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**BALUCHISTAN AREA
DEVELOPMENT PROJECT
(BALAD)
GOB / USAID**

**WATER SECTOR
THIRD INTERIM REPORT
FEBRUARY 1989**

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WATER SECTOR ANNUAL REPORT FEBRUARY 1989

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1.0 Introduction

The Water Sector of the BALAD Project is now well into the production phase of the workplan. Project identification and contracting procedures are now firmly established. Four main types of activity are being undertaken; watercourse improvements, karez boring, recharge dams, and karez improvements. A variety of schemes in each category have been completed and more are currently in the approval, design, contracting, or construction phases.

Monitoring of the results of the projects is on-going. In the case of the karez borings, infiltration galleries, and channel linings the results are immediately observable. In the case of the check dams and recharge schemes, however, the results will only be apparent after more precipitation events occur and the effects on downstream karezes are observed.

A project summary for each of the completed projects is included in this interim report. A summary of the project output, recommendations, and design examples are also included.

2.0 Summary of Project Output

As of December 31, 1988 contracts totaling Rs 20,645,517 have been awarded under the BALAD Project for Water Sector Projects. This figure does not include PVC pipe which has been supplied to contractors for BALAD Projects and which accounts for an additional Rs 7,529,068. Recharge schemes have accounted for 43 per cent of the total expenditure. Recharge schemes are the most costly as well as the most potentially beneficial to the community. Karez improvements comprise 29 per cent of the to date expenditures, watercourse improvements 20 per cent, and karez boring 8 per cent.

Thus far 58 per cent of the expenditure has been in the Turbat District with the remaining 42 per cent in Panjgur. These data are summarized on Figures 1 and 2.

The estimates of project output presented in the project paper are based on IA Contractor mobilization date approximately one year previous to actual mobilization. For purposes of comparison the outputs projected in the Project Paper are thus moved back by one year. A comparison of projected versus actual outputs is presented below:

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Activity	Projected Output Proj Paper/1987	Actual Output Completed/Under Construction Schemes
Check Dams	17*	7/14
Karez Drilling	41**	46/74
Karez Improvement	25***	14/19
Watercourse Improvement	44****	13/31

* Project Paper, pp 101

** Project Paper, Annex 15, pp25

*** Project Paper, Annex 15, pp28

**** Project Paper, Annex 15, pp31

3.0 Water Section-Project Selection and Design Criteria

3.1 Selection Criteria

All projects are identified by the three District Coordination Committees (DCC) at the instigation of the Project Director, PPMU. Identification is apparently based on applications from individuals or politicians. Schemes are not visited or evaluated in any way by the DCC. Some schemes recommended by the DCC are, in fact, non-existent. The BALAD staff does not get involved in this process. BALAD staff may, on occasion, propose projects which have been observed in the field or brought to their attention directly by sarrishtas or water users during the course of fieldwork. The DCC has generally accepted these schemes.

Projects are then approved at a Divisional Working Committee (DWC) meeting in Turbat which is chaired by the Commissioner, Makran and attended by representatives from GOB line agencies and the Deputy Commissioners of the three districts of Makran. Since a number of the proposed schemes are found not to be feasible, the DWC is requested to sanction approximately 50 per cent more projects than BALAD anticipates working on.

Frequently the type of project requested is neither appropriate nor within the BALAD scope of work, and in such cases the feasibility investigation seeks to determine if any applicable scheme can be implemented. Taking the above methodology into consideration the DCC has been asked only to sanction the particular karez or watercourse for work and the BALAD team then determine, in association with the sarrishta, what type of scheme would be appropriate.

After identification by the DWC, the BALAD Baluchi speaking sociologist visits each site proposed and collects information such as to the identity of the sarrishta, project type and location, and physical information about the status of the karez or water source. Requests for activities not within the BALAD scope of work, such as karez cleaning or extension, are eliminated at this point. Following this initial screening BALAD engineers visit the sites which still appear suitable accompanied by the sociologist, to make an initial assessment as to the feasibility of the proposed project. A feasibility study is conducted and the following criteria applied:

1. Watercourse Improvements: Watercourse improvements are undertaken in the case where measurable seepage losses occur or where periodic destruction of the watercourse by flooding generate excessive maintenance costs and an interruption of the water supply occurs. This activity has been concentrated on nullah crossings, the major hazard to watercourses in the project area.

2. Karez Boring: The criteria for karez boring, thus far, has been simply: a) the approval of the sarrishta and b) karez location. Since results from previous karez borings are virtually non-existent the program is considered exploratory. Karezes have been selected to realize a geographical distribution to afford data in order to plan future work. In the case of mechanical boring, which involves the mobilization of equipment from outside the Makran, karezes are selected within those areas, which permit easy access of the equipment and low mobilization expenses.

3. Delay Action Dams: Damsites have been selected from lists of such sites proposed by the Irrigation Department. These lists include virtually every major nullah in the Turbat District. Sites are then visited and selected based on the availability of target karezes associated with the nullah and the physical characteristics of the nullah itself with respect to dam construction. Sites are then submitted to the DWC for approval and are generally approved.

4. Karez Rehabilitation: From the list of karez improvement projects approved by the DWC the BALAD Project attempts to select those karezes which most need improvement, those whose owners display interest and maintain their karezes, and those which introduce new concepts into the area. Each scheme is first screened to determine if the requested activity is a maintenance activity, such as karez cleaning or extension, or an improvement activity. Priority is given to schemes which will provide supplemental water to the karez. Priority is also given to schemes which will introduce new ideas to the karez owners which they will subsequently be able to duplicate. These include

infiltration galleries and lining sections of karezes which pose particular maintenance problems. Priority is also given to those karezes which are currently unusable but which appear to have a good chance to be revived.

Since karez rehabilitation presents an extremely wide range of possible solutions each case must be examined and evaluated individually. Most karez schemes which are identified by the DWC are not recommended for implementation. Successful karez rehabilitation schemes, however, have the most immediate and widely appreciated impact of all the water sector projects undertaken by the BALAD Project.

3.2 Design Criteria

BALAD Projects are scoped, with few exceptions, to fall within the PPMU contracting limit, \$50,000. This limit has been recently raised to \$100,000.

To facilitate the preparation of Drawings, construction, and construction inspection, designs are standardized to the extent possible, at some small sacrifice to optimal cost effectiveness. Designs for siphons, manhole chambers, channel linings, infiltration galleries, and gabions, have been standardized. Example designs developed from the standard Drawings are included with this report. Construction materials have also been standardized as much as possible to facilitate contractor procurement. Whenever possible 12" diameter pvc pipe, number 4 reinforcing bars, and 10 gauge SWG gabion wire are used in the designs. The Drawings for manhole design are included in Appendix G.

3.3 Maintenance.

BALAD Projects are designed to be as maintenance free as possible. All projects, however, eventually require maintenance. All gabion work and riprap is currently inspected after each rainy season by BALAD staff. Means have been established for performing minor maintenance during the tenure of BALAD. Manholes and pipelines are repaired on an as needed basis. Dam outlet conduits are inspected after rain events and should be cleared of debris. Siphon inlets and silt traps should be cleaned by the karez owners.

Routine maintenance, post BALAD, should be budgeted and PPMU, or another GOB line agency, should take this over. Experience gained over the next two rainy seasons should provide data for estimating maintenance budgets.

4.0 Water Sector Projects: Watercourse Improvements

4.1 Rational

A typical Makran karez irrigates from 40 to 80 acres utilizing approximately 0.5 to 1.0 cusecs of water. The karez channels (kalmers) are generally in poor state of repair and surprising water losses occur from overtopping of channel banks and from seepage. Kalmers also require frequent rebuilding, especially in the sections where nullahs are crossed and the channels are subject to periodic flood damage.

The Project Paper estimates that conveyance losses range from 40 to 60 percent. Measurements collected from the BALAD Project, presented on Table 1, confirm this.

Perhaps the greatest opportunity for providing more water to the Makran farmers is in conserving the water currently available from karezes. Although the On Farm Water Management component of the BALAD Project has to date not been mobilized, the BALAD project has undertaken a number of selected watercourse improvements. In particular inverted siphons are being provided across nullah crossings and selected portions of kalmers are being lined.

The response of the sarrishtas to watercourse improvement activities has been entirely positive. Although many sarrishtas do not appear willing to undertake maintenance, other than that essential for the operation of the kalmer, the benefits of watercourse improvements are universally perceived and acknowledged.

Watercourse improvements have been carried out in over thirty karezes in Makran.

4.2 Recommendations/Design Criteria

BALAD selected only the worst portions of existing channels for work during the initial phase of the project. The scope of work for watercourse improvements consists of the karez reach between the mouth and the turnouts to the feeder canals for individual plots. Project areas generally consist of nullah crossings which, due to their periodic destruction from flood events and to the permeable soil, generate the highest maintenance costs and seepage losses. In general, well defined nullahs are crossed with inverted siphons, and broad channels exposed to sheet flow crossed with concrete channels. For a typical Makran karez, with an average flow rate of approximately 1 cusec, the cost for concrete channel lining (excluding excavation costs) is approximately 860 Rs/linear meter as opposed to 730 Rs/linear meter for a PVC siphon. Although excavation costs are typically slightly

higher for siphons the PVC pipeline is usually slightly less costly than the concrete channel. Generally a single 12 inch diameter pipe is sufficient but for unusually large flows or shallow gradients, where more than one pipe must be used, the total cost for concrete channel may be less than for a pvc pipeline.

4.2.1 Estimation of Design Karez Flow

Karez flow fluctuates widely over the course of a year and estimates made from a single observation can be misleading. Typical curves showing the percentage of maximum observed flow over the course of three years have been prepared for Turbat karezes and are presented in Figures 3 and 4. By comparison with the season and the lapse since last rainfall an estimate of maximum and minimum design flows can be made from a single point observation.

4.2.2 Inverted Siphons

Under BALAD inverted siphons have been constructed on many watercourses in Makran. All siphons have utilized PVC pipe. Class B Zed Jointed pipe (including rubber gasket) has been found to provide the most trouble free installation and performance. Bell jointed pipe was found to frequently leak, requiring excessive construction attention. Zed jointed pipes are filled with water and tested for leaks under essentially operating conditions prior to backfilling. Siphons are generally placed a minimum depth of 1.5 meters beneath the low point of the nullah. This has been found to be adequate to prevent exposure by scour. Procurement of small quantities of PVC pipe by the contractors is difficult as pipe is generally made to order and BALAD has, therefore, undertaken to procure and stockpile the required pipe for all projects. Siphons are designed to carry approximately 0.5 cusecs in excess of the estimated maximum flow without causing backwater in the channel. In siphons with very low flows this criteria is relaxed and the design is based on double the maximum anticipated flow.

Although minimum flow rates are such that dry season water velocity in the siphons is very low, sedimentation has not been found to be a significant problem in the siphons. BALAD siphons have been operating trouble free for more than two years. Sediment traps, installed in the upstream end of all siphons, usually collect little or no sediment. Karez water is generally sediment free except during periodic karez cleaning. Sediment blockage has been experienced at Churro and Nokjo siphons but was due, in both cases, to inundation by flooding during floods by river water, not due to the normal operation of the siphon. Head loss has been measured repeatedly for more than one year at Saadabad siphon and does not appear to be increasing which indicates that no significant sediment is being deposited in the pipe.

Siphons are provided with upstream and downstream manholes which have trash racks and sediment traps. The most persistent problem encountered in the siphons has been vandalism to the siphon covers. Any easily removable covers have been immediately removed and the chambers used by village children for bathing. Cross bars are now being installed on all pipe openings to prevent human intruders and debris from entering the pipes.

4.2.3 Channel Linings

Channel linings are constructed over sections of kalmers where seepage losses are determined to be excessive, and in deep kalmers where sloughing of the walls causes maintenance problems. The channels are provided with trash racks and sediment traps and are generally covered with precast concrete slabs to prevent the entry of debris. Channels are generally designed to provide 0.3 meters free board at maximum anticipated flow and to utilize maximum available hydraulic gradients.

The Drawings for the siphons at Tump Watercourse Improvements are presented in Appendix G as a design example of inverted siphons and watercourse lining.

5.0 Water Sector Activities: Karez/Korjo Improvement/Rehabilitation

5.1. Rational

The older karezes in Turbat are generally in poor state of repair and many are inoperable from lack of maintenance or from declining water tables. As stated in the Project Paper (page 70) a typical karez requires on the order of Rs 55,000 for annual cleaning. The Project Paper proposed that capping the karezes would reduce cleaning costs. Newly constructed karezes, particularly prevalent in the Tump and Buleda areas, have well constructed karez access wells. The spoil berms around these wells are well developed with appropriate drainage outlets and the well mouths are protected by stone pitching. It is doubtful, especially considering local construction standards, whether concrete capping would be a significant improvement on this construction.

In Turbat little interest has been exhibited by owners in karez capping. This is probably due to the fact that, of the problems facing the Turbat karez owners, maintenance is considered to be a relatively minor item. The central problem as perceived by the karez owners is the declining water table. Turbat farmers are unanimous in their recollection that the Ketch was perennial within the lifetime of the present generation. Eleven year moving means and the deviation from the mean, statistics derived from

rainfall records, figure 5, also indicate that the last two decades have been particularly dry. The continual deepening and lengthening of the karezses also indicates the struggle to chase the declining water table. In Panjgur, however, rainfall appears normal in recent decades, Figure 6. In response to the overwhelming requests from karez owners for karez extensions, rather than for capping, the BALAD Project has expanded this category of activity to include any sort of karez improvement, exclusive of routine maintenance, giving preference to those improvements which will provide supplemental water to the karez. Karez improvements undertaken by the BALAD project include: a) the construction of infiltration galleries to provide supplemental water from nullahs to karezses, b) construction of pipelines over sections of karezses crossing nullahs where perennial maintenance problems occur, and c) karez capping in selected areas.

5.2 Recommendations/Design Criteria

5.2.1 Karez Maintenance

The two most common maintenance problems associated with karez operation in Makran are (1) the shallow sections of karezses which pass beneath nullahs frequently collapse from repeated soil saturation, and, (2) deeply eroded open channel sections of karezses invite sloughing of the steep banks and deposition of refuse, necessitating continual maintenance with resultant periodic interruptions in the water supply. The BALAD Project has attempted to solve these types of karez problems on a case by case basis. Although difficult to quantify, these type of karez improvements are thought to be economically viable.

A. Karez Nullah Crossings: Karez sections crossing nullahs which are shallow enough to be trenched from the surface, ie less than 6 meters, can be improved by replacing the karez tunnel with a PVC pipeline. The pipeline design is similar in all details to the inverted siphons described in the Watercourse Improvement Section (4.2.2). The karez wells on either side of the nullah are fitted with manholes with connecting PVC pipe beneath the nullah. The upstream chamber should be depressed at least 0.5 meters below the pipe invert to allow for sediment accumulation and the pipe inlet and outlet should be fitted with trash racks. The pipeline should be depressed at least 0.3 meters below the existing karez invert to allow for future lowering of the karez channel. The karez tunnel is, empirically, located below scour depth. The pipeline should be designed to carry at least 1.5 times the estimated maximum flow to allow for future karez improvements.

Karez nullah crossing projects have been completed or designed at Nakam, Zaindan Daz, Phullabad, Mir Mir, Gharibabad (Buleda) and Kallag (Panjgur) karezes. Kallag Karez Drawings are included as a design example in Appendix G.

B. Channel Linings: Shallow sections of karezes, which have been eroded so that the karez tunnel eventually becomes an ever widening open channel, occasion continual maintenance problems. In karez sections passing through villages this problem is exacerbated by refuse thrown into the channels. This problem has been solved in certain karezes by providing a covered lined channel and allowing the banks to slough. The design is similar to other channel linings as presented in the Watercourse Improvements section.

This type of karez improvement has been undertaken at Challo and Maliki karezes.

5.2.2 Infiltration Galleries

Korjos with open channel sections extending into river channels and karezes with shallow mother wells adjacent to river banks can be improved by extending infiltration galleries from the mother well. Infiltration galleries are constructed by using perforated PVC pipe surrounded with pervious gravel envelopes. Class B, Bell jointed pvc pipe of 12 or 14 inch diameter with factory cut perforations has been successfully used.

Specifications for the gravel envelope material developed for the Rakhshan are included in the design example. Suitable envelope material is readily available in the river channels. Infiltration galleries should be placed below the anticipated scour depth of the river. In the major Makran Rivers, the Katch and the Rakhshan, the channel bottoms have been found to be heavily armored and experience indicates that erosion is concentrated at the banks, with bottom scour being minimal. It is recommended that pipe for the galleries be placed a minimum of 1.5 meters below channel depth. Inspections chambers should be provided at an approximate spacing of 200 meters to facilitate maintenance. Manhole chamber designs are similar to those provided in watercourse improvement projects. Infiltration galleries should always be fitted with a control valve so that the flow can be regulated and, when not needed, water can be stored in the ground rather than wasted. Manholes placed in the river channel should not extend above the channel bed and should be protected by gabion reinforcement. Manholes completed in the Rakhshan River weathered a 50 year flood in 1988 with only minor disturbance to the gabions. Korjos and infiltration galleries are generally more productive when placed in the center of a channel but infiltration galleries should, whenever possible, try to follow the original Korjo

alignment since this is assumed to be the most permeable alignment discovered by trial and error through repeated korjo reconstruction. The length of infiltration galleries depends on the available alignment, potential interference with other karezes or korjos, and on the desired yield. In the Rakhehan channel in Panjgur average yields are generally in the order of 0.0018 cusecs per meter. Korjo sources must be 1500 feet apart as per GOB regulations. Detailed sociological investigations of the proposed alignments must be undertaken prior to project design since access rights for existing karezes and korjos are matters of intense local disputes.

To date infiltration galleries have been successfully completed only in Panjgur. Most korjos are currently operating in Panjgur and the introduction of the infiltration gallery is an improvement to operating systems. In Turbat, however, only one perennial korjo still operates. BALAD has sought to revive three korjos in Turbat with infiltration galleries: Nokash (Koshkhalat), Karmandez, and Malikabad. Although available gradients are much poorer in the Ketch than in the Rakhehan, it is still thought that these systems will operate on at least semi-perennial basis. It is also anticipated that the Nokash and Karmandez Korjos, both of which are located on the south bank of the Ketch River immediately downstream of the Ketch bridge, which is currently under construction, will improve dramatically when the river channel is relocated, by the bridge, towards the south bank. There is, however, a corresponding concern about the effects of the bridge on the north bank korjos of Malikabad and Ginnah, the one which is still operating perennially.

The three Turbat infiltration galleries are currently held up due to construction problems. These projects should be pursued with new contractors if necessary.

Infiltration galleries have been completed at Takhan, Churno, Juhiljo, Nokjo, Mehmoodabad, and Doznap, korjos and karezes. The locations of BALAD infiltration galleries are shown on Figures 7.1-7.8. The results of the gallery construction are summarized on Table 2. The Drawing for Pir Bux Infiltration Gallery, currently under construction, is included in Appendix 9 as a design example.

6.0 Water Sector Activities: Karez Boring

6.1 Karez Boring Rational

One traditional method of providing supplemental water to the karezes in Makran has been to drill small diameter borings, using hand operated percussion techniques, inside the mother well of karezes. Reports from sarrishtas about the success and productivity of these borings have been

ambiguous. Figures quoted in the Project Paper (page 37, USAID, 1984) reporting on the results of Irrigation Department drilling could not be substantiated. Borings using hand percussion drilling techniques have been completed in a variety of locations and the supplemental flow rates has been verified (refer to Figures 7.1-7.8 and Table 3). Borings with a mechanical rotary rig are now underway. It was estimated in the Project Paper (page 70) that a 15 per cent increase in flow could be realized by boring. Increases in flow in the karezes bored under the BALAD Program have been of this order of magnitude.

There is no evidence that regional confined aquifers exist in Makran (WAPDA, 1985). It appears that any confined aquifers are localized in extent. The major source of supplemental water from karez borings appears to be from shallow artesian conditions in the karez underflow. For this reason it is recommended that all boring be undertaken in the recharge area of karezes rather than in the command areas as previously suggested (Ayub, 1985).

Estimates for the cost of karez boring presented in the Project Paper (page 37), Rs 25,000, are similar to actual costs incurred, approximately Rs 30,000 per well for borings up to 150 feet. The cost of mechanical boring has been approximately Rs 55,000 per well for a similar depth. The economics of deeper boring is questionable. The increase in boring diameter and the installation of efficient well screen and gravel made possible with mechanical boring sufficiently increases the life and productivity of the wells to justify the additional expense. Currently mechanical borings are being utilized in accessible areas and hand borings in the more remote areas.

The response of sarrishtas to the borings has been ambiguous. Many sarrishtas have expressed the view that hand borings are not acceptable but that mechanical borings will benefit their karezes. Five sarrishtas have, thus far, not allowed hand boring in their karezes.

In general the success rate of borings has been somewhat over fifty per cent. As more borings are completed and are seen to be successful the program appears to be gaining acceptance among the sarrishtas. In most cases the sarrishtas will not express satisfaction with the borings. This appears to be due to the desire on the part of the sarrishtas to use dissatisfaction as leverage to influence future works. All in all, relatively few sarrishtas have refused the borings and new applications are being submitted.

6.2 Karez Boring: Criteria/Recommendations

Karez borings have been successful in over fifty per cent of the karez attempts. Payback periods for these borings is generally less than two years and the projected Internal Rate of Return is generally over twenty per cent. It should be noted, however, that the actual quantities of water supplied are small, 0.1 to 0.2 cusecs, and it may be that in many cases the amount of supplemental water provided by a karez boring is too small to be beneficially used with prevailing local water management techniques.

Currently BALAD is sponsoring both hand borings and mechanical borings. The mechanical borings are 12 inch or larger diameter holes drilled by percussion rigs. The borings are advanced to 150 feet and, if successful, are cased with 4 inch diameter factory perforated PVC pipe. The annulus of the borehole is then packed with pea gravel. Several of these borings have been producing water with no noticeable decrease for nearly one year.

BALAD is also sponsoring, in the more remote locations, traditional hand percussion borings which involve drilling approximately 3 inch diameter holes and installing 2 inch diameter slotted casing when the borings are successful. Some hand borings have been operating for more than one year without noticeable decline in yield.

Both types of borings should be continued in as many karezes as possible. It is not yet possible yet to rule out drilling in any particular locality because, with the exception of one area between Tump and Turbat, favorable results have been obtainable where attempted.

7.0 Water Sector Activities: Delay Action Dams

7.1 Rational

Much of the recharge to the karezes is accomplished through infiltration of surface runoff in the permeable sediments of alluvial fans associated with the nullahs from which karezes originate. Measured infiltration rates, shown on Figure 8 indicate that infiltration rates in the nullah alluvium is nearly an order of magnitude higher than in the adjacent pediments. In the Ketch, Rakhshan, and Nihing valleys significant recharge is also coming from the rivers. Due to the scant vegetative cover and steep topography much surface runoff is lost for recharge purposes. Small delay action dams have been designed to check this runoff and increase infiltration opportunity time, thereby enhancing the recharge of the shallow aquifers from which the karezes feed.

As per the Project Paper (page 39) a variety of recharge designs have been considered. Both gabion and earthfill dams as well as combinations thereof are being constructed. Sites are typically selected above the alluvial fan and upstream from several target karezes. Small check dams are also designed to operate as water spreading devices where feasible. Costs of the dams vary considerably and are summarized on Table 4. Dam locations are presented on Figures 7.1-7.8. Turbat Delay Action Dams are shown on Figure 9.

Many relatively large so called delay action dams have been constructed in Baluchistan. All of the delay action dams constructed by the Irrigation Department appear to be storage dams with no outlets. Based on observations of the sedimentation in the reservoirs of these dams, the low permeability in the subsurface, and of the evaporation rate in Makran (over 100 inches per year, WAFDA 1984) these dams, probably function as evaporation ponds. For these reasons all of the BALAD check dams are designed to be permeable. The BALAD Project has constructed an earthfill delay action dam, Zankani, which will, by use of an outlet conduit, function as a delay action dam. The flow in the nullah will be reduced to more closely approximate the infiltration capacity of the nullah.

Flood control is an additional benefit from the check dams. In some cases this is a significant benefit in preventing both damage to property and roadway washout. As a further development, Miskeen Low Water Crossing, has been designed as a road project, to prevent the periodic washout of the Turbat - Hoshab Road on Miskeen Kaur, with the additional benefit of spreading the runoff and promoting recharge in Miskeen Nullah.

The target karezes located downstream from each of the BALAD damsites are being monitored on a bi-weekly basis and the effects of the dams will thus be available for analysis. A variety of designs and of project scales have been provided, monitoring of the downstream karezes will produce data for the rational planning of construction of delay action dams in the future.

The response of sarrishtas to the construction of delay action dams of any sort has been nearly universally positive. Although there has been vandalism of monitor wells and bench marks established at the sites there has been no stated opposition to check dam construction on nullahs. The construction of dams on the main rivers, i.e. the Rakhshan, Nihing and Ketch Kaur, upstream from karezes is, however, widely opposed.

7.2 Criteria/Recommendations

The most important nullahs in an area identified for improvement are first selected based on the relative size of the catchment area as determined from maps and by the empirical evidence of the number of karezes which originate from the particular nullah. The presence of numerous karezes from a particular nullah is taken as empirical evidence that a shallow aquifer of suitable permeability for a recharge scheme exists. This is verified by permeability and infiltration tests when possible. Nullah identification must be verified by field investigation since no maps of sufficient quality for karez identification and location are available. Nullahs which have been selected for recharge schemes generally serve as the origins for at least three karezes. The nullah is then investigated for a suitable site. The physical aspects of each nullah which are taken into consideration are the availability of suitable abutments, the nullah subsoil, the potential reservoir area, distance from the target karezes, cost per storage unit, and accessibility for construction. If possible the dam is located immediately upstream from, or at, the apex of the alluvial fan.

When a site is determined to be feasible a dam is designed as either a gabion weir, an earthfill dam, or a combination thereof. This is dependant on the width of the nullah, the design flow, and the size of the potential reservoir. If the nullah is narrow enough so that essentially the entire width is required for a spillway to pass the design storm, a gabion weir is designed. These weirs may be placed in series or in parallel on narrow nullahs. If the nullah width is in excess of this a combination of earth bund and gabion overflow section is designed. If the nullah is wide, the abutments suitable, and the potential reservoir area large, an earthfill dam with an outlet conduit is designed. The design storm is based on the reservoir size and the projected life of the dam. Design storms of 25, 50, or 100 years are used depending on the estimated life of the dam. The scheme is then considered from the point of view of potential detrimental effects on downstream water users. Schemes which are considered to have potential negative impacts on downstream water users are rejected.

All recharge dams are designed to be permeable. The silt blanket deposited in the reservoir behind dams in Baluchistan is observed to quickly reduce reservoir permeability and therefore recharge is most effectively achieved downstream from the dam in the alluvial fan. Earthfill dams are fitted with outlet conduits consisting of a minimum of 30 inch diameter pipes. Empty oil drums are currently being used for forms for these conduits. This size is considered the minimum size for necessary maintenance purposes. All conduits are provided with trashracks on the

upstream and gabion reinforced outlets. If the recharge characteristics of the nullah favor a smaller flow than would be effected by a 30 inch diameter pipe, an orifice plate is provided to reduce flow to approximate the estimated recharge characteristics of the nullah. Gabion dams are permeable and are provided with additional outlet conduits in some cases.

Gabion construction quality has been found to be poor in Makran and three spillways have been damaged due to improper tying of gabions. New specifications have been developed and enforced for gabion construction and the contractors are currently struggling with these innovations.

Earth construction in Makran is also very poor with even simple compaction procedures entirely absent. Any sort of compaction requires nearly continual supervision to ensure that specifications are followed.

A variety of types and of scales of check dams are currently in place and it is recommended that these be observed until further check dams are proposed.

It should be noted that there are two typical karez orientations in Makran. Most karezes are constructed parallel to the main rivers and have their origins near the toes of alluvial fans draining into the main rivers. A second type of orientation, found occasionally in the Sharrak and Tump regions, consists of karezes constructed perpendicular to the main rivers and running up the tributary nullahs. Presumably these karezes which run up the nullahs receive their recharge nearly exclusively from the nullah while the more typical karezes constructed parallel to the rivers receive most of their recharge from the rivers. Nullahs which have karezes running up them would seem to be particularly appropriate sites. Two such dams have been constructed in series on Shappuk nullah and should be monitored carefully. The results of monitoring on Shappuk Kaur thus far are presented with the project summary in Appendix D.

B.0 Data Collection

8.1 Karez Operation Data

There are currently approximately 450 karezes in Makran, most of which are operating and support command areas. Most karezes are oriented parallel to the major rivers and receive their recharge from the perennial subsurface flow and from the periodic flood events in these rivers. Karez response to flooding in these rivers due to rainfall in the upper reaches of their catchments is dramatic, Figures 3 and 4. In the Turbat and Panjgur districts karezes typically

supply from 0.3 to 1.0 cusecs of perennial flow which supports a command area ranging from 25 to 100 acres. Occasionally kareztes supply as much as 3 cusecs of water and support command areas of up to 150 acres. Measured water utilization in the Turbat and Panjgur command areas ranges from 7.5 to 10.5 acre-feet per acre. Water and land for a karez are distributed by hangams, which is a weekly unit of karez flow. Most kareztes have 14 or 28 hangams, corresponding to 12 and 6 hours per week, respectively. Makran karez command areas range from 1.5 to over 5 acres per hangam depending on the karez flow rate. Based on potential evapotranspiration rates computed from the Blainy Criddle approach (WAPDA, 1984, 1986) and a consumptive use factor of 0.8 estimated for the Turbat cropping pattern, consumptive use rates are estimated as 5.6 feet and 4.9 feet respectively for Turbat and Panjgur. Irrigation efficiencies appear to range from 55 to 75 percent. Some kareztes, such as Miri, one of the most productive kareztes in Makran, appear to have more water than available land. Most kareztes, however, have uncultivated land which could be put into production if water were available. Korjos are generally more productive than kareztes and have larger command areas, ranging from 5 to 20 acres per hangam. Most korjos in the Turbat District currently have vast uncultivated areas. These data are presented in Table 5, 6, and 7. Karez and korjo flow rate data are included with the relevant project summaries for each karez and beginning with Figure 12.

8.2 Karez Economics

Operating kareztes require annual maintenance expenses of up to Rs.100,000 depending on the age and length of the karez and the local topography and soil type. Most kareztes require approximately Rs.40,000 to Rs.50,000 per year for maintenance. Operating kareztes are, therefore, economic water supply systems with karez water costing on order of Rs.150 per acre foot.

New kareztes are also being constructed in many regions in Makran at a cost of an order of Rs.2.0 million. Additional expense may be incurred in preparing the command area. The economics of new karez investment appear dubious. A case history for Bayan, a new karez in the Turbat District is presented in Appendix E.

8.3 Karez Inventory

No reliable karez inventory is available in Makran. BALAD has compiled, on *dBASE III*, and is refining, a Division wide karez inventory. Over 450 kareztes have been field verified and single flow rate data have been collected for the majority of the kareztes and korjos. Data on the karez

ownership, measured flow rate, command area, and any karez improvement projects, are listed in the inventory. The karez inventory is included in Appendix E. Total command area and flow for each location are presented but should be used with caution until further refined.

Estimates developed from the Karez Inventory indicate a total command area for Panjgur District of approximately 5,500 acres. Existing karezes and korjos in Panjgur supply on order of 85 cusecs of flow. The existing flow at Panjgur should support, at measured Panjgur water utilization rates, approximately 6800 acres. This indicates that most of the existing command area in Panjgur is currently being irrigated and may be under expansion.

In the Turbat District irrigation appears, however, to be in decline. The total command area estimated for Turbat District is approximately 20,000 acres. Available water supplied by karezes is estimated at 130 cusecs which could support, at measured Turbat water utilization rates, approximately 10,000 acres. This indicates that of the order of half the total historical command areas currently have no water. Dead command areas are a common sight in the Ketch River valley, particularly in the area to the west of Turbat town.

8.4 Rainfall-Runoff Data

Rainfall Data for Baluchistan have been recently analyzed by the Arid Zone Research Institute in Quetta. BALAD has prepared Depth-Duration-Frequency curves for Turbat and Panjgur based on that analyses. These data are presented in Figures 10 and 11. Run-off has been measured at Shahwani Kaur for five flood events during 1987-89. The SCS curve number has been back calculated with the assumption that measured rainfall in Turbat was applicable over the entire Shahwani catchment (Figure 8).

9.0 Conclusions & Recommendations

The first phase of the BALAD Project has largely been a construction project during which a large number of small essentially ad-hoc water projects have been undertaken. This work has established that numerous potential projects are available on Makran karez systems and that projects can be constructed with local contractors.

The remaining phase of BALAD water section work should concentrate on integrating the upstream karez improvements with downstream command area improvements. It may be that on farm improvements in water and crop management will outweigh

the impacts of karez improvements. In addition BALAD efforts should be integrated with those of the GOB line agencies. Hopefully the anticipated strengthening of the PFMU will promote increased coordination between BALAD and GOB.

Karezes have been selected for comprehensive karez, kalmer, and command area improvements and feasibility work is currently underway on several schemes. Specific recommendations for water sector activities have been submitted to USAID for the project extension. These are summarized below:

- Water Sector projects should continue without significant change in the selection or design process for watercourse and karez improvements, and for karez borings.
- Existing check dams should be evaluated for two rainy seasons prior to any further check dam construction.
- Water Sector projects should be integrated with command area water and crop management improvements.
- Electrical resistivity equipment should be procured and utilized for infiltration gallery alignment selection. Quotations for recommended equipment are being sought from the U.S.
- Windmills could be considered for utilization to lift water in dead karezes, particularly where the water table has fallen in recent years and is only slightly below the karez invert level at the mother well. This could save large investment in the existing water conveyance system to revive the karez by conventional means.
- The Makran Karez inventory should be refined. Special attention should be given to improving the flow rate and command area data.
- The impact of changing the course of the Ketch River by the Ketch Bridge should be monitored with respect to korjos in the Ketch Kaur. The prospect for infiltration galleries on the south bank of the Ketch may be improved.

INTWSRFT/DD-WMO1.

TABLES

TABLE 1

Kalmer Seepage Losses

	Date	Flow Rate		Losses Cusecs/Per Cent
		*Upstream Cusecs	*Downstream Cusecs	
-Kan	04/05/87	1.51	0.67	0.84/56
abad	09/30/87	0.97	0.79	0.18/18.9
lo	10/09/87	1.16	0.73	0.43/37
-abad	10/07/87	0.78	0.65	0.13/16.7
abad	10/07/87	1.11	0.94	0.17/15.3
sabad	10/07/87	0.70	0.67	0.03/4.3
abad	10/07/87	1.25	0.93	0.32/25.6
an (Sordo)	11/06/87	0.76	0.72	0.04/5.5
lag	15/11/87	1.42	0.83	0.59/42
an (Sani)	12/14/87	1.36	1.01	0.35/26

*Measurements taken on upstream and downstream of the project area

TABLE 2

Summary Of Results
Panjgur Infiltration Galleries

Infiltration Gallery	Location (Kaur)	Cost (Rs)	Length (meters)	Average Flow (cusecs)	Flow/Meter (cusecs/meter)	Annual Flow (acre/feet)	Potential Irr Acres	Potential IRR + (Percent)	
								10 year	20 year
Takhan	Rakhshan	347,701	200	0.3	0.0015	220	25	14	20
Churro	Rakhshan	330,963	500	0.9	0.0016	590	70		
Juhiljo	Rakhshan	584,292	470	0.9	0.0017	590	70	16	22
Nokjo	Rakhshan	779,558	270	0.6	0.0022	430	55	4	12
Doznap	Rakhshan	733,630	350	0.9	0.0026	651	80	11	19
Nakan	Parwan	376,946	200	Flooded					
Mehroodabad	Rakhshan	384,662	400	0.45	0.0011	326	40	16	23

* Estimated Cost

* Includes only revenue possible from supplemental water

SUMFINSL/DH-40.

TABLE 3

KAREZ BORING RESULTS

SR. NO.	KAREZ NAME	NO. OF BORE	DEPTH OF BORE	BORE TYPE	STATUS	DRAWING REF.	
1.	Baluchabad	1	159	H	S *	1	
2.	Challo	3	47-13-16	H	S	1	
3.	Timp	2	81-86	H	S	1	
4.	Sohrani	3	27-16-21	H	S	1	
5.	Razai	2	21-25	H	U **	1	
6.	Aftari	1	150	M	U	1	
7.	Maliki	1	112	M	S	1	
8.	Koshak	1	120	M	S	1	
9.	Soragi	1	90	M	S	1	
10.	Hotabad	1	150	M	U	4	
11.	Gebion	1	150	M	U	3	
12.	Phullani	1	150	N	U	2	
13.	Get	1	140	M	S		
14.	Nejan	1	150	M	U		
15.	Sikuni	A B A N D O N E D					
16.	Mir Mir	A B A N D O N E D					2
17.	Shakarabad	A B A N D O N E D					
18.	Imani	1	150	M	S	1	
19.	Daziabad	1	104	M	S	1	
20.	Challo	2	52-98	M	S	1	
21.	Siri Kan	1	150	M	U	1	
22.	Sohrani	1	150	M	S	1	
23.	Nokabad	1	150	M	U		
24.	Bullo	2	148-90	H	S	5	

TABLE 3

SR. NO.	KAREZ NAME	NO. OF BORE	DEPTH OF BORE	BORE TYPE	STATUS	DRAWING REF.
25.	Garibabad	2	82-70	H	S	5
26.	Hikaluk	2	35-25	H	S	5
27.	Phullabad	1	150	H	U	3
28.	Sari Minab	3	30-20-23	H	S	6
29.	Gwali Malk	2	12-15	H	S	6
30.	Waqf	3	64-26-10	H	S	6
31.	Kaur-e-Sar	4	10-40-30-20	H	S	6
32.	Kali Kat	3	40-32-35	H	S	6
33.	Zardien Gungan	4	15-25-45-20	H	S	6
34.	Band-e-Joh	3	47-25-28	H	S	6
35.	Malikabad	1	100	H	S	6
36.	Raisabad	2	50-50	H	S	6
37.	Zirabad	3	41-44-15	H	U	6
38.	Degani Shehr	2	50-50	H	S	6
39.	Toppus	IN PROGRESS		H		6
40.	Rediani			H		6
41.	Toba	3	24-37-16	H	S	6
42.	Afshan					
43.	Arabad	IN PROGRESS		H		6
44.	Anzol	3	27-35-40	H	U	6
45.	Milk	3	53-25-20	H	U	6
46.	Kalag	3	44-43-16	H	U	6
47.	Nokabad					6
48.	Sar-e-Jo					6
49.	Gilli	1	150	M	S	7

TABLE 3

SR. NO.	KAREZ NAME	NO. OF BORE	DEPTH OF BORE	BORE TYPE	STATUS	DRAWING REF.
50.	Samadabad	1	104	M	S	7
51.	Farooqabad	1	120	M	S	7
52.	Sheda	1	150	M	S	7
53.	Muslimabad	1	150	M	S	7
54.	Kaisak	1	150	M	U	
55.	Mir Ketchi	3	45-60-50	H	S	8
56.	Naukay	4	15-35-70-30	H	S	8
57.	Hirabad	3	51-55-45	H	S	8
58.	Nakam	3	56-45-44	H	U	8
59.	Phullabad	1	156	H	U	8

* Successful

** Unsuccessful

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TABLE 4

Check Dam Details

Dam	Location	Catchment Sq.Miles	Type	Design Flow Cusecs Return Period	Reservoir Acre Feet	Cost Rs	Cost/AF Rs	Life Years	Target Karezes	Status
Shahwani	Turbat	12	Rockfill/Gabion	1200/5yr		211,959			3	Completed
Sheppuk	Turbat	8**	Gabion Weir	1600	10	431,474	43,147	5	3	Completed
Zankani	Turbat	14.5	Earthfill	9000/100yr	320	3,500,000	10,938	57	5	Completed
Miskeen A	Turbat	3.6	Earthfill/Gabion	1200/25yr	22	423,165	19,235	10	4	Completed
Miskeen B	Turbat	4.2	Earthfill/Gabion	1700/25yr	18	407,635	22,658	11	4	Completed
Miskeen C	Turbat	7.2	Earthfill/Gabion	3600/25yr	20	759,957	37,998	9	4	Completed
Miskeen Total		15			60	1,590,957	26,516		4	
Niwan	Panjgur	19.1	Gabion Weir	7500/25yr	20	412,265	20,613	5	5	Completed****
Niwan 2	Panjgur	19.1	Gabion Weir	7500/25yr	45	632,000	19,449	11	5	Construction
Farden	Panjgur	25	Earthfill/Gabion	7500/50yr	60	675,000	10,938	13	15	Incomplete***
Shahwani	Turbat	13.5	Gabion Weir	5600/25yr	17	271,213	15,954	5	3	Completed
Seruk	Turbat	36	Earthfill	14000/100yr	260	5,380,942	20,696	50	6	Submitted to AID
Dezvi-East Tusp		1.8	Earthfill/Gabion	2150/25yr	8	405,000	50,625	10	6	Construction
Dezvi-West Tusp		1.8	Earthfill/Gabion	2150/25yr	15	475,000	31,611	10	6	Construction
Latidan	Pidrak	10	Gabion	5300/25yr	22	915,795	37,082	10	20	Construction
Makden	Pidrak	7	Earthfill/Gabion	6000/25yr	14	681,000	48,643	15	20	Construction
Faqirabad	Panjgur	20.5	Earthfill	6300/25yr	50	662,600	17,452	10	4	Construction

*Trial Structure, design based on financial limit of purchase order

**Estimate, no map available

***Work damaged by flood during construction. Revised proposal under consideration

****Work damaged by flood during construction. Restoration not under consideration

TABLE 5

Water Utilization For Turbat Karezes
During 1987

Karez Name	No. Of Hangaes	Acres Per Hangam	Total Irrigated Acres	Average Flow (cusecs)	Total Annual Flow (acre-feet)	Consumptive Use (acre-ft/acre)	Irrigation Efficiency (percent)
Challo	14.0	3.8	53.5	0.7	514.0	9.6	58.3
Siri-Kan	14.0	3.6	51.0	0.7	529.3	10.4	54.0
Ugetabad	14.0	4.2	58.6	0.8	555.0	9.5	59.1
Mirri	28.0	5.2	146.4	3.3	2752.9	15.1 *	34.8
Sohrani	28.0	4.7	130.7	1.4	981.7	7.5	74.5
Istellabad	14.0	5.8	81.0	0.9	628.7	7.8	72.1
Average Consumptive Use						8.9 acre-ft/acre	
* Excess water disposed into Katch due to insufficient available land, not included in average							
Shahpul	14.0	1.6	22.4	0.9	652.0	29.1	19.3
Sirchupi	14.0	2.2	32.0	0.7	492.0	15.4	36.4
Kaian	28.0	3.1	86.0	1.8	1296.0	15.1	37.2
Gat	14.0	2.9	41.0	0.9	651.0	15.9	35.3
Bayan	17.0	2.8		0.2	159.0		

TABLE 6

Water Utilization For Panjgur Karezes
During 1989

Karez Name	No. Of Hangams	Acres Per Hangam	Total Irrigated Acres	Average Flow (cusecs)	Total Annual Flow (acre-feet)	Consumptive Use (acre-ft/acre)	Irrigation Efficiency (percent)
Takhan	28.0	2.5	70.5	0.8	586.0	9.6	59.0
Ballan	24.0	4.8	115.4	1.5	1086.0	9.4	52.0
Voorabad	24.0	5.0	118.7	1.1	796.0	6.7	73.0
Average Consumptive Use						8.6 acre-ft/acre	

TABLE 7

Water Utilization For Buleda Korjos
During 1988

Korjo Name	No. Of Hangers	Acres Per Hanger	Total Irrigated Acres	Average Flow (cusecs)	Total Annual Flow (acre-feet)	Consumptive Use (acre-ft/acre)	Irrigation Efficiency (percent)
Chib	28.0	14.0	93.0	0.3 *			
Sullo	28.0	6.8	61.0	0.3 *			
Bit	104.0	9.1	546.0	2.9 *			
Asiabad	19.0		150.0				

* Single Measurement

TABLE 8

 RAINFALL/RUNOFF AT SHAHWANI KAUR

DATE	TURBAT RAINFALL (INCHES)	RUNOFF (CUSECS)	BACK CALCULATED CURVE NUMBERS
1/10-0/11 1988	1.35*	1200	86
7/2	0.43	560	94
7/19	0.94	470	87
11/24	0.14	50	86
1/4/89	NA	80	

* Hoshab Rainfall, no rainfall recorded at Turbat

RAINFAL/QH-HD.

FIGURES

FIGURE 1

Water Sector Contracts

Schemes Under Construction 01/01/89

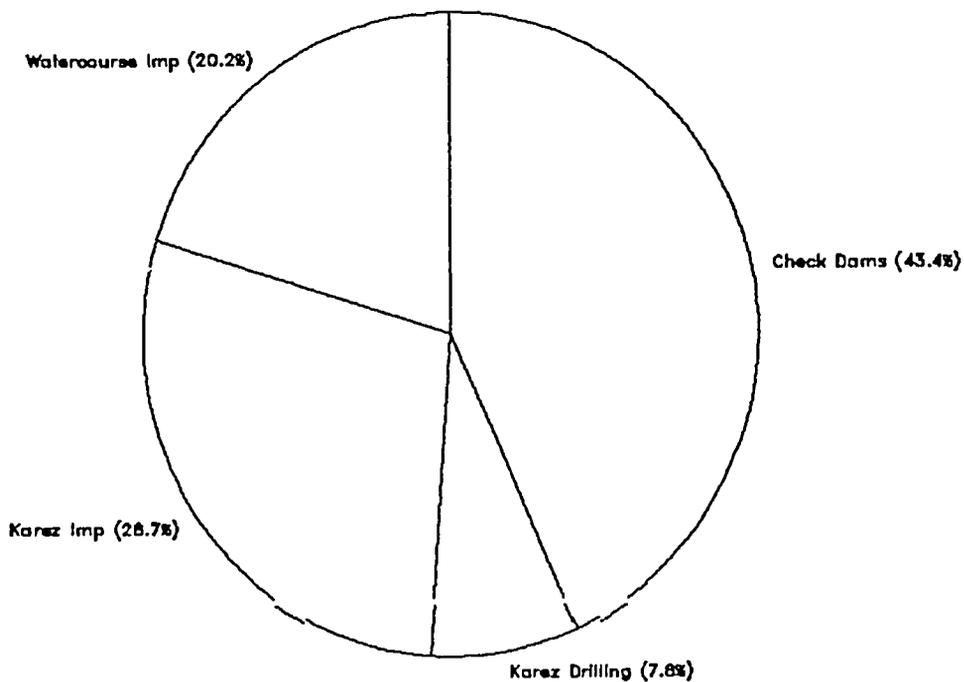
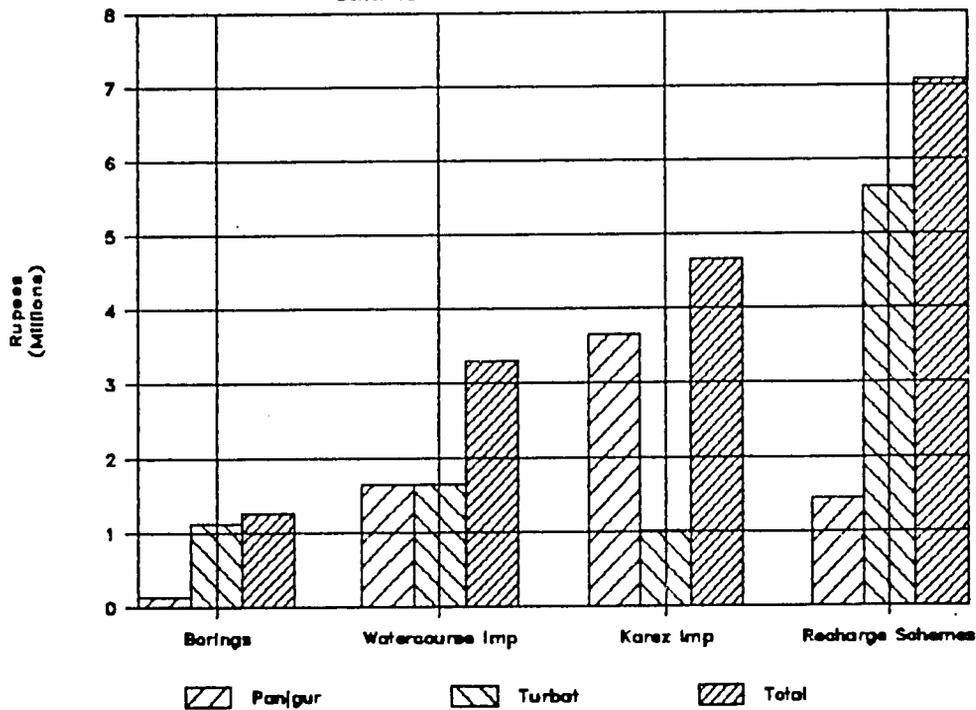


FIGURE 2

Water Sector Contracts

Schemes Under Construction 01/01/89



Flow Rate Seasonal Fluctuations

Turbat Karez, 1986-1989

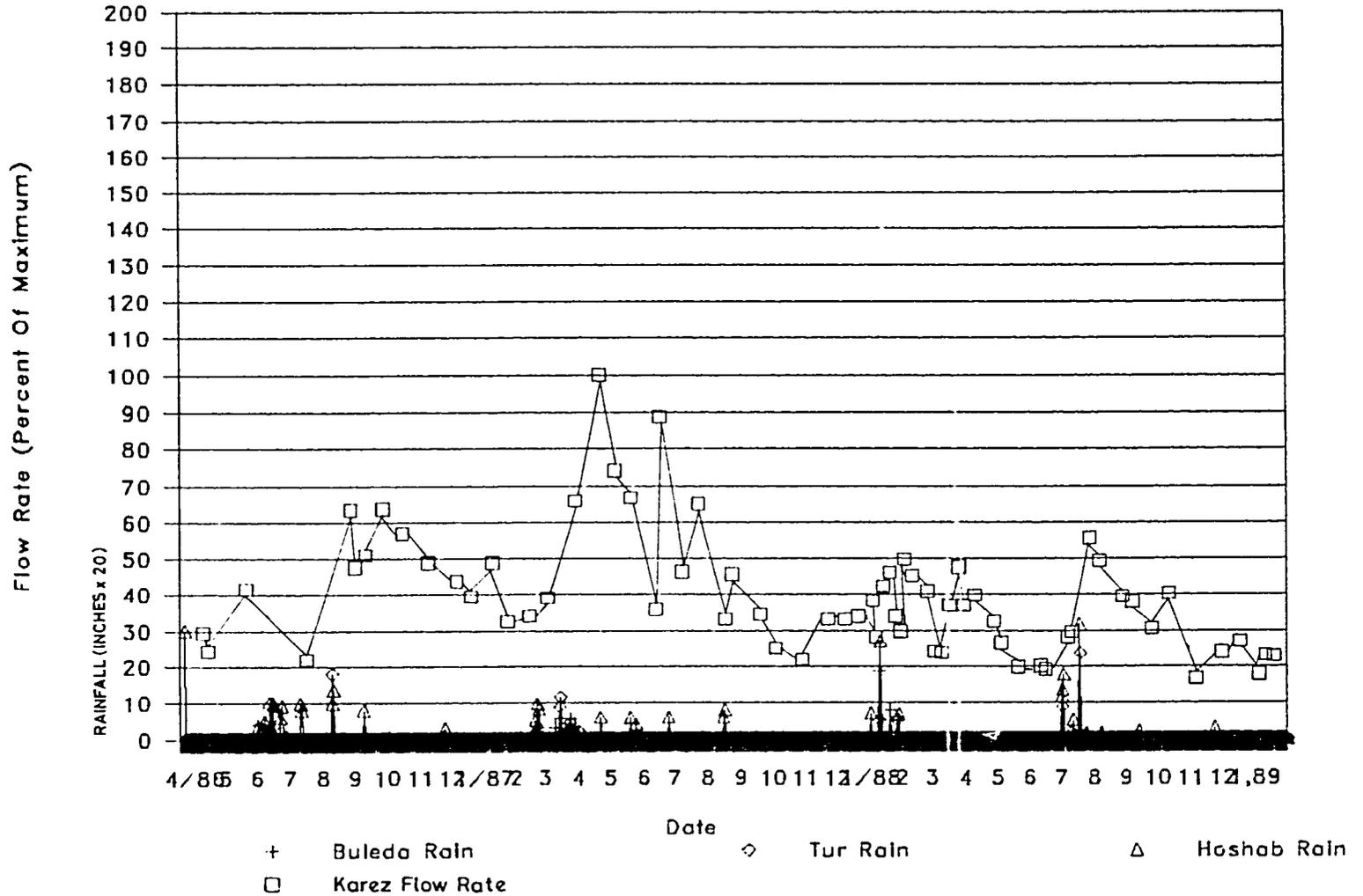


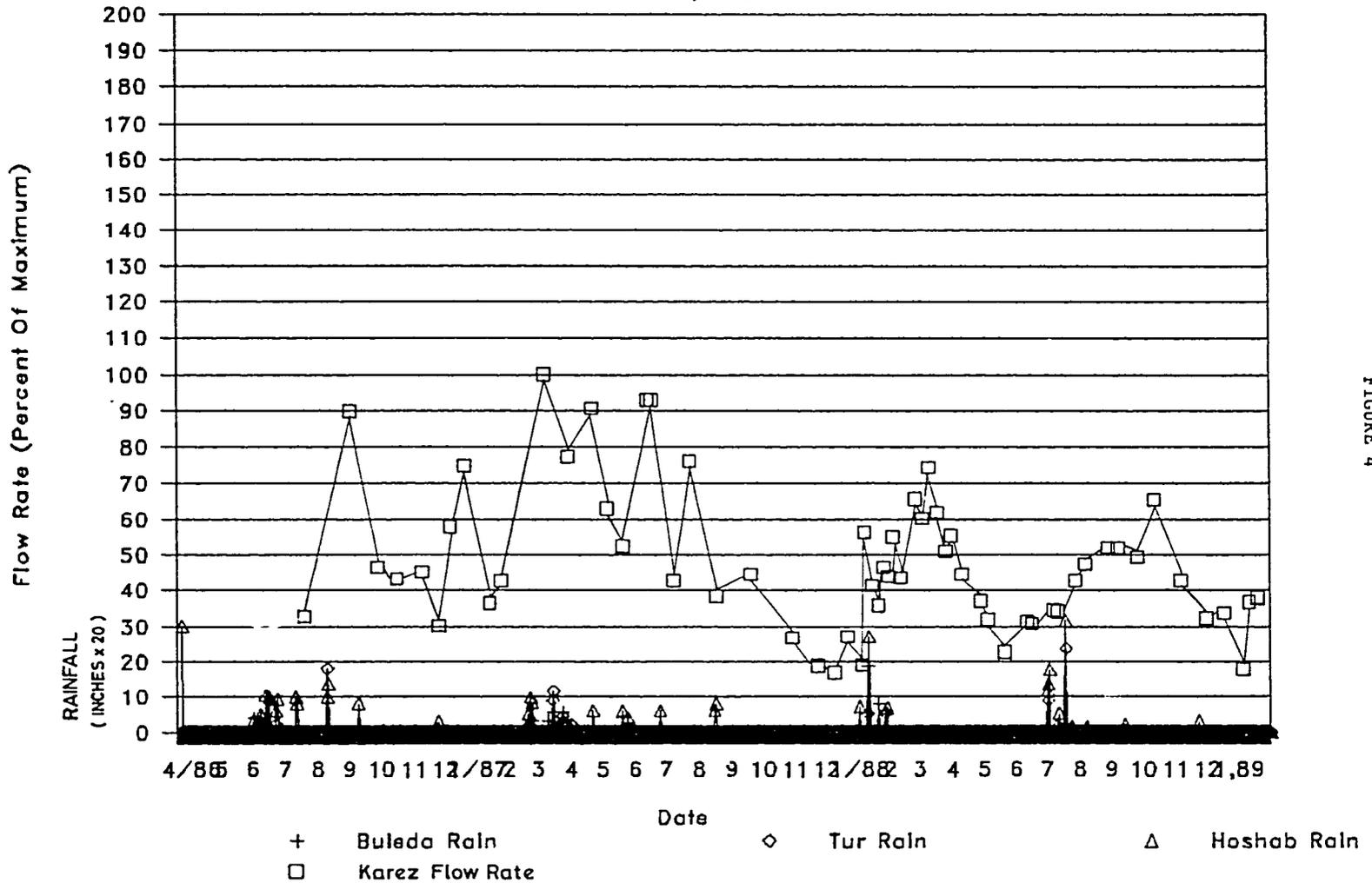
FIGURE 3

DATA FROM SIRI KAN KAREZ - TURBAT

25

Flow Rate Seasonal Fluctuations

Turbat Karezes, 1986-1989



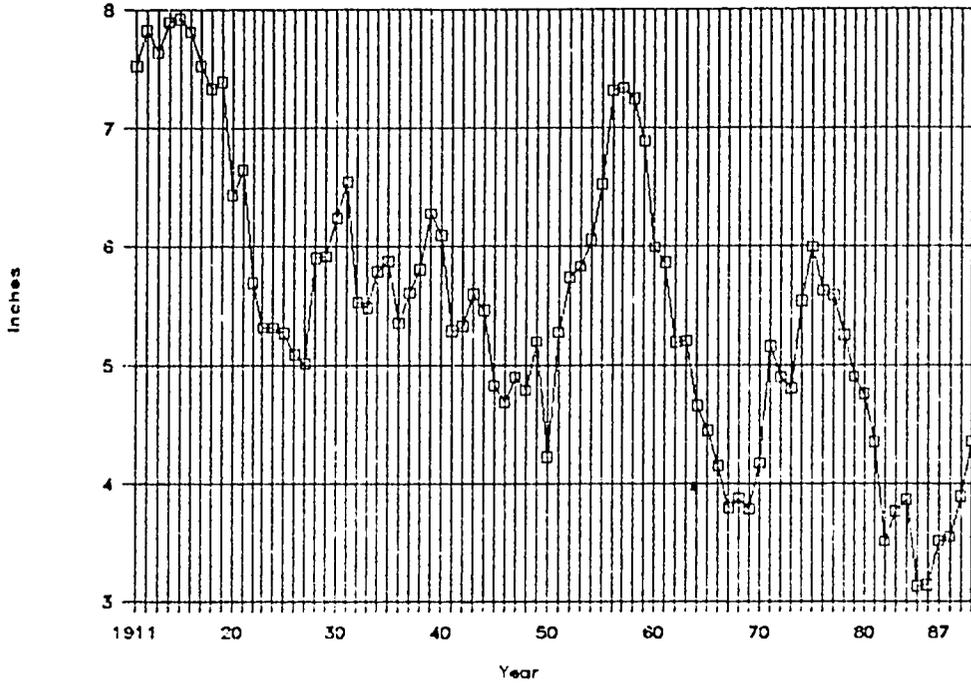
DATA FROM ISTEELABAD KAREZ, TURBAT

FIGURE 4

FIGURE 5

Rainfall Turbat

1911-1987 Eleven Year Moving Mean



Rainfall Turbat

1911-1987 Deviation From Mean

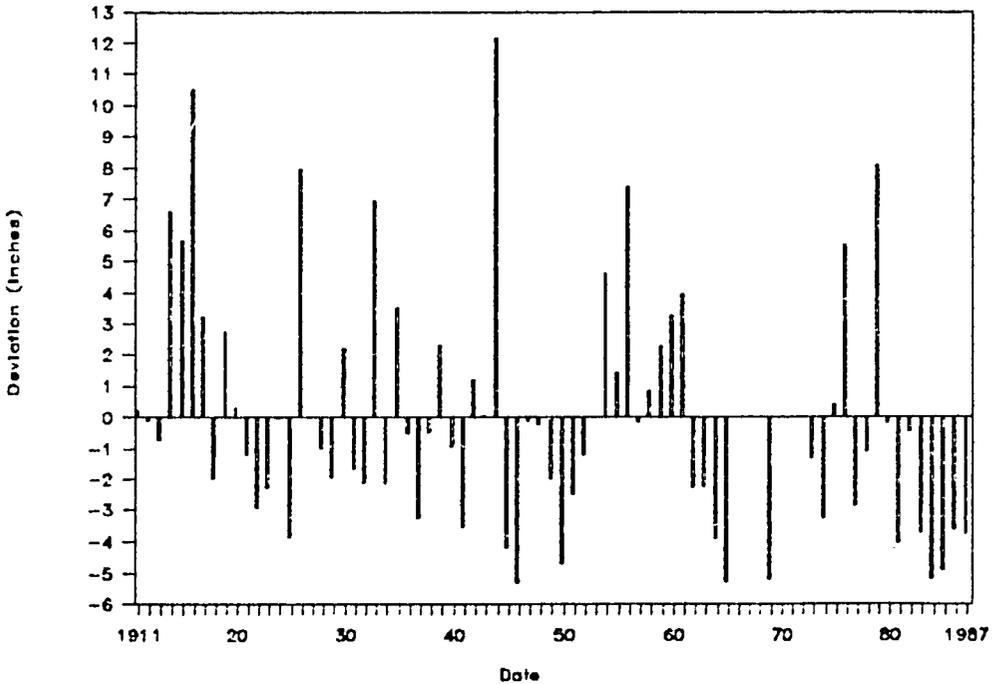
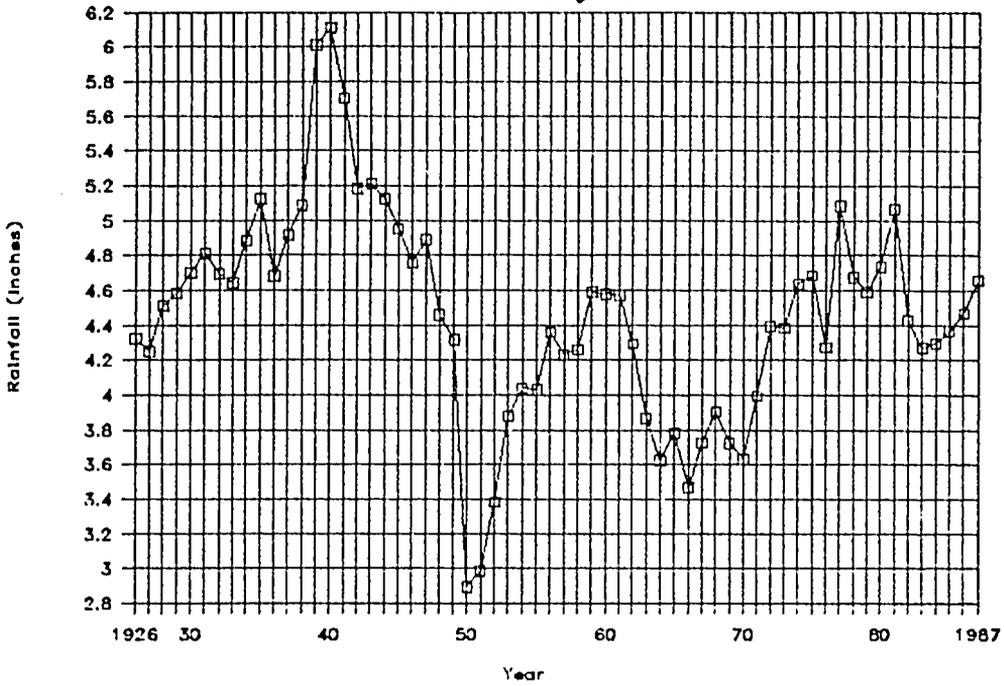
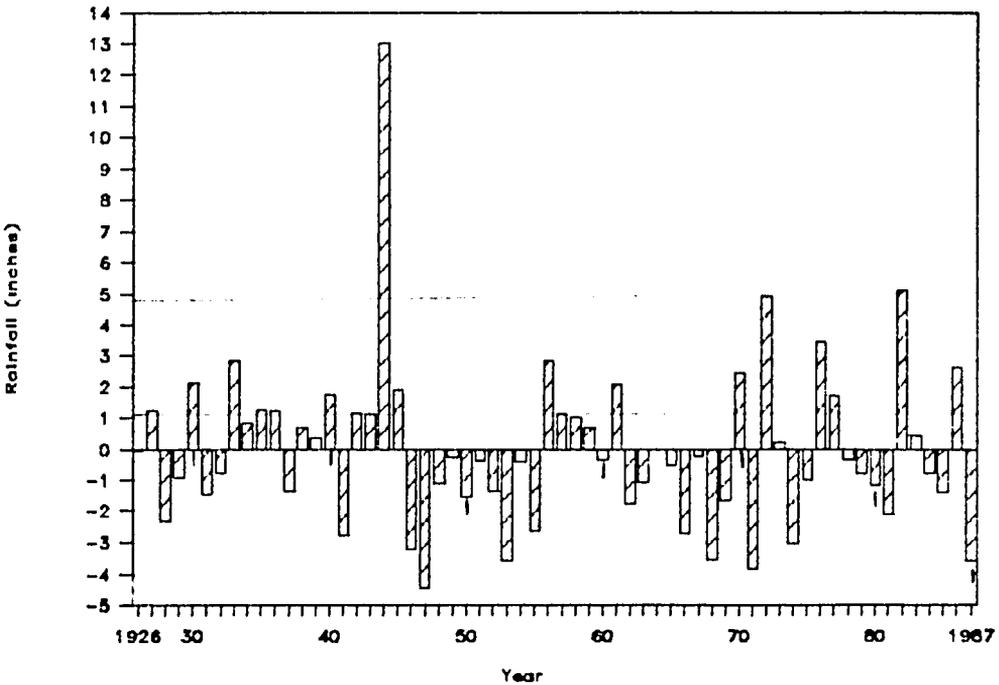


FIGURE 6

Rainfall Panjgur Eleven Year Moving Mean



Rainfall Panjgur Deviation From Mean



LEGEND FOR LOCATION MAPS

KAREZ BORINGS

SR. NO.	KAREZ NAME	NO. OF BORE	DEPTH OF BORE	BORE TYPE	STATUS	DRAWING REF.	
1.	Baluchabad	1	159	H	S *	1	
2.	Challo	3	47-13-16	H	S	1	
3.	Trump	2	81-86	H	S	1	
4.	Sohrani	3	27-16-21	H	S	1	
5.	Razai	2	21-25	H	U **	1	
6.	Afbari	1	150	M	U	1	
7.	Malidi	1	112	M	S	1	
8.	Koshak	1	120	M	S	1	
9.	Soragi	1	90	M	S	1	
10.	Hotabad	1	150	M	U	4	
11.	Gabion	1	150	M	U	3	
12.	Phullani	1	150	M	U	2	
13.	Gat	1	140	M	S		
14.	Nelan	1	150	M	U		
15.	Sikuni	A B A N D O N E D					
16.	Mir Mir	A B A N D O N E D					2
17.	Shekarabad	A B A N D O N E D					
18.	Imami	1	150	M	S	1	
19.	Daziabad	1	104	M	S	1	
20.	Challo	2	52-98	M	S	1	
21.	Siri Kan	1	150	M	U	1	
22.	Sohrani	1	150	M	S	1	
23.	Nokabad	1	150	M	U		

SR. NO.	KAREZ NAME	NO. OF BORE	DEPTH OF BORE	BORE TYPE	STATUS	DRAWING REF.
24.	Bullo	2	148-90	H	S	5
25.	Garibabad	2	82-70	H	S	5
26.	Hikaluk	2	35-25	H	S	5
27.	Phullabad	1	150	H	U	3
28.	Sari Minab	3	30-20-23	H	S	6
29.	Gwali Malk	2	12-15	H	S	6
30.	Waqf	3	64-26-10	H	S	6
31.	Kaur-e-Sar	4	10-40-30-20	H	S	6
32.	Kali Kat	3	40-32-35	H	S	6
33.	Zerdien Bungan	4	15-25-45-20	H	S	6
34.	Band-e-Joh	3	47-25-28	H	S	6
35.	Malikabad	1	100	H	S	6
36.	Raisabad	2	50-50	H	S	6
37.	Zirabad	3	41-44-15	H	U	6
38.	Degani Shehr	2	50-50	H	S	6
39.	Toppus	IN PROGRESS		H		6
40.	Rodian			H		6
41.	Toba	3	34-27-16	H	S	6
42.	Afshan					
43.	Arabad	IN PROGRESS		H		6
44.	Anzol	3	27-35-40	H	U	6
45.	Malk	3	53-25-20	H	U	6
46.	Kalag	3	44-43-16	H	U	6
47.	Nokabad					6
48.	Saro-Jo					6

SR. NO.	KAREZ NAME	NO. OF BORE	DEPTH OF BORE	BORE TYPE	STATUS	DRAWING REF.
49.	Gilli	1	150	M	S	7
50.	Samadabad	1	104	M	S	7
51.	Farooqabad	1	120	M	S	7
52.	Sheda	1	150	M	S	7
53.	Muslimabad	1	150	M	S	7
54.	Kaisak	1	150	M	U	
55.	Mir Ketchi	3	45-60-50	H	S	8
56.	Naukay	4	15-35-70-30	H	S	8
57.	Mirabad	3	51-55-45	H	S	8
58.	Nakam	3	55-45-44	H	U	8
59.	Phullabad	1	156	H	U	8

* Successful

** Unsuccessful

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LEGEND FOR LOCATION MAPS

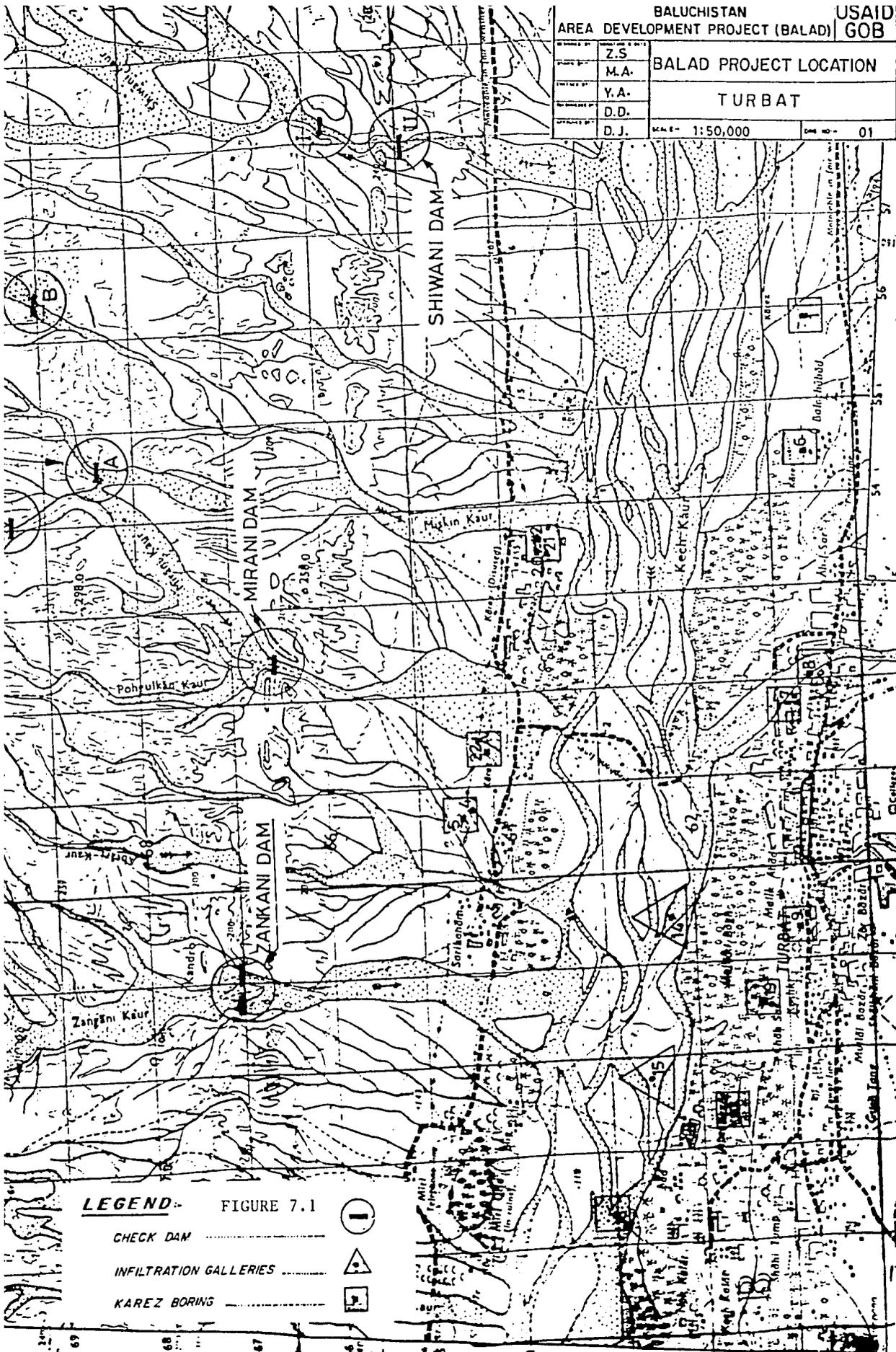
INFILTRATION GALLERIES

<u>NAME OF KORJO</u>	<u>DISTRICT</u>	<u>DRAWING FEE.</u>
1. Takhan	Panigur	8
2. Nakan	Panigur	8
3. Churno	Panigur	8
4. Abdul Karim	Panigur	8
5. Gram Kan	Panigur	8
6. Jhiljoh	Panigur	8
7. Nokjo	Panigur	8
8. Ghulam Qadir	Panigur	8
9. Pir Bux	Panigur	8
10. Mehmoodabad	Panigur	8
11. Doznep	Panigur	8
12. Kahilan	Panigur	8
13. Sarhalum	Panigur	8
14. Nokash (Koshkalat)	Turbat	1
15. Karmandaz	Turbat	1
16. Malikabad	Turbat	1

...

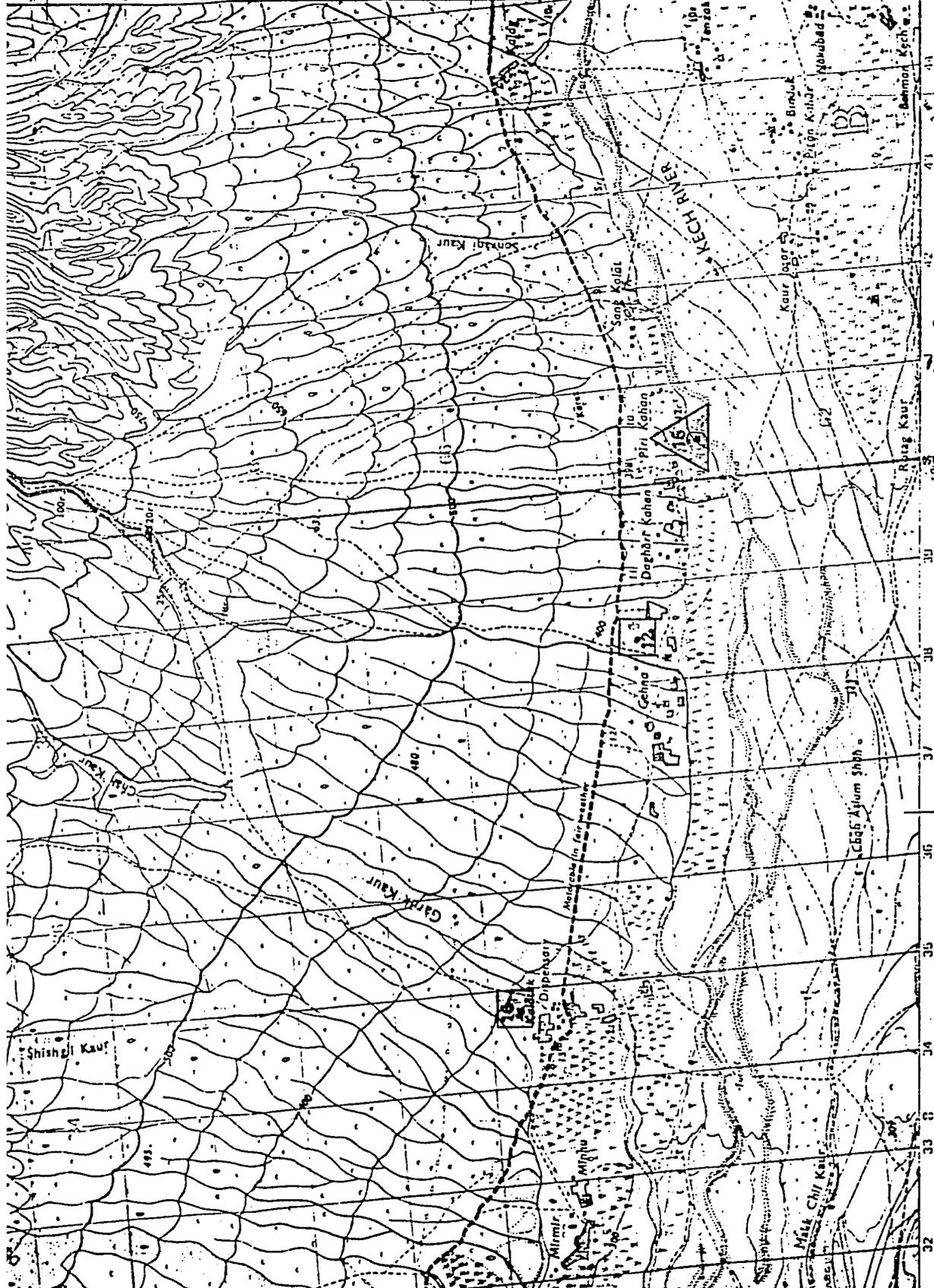
INFLOGLST/QHI-UM01.

AREA DEVELOPMENT PROJECT (BALAD)		BALAD PROJECT LOCATION	
SCALE BY	Z.S.		
DATE BY	M.A.		
DESIGNED BY	Y.A.	TURBAT	
DRAWN BY	D.D.	SCALE - 1:50,000	DATE - 01
CHECKED BY	D.J.		



LEGEND:- FIGURE 7.1

- CHECK DAM 
- INFILTRATION GALLERIES 
- KAREZ BORING 



LEGEND-

FIGURE 7.2

INFILTRATION GALLERIES ———

KAREZ BORING ———



BALUCHISTAN		USAID GOB
AREA DEVELOPMENT PROJECT (BALADI)		
25	MA	BALAD PROJECT LOCATION
MY		
DD		
DJ		
TURBAT		
1:50,000		02

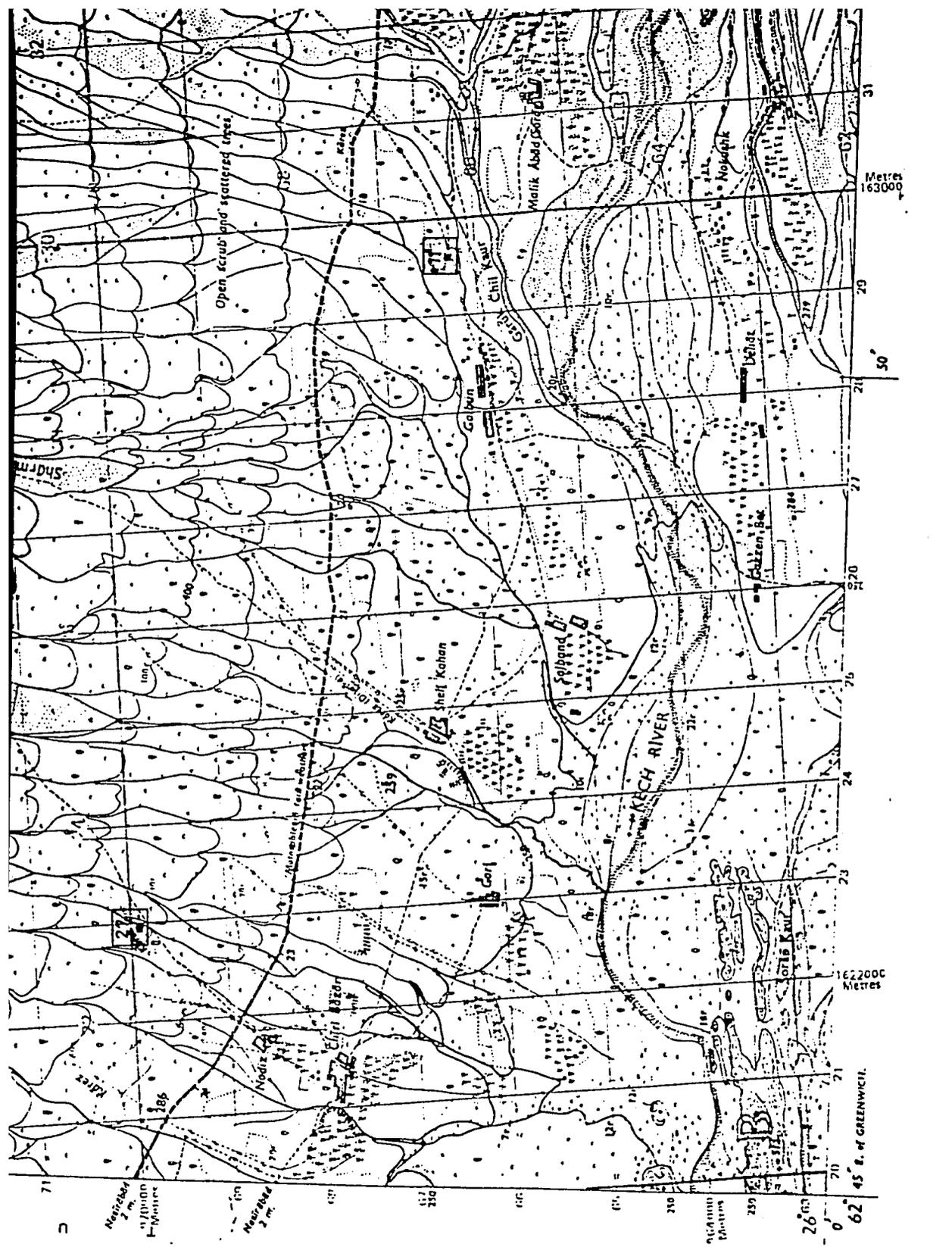
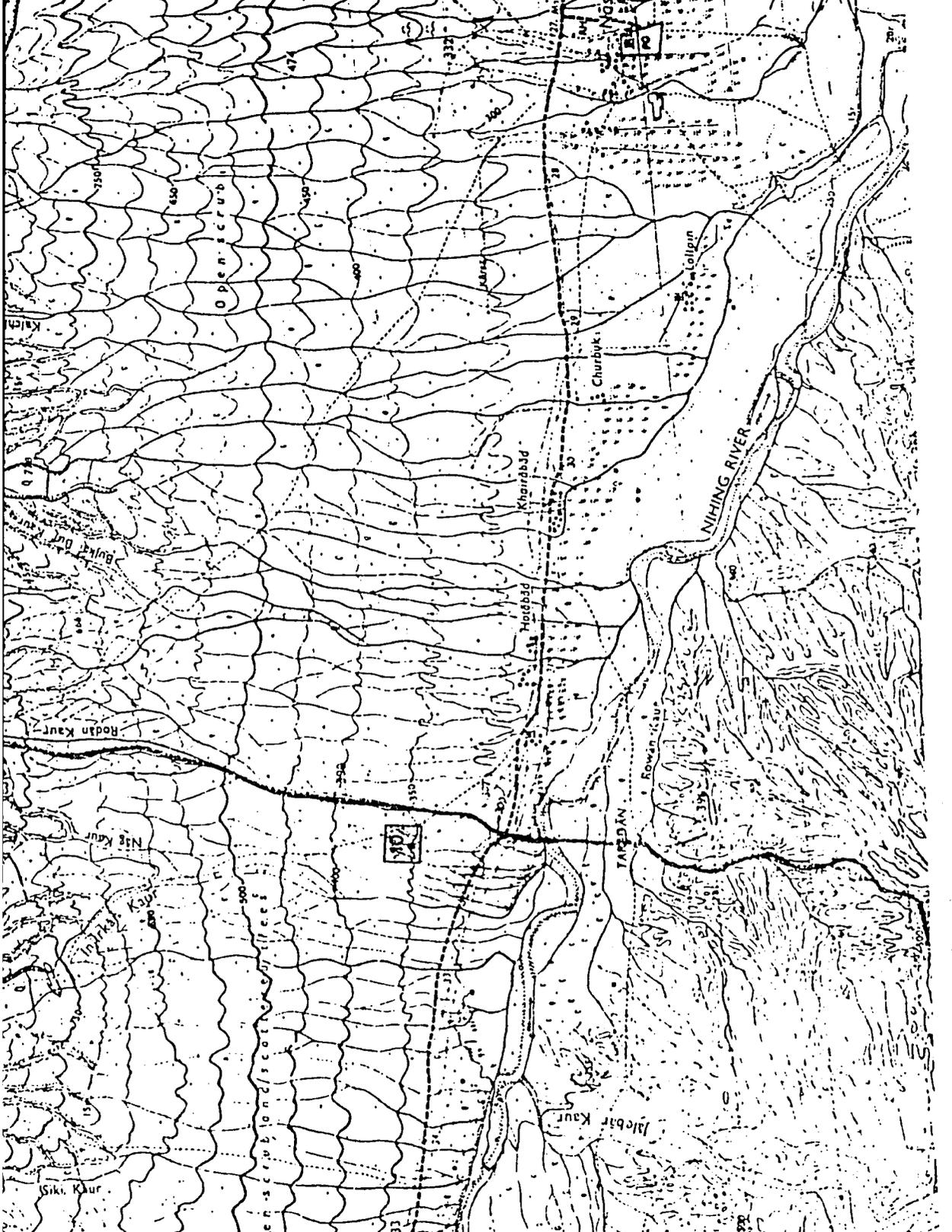


FIGURE 7.3

LEGEND:-

KAREZ BORING

BALUCHISTAN		USAID GOB
AREA DEVELOPMENT PROJECT (BALAD)		
BALAD PROJECT LOCATION		
TURBAT		
Scale: 1:150,000		63



LEGEND

FIGURE 7.4

KAREZ BORING

BALUCHISTAN		USAID
AREA DEVELOPMENT PROJECT (BALAD)		GOB
BALAD PROJECT LOCATION		
TURBAT		
SCALE: 1:50,000		0.6



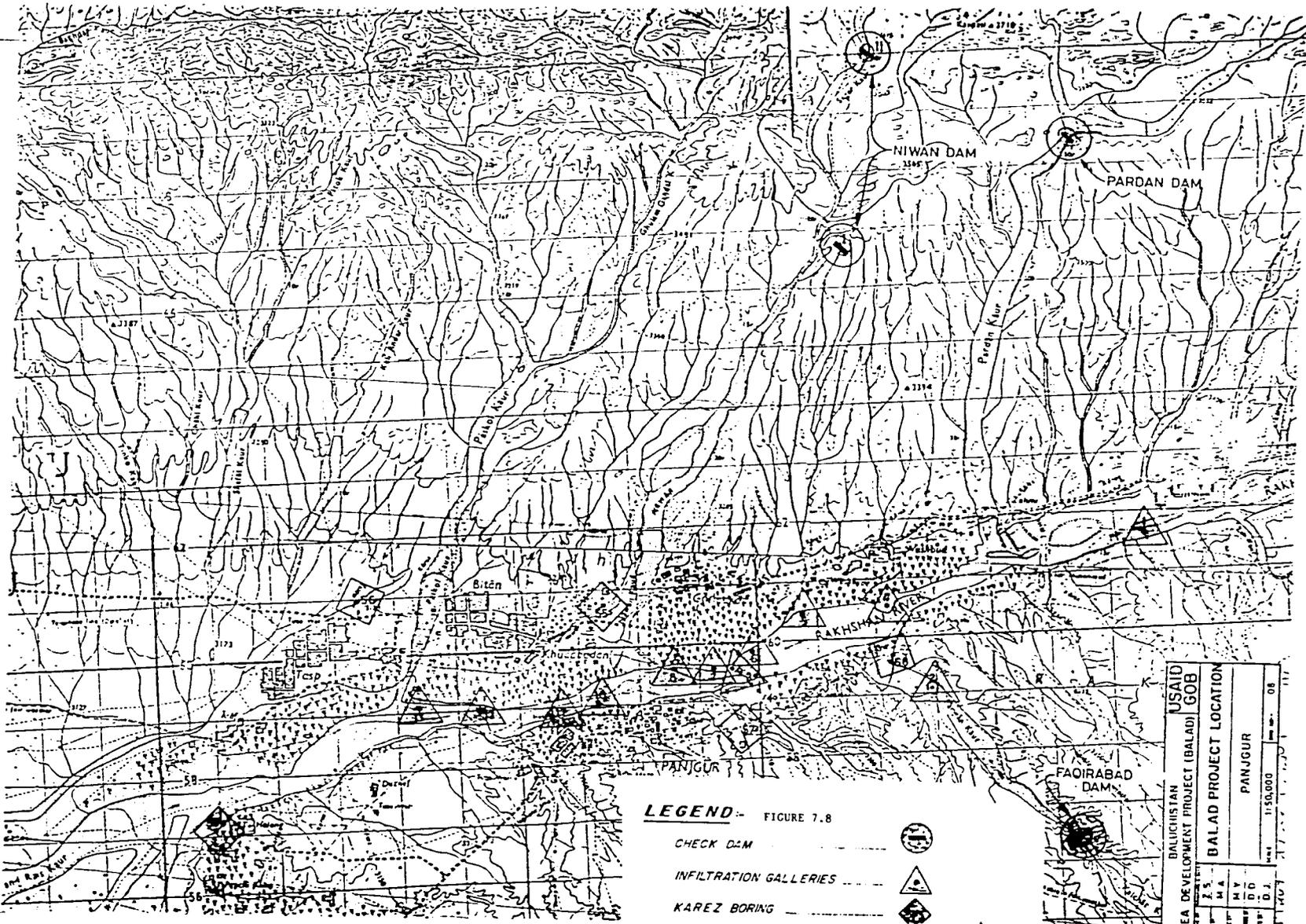
LEGEND

FIGURE 7.5

KAREZ BORING

BALUCHISTAN		USAID
AREA DEVELOPMENT PROJECT (BALAD)		GOB
Z S	BALAD PROJECT LOCATION	
M A		
M Y		
G C		
G J		
MAND		
1:50,000		05

BEST AVAILABLE COPY



LEGEND- FIGURE 7.8

- CHECK D.M. 
- INFILTRATION GALLERIES 
- KAREZ BORING 

USAID	
BALUCHISTAN	
IEA DEVELOPMENT PROJECT (BALAD) GOB	
BALAD PROJECT LOCATION	
SCALE	1:50,000
DATE	08

Infiltration Rates

Zankari Kaur

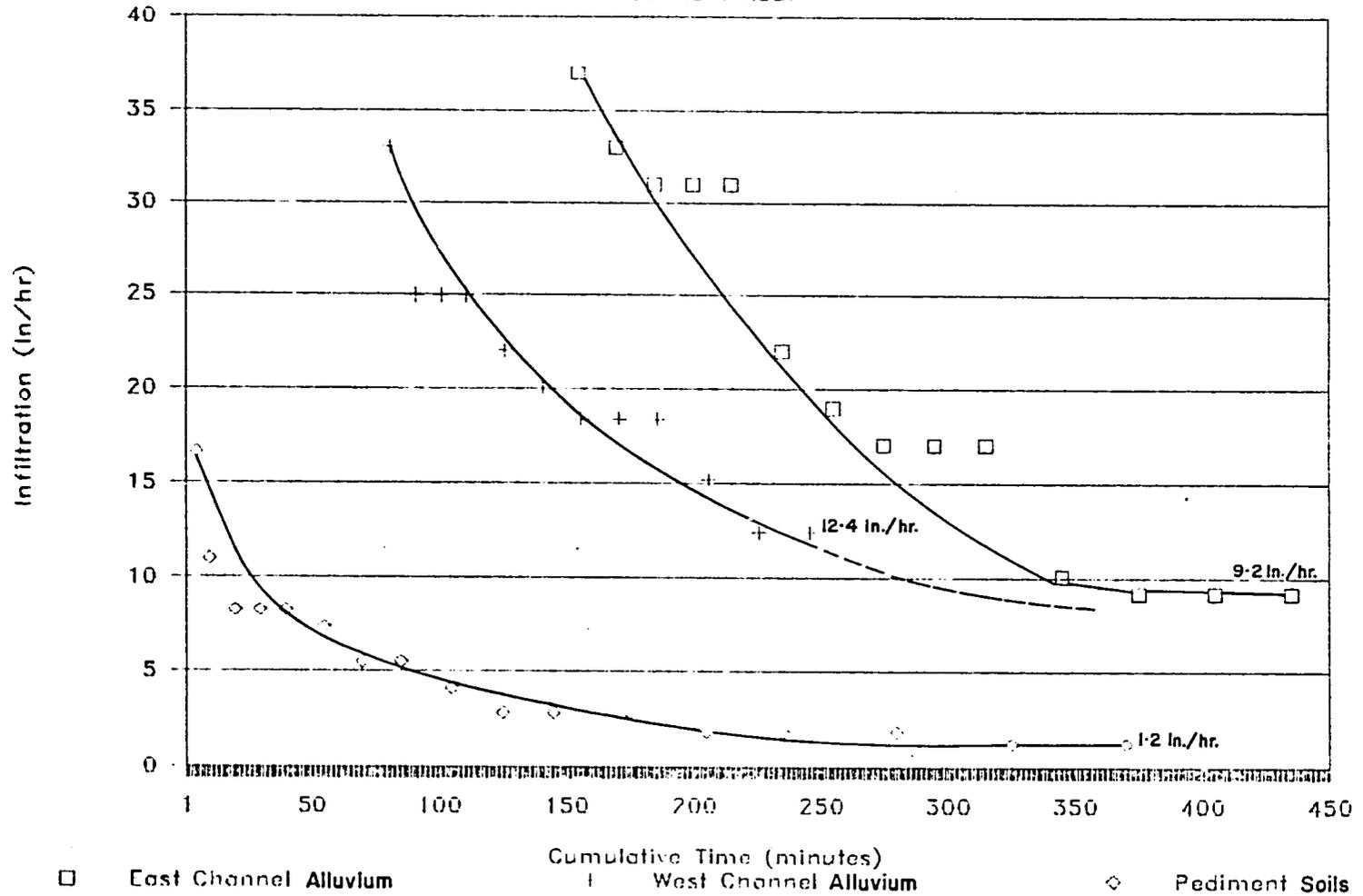
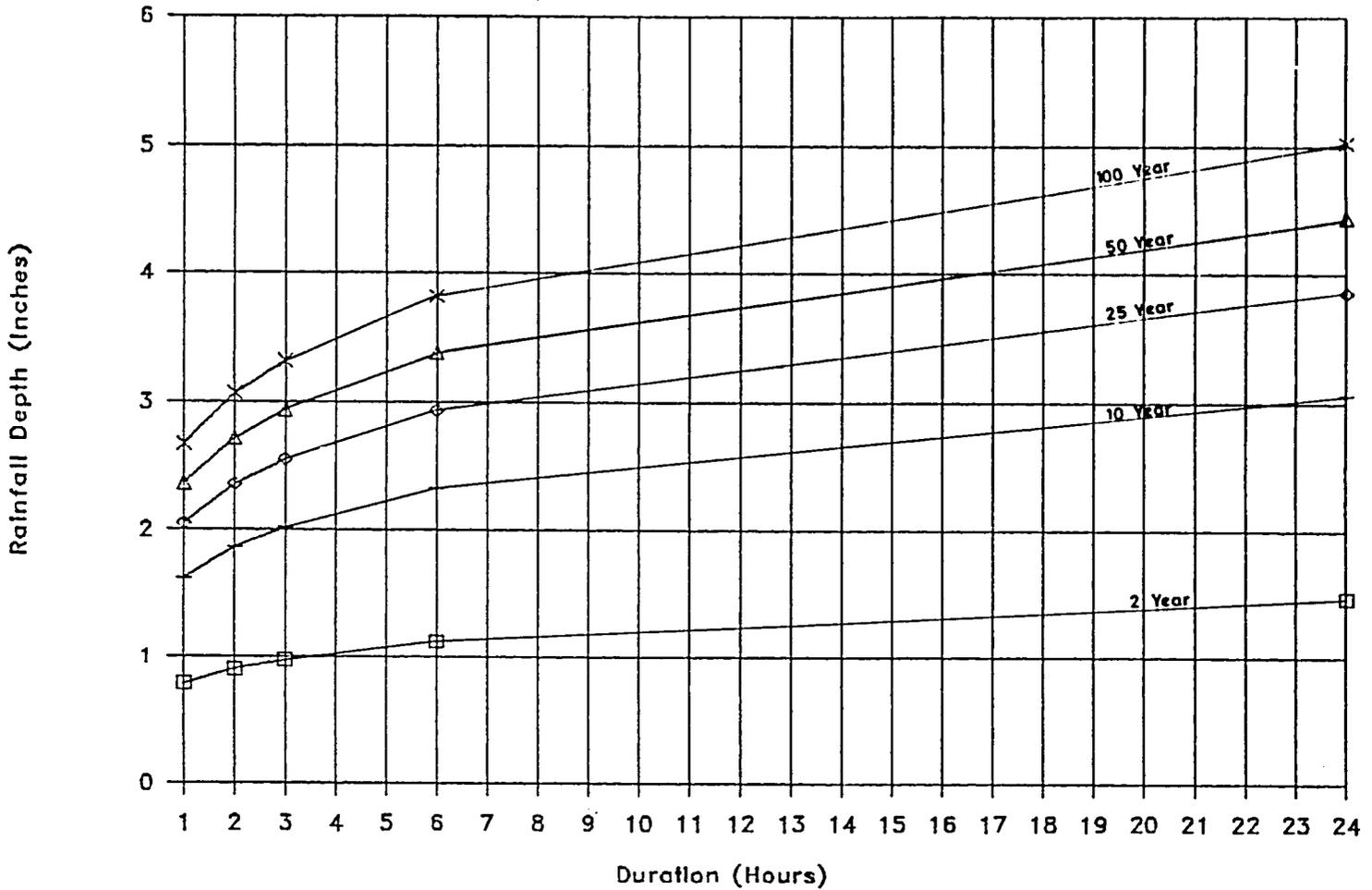


FIGURE 8

13

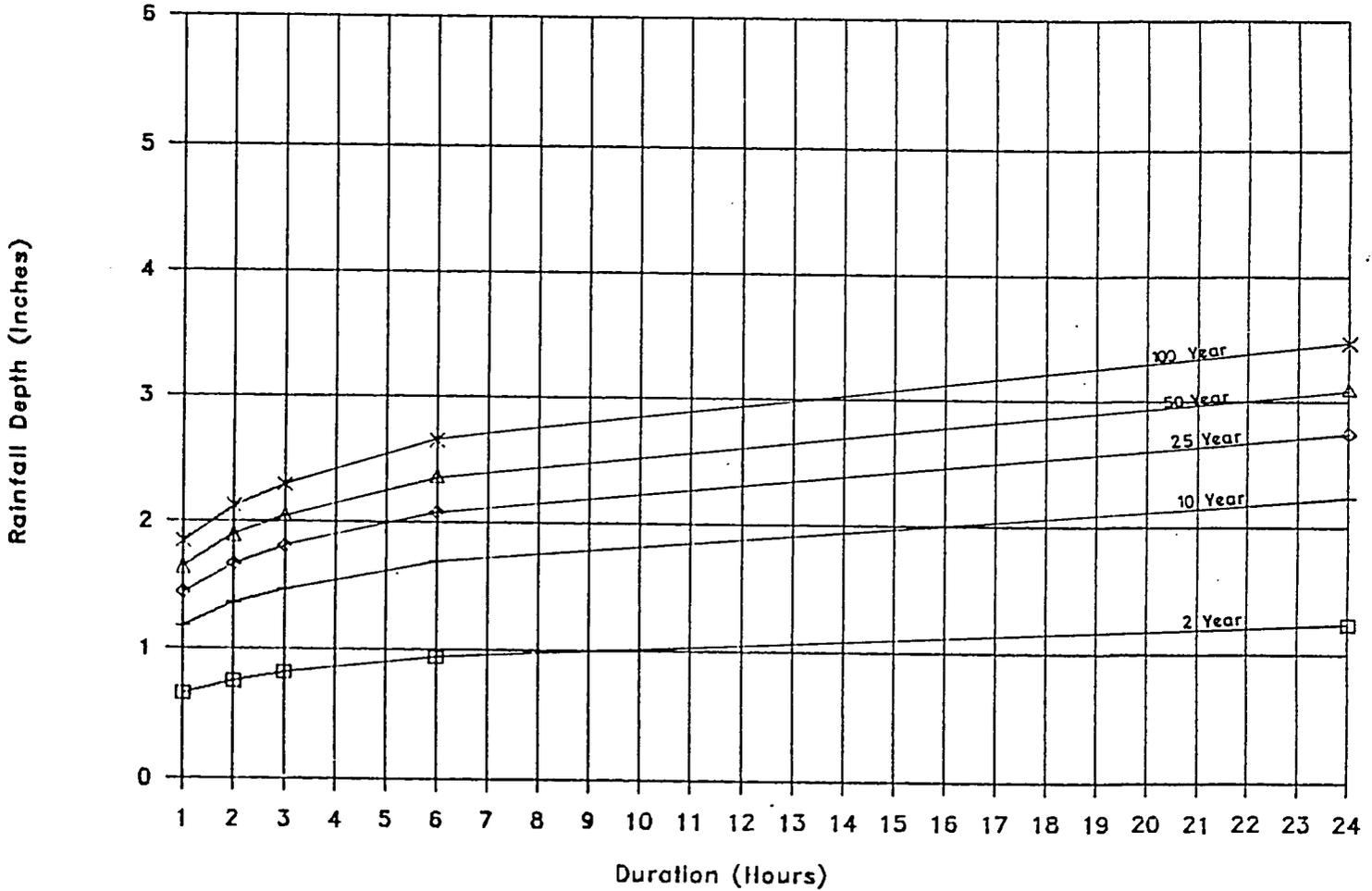
TURBAT RAINFALL



Data from BMIAD, 1988

FIGURE 10

PANJGUR RAINFALL



Data from BMIAD, 1988

FIGURE 11

51

Karez Flow Rates Uget-Abad

Turbat, 1986-1989

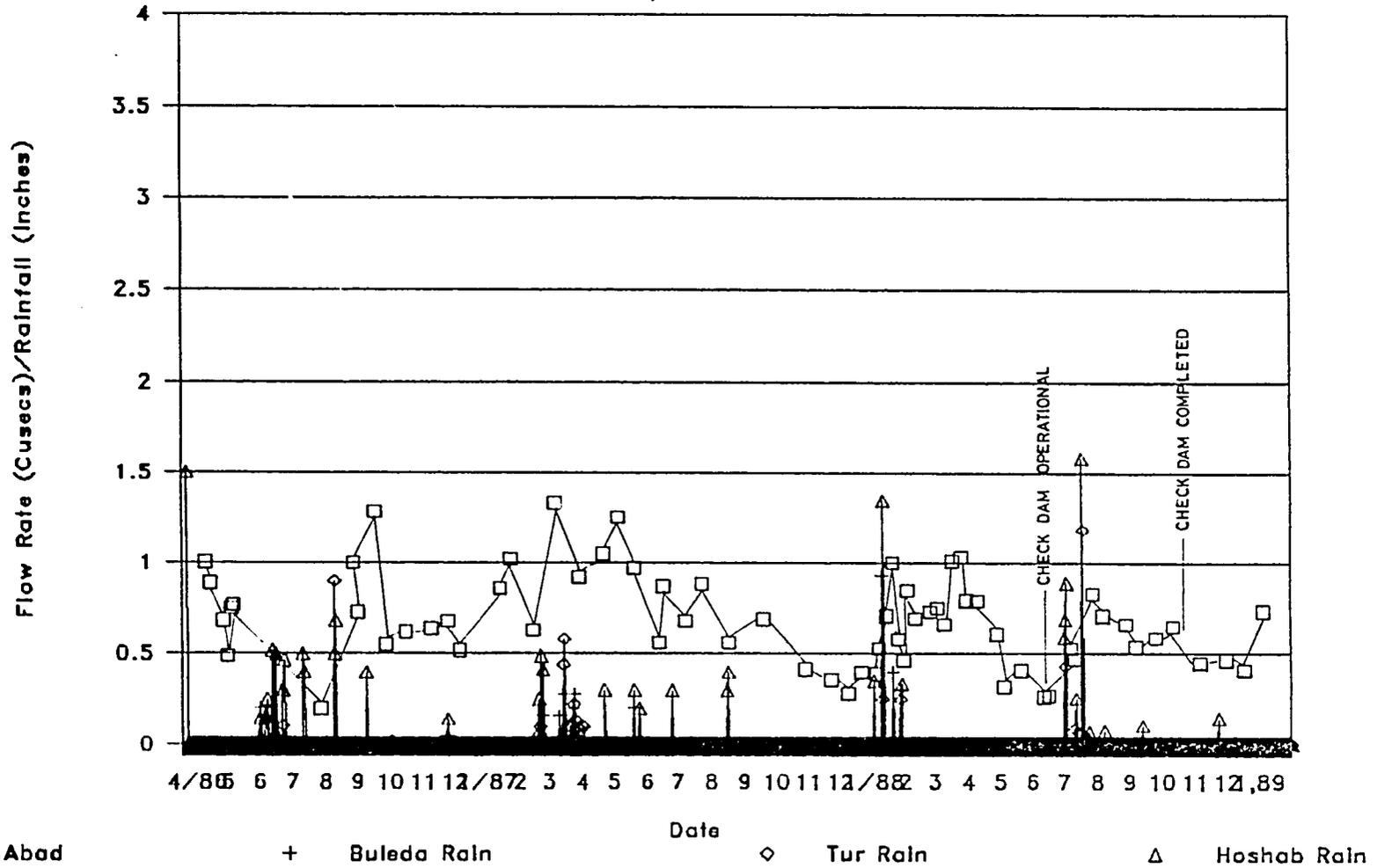
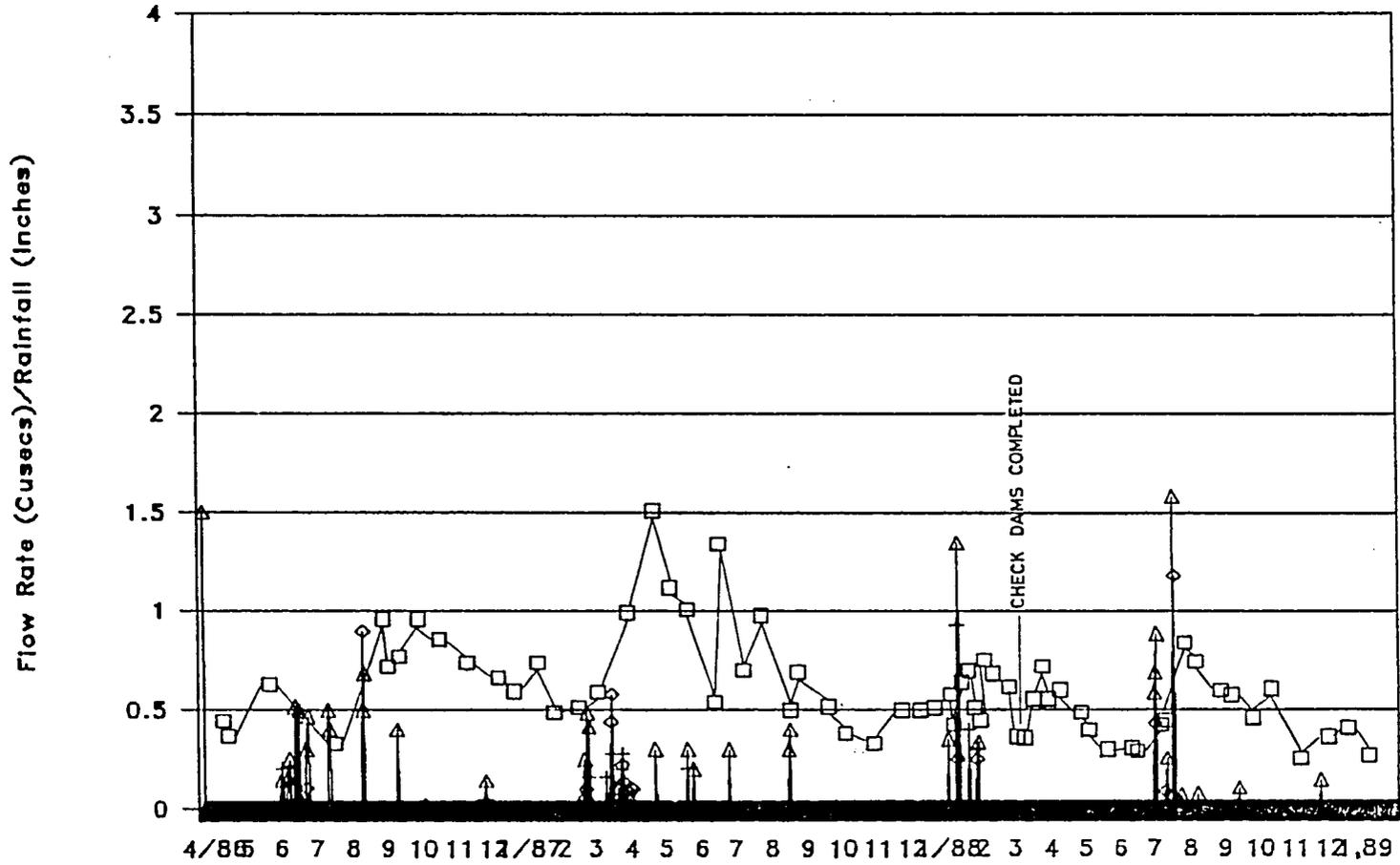


FIGURE 12.1

52

Karez Flow Rates Siri-Kan

Turbat, 1986-1989



Siri-Kan

+ Buleda Rain

Date

◇ Tur Rain

△ Hoshab Rain

FIGURE 12.2

Karez Flow Rates Challo

Turbat, 1986-1989

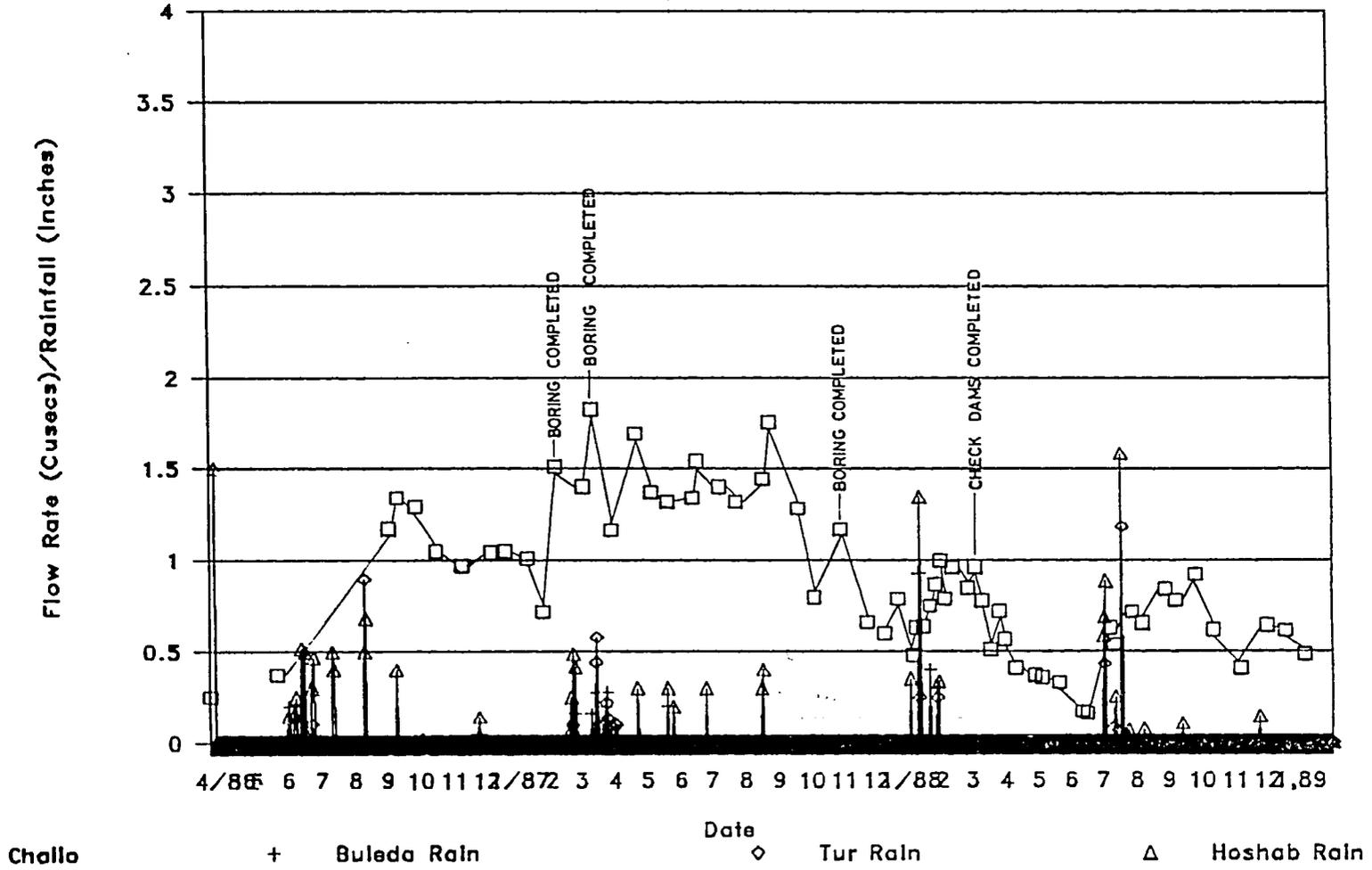
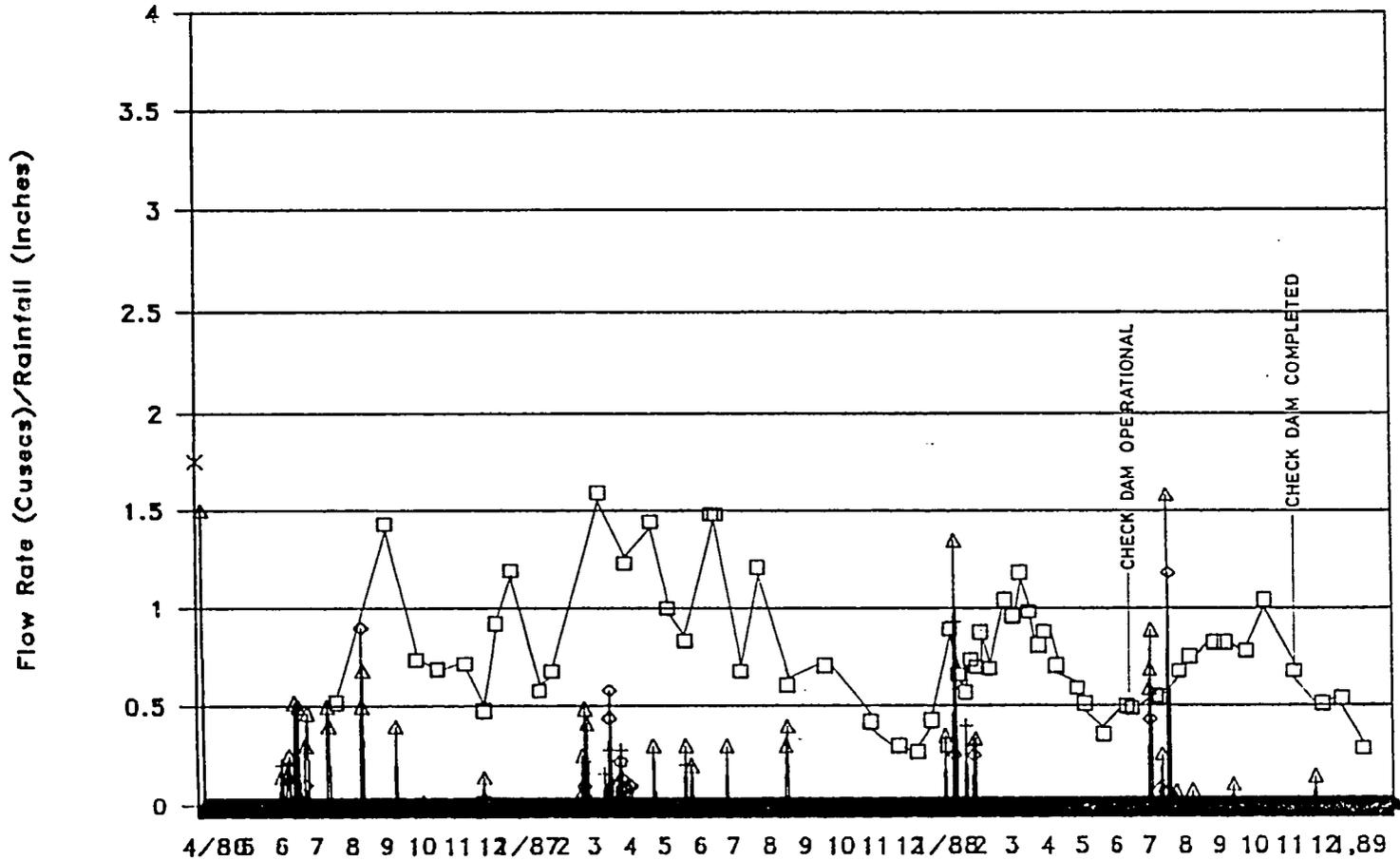


FIGURE 12.3

54

Karez Flow Rates Istellabad

Turbat, 1986-1989



Istellabad

+ Buléda Rain

Date

◇ Tur Rain

△ Hoshab Rain

FIGURE 12.4

Karez Flow Rates Miri

Turbat, 1986-1989

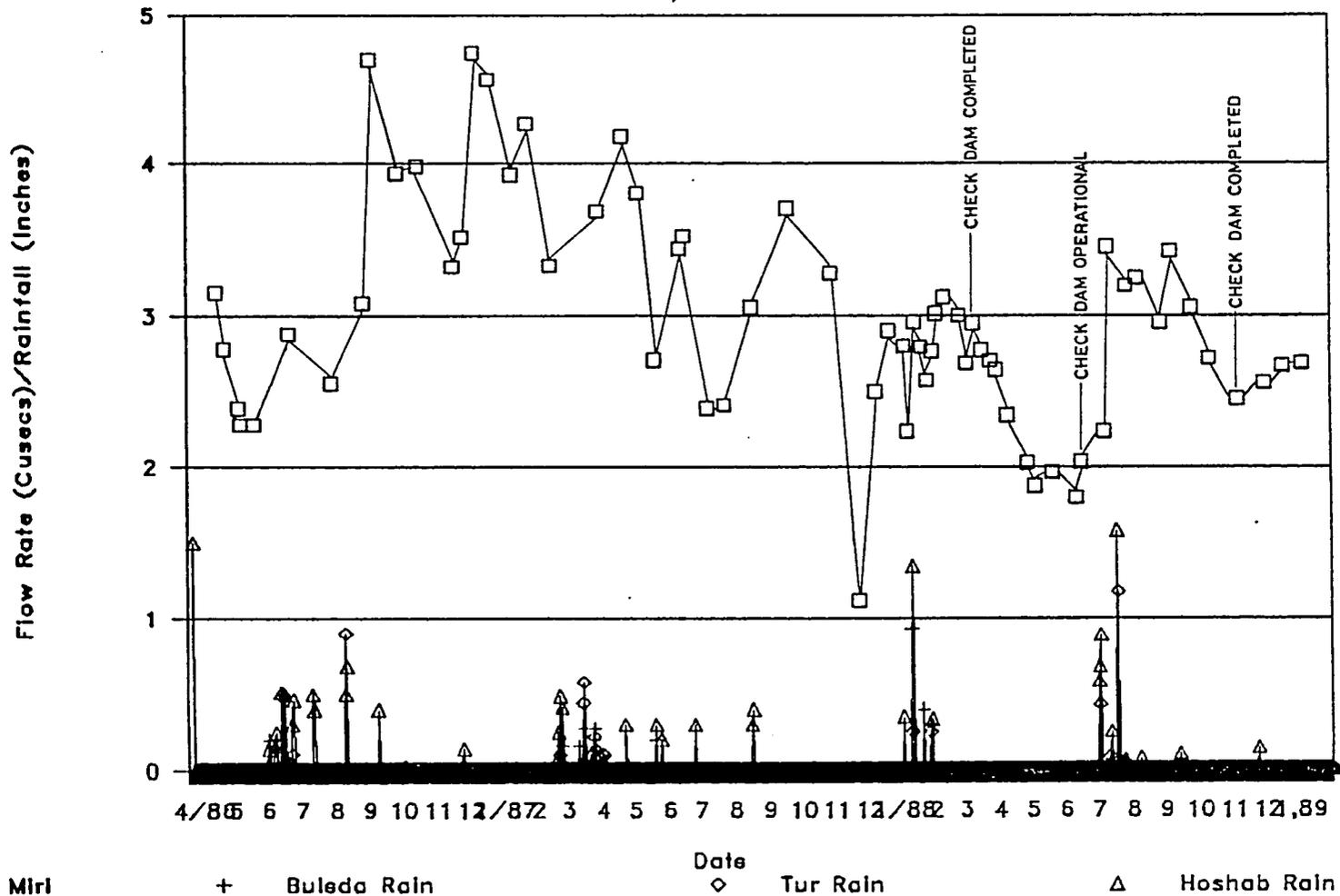


FIGURE 12.5

56

Karez Flow Rates Sohrani

Turbat, 1986-1989

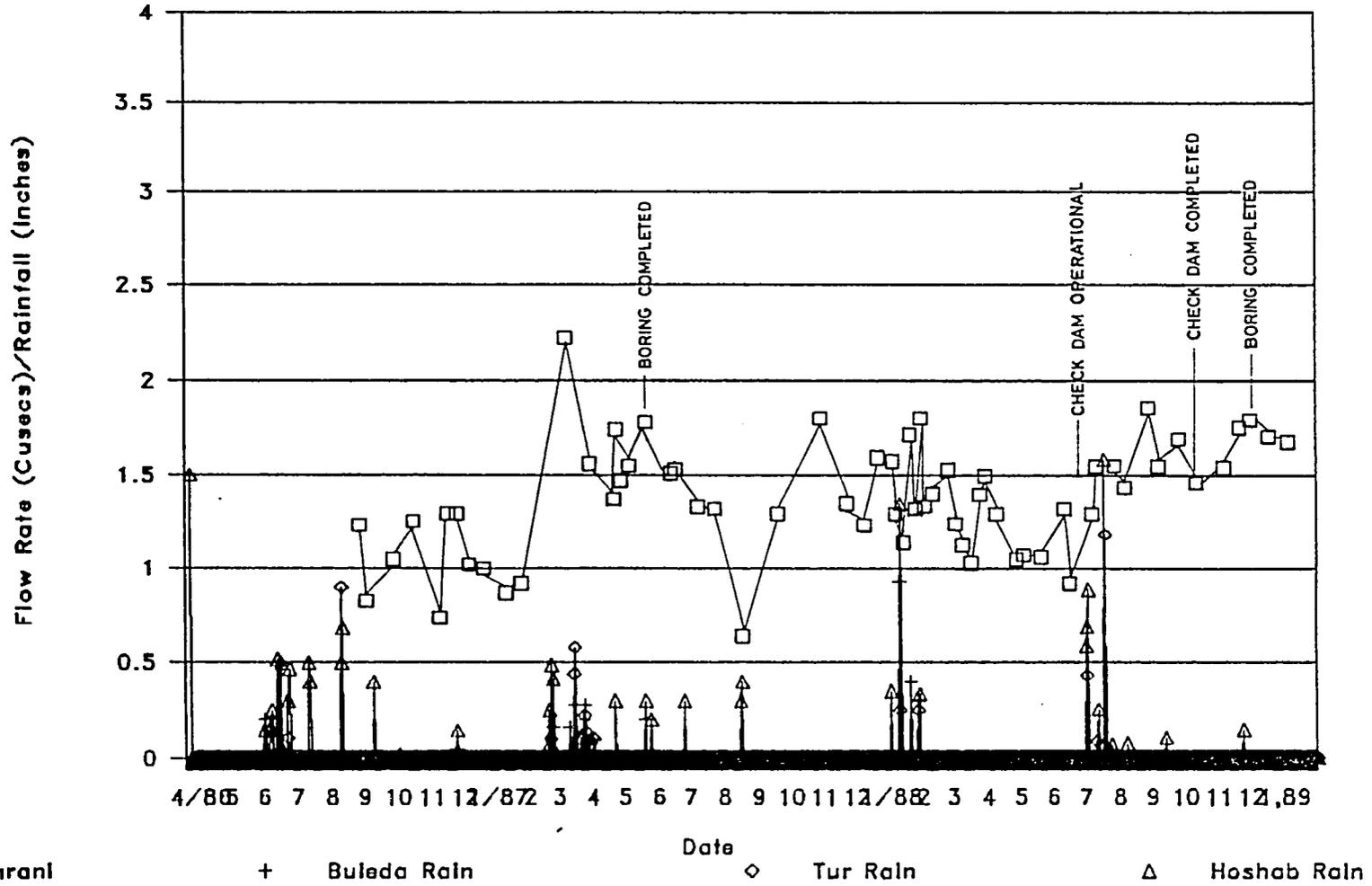


FIGURE 12.6

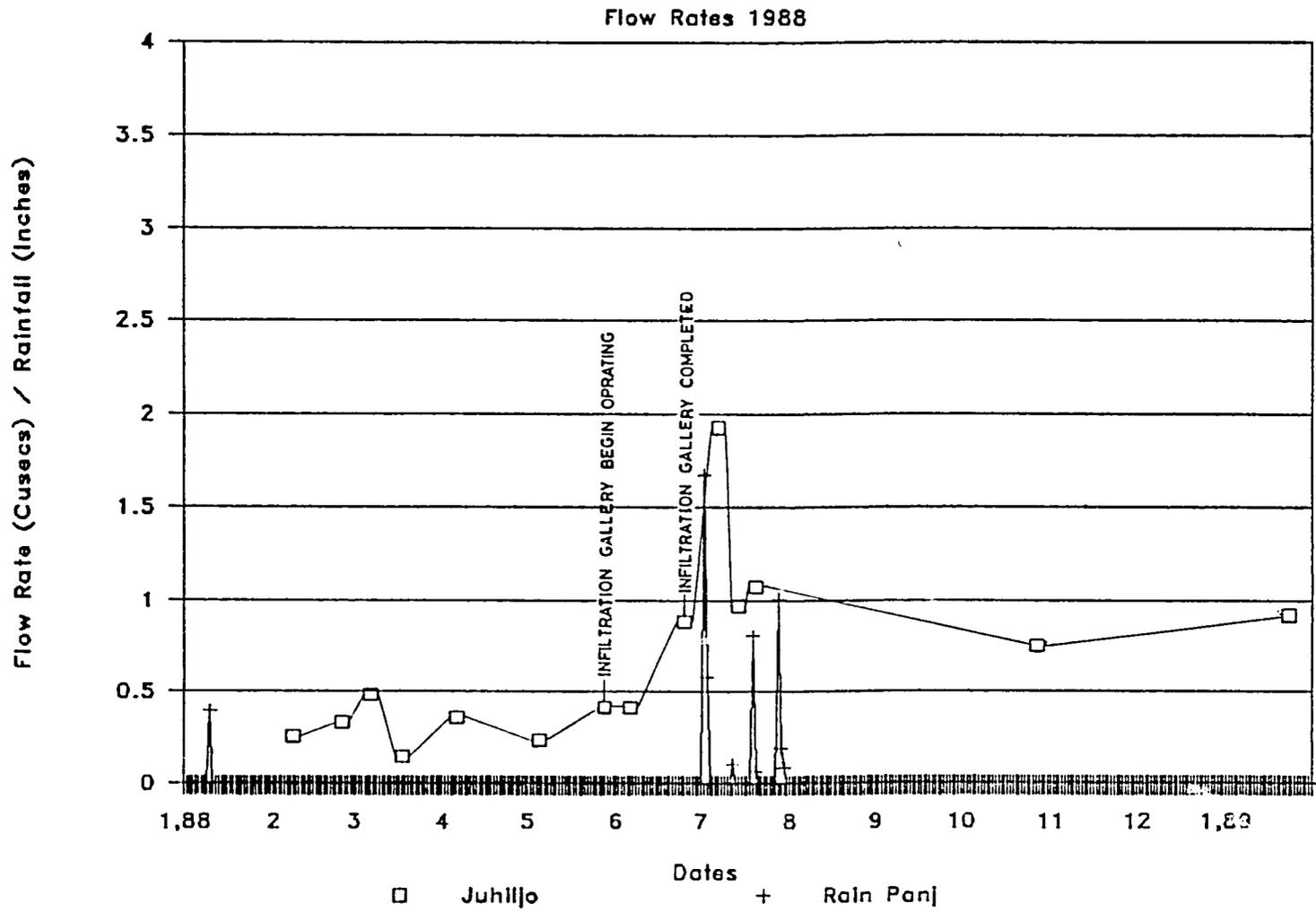


FIGURE 12.7

8.

Doznap Korjo

Flow Rates 1988 - 1989

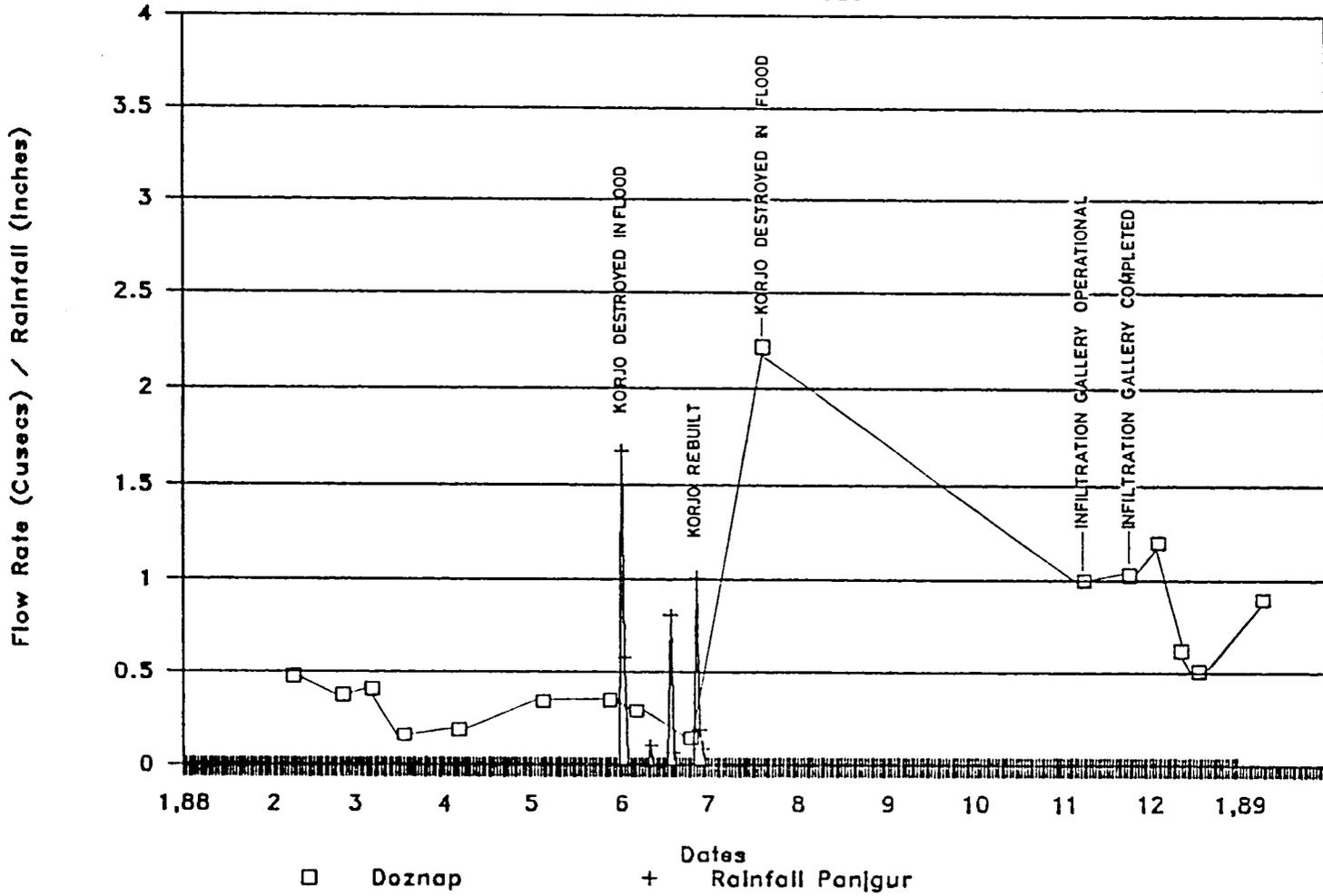


FIGURE 12.8

51

Mehmoodabad Karez

Flow Rates 1988 - 1989

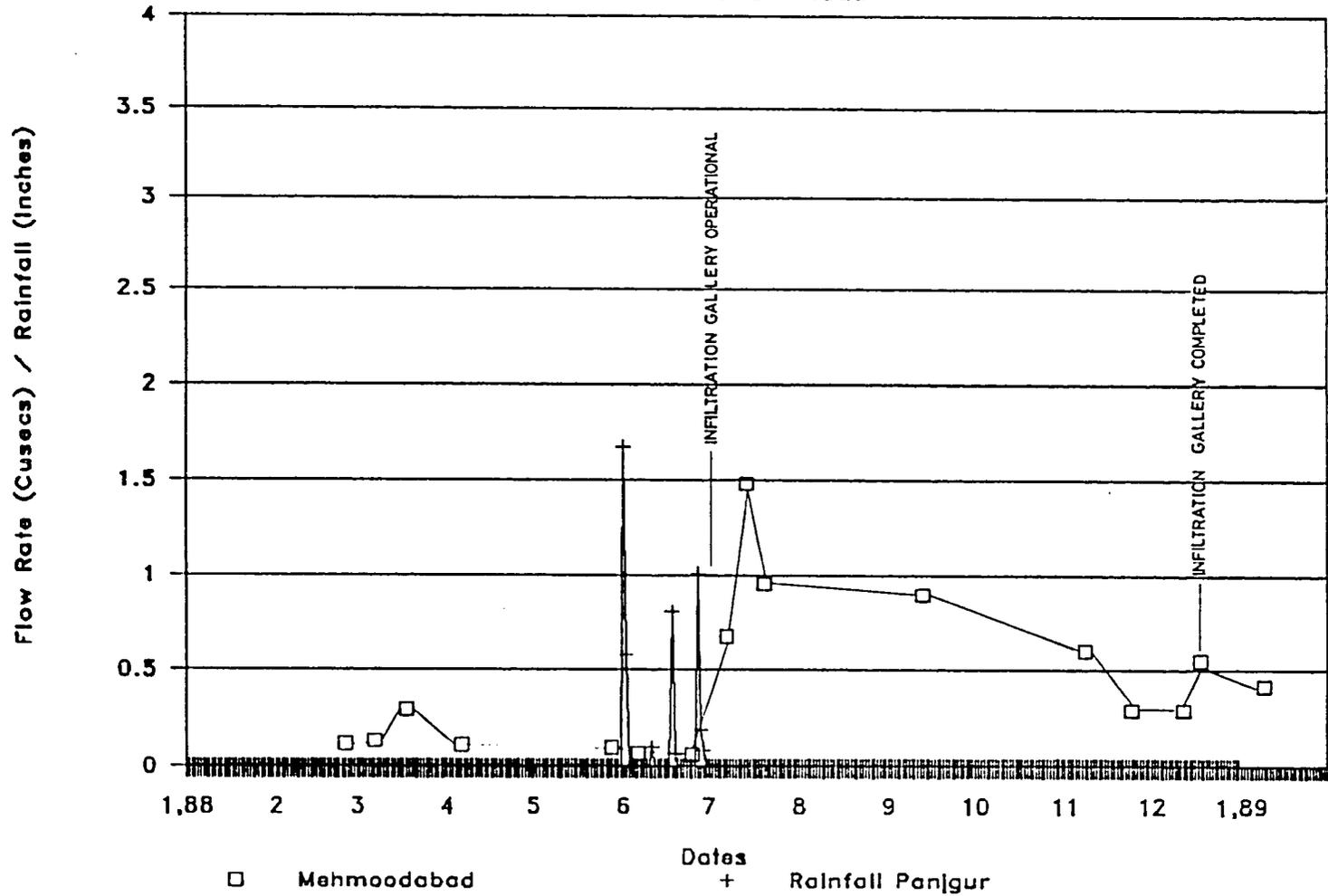


FIGURE 12.9

50

Takhan Karez

Flow Rates 1988

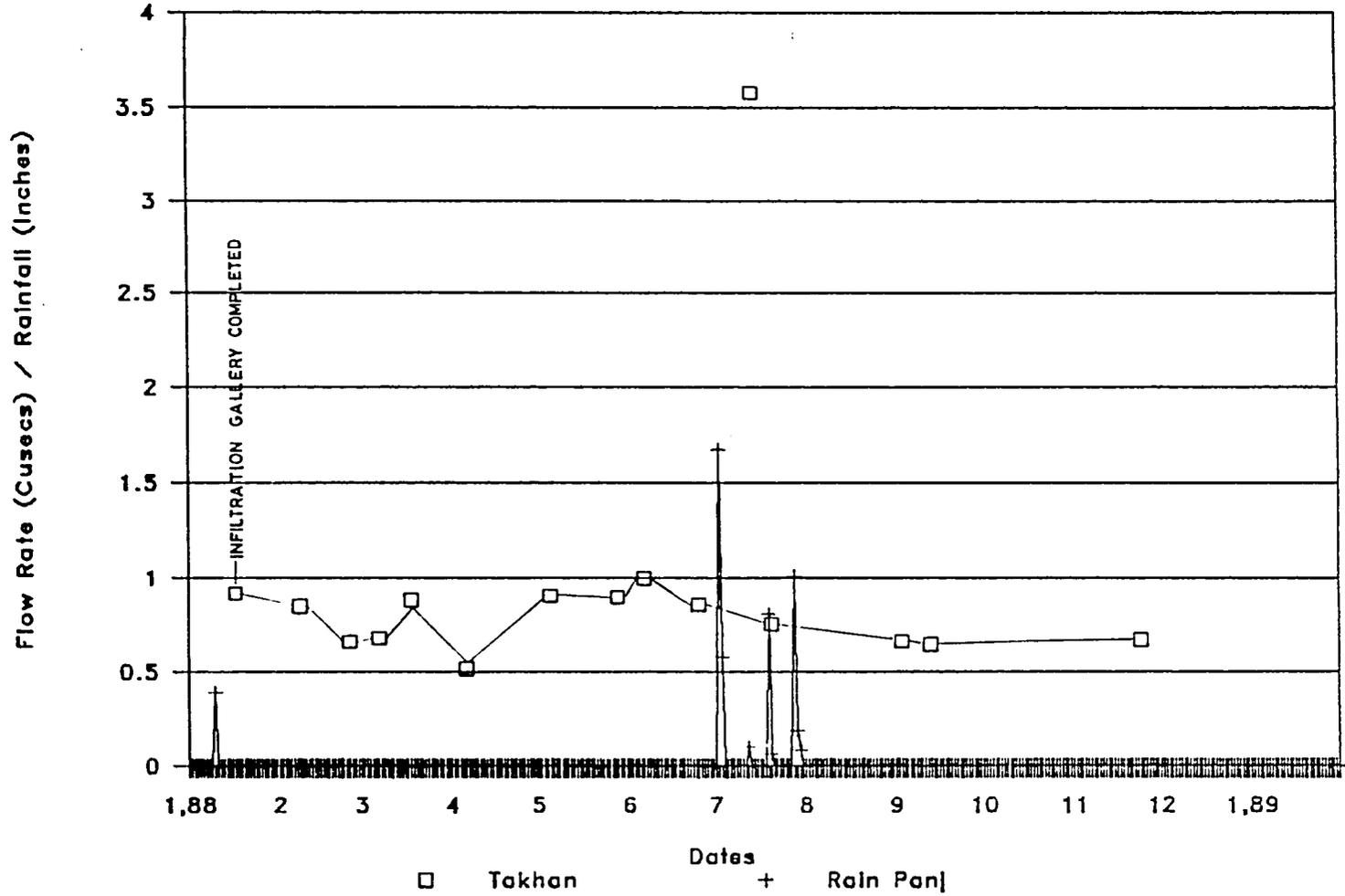


FIGURE 12.10

Mir Ketchi Karez

Flow Rates 1987 - 1989

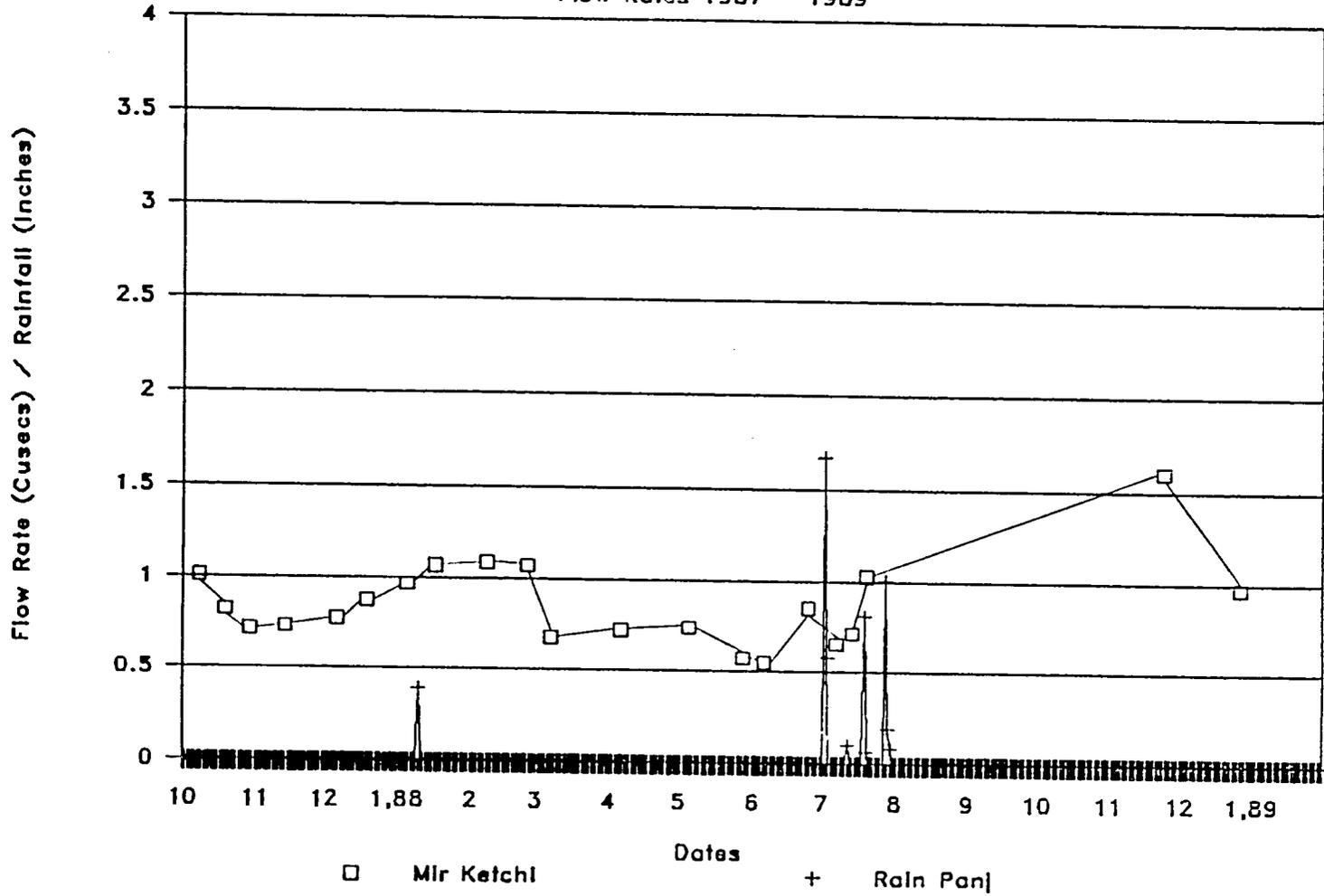


FIGURE 12.11

29

APPENDICES

APPENDIX A

BALAD Water Sector Projects

Project Name: Uget-Abad Siphon (3003)

Project Location: Kalmar of Uget-abad Karez in Kalatuk Village, approximately 20 kilometers west of Turbat on Turbat Mand road.

Project Description: A siphon using 10 inch diameter PVC pipe was placed across nullah of approximately 105 meters length to replace an earthen embankment which formed the existing channel.

Purpose: The kalmar was reported to be washed out frequently causing excessive repair costs and interruption of water supply. The seepage losses, although unfortunately not measured, were undoubtedly considerable based on measurements since collected in similar nullahs. Additional command area was also opened up on the north side of the existing command area by realigning the watercourse.

Project Identification: Identified and PC-1 approved by PFMU before arrival of TA team, apparently from direct request by sannishta.

PC-1 Approval: 04/02/86

Construction Started: 10/25/86

Construction Completed: 01/30/87 (approximately)

Status: Operational

Contractor: Atta-Muhammed

Estimated Cost: Rs 99,214

Actual Cost: Rs 108,686

Special Problems: Design problems involved uncertainty about maximum and minimum flow rates since only one month worth of measurements were available. Contractor took excessive amount of time on this scheme due to non availability of PVC pipe in Karachi. This problem apparently arose due to the fact that sufficient orders are required by the manufacturer before a production run is started. Contractors and PFMU complained that the drawings were too complex and the contractors inability to interpret the drawings was demonstrated. The contractor was, however, cooperative and the work satisfactory. Insufficient field personnel are available on the BALAD staff for adequate construction supervision.

Results: The scheme is operating successfully and the previous watercourse has been washed out by flooding. New command area appears to have been opened up by the karez owners. The lack of sediment buildup in the silt trap is

encouraging for maintenance free siphon operation in the watercourse. The scheme introduced PVC for siphons rather than RCC channels as are usually constructed in Makran. The project was completed for approximately 70 per cent of the PC-1 estimate for a concrete siphon and will function much better. Open trench excavation is done with nearly vertical walls and appears to be more stable than anticipated due to the consolidated nature of the nullah bed material.

Recommendations:

1. Measurements of the seepage losses in watercourses should be collected before future schemes are constructed to establish the benefit cost ratios.
2. Karez flow rate data should be collected on a variety of typical karezes of varying sizes and in various locations to establish maximum and minimum flow rates for watercourse improvement design.
3. PVC pipe should be procured by the BALAD project and stockpiled for distribution to the contractors. This procedure will save both time and money.
4. Since contractors appear to be incapable of interpreting drawings or of planning projects more experienced and responsible construction inspectors are required for the project.

BALAD Water Sector Projects

Project Name: Siri-Kan Siphon and Watercourse Lining (3014)

Project Location: Kalmer of Siri-Kan Karez in Kallag Village, approximately 10 kilometers west of Turbat on Turbat Mand road.

Project Description: Two siphons using 12 inch diameter PVC pipe were placed across two nullahs of approximately 46 and 35 meters length to replace the existing channel. Portions of the existing channel were lined but were in a poor state of repair and were leaking. The lined sections of Siri-Kan kalmer were replaced.

Purpose: The kalmer was reported to be washed out frequently causing excessive repair costs and interruption of water supply. The conveyance losses over the project length, due to seepage and channel overtopping, were observed to be over 50 per cent when measured in April, 1987. The project is designed to reduce the losses and the kalmer maintenance costs.

Project Identification: Identified and PC-1 approved by PFMU before arrival of TA team, apparently from direct request by sarrishta.

PC-1 Approval: 04/02/86

Construction Started: 06/10/87

Construction Completed: 11/30/87

Status: Operational

Contractor: Muhammed Murad

Estimated Cost: Rs 167,022

Actual Cost: Rs 220,459

Rs 50,575 for PVC pipe for siphons, supplied by BALAD Project to contractor

Total: Rs 271,034

Special Problems: Cost estimate was based on a premium of 20 per cent above 1985 CSR rates which proved to be too low, especially in the items related to concrete. Contractor took excessive time on this scheme due to poor planning. He encountered routine problems such as running out of steel and concrete. Surveying pegs were placed on downstream watercourse but were removed. The contractor subsequently installed the downstream siphon outlet and watercourse at incorrect levels. It was determined that sufficient freeboard was available in the channel to contain the backwater at maximum flow conditions so the work was not

removed. Some leakage in the siphon was encountered around the bend sections. This problem was solved by encasing the leaking portion in concrete.

Results: Water losses are considerably reduced in the Siri-Kan kalmer. measurements collected in December, 1987 indicate that losses over the project area are essentially nil. Siphon and watercourse are operating effectively. The siphons and watercourse are designed to operate between flow rates of 0.5 to 1.75 cusecs (the maximum observed flow rate in Siri-Kan in 1987-1987 was 1.5 cusecs).

After the winter rains in 1988 some scour was observed in the upstream section of the lined channel. This was protected by placing rip rap below this channel.

Contractors work was slow, unorganized, and the quality was poor.

Recommendations:

1. Zed joint PVC pipe should be used in future siphon construction to prevent leakage.
2. More qualified construction supervisors are required to supervise the contractors.
3. Watercourse improvement work should be accelerated since enormous savings of water can be realized with minimal expenditure.
4. Channel linings should, in the future, contain a turnout for clothes washing.
5. Cost estimates should continue to be based on a 30 per cent premium until more experience with local rates is achieved.

BALAD Water Sector Projects

Project Name: Khuda-abad Watercourse Lining (3030)

Project Location: Kalmer of Khuda-abad Karez in Sordo Village, Panjgur.

Project Description: A portion of the Khuda-abad kalmer crossing a congested part of Sordo was lined with concrete to reduce water losses and choking of the channel. The lined portion of the channel is approximately 160 meters in length.

Purpose: The kalmer was reported to be frequently blocked due to the deposition of rubbish from the village. The kalmer also lost significant water over the project area. Measurements collected on October 7, 1987 indicated that 0.32 cusecs, or 25.6 per cent of the karez flow, was being lost due to seepage and overtopping of the kalmer. These losses have been eliminated by channel lining.

Project Identification: Identified by the Panjgur DCC, apparently from direct request by sarrishta. Approved by the Turbat DWC.

PC-1 Approval: 06/30/87

Construction Started: 10/27/87

Construction Completed: 11/30/87

Status: Operational

Contractor: Naseeruddin

Estimated Cost: Rs 95,662

Actual Cost: Rs 91,169

Special Problems: After construction was started the sarrishta requested that the channel width be increased from 0.30 meters to 0.45 meters to improve access for cleaning. The point was considered valid and the design was changed and approved. The resulting increase in cost was approximately 8 per cent.

Results: Water losses are reduced to essentially nil in the lined portion of the Khuda-abad kalmer. The improved watercourse is operating effectively.

Recommendations:

1. A minimum channel width of 0.45 meters will be adopted for future channel designs.

BALAD Water Sector Projects

Project Name: Atta-abad Siphons (3065)

Project Location: Kalmer of Atta-abad Karez in Sardul Village, Panjgur District.

Project Description: Three siphons using 10 inch diameter PVC pipe were placed across three nullahs crossed by Atta-abad kalmer.

Purpose: The siphons will reduce the conveyance losses, measured at 16 per cent, and will reduce the kalmer maintenance costs and prevent the periodic interruption of water supply. Atta-abad is a new karez and the command area is currently under preparation.

Project Identification: Brought to the attention of the BALAD staff by the sarrishta and approved by the DWC.

PC-1 Approval: 08/16/87

Construction Started: 10/27/87

Construction Completed: 01/07/88

Status: Operational

Contractor: Naseeruddin

Estimated Cost: Rs 63,057

Actual Cost: Rs 60,162

Rs 65,300 for PVC pipe for siphons, supplied by BALAD Project to contractor

Total: Rs 125,462

Special Problems: No special problems were encountered. The contractor did a satisfactory job.

Results: Conveyance losses are considerably reduced in the kalmer. Siphons are operating effectively. All three channels have been washed out by flooding in early January and the channel reconstruction costs and the interruption of the water supply were prevented by the siphons.

Recommendations:

1. Assumption of 2:1 trench slopes in the BOQ, even in the nullah beds, is excessive and should be reduced in future BOQs.

BALAD Water Sector Projects

Project Name: Ghousabad/Noorabad Siphons (3053)

Project Location: Kalmer of Ghousabad and Noorabad Karezes in Washbub Village, Panjgur District.

Project Description: A siphon using 12 inch diameter PVC pipes was placed across two nullahs, both branches of Pardan Kaur, of approximately 100 meters each in length to replace the existing channel. Two pipes were used for Noorabad and one for Ghousabad. The inlet and outlet chambers of these siphons were combined in one structure.

Purpose: Ghousabad and Noorbad Karezes are both losing significant water to seepage across the nullahs. Both are also experiencing periodic interruptions of water supply due to washouts results from flooding events in Fardan Kaur. One of the nullahs has an aquaduct for Ghousabad which has been partially destroyed by flooding in the one year since it was constructed. Measurements indicate that Ghousabad and Noorabad are losing 4 and 15 per cent, respectively, of the karez flows across the project area. The construction of the siphons will conserve the water currently lost to seepage and will prevent the periodic interruptions in water supply as well as reducing the kalmer maintenace costs.

Project Identification: Brought to the attention of the BALAD staff by the sarrishta and approved by the DWC.

PC-1 Approval: 08/16/87

Construction Started: 10/27/87

Construction Completed: 12/31/87

Status: Operational

Contractor: Muhammed Jan

Estimated Cost: Rs 321,000

Actual Cost: Rs 187,531

Rs 369,940 for PVC pipe for siphons, supplied by BALAD
Project to contractor

Total: Rs 557,471

Special Problems: No special problems were encountered. Contractor was unresponsive to the Engineer's requests and directions. The downstream chambers at both siphons are leaking and the contractor seems uninterested in completing the project.

Results: Conveyance losses are considerably reduced in the

kalmers. Siphons are operating effectively. The kalmers are now protected against flooding of the Pardan Kaur.

Recommendations:

1. Assumption of 2:1 trench slopes in the BOQ, even in the nullah beds, is excessive and should be reduced in future BOQs.
- 2, The contractor's retention money should not be released until such time as the channel repairs are made.

BALAD Water Sector Projects

Project Name: Tump Watercourse Lining (3013)

Project Location: Kalmer of Tump Karez in Shai-Tump, Turbat.

Project Description: A portion of the Tump kalmer crossing a small nullah in Shai-Tump was lined with concrete to reduce water losses and periodic maintenance of the channel. The lined portion of the channel is approximately 40 meters in length and includes a road crossing and a drainage crossing.

Purpose: The kalmer was reported to be frequently blocked due to the deposition of rubbish from the village. The kalmer also lost significant water over the project area at the road crossing. The project will prevent periodic damage of the kalmer by flooding and choking of the channel by deposition of rubbish.

Project Identification: Identified by the FFMU apparently from direct request by sarrishta prior to the arrival of the TA team. Approved by the Turbat DWC.

PC-1 Approval: 04/03/86

Construction Started: 02/12/88

Construction Completed: 03/10/88

Status: Operational

Contractor: Rasool Buksh

Estimated Cost: Rs 43,135

Actual Cost: Rs 40,533

Special Problems: The project was too small to attract contractors interest when first tendered. Based on previous experience at Khuda-abad the channel width was increased to 0.45 meters width. The drainage crossing was, consequently lowered by 0.20 meters to enhance the effectiveness of the drainage.

Results: Water losses are reduced to essentially nil in the lined portion of the Tump kalmer and the channel is safe against flooding in the nullah. The improved watercourse is operating effectively. The contractor was cooperative and the quality of the workmanship was satisfactory.

Recommendations:

1. Projects of this size should only be contracted in clusters to make the contracts large enough to be interesting to local contractors.

BALAD Water Sector Projects

Project Name: Kallan and Churro Siphons (3091)

Project Location: Kalmers of Kallan Karez in Sordo Village, and upstream portion of Churro korjo, 600 meters downstream from infiltration gallery. Both located in the Panjgur District.

Project Description: One siphon using 12 inch diameter PVC pipe was placed across the Kallan kalmers crossing of Parwan Kaur. An additional siphon using 2 pipes of 12 inch diameter was placed on the Churro korjo in the Rakhshan floodplain.

Purpose: The Kallan siphon will reduce the conveyance losses, measured at 5.5 per cent of the karez flow, and will reduce the kalmers maintenance costs and prevent the periodic interruption of water supply. The Churro siphon will prevent breaching of the channel by flow from the nullah crossing and by high flow from the Rakhshan. The Kallan siphon is designed to accommodate 1.5 cusecs and the Churro siphon for 3 cusecs of flow.

Project Identification: Project identified directly by IA team. The Kallan kalmers crosses Parwan Kaur near the Nakam infiltration gallery and the problem was observed during the Nakam construction. The Churro siphon was observed during the construction of the Churro Infiltration Gallery.

PC-1 Approval: 11/16/87
Construction Started: 02/10/88
Construction Completed: 03/17/88

Status: Operational

Contractor: Naseer-Ud-Din

Estimated Cost: Rs 73,000
Actual Cost: Rs 75,033

Rs 157,200 for PVC pipe for siphons, supplied by BALAD Project to contractor

Total: Rs 228,574

Special Problems: No special problems were encountered. The contractor did a satisfactory job.

Results: Conveyance losses are considerably reduced in the kalmers. Siphons are operating effectively and the channels are protected from flooding. It is estimated that each siphon will save approximately 25 acre-feet of irrigation water, enough to irrigate approximately 3 acres, per year.

One of the siphon pipes at Churro was partially infilled with sediment during the monsoon flooding of 1988. The sedimentation was the result of inundation by river water not from deposition from Karez water.

Recommendations:

1. Miscellaneous tractor work for removal of the existing channels should be included in future SOQ's for siphon construction.

Project Summary
BALAD Water Sector Projects

Project Name: Saadabad Siphon and Channel Improvement (3006)

Project Location: Kalmar of Saadabad Karez in Kalatuk Village, approximately 30 kilometers west of Turbat on Turbat Mand road.

Project Description: A siphon using 12 inch diameter PVC pipe was placed across nullah of approximately 54 meters length to replace an earthen embankment which formed the existing channel. A culvert was constructed to allow for the passage of vehicles over the channel. The earthen embankments were raised for flood protection. An existing aquaduct was repaired and protected against future flood damage.

Purpose: The kalmar was reported to be washed out frequently causing excessive repair costs and interruption of water supply. The seepage losses, measured on 09/30/87, were 0.18 cusecs or 19 per cent of the total karez flow. The purpose of the scheme was to reduce the maintenance costs, prevent the interruption of water supply, and to conserve water currently being lost.

Project Identification: Identified and PC-1 approved by FFMU before arrival of TA team, apparently from direct request by sarrishta.

PC-1 Approval: 04/03/86

Construction Started: 10/13/87

Construction Completed: 04/7/88

Status: Operational

Contractor: Muhammed Murad

Estimated Cost: Rs 184,461

Actual Cost: Rs 192,874

Cost of PVC Pipe: Rs 35,700

Total Cost: Rs 228,574

Special Problems: Between the project design and construction phase heavy flooding damaged the cover slabs of the existing aquaduct at Saadabad. The repair and protection of this aquaduct was added to the project during construction.

Results: The siphon and culvert and channel protection are operating effectively. The three flood events occurred in the winter rainy season of 1988 and minor damage to the flood

protection bunds at the aquaduct occurred. Monitoring has shown that thus far there is no sediment deposition in the siphon. The measurements collected thus far are given below:

Date	Flow Rate (cusecs)	Mannings n
01/27	1.13	0.013
02/25	1.42	0.011
03/30	1.02	0.010

Recommendations:

1. Measurements should be collected in the upstream and the downstream siphon chambers along with flow rates on a periodic basis. Computation of the friction loss coefficient each month will allow for observation of sedimentation, if any, in the siphon.
2. Measurements indicate that Manning's n for the Sarina PVC is approximately 0.012. The manufacturers specifications do not include this coefficient.
3. The grating used at Saadabad, 1 inch by 1 inch mesh, made with the rebar embedded into the wall of the chambers, is performing better than any grating yet constructed. Future siphons should use this mesh size and construction method.

BALAD Water Sector Projects

Project Name: Challo Karez Channel Improvement (3114)

Project Location: Kalmer of Challo Karez near Kallag Village, approximately 5 kilometers west of Turbat on Turbat Mand road.

Project Description: An RCC channel was constructed to replace the Challo kalmer which was in poor condition requiring recurring maintenance costs and entailing high conveyance losses.

Purpose: The kalmer was observed to be losing approximately 25 per cent of the water supplied by Challo Karez. In addition, since the kalmer was in a deep channel, the maintenance costs of this kalmer were excessive. The channel lining was intended to reduce the maintenance costs and to conserve the water currently lost to seepage and weeds.

Project Identification: Identified and PC-1 approved by DWC apparently from direct request by sarrishta.

PC-1 Approval: 12/26/87

Construction Started: 02/12/88

Construction Completed: 06/28/88

Status: Operational

Contractor: Muhammed Murad

Estimated Cost: Rs 213,200

Actual Cost: Rs 135,364

Special Problems: The upstream portion of the proposed channel, approximately 50 meters in length, was abandoned due to loose soil encountered in the excavation. Several small collapses occurred which indicated that a danger to the workmen was present in this portion of the karez. This section was not considered to be essential to the functioning of the channel lining and was abandoned. Numerous unproductive encounters between the sarrishta and the contractor occurred and on more than one occasion the sarrishta interfered with the contractor's work with no sensible cause. These problems were eventually resolved. The channel was lowered below the design level at the insistence of the sarrishta.

Results: The kalmer channel is operating effectively now and is saving channel maintenance and conveyance losses are reduced. It is anticipated that approximately 100 acre-feet per year will be conserved by the project, a quantity sufficient to irrigate approximately 14 acres at the

measured consumptive use rates at Challo karez. Considerable savings resulted in the reduction of the channel lining by approximately 50 meters. Since the excavation was greatest in the abandoned portion the savings are disproportionate to the actual scope of the deleted work. The contractors work, though slow, was satisfactory and was well organized. The quality of the work has improved considerably during the three contracts completed by Mr. Murad.

Project Summary
BALAD Water Sector Projects

Project Name: Bayan Siphon (3129)

Project Location: Kalmer of Bayan Karez near Tump village, Turbat District.

Project Description: A 55 meter siphon using 12 inch diameter PVC pipes was placed across a nullah which divides the newly created Bayan command area.

Purpose: Bayan is a new karez and the command area is currently being prepared for cultivation. The command area was divided by a deep nullah. The siphon conveys the karez water across the nullah and allows for the utilization of the eastern command area.

Project Identification: Identified by the sarrishta and approved by the DWC.

PC-1 Approval: 08/16/87

Construction Started: 06/31/88

Construction Completed: 12/05/88

Status: Operational

Contractor: Muhammed Yousuf & Brothers

Estimated Cost: Rs 72,200*

Actual Cost: Rs 76,952*

Rs 67,500 for PVC pipe for siphons, supplied by BALAD Project to contractor*

Total: Rs 144,452*

*Includes Gharibabad, Bayan, and Allah Bukht siphons, all contracted together

Special Problems: No special problems were encountered.

Results: The siphon is operating the command area on the eastern side of the nullah is now being prepared for cultivation. The siphon has allowed the command area to be doubled.

Recommendations:

Project Summary
BALAD Water Sector Projects

Project Name: Allah Bukht Siphon (2045)

Project Location: Kalmer of Allah Bukht Karezes in Kalatuk village, Turbat District.

Project Description: A 24 meter siphon using 12 inch diameter PVC pipes was placed across the Turbat Mand road to replace an existing culvert which had been superimposed on the road and was failing structurally. The existing culvert also imposed a dangerous vertical curve on the road.

Purpose: To allow for the removal of the damaged culvert and the dangerous vertical curve on the near Kalatuk village.

Project Identification: Identified by the BALAD Road Section and approved by the DWC.

PC-1 Approval: 08/16/87

Construction Started: 06/31/88

Construction Completed: 12/05/88

Status: Operational

Contractor: Muhammed Yousuf & Brothers

Estimated Cost: Rs 72,200*

Actual Cost: Rs 76,952*

Rs 87,500 for PVC pipe for siphons, supplied by BALAD Project to contractor*

Total: Rs 164,452*

*Includes Gharibabad, Bayan, and Allah Bukht siphons, all contracted together

Special Problems: No special problems were encountered.

Results: The siphon is operating and the damaged culvert has been removed. The road has been leveled and the dangerous vertical curve removed.

Recommendations:

APPENDIX B

BALAD Water Sector Projects

Project Name: Karez Extensions

Project Location: Challo, Uget-abad, Miri, Siri-Kan, and Kaisak karezes, all in the Turbat district.

Project Description: The karezes were extended upstream by the addition of one well and the connection of this well by karez tunnel. Traditional labor techniques were used.

Purpose: Karez extension is the most ubiquitous technique of providing additional irrigation water in Makran. One main purpose of the scheme was to observe the effects of karez extension and to collect data on the current practices of karez enhancement.

Project Identification: Identified and PC-1 approved by PFMU before arrival of TA team, apparently from direct request by sarrishtas. Although this work is outside the scope of the project paper the project was recommended partially to alleviate frustrations among local officials in the slow start to BALAD work. The project was then used to collect information on karez flows and construction practices.

PC-1 Approval: 04/03/86
Construction Started: 04/15/86
Construction Completed: 07/15/86

Status: Operational

Contractor: Work was contracted by PFMU directly with the sarrishta of each concerned karez, according to traditional karez work. A lump sum of Rs 9,000 for each well and Rs 21,000 for each karez connection was agreed with the condition that each new well must be at least as far from the existing last well as it was from the previous well. The cost estimate was verified, as much as possible, by TA team inquiries with sarrishtas and with the Irrigation Department.

Estimated Cost: Rs 150,000 (Rs 30,000 for each extension)
Actual Cost: Rs 150,000

Special Problems: Measuring of flow rates at the karez mouths proved difficult. V notch weirs were installed at each karez and assurances were given by the concerned sarrishtas that the weirs would be protected and that assistance would be given for collection of measurements. No assistance was forthcoming and most of the weirs were removed. Lump sum payments were made for excavation work although there was considerable variation in the actual work involved in each extension.

Results: Significant increases in the flow rates at each of the karez were realized. Some measurements were collected and indications of increases ranging from 5 to 20 per cent were recorded. It was observed that karez flow rates change drastically and rapidly in response to climatic conditions.

Recommendations:

1. Collection of long term flow rates is essential since it is obvious from the data collected that karez flows change rapidly and drastically seasonally. Maximum and minimum flow rates must be known for design of watercourse improvements. Portable current velocity meters should be procured for this purpose.
2. Any future karez excavation work should be paid on a unit cost rather than a lump sum basis.
3. Karez extension and deepening are the most frequently requested projects from the karez owners. Karez extension and deepening is usually done to maintain existing flow rates rather than to increase water supply and thus are maintenance rather than improvement activities, and are not recommended for financing by the BALAD Project.

BALAD Water Sector Projects

Project Name: Nakam Pipeline and Infiltration Gallery (3056)

Project Location: Nakam Karez, Sordo, Panjgur

Project Description: Nakam karez originates in Parwan Kaur and has been completely dead for a number of years. The karez is dead due to the collapse of the shallow tunnel which flows beneath Parwan Kaur and is exposed to saturation when the nullah floods. The project provides a pipeline across the Parwan Kaur, constructed of FVC pipe laid in an open trench, so that the karez will operate without the requirement of maintaining the tunnel across the nullah. The project also provides an extension of the karez by a 300 meter infiltration gallery upstream along Parwan Kaur. The infiltration gallery consists of 300 mm strainer pipe (0.032 inch slot size) laid beneath the water table and backfilled with a gravel filter envelope.

Purpose: The purpose of the scheme was to revive this dead karez, to solve the maintenance problem where the karez crosses the nullah, and to provide perennial flow from the subsurface flow in the Parwan Kaur. A further purpose is to introduce the idea of karez extension by infiltration gallery, an idea with potential for widespread applications on nullahs throughout Makran.

Project Identification: Project identified by TA team from direct observation and discussion with sarrishta. The project was supported by the DC. The project was approved by the DWC.

PC-1 Approval: 04/06/87

Construction Started: 08/04/87

Construction Completed: 01/25/88

Status: Operational

Contractor: Mohammed Jan

Estimated Cost: Rs 157,152

Actual Cost: Rs 152,376

Cost of FVC Pipe: Rs 226,570

Total Cost: 378,946

Special Problems: Nakam was retendered once due to high rates quoted by contractors in initial tenders, all premiums were over 40 per cent above 1986 CSR rates. Tendering was difficult even the second time due to confusion among the contractors in how to fill out their bids. Contractors were

also reluctant to bid as the USAID terms of payment were different to the normal GOB procedures. These problems were solved by a series of meetings with the contractors.

Shareholders from Faqirabad karez, which originates approximately 700 meters upstream and upgradient from Nakam on the same nullah, strongly opposed the project after construction was started. They are concerned that Nakam will take water from Faqirabad karez. The water levels in the respective karez were surveyed. It was found, as expected, that the portion of Faqirabad near to Nakam is only a channel conveying water and is approximately 1 meter above the water table, thus not a recharge section of the karez. Although we are convinced that there will be no impact, and although the upstream end of the infiltration gallery is more than 1500 feet, as stipulated by the GOB for the minimum distance between mother wells, from the mother well of Faqirabad, the Faqirabad shareholders are not satisfied. As the command areas of these two karezes are adjacent it appears to be a longstanding dispute which originated when Nakam was converted from a kaurjo to a karez several years ago. The shareholders of Faqirabad have received no support from the local authorities. The BALAD Project is currently constructing a check dam located on Parwan Kaur upstream from these karezes which would benefit both parties.

The contractor has demonstrated his ability to understand the work and the drawings and has organized the job very well.

Results: Nakam was tendered with separate bids for constructing the pipeline with an RCC conduit, the usual Makran practice, and with PVC pipe. Since the PVC construction, as expected, was less expensive and certainly easier, the pipeline was constructed with PVC supplied by the BALAD project. The infiltration gallery is currently operating. In January 1988 the gallery was producing 0.55 cusecs (0.0018 cusecs/meter) of irrigation water. This flow is expected to fluctuate considerably in response to seasonal variations in the water table and will be monitored throughout the duration of the project. The sarrishta immediately cleaned out his portion of the kalmer and the water was being used for irrigating the Nakam command area.

The formerly dead karez was been revived and it is estimated that over 200 acre feet of irrigation water could be produced annually by the project providing sufficient water for the irrigation of approximately 25 acres.

Portions of the channel downstream from the project area were silted up in the monsoon flooding of 1988. The shareholders have shown no interest in cleaning this channel and water is currently standing, unused, in the infiltration gallery.

Recommendations:

1. PVC should be used for all karez or watercourse pipelines as it is less expensive and easier construction.

2. A check dam on Parwan Kaur upstream from Nakam and Faqirabad karezes to promote recharge of the shallow aquifer should be considered.

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BALAD Water Sector Projects

Project Name: Churro Infiltration Gallery (3032)

Project Location: Churro Karez, Chaitkan, Panjgur

Project Description: Churro karez originates as a korjo in the Rakhshan River and passes into a karez. Churro was flowing in December 1986 but was completely dry by August 1987. The project involved extending the open channel of the kaurjo upstream by approximately 400 meters and then placing 100 meters of strainer pipe as an infiltration gallery upgradient beneath the Rakhshan.

Purpose: The purpose of the scheme was to revive this ephemeral karez and to provide perennial flow from the subsurface flow in the Rakhshan. A further purpose is to introduce the idea of karez extension by infiltration gallery, an idea with potential for widespread applications on nullahs throughout Makran.

Project Identification: Project identified by TA team from direct observation and discussion with sarrahshta. The project was strongly supported and assigned a high priority by the DC, Panjgur. The project was approved by the DWC.

PC-1 Approval: 04/04/87

Construction Started: 08/04/87

Construction Completed: 02/29/88

Status: Operational

Contractor: Mohammed Hamzah

Estimated Cost: Rs 289,961

Actual Cost: Rs 263,194

Cost of PVC Pipe: Rs 67,770

Total Cost: Rs 330,964

Special Problems: Churro was retendered once due to high rates quoted by contractors in initial tenders, all premiums were over 40 per cent above 1985 CSR rates. Tendering was difficult even the second time due to confusion among the contractors in how to fill out their bids. Contractors were also reluctant to bid as the USAID terms of payment were different to the normal GDB procedures. These problems were solved by a series of meetings with the contractors. The contractor was reasonably cooperative but required close supervision at each step of the project. No particular problems in design or construction have been encountered.

Results: Churro karez was dead prior to the construction of the infiltration gallery. The karez was immediately revived when the open channel was excavated. A table of measured flow rates from the channel is presented below:

Date	Flow Rate (Cusecs)	Flow/Unit Length Cusecs/meter
10/08/87	0.43	0.00086
19/10/87	0.44	0.00088
06/12/87	0.65	0.0013
20/12/87	0.68	0.0014
06/01/88	0.72	0.0014
17/01/88	1.35	0.0027
08/02/88	1.25	0.0025

It is estimated that over 400 acre feet of irrigation water per year will be produced by the project, enough to irrigate over 40 acres of land year round. The karez channel was not cleaned by the sarrishtas immediately after completion of the gallery and much of the water was being wasted. The shareholders eventually cleaned the karez channel and began utilizing the water.

A further result of this project has been the generation of interest in constructing infiltration galleries among the sarrishtas. The Deputy Commissioner in Panjgur reports that many requests for karez projects have been received since the completion of the Churro infiltration gallery.

The open channel at Churro was infilled with sediment during the exceptional flooding during the summer of 1988. No effort on the part of the shareholders has been made to reconstruct this channel. A FVC pipeline is being considered for this channel.

Recommendations:

1. A detailed investigation of the use of the water at Churro karez should be undertaken. Since this karez was dead and the command area is dying Churro is an ideal situation to observe the results of increased water supply.
2. Flow rates at Churro should be monitored throughout the year to assess the performance of the infiltration gallery.
3. Infiltration galleries completed in the Rakhshan may use a slightly larger slot size due to the high quality filter material available in the river channel.
4. A siphon with a capacity of 2 cusecs should be constructed on the downstream portion of the channel. This area is frequently washed out due to flooding of a small nullah.
5. The infilled open channel at Churro should be replaced with a lined channel or a FVC pipeline.

Project Summary
BALAD Water Sector Projects

Project Name: Takhan Infiltration Gallery (3057)

Project Location: Takhan Karez, Sari Koran, Panjgur

Project Description: Takhan Karez runs parallel to the Rakhshan River and was dying until recently extended by the sarrishta. A karez extension, using 300 mm diameter PVC strainer pipe (0.032 inch slot size) with a filter envelope as an infiltration gallery, was placed beneath the Rakhshan River to collect ground water flowing beneath the ephemeral river and feed it directly into Takhan Karez. The infiltration gallery was constructed at the closest point between the karez and the Rakhshan Kaur. According to the sarrishta the karez had been successfully extended beneath the Rakhshan in the past but the tunnel could not be maintained.

Purpose: The purpose of the scheme is to provide supplemental water to Takhan Karez by the addition of a maintenance free infiltration gallery. A further purpose is to introduce the idea of karez extension by infiltration gallery, an idea with potential for widespread applications on nullahs throughout Makran.

Project Identification: Project identified by TA team from direct observation and discussion with sarrishta. The project was supported by the EC. The project was approved by the EWC.

PC-1 Approval: 01/27/87
Construction Started: 08/04/87
Construction Completed: 01/30/88

Status: Operational

Contractor: Munir Ahmed Baluch

Estimated Cost: Rs 313,595
Actual Cost: Rs 204,981

Cost of PVC Pipe: Rs 142,720

Total Cost: Rs 347,701

Special Problems: Takhan was retendered once due to high rates quoted by contractors in initial tenders, all premiums were over 40 per cent above 1986 CSR rates. Tendering was difficult even the second time due to confusion among the contractors in how to fill out their bids. Contractors were also reluctant to bid as the USAID terms of payment were different to the normal GOB procedures. These problems were

solved by a series of meetings with the contractors.

Some portions of the excavation were much harder than anticipated due to an unexpected layer of caliche. The contractor has submitted a variation claim for the rock excavation which was recommended for approval. Since the excavation side slope is much steeper than expected, for the same reason i.e. the unexpectedly hard subsoil conditions, the total cost was considerably less than the estimate. The contractor has demonstrated his inability to understand the drawings or the contract but has organized the job relatively well and has been cooperative. The work has been satisfactory but required close supervision.

Results: The infiltration gallery is operating and the results are being monitored. Flow rates collected in December 1987 and January 1988 indicate that the infiltration gallery is producing approximately 0.25 cusecs (0.0013 cusecs/meter) of supplemental water or approximately 26 per cent of the total karez flow. The water is currently being utilized to irrigate the Takhan command area. It is estimated that the Takhan infiltration gallery will produce 180 acre-feet of water annually, enough to irrigate approximately 20 acres. Monitoring of the performance of Takhan Infiltration Gallery will continue.

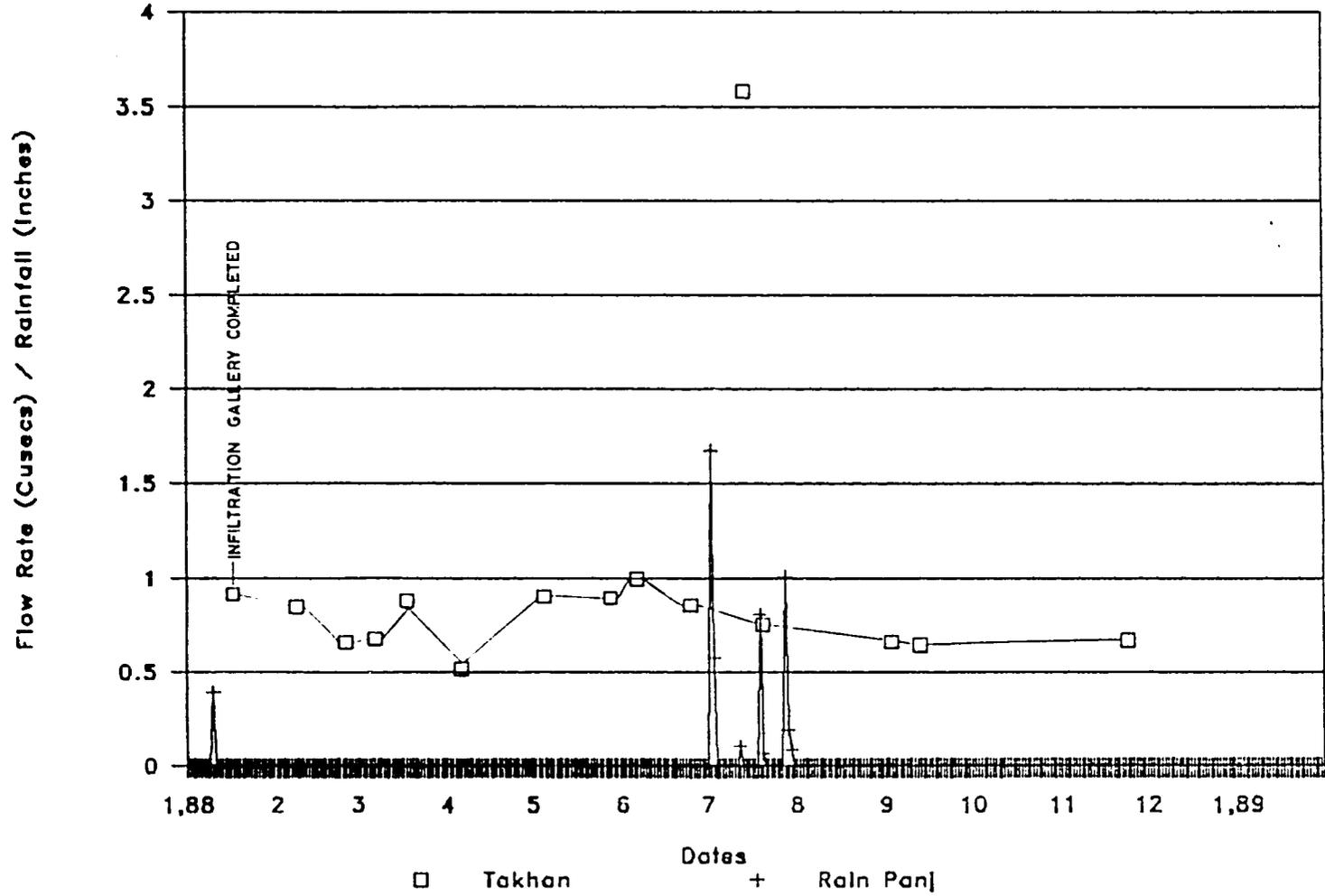
During the summer monsoon the sarrishta of Takhan karez utilized the sluice valve provided in the infiltration gallery and ran the gallery at only 25 per cent capacity. It has been observed that this sarrishta will reduce the flow in the gallery, as recommended, when his downstream channel is full. No other sarrishtas have been convinced to adopt this practice.

Recommendations:

1. Trench section should be revised on future cost estimates to reflect actual method of excavation.
2. Future BOQ's should always include a nominal item for rock excavation to establish the contractors rate.
3. High quality gravel filter material is available in the Rahshan. In future infiltration galleries completed beneath the Rahshan larger slot size may be used for the perforated strainer pipe.

Takhan Karez

Flow Rates 1988



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BALAD Water Sector Projects

Project Name: Kohosi Karez Rehabilitation (3026)

Project Location: Kohosi Karez, Ab-Sar, Turbat

Project Description: Kohosi karez has its source in Ab-Sar and crosses Doccrum Kaur to reach the command area. The karez has been dead for several years due to the collapse of the karez beneath the river. Significant water and acceptable gradients were demonstrated upstream from the collapsed portion. The project involves the re-excavation of the karez and lining of the channel with a pipeline to reduce maintenance. An additional part of the project would connect an artesian well located near the mother well to the karez to provide additional recharge. The project also involves the cleaning of the upstream portions of the karez by the sarrishta at his own expense. This portion of the karez has been allowed to deteriorate since the karez has been dead.

Purpose: The scheme would revive the dead karez and reduce the future maintenance costs. The scheme would also provide supplemental water from an existing tubewell which was drilled for that purpose but never utilized. Karez lining has been suggested as a solution to the karez maintenance problem (Kemper, et.al. 1982). The BALAD Project has suggested this solution only in portions of karezes passing beneath nullahs and in cases where the water level is expected to be maintained, i.e. where a supplemental source of water is being developed.

Project Identification: Project identified by PPMU and strongly supported by local government officials. Project approved by DNC.

PC-1 Approval: 11/24/86

Construction Started: 05/16/87

Construction Completed: 06/15/88

Status: Completed

Contractor: Atta Muhammed

Estimated Cost: Rs 408,500

Actual Cost: Rs 217,223

Special Problems: Upon re-excavation of the karez it was determined that the karez channel was too tortuous for the installation of pipe. It was also determined that only a relatively small portion of the karez was totally collapsed. The work has been suspended pending the completion of the sarrishta's portion of the upstream karez cleaning. The

sarrishta did not demonstrate any serious intentions of completing his portion of the scheme.

Results: The portion of the karez crossing the Doccrum nullah was re-excavated and protected by backfilling and capping of the re-excavated wells. The results of the upstream water supplementation scheme are pending the completion of the karez cleaning by the sarrishta. The sarrishta does not appear to have any serious intention of completing this work.

Recommendations:

1. Karez rehabilitation projects which involve any work component by the sarrishta should begin only when the sarrishtas work is accomplished.
2. Lining inside of karezes should only be attempted in cases where the karez is shallow enough for open trench excavation.

Project Summary
BALAD Water Sector Projects

Project Name: Zaindan Daz Karez Rehabilitation (3046)

Project Location: Zaindan Daz, Panjgur

Project Description: Zaindan Daz is an important karez in the village of the same name. This karez experiences perennial maintenance problems over a small section where the karez passes, at a shallow depth, beneath a small nullah. The project involves construction of a pipeline beneath the nullah with manholes at each end. The pipe was laid in an open excavation. The pipe was designed to accommodate 1.5 cusecs of flow. The cost estimate includes the installation of a gravel filter in the event that water was encountered in the excavation.

Purpose: The purpose of this scheme was to reduce the karez maintenance costs and to prevent the interruption of water supply from this karez. In the event of a shallow water table beneath the nullah supplemental water would be harvested for the karez.

Project Identification: Project brought to the attention of DCC by the sarrishta and approved by DWC.

PC-1 Approval: 06/30/87

Construction Started: 10/27/87

Construction Completed: 12/31/87

Status: Operational

Contractor: Rahim Dad

Estimated Cost: Rs 115,159

Actual Cost: Rs 77,401

Cost of PVC Pipe: Rs 62,475

Total Cost: Rs 139,876

Special Problems: No special problems were encountered and the contractors work was satisfactory. No ground water was encountered in the excavation so the gravel envelope was eliminated from the pipeline resulting in significant savings from the estimated cost. The pipe was installed at an incorrect level due to misinformation about the karez realignment channel. An additional contract of Rs 48,407 was required to rectify the work.

Results: The pipeline is functioning without problems.

Recommendations:

1. This type of karez improvement is relatively simple to undertake and realizes a significant benefit for a small cost. The project appears to be well received and similar projects should be encouraged.
2. Any projects involving aspects of work to be completed by the sarrishta should require that this work is completed prior to commencement of the project work.

Project Summary
BALAD Water Sector Projects

Project Name: Doznap Infiltration Gallery (3118)

Project Location: Doznap Korjo, Rakhshan Kaur, Panjgur

Project Description: Doznap korjo originates on the south bank of the Rakhshan River and supplies a perennial flow of approximately 0.3 cusecs in 24 hangams to the command area. The project involved extending an infiltration gallery and siphon upstream into the bed of the Rakhshan River along the approximate alignment of the original korjo. The infiltration gallery consisted of 400 meters of strainer pipe (0.045 slot) with a gravel envelope and concrete collection/inspection chambers. The infiltration gallery will save the maintenance costs of the korjo and provide supplemental water to the korjo.

Purpose: The purpose of the scheme was to improve this declining korjo and to provide perennial flow from the subsurface flow in the Rakhshan. A further purpose is to introduce the idea of karez extension by infiltration gallery, an idea with potential for widespread applications on nullahs throughout Makran. It was estimated that 0.6 cusecs of additional flow could be produced by the project.

Project Identification: The project was identified by the Panjgur DCC in November 1987. The project was approved by the DWC.

PC-1 Approval: 04/06/88
Construction Started: 09/28/88
Construction Completed: 11/30/88

Status: Operational

Contractor: Mohammed Munir

Estimated Cost: Rs 205,029

Actual Cost: Rs 241,080

Cost of PVC Pipe: Rs 492,750

Total Cost: Rs 733,830

Special Problems: After construction was started at Mehmoodabad Infiltration Gallery, located approximately 500 meters upstream from Doznap korjo, the Doznap shareholders complained and stopped the work. This issue was resolved with great difficulty and finally required the intervention of the DC Panjgur. The Doznap shareholders only allowed the Mehmoodabad construction to proceed conditionally on the

alignment of Mehmoodabad being changed towards the left bank of the Rakhshan and on the sluice valve being closed until the Doznap infiltration gallery is completed. The construction of Doznap proceeded without significant delays or problems.

The alignment and design of Doznap Infiltration Gallery were changed after initial contract award but before construction started based on suggestions from the sarrishta and shareholders. In the original design the infiltration gallery was an add on to the existing korjo and would have supplied more water but would not prevent the routine destruction of the korjo channel. The shareholders requested that a system which provided them with less water but that was maintenance free would be preferred. The recommendations of the sarrishta and the shareholders were incorporated into a revised design, the initial contract was terminated and the project was retendered.

The manhole covers at Doznap were stolen immediately after construction leaving the gallery vulnerable to sedimentation. Additional expense will be entailed in replacing the covers.

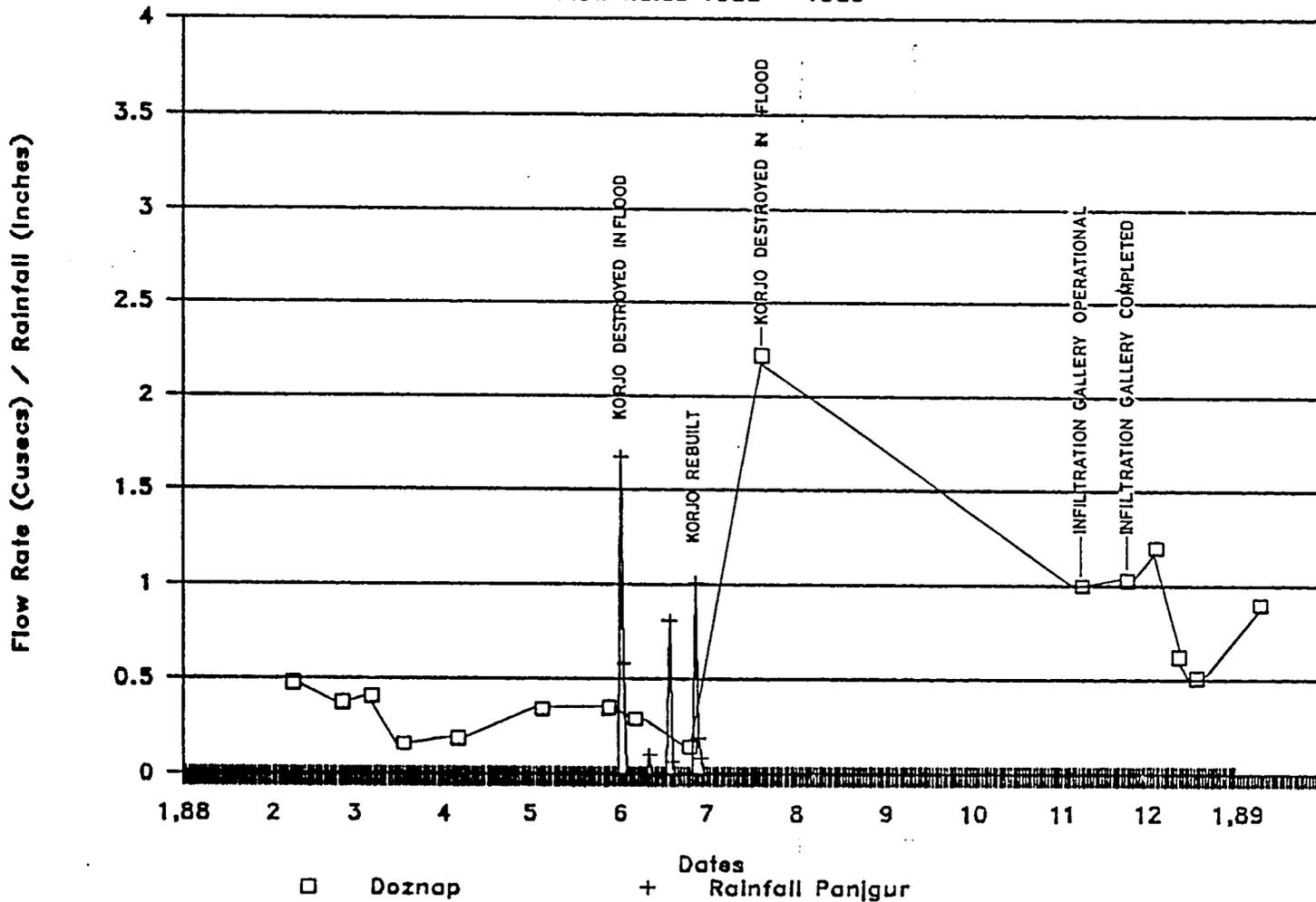
Results: Doznap was producing in excess 1.0 cusecs during the first month of operation. The measured flow rates at Doznap korjo are presented on figure 1.

Recommendations:

1. In the future a project description, written in english and Urdu, should be placed at the tesildars office during the tender period with an invitation to enter any complaints which may result from the proposed work.
2. Manhole designs should be altered to make removal of the covers more difficult.

Doznap Korjo

Flow Rates 1988 - 1989



BALAD Water Sector Projects

Project Name: Nokabad Karez Rehabilitation (3041)

Project Location: Nokabad Karez, Koshkalat, Turbat

Project Description: Nokabad karez is an old karez which has eroded to the extent that it is now entirely an open channel. The water table has declined and the karez has been allowed to die. Water levels collected at Imami karez, located 60 meters to the north of Nokabad, indicated that by lowering the level of Nokabad by 1 meter would revive the karez. It was established that the recharge area of Nokabad could be lowered by 1 meter and sufficient gradient would still be available to deliver the water to the command area. The karez was also to be widened in the recharge area to allow more water into the karez. A karez boring would be attempted to produce supplemental water to the karez.

Purpose: The purpose of this scheme was to revive the dead karez so that the dying command area could be rehabilitated. This was to be accomplished by lowering the karez invert to intersect the current water table and by providing supplemental water from a boring in the recharge area.

Project Identification: Project brought to the attention of PPMU by the sarrishta and approved by DWC.

PC-1 Approval: 04/06/87

Construction Started: 07/02/87

Construction Completed: 04/05/88

Status: Operational

Contractor: Akhtar Ali

Estimated Cost: Rs 113,808

Actual Cost: Rs 112,746

Special Problems: The contractor was excessively slow and has never demonstrated any serious interest in the work. No section of the channel was initially excavated according to the design. The contractor has repeatedly disputed, without any grounds, the quantity measurements and has shown a disregard for the construction requirements. The sarrishta has entered into these disputes on the side of the contractor. Neither the sarrishta nor the contractor, who is himself a shareholder in this karez, demonstrated any serious intent to rehabilitate the karez. Although the performance improved somewhat when the water reached the command area the contractors performance was at no time satisfactory.

Results: Water began flowing to the command area of this karez, for the first time in many years, in January 1988. It is estimated from this that more than 130 acre-feet of water per year will be produced by the project. At the estimated rate of consumptive use this will allow for the year round irrigation of approximately 25 acres. Measured flow rates at the command area since the revival of the karez are summarized on figure 1 and are listed below:

Date	Flow Rate (Cusecs)
02/14	0.14
02/18	0.19
02/24	0.13
03/03	0.43
03/10	0.41
03/17	0.29
03/26	0.27
03/31	0.35

Three borings have been completed at Nokabad. The boring data are summarized below:

Boring No.	Distance From Mother Well (feet)	Depth (feet)	Flow (cusecs)
1	10	23	0.15
2	150	24	nominal
3	300	24	nominal

The borings were all terminated at approximately 25 feet depth when hard strata was encountered. One of the three borings attempted at Nokabad is producing significant quantities of supplemental water to the karez, approximately 0.15 cusecs. The other two borings are producing nominal amounts of water. The borings have been completed with 4 inch diameter perforated casing and are producing significant quantities of water to the karez.

Recommendations:

1. No bids from Akhtar Ali should, in the future, be considered for any BALAD work.
2. Karez maintenance by the shareholders, now that the karez has been revived, should be monitored.
3. Karez borings should be added on as an item in all karez rehabilitation work.

BALAD Water Sector Projects

Project Name: Juhiljo Infiltration Gallery (3115)

Project Location: Juhiljo Karez, Panjgur

Project Description: Juhiljo karez originates on the north bank of the Rakhshan River and prior to the construction of the infiltration gallery supplied a relatively small amount, less than 0.25 cusecs, of water to the command area. The project involved extending an infiltration gallery upstream into the bed of the Rakhshan River. The infiltration gallery consists of 470 meters of strainer pipe (0.045 slot) with a gravel envelope and concrete collection/inspection chambers.

Purpose: The purpose of the scheme was to improve this declining karez and to provide perennial flow from the subsurface flow in the Rakhshan. A further purpose is to introduce the idea of karez extension by infiltration gallery, an idea with potential for widespread applications on nullahs throughout Makran. It was estimated that 0.4 cusecs of additional flow could be produced by the project.

Project Identification: The project was identified by the Panjgur DCC in November 1987. The project was approved by the DWC in Turbat.

PC-1 Approval: 02/04/88
Construction Started: 03/24/88
Construction Completed: 08/07/88

Status: Operational

Contractor: Mohammed Munir

Estimated Cost: Rs 232,000

Actual Cost: Rs 200,042

Cost of PVC Pipe: Rs 384,250

Total Cost: Rs 584,292

Special Problems: After construction was started at Juhiljo the surrounding landowners complained and stopped the work. Although the land was not currently planted and would be restored to it's original condition the landowners refused to allow the extension of the karez across their land. This issue was resolved with great difficulty and finally required the intervention of the DC Panjgur. The landowners only allowed the construction to proceed when the alignment of the infiltration gallery was shifted. The new alignment will probably result in some loss of water since the

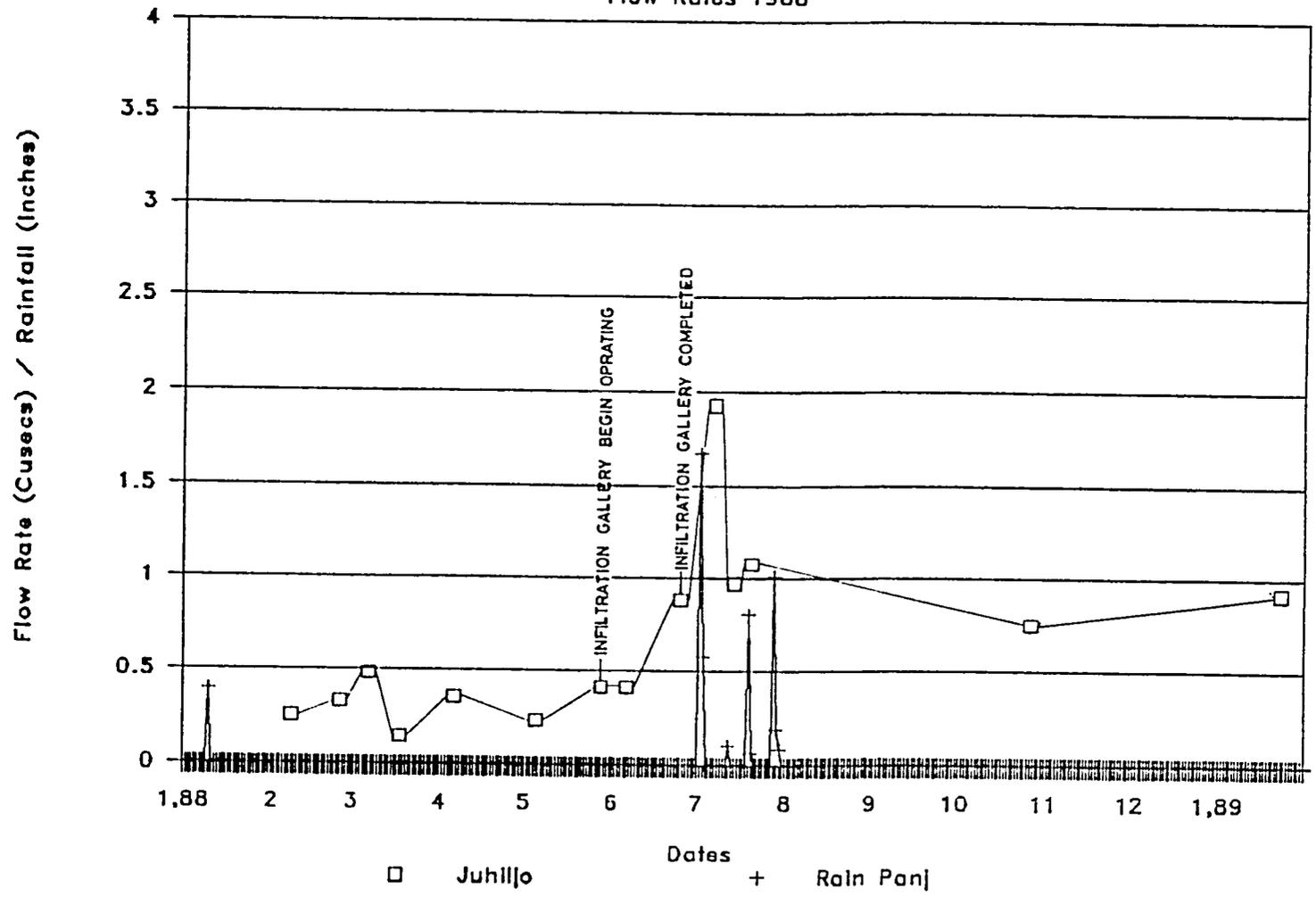
landowners did not allow the gallery to extend beneath the Rakhshan. The bund systems constructed to develop the agricultural land in question were completely destroyed in the flooding in July 1988. The infiltration gallery was shortened by approximately 90 meters to accommodate the landowners.

Results: The infiltration gallery is currently operating and has more than tripled the water supply to the karez. Flow rates have ranged from 0.002 to 0.004 cusecs per linear meter during the monsoon season the flow rate will decline as the Rakhshan Kaur drains and the water table declines in the dry season. The contractor ran a well organized and efficient job. The trenching, production of filter material and backfilling were all accomplished in a single efficient operation. The contractor demonstrated that he had learned a great deal about construction organization on the previous project completed at Takhan Infiltration Gallery. The infiltration gallery is currently operating beyond expectations and the water is being utilized by the shareholders for irrigation of the command area. The infiltration gallery was in place during the repeated heavy flooding of the Rakhshan River in July 1988. The peak flood during July, estimated by the local inhabitants to be a flood of approximately a fifty year return period, did not damage the collection chambers or the pipe. Minor erosion of the rip rap surrounding the chambers was observed. The scour in the river bed, even under these unusual flooding conditions was minimal and was less than anticipated.

Recommendations:

1. In the future a project description, written in english and Urdu, should be placed at the tesildars office during the tender period with an invitation to the public to enter any complaints which may result from the proposed work.
2. Scour depth in the Rakhshan is much less than previously thought. Based on the performance of Juhiljo during the intense flooding in July 1988 it is considered safe to place infiltration galleries at depths of a minimum of 1 meter below the ground surface, rather than 2 meters, the previous design criteria.
3. The karez flow rate should be monitored for the duration of the BALAD project.
4. The korjos in Panjgur should be replaced with infiltration galleries whenever possible to increase productivity and to decrease maintenance costs.

Flow Rates 1988



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BALAD Water Sector Projects

Project Name: Mehmoodabad Infiltration Gallery (3117)

Project Location: Mehmoodabad Karez, Panjgur

Project Description: Mehmoodabad karez originates on the south bank of the Rakhshan River and supplied a relatively small amount of water, less than 0.25 cusecs, to the command area. The project involved extending an infiltration gallery upstream into the bed of the Rakhshan River. The infiltration gallery consisted of 400 meters of strainer pipe (0.045 slot) with a gravel envelope and concrete collection/inspection chambers.

Purpose: The purpose of the scheme was to improve this declining karez and to provide perennial flow from the subsurface flow in the Rakhshan. A further purpose is to introduce the idea of karez extension by infiltration gallery, an idea with potential for widespread applications on nullahs throughout Makran. It was estimated that 0.4 cusecs of additional flow could be produced by the project.

Project Identification: The project was identified by the Panjgur DCC in November 1987. The project was approved by the DWC.

PC-1 Approval: 02/04/88
Construction Started: 03/24/88
Construction Completed: 01/05/88

Status: Operational

Contractor: Mohammed Hamzah

Estimated Cost: Rs 178,000

Actual Cost: Rs

Cost of PVC Pipe: Rs 300,000

Total Cost: Rs

Special Problems: After construction was started at Mehmoodabad the shareholders from Doznap, a korjo located in the Rakhshan River approximately 500 meters downstream from Mehmoodabad, complained and stopped the work. This issue was resolved with great difficulty and finally required the intervention of the DC Panjgur. The Doznap shareholders only allowed the construction to proceed conditionally on the alignment of Mehmoodabad being changed towards the left bank of the Rakhshan and on the sluice valve being closed until the Doznap infiltration gallery is completed. The excavated

channel and the downstream manhole excavation were infilled twice during construction due to flooding in the Rakhshan. Construction was halted for approximately two months due to flooding.

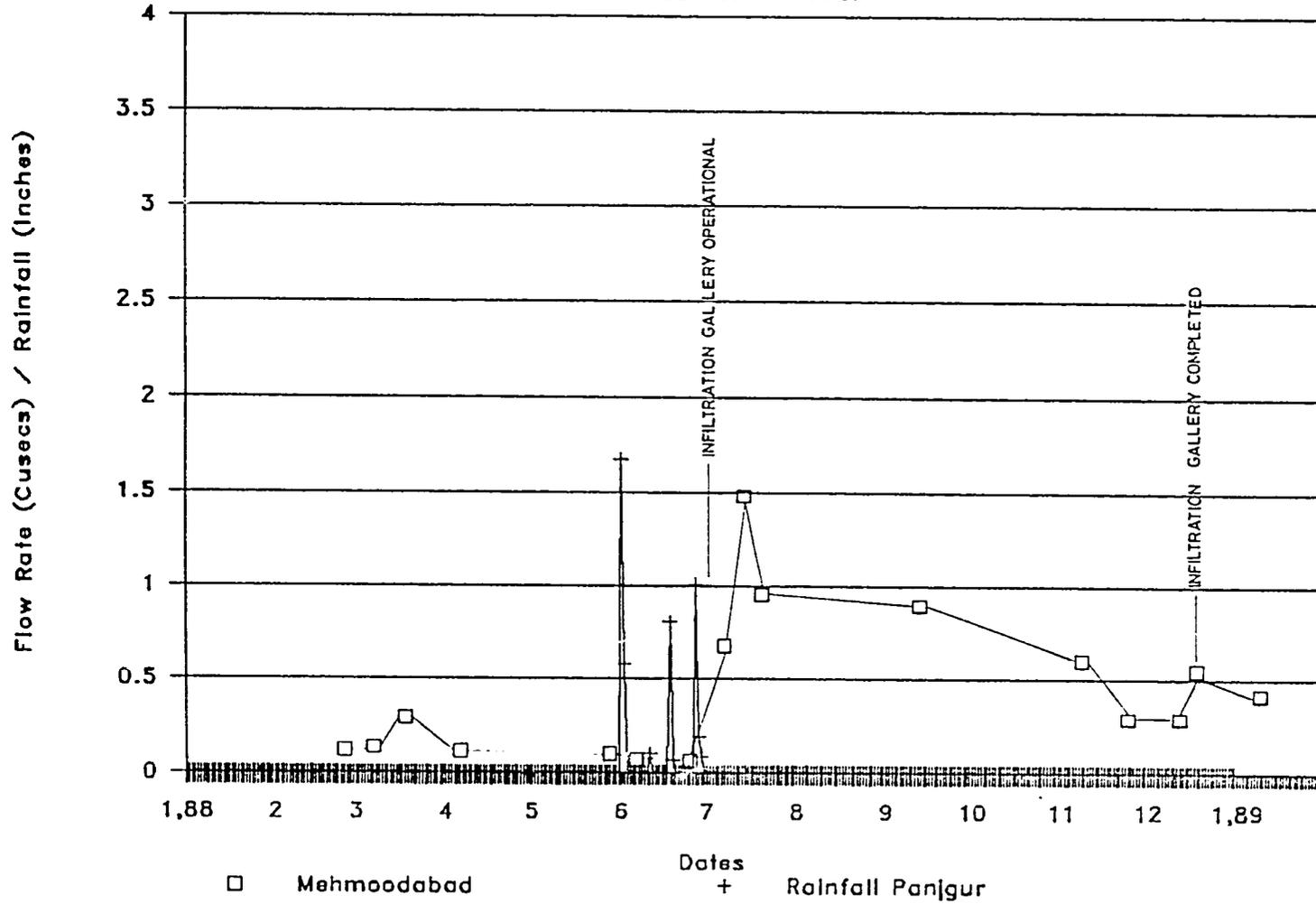
Results: During construction the flow rate in the karez increase from 0.15 to 0.6 cusecs. Flow rates measured subsequently are presented on figure 1. The downstream 50 meters of the infiltration gallery is constructed in relatively impermeable material. A significant loss of potential water production resulted from the forced change in alignment.

Recommendations:

1. In the future a project description, written in english and Urdu, should be placed at the tesildars office during the tender period with an invitation to enter any complaints which may result from the proposed work.
2. Experiments should be conducted to determine if the flow at Mehmeedabad has any influence on the Doznap korjo flow rate. The flow rate at Doznap should be continuously monitored while the valve at Mehmoodabad is shut and any increase in flow rate should be noted.

Mehmoodabad Karez

Flow Rates 1988 - 1989



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Project Summary
BALAD Water Sector Projects

Project Name: Nokjo Infiltration Gallery (3116)

Project Location: Nokjo Korjo, Panjgur

Project Description: Nokjo korjo originates on the north bank of the Rakhshan River and prior to the construction of the infiltration gallery supplied a relatively small amount, less than 0.25 cusecs, of irrigation water to the command area. The project involved extending an infiltration gallery upstream into the bed of the Rakhshan River and providing a lined concrete channel, a pipeline, and a siphon to convey the water to the command area. The infiltration gallery consists of 270 meters of strainer pipe (0.045 inch slot size) with a gravel envelope and concrete collection/insection chambers. A total of 250 meters of pipeline and siphon and 257 meters of concrete channel are also provided.

Purpose: The purpose of the scheme was to improve this declining korjo and to provide perennial flow from the subsurface flow in the Rakhshan. A further purpose is to introduce the idea of korjo improvement by infiltration gallery, an idea with potential for widespread applications on nullahs throughout Makran. It was estimated that 0.45 cusecs of perennial flow will be produced by the project.

Project Identification: The project was identified by the Panjgur DCC in November 1987. The project was approved by the DWC in Turbat.

PC-1 Approval: 04/06/88

Construction Started: 05/16/88

Construction Completed: 10/26/88

Status: Operational

Contractor: Muhammad Naseem

Estimated Cost: Rs 420,000

Actual Cost: Rs 345,184

Cost of PVC Pipe: Rs 434,374

Total Cost: Rs 779,558

Special Problems: The heavy flooding during the summer monsoon of 1988, the largest flooding since 1944, inundated the trenches several times during construction. Substantial delays occurred by no major damage was sustained. The open channel and flood protection bund portion of the system was

replaced with a PVC pipeline based on flood level observations during the monsoon floods. This design alteration resulted in savings in the estimated contract cost.

Results: After completion in October the infiltration gallery produced approximately 0.95 cusecs of water to the Nokjo command area. This flow rate is expected to decline somewhat with time and to stabilize at approximately 0.5 cusecs. At measured consumption rates in the Turbat area the infiltration gallery should produce sufficient irrigation water for approximately 45 acres. The projected Internal Rate of Return for the project, over a ten year period and assuming a 5 per cent annual maintenance cost, is 16 per cent. The contractor was co-operative and ran a reasonably well organized job.

Recommendations:

1. Scour depth in the Rakhshan is much less than previously thought. Based on the performance of Nokjo during the intense flooding in July 1988 it is considered safe to place infiltration galleries at depths of a minimum of 1 meter below the ground surface, rather than 2 meters, the previous design criteria.
2. The karez flow rate should be monitored for the duration of the BALAD project.
3. The korjos in Panjgur should be replaced with infiltration galleries whenever possible to increase productivity and to decrease maintenance costs.

APPENDIX C

BALAD Water Sector Projects

Project Name: Hand Boring in Karezes: Turbat

Project Location: Challo, Tump, Rizai, Sohrani, and Baluchabad Karezes located in the Turbat vicinity.

Project Description: Small diameter, approximately 2 inch, borings are advanced to a maximum depth of 150 feet inside the recharge zone, i.e. in or near the mother well, of the karez to provide supplemental water from shallow artesian conditions. Boring is accomplished using hand operated percussion techniques.

Purpose: To provide supplemental flow by gravity to existing karezes from shallow artesian conditions. An increase in flow of ten per cent is the target.

Project Identification: Ten sites were originally proposed by TA team to give a geographical spread. Six sites were selected/approved by the DCC based on unknown criteria. The projects recommended by the DCC did, however, realize a geographical spread and were recommended for implementation.

PC-1 Approval: 09/15/86

Construction Started: 12/09/86

Construction Completed: 07/07/87

Status: Operational

Contractor: Sabir Ali Ghichki

Estimated Cost: Rs 180,000

Actual Cost: Rs 100,161

Cost of PVC Casing: Rs 1,075

Total Cost: 101,236

Special Problems: Insufficient bids were received when the project was first tendered. Only two bids were received the second time. Karez workers who traditionally do the hand boring do not have the sophistication to understand BALAD bidding procedures. Although the work was excessively slow no particular problems were encountered. Hand boring provides very small diameter hole and it is impossible to drill if hard material is encountered. No meaningful samples can be collected. Collecting flow measurements inside the karez to monitor the results is extremely difficult. Two sites, Shaida and Muslimabad, were abandoned since the sarrishtas did not want the borings, even though the karezes were recommended by the DWC for this work. These karezes were substituted with Sohrani and Razai. The work at Azian

was abandoned due to hard rock in the subsurface.

Results: Although difficult to verify each of the completed borings appeared to be at least marginally productive. Flow increases appeared to range from 5 to 20 per cent. At Challo karez very shallow borings, less than 20 feet, produced positive results. Since no regional confined aquifer is known to exist in the Turbat area (WAFDA, 1984) it would appear that the supplemental water is being produced by tapping the underflow beneath the karez rather than a true confined aquifer. See attached table for individual results. The borings at Challo karez were not cased and appear to be collapsed after approximately 9 months of operation. The borings at Sohrani were cased and are still producing significant quantities of supplemental water.

Karez	Boring	Depth (feet)	Flow Increase (cusecs)
Baluchabad	1	159	0.15
Challo	1	47	
	2	13	
	3	16	0.42
Tump	1	81	0.3
	2	86	
Sohrani	1	27	
	2	16	
	3	21	0.4
Razai	1	21	
	2	25	

Recommendations:

1. Borings should concentrate on the recharge zone of the karez since the source of the water does not appear to be a confined aquifer.
2. Borings should be cased with perforated PVC pipe to extend the life of the wells.
3. Since the results of this pilot project indicate that chances for success are good a mechanical rig of some sort should be purchased. An auger rig of the type used in soil exploration programs would be ideal. Larger diameter holes, four or six inch, suitable for the installation of PVC strainer and gravel envelopes should be completed.
4. Karez flow rates should be monitored periodically to determine long term results.

BALAD Water Sector Projects

Project Name: Hand Boring in Karezes: Mand

Project Location: Bullo, Hikaluk, Garibad, and Phullabad Karezes in the Mand vicinity.

Project Description: Small diameter, approximately 2 inch, borings are advanced to a maximum depth of 150 feet inside the recharge zone, i.e. in or near the mother well, of the karez to provide supplemental water from shallow artesian conditions. Boring is accomplished using hand operated percussion techniques. Successful borings are completed with 2 inch diameter perforated casing. If sufficient water or hard rock are encountered before 150 feet the hole is terminated and additional borings in the same karez are attempted.

Purpose: To provide supplemental flow by gravity to existing karezes from shallow artesian conditions. An increase in flow of ten per cent is the target.

Project Identification: Karezes were selected by the DWC and were recommended by the BALAD Project based on a geographical spread.

PC-1 Approval: 05/12/87

Construction Started: 10/29/87

Construction Completed: 01/16/88

Status: Operational

Contractor: Sabir Ali Ghichki

Estimated Cost: Rs 131,400 (Rs 32,850 for each well)

Actual Cost: Rs 131,400

Cost of PVC Pipe for Casing: Rs 2,700

Total Cost: Rs 134,100

Special Problems: It was not possible to visit the sites during or prior to the boring operation due to travel restrictions on the BALAD staff due to anticipated civil disturbances. Monitoring of karez flow rates prior to borings was, therefore, not undertaken.

Results: Borings in three of the four karezes attempted were successful in providing supplemental water to the karez. One well at Hikaluk, Bullao, and Ghribabad were successful. The boring attempted at Phullabad was not successful. A table presenting the individual results is attached.

Karez	Boring	Depth (feet)	Flow Increase (cusecs/per cent)
Bullo	1	148	0.15/18
	2	90	Nil
Gharibabad	1	82	0.08/20
	2	70	0.17/25
Hikaluk	1	35	0.14/11
	2	25	Nil
Phullabad	1	150	Nil

Recommendations:

1. Karez borings in the Mand area and periodic monitoring should be continued.

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BALAD Water Sector Projects

Project Name: Hand Boring in Karezes: Panjgur

Project Location: Mir Ketchi, Nokay, Nakam, Mirabad, and Abdullahbad Karezes located in the Panjgur vicinity.

Project Description: Small diameter, approximately 2 inch, borings are advanced to a maximum depth of 150 feet inside the recharge zone, i.e. in or near the mother well, of the karez to provide supplemental water from shallow artesian conditions. Boring is accomplished using hand operated percussion techniques. If sufficient water or hard rock are encountered before 150 feet the hole is terminated and additional borings in the same karez are attempted.

Purpose: To provide supplemental flow by gravity to existing karezes from shallow artesian conditions. An increase in flow of ten per cent is the target.

Project Identification: Karezes were selected by the DWC and were recommended by the BALAD Project based on a geographical spread.

PC-1 Approval: 01/27/87

Construction Started: 05/18/86

Construction Completed: 10/28/87

Status: Operational

Contractor: Sabir Ali Ghichki

Estimated Cost: Rs 209,400

Actual Cost: Rs 154,310

Cost of PVC Casing: Rs 1,615

Total Cost: 155,966

Special Problems: Insufficient bids were received when the project was tendered. Karez workers who traditionally do the hand boring are not sophisticated enough to understand bidding procedures. Although the work was excessively slow no particular problems were encountered. Hand boring provides very small diameter hole and it is impossible to drill if hard material is encountered. No meaningful samples can be collected. Collecting flow measurements inside the karez to monitor the results is extremely difficult. One approved karez, Luqmanabad, was abandoned since the sarrihta indicated that he did not want the work in his karez.

Results: At least one of the borings in each karez, with the

exception of Abdullahbad and Nakam, was successful in providing significant supplemental water.

Karez	Boring	Depth (feet)	Flow Increase (cusecs/per cent)
Mir Ketchi	1	45	
	2	60	
	3	50	0.22/16
Naukay	1	15	
	2	35	
	3	70	0.08/16
	4	30	
Mirabad	1	51	
	2	55	0.06/100
	3	45	
Nakam	1	56	
	2	45	
	3	44	
Phullabad	1	156	

Recommendations:

1. Borings should concentrate on the recharge zone of the karezes since the source of the water does not appear to be a confined aquifer.
2. Borings should be cased with perforated PVC pipe to extend the life of the wells.
3. Since the results of this pilot project indicate that chances for success are good a mechanical rig of some sort should be purchased. An auger rig of the type used in soil exploration programs would be ideal. Larger diameter holes, four or six inch, suitable for the installation of PVC strainer and gravel envelopes should be completed.
4. Karez flow rates should be monitored periodically to determine long term results.

Project Summary
BALAD Water Sector Projects

Project Name: Hand Boring in Karezes: Pidarak I

Project Location: Sar-i-Minab, Waqf, Raisabad, Gowali Malk, and Sar-i-Joh karezes in Pidarak.

Project Description: Small diameter, approximately 2 inch, borings are advanced to a maximum depth of 100 feet inside the recharge zone, i.e. in or near the mother well of the karez, to provide supplemental water from shallow artesian conditions. Boring is accomplished using hand operated percussion techniques. Successful borings are to be cased with perforated PVC.

Purpose: To provide supplemental flow by gravity to existing karezes from shallow artesian conditions. An increase in flow of ten per cent is the target.

Project Identification: All of the karezes in Pidarak have been identified for boring. Since boring has not been tried in this area previously five karezes were randomly selected for the initial trial.

PC-1 Approval: 05/05/88

Construction Started: 06/23/88

Construction Completed: 10/23/88

Status: Contract terminated/Borings in three karezes operational

Contractor: Sabir Ali Ghichki

Estimated Cost: Rs 101,750

Actual Cost: Rs 36,990

Cost of PVC Casing: Rs 10,360

Total Cost: Rs 47,350

Special Problems: The work proceeded very slowly. This was apparently due to disputes between the contractor and his laborers. The contractor showed no serious intent to complete the work even after numerous warnings. Even after a time extension was granted only 35 per cent of the work was completed. The contract was terminated after only three of the five karezes were completed due to lack of performance on the part of the contractor.

Results: Three borings were successfully completed and cased each in Sar-i-Minab and in Waqf karezes. Two borings were successfully completed at Gwali Malk karez. The borings produced approximately 0.2 cusecs of supplemental flow to

each karez.

Karez	Borings	Depth (ft)	Casing
Sar-i-Minab	1	30	2 inch perf, 30
	2	20	2 inch perf, 20
	3	23	2 inch perf, 23
Gwali Malk	1	12	2 inch perf, 12
	2	15	2 inch perf, 15
Waqf	1	64	2 inch perf, 52
	2	26	2 inch perf, 26
	3	10	Nil

Recommendations:

1. Borings should be continued in the Fidarak area as results thus far have been successful.
2. Sabir Ali Ghichki has now been terminated from two different boring contracts and should not be considered for any other BALAD work.

Project Summary
BALAD Water Sector Projects

Project Name: Hand Boring in Karezes: Pidarak II, (3190-3194)

Project Location: Kaur-e-Sai Kalikat, Zerdien-Gungan, Bund-e-Joh, and Malikabad Karezes in Pidarak.

Project Description: Small diameter, approximately 2 inch, borings are advanced to a maximum depth of 100 feet inside the recharge zone, i.e. in or near the mother well of the karez, to provide supplemental water from shallow artesian conditions. Boring is accomplished using hand operated percussion techniques. Successful borings are to be cased with perforated PVC.

Purpose: To provide supplemental flow by gravity to existing karezes from shallow artesian conditions. An increase in flow of ten per cent is the target.

Project Identification: All of the karezes in Pidarak have been identified for boring.

PC-1 Approval: 05/05/88

Construction Started: 10/15/88

Construction Completed: 12/08/88

Status: Boring in all of the karezes, with the exception of Malikabad, were successful and are operational.

Contractor: Waris Baluch

Estimated Cost: Rs 101,750

Actual Cost: Rs 112,676

Cost of PVC Casing: Rs 3,016

Total Cost: Rs 115,676

Special Problems: The work progressed satisfactorily without significant problems.

Results: A total of 15 boring in the five karezes were completed and 13 of those boring were successful and were completed with 2 inch diameter pvc casing. Flow sets from the boring range from 0.05 to 0.10 which is in all cusecs at least a ten percent increase in the karez flow.

Karez	Borings	Depth (ft)	Casing
Kaur-i-Saur	1	10	2 inch perf, 10
	2	40	2 inch perf, 40
	3	30	2 inch perf, 30
	4	20	2 inch perf, 20
Kali Kat	1	40	2 inch perf, 40
	2	32	2 inch perf, 32
	3	35	unsuccessful
Zerdain-Dungan	1	15	2 inch perf, 15
	2	25	2 inch perf, 25
	3	45	2 inch perf, 45
	4	20	2 inch perf, 20
Band-e-Joh	1	47	2 inch perf, 47
	2	25	2 inch perf, 25
	3	28	2 inch perf, 28
Malikabad	1	100	2 inch perf, 50

Recommendations:

1. Borings should be continued in the Pidarak area as results thus far have been successful.

FROM SOURCE.

BALAD Water Sector Projects

Project Name: Mechanical Boring in Karezes

Project Location: Turbat District

Project Description: Large diameter, 22 inch, borings were advanced to a maximum depth of 150 feet inside the recharge zone, i.e. in or near the mother well, of the karez to provide supplemental water from shallow artesian conditions. Boring is accomplished using mechanical percussion drilling rig. Successful borings were completed with two inch diameter perforated casing and with pea gravel shrouding.

Purpose: To provide supplemental flow by gravity to existing karezes from shallow artesian conditions. An increase in flow of ten per cent is the target.

Project Identification: Karezes were selected from a list of proposed projects supplied by the DWC. Individual karezes were selected based on their geographical proximity and the willingness of the sarrishta for the borings.

PC-1 Approval: 05/12/87

Construction Started: 12/04/87

Construction Completed: 02/07/89

Status: Operational

Contractor: Khalid Baluch

Estimated Cost: Rs 798,000

Actual Cost: Rs 535,400

Cost of PVC Casing: 10,243

Total Cost: Rs 545,643

Special Problems: Borings at Shakarabad and Sikuni were abandoned due to objections raised by the shareholders or the shareholders of adjacent karezes. The contractor had repeated problems during the early mobilization but by the end of the contract was performing satisfactorily. Savings were realized due to cancelled boreholes and to unused footage.

Results: The results of the borings are summarized below:

Karez	Date	Depth (feet)	Casing (feet)	Flow (cusecs)	Cost (Rs)
Aftari	03/26/88	150	nil	nil	53,857

Meliki	04/14/88	112	112	0.2	40,265
Koshak	05/03/88	120	120	0.15	43,634
Soragi	05/13/88	90	90	0.2	32,634
Sohani	05/24/88	150	150	0.25	58,855
Hothabad	06/26/88	150	nil	nil	53,357
Gaiton	09/10/88	150	nil	nil	53,000
Fhullani	10/14/88	150	nil	nil	53,857
Sat	12/22/88	150	150	0.25	58,855
Sihani	12/29/88	53	abandoned		
Mir Mir	11/23/88	abandoned			nil
Shakarabad	11/23/88	abandoned			5,000
Nelan	01/03/89	150	nil	nil	53,857
Hitan	02/07/89	102	nil	nil	

Tump

Recommendations:

APPENDIX D

Project Summary
BALAD Water Sector Projects

Project Name: Zankani Recharge Dam (3019)

Project Location: Zankani damsite is located approximately 2.5 kilometers north of Siri-Kan village or 5.5 kilometers north of Turbat.

Project Description: Zankani Kaur is one of the larger drainages in the Turbat area and is the source of several karezes. Two small earthfill dams were constructed on Zankani nullah near the apex of the alluvial fan. A natural saddle between the dam was used to construct an emergency spillway. Impermeable shale bedrock was found at a shallow depth in the reservoir area and it was determined that recharge could only be enhanced in the downstream alluvium in the nullah bed. The east dam is provided with an outlet conduit which will limit the outflow in Zankani Kaur to a maximum rate of approximately 45 cusecs when the dam is full. A gabion spillway is provided to accommodate large storm events. The spillway design is based on the 100 year 24 hour storm under AMC III conditions.

Purpose: The scheme is designed to increase the infiltration to the shallow aquifer from which the downstream karezes feed. Storm runoff will be detained in the Zankani reservoir and the outflow will be reduced to a level which approximates the infiltration capacity of the nullah. The peak flow in the nullah for normal storms will be reduced and the hydrograph will be extended.

Project Identification: Selected from a list of delay action dams proposed by the Irrigation Department and approved by the DWC.

PC-1 Approval: 07/29/87

Construction Started: 03/28/88

Construction Completed: 10/31/88

Status: Operational

Contractor: Gul Jan

Estimated Cost: Rs 3,565,448

Actual Cost: 3,635,951

Special Problems: Minor delays occurred due to inadequate planning for the installation of the culvert pipe. A great deal of supervision and training were required to insure that proper fill material was used and proper compaction achieved. Some of the material excavated from the spillway was unsuitable for the embankment fill and the borrow pit excavation was consequently increased over the estimated

quantity. This resulted in a cost overrun of approximately 5 per cent.

Results: The dam is now operational and the runoff from Zankani Kaur is now reduced to a maximum flow rate of approximately 45 cusecs under reservoir full conditions. The reservoir, once filled, will require approximately 5 days to drain thus increasing the infiltration opportunity time. The reservoir was flooded twice during construction. The downstream karezes are being monitored to determine the impact of the dam.

The contractor ran a relatively well organized job. With the exception of the installation of the outlet culvert there were no substantial delays in progress. The contractor learned a great deal about compaction, about selection of fill material, and general construction organization during the course of the project.

Recommendations:

1. The performance of the reservoir and the outlet should be closely monitored to determine if the outlet conduit is adequate. The outlet orifice is currently restricted by 50 per cent by a reducer plate. The spillway is intended to operate only in storms of greater than a two year return period. The outlet orifice should be adjusted based on observations after storm events to maximize the benefits of the dam. Ideally all of the water flowing from the outlet should be absorbed into the nullah alluvium before reaching the Katch.

2. When the spillway becomes operational the area downstream from the spillway apron should be inspected for erosion. Maintenance operations should be undertaken as required.

3. The inlet to the conduit should be inspected following the first storm events. It is probable, particularly during the first storm events, that debris will collect on the trash rack which will require removal. The inlet should be routinely inspected and cleaned following storm events. The collected debris may be removable by burning.

BALAD Water Sector Projects

Project Name: Shahwani Trial Check Dam (3024)

Project Location: Shahwani nullah, approximately 6 kilometers east of Turbat on the north side of the Turbat Hoshab road

Project Description: A small stone weir with a gabion overflow section was constructed as a trial check dam.

Purpose: The structure was intended as a trial to observe local construction techniques, to investigate using only gabion overflow sections on check dams, and to observe sedimentation during the coming rainy season. The dam was intended as a trial to be constructed before the winter rainy season. The dam would operate to increase recharge into the shallow aquifer in the vicinity of Jusak from which several karezes, currently dead due to the declining water table, derive their water.

Project Identification: Selected from a list of delay action dams proposed by the Irrigation Department and approved by the DWC.

FC-1 Approval: 12/04/86
Construction Started: 04/27/87
Construction Completed: 07/30/87

Status: Operational

Contractor: Gul-Jan

Estimated Cost: Rs 167,132
Actual Cost: Rs 155,909

Total Cost (Including Feasibility): Rs 211,959

Special Problems: The scheme was planned as a trial structure to collect information about contractors abilities with gabion work as well as to collect some experience of the operation of the proposed check dams during the winter rainy season. The scheme was proposed to cost less than \$10,000 so that a purchase order type contract would allow quick contracting and construction. A design storm of 5 year return period was used to minimize the cost. Contracting took much longer than expected and the project missed the rainy season.

Results: The scheme was not begun in time for the winter rainy season and was therefore expanded by the addition of an apron for scour protection to enhance the life of the project. The contractors operation was well organized and

proceeded without significant delay. The gabion work was far better than expected. The contractor was responsive and cooperative. The spillway suffered considerable damage in the winter rainy season of 1988. The damage resulted from a storm which produced nearly 1000 cusecs peak flow in January 1988. The cause of the damage was a failure of the apron due to unrestrained riprap being eroded by overflow from the spillway. The apron and spillway have since been repaired and the dam has since passed peak flows of approximately 950 cusecs without sustaining any damage. The reservoir has been filled six times during 1988.

Recommendations:

1. Gabion construction should use gabions woven at the site. The woven gabions will be superior to the manufactured spot welded gabions available in Karachi.
2. Gabion wire of SWG 10 gauge is sufficient. No. 2 bars (1/4 inch dia) are insufficient for gabion perimeter reinforcement. Future gabion work will specify 3/8 and 1/2 inch dia perimeter reinforcement on a trial basis.
3. Gabion work should be encouraged since the contractors are able to perform unexpectedly well at this work.
4. A second check dam should be constructed further downstream on Shahwani to operate in series with this dam.

Project Summary
BALAD Water Sector Projects

Project Name: Shappuk Check Dams (3020)

Project Location: Shappuk nullah, approximately 1.5 kilometers north of the Turbat Hoshab road on Shappuk Kaur, approximately 40 kilometers east of Turbat on the Turbat Hoshab road.

Project Description: Two small gabion weirs were constructed on Shappuk Kaur to operate in series as delay action dams and water spreading devices. The weirs are designed, as per the project paper, to be raised as they fill with sediment. Downstream aprons have been designed to protect against scour. No maps of this area are available and the spillway has thus been designed to utilize the full nullah width. Shappuk is a particularly good nullah for check dam construction in that the karezes associated with Shappuk run up the nullah rather than perpendicular to the nullah as is generally the case. The arrangement of the three target karezes; Shappuk, Shirchuppi, and Ukkai, indicate that their primary recharge is derived from the Shappuk nullah rather than from the Ketch Kaur.

Purpose: The scheme is designed to increase the infiltration to the shallow aquifer from which the three downstream karezes in Shappuk feed.

Project Identification: Selected from a list of delay action dams proposed by the Irrigation Department and approved by the DWL.

PC-1 Approval: 04/06/86

Construction Started: 06/17/87

Construction Completed: 10/25/87

Status: Operational

Contractor: Gul-Jan

Estimated Cost: Rs 330,110

Actual Cost: Rs 316,529

Total Cost (Including Feasibility): Rs 431,474

Special Problems: The contractor did not provide for the specified perimeter reinforcement in his bid due to his inability to understand the specifications. His claim to recover this additional cost was analyzed and accepted. The monitor wells installed during the damsite exploration program were destroyed by vandals.

Results: Contractor did an excellent and well organized job. The dams have operated as anticipated and have filled seven times during 1968. Sediment deposition in the reservoirs has been less than one foot during the first year of operation. Monitoring results are attached.

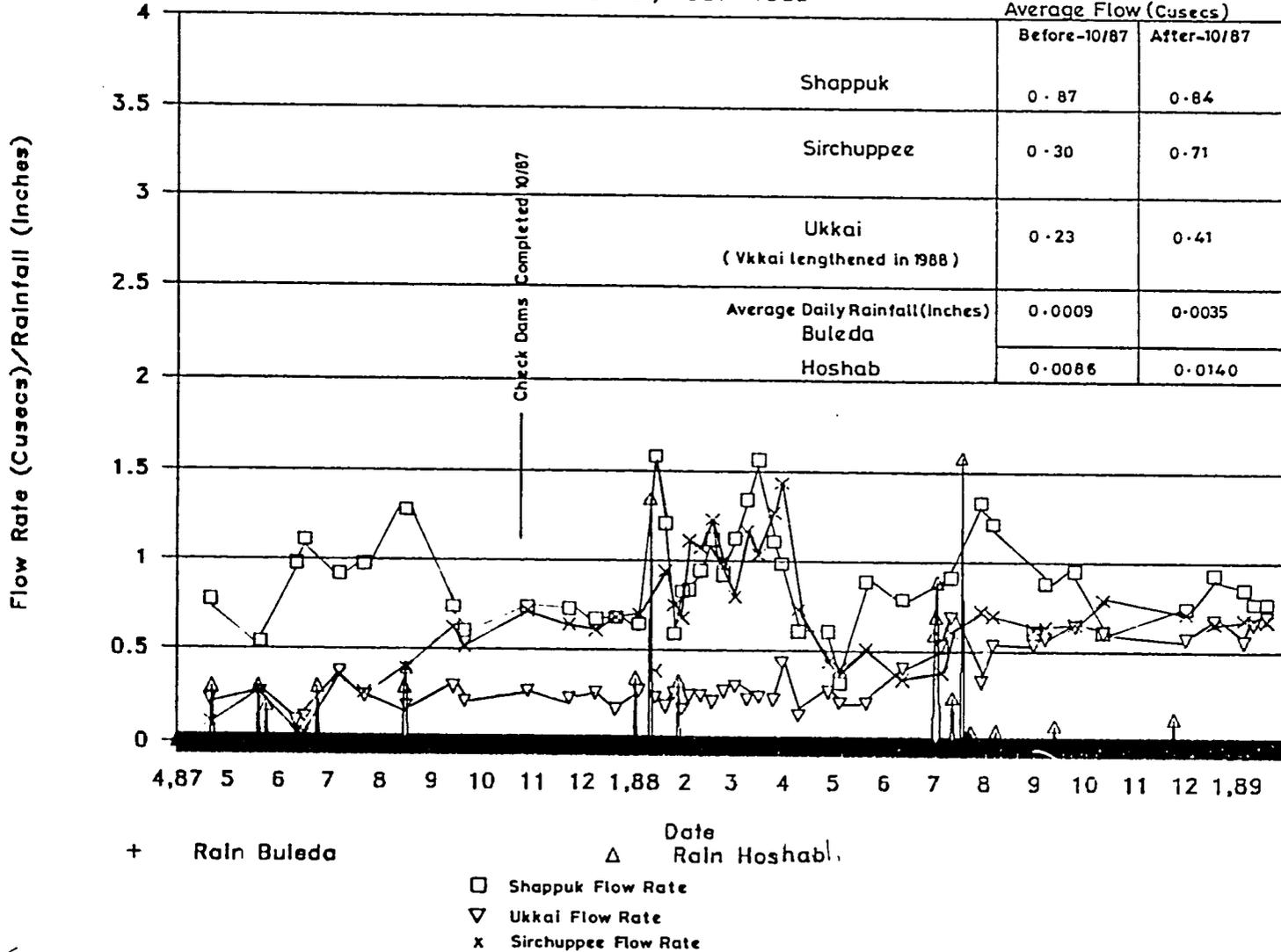
Recommendations:

1. Gabion wire of SWG 10 gauge is sufficient. No. 3 bars should be used for perimeter reinforcement.
2. Contractor is not providing gabion partitions. The construction is acceptable, for the gabion sizes used, and future EOC's should reflect this construction.
3. Gabions placed entirely beneath the ground surface do not require perimeter reinforcement. Future EOC's should reflect this construction.

Karez Flow Rates Shappuk

10/25/87

Turbat, 1987-1989



D-7

10/25/87

Project Summary
BALAD Water Sector Projects

Project Name: Miskeen Check Dam A (3018)

Project Location: Miskeen Kaur is located near the village of Jusak immediately east of Turbat. The check dam is located approximately 3 kilometers north of the Turbat-Hoshab road on Miskeen Kaur.

Project Description: A series of three check dams were constructed in the upstream reaches of Miskeen Kaur. Miskeen A, the smallest of the three, is an earthen bund approximately 3 meters high with a gabion spillway, 1.5 meters high, designed for the 25 year 24 hour storm. The reservoir area of the dam is approximately 22 acre-feet.

Purpose: The purpose of the scheme is to spread the hydrograph and delay the flood runoff thus increasing the infiltration opportunity time and the ground water recharge to the shallow aquifer feeding the karezes which derive from this nullah.

Project Identification: Project selected from a list of proposed delay action dam sites prepared by the Irrigation Department. Project approved by the DWC.

PC-1 Approval: 08/16/87

Construction Started: 11/10/87

Construction Completed: 02/20/88

Status: Operational

Contractor: Gul Jan

Estimated Cost: Rs 294.151

Actual Cost: Rs 285.305

Feasibility Cost: Rs 137.8e0

Total Cost: Rs 423.155

Special Problems: Contractor had no previous experience with compaction. Embankment was constructed without compaction on key trenches. The abutments were then exposed and the key trenches installed and backfilled with compacted material. The embankment was left in place and the compaction deleted from the payment. A survey error was discovered during construction which necessitated the construction of a second bund. This raised the cost of the scheme by approximately 10 per cent but had the benefit of increasing the storage area from 14 to 22 acre-feet.

Results: The check dam is operational and the reservoir has been filled six times during 1988 and the results are being monitored. A silt blanket is being deposited in the reservoir area and farming should develop there.

Recommendations:

1. A downstream water spreading structure at the Miskeen road crossing should be considered.
2. The gabion size used in the cistern and apron should be a maximum of 1.5x1.5 meters.

Project Summaries
BALAD Water Sector Projects

Project Name: Miskeen Check Dam B (3066)

Project Location: Miskeen Kaur is located near the village of Jusak immediately east of Turbat. Miskeen B is located approximately 3.5 kilometers north of the Turbat-Hoshab road on the eastern portion of Miskeen Kaur.

Project Description: A series of three check dams were constructed in the upstream reaches of Miskeen Kaur. Miskeen B is an earthen bund approximately 3 meters high with a 1.5 meter high gabion spillway designed for the 25 year 24 hour storm. The reservoir area of the check dam is approximately 18 acre-feet. An additional bund was constructed to protect bund farms currently in operation on the west side of the reservoir.

Purpose: The purpose of the scheme is to spread the hydrograph and delay the flood runoff thus increasing the infiltration opportunity time and the ground water recharge to the shallow aquifer which feeds the karezes which derive from this nullah.

Project Identification: Project selected from a list of proposed delay action dam sites prepared by the Irrigation Department. Project approved by the DWC.

PC-1 Approval: 08/10/87
Construction Started: 11/10/87
Construction Completed: 03/10/88

Status: Operational

Contractor: Atta-Muhammed

Estimated Cost: Rs 468,000
Actual Cost: Rs 406,496

Cost of Project Supplied Material: Rs 1339

Total Cost: Rs 407,835

Special Problems: Contractor had no previous experience with compaction. A training program utilizing the plate compactors from the ACE equipment was organized for the contractor. Results were satisfactory. The contractor experienced difficulty in forming gabions with the specified SWG 8 wire. The gabions are, however, satisfactory.

Results: The contractor was educated in soil compaction and quality control. Savings in the estimated cost were realized due to the use of larger gabion size at the site than were

assumed in the cost estimate. The embankment slopes as constructed were lower than designed. This slightly increased the gabion requirements in the abutments and the stone pitching. The stone pitching on the downstream face of the dam was eliminated to account for this difference. The quality of the larger sized gabions is adequate. The quality of the gabion work was sub-standard and generally sloppy. The reservoir was filled several times during the summer and once during November of 1988 and the effects on downstream karozes are being monitored.

Recommendations:

1. A water spreading scheme should be considered on the downstream portion of Miskeen Kaur.
2. SWG 8 wire should only be specified on the gabion faces exposed to flowing water.

**Project Summaries
BALAD Water Sector Projects**

Project Name: Miskeen Check Dam C (3067)

Project Location: Miskeen Kaur is located near the village of Jusak immediately east of Turbat. Miskeen C is located approximately 3.5 kilometers north of the Turbat-Hoshab road on the west branch of Miskeen Kaur.

Project Description: A series of three check dams were constructed in the upstream reaches of Miskeen Kaur. Miskeen C, the largest of the three, is an earthen bund approximately 4 meters high with a gabion spillway designed for the 25 year 24 hour storm. The reservoir area is approximately 22 acre-feet.

Purpose: The purpose of the scheme is to spread the hydrograph and delay the flood runoff thus increasing the infiltration opportunity time and the ground water recharge to the shallow aquifer which feeds the karezes which derive from this nullah.

Project Identification: Project selected from a list of proposed delay action dam sites prepared by the Irrigation Department. Project approved by the DWC.

PC-1 Approval: 10/08/87

Construction Started: 11/13/87

Construction Completed: 02/04/88

Status: Operational

Contractor: Gul Jan

Estimated Cost: Rs 751,523

Actual Cost: Rs 754,025

Cost of Project Supplied Material: Rs 5950

Total Cost: Rs 759,974

Special Problems: Contractor had no previous experience with compaction. Considerable effort was expended to educate the contractor in soil compaction. A training program was organized in the use of jack hammers to cut the key trench, and in the use of plate compactors to achieve the desired compaction. The cistern and apron were increased during construction from 0.5 to 1.0 meters. Gabion size in the new apron construction was also reduced. The riprap used in the lower apron was of insufficient weight. This was improved considerably in the upper apron.

Results: The contractor and the contractors workers were trained in soil compaction. The contractor was responsive and the workmanship was very good. The job was performed in an organized and efficient sequence. Savings were realized due to larger gabion sizes being approved on site than were assumed in the cost estimate. The reservoir has filled six times during 1988 and is functioning as designed. The results are being monitored.

Recommendations:

1. Number 3 rebar was used as perimeter reinforcement for the gabion work. This reinforcement is adequate and is recommended for future gabion work.
2. Plate compactors (from ACE equipment) should be released to line agencies as soon as possible to insure their availability to contractors.
3. In structures higher than 2 meters the cistern and apron should be at least 1 meter in thickness.
4. A second check dam to operate in series with Miskeen C should be considered on Mirani Kaur.

APPENDIX E

NEW KAREZ ECONOMIC

New karez construction is on-going in several areas within Makran. In the Turbat District new karezes are under development near Sami, Tump, and Suleda. In Panjgur new karezes are under development on the east side of Panjgur and in the remote Paroom region. The oldest karez in Paroom is eleven years old and currently at least four karezes are operating in this area. Many appear to be under expansion.

Verbal reports indicate that a typical expense associated with the development of a new karez, including karez construction and land preparation, is in the order of Rs.2,000,000. Specific data are scarce.

BALAD has collected economic data of Bayan karez, currently being developed in the Tump area. The karez data were collected by BALAD sociologist, Abdul Rashid Saluch, during interviews with the sannishta and shareholders. The data are summarized below:

Karez	:	Bayan
Location	:	Balicha, Turbat District
Sannishta	:	Mir Bayan
No. of Hangams	:	17
Total Construction cost (karez)	:	Rs. 1,400,000
Total cost Land Leveling :		
Bulldozer hours	:	3,500 (16 hangams)*
Rental cost paid for Bulldozer rental from Agriculture Dept	:	Rs. 180/hr.
More probable Bulldozer operating Cost (C&W Estimate)	:	Rs. 472/hr.
Total Command Area	:	50 Acres (17 hangams)

* Land leveling still in progress.

Cost Karez	:	Rs.1,400,000
Actual Cost Land Development	:	Rs. 669,375 (bulldozer rental cost)
Actual Total Cost	:	Rs.2,069,375 (17 hangams)

Probable Land development cost (based on realistic dozer hire rate)	:	Rs.1,755,250
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Realistic Estimate
of Non subsidized
total cost : Rs.3,155,250.

The development of the command area is considerably subsidized by the Agricultural Dept. The bulldozer rental paid by the developer is Rs.180 per hours. The C&W estimates that the actual cost is Rs.472 per hour.

To support the 50 acres currently under development, assuming relatively efficient water utilization since the kalmar is very short, i.e. 7.5 acre-ft/acre, 350 acre-feet per year, or an average flow rate of 0.52 cusecs, will be required.

The observed flow rate at Bayan Karez, during 1988, was approximately 0.25 cusecs. The sarrishta is reportedly considering extending the karez. This will increase the capital expenditure and it is doubtful if the 0.5 cusec goal can be reached. At the current flow rate sufficient water will be available for only 25 acres of cultivation. Internal Rate of Return for a variety of conditions have been computed and are summarized below. Net return per acre is assumed to be Rs.4,250, as per the BALAD Project Paper, p.37.

TIME PERIOD	C&W BULLDOZER RENTAL 0.5 CUSEC FLOW	ACTUAL BULL-DOZER COST 0.5 CUSEC FLOW	ACTUAL BULL-DOZER COST 0.25 CUSEC FLOW
10 year	-0.06	-0.12	-0.21
20 year	0.05	0.01	-0.05
50 year	0.09	0.05	0.02

It would appear from this cursory analysis that the Bayan karez is a poor investment. Even if it met the expectations of it's developers, which is doubtful, the IRR is unacceptable. It is probable that social factors, such as the lack of other investment opportunities and the social prestige of owning land, are important in new karez development.

Mir Boyan, the sarrishta of Bayan Karez, intends to sell shares in the karez. For one hangam, which refers in this case to 2.9 acres of land with 10 hours of water rights per week, Mir Boyan intends to ask Rs.6 lac. The potential revenue from one hangam, assuming sufficient water is available, is approximately Rs.12,325 per year.

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NEWKRZEC/QH-WM01.

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APPENDIX F

MEKRAK KAREZES INVENTORY

LOCATION WISE SUMMARY OF COMMAND AREA & FLOW RATES

LOCATION	COMMAND AREA (acres)	AVERAGE FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST
PANJGUR				
BONISTAN Subsubtotal *	70	0.060	43	106800
CHITKAN Subsubtotal *	68	1.847	1337	95000
DOZNAP Subsubtotal *	30	0.124	90	48000
ESSAI Subsubtotal *	575	9.550	6914	457600
GARMAKAN Subsubtotal *	703	9.630	6972	573000
GICHK Subsubtotal *	124	1.254	908	327000
GOWARHO Subsubtotal *	83	0.852	617	196000
KAHAN ZANGI Subsubtotal *	75	0.812	588	60000
KALAG Subsubtotal *	319	3.336	2415	564500
KHUDABDAN Subsubtotal *	709	13.636	9872	814000
PANCHI KAHAN Subsubtotal *	115	1.321	956	152000
PROOM Subsubtotal *	143	1.189	861	238000

MEKRAN KAREZES INVENTORY

LOCATION WISE SUMMARY OF COMMAND AREA & FLOW RATES

LOCATION	COMMAND AREA (acres)	AVERAGE FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST
SAMSURI Subsubtotal *	16	0.116	84	40000
SARAWAK Subsubtotal *	35	1.595	1155	120000
SIRI KORAN Subsubtotal *	357	4.255	3081	368000
SORDO Subsubtotal *	190	4.811	3483	232000
TASP Subsubtotal *	1031	16.818	12176	1094600
WASHEUD Subsubtotal *	774	10.782	7806	814000
ZAINDEN DAZ Subsubtotal *	75	1.470	1064	60000
Subtotal **	5492	83.458	60424	6360500

MEKRAN KAREZES INVENTORY

LOCATION WISE SUMMARY OF COMMAND AREA & FLOW RATES

LOCATION	COMMAND AREA (acres)	AVERAGE FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST
TURBAT				
ABSAR Subsubtotal *	300	0.000	0	0
BAHMAN Subsubtotal *	121	0.400	290	118000
BALNIGOR Subsubtotal *	178	0.760	550	232900
BULEDA Subsubtotal *	878	4.590	3323	187000
BULEDA BIT Subsubtotal *	1046	2.900	2100	30000
BULEDA CHIB Subsubtotal *	468	1.336	967	93000
BULEDA HOSHK Subsubtotal *	700	6.170	4467	55000
BULEDA MENAZ Subsubtotal *	470	0.370	268	58000
BULEDA SEEKI Subsubtotal *	75	0.000	0	0
BULEDA SULLO Subsubtotal *	191	0.310	224	30000
BULEDA ZAMURAN Subsubtotal *	142	1.750	1267	71000
BULEDA ZAMURAN NAG Subsubtotal *	44	0.900	652	40000

MEKRAN KAREZES INVENTORY

LOCATION WISE SUMMARY OF COMMAND AREA & FLOW RATES

LOCATION	COMMAND AREA (acres)	AVERAGE FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST
DASHT Subsubtotal *	0	0.000	0	0
DEGARI KAHAN Subsubtotal *	145	0.320	232	126000
GASHTANG Subsubtotal *	130	0.560	405	100000
GINNA Subsubtotal *	1290	8.600	6226	289000
GODI Subsubtotal *	56	1.000	724	64000
GOKDAN Subsubtotal *	182	0.000	0	0
GOWARKOP Subsubtotal *	166	0.355	257	205000
HEROONIK Subsubtotal *	202	1.800	1303	163000
HOSHAB Subsubtotal *	277	3.893	2819	269000
HOTABAD Subsubtotal *	100	3.200	2317	50000
JUSAK Subsubtotal *	200	0.000	0	0
KAISAK Subsubtotal *	110	0.300	217	128000
KALATUK				

MEKRAN KAREZES INVENTORY

LOCATION WISE SUMMARY OF COMMAND AREA & FLOW RATES

LOCATION	COMMAND AREA (acres)	AVERAGE FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAJNT. COST
Subsubtotal *	331	2.610	1890	254200
KALATUK GAIBON Subsubtotal *	70	0.500	362	75000
KALLAG Subsubtotal *	420	2.805	2031	196000
KIKIN Subsubtotal *	70	0.030	22	0
KOSHKALAT Subsubtotal *	964	1.327	961	275000
MALIKABAD Subsubtotal *	80	1.000	724	64000
MAND Subsubtotal *	865	2.420	1752	0
MAND BULLO Subsubtotal *	395	2.400	1738	104000
MAND DILSAR Subsubtotal *	100	0.000	0	0
MAND GIAB Subsubtotal *	150	0.000	0	0
MAND GWAK Subsubtotal *	150	2.180	1578	126000
MAND MAHTAB Subsubtotal *	200	0.000	0	0
MAND QASMICHAT				

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MEKRAK KAREZES INVENTORY

LOCATION WISE SUMMARY OF COMMAND AREA & FLOW RATES

LOCATION	COMMAND AREA (acres)	AVERAGE FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST
Subsubtotal *	100	0.000	0	0
MAND SORO Subsubtotal *	0	0.000	0	0
MAND UZAI Subsubtotal *	455	0.000	0	0
MIR MIR Subsubtotal *	60	3.000	2172	56000
MIRABAD Subsubtotal *	75	1.500	1086	48000
MIRI Subsubtotal *	202	3.040	2201	70000
NASIRABAD Subsubtotal *	509	4.070	2947	431000
NODIZ Subsubtotal *	121	1.100	796	48000
PEERI KAHAN Subsubtotal *	75	1.500	1086	63000
FHULLABAD Subsubtotal *	0	0.000	0	0
FIDRAK Subsubtotal *	466	3.986	2886	803000
SAMI Subsubtotal *	591	10.935	7917	467000
SHAHI TUMP				

MEKRAK KAREZES INVENTORY

LOCATION WISE SUMMARY OF COMMAND AREA & FLOW RATES

LOCATION	COMMAND AREA (acres)	AVERAGE FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST
Subsubtotal *	200	1.345	974	189000
SHAHFUK Subsubtotal *	418	6.671	4830	373000
SHARAK Subsubtotal *	240	3.220	2331	243000
SINGKALAT Subsubtotal *	64	0.000	0	0
SIRI KAHAN Subsubtotal *	104	1.540	1115	126000
SOLBAND Subsubtotal *	150	0.823	596	51000
TANZAG Subsubtotal *	990	0.000	0	0
TUMF Subsubtotal *	529	5.890	4264	372000
TUMF ASIABAD Subsubtotal *	270	0.918	665	62000
TUMF AZIAN Subsubtotal *	64	0.300	217	65000
TUMF BALICHA Subsubtotal *	677	8.370	6060	578000
TUMF BOSTAN Subsubtotal *	75	1.100	796	48000
TUMF DAZEN				

MEKLAN KAREZES INVENTORY

LOCATION WISE SUMMARY OF COMMAND AREA & FLOW RATES

LOCATION	COMMAND AREA (acres)	AVERAGE FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST
Subsubtotal *	64	0.000	0	60000
TUMP GOMAZI Subsubtotal *	502	6.290	4554	451000
TUMP KASANO Subsubtotal *	80	0.750	543	56000
TUMP KOHAD Subsubtotal *	100	0.000	0	0
TUMP KOLAHOO Subsubtotal *	100	0.000	0	0
TUMP KOSHKALAT Subsubtotal *	70	1.400	1014	64000
TUMP MALANT Subsubtotal *	85	0.650	471	64000
TUMP MALIKABAD Subsubtotal *	85	1.100	796	64000
TUMP NAZARABAD Subsubtotal *	85	1.118	809	68000
TUMP PHULLABAD Subsubtotal *	195	2.096	1518	194000
TUMP SAMADABAD Subsubtotal *	150	0.000	0	0
TUMP SORO Subsubtotal *	100	0.000	0	0
TURBAT				

MEKRAK KAREZES INVENTORY

LOCATION WISE SUMMARY OF COMMAND AREA & FLOW RATES

LOCATION	COMMAND AREA (acres)	AVERAGE FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST
Subsubtotal *	605	1.805	1307	252000
Subtotal **	19922	129.303	93615	8774100
* Total ***	25414	212.761	154039	15134600

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MEK RAN KAREZ INVENTORY
Explanatory Notes

LOCATION:- Given by village or region and district.

MAJOR SHAREHOLDER:- Karez sarrishta verified, when possible by BALAD Staff.

AVERAGE FLOW:- Average flow is a weighted average of annual bimonthly measurements.

MAXIMUM FLOW:- Available only for karezes with 1 year of data.

ANNUAL MAINTENANCE COST:- Estimated from data collected from shareholders.

NAME OF NULLAH:- Nullah from which the karez originates.

KAREZ STATUS:- Alive, Dead or Under construction.

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL		NAME OF NULLAH	KAREZ STATUS	REMARKS
							ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST			
KAREZ HAJIABAD	BONISTAN DIST. PANJGUR	BASHIR AHMED	30	32					RAKSHAN	DE	Karez has been dead for many years.
KAREZ HABIBABAD	BONISTAN DIST. PANJGUR	HAJI GHULAM RASDOL	35	14					RAKSHAN	DE	
KAREZ MUSAFIRABAD	BONISTAN DIST. PANJGUR	M. ALI		32					RAKSHAN	UC	
KAREZ FAISALABAD	BONISTAN DIST. PANJGUR	GHULAM HUSSAIN	5	32	0.06 *		43	57800	SINGANI KAUR	AL	Karez was completed two years ago. Command area is being developed.
KAREZ UMIDABAD	BONISTAN DIST. PANJGUR	AHMED KHAN		14				49000	LODI KAUR	AL	
KAREZ MIRABAD	CHITKAN DIST. PANJGUR	MUHAMMAD USMAN	25	24	0.05 *		43	45000	RAKSHAN	AL	Hand boring completed in Nov. 87.
KORJO CHURRO	CHITKAN DIST. PANJGUR	MUHAMMAD USMAN	26	24	0.68	1.35	492	25000	RAKSHAN	AL	Infiltration Gallery completed in 02/88. Siphon was constructed in 03/88.
KORJO NOKABAD	CHITKAN DIST. PANJGUR	MUHAMMAD HAYAT	17	20	1.11 *		801	25000	RAKSHAN	AL	
KAREZ MAHMOODABAD	DOZNAP DIST. PANJGUR	MIR AHMED KHAN	30	24	0.12	0.96	90	48000	RAKSHAN	AL	Infiltration Gallery completed in 12/88.
KORJO DOZNAP	ESSAI DIST. PANJGUR	FAZAL MUHAMMED	45	24	0.30	0.48	220	36000	RAKSHAN	AL	Improvement work completed.
KAREZ ABDULLAHABAD	ESSAI DIST. PANJGUR	MIR ALI JAN	45	28					RAKSHAN	DE	Hand Boring unsuccessfully completed in Nov. 87.
KORJO AFZALABAD	ESSAI DIST. PANJGUR	FAZAL MUHAMMED	50	32	1.50 *		1086	35000	RAKSHAN	AL	
KAREZ NOKJO	ESSAI DIST. PANJGUR	M. ESSA	60	32	0.79 *		568	51200	RAKSHAN	AL	
KAREZ WARANROOD	ESSAI DIST. PANJGUR	BASHIR AHMED	70	32	1.50 *		1086	70000	RAKSHAN	AL	

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJD	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL		NAME OF NULLAH	KAREZ STATUS	REMARKS
							ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST			
KAREZ SHAHD KAHN	ESSAI DIST. PANJGUR	MUHAMMAD	65	26	1.00 *		725	65000	RAKHSAN	AL	
KORJO ESSAI	ESSAI DIST. PANJGUR	FAZAL JAN	40	32					RAKHSAN	DE	Korjo has been dead for 15 years.
KAREZ HASILABAD	ESSAI DIST. PANJGUR	ABUBAKR	50	24	0.68 *		495	44000	RAKHSAN	AL	
KAREZ UMIDABAD	ESSAI DIST. PANJGUR	UMID	15	32	0.02 *		14	57600	SHAMI KAUR	AL	
KAREZ SHAKRAK	ESSAI DIST. PANJGUR	M. ESSA	95	28	2.23 *		1615	58800	RAKHSAN	AL	
KAREZ FAZALABAD	ESSAI DIST. PANJGUR	FAZAL JAN	40	32	1.52 *		1104	40000	RAKHSAN	AL	
KAREZ KALLAN	GARMAKAN DIST. PANJGUR	MIR GHULAM NABI	115 *	27	1.51	2.47	1093	54000	PARDAN	AL	Siphon under construction.
KAREZ QADIRABAD	GARMAKAN DIST. PANJGUR	ALI MUHAMMAD	50	32	0.98 *		709		PARDAN	AL	
KAREZ PAIGAN	GARMAKAN DIST. PANJGUR	HAJI DAD MUHAMMAD	35	32	0.34 *		250	55000	PARDAN	AL	Check Dam under construction.
KAREZ GHARIBABAD	GARMAKAN DIST. PANJGUR	AHMED ALI	55	32	0.91 *		662	49000	PARDAN	AL	Check Dam under construction.
KAREZ MUHAMMAD SHARIF	GARMAKAN DIST. PANJGUR	ABDUL HAMEED	60	30	1.20 *		870	60000	PARDAN	AL	Check dam under construction.
KAREZ BASALDAR DOSTEEN	GARMAKAN DIST. PANJGUR	HAJI NAZIR KHAM	50	28	0.53 *		384	56000	PARDAN	AL	Check dam under construction.
KORJO FAQIRABAD	GARMAKAN DIST. PANJGUR	ABDUL MALIK	45	30	0.85 *		615		RAKHSAN	AL	
KORJO GHULAM QADIR	GARMAKAN DIST. PANJGUR	GHULAM QADIR	38	24				36000	RAKHSAN	AL	Infiltration gallery proposed. PC-1 submitted in 12/88.
KAREZ ABDUL GHAFUOR	GARMAKAN DIST. PANJGUR	ABDUL GHAFUOR	45	30	0.52 *		374	45000	PARDAN	AL	Check Dam under construction.

HEKKAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KAREZ RAHM DAD	GARMAKAN DIST. PANJGUR	RAHM DAD							PARDAN	UC	Check dam under construction.
KAREZ HAJI ISHAQ	GARMAKAN DIST. PANJGUR	HAJI ISHAQ							PARDAN	UC	Check dam under construction.
KAREZ HAJI MAZAR	GARMAKAN DIST. PANJGUR	MAZAR	45	30	0.69 *		502	58000	PARDAN	AL	Check dam under construction.
KAREZ ZARKAAN	GARMAKAN DIST. PANJGUR	HAJI NIAZ AHMED							PARDAN	UC	Check dam under construction.
KORJO JUHILJO	GARMAKAN DIST. PANJGUR	LAL KHAN	30	24	1.00 *		724	25000	RAKSHAN	AL	
KORJO NOKJO	GARMAKAN DIST. PANJGUR	ISHAQ	40	24	0.95 *		688	25000	RAKSHAN	AL	Infiltration gallery completed in 11/88.
KORJO PIR BUKSH	GARMAKAN DIST. PANJGUR	HAJI FAQIR MUHAMMAD	30	24				30000	RAKSHAN	AL	Infiltration gallery PC-1 submitted in 12/88.
KAREZ MALANG	GARMAKAN DIST. PANJGUR	HAJI MALANG	25	20	0.14	0.37	101	50000	RAKSHAN	AL	Construction of siphon underway.
KORJO RASOOL BUX	GARMAKAN DIST. PANJGUR	RASOOL BUX	40	24				30000	RAKSHAN	AL	
KAREZ SADAI KALAT	GICHK DIST. PANJGUR	LAL BUKSH	17	20	0.18 *		132	38000	HALDOL	AL	
KAREZ FUNRI	GICHK DIST. PANJGUR	ABDUL REHMAN	15	20	0.29 *		212	40000	KAUR ISSAR	AL	
KAREZ JAWANTUK	GICHK DIST. PANJGUR	NOOR AHMED	8	14	0.07 *		54	42000	JAWANTUK	AL	
KAREZ BASHIRABAD	GICHK DIST. PANJGUR	BASHIR AHMED	8	14						DE	
KORJO JWANTUK	GICHK DIST. PANJGUR	ALI JAN	3	14					JWANTUK	DE	Korjo has been dead for many years.
KAREZ WARASABAD	GICHK DIST. PANJGUR	MUHAMMAD WARAS	10	14	0.01 *					AL	

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HEKARAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJD	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO.OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KAREZ KHUDBAD	GICHK DIST. PANJGUR	MUHAMMAD SAEED	18	14	0.12 *		87	35000	HALOOL	AL	
KAREZ SHAKRAQ	GICHK DIST. PANJGUR	GHULAM QADIR	9	15	0.01 *		4	45000	SHAKARAK	AL	
KAREZ SARDAR SIR BALAND	GICHK DIST. PANJGUR	HAJI AMEER MUHAMMAD	8	14	0.05 *		36		38000	AL	
KAREZ KHMASTI KAHAN	GICHK DIST. PANJGUR	KARIM BUKSH	11	21	0.34 *		245	63000	SDRAP	AL	
KAREZ GHARIBABAD	GICHK DIST. PANJGUR	LAL BUX	10	18	0.09 *		67	36000	HALOOL	AL	
KAREZ DILSAR	GICHK DIST. PANJGUR	LAL BUX	7	14	0.09 *		64	28000	HALOOL	AL	
KAREZ KARGAI	GDWARKO DIST. PANJGUR	NOOR AHMED	15	16	0.10 *		72	32000	KARGAI KAUR	AL	
KORJD CHUKLI	GDWARKO DIST. PANJGUR	MULLA HASSAN	8		0.03 *		22	28000	CHUKLI KAUR	AL	
KORJD SAMAN-I-PIR	GDWARKO DIST. PANJGUR	NAZEER AHMED	8		0.03 *		22	20000	CHUKLI KAUR	AL	
KORJD KULLAN	GDWARKO DIST. PANJGUR	MURAD BUKSH	17	18	0.13 *		96	36000	SDRAP	AL	
KORJD SDRAP	GDWARKO DIST. PANJGUR	ALI MUHAMMED	17	20	0.41 *		296	40000	SDRAP	AL	
KAREZ CHAHAG	GDWARKO DIST. PANJGUR	MURAD BUX	18	20	0.15 *		109	40000	SDRAP	AL	
KAREZ KAHAN ZANGI	KAHAN ZANGI DIST. PANJGUR	MURAD BUX	45	30	0.81 *		588	60000	RAKSHAN	AL	
KAREZ MURADABAD	KAHAN ZANGI DIST. PANJGUR	MURAD BUX	30	24					RAKSHAN	DE	Karez has been dead for 8 years.
KAREZ NOKABAD	KALAG DIST. PANJGUR	MUHAMMAD JAN	16	22	0.12 *		87	40000		AL	
KAREZ	KALAG DIST.	MUHAMMAD IBRAHIM	16	28	0.43 *		310	50000	SIMSURI	AL	

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
IBRAHIMABAD	PANJGUR										
KAREZ MUHAMMAD KHAN ABAD	KALAG DIST. PANJGUR	KHUDA MUHAMMAD KHAN	16	28	0.20 *		147	40000	SIMSURI	AL	
KAREZ FAQIRABAD	KALAG DIST. PANJGUR	FAQIR MUHAMMED	30	20	0.34 *		246	45000	SIMSURI	AL	
KAREZ SAHIB KAHN	KALAG DIST. PANJGUR	DUR MUHAMMED	15	28	0.20 *		143	35000	SUHR KAUR	AL	
KAREZ MIRABAD	KALAG DIST. PANJGUR	AMIR BUKSH	18	28	0.03 *		25	56000	SUHR KAUR	AL	
KAREZ KALAG	KALAG DIST. PANJGUR	ELLAHI BUX	30	25	0.34 *		246	62500	CHILL KAUR	AL	
KAREZ KOHNEEN KALAG	KALAG DIST. PANJGUR	FAQIR MUHAMMED	40	25	0.30 *		220	48000	CHILL KAUR	AL	
KAREZ HAJI DAD REHMAN	KALAG DIST. PANJGUR	DAD REHMAN	38	28	0.39 *		282	48000		AL	
KAREZ DALABAD	KALAG DIST. PANJGUR	HAJI ALI MUHAMMED	35	36	0.25 *		181	52000		AL	
KAREZ PANCHI	KALAG DIST. PANJGUR	GUL MUHAMMED	35	27	0.39 *		281	48000		AL	
KAREZ SIMSURI	KALAG DIST. PANJGUR	IBRAHIM	30	20	0.34 *		248	40000		AL	
KAREZ GHOUSABAD	KHUDABDAN DIST. PANJGUR	ABDUL RAHIM	25	28	0.39	0.70	282	56000	NIWAN	AL	
KAREZ MIR KETCHI	KHUDABDAN DIST. PANJGUR	HAJI MUHAMMAD AYUB	30	28	0.75	1.09	543	56000	NIWAN	AL	Hand boring completed in 11/87. Check Dam under construction.
KAREZ ALLAHABAD	KHUDABDAN DIST. PANJGUR	ABDUL KARIM	30	24	0.35 *		250	48000	NIWAN	AL	
KAREZ ALLAHABAD	KHUDABDAN DIST. PANJGUR	SOOFI DAD REHMAN	35	28	0.45 *		326	49000	NIWAN	AL	
KAREZ NOKABAD	KHUDABDAN DIST. PANJGUR	HAJI MUHAMMAD KARIM	37	24	0.98 *		710	48000	NIWAN	AL	Check Dam under construction.

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LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL		NAME OF NULLAH	KAREZ STATUS	REMARKS
							ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST			
KAREZ DHULL	KHUDABDAN DIST. PANJGUR	RASOOL BUKSH	18	29	0.50	1.17	362	58000	NIWAN	AL	Karez was completed two years ago.
KAREZ LALABAD	KHUDABDAN DIST. PANJGUR	MOULVI ABDULLAH	35	25	0.97	1.45	706	50000	NIWAN	AL	Check Dam under construction.
KAREZ FAIZABAD	KHUDABDAN DIST. PANJGUR	ABDUL RAHIM	35	25	0.66 *		478	60000	NIWAN	AL	
KORJO KAHILAN	KHUDABDAN DIST. PANJGUR	MURAD BUX	35	18	0.06 *		43	20000	RAKSHAN/PARDAN	AL	
KORJO MALIKABAD	KHUDABDAN DIST. PANJGUR	DAMAR HASAN	29	22	0.20 *		145	25000	RAKSHAN	AL	
KORJO SHERABAD	KHUDABDAN DIST. PANJGUR	TAJ MUHAMMAD	25	22	0.65 *		471	30000	RAKSHAN	AL	
KORJO JUHILJO	KHUDABDAN DIST. PANJGUR	M. KARIM	35	24	0.39	0.89	282	20000	RAKSHAN	AL	
KORJO NOKAN JO	KHUDABDAN DIST. PANJGUR	MUHAMMAD BUKSH	29	24	0.85 *		615	25000	RAKSHAN	AL	
KORJO PAKISTAN	KHUDABDAN DIST. PANJGUR	KARIM BUKSH	38	24	1.30 *		940	30000	RAKSHAN	AL	
KORJO SHAKRO	KHUDABDAN DIST. PANJGUR	HAJI GHULAM JAN	40	25	1.20 *		869	25000	RAKSHAN	AL	
KAREZ KULLAN	KHUDABDAN DIST. PANJGUR	HAJI MUHAMMAD KARIM	35	24	0.75	1.93	543		RAKSHAN	AL	Construction of siphon underway.
KAREZ NOKEY KAHAM	KHUDABDAN DIST. PANJGUR	LAL MUHAMMAD	45	24	0.25	0.71	181	48000	NIWAN	AL	Hand boring completed in 11/87. Check Dam under construction.
KAREZ KHUDABDAN	KHUDABDAN DIST. PANJGUR	DAD REHMAN	40	24	0.73 *		529	50000	RAKSHAN	AL	
KORJO NIAZABAD	KHUDABDAN DIST. PANJGUR	NIAZ AHMED	45	24	1.40	2.12	1015	48000	NIWAN	AL	
KAREZ FAIZ JAN	KHUDABDAN DIST. PANJGUR	FAIZ MUHAMMAD	30	24	0.46	0.86	333	48000	NIWAN	AL	

MEKRAK KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL		NAME OF NULLAH	KAREZ STATUS	REMARKS
							ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST			
KORJO NOXJO	KHURDAN DIST. PANJGUR	ABDUL RAHIM	38	20	0.34		246	20000	RAKSHAN	AL	
KAREZ FAQIRABAD	PANCHI KAHAN DIST. PANJGUR	FAQIR MUHAMMAD	45	28	0.79 *		571	56000	BAGDAR	AL	
KAREZ PHULLABAD	PANCHI KAHAN DIST. PANJGUR	GHULAM JAN	40	24	0.21 *		150	48000	BAGDAR	AL	
KAREZ QADIRABAD	PANCHI KAHAN DIST. PANJGUR	DIN JAN	30	24	0.33 *		235	48000	BAGDAR	AL	
KAREZ KUMBAK	PROOM DIST. PANJGUR	GHULAM NABI	40	28	0.21 *		149	70000	KUMBAK	AL	Channel lining proposed. PC-1 submitted.
KAREZ NAEEMABAD	PROOM DIST. PANJGUR	HAJI NAEEM	45	28				50000	KUMBAK	AL	Siphon and channel lining proposed. PC-1 submitted.
KAREZ IRAQI	PROOM DIST. PANJGUR	GHULAM NABI		28						UC	Construction of karez is almost completed.
KAREZ QADIRABAD	PROOM DIST. PANJGUR	QADIR BUKSH								DE	
KAREZ KARADI	PROOM DIST. PANJGUR	KAHUDA A. HAKIM								DE	
KAREZ ALLAHABAD	PROOM DIST. PANJGUR	HAJI NAEEM	28	25	0.53 *		386	62000		AL	Channel lining underway.
KAREZ GHARIBABAD	PROOM DIST. PANJGUR	HAJI MUHAMMAD HASAN	30	28	0.45 *		326	56000	HUKANI	AL	Pipeline in deep channel is proposed.
KAREZ SAMSURI	SAMSURI DIST. PANJGUR	MUHAMMAD IBRAHIM	16	22	0.12 *		64	40000	SIMSURI	AL	
KAREZ ATTABAD	SARAWAK DIST. PANJGUR	ATTA UR REHMAN	20	24	0.61	0.78	442	60000	SURAP/RAKSHAN	AL	Three siphons constructed in 01/88.
KAREZ HABIBABAD	SARAWAK DIST. PANJGUR	GUL MUHAMMAD	15	24	0.98 *		713	60000	SURAP/RAKSHAN	AL	
KAREZ ABDULLAHABAD	SIRI KORAN DIST. PANJGUR	MOULVI MUHAMMAD SAEED	45	28	1.20 *		869	56000	RAKSHAN	AL	

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KAREZ TAKHAN	SIRI KORAN DIST. PANJGUR	HAJI GHULAM NABI	71	28	0.70	1.00	507	56000	RAKSHAN	AL	Infiltration Gallery completed in 01/88.
KORJO LUNDO	SIRI KORAN DIST. PANJGUR	HAJI M. SHARIF	40	28						DE	
KAREZ KALAG NO.2	SIRI KORAN DIST. PANJGUR	GHULAM RASOOL	38	30	0.24	*	174	50000	RAKSHAN	AL	
KAREZ KARIMABAD	SIRI KORAN DIST. PANJGUR	MIR KARIM JAN	45	24	0.24	0.72	173	59000	RAKSHAN	AL	
KAREZ GHARIBABAD	SIRI KORAN DIST. PANJGUR	HAJI ALI MUHAMMAD	45	30	1.24	*	898	50000	RAKSHAN	AL	
KAREZ KALAG NO.1	SIRI KORAN DIST. PANJGUR	HAJI ALI AHMED	35	30	0.29	*	207	50000	RAKSHAN	AL	Siphon proposed.
KAREZ HASANABAD	SIRI KORAN DIST. PANJGUR	MUHAMMAD ALI	38	24	0.35	*	253	48000	RAKSHAN	AL	
KAREZ KHUDBAD	SORDD DIST. PANJGUR	MUHAMMAD KARIM	45	24	0.94	1.31	681	56000	PARWAN	AL	Channel lining completed in 11/87. Check Dam under construction.
KAREZ IBRAHIMABAD	SORDD DIST. PANJGUR	MIR IBRAHIM KHAN	35	24	0.98	*	709	55000	PARWAN	AL	
KAREZ FAQIRABAD	SORDD DIST. PANJGUR	HAJI FAQIR MUHAMMAD	30	21	1.32	*	956	65000	PARWAN	AL	
KAREZ MAKAM	SORDD DIST. PANJGUR	MIR ANYATULLAH	40	24		0.84			PARWAN	DE	Infiltration gallery completed in 01/88. Hand Boring completed in 11/87. Check Dam under construction.
KAREZ SUBEDAR 6. RASOOL	SORDD DIST. PANJGUR	SUBEDAR GHULAM RASOOL		24						UC	
KAREZ KALLAN	SORDD DIST. PANJGUR	SARDAR SURBULAND	40	24	1.57	*	1138	58000	RAKSHAN	AL	Siphon constructed in 03/88.
KAREZ ISLAMABAD	TASP DIST. PANJGUR	MUHAMMAD ISLAM	45	27	0.76	*	550	45000	PISCOL	AL	

MEKRAK KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/AURJD	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL		NAME OF NULLAH	KAREZ STATUS	REMARKS
							ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST			
KAREZ IQBALABAD	TASP DIST. PANJGUR	MUHAMMAD ISLAM	30	27	0.45 *		326	50000	PISCOL	AL	
KAREZ GUNKI	TASP DIST. PANJGUR	NAZEER AHMED	45	28	0.95 *		688	45000	PISCOL	AL	
KAREZ MAZDOORABAD	TASP DIST. PANJGUR	HAJI SHER MUHAMMAD	40	28	0.70 *		507	56000	PISCOL	AL	
KAREZ SAR KOHAN	TASP DIST. PANJGUR	MUHAMMAD JAN	25	28	0.35 *		253	46000	PISCOL	AL	
KAREZ SHAKRI KAHAN	TASP DIST. PANJGUR	HAJI MAULA BUKSH	30	33	0.45 *		326	49000	PISCOL	AL	
KAREZ BHARIBABAD	TASP DIST. PANJGUR	GHULAM MUHAMMED	35	28	0.36	0.60	261	56000	PISCOL	AL	
KAREZ ALAMABAD	TASP DIST. PANJGUR	DAZI ALAM	40	28	0.79 *		572	60000	PISCOL	AL	
KAREZ FABIRABAD	TASP DIST. PANJGUR	HAJI PIR JAN	50	28	1.00 *		724	64000	PISCOL	AL	
KAREZ AIN ZARKAAN	TASP DIST. PANJGUR	HAJI ISLAM	35	28	0.35 *		253	45000	PISCOL	AL	
KAREZ NAWAZABAD	TASP DIST. PANJGUR	PIR JAN	25	24					PISCOL	DE	
KAREZ MOHANABAD	TASP DIST. PANJGUR	BAB JAN	45	28	1.00 *		724		PISCOL	AL	
KAREZ MUSLIMABAD	TASP DIST. PANJGUR	MUHAMMAD ISLAM	50	28	1.00 *		724	56000	PISCOL	DE	
KAREZ NOKEEN KOHAN	TASP DIST. PANJGUR	MUHAMMAD ASLAM	30	28	0.35 *		253	40000	PISCOL	AL	Hand Spring completed in 11/87.
KAREZ SHER MUHAMMAD	TASP DIST. PANJGUR	SHER MUHAMMAD	35	28	0.30 *		220	56000	PISCOL	AL	
KAREZ KHUDARAD	TASP DIST. PANJGUR	DOCTOR PIR JAN	38	28	0.36 *		261	45000	PISCOL	AL	
KAREZ KHUDARAD	TASP DIST.	MUHAMMAD KARIM	46	25	0.36 *		259	52000	PISCOL	AL	Check Dam under

MEKRAK KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAJURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
	PANJGUR										construction.
KAREZ ALLAHABAD	TASP DIST. PANJGUR	MUHAMMAD AZIM	55		0.98	1.34	710	46000	PISCOL	AL	
KORJO SAR HULAMB	TASP DIST. PANJGUR	HABIB ULLAH	65	33	2.30 *		1665	30000	RAKSHAN	AL	
KORJO HAASALABAD	TASP DIST. PANJGUR	MUHAMMAD IQBAL	45	25	1.10 *		796	30000	RAKSHAN	AL	
KAREZ PIRABAD	TASP DIST. PANJGUR	HAJI PIR JAN	47	28	1.00 *		724	61600	PISCOL	AL	
KAREZ CHAMAG	TASP DIST. PANJGUR	ALI JAN	35	28	0.50 *		362	50000	RAKSHAN	AL	
KAREZ NAZEERABAD	TASP DIST. PANJGUR	NAZEER AHMED	30	24						DE	Karez dried up 8 years ago.
KAREZ MAQBODLABAD	TASP DIST. PANJGUR	MAQBODL AHMED								UC	Karez is under construction.
KAREZ ALLAHABAD	TASP DIST. PANJGUR	ALLAH BUKSH	35	24	0.31 *		222	45000	PISCOL	AL	
KAREZ PEERI KAHAN	TASP DIST. PANJGUR	MUHAMMAD ASHRAF	20	25						DE	
KAREZ JOVAANABAD	TASP DIST. PANJGUR	LAL BUKSH	55	28	1.10 *		796	65000	PISCOL	AL	
KAREZ AHMEDABAD	WASHEUD DIST. PANJGUR	MUHAMMAD SAEED	25	24	0.50	0.69	362		PARDAN	AL	Check Dae under construction.
KAREZ SAMUNDAR KHAN	WASHEUD DIST. PANJGUR	DAZI ABDULLAH	50	26	1.00 *		724	60000	PARDAN	AL	
KAREZ AHMEDABAD	WASHBUD DIST. PANJGUR	HAJI MALANG	50	22	0.68 *		489	55000	PARDAN	AL	Check Dae under construction.
KAREZ SARIABAD	WASHBUD DIST. PANJGUR	PIR BUX	35	22	0.31 *		224	49000	PARDAN	AL	Check Dae under construction.
KAREZ DOSTABAD	WASHBUD DIST. PANJGUR	HAJI DOST MUHAMMAD	50	32	1.00 *		724	60000	PARDAN	AL	

MEHRAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL		NAME OF NULLAH	KAREZ STATUS	REMARKS	
							ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST				
KAREZ NOORABAD	WASHBUD DIST. PANJGUR	NOOR MUHAMMAD	119	24	1.11	*	804	58000	PARDAN	AL	Siphon completed in v6/68. Check Dam under construction.	
KAREZ FARIMABAD	WASHBUD DIST. PANJGUR	HAJI KARIM BUKSH	35	22	0.21	*	151	52000	PARDAN	AL		
KAREZ QAZIABAD	WASHBUD DIST. PANJGUR	IBRAHIM	45	26	0.41	*	293	56000	PARDAN	AL	Check Dam under construction.	
KAREZ SHAFIABAD	WASHBUD DIST. PANJGUR	SHAFI MUHAMMAD	50	24	0.88	*	634	60000	PARDAN	AL	Construction of siphon, and channel lining completed in 05/89. Check Dam under construction.	
KAREZ GHOUSABAD	WASHBUD DIST. PANJGUR		50	24	0.44		1.02	316	60000	PARDAN	AL	Siphon completed in 06/88. Check dam under construction.
KAREZ WASHBUD	WASHBUD DIST. PANJGUR	MULLA A. GHAFDOR	55	32	0.85	*	615	64000	PARDAN	AL		
KAREZ ALI ABDUL REHMAN	WASHBUD DIST. PANJGUR	ALI JAN		24	0.20	*	148	48000	PARDAN	AL		
KORJO WASHBUD	WASHBUD DIST. PANJGUR	A. WAHID	30	20					RAKSHAN	DE	Korjo has been dead for many years.	
KAREZ HABIBABAD	WASHBUD DIST. PANJGUR	GUL MUHAMMED	15	24	0.99	*	715	60000	RAKSHAN	AL		
KAREZ HAJI NOOR ELLAHI	WASHBUD DIST. PANJGUR	HAJI NOOR ELLAHI	40	22	1.41	*	1019	52000	SORGAN	AL		
KAREZ BAISHAM	WASHBUD DIST. PANJGUR	SURBULAND	40	24						DE	Karez has been dead for many years.	
KAREZ KHUDABAD	WASHBUD DIST. PANJGUR	HANEED	50	24	0.59	*	425	60000	PARDAN	AL	Siphon constructed in 11/87.	
KORJO KARIMABAD	WASHBUD DIST. PANJGUR	ABDUL KARIM	35	24	0.23	*	164	20000	RAKSHAN	AL		
KAREZ GULABAD	ZAINDEN DAZ DIST. PANJGUR	GUL MUHAMMAD	30	24	0.75	*	543	60000	SORGAN	AL		

MEKRAM KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL		NAME OF NULLAH	KAREZ STATUS	REMARKS
							ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST			
KAREZ ZAINDEN DAZ	ZAINDEN DAZ DIST. PANJGUR	GHULAM NABI	45	16	0.72	0.81	521		SORGAN	AL	Siphon constructed in 01/88.
KAREZ HAFTARI	ABSAR DIST. TURBAT	RAIS MUSA*	100	28					KECH	DE	Mechanical Drilling completed to 150 ft unsuccessfully.
KAREZ IZZAT	ABSAR DIST. TURBAT	HAJI MUHAMMAD USMAN	70	14					KECH	DE	Karez has been abandoned.
KAREZ CHORUK	ABSAR DIST. TURBAT	HAJI MUHAMMAD LUDMAN	65	14					KECH	DE	Karez has been abandoned.
KAREZ JOLAIGAN	ABSAR DIST. TURBAT	MIR ABDUL NABI	65	14					KECH	DE	Karez has been abandoned.
KAREZ SHAIKHAN	BAHMAN DIST. TURBAT	MIR GHULAM RASOOL	56	14	0.20 *		145	62000	ROTUG	AL	Mechanical Drilling completed to 150 ft unsuccessfully.
KAREZ BAHMAN	BAHMAN DIST. TURBAT	MIR QASIM	65	14	0.20 *		145	56000	ROTUG	AL	
KAREZ ASSA	BALNIGOR DIST. TURBAT	ASSA	10	14	0.05		36	14000	KASHAP	AL	
KAREZ SORAGI	BALNIGOR DIST. TURBAT	HAJI SAIBDN	13	14	0.03 *		22	19600	KASHAP	AL	
KAREZ KALSAR	BALNIGOR DIST. TURBAT	MADYAN	12	14	0.08 *		58	16300	KALSAR	AL	
KAREZ JAMAK	BALNIGOR DIST. TURBAT	HAJI HAKIM	15	14	0.02 *		14	14000	KASHAP	AL	
KAREZ ABDUL GHAFFOOR	BALNIGOR DIST. TURBAT	ABDUL GHAFFOOR	13	14	0.05 *		36	16800	KASHAP	AL	
KAREZ KASHAP	BALNIGOR DIST. TURBAT	SYED MOHAMMAD	15	14	0.07 *		51	16000	KASHAP	AL	
KAREZ GRIMPUKI	BALNIGOR DIST. TURBAT	HAJI MUHAMMAD KARIM	12	14	0.05 *		36	18200	KASHAP	AL	
KAREZ ABDUL KARIM	BALNIGOR DIST. TURBAT	ABDUL KARIM	14	14	0.05 *		36	19600	KASHAP	AL	

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KAREZ KALCHAT	BALNIGOR DIST. TURBAT	SHIDAD	13	14	0.03 *		22	18200	KASHAP	AL	
KAREZ JAMAK	BALNIGOR DIST. TURBAT	MUHAMMAD JAN	15	14	0.03 *		22	21000		AL	
KORJO KALSAR	BALNIGOR DIST. TURBAT	ABDUL GAFFOOR	16	14	0.05 *		36	19200	KALSAR	AL	
KAREZ BOHRAG	BALNIGOR DIST. TURBAT	MIR ASHRAF	30	17	0.25 *		181	40000		AL	
KORJO HUSKAI	BULEDA DIST. TURBAT	KHUDA ESSA	75							AL	
KAREZ FAROOQBABAD	BULEDA DIST. TURBAT	MUHAMMAD BALUCH	65	16	0.80	1.50	579		SIMSURI	AL	Siphon and channel lining underway.
KAREZ JALILABAD	BULEDA DIST. TURBAT	HAJI JEHANGIR	84	28	0.90	1.65	652	56000	RUNGUN	AL	Construction of siphon underway.
KORJO GOD	BULEDA DIST. TURBAT		100							AL	
KAREZ SHAMA RASHID MALIK	BULEDA DIST. TURBAT		75							AL	
KAREZ SHAMA BARATI	BULEDA DIST. TURBAT		100							AL	
KORJO KORAM	BULEDA DIST. TURBAT	HAYDAR	75							AL	
KAREZ SORAG	BULEDA DIST. TURBAT		100							AL	
KAREZ BASHIRABAD	BULEDA DIST. TURBAT									AL	
KAREZ FATEHABAD	BULEDA DIST. TURBAT	FATEH MUHAMMAD								AL	Mechanical Drilling contracted.
KAREZ BHARIBABAD	BULEDA DIST. TURBAT	ABDUL SAMAD	84	28	1.00	1.70	724		RUNGAN	AL	Siphon construction underway.
KAREZ GILLI	BULEDA DIST.	MUNSHI MUHAMMAD	45	14	0.80 *		579	75000	GILLI	AL	

PEKRAM KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
	TURBAT										
KAREZ KALATU	BULEDA DIST. TURBAT	ELAHI BUKSH	75	28	1.09 *		789	56000	RUNGAN	AL	Construction of siphon underway.
KORJO BIT	BULEDA BIT DIST. TURBAT	SYED MUHAMMAD	946	104	2.90 *		2100	30000	GISHKAUR	AL	
KAREZ BIT JOS SARDAN	BULEDA BIT DIST. TURBAT		100							AL	
KAREZ SHAIDA	BULEDA CHIB DIST. TURBAT	AYUB JAN	75	14	1.00 *		724	58000		AL	Mechanical Drilling underway.
KORJO CHIB	BULEDA CHIB DIST. TURBAT	MUHAMMAD UMER	393	28	0.34 *		243	35000	GISHKAUR	AL	
KORJO KOSHK	BULEDA KOSHK DIST. TURBAT	MIR MAZAR	600		4.89 *		3540	30000	KISHKAUR	AL	
KORJO MIRABAD	BULEDA KOSHK DIST. TURBAT	MIR MAZAR	100		1.28 *		927	25000	KISHKAUR	AL	
KAREZ BALUCHABAD	BULEDA MENAZ DIST. TURBAT	DIL MURAD	100							AL	
KAREZ GELAWAN	BULEDA MENAZ DIST. TURBAT		100							AL	
KAREZ MUSLIMABAD	BULEDA MENAZ DIST. TURBAT	IMAM BUKSH	80	16	0.37	0.80	268	58000		AL	Construction of siphon and channel lining underway.
KORJO MENAZ	BULEDA MENAZ DIST. TURBAT	HAJI JAHANGIR	190	28					KISHKAUR	DE	Korjo has been dead for many years.
KAREZ RAHIMABAD	BULEDA SEEKI DIST. TURBAT	HAJI JAHANGIR	75	28					RUNGAN	UC	
KORJO SULLO	BULEDA SULLO DIST. TURBAT	SALEH MUHAMMAD	191	28	0.31 *		224	30000	KISHKAUR	AL	
KAREZ TAJ BAREAN	BULEDA ZAMURAN DIST. TURBAT	MIR ABDUR RAHMAN	100							AL	
KORJO JAN MALIK	BULEDA ZAMURAN DIST. TURBAT	RASOOL BUX	6	14	0.02 *		14	7000	SUKI KAUR	AL	

MEHRAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAUKJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO.OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KORJO KHAIRABAD	BULEDA ZAMURAN DIST. TURBAT	LAL MUHAMMAD	4	14	0.10 *		72	8000	KHAIRABAD	AL	
KORJO DAGARD	BULEDA ZAMURAN DIST. TURBAT	LAL MUHAMMAD	3		0.90 *		652	8000	KUNARDAN	AL	
KORJO GITAN	BULEDA ZAMURAN DIST. TURBAT	MUHAMMAD UMMER	4	14	0.09 *		65	10000	GITAN KAUR	AL	
KORJO GARBUN	BULEDA ZAMURAN DIST. TURBAT	LAL MUHAMMAD	8	14	0.30 *		217	15000	GARBUN	AL	
KORJO SARZA	BULEDA ZAMURAN DIST. TURBAT	MUHAMMAD UMER	5	14	0.08 *		58	5000	GITAN	AL	
KORJO SIAGISI	BULEDA ZAMURAN DIST. TURBAT		8	14	0.18 *		130	15000	SIAGISI	AL	
KORJO TAHDIM	BULEDA ZAMURAN DIST. TURBAT	FAZAL KARIM	4	14	0.08 *		58	8000	TAHDIM KAUR	AL	
KORJO ABDUL KARIM	BULEDA ZAMURAN NAG DIST. TURBAT	ABDUL KARIM	16	8	0.80 *		579	10000	NAGI KAUR	AL	
KAREZ NAG	BULEDA ZAMURAN NAG DIST. TURBAT	ABDUL KARIM	28	14	0.10 *		72	30000	NAGI KAUR	AL	
KAREZ BANDGAH	DASHT DIST. TURBAT	KHALID JAN (NAMAB)								DE	
KAREZ DEGARI KAHAN	DEGARI KAHAN DIST. TURBAT	MULLA MUHAMMED	70	14	0.30 *		217	62000	KECH/DOZZANI	AL	
KAREZ MAZARI KAHAN	DEGARI KAHAN DIST. TURBAT	ALI AHMED	75	14	0.02 *		14	64000	KECH/DOZZANI SHEEP	AL	
KAREZ HANZARAD	GASHTANG DIST. TURBAT	MIR BAHRAM	65	14	0.22 *		159	50000	KECH/ROTUG	AL	
KAREZ PIRKI	GASHTANG DIST. TURBAT	MIR BAHRAM	65	14	0.34 *		246	50000	KECH/ROTUG	AL	
KAREZ RAZAI	GINNA DIST. TURBAT	LAL JAN	56	14	0.65 *		471	48000	DOZZANI SHEEP	AL	Hand boring completed in Dec. 87.

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MEHRAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KORJO GINNA	GINNA DIST. TURBAT	MIR DAD MUHAMMAD	999	120	1.50 *		1086	30000	KECH	AL	
KAREZ SHAKARABAD	GINNA DIST. TURBAT	LAL JAN	25	14	2.60 *		1882	63000	KECH/DOZZANI SHEEP	AL	
KAREZ PHULLANI	GINNA DIST. TURBAT	MIR ABDUR RAHIM	130	28	2.00 *		1448	84000	KECH/DDZZANI SHEEP	AL	Mechanical Drilling completed to 150 ft unsuccessfully.
KAREZ FATEH ALI	GINNA DIST. TURBAT	ABDUL RAHIM	80	14	1.50 *		1086	64000		AL	Contracted for Mechanical Drilling.
KAREZ NAZIRABAD	GINNA DIST. TURBAT	ABDUL RAHIM		14	0.35 *		253		DOZZANI SHEEP	AL	Karez has been newly constructed.
KAREZ GUDI	GUDI DIST. TURBAT	MIR RAHIM BUKSH	56	14	1.00 *		724	64000	SHARMA/GHETTY	AL	
KAREZ GOKDAN	GOKDAN DIST. TURBAT	GAJEYAN	70	14					SORAP	DE	Karez has been dead for 4 years.
KAREZ CHURRUK	GOKDAN DIST. TURBAT	YAR MUHAMMAD	56	14					SORAP	DE	Karez has been dead for 4 years.
KAREZ PERRIK	GOKDAN DIST. TURBAT	MURAD JAN	56	14					SORAP	DE	Karez has been dead for 4 years.
KAREZ MALANGI	GOWARKOP DIST. TURBAT	MIR BIJJAR	15	4	0.04 *		29	25000		AL	
KAREZ FAQIRABAD	GOWARKOP DIST. TURBAT	MUHAMMAD Yaqub	10	4	0.02 *		14	25000		AL	
KAREZ LANJI	GOWARKOP DIST. TURBAT	BAHADIN	20	4	0.05 *		36	25000		AL	
KAREZ CHARUK	GOWARKOP DIST. TURBAT	DILJAN	15	4	0.01 *		7	20000		AL	
KAREZ SARI SHAHR	GOWARKOP DIST. TURBAT	ESSA	16	4	0.03 *		22	20000		AL	
KAREZ BRAP	GOWARKOP DIST. TURBAT	DDSTEEN	16	4	0.08 *		58	15000		AL	

MEKLAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/FAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KAREZ MASHKAY	GOWARKOP DIST. TURBAT	GHULAM MUHAMMAD	10	4	0.01 *		11	20000		AL	
KAREZ SHAH MACHI	GOWARKOP DIST. TURBAT	SARDU	8	4	0.01 *		8	15000		AL	
KAREZ MAHORI	GOWARKOP DIST. TURBAT	DIL JAN	10	4						DE	
KAREZ MIAMI KALAG	GOWARKOP DIST. TURBAT	MOHIBULLAH	12	4						DE	
KAREZ NOKEEN SHER	GOWARKOP DIST. TURBAT	ALI MUHAMMAD	18	4	0.01 *		7	25000		AL	
KAREZ SOLANI	GOWARKOP DIST. TURBAT	NOOR MUHAMMAD	16	4	0.09 *		64	15000		AL	
KAREZ GODAR	HEROONK DIST. TURBAT	DUR MUHAMMAD	45	15	0.05 *		36	30000		AL	
KAREZ TOGO	HEROONK DIST. TURBAT	YAR MUHAMMAD	56	16	0.75 *		543	48000		AL	
KAREZ MONO	HEROONK DIST. TURBAT	DUR MUHAMMAD	56	14	0.65 *		471	45000		AL	
KORJO HERUNK	HEROONK DIST. TURBAT	DUR MUHAMMAD	45	14	0.35 *		253	40000		AL	
KAREZ MULA ESSA	HOSHAH DIST. TURBAT	HAIDER	56	28	1.10 *		796	45000	KECH	AL	
KAREZ RAMZAN	HOSHAH DIST. TURBAT	RAMZAN	25	14	0.25 *		181	35000	KECH	AL	
KAREZ KHAIRULLAH	HOSHAH DIST. TURBAT	KHAIRULLAH	42	14	0.39 *		285	35000	KECH/SORAP	AL	
KAREZ MULA BARKAT	HOSHAH DIST. TURBAT	MULA BARKAT	42	14	0.35 *		253	45000		AL	
KAREZ MULA HABIB	HOSHAH DIST. TURBAT	MULA HABIB	42	14	0.30 *		217	45000		AL	
KAREZ PHULLABAD	HOSHAH DIST.	MIR MAQSOOD	70	16	1.50 *		1086	64000		AL	Construction of

MEKRAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
	TURBAT										Infiltration Gallery and Siphon in progress.
KAREZ HOTABAD	HOTABAD DIST. TURBAT	MIR ANYATULLAH	100	14	3.20 *		2317	50000	INGIRKAN/RODAN	AL	Mechanical Drilling completed to 150 ft unsuccessfully.
KAREZ JUSAK	JUSAK DIST. TURBAT	HAJI MUHAMMAD USMAN	100	14					SHAHWANI	DE	Check Dams constructed in 07/87 and 06/88. Karez has been abandoned for many years.
KAREZ USMANABAD	JUSAK DIST. TURBAT	HAJI MUHAMMAD USMAN	100	14					MISKEEN/SHAHWANI	DE	Karez has been abandoned.
KAREZ KAISAK	KAISAK DIST. TURBAT	MIR ABDUL GHAFAR	35	14	0.22	0.43	159	38000	KAISAK	AL	Flow rates are based on readings taken during 4/86-6/86. Karez was extended in July 86.
KAREZ HITAN	KAISAK DIST. TURBAT	TURBAT	15	14				45000		AL	Contracted for Mechanical Drilling.
KAREZ CHAMAG	KAISAK DIST. TURBAT	SYED MUHAMMAD	35	14					KAISAK KAUR	DE	Karez has been dead for some time. Mechanical Drilling completed unsuccessfully 12/88 at 150 ft.
KAREZ HAITAN	KAISAK DIST. TURBAT	GHULAM NABI	25	14	0.08 *		58	45000	KAISAK	AL	
KAREZ SAADABAD	KALATUK DIST. TURBAT	MUHAMMAD UMER	145	28	0.90	2.30	652	98000	GARUK	AL	Siphon and channel lining completed in 04/88.
KAREZ NOK KAHAN	KALATUK DIST. TURBAT	ALI AHMED	85	14	0.50 *		362	60200	GARUK	AL	
KAREZ ALLAH BAHT	KALATUK DIST. TURBAT	BAHRAM	45	14	0.56 *		405	48000	GARUK	AL	Siphon completed.

MEKRAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANSAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KAREZ FHULLABAD	KALATUK DIST. TURBAT	RASDOL BUKSH	56	14	0.65 *		471	48000	GARUK	AL	Hand Boring completed in 12/67.
KAREZ GAIBON	KALATUK SAIBON DIST. TURBAT	MIR MUHAMMAD HASSAN	70	14	0.50 *		362	75000	GARUK/SHARMA/GHETTY	AL	Mechanical Drilling Completed to 150 ft unsuccessfully.
KAREZ ISTELLABAD	KALLAG DIST. TURBAT	GHULAM HABIB	81 \$	14	0.79	1.59	573	56090	ZANKANI	AL	Flow rates are based on readings taken during 1986-88. Consumptive Use of karez water is 7.76 acre-ft/acre. Check Dam completed.
KAREZ FAQIRABAD	KALLAG DIST. TURBAT	SHAH MEHRAB	150	14					ZANKANI	DE	Check Dam completed.
KAREZ SOHRANI	KALLAG DIST. TURBAT	LAL JAN	130 \$	28	1.31	2.22	951	84000	ZANKANI	AL	Flow rates are based on readings taken during 1986-88. Hand Boring completed in June 87. Mechanical Drilling completed successfully at 150 ft. Consumptive Use of karez water is 7.51 acre-ft/acre. Check Dam completed.
KAREZ UGETABAD	KALLAG DIST. TURBAT	SULEMAN	59 \$	14	0.70	1.33	507	56000	ZANKANI	AL	Flow rates are based on readings taken during 1986-88. Karez was extended in July 86. A siphon was completed on 06/87. Consumptive Use of karez water is 9.47 acre-ft/acre. Check Dam completed.
KAREZ KIKIN	KIKIN DIST. TURBAT	KHUDA IBRAHIM	40	14	0.03 *		22		KIKIN KAUR	AL	
KAREZ SHOWAKI	KIKIN DIST.	GUM SHAD	30	14					KIKIN KAUR	DE	

MEKRAM KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KAREZ CHAMAN	MAND UZAI DIST. TURBAT	ABDUL GHANI	150							AL	
KAREZ NOKABAD	MAND UZAI DIST. TURBAT	MASJAN	150							AL	
KAREZ MIR MIR	MIR MIR DIST. TURBAT	ALTAH MUSSAIM	60	14	3.00 *		2172	56000	GARUK	AL	Contracted for Mechanical Drilling.
KAREZ MIRABAD	MIRABAD DIST. TURBAT	DUR MUHAMMED	75	17	1.50 *		1086	48000	GHETTY/RODAN	AL	
KAREZ MIRI	MIRI DIST. TURBAT	QAZI GHULAM MUHAMMAD	146	28	3.04	6.70	2201	70000	MISKEEN/ZANKANI	AL	Flow rates are based on readings taken during 1986-88. Karez was extended in July 86. Consuative Use of karez water is 16.07 acre-ft/acre. Three Check Daes constructed in 87.
KAREZ SARIABAD	MIRI DIST. TURBAT	NAMAB SAHIB	56	14					SHAHWANI	DE	Check Daes constructed in 07/87 and 06/88. Karez has been dead for many years.
KAREZ CHURBUK	NASIRABAD DIST. TURBAT	ASSADULLAH	56	14	0.40 *		290	50000	RODAN/INGERKAN	AL	
KAREZ NOKABAD	NASIRABAD DIST. TURBAT	RASDOL BUKSH	56	14	0.30 *		217	48000	GORIDAR	AL	
KAREZ NASIRABAD	NASIRABAD DIST. TURBAT	KHUDA SULEMAN	68	17	0.85 *		615	65000	GORIDAR	AL	
KAREZ CHANJAN	NASIRABAD DIST. TURBAT	GHULAM MUSTAFA	70	15	0.48 *		348	48000	GORIDAR	AL	
KAREZ KHAIRABAD	NASIRABAD DIST. TURBAT	GHULAM MUSTAFA	64	16	0.30 *		217	58000	RODAN/INGERKAN	AL	
KAREZ LALIN	NASIRABAD DIST. TURBAT	GHULAM MUSTAFA	65	16	0.80 *		579	56000	RODAN/INGERKAN	AL	

MEKRAK KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAUJRJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL		NAME OF NULLAH	KAREZ STATUS	REMARKS
							ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST			
KAREZ MUHAMMADABAD	NASIRABAD DIST. TURBAT	KHUDA BUKSH	65	16	0.38 *		275	50000	GORIDAR	AL	
KAREZ GONAPAW	NASIRABAD DIST. TURBAT	NABI BUKSH	65	16	0.56 *		405	50000	GORIDAR	AL	
KAREZ TOJAN	NODIZ DIST. TURBAT	USMAN	65	14	1.10 *		796	48000	NABINDAR	AL	
KAREZ NODIZ	NODIZ DIST. TURBAT	KHAN MUHAMMAD	56	14					NABINDAR	DE	
KAREZ PEERI KAHAN	PEERI KAHAN DIST. TURBAT	ABDUL RAHIM	75	14	1.50 *		1086	63000	DOZZANI KAUR	AL	
KAREZ GORANI BAND	FHULLABAD DIST. TURBAT	GHULAM MOHAMMAD/ BIRAKAR		16					DEZIN/NIHING	DE	Karez has been dead for many years.
KAREZ NALAGIN	PIDRAK DIST. TURBAT	LAL MUHAMMAD	16	4	0.12 *		90	32000		DE	Karez abandoned.
KAREZ SARI JOH	PIDRAK DIST. TURBAT	AZIZ AHMAD	28	5	0.22	0.26	156		KAKDAN	AL	Contracted for Hand Boring. Check Dam tendered.
KAREZ TOBA	PIDRAK DIST. TURBAT	PHULLAN	16	4	0.01 *		8	15000	KAKDAN	AL	Check Dam under construction.
KAREZ MANAK FARAN	PIDRAK DIST. TURBAT	LAL BUKSH	14	7	0.03 *		22	40000	KAKDAN	AL	Check Dam under construction.
KAREZ AFSHAN	PIDRAK DIST. TURBAT	M. RAHIM	12	4	0.10 *		72	16000	KAKDAN	AL	Check Dam under construction.
KAREZ DURMAKOL	PIDRAK DIST. TURBAT	REHMAT	28	4	0.55 *		398	15000	LATIDAN	AL	
KAREZ ZARDEEN GUNJAN	PIDRAK DIST. TURBAT	AKBER	16	4	0.12 *		85	35000	KAKDAN	AL	Hand boring completed. Check Dam under construction.
KAREZ KADHI SHAP	PIDRAK DIST. TURBAT	MULA NOORUDDIN	15	3	0.13 *		94	35000	KAKDAN	AL	Hand Boring completed.
KAREZ ARABAD	PIDRAK DIST. TURBAT	AKBAR	16	4	0.01 *		9	25000	KAKDAN	AL	Check Dam under construction.

MEHRAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAJURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
											Contracted for hand boring.
KAREZ KAUR E SAR	PIDRAK DIST. TURBAT	NOORUDIN	16	8	0.12 *		87	40000	KAKDAN	AL	Hand boring completed.
KAREZ ANZOL	PIDRAK DIST. TURBAT	FAQIR	16	4	0.11 *		80	30000	KAKDAN	AL	Contracted for hand boring. Check Dam under construction.
KAREZ BANDAY JOH	PIDRAK DIST. TURBAT	KHUDA DAD	12	3	0.10		72	30000	KULLIBAD/KAKDAN	AL	Hand Boring completed.
KAREZ MILK	PIDRAK DIST. TURBAT	RASOOL BUX	12	4	0.08 *		58	10000	KAKDAN	AL	Check Dam under construction.
KAREZ WAFQ	PIDRAK DIST. TURBAT	TAJ MUHAMMAD	20	4	0.61	0.93	439	38000	KAKDAN	AL	Contracted for Hand Boring. Check Dam tendered.
KAREZ KALIKOT	PIDRAK DIST. TURBAT	GHULAM	18	3	0.09 *		63	15000	KAKDAN	AL	Check Dam under construction. Hand boring completed.
KAREZ SARI MINAB	PIDRAK DIST. TURBAT	ASUMI	21	3	0.23	0.30	163	40000	KAKDAN	AL	Hand Boring completed. Check Dam under construction.
KAREZ GWALI MULK	PIDRAK DIST. TURBAT	MALANG	15	4	0.13	0.21	93	38000	KAKDAN	AL	Hand Boring completed. Check Dam under construction.
KAREZ TOLLUS	PIDRAK DIST. TURBAT	BAHADUR	20	4	0.11 *		80	25000	KAKDAN	AL	Check Dam tendered.
KAREZ KALAG	PIDRAK DIST. TURBAT	MUHAMMAD BUX	16	4	0.03 *		21	25000	KALAG KAUR	AL	
KAREZ RAISABAD	PIDRAK DIST. TURBAT	ATTA MUHAMMAD	18	6	0.11	0.15	78	45000	KAKDAN	AL	Check Dam under construction.
KAREZ DEGARI SHEHR	PIDRAK DIST. TURBAT	AGINA	16	4	0.11 *		80	35000	KAKDAN	AL	Check Dam under construction.
KAREZ ASHADI	PIDRAK DIST. TURBAT	GHULAM QADIR	21	7	0.12 *		87	35000	KULLIBAD	AL	

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO.OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL		NAME OF NULLAH	KAREZ STATUS	REMARKS
							ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST			
KAREZ RODAN	PIDRAK DIST. TURBAT	ASUMI	16	8	0.11 *		80	38000	KAKDAN	AL	
KAREZ ZARABAD	PIDRAK DIST. TURBAT	AZIZ AHMED	16	4	0.12 *		87	38000	KAKDAN	AL	Check Dam under construction. Contracted for hand boring.
KAREZ NOKABAD	PIDRAK DIST. TURBAT	ASUMI	15	3	0.14 *		101	28000	KAKDAN	AL	Check dam under construction.
KAREZ MALIKABAD	PIDRAK DIST. TURBAT	MURAD	8	4	0.02 *		14	30000	KAKDAN	AL	Hand boring completed.
KORJO CHEERI JOH	PIDRAK DIST. TURBAT	YOUSAF	21	7	0.25 *		181	35000	LATIDAN	AL	Check dam under construction.
KAREZ CHEER SHER	PIDRAK DIST. TURBAT	FAQIR	8	4	0.12 *		87	15000	LATIDAN	AL	Check Dam under construction.
KAREZ CHAMAGAN	SAMI DIST. TURBAT	BASHIR AHMED	56	14	1.00 *		724	56000	HILLS	AL	
KAREZ SORD	SAMI DIST. TURBAT	MUHAMMAD AMIN	42	14					HILLS	DE	
KAREZ PATANDAR	SAMI DIST. TURBAT	JAN MUHAMMAD	56	14	1.30 *		941	55000	PATANDAR	AL	
KORJO BAIKT	SAMI DIST. TURBAT	LAL BUKSH	85	28				30000	KECH	AL	
KAREZ DORGIND	SAMI DIST. TURBAT	HASSAN	45	14	0.89 *		644	60000		AL	
KAREZ SHIRAZI	SAMI DIST. TURBAT	KHALID JAN		14						DE	Karez has been dead for many years.
KAREZ PHULLARAD	SAMI DIST. TURBAT	ABDUL REHMAN	56	14	1.00 *		724	56000		AL	
KAREZ BORANI	SAMI DIST. TURBAT	IAHUDA ESSA	56	14	1.20 *		669	50000		AL	
KAREZ KALAG	SAMI DIST. TURBAT	YHUDA SHAHI	64	16	2.90 *		2100	56000	KECH	AL	Channel lining in progress.

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KAREZ KALLAM	SAMI DIST. TURBAT	MIR GHULAM RASOOL	86 *	28	1.75	3.46	1267	48000	KECH	AL	Channel lining in progress. Water being sold because water availability more than land. Consumptive use of karez water is 15.07 acre-ft/acre.
KAREZ GUNSHJIRD	SAMI DIST. TURBAT	MULA ESSA	45	14	0.90 *		648	56000	PATANDAR	AL	
KAREZ QAZIABAD	SHAHI TUMP DIST. TURBAT	NAWAB KHALID JAN	65	14	0.14		98	63000	KECH/ROTUG	AL	Boring completed 12/88 successfully at 104 ft.
KAREZ TUMP	SHAHI TUMP DIST. TURBAT	DR. RIAZ AHMED	65	14	0.65 *		471	63000		AL	Hand boring completed in June 57. Channel lining completed in March 88.
KAREZ HAMZABAD	SHAHI TUMP DIST. TURBAT	ABRAHIM	70	14	0.56 *		405	63000	KECH/ROTUG	AL	
KAREZ GONAKI	SHAHPUK DIST. TURBAT	KHUDA SHER MUHAMMAD	42	14	1.10 *		796	58000	GONAKI KAUR	AL	
KAREZ AHMEDIDAR	SHAHPUK DIST. TURBAT	KHAIR MUHAMMAD	35	14	0.35 *		253	45000	SHAHPUK	AL	
KAREZ CHURBUK	SHAHPUK DIST. TURBAT	SHER MUHAMMAD	32	14	0.58 *		420	46000	SHAHPUK/DASHTARI	AL	
KAREZ UHERI KAHAN	SHAHPUK DIST. TURBAT	PIR BUX	35	14	0.35 *		253	48000	SHAHPUK	AL	
KAREZ DASHTARI KAHAN	SHAHPUK DIST. TURBAT	USMAN	32	14	0.89 *		644	40000	SHAHPUK/DASHTARI	AL	
KAREZ SIRCHUPI	SHAHPUK DIST. TURBAT	SYED MUHAMMAD	32 *	14	0.66	1.44	478		SHAHPUK	AL	Consumptive use of karez water is 15.38 acre-ft/acre. Check Dam constructed in 10/87.

MEKLAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KAREZ SARI MOLAK	SHAHPUK DIST. TURBAT	MUHAMMAD	50	14					SHAHPUK/DASHTARI	DE	
KAREZ UKAI	SHAHPUK DIST. TURBAT	SHER MUHAMMAD	45	14	0.27	0.69	196		SHAHPUK	AL	Check Dam constructed for karez in 10/87. Karez extended in 1988.
KAREZ SHAHPUK	SHAHPUK DIST. TURBAT	DUR MUHAMMAD	22 *	14	0.89	1.58	644	49000	SHAHPUK	AL	Check Dam constructed in 10/87 for the karez recharge. Consuative Use of karez water is 29.09 acre-ft/acre. Check Dam constructed in 10/87.
KAREZ EIJLI	SHAHPUK DIST. TURBAT	FIR BUX	30	14					DASHTARI KAUR	DE	
KAREZ HAIDARI KAHAM	SHAHPUK DIST. TURBAT	PIR BUX	28	14	0.79 *		572	39000	SHAHPUK/DASHTARI	AL	
KAREZ DALAY SAR	SHAHPUK DIST. TURBAT	MUHAMMAD AMIN	35	14	0.79 *		572	48000	SHAHPUK/DASHTARI	AL	
KAREZ NELAN	SHARAF DIST. TUPEAT	MIR FALAK NAZ	56	14	0.12 *		87	65000	NELAN	AL	Contracted for Mechanical Drilling.
KAREZ NOKABAD	SHARAF DIST. TURBAT	HAJI FAQIR MUHAMMAD	42	14						DE	A recharge scheme was tendered, but no bids received.
KAREZ GATT	SHARAF DIST. TURBAT	NIZAR	41	14	2.00 *		1448	60000	GATT KAUR	AL	Mechanical Drilling completed in 12/88.
KAREZ SIKUNI	SHARAF DIST. TURBAT	KHUDA RASOOL BUKSH	45	14	0.10 *		72	60000	SIKUNI KAUR	AL	Mechanical Drilling terminated.
KAREZ NAKANI	SHARAF DIST. TURBAT	KHUDA RASOOL BUKSH	56	14	1.00 *		724	58000	SIKUNI KAUR	AL	
KAREZ SINGKALAT	SINGKALAT DIST. TURBAT	ELAHI BUKSH	64	14					DOZZANI SHEEP	DE	Karez has been dead for 20 years.
KAREZ CHALLO	SIRI YAHAN	QADIR BUX	53 *	14	0.92	1.82	666	63000	MISKEEN	AL	Flow rates are based

MEHRAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
	DIST. TURBAT										on readings taken during 1986-88. Karez was extended in July 86. Hand boring was completed in June 87 and channel lining completed in June 88. Consumptive Use of karez water is 9.61 acre-ft/acre. Three Check Dams constructed in 87. Mechanical Drilling completed 12/88 successfully at 52 ft.
KAREZ SIRI KAHAN	SIRI KAHAN DIST. TURBAT	AMIR RUKSH	51 *	14	0.62	1.51	449	63000	MISKEEN	AL	Flow reading are based on readings taken during 1986-88. Karez was extended in July 86. Two siphons were also constructed on the karez in 11/87. Consumptive use of the karez water is 10.38 acre-ft/acre. Three Check Dams constructed in 87.
KAREZ BALUCHABAD	SOLBAND DIST. TURBAT	MOULVI GHULAM MUHAMMED	70	14	0.04	0.35	31		GARUK	AL	
KAREZ SOLBAND	SOLBAND DIST. TURBAT	ABDUL DAYUM	80	17	0.78 *		565	51000	GARUK/SHARMA	AL	
KORJO KARMANDAI	TANZAG DIST. TURBAT	MULA HUSSAIN	990	62					KETCH	DE	Contracted for construction of Infiltration Gallery.
KAREZ ZAFARABAD	TUMP DIST. TURBAT	WALI MUHAMMAD HOT	75	16	0.89 *		644	58000	NIHING	AL	
KORJO IANMUNDEI	TUMP DIST. TURBAT	HAJI MUHAMMAD IBRAHIM								UC	
KAREZ TUMP	TUMP DIST. TURBAT	NADIR JAN	85	16	1.50 *		1086	64000	NIHING/NABINDAR	AL	Siphon under construction.

MEKRRAN KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL	ANNUAL	NAME OF NULLAH	KAREZ STATUS	REMARKS
							ANNUAL FLOW (ac-ft)	MAINT. COST			
KAREZ GULISTAN	TUMP DIST. TURBAT	MIR ABDULLAH	80	17	1.10 *		796	60000	NIHING/NABINDAR	AL	
KAREZ CHAGDGI	TUMP DIST. TURBAT	NADIR JAN	80	16	1.00 *		724	64000	NIHING/NABINDAR	AL	Siphons contracted.
KAREZ MIR ESSA	TUMP DIST. TURBAT	GHULAM NABI	64	16	1.40 *		1014	54000	NIHING/NABINDAR	AL	Siphons contracted.
KAREZ MIR ASHRAF	TUMP DIST. TURBAT	MIR ASHRAF	100	24				72000		AL	
KAREZ NUSRAT	TUMP DIST. TURBAT	NUSRATULLAH	45	16					NIHING	DE	
KAREZ NOKABAD	TUMP ASIABAD DIST. TURBAT	DAD RAHIM	100						NIHING	AL	Irrigates same command area as Asiabad Korjo.
KORJO ASIABAD	TUMP ASIABAD DIST. TURBAT	ABUL HASSAN	100						NIHING	AL	Korjo operates only during flooding of Nihing.
KAREZ ASIABAD	TUMP ASIABAD DIST. TURBAT	SYED MUHAMMED	70	15	0.92	1.05	665	62000	NIHING	AL	Siphon and hand boring completed.
KAREZ AZIAN	TUMP AZIAN DIST. TURBAT	MIR SHAHU	64	16	0.30 *		217	65000	NIHING	AL	
KAREZ KHUSHKABAD	TUMP BALICHA DIST. TURBAT	MOTABER ABDULLAH	100	16	1.20 *		869	65000	LUTUM/SHAHAP	AL	
KAREZ GAMISHI	TUMP BALICHA DIST. TURBAT	HAJI SHAD DAD	75	17	1.00 *		724	54000	LUTUM	AL	
KAREZ RAISABAD	TUMP BALICHA DIST. TURBAT	MOTABER ABDULLAH	110	28	1.20 *		869	56000	SHAHAP/LUTUM	AL	
KAREZ RODBUN	TUMP BALICHA DIST. TURBAT	HAJI MEHRAB	64	16	0.59	0.61	427	58000	LUTUM	AL	
KAREZ BALICHA	TUMP BALICHA DIST. TURBAT	ABDUL HAKIM	90	17	1.20 *		869	58000	SHAHAP/LUTUM	AL	Approved for Siphon.
KAREZ SIRINKIN	TUMP BALICHA DIST. TURBAT	MUHAMMAD UMER	68	17	1.00 *		724	60000	SHAHAP/LUTUM	AL	

MEKRAM KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO. OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KAREZ RINDABAD	TUMP BALICHA DIST. TURBAT	NANAB	65	17	1.00 *		724	51000	SHAHAP/LUTUM	AL	
KAREZ BAYAN	TUMP BALICHA DIST. TURBAT	BAYAN	35	17	0.18	0.22	130	60000	LUTUM/SHAHAP	AL	Siphon completed.
KAREZ BHARIBABAD	TUMP BALICHA DIST. TURBAT	MUHAMMAD KARIM	15	17	0.11 *		80	51000	LUTUM/SHAHAP	AL	Siphon completed.
KAREZ KHUSHKABAD	TUMP BALICHA DIST. TURBAT	MOTARER ABDULLAH	55	17	0.89 *		644	55000	LUTUM/SHAHAP	AL	
KAREZ BOSTAN	TUMP BOSTAN DIST. TURBAT	MIR BAHRAM KHAN	75	16	1.10 *		796	48000	DEZIN	AL	
KAREZ DAZEN	TUMP DAZEN DIST. TURBAT	MUHAMMAD ISLAM	64	16	*			60000	NIHING	DE	Mechanical Drilling contracted.
KAREZ HAJIABAD	TUMP GOMAZI DIST. TURBAT	HAJI BAD KARIM	70	14	0.89 *		644	65000	DEZVI	AL	Hand boring, completed.
KAREZ SANKIN	TUMP GOMAZI DIST. TURBAT	MIR DASIM	95	17	1.00 *		724	65000	DEZVI/BONPIR	AL	
KAREZ GOMAZI	TUMP GOMAZI DIST. TURBAT	MUHAMMAD YOUSAF	90	16	1.10 *		796	80000	DEZVI/BONPIR	AL	Contracted for Mechanical Drilling.
KAREZ SHAHBAK	TUMP GOMAZI DIST. TURBAT	SHAHBAK	95	24	1.20 *		869	82000	DEZVI/BONPIR	AL	
KAREZ TARATI	TUMP GOMAZI DIST. TURBAT	MOTEBER YOUSAF	68	17	1.00 *		724	75000	DEZVI/BONPIR	AL	
KAREZ SARI BAST	TUMP GOMAZI DIST. TURBAT	MUHAMMAD NOOR	84	28	1.10 *		796	84000	DEZVI/BONPIR	AL	
KAREZ KASAND	TUMP KASAND DIST. TURBAT	ABDUL RAHMAN/ GUMSHAD	80	16	0.75 *		543	56000	NIHING	AL	
KAREZ KOHAD	TUMP KOHAD DIST. TURBAT	HAYATAN	100							AL	
KAREZ KOLAHOD	TUMP KOLAHOD DIST. TURBAT	ABDULLAH MUHAMMAD	100							AL	
KAREZ KUSHKALAT	TUMP KUSHKALAT	BASHIR BEDAR	70	16	1.40 *		1014	64000	NIHING	AL	

MEKRAM KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJD	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO.OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
	DIST. TURBAT										
KAREZ MALANT	TUMP MALANT DIST. TURBAT	MUHAMMAD ASLAM	85	16	0.65 *		471	64000	DEZVI	AL	
KAREZ MALIKABAD	TUMP MALIKABAD DIST. TURBAT	AHMED JAM	85	16	1.10 *		796	64000	NIHING	AL	
KAREZ NAZARABAD	TUMP NAZARABAD DIST. TURBAT	MOTABER YAQOOB	85	17	1.12	1.15	809	68000	NIHING	AL	Hand boring in progress.
KAREZ HAJIABAD	TUMP PHULLABAD DIST. TURBAT	HAJI DAD KARIM	65	16	0.49	0.56	352	64000	DEZVI	AL	Hand Boring completed.
KAREZ PHULLABAD	TUMP PHULLABAD DIST. TURBAT	ANYATULLAH	75	17	0.72 *		521	68000	DEZVI/NIHING	AL	
KAREZ HOTHJO	TUMP PHULLABAD DIST. TURBAT	KHALIFA M. KARIM	55	14	0.89 *		644	62000	DEZVI/NIHING	AL	
KAREZ SAMADABAD	TUMP SAMADABAD DIST. TURBAT	HAJI ABDUS SAMAD	150							AL	
KAREZ SORO	TUMP SORO DIST. TURBAT	SARDAR MULADAD	100							AL	
KAREZ KHUSRAVI	TURBAT DIST. TURBAT	MIR ABDUL KARIM GICHKI	100	14						DE	Karez has been dead for many years.
KAREZ WAZIRABAD	TURBAT DIST. TURBAT	GHULAM PASOOL	100	14						DE	
KAREZ MALIKI	TURBAT DIST. TURBAT	RASOOL BUKSH	85	14	0.47	0.98	340	63000	DOCRUM/KETCH	AL	Mechanical Drilling completed 04/88 successfully at 112 ft.
KAREZ KOSHK	TURBAT DIST. TURBAT	MIR KHAN MUHAMMAD	75	14	0.73	1.41	529	56000	DOCRUM/KETCH	AL	Mechanical Drilling completed 05/88 successfully at 120 ft.
KAREZ SORAGI	TURBAT DIST. TURBAT	KAHUDA ASSA	95	14	0.61 *	1.00	439	70000	DOCRUM/KETCH	AL	Mechanical Drilling completed 05/88 successfully at 120 ft.

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MEKRAM KAREZES INVENTORY

LIST OF KAREZES BY DISTRICT/LOCATION

NAME OF KAREZ/KAURJO	LOCATION	NAME OF MAJOR SHARE HOLDER	COMMAND AREA (acres)	NO.OF HANGAMS	AVERAGE FLOW (cusecs)	MAXIMUM FLOW (cusecs)	TOTAL ANNUAL FLOW (ac-ft)	ANNUAL MAINT. COST	NAME OF NULLAH	KAREZ STATUS	REMARKS
KAREZ RAISI	TURBAT DIST. TURBAT	MIR DURRA	75	14				63000	DOCRUM	AL	
KAREZ KANASI	TURBAT DIST. TURBAT	MIR DURRA	75	14					DOCRUM/KECH	DE	Rehabilitation work done without any success.

* Placed with the column labelled AVERAGE FLOW indicates the average flow is based on single reading.

\$ Placed with the column labelled COMMAND AREA indicates an actual measured area.

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