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STUDY AND DETAILS OF THE RR SCHEME FOR ANDHERA AND 9 VILLAGES

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ABSTRACT
According to Census 2011 info the placement code or village code of Andhera village is 529329. Andhera village is found in Deulgaon Raja Tehsil of Buldhana district in geographic region, India. it's set 36km aloof from sub-district headquarter Deulgaon Raja (tehsildar office) and 45km aloof from district headquarter Buldhana. As per 2009 stats, Andhera village is additionally a gram panchayat. Sevanagar, Baigaon Pr Malkapur Pangra, Khadka, Mendgaon, Shivni Armal, Padali Shinde Pr Malkapur Pang, Saokhed are the few villages close Andhera village. As of 2011 Bharat Deulgaon Raja had a population of thirty, 827. Males represent fifty two of the population and females forty eighth. Deulgaon Raja has a median acquisition rate of seventy six, on top of the national average of fifty nine.5%: male acquisition is eighty one.5% and, feminine acquisition is seventieth. In Deulgaon Raja, thirteen of the population is underneath half dozen years of ages. Deulgaon Raja is understood for the temple of Balaji.

Keywords:
Water distribution scheme, Designing, Scheduling, Distribution

GEOGRAPHY OF THE VILLAGE

The total geographical area of village is 3006 hectares. Andhera has a total population of 5,023 peoples, out of which male population is 2,607 while female population is 2,416. There are about 1,067 houses in Andhera village. Chikhli is nearest town to Andhera for all major economic activities, which is approximately 28km away. The coordinates of Deulgaon is 20°01'N 76°17'E. Total area of Deulgaon raja tehsil is 476 km² including 468.19 km² rural area and 7.86 km² urban area. Deulgaon Raja tehsil has a population of 1,25,350 peoples, out of which urban population is 30,827 while rural population is 94,523. There are about 26,029 houses in the sub-district, including 5,972 urban houses and 20,057 rural houses.

KHADAKPURNA DAM

The Khadakpurna Major Irrigation Project is being constructed across river Khadakpurna, a tributary of river Godavari in the Godavari Basin in Buldhana district of Maharashtra. The project envisages construction of 2160 m long earth dam with a maximum height of 18.50 m and 381.67 m long composite masonry and concrete dam with the maximum height of 51 m having 282 m long central gated spillway with 54.67 m long non-overflow blocks on left flank and 45 m long blocks on right flank of the spillway. The ogee-shaped spillway is provided with 19 radial gates each of size 12m x 8m to pass design flood of 18,047 m^3/s. The canal system consists of 38 km long Right Bank Canal (RBC); 10 km long Left Bank Canal (LBC); 14.70 km long lift Canal taking off at RD 6840 m of LBC; 11.20 km long lift Canal taking off at RD 18230 m of RBC. A Lift Irrigation Scheme in 4 stages i.e. Stage - I to IV; and Dagadwadi LIS have also been planned. In addition, there is provision for the offshore lift irrigation schemes to be constructed at the cost borne by the farmers to cater to 2500 ha of the culturable command area (CCA).

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SALIENT FEATURES OF KHADAKPURNA DAM

Table No. 1 Salient features of Khadakpurna Dam

Attributes	Values
Name of Dam	Khadakpurna
Nearest City	Deulgaonraja
District	Buldhana
State	Maharashtra
Purpose of Dam	Irrigation, Hydroelectric, Drinking / Water Supply
River Bed Level (m)	501.00 m
Ogee Crest Level (m)	512.50 m
Minimum Draw Down Level (m)	518.18 m
Full Reservoir Level (m)	520.50 m
Maximum Water Level (m)	523.80 m
Gross Storage Capacity (Mcum)	159.523 Mcum
Number of Spillway Gates	19

MAIN FEATURES OF THE SCHEME

Table No. 2 Main features of the Water supply Scheme

1) Name of the village	a) Waki BK b) Sura c) Mandapgaon d) Dhotra Nandai e) Pimpri Andhale f) Sawkhed Nagre g) Mendgaon h) Baigaon BK i) Andhera j) Shivani Armal	
2) Taluka	Deulgaon raja	
3) District	Buldhana	
4) Source of supply	Jack well in the submergence of Khadakpurna Dam	
5) Population in person as per census 2011	18832	Person
6) Population in designed stage (Person) 2038 Person in designed stage (Person) 2053	25339.0 29696.0	Person Person
7) Rate of water supply	55	LPCD
8) Daily water supply	1.687	MLD
9) Daily gross demand with losses (15% losses)	1.990	MLD
10) Rate of pumping	99500	LPH
11) Daily pumping	20	Hrs.
12) Cost of the scheme DSR 2021-2022	Rs. 291770632.00	

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13) Per capita cost of the scheme (Ultimate Stage) Per capita cost of the scheme (Considering 3 km long rising main)	Rs. 9825.00 Rs. 4904.45	
14) Cost of water per 1000 liter i. With depreciation cost a) For year 2023 b) For year 2038 ii. Without depreciation cost a) For year 2023 b) For year 2038	 Rs. 8.63 Rs. 13.11 Rs. 5.51 Rs. 10.45	
15) Cost of water per 1000 liter iii. With depreciation cost c) For year 2023 d) For year 2038 iv. Without depreciation cost c) For year 2023 d) For year 2038	 Rs. 8.63 Rs. 13.11 Rs. 5.51 Rs. 10.45	
16) General water tax per house per year a) For year 2023 b) For year 2038	 Rs. 1680.00 Rs. 2400.00	 Per year Per year
17) General water tax per house per year a) For year 2023 b) For year 2038	 Rs. 1680.00 Rs. 2400.00	 Per year Per year
18) General water tax per house per year a) For year 2023 b) For year 2038	 Rs. 1680.00 Rs. 2400.00	 Per year Per year
19) Recurring charges per year per head i. With depreciation cost a) For year 2023 b) For year 2038	 Rs. 265.25 Rs.343.33	 Per head Per head

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ii. Without depreciation cost a) For year 2023 b) For year 2038	 Rs.169.34 Rs. 273.80	 Per head Per head

KHADAKPURNA PROJECT SALIENT FEATURES

Table No. 3 Khadakpurna Project Salient Features

Name of the project	Khadakpurna River Project
2. River basin	Godavari
3. Name of stream/sub basin	Khadakpurna
4. Location	
a) Nearby village/town	Garkhed
b) Taluka	Deulgaon Raja
c) District	Buldhana
d) Latitude	20°9'30"N
e) Longitude	76°4'30"E
5. Catchment area in Sq.km	5133.18 sqkm
6. Yield (in Mcum.)	478.668 mm^3
7. Storage (in Mcum.)	
a) Gross	160.606 Mcum
b) Dead	67.202 Mcum
c) Live (above MDDL)	93.404 Mcum
8. Planned utilization in Mcum	
a) Withdrawals by canals for irrigation	74.993 Mcum
b) Withdrawals for water supply	7.872 Mcum
c) Reservoir losses	31.766 Mcum
d) Gross utilization	114.631 Mcum
9. Dam	
a) Type	Composite rolled filled earth dam, with masonry central gated spillway
b) Length(Mtr.)	2160 Mtr
c) Height(Mtr.)	18.50Mtr (Earth Dam)
d) M.W.L(Mtr.)	523.796 Mtr
e) F.R.L(Mtr.)	520.500 Mtr
f) M.D.D.L (Mtr.)	518.180 Mtr
g) Dead storage level (Mtr.)	516.405 Mtr
10. Spillway	
a) Location	RD 1292.33 Mtr to 1680 Mtr
b) Length (Mtr.)	282 Mtr
c) Flood lift(Mtr.)	3.296
d) Discharge capacity(cumecs)	18407
e) Crest gates	Radial 12*8 Mtr non standard
f) Crest level(Mtr.)	512.50 Mtr
11. Submersion	
a) Area in ha. at F.R.L(ha)	2990 Ha.
b) No. of villages affected	8,6
c) Population affected	14714

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d) Forest area required for project (ha)	7.95 Ha Dam/ 9.50 Ha Canal
12. Irrigation in Ha General characteristics of soil in command area	Black cotton soil with good drainage
13. Canals	
a) Right bank canal i. Length in km.	36 km
ii. Capacity at head in cumecs	3.38 cum/s
iii. Irrigation in ha(ICA)	2931 Ha
iv. Whether lined / unlined	Unlined
b) Left bank canal	
i. Length in Km.	10 km
ii. Capacity at head in cumecs	2.06 cum/s
iii. Irrigation in ha (ICA)	2219 Ha
iv. Whether lined / unlined	Unlined

PRINCIPAL FEATURES OF SCHEME

Table No. 4 Features of the scheme

1. Population Year 1971 1981 1991 2001 2011	 Population 10966 souls 12205 souls 14541 souls 16668 souls 18832 souls
2. Design population Year 2023 2038 2053	 Population 21529 souls 25339 souls 29696 souls
3. Rate of water supply	55 LPCD
4. Daily demand Year 2023 2038 2058	 Demand 1686880 Lit 1985413 Lit 2326798 Lit
5. Yearly requirement	0.849 mm^3
6. Proposed head works a) Proposed head works • Proposed 6m dia. Jack well with overhead pump house. The jack well is 11m deep below G.L & 7.29m above G.L. • Proposed 3m dia. Intake well. • Proposed 350mm dia. D.I.K-7 connecting main 60m long. • Proposed 2m dia. Inspection well-1 nos. • Proposed 3.5m wide Approach Bridge 60m long. b) Raw water pumping machinery • Proposed pumping machinery at jack well consists of 75 BHP VT pumps (2 No) with 100% stand by having designed discharge 111440 lph for each pump & 103m head.	

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c) Raw water rising main.
- Proposed 250mm dia. D.I K-9 pipes raw water rising main 15090m long from jack well to proposed water treatment plant.

d) Water treatment plant
- The proposed WTP capacity is 2.50 MLD Un-conventional.
- Ground level at WTP is 584.65m.
- Lip of aeration fountain of WTP is 584.65m.

e) Proposed pure water gravity main
- Proposed 225 to 110mm dia. HDPE & 300 mm dia. D.I pipes 35.07 km long pure water gravity main from pure water sump to various ESR is proposed.
- 225mm dia. HDPE 6kg pipes-4170m.
- 200mm dia. HDPE 6kg pipes-5830m.
- 160mm dia. HDPE 6kg pipes-1110m.
- 140mm dia. HDPE 6kg pipes-2605m.
- 110mm dia. HDPE 6kg pipes-16355m.
- 300mm dia. D.I. K-7 pipes-2450m.
- 250mm dia. D.I. K-7 pipes-300m.
- 200mm dia. D.I. K-7 pipes-300m.
- 150mm dia. D.I. K-7 pipes-450m.
- 100mm dia. D.I. K-7 pipes-1500m.

f) Proposed R.C.C ESR
- Proposed RCC ESR at Dhotra Nandai 30000 liter capacity.
- Proposed RCC ESR at Pimpri Andhale 20000 liter capacity.
- Proposed RCC ESR at Mendgaon 45000 liter capacity.
- Proposed RCC ESR at Baigaon BK. 25000 liter capacity.
- Proposed RCC ESR at Andhera 25000 liter capacity.
- Proposed RCC ESR at Shivni Armal 25000 liter capacity.

g) Miscellaneous work

Necessary provision of following works are made in the DPR

a) Trial run for One year
b) Wire fencing at all ESR
c) Compound wall to WTP site

a. Statement showing population forecast

The designed population of the year 2038 of scheme as per JJM guidelines is 25126 whereas from three methods average population is 25339. And the designed population of year 2053 of scheme as per JJM guidelines is 28109 whereas from three methods average population is 29696. Hence, for this scheme the population adopted as per averages of three different methods.

b. Statement showing yearly requirement calculations for water

As per the design population of year 2023, 2038 and 2053 the population is 21529, 25339 and 29696 resp. considering the factors such as daily design demand for non peri urban villages, total domestic demand, daily/institutional/industrial and commercial demand 5% of domestic demand, total live stock in villages, daily demand at ESR considering 15% losses in distribution system, total daily demand at head works yearly requirement of water at head works is carried out. Accordingly the year 2023, 2038 and 2053 the water required for the distribution required are 0.616 mm3, 0.725 mm3 and 0.849 mm3 respectively.

c. Statement showing design period & components of the scheme

The water supply scheme consist of the components like intake well, connecting mains, jack well with pump house, approach bridge, raw water pumping machinery, raw water rising main, unconventional WTP, pure water gravity main WTP to ESR, RCC ESR. Each of these components has a different design period in years. From above components intake well, connecting mains, jack well with pump house, Approach Bridge, raw water rising main and pure water gravity main WTP to ESR have a design period of 30 years and design year of 2053. While other components like raw water pumping machinery, unconventional WTP and RCC ESR have a design period of 15 years having design year of 2038.

d. Designs of the components

a) Design of rose piece: As per the design period and design year the design of rose piece is prepared. From the design provided separately we came to know that the dia. of rose piece should be 400mm, length should be 0.55m, dia. of the connecting barrel should be 250mm and its length should be 1.50m. And the weight of the rose piece should be 250 kgs.

b) Design of connecting main: As per the design criteria the calculated dimensions of the connecting main are calculated as 350 mm in dia. and DI K-7 pipe component of the connecting main.

c) **Design of jack well:** The design for the jack well is for the year 2053. The total depth of the well is calculated as 18.29m. Depth of well above GL is 7.29m. Depth of well below GL 11.00m. GL at jack well is 518.00m. Detention period should be 20 mins. Storage should be 38.83m^3.

d) Design of raw water pumping machinery: According to the designs prepared 2 pump sets of 75 HP having discharging capacity of 103600 LPH & Head 106 m are required.

e) Design of raw water rising main: The design period of the rising main is for 30 years and design year 2053. The requirement of the water in year 2023, 2038 and 2058 is 1686880 lit, 1985413 lit and 2326798 lit resp. the length of the pumping main is estimated to be 15090.00 m at a level of 584.650 m having LSL of pump 509.50 m and residual head of 4 m. The discharge of the water in year 2038 and 2053 is 99271 LPH and 130301 LPH resp.

f) Water hammer for proposed rising main from jack well to WTP: according to the calculations done 250 mm dia. DI Class K-9 pipe is seems to be suitable for rising main.

g) Design of pure water gravity main from pure water sump: Since there are number of pipelines a large number of calculations are required. For different zones different pipelines are designed. The design of these pipes will be different for different villages and according to the zones. The data required will be attached separately.

e. Management of the water supply scheme

As we are using WaterGems software, it reveals saving of 9.6% and 12.5 % based on the cost of the pipes and energy consumption respectively in the existing network also confirmed that the WaterGems optimization techniques has constantly obtained lower cost solutions used by many design engineers. The findings of this study showed that the WaterGems pumping operation was an attractive approach for effective scheduling of the water pumping operations to accomplish management targets namely the minimum cost, quality upgrading, and pressure regulation. The optimized water distribution networks in the study area was controlled the water pressure within the network nodes and it thus may reduce the water losses in the system is noteworthy as the more complex problems to deal with concerning water supply network.

As the scheme consists of the 11 villages and is a RR scheme all the execution and construction work will be done simultaneously.

f. Scheduling of the water supply scheme

The objective of scheduling is to develop an optimal schedule that ensures that each village is supplied with its corresponding water requirement using the available infrastructure. Also, if it is impossible to meet the daily demand with the available infrastructure, the schedule has to ensure that the water is supplied equitably i.e., every village receives an amount of water that is proportional to their actual demand. In order to achieve this, a schedule has to be prepared which minimizes the time required to supply the water. If the minimum time is less than the maximum time of operation (e.g., 24 hours if daily demand is specified), the solution is feasible. However, if the minimum required time is greater than the available time, the solution is infeasible. In such a case, we reduce the demands of the villages by a factor equal to the ratio of required minimum time to available time.

The system in consideration consists of a source supplying water to multiple villages. Water is stored in a master balancing reservoir (MBR) and then supplied to village reservoirs by gravity. Though systems with only a single source are addressed here, the proposed technique can easily be extended to systems with multiple sources as well. The network is provided with valves which are either completely open or closed for each village and these can be operated to open or close the flow of water to the particular village (thus behaving as ON/OFF valves). Generally, these valves are operated manually by valve men and the schedules are decided based on heuristics or practical limitations. Such an operation is not guaranteed to use existing resources

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optimally or ensure equitable distribution.

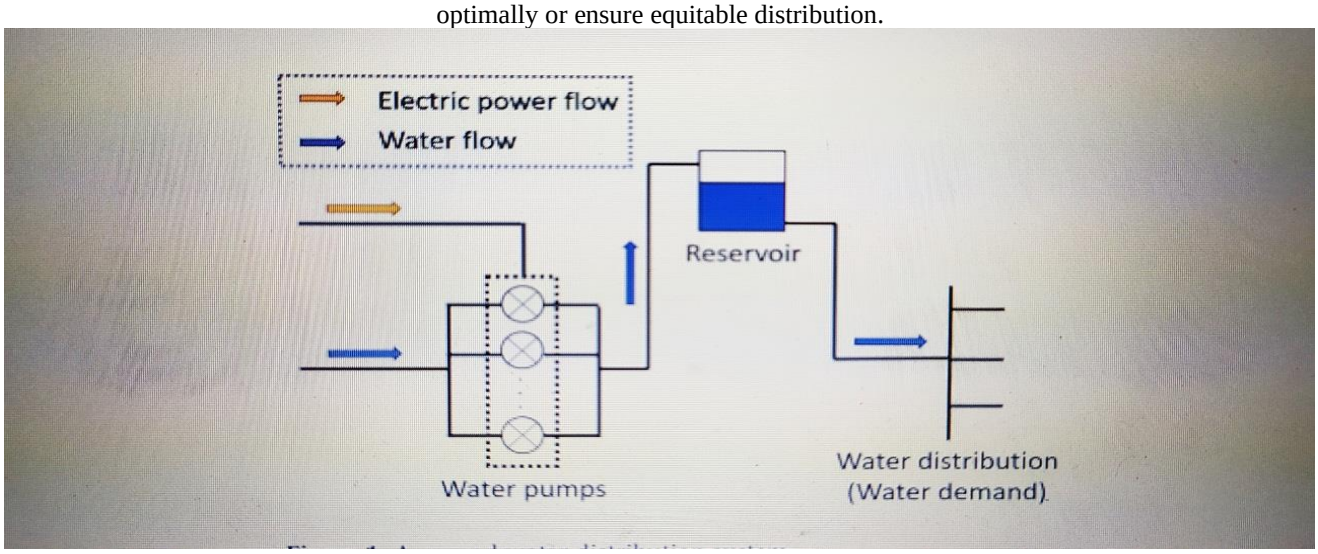

Fig No.1 Assumed water supply distribution system

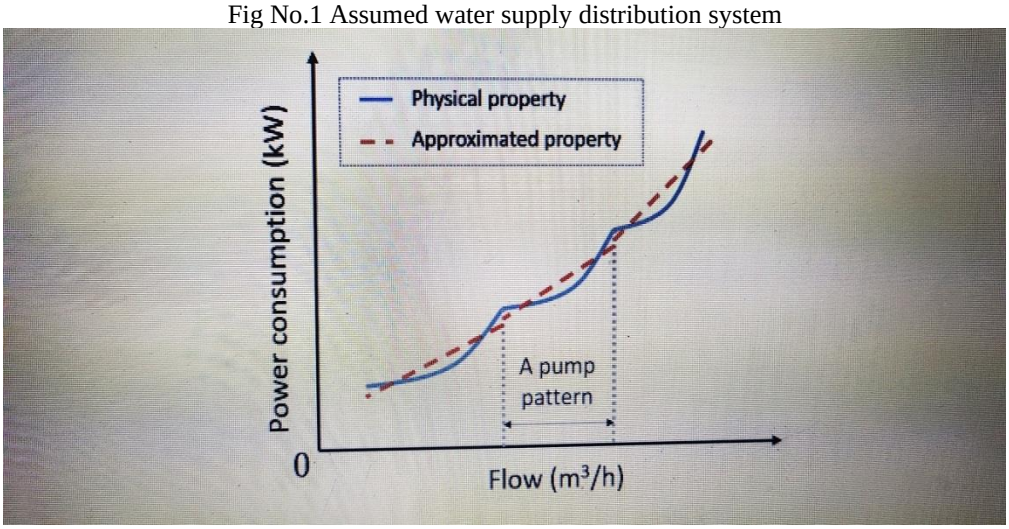

Fig No. 2 Approximated properties of the water pumps.

Fig No.3 Profile of hourly water demand

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The scheduling of the scheme is done with respect to the time required for the execution to the implementation of the scheme. It may include several factors such as survey work, excavation, construction of the water treatment plant, construction of the ESR, lying of the pipes, trial of the ESR's etc. From proposal of the scheme till execution it may take up to about 3-4 years of time. The execution work of all the components are carried out simultaneously so as it require less time. It consists of various task works as follows:

i. Survey work: Survey work of any village may take time about 3-4 months. It includes all types of surveys to be carried out. Reconnaissance survey, preliminary survey and detailed survey.
ii. Test procedure to be carried out: Test like soil test, strata test, etc. are carried out at several intervals. It may take about up to 2 month. The results are then sending to the head office. If suitable results are not obtained, alternative measures are taken for that specific area.
iii. Excavation process: Excavation is carried out for lying of the pipes, for the construction of the ESR and treatment plant. The important factor which affects the excavation work is the type of soil. If the strata are hard it may take approximately up to 3-4 months. And if the strata are soft it may require only 1-2 months.
iv. Transportation of the material: As the excavation work is started the transportation of the material is started so as to fasten the lying of the pipes and work started soon. It may take only up to 2-3 months for transportation of the material.
v. Construction of the ESR and WTP: After excavation and transportation of the material construction of the other components is started. Because of the heavy work of construction it requires a lot of time up to 9-10 months. Various factors affect the construction of these components such as weather, availability of the labour etc.
vi. Implementation of the machinery: After the completion of construction work the machineries are installed at the respective places. It can take approximately up to 5-6 months as the size of the machines is very large. And it also requires skilled labors.
vii. Trial of the scheme: After all the work is done the testing of the scheme is carried out. The water is pumped through the main source and tested at various points. It may require up to 5-6 months as each and every house is getting the water or not is checked.

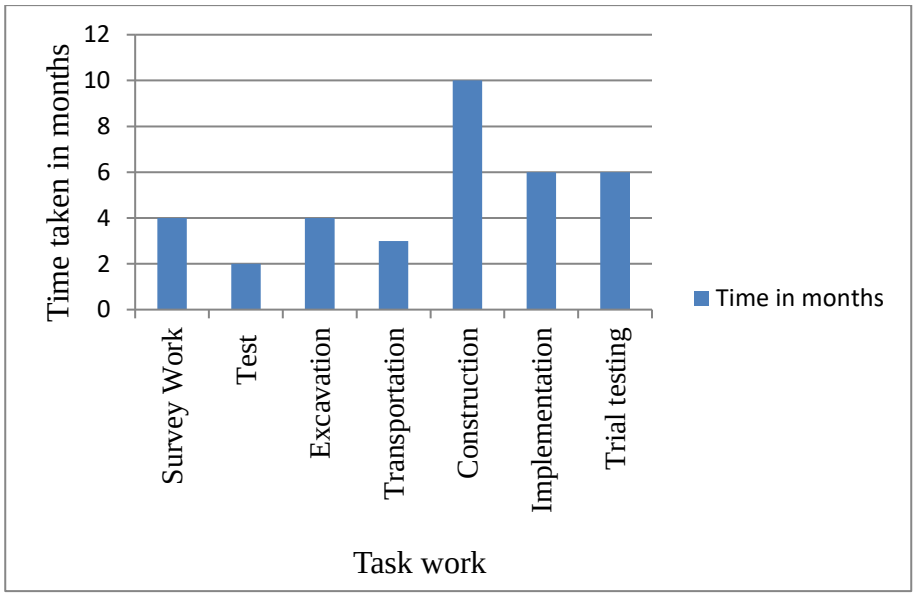

Fig No. 4 Time required by each task work

If we compare the length of pipes to be laid in each village we can tell how much time will be taken by each village for its execution process. From all the villages each and every village has its existing pipelines. The extra proposed pipelines are to be laid. From all these villages Andhera village have highest number of length of pipeline to be laid while Dhotra Mandai have the shortest length of the pipeline.

So the time required for lying of the pipelines can be estimated from its length and the strata found.

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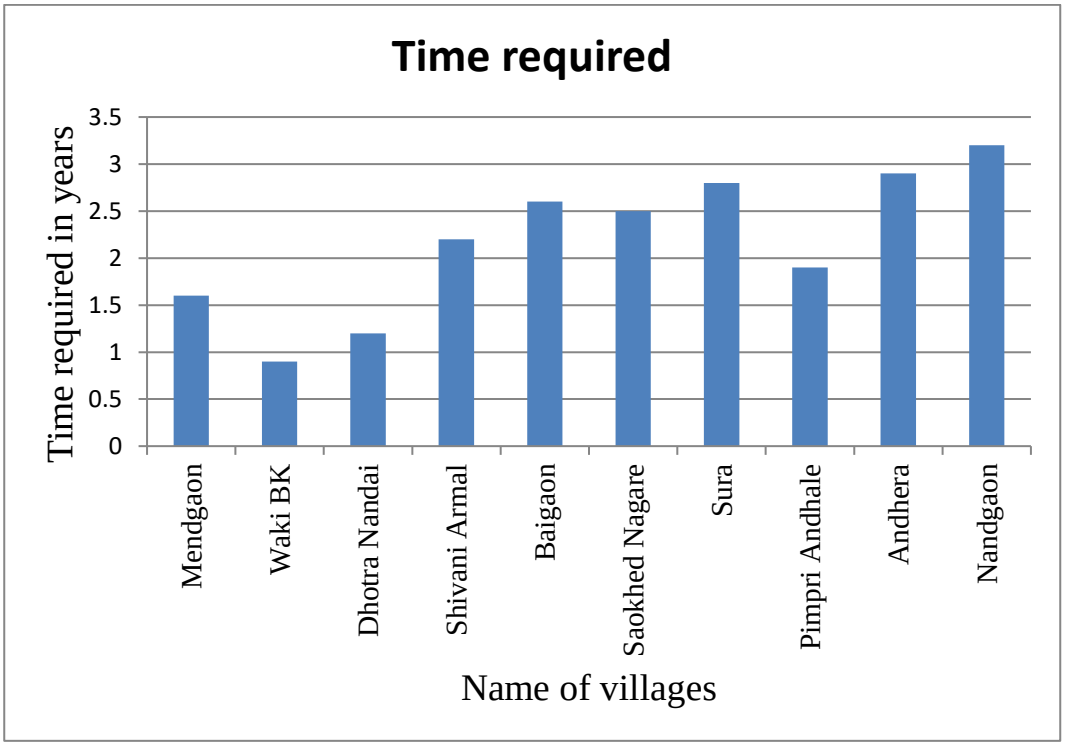

Fig No.5 Time required for each village to complete its execution

RESULT AND CONCLUSION

SUMMARY

As the scheme prepared is a RR scheme, we cannot decide the exact time of execution of the scheme. According to the whole scheme we can say that for the total execution of the scheme can take around 3-4 years. If we want to decide the time taken to the execution one have to go through the length, areas of the villages to decide the time taken for each village.

VILLAGES AND THERE LENGTH OF PIPES TO BE LAID

Table No.5 Details of length of pipelines existing and proposed

Sr No.	Village	Details of distribution system from existing ESR(m)	Details of distribution system from proposed ESR(m)
1	Mendgaon	3014	1829
2	Waki BK	2035	-
3	Dhotra Nandai	2044	1753
4	Shivani Armal	2029	2374
5	Baigaon	3204	-
6	Saokhed Nagare	2467	-
7	Sura	2515	-

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8	Pimpri Andhale	1386	1993
9	Andhera	4277	3855
10	Mandgaon	7488	-

OBSERVATION

After collecting all the data of the distribution network of the scheme, pressure, flow and velocities have been computed using various software and by the methodology described before, results by Water Gems are obtained, analysis of results has been carried out and computed results for junction and pipes have been checked by the engineers of MJP. The purpose of the study is to design water distribution network for Andhera region. In this study it is observed that storage capacity located at Khadakpurna Dam which is not satisfactory so by considering demand of water for villages' design of new water distribution network is necessary to install, so proposed network is planned and need to execute for effective distribution with sufficient pressure.

From the above study we can say that the time required for the execution of a water supply scheme will take more than 3 years. Proper utilization of the time will be beneficial for the execution work. The execution work mainly depends on the length of the pipelines to be laid and area of the village. Due to the existing project it got easy for the execution.

CONCLUSION

Based on the above study, it was found that the resulting pressures at all the junctions and the flows with their velocities at all pipes are adequate enough to provide water to the study area as per the consumer needs. There may be leakages in the pipes which results in the pressure difference which consequently results into the scarcity of water. Comparison of these results indicates that the simulated model seems to be reasonably close to actual network. With the use of this software one can indeed analyze the network at the desk and can foresee the error, if any, in the design and consequently the changes required to be done in such designs for its successful execution at site. The result reveals that the software used for the design has the capability to handle various pipe network problems without changing in model of or mathematical formulation. The software used was viable alternative to other methods particularly in view of accuracy and its results in a simpler algorithm, without any iterative process. The results showed that the least cost solutions were obtained which fulfilled the required flow and pressure consistently at the node.

The results are statistically significant difference of pre-optimization and post-optimization such as cost, pressure, velocity, and flow. The findings of this study can be concluded that WaterGems modeling approach based on genetic algorithm is a promising alternative for the optimal design of the water distribution system, as they demonstrated for the Andhera village water distribution considered in terms of hydraulic pressure and computational efficiency.

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