



INTRODUCTION :

The object of this book-let is to place before the public the scheme of under-ground drainage proposed to be undertaken in Kolhapur City. It will be seen from the papers that the proposal started about three years ago with a letter from the Chief Engineer suggesting to the Prime Minister that early steps should be taken to execute a scheme of under-ground drainage in Kolhapur City. This letter was passed on to the Kolhapur Municipality which authorised its President to carry on further correspondence on the subject. Accordingly, the President engaged the services of Mr. S. S. Naik, Consulting Engineer, Bombay, in order to design a system of under-ground drainage for the City of Kolhapur. Mr. Naik submitted his preliminary report on the subject which was considered both by the Kolhapur City Municipality and by the Kolhapur Government and generally approved. In accordance with the recommendations made by Mr. Naik in his preliminary report, it was decided to prepare a Financial Forecast of the scheme to begin with. Accordingly, a special division for the purpose was created and put in charge of Mr. B. L. Jadhav, Executive Engineer. Mr. Jadhav prepared preliminary plans which were inspected by Mr. Naik at site and a tentative scheme was prepared. This was shown to Mr. N. V. Modak, City Engineer of Bombay, who fully approved of it. Finally, Mr. Naik prepared the Financial Forecast of the scheme and submitted it to the Kolhapur Government and the Municipality in a detailed and valuable report. A perusal of the report shows that the under-ground drainage scheme, as designed by Mr. Naik, is unique in several ways and is likely to benefit the inhabitants of the City very considerably. It was, therefore, considered advisable to educate public opinion on the subject and hence all the above correspondence on the subject is now being released.

M. R. BAGWE
Development Minister, Kolhapur.

C O N T E N T S.

- (1) Letter No. RHE/43/H/1163 of 7th April 1942 from the Chief Engineer, Kolhapur, to the Prime Minister of Kolhapur.
- (2) Resolution of the Kolhapur City Municipality No. 371 of 20-8-1942.
- (3) The Preliminary Report on a Drainage Scheme for the City of Kolhapur by S. S. Naik Esq., B. A., B. SC., (EDIN) L. C. E., Consulting Engineer, Bombay.
- (4) Note for the Council regarding the above report and G. R. R. D. No. 558 of 29-2-1944.
- (5) Opinion of N. V. Modak Esq., C. I. E., City Engineer, Bombay on the Drainage Scheme for Kolhapur City.
- (6) Note for the Council on the above opinion and G. R. R. D. No. 868 of 2-11-1944.
- (7) A note on the Kolhapur City Drainage Project and its financial forecast prepared by S. S. Naik Esq. B. A., B. SC., (Edin) L. C. E., Consulting Engineer, Bombay.
- (8) Note for the Council on the above financial forecast and G. R. D. D. No. 74 of 11-1-45.

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Letter No. RHE/43-H/1163 of 7-4-1942 from the Chief Engineer, Kolhapur State, addressed to the Prime Minister of Kolhapur.

Subject:— Drainage arrangements for Kolhapur City.

Sir,

I have the honour to state that the construction work for the Water Supply of Kolhapur City has already been taken up in hand. According to the present proposals, this scheme is to be evolved in two stages. To begin with, the supply will be at the rate of Thirty Gallons per head per day for a population of 1,20,000 souls. This supply will finally be increased from 30 to 40 Gallons per head per day and for a population of 1,50,000 souls which is expected to be reached by about 1971.

2. The first stage of the Water Supply Scheme is likely to be completed by about June 1945 and a copious water supply could be made available throughout the day to all the localities of the City including its extensions. As a natural consequence it is necessary to provide a suitable Drainage System in order to avoid the bad effects of water stagnation when the supply will have increased considerably. As a matter of fact, a drainage system should invariably precede a water supply system as both of them are inter-dependent. It is, therefore, necessary to take up the question of a Drainage System to the Kolhapur City in time, so that it could be made to function by about the time the first stage of the water supply scheme comes into working.

3. It would, therefore, be desirable to move the Municipal Authorities to take up this matter for consideration *forthwith* and make necessary arrangements for the execution of the Drainage Scheme, in consultation with this Department. Necessary orders in this connection may kindly be issued in due course.

कोल्हापूर नगरपालिका

ज. क. ठ. नं. ३७१

सदर कामी मे. तेंडोलकर यांनी सूचना आणिली व तीस अनुमोदन मे. उपलेकर यांनी दिले की राधानगरी हायड्रो. इले. वर्क्सचे पाणी जून १९४५ चे नंतर कोल्हापुरास दर माणसी तीस गॅलनपर्यंत मिळणार असलेने सदर पाण्याची निर्गत होणेसाठी अंडर ग्राउंड ड्रेनेज होणे अत्यंत जरूर आहे. या बाबतीत काही कौन्सिलर्स, हे. ऑ., चीफ ऑफिसर व अॅडव्हायसर वगैरे यांची इनफॉर्मल मीटिंग होऊन वाटाघाट झाली. त्यावरून ओपन स्टीम गटर्स बांधणेचे झालेस १७-१८ लाख रुपये खर्च लागणार आहे. धिवाय मंगी लोकांत शिक्षण ज्या प्रमाणांत वाढेल त्या भावानें मंगी कमी मिळू लागणार. अंडर ग्राउंड ड्रेनेज असले ठिकाणी सांसारिक रोग कमी होऊन शहराचे आरोग्य सुधारेल. अंडर ग्राउंड ड्रेनेज बांधणेचे झालेस त्याचा उपयोग एकाच पिढीस होत नसून तीन चार पिढ्या त्याचा उपयोग होणार आहे. आतां जो खर्च येणार तो कर्ज काढून ते कर्ज दोन तीन पिढ्यावर (३० ते ४०) वर्षांत बसून होण्याचा असलेने जी रकम कर्ज म्हणून काढली जाईल त्याचे व्याज व ऐनापैकी थोडी रकम अशा रीतीने कर्जाची फेड झाल्यास शहर सुधारणा होऊन कर हल्लीच्या नागरिकांवर डोहजड असा बसणार नाही. मात्र अंडर ग्राउंड ड्रेनेज करणेचे झाल्यास तज्ज्ञ लोकांचा सल्ला घेऊन हातीं घेणें जरूर आहे. तरी ही स्कीम कशा तऱ्हेने अंमलांत आणावी याबद्दल मे. प्रिंसिपॅट यांनी वरिष्ठांकडे पत्रव्यवहार करावा. सूचना मतांस घालतां सूचनेप्रमाणें सर्वानुमते ठरावांत आले. ता. २०-१-४२.

REPORT ON A DRAINAGE SCHEME FOR THE CITY OF KOLHAPUR.

Introduction

This is only a preliminary report giving advice regarding the nature of the drainage system suitable for the conditions prevailing at Kolhapur and the general broad outlines as to how the various component parts of such a system should be designed. It is not possible to include in this report a financial forecast as regards the capital outlay involved in the execution of such a scheme, the expenditure required for its maintenance, and the annual liability of the town Municipality by way of recurring expenditure after taking into consideration the income likely to be obtained by the promotion of such a scheme and the annual instalments to be paid by way of sinking fund and interest charges. Such a financial forecast can be given after detailed surveys are carried out and plans and estimates for the scheme are prepared. The survey work already carried out by the Municipality in this behalf has been very useful in the preparation of the present report and the Municipality deserves congratulations for the same.

Significance of the Various Technical Terms in Use

2. In order to thoroughly understand the various terms generally used in connection with a drainage scheme and the various methods of collection in vogue, it is necessary in the first instance to say a few words regarding them.

Wastes from houses are in two forms- liquid and solid. The former includes waste water from bath-rooms, washing places, ablution water from latrines, etc., and it is generally known as 'sullage'. The latter comprises of mainly 'house refuse' and 'night-soil'. When 'night-soil' is admitted through the agency of 'water' into the same conduits as those employed for the removal of liquid wastes, the combined contents finding their way into the conduits are known as 'sewage', i. e. 'sullage' plus 'night-soil'. This system of drainage is known as the 'water-carriage' system.

Till adequate water supply is available for the introduction of the water-carriage system for the removal of the 'night-soil', it has to be removed separately on 'head-loads' from the houses and taken to trenching ground for 'disposal', but when a 'water-carriage' system is introduced, the latrines are converted from the 'dry-system' into 'water-closets'.

It is universal to use closed conduits for the removal of 'sewage' and the reason for their adoption is evident. 'Night-soil' cannot be allowed to flow through open drains. This would be highly objectionable both from aesthetic and public health points of view.

Water Supply Scheme and Water Supply per capita

3. Due to the poverty of the local bodies all over India, a local body cannot afford to provide water supply sufficient to meet the requirements of a water-carriage system and consequently a beginning is made by providing a supply just sufficient to meet the demands of the consumers for cooking, drinking and washing without any allowance for 'water-carriage'. Consequently, the waste water to be dealt with by a system serving such towns is of the nature of 'sullage' for a number of years after the execution of the water supply scheme. It is only when adequate funds are available that the water supply is improved so as to be sufficient for the introduction of the 'water-carriage' system, and experience has shown that the cost incurred on the sewerage scheme at this stage is very much in excess of what it would have cost the town if proper thought and long foresight were shown in the design and execution of the original drainage scheme.

It has been estimated that about 10 to 15 gallons of water per head per day are sufficient for cooking, drinking and washing of clothes, but for a water-carriage system, an allowance of at least 25 to 30 gallons per head per day is necessary. It is the usual experience of towns that when a piped water supply is introduced that the inhabitants thereof clamour for more and more water and this leads to water being used on a lavish scale in the houses and more attention is paid to personal cleanliness. As water can be had by simply turning a tap, 'waste' is on the increase. The only satisfactory measure to prevent waste is to resort to metering. Every water connection to a consumer must be metered and whenever water used on the premises is to be in excess of the requirements, the additional supply taken must be paid for at a certain rate by the consumer over and above the rate paid for the individual house connection. Such metering should in no way encourage the landlords to prevent the tenants from using the legitimate quantity of water required for ablution, washing and personal cleanliness. In the case of towns with industries, the allowance per capita increases depending upon the nature of the industries, but an average allowance of 50 gallons per capita may be said to be an adequate allowance for such towns.

Necessitating the Schemes of Water Supply and Drainage simultaneously

4. Indian towns have made a great blunder in the past in not providing, along with the water supply scheme, an adequate drainage system for the removal of the 'waste water' from the premises and they have been repenting for this omission, as it is found that introduction of a water supply in the town does not improve the health of the citizens, and full benefits thereof can only accrue if it is coupled with a satisfactory system of drainage. The absence of a drainage scheme creates mosquito trouble and sometimes leads to the contamination of the water supply itself if the intake of the water supply happens

to be on the down stream side of a town. The ideal to be aimed at by every Indian Town Municipality in the future should be the construction of water and drainage works simultaneously, irrespective of cost, and this principle should be invariably kept in view in the case of the new developments of an existing town and there is no reason why it should not be done.

Open versus Underground Drains

5. The provision of a drainage system as an after thought gives rise to several complicated problems in respect of the type of drains to be adopted and so forth. One is accustomed to see the presence of 'open drains' by the sides of streets for the conveyance of 'sullage' away from the premises. These open drains serve two purposes, one of conveying the sullage (waste water from bathing and washing places, ablution water from latrines, etc.) to the point of collection, and the other to convey rain water during the rainy season. Their size must therefore be sufficient to convey both storm water and 'sullage'. The quantity of sullage is insignificant as compared to that of storm water and consequently these drains have to be laid to such gradients as to create self-cleansing velocity therein under the condition of 'minimum flow', otherwise they would tend to get silted up in course of time during the fair weather requiring a large staff and a large quantity of water for their maintenance. The gradients to be given to such drains depend upon the configuration of the town. If a town is flat, the drains become deep and are required to be covered up with stone dhapas or concrete slabs for the safety of the occupants of the houses abutting these drains, especially the children. When the water supply is adequately increased and the time for the conversion of latrines into water-closets comes, separate underground conduits consisting of pipe or masonry have to be constructed for the conveyance of sewage (sullage plus night-soil) and the house connections will also have to be altered to suit the underground system of drainage resulting in additional cost. The open drains already constructed continue to work as storm water drains for some time but are usually replaced by underground drains as the town prospers, irrespective of the cost involved.

Combined versus Separate System of Drainage

6. This brings in the question as to whether sullage-sewage and storm water should be conveyed through the same conduit or through two separate conduits. The drainage arrangements in which one conduit is used both for sullage-sewage and storm water is known as the 'combined system' of drainage. The system in which two separate conduits, one for sullage-sewage and the other for storm water are employed, is known as the 'separate system'. In Europe, and in Great Britain, where it rains practically all the year round and where the intensity of rainfall is not so great as that in India, a combined system of drainage is found to be suitable. Some of the American towns, where the monsoon is restricted to a few months in the year as in India and

where the intensity of rainfall is similar to that in India, have come to grief by emulating the English practice of 'combined system' which has since been altered to the 'separate system' on economical and sanitary grounds.

Desirability of providing Underground Drains even for Sullage under Separate Conditions

7. The Sanitary Engineers of today do think that if the configuration of the town is favourable, it is more economical to introduce from the very commencement an underground system of drainage even for the conveyance or 'sullage' in the initial stages in preference to the system of open surface drains, because no works already carried out under this system are required to be scrapped when 'night-soil' is introduced, and no extra cost is involved in modifying suitably the house connections. The adoption of such a system can also be justified on grounds of public health and sanitation as it does away with the places usually afforded by open drains for breeding mosquitoes, and there is not the remotest chance of the drains being used by the children for answering calls of nature, by the male adults for urinating purposes and by the housewives for getting rid of the house refuse. It is also economical from the point of view of maintenance provided the sections of the drains are so designed as to create self-cleansing velocity under minimum conditions of flow after taking into consideration the future increase in the allowance for water supply per capita.

What should be done for Kolhapur Town

8. How far will the town of Kolhapur satisfy the above requirements in regard to the system of drainage to be adopted, whether it should comprise only of (a) open drains, (b) a combination of open and underground drains, or (c) underground drains. The answer to this question is as follows:—

The water supply of the town today is not adequate for the introduction of a 'water-carriage' system. Schemes are in hand for improving the existing water supply and it is estimated that by the year 1955, when Radhanagari scheme is expected to be completed, water supply per capita will be increased from the present rate of about 14 gallons per head per day to about 40 gallons. Till 1955, only sullage will have to be dealt with by the drainage system. If care is taken to select suitable sections of drains with good gradients to create a self-cleansing velocity with the present and future flows of sullage-sewage, there is no reason why an underground system of drainage should not be introduced from now as it would in the long run be more economical than that of open surface drains. Is the lie or configuration of the town suitable for this purpose? Is it possible to get good slopes for self-cleansing velocities without making the drainage system more than reasonably deep? *The town appears to be very favourably situated in this respect.* It has good natural slopes. Storm water finds its way into the river through the

natural water courses, viz. the various 'nalas'. No flooding of streets takes place during the monsoon. The fall from the centre of the town towards the river is as much as 100 ft. Drains of smaller sizes can be laid to steep gradients with self-cleansing velocities to meet the requirements of the localities served by them. No deep drains will be necessary and auxiliary pumping station or stations will not be required to avoid deep drains under the circumstances. It would be a folly to construct open drains in the old town for sullage and then to replace them by underground drains after the improvements to the water supply are completed. Besides, town planning schemes for the development of the town are under consideration. The new developed areas should be provided with at least one set of underground drains for the conveyance of 'sullage' as per modern practice. The storm water may be dealt with by open drains or by a combination of open and underground drains. It would be a 'penny wise and pound foolish' policy if open drains for sullage and storm water are constructed in these areas. It is, therefore, strongly recommended that underground drains be constructed from now, which would for the present deal with sullage and ultimately with sewage when the water supply is improved.

Method of disposal—Treatment works

9. Having decided upon the most suitable system of drainage, the most important points on which decision has to be taken are (a) the method of disposal, (b) the point or points of collection, and (c) the site of treatment works. It is an axiom in sewage disposal that sewage should only be treated to a degree just sufficient to meet the requirements of the situation and no further, as it means waste of public money. Kolhapur is surrounded on all sides by nalas and rivers and consequently the final disposal of the effluent has to be by dilution. Large tracks of good agricultural land are available round about the town for sullage-sewage farming. The soil thereof is most suitable for growing crops. The most economical and efficient method of disposal would under the circumstances be 'land treatment', i. e. 'sewage farming'. When sullage-sewage is not required for land treatment, the disposal will have to be by dilution into the river. Sullage-sewage will have to be passed through a detritus tank and treated in a primary settling tank providing a retention period of about 2 to 3 hours before application on land. The character of sullage-sewage will be mostly domestic as there are not many industries in the town, there being a few cotton mills and a distillery. There is a likelihood of more industries being started in the near future. So long as the volume of the trade wastes is insignificant as compared with that of the domestic sewage, no special treatment for the trade wastes on the premises of the industry is considered necessary before their admission into the drainage system. However, when the industries are situated just at the tail end of the drainage system, sudden discharge therefrom is likely to affect the working of the disposal

works, viz. the primary settling tanks and sewage farming. It may, therefore, become necessary to subject trade wastes to some kind of preliminary and perhaps secondary treatment before their admission into the public drains. It is, therefore, desirable that legislation should be passed from now by the Durbar obtaining powers to insist upon the industrialists to treat the trade effluents to a certain standard of purity to be laid down in each individual case after analysing the trade effluent therefrom, before their admission into the drainage system. This will help to keep down the cost of disposal works.

Preliminary Treatment

10. Preliminary treatment of sewage is absolutely necessary to remove large portions of settleable solids, otherwise their application on land will make the land sewage-sick in a few years and aerial nuisance will be created. In order to avoid this nuisance a large portion of the land is required to be kept fallow. Experience has indicated that when the soil of the farm is black cotton, alternate watering of sullage-sewage and fresh water are necessary to keep the farm in a satisfactory condition and also to avoid aerial nuisance.

Provision will have to be made, as pointed out before, to deal with the sullage-sewage when it is required for irrigation purposes, especially during the monsoon period and also on some days in the cold weather. 'Lagoons' will have to be provided for storing the sullage-sewage into them when not required for irrigation purposes so that their contents can be discharged into the river when it is in floods or when a large quantity of water is available for dilution.

In case it is found that further treatment of sewage is necessary before application or that the percolation from the sewage farm requires treatment prior to its discharge into the river, an enclosed type of filter may be provided which will be helpful in improving the degree of purity of the preliminary settled sewage or of the percolation effluent from the farm before discharge into the river. No secondary treatment in an enclosed filter is considered necessary at the commencement but the method of disposal has only been indicated in case it is found necessary at a future date.

The question will be asked as to why sullage-sewage without any treatment should not be discharged directly into the river during the monsoon period when there is plenty of water for dilution. No Sanitary Engineer of today will ever advocate such a proposal; as in the first instance looking to the erratic condition of the Indian monsoon it is doubtful whether the river would be in floods continuously for four months of the year and if there happens to be a draught during the monsoon period, the problem of treating sullage-sewage before discharge into the river will have to be tackled and in that case a stand-by plant will have to be provided for treating the same prior to its discharge into

the river to meet such emergencies. Such an arrangement cannot be said to be satisfactory. It will certainly be the most retrograde step from the public health point of view.

Point or Points of Collection.

11. As regards (b) and (c), viz. the point or points of collection, the study of the contour plan shows that the point marked X on the accompanying plan† is most suitable for collecting the sullage-sewage from the old town as well as from the areas already developed and those under contemplation outside the old town. It may not, however, be necessary to bring the sewage from the areas already developed and to be developed to this point from the very commencement on economical grounds but this can only be decided after several alternatives are worked out to ascertain the first economical stage in the execution of the scheme. The most important factor to be remembered in selecting the point or points of collection is that sullage-sewage should arrive thereat in a fresh condition. If tendency towards septicity is apt to be created by a long travel, it is advisable to introduce pumping stations to convey sullage-sewage to the point of collection in about 4 hours to keep it sweet and fresh.

Alternate Sites for Sullage-Sewage Farm

12. There are two sites worth considering for the location of the sullage-sewage farm. One is to the east of the town in the vicinity of the proposed developments, and the other is towards the west in the close proximity of the point of collection for the old town. East side is not in the direction of prevailing winds, and consequently there is no likelihood of bad odour being brought into the town by the south-west wind if anything goes wrong with the farm. There is plenty of land available for treating the quantity of sullage-sewage expected with the present rate of water consumption and that expected when the water supply is improved and dry-system latrines are converted into water-closets. The soil at both the sites is good. Fresh water for alternate waterings can be obtained from the river at each site by resorting to pumping. Each site has its own advantages and disadvantages. The west side is close to the river and special precautions will have to be taken to collect the percolation water from the farm by providing a trench parallel to the river at the end of the sewage farm to prevent contamination of the river, the water of which is used for drinking purposes by the villagers on the down-stream side. This site has several other advantages, such as (a) it can be divided into groups of 400 to 500 acres each, (b) shorter length of rising main for conveying sullage than that required for the eastern site, (c) high lands are available for locating individual preliminary settling—balancing tanks to maintain a balance between the rate of pumping and that at which sullage-sewage will be applied to land

† The plan is too large to be printed; it can be seen in the Municipal Office.

commanded by each individual group, (d) sugarcane crop is already being grown with the help of river water by resorting to pumping, and (e) the farm on this site therefore will give a return from the very commencement of the scheme which would not be the case with the site on the east where Jawari crops are at present being grown, sugar plantation has not yet established itself and pumping from the river is not used on a large scale. It will take some time to get a good return from the eastern site as custom will have to be created for sullage effluent by starting a model farm to demonstrate to the cultivators the utility of sullage for sewage farming. With all this, it may be necessary on economical grounds to work both the sites in the early stages of the scheme to keep down initial cost on the major works of the scheme, such as collecting sewers, etc., and whichever site is found to be more lucrative will have to be fully developed in the final stage of the scheme.

Usual Precautions to be taken in working a Sullage-Sewage Farm

13. It should, however, be remembered that purification of sullage-sewage by bacterial agency is the main object of land treatment. This objective should under no circumstances be made subservient to the tendency shown by the cultivators in obtaining as much yield as possible from the land, which results in making the land sullage-sewage sick in a short time even with alternate waterings of fresh water and sullage-sewage. Black cotton soil is retentive of moisture, and if the application of sullage-sewage is in excess of what the land can absorb, mosquito and other troubles start. Bad smell begins to emanate vitiating the atmosphere round about. The difficulty can be got over to a certain extent by 'under drainage' of the farm at an exorbitant cost and there is also no guarantee that it would be successful in getting rid of the trouble caused by over-dosages of sullage-sewage. It would, therefore, be necessary either to acquire in the first stage of the scheme sufficient land required for farming or if no such land is acquired, steps will have to be taken to control farming activities on private land by imposing certain conditions regarding the depth of watering, rotation of crops, the nature of the crops to be grown, and so forth. No crop which is likely to be eaten in a 'raw state', i. e. without cooking, should be allowed to grow on the farm as far as possible. Sugarcane which is likely to be used for 'juice' should be cleaned properly before it is allowed to reach the market in order to prevent the spread of typhus and other similar diseases. It may not be necessary in the early stages of the scheme to acquire any land for cultivation on the west side of the town where cultivation of 'sugarcane' is already being practised, and it would be easy to control farming activities on this site, the 'State' agreeing to give in bulk a certain quantity of sullage-sewage every day at a fixed rate.

The whole Scheme can be built in Parts

14. This, in short, is the general outline of the drainage scheme. It is not necessary to provide money for completing the whole of it in one single

stage. It can be built in 'parts', i. e. in several stages by tackling such areas which are in immediate need of relief. Sullage only will find its way into the drainage system till the water supply rate is increased to at least 25 to 30 gallons per head per day. Similarly, even after the improvement of water supply, it will take a long time before 'night-soil' is admitted into the system. Here again, the work should be carried out slowly in parts. Those landlords who are in a position to convert latrines into water-closets should be encouraged to do so. It always takes a long time to get all the latrines converted, especially those which are serving the poorer localities of the town. One way by which this action can be hastened is to give a subsidy to the house-owners for every latrine converted.

Immediate Survey Work Necessary if a Beginning is to be made from Next Year

15. As the Durbar is very anxious to make a beginning on the scheme as early as possible and as there is a likelihood of some provision being made for the same in the next year's budget, it is recommended that detailed plans of the scheme should be taken in hand immediately by deputing to Bombay an Officer of the 'State' for this purpose assisted by adequate staff who will be guided by me in the preparation of rough plans and block estimates sufficient for working out approximately the total cost of the various alternative schemes so as to select the most economical and suitable one out of them. This will take 3 to 4 months. It will then be possible to submit for the consideration of the Durbar full implications of the final scheme in regard to capital outlay and recurring expenditure. When this scheme is approved by the Durbar, a programme will be fixed as to how the scheme should be completed in stages and detailed plans and estimates for each stage can then be prepared.

Desirability of a 'Master Plan'

16. It is also recommended that a 'master plan' should be prepared from now for the whole of the town including future extension, so that the various utility services, such as water, drainage, electricity can be planned well in advance to meet the future needs of the town in an economical way. Haphazard planning is always defective and proves very costly in the long run. The 'master plan' of course must be flexible as it may have to be modified from time to time due to some unforeseen circumstances. Adequate water supply and quick disposal of waste water are the back-bone of a town development, and a town-planner must act in co-operation with the Engineer entrusted with the work of improvement to water supply and drainage. Such co-operation avoids waste.

Final recommendations

17. The following are the recommendations in brief, in regard to the contemplated drainage scheme:—

- (1) Underground system of drainage should be introduced from the very commencement instead of open surface drains as such a scheme would be economical in the long run due to the favourable configuration of the town.
- (2) Water-carriage system should be of the 'separate type'. The existing kutchā drains by the sides of roads should be utilized, for the present, for the conveyance of storm water, but they should be made pucca in parts as the city develops. In the areas of the town to be developed under the town-planning scheme, it is desirable that underground drains for storm water should be constructed from the very commencement instead of open surface drains, if funds permit.
- (3) In designing the sizes of the sewers, care should be taken to see that not only the sewers run with self-cleansing velocity during the period of minimum flows but they also are sufficient to meet the present and the future requirements of the population. They should be so aligned and graded that they can be either extended or duplicated to meet the future requirements if the town does not develop in accordance with the pre-conceived plan.
- (4) The pumping station should be designed in such a manner that it can be extended to cope with the proportionate increase in the quantity of sullage-sewage due to the increase in the supply of water per capita and increase in the population. In selecting pumps and the motive power for driving them, the fact that electricity would be the final motive power should not be lost sight of.

The depth of the pump-well of the pumping station should be so fixed that it should be possible to run independently collecting drains from certain areas direct to the pumping station to save cost on large main sewers in the initial stages of the scheme.
- (5) Sullage-sewage on no account should be discharged into the river before it is properly treated even in the rainy season, as such a course would not be in the interest of the inhabitants of the town itself and also of the villagers residing on the downstream side of the river.
- (6) The only treatment necessary appears to be preliminary sedimentation and land treatment. Sufficient quantity of cultivable land is available for this purpose round about the town.

The site or sites for the 'farm' should be selected very judiciously both from economical and sanitary points of view. Alternate waterings of fresh water and sullage-sewage should be provided for.

When sullage-sewage is not required for application on land during the monsoon or in the cold weather, it should be stored in 'lagoons' for being discharged into the river during heavy floods only.

Percolation of sullage-sewage from farm land should not be allowed to enter the river. Catch-water drains should be constructed for the purpose and the percolation should be returned to land again for further treatment.

- (7) In fixing the sizes of sewers, the capacity of pumping stations, etc., care should be taken to keep the expenditure in the initial stages of the scheme down to a minimum to avoid extra burden on the present rate-payer by catering for the requirements of the future generation.
- (8) That a special officer from the State with adequate staff should be deputed to Bombay for preparing plans and block estimates and also a financial forecast of the scheme showing the initial capital outlay and the recurring expenditure thereof after taking into consideration the return likely to be obtained from 'farming'. After the Durbar approves of this scheme, it should be divided into suitable stages in accordance with funds available and detailed working drawings for each stage should be prepared by the same officer to enable the work on the same being started.
- (9) That a flexible 'master plan' of the proposed improvements and new developments should be prepared from now, and the various utility services, such as water, sewerage, etc. should be planned in accordance with the same to avoid waste.

S. S. Naik
Consulting Engineer.

Note for the Council dated 2-2-1944.

I have great pleasure in presenting to the Council a preliminary report regarding a drainage scheme for Kolhapur City. (Copies of the report have already been circulated). The report is self-explanatory and does not need any comments. I would, however, draw the attention of the Council specially to para 17 of the report which summarises the recommendations.

2. It will be seen that the main features of the scheme proposed therein are the following:—

(a) A scheme of underground drainage is likely to be cheaper than a scheme of surface drainage in the natural conditions prevailing in Kolhapur (Para 8).

(b) An elastic master-plan of the drainage of the whole city, inclusive of extensions, should be got ready in the first instance. (Para 16).

(c) The whole scheme should not be taken up at once for execution; rather the ideas of the master-plan should be worked out step by step in a period of about 20 years. (Para 14).

(d) Underground drains should be constructed from now, for the present they will carry sullage and ultimately sewage when the water supply is improved (Para 8).

The other points dealt with in the report are purely technical and need not be discussed here.

3. I recommend that the report may generally be approved as a basis for working out further details.

4. A reference to para 15 of the report will show that the whole scheme has been divided into 4 stages:—

(a) Approval of the Preliminary Report.

(b) Preparation and approval of the financial forecast.

(c) Preparation of a definite Master-plan and a Programme spread over a number of years,

(d) Execution of the scheme.

5. We must now turn our attention to the second step i. e. the preparation of the financial forecast. For this purpose, it is necessary to take the following measures:—

(a) Mr. S. S. Naik will have to come and stay at Kolhapur for about a week and study carefully all the data already collected. He will also give detailed instructions to local officers regarding any additional data that may have to be collected.

(b) Mr. B. L. Jadhav should collect all such data (with the help of temporary staff, if necessary) and should go to Bombay for the preparation of a financial forecast, early in April. Mr. S. V. Desai should also be deputed in June for the same purpose. It is hoped that the whole work will be ready by the end of June 1944. (Vide recommendation No. 8 of the report).

I request the Council to approve of these proposals.

6. *Costs*: The amount of money likely to be required for the scheme during this year is Rs. 5,000 as under :—

- Rs. 750 Honorarium to be paid to Mr. S. S. Naik,
 „ 3,000 Cost of the temporary establishment necessary to be
 employed for the scheme in Kolhapur and in Bombay.
 „ 1,250 Travelling and other sundry expenses.

I request the Council to sanction this amount.

M. R. BAGWE
 Revenue Minister, Kolhapur.

G. R. R. D. No. 558/29-2-44.

“ Approved the preliminary report of Mr. S. S. Naik on Kolhapur Drainage and approved expenditure of Rs. 5,000 by the Municipality for the preparation of a financial forecast.

**Opinion of Mr. N. V. Modak, City Engineer, Bombay
 on the Scheme prepared by Mr. S. S. Naik.**

Mr. S. S. Naik, consulting Engineer, Bombay, showed me the data collected by Mr. Jadhav, Ex. Engineer, Kolhapur State, for the preparation of a drainage scheme for the City of Kolhapur and I got an opportunity of studying the same on site during my recent visit to Kolhapur (20th to 23rd September 1944). I attended a meeting of the City Development Board at the request of Mr. Naik when I was asked by him to express an opinion on the drainage scheme under preparation for the information of the members of the Board which I did then. Mr. Naik has now asked me to reproduce in brief my talk at the meeting. I am therefore giving below, from memory, a brief summary of the same.

2. A satisfactory drainage scheme has to satisfy generally the following conditions:—

(1) The main collecting sewers must follow most convenient and shortest routes according to the contours and should convey sewage from the houses to the main point of collection as quickly as possible in order to keep it 'sweet'. The prevention of 'septicity' helps to keep down the cost of disposal works. It also prevents emanation of foul and offensive odours which usually result when sewage to be treated reaches in a septic condition either at the point of collection or disposal.

(2) The sizes of grades of sewers should be such as to create self-cleansing velocities in the initial stages of the scheme when sewage admitted into the system is not adequate to satisfy running 'half full' or 'full' conditions required for self-cleansing velocities due to the insufficiency of the City's water supply. Stagnation of solid organic water contained in sewage or sullage takes place

under these conditions. This leads to the production H_2S gas which has an adverse effect on the sewers if they are not properly ventilated. In the majority of cases, water supply is improved after the introduction of the drainage system and consequently, in the initial stages only sullage has to be admitted into the sewers and the night soil is continued to be removed separately on head loads for a number of years.

3. The site selected for the disposal works must not convey bad odours to any part of the City and that the method of treatment adopted must be suited to meet local requirements from the sanitary and hygienic points of view. There should not be the slightest chance of any river or stream being polluted by the discharge of treated sewage, daily or occasionally, so as to endanger public health.

There should be sufficient room for expansion as and when needed and that the works should be capable of being expanded to turn out an effluent of a higher degree of purity if it becomes imperative due to a change in the public opinion.

4. Conditions 1 and 2 do appear to apply satisfactorily to the lay-out of the sewers and the sites selected for the pumping stations. The lines selected for the alignment of main collecting sewers follow convenient routes and are short in length as far as practicable. The natural physical conditions of the City are favourable for laying these sewers to self-cleansing grades without very deep excavation. The gradients selected are such as would create self-cleansing velocities with minimum flows expected in the initial stages of the scheme. Provision has also been made to introduce 'waste' water from ground tanks into the head manholes of the collecting sewers to improve conditions of flow for some months of the year in the initial stages of the scheme when sullage only will be admitted into the sewers and the rate of water-supply would not exceed 10 to 12 gallons per head per day.

5. The most suitable point for the collection of sewage appears to be the north-west end of the City in the proximity of Brahmपुरi area. The sewage can be conveyed to this point from all the parts of the City by gravity. After collection at this point sewage will have to be lifted by pump to the 'disposal works'. The main pumping station will, therefore, be constructed at this point.

6. The existing and a part of the future extensions of the City will be drained to the main pumping station referred to in para 5 above by two main collecting sewers A and B. (Vide Index plan). Sewer A will start from Kalamba Reservoir and will run in a northerly direction up to the main pumping station. In order to increase the flow through this sewer in the initial stages of the scheme, the Rankala channel will be connected thereto at a point close to Ubha Maruti. It will also receive a large quantity of waste water from private borings, wells etc.

It should be possible to connect sewer 'B' directly by gravity to the main pumping station by flattening the grades. If this were done, good self-cleansing velocities would not be created in this sewer in the initial stages of the scheme and the cost of maintaining it in a satisfactory condition would be considerable. As pointed out before, this may have an adverse effect on the material of the sewers. Mr. Jadhav has done well in recommending the installation of an auxiliary pumping station on the sewer before it is connected with the main pumping station. Sewer B will start from a point south-east of Rajaram Puri and will run up to the auxiliary pumping station, which will be located at a convenient point in the compound of the Victoria Maratha Boarding House. The sewage from the auxiliary pumping station will be pumped through a small length of rising main into a high level gravitation sewer to be connected with the main pumping station.

The 'waste' from Padmala Tank and the flow of 'Jitti nala' will be picked up at convenient points into this sewer (sewer B) to improve 'flow' in the initial stages of the scheme.

With the same object in view, storm water will be introduced in both the sewers A & B at convenient points in the initial stages of the scheme.

7. It appears that due to favourable gradients available the sizes of the sewers (main) will be on the lower side. They will vary from 9" to 27" or 30". These sizes will be adequate to cope with the peak load plans in the final stages of the scheme under 2/3rd full condition. They will also create self-cleansing velocities of 2½ to 3 ft. per second with the minimum flow expected in the initial stages of the scheme.

8. The auxiliary pumping station will serve Satmari, and the new and proposed extensions on the south-east side of the City. A separate sewer to pick up drainage of Satmari, Khasbag and Laxmipuri areas will be laid and connected with the auxiliary pumping station. Any other areas, which may be developed hereafter can be drained directly into this station by laying gravitation sewers. There should, therefore, be no difficulty in connecting with the drainage system any part of the proposed extension of the City on this side.

This station will also be useful in diverting the sewage from nearly 2/3rd of the City to another point for 'disposal' if it becomes necessary to do so in the distant future either due to the desire of the inhabitants of the town to remove treatment works further away from the City or due to the insufficiency of the area of the land on 'Ambewadi' side where sewage is proposed to be treated in the early stages of the scheme. This aspect is dealt with in the later part of this note.

9. The decision to divide the scheme in three stages is a wise one. The population and rates of water-supply assumed in the three stages appear to be

reasonable. It is assumed that in the initial stages of the scheme, the population will be 1.2 lakhs and that the rate of water-supply per capita will be about 8 to 10 gallons. In the 2nd stage the population is assumed to reach a figure of 2 lakhs and the rate of water-supply to stand between 25 to 30 gallons per capita; and in the third or final stage the population will reach a figure of 2½ lakhs and the water-supply will be improved so as to give a rate of 40 gallons per capita.

10. Coming to the question of 'disposal works' it appears that Mr. Naik had recommended 'land treatment' in his preliminary report and that after preliminary survey he finds that the site for the 'sewage farm' on the west side (Ambewadi) is more favourable than that on the 'Uchgaon' side for various obvious reasons. The only drawback of the former side is its close proximity to the City and that it is in the direction of 'prevailing winds'. Modern sewage disposal works, if properly maintained, are free from smell. There should, therefore, be no anxiety on this account. The sewage will not be applied to land 'raw' but it would be diluted with river water in the initial stages of the scheme. A sewage farm grown with raw sewage smells. But when sewage is applied after dilution, the farm loses its offensive character. Besides, if nuisance is at all felt, sewage may be further treated and then applied to land to remove this defect. Sugar industry is already established on the west side and if the farm were located on this side the scheme will bring in some return from the very commencement which would not be the case if the 'farm' were located on Uchgaon side. There is also no propriety in pumping the sewage to an additional height of 100 ft. from the commencement simply because it is feared by some that bad smells may be received by the inhabitants of a part of City when the prevailing winds are unfavourable.

The main point that under no circumstances water-supply of the river should be polluted is common and proper steps have to be taken to prevent the pollution of the river by subjecting sewage to proper treatment before discharging it into the river.

11. As pointed out before, the method of treatment will be application on land. Sewage will first be passed through a ditritus tank of suitable design after it is screened and then admitted into a settling tank of requisite capacity and of the continuous flow type.

The settled sewage will then be applied on land after dilution with fresh water. A special pumping station will be installed on the river to pump river water required for dilution. Waterings will be given according to the kind of crop. Rotation of crops will be insisted upon to prevent land getting sewage sick. The land under treatment will be suitably drained with cross and straight trenches running parallel to the river and the water collected by the trenches will be pumped back into the settling tank. When sewage will

not be required for application on land either due to incessant rains or any unforeseen causes, it will be treated first in a two-stage shallow predating filter and the filtered effluent will be chlorinated, if necessary, before discharging it into the river. The discharge of the filtered effluent will take place when the river is in floods and consequently there will not be the least chance of the river water being polluted during this period.

12. It would be worth while to experiment on a "fish pond". The excess sewage (settled) when not required for application on land can be allowed to run into a "Fish pond." Fish pond requires a good deal of water for dilution and this can be obtained from the river close by.

13. There are more than 1500 acres of land under sugar cane cultivation on Ambewadi side. All this area can be brought under command of the sewage farm. It is proposed to lease about 500 acres of land on this side to start with to show to the cultivators the advantages of sewage farming. The recommendation to run a model farm on this side and to collect data of the working of the shallow filters with the help of an agriculturist and chemist is sound and it should be accepted without hesitation. The farm may be extended as the scheme progresses.

14. The scheme is elastic and whatever works will be constructed in the various stages of the scheme will not be wasted but they will form a part of the big comprehensive scheme of the distant future. It can therefore be built in parts as funds permit. Care should be taken in designing the auxiliary pumping station so that it can be easily converted into a main pumping station when land on Uchgaon side is to be brought under cultivation. The question of utilising "slope" from the settling tanks for the production of sludge gas by digestion should be considered from now.

15. I am glad to note that the financial forecast of the scheme will include the following items:—

1. Subvert main collecting sewers; pumping stations; Rising mains; Half-full sewer; disposal works; Pail depots, staff quarters, chemical laboratory, office building, equipment and apparatus for the cleaning of sewers and maintenance of pumping stations.
2. House connections, subsidies to be paid to the owners of private buildings to convert the existing privies into water-flushed latrines or to construct a new water-closet in lieu of the existing privy— (These will depend upon the owner's ability to pay) compensation to be paid for damages that may take place while the sewers are under construction. Conveniences such as latrines, moris, etc. in all Municipal and State buildings, conversion of all the public latrines and urinels into water-closets and connecting them to the sewage system.

3. Storm water drains—catch pits—channelling of Nallas and water-courses and such other works necessary for the efficient disposal of storm-water.

This will give a clear idea to the Municipality of its total liability when the Scheme is finally completed. It is also noted that a statement showing the running expenditure to be incurred in the three stages of the scheme will be attached to the financial forecast.

16. It should be possible to complete all the works included in the three stages of the scheme in 8 to 10 years' time if unforeseen difficulties do not crop up. It should also be possible to bring part of the first stage of the scheme into operation in about 2½ to 3 years' time from the date of starting the work on the scheme. After this, it would be possible to tackle the drainage of several parts of the City one after another. That part which is most congested and insanitary should be given priority. The works in the first stage should be so commenced that they should begin to function as soon as completed. This will result in obtaining immediate return on the money spent.

N. V. MODAK

Note for the Council, dated 25-10-44

I have great pleasure in submitting to the Council a note regarding the Drainage Scheme for Kolhapur City. The note has been prepared by Mr. N. V. Modak, the City Engineer of Bombay. Mr. Modak is considered to be the best authority in India on problems of underground drainage and his book on "Sewage Disposal" has become a classic. His opinion—therefore, has great value and augurs well for the success of the scheme.

2. I understand from Messrs B. L. Jadhav and S. S. Naik that the financial forecast of the scheme will be ready by the end of December. It will be placed before the Council in due course.

3. As I look at the problem, it is not necessary to wait till such details as the financial forecast etc., are ready. With the completion of the Chambukhadi scheme, the supply of water to the city will be about 40 gallons per head per day. Unless we have a drainage system for removing all the water that will be supplied to the City, this additional supply of water will be a nuisance and a curse. In the interest of the health of the City, it is therefore necessary to have a proper drainage system and it cannot be abandoned or postponed because of financial or any other consideration. I therefore feel that the drainage scheme is inescapable and request the Council to give its decision on the point.

4. Work on the preliminary measures of the drainage scheme will start next year. But unless we move from now, it will be impossible to secure the machinery etc., that we need in good time. I, therefore, propose that Mr. S. S. Naik should be requested to work out the detailed requirements in this direction for the first stage of the scheme and submit them to the Council. As soon as these are approved, orders should be placed regarding the machinery and other equipment that we need.

M. R. BAGWE
Revenue Minister, Kolhapur.

G. R. R. D. No. 868/44, dated 2-11-44.

Administrative approval was granted to the Revenue Minister's proposals for the working out of a Drainage Scheme for Kolhapur City; and it was further resolved that action to implement the scheme should be started immediately.

KOLHAPUR CITY DRAINAGE PROJECT.

*A note on the above scheme and its financial forecast
prepared by Mr. S. S. Naik, Consulting Engineer*

As suggested by me in Clause 8 of para 17 of my report on drainage scheme for the City of Kolhapur, Mr. Jadhav, the Executive Engineer, was deputed to Bombay for receiving instructions from me to collect data and carry out survey work required for the preparation of the total cost of the scheme and the financial forecast. After Mr. Jadhav had collected the information and fixed the alignments of the main collecting sewers, I visited Kolhapur and inspected with him the lines of the proposed sewers and the sites selected for the location of pumping stations and disposal works. During my stay at Kolhapur, a meeting of the Advisory Board for City Development was arranged where I explained to the members the salient features of the scheme, especially in regard to the selection of the site of the disposal works as disclosed to me after careful study of the data collected by Mr. Jadhav. I pointed out to the members the reasons why Ambewadi site has been selected by me for the location of the disposal works in the first instance. Mr. Jadhav has now completed the preliminary plans and rough estimates for the scheme and I am therefore in a position to give rough estimates of the costs thereof together with the financial forecast.

Whole scheme to be completed in 9 years.

2. I had suggested before that the whole scheme should be completed in 8 to 10 years' time from the commencement but I now find that the most convenient time limit would be 9 years so as to divide it into two stages, the first of 5 years and the second of 4 years.

It should be possible to complete the whole of the scheme in a shorter period but looking to the present conditions it is doubtful whether materials and labour would be available for the next five years even if the war were to come to an end early next year. It is no use spending a large amount of money when the prices of materials and labour are high.

Cost of the whole scheme.

3. The cost of the whole scheme when completed, i. e. at the end of 9 years from the date of commencement will be about Rs. 58 lakhs as detailed below:—

(1) Land compensation for the different works such as collecting sewers, pumping stations, disposal works etc.	Rs. 86,000
	C. F. Rs. 86,000

B. O. Rs. 86,000

- (2) Four main collecting sewers A, B, C and D including manholes, ventilating columns, flushing tanks, s. w. overflows and other appurtenances (vide index plan). Rs. 6,77,800
- (3) Branch, sub-branch and lateral sewers, including manholes, vent columns, flushing tanks and other appurtenances draining into the four main sewers A, B, C and D. Rs. 17,43,700
- (4) 2 pumping stations (one main and one auxiliary) including pumps, generating sets, workshop, rising mains, balancing tank, outfall sewer and other accessories to lift and convey sewage to disposal works to be located at Ambewadi (vide index plan). Rs. 13,25,900
- (5) Disposal works including screens, detritus tanks, preliminary settling tanks, bio-filters, main effluent carriers and channels, dilution tank and pumping main and pumping plant for river water, digestion tank and sludge drying beds. Rs. 10,00,000
- (6) Staff quarters for men employed at pumping stations and disposal works both in the city and at the farm. Rs. 2,08,400
- (7) Canalisation of Jiti Nalla. Rs. 1,25,000
- (8) Conversion of the existing public conveniences into water flushed and construction of new public conveniences at convenient sites and construction of 10 cart depots and 10 pail depots. Rs. 72,000
- (9) Subsidy to be paid for conversion of existing latrines on dry system into water flushed at premises the owners of which are not well off to bear the whole expenditure of conversion. Rs. 1,00,000
- (10) House connections for connecting house drainage to municipal sewers. Rs. 2,25,000
- Total Rs. 55,63,800
- (11) Add for special tools and plant and supervision charges at 4 p. c. Rs. 2,22,552
- Rs. 57,86,352
or Say Rs. 58 lakhs.

The above estimates are based on pre-war rates prevailing in Kolhapur with sufficient allowance to cover the present increase in prices due to conditions created by the War, in consultation with Mr. Jadhav who assures me that they are on the safe side and that there is no likelihood of their being exceeded. On the contrary, he is hoping that if the present situation is eased in a couple of years, there would be some saving on these estimates. Due to war, it is difficult to estimate accurately the cost of the various machinery and appliances as the rates are fluctuating day to day but the provisions in the estimate are made to suit the prevailing market rates.

These estimates do not make provision for the construction of branch sewers and laterals required for the various town planning schemes under contemplation by the State as it is but legitimate that the cost thereof should be borne by the town-planning schemes themselves. The levels of the main collecting sewers and branches included in the present scheme have been so kept that the sewers from the areas to be town-planned hereafter can drain by gravity into them without any difficulty. The town planning areas excluded from the scheme and the points where their sewage can be connected with the sewers to be laid under the present scheme are shown on the index plan.

Principal feature of each item included in the main estimate.

4. The following is the brief description of the important features of each individual item included in the main estimate, ad seriatim:—

Item (1) Land compensation.

Provision has been made in the estimate for the acquisition of land required for the location of two pumping stations (one main and one auxiliary) and for certain items of disposal works. There are a few buildings standing on the site selected for the disposal works and these buildings will have to be acquired after paying due compensation.

Item (2) Main collecting sewers etc.

There will be in all four main collecting sewers A, B, C & D.

Sewer A will drain a part of Mangalwar, Varun Tirtha, Sakoli, Dhotri, Uttreshwar, Shukrawar and a part of Juna Budhwar area. It will also pick up waste overflows from Varun Tirtha, waterlogged area of Sakoli and irrigation channel from Rankala Tank and Dhobighat.

Sewer B will serve Rajaram Puri, Syke's Extension and Shahupuri. It will also serve the Tarabai Park area and the extension round about when they are developed.

Sewer C will drain old race course, Sathmari, Khasabag, part of Mangalwar, Laxmipuri and area round about Merry Weather market. This sewer will also receive sewage from Shahu Mill area right upto Poona Belgaum road and that to the south west of B/Ward. Besides, it will pick up waste water flow from Padmala, Ravaneshwar Tank and Jiti Nalla.

Sewer D will drain area round about A. E. Hospital, part of Shanwar Peth, part of Budhwar Peth, Dasara Chowk and Maharwada.

The sewers have been designed for the future population of 250000 at the rate of 30 gallons per head per day when running half-full. There is thus ample margin to accommodate additional sewage if the water supply is increased from 30 to 40 gallons per capita. The sewers will be laid to such gradients that self-cleaning velocity will be created therein with the minimum flow expected in the initial stages of the scheme. The admission of waste water overflows in sewers A & C will be helpful in keeping the sewers clean in the initial stages. In order to obtain similar effect in sewer B, flushing tanks will be provided at the head manholes which will be worked only during the initial stages of the scheme. Sewer D does not require such arrangement as it will receive the discharge from the auxiliary pumping station.

Ventilators will be provided on the sewers at intervals varying from 500 feet to 600 ft. to let out the foul gases generated in the sewers. Besides, the vent columns on houses when connected with the sewerage system will serve the same purpose.

Stoneware and/or hume pipes will be used in the construction of these sewers and their sizes will vary from 6" to 33". The total length of the main sewers will be about six miles.

Item (3) Branch sewers etc :

The length of branch and lateral sewers included in this item is for draining the city as it exists today, viz. consisting of A, B, C, D & E Wards, and their total length will be about 47 miles. As pointed out before, the length of sewers to be laid in connection with the future town-planning schemes has not been included in the present estimate.

Item (4) Pumping stations etc :

There will be two pumping stations (one main and one auxiliary). Main sewers B & C will empty their contents into the sump of the auxiliary pumping station and will be lifted therefrom through a small length of rising main into collecting sewer D which in turn will empty its contents into the sump of the main pumping station. The sewage therefrom will again be lifted along with that brought by the main collecting sewer A and discharged after passing through a balancing tank into an outfall sewer which will convey it to the disposal works.

The auxiliary pumping station will be so designed that if in future it is decided to change the site of the effluent farm from Ambewadi to Ujgaon, it should be possible to do so with minimum cost by exchanging the pumping plant and by laying a new rising main to the disposal works to be located at Ujgaon.

The main pumping station in that case will continue to discharge into the outfall sewer leading to the disposal works at Ambewadi as proposed under the present scheme.

Sufficient room will be left at each pumping station to enable additional pumps being installed in the various stages as the population grows and the water supply increases.

It is intended to run the pumping stations on electricity from the very commencement and generating sets have been provided for this purpose. In the initial stage of the scheme these sets will run on crude oil engines but when the sludge is digested they will be converted to run on sludge gas. It is believed that the gas so obtained will be sufficient to generate electricity required for working the two pumping stations and a few appurtenances at the disposal works saving thereby the cost of fuel required for working the pumping stations. In the financial forecast hereafter put up, no credit has been given for this gas to err on the safe side.

Item (5) Disposal works.

The sewage after passing through a screening chamber, detritus tank and preliminary settling tanks will be applied on land for growing sugar cane and other suitable crops. As the effluent will be rich in nitrogen, steps will have to be taken either to use it on land after sufficient dilution with river water or by resorting to alternate watering of fresh water and effluent. This can easily be done by the cultivators who have their own pumping arrangements for pumping river or well water. I am assured that the cultivators will be too glad to use the effluent as it will save them considerable money which they are at present spending on the purchase of artificial manures. It is proposed to sell the effluent to the cultivators on the nitrogen content basis and this will be determined in the laboratory provided at the disposal works. Though every drop of effluent is likely to be in demand by the cultivators, it is proposed to lease 500 acres of land not so far used for sugar cane cultivation to demonstrate to the farmers the value of humus contained in the effluent and its suitability for growing sugar cane and other valuable crops. Such a farm will also have a great educational value as a number of experiments can be carried out on the various varieties of sugar cane, methods of cultivation etc. with a view to ascertain the most advantageous and lucrative method of cultivation. The experimental farm may also be utilised for supplying the right type of seeds to the cultivators.

In the rainy season or on days when effluent will not be required for application on land, it will be passed through a bio-filter and then stored in a fish pond. When it is found necessary to discharge the effluent stored in the fish pond into the river it will be first treated with chlorine gas and then discharged into the river. There will therefore be no chance of the river

water being polluted. A fish pond has been recommended as sufficient water is available in the river for dilution purposes and as fish is at present imported from Ratnagiri and other places. It is found that fish ponds give considerable return in other countries where they are in use. The Central Advisory Committee for Fish is taking keen interest in this matter and are taking steps to establish fish ponds for the utilisation of the sewage effluent in various parts of the country.

It is also intended to work the bio-filter all the year round in the initial stages of the scheme with a view to find out whether dilution of effluent with river water can be dispensed with.

The sludge from the preliminary settling tanks will be first consolidated and then digested in a digestion tank and the gases generated therefrom will be used in generating electricity required for driving pumping machinery and the other appurtenances at disposal works as mentioned before. The digested sludge will be dried on suitably designed sludge drying beds. There will be a market for this dried sludge as it will contain about 2½ p. c. nitrogen and 3 p. c. phosphoric acid. For this reason this factor has been taken into consideration in the financial forecast.

Sufficient area of land for the application of effluent expected in the final stage of the scheme is available at Ambewadi site and there will therefore be no necessity of shifting the same to Ujgaon on this account.

Item (6) Staff quarters :

Provision has been made to house the staff engaged at the pumping stations as well as the staff such as Agricultural Supervisor, Chemist, Laboratory Assistant etc. working at the disposal works. It is in the interest of the administration to provide quarters for this staff as they are required to be at the works for 24 hours.

Item (7) Canalising of Jiti Nalla :

When the sewerage system is executed, there will be no flow in this Nalla except in the monsoon and that too will consist of storm water and occasional overflow from the sewers. All the sullage water which finds its way into this Nalla at present will be picked up at convenient points and admitted into the sewers in the first stage of the scheme.

Item (8) Conversion of the existing public privies etc.

The necessity of this item is obvious. Public conveniences which are on the dry system must be converted into water flushed latrines. Similarly, it is necessary to construct cart depots and pail depots for discharging night soil into the sewerage system through hoppers at convenient points.

Item (9) Subsidy to houseowners for conversion of privies into water closets.

There would be certain house owners who would not be in a position to bear the cost of conversion of their privies into water closets and it is but

proper that they should be helped to do this work by paying them a subsidy. It is hoped that provision made under this head will be sufficient for this purpose.

Item (10) Street Connections :

A part provision for connecting 4000 houses with the sewers has been made in this estimate. As the scheme develops and the house owners come forward to connect the house drains with the sewers, provision should be made from year to year in the revenue budget. The usual experience is that it takes a long time before all the house drains in a town are connected with the sewerage system.

Item (11) Tools and Plant and supervision charges :

This item provides for the special tools and plant required for the execution of the work as well as for supervision of the work during construction.

Recurring expenditure per annum.

5. It is suggested that the cost of the scheme should be met partly by requesting the Durbar to give half the estimated cost as free grant and partly by raising a loan at Durbar's guarantee repayable in 30 years at 4% interest. The recurring expenditure to be incurred per annum on maintaining the works efficiently and in a satisfactory condition will amount to Rs. 253000/- exclusive of the annual instalment for the repayment of the loan to be raised including interest thereon as detailed below:-

(1) General Supervision on (Staff)	Rs. 6,000
(2) Maintenance of sewers and civil works (staff only)	Rs. 30,000
(3) Maintenance of pumping stations (staff only)	Rs. 18,000
(4) Disposal works (staff only)	Rs. 19,000
(5) Recurring expenditure on running of the machinery such as pumps etc. including that on the effluent farm	Rs. 1,43,000
(There is a likelihood of some saving being effected on this item with the use of sludge gas but to err on the safe side, this has not been taken into account).	
(6) Renewal fund for machinery at 3 p. c. Life 20 years.	Rs. 37,000
	<u>Rs. 2,53,000</u>

If the Darbar agrees to give half the cost viz. Rs. 29 lakhs as free grant, the recurring expenditure inclusive of the interest and sinking fund charges on the loan of Rs. 29 lakhs to be raised by the Municipality will be say about Rs. 3,42,400 (Rs. 2,53,000 plus Rs. 89,400). If on the other hand, the whole amount of Rs. 58 lakhs is required to be found by the Municipality by raising a loan payable in 30 years at 4 per cent interest, the total recurring expenditure per annum will amount to Rs. 4,31,800 (Rs. 2,53,000 plus Rs. 1,78,800 for repayment of loan of Rs. 58 lakhs including interest.)

Return from the scheme.

6. Against the recurring expenditure of $\frac{\text{Rs. } 3,42,400}{\text{Rs. } 4,31,800}$ the return likely to be obtained by the sale of effluent and sludge and the use thereof on model farm together with the saving likely to accrue on 'conservancy' will be about Rs. 5.8 lakhs as given below:—

(1) Sale of effluent and digested sludge.	Rs. 3,03,000†
(2) Return from Model farm (sugar cane and sundry crops).	1,76,000
(3) Saving on conservancy establishment.	Rs. 1,00,000¶
	<u>Rs. 5,79,000§</u>
	Say Rs. 5.8 lakhs.

¶ The expenditure at present incurred on conservancy by the Municipality is Rs. 90,000 for collecting night soil from 4000 latrines. Though this number is bound to increase at the end of ten years, the cost to be incurred on this head has only been taken at 1,00,000).

† The income to be derived from this source would increase to Rs. 5,04,000 when the population would increase to 2 lakhs in the year 1981 as the rate for the sale of the effluent is based on the nitrogen content of the effluent. The figure of Rs. 3,03,000 is based on a population of 1,20,000 which is expected to remain constant till the completion of the whole scheme.

§ The income of Rs. 86,000 derived at present from the levy of halalkhore tax on certain houses has not been deducted from the saving of Rs. 5.8 lakhs as it is recommended that this cess should be converted into a 'sanitary cess' for all the houses in the city and the income under this head should be allowed to continue.

It is apparent from the figures that the scheme will not only be self-supporting but will bring in an additional revenue to the extent of about 2.38/1.49 lakhs per annum according to the extent of the funds to be raised by the Municipality to meet the estimated cost of Rs. 58 lakhs either by borrowing half the amount or full amount. Taking the worst case and assuming that calculations made in regard to the income to be obtained by the sale of

effluent and sludge as well as the return from the model effluent farm go wrong and that the return under the two heads actually realised is only half viz. (1.54 + 0.88) the scheme will be self-supporting if the Municipality has to borrow only 29 lakhs and the remaining 29 lakhs of rupees are given by Government. If however the Municipality has to borrow the whole amount of Rs. 58 lakhs there will be a deficit of about Rs. 90,000 which the Municipality can make up by levying an additional tax which on the basis of the present number of houses of 14000 will not exceed to Rs. 7 per annum per house and this cannot be said to be a heavy burden on the rate payer looking the benefits to be derived from the improved sanitation by the introduction of the sewerage system.

Cost of works to be included in the first stage of the scheme.

7. The following works are recommended for inclusion in the first stage of the scheme, the cost of which is estimated at Rs. 27 lakhs:—

- | | |
|--|---------------------|
| (1) Land compensation for the different works such as collecting sewers, pumping stations, disposal works etc. | Rs. 60,000 |
| (2) Four main collecting sewers: 'A' 2/3rd length, 'B' half length 'C' 2/3rd length and 'D' whole length including manholes, ventilating columns, flushing tanks, s. w. overflows and other appurtenances. | Rs. 4,16,900 |
| (3) Branch, sub-branch and lateral sewers, including manholes, vent columns, flushing tanks etc. for picking up the existing sullage water only. | Rs. 3,50,000 |
| (4) 2 pumping stations (one main and one auxiliary) including pumps, generating sets, workshop, outfall sewer and other accessories to lift and convey sewage to disposal works to be located at Ambewadi (provision for pumping machinery required for coping with sewage flow expected to reach the pumping stations during this stage). | Rs. 11,01,900 |
| (5) Disposal works, including screens, detritus tanks, preliminary settling tanks, bio-filters, main effluent carriers and channels, dilution tank and pumping main and pumping plant for river water excluding digestion tank and sludge drying beds (The work to be provided will be sufficient to cope with the flow of sewage expected in this stage). | Rs. 3,56,000 |
| | C. F. Rs. 22,84,800 |

	B. O. 22,84,800
(6) Staff quarters for men employed at pumping stations and disposal works both in the city and at the farm. (60 p. c. of the second or final stage)	Rs. 1,25,000
(7) Canalisation of Jiti Nalla	Rs. 1,25,000
(8) Conversion of the existing public conveniences into water flushed and construction of new public conveniences at convenient sites and construction of 10 cart depots and 10 pail depots in the area served by the main sewers to be constructed in this stage.	<u>Rs. 60,000</u>
	Rs. 25,94,800
Add for special tools and plant and supervision charges at 4 p. c.	<u>Rs. 1,03,792</u>
	Rs. 26,98,592
	or say Rs. 27 lakhs.

Benefits to be derived by the execution of 1st stage.

8. By the execution of the above works, the following benefits will be immediately derived:-

(a) Jitinalla which is at present a source of nuisance and a danger spot from the public health point of view, will remain free of sullage for 8 months of the year and will only flow during the monsoon.

(b) Sullage from private houses at present finding its way into the open gutters will be picked up at convenient points into the main collecting sewers and there will thus be no flow of sullage through them during 12 months of the year and they will convey only storm water in the rains. This will prevent breeding of mosquitos in the heart of the city.

(c) The existing hand-operated public latrines will be converted into water flushed and they will be more sanitary and comfortable for the users. They being located in the congested parts of the city, their conversion will improve the environments.

(d) The nuisance created by night soil carts in the middle of the city will be consequently reduced as the night soil will be dumped into the collecting sewers at convenient points through pail depots. This will also help to reduce the expenditure on conservancy incurred at present.

(e) The public water taps and urinals will also be connected with the sewerage system and this will prevent the flow of waste water in open gutters and on streets.

On the whole the advantages to be obtained will be of considerable help in improving the health and sanitation of the city as well as in preventing spread of epidemics and the spread of malaria.

Return after the execution of the 1st stage of the scheme.

9. The recurring expenditure to be incurred per annum on the maintenance of the works proposed to be carried out in the first stage of the scheme, exclusive of the interest and sinking fund charges on the loan to be raised will be Rs. 1,54,900 or say Rs. 1.55 lakhs as detailed below:—

(1) General supervision (staff)	Rs.	6,000
(2) Maintenance of sewers and civil works (staff only).	„	12,000
(3) Maintenance of pumping stations (staff only).	„	7,300
(4) Disposal works (staff only).	„	7,600
(5) Recurring expenditure on the running of machinery such as pumps etc.	„	90,000
(6) Renewal fund for machinery etc. Life 20 years.	„	30,000

Rs. 1,54,900
or say Rs. 1.55 lakhs.

This amount will increase to Rs. 1,96,620 (Rs. 1,54,900 + Rs. 41,620 for interest and sinking fund charges on the loan of Rs. 13½ lakhs.) if the Durbar gives half the share of the estimated cost of Rs. 27 lakhs as 'free grant' and the balance of Rs. 13½ lakhs is borrowed by the Municipality. There will be a further increase in the recurring expenditure by Rs. 41,620/- making the total of Rs. 2,38,240 if the whole amount of the estimated cost is required to be borrowed by the Municipality.

Return from the first stage.

10. Against the recurring expenditure of Rs. $\frac{1,96,620}{2,38,240}$, the return from the execution of the works included in the first stage of the scheme will be Rs. 2,81,000 as follows:—

(1) Sale of effluent.	Rs.	75,000
(2) Return from Model farm (sugar cane and sundry crops).	„	1,76,000
(3) Saving on conservancy establishment.	„	30,000†
		Rs. 2,81,000

† The question of deducting the revenue derived from conservancy cess does not arise at this stage as the scheme will serve only a part of the town.

It is thus self-evident that the scheme even when partially carried out will be self-supporting and will not add to the burden of the rate payer. If the amount of Rs. 75,000 expected to be realised from the sale of effluent to cultivators does not materialise, the return will be reduced to Rs. 2,06,000 against the recurring expenditure of Rs. 1,96,620 and Rs. 2,38,240 respectively depending upon the extent of the financial assistance given by the Durbar. If the Durbar is not inclined to accede to the request of the Municipality, the latter will have to look to an additional source of income to the extent of about Rs. 32,000 to make up the deficit. This will mean an extra taxation not exceeding Rs. 3 per annum per house on the 14,000 houses in the city. This taxation will be insignificant as compared with the advantages to be derived from the execution of a part of the whole scheme.

Comparison of cost with that spent on similar schemes in other towns.

11. At the pre-war rates the total cost of the whole scheme and that of the first stage would have amounted to Rs. 30 lakhs and Rs. 13 lakhs respectively. On the basis of population it would have cost Rs. 15 per head. The corresponding figures for other towns in pre-war days were between 25 and 40 per head of the population depending upon the extent of the town, density of population and other factors. On the cost as now worked out, the cost per head of the population comes to about Rs. 30 only which cannot be said to be high under the present circumstances. The scheme as now proposed is therefore most economical. The financial forecast of the scheme is given for the cost as worked out according to the present rates and there is reason to believe that the scheme when actually executed will cost considerably less. There should therefore be no hesitation to make a start on the same and to take in hand immediately the works included in the first stage thereof. As pointed out above, the execution of the first stage will under worst conditions entail a levy of Rs. 3 per annum per house if the expectations regarding sale of effluent do not materialise. There is however no reason to assume why the expected return should not be realised. The risk run by the Municipality, if any, in launching the scheme will be considerably minimised if the Durbar comes forward to its help as it has done in the past in the promotion of works intended for the improvement of the health and sanitation of this capital town. The very fact that the Durbar has sanctioned the execution of the works to be included in the 1st stage of the scheme without waiting for the financial forecast is in itself an evidence of the keen desire of the Durbar to help the Municipality in promoting the scheme.

12. I am now arranging to take steps to carry out the wishes of the Durbar and I hope to submit detailed estimates for the first stage with the assistance of Mr. Jadhav shortly to enable the Durbar to make a provision for this work in the next year's budget. I suggest that a provision of Rs. 7.25

lakhs be made in the budget estimates of 1945-46. The detailed estimates for the same will be submitted by Mr. Jadhav for obtaining technical sanction.

13. I am very glad to state that Mr. Jadhav has been very helpful in preliminary stages and in drawing up of the financial forecast and in my opinion he will be the most suitable and competent Engineer to execute the scheme as he is connected with the same from its conception. He has a good grasp and follows the instructions intelligently. I therefore strongly recommend that he be deputed to work on this scheme till completion to secure continuity and maintain efficiency. His assistants, Mr. Lele and others have also proved to be efficient and they should also be continued on this work.

14. I have made this report as comprehensive as possible and have touched on each and every point which is likely to affect the interest of the Municipality as well as of the Durbar. I trust, it would help those in authority to come to the right conclusion. I shall be glad to furnish any other information required in connection therewith if so desired. The information as to how the various costs have been arrived at as well as the details of the recurring expenditures and of the returns will be explained by Mr. Jadhav whenever called upon to do so.

15. Before concluding I should like to point out that the scheme outlined by me provides for sewerage and sewage disposal works only. It does not make any provision for improving the existing s. w. drainage system of the town. I understand that there are several low-lying parts of the city which are under water during the rains. It is desirable that steps should be taken to improve the s. w. drainage arrangements of the town as early as possible. If the Durbar so desires, a comprehensive scheme for the improvement of s. w. drainage system will be prepared and submitted for consideration.

Bandra,
26-12-44.

S. S. Naik
Consulting Engineer

Note for Council

I enclose herewith a copy of a note on the financial forecast of the scheme of underground drainage for Kolhapur City prepared by Mr. S. S. Naik, the consulting Engineer. The main facts of the forecast can be summarised as under:—

- (a) That the whole scheme can be completed in a period of 9 years. The first stage of the scheme can be completed in a period of 5 years and the second in four.
- (b) The cost of the whole scheme would be about Rs. 58 Lakhs. The cost of the first stage will be Rs. 27 Lakhs.
- (c) In the process of treating sewage, a gas called the Sludge gas can be produced. This is now being done successfully in Bombay and the motor lorries of the Bombay Corporation now run mostly on sludge gas. It is proposed to produce sludge gas here and to use it for working up all the machinery required for the scheme.
- (d) The sewage will be treated first and the effluent will be given to farmers for manuring the sugarcane fields. In this way, the Nitrogen cycle will be completed, the fertility of soil and production of food will be increased, and a good deal of wealth that now goes out of the State for purchase of artificial manures will be saved.
- (e) A sewage farm of 500 acres will be maintained.
- (f) The effluent not required for fields will be stored in a fish pond and the production of fish on a large scale will be undertaken.
- (g) The recurring expenditure of the scheme will come to Rs. 2,53,000 and an annual provision of Rs. 1,78,000 will be required for repayment of the loan of Rs. 58 Lakhs including interest. That is a total expenditure of Rs. 4,31,800 per annum.
- (h) The annual income from the scheme is expected to be :—

(a) Sale of effluent	Rs. 3,03,000
(b) Return from the sewage farm	,, 1,76,000
Total	Rs. 4,79,000

In other words, the scheme will be self-supporting. Besides, the Municipality will be saved the annual expenditure of about one lakh of rupees which it now incurs on the conservancy establishment.

Even if it is assumed that the estimates of income go wrong by 50 p. c., the scheme will be still made self-supporting, if the Municipality continues to lay a tax of Rs. 7 per latrine which is already being levied for Bhangi service.

2. This self-supporting or profitable aspect of the scheme makes it unique in the whole of India because every underground drainage scheme is one of heavy deficits. This result, hardly short of a miracle, is due partly to the natural advantages which Kolhapur has and partly to the skill of the designs. The reasons of the favourable financial forecast may, therefore, be stated as under:—

- (a) Kolhapur gives fine gradients with the result that sewers of small size only are needed; there is no need to go deep in ground anywhere; good self-cleansing velocities are easily obtained; and the sewage reaches the collection point so quickly that there is hardly any possibility of septic conditions arising.
- (b) The most modern methods and equipments are introduced in the scheme.
- (c) Almost all the wastes are fully utilized. For instance, the sludge is to be sold as manure and gases produced are to be used for running the machinery. Sludge not required for agriculture is used for a fish pond, etc.

3. I request the Council to approve of the financial forecast and to give administrative approval to the first stage of the scheme which is estimated to cost Rs. 27 lakhs. The advantages, the details of expenditure, and the financial implications of this stage are given in paras 8, 9, 10 of Mr. Naik's report.

4. The following issues have now to be decided:—

- (a) How is the scheme to be financed ?
- (b) What provision is to be made in the current year's budget for the scheme ?
- (c) What provision will be required to be made in the next year's budget ?
- (d) What steps are to be taken to obtain the machinery required ?

5. Regarding (a), I propose that the scheme should be financed by the State; A pro forma account should be maintained for the purpose; and the whole of the expenditure with interest at 3 p. c. should be recovered from the Kolhapur Municipal Borough. Necessary steps will have to be taken to make a legal agreement with the Municipality under the Local Authorities Loans Act.

6. Regarding (b), and (c), I quote the following from the letter of Mr. S. S. Naik:-

“(1) We will require about Rs. 80,000/- during this year upto end of June 1945 for works detailed below:-

(1) Canalisation of Part of Jiti Nala.	20,000
(2) Land acquisition for sewage Pumping station and disposal works.	10,000
(3) Staff quarters & construction of stores etc.	30,000
(4) Miscellaneous orders for machinery pumping etc.	20,000
	80,000

(2) During 1945-46 Rs. 7,25,000 may please be included in the budget. These will include:

(1) Completion of canalisation of Jiti Nala	1,00,000
(2) Land compensation	25,000
(3) Pumping Stations	1,50,000
(4) Collecting sewers	1,00,000
(5) Disposal Works	50,000
(6) Advances for machinery and piping	3,00,000
	Rs. 7,25,000

I request the Council to sanction the proposal.

7. Regarding (d), Mr. Naik makes the following proposal:-

“As regards the details of the plants and machinery the question as to what kind and make are available in these days is most important. I have got a general specification of what I want for the scheme. The priority certificate and transport difficulties are great, and many firms who would gladly supply the machinery and plant are not in a position to do so due to war conditions. I am of opinion that we will have to depend on American plant and machinery.

My proposal, therefore, in regard to the above selection is as under :

I may be allowed with the aid of the experts here, to have correspondence on behalf of your Government with the suppliers of plant and machinery as I can do so more efficiently in Bombay. After I get the whole thing selected to my satisfaction, I will submit a full report to you and you will please place the order on behalf of the Darbar, according to your official routine.”

I request that this proposal also may be approved.

M. R. BAGWE
Revenue Minister, Kolhapur.

G. R. D. D. No. 14 dated 11-1-45.

The Development Minister's note on the scheme for under-ground drainage for Kolhapur City, prepared by the Consulting Engineer, Mr. S. S. Naik, was considered, and administrative approval was granted subject to the following conditions:—

- (1) The Scheme should be financed entirely by the Municipality, if necessary by means of a loan raised either in the open market or from Banks. The loan might be guaranteed by the Darbar.
- (2) No expenditure should be incurred during the current financial year.
- (3) Tenders should be called for by the Municipality for all machinery and plant required.

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