DRAFT REPORT

1.0 Community Participation Unit (CPU), Churu awarded the work of documentation of Technical features of PMC- Aapni Yojna vide its letter dated 20th February 2006. It was stipulated in the letter of award that the entire work shall be so undertaken that the final report is available by 20th March 2006.

The scope of study included following basic steps:

1. Review of available secondary sources (reports, presentations etc.) as relevant to the study.
2. Discussions with different stakeholders
3. A qualitative study at project area to complement the findings.

2.0 Background

To improve the rural water supply situation and the communities' health in north-western Rajasthan, the Government of Rajasthan (GOR) has implemented phase I of the 'Aapni Yojna' – The Integrated Water Supply, Sanitation and Health Education Program in 370 villages and 2 towns of two districts namely Hamumangarh and Churu. The source of water is Indira Gandhi canal for the project. The water after treatment/filtration and disinfection is pumped through large diameter trunk pipe lines to intermediate pumping station reservoirs. Water from these reservoirs is then pumped to over-head Service Reservoirs, called cluster reservoirs. Water is distributed to a cluster of villages through a network of distribution pipe lines from such cluster reservoirs. Water is distributed in the village through Public Stand Posts (PSPs) and Cattle Water Troughs (CWTs) connected to village distribution system. In some big villages, house service connections have also been provided. To support GOR in this project, the German Government had committed financial co-operation funds of Euro 95million. The project work started in 1994 and is at the verge of completion by end March 2006.

The design and construction of the project was implemented from 1994 by a specially created Project Management Cell (PMC) in Public Health Engineering Department (PHED) of GOR. The Operation and Maintenance of water supply system is being carried out by PHED.

To facilitate and support the participation of the beneficiaries in the planning, operation and maintenance of the water supply system at the village level, a Community Participation Unit (CPU) was formed. CPU is a consortium of 5 regional NGOs, led by the Indian Institute of Health Management Research (IIHMR), Jaipur.

An Indo-German consulting consortium, IK, supported PMC and CPU in the implementation of Aapni Yojna.

Water and Health Committees (WHC) were formed in all the project villages, which are responsible for the operation and maintenance of village water distribution systems. These function as sub committees of the Gram Panchayat (GP). The WHCs are involved in the planning of the village distribution systems, specially the siting of the PSPs and CWTs. In addition, CPU provides sanitation units to at least 33% of the village house holds, and imparts health and hygiene education to the target population. Women's empowerment was facilitated through the formation of Self Help Groups (SHG), which engage in loaning and income generation activities, as well as through provision of specific medical services. Few SHGs were also supported in starting their dairy development activities. CPU also played a key role in motivating the WHCs in deciding water tariff in villages and collecting water charges from the users and depositing the same with PHED in time.

The project provides 24 hours water supply to the project villages and recovers water charges as per actual consumption by the village recorded by the village water meter. This has greatly checked wastage of water and thus reduced water consumption substantially. The experiences of the project are unique in nature and are exemplary. The strategy adopted in the project has become a role model for future projects in the state of Rajasthan. KFW, the German Bank for Reconstruction, which provided loan assistance, therefore, decided to document the Technical features of the project and the lessons learned. The present study should be looked in above background.

3.0 METHODOLOGY

The study has been carried out in the following steps:

1. Collection of basic data and reports from the Project Management Cell of PHED, Churu.
2. Review of data and reports and any other secondary data collected.
3. Discussions with PMC officials followed by discussions with PHED officers, who are doing O&M of the system and collecting revenue.
4. Discussions with the other stakeholders like CPU officials, public representatives, beneficiaries and contractors/suppliers.

As the time available was very short for the completion of the study, qualitative study at the project area was not possible.

4.0 PRE – PROJECT SITUATION

During pre-independence period, people were mostly dependent on rainwater as ground water was highly saline and not potable. Rainwater harvesting was most commonly practiced in both Urban and Rural areas. It was individual based in Urban areas but Community based in Rural areas. Rainwater used to be collected in underground covered tanks with protected catchments around the tank. The tank opening used to be locked and

water use was almost rationed. However, due to very frequent failure of rainfall, people were required to either migrate or transport water from long distances during scarcity periods. In any case, it was the poor people who were to suffer from water scarcity. It was a common experience that people feared that guests would ask for water to drink. They were more willing to offer milk and butter rather than Water to the guests.
After independence in 1947, the state and central governments looked into this gigantic problem. Water supply schemes were provided for large number of villages by tapping ground water sources wherever available, ranging from 5km to 50 km. These schemes were mostly for a group of villages as water sources were limited. However, the quality of water of these sources was not as per standards in general, but far better than the locally available ground water. Secondly, the water sources tapped for the schemes were not sustainable on long term basis.

Meanwhile, Government of Rajasthan (GOR) was executing a major canal project to bring water of Himalayas to the desert area.. GOR, therefore, sanctioned a water supply project from canal water with Rate of water supply as 70 LPCD for about 300 villages of Churu district in early eighties. The project implementation was a serious problem on account of lack of infrastructure and hostile environment. The availability of Electric Power was most erratic and Roads were almost non-existent.

Notwithstanding government making huge investments on water supply infrastructure in Churu district, people were not relieved of drinking water problem. The quality of water supplied was not satisfactory, the supply was erratic and not dependable. The people of the tail end villages of Regional(group of villages) schemes used to starve for water.

The limitations of these schemes/projects may be summarized as below:

- Inadequate time for overall planning.
- Political interference in Technical planning.
- Lack of supervision.
- Absence of cost recovery concept resulting in waste of water.
- Indifferent public attitude to water supply system. This results in poor upkeep of the system and frequent damages/breakdowns.
- Grossly inadequate logistics support to executing agencies.
- Erratic and inadequate power supply.
- Lack of O&M culture.

5 INTRODUCTION

5.1 Recent history of the Project

The Integrated water supply, sanitation and health education project for the Churu District, part of Jhunjhunu and Sri Ganganagar Districts of Rajasthan was started in 1991. The first activity was the analysis of the actual situation and the study of alternatives for the supply of the area under consideration. After the reconnaissance it emerged that the project had to cover seven Tehsils of Churu District, part of the Jhnujhunu Tehsil and part of the Nohar Tehsil of the respective districts.

Thus, the project area covered by the master plan and feasibility study finally included 956 villages and 11 towns in an area of about 20000 km^2. This study was completed in January 1993. It was proposed to implement the project in two phases: the first to cover about 727 villages and 6 towns and the second to cover the entire area. The implementation of the entire project was supposed to start in 1994 and to stretch over 8 years up to 2002. For this period a total budget of Rs. 8,478 million was estimated to be provided in annual installments according to the progress achieved.

During the appraisal mission of the German funding agency, the Kreditanstalt für Wiederaufbau (KfW), in March/April 1993, it was decided to subdivide the first phase of the project into two phases. This, because of financing considerations of KfW. The volume of this modified first phase was laid down broadly in the report F, submitted in April 1993, approved by PHED and KfW and subsequently sanctioned by GoR in the 115th meeting of the Policy Planning Committee (PPC) held on 26th July, 1994.

The bilateral negotiations took place in the second part of 1993 and the decision making process of the German Government was finalized in March 1994. The bilateral loan and Financing Agreement between GoI and KfW, the Project Agreement between KfW and GoR and the Separate Agreement between KfW and PHED were signed in Frankfurt, Germany on June 17th 1994. The board indicators of this sanctioned first project phase are:

- Covered villages: 325 (370 as per 2001 census)
- Covered towns: 2
- Target population in 1991 and in the design year (2012): about 665, 000/ 862,000
- Estimated cost of the first phase: Rs. 2,530 mio (DM 141 mio)
- Share of GoR: Rs. 560 mio (DM 31 mio)
- Share of KfW: Loan: Rs. 720 mio (DM 40 mio)

  Financial contribution (Grant): Rs. 980 mio (DM 55 mio)

According to a Separate Agreement, it is envisaged to increase the financial contribution of the German Government by another DM 15 millions. Thus, the German share will be DM 110 millions. In addition to that, the German Government will provide an additional budget of Rs. 450 millions (DM 25 millions), required to substitute the proposed AC pipes by pipes of another material.

The global project has been elaborated and presented in 6 different sequential reports:

- Report A: Findings of Investigations; Existing Situation, (June 1991)
- Report B: Design Criteria; Study of Alternatives, (June 1991)

- Report C: Sanitation and Health; Existing Situation and Proposals, (June 1991)

- Report D: Preliminary Design, Implementation and O&M, (January 1993)

- Report E: Strategies for sanitation, health education and community participation (January 1993)

- Report F: Redefinition of the Phase 1 of the project (April 1993)

These reports are the basis for the implementation of the project. The Report G, 'Sanctioned Project Report' provides a comprehensive and concise presentation of the sanctioned Phase 1. It includes all the details which were not specifically worked out or mentioned in Report F and thus, is an elaboration of the latter. The Sanctioned Project Report, together with the supporting reports were to be the basis for the detailed design to be undertaken in the next phase.

The extension works of the treatment plant of Sahwa and the new plant of Pandoosar which were to be commissioned in 1993 were still not commissioned at the time of sanction of of Phase I project and were accordingly included in the project implementation as an additional implementation unit..

5.2 The components of the Global Project

The sanctioned project cannot be understood without knowing the concept and the layout of the global project. Most of the elements of the project were to be designed taking into account the future integration. Basically, the first phase is just the first part in space and time of the global project, resulting from its proposed implementation schedule and 'implementation path'.

5.2.1 THE PROJECT AREA

The project area covers about 20,000 km^2 in 6 of the 7 Tehsils of the District of Churu and parts of the Jhunjhunu and Nohar Tehsils of the neighbouring Districts of Jhunjhunu and Sri Ganganagar. The actual population in the 956 villages and the 11 towns is 1,69 million – ¼ in towns and ¾ in villages. More than 80% of the villages have less than 2,000 inhabitants and nearly 50% have even less than 1,000.

The project area has an arid climate of semi-desert type with temperatures up to 48^0C and limited areas for rainfed agriculture. In spite of these adverse conditions animal husbandary is an integral part of the economy. Infrastructure is not very much developed nor is industry. The same applies to the educational and medical facilities of this rural area. The backwardness of the region is also reflected in a low literacy rate, not exceeding 10% among rural women. Social structures are dominated by traditional behaviour patterns. The income of the rural population is low.

The total population is expected to rise from about 1.7 million to 2.2 million in 2002 and to 2.6 million in 2012. That year is the end of the project period.

5.2.2 WATER SUPPLY AND SANITATION PROJECT

The Water Supply Project consists of 4 main and 3 additional components for which the preliminary design was made:

- Treatment plants with raw water storage reservoirs;
- Trunk system of pipelines and pumping station, including interim reservoirs;
- Distribution system of the village clusters and of the towns, including service reservoirs;
- Dedicated electrical grid with substations, supplying the plants and stations;
- Workshops (Support Centres); Headquarters at Churu with staff colony for the implementing agency (PMC)
- Communication system linking the plants and the headquarters;
- Limited sanitation measures in the towns.

Strictly speaking, the urban sanitation components is a part of the complementary measures in the fields of sanitation, health education and community participation, but its technical elements are included in the technical part of the project. In addition to that, and as supporting measures, technical assistance through consultants is included in the implementation as well as fellowships for the PHED staff involved in the project.

The total water demand in the project area according to the covered areas is 187,563 m^3 in Phase 2. This demand has been worked out on the basis of following design criteria:

-	rural consumption:	35 lpcd in Ph 1	40 lpcd in Ph2
-	provision for cattle:	30 l per cattle-unit in Ph 1 and Ph 2	
-	urban consumption:	70 lpcd in Ph 1	90 lpcd in Ph 2

The water demand will be covered by the **existing treatment plants** at Sahwa and at Pandoosar and by **three new treatment plants** at Dharnasar, Karamsana and at Taranagar, the latter will be constructed in Phase 2 only. At each of the proposed plants, raw water storage reservoirs will be provided to cover the demand of about 10 days closure of the irrigation canals. If the period is longer the water will be rationed in order to bridge the gap. The clear water reservoirs and the pumping stations of these plants are the starting points of the trunk systems.

The **trunk systems** consist of pipelines and the intermediate pumping stations, including the existing ones of the Gandheli Sahwa Scheme. The total length of new pipes is 467 km, ranging from DN 350 to DN 1100 mm. These mostly are prestressed concrete pipes and only the smaller diameters below DN 500 were proposed to be of asbestos cement. 31 pumping stations are required to convey the water; they are located in intervals from 12 to 23 km. 5 of them exist already in the Gandheli Sahwa Scheme. The whole project area, clusters of villages and towns, are supplied exclusively from these stations. No other pumping stations will be required within the project area. The capacities of the transmission pumps rang from 450 to 1,400 m^3/h. Smaller pump-sets are provided for the supply to the clusters and towns. At each intermediate pumping station an intermediate reservoir and adequate water hammer protection devices such as surge tanks and air vessels are provided. Other measures such as zero velocity valves or air cushion valves will be studied during detailed design.

In the frame of the feasibility study the **distribution systems** of several ‘typical clusters’ of villages and of towns had been analyzed in order to assess the technical feasibility and to estimate the costs for all the 34 clusters and the 11 towns. It appeared that for the detailed design of the cluster distribution systems topographic surveys are necessary since the spot levels indicated on the toposheets do not really represent the topographic details such as apex points along a pipeline or the different altitudes in the villages. Each cluster distribution system has been designed for a continuous supply from one master balancing reservoir or as a combined system with additional supply from the pumping station. The pumping stations for the clusters are located at the intermediate pumping stations of the trunk system. Thus, no additional pumping stations are required inside the cluster area where power supply is most unreliable.

Continuous power supply is most vital for the operation of the water supply scheme. Hence, after various discussions with the Rajasthan State Electricity Board (RSEB) it was proposed to provide a **dedicated electrical grid** for the water supply scheme. Thus, a minimum power supply of 16 hours per day can be guaranteed. Such a grid has to be designed and implemented by RSEB. Nevertheless, in order to analyze the technical feasibility and the cost, a preliminary design had been worked out in close consultation with RSEB. The total power requirements for the pumping stations and treatment plant are 18.2 MW in the second phase. This capacity has to be provided through 611 km of 33 kV HT lines feeding all the stations and plants. Not more than 2 stations will be supplied by one feeder departing from a 132 kV sub-station. Moreover, link lines will be laid between adjacent pumping stations. By these arrangements the power supply for the water supply installations will have a highest degree of reliability and except for load shedding and interruptions on the 132 kV grid of RSEB (which are very few), there will be a continuous power supply. Arrangements have to be made between RSEB, IGNP and PHED for the costs sharing of those installations which are commonly used.

According to the information supplied by IGNP and RSEB, IGNP needs HT lines with one 132 kV (at Jokhasar) and several 33 kV sub-stations for the Shawa Lift Scheme. The Jokhasar sub-station is a suitable starting point for the northern and eastern project area.

The proper operation of the scheme cannot be made without an efficient maintenance structure. **Three support centres** will be provided at 3 of the pumping stations or treatment plants. They include a workshop, a mobile repair unit, stores and spare parts. At one of them (Taranagar) a small training centre will be provided. Moreover, at this centre the highest level of equipment will be provided for the case of repairs of a particular kind.

The complexity of the system requires a constant and permanent **communication system** between the intermediate pumping stations. It must be excluded that due to lack of communication water is waster by spilling over or in case of leaks and that the operation of the scheme is made without the required precision. The safest and most suitable system is the wireless communication by VHF (radio frequency). This, however, needs an allocation of frequencies for which the clearance from the department of communication and from the Ministry of Defense is required.

According to the scope of work the **urban sanitation measures** should consists in the identification of ‘critical zones’ and of proposals for their sanitation. After the appraisal mission of KfW it was decided to start the urban sanitation programmes with the most urgent components i.e. with the elimination of the waster water ponds in the low lying areas. Since the towns of Sardarshahar and of Taranagar are included in the first phase of the water supply scheme it is proposed to take up these towns for the urban sanitation measures too. These measures will be designed in a way to complete them at a later stage according to the Master Plan prepared in the Feasibility Study.

5.2.3 PROJECT IMPLEMENTATION

The individual project components have been designed to be implemented in stages covering the entire implementation period. About 50 Implementation Units had been identified which could form one of part of a tender package each. The starting point for the implementation is the existing Gandheli Sahwa Scheme and its offshooting regional systems. The distribution systems of this first batch of clusters can be adapted within a short time. The fact that the extension of the treatment plant Sahwa and the new treatment plant Pandoosar have not yet been completed and that not fully treated water is supplied immediately will be explained to the consumers. In any case, the reliability of the supply will be improved by the implemented measures.

During the same time the new treatment plants can be constructed which requires several years. A second batch of clusters will be taken up after the completion of the treatment plants at Dharnasar and at Karamsana. It will be implemented over the following 2 years and it will cover all the clusters between Sahwa and Gandheli which actually receive raw water, they can be supplied from the new treatment plant Karamsana and the first stretches of the trunk system supplied from there. Further, 4 of 5 clusters between Dharnasar and Sardarshahar and this town itself can be supplied from the treatment plant

Dharnasar. A third batch will be supplied after the extension of the eastern trunk system beyond Taranagar to the south and east. By this, the towns of Rajgarh, Churu and Bissau and the area of the south of Taranagar will be supplied. This batch also includes the remaining cluster 5 of the western trunk. The last batch of the first phase are the remaining clusters in the south-east part of the project area covering all the villages and towns of the Ratangarh and Sujangarh Tehsils.

By this, the implementation of the whole project will be continuous over 8-10 years starting from mid 1994. In the first year, however, mostly preparatory and design activities will take place. Physical activities will not start before mid 1995. All the other project components such as treatment plants, trunk mains, pumping stations, high tension lines and sub-stations and the communication system have to be implemented accordingly. The annual development of villages shifted from their actual sources to the new scheme and the cumulative number connected are as follows:

Broad implementation schedule as projected

Year of commission	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Villages	57	85	98	85	138	63	124	77	90	139
Cumulated	57	142	240	325	463	526	650	727	827	956
Towns			1	1	1	3		2	3	
Cumulated			1	2	3	6	6	8	11	11
Cumulative design pop. (1,000 in 2012)	154	349	575	862	1,186	1,431	1,704	1,840	2,141	2,620

The project design, implementation and O&M will be executed by a **Project Management Cell (PMC)**, which is entirely dedicated to this project. The PMC will be largely independent and its structures and procedures will be defined according to the needs of the project. It will act independent of Tehsil and District boundaries and will be located in Churu. During the first years, when the design work is at its peak, PMC will be assisted through consultants. This constitutes an important element of institutional development and human resources development for PHED. The functions of the required units of the proposed PMC have to cover the fields of:

- detailed design and tenders;
- implementation, supervision, quality control and commissioning;
- operation and maintenance;
- accounting, billing, financial control, MIS.

The Project Management Cell will be headed by a Chief Engineer. He will be responsible for the technical sanctioning of the tenders prepared by the PMC.

The bulk distribution of the water can be easily controlled from the trunk system. This is also the case for the distribution in the towns. The distribution to the villages and particularly to the tail-end villages of the clusters, however, is difficult to control and is the weakest element in all the existing regional schemes. For this reason, it is imperative to establish an efficient **water distribution management** for the rural supply. The second field is the procedures of payments and the measures in case of non-payment which have to be implemented together with the new schemes and the particular PMC set-up for its operation. A third field is the maintenance of the stand posts and cattle troughs as well as the supervision of the different installations of the cluster distribution systems. Finally, the operation of the scheme and the equal distribution in the cases of emergency fall under the water distribution management.

In this context it may be pointed out that one important issue of the agreements between GoR and KfW is the increase of tariffs in order to reduce the subsidies of the Government.

All this cannot be possible nor successful without the active participation of the consumers in the villages and without a very close co-operation between PMC and the villagers. Both parties have to build up awareness for these fields. The participation of the villagers will be effective through the Water Watch Groups to be constituted in every village. These are represented by a Water Panchayat which negotiates with PMC on matters which concern the water supply to the entire cluster. At PHED level one or two PMC employees of each pumping station will be nominated as a link between PHED and the consumers. They should have a special training in the field of public and human relations. All these measures are the most important part of the complementary measures.

5.2.4 THE COMPLEMENTARY MEASURES

The activities in the fields of community participation, sanitation and health education will be implemented in an integrated programme along with the implementation of the water supply scheme. The executive period stretches from 1994 to 2005. The main objectives of these measures are the support of the operation and maintenance of the water supply project ensuring the sustainability of the project, and to maximize its benefits for the target population.

The implementation of the project will be undertaken by a **consortium of NGOs** called **Community Participation Unit (CPU)**. The CPU is supported by consultants. All staff members will work on full time basis. There are three hierarchic and functional levels:

- Steering Team (STT) with several staff members including the Programme Director (who is the head of the CPU) and Programme Officers for the different fields to be covered. The workload is characterized by conceptual tasks.

- Operation Team (OT) with the Chief OT and supervisors which are preparing and supervising the field work and support to the field workers.

- Field Teams (FTs) with field workers in several teams performing the activities on the spot.

The complementary measures will be carried out in close co-operation with the PMC. The CPU will focus its activities on those parts (batches, clusters, towns) of the project area where the construction work for the water supply facilities is under execution.

The field work is organized in five main modules or fields of activity, each of them requiring specific actions. A part of them are executed in all villages others will be launched in villages where specific conditions or interests prevail.

- to involve, inform and develop the target communities;

- to create awareness and responsibility for the consumption of water (Water Watch Groups) and to establish a water distribution management system in the villages;

- to implement the construction of low cost sanitation facilities;

- To launch women development activities, and to promote family welfare measures;

- to implement ad-hoc measures according to particular situation in the village.

5.3 **Phase 1 – Sanctioned Project**

5.3.1 WATER SUPPLY MEASURES

The Feasibility Study contains an implementation schedule which has been worked out according to the financing possibilities of both GoR and KfW and to the absorption capacities of PHED. It is a continuous implementation over more than 10 years from 1994 to 2005, when the last units will be commissioned. During the appraisal mission of KfW in March 1993 it was agreed on the re-definition of a first **Phase 1** which should include a portion of the project without creating too much pre-investments. This Phase includes the Batches 1 and 2 of the global implementation schedule with all the implementation units of the first four years plus one preparation year. This means it will stretch to the year 1999. The postponement by one year (initially, 1998 was the last year of the implementation) is due to various delays during the preparation of the appraisal report and the inter-governmental negotiations. The implementation was to commence from 1995 and is to be completed in about 5 years by means of a continuous planning, tendering and implementation process.

The following project components will be completely or partly executed during this period:

- treatment plant Dharnasar (partly);
- treatment plant Karamsana (partly);
- pipeline from TP Dharnasar to Sardarshahar;
- pipeline from Karamsana to Sahwa;
- intermediate pumping station with reservoirs along these pipelines (partly);
- dedicated electrical grid (partly);
- distribution systems in 18 Clusters with 325 villages and 2 towns; rehabilitation works, new pipes, additional pipes;
- communication system for all these project components;
- workshop with training centre at Taranagar;
- headquarters at Churu and staff quarters;
- rehabilitation and completion measure in the treatment plants of Sahwa and Pandoosar (optional in case of no-commissioning in 1995);
- rehabilitation and adaptation measures in the existing trunk system (pipelines and pumping stations);
- training fellowships;
- technical assistance through consultants.

A more precise description of these elements is presented in the following paras. However, the final details, suitable for tendering and implementation will be fixed during the detailed design stage. After the implementation of these measures, 861,650 inhabitants (2012) will be supplied continuously with safe water.

If, for practical reasons, it is more suitable to launch tenders for bigger components, the tenders will be designed accordingly and several smaller units might be included in one tender. In order to partly commission completed works the contracts have to be edited accordingly. This will be decided in the detailed design stage according to the details worked out at that stage.

After the implementation of the elements which are required for these works, the 325 villages will be connected to the new set-up of the global scheme. These are villages which actually either depend on supply of raw water or brackish water or which do not have at all a regular supply. This also includes villages of the existing Gandheli-Sahwa Scheme, many of which for several reasons are not correctly supplied actually (raw water, tail-end villages, villages depending on booster stations, insufficient quantity, excess wastage of water).

The salient figures are:

- 173 villages will be newly supplied with treated water;
- 116 villages of the Gandheli Sahwa Scheme being actually supplied with raw water will receive treated water;
- in 36 villages of the GS-Scheme the supply will be augmented and improved.

The 325 villages are located in the following Tehsils:

- Nohar Tehsil (Sri-Ganganagar District): 113
- Taranagar Tehsil (Churu District): 66
- Sardarshahar Tehsil (Churu District): 103
- Rajgarh Tehsil (Churu District): 37
- Churu Tehsil (Churu District): 6

The towns of Taranagar and Sardarshahar are also covered under the new scheme.

The remaining villages of the GS-Scheme (located in Batches 3 and 4 to be supplied in the next phase; about 45 in Rajgarh and 10 in Churu Tehsil) will continue to be supplied as per the present situation. The partly very complicated details of the transition period will be worked out during the detailed design. It will be ensured that a village which now receives water from TP Sahwa or Pandoosar, will continue to be supplied either under the new arrangements (cluster distribution systems) or with temporary arrangements until it will be served under the new scheme.

5.3.2 SANITATION IN THE TOWNS OF SARDARSHAHAR AND TARANAGAR

The following sanitation measures are proposed for the towns of Sardarshahar and Taranagar:

- construction of retention ponds in the depressions (since no additional drains will be constructed these ponds will be smaller than those proposed in the FS; staging will be possible for future extension);

- construction of pumping stations with pumps for dry weather and storm water flow (the latter according to a reduced inflow because no collecting channels for rain water will be constructed;

- construction of pipelines and open channels to transfer the waster water and the rain water near to the location of the future waster water treatment plant (oxidation pond) and to open land (storm water). The site for percolation and evaporation has to be fenced and at safe distance from the towns.

The main and secondary drains as proposed in the master plan are not included. However, those drains which are used for the conveyance of the water from one pumping station to another will be included in the sanitation measures.

5.3.3 COMPLEMENTARY MEASURES

The sanitation, health education and community participation measure will be executed as proposed in the Feasibility Report. They will cover all the villages and the towns of the Phase 1.

5.3.4 PREVIEW OF THE FOLLOWING PHASE

The continuous design, tendering and implementation process for the Implementation Units of the first phase will not end with the termination of Phase 1. Timely, say after 3 years and according to the progress reached at that time negotiations have to be taken up with the Government of Germany with view to the implementation of the next phase of the project. For these negotiations, however, it is important that – apart from satisfactory achievements in the technical fields – the issues concerning the increase of the tariffs in the supplied project area will be solved according to the agreements between GoR and KfW.

6. Supplied population and demand

The following figures are the summary and include the design figures for 2002 and 2012 related to the area covered in Phase 1. In order to compare the Phase 1 with the global project these figures are also given for information.

Population, consumption & production figures related to the area under Phase 1

Particulars	Global Proj.	Area of Phase 1	
	2012	2002	2012
Number of villages	956	325	325
Total rural population	1,965,410	584,135	720,470
Cattle units in villages	552,850	212,456	222,674
Number of towns	11	2	2
Urban population	654,860	128,210	153,620
Total population	2,620,270	702,345	875,090
Per capita consumption in villages (lpcd)	40	35	40
Consumption per cattle unit (l/d)	30	30	30
Per capita consumption in towns (lpcd)	90	70	90
Human consumption in villages (m^3/d)	78,616	20,445	28,819
Cattle consumption in villages (m^3/d)	16,585	6,394	6,802
Consumption in town (m^3/d)	58,937	8,975	13,825
Distribution losses in clusters (*) (%)	15	15	15
Distribution losses in towns (*) (%)	22	22	22
Supply to villages (m^3/d)	112,008	31,575	41,907
Supply to towns (m^3/d)	75,560	11,506	17,724
Total supply (m^3/d)	187,563	43,081	59,631
During 16 h operation period (m^3/d)	11,723	2,276	3,726
Treatment losses (**) (%)	3	3	3
Total production (m^3/d)	193,363	44,414	61,476
Total production (m^3/h)	12,085	2,775	3,842

(*) % of the supply from the IPS; (**) % of the production, taking into account recycling of filter backwash water

The above table requires one important additional comment. The figures worked out for the design year 2002 are only 30% above the capacity of the treatment plants of Sahwa and Pandoosar after completion, 1,745 m^3 clear water output. The reason for this is that the treatment plants of Sahwa and Pandoosar are designed for more villages as are covered under the first phase of the project.

Required capacity of the four treatment plants in Phase 1

Command area of the treatment plants	Batches, Clusters	Required Capacity (output) Phase 1
TP Sahwa supplies the clusters which are all downstream Sahwa. It also continues to supply those villages of the Ghandheli Sahwa Scheme which are not yet covered under Phase 1.	Eastern batches: 17.1, 18, 19, 20, 21, 22, 23, 24, 45	858 m^3/h 13,723 m^3/d Existing after completion
TP Pandoosar supplies the clusters which downstream Pandoosar. It also continues to supply those villages already connected to it and which are not yet covered under Phase 1.	Central batches: 13 ,15	228 m^3/h 3,646 m^3/d Existing after completion
TP Karamsana supplies the clusters which are upstream Sahwa and which now receive raw water only.	Eastern batches: 11, 12, 14, 16	371 m^3/h 5,937 m^3/d
TP Dharnasar supplies the clusters between Dharnasar and Sardarshahar.	Western batches: 1, 2, 3, 4, 5.1, 41	1,352 m^3/h 21,638 m^3/d

This capacity has to be provided by the first units to be constructed in Phase 1 and by the capacity of the existing plants. The new units of the proposed plants have to be dimensioned with view to the required final capacity in Phase 2 of the project.

Proposed sizes (clear water output) of treatment plants Phase 1

Plant	Final Cap.Ph 2	Units Ph 2	**Reqd. Ph 1**	Units Ph 1	**Cap. Ph 1**
Dharnasar	4,350 m^3/h	4 of 1,088	1,352 m^3/h	2 of 1,088	2,176 m^3/h
	69,900 m^3/d	4 of 17,475	21,638 m^3/d	2 of 17,475	34,950 m^3/d
Karamsana	2,428 m^3/h	3 of 810	371 m^3/h	2 of 810	1,620 m^3/h
	38,850 m^3/d	3 of 12,950	5,937 m^3/d	1 of 12,950	25,900 m^3/d
Sahwa (existing)	1,310 m^3/h	3 of 435	858 m^3/h	3 of 435	1,310 m^3/h
	20,690 m^3/d	3 of 6,897	13,723 m^3/d	3 of 6,897	20,690 m^3/d
Pandoosar (ex.)	435 m^3/h	1 of 435	228 m^3/h	1 of 435	435 m^3/h
	6,960 m^3/d	1 of 6,960	3,646 m^3/d	1 of 6,960	6,960 m^3/d
Total			2,809 m^3/h		5,541 m^3/h
			44,944 m^3/d		88,500 m^3/d

It appears that by a reasonable choice of the sizes of the plants with view to their final capacity, the available capacity in Phase 1 is larger than that required to cover the clusters under Phase 1.

7. Intakes and treatment plants

The design of the intakes and treatment plants, as well as that of all the other project components to be implemented in the first phase, cannot be made thoroughly without taking into account the global requirements and technical solutions. For this reason it is essential for better understanding to first present the layout of the final phase and then those units which will be implemented in the first phase.

7.1 Global requirements

The required production of the global project will be 187,560 m^3/d which corresponds to 11,723 m^3/h during 16 hours.

This demand will be covered by the existing treatment plants at Sahwa (after commissioning of the extension works) and at Pandoosar (after commissioning the new works) and by 3 new plants at Dharnasar, Karamsana and at Taranagar. The total clear water output of the existing treatment plants after completion will be 1,745 m^3/h. Hence, the balance has to be produced in the 3 new plants. The total clear water output and the design capacity of these new plants must be 159,624 m^3/d or 9,978 m^3/h. It will be covered from the individual plants as follows:

- Dharnasar: 4,350 m^3/h (design capacity raw water: 4,485 m^3/h)
- Karamsana: 2,428 m^3/h (design capacity raw water: 2,500 m^3/h)
- Taranagar: 3,200 m^3/h (design capacity raw water: 3,300 m^3/h)

In the first phase of the project, the first units of the plants at Dharnasar and at Karamsana will be implemented. Later, other units will be added and an additional treatment plant will be constructed at Taranagar, at the last stretch of the Sahwa Lift Canal.

The demand of raw water will be covered from the following sources:

- the existing PHED-canal from Ghandeli to Sheorani, via Karamsana will be utilized at its full capacity and allocation which is 1.2 m^3/s or 4320 m^3/h

- the intake at the first (gravity flow) stretch of the Sahwa Lift Canal at Dharnasar will have the capacity of 4,350 m^3/h
- the intake at Taranagar will be designed for 3,200 m^3/h

7.2 Works at the existing plants

In the frame of the present project no extension of the capacities of the existing plants of Sahwa and Pandoosar is considered because this would require an extension of the raw water pumping stations and many other interventions in the existing elements. There will be only minor changes and adaptations in the pumping stations according to the final design for the cluster distribution systems being supplied from these stations.

Since the PHED canal will be used at its maximum capacity and closures should be avoided, it was proposed to construct a simple floating desilting/dredging device with which the canal could be desilted during operation of the canal. Tests can be made during the detailed design phase by the design unit of the Project Management Cell..

7.3 Proposed intakes and treatment plants

All the proposed treatment plants will have a similar design because the treatment process and the technical requirements will be similar for all of them. The raw water has a similar quality since it is taken from the Indira Gandhi Canal.

The treatment required is pre-chlorination, coagulation / flocculation sedimentation, filtration and post-chlorination. This classical procedure has been successfully adopted by PHED at several places for the treatment of the water from the Indira Gandhi Canal. If correctly constructed and operated the quality of the treated water will always match the drinking water standards.

The intakes from the supply canals have to be designed for the normal intake and for the increased withdrawal for the filling of the raw water storage reservoirs. In addition, 50% of these loads are added for security reasons. Thus the design load had to be 1.2 m^3/s for Karamsana and 3.0 m^3/s for Dharnasar. The actual diversion from the irrigation canal at Dharnasar is less than 6% of its design flow (2.08 of 21.74 m^3/s) during normal operation and 9.6% when the raw water storage reservoirs are being filled. The withdrawal of 1.52 m^3/s at Taranagar, however, is 44% of the design flow of 3.5 m^3/s in the last stretch of the canal. This has an important impact on the design of the command area. Water supply having the topmost priority, this is accepted and the IGNP has agreed to that withdrawal. The intake at Karamsana will be designed for the total recommended capacity of the PHED canal, 1.2 m^3/s.

The raw water pumps are of submerged type and are installed in a raw water distribution reservoir which is fed from the intake by gravity. They have to be designed to match the different hydraulic conditions during normal periods and during emptying of the raw water reservoirs. They will convey the raw water to the flash mixing units.

The raw water storage reservoirs are designed to cover the demand of 10 days closure plus provision for 20-30% losses. If the closure period is longer, the water will be rationed in order to bridge the gap. This rationing and the wise use of the then available water will be one of the important elements of the water distribution management. In case of difficulties in water storage management the number of reservoirs will be increased later. Provision for land has to be made already in the first phase. The storage reservoirs will be filled by gravity via the raw water distribution reservoirs at Karamsana will be designed to provide storage also for the TP Sahwa and Pandoosar, because the storage reservoir at Lalaniya is inadequate in size and not lined. Thus, the lift station Karamsana can work continuously even during a closure period of the Rawatsar distributory. The detailed operation and the location of the storage reservoirs will be verified during the detailed design phase. The unit sizes of the raw water storage reservoirs vary between 53,000 and 72,000 m^3.

The addition of alum requires flash mixing and coagulation. The flash mixing unit will be upstream of the clariflocculators which will be fed from here by gravity for flocculation and sedimentation. This type of treatment units are already existing in the TP Sahwa. For all new plants the unit size of 1,700 m^3 is proposed. At least two units have to be constructed in order to ensure operational security.

Classical open rapid sand filters of the rising level type will be provided in the plants. They will be backwashed with air and water in order to reduce the quantity of water for backwashing. Here again, a uniform unit size of 40 m^2 is proposed for all the plants.

The backwash water will be collected in sedimentation basins and recycled and/or used for irrigation within the treatment plat. The supernatant backwash water will be recycled into the raw water distribution or the flash mixer or used for irrigation purposes. Thus, the treatment losses can be kept at 3%.

The chemicals dosing plant with store will contain all the facilities for dosing and storage of:

- gaseous chlorine (for pre and post-chlorination)
- alum (for coagulation)
- copper sulphate (temporarily in the case of algae growth)
- lime (if required for pH correction)

Seven days storage will be provided in the chemical plant; provision for bulk chemicals storage for 1 month of operation will be made on the site. The chlorine drums will be stored in a separate part of the store with all the required safety devices for handling and for the case of leakage.

The clear water reservoirs in the treatment plant will be the starting point for the pumping into the respective trunk system and the suction reservoir for the supply of the surrounding clusters. It will have a volume of 2 h of the treatment plant capacity which corresponds to 5,000 m^3 at Karamsana, 9,000 m^3 at Dharnasar and 7,000 m^3 at Taranagar.

The smooth functioning and reasonable working conditions for the staff requires several auxiliary installations such as:

- Administrative building
- Staff colony, guest house
- Roads and car parks
- Internal water supply
- Green spaces with irrigation system
- Waste water disposal system (septic tank and infiltration trenches)
- Lighting
- Compound wall for the treatment units and scrub/tree belt for the raw water storage reservoirs.

7.4 Implementation units of the treatment plants of Phase 1

For Phase 1, not all of the above mentioned components of the treatment plants have to be implemented. Only those units which are required to cover the demand of the first phase and those units which are vital for the smooth functioning of the plant and its downstream installations will be installed. Others will be added in later stages of the project.

The following units are provided for Phase 1:

- Dharnasar: 50% of the final capacity in 2 treatment units of 1,088 m^3/h (17,475 m^3/d) each. Each unit consists of 1 clariflocculator and 4 rapid sand filters.

- Karamsana: 2/3 of the final capacity in 2 treatment units of 810 m^3/h (12,950 m^3/d) each. Each unit consists of 1 clariflocculator and 3 rapid sand filters.

The clear water pumps of the TP Dharnasar and Karamsana are in fact the initial pumping stations of the trunk system. Hence, all the components of the pumping stations are included in the IUs of the trunk system:

- the 33 kV substation;
- the clear water reservoirs;
- the pump house, the pumps and the EM equipment (transmission pumps, cluster pumps);
- the water hammer protection devices.

7.4.1 IMPLEMENTATION UNIT TP1 – TREATMENT UNITS DHARNASAR

This implementation unit will include the following components:

- Intake channel
- Raw water distribution reservoir
- Raw water pumps for Phase 1
- Control house (complete) raw water pumps incl. electrical and mechanical equipment (Phase 1)
- Flash mixer and coagulation chamber incl. piping (complete)
- Clariflocculators 1 and 2 for Phase 1
- Filters 1 – 8 for Ph 1
- Filter gallery building for all the filters
- Piping in the filter gallery
- Air blowers and backwash pumps (complete)
- Reservoir for backwash water (complete)
- Sedimentation basins, sump and recycling pumps (complete)
- Chemical house for the final capacity and dosing plat (complete)

7.4.2 IMPLEMENTATION UNIT TP2 – TREATMENT UNITS KARAMSANA

- Intake channel (complete)
- Balance reservoir (complete)
- Raw water distribution reservoir (complete)
- Raw water pumps Phase 1
- Control house (complete) for raw water pumps incl. electrical and mechanical equipment (Phase 1)

- Flash mixer and coagulation chamber incl. piping (complete)
- Clariflocculators 1 and 2
- Filters and filter gallery 1 to 8
- Reservoir for backwash water (complete)
- Sedimentation basins, sump and recycling pumps (complete)
- Chemical store and dosing plant (complete)

7.4.3 IU TP3– BUILDING, INFRASTRUCTURE DHANNASAR

- Bulk chemical store
- Administrative building (complete)
- Infrastructure (roads, wall, lighting, green spaces, demarcation of future units, tree belt) Ph 1
- Staff colony (complete)

7.4.4 IU TP4 – BUILDING, INFRASTRUCTURE KARAMSANA

- Bulk chemical store
- Administrative building (complete)
- Infrastructure (roads, wall, lighting, green spaces, tree belt)
- Staff colony (complete)

7.4.5 IU TP5 – RAW WATER RESERVOIR DHARNASAR

- Raw water storage tanks including piping

7.4.6 IU TP6 – RAW WATER RESERVOIR KARAMSANA

- Raw water storage tanks including piping

7.4.7 IU TP7 – COMPLETION SAHWA AND PANDOOSAR

This unit completion of TP Pandusar and rehabilitation of TP Sahawa.

8. Trunk system of pipelines and pumping stations

The trunk system consists of pipelines and the intermediate pumping station, including the existing ones of the Gandheli Sahwa Scheme. They have been preliminarily designed taking into account the following criteria:

- demand of the clusters
- points of supply to the clusters and towns
- location of the source (treatment plants)
- L-sections along the pipeline alignment
- effects of water hammer and surge
- pressure classes of pipes
- capacity of existing trunk pipes
- location of existing pumping stations

8.1 Global requirements for Phase 2

8.1.1 PIPELINE STRETCHES

Each stretch of the pipeline will carry the inflow to the intermediate pumping station, reduced by the outflow to the clusters and towns supplied from this particular pumping station. These design loads have been calculated with the allocation of clusters to each station. The allocation of cluster demand, fully or partially, to one IPS is made according to the preliminary design for the typical clusters. For the remaining clusters, the allotment is made on the basis of a pre-analysis of the potential cluster schemes and the source-IPS(s) for each of them.

The salient results for the new pipes required for the global scheme are:

- total pipe length: 467 km

- range of diameter: DN 350 – Dn 1100
- material: AC for DN <500, other DN: PSC
- range of pressure class: Class 6 – Class 14

According to the loan agreement, no AC pipes should be laid in the project. The German Government allocated DM 25 millions for the substitution of these pipes

8.1.2 INTERMEDIATE PUMPING STATIONS AND RESERVOIRS (IPS)

The pumps of the IPS pumping water to the reservoir of the next IPS are also determined with the design load. In each station 1 to 3 pumps plus 1 standby unit will be provided. The power of the pump motors should be below 400 kVA in order to reduce problems during start-up. During detailed design the possibility of motors with higher tension will be analyzed. The hydraulic characteristics of the pumps in the proposed pumping stations covering the demand of Phase 2 have the following range:

- manometric head: 66 – 14 m
- discharge: 1,427 – 452 m^3/h
- total number of pumps: 52 + 25 standby

The details are presented in the following table. We have presented the duty points for the capacity of Phase 1 and those of Phase 2. During detailed design, the adequate types of pumps as well as their duty points with regard to the required Phase 1 and Phase 2 capacities will be analyzed in detail. The control and security systems for the pumping stations and their equipment as well as the level of automatic operation will also be designed at that stage. This includes also the integration into the communication and data transmission system provided for the project. Meters will be provided too at each pumping station both for the trunk system and for the cluster pumps.

Details of the pump design

IPS (+)	Q Ph 1 m^3/h	H Ph 1 m	Pumps	Q Ph 2 m^3/h	H Ph 2 m	Pumps
1 *)	1545	29.09	1+1	1427	45.48	3+1
2	1411	5.71	1+1	1368	21.74	3+1
3	1390	17.57	1+1	1358	32.42	3+1
4	1143	19.06	1+1	1252	33.29	3+1
5	1043	15.57	1+1	1210	26.74	3+1
6)				1275	66.20	3+1
7)				1275	47.93	3+1
8)				1304	25.77	2+1
9)	Phase 2 only			2354	14.05	1+1

10)				1965	15.41	1+1
11)				911	16.50	1+1
12)				431	30.88	1+1
14 *)	1099	45.44	2+1	1067	44.62	2+1
15	1031	27.20	2+1	978	25.79	2+1
16	1031	25.21	2+1	978	23.12	2+1
17	1151	24.76	2+1	978	20.14	2+1
18-19	1733	19.45	1+1	1366	32.65	3+1
18-30	681	17.97	1+1	1101	27.05	1+1
19	1668	15.46	1+1	1336	24.86	3+1
20-32	841	27.64	2+1	841	27.64	2+1
20-21	780	40.41	2+1	727	47.60	3+1
21	735	18.85	2+1	1033	23.80	2+1
22	554	21.88	1+1	756	27.98	1+1
23	341	17.23	1+1	452	22.94	1+1
25 *)						
26 *)						
27)	Existing pumps will be used for IPS 27, 28 and 29					
28)						
29)						
30	574	10.98	1+1	961	16.04	1+1

(+) The terminal pumping stations 13, 24 and 31 only have cluster pumps.
****) IPSs 1, 14, 25 and 26 are situated in the respective treatment plants. Their suction reservoir is the clear water reservoir of the TP.***

31 single or twin reservoirs ranging from 500 to 4,500 m^3 will be constructed in the IPS. The total storage volume will be 80,000 m^3 in Phase 2. Generally 1 hour storage is provided in order to compensate variations of the inflow from the preceding IPS and the outflow to the next IPS and to the clusters and towns. In case of operational difficulties the storage volume will be increased to 2 hours. The details are as follows:

The respect of the pressure limits due to sudden variations of the flow in the pipelines has to be ensured by water hammer protection devices. During detailed design the protection measures will be adapted to the local conditions and the detailed data of the pumps. At the stage of the feasibility study only surge tanks and air vessels were analyzed preliminarily. If possible, surge tanks were provided because they are completely non-mechanized and more reliable.

The status as per the feasibility study is:

- 17 surge tanks: height: 15-35 m, diameter: 4.5 – 5 m
- 4 air vessels: volume: 175-700 m^3 in one or several units
- 4 combinations: air vessel at pump house and surge tank at apex point of the pipeline

Proposed water hammer protection devices

IPS	Type of water hammer protection
1 TP	Air vessel 30 m^3, Surge Tank H = 35m, d = 5m
2	Surge Tank H = 25m, d = 5m
3	Surge Tank H = 25m, d = 5m
4	Air vessel 30 m^3, Surge Tank H = 35m, d = 5m
5	Surge Tank H = 30m, d = 5m
6	Air vessel 425 m^3
7	Air vessel 700 m^3
8	Surge Tank H = 30m, d = 5m
9	Surge Tank H = 15m, d = 4.5m
10	Surge Tank H = 20m, d = 4.5m
11	Surge Tank H = 20m, d = 4.5m
12	Air vessel 175 m^3
14 TP	Air vessel 30 m^3, Surge Tank H = 35m, d = 5m
15	Surge Tank H = 30m, d = 5m
16	Surge Tank H = 25m, d = 5m
17	Surge Tank H = 25m, d = 4.5m
18-19	Surge Tank H = 35m, d = 5m
18-30	Surge Tank H = 30m, d = 4.5m
19	Surge Tank H = 25m, d = 5m
20-32	Surge Tank H = 30m, d = 4.5m
20-21	Air vessel 250 m^3
21	Air vessel 30 m^3, Surge Tank H = 35m, d = 4m
22	Surge Tank H = 35m, d = 4m
23	Surge Tank H = 25m, d = 4m
25 TP	existing (Pandoosar)
26 TP	existing (Sahwa)
27	existing IPS
28	existing IPS
29	existing IPS
30	Surge Tank H = 20m, d = 4m

During detailed design, however, other devices and protection measures will be included into the analysis:

- zero velocity valves;
- air cushion valves;
- discharge tanks at apex points of the pipeline;
- surge tanks at high points;
- admission of negative pressure to say – 3 m;

- air inlet/outlet at high points;
- pressure relief valves;
- throttling the inlet/outlet of the air vessels or the surge tanks by orifices;
- surge tanks with variable diameter.

The detailed consideration of water hammer problems might have an impact on the pipe characteristics and the location of the pumping stations. Generally, the water hammer protection measures will be included in the pipeline system, whether they are located at the pumping station or in the pipeline.

Each pump house will have 3 units: the booster pumps unit, the cluster and /or town pumps unit and a central unit with control room, rechlorination room and store.

As far as the cluster/town pumps are concerned they have been analyzed in the frame of the preliminary design of the selected typical cluster and town distribution systems. There will be more than 60 pump groups in the whole trunk system because many of the clusters cannot be supplied with one pump set due to topographical or hydraulic reasons.

Because of the large number of pumping stations and their equipment there is a huge scope for standardization. This has to be taken into account from the very beginning of the design phase of the project. In the long run it is more advantageous to reduce the multitude of types of equipment instead of saving some percent by design of tailor made equipment for each particular condition.

8.1.3 TESTING AND REHABILITATION OF THE EXISTING TRUNK PIPELINES

The existing pipelines will be integrated into the global trunk system. These pipes will have to continue to operate according to the present or the future requirements. In order to ensure their reliability, the pipelines will be tested. In case of available parallel pipelines repair works will be easily possible after providing bypass pipes. If no parallel pipe is available, the implementation of the rehabilitation measures has to be worked out in detail according to the particular work to be done. Since such works cannot be undertaken in a few hours it is important to inform the downstream population and to ask for cooperation through private storage and reduced consumption of water during 2-3 days. These tasks are covered under the emergency management of the operating team and will be part of the awareness campaigns of CPU as far as the population is concerned.

8.1.4 PROPOSED MODIFICATIONS IN THE TRUNK SYSTEM

Due to the uncertainty to the completion of the treatment plants of Sahwa (extensions) and Pandoosar, the new treatment plant of Karamsana may be linked to that of Sahwa. By implementing additional capacity at TP Karamsana, the excess production could substitute a big part of the uncompleted capacity of the two existing plants. Once the TP Karamsana being in operation, the work at Sahwa and Pandoosar could be completed under this project if they are not yet completed.

In order to avoid laying a pipe between Pandoosar and Sahwa bringing the excess water from Pandoosar back to the eastern trunk system the following could be considered:

- suppress the pipe Pandoosar to Sahwa;
- supply only that much water from Sheorani to TP Pandoosar which is required for the supply of the clusters allocated to the plant (clusters 13 and 15; those villages already connected to TP Pandoosar); thus the TP Pandoosar might work slightly below its design capacity;
- the additional water will be produced in TP Karamsana by slightly increasing the capacity.

In addition to that, all existing stations and pipelines of the Ghandeli Sahwa Scheme have to be tested and adapted to the new requirements.

8.2 Implementation units of pipeline stretch of Phase 1

Generally, for Phase 1 the following pipeline stretches in the final design capacity will be implemented:

8.2.1 <u>IMPLEMENTATION UNIT PL1 – STRETCHES IPS1 – PIS6 (TP DHARNASAR – SARDARSHAHAR)</u>

- stretches IPS1-IPS2, IPS2-IPS3, IPS3-IPS4, IPS4-IPS5, IPS5-IPS6

8.2.2 <u>IMPLEMENTATION UNIT – PL2 – STRETCH IPS14 – IPS16 (TP KARAMSANA – SAHWA)</u>

- stretch IPS14- IPS15, IPS15 to IPS16

8.2.3 <u>IMPLEMENTATION UNIT PL3 – TESTING AND REHABILITATION OF THE EXISTING PIPELINES BETWEEN SAHWA AND TARANAGAR</u>

- testing of the pipelines
- rehabilitation works if required
- connection works and adaptation to the new system

8.3 Implementation units of the pumping stations of Phase 1

For all the pipeline stretches the pumping stations are included in the following implementation units:

- pump houses in the final layout, unless there is a possibility to construct a part of it later (e.g. cluster pumps section of the pump house of a terminal stretch)

- the possibility of partly implementation of the following elements will be examined during detailed design:

- pumps
- hydraulic and electro-mechanical equipment, meters
- control panel, provisions for communication and telemetry
- sub stations and transformers

A possible grouping in implementation units is given below. The final grouping and tendering procedures have to be analyzed in detail together with the implementation of the pipelines.

8.3.1 IMPLEMENTATION UNIT PS1 – PUMPING STATIONS DHARNASAR, PURVASAR, BISRASAR

- Pump houses including transmission pumps, cluster pumps, water hammer devices of the stations of Sadasar, Bhojrasar, Sardarshahar

8.3.3 IMPLEMENTATION UNIT PS3 – PUMPING STATIONS KARAMSANA, SHEORANI

- Pump houses including transmission pumps, cluster pumps, water hammer devices of the stations of Karamsana and Sheorani

- Access road linking Karamsana to Sahwa TP

8.3.4 IMPLEMENTATION UNIT PS4 – PUMPING STATIONS SAHWA, PANDOOSAR

- Rehabilitation and completion of pump houses including transmission pumps, cluster pumps, water hammer devices of the stations of Sahwa and Pandoosar, adaptation to the new system.

8.3.5 IMPLEMENTATION UNIT PS5 – TESTING AND REHABIL. ESISTING PUMPING ST.

- Testing and rehabilitation of existing pump houses including transmission pumps, cluster pumps, water hammer devices of Dabri, Bhalau Tibba and Taranager, adaptation to the new system.

8.4 Implementation units of the intermediate reservoirs

For all the pipeline stretches the intermediate reservoirs are included in the following implementation units:

8.4.1 IMPLEMENATION UNIT IR1 – RESERVOIRS AT DHARNASAR, PURVASAR, BISRASAR

- Reservoirs and complete piping of the stations of Dharnasar, Purvasar, Bisrasar and Sadasar.

8.4.2 IMPLEMENTATION UNIT IR2 – RESERVOIRS AT SADASAR, BHOJRASAR, SARDARSHAHAR

- Reservoirs and complete piping of the stations of the stations of Sadasar, Bhojrasar, Sardarshahar.

8.4.3 IMPLEMENTATION UNIT IR3 – RESERVOIRS AT KARAMSANA, SHEORANI

- Reservoirs and complete piping of the stations of the station of Karamsana and Sheorani.

8.4.4 IMPLEMENTATION UNIT IR4 – RESERVOIRS AT SAHWA, PANDOOSAR

- Adaptation of the reservoirs of the stations of Sahwa and Pandoosar to the new system

8.4.5 IMPLEMENTATION UNIT IR5 – RESERVOIRS AT DABRI, BHALAU TIBBA

- Adaptation of the reservoirs of the stations of Dabri, Bhalau Tibba and Taranagar to the new system.
-

9 Supply to the towns and the villages

The supply to the clusters of villages as well as the supply of the towns is made in all cases uniquely from one of the intermediate pumping stations of the trunk system. No additional booster stations are to be located off the trunk system where the 33 kV line is available. The distribution systems are right away designed for the demand of Phase 2.

9.1 Cluster distribution systems

The essential designs are summarized hereafter:

- The consumption figures for the villages are taken according to the tables presented in Report B. During detailed design, the population and demand figures will be broadly verified again.

- The minimum pressure is 10 m at peak flow conditions; for exceptional situations (small village, high elevation) this figure can be less if at average flow conditions the 10 m criteria is respected.

- The maximum pressure in distribution pipes is 50 m which corresponds to 50% of the test pressure of a Class 10 AC pipes. In extreme cases and night flow or static conditions, exceeding this figure by 5-10 m is accepted if it occurs at one or two points only (in any case, existing pipes will be tested before integration in the proposed scheme).

- The hydraulic calculations are done for the following flow conditions:

    - peak flow (rural): 11% of the daily demand
    - average flow: 7% of the daily demand

    During these flow conditions and at no-flow condition (static head of the reservoir) the pressure limits have to be respected.

- The maximum pressure in transmission pipes should correspond to the hydraulic requirements; 100 m should not be exceeded. If existing pipes are used their pressure class is 10 and the working pressure of 50 m must not be exceeded.

- This is proposed in spite of the fact that at many places in the existing schemes pumps delivering into class 10 pipes operate at more than 5 an sometimes at 7 bars.

- The pumps at the trunk system supplying the cluster reservoir usually operate for 16 hours.

- The volume of the service reservoirs of the clusters corresponds to 30% of the daily demand in Phase 2. This corresponds to around 1.5 times the volume required to compensate the fluctuations caused by the consumption pattern.

- Thus the supply in the villages can be maintained for 24 hours.

The criteria for the layout cannot be fixed in a very rigid manner. They however can serve as a guideline for analyzing different alternatives. They will be adapted to the particular conditions of each cluster.

- The starting level in the reservoirs at the IPS (Intermediate Pumping Stations) of the trunk system and in the service reservoirs of the cluster is the mean water level. The bottom and the top water levels might be 2-3 m lower and higher.

- A general consideration is to reduce the number of the service reservoirs and transmission mains. If possible all operation points should be concentrated at the IPS.

- The location of the service reservoir and the transmission main is selected according to the following priority:

1. Reservoir in the IPS complex; short transmission main
2. Reservoir not too far from the IPS; combined or simple system
3. Reservoir not too far from the IPS; transmission main of several km
4. Reservoir far from the IPS; combined system: reservoir floating on the line.
5. Reservoir far from the IPS; long transmission main.
6. Reservoir far from the IPS; long transmission main; intermediate pumping station required (only possible if the 33 KV grid is available in the vicinity)

- Any combination of the above possibilities can be considered.

- In the case of a combined system, the analysis of the pressure at pumping conditions during low or zero-consumption periods determines the highest pressure at low-lying areas. This is often the exclusion factor for the choice of such a combined system.

- In the detailed design phase the pump performance in combined systems has to be analyzed thoroughly. The reason is the fact that even if the hydraulic conditions are respected the pumps might not be able to feed the reservoirs with the quantity required for the peak hour and the hours without pumping. This reservoir balance simulation has to be executed for 24 hours of the day. At the present stage we have not analyzed in detail the balance situation because all the topographic data are preliminary.

- In combined systems the pressure in the case of a breakdown of the pumps during peak hours will drop. In such (abnormal) cases the cluster will be supplied from the reservoir only but the supply is possible for very low demand only.

- The pipes of existing regional schemes will be used to a large extent. If the capacity is insufficient, doubling will be required. If possible, the flow direction should follow the staging of the diameters.

- The integration of existing pipelines leads in some cases to odd operation conditions (very low flow velocity, bringing water to a point in a circuitous way). This, however, is more acceptable than laying a new pipe and abandoning an existing one.

- In order to maintain the system-pressure at all places, the existing ground level or elevated reservoirs will be connected to the system with DN 25 pipes; these will be equipped with stop valves and float valves. They will serve as standby reserve for cases of breakdown of the system and for cattle supply. The use of these reservoirs will be rigorously submitted to the supervision in the frame of the water distribution management.

- The distribution to the villagers will be made by several small diameter pipes (DN 50 – DN 60) supplying standpipes and cattle troughs at different locations in the village.

For the detailed design and the preparation of tender documents the following preparatory actions will be required:

- reactualisation of the existing pipes (DN, material, Class alignment, age, condition);

- topographic survey along the alignments of new pipes including alternative alignments with spot levels at high and low points;

- preferably the same type of survey for the existing pipes which can be included in the scheme;

- assessment of the stability of the desert roads.

This work has to be done irrespective of the boundaries of the clusters. The final cluster boundaries will be fixed after the detailed investigations with the help of detailed hydraulic analysis.

9.2 Technical details for design

Technical details will be worked out during the detailed design phase. However, some important elements which are required in order to improve the O&M, to ensure the sustainability and to reduce the problems can be highlighted in advance at the present stage.

Cluster pumps

These will be located in the IPS. Mostly there will be one working pump and one standby pump for each cluster. The foundations of the pumps and the suction and delivery mains are designed for Phase 2 and allowing for additional reserves. A meter and a pressure switch have to be installed in the pipe supplying the cluster. The pumps will be started manually and they stop when the pressure in the system rises because the valve at the receiving service reservoir closes. This is done by the pressure switch. Water hammer protection devices will be provided for systems with a dedicated transmission pipe to the service reservoir. These devices may consist of excess pressure release valve or a small air vessel with a tight bladder, needing no compressor. There will be a valve in the suction and delivery pipe of each pump. A spring loaded non-return valve will be installed in the pressure pipe.

Operation

The pumps will be started or stopped manually; when the reservoir is full they will stop automatically via the pressure switch, which also operates an acoustic alarm. If this occurs during daytime the pumps have to be Reservoir-started after a certain lapse of time. The duration of this lapse will be determined according to the experience of the operators of the system.

In case of a pipe break the water watch groups should close the valve downstream of the leak and should inform the intermediate pumping station.

Water watch groups or other concerned villagers should regularly patrol along the pipelines and look for visible leaks. They should educate everybody to keep his eyes open and to report any abnormality.

Regular leakage tests will have to be made during night flow conditions.

Service Reservoir

There will be two types of service reservoirs: Reservoir floating on the line or gravity supply reservoirs being fed by a dedicated transmission main. The inflow is controlled by a float valve so that the closing can be transmitted hydraulically to the pumping station. Reservoirs of the combined systems will be equipped with the necessary non-return valves to ensure correct working. In the case of gravity supply reservoirs a meter is installed in the distribution main. There will be a water level indicator outside and a level scale inside the reservoir.

Transfer point at the village

At each village there is a transfer chamber or a small building where a branch pipe is connected, supplying the small village pipes leading to different stand posts. In this chamber or building the following equipment is installed:

- a valve in the branch which leads to the next village
- a valve in the branch to the village
- a meter in the branch to the village
- a washout valve
- a pressure gauge
- one or more branches for the distribution in the village, each one with a valve

The water watch group should have access to this building and should maintain it. Meter readings have to be made at regular intervals.

Distribution pipes

The distribution pipes will be laid deep enough to avoid exposure due to sand-drift. The alignment has to be straight between bends. Concrete poles of at least 2 m height above ground indicate the pipe bends and the location of valve chambers. At each junction or branch a valve is installed. The installation in a chamber has to ensure that the valve spindle is accessible at any time. The water watch group of the adjoining village has to care for the permanent accessibility of this manhole, particularly after sandstorms.

Pressure tests for existing pipes

During the construction period all existing pipes which are to be integrated into the system will be tested at least 1.5 of their working pressure. If these tests fail, repairs have to be made or parts of the pipe stretch have to be replaced. The details of the tests, the implementation of the repairs and the replacements will be worked out in the detailed design phase.

Relaying of pipes

In many cases pipes are not properly laid or their cover is insufficient. Many pipes are even visible. In the detailed design stage possibilities will be analyzed how and up to which degree pipes will be undug and newly laid, taking into account a certain loss of pipes and a complete replacement of joints. Since most of the pipes are not older than 15 years, this approach is justified.

Village supply

The village standpipes will be supplied from the transfer chamber by small PVC pipes not exceeding DN 50-60. Standpipes and cattle troughs will be placed at locations in consultation with the water watch groups. At each standpipe a platform and a soak pit will be constructed. Next to the standpost a bathe platform will be constructed. These details will be worked out in cooperation with the villagers (CPU-activities).

Preferably, cattle troughs will be installed at the outskirts of the village. Each standpipe will have a valve, which is controlled by the water watch groups. If house connections are installed they will have a connection pipe of DN 15' a meter and a stop valve will be installed in a meter box inside the plot. This question, however, will be studied more in detail during detailed design, in close cooperation with the CPU.

Remote hamlets which cannot be supplied directly in an economic manner will be supplied from cart filling hydrants to be installed at locations to be discussed with the water watch groups.

Existing reservoirs

The existing ground level or elevated reservoirs will be considered to be a consumer and will be connected to the system with DN 25 pipes; these will be equipped with a meter, a valve and a float valve. They will serve as standby reserve in case of breakdown of the system and for cattle supply. The use of these reservoirs and the functioning of the float valves will be supervised by the water watch groups in the frame of the water distribution management. The use of water for human consumption from these reservoirs must be regulated. The water must be boiled.

Existing pumps

In some cases the existing pumps of the regional systems off shooting from the pumping stations of the Gandheli-Sahwa Scheme could be used for the supply of the respective cluster of this project. In the detailed design stage of the project one of the preparatory activities is the updating of the reconnaissance data collected during feasibility study and the analysis of the possible integration of the existing pumps.

9.3 Urban distribution systems

The general situation in the town is this: There will be one or several supply zones having each its elevated service reservoir(s) (MBR). If the levels in altitude do not vary the areas can be interconnected to constitute one area. If this is not the case several pressure zones (water districts) have to be created. These zones will be independent of each other. However, there could be emergency bypasses to supply from one zone to the other one; this, however, is only possible from an upper to a lower zone. The supply of a zone with not too high altitudes is possible to some extent from a lower zone.

The basis on which the technical analysis has to be carried out is common to all the towns and is given below. The present system of ground water supply will be discontinued and all the wells will be delinked from the network. Barring some exceptions, almost all the components of the existing system could be incorporated into the design of the new system.

The network extensions are based on the latest available town development plans. However, these plans are not detailed and not yet finalized by the town development authorities and may eventually undergo some changes. Moreover, it is quite possible that some of the proposed roads may not be constructed for the implementation. Thus the proposed network system will have to be verified at the time of detailed design to match with the development plans. For the towns without development plans assumptions have been made according to our observations on site.

Since this is a very unsatisfactory approach, we propose to execute an aerial survey and to prepare town maps with 0.5 m contours and at a scale of 1:5,000 or 1:2,500. These maps would be of huge benefit not only for the detailed design of the water distribution schemes but also for:

- urban development planners
- sanitation and drainage scheme
- road development and traffic analysis
- environmental assessment
- community development activities

Most of the town distribution schemes were executed 25-30 year ago. The design criteria has been updated to account for the age of pies and losses in the system (in case of towns there are a lot of bends, tees, specials, tapping points) by taking the k value of 1 for the existing pipes and 0.4 for the new pipes.

The existing elevated reservoirs are accommodated in the present proposals to the maximum possible extent, with due regard to their physical condition and the capacity.

The distribution systems have been designed considering that supply will be made from elevated service reservoirs over 24 h.

The water will be supplied to the MBR's from the nearest intermediate pumping station of the trunk system. The possibility of a combined system is taken into account when designing the schemes. The entire town may be designed to be served by a single network without any zoning or by multiple independent zones, each having its own MBR(s). The zoning, the type of distribution (direct, by gravity or combined) and the location and number of reservoirs depend on:

- the topographic situation;
- the area of the town;
- the number, volume and water level of the existing reservoirs;
- existing distribution network;
- the location of the Intermediate Pumping Station

The per capita consumption for Phase 2 is 90 I. The system losses in the distribution system are 22%. The daily peak hourly supply is taken as 9% of the total daily demand. However, the network is designed for the annual peak which is 1.25 times i.e. 11.25%. The average hourly supply is taken as 7% of the total daily demand.

For the calculation of the nodal demands the variation in density of population or in demand per ha among different parts of a town has been accounted for by inclusion of a ponderation factor applied to the average demand per ha. One percent of the total daily demand has been distributed according to the command area of each node, considering concurrently the variation in density of the population. The hydraulic computations are made by multiplying this unit demand (1%) by the peak factor corresponding to the hour in question according to the consumption pattern and taking in account the annual peak.

The minimum nodal pressure at annual peak flow (11.25%) for the distribution network design is taken as 10 m. However, at some nodes these criteria could not be satisfied due to acceptable to increase the height of the elevated reservoirs just to give those few nodes the pressure of 10 m. The minimum pressure at all the nodes at daily peak (9%) was found to be more than 10 m. Only the primary network has been analyzed to assess the capacity of the distribution system. On consideration of the secondary network the nodal pressure would further improve. Generally all pipes of DN 100 and more are considered as component of the primary network. If, however a smaller pipe has a hydraulic function in the looped scheme it may also be included in the hydraulic scheme.

The pumping pattern of the pumps supplying the reservoirs fully depends on the availability of energy. Precision about the most possible power supply periods cannot be obtained from RSEB because it is impossible to foresee the future conditions of the hourly pattern in the HT grid of RSEB. The only safe assumption is the availability of at least 16 hours per day guaranteed by RSEB.

In several trials the required storage volume has been worked out by mass balance simulation for different conditions for the pumping period. The optimum period of starting the pumping was observed to lie between 4 a.m. to 6 a.m. The reservoir volume was found to be less than 25% of the daily demand under the aforementioned condition of starting of pumping and continuing it for the next 16 hours. The starting of pumping should never be done later than 8 a.m. or earlier than 2 a.m. to avoid balance problems. The minimum storage required under these conditions of pumping works out to more than 30% of the daily requirement, requiring greater storage and resulting in a less economic system.

The latter is an idealistic situation and gives the minimum required storage. Considering the risk involved, this alternative cannot be preferred. Assuming 16 h assured electricity supply over a day based on the preceding discussion it is recommended to provide a storage volume of 30% of daily demand in the elevated reservoirs. It is in conformity with the design criteria.

During detailed design it is important to verify the reservoir balance of combined systems over 24 hours because of the varying performance of the pumps, which depends on the actual pressure in the network.

9.4 Implementation units of cluster and town distribution systems of Phase 1

Generally, the cluster and town distribution systems with their service reservoirs and the cluster supply pumps will be designed for the Phase 2 of the project. This means that the pumps might work for less than 16 hours during the first years. Each cluster distribution system or town distribution system will represent one implementation unit. It will include:

- testing of existing pipes and rehabilitation or replacement if required;
- new distribution pipes;
- service reservoir(s);
- cluster- or town pumping station at the respective intermediate pumping station.

The priority of the implementation of the clusters is governed by the following facts:

a) Since the treatment plants of Sahwa and of Pandoosar already exist, the first batch of implementation will cover the improvement of supply of those parts of the project area which are actually connected to the Gandheli Sahwa system, downstream Sahwa and around Pandoosar. This will have an immediate impact on the continuity and reliability of the supply situation both the most wanted improvements. The fact that the plants are still not supplying fully treated water will be explained to the people. The quality of the water supplied will at least be the same as supplied now.

b) A second batch can be taken up after the termination of the treatment plants at Dharnasar and at Karamsana. It will be implemented over the following years and it will cover:

- all the clusters between Sahwa and Gandheli which actually receive raw water; they can be supplied from the new treatment plant Karamsana and the first stretches of the eastern trunk pipeline;

- the clusters between Dharnasar and Sardarshahar to be supplied from the TP Dharnasar;

- the town of Sardarshahar;

- the town of Taranagar

Thus, the following implementation units are provided for the cluster and down distribution systems:

- Implementation Unit D1 – Clusters 13, 15
- Implementation Unit D2 – Clusters 17.1, 18, 19, 20
- Implementation Unit D3 – Cluster 21, 22, 23, 24
- Implementation Unit D4 – Cluster 11, 12, 14, 16
- Implementation Unit D5 – Town of Taranagar (Cl. 45)
- Implementation Unit D6 – Clusters 1, 2, 3, 4
- Implementation Unit D7 – Town of Sardarshahar (Cl. 41)

10. Electricity supply

10.1 Power requirements

Continuous power supply is needed for the water treatment plants and pumping stations located along two trunk routes running from North to South covering the project area. Based on the demand and the actual situation a proposal for a dedicated system through new 33 kV lines and sub-stations is worked out. These lines will be a dedicated source of supply for the water supply scheme ensuring a continuous power supply of minimum 16 hours/day.

The total absorbed power for the WS-Scheme in Phase 2 is as follows:

- absorbed power: 14,457 kW
- installed power: 18,158 kW
- power required: 23,450 kVA

This is inclusive of all the existing treatment plants and stations at Karamsana, Lalaniya, Sheorani, Pandoosar, Sahwa, Dabri and Bhalau Tibba, which have a combined load of 3.3 MVA. Hence, the additional load requirement is about 20.15 MVA in the final layout of Phase 2. This load is scattered in 31 plants/stations over the entire project area. It can be allocated to the following 132 kV sub-stations:

Load from the plants and stations on the 132/33 kV sub-stations

Sub-station	**Number of plants**	**Load (KVA)**
Sujangarh	3 plants	1,300 kVA
Ratangarh	3 plants	2,600 kVA
Churu	5 plants	2,150 kVA
Rajgarh	5 plants	3,050 kVA
Sardarshahar (proposed)	4 plants	5,300 kVA
Jokhasar	11 plants	9,050 kVA
Total:-	31 plants	23,450 kVA

10.2 Required installations

The 33 kV network of RSEB has its limitations because of over-loading and very extensive lengths. It is therefore proposed that a 33 kV network dedicated for the loads of the plants and stations of the WS-scheme only be created with not more than two pumping stations on one feeder. Further the 33 kV feeder will be taken from the nearest 132 kV sub-station so that the length of the 33 kV line is limited to not more than 40 km in the normal working conditions.

It is proposed that each pumping station shall receive power supply from at least two places, so that in case one line is out of order or under maintenance, the other will be able to feed the pumping station. To achieve this, in addition to a 33 kV radial feeder from 132 kV sub-station one 33 kV line from the adjacent pumping station shall be laid so that the link line will serve as standby line for both the stations. There are some locations where there is a 33/11 kV RSEB sub-station at the location of the pumping station. At such places a 33 kV link line shall be laid between the pumping station and the RSEB sub-station to be used only in emergencies. The proposed 33 kV lines to the pumping stations are shown on Drawing 3.

The 33 kV lines will be on 45 kg/m rail poles with triangular formation by using minimum 65 sq. mm ACSR (DOG) conductor. The voltage drops in all the HT lines are less than 4%. The limit of supply of RSEB will be the 33 kV bus at each pumping station. The transformers, the dropout fuse and the 33 kV isolator are included in the electro-mechanical equipment of the respective pumping station.

By these arrangements the power supply for the water supply installations will have a highest degree of reliability and, except for load shedding and interruptions on the 132 kV grid of RSEB (which are very few), there will be continuous power supply available at all the pumping stations. This is one substantial primary condition for a trouble free operation of the very complex trunk system.

The following installations will be required at the sub-stations in the project area:

6.2.1 132/33 kV SUJANGARH SUB-STATION

The 132/33 kV sub-station at Sujangarh is normally fed from the 220/132 kV sub-station at Ratangarh. It has two 132/33 kV transformers with capacities of 12.5 MVA and 6 MVA making the total capacity as 18.5 MVA.

The sub-station capacity is sufficient to cater to the loads upto year 2002 A.D. The pumping load on this sub-station will come during the year 2004 by which time the total load requirement of the sub-station will be 21.47 MVA. Rajasthan State Electricity Board may propose to replace the existing 6 MVA transformer by a 12.5 MVA transformer in the year 2003 which will take care of the normal development as well as pumping load of the project.

10.2.2 220/132 kV RATANGARH SUB-STATION

The 220/132 kV sub-station at Ratangarh supplies power to 132 kV Ratangarh sub-station. This sub-station has 132 kV, 66 kV, 33 kV and 11 kV voltage levels. Capacities and loads on 33 kV bus only are considered here.

The 132/33 kV transformer capacity presently existing is as under:

Transformer-1	-	132/66/33 kV	-	3.0 MVA
Transformer-2	-	132/66/33 kV	-	3.0 MVA
Transformer-3	-	132/66 kV	-	7.5 MVA
Total			-	13.5 MVA

This sub-station capacity is sufficient to cater to the load growth upto 1994 by which time a new 132/33 kV sub-station at Sardarshahar proposed by RSEB will come up. It will give substantial relief to Ratangarh and will be able to take up the projected load demand of 12.38 MVA by 2004 with the same installed capacity. As such no change is envisaged in the existing 132/33 kV sub-station at Ratangarh.

10.2.3 132/33 kV CHURU SUB-STATION

The 132/33 kV sub-station at Churu is on the 132 kV line connecting 220/132 kV Hissar sub-station in Haryana and 220/132 kV sub-station at Ratangarh in Rajasthan. It is now normally fed from Hissar. The sub-station has a transformer capacity of 2 x 6 = 12.0 MVA.

By the year 1995, the present capacity will be inadequate and RSEB may propose to replace one existing 6 MVA transformer by a 12.5 MVA transformer increasing the sub-station capacity to 18.5 MVA which will be sufficient to cater to the load growth as well as the pumping load of this project up to the year 2000 A.D. The second 6 MVA transformer can then be replaced by another 12.5 MVA thus raising the capacity to 25 MVA. This will be able to meet the load demand beyond 2004.

10.2.4 132/33 kV RAJGARH SUB-STATION

The 132/33 kV sub-station at Rajgarh is located on the 132 kV line connecting 220/132 kV sub-station at Hissar and 220/132 kV sub-station at Ratangarh. The capacity of this sub-station is 12.5 MVA. By the year 1997, some of the load presently being fed from this sub-station will be transferred to the proposed 132/33 kV sub-station at Jokhasar and the present sub-stations capacity will be adequate up to the year 1999. From the year 2000 the IGNP pumping load as well as phase II load of the pumping stations of this project will come up and a second 12.5 MVA transformer will have to be planned in the year 2000. Raising the sub-station’s capacity to 25 MVA which will be able to meet the load demand beyond 2004.

10.2.5 132/33 kV SARDARSHAHAR SUB-STATION (PROPOSED)

The town of Sardarshahar and the surrounding area has a load demand of about 5.6 MVA presently being fed on 33 kV from 132/33 kV Ratangarh sub-station through 33/11 kV sub-stations at Sardarshahar and Bhanipura. 33/11 kV sub-stations at Gadsibar and Shimla are proposed by RSEB. To satisfactorily cater to the load demands in the area, RSEB has proposed to put up a 132/33 kV 12.5 MVA sub-station at Sardarshahar sub-station. The existing 33/11 kV sub-stations as well as the proposed ones can be fed through this sub-station.

It has been planned to tap the existing 132 kV Ratangarh – Rajiasar line at Sardarshahar with a loop-in – loop-out arrangement. Considering the load development to the area, the 132/33 kV sub-station should come up by 1995 so that from 1996 onwards, it will be able to feed the projected load.

The 12.5 MVA sub-station capacity can meet the load demand up to 2002 and thereafter when the phase II loads from the WS-Scheme are added, a second transformer of 12.5 MVA capacity can be installed taking the sub-station capacity to 25 MVA.

6.2.6 132/33 kV JOKHASAR SUB-STATION (PROPOSED)
The load projection indicate that in the year 1997 when the first pumping station of the IGNP project is planned to be commissioned, the load requirement in the area will be about 10.25 MVA which will shoot up to 21.5 MVA the next year. RSEB have proposed a 132/33 kV sub-station at Jokhasar to cater to this load. A 132 kV line shall be laid from the 220/132 kV Suratgarh sub-stations to Jokhasar sub-station which will subsequently be extedded to the 220/132 kV Ratangarh sub-station, IGNP has already paid for the proposed line and sub-station and RSEB is planning for completion of the Jokhasar sub-station by 1996.

Considering the simultaneous requirement of power by IGNP as well as for this project, RSEB will have to plan a 2 x 12.5 MVA transformer capacity to start with, with addition of one 12.5 MVA transformer in the year 2000.

10.3 Implementation units of the dedicated electrical grid for Phase 1

The electricity supply system is subdivided in four units. The number and the details, however, have to be verified together with RSEB which will implement the dedicated grid according to the procedures. The limit of supply will be the sub-station in the treatment plants and pumping stations. RSEB supplies the 132 bays and the 33 kV lines. The sub-station with meter and transformers will be part of the electrical equipment of the pumping stations.

The 132 kV line from Ratangarh to Jokhasar and the link to Suratgarh which will reinforce the northern grid of RSEB is not included in the costs of the Phase 1.

Similarly, cost-sharing mechanisms have to be worked out between PHED, IGNP and RSEB for the general installations at Jokhasar 132 kV sub-station as well as for the running costs.

10.3.1 IMPLEMENTATION UNIT E1 – 132 kV SUBSTATIONS

- 33 kV bay extensions in 132 kV sub-station at Sardarshahar
- 33 kV bay extensions in 132 kV sub-station at Jokhasar

10.3.2 IMPLEMENTATION UNIT E2 – 33 kV LINES - WEST

- HT lines in stretches Jokhasar-Dharnasar, Jokhasar-Purvasar-Dharnasar, Jokhasar-Bisrasar, Bisrasar-Sadasar-Bhojrasar-Sardarshahar

10.3.3 IMPLEMENTATION UNIT E3 – 33 kV LINE - EAST

- HT lines in stretches Dabri-Bhalau Tibba, Link line from Bhalau Tibba to RSEB line, Bhalau Tibba-Bungi-Rajgarh.

10.3.4 IMPLEMENTATION UNIT E4 – 33 kV LINES - NORTH

- HT lines in stretches Jokhasar-Karamsana, Jokhasar-Sheorani, Jokhasar-Pandoosar-Sahwa, Sahwa-Dabri, Link line Sahwa TP to IPS Sahwa.

11. Communication system

11.1 Technical layout

The complexity of the system requires a constant and permanent communication between the intermediate pumping stations. This is required for the starting of treatment units and of pumps, for the stopping of pumps in case of reservoirs being filled and in the case of any unforeseen mishap (leakage, spilling over). It must be excluded that due to non-communication water is waster by spilling over or leaks and that the operation of the scheme is made without the required precision. The communication system must respond to the following requirements:

- operation possible during power failure
- simple operation
- reasonable cost
- low maintenance input
- voice transmission
- data transmission, telemetry

We propose to provide a system for communication of speech and telemetry. A direct intervention in the operation via remote control is not envisaged for the time being but all facilities should be provided for a later installation. All data will be transmitted to the headquarters in Churu where a permanent computer log is maintained of all the activities and the status of the system components.

The safest system is the wireless communication by VHF (radio frequency) because the installation conditions for the system are good:

- there are surge tanks and elevated reservoirs along the pipelines which could serve as transmission towers so that the straight line of sight communication is ensured; The antenna could be mounted on top so that a height of 25-35 m could easily be obtained; in nearly all the cases there will be no need for transmission towers or for repeater stations between two IPS;

- at all the stations the facilities are there for charging the batteries for uninterrupted power supply and for maintenance of the equipment;

A Master-Slave system is proposed which has considerable advantages compared with a simple relay system.

- lesser number of frequencies
- lesser number of trans-receivers
- failure at one station does not have impact on the communication between the other stations

The scheme has to include a primary network with 3 masters and 3 secondary networks. Each slave is provided with one trans-receiver set; each master is provided with two trans-receiver sets, one for communication with the slaves of the secondary network under its control and one for inter-master communication (primary network). Each set must be operated from UPS of required capacity.

More details about the system required will be defined in detail at the detailed design stage. Field reconnaissance will be required for measurements of the field strength, based on which details regarding frequencies, mast heights and antenna types can be worked out.

Since these systems need an allocation of frequencies the clearance by the department of communication is required. Moreover, owing to the strategically sensitive location of project area clearance from the Ministry of Defense may also be required. Necessary steps should be taken at an early stage.

The first part of the communication system could be implemented at the very beginning relaying the stations of Karamsana, Lalaniya, Sahwa, Pandoosar and the pumping stations Bhaleri and Bhalau Tibba of the existing Gandheli Sahwa scheme. These stations will also be connected to the headquarters of the scheme in Churu.

In order to improve the operation of the existing scheme the existing major pumping stations downstream Taranagar are also included in the first phase.

Subsequent units have to be implemented according to the schedule of the implementation of the trunk system.

11.2 Implementation unit of the communication system for Phase 1

11.2.1 IMPLEMENTATION UNIT C1 – VHF – SYSTEM FOR THE EXISTING GS-SCHEME

- Linking Raw water pumping stations Karamsana and Lalaniya, Sheorani, TP Sahwa, TP Pandoosar, pumping stations Bhalau Tibba, Bhaleri, Taranager, Taranagar workshop and headquarters in Churu. Connection to the existing pumping stations downstream Taranager and to PHED Rajgarh.

11.2.2 IMPLEMENTATION UNIT C2 – VHF – SYSTEM FOR NEW INSTALLATIONS

- Linking TP Dharnasar, TP Karamsana, all the new IPS in the eastern and western trunk pipelines to the headquarters in Churu.

12. Training and support centers for O&M

12.1 General requirements

In the present case we analyze the equipment and the material which is required to guarantee the sustainability of the project. It is chosen according to the spatial and vertical setup of the organization. In the final stage there will be 5 treatment plants and 32 intermediate pumping stations. At three of the plants/stations support centers with repair units will be created.

- Treatment plant Dharnasar (Northern Region0
- IPS (or TP) Taranagar (Eastern Region)
- IPS Sardarshahar (Southern Region)

The first support center will be implemented at Taranagar in the first phase and the others in the Phase 2 when the southern parts of the project area are connected to the system.

The aim of the provision of the O&M equipment cannot be to make every any repair. There will be many components for which repairs have to be done only occasionally.

Complicated repairs will be left to the specialist experts of the suppliers or their service centers. For this reason standby units are provided at all stations.

Hence, the O&M equipment must allow for smaller and less complicated repairs and for preventive maintenance in the stations and plants.

Things are different in regard to the pipelines. The repair units must be able to repair any type and any diameter of pipe on their own. It is not merely the question of laying kilometers of pipes. They must have the skills and the means to replace a pipe, to repair a leak, to weld a bend or a tee, to replace a valve. At each of the support centers the tools and parts must be available for the pipes and specials within its range of action.

The support centers include the following units:

- workshop with machine shop;
- central store indoor;
- central store outdoor;
- office;
- at one support center: training center (auditorium cum classroom);
- records keeping room;
- technical library.

They will be set up next to the corresponding treatment plant of IPS so that the electricity and water supply will be ensured. There will be similar auxiliary installations and arrangements as in the treatment plants, however, on a smaller scale and according to the particular operation requirements of the support centers:

- staff quarters;
- access roads and a car park;
- shed for the truck and other vehicles;
- sheds for parts of the outdoor store;
- green spaces, trees;
- an irrigation system for the green spaces;
- a septic tank with infiltration pit/trech;
- sufficient lighting outside;
- compound wall and entrance gate.

The tables below are a broad overview of equipment and material recommended for the support centers, for the intermediate pumping stations and for the treatment plants. The details of them will be defined in the design phase and they will be included in the different tenders according to the implementation schedule. More details will be worked out with the suppliers of the electro-mechanical and electrical equipment.

As far as the stocks of spare parts are concerned the requirement of about two years will be included in the supply contracts of the respective equipment. Here too, details will be worked out with the respective suppliers. Workshops to be equipped with moderate equipment but to provide the space for eventualities to install more sophisticated equipment if this is required at a later stage.

12.2 Equipment and tools of the IPS and treatment plants

At each intermediate pumping station and treatment plant some tools and spare parts have to be stored. If the equipment of pumping stations is more or less identical, spare parts could be stored in one of 3 or 4 IPS.

In all the treatment plants and the intermediate pumping stations small workshops with stores will be provided (about 20 m^2).

12.3 Spare parts in the villages

In addition to the material stored in the central and IPS stores, there must be some material in the villages (with the water watch groups) so that they can make on-spot repairs at the standpipes and the cattle troughs.

- taps for the standpipes
- valves for the standpipes and the cattle troughs
- float valves for the cattle troughs
- valves for house connections

12.4 Office complex and staff quarters in Churu

The headquarters of the future system will be in Churu. For this purpose an office complex has to be provided there. It has been decided to construct this complex at the very beginning so that all the implementation activities can be controlled from there. This complex will also accommodate the CPU so that the closest coordination is always possible.

As each treatment plant or pumping station has a staff colony, the office complex will also have a staff colony with community center and guesthouse for visitors or state guests.

12.5 Training

The following fields are recommended for training courses for the PHED staff, other fields can be identified by PMC itself according to felt needs during the project implementation:

- Operation of urban and rural water supply schemes, operation of treatment plants
- Water Distribution Management, that is distribution of the available water in an equitable manner to all the clients in normal and in emergency situations;
- Public relations, relations with the clients, confidence building, human relations, community participation;
- Corporate identity, creation of the spirit of civil servants in the PHED staff;
- Preventive maintenance for plants and equipment;
- Leakage detection, leakage reduction, leakage control;
- Design, optimization, construction and operation of distribution networks;
- Design of pumping stations; EM-equipment for pumping station; assessment of water hammer problems and protective devices;
- Operational data in water supply systems, monitoring, record-keeping for production, consumption, daily, monthly and annual fluctuations;

Some of these fields are closely related with the objectives of the proposed IEC-cell of PHED. So the training activities have to be coordinated with those of this cell.

Courses for these and other types of training are offered from the IRC-Institute in Delft (Netherlands), from the German Center for International Training in Water and Waste Management and from other institutions (e.g. in Great Britain or US). In the frame of the present project we propose to provide fellowships for courses between 2 weeks and several months and seminars of 1 to 3 weeks duration. With view to language difficulties we recommend the courses to be sought in an English speaking country.

Generally, training for O&M will be included to a large extent in the contracts of the suppliers and contractors. Special training will be provided in India according to the needs to be identified by PMC.

12.6 Implementation units for O&M for Phase 1

12.6.1 IMPLEMENTATION UNIT 01 – SUPPORT CENTRE TARANAGAR

- Support center Taranagar
- Spare parts for support Centre Taranagar

12.6.2 IMPLEMENTATION UNIT 02 – SPARE PARTS FOR VILLAGES

12.6.3 IMPLEMENTATION UNIT 03 – OFFICE COMPLEX IN CHURU

12.6.4 IMPLEMENTATION UNIT 04 – STAFF QUARTERS IN CHURU

12.6.5 IMPLEMENTATION UNIT 05 – FELLOWSHIPS FOR TRAINING

13. Sanitation measures in Taranagar and Sardarshahar

13.1 Technical proposals

In a general manner the towns similar problems which call for similar solutions. Since all of them are located in depressions a common requirement are pumping stations to evacuate the lowest areas at which huge ‘sewage ponds’ exist and which are flooded during monsoon season. Since the installation of big pumps for peak conditions is not feasible we recommend to provide retention ponds which can retain the entire runoff of a one-hour rainfall. The pumping stations will be designed to evacuate the ponds during 24 hours.

In the frame of the present project, the so called ‘sewage ponds’ in the low lying areas of the towns of Taranagar and Sardarshahar will be eliminated by the construction of:

- retention ponds
- pumping stations
- conveyance pipes or drains relaying the ponds
- conveyance pipes bringing the sewage water outside of the towns to open lands

In all the cases the drainage systems of the towns consist in several drainage zones so that more than one pumping station is required. The storm water is pumped to the nearest open land and the waste water is conveyed to a drainage zone from where it can be pumped to the treatment plant. The pumping stations have one common pump house, a wet well for waste water and a wet well for storm water. The latter is fed from the retention pond through a pipe. There will be different pumps for waste water with different capacities so that an adaptation to the varying flow is possible. The following technical feature are proposed for the 2 towns:

Sanitation measures in Taranagar and Sardarshahar

Designation	**Taranagar**	**Sardarshahar**
Number and size of ponds	2 ponds, 10,000 and 34,500 m^3	4 ponds, 4,700 – 34,300 m^3
Number of pumping stations	2 pump houses	4 pump houses
Conveyance mains sewage	DN 300, 3,500m; DN 150, 900m	DN 400, 1,400m; DN 450, 2,500m; DN 150, 450m; DN 150, 600m
Conveyance mains storm water	DN 600, 1,500m; DN 350, 750m	DN 700, 1,300m; DN 500, 1,300m; DN 250, 400m; DN 300, 400m

13.2 Implementation units of the urban sanitation measures Ph. 1

13.2.1 IMPLEMENTATION UNIT S1 – SANITATION MEASURES TARANAGAR

- 2 retention ponds with 2 pump houses
- conveyance mains for waste water and storm water

13.2.2 IMPLEMENTATION UNIT S2 – SANITATION MEASURES SARDARSHAHAR

- 4 retention ponds with 4 pump houses
- conveyance mains for waste water and storm water

14. Critical issues

The following issues have to be discussed and decided as soon as possible during executionof phase I

- Status of the 132/33 kV sub-station at Jokasar and its 132 kV connection lines to Suratgarh and to Ratangarh.
- Status of the 132/33 kV sub-station at Sardarshahar.
- General coordination with RSEB; discussion of the technical and financial issues for the implementation of the dedicated electrical grid.
- Sanctioning of a VHF communication system for the project area.
- Allocation of the raw water by IGNP.

- Immediate launching of the construction of the office complex and staff quarters.

- Staffing of the PMC.

- Immediate construction of the project office and the staff quarters in Churu.

15.0 Present Status

The project work started in 1995 and is on the verge of completion by 31.3.2006. The project implementation has taken place on the strategies worked out during feasibility study as narrated in previous paragraphs. |Strong dedicated 33kv grid power supply and a good voice communication system are proving to be the back bone of the project apart from commendable quality work and community involvement in planning, execution and O&M.

The design strategy, packaging of works. Contracting etc.were as stipulated in feasibility study and explained above, but some of the key recommendations were not fulfilled. Some of the important requirements which did not materialized and which seriously hampered progress of project are given below:

- No incentives were given to the officers and staff deputed on project work resulting in lack of motivation and non-interest amongst them to continue on the project work due to hostile environment.
- Serious lack of continuity of staff on project resulting in slower work progress and difficulty in continuing project philosophy.
- The project had to be executed under routine governmental rules and regulations, causing problems in management.
- The concept of giving autonomy to project authorities in financial and administrative matters was not implemented. This was one of the major reasons of delay/non-decision in decision making with regard to award of contracts, contract handling, Human Resource Management, tariff enhancement and other related issues.
- The O&M of the project components on completion was not given to project officers. The other PHED officers, who handled O&M had no concept of project philosophy and accordingly the benefits of the project could not be availed as stipulated.
- The project was to be used as a training platform for the engineers so that such people could replicate project achievements in other parts of the state. No attempt was made by the government to take advantage of the Human Resource infrastructure developed.

The salient features of the physical works undertaken are given below:

1.Population to be benefited		
S.N	Area	Designed population in Year 2012/ population in Year 1991
1	Rural	720470 / 594110
2	Urban	153620 / 128210
3	Cattle Units	222677 / 216150
2. Proposed per capita per day water supply		
S.N	Area	Quantity
1	Rural	40 lpcd
2	Urban	90 lpcd
3	Cattle Units	30 lpud
3. Proposed Water Demand		
S.N	Area	Water Demand
1	Rural	35.621 Cum. / Day (35.62 MLD)
2	Urban	13.825 Cum. / Day (13.83 MLD)
	Total	49.446 Cum. / Day (49.45 MLD)

4. Major Technical Components of the project	
Source of water	Indira Gandhi Canal System
Outlets:	
At Dhannasar From Sahawa Lift Canal	1.25 Cumecs.
At Gandhaeli from Rawatsar Distributory	1.20 Cumecs.
Water Treatment Plant	
Dhannasar	Capacity : 4350 Cum/Hr(69.60 MLD)
Karamsana	Capacity : 2428 Cum/Hr(38.84 MLD)
Raw Water Reservoirs	
Dhannasar	Capacity: 1.27 MCM
Karamasana	Capacity: 1.68 MCM
Pumping Station	
Raw water pumping station Dhannasar	Capacity:2298 Cum/Hr At 8-13.5 Mtr.Head
Clear water pumping station Dhannasar	Capacity:2230 Cum/Hr At 31.5 Mtr. Head
Clear water pumping station Palloo	Capacity:2186 Cum/Hr At 36.0 Mtr. Head
Clear water pumping station Sadasar	Capacity:2026 Cum/Hr At 36.0 Mtr. Head
Raw water pumping station Karamasana	Capacity:1670 Cum/Hr At 27.0 Mtr. Head
Clear water pumping station Karamasana	Capacity:1450 Cum/Hr At 34.0 Mtr.Head
Clear Water Reservoirs	
Dhannasar	Capacity:4350 Cum
Palloo	Capacity:4350 Cum
Sadasar	Capacity:4100 Cum

Sardarsahar	Capacity:4100 Cum
Karmsana (2 Nos)	Capacity:5000 Cum
Sahawa	Capacity:2500 Cum
Trunk Mains	
1100 mm PSCC pipe line(From Dhannasar to Sardarshahar)	93.50 Km.
900 mm PSCC pipe line (From Karamasana to Shahwa)	35.00 Km.
Cluster Distribution System	
DI Pipe line	App. 475 Km.
uPVC pipe line	App. 1635 Km.
AC Pipe line (Reuse)	App. 275 Km.
RCC Elevated Service Reservoiers	48 Nos.,
Rehabilitation of Pumping stations	4 Nos.
Cluster pumping stations	8 Nos.
Dedicated Electric grid lines (33 KV)	283 Km.
NGO`s Consortium involved in implementation	5 Nos. (IIHMR Jaipur,BCT Churu,GVM Sardarshahar,US Bikaner and IIRM Jaipur)
Achievements:	
Pani Panchayat	42 Nos.
Water Health Committee	362 Nos.
Public Stand Post	3009 Nos.
Cattle Water Trough	618 Nos.
Commissioned Villages	357 Nos.
Sanitation Measures (At Sardarshahar and Taranagar)	11 Ginanies
Sanitation Units	20520 Nos.
Women Group	318 Nos.
Self Help Group	222 Nos.
Revenue Realisation For Year 2003-04	1.30 Crores
Revenue Realisation For Year 2004-05	1.52 Crores
O&M	Either by contractor / Regular PHED staff

The list of contract packages and their progress up to March 2005 is placed in Annexures. The list of villages, clusterwise, population etc. is also placed in annexures. Maps showing location of SRs and the villages with distribution network for all clusters are also placed in annexures.

16. Issues requiring attention:

- Lack of O & M strategy: a consultant has suggested the operation and maintenance system after carrying out a study and detailed discussion with all concerned. However, no decision has yet been taken by the government on the recommendations made. In its absence, only breakdown maintenance is undertaken, and that too is not proper. The assets created are thus deteriorating and may result into irreparable stage.
- Presently, a special cell called Project Management Cell (PMC), taken out from P.H.E.D. of GOR, is executing the project. However, the O&M is looked after by the regular infrastructure of PHED, which is also responsible for other works also. The staff responsible for miscellaneous works does not have background of project philosophy and have other over riding priorities. This results in no preventive maintenance and improper breakdown maintenance. This also results in irregular supply of water in project villages at times. Institutional study was carried out by a consultant and its recommendations are pending with the government. This requires immediate attention.
- The project philosophy requires community participation and cost recovery as integral parts. It is essential that similar approach be adopted in villages around being connected to the same system. In absence of cost recovery from such villages, it may be difficult to continue present state of cost recovery and community involving in O&M.
- The project envisaged cost recovery @30% of O&M cost in first year of O&M, to be gradually increased to 100% over a period of 5 years. The project authorities submitted revision in tariff about 4 years back, but is still pending with the government. Unless tariff is revised regularly to appropriate levels, the project may become unsustainable.
- There has been frequent change of engineers on the project denying the benefit of continuity of committed staff on the project. This results in delay in implementation of project components and weakening of quality of works.
- The office of Chief Engineer, PMC has been abolished and the work is left to a Superintending Engineer. This shows serious lack of appreciation at Government level for the project. The legacy and the philosophy developed over long period of time seems to be on the verge of extinction.

17.0 CASE STUDIES;

- **Operation & Maintenance**

❖ There have been 3 pipe bursts in 1100 mm PSC pipeline during last 3 years. These bursts are attributed to water hammer. It was pointed out that the feed tanks constructed for water hammer prevention are not functioning.

❖ The NRVs are not maintained properly. The springs are not of good quality and no replacement has been attempted.

❖ The Air Vessel installed at Lalania Pumping Station for water hammer prevention is not functioning as compressors are out of order and operators are not trained for proper operation of air vessel. The pumping main is thus working with out any water hammer control.

- All ESRs have been fitted with float valves to facilitate automatic shutoff of pumps when tank gets filled fully. It has been reported that 6 float valves have been stolen from the reservoirs but not replace yet. Thus, the automatic system developed has become redundant at those places.
- Air Valve tempering is reported to be very common. No serious attempt seems to have been made to prevent such occurrences.
- Lead wool is being used to repair leakages in DI pipe joints. This does not seem to be proper as it may result in permanent damage to rubber gasket. Leakage in joints is reported to be also resulting in erosion of DI pipe spigots, increasing amount of leakage and ultimately requiring pipe replacement.
- There has been no burst in DI and PVC pipelines during last 4 years of their operation.
- Stand Post maintenance is not proper at many places.
- No infrastructure provided for maintenance of bulk and domestic water meters.
- No house connections are allowed in villages. But villagers have made illegal house connections, particularly in big villages. This has resulted in sharp drop in terminal pressures at PSPs at tail end. Some effort has been made to remove these illegal house connections, but still large number of them still exists.
- Almost all Vacuum Circuit Breakers in Switch Yards, 50% of Chlorination plants at cluster pumping stations, one 1000KW 33/o.4KV transformer, one 1000 amp. ACB, 136amp. MPR have gone out of order due to lack of routine maintenance.
- Water supply has been limited to 13hrs a day (6am to 7pm) in all villages on the Karamasna part of the project against project design and philosophy of 24 hrs supply.

Buchhawas Village:

The village Buchhawas is located about 20 Km from cluster pumping station at Taranagar. It has a ESR located in the village which serves total 3 villages. The population of these 3 villages as per 91 census is 12344 and the present population is about 17500.

The present population of Buchhawas is about 9000. It has 58 PSPs in the village. There are no house connections released in the village. However, it was informed that there are around 400 illegal house connections taken by the people. Even after efforts made by the CPU and WHC, the house connections could not be removed. The water consumption has gone up and the project authorities have to curtail the water supply to 4 hours daily only. The large number of illegal connections has resulted in drop of pressure in tail end PSPs. As illegal connections have been taken by influential/powerful people of the village, nothing serious seems to have been done to remove them. But non-removal of illegal connections in this village is paving way for illegal connections in other villages. The WHC is paying water charges regularly.

Chainpura Bada Village:

The village is located on Rajgarh-Sidhmukh road and has 1991 census population as 1713. The present population is about 2500. The village is connected to Sidhmukh cluster ESR. It has 14 PSPs. The water supply is good and with adequate pressure. The terminal pressure on SPs is more then 10m. The Chairman of the WHC is also village Sarpanch. The treasurer of WHC is a retired military person. The average monthly bill is about Rs.4000/-. They distribute the water bill received amongst them based on units in a family. They collect gross amount of the bill from the villagers and retain the rebate amount allowed by the department. They receive back 10% of water charges paid from the department towards maintenance of village distribution. The WHC had Rs.22396/- in balance on 1st October 2004.

They have a serious problem of tap damage, which is quite frequent. It was informed that taps start leaking frequently due to high pressure. They have spent Rs.3450/- towards tap replacement during 2003-2004. The matter was discussed with the Chief Consultant of the project by me, who informed that they have now selected a tap which is quite robust and are in the process of replacing all existing taps.

The WHC Chairman informed that there has been no leakage in village distribution pipelines during last 4 years. However, he is required to regulate water supply in the village to ensure that water bill is within limits. This requires lot of hammering. There is demand for putting up additional PSPs.

The general economic status in the village is not good due 4th consecutive drought. The financial condition of the Gram Panchayat is also not good. Total 68 sanitation units have been constructed and 31 are in progress out of 300 households. The Sarpanch informed that he has got 80 houses constructed under Indira Awas Yojna, 70 kunds under famine for rainwater harvesting during last 5 years.

Sidhmukh Village:

Sidhmukh village has 91 census population of 5563 and present population is about 8000. Total house holds are 780. The village was served with house connections prior to project and was facing acute water supply problem. Thee were 700 odd connections at that time. All the old connections have been integrated and the total house connections now are 970. There are no PSPs in the village.

The WHC Chairman is Mr. Begraj and Treasurer is a retired teacher Mr. Nathuram both of whom talked to me.There are 51 members in WHC of which 6 are women. The strength of members has been kept according to number of wards in the village. They have engaged one bill clerk for billing and accounting work and one caretaker for regulating and maintaining distribution system. The total monthly salary is 3600/-. They have a cash balance of Rs.55000/- and a sum of Rs.100000/- is outstanding in consumers. The outstanding revenue is mostly from people not having house connections. The chairman informed that it is difficult to recover money from people without house connection. They charge Rs.20/- per month from families not having house connections. They are having problem of low pressure at tail end consumers due to limited period supply. They also have a demand for laying 1km pipeline to provide water to uncovered areas.

The village faced a serious problem of high water consumption in April 2004. It was 24570 KL(100 LPCD). The bill amount was Rs.83061/- without rebate and Rs.71364/-

with rebate. It was difficult to collect this high amount from the villagers by the WHC, so it paid part amount from the reserve fund it from connection security. But it raised an alarm and they decided to curtail consumption by regulating supply hours and canvassing with the consumers. This had salutary effect, which is evident from the table below, and the consumption is down to 9830 KL in September 2004 with a gross bill of Rs.30141/-.

Consumption April 04	Consumption May 04	Consumption June 04	Consumption July 04	Consumption August 04	Consumption September 04
24570 kl	18400 kl	17300 kl	13690 kl	12840 kl	9830 kl
Water charge net 4/04	Water charge net 5/04	Water charge net 6/04	Water charge net 7/04	Water charge net 8/04	Water charge net 9/04
Rs.71364	Rs.51620	Rs.48100	Rs.36548	Rs.33828	Rs.24196
Water charge gross 4/04	Water charge gross 5/04	Water charge gross 6/04	Water charge gross 7/04	Water charge gross 8/04	Water charge gross 9/04
Rs.83061	Rs.64421	Rs.60031	Rs.45581	Rs.42181	Rs.30141

Chainpura Chhota:

This is a village about 6 km from Chainpura bada village. It is not a part of project and is getting water from old PHED system. The water supply was reported to be irregular. They get water once in two days and for this each family is to pay a sum of Rs.10/- per month to a private individual for maintaining main pipeline coming from pumping station. This person does not have any authority from the government to charge money. The local people were aware that village connected to project have very regular and adequate water supply for which they have to pay. They are very much willing to be connected to the project on its conditions.

OTHER ISSUES:

- A water audit was carried out for few clusters and the result is given in table below:

Cluster name	2	3	4	5	6	7	8	9	10	11	12	13
Kanjan	18.85	13.65	5.2	27.6	19.68	14.6	5.08	26	16.03	13.11	2.92	18.2
Sidhmukh	29.10	34.2	-5.1	-17.5	28.7	29.73	-1.03	-3.6	23.63	22.55	1.08	4.58
Ramsara tibba	49.22	28.14	21.1	42.8	50.71	34.89	15.82	31.2	43.16	32.77	10.39	24.1

Mahatma	5.92	4.42	1.5	25.3	4.48	4.98	-0.5	-11.2	4.17	6.14	-1.97	-47
Satyun					26.28	23.65	2.63	10	23.16	22.43	0.73	3.16
Ojharia					11.29	10.13	1.16	10.3	11.29	10.67	0.62	5.5

Column 2: Consumption in ML as per bulk meter reading for May 2004
Column 3: Consumption in ML as per village meter reading bills for May 2004
Column 4: UFW in ML for May 2004
Column 5: UFW as % of bulk supply
Column 6: Consumption in ML as per bulk meter reading for June 2004
Column 7: Consumption in ML as per village meter reading bills for June 2004
Column 8: UFW in ML for June 2004
Column 9: UFW as % of bulk supply
Column 10: Consumption in ML as per bulk meter reading for July 2004
Column11: Consumption in ML as per village meter reading bills for July 2004
Column12: UFW in ML for July 2004
Column13: UFW as % of bulk supply

No follow up action seems to have been taken so far to evaluate the findings and taking up remedial measures.

- A customer Service was established in October 2003 to provide better service to the consumers and monitor functioning of the O&M, which ultimately decides the level of service. Presently four persons have been put into this unit but not with proper infrastructure and a defined role to play. However, a beginning has been made.
- The consultants carried out a financial analysis about the sustainability of the project. They worked out the production cost based on O&M charges. The year wise production cost has been shown as below:

2004	Rs .8.97 per KL
2005	Rs. 9.54 per KL
2006	Rs.10.05 per Kl
2007	Rs.10.64 per Kl
2008	Rs.11.22 per KL
2009	Rs.11.63 per KL
2010	Rs.12.03 per KL
2011	Rs.12.47 per KL
2012	Rs.12.92 per KL

The present recovery rate is 30% of production cost which is to be increased to 100% over a period of 5 years.

ANNEXURES