

Sapgaon Rural Water Supply Scheme
Village: Sapgaon, Taluka: Shahapur, District: Thane
Assessment Report



April 2017

Technology and Development Solutions Cell (TDSC)
Centre for Technology Alternatives for Rural Areas (CTARA)
Indian Institute of Technology Bombay
Powai, Mumbai

Team

Vaishali Bharambe
Project Engineer TDSC IITB
vbharambe01@gmail.com

Anuradha Giri
anuradhagiri.giri@gmail.com

Bharat Chaudhari
M Tech student, VJTI

Advisors

Yatin Diwakar
Project Manager TDSC IITB
yatindestel@gmail.com

Prof. Puru Kulkarni
IIT Bombay

Prof. Om Damani
IIT Bombay

Technology and Development Solutions Cell (TDSC)

Centre for Technology Alternatives for Rural Areas
Indian Institute of Technology Bombay
Powai, Mumbai 400076
Maharashtra, India.
Telephone: (022) 25764809
Telefax: (022) 25767874
www.ctara.iitb.ac.in/tdsc

Contents

Executive Summary	iv
1. Introduction	1
1.1. Background	1
1.2. Objectives of technical audit.....	1
1.3. Scheme description.....	1
1.4. Site visit details	2
2. DPR Assessment	3
2.1. Scheme overview	3
2.2. List of document in DPR.....	3
3. Scheme Assets and Attributes	4
3.1. Design verification	4
3.2. Physical assets verification.....	5
105000 Liter	5
3.3. Assets summary	6
3.4. Scheme operations	9
3.5. Financial status of scheme.....	10
4. Scheme Findings	12
4.1. Documentation	12
4.2. Design.....	12
4.3. Assets	12
4.4. Coverage	13
4.5. Financials.....	13
4.6. Other	13
5. Success Indicator	14
6. Recommendations	14
6.1. Scheme specific.....	14
6.2. General.....	15

Executive Summary

Sapgaon, a village in Shahapur taluka of Thane district has a rural water supply scheme which includes an old jackwell at the bank of Bhatsa River, rising main, pumping machinery, pump house, two ESRs and distribution network. The scheme was completed in 2016 and was designed for 15 years capacity. The habitations served by this scheme are Sapgaon and Sherepada.

Findings and recommendations of this scheme are as follows

- **Assets in poor condition**
 - Old jackwell used in scheme is completely deteriorated and cracked, construction of new jackwell is needed.
- **Non-compliance with DPR**
 - Staging height of new ESR is 9 meters whereas staging height in DPR is 12 meters.
 - Scheme design consist of one ESR in practice old ESR is also used to serve some area of village. No standby pumps are provided for pumping water in both ESR.
 - Laying of distribution line deviates largely on-field from that suggested in DPR. Drawings and design documents related to change in design of distribution network are not available in DPR.
 - Area along main Kinhavali main road is considered in design for laying pipes of distribution network, but pipes are not laid in this area.
 - 2-3 additional sub-distribution lines (not in DPR) running from Govind nagar main distribution line are laid by Gram Panchayat.
- **Sub-optimal operations**
 - Scheme operations such as pumping hours, supply hours are completely deviated from scheme design consideration. In this scheme pumps are operated for about 18 hours daily instead of 8 hours per day as per DPR. The scheme supplies 0.45 MLD (using the two ESRs) instead of 0.24 MLD as mentioned in the DPR.
 - Parshuram Nagar which is located on high elevation has problem of low pressure, water hardly reaches to that area. A separate valve on this sub line can be installed to control pressure and supply enough water to this area.
- **Incomplete expenditure records and unsustainable financial status**
 - Expenditure records in measurement book added to only 50% of the scheme budget. Records of several complete assets were not found.
 - Scheme is financially unsustainable, actual expenditure of scheme is around Rs.10,000,00 whereas actually recovery from scheme is Rs 2,60,000 considering 100% recovery from scheme.
- Success indicator score for this scheme is **58.3**, which shows scheme will succeed if some improvements are made in implementation, by adherence to DPR and operations are carried out as per a schedule, which needs to be prepared

1. Introduction

1.1. Background

Thane Zilla Parishad empaneled Technology and Development Cell (TDSC) as the third-party evaluator in Thane district to improve Rural Water Supply Schemes (RWSS). The broad aim behind third-party technical evaluation of RWSS is improving sustainability, efficiency and equitability of these schemes. The technical evaluation is done in two phases. First evaluation is done after 30% work completion and the second after 70% work completion. Thane Zilla Parishad has given 23 ongoing schemes under National Rural Drinking Water Program (NRDWP) for third-party evaluation. TDSC is assessing these schemes through design verification physical asset verification, performance and adherence of scheme to design as per Detailed Project Report (DPR). Sapgaon Rural Water Supply Scheme is a complete scheme. Detailed study of the Sapgaon RWSS is presented in this report.

1.2. Objectives of technical audit

The objectives of the technical audit are as follows:

- Assessment of Detailed Project Report (DPR) to know design details of assets proposed in the scheme and to check whether supporting documents are prepared or not.
- To verify the design of key assets of scheme given in DPR is appropriate or not.
- Physical verification of assets to know whether the scheme has been implemented according to design mentioned in the DPR.
- Checking the performance of the scheme for judging the sustainability of the scheme.
- Summarize findings and propose recommendations.

1.3. Scheme description

Sapgaon village is situated in Shahapur Taluka of Thane District. It is at distance of 4 km from Shahapur and 59 km toward east from Thane District. Average rainfall of this area is 2663 mm. This scheme was sanctioned in year 2015-16. This scheme is designed for 15 years for population of 5286.



Figure 1: Google earth image showing Sapgaon village

Details of the scheme which has been taken from the Detailed project report (DPR) mentioned in the following table.

Table 1: Scheme details

Scheme Name		Sapgaon Rural water supply scheme	
Taluka and District		Shahapur and Thane	
Sanction Year		2015-2016	
Source		Bhatsa River	
Villages and Habitations covered		Sapgaon & Sherpada	
Scheme capacity		0.243 MLD	
Technical approval date	25/06/2014	Administrative approval Date	10/11/2014
Work Order date	10/03/2015	Time limit	18 months
Total Budget estimate	Rs1,22,78,526	Budget spent	
Implementation agency (GP/ZillaParishad/MJP/ VWSC)		VWSC	

1.4. Site visit details

Physical verification of all assets of scheme is done by site visit. Activities carried out and purpose of site visits are mention in following table.

Table 2: Site visit details

Sr. no.	Visit Dates	Purpose	Findings
1	21/02/2017	Preliminary visit	Source and Jack well visited, meet Gramsevak and operators
2	22/02/2017	Service level Assessment	Assessment of Distribution System, distribution network shown by operators

2. DPR Assessment

2.1. Scheme overview

In Sapgaon, water supply scheme was constructed by MJP in 1988. From this old scheme, water did not reach to Katkarwadi, Sherepada and Dalvipada. Water supplied by this scheme was not sufficient for villagers as population has increased. Old jackwell, one pumping machinery and old rising main upto old ESR is used in new scheme.

The new pipe water supply scheme is based on surface water. Jackwell at the Bhatsa River is the source of Scheme. According to DPR jackwell is to be fed by trench gallery. Two 10 HP submersible (out of two, one is standby) pumps are used to pump water from Jackwell to Elevated service reservoirs (ESR). There are two ESRs, one from old scheme of 25,000 liters capacity is to be used to serve zone 1 near to jackwell and other is new one constructed in Trimbak nagar having capacity of about 1,05,000 liters is to serve zone 2 and zone 3. Water is to be pumped through 110 mm diameter HDPE pipe 12.5 kg/sqm having length of about 1550 meters from jackwell to new ESR. Water is to be distributed to village from ESRs by gravity. From old ESR water is distributed to zone 1 (Pandurang Nagar) and from new ESR water distributed to zone 2 & zone 3 (Trimbak Nagar, Katkaripada, sherepada& Dalvi pada)

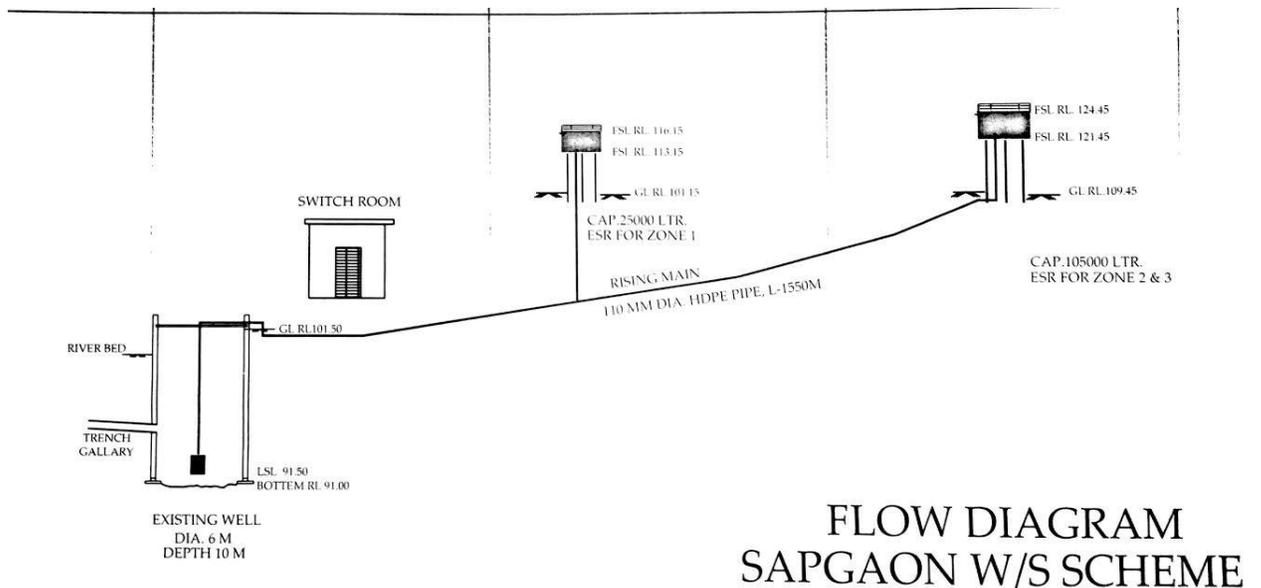


Figure 2: Schematic layout of the scheme

2.2. List of document in DPR

In order to check official procedure for demanding the scheme, utility of material and source sustainability, the following documents were verified

Table 3: Document assessed

Document	Present in DPR(YES/NO)	Remarks
Demand letter	YES	Not signed by 40% villagers

GSDA permission/authorization letter/report	YES	New jack well is suggested
Yield Test	NA	Surface source
Material test report	YES	Compressive strength of concrete report provided and ultimate stress and elongation test of pipe provided but type of material not mention.
Water quality test	No	
Budget Estimate	YES	
Distribution system Summary/ software program I/O	YES	BRANCH version 3.0 output is provided
Key plan	YES	
Survey map	NO	

3. Scheme Assets and Attributes

This section details the verification of design given in DPR and physical asset verification on ground against that given in DPR. Data collected on operation and financial status of the scheme is also presented

3.1. Design verification

The first step of technical audit is design verification of different assets of the scheme. Hydraulic design of various assets is given in the DPR; through design verification it is verified whether the given design details of various assets are correct or not.

Table 4: Assets design details

Designing component	Dimensions/ Material	From DPR	From design verification	Remarks
Population forecasting	year2030	5286	5286	Average of incremental increase method and geometric method
Demand	40 liter per capita	0.243 MLD	0.243 MLD	
Raw water Pumping machinery	BHP	10 HP	10 HP	Static head could not be verified because pump level could not be measured
	Standby	1		
	Head	32.95 m	32.95 m	
	Pump flow rate	6.305 lps	6.305 lps	
Raw Rising main	Diameter	85.400 mm	90 mm	During calculation, internal dia are used but these are not properly calculated
Storage tank	Volume	105000 Liters	125000 Liters	Non-revenue water isnot taken into consideration
Distribution main		50 mm-2595 m 65 mm-4752 m 80 mm-552 m 100mm-185 m		Laying of distribution line is totally different from design document

3.2. Physical assets verification

Physical verification of assets includes checking performance and adherence of the scheme to the design mentioned in DPR. Physical assets to be verified are the source, rising main, pumping machinery, pump house, ESRs, and distribution network. The physical assets were verified through on-site inspections.

Table 5: Physical assets detail

Asset name	Dimensions/Material	From DPR/ Structural design	From Field visit	Remarks
Trench Gallery	Length			No trench gallery is seen, but contractor said it is there old trench gallery used in scheme
	Diameter			
	Pipe material			
Source (Jack well)	Diameter	6 m	4.30 m	Old scheme Jackwell is used, which is too old and cracks are seen on well
	Depth	10 m	5.30 m	
	Water column		3.75 m	
Pumping machinery	BHP	10	12.5, 7.5	2 pumps are used for two rising main, No stand by pump. 7.5 BHP pump from old scheme
	Pump type	Submersible	Submersible	
	Pump flow rate	6.306 L/s		
	Pressure gauge	1	0	
	Diameter (mm) Length (m) -	110 - 1550	110 - 1270 65 – 300	
Rising main	Diameter	110 mm	110 mm	Length measured is not exact;
	Material	HDPE (110 mm)	HDPE (110 mm) PVC (65 mm)	For the old ESR, PVC rising main used.
	Valves	Sluice valves – 2 Air valves - 6	Sluice valves – 2 Air valves - 0	
Old ESR New ESR	Length x width	-	-	Stair case is damaged, capacity not measured, but according to contractor capacity is 25000 Lit
	Depth + Free board	-	-	
	Volume	-	-	
	Staging height	-	-	
New ESR	Diameter		5.60 m	
	Depth + Free board		4.3 + 0.3 m	
	Volume	105000 Liter	105363 Liter	
	Staging height	12 m	9m	
Distribution network	Diameter (mm) – Length (m)	100 – 185 80 – 552	100 – 913 80 – 1520	Length of distribution network laid in ground is

		65 – 4752 50 – 2595	65 – 1660 50 – 2747 40 – 320	approximately 89%, diameter lower than lowest diameter in DPR is used.
	Material	G.I medium class	G.I medium class	
	Valves	Sluice valves – 6 Air valves - 2	Sluice valves -15 Air valves - 0	

3.3. Assets summary

- **Trench gallery** – On the field trench gallery not visible, because of high water level in the Bhatsa River. According to the contractor trench gallery is there from the old scheme.
- **Jack-Well** – **Old Jack well is used for the new scheme**, which is deteriorated, cracks are seen from the outside.



Figure 3: Source Bhatsa River and Jackwell

- **Pumping Machinery** – According to contractor 12.5 HP pump inserted in the Jack well which is used for pumping water to New ESR & 7.5 HP pump from the old scheme is used for pumping water to Old ESR. **No stand by pumps** in field, but DPR suggested one stand by pump of 12.5 Hp for pumping water from jackwell to new ESR.
- **Pump house** – Pump house 3m * 3m is built near the jack well. It has an electric connection with paneling but electric wires are not properly placed.



Figure 4: Pump house outside and inside view

- **Rising main** – Separate rising main for old ESR and New ESR. For old ESR PVC pipe used for rising main from the old Scheme. HDPE pipe having 110 mm diameter of 1550 meter length of PE-100class rising main runs from jackwell to new ESR. Both rising mains are of G.I material upto pump house. Rising mains are resting on temporary support as seen in Figure 3
- **ESRs**–Old ESR is near to the Jack well, this was repaired. The stair for old ESR is in deteriorated condition, not safe for use. The New ESR is 1.5 Km far from the Jackwell and has a capacity of 105000 liters. There is no overflow pipe & wash out valve in both ESRs. Staging height of new ESR is changed from 12 m to 9 m.



Figure 5: Elevated service reservoir

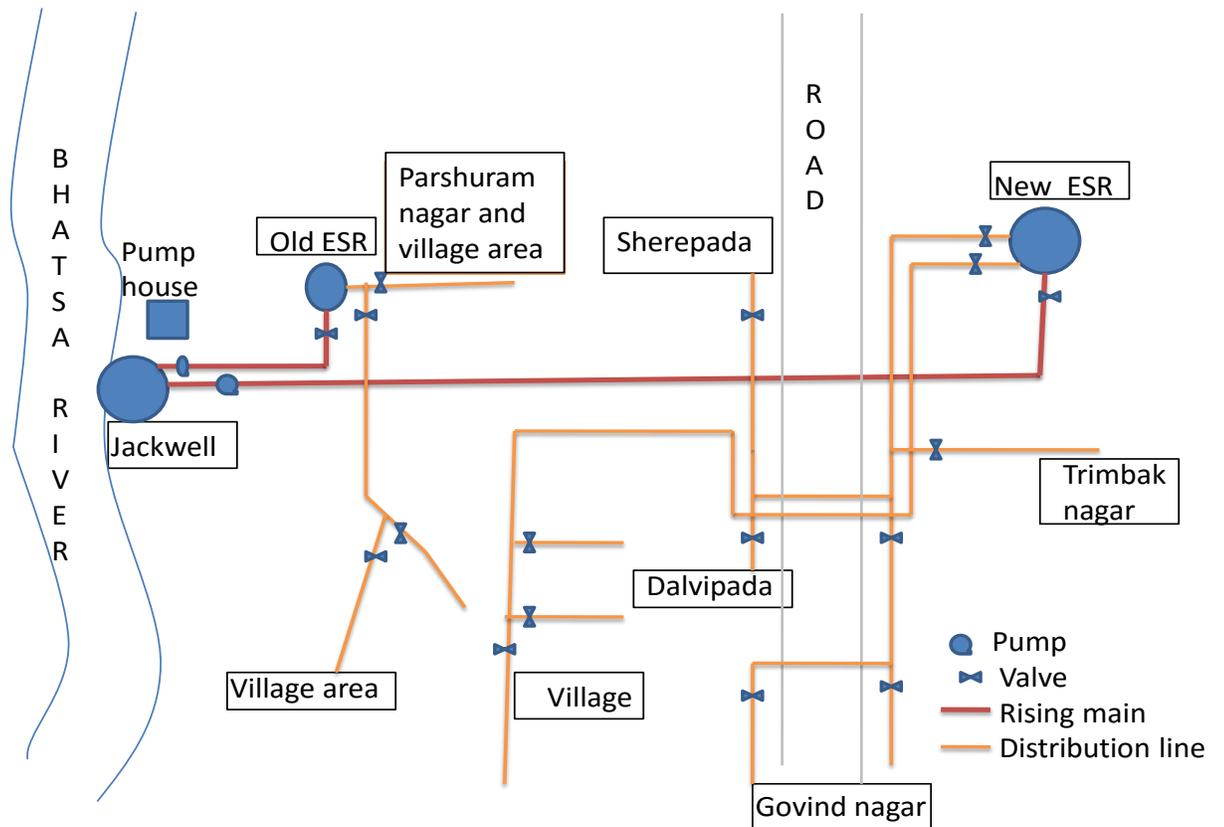


Figure 6: Existing scheme diagram

- **Distribution main –**

Distribution network from old ESR is divided into two zones; each zone is served for about 2.30 hours and then tank is filled in 2 hours.

Two distribution main lines emerge from new ESR; one directly goes to main village area and then it is divided in three sub lines. Each sub line has valve, water is supplied to this zone from 7 am to 10.30 pm. Second distribution line is divided into four branches, one goes toward sherepada other to dalvipada third to Trimbaknagar and last one to Govindnagar.

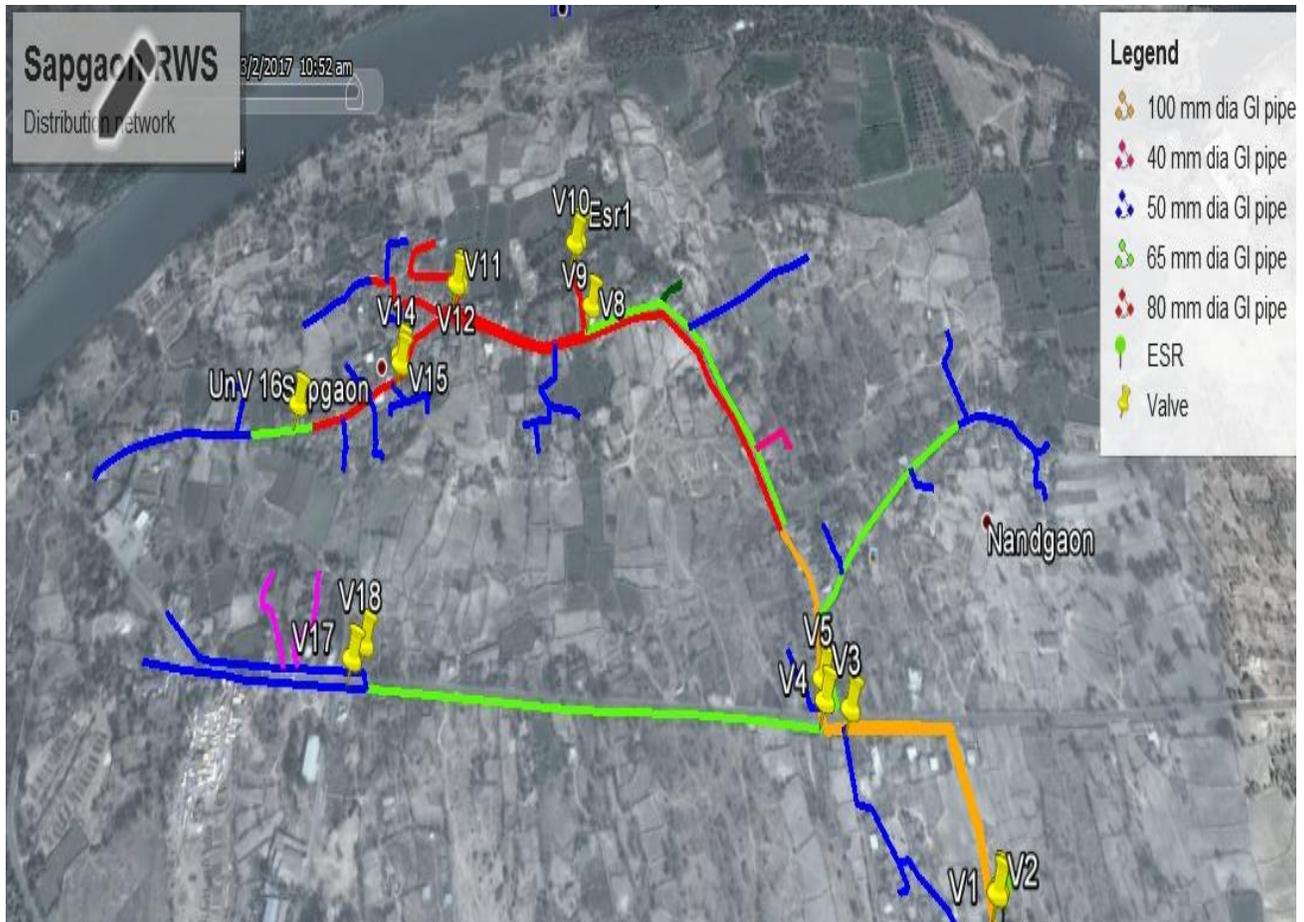


Figure 7: Distribution system diagram

3.4. Scheme operations

- This scheme was completed in March 2016. Now scheme has come to hand over phase.
- Old ESR is filled in 2 hours and new ESR takes 3.30 Hours to fill completely. From both tanks, inflow and outflows take place continuously. Pump for old ESR start from 7.am to 2.00 pm and pump for new ESR starts from morning 7.00 am to 2.30 pm. In evening pump for new is again started to fill the tank.
- Distribution network from old ESR is divided into two zones each zone is served for about 2.30 hours and then tank get filled in 2 hours.
- Two distribution main line emerges from new ESR one directly goes to main village area then it divided in three sub line each sub line has valve, water is supplied to this zone from 7 am to 10.30 pm. Second distribution line divided into four branches one goes toward Sherepada other to Dalvipada third to Trimbak nagar and last one to Govind nagar. Water supplied to Trimbaknagar from 10.30 am to 11.30 am. Sherepada and Dalvipada gets water from 1.30 pm to 3.00 pm. Govind nagar again divided into two branches these branches are supplied water from 11.30 am to 1.30 pm.
- Total quantity of water delivered from scheme is calculated below
-

Table 6 Total quantity of water delivered from scheme

ESR	Capacity of ESR (liters)	Time to fill (hours)	Flow rate (lph)	Pumping hours	Total quantity of water supplied (liters)
Old ESR	25,000	2	12,500	7	87,500
New ESR	1,13,000	3.30	32,285	11.30	3,64,820
Total					4,52,320

Table 7: Flow measurement

Sr. no	Location	Name	Size of utensil (liters)	Time (seconds)	Flow (lps)	Water available in 60 min (lit)
1	Jay Malhar Mandir (Old ESR)	Balanarayan	9	42	0.2142	771
2	Jay Malhar Mandir (Old ESR)	Ragunath Andale	5	33	0.1515	545
3	Aanad wadi (Old ESR)	Maya Dongare	8	31	0.258	930
4	Trimbak Nagar	MangiSavarle	12	45	0.266	960
5	Trimbak Nagar	Ravindra Shedake	5	27	0.185	670
6	Village area from new ESR	Shivram Hari	4	16	0.25	900

Flow rates are measured mostly at tail end houses. In many areas, we could not measure the flow because of electricity failure. From above table, we come to know that per capita supply is more than 100 lpcd in every area.

3.5. Financial status of scheme

Total budget of each asset mentioned in DPR and actual budget spend on each asset recorded in MB mentioned in following table

Table 8: Utilization of budget

No.	Asset	Total Budget of an Asset(Rs.)	Expenditure from MB records (Rs.)	Remark
1.	Pump house	1,10,394	----	Not found in MB record
2.	Pumping machinery	9,31,765	1,35,491	Cost of one pump and MSEB connection not part of scheme
3.	Rising main	15,72,290	13,60,575	
4.	Tanks (ESR)	19,58,471	19,37,185	
5.	Distribution system	60,42,023	41,86,765	
6.	Disinfection arrangements	30,000	----	Not found in MB record
7.	Trial run	2,24,404	----	Not found in MB record
8.	Miscellaneous	3,95,356	----	Not found in MB record
	Total	1,12,64,703	56,82,831	

This scheme is completed about a year ago but we found MB record which show total budget spent is 50%. Physical completion of scheme is approximately 100%

Financial sustainability of scheme is an important aspect. Following table gives idea about expenditure and cost recovery of scheme.

Table 9: Annual charges

Sr no	Heads	From DPR (Rs)	Actual (Rs)
i	Annual M&R charges	2,41,216	5,27,767
ii	Annual repairs	4,69,587	4,69,587
1	Total annual burden	7,10,803	9,97,354
i	Taxable houses	672	360
ii	Revenue from general cess	0	0
iii	Revenue from household connections	7,25,760	2,59,200
2	Total revenue	7,25,760	2,59,200

Actual hours of pumping and capacity of pump is considering while calculating actual annual M&R charges as electricity charges is most important expenditure. Pumping hours are large in this scheme so annual burden increases. Number of taxable houses and revenue details are collected from Gram panchayat. This scheme is financially unsustainable as number of household connection is very less as compare to consider household connection and tariff charges are very low.

4. Scheme Findings

4.1. Documentation

- Technical sanction letter is not available in DPR
- Design document of changed distribution line is not available in DPR.

4.2. Design

- Design of old rising main was not verified.
- Pumping machinery for old ESR was not designed.
- In ESR capacity of new ESR non-revenue water is not taken into consideration, but old ESR of 25,000 liters is present hence okay.

4.3. Assets

- Jack well is deteriorated; cracks are seen on the wall of Jack well.
- Wash out valve & over Flow valve not present in the both the ESR.
- Rising main is resting on temporary supports.
- Chamber is not provided anywhere for valves, if chamber is present, they are in broken condition.
- We could not verify distribution network as survey map is not available. Design document and drawing in villages show different picture than actual network on field.
- We did not find any air valve on rising main and distribution line whereas estimate and MB records mention 7 air valves on rising main and 6 air valves on distribution main.
- Staging height of new ESR changed from 12 m to 9 m, in DPR 12-meter height of ESR is suggested but in field we find 9-meter staging height.
- In many households, connections are without tap so there is a huge loss of water once their demand is fulfilled. This leads to excess pumping and contributes to make scheme unviable.



Figure 8: household connections without tap

4.4. Coverage

- All the habitations are covered in the scheme; 86%houses have household connections.
- Parshuram Nagar which is located on high elevation has problem of low pressure, water hardly reached to that area.
- 2-3 sub distribution line running from Govind nagar main distribution lines are laid by Gram Panchyat.
- Area along main Kinhavali main road is considered in designed but pipes are not laid in this area.

4.5. Financials

- Expenditure records in measurement book added to only 50% of the scheme budget. Records of several complete assets were not found
- Scheme is financially unsustainable, actual expenditure of scheme is around Rs. 10,000,00 whereas actually recovery from scheme is Rs. 2,60,000 considering 100% recovery from scheme.

4.6. Other

- TCL is added into the jackwell according to operator, no record maintained.
- The document which we gave Gramsevak, in that he mentioned VWSC was not changed, but TDSC found totally different names from document which is attach in appendix. Charges for MSEB connection provided for in DPR is Rs. 7,50,000 but there was a prior connection for old scheme, so new connection was not required and pump house is close to the village.
- Commercial water connection has to pay same cost as household connection.

5. Success Indicator

Based on field verification and success indicator methodology developed at TDSC, CTARA, IIT Bombay, success indicator score has been calculated as detailed in Appendix. For the Sagmaon RWS scheme, the success indicator score in 4 categories and final score is as given in table below.

Table 10: Final Success Indicator score

Sr no	Stages	Marks obtain
1	Planning & Design	68.5
2	Implementation	55.5
3	Operation and Maintenance	52.2
4	Exit and Handover	NA
	Final Score	58.7

This success indicator score reflects that the scheme is likely do well if certain improvements are done in completed. The major concerns are highlighted in the next section along with recommendations for improving sustainability of scheme.

6. Recommendations

6.1. Scheme specific

Assets

- New jackwell is required.
- Proper concrete block construction is required to support rising main near jackwell.
- Air valve should be provided on rising main and distribution main.
- Construct chamber around operation valves to avoid damage.
- Wash out valves and overflow pipe which is connected to outflow pipe should be provided at both ESRs.

Design and operations

- Every household connection should have tap and a fine for noncompliance.
- New design and diagram according to which distribution network laid should make available so we can verify network.
- Sub line of distribution network which runs toward Parshuram nagar should have separate valve on Parshuram nagar subline to control pressure for distribution to Parshuram nagar.
- Pressure gauge and air valves should be installed on rising main.
- To reduce pumping hours, proper zoning of village is needed to be done.

Financial

- Cost for commercial connection should be increased and household connection cost also needs to be increased than current cost as water provided is above the norms.

6.2. General

- Survey map which showing nodes, its elevation and length between connective node, pipe inventory map which showing existing and newly proposed pipe in village and map showing valve locations in distribution network and key locations in village and habitations should be marked in these maps. These maps help contractor in laying of distribution network and auditor during verification of network
- Bulk water meter should be installed in the scheme so quantity of water supplied can be measured.
- Pump operating schedule, valve operating schedule and supply schedule should be available in DPR.

Prepared by

**Vaishali Bharambe
Project Engineer
TDSC, IIT Bombay**

**Damani
Bombay**

**Prof. Om
TDSC, IIT**

Checked by