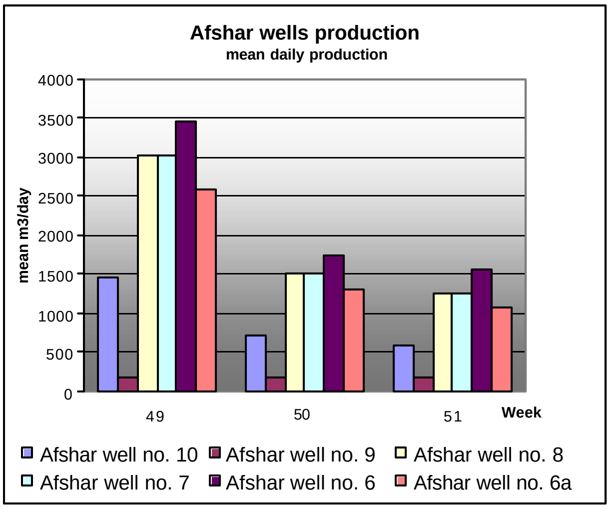

Figure 15a *Weekly total production of the Afshar wells*

Electricity supply to Kabul and water distribution

Water supply, like many other activities necessary for a normal life of a town, cannot be imagined without the availability of electricity. Power can be secured from thermal units but there must be a regular supply of fuel or gas. Regularity of a supply is generally not the case in troubled situations. Unfortunately, like many towns in similar situations, Kabul has not been an exception. By the end of 2001, fuel was still difficult to obtain, its cost was quite high and the pipelines due to supply the town from the northern neighbouring countries were not built or were not in operation.

Despite the damage suffered during the 1992 to 1994 civil war and during the hostilities for the control of the town in the summer of 1996, when the Taliban were able to establish their ruling over almost the whole country, the main electrical grid could be maintained in fair operating conditions and power could be gradually secured since 1995. Many high voltage lines, supplying the main sub-stations were in poor state, but by the end of 2001, when the Taliban regime was ousted most of the pumping stations, hospitals and public facilities were more or less supplied with power from the 15 KV grid. The state of the grid was considered by the acting ministries as one of the major problems to tackle, and huge lists of materials were prepared to rehabilitate the grid. These were submitted to different donors or potential implementing agencies.

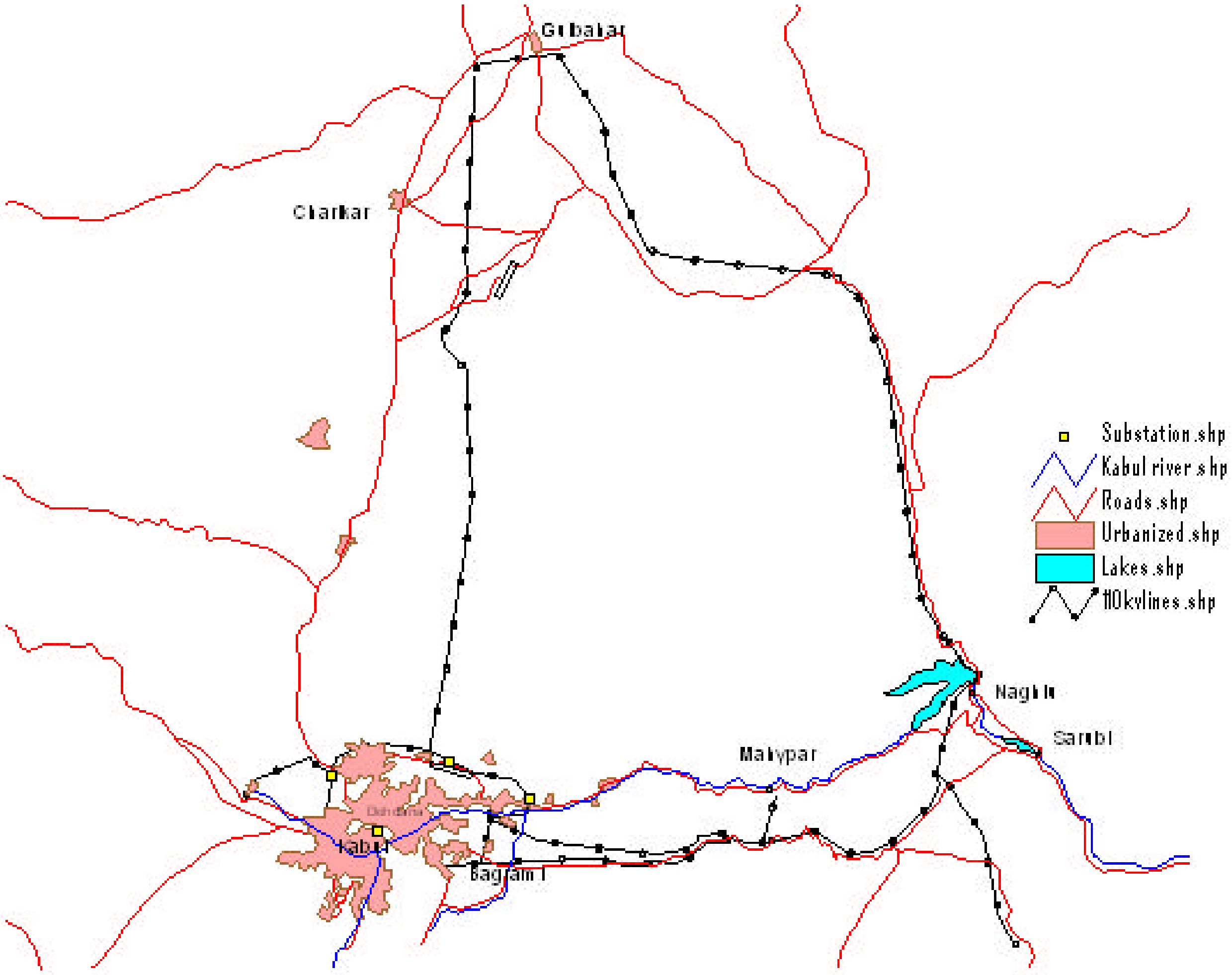

Figure 17 *Layout of the 110 KV lines, and location of the major dams, and the substations(approximate)*

Power supply to the town of Kabul

Kabul is supplied by a high-voltage grid (110,000 V), with power produced at different locations using hydro electrical facilities. Several hydropower stations have been installed and have a nominal production capacity of about 187 MW. Table VI presents the potential productions in Mega Watts (MW) of the respective stations and those estimated for peak use[21].

Table VI *Characteristics of the different power stations supplying Kabul*

Power station	Installed power (Mega Watts) MW	P (power) produced in May 2002 MW	P max max daily power 2-3 hours in the evening MW	Indicative P max 23 March at 11.0 h measured at substation North MW
Sarubi	**21** (2 x 10.5)	10.5	10.5	21
Naghlu	**100** (4 x 25)	21 (11*)	50	23
Mahypar	**66** (2 x 22)	0	11	4
Total	187	31.5 (21*)	71.5	48
Total after transport losses and step-up and down transformation	172	29	66	48

** It was not possible to ascertain if the 21 MW were related to the total power produced (11 MW + 10.5 MW) or if produced by one specific turbine group. The totals vary consequently.*

According to MoWE, 122 MW are in principle available in “normal” times, but due to the situation, only 67 are in fact produced. This is apparently related to the low level of the water in the dams and to the poor state of the 110 KV transmission lines.

Figure 17 shows the general layout of the 110 KV grid with the location of the main accumulation lakes, the dams and the major power stations.

This 110 KV grid supplies several (4) substations located on the outskirts of the town, where the voltage is stepped down to 15KV. From the substation, power is then distributed into the 15,000 V grid through aerial lines (aluminium/steel cables) and underground cables (lead cables isolated with impregnated paper). The whole grid is isolated and cannot be interconnected to other grids, damaged during the hostilities, like the one connected to the Jalalabad grid. The dispatch to Gulbahar is also out of order. Fluctuations of power productions are common and are related to the low level of the water in the lakes, allowing for only limited hours of production. The drought of the last three years has created a huge deficit of water and even if the current year is reported to be better, the deficits of rainfall/snowfall are important, close to 50%. As a consequence, only a limited number of turbines can be operated and the power production is not sufficient to cover the increased needs of the town.

Figure 18 *Aerial view of the Sarubi lake and dam*

Dispatch of power from one area of the town to the other is a daily reality and voltage drops to 150 V (instead of 230 V) are common. Regardless of the problem due to the lack of water in the dams, all the three power stations are apparently in working condition but in need of in-depth refurbishment.

Many sections of the 110 KV aerial transmission lines also need to be replaced, as well as the aerial lines of the 15,000 V grid, which have been badly damaged since 1992 and looted subsequently. The 20 MVA transformer of the East substation, out of work since the 1992 war, will have to be replaced as repairs were apparently not successful (June 2002), despite all the efforts done by the engineers of MoWE to re-commission it.

The next figure shows in a schematic way, the production facilities of the three hydro-power stations, the main transmission lines and the step-down transforming capacities of the different substations. The state of the 110/15 KV step-down transformer located at the East substation is of paramount importance for the different electrification options of the Logar well fields and of the Bagrami high lift pumping station, as will be discussed in the following chapter.

The 15 KV grid and the state of the transformers

The initial figures describing the situation of the step-down transformers given by the MoWE were quite appalling, with only 270 step-down transformers being in working condition out of a total number of 740[22]. Their power varied between 400/600/1000 KVA. Out of 4 substations (110KV/15 KV) only two were in working condition,[23] and out of 12 junctions (15 KV to 400 V), only three were working.

[21] M.Weber. Logar electrification project, ICRC. May 2002

[22] MoWE, personal communication. January 2002

[23] The number of substations is 4 (East, North , NWEST and Pul-I-Sharki substations)

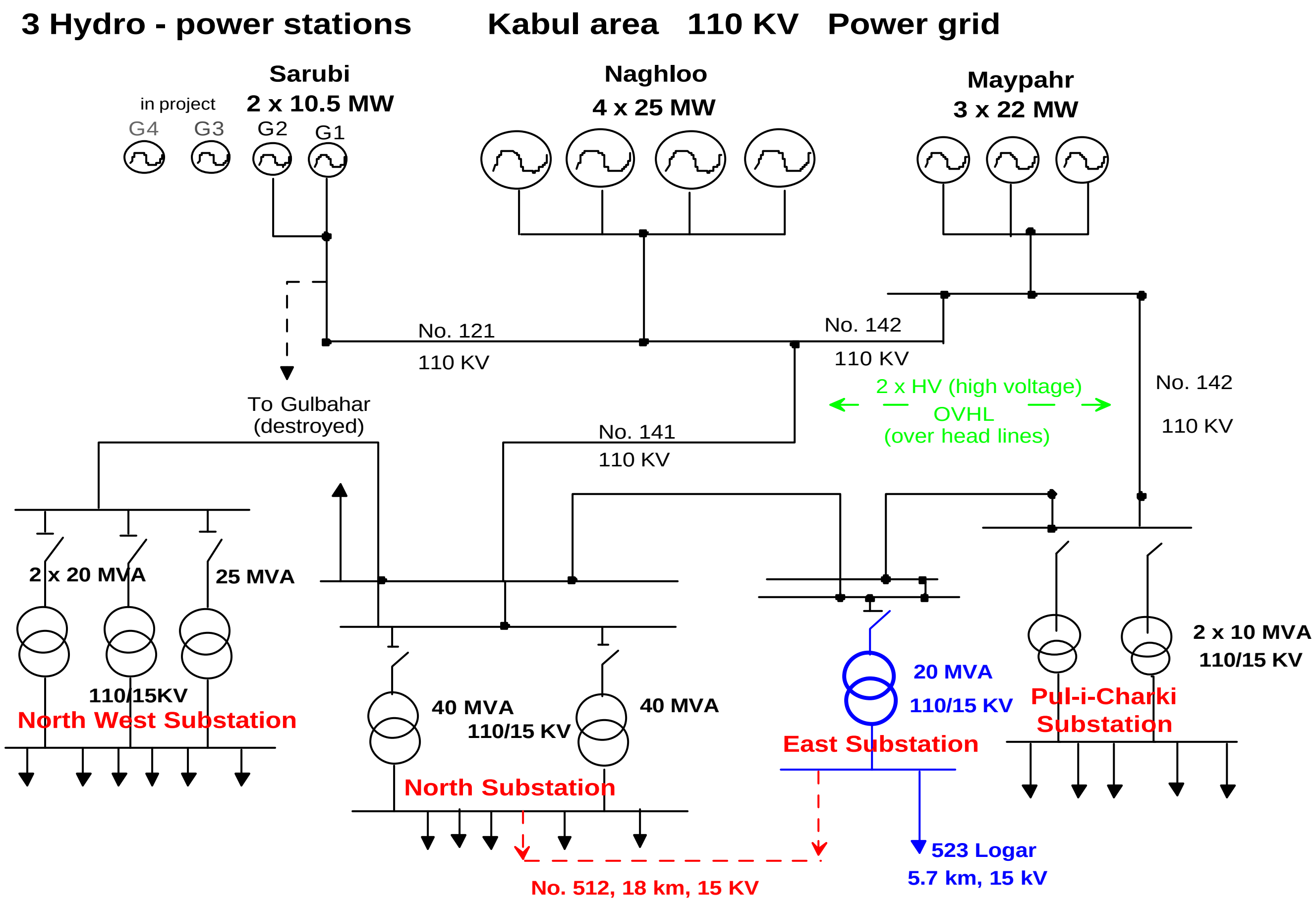

Figure 19 *Scheme of the production capacities at the different hydro-power stations, of the main 110 kV transmission lines, of the transforming capacity of the substations and of the proposed interventions (courtesy of ICRC, M.Weber and Eng. Zarga (MoWE).*

The pumping stations of the different well fields are supplied through the 15 KV line. Power is stepped down to 400 V, with most of the stations supplied specifically through their own transformers. A particular effort was made to secure the power supply of these premises. A survey of transformers supplying the pumping stations and the health facilities was undertaken and the location, performance, power of all the units linked to the 15 KV grid was finally reported on a map using GIS facilities. The survey was carried out in co-operation with the MoWE. Some of the results are shown in figure 20 on the following page.

Table VII *Type and number of active transformers (MoWE and P.G.Nembrini)*

Type /Power	**1'000 KVA**	**800 KVA**	**630 KVA**	**400 KVA**	**200 KVA**	**Other**
No. active Total 363	14	41	118	112	46	32

By the beginning of 2002, most of the transformers located in districts 6, 7, 3, 8 and in district 9 (industrial area) were out of operation (red squares) and most probably beyond any repair. These are also the districts deeply affected during the civil war and where most of the houses have been damaged.

In the initial database the units have been located manually on the map, using a schematic map of the grid and taking advantage of the knowledge of the local engineers. The use of a GPS will facilitate the precise identification of all the units and will also allow to map the tracks of the 15 KV electrical lines, presently reported as direct connections between the units or the junctions. Table VII gives the proportion of the units of various power, which were operational at the beginning of 2002. Many of them were overloaded and were in need of maintenance.

By the beginning of 2002, the main priority was to secure a stable supply and begin the rehabilitation of the damaged substations, from where power could be dispatched to the mid-voltage grid. Priority was given to the East substation, from where several crucial areas would be supplied, like the industrial area and several well-fields, both essential for the economic survival and future development of the town.

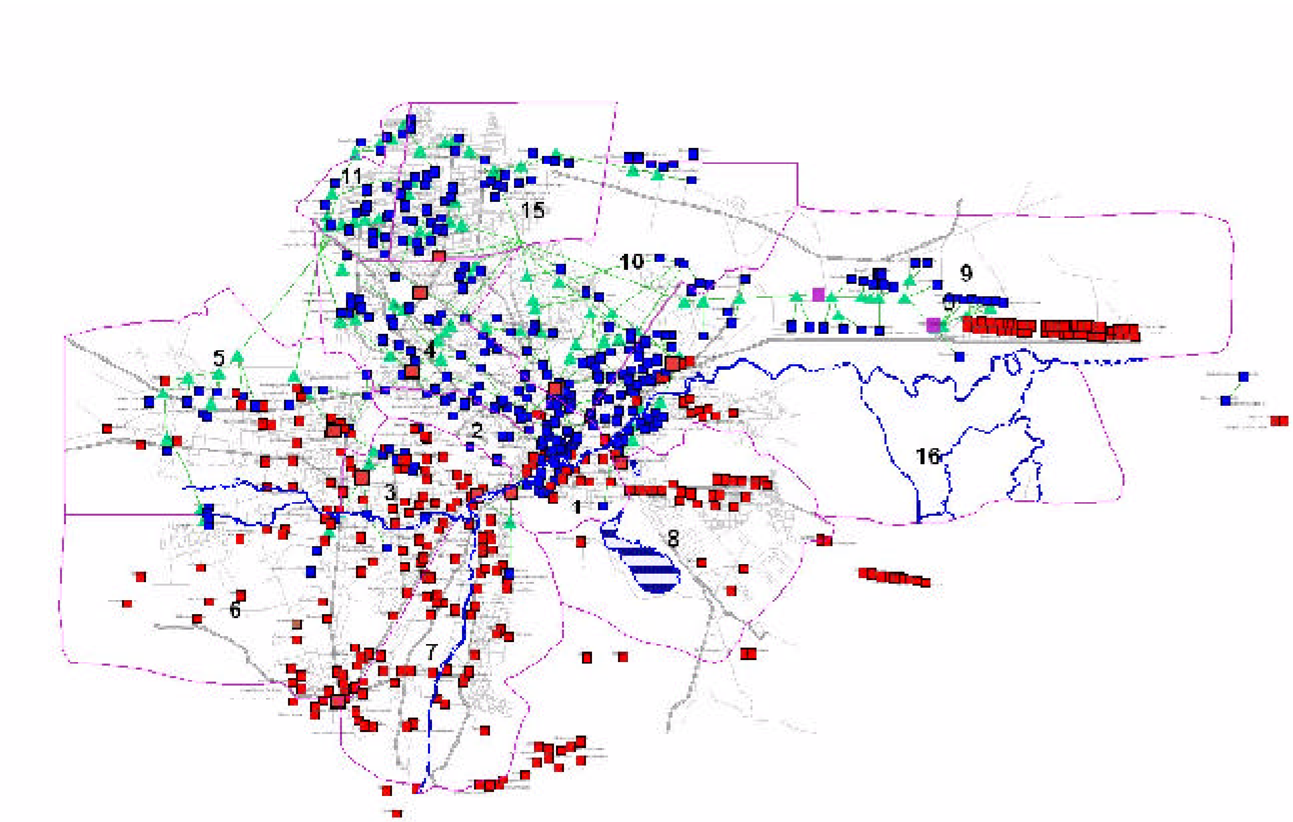

Figure 20 *Kabul 15 KV grid. Location and state of the step-down transformers Blue squares: operational Red squares: out of order.*

The example of the electrification of the Logar scheme will be presented in the following.

It was clear that it would take years to re-establish a proper grid in the most affected districts and the investment was immediately foreseen to be huge. Not only all would the lines have to be laid or installed, but the number of transformers needed would also be quite important, between 2-300, depending on how the people would move and settle in these suburbs.

The Logar project cannot be operated without electricity and the production of electricity is now stretched to its minimum. The whole city is in need of electricity and water. How the available power will be allocated remains to be decided and painful decisions may have to be taken in the near future, if the present drought persists. Other types of power facilities will be required but they can be built if the present peace situation prevails.

The Logar project

The Logar project was in principle designed to supply the central and the north-western part of Kabul. The area concerned is shown in figure 21. Included in the Master Plan prepared by the PRIL consultants over a poeriod of about 6 years, its completion has suffered from the numerous changes of the political situation.

From 1972 when the initial feasibility study began, until 2002, seven different governments were ruling the country or part of it, with years of civil war and turmoil. The chronology of the political events and their effects on the technical completion of this project is given in annex I.

When the final design was ready, in April 1978, a drastic change in the political situation and the increased violence resulted in the exit of the consulting company, followed, in December 1979, by the soviet military intervention.

The first phase of the project was nevertheless pursued during the years of occupation and was completed in 1984. Everything was then stopped during the civil war. In 1995, OXFAM expressed interest in this project and a lot of work was carried out to drill 10 new boreholes in this aquifer, considered the best of Kabul. Other agencies were involved at different degrees, mainly providing funds, but, since 1992, when the civil war disrupted the electricity supply of the town, not a single drop of water has been distributed into the network. One of the main reasons is due to the kind of energy chosen to operate the pumps, which were powered by diesel generators, and diesel was not only a strategic commodity but also extremely expensive, with an estimated monthly cost of about 40’000 USD to operate the whole scheme.

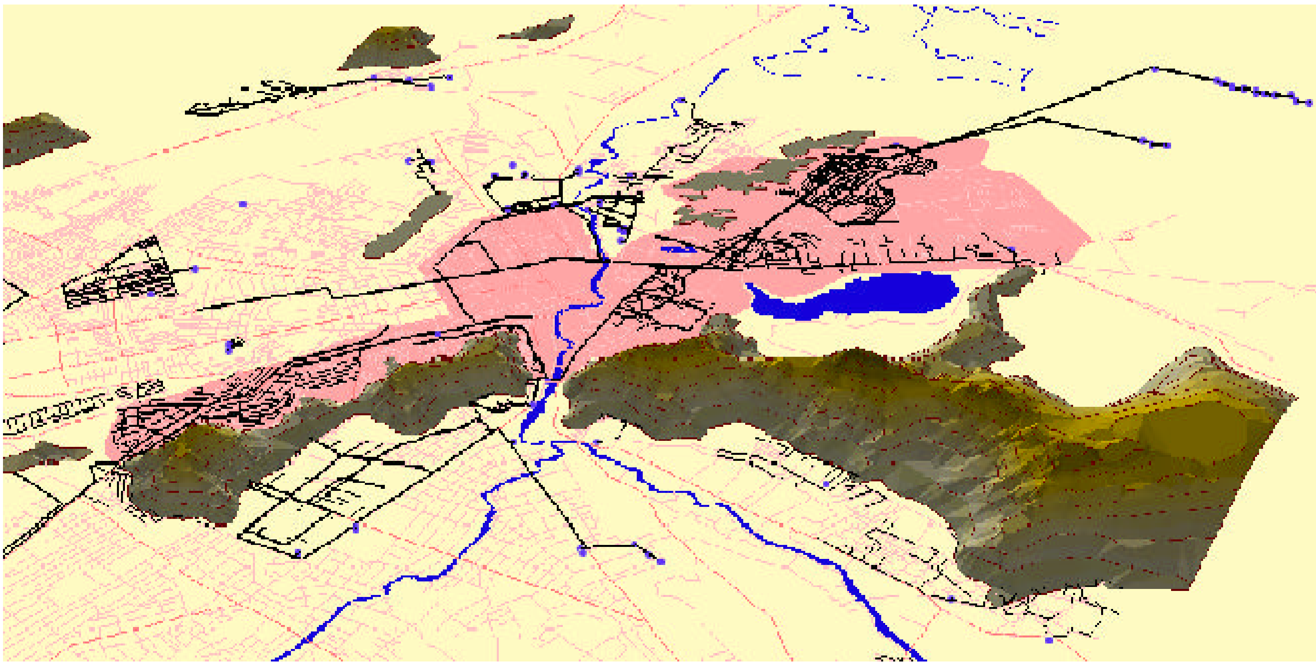

Figure 21 *3D view of Kabul. Area supplied by the Logar project (in red). The Logar wellfield is shown in the upper right corner of the picture, with the Nasaji well field just beside.*

The involvement of OXFAM, in early 1995, was triggered by the perspective of peace, and the agency felt that some investments in major projects could begin. The agency also considered that the scheme was technically quite “simple” and thought that his involvement was manageable and was confident that the whole operation would result in a huge impact on the health status of the population living in the districts concerned by the project, estimated to be close to 400,000. At the end, when the “simple” technical part was completed and the first phase of the whole scheme almost ready to be commissioned, OXFAM asked a consultant to review what eventually went wrong. The only water pumped through the scheme was the one used to test it, when the commissioning was done. Among other conclusions, linked with the internal procedures of the agency, several lessons were drawn[24, 25]:

- the feasibility study was not sufficiently detailed and focused almost only on technical aspects

- the objective of the whole OXFAM involvement were not clearly defined and the analysis of the political situation was too optimistic

- it was not enough to consider that this water project, despite its technical “simplicity” was viable only if the utility was ready to run it and when the social, institutional and financial components would have been integrated and, in principle, solved.

It appears that there were these last problems, together with the complex political situation, due to the strict orthodox policy of the Taliban, in conflict with what OXFAM was trying to prone, that made the project “fail”. Technically, OXFAM did a remarkable job, even if minor technical problems could probably be avoided. The first phase was commissioned at the end of 1999, when water was pumped from the well fields to the Bagrami high lift pumping station and from there to the reservoir “0”. This was possible with the resolution of several minor technical problems[26]. Apart from these lessons learnt, a major recommendation is worth noting and was directed to CAWSS (Abrasani). It draws the attention of the para-statal entity to *“make a commitment to provide adequate human, financial and material resources to ensure the future sustainability of the scheme”*, as it would be difficult to find further donors, unless this was done.

[24] R.Luff, Oxfam (GB) the Loggar Project. ICRC seminar, Belgrade
[25] See previous reference: J.Cosgrave

[26] M.Elliot, Commissioning of Logar boreholes and Bagrami High-lift pumps in Kabul Afghanistan, final report for OXFAM, November 1999

Nothing really changed in the following years, when CAWSS requested the assistance of ICRC to study the feasibility of the electrification of the Logar scheme. The institution responded positively to the request and began an in-depth survey of the feasibility of the eletrification, but postponed its commitment at the budgeting phase twice, arguing that the political situation was not clear enough to engage in such a project and also because there wasn't any new commitment neither the capacity within the utility to become involved in the "soft" aspects of the management of the whole scheme. Furthermore, a constant decline of the operational capacity of the utility throughout the years was easy to witness. Therefore, the decision of ICRC to engage in this phase of the project would inevitably be related to a firm commitment of a donor to be involved in the institutional strengthening of CAWSS.

Previous involvement of the ICRC in other smaller schemes

If the Logar project was considered important, other schemes received the support of ICRC. The Water and Habitat section of the institution began to run a latrine improvement project in 1996, in order to tackle the appalling situation of the human wastes evacuation[27]. But the water field was not neglected. We have already discussed what has been done by ICRC in the hand-dug wells field. CAWSS and other entities, like the Public Maintenance Department or the GRRD (General Rural Rehabilitation Department) were assisted during 2000 and throughout 2001 but the attention was focused on smaller projects, with a relative quick impact on the communities and, very important, manageable by them, at least to a certain extent. This approach was due to be reconducted during 2002, with several projects already identified and surveyed. Table VIII gives the list of these projects.

Figure 22 *Aerial view of the Logar well field, the Logar river and the 10 pumping stations (January 2002)*

Other actors were involved in similar projects. CARE, already quoted, was involved in the Nesaji and Alludin well fields and in the refurbishment of the drainage channels, essential to avoid flooding and to allow for the possible increased production of waste water, due to the improvement of the pumping capacities.

HABITAT has also been involved in several small projects where all the environmental aspects were tackled, from water supply to its evacuation and to the solid wastes collection. Community "fora" were established by this organisation to involve the community in the complete management of all the environmental aspects. It is expected that the recent events may have perturbed in a significant way the huge work carried out, and that a lot of investment will have to be made to resume the previous achievements.

The electrification of the Logar scheme

By the beginning of 2002, it was felt that it was time to become involved in the electrification of the Logar well field. ICRC's decision was eased by the involvement of KfW (Kredit anstalt für Wiederaufabau), the German equivalent of the World Bank, in support of CAWSS (Abrasani) for the rehabilitation of the whole network of the town and in the institutional capacity necessary to manage such a scheme. The Germans were also involved in the rehabilitation of the electrical grid and in the overhaul of the East substation, from where power would have to be tapped.

What convinced ICRC to remain in the competition was its previous commitment, its immediate operational capacity and the knowledge gained during the first feasibility studies, which would speed up the operations, allowing to resume the distribution of water not later than mid-2003. It was anticipated, like OXFAM did in mid-1995 that a huge number of refugees would have returned to Kabul by that time, adding a burden on any service provision in the city. Once again, the town would become densely populated, economic activities would begin and the water supply situation would be of particular concern, and particularly the quality of the water extracted from the shallow wells, already poor and likely to become more contaminated.

[27] P.Jansen and all., see previous reference

Table VIII *Quick impact water projects for urban communities completed during in 2001 up to March 2002*

Location	D	No. of bene-ficiaries	Production	Distribution system	Planned activities	Project partner
Chelstoon	7	8'000	- 25 m3/h - 160 m3/day	- public stand-posts	- repair the pump - repair the gen set - remove leaks	GRRD
Projet Jadid	15	60'000	- 79 m3/h - 1800 m3/day	- house connections - public stand-posts	- provide pump - provide cable and switchboard - remove leaks	CAWSS
Qalai Zaman Khan	16	6'000	- 62 m3/h -180 m3/day	- public stand posts	- repair the pump - remove leaks	GRRD
Afshar	5	400'000	- 623 m3/h - 11'500 m3/d	- house connections	- provide transformer - valves - electro-mechanical spare parts	CAWSS
Qasaba blocks	10	10'000	- 54 m3/h - 300 m3/day	- house connections	- new well - provide pump cables etc.. - provide pipes and fittings	PMD Munci-pality
Micro-rayon	-	135'000	-	- house connections	- removal of major leaks in the buildings - provision of fittings - replacement of electrical motors of the sewage pumps	PMD CWASS Munici-pality

The commitment of the Germans was also of paramount importance, as it provided the necessary support to strengthen the operational and management capacity of the utility, essential to resume such a project. How far and how long this would last was not clear but a time frame of years was announced[28].

Status of the Logar first phase

Despite the data already available it was felt necessary to carry out a new survey, to define the exact status of the project. ICRC was able, with the assistance of OXFAM, to trace the same engineer who did the commissioning for Abrasani in 1999 and hired a consultant specialised in medium/high voltage systems to confirm or amend the lists of equipment drafted during the previous surveys.

The decision was wise. The initial plans of MOWE, submitted to ICRC were to install a new line of 15,000 V on a length of 15km from the North substation to the East substation and then to extend it for an other 6km to Bagrami, where it would be stepped down to 6 KV and to 400 V to power the 10 pumping stations, connected through an aerial line of about 2.3km. The previous surveys found out that one of the needed 3 x 15 KV/400 V transformers was still in working condition but two others were due to be purchased. The exact status of the 15 KV/6KV transformers at the Bagrami lifting station was considered good.

New proposals

The new proposals, agreed in principle by all the involved parties, were quite different. The 15-18km 15 KV aerial line (OVHL) project from the North substation to the East substation was cancelled. There was no more a question of a 6kV line, which was in principle foreseen by MoWE to operate the 2 x 6.3 kV old pumps of the station, which had not been operated since 1990. One was even reported to be out of order.

It was assumed that the work to rehabilitate the 20 MVA 110 kV/15 kV transformer of the East substation, under the responsibility of the MOWE, assisted by KfW through a consultancy firm, DECON, would have to be done anyway. In case of problems, a new transformer would have to be purchased and installed.

28 January 2002. Press statement. "KfW will assist the public utility (CAWSS) in the rehabilitation of the whole network of Kabul

The only pumps to be considered were the 400 V/185 kW Goulds pumps installed by OXFAM. They would be operated from a 15 kV line connecting East substation to the Bagrami High Lift Pumping Station, of a length of 5.8 km. A new 15 kV/ 400 V step down transformer of 1000 KVA would be installed to operate the two high lift pumps. The 15 kV aerial line would be prolonged for about 2 km to reach the pumping houses. Three new 15 kV/400 V transformers of 250 KVA, to operate the submersible pumps, would have to be installed.

Hydraulic situation

At the hydraulic level, several tests have been carried out. All the pumps have been tested and found to be in working condition and in no need of capital investment.

Figure 23 *Bagrami High Lift pumping Station*

Figure 24 *High Lift pump (400 kV/ 185 kW)*

Their output was measured and found compatible with the specifications of the supplier and a "similar and fairly constant static water was measured in all the boreholes, with a relatively small draw-down when pumping"[29]. It was decided that only one high lift pump would be operated at the initial stage, bearing in mind the poor state of the network. A total of 6,500 m3/10 hours would need to be produced. To avoid heavy losses in the damaged network, it was recommended to supply only two districts, D1 and D8, the first being one of the most densely populated district of the town and the second because of its high saline water, with conductivities reaching values by far higher than the admitted WHO guideline of 1,500 uS/cm[30].

Other problems were identified which would require immediate attention:

- the surge protection (anti-hammer device) system would have to be checked and equipped with a compressor. In 1999, to avoid any possible damage during the tests carried out when the first phase was re-commissioned, the OXFAM engineer used the Atlas Copco compressor from the workshop to pressurise the surge tank.

- the valving system at reservoir "0" would have to be tested. It was recommended not to use the reservoir until the whole system, including the surge protection system, would be checked. Using the reservoir would add additional pressure (3 bars) to the network, therefore increasing leaks, already estimated to as high as 30-40%, and putting additional threat to the surge tank, increasing the possible water hammer.

- The disinfection system (producing hypochlorite solutions) installed by OXFAM and not tested would have to be checked and commissioned.

Conclusions

The Logar project is not what we may call a "simple project". OXFAM has learned at it own expense how difficult it is to carry out such projects in a volatile situation. If technical problems may be quite simple to solve at a first glance, suddenly other "minor" issues appear at the surface, becoming quickly so important that the whole project may be prone to fail. These issues were there right from the beginning and only a detailed assessment may have helped to gain better information allowing the agency to embark in a relatively low-risk project. This information is now more precise but there are still a lot of unknowns.

[29] M.J. Elliot. ICRC Report. Logar electrification project. May 2002

[30] WHO, Guidelines for water quality standards, Geneva, 1995 and 2000

It is still not sure that ICRC and KfW, together with CAWSS and MoWE, will succeed where OXFAM has, let's say, failed. Remarkable outputs have been achieved by the agency and now it is time to capitalise on them. The context has changed and the high risky conditions prevailing when everything began are now considered less critical.

Nevertheless, many problems still exist:

• the main environmental factor: the drought, leading to a poor power production due to low levels of water in the dams
• the poor institutional capacity of the public utility
• the damage inflicted to the systems hardware (electrical lines, pumps, transmission lines, etc.
• the changes in the population structure with a huge number of newcomers
• the time frame given to the interim government to become operational and to prove that the general situation of the country/or of the town is improving.

Some of these issues may not be controlled. For instance nobody can tell how the rainfall will be in the future. Others have received the proper address and it is likely that most of the technical problems will be solved, particularly if the present support is maintained, even if the pace may be slower than foreseen. But nothing will be sustainable if the operational capacity of the public utility is not restored. This can only be achieved in the long term, and will be closely linked with what the new government will be able to achieve to preserve the present stability and to define the policies to be applied in all the fields of the Afghan society.

The Logar project is quite emblematic in that respect as all these problems are imbedded in it. The success of this project is highly linked to the development and progress of the Afghan society.

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Annex I: Chronology of political events affecting the development of the water supply schemes of Kabul and particularly on the Logar Water Project
(adapted from Cosgrave (OXFAM) and completed with recent development)

Year	Major political events	Major technical events	Agencies involved
1971	King Zahir on power	Project for a water, Sewerage and drainage Master Plan.	UNDP
1972 April **1973** 1974 May	 Daud Khan seizes power from King Zahir. Republic of Afghanistan is established	Consultant begin to work on Master Plan and Logar feasibility Army officer loyal to the government are placed in key institution and in the water department also. Completion of the feasibility study for Logar	PRIL consultants PRIL consultants
1975 June October		IDA grants a loan of 8.7 M USD for Logar Scheme Beginning of detailed design of Logar	 PRIL consultants
1978 **April** June	Democratic Republic of Afghanistan. Coup by the communist People's Party	 Final project report for the design of Logar project	 PRIL
December		PRIL International staff leave Kabul due to increased violence	PRIL
1979 February August **December**	Murder of US ambassador **Soviet military intervention**	US assistance is ended Resumption of work on Logar Project without international technical assistance	
1980 **1987**	Mujahideen war against the communist Republic of Afghanistan		
1989 **February** **1992** **April**	**Withdrawal of soviet army troops** **Islamic state of Afghanistan** Fighting between factions	 End of electric power supply to Kabul and distribution of water through network is stopped	
1994 September	**Battle for control of Kabul** **First Taliban appearence**	Major damage to the town	
November **1995** March	**Kandahar under Taliban control**	 First assessment carried out by OXFAM and involvement in the Logar project	 OXFAM

1995 July		Beginning of involvement and Water Management Team	OXFAM/ODA
		Funds made available for project . Link of Nesaji pumps to Logar scheme.	OXFAM/ CARE/ ECHO
September October	**Herat under Taliban control . Kabul is threatened.**	First proposal of an Environmental Health Programme. Change from submersible to shaft driven for the high lift pumps. Grant for Logar project by UNHCR **Skilled personnel from CAWSS recruited by Aid Agencies. 1 expat engineer as WMT (Water Management Team) leader.**	OXFAM OXFAM UNHCR
November **1996** February	 **400 rockets have fallen since December**	Beginning of repairs to main reservoir and network Release of funds from SIDA. Health education component added to the project.	OXFAM WMT and CAWSS HABITAT/ SIDA
March		Order placed for capital equipment. Beginning of the construction of the workshop.	OXFAM
June July August September	 **TALIBAN take Kabul. Execution of Najbullah, former president .**	First shipment of Gould's equipment arrives in Kabul. Work in securing funds to run the system. Project proposal for 2nd phase (distribution system) estimate: More than 400'000 USD of which 40 % for running costs. Second shipment of Gould's equipment. Damage to pump motor during unloading at Kabul airport. **2 expatriate engineers working for two agencies** Pledge for running costs: 40'000 USD/month Habitat applies for the 2nd phase of the project (distribution): 500'000 USD Beginning of installation of boreholes pumps. **Evacuation of all international staff**	OXFAM OXFAM HABITAT ECHO ODA
October December		All OXFAM project suspended or cancelled Disagreement between HABITAT and OXFAM on the execution of different phases. Phase 2 on hold. **1 expatriate engineer back to Kabul**	
1997 January	**Ruling restriction for women**	All equipment installed	
April May	 **Recognition of Taliban Government of Afghanistan by Saudi**	Funding for 1 year completion agreed. Phase 2 on hold.	DFID

June		Disagreement and competition between HABITAT and OXFAM on Phase 2. OXFAM is solely responsible for the project. WMT dismantled	OXFAM
July		Order of the replacement of the high-lift pump damaged at the airport 12 month	OXFAM
October	**Islamic emirate of Afghanistan**		
November		OXFAM declines HABITAT offer to fund a consultancy to study the possible electrification of Logar. Delivery of the 2nd high lift pump.	OXFAM
December **1998** January	 **No changes in female policy**	The hold position on phase 2 is abandoned. An engineer is in charge to commission the first phase	 OXFAM / Goulds
April		Order of additional equipment for phase 1.	OXFAM
July August	**Order to relocate offices** **Missile attack on Khost and Jalalabad by US in revenge for embassy bombing in Nairobi and Dar-es Salaam**	Almost all NGO leave Kabul. New equipment kept on hold in Peshawar. Only ICRC retains an expatriate presence in Kabul.	
1999 March July September **2000** July	 **Hostilities between the Taliban and northern alliance result in rockets fall on the city.**	New OXFAM CR (country representative) in Kabul. Test pumping from High lift pump to balance tank. Beginning of Logar evaluation. Logar commissioning. Funds to run the system 1 hour per week secured until spring 2000. **Involvement of OXFAM stopped.** CAWSS approaches **ICRC** to seek support for the electrification of Logar.	OXFAM OXFAM
August **2001** Spring	**Disagreement on selection of contractors between ICRC and Taleban's ministry in relation to health assistance.**	Technical assessment by ICRC and MOWE (Ministry of water and energy) of the electrification feasibility. Project proposal not included in 2001 budget due to lack of precisions on who would run Phase 2 Strategies for a possible involvement of ICRC in the project defined for 2002.	ICRC ICRC

September	**Attack on WTCenter.**		
October	Withdrawal of all ICRC eypatriate staff from Kabul	All ICRC Afghan staff remains operational. 1 engineer in Islamabad to prepare plans for the resumption of the activities.	
November	Northern alliance backed by US and allied troops in Kabul. 18 November: first ICRC flight to Kabul		
December **2002** January	**Transitional government**	Full resumption of ICRC water/habitat activities Electrification of Logar project planned. Rapid assessment of the Logar project and funding of fuel and incentives to run the installed equipment.	ICRC ICRC/CAWS S
February		Letter of commitment of ICRC sent to CAWS Arrival of KfW (Kreditanstalt fuer Wiederaufbau) and press statement of their involvement in the water systems of Kabul, including Logar.	ICRC
March		Negotiations between ICRC and KfW for reciprocal involvement	ICRC/KfW
April		Visit by ICRC engineer to substation East Repairs by MOWE under way. Length of the foreseen repairs estimated to last up to October with 20 MVA transformer estimated to be operational mid-November.	MOWE
May		Technical assessment of the re-electrification project of Bagrami and of the hydraulic status up to Reservoir 0 by ICRC consultants. **Indicative time table for repairs set at 12-15 months.**	ICRC/CAWS S
June July	**Loja Jirga in Kabul.** New government of Amid Karzai in place	 2 expatriate engineers are mobilized for re-electrification project implementation	 ICRC
August		Feasibility of the rehabilitation of the East Substation.	DECON/KfW
September		Budget approval for the complete replacement of the 20 MVA transformer as repairs were not considered reliable.	DECON/KfW