FIRST REPORT

OF THE

COMMITTEE FOR PLANNING MEASURES AGAINST FLOODS AND SIMILAR CALAMITIES IN DELHI

(Constituted by the
PRIME MINISTER
on 23rd July, 1958)

Indian Press Delhi—6

19

FIRST REPORT OF THE COMMITTEE FOR PLANNING MEASURES AGAINST FLOODS AND SIMILAR CALAMITIES IN DELHI.

CONTENTS

ANNEXURES

I

INTRODUCTION

An all-time record rainfall of more than 10·5″ in 24 hours (with a maximum of 2·8″ in one hour) on 20th and 21st July 1958 flooded large areas in the Capital causing some damage to roads and buildings and paralysing communications. The Prime Minister called a meeting on 23rd July of the Ministers concerned, the Mayor of Delhi and other civil and military officers to consider the situation that had arisen and, after discussions, decided to set up a Committee for planning measures against floods and similar calamities in Delhi. The Committee consisted of the following. :—

1. Shri K. C. Reddy, Minister for W. H. & S. (*Chairman*).
2. Secretary, Ministry of Rehabilitation (Shri Dharma Vira).
3. Secretary, Ministry of Health (Shri V. K. B. Pillai).
4. Chief Commissoner, Delhi. (Shri A. D. Pandit).
5. Shri P. R. Nayak, Commisioner, Delhi Corporation.
6. Chief Engineer, C.P.W.D. (Shri J. M. Rijhwani).
7. Financial Adviser, Ministry of W. H. & S. (Shri S. Vohra).
8. Shri G. Mukharji, Chairman, Town Planning Organisation.
9. A representative of the Central Water & Power Commission (Shri Kanwar Sain, Chairman).
10. Drainage Engineer, Delhi Municipal Corporation (Shri M. A. Lokhande).
11. Maj. Genl. R. E. Aserappa, Engineer-in-Chief.
12. Shri M. R. Sachdev, Secretary, Ministry of W. H. & S. (Convenor).

The Committee co-opted Shri Walter George and also invited Shri Karnail Singh, Member, Railway Board to Assist the Committee in its deliberations from time to time.

Terms of Reference.

The Committee was to deal with short-term projects and also consider related long-term schemes. Implementation of the recommendations was also the responsibility of this Committee. Its terms of reference were :

1. to consider protective measures from consequences of floods, heavy rains etc. ;
2. to examine the adequacy of existing drainage & sewerage systems and to suggest improvements ;
3. to go into the problem of water logging, low lying land and subsoil water ;
4. to examine bridges, bunds, etc. from structural point of view ; and
5. to look into the matter relating to equipment, such as pumps etc. necessary to deal with emergencies.

The Committee has held four meetings so far and copies of the minutes of the first three meetings are attached (Annexures I to III). At its fourth meeting held on 9th August, the Committee approved of this first interim report. The Committee, had set up three sub-committees, one to deal with urgent and emergent repairs, another to suggest short and long term remedial measures and the third to ensure that there were no administrative and financial bottlenecks in the implementation of the proposals and the schemes, which had the approval of the Committee. The first two technical sub-committees have had several meetings and taken action to carry out urgent works and implement other decisions.

The Chairman and several members of the Committee have visited many of the flood affected areas and have inspected the storm water drains and bunds.

II

Causes of the Flood

Before the construction of the New Delhi Capital the whole estate was an open country with some cultivation subsisting on wells or on rains. At times of heavy rainfall there was no obstruction to the run off. Two big natural drains carried away practically all the run off of the cultivated and uncultivated areas. With the building up of the Capital these natural drainage lines and channels were blocked and artificial drains were provided to carry away storm water from the built up area. The original stormwater drainage was designed and built in 1918 for a $\frac{1}{4}$" run off (which means that only $\frac{1}{4}$" of rain water per hour finds its way into the storm water drains) except for the then Viceregal Estate and the Secretariat area which was designed for 1" run off. This design was based on the engineering practice then obtaining and the meteorological data available at the time.

The following extract from the report of the Meteorological Office gives details of the heavy rainfall on 20th and 21st July and compares it with the heavy rainfall on two previous occasions—in 1936 and 1954.

> "For the 24 hours ending at 8·30 A.M. on 21st, a rainfall of 10·5" (26·6 cms) was recorded in the Lodi Road Observatory This is an all time record of 24 hours rainfall for Delhi ; the previous record being 9·27" recorded on 28th June, 1936.
>
> The rain commenced on the 19th and continued intermittent throughout the 19th and upto 4 P.M. of 20th. For the 24 hours ending at 08·30 I.S.T. of 20th 2·4 cms (nearly 1") of rain was recorded. From 08·30 to 1600 of 20th, 42 m.m. (1·7" nearly) of rain fell. There was a break in the rain thereafter upto 11 P.M. after which moderate to heavy rain set in and continued upto 0645 hours of 21st. The intensity was very high between 0245 and 0500 hours and again from 0530 to 0615.

Rainfall from	1100-0245	28 m.m (1·1")
Rainfall from	0245-0500	120 m.m (4·8")
Rainfall from	0530-0615	25 m.m (2·2")

The maximum rainfall in one full hour during this period was 70 mm (2·8") from 4 A.M. to 5. A.M. of 21st.

Average intensity during the period 0245-0615 was 53 m.m per hour or 2·1 inches per hour.

The maximum intensity of rainfall during short period of 3 minutes during the heavy spell was 3·4" per hour.

Previous occasions of such heavy rain.

(1) On 28th June, 1936, rainfall of 9·27" was recorded in Delhi. This was an all time record from 1881 onwards upto that year. This year's 10·5" has thus beaten the previous record. Details of the 1936 rainfall are not available.

(2) From the noon of 30th September to 3 P.M. of 1st October, 1954, Delhi recorded rainfall of 9·36". This heavy fall also occurred in association with a late monsoon Depression. But the maximum hourly rainfall was of the order of 1·5 inches to 1·6 inches while short period intensity (5 minutes) was about 3·5 inches per hour.

As the ground was already fully soaked by previous showers, most of the water found its way into the drains which were only designed for $\frac{1}{4}$" run off. These drains obviously could not clear a discharge far in excess of the designed capacity and hence the flooding of areas became inevitable.

The problem is to consider for what intensity of rainfall should the drainage system in Delhi be designed. The total rainfall of 10·5 inches (26·6 c.m.) in 24 hours, with an intensity of 2·8 inches in an hour, on 20th/21st July, 1958,

was not experienced since 1881. There have been cloudbursts in 1936 and 1954 but the maximum hourly intensity did not exceed 1·6 inches. The drainage is primarily affected by the intensity of rainfall, and the intensity as on 20th/21st July, 1958 may not be expected for a long time to come. Provision of drainage system for such unusual cloudbursts, which may only occur very rarely, is therefore not a justifiable proposition on account of the excessive costs, both initial and recurring. There is no doubt that a certain amount of calculated risk has to be taken in not designing the drainage system to meet the requirements of the heaviest rainfall so far recorded or ever expected. This accords with the accepted principles of design in practice everywhere.

The *Ad hoc* committee on subsoil water level (referred to separately), at its meeting on 5-8-1958, considered afresh the question of what "run-off" should be adopted for the drainage system in the light of the experience of the recent rains in Delhi. On the basis of a study made by the officers of the Meteorological Department on the intensity, duration and frequency relationships of rainfall at selected stations in India upto 1955, a rainfall intensity of 1·71 inches per hour can occur in Delhi with a probability of once in 10 years. The Committee have held that this should be the maximum intensity for which the drainage system should be designed. As the total rainfall does not always find its way into the drains, it is essential to determine the actual "run-off" into the drainage system as a co-efficient of the total rainfall. After careful study, the *Ad hoc* committee has suggested that the co-efficient of "run-off" in an area like New Delhi should be between 0·25 and 0·5. This is a very inportant matter ; the recommendations of the *Ad hoc* committee and views of other authorities that may be received will have to be carefully considered by the Committee, before a final decision is taken.

III

Areas flooded and the Extent of Damage.

As has been explained above the drains were not able to cope with the discharge consequent on the unprecedented rainfall on 20th and 21st July, thus resulting in the flooding of low lying areas. Some of the areas that were flooded within the limits of New Delhi and the Delhi Corporation are mentioned below :

(*a*) low lying areas like the Gole Market, Parliament Street, parts of Ashoka Road, Talkatora Road, Old Mill Road, Raisina Road, Queen Victoria Road, York Road, King Edward Road, Central Vista and the Golf Link area,

(*b*) Places where the open Nullahs overflowed their banks like the Lajpatnagar Nullah affecting Lajpatnagar and Jangpura ; the Hardinge Bridge Nullah affecting Indraprastha Estate ; the Dariya-e-Nullah (Ganda Nullah) affecting areas near Rohtak Road; and the Najafgarh Nullah affecting built up areas such as the University Enclave, Rana Pratap Bagh, Model Town, Vijayanagar, etc.,

(*c*) depressions like the Minto Road Subway,

(*d*) areas like Shahdara, Gandhinagar and Gita Colony on the left bank of the River Yamuna.

A plan showing the various Nullahs will be found at the end.

As a result of the heavy rains, flooding also occurred in the Krishi Bhavan on the Queen Victoria Road ; the All India Radio building on Parliament Street; and the Telephone Exchange building in Connaught Place, resulting in the dislocation of telephonic communications. There has, however, been no damage to any of these buildings.

The 27 feet high approach road to the recently built overhead railway bridge on Delhi Mathura Road settled down by about 1½′ in a length of about 100′. The torrential flood water also scoured out one of the side slopes of the high embankment in a length of about 95′. There was, however, no damage to the bridges. The damage caused to the road is estimated at less than Rs. 5000/-.

A detailed statement showing the areas that got flooded, the damage, as far as known, and the steps taken or proposed to be taken to meet the situation in each

case, is attached as Annexure IV. The information in respect of damage to private properties, which suffered in varying degrees is not available. A large number of old and dilapidated houses in old Delhi suffered a partial or complete collapse resulting in some loss of life and injury to persons. Fourteen lives are reported to have been lost in house collapses and by drowning and electrocution etc.

IV

Work of the two Technical Sub-Committees (A and B)

The Sub-Committee A, to consider the problem of emergent repairs and maintenance of stormwater drains, has had 3 meetings so far, and copies of the minutes of the meetings are enclosed (as Annexures V, VI and VII). At the first meeting, the Sub-Committee took stock of the existing drainage arrangements in New Delhi and Delhi areas and detailed different officers of the C.P. W.D. and the Delhi Corporation to inspect the various drains and to submit reports on emergent repairs required to be carried out. The drainage system of New Delhi consists of open drains into which drain the surface water from the roads through gullies and from open areas by surface flow. These open drains discharge into covered drains which, in turn, discharge into various open Nullahs joining the river at various places. The inspections, which were carried out after the floods showed that most of the drains functioned to the limit of their designed capacity but because of the unprecedented rains, a number of the Nullahs into which these drains discharged overflowed, resulting in some breaches and flooding of the low lying areas. In some cases, the breaches in the Nullahs resulted from artificial cuts made by the people living in low lying areas near the drains.

The officers concerned were authorised to carry out immediate repairs to banks, to close breaches and remove obstructions etc. These emergent works have already been completed.

Details of the works carried out are indicated in Annexure VIII.

In addition to these emergent repairs, other urgent works to improve the drainage of Delhi were considered by the Committee as explained below :

1. Proposals have been finalised for regrading of the intercepting drain along the ridge (upper reaches of Kushak Nullah). This should prevent to a considerable extent flooding of the Gole Market area.
2. Widening of the culvert across the railway line and re-modelling of the two road bridges nearby over the drain from Lajpat Nagar.
3. Regarding Dariya-e-Nullah which affected areas along Rohtak Road near Sarai Rohilla, it has been decided that an extra opening should be provided for the sewer line which goes through the Railway culvert.

It has also been decided that immediate investigation should be undertaken in connection with the regrading of the Nullah and to provide separate drainage for the low lying area between the Rohtak Road and the railway line.

4. It has been decided that the culvert over the drain in the Friends Colony should also be widened. This work will be done by the Central P.W.D. on behalf of the Corporation.

The Second Technical Sub-Committee :

The Sub-committee B has also had 3 meetings ; first on 25th July, second on 30th July and the 3rd on 8th August. Copies of the minutes of the first two meetings are enclosed (as Annexures IX and X).

This Committee is required to suggest short and long term measures for preventing flooding of New Delhi and Delhi areas. The Committee has decided the lines on which investigations for the long term measures should be carried out and is collecting the following technical data for the purpose :—

1. Contour plan of the entire Delhi area
2. Complete rainfall data, maximum intensity of rain and time of concentration

3. Investigation of the existing drainage system.
4. Design data of the existing drains.
5. Theoretical check of the existing drains.
6. Site check of the existing drains.
7. High flood level of nallahs and high flood of river at these junctions.
8. Hydraulic data of the Railway and roads bridges crossing the various outfall nallahs.
9. Indication of low lying areas which cannot normally drain into any of the existing drainage systems and from which water will have to be pumped out.
10. Causes of improper drainage and remedial measures.

The necessary data regarding the existing drainage system in New Delhi area is already available. A considerable amount of work has already been done by the *Ad Hoc* Committee on subsoil water level on the existing drainage arrangements in New Delhi area. The deficiency in the existing drainage system and remedial measures to be undertaken have also been indicated by this committee. No such data is, however, so far, available in respect of the Old Delhi area.

Necessary staff to assist this Technical Sub-Committee in carrying out the necessary detailed survey is being placed at its disposal.

The Sub-Committee has also considered short term measures to prevent flooding of areas like the Minto Road Bridge, the Telephone Exchange, the Queen Victoria Road Office Building and the Indraprastha Estate.

Minto Road Bridge :

The flooding of the Minto Road bridge which was constructed some 30 years ago is due to the ingress of rain water from the adjoining built up areas into the depression under the bridge. The Railways have already taken action to improve the drainage of the railway yard both on the East and the West side of the railway line. Steps are being taken to improve the general drainage of other areas on both sides of the bridge. A hump will be provided on the Minto Road side of the bridge similar to the one that exists on the Cannuaght Place side.

The pumps installed at the bridge are only capable of dealing with the flow of the sub-soil water into the depression. In order to meet the situation during the rains, it has been decided to increase the pumping capacity and to have vertical type pumps. In the meanwhile action has also been taken to ensure that the Pump House is not flooded.

Telephone Exchange :

Proposals have been formulated for the drainage of this area by the *Ad Hoc* Committee on Subsoil Water but as this will be a long term measure, a fresh scheme has been prepared for providing a temporary drain to drain off this area.

In addition, action to seal off the multi-storeyed buildings, like the Krishi Bhavan, the All India Radio Buldg., the Telephone Exchange and other buldgs. in the Indraprastha Estate area has also been taken. The annexure at IV gives details of flooding of the basements of these multi-storeyed buildings.

Maintenance of the Drainage System :

The Committee has emphasized the need for a high standard of maintenance of storm water drains. At present, the storm water drains of New Delhi area are maintained by the N.D.M.C. and the drainage system of Old Delhi is under the maintenance of the Corporation authorities.

There should be a separate set-up under the respective local bodies for efficient maintenance of these drains. In respect of the New Delhi area the drains should be examined by the senior Engineer of the C.P.W.D. and a report on the condition of the drains should be submitted to the Ministry of WH&S through the Chief Engineer with a copy to the Ministry of Health. Similarly in respect of the drains in the Old Delhi area the Corporation Engineer will submit a report on the condition of the drains to the Health Ministry through the Commissioner of the Corporation with a copy to the Ministry of WH&S.

These drains should be carefully examined by the appropriate authorities in the month of October each year. Action should be taken to desilt and carry out repairs to the storm water drains wherever necessary during the winter months and an inspection should again be made in the month of April, to ensure that the necessary repairs, required to be carried out, have been done and the drains are in good order. Such systematic annual inspection will ensure the efficient functioning of the stormwater drains during the rains.

Maintenance of the Sewerage System :

The position regarding the Sewerage System in Delhi is that in the area within the city walls, there are combined sewers-storm-water drains. The capacity of these is not adequate even to carry the sewage, and when they have to carry a large quantity of water during rains, they overflow and even burst at places, causing flooding, nuisance and insanitation. The Old Delhi system is connected to the trunk sewer from Delhi Gate to Kilokri, which also carries sewage of New Delhi. Owing to the increase in population during the last 10 years, the capacity of this trunk sewer is entirely inadequate and the scheme for building another trunk sewer from Delhi-Gate to Ring Road, from where it will be pumped to the Okhla Sewage Disposal Works is in hand. At present the mote along the city wall has to carry some of the sewage from the city. When the additional trunk sewer is in position, this nuisance will be stopped and the mote will be used only for storm water. It is also necessary gradually to build two separate storm water drains for Old Delhi to relieve the pressure on the existing combined system. The Corporation will have to undertake quite heavy capital expenditure for this purpose during the next few years.

It is well known that many of the rehabilitation colonies were built and occupied without completing the arrangements for the disposal of human wastes. The Improvement Trust created an industrial area on Najafgarh Road in 1937 in which several factories have sprung up without making any arrangements for water supply or sewerage. The whole of the sewage from West Delhi as well as portions of Old Delhi finds its way into the Najafgarh Nala, which was originally intended to be a stormwater drain. The Corporation is laying a trunk sewer along the Najafgarh Road and has already erected a sewage disposal plant at Keshopore. It will be necessary to provide another trunk sewer along the Najafgarh drain. Tenders for this work also have been invited by the Corporation. New developments, such as Friends' Colony, on both sides of the Mathura Road in recent years have also not been provided with sewerage facilities. Another trunk sewer will therefore be necessary from Friends' Colony up to the Ring Road Pumping Station to pick up the sewage from both sides of the Mathura Road and the Bara Pula Nala. This will also reduce the danger from flooding as well as the nuisance from sick soakage pits in the Friends' Colony area.

The problem of Shahdara, where extensive development—both private and by the Rehabilitation Ministry—has taken place after Independence, does not admit of an easy solution owing to the fact that by and large Shahdara is set in a trough, bounded by the Hindan and Yamuna Rivers, the Northern Railway embankment and the diversion channel on the other two sides, with no outlet for the storm water to flow by gravity into either of the rivers. A preliminary survey shows that the southern part is sloping generally towards the Hindan Cut, and if the obstructions to the free flow of water are removed and the flow canalised, it may be possible to drain a large percentage of the storm water by gravity into the river Yamuna below Okhla.

As regards sewerage, Shahdara is at present entirely served by the dry system, as it has neither sewer nor water-supply system. Supplying filtered-water to Shahdara is itself a difficult problem, which is not expected to be solved for some years. It would be of no use putting underground sewer until a sufficient quantity of water-supply at a fairly high pressure can be ensured. Moreover, even if a piped water supply is available for Shahdara, installation of a modern method of sewage disposal will be comparatively costly here, as owing to the peculiar nature of the topography, more than one sewage disposal plant and pumping station will be necessary. In the first instance, however, the Corporation proposes to instal a sludge digestion plant, which will work in conjunction with the present dry system, so that the disposal of night soil may be freed from nuisance and danger to health.

As regards sewage disposal plants for areas other than Shahdara, primary and secondary treatment plants have been installed at Keshopur for West Delhi and in Coronation Plant for North Delhi. For the south, an additional plant is being created at Okhla. But the present scheme does not provide for the secondary treatment.

As regards the cleaning and maintenance of sewers, the Delhi Corporation have two sewer cleaning machines and four pumps with necessary staff for cleaning sewers and they have five more machines on order along with six pumps.

The Committee has not been able so far, to examine the internal sewer system of the City. The Committee proposes to go into the questions referred to above at its future sittings, as also into questions relating to the sewerage in Rehabilitation Colonies and in old areas such as the University enclave, Kingsway Camp etc.

V

PROBLEM OF WATER LOGGING IN LOW LYING LAND AND SUB-SOIL WATER

The Government of India had appointed an *Ad hoc* committee to investigate the sub-soil water problem in New Delhi. This Committee was appointed in 1953 and its terms of reference were to examine the question whether the sub-soil water table in New Delhi area was rising, and if so, to suggest what, if any, protective measures were necessary to safeguard buildings and structures in New Delhi. A brief resume of the work done by this Committee is given below.

The Committee has held twenty meetings apart from the meetings of the various Sub-Committees appointed for the investigation of specific problems.

The Committee could not proceed with this work expeditiouly as there was no data or observations available when it started. Soon after the completion of the New Delhi Capital, the C.P.W..D. installed some observation pipes and started recording sub-soil water levels. During World War II, these observations were suspended, and many of the pipes got rusted and choked. The Committee decided that fresh observation pipes should be installed, spread over the whole of New Delhi and observations taken every fortnight. In addition, a mass of data required by the Committee had to be collected from old records, site survey, etc. A Special Division was created to carry out all the surveys, and experiments, and make observations. It was this Division's function to process the data in the form of maps, diagrams and charts and to provide complete information for the consideration of the Committee.

The detailed examination of the data provided by the Central P. W. D. established that

(1) the water level in the river has little influence on the fluctuation of the sub-soil water table,

(2) the sub-soil water table rises from June to October and falls from October to June. Heavy rain falls during the monsoon are responsible for an abnormal rise leading to a net permanent rise in the level, and

(3) since 1912 there has been a general rise in sub-soil water table varying from 2 to 17 ft.

The *Ad hoc* Committee submitted an interim report in 1956, and a copy of its report is added as Annexure XI. Since then the Committee has pursued further studies and research work and also given consideration to the schemes for lowering sub-soil water level by improving drainage and pumping out water.

At the instance of the *Ad hoc* Committee the Road Research Institute have completed their study of the problem of differential settlements of buildings as a result of the lowering of the sub-soil water table. This report has been considered by the Committee, and its recommendations accepted. The conclusions briefly are that the possibility of appreciable surface subsidence occurring in the unbuilt areas as a result of dewatering is ruled out. For the built up areas in the case of the existing buildings, by and large the resulting differential settlement due to lowering of water table to 10 ft. below ground level will

be insignificant. [Repeated fluctuations of the water table may, however, cause a settlement of the order of ½ inch in the case of a few foundations which rest upon sand. Although this magnitude of settlement is within allowable limits, it is advisable that pumping should be so arranged that frequent fluctuations within a depth of 10 ft. below ground level are avoided as far as possible.]

The Geological Department have carried out a study and have submitted a report. They have asked for further facilities for continuing their study to prepare a Geological map of the Delhi area.

On the basis of the information, derived from studies made by the Meteorological Department, the Committee have adopted certain coefficients for the built up area in New Delhi. Using these coefficients they have arrived at the figure of ·5 inches per hour run off (on an average) for designing the drainage system of New Delhi. A report of the Committee meeting held on 5-8-1958 is attached as Annexure XII.

Further action has been taken by the Committee as follows :—

(1) 16 tube wells have been installed in the badly affected area where the water table in the month of October is at a depth less than 6 ft. from the ground surface. These tube wells are working already. To start with pumping was restricted to a few hours per day. During the month of June 1958, 2·24 million gallons of water were pumped out from the sub-soil. Pumping is now being increased to 22 hours per day. Careful watch is kept on the saline content of the tube well water so that if suitable, this could be utilised for irrigation purposes. Generally, however, the water is brackish.

(2) A line of porous concrete pipes 10 ft. below ground level has been laid in the Central Vista. Pumping has been continuous. Before the heavy rain of July, it was possible to lower the water table to a depth of 8 ft. Pumping is now being increased to remove the excessive quantity of water received as a result of the heavy rain fall.

(3) Preliminary experiments on the reclamation of salt and alkaline patches in the Central Vista with the help of D.D.T. waste have been carried out. With the experience gained, a scheme for the reclamation of all saline and alkaline patches is being prepared.

On the recommendations of the Committee a complete scheme for improving the surface drainage of the New Delhi area, lowering of the sub-soil water in the badly affected and the moderately affected areas and preventing the rise of sub-soil water level in the unaffected and the new colonies has been prepared and the necessary estimates are being submitted to the Government of India.

The salient features of the complete scheme are :—

(1) Installation of tube-wells in the moderately affected area and in badly affected area.

(2) Regrading and regrassing the lawns of the Central Vista.

(3) Providing relief drains to the underground drainage system in New Delhi area.

(4) Regrading, and redesigning of the drainage system of the New Delhi area where necessary.

(5) Providing complete Porous concrete drains in the Central Vista.

(6) Economic use of unfiltered water in lawns and gardens, and use of sprinklers in some selected areas as an experimental measure.

The *Ad hoc* Committee has compiled a mass of very useful data plotted on charts, diagrams, etc., for ready reference. Observations and studies on various aspects of the problem are continuing and the diagrams and charts are kept up-to-date.

The Committee proposes to consider the recommendations of the *Ad hoc* Committee to ensure that such of its recommendations as are accepted are speedily implemented and to watch the progress of its work from time to time.

VI

BUNDS AND BRIDGES AND SUMMARY OF ACTION TAKEN.

Bunds :

The Committee directed that the existing bunds along the river Yamuna should be examined by the C. W. P. C. along with the officers of the C.P.W.D. and the Corporation. A report on the condition of the river bunds has been received by the Committee and necessary repairs and improvements have also been undertaken.

A system of inspection of these bunds should be established and the S.E., Delhi State Circle through the Chief Commissioner of Delhi should submit a report to the Ministry of Irrigation and Power with a copy to the Ministry of W. H. & S. every year in the month of April on the condition of the bunds. Similar action should be taken by the S. E., Agra Canal (U. P. Irrigation) for the marginal Bund on the left bank of the Yamuna under his charge. The bunds should be maintained to the standards prescribed by the C.W.P.C. in terms of the Embankment Manual prepared by the Flood Wing of the C.W.P.C. in 1956.

Bridges :

Most of the nallahs that drain the rain water of Delhi into the Yamuna, cut across the Railway line and in many places, the road embankments also. The adequacy of the existing waterways across the Railway line as well as the Roadways is a matter for detailed investigation and has to be considered as a part of the long term measures. As already indicated in previous paragraphs, wherever the drains did not function properly on account of restricted waterway, the authorities concerned have been requested to increase the size of the openings on a priority basis.

Normally where levels are satisfactory there will not be any need for pumping out stormwater. Pumping of stormwater will be necessary only in cases of low lying areas, which cannot discharge into the nallahs or into the river during high flood level. Such areas are to be dealt with separately. Wherever possible, the drains should function by gravity, as pumping will not be an economical process. The Technical Sub-Committee B is already seized of the problem and will take this aspect of the matter into consideration when formulating short and long term remedial measures.

To sum up—

(*a*) urgent repairs by way of removal of obstructions, closing of breaches, strengthening of bunds, etc., wherever necessary, have already been carried out or are in hand,

(*b*) Suitable short term remedial measures have been taken to prevent the flooding of the strategic points, like the Minto Road Bridge, the Telephone Exchange, the Krishi Bhavan and the buildings in the Indraprastha Estate,

(*c*) the Committee has prescribed a procedure for the standard of maintenance of stormwater drains for the future. A system of strict inspection of drains before and after rains will be insisted upon,

(*d*) the entire existing drainage system in New Delhi and Old Delhi will have to be examined in the light of their adequacy for higher discharge. This is being done. The existing size of the drains will not be able to cope with heavy rains likely to occur say once in 10 years,

(*e*) as a short term measure the committee has already approved proposals for the regrading of Nallahs and widening of bridges wherever required without waiting for long term remedial measures.

(*f*) The Committee has directed the *Ad Hoc* Committee on Subsoil water to make its final recommendations and also to proceed expeditiously with the schemes already formulated by them for the lowering of subsoil water level,

(*g*) The river bunds have already been inspected and action taken to strengthen them, where called for and

(*h*) Action to remodel or widen some of the existing openings across Railways and roads, is being taken on a priority basis.

VII

Flooding of the rural area of Delhi.

The main drainage of the rural area *i.e.*, the Najafgarh Block and the Alipur Block is carried by the Najafgarh Nallah. The two main drains, which drain into the Najafgarh from the Alipur Block and part of Najafgarh, are the Mangeshpur drain and the Nangloi drain with a catchment area of 298 sq. miles. These two main drains have several small branches, which drain the countryside of Delhi. Besides these two main drains, there is the Najafgarh Jheel and its catchment, which also drains into the Najafgarh Nallah.

The beds of these drains have been heavily silted and choked up with the result that after a heavy rainfall, the water spreads out and submerges the surrounding crops. These drains have also very sharp bends.

A survey of the Najafgarh drain and the levels along the bed of the drain, has been carried out and this showed that the width of the Nallah had been considerably reduced due to silting up and a hump had been formed, which prevented the drainage from the Jheel side passing into the Yamuna. The work of the removal of the hump in the main Najafgarh drain as suggested by the C.W.P.C. has been completed by the C.P.W.D., with the exception of pitching, which also has been partly completed.

A survey is now in hand for improving the drainage of the Nangloi drain. The drain is proposed to be designed on the basis of a discharge of 5 cusecs per sq. mile in the catchment area. This is being done keeping in view the limited capacity of the main Najafgarh drain itself.

The survey of the Mangeshpur drain and its branches has not yet been undertaken.

Another drain, which serves to clear the storm water from the rest of the Alipur Block is the Bowana Escape drain, which discharges independently into the Yamuna. This drain has to be attended to also.

The rest of the problem of the rural Delhi relates to the villages between the Yamuna and the Shahdara Bund and the villages between the Yamuna and the G. T. Road below village Palla which are affected by floods from the river. In the first case the remedy is for these villages to be moved away. Sites have already been selected but the villagers have not moved so far. In the second case, that is in respect of the villages between the Yamuna and the G. T. Road, the remedy is for the sites of villages to be raised.

A bund in this region cannot be constructed as the Standing Yamuna Committee, which has been set up by the Ganga River Commission, has ruled that no long embankments on the River Yamuna are to be constructed by Delhi, U. P. or Punjab authorities. Such measures according to that Committee would cut out large valley storages resulting in higher flood levels at the Delhi Railway Bridge, thus endangering the safety of the bridge. Without any embankments the highest flood level already recorded at the Railway Bridge is upto the top of the piers. This scheme should give substantial relief to areas which are liable to flooding so as to minimise damage to crops at the same time ensuring that the water from the rural areas does not flow into the city but is properly drained off into the river. This has to be coupled with adequate flood protection measures against damage to village " abadies " in the event of heavy rains or floods in the river.

The Committee proposes to go into this matter further and to initiate or take suitable action in consultation with the Ministries concerned and irrigation authorities of the Uttar Pradesh and Punjab Governments.

ANNEXURE I

Minutes of the meeting held in the room of Shri K. C. Reddy, Minister of Works, Housing and Supply, at 10.00 a.m. on the 24th July, 1958 to discuss the defective drainage and sewerage systems, the problems of flooding of low-lying areas and sub-soil water in Delhi and also the condition of bridges and bunds.

PRESENT

Ministry of W. H. & S.

1. Shri K. C. Reddy, Minister.
2. Shri M. R. Sachdev, Secretary.
3. Shri S. Chaudhuri, Deputy Secretary.

Ministry of Health.

4. Shri V. K. B. Pillai, Secretary.
5. Shri A. V. Venkatasubban, Dy. Secretary.

Ministry of Rehabilitation

6. Shri Dharma Vira, Secretary.

Ministry of Defence

7. Maj. Gen. R. B. Aserappa, Engineer-in-Chief.

Ministry of Finance.

8. Shri O. V. Ramadorai, Dy. Financial Adviser.

Delhi Administration

9. Shri A. D. Pandit, Chief Commissioner.

Municipal Corporation of Delhi

10. Shri P. R. Nayak, Commissioner
11. Shri M. A. Lokhande, Sewerage Engineer.

Delhi Development Authority

12. Shri G. Mukharji, Vice-Chairman.

D.G.H.S.

13. Shri K. S. Krishnaswamy, Dy. Dir. General.

C.W. & P.C.

14. Shri Kanwar Sain, Chairman.

Central P.W.D.

15. Shri J. M. Rijhwani, Chief Engineer.
16. Shri V. Kandaswamy, Superintending Surveyor of Works.

P.I.B.

17. Shri G. Trivedi, Information Officer.

Initiating the discussion, the Minister of Works, Housing & Supply stated that although the committee had been constituted mainly to deal with long-term measures, it would be required to take effective steps to tackle immediate problems as well. In this connection, he mentioned the apprehension of large-scale floods in Delhi during the next five or six weeks. Though the terms of reference of the Committee had not yet been formally received, they would include the examination of the adequacy or otherwise of the existing drainage and sewerage systems in Delhi and recommendation as to what should be done on a long-term basis. The examination of the problems of low-lying areas, water-logging, sub-soil water, and the condition of bridges and bunds was also included in the terms of reference. The Committee would be required not only to have detailed examination carried out but also to take steps to implement its decisions both in regard to immediate, short term and long term measures.

2. Shri V.K.B. Pillai desired to know what action had been taken on the specific recommendations of the *Ah hoc* Committee appointed in 1953 to study the problem of sub-soil water in Delhi. In reply, the Chief Engineer stated that a separate post of Executive Engineer had been created with a view to giving effect to the *Ad hoc* Committee's suggestions and a scheme drawn up. The problem this year was the direct result of the unusually heavy rainfall on the 20th-21st July. However, the survey, recommended by the *Ad hoc* Committee, had already been completed, and estimates framed and scrutinised. These were being sent to Government for sanction.

3. Shri Sachdev referred to a note recorded by the Health Officer of the N.D.M.C. in November, 1956 based on recommendations of the C.P.W.D. and also a letter dated 5th April, 1958, from the Committee's Secretary to the Ministry of Health. The former gave a detailed list of drains which had to be desilted cleaned up and repaired and in the communication of 5-4-58, the N.D.M.C. had asked for funds to enable them to carry out some important drainage and water supply works. Shri Pillai stated that the schemes of the CPWD were good and would be effective, but that the main problem was lack of funds. Shri Reddy stated that so far as New Delhi was concerned, under the existing arrangements, the entire cost of drainage schemes would be borne by Government whereas the cost of sewerage schemes would be shared between Government and the NDMC on a 50:50 basis. All schemes within the jurisdiction of the Municipal Corporation would, of course, be paid for by the Corporation.

4. Shri Pandit stated that, before developing new areas, the C.P.W.D. were not carrying out proper surveys with reference to the natural drainage system. As a result, the natural drainage lines were often out across and drainage obstructed. It was agreed that it was essential to prepare a contour plan of the whole of Delhi. Shri Mukharji informed the meeting that the Town Planning Organisation of the Delhi Development Authority were already preparing a contour plan of Delhi audits suburbs and it was likely to be ready in 3-4 months' time.

5. Shri Nayak mentioned the problem of absence of inadequacy of drainage in several low-lying colonies which were being flooded during the monsoons. A very ambitious scheme, costing about Rs. 5½ crores, had been drawn up to deal with the problem but it would not be possible to take it up in the near future for want of funds. Some short-term arrangements of pumping and providing drainage channels should, therefore, be thought of. Shri Nayak added how some surface drainage channels, like the Darya-e-nallah (Ganda Nallah), the Najafgarh Nallah, and the Barapulla Nalla, presented the greatest problem. The recent rains had caused extensive damage to the first nallah, the banks of which would need strengthening and the surface would require to be covered. Strengthening of banks in the case of the other two nallahs was also necessary. He desired that the C.P.W.D. should speed up all works of sewerage and drainage in the west-zone colonies for which funds had already been provided by the Ministry of Rehabilitation. Another problem mentioned by Shri Nayak was the undrained, unsewered and low-lying areas in old Delhi. Of course, the solution to the problem was for the Corporation to find.

6. Shri Venkatasubban stated that, in the walled city of old Delhi, storm water was flowing into the sewers, often resulting in local flooding. This needed looking into.

7. Shri Kanwar Sain suggested the separation of the two questions, namely, (1) the adequacy of the constructed drains and (2) the adequacy of their maintenance. The local authorities and the CPWD must ensure proper maintenance in future. The drains were originally designed for ¼" run-off per hour, and the new design was for ½" run-off per hour. The drains should be so designed as to minimise damage to buildings, etc., following unusual rainfall. In the Master Plan of Delhi, the localities should be clearly marked where buildings would be liable to heavy flood and consequent damage. Shri Kanwar Sain suggested that it would be safer to have the drains designed for o 8" run-off per hour. Immediate steps should be taken to widen the inadequate waterways under roads, bridges, railway culverts, etc. To enable the CPWD properly to discharge their responsibility for maintaining drains, etc., the appointment of Superintending Engineer to take charge of the Service Division was recommended. It was suggested that a committee should be formed with the Chief Commissioner as chairman to look into the question of bottlenecks in the execution of works.

8. Shri Dharma Vira stressed the need for immediate steps being taken to prevent the recurrence of what happened in some places like the Minto Bridge, the Hardinge Bridge, the Krishi Bhavan and the CBR building during the recent rains. He suggested that more and larger pumps should be kept ready for meeting such eventualities.

9. After further discussions, the chairman summarised the conclusions as below:

(1) ADEQUACY OF MAINTENANCE AND AGENCY OF WORK

Immediate steps should be taken by the CPWD in New Delhi and by the Municipal Corporation in Old Delhi for the clearing up of silt, removal of debris and ensuring free flow of water in the existing drains. For proper coordination of work on nullahs, etc. running through both New and Old Delhi, a small technical committee, consisting of the chief Engineer, CPWD (Chairman), the Medical Officer of Health, NDMC, and an engineer of the Corporation, should be set up. If convenient and desirable, the C.P.W.D. should carry out the work on the entire nullah, as the Corporation was agreeable to bear the cost of such works in areas falling under its jurisdiction. This committee should take immediate action and also furnish its broad programme at the next meeting of the high-power compmittee. Action should proceed immediately and the technical committee should submit regular reports of progress achieved.

Shri Pandit's suggestion that the Chief Engineer, C.P.W.D., and the Chief Engineer of the Corporation should be asked to send a report to the Ministries of Health and W.H. & S. in April every year on the state of drains, nullahs etc., etc., was accepted. This report would enable timely action being taken to prevent overflowing because of the silted and otherwise choked drains and nullahs.

(2) IMMEDIATE PROTECTIVE MEASURES

To make suggestions in this behalf, a committee, to be called the Local Spots Committee, would be set up with the following composition:

(*i*) Shri J. M. Rijhwani, Chief Engineer, C.P.W.D.,

(*ii*) Shri Kanwar Sain, Chairman C.W.& P.C. or his nominee,

(*iii*) A Railway Engineer—to be coopted by the Chief Engineer, CPWD,

(*iv*) Shri M. A. Lokhande, Sewerage Engineer of the Corporation,

(*v*) Maj. Gen. R.B. Aserappa, Engineer-in-Chief, Ministry of Defence or his nominee,

(*vi*) Shri Balbir Singh Saigal, Engineer—Member, Delhi Development Authority.

Besides making suggestions on immediate protective measures, this committee would also study and advise on the adequacy of waterways, and the long-range problems of reorganisation of drainage, etc. Shri Nayak emphasized that the Local Spots Committee should study the problem of Shahdara as a matter of great urgency.

10. The following further decisions were taken at the meeting:—

(*a*) The Chief Engineer, C.P.W.D., should collect all existing contour plans from the DDA and other authorities, for use in connection with the committee's work on the long-range problem.

(*b*) S/s. Kanwar Sain and J. M. Rijhwani would arrange very early inspection of all the bunds and suggest suitable protective measures against floods.

(*c*) An Administrative Land Finance Committee, consisting of S/s. M. R. Sachdev, V. K. B. Pillai, P. R. Nayak and S. Vohra [Financial Adviser, (Works)] should be formed to expedite sanctions, and to ensure that there was no hold up in the matter of provision of essential finance, etc. The Committee will also decide on allocation of expenditure as between Govt. N.D.M.C. and the Corporation.

Shri Reddy suggested that the members of the committee should, individually or in groups, inspect the affected sites systematically, as such personal inspection would be very useful and important in that their suggestions could receive immediate attention.

11. The next meeting of the committee would be held at 10·00 A.M. on 1st August, 1958, in the room of the Minister for Works, Housing and Supply.

ANNEXURE II

Minutes of the meeting of the Committee set up for planning measures against floods and similar calamities held in the room of Shri K. C. Reddy, Minister for Works, Housing and Supply, at 10·00 a. m. on the 1st August, 1958.

PRESENT :

Ministry of Works, Housing & Supply :

1. Shri K. C. Reddy, Minister—*Chairman.*
2. Shri Anil K. Chanda, Deputy Minister.
3. Shri M. R. Sachdev, Secretary.
4. Shri D. P. Karnik, Deputy Secretary.
5. Shri S. Chaudhuri, Deputy Secretary.

Ministry of Health :

6. Shri V. K. B. Pillai, Secretary.
7. Shri A. V. Venkatasubban, Dy. Secretary.
8. Shri K. S. Krishnaswamy, D.D.H.S.

Ministry of Rehabilitation :

9. Shri Dharma Vira, Secretary.

Ministry of Finance :

10. Shri S. Vohra, Jt. Secretary.
11. Shri Kirpa Singh, A.F.A. (Health).

Ministry of Railways :

12. Shri B. B. Mathur, General Manager (N.R.).
13. Shri U. S. Rao, Dy. Chief Engineer (N.R.).

Ministry of Defence :

14. Maj. Gen. R. E. Aserappa, Engineer-in-Chief.

Delhi Administration :

15. Shri A. D. Pandit, Chief Commissioner.

Municipal Corporation of Delhi :

16. Shri P. R. Nayak, Commissioner.
17. Shri M. A. Lokhande, Drainage Engineer.

Delhi development Authority :

18. Shri G. Mukherji, Chairman, Town Planning Organisation.

Central Water & Power Commission :

19. Shri Kanwar Sain, Chairman.
20. Shri P. R. Ahuja, Director.

Central Public Works Department :

21. Shri J. M. Rijhwani, Chief Engineer.
22. Shri V. Kandaswamy, Superintending Surveyor of Works.
23. Shri Walter George, ARCA (Lond.) FRIBA.

Press Information Bureau :

24. Shri G. Trivedi, Information Officer.

The Chairman opened the second meeting of the Committee by recalling that, at its first meeting, two sub-committees had been constituted which had already started work and held some meetings. He referred to two letters to the Prime Minister—one from Mr. Walter George and the other from Shri Brij Krishan Chandiwala of the Bharat Sevak Samaj—which had been circulated to the Members with the agenda of the meeting. Besides, copies of a letter dated 25th July, 1958, from Shri Gulab Singh Sethi, Senior Vice President, N.D.M.C., and another dated 26th July, 1958. from the residents of the College Lane Railway quarters were circulated at the meeting. The Chairman also mentioned about another letter from one Shri R.S. Thacker who offered a plan, against payment, for dealing with the problem of flooding of the Minto Road depression. He desired that copies of such letters should be made available to the Members to apprise them of the public feeling in the matter.

2. The Chairman then called upon the Chief Engineer to give an account of the progress of work that had been done. The latter explained in detail the various measures taken and proposed to be taken.

3. The Chief Engineer observed that the labour camps behind the Camp College and the Reading Road Police Station and also in the vicinity of Dr. Sen's Nursing Home in the Indraprastha Estate must be removed as, otherwise, the residents of these camps were during the rains, in a habit of cutting the embankments of the nullahs near by in order to save their own huts from flooding. The Chief Commissioner remarked that divergent policies were being followed by the various Ministries in this behalf. He added that the removal of the camps would not be an easy matter as alternative accommodation would have to be found for the large number of people concentrated in those camps within easy reach of their places of employment. According to him, the removal of labour camps was a long-term proposal and he agreed with the Chairman that this was intimately connected with the problem of slum clearance. It was, therefore, agreed that this question should be taken up and pursued separately.

4. The Chief Engineer prefaced his remarks by a reference to the unprecedented rainfall and explained how it was impossible to provide against the resultant flooding. Shri Kanwar Sain invited the attention of the Members to a report submitted by Shri P. R. Ahuja (Director, CW&PC), after a joint inspection by him of the flood embankments, together with the Additional Chief Engineer (Northern Zone), C.P.W.D.

5. The Chairman stated that his on-the-spot inspection confirmed the complaints of the residents of the Rohtak Road colony that water had risen between 4 ft. and 9 ft. in the colony during the peak period of the flooding. The main cause pointed out was the narrow railway culvert adjoining the colony, which was not adequate to discharge the rushing waters quickly. In Lajpat Nagar also, the railway bridge had not been widened along with the nullah, the width of which had been increased. As a result, the discharge was slow and there was accumulation of water. The Chairman requested Shri Mathur of the Northern Railway to examine the question of widening these two railway bridges. Shri Mathur said that the railway authorities would give all necessary data relating to the Darya-e-Nallah to the technical sub-committee, but he was of the opinion that a regrading might be helpful as the present opening of the railway culvert was enough for a discharge of 900 cusecs of water. The technical sub-committee would go into the problem and make specific recommendations. The Chief Engineer also undertook to report, in about a week's time the completion of desilting of the Darya-e-Nallah (Ganda Nallah) near the Rohtak Road colony. Shri Nayak stated that more damage had been caused to the Nallah down-stream during the last two days. He suggested that the C.P.W.D., who were looking after this portion of the drain, should attend to these recent damages as well.

6. The Chairman again referred to the Chief Engineer's report according to which emergent work on 10 out of 13 items listed had already been completed. He urged that all blocks in the drains should be removed immediately, followed by desilting operations where necessary. Shri Lokhande, who stated that the damage caused by the overflowing of the Sunehrapul Nallah running at the back of Teen Murti Lane had been accentuated by the unusually heavy rainfall, agreed to submit a report to the Committee. Shri Nayak would look into the matter and apprise the Committee of his findings at the next meeting. The Chief Engineer invited attention to the difficulty of keeping drains, etc., in a

proper state of repair because of indiscriminate quarrying. The Chief Commissioner was requested to examine the position and report action that could be taken both in Law and administratively to stop indiscriminate quarrying. He mentioned the difficulty arising out of court injunctions, taken out by some quarrying contractors, in favour of whom licences had been issued. However, he promised to look into the matter and make a report to the Committee at its next meeting. The Chairman suggested that, if necessary, requisite powers should be sought by legislation to deal with this problem of quarrying.

The Chief Engineer stated that small drains, etc., in New Delhi were found to be working all right.

7. The Chairman then invited suggestions about the problem of heavy flooding of houses in the Friends Colony, between the Mathura Road and Okhla. The Chief Engineer C.P.W.D. explained that this was as a result of breaches in the embankments of the existing nullahs. The technical sub-committee would look into this matter.

8. In the Chief Engineer's note, mention was made of the obstruction caused by the baffle wall put up over the city ditch. Shri Nayak said that, when the work of laying of a trunk sewer from the Delhi Gate to the Ring Road was completed, the nuisance would be removed. This work was previously entrusted to the C.P.W.D. and had since been taken over by the Corporation authorities.

9. The Chairman then enquired about the possibility of having an artificial lake in a low-lying area. It was decided that the technical sub-committee should examine this question. Mr. Walter George said that such a lake could be thought of on the western side of the Ridge. This could take all the surface water drained into it from the neighbouring areas. The existing Najafgarh Jheel could also be deepened and widened to serve as a lake for similar purposes.

10. Shri Kanwar Sain read out a report on rainfall. obtained from the Meteorological Department. This disclosed certain very interesting features, namely that the maximum rainfall in full one hour between 4 and 5 A.M. on the 21st July was nearly 3". This was an all-time record for Delhi.

11. The Chief Engineer stated that action had already been taken to close the ventilators of the basement of the new AIR building on the Parliament Street.

It was agreed that S/s. Kanwar Sain and Rijhwani would go into the question of additional staff required for the purpose of executing all the works and make specific proposals in this behalf, when the Finance and Administrative Sub-Committee, set up in this connection, would be approached for necessary sanction.

12. Before discussion on item 2 of the agenda was closed, Shri Kanwar Sain suggested that the help of a Survey of India Officer, conversant with maps, should be obtained for getting necessary contour maps without delay. The C.E., C.P.W.D. promised to take urgent action through his local offices at Dehradun.

13. Item one of the agenda was then taken up. Shri Sachdev read out the main recommendations of the *Ad Hoc* Committee on Sub-soil Water in Delhi. The Chairman said that the Committee would like to know in detail within a fortnight, what action had been taken to implement the *Ad Hoc* Committee's recommendations. The Chief Engineer said that, pursuant to the recommendations, 16 tube-wells had been sunk in some of the badly affected localities. As pumping for 8 hours a day had not proved very effective, it was proposed to resort to pumping for 24 hours daily. The Engineer-in-Chief, Ministry of Defence, however, sounded a note of caution that oscillations resulting from increasing the period of pumping from 8 to 24 hours might prove risky to buildings in the neighbourhood. Mr. Walter George was of the view that the existing situation with regard to the level of sub-soil water in Delhi was not bad in respect of normal buildings, but that care should be taken about multi-storeyed buildings which were liable to be affected by the sub-soil water level. The report called by the *Ad Hoc* committee from the Road Research Laboratory had since been received and would be examined by the *Ad Hoc* Committee in their next meeting. The Chief Engineer also mentioned that a scheme for tubewells for pumping out sub-soil water in moderately affected areas had been prepared. In regard to the recommendation of the *Ad Hoc* Committee in connection with enforcement of administrative measures for economy in the use of irrigation water, the Chairman

wanted that lawns should not be flooded and that further efforts should be made to resort to irrigation by sprinklers. Unfiltered water supply should also be strictly regulated, as unrestricted water supply led to waste and also accentuation of the problem of sub-soil water. It was felt that the *Ad Hoc* Committee should meet urgently and keep the Technical Committee informed of progress made.

14. The Chairman raised the question of repairs to damaged houses of displaced persons in rehabilitation colonies and grant of relief to them. It was mentioned that this matter was already under the consideration of the other committee, set up by the Prime Minister to deal with matters relating to relief.

15. The Minister suggested that the Committee should submit an interim report within a week after a further meeting had been held.

16. Mr. Walter George was coopted as a Member of the Committee.

17. The next meeting of the Committee would be held at 9-30 A.M. on the 6th August, 1958, in the room of the Chairman.

S. CHAUDHURI,

Deputy Secretary to the Govt. of India.

ANNEXURE III

Minutes of the Meeting of the Committee set up for Planning Measures against Floods and similar Calamities held in the room of Shri K. C. Reddy, Minister for Works, Housing & Supply at 9-30 a.m. on the 6th August, 1958.

PRESENT

Ministry of Works, Housing and Supply :

1. Shri K. C. Reddy, Minister, (*Chairman*).
2. Shri Anil K. Chanda, Deputy Minister.
3. Shri M. R. Sachdev, Secretary (Convener).
4. Shri S. Chaudhuri, Deputy Secretary.

Ministry of Health :

5. Shri V. K. B. Pillai, Secretary.
6. Sri A. V. Venkatasubban, Deputy Secretary.

Ministry of Rehabilitation :

7. Shri Dharma Vira, Secretary.

Ministry of Finance :

8. Shri S. Vohra, Joint Secretary.

Ministry of Railways :

9. Shri Karnail Singh, Member (Engineering), Railway Board.
10. Shri B. B. Mathur, General Manager (N.R.).
11. Shri U. S. Rao, Dy Chief Engineer (N.R.)

Ministry of Defence :

12. Maj. Genl. R. E. Aserappa, Engineer-in-Chief.

Delhi Administration:

13. Shri A. D. Pandit, Chief Commissioner.

Municipal Corporation of Delhi :

14. Shri P. R. Nayak, Commissioner.
15. Shri M. A. Lokhande, Drainage Engineer.

Delhi Development Authority :

16. Shri G. Mukharji, Chairman, Town Planning Organisation.

Central Water & Power Commission :

17. Shri Kanwar Sain, *Chairman*.
18. Shri P. R. Ahuja, Director.

Central Public Works Department :

19. Shri J. M. Rijhwani, Chief Engineer.
20. Shri B. K. Guha, Addl. Chief Engineer (N).
21. Shri V. Kandaswamy, Superintending Surveyor of Works.
22. Shri G. R. Hingorani, Superintending Engineer.

Press Information Bureau

23. Shri G. Trivedi, Information Officer.

Before the discussion started, an extract from a letter of 31st July, 1958, from the Secretary, Rohtak Road Welfare Association, addressed to the Minister for Works, Housing & Supply and another letter dated the 26th July, 1958, from one Shri Harish Chandra, addressed to the New Delhi Municipal Committee, were circulated. In the first letter, the association urged adequate widening of the culvert of the Dariya-e-Nallah under the railway lines, desilting of the nallah and provision of gratings in Block 5C for the removal of stagnant water. In the other letter, attention was drawn to the damage caused to several houses in the Golf Link Colony by the rainfall and consequent flooding and also certain requests made for payment of compensation, cleaning of drains and installation of a pumping set.

2. Opening the third meeting, the Chairman pointed out how serious insanitation was being caused by people by throwing all sorts of garbage and rubbish on both sides of the railway line in the Rohtak Road colony. Shri Karnail Singh stated that this could only be stopped by the police. As the Railway Police were under the Punjab Police, it was decided that an approach should be made to the latter in this connection.

(Action : General Manager, Northern Rly.).

3. The Chairman then called upon the Chief Engineer to report on the progress of clearance of storm water channels and other anti-flood measures. The Chief Engineer handed over a note on the subject which was read out by the Chairman. In the course of the discussion on the Chief Engineer's note, Shri Pandit referred to the criticism on account of the absence of any agency below Tajewala for giving flood warnings. Shri Karnail Singh said that necessary arrangements in this regard should be left to be made by the C.W. & P.C. Shri Ahuja stated that the Meteorological Department had already been working on the problem. Shri Kanwar Sain said that the C.W. & P.C. had their forecasting units and that the question how far flood forecasts for Delhi could be made from the study of the existing data was being examined by one of the units. The Irrigation & Power Ministry were trying to study the intensity of rainfall and its correlation to the discharge of water. It was decided that the Punjab Irrigation Engineers should be requested to instal a gauge at a suitable station between Tajewala and Delhi. The Chairman C.W.P.C. was requested to take suitable action.

(Action : Shri Kanwar Sain).

4. Recalling the discussion at the last meeting Shri Pandit said that he had looked into the problem of quarrying, mentioned by the Chief Engineer as a contributory cause of floods on account of breaches in the nallahs. Only in the Kitchner Road area, quarry permits had been granted to the Railways and to the Defence Ministries in special circumstances. No permit had been granted for quarrying behind Reading Road. Only permission for levelling the play grounds of the South Indian School had been given. Even this permission had since been withdrawn and the work of levelling stopped. Shri Pandit added that no special powers were needed to deal with the problem, as such powers already existed under the Mines and Minerals Act and the Mineral Concession Rules, which prohibited quarrying without licences. The Chairman suggested that the C.P.W.D should report to the Deputy Commissioner, Delhi, all instances of quarrying in contravention of the conditions of licences. A suggestion by Shri Sachdev, that a small committee consisting of the Chief Commissioner, the Chief Engineer, the Chairman, Town Planning Organisation and the Deputy Commissioner, Delhi, should go into the problem and report was accepted.

(Action Chief Commissioner, Delhi).

5. Shri Karnail Singh agreed to the widening of the railway bridge in Lajpat Nagar, if found necessary after further examination of the problem.

(Action : General Manager, Northern Rly.).

6. The Chairman asked Shri Lokhande to submit a report on the work done by the Corporation to clean the City Ditch.

(Action : Shri Lokhande).

7. Shri Nayak agreed that the C.P.W.D. should widen the culvert on the road inside Friends' Colony on behalf of the Corporation

(Action : Chief Engineer, C.P.W.D.)

8. The Chief Engineer assured the meeting that the estimate for the regrading of the Kushak Nallah would be submitted in about a week's time.

9. With reference to the Chief Engineer's suggestion for a level crossing at the Minto Bridge, Shri Karnail Singh said that this was neither possible nor desirable on a busy road like the Minto Road. He added that it should be possible for the Corporation to take adequate action to keep the bridge depression free from water-logging. Shri Rao stated that the Railways had constructed a bund to divert the water into the existing intercepting drain in the Connaught Circus area, thus preventing it from going and accumulating under the Minto Bridge.

The Chairman asked the Corporation Engineer for a report on the action taken, and proposed to be taken by the Corporation authorities.

(Action : Shri Rijhwani and Lokhande).

10. The Chairman said that he had seen he large accumulation of water in the Lodi Gardens area in what was said to be at one time the bed of the Jamuna. He suggested that the possibility of having a lake there by deepening and widening the existing depression would be worth looking. into. Shri Pandit stated that the excavation of the lake in the area might give rise to the breeding of flies and mosquitoes. Shri Mukharji said that some lakes and natural ponds had been formed as a result of quarrying, but the problem of replenishment of their water was difficult to solve. The same problem might be experienced in the case of the proposed lake in the Lodi Gardens. However, the suggestion should be pursued.

(Action : Shri Rijhwani).

11. A note by the Chief Engineer on the problem, presented by the Dariya-e-Nallah, was then discussed. Shri Karnail singh stated that, even during the peak period of the flood, the difference in the level of water under the railway culvert near the Rohtak Road colony, was only 7". He was, therefore, of the opinion that no widening of the culvert was really necessary but that the sewer passing under the culvert had aggravated the situation and should be shifted. Shri Lokhande thought that the problem of shifting the sewer would not be an easy one as it would have to be laid elsewhere, again under another railway culvert. Shri Karnail Singh's answer was that the work of removal of the sewer should be left to the Railway authorities.

The Chairman suggested that Shri Karnail Singh or his nominee, the Chief Engineer and Shri Lokhande should examine the problem of drainage of the low-lying areas in the Rohtak Road colony and make concerete proposals. Shri Karnail Singh agreed that the Railways would build a separate railway bridge, if found necessary.

(Action : General Manager, Northern Rly.).

12. Shri Pandit referred to a letter published in the Statesman of date, in which the writer had attributed the recent flooding to excessive building in New Delhi. This will be examined separately.

13. A note prepared by Shri Nayak on the damage caused by the overflowing of the Sonehrapul Nallah was then discussed. In the note, it was stated that the damaged portion of the nullah could be repaired only after the trunk sewer from the Delhi Gate to the Ring Road had been completed, resulting in a reduction in the load in the main sewers and then diverting the sewage through a cross connection. Shri Nayak said that this would take between 18 and 24 months. The Chief Engineer and his technical sub-committee were asked to look into the question as to whether anything could be done in the matter, pending the laying of the trunk sewer from the Delhi Gate to the Ring Road.

(Action : Shri Rijhwani)

14. Shri Pandit referred to the problem of demolition of unsound buildings. He said, that, under the Slum Clearance Act, notices were issued to owners to repair their houses which should really have been pulled down. Some minor

repairs only were carried out by the owners. These were not enough to prevent their collapse. After a brief discussion, it was decided that the matter would be considered separately.

15. The Chairman referred to the problem affecting the rural areas of Delhi. He asked Shri Pandit for a list of villages liable to floods and also for a note, explaining the problem.

(Action : Shri Pandit)

16. Shri Rijhwani stated that most of the works referred to by Shri Ahuja in his report on the inspection of flood embankments, had already been completed. Shri Sachdev read out the Chief Engineer's note on the action taken in this regard.

17. Shri Pillai suggested that the possibility of forming a lake in the Shahdara area, where flood threats were endemic, should be investigated.

(Action : Shri Lokhande)

18. In the course of the discussion on the work of the *Ad hoc* Committee on Sub-Soil Water Level, Shri Rijhwani pointed out that between June 1957 and June 1958, there had been a slight drop in the sub-soil water table in the badly affected areas, whereas the table rose in the moderately affected areas. Shri Pillai thought that the data collected by the *Ad hoc* Committee were inadequate for coming to any definite conclusions about the various factors contributing to the rise of sub-soil water table. In this connection, the Chairman reiterated his earlier suggestion for the control of the use of unfiltered water for irrigation of lawns, etc. He directed that the Chief Engineer should carry out experiments by using sprinklers in a few selected areas. Shri Mukharji pointed out certain practical diffculties in using sprinklers. But the Chairman felt that some experiments would be useful and this should be carried out in the Prime Minister's House, the Central Vista and in his (Chairman's) house. The Chief Engineer would submit a report after the experiments had been carried out over a period of time.

(Action : Shri Rijhwani)

19. The next meeting of the Committee would be held at 9-30 A.M. on the 9th August, 1958, to consider a draft interim report to be submitted to Government.

S. CHAUDHURI,
Deputy Secretary to the Govt. of India.

ANNEXURE IV

According to the information collected so far, the following buildings and areas were affected by the recent floods :—

1. *Krishi Bhavan.*—Rain water accumulated on the Talkatora, Old Mill and Raisina Roads, rushed into this building and flooded its basements. The Executive Engineer in charge of the building who lives in the nearby Raisina Hostel, saw the invading waters, early in the morning. There were pumps fixed in the basement for pumping out rain water. These pumps were pumping out water upto 4 A.M. when sudden on-rush of water from outside submerged them. The filtered water tank and the pumping unit for the rain water also got submerged. Immediately pumps of the C.P.W.D. Fire Brigade were put in commission to pump out the flood waters. Another 20 pumps of various capacities were brought in and they worked non-stop for 48 hours and clreared all the basements and the grounds. No damage was caused to the structure any-where. Temporary arrangements were made for supply of electric energy and filtered water for the office. All accesses to the basements have been sealed by building small masonry walls across the six courtyards. An additional 6" dia. delivery pipe is going to be provided for the existing sump. The C.P.W.D. Fire Brigade pumps have been put on 24 hour duty. The submerged pumps are at present being repaired. Additional pumps have also been put on the ground near the sumps. There are two sumps into which rain water from the courts and the basement is collected by a system of covered drains provided for the purpose. The pumping units for rain water referred to above, pump the water from the sumps which consist of 4 electric pumps having an arrangements normal capacity of 60,000 gallons per hour which could, in an emergency, be augmented to 90,000 gallons per hour. The pumps are designed to pump rain water off the courts and the strip of land in the immediate vicinity of the plinth wall all round the building. On the morning of the 21st however, due to unprecedented rainfall accumulated water poured in from outside areas along the Talkatora Road, Old Mill Road, Raisina Road, etc., into the compound and the basement. The pumps were not expected to cope with this situation.

2. *Pandara Road Flats.*—Water got into a few quarters and stood about 3" deep on the floors. The colony was, however, got cleared of water in about 12 hours. No building sustained any damage

3. *The D.G.S. & D. Hutments.*—About 40 rooms of these office hutments which were constructed to temporary specifications during the war and which have already long outlived their life developed cracks as a result of rain water, which accumulated there due to the incapacity of the underground drain (passing through the hutments area) to carry all the discharge contributed by the Shahjahan Road drains. The area was cleared after 12 hours. The underground drain is being cleared. The affected rooms are being vacated and repairs are being attended to.

4. *The All India Radio multi-storeyed building on the Parliament Street.*—The rain water, accumulated on the Parliament Street, found its way into the basement of this building through its ventilators. That water was pumped out quickly and the ventilators sealed off temporarily. No damage was caused. It is proposed to provide dwarf walls in front of the ventilators or to close the latter and then resort to artificial ventilation to make the basement useable.

According to the original plan, no basement had been provided. While the building was under construction it was found that subsoil under one wing was of a treacherous nature, which made a deeper foundation necessary. In order to make good use of the deeper foundations, a basement was provided in the wing. As the roof of that basement had to be kept at plinth level, which was not very much above the general ground level outside ventilators had to be provided at low level for neces ary ventilation. During normal rains, there was no chance for the water to find entry into the basements through the ventilators.

It was due to the piling up of water as a result of the very hign intensity of shower that some quantity of water found its way through the ventilators down to the basements.

5. *Gandhi Sangrahalaya* —A portion of the Compound wall fell down causing damage to the extent of Rs. 3000-/ approximately.

6. *City Extension area.*—A few houses on the Nurjahan Road, Press Road and Turkman Road stood in about 2′ depth of water, but no damage was caused.

7. *G.O.I. Press Building.*—Water got into one of its godowns. No damage was caused to the buildings but some paper materials that lay on the floor were damaged.

8. *Fire Brigade Lane, Barakhamba Lane, Atul Grove Lane, Ferozeshah Road and Canning Lane* .—Rain water got into a few quarters in those places also, including the basement of the Connaught Place Telephone Exchange building. No damage, however, was caused to the building.

9. *King Edward Road, York Road and Sonehri Bagh Road areas* .—Road side drains in these areas had swollen to the maximum, but became clear by the evening of 21-7-58. The lawns of bungalows 5-Sonehri Bagh Road and 3 & 5 York Road, however, carried about 6″ deep water for two days. Compound walls of those bungalows had to be broken by the servants of their tenants to provide quick passage to the trapped water. The buildings were not damaged by the rain water.

10. *Hastings Road, Ashoka Road & Akbar Road* .—Some of the very old servants quartars on those roads developed cracks *e.g.* those attached to 4 & 6 Hasting Road, 12 Akbar Road. They will have to be surveyed and possibly removed.

11. *Mansingh Road.* .—The areas on this road including the compounds of the Princely houses and the nutments attached thereto (Kotah House, Jaisalmer House, Dholpur House) were flooded. Whereas the temporary structures had 3″ rain water standing over their floors, the main buildings were free from flooding. In the Dholpur House, pavement of a room sank-down as a result of this the partition walls standing thereon developed some cracks. This damage will be made good at a cost of about Rs. 1,500/-. In the Jaisalmer House, a temporary cycle shed collapsed and will have to be re-erected.

12. *C.B.R Building and other buildings.*—The Nullah running by the side of Dr. Sen's Nursing Home in the Indraprastha Estate breached. According to unconfirmed reports the Nullah had been breached by the unauthorized squatters on the other side of the Nullah to prevent flooding on their side. The water gushing out of the breach spread over the whole area including the plot bearing the C.B.R. building. Due to continuous rainfall the level of this water rose to about 3′. On this account a few inches water stood on the floors of the C.B.R. building also. No damage to the building or any other property in the C.B.R. building occurred. The breach of the nullan has been closed. As a permanent measure the bund is being strengthened. There is also a proposal to replace the open drain by a covered barrel.

As a permanent arrangement it is proposed to instal pumps for pumping out the rain water, which will be collected in a sump by means of a drainage system, which is under construction. When the pumps are installed the drainage arrangement of this area will be adequate.

The flooding water surrounded the A.G.C.R. building also, but it did not get to its floors. The building was not damaged.

Minor damage was suffered by the stone pitching at the back of the Comptroller and Auditor General's Office Building.

13. *129 acre plot on the south of the Hindustan Housing Factory* .—In two blocks, open paved platforms subsided. The contractor is making good this damage and the work is in progress.

14. *The 104 acres plot on the North of Medical Enclave.*—There was no accumulation of water here. The nalla embankment requires to be pitched as a precaution against the possible erosion in the future.

15. *The All India Medical Institute.*—Rain water entered the basement of the Preclinical Block through the opening in the basement below the Lecture Theatre, which has later on to be extended to the Teaching Block to be taken up in Phase II. All water was pumped out immediately. Some departmental electric stores however got wet. This damage is worth about Rs. 1000/- only. The opening has been sealed up now. No damage was caused to the structure. Electric energy to this block was interrupted for a day. The pumping unit that raised water to the overhead tank got affected but it was repaired and put into commission in 4 days time.

16. *The Zoological Park.*—This park spreads over about 200 acres of swampy land and does not, at present, command efficient system of drainage due to the presence of a Railway track behind it. The pavement level of the existing culvert No. 15 on the main railway line is too high and therefore cannot admit of efficient drainage of water. The result of this was that the low lying areas, pools, ponds and streams existing in the park area got flooded with rain water contributed by Purana Quila, Sundernagar and Sunder Nursery. The Structures as well as animals, including their enclosures were safe. The approaches to a few culverts however settled down to a certain extent. Arrangements are proposed to be made for improving the drainage system of the park permanently.

17. *Delhi Mathura Road.*—The 27 feet high approach (Mathura side) to the recently built over-bridge (having maximum embankment height of 35 ft.) across the American warehouse railway line and the Delhi Mathura main railway line, settled down by about $1\frac{1}{2}'$ in a length of about 100 feet. The flowing rain water also scoured the embankment in a length of about 95′ near one of the railway bridges. While the western carriageway was being repaired, the eastern one was opened to traffic within 24 hours. The total damage is estimated to cost about Rs. 5000/-. All bridges there are perfectly safe.

Two arch culverts—one in mile 9/1 and the other in 10/3 suffered damage on their downstream side. Both the culverts will be reconstructed after the Ministry of Transport gives their designs taking into consideration the recent heavy rains.

18. The Bund from Shah Alam Bridge to the Coronation pillar breached at three places—one near the escape channel from the Najafgarh drain and the other two near the sluices provided in the Bund for the drainage. All the three breaches have since been repaired by the C.P.W.D.

19. *The Rehabilitation Colonies.*—The drainage of all the Rehabilitation colonies was designed by the C.P.W.D. for a runoff of $\frac{1}{2}''$ per hour for the plains and $\frac{3}{4}''$ runoff per hour for the rocky areas like New Rajinder Nagar. Out of the 22 rehabilitation colonies, only five got flooded as explained below :—

(*a*) *Lajpat Nagar* :—An open drain passes through the colony and meets the Barapula Nalla. Across this Nalla, there are several road bridges besides one railway bridge. Due to the unprecedented rainfall, the nalla burst its banks, where the local residents had removed the earth area, and over flowed at several low-lying places. The Railway bridge will have to be widened and the two road bridges nearby remodelled.

(*b*) *Jangpura* :—The above mentioned nalla, passing through Lajpat Nagar also passes through Jangpura where it overflowed its banks specially at its junction with the Barapula nalla. The banks then will have to be raised with due regard to the flood levels during the recent heavy rains.

(*c*) *Nizamuddin* : On the left bank of Barapula nalla there are three culverts which had been constructed long back presumably to drain away water of the Nizamuddin area into Barapula nalla when water in the latter is low. When water in the Barapula nalla is high, rain water of the colony cannot get therein. On the contrary the Barapula halla discharges its contents into the colony. This is why Nizamuddin remained flooded for some time till water in Barapula nalla subsided. The only remedy for this will be to clear the bed and banks of the Barapula nalla to increase its efficiency and also to provide all the three culverts with gates which

will have to be manually operated during the rains. It may be added that when the water in the Barapula nalla is high, rain water accumulated in this colony will have to wait till water in the nalla subsides. A solution appears to be in providing a permanent pumping plant there to deal with the rain water when level in the Barapula nalla cannot admit the drainage of the Nizamuddin area.

(*d*) *Sarai Rohilla* :—This colony got flooded with the water contributed by the high lying railway area. There is no proper outlet for this area. The drainage system of the colony will have to be reorganised by the Delhi Corporation.

(*e*) *Gandhi Nagar* :—This colony was developed beyond the left bank of the river Jumna where water gets impounded between the river embankment and the road. The drainage of this colony will be effected by pumping out rain water over the embankment into the river Jumna. The pumping units will be installed shortly. The Delhi Corporation are also looking into the problem of this colony.

Apart from the above a few roads and their katcha berms in the various colonies got damaged due to the rush of rain water. Also brick pitching in the same open drains slipped at several places in various colonies.

In old Delhi, the stone pitching of the Daryai Nalla (locally known as Ganda Nalla) slipped at several places. The nalla over-flowed its banks in the section between Rohtak road and the Railway line and flooded the area around causing damage to buildings there.

ANNEXURE V

A meeting was held on the 24th July, 1958 in the room of the Chief Engineer, Central P. W. D. to consider the problem of emergent repairs and maintenance of storm water drains and nallahs draining, New Delhi and the Rehabilitated colonies in the Corporation area necessitated by the recent heavy rains. The following officers were present :—

1. Shri J. M. Rijhwani, Chief Engineer, Central P.W.D.
2. Shri Venkatasubhan, Ministry of Health.
3. Shri Kandaswamy.) Central P. W. D.
4. Shri Desraj.)
5. Shri Harbajan Singh.)
6. Shri Sadarangani.)
7. Shri Lokhande, Delhi Municipal Corporation.
8. Shri Bhatia, New Delhi Municipal Committee.
9. Shri Krishnaswamy, D. G. H. & S.
10. Shri Y. S. Ramaswamy, P. A. (M) C.P.W.D.

Initiating the discussions Shri Rijhwani stated that it would be necessary to have an inspection of all the main Nallahs draining the area with a view to undertaking any emergent repairs that may be necessary to keep them functioning efficiently. The Chief Engineer further stated that emergent works like repairs to banks, strengthening of bunds and silt clearance and removing of obstruction may be taken up by the respective Divisions assigned duties as per the decisions in the meeting, in consultation with the S. Es. A report on the work involved and approx. expenditure likely to be incurred should be made available at the next meeting. A list of nallahs was then provided and this was considered in detail.

1. *Kerbla out-fall drain.*

This drain runs from Jorbagh up to its junction with Kushak Nallah.

It was stated that this drain was desilted in 1957 but it was decided that a check may be made now to see whether the drain has silted up again. This year there was stagnation of water in the Jorbagh area. E. E. Services Division will examine this drain and take necessary action.

(Action : E. E. Services Division).

2. *Sunehrapul outfall drain ; starting from Lodi Road to Barapulla Nallah.*

It was stated that this Nallah is intercepted by a sewer, which has burst and has not been repaired effectively. This may be examined and suitable measures taken to avoid the discharge of sewer into the Nallah.

(Action : E. E. Services Division).

3. *Drain No. 15 behind Sunder Nagar, near the Zoo.*

Shri Lokhande stated that this drain is also silted up. But there was no trouble of water stagnation in the Sunder Nagar area. The drain may be examined and any further improvement required dealt on a long term basis.

4. *Drain along Mathura Road passing through Exhibition ground.*

It was decided that this drain should be inspected and any remedial measures required taken by the E. E. Sub-Soil Water Investigation Divn.

(Action : E. E. Sub-Soil Water Investigation Divn).

5. *Storm water drain along Dr. Sen's Nursing home from Mathura Road.*

Shri Sadarangari, E. E. Services Division stated that there is no silting up of the drain except in a short length in the last reach. This may be inspected

in detail and desilted if necessary. Any strengthening of the banks required should also be done so that there is no further breach.

(Action : E. E. Services Division)

6. *Low level drain passing at the back of C. B. R. Building.*

E. E. Services Divn. stated that it was necessary to temporarily widen the Syphen Chamber on the down stream side to drain off the water quickly. The Chief Engineer suggested that if it is necessary to widen the down stream chamber for better discharge this may be done as a permanent measure.

(Action : E. E. Services Divn.).

7. *Storm Water Drain.*

Starting from P. K. Road, Cremation grounds up to Sunehera Pul running at the back of Teen Murthi Lane to Khushak Nallah.

Chief Engineer stated that S. E. Second Circle, has already been directed to inspect and take necessary action to desilt remove obstruction and repairs to banks wherever necessary for the head reach.

(Action : S. E. Second Circle).

8. *Storm water drain.*

Starting from the back of the Refugee Market, Lodi Colony to its junction with Sunehra Pul outfall drain.

This drain may be inspected and necessary action taken if there is any silting of the drain.

(Action : E. E. Services Division).

9. *Kushak Nalla.*

This drain falls into Chirakh Nalla. It was decided that this drain alongwith Chirakh Nalla should be inspected in detail and if there is any breach or silting up, the same should be attended to immediately.

(Action : S. E. III Circle and E. E. Constn. Divn. No. III).

10. *Barapura Nalla.*

It was decided that this Nalla should also be inspected in detail and suitable action to close breach or desilting wherever necessary should be attended to immediately.

(Action: E. E. Reh. III).

11. *Drain from Lajpatnagar to Jangpura.*

This drain should also be inspected in detail and necessary action taken.

(Action: E. E. Reh. III).

12. *Darayala Nallaha.*

Shri Lokanda stated that this nallaha is damaged badly. This should be inspected and necessary action taken. Chief. Engineer stated that he had already instructed and detailed Executive Engineer, Constn. Divn. No. III to do the needful. Shri Lokanda may intimate action required to E. E. Constn. Divn. III.

(Action : Shri Lokanda—S. E. III and E. E. Constn. III).

13. *Outfall Channel No. II.*

It was decided that E. E. Sub-Soil Water Investigation Divn. should inspect this and take necessary action for desilting if necessary.

(Action : E. E. Sub Soil Water Divn.).

14. *City Ditch.*

It was decided that this needs inspection and desilting immediately. There are some baffle walls in the drain which should also be examined to see that this does not obstruct the free flow of water. It was also stated that there is an over flow of sewer at the back of Hardinge avenue, which would be examined by Shri Lokhande. Any necessary technical help will be given by the C.P.W.D.

(Action : Shri Lokhande)

15. *Najafgarh Drain.*

The Najafgarh drain should be inspected in detail by S. E. Delhi State Circle for any action required to close breaches, desilting etc. The Ex. Engineer, Development Divn. should inspect and take similar action with respect to all drains connecting the Rehabilitation Colonies to the Najafgarh Nallah.

(Action S. E. Delhi State Circle, E. E. Devl. Divn.)

16. In addition to these main drains a list of Intra Mural Drains was also read out and it was stated by the Medical Officer, NDMC, that all these drains were functioning properly. In the case of the following drains which further checking up should be made.

Drain on Keeling lane.
Drain on Market Road drain.
Drain on Aurambagh.
Drain on Chitragupta Road.
Drain on Cornwallis Road along Bungalow 7 to 28.
Drain on Rajendra Road.
Drain on Prithviraj Road.

Shri Bhatia and Shri Lokhande will report at the next meeting action taken to clear these drains.

(Action : Shri Bhatia and Lokhande).

17. It was stated at the meeting that the silt removed from the drains are not removed away from the site resulting in silting up of the drain and obstructing water entering the drain. Shri Bhatia stated that the silt removed is being carted away as expeditiously as possible.

18. Chief Engineer suggested that the Link drains between roads and storm water drains need check on a high priority as in some cases the water has been obstructed by the silting up of the Link drains.

(Action : Shri Bhatia)

Chief Engineer also suggested as a long term measure that on important roads Lenier covered drains may be provided at the curbs so that the water from the roads is drained into this and water out from the beams goes to the side drains.

19. The officers present then intimated the following local spots where water accumulation was predominant for necessary examination.

Local spots.

1. Fire Brigade Lane.
2. Prithvi Raj Road.
3. Hardinge Road.
4. Rajinder Road.
5. Jorbagh Nursury.
6. Trathi Islands, Akbar Road.
7. Shahjahan Road.
8. Lajpatnagar.
9. Nizamuddin.
10. Gole Market.
11. Lawrence Square.
12. Manakpura.

13. Chorri Junction.
14. Faij Road.
15. Kashmeri Bagh.
16. Barakhadi Khana.
17. Pandara Road.
18. Kaka Nagar.
19. Market Road.
20. Ferojshah Road, M. P.'s Qr.
21. Nai Basti.
22. Rana Pratap Bagh (Back flow from Najafgarh Nalla).
23. Electric Lane.
24. Chandraval village.
25. Gurki Mandi.
26. Rajpur village.
27. Kingsway Camp (Rehn. Colony).
28. Dhaka Village.
29. Military Parade Road.
30. Najafgarh Pumping Station.
31. Krishi Bhavan.
32. Minto Road Bridge.
33. Queensway
34. York Place.
35. Sarai Rohilla.
36. Fej Road.

Then will be considered of another Committee.

20. The next meeting of the Committee will be held on Monday the 28th at 10-30 A.M. in the Chief Engineer's Room. It is requested that the action taken should be intimated to P. A. (M) before that day.

It is to be noted that action has to be taken three-fold.

(*i*) To report on emergent repairs required by way of repairs to banks, breaches, desilting and removing obstructions.

(*ii*) To take up the work of emergent repairs in anticipation of sanction. The officers will report the approximate value of the work involved and at the same time they will report in the next meeting the work completed by them.

(*iii*) To report if any long term improvements are required by way of widening sanctions or strengthening and raising banks or desilting on a large scale.

As the work is being authorised to be carried out in anticipation of sanction, it should be the responsibility of the Executive Engineers to ensure that minimum essential work is done in the most economical ways. It will be the responsibility of the Superintending Engineer to check this activity of the Executive Engineers for doing these emergent works.

ANNEXURE VI

The Second Meeting of the Sub-Committee to consider the problem of emergent repairs and maintenance of storm water drains and nallahs in Delhi and New Delhi was held on Monday the 28th July at 10.30 A.M. The following officers were present:—

1. Shri J. M. Rijhwani, Chief Engineer, Central P.W.D.
2. Shri A. V. Venkatasubhan, Dy. Secy., Min. of Health.
3. Shri Krishnaswamy, D.G.H.S.
4. Shri N. N. Khanna, S.E. 1st Circle.
5. Shri Swami Dial, S.E. Second Circle.
6. Shri N. S. L. Rao, S.E. Third Circle.
7. Shri Harbajan Singh, S.E. Reh. Circle.
8. Shri Kandaswamy, S.S.W. (C.Z.).
9. Shri Sandarangani, E.E. Services Divn.
10. Shri T. S. Sodhi, E.E. Constn. Divn. III.
11. Shri Y. S. Ramaswamy, P.A. (M) to A.C.E. (C).

The report of the officers concerned regarding the respective works entrusted to them was then considered.

1. *Karbla out-fall drain.*

Shri Sadarangani, E.E. Services Divn. stated that the first reach of 100' of this drain was cleared last year. This has silted up again to about a foot depth. The desilting is now being carried out. The banks and bed slopes are alright but in certain portions the pitching needs repairs. The desilting and repairs were estimated to cost approximate Rs. 1,000. The Chief Engineer authorised the Executive Engineer to go ahead with these repairs and to send estimate in proper form through his S.E. for necessary sanction.

(Action : S.E. 1st Circle/E.E. Services Divn.)

Shri Sadarangani further stated that the storm water drain along the Safderjung tomb and Qutab Road which actually forms the head reach of Karbla Nala is also silted badly. This is being cleaned and the work will be completed in a day or two.

It was further stated by E.E. Services Divn. that the possible causes of flooding in Jor Bagh area was due to (a) Local (b) Flat slope of Karbla Nala (c) inadequate water way of a culvert on Qutab Road. As regards (c) it was stated that due to inadequate water way, the water from the aerodrome side flowed over the road and entered the Jor Bagh area which is lower than the Qutab Road. However, any redesigning of the culvert on the road will have to be considered along with proposals of widening of the Qutab Road and also the design data of run off which has to be decided by the other Technical Committee constituted for this purpose.

As regards the flat slope, this aspect also falls within the perview of the technical Committee for checking adequacy of drains draining particular areas. Chief Engineer desired that S.S.W. (C.Z.) should keep these in view to tackle the problem as a long term measure.

[Action : S.S.W. (C.Z.)]

2. *Sunchrapul outfall drain, starting from Lodi Road to Barapulla Nallaha.*

It was stated by E.E. Services Divn. that there is sewerage overflow into this nala. This may be due to the capacity of trunk sewer not being adequate. This will have to be cnecked up and proper remedial measures taken by the Delhi Corporation. It was felt that this should be examined by Shri R.S. Mehra, C.E. (Water Works) Municipal Corporation and report sent to the Technical Committee.

[Action : Shri R. S. Mehta, & S.S.W. (C)]

3. *Drain No. 15 behind Sunder Nagar near the Zoo.*

The E.E. Services Divn. stated that he has examined this drain and that it is functioning properly. Though long term improvements will have to be done to protect the zoo ground.

4. *Drain along Mathura Road passing through the Exhibition Ground.*

It was reported that this nala has silted up to a depth of 6" to 9" practically throughout its length, and that there is obstruction by way of wild vegetation growth and that at a few places the earthen banks along with pitching has slipped thereby blocking the drain to some extent. It was further reported that a culvert on this nala in the exhibition ground has been provided with 3 Nos. 24" di. pipes which is not adequate to discharge the water flowing in the nala.

It was decided that E.E. Sub Soil Water Divn. should immediately undertake the repairs to pitching banks and removing of obstructions.

[Action : E.E. Sub-Soil Water Divn./S.E. 1st Circle].

As regards the redesigning of the culvert, it was decided that this work should also be taken on hand immediately. The E.E. Services Divn. should work out the design and estimate of the culvert and get it approved by S.S.W. (C.Z.) before taking up the work on hand.

[Action : E.E. Services Divn./S.E. 1st Circle].

5. *Storm water drain along Dr. Sen's Nursing Home from Mathura Road.*

It was stated by E.E. Services Divn. that on an inspection of the entire length of drain, it was noticed that practically the entire length of about 5000' of nallaha needs desilting.

The Chief Engineer stated that he had already issued instructions that the present banks should be strengthened by increasing its height adequatly considering to have at least 2' free board above the hignest flood level now noticed. The banks should be first raised to a width of 4' and then to full width.

It was further suggested that it would be necessary to cover this entire length of drain as a long term measure. This will take time and hence the banks should be properly strengthened for a free-flow of 4' and with a cover of 2' over saturation line 1 to 6. For this estimate should be sent.

The cost of desilting was reported to be about Rs. 16,000/- and raising of the banks would be extra.

The Chief Engineer suggested that the silt clearance may be done only in the last reach for a few hundred feet and necessary estimates submitted for raising of the banks. Proper petroling to be done day and night against breaches and artificial cuts.

(Action : E.E. Services Divn./S.E. 1st Circle).

6. *Low level drain passing at the back of C.B.R. Building.*

Shri Swami Dial, S.E., Second Circle, stated that arrangements for fixing a pump near the sump well of the syphon was being completed by the S.E., Cent. Elect. Circle.

The Chief Engineer desired that this should be done mimediately and E.E. K-Divn. should be made responsible to ensure that this pumping arrangement is in proper condition at all times. Chief Engineer further stated that the sluice gates at the down stream side of the syphon to prevent river water entering the drain when the river is in flood, should also be widened along with the widening of the chamber and he particularly stressed that S.E.'s I and II Circle should jointly be responsible to ensure that this sluice is in perfect working condition.

As an additional precaution, he suggested that it may be worthwhile having a second control on the drain in case the sluice does not work in times of river flooding. For this needles could be provided.

(Action: S.E. 1st Circle/S.E. Second Circle).

7. *Storm water Drain.*

Starting from P.K. Road, Cremation Grounds up to Sunehera Pul running at the back of Teen Murti Lane to Khushak Nallaha.

Shri Swami Dial, S.E. Second Circle, stated that there was a breach behind M.B. High School which has now been closed. He further stated that labour has been employed for removing obstructions wherever required.

S.E., Second Circle stated that proper Section of the drain cannot be maintained, due to quarying operation going on by the edge of the drain. It was decided that the Municipal Corporation or Chief Commissioner should be addressed to ensure that quarying operations are stopped forthwith for at least 500' from the edge of the drain.

[Action : S.E. Second Circle,. A.C.E.(C) for quary operation.]

Incidently it was also suggested that the coolie camp in this area should be shifted from its present site to a higher reach which should be at least 5' above the highest flood level.

(Action : Shri A.V. Venkatasubhan and N.D.M.C.)

There is a culvert behind Madrasi School on this drain which has not got adequate water way. This culvert has been constructed by the school authorities and it should be reconstructed with adequate water way by the school authorities. E.E. Services Divn. should prepare necessary estimate to reconstruct and carry out the work at the cost of the school authorities, if they pay for it. In the meantime it should be dismentled.

(Action : E.E. Services Divn./S.E. 1st Circle).

It was pointed out that the Section from D.A.V. School to Birla Mandir needed regrading and resectioning. It would be difficult to undertake regrading of the drain but this may be overcome by raising banks on both sides to ensure that water flows towards Talkatora Garden side.

(Action : E.E. Services Divn./S.E. 1st Circle & S.E. II).

Item 8. *Storm water drain starting from the back of the refugee market, Lodi Colony to its junction with Sunehra Pul.*

This is a kutcha nallaha and it has silted up. The desilting of the nallaha should be undertaken immediately.

(Action : E.E. Services Divn./S.E. First Circle).

The Nallaha has been diverted at the outskirt of the premises of the police lines by a 4' barrel. It may be examined whether the size of barrel is adequate.

(Action : E.E. Services Divn./S.E. First Circle).

Item 9. *Kushak Nallaha.*

S.E. IIIrd Circle, stated that this Nallaha was functioning properly except that 3 cuts were made into the nallaha in Nijamuddin to allow the flood water to flow into the drain. It was stated that these breaches had since been closed.

Chief Engineer observed that it may be necessary to provide some pipe outlets with proper head works to adequately meet a similar situation if it arises at a later date. He desired that this work should be carried out after getting the design for the pipes checked by S.S.W. (C.Z.).

[Action : E.E. Constn. III/S.E. IIIrd Circle S.S.W. (C.Z.)]

Item No. 10. *Barapura Nallaha.*

S.E. Reh. Circle stated that he would inspect and report if any works are required at the next meeting.

(Action : S.E. Rehn. Circle).

Item No. 11. *Drain from Lajpatnagar to Jungpura.*

S.E. Rehn. Circle stated that there have been a number of breaches and drainage to banks and pitching along this nala. There is also silting up at curves. It was stated that work of desilting repairs to banks and pitching had been taken on hand. The approx. cost of repair work involved is about Rs. 3,000. S.E. Rehn. Circle was requested to get the repair work completed immediately. It

was suggested that S.E. Rehn. Circle should examine whether the junction of the drain with Kushak Nallaha needed any realignment as a long term measure.

(Action : S.E. Rehn. Circle).

Item No. 12. *Darayala Nala.*

This nala has been inspected by S.E. IIIrd Circle along with Shri Dutt. It was stated that the Municipal Corporation would carry out the desilting of the entire length of the nallaha and any repairs to pitching etc. required for the length of drain between New Rohtak Road and Old Rohtak Road.

It was further stated that the Corporation want the C.P.W.D. to repair the broken pitching from Old Rohtak Road to Ayad Kutcha Road and also strengthen back at a few places. The approx. cost of repairs will be Rs. 8,000. S.E. IIIrd Circle was authorised to carry out the emergent work required and to submit necessary estimates for sanction.

(Action : S.E. IIIrd Circle).

Item No. 13. *Out-fall Channel No. II.*

The bed of this nallaha is silted up to about 6″ to 9″ except in the middle 1000′ stretch. There has been no major damage to the banks. There are only slight land slips from the banks which should be attended to by E.E. Sub-Soil Water Divn.

(Action : E.E. Sub-Soil Water Div./S.E. 1st Circle).

Item No. 14. *City Ditch.*

As Shri Lokhande was not present, this item will be considered at the next meeting.

Item No. 15. *Najafgarh Drain.*

A part of this drain has been inspected by S.E. 3rd Circle and it has been reported that the Corporation desired that repairs to pitching for the drain from beyond G.T. Road should be undertaken by C.P.W.D. This work should be done by E.E. Delhi State Divn. No. I in consultation with S.E. Delhi State Circle.

The length of Najafgarh drain should be inspected by S.E. Delhi State Circle for necessary action.

(Action : E.E. Delhi State I/S.E. Delhi State Circle).

Item No. 16. *Intra Mural Drains.*

Shri A. V. Venkatasubhan stated that he had inspected all these drains along with Shri Bhatia and that they are functioning properly now.

Item No. 18. *Link Drains.*

Shri A. V. Venkatasubhan stated that he has inspected a few of the link drains and has seen them working properly.

Before concluding the meeting Chief Engineer observed that in considering further development of land in Delhi it would be essential to provide breaching sections into open land for all Nallahas, so that at times when heavy rainfall and floods in the river synchronise it may be possible to meet the situation by allowing water to spread over certain open spaces and thus prevent back flow of water from the river. S.S.W. (C.Z.) was asked to keep this in view, when question is discussed in the technical committee.

[Action : S.S.W. (C.Z.)].

It was agreed that the next meeting of the Committee will be held in the Chief Engineer's room, 'L' Block, on Thursday, the 31st July, 1958 at 10 A.M.

Y. S. RAMASWAMY,
For Addl. Chief Engineer (C).
30-7-1958.

ANNEXURE VII

The third meeting of the Sub-Committee to consider the problem of emergent repairs and maintenance of stormwater drains and nallahs in Delhi/New Delhi was held on Thursday 30th July at 11 A.M. in the Conference Room, 'L' Block. The following officers were present:—

1. Shri N. N. Khanna, S.E. First Circle.
2. Shri Swami Dayal, S.E. Second Circle.
3. Shri Harbhajan Singh, S.E. Rehabilitation Circle.
4. Shri Y. S. Ramaswamy, P.A. (M).

The minutes of the 2nd meeting were read over and the position of works as far as the officers present were concerned were noted:—

1. Drain along Mathura Road passing through the Exhibition Grounds: Removing of major obstructions for the free flow of water is on hand and will be completed in a day or two.

2. Stormwater drain along Dr. Sen's Nursing Home from Mathura Road.

Shri Swami Dayal stated that he has learnt that the breach on this drain was due to an artificial cut made by the labourers living close to the drain. The work of strengthening of the banks is in progress.

Proper patrol should be kept so that there are no chances for any outside agencies breaching the drains. In fact, strengthening should also be done on the labour colonies side so that they do not get threatened with any floods.

(Action : E. E. Services Division/S.E. 1st Circle.)

3. Low level drain passing at the back of C.B.R. Building.

S. Es. First and Second Circles have jointly inspected this drain. The floor level of the pump house is being raised above the high flood level. This will take a day or two for completion. Arrangements are also on hand to provide a second control on the drain as recommended by the Committee and also for the repairs to the syphon chamber.

(Action : S.E. 1st Circle/2nd Circle).

4. *Barapura Nallah*:

S.E. Rehabilitation Circle has inspected this drain and has reported that it has well defined banks upto the Railway bridge. The Nizamuddin area actually falls under Barapura Nallah and not under Khushak Nallah. The proposal to provide pipe outlets with head works to drain off Nizamuddin will be necessary on this Nallah.

This work must be taken in hand immediately if it has not been done so far.

The probable cost of desilting and removing obstructions will be approximately Rs. 1,000.

(Action : S.E., Rehabilitation Circle).

5. *Drain from Lajpatnagar to Jungpura.*

S.E. Rehabilitation Circle stated that the following works were required as a long term measure on this drain.

(*a*) Widening of waterways for Railway as well as Road culverts.
(*b*) Widening section of Nallah to take full discharge.
(*c*) Raise banks wherever found low during recent floods.
(*d*) The raising of banks should be taken up in hand, if it has not been done so far.

(Action : S.E. Reh. Circle).

As the other officers could not be present the discussion on other items in the proceedings of the Second Meeting was postponed to a later date.

Sd/- Y. S. RAMASWAMY,
P. A. to A. C. E. (C).

ANNEXURE VIII

Details of storm water drains and nallahs on which emergent repairs were carried out by Central P.W.D.

Serial No.	Name of Nallah	Locality	Conditions of Nallah after the heavy rain dated 20/21-7-58	Action taken — Recommended	Present progress	Remarks
1	Kerbla outfall drain	Jorbagh and Willingdon Aerodrome Area.	(*a*) Heavy silting 1st 100'.	(*a*) Desilting in 1st 100' and wherever necessary.	Completed.	
			(*b*) Drain along aerodrome on Qutab Road, full of rank vegetation and obstructions.	(*b*) Clearing of rank vegetation, and obstruction.	Do.	
			(*c*) Obstruction of flow by inadequate opening of a culvert on Qutab Road.	(*c*) Increase size of culverts openings.	(*c*) To be considered as a long term measure along with widening of Qutab Road or earlier if widening is delayed.	
2	Sunehrapul outfall drain from Lodi Road to Barapura Nallah.	Lodi Road, Shan Nagar, part of Golf Link area.	(*a*) Nallah functioned efficiently and there was no overflow.			
			(*b*) Sewerage overflow near wireless station site.	(*b*) Corporation Engineers requested to examine and take remedial measures.	Report received from the Corporation Engineer under consideration of the Committee.	This overflow from the sewer does not affect the flow in the drain.
3	Kushak Nallah .	From Panchkuin Road upto Lodi Colony.	(*a*) Nallah functioned satifactorily in lower reaches.	(*b*) Closing of breaches immediately.	Completed.	
			(*b*) Repairs to damaged pitching.			
			(*c*) Two breaches.	(*c*) Repair damaged breaches.	Do.	
			(*d*) Strengthening the banks for the last 6 furlongs length.	(*d*) Strengthening banks wherever immediately necessary.	Works in progress.	
			(*e*) Slope in head reach of the nallah is defective.	(*e*) Regrading of the head reach.	Survey work completed and estimates and design under preparation.	

4	Barapura Nallah .	Jungpura Extension and Nizamuddin.	(*a*) Nallah flowed full.	(*a*) Section of Nallah to be checked.	(*a*) Will be considered along with other long term measures.	
			(*b*) Outfall drains from Nizamuddin into this failed to function due to rise of water upto the brim.	(*b*) Pipe outlets with proper head works to drain water from low lying areas in Nizamuddin.	(*b*) Work is being taken on hand.	
			(*c*) Silting up of Nallah in certain reaches.	(*c*) Desilting wherever necessary.	(*c*) Completed.	
5	Lajpatnagar Nallah .	Lajpatnagar and Junpgura.	(*a*) Nallah overflowed.	(*a*) Section of Nallah to be redesigned for greater discharge.	(*a*) Banks are being raised wherever necessary.	
			(*b*) Heading up of water particularly at Railway culvert.	(*b*) Railway culvert to be widened.	(*b*) Railways have agreed to widen the railway bridge after examination.	
			(*c*) Breaches in banks.	(*c*) Breaches to be closed.	(*c*) Completed.	
			(*d*) Collapsing of mouths of inlets of storm water channels.	(*d*) Repair inlets of storm water channels.	(*d*) Completed.	
			(*e*) Damage to brick pitching.	(*e*) Repair brick pitching.	(*e*) In progress.	Work hampered due to continuous rain.
			(*f*) Silting up at curves and in beds.	(*f*) Desilt wherever necessary.	(*f*) In progress.	
6	Drain No. 15 behind Sunder Nagar near the Zoo.	Sunder Nagar area.	(*a*) Nallah functioning satisfactorily.	(*a*) No action.		
			(*b*) The outlet level of the Railway culvert No. 15 is higher and needs to be lowered.	(*b*) Proper outlet should be provided.	(*b*) Will be dealt as a long term measure matter.	
7	Drain along Mathura Road passing through Extension Ground.	Purana Quilla and Stadium.	(*a*) Obstruction to flow by silting	(*a*) Obstructions to be removed.	Completed.	
			(*b*) Collapse of sides of banks.	(*b*) Sides to be repaired.	Completed work on hand.	Progress hampered on account of incessant rains.
			(*c*) Damage to pitching.	(*c*) Repair damaged pitching.		
8	Storm water drain in Inderprastha Estate (Hardinge Bridge Nallah).	(*a*) Breach of Nallah.	(*a*) Breaches to be repaired, and bank on C.B.R. building side raised to prevent further flooding.	(*a*) Completed.	In addition, pumping arrangement for pumping water where up in operation for low level drain.	
		(*b*) Silting up of low level drain.	(*b*) Desilting of low level drain.	(*b*) Completed.		

1	2	3	4	5	6	7
		(*c*) Silting up of storm water drain.	(*c*) Desilting of storm water drain.	(*c*) In progress. Work hampered due to back water from river in drain.		
		(*d*) Inadequate size of syphon to discharge water from low level drain.	(*d*) Syphon chamber to be widened.	(*d*) Completed.		
9	Daryala Nala	Rohtak Road and Sarai Rohilla.	(*a*) Breaches.	(*a*) Repair breaches and removing of obstruction.	(*a*) Work in hand 75% completed.	
			(*b*) Damage to pitching.	(*b*) Repair damaged pitching.	(*b*) Work in hand 75% completed.	
			(*c*) Overflow.	(*c*) (*i*) Diversion of the sewer from the bed of the culvert.	(*c*) (*i*), (*ii*), (*iii*) Rlys. and Corporation authorities have to take an agreed expeditious action. This will be long term arrangement.	
				(*ii*) Addl. openings in the embankment to give outlet to the rain water, and this reduce load in the Nallah.		
				(*iii*) Draining of the low pockets behind the fall.		
				(*iv*) Desilting of Nala.	(*iv*) Work taken up by the Corporation.	
10	Najafgarh Drain	Reh. Colonies and Old Delhi.	(*a*) Nallah functioned satisfactorily.			
			(*b*) Damage to pitching beyond G. T. Road.	(*b*) Damaged pitching to be repaired.	Work in hand.	
11	Storm water drain through Friends Colony.	Friends Colony.	(*a*) Nallah overflowed.	(*a*) Nallah to be redesigned.	(*a*) Will be investigated by the Technical Committee.	
			(*b*) Damage to pitching.	(*b*) Pitching to be repaired.	(*b*) Work in hand.	
			(*c*) Breaches on sides.	(*c*) Breaches to be closed.	(*c*) Work in hand.	
			(*d*) Overflow of Nallah aggravated by small size of opening of culvert on road within friends colony.	(*d*) Culvert to be redesigned and reconstructed.	(*d*) Work ordered to be taken up after proper design approved by SSW (N).	

ANNEXURE IX

Minutes of the meeting of the Technical Sub-Committee 'B' held on 25th July 1958 in the Conference Room, 'L' Block, New Delhi.

The following were present :—

1. Shri J. M. Rijhwani, Chief Engineer, Central P.W.D., New Delhi.
2. Shri B. K. Guha, Additional Chief Engineer, Northern Zone, C.P.W.D., New Delhi.
3. Shri O. Muthachen, Additional Chief Engineer, Central Zone, C.P.W.D., New Delhi.
4. Shri U. S. Rao, Dy. Chief Engineer, Northern Railway.
5. Shri P. R. Ahuja, Director, Cental Water and Power Commission.
6. Col. P. R. Kumar, Engineer-in-Chief's Branch.
7. Shri M. A. Lokhande, Drainage Engineer, Delhi Corporation.
8. Shri B. R. Shori, Superintending Engineer, C.W.P.C.
9. Shri Harbhajan Singh, Supdt. Engineer, Reh. Circle.
10. Shri Balbir Singh, Engineer Member, D.D.A.
11. Shri Des Raj, S.S.W. (Union Territory).
12. Capt. L. V. Ram Krishna, Representative of E-in-C's Branch, Army Headquarters.
13. Shri N. M. Malkani, S.S.W. (Northern Zone), C.P.W.D.
14. Shri N. N. Khanna, Supdg. Engineer, 1st Circle, C.P.W.D.
15. Shri Harbans Swarup, Executive Engineer, Subsoil Water Division, C.P.W.D.
16. Shri V. Kandaswamy, S.S. W.(Central Zone), C.P.W.D.

The Chairman, Shri Rijhwani welcoming the members explained the background leading to the constitution of this Technical Sub-Committee to deal with the problem of drainage of New Delhi and Delhi areas in general. The task is rather big and consists of drawing out both long and short term measures for preventing occurrence of floods not only in New Delhi but Old Delhi areas, as well. The immediate task of this Sub-Committee is to undertake survey of local spots subject to floods during rains and make recommendations for taking urgent steps to prevent such reoccurrence during the present monsoon.

To enable the Committee to proceed further it was decided that a proper contour plan of the entire area should be obtained. While the necessary contour plans for New Delhi area is available, contour plans of the other areas are not readily available. It was decided that the E-in-C's representative will collect the contour plans available for the Delhi Cantt. area while Shri Lokhande will send the contour plan for the Delhi town area. D.D.A's representative will make available the plans with them. Shri Shori of the C.W.P.C. said that he would make available all the contour plans of the rural Delhi area. All these plans will be sent to Shri Kandaswamy, Superintending Surveyor of Works, Central Zone, C.P.W.D., New Delhi. After obtaining these contour plan these flooded areas will be marked on these plans indicating separately areas with floods more than 8',4' to 8' and below 2-4' and 1-2' in separate colours. These plans should be made available to the Committee early. For a correct assessment of causes of floods it was necessary to collect this data and also details of drainage beyond the Delhi State area including the irrigation channels and escapes in the neighbourhoods.

(Action : M/s Lokhande, Shori & P. R. Kumar).

The Committee decided that a list of the localities subject to intensive flooding during the recent rains should be prepared and priority fixed for carrying out immediate works taking into consideration the importance of the locality and the depth of water. The list of areas subject to flooding during the heavy rains was then listed out as pointed out by the various members of the Committee as per Appendix "A".

It is also very necessary to collect the rain-fall data to arrive at proper conclusions and Shri Ahuja agreed to collect the above information from the Met. Department, analyse the data and prepare a note for consideration of the Committee. He also stated that inquiries from the Meteorological Department reveal that the maximum intensity of rainfall on 20th night was 2·5" per hour.

Then the Committee took up for consideration the areas in New Delhi which could not afford to be flooded and also considered the remedial measures to be taken. These areas were (*a*) Minto Road Bridge, (*b*) Area behind Telephone Exchange and (*c*) Queen Victoria Road.

Minto Road Bridge :

It was explained that it was very necessary to prevent storm water from the Rly. Yard and adjoining areas draining into the Minto Bridge depression. Usually the Minto Road Bridge gets flooded even with 1" rain fall. It is, therefore, very imperative to take measures to prevent large quantities of water from the Rly. Yard and the adjoining areas from draining into this depression. It was, therefore, decided that Shri Rao, Dy. Chief Engineer, Railway, Shri Khanna, Shri Lokhande and Shri Chatterjee of the N.D.M.C., should inspect the site and submit proposals for preventing the storm water finding its way into the Minto Bridge area. The report should be submitted to the Committee within 3 or 4 days for consideration. The report should include further precautions to be taken.

The possibility of providing a level crossing in this vicinity which could be used in an emergency, should also be considered by this Committee.

The pump installation should be such that in an emergency like this, it does not go out of order. Possibility of raising the motor, or providing vertical pumps or alternatively raising the walls of the Pump House and keeping the entrance to the Pump House at a level higher than the high flood level, should be examined.

(*Action*: M/s Rao, Khanna, Lokhande & Chatterjee).

Fire Brigade Lane :

This area should be kept clear of water to prevent the Telephone Exchange from getting flooded. The proposals for constructing a separate storm water drain behind the Fire Brigade Lane proposed in connection with the lowering of subsoil water was considered by the Committee. This drain is not likely to function efficiently in the present from and it was, therefore, suggested that possibility of taking it right across the Rly. Bund or alternatively providing a parallel drain along the Barakhamba Road should be examined. As a short term measure possibility of providing an open drain along the proposed covered drain behind the Fire Brigade Lane may also be considered. Shri Harbans Swarup was asked to investigate and send a note on this for consideration in the next meeting. It was also decided that all the openings in the Telephone Exchange Building should be sealed up to 6" higher than the high flood level. Such walls should be designed on the basis of .7 x height of water to be retained.

(*Action* : S.E., 1st Circle & Shri Harbans Swarup).

Queen Victoria Road office Building :

It appears that the present flooding of the Queen Victoria Road Office Building was due to overflow from areas of Talkatora Road and Old Mill Road, water finding its way to the Queen Victoria Road *via* Talkatora Road. Whether there was any overflow from the Kushak Nallah has also to be examined. Shri Chakravarthy, E. E. has already been given the task of inspecting and taking necessary action to desilt and strengthen the Bunds of the Kushak Nallah wherever necessary. He should be asked to submit report by local enquiry or otherwise as to whether water from this ridge actually found its way through Talkatora Road to other areas.

(*Action* : Shri Chakravarthy).

As far as the Krishi Bhavan Building was concerned it was decided that pumping arrangements should be strengthened. It was suggested that runoff may be assumed as 3" per hour. It was, however, decided that the runoff would be decided after further data had been collected. The vertical pumps would be more suitable in such circumstances. The new additional pumps should be of the automatic type. Suitable action should also be taken to raise the level of the openings in the pump house to prevent storm water flooding the pump house

or to raise the pump house. All the barricade walls now proposed for sealing of the basement should be of adequate thickness and should be 6" higher than highest flood level noticed on the road. Additional deliveries will be provided to enable all the four pumps to function simultaneously.

Indraprastha Estate

It was decided that to prevent flooding in this area desilting of the existing drains was necessary. Vigilant watch should be kept including night patrol to see that the Bunds of the drains do not get breached. The syphon should be cut off whenever there is high flood in the river. Here also it is necessary to see that the pumps when installed will not get flooded in case of floods.

Dariya-e-Nullah (Ganda Nullah)

It was explained by Shri Lokhande that the areas situated on the either side of this Nallah were subject to heavy damage. Directions have already been issued for carrying out urgent works on this Nallah. Shri Lokhande along with Shri Rao, Supdg. Engineer, 3rd Circle will inspect the above Nallah and prepare a note giving proposals for remady as an immediate measure of relief.

(Action : M/s Rao and Lokhande).

Shahdara

Shri Lokhande was requested to give proposals for proper drainage of this area and also bring Shri Mehta in the next meeting, who is well conversant with the drainage of this area.

(Action : Shri Lokande).

Shri Rijhwani informed the Committee that he has already issued instructions that all urgent repairs to Nallahs should be carried out in anticipation of sanction. It was then suggested by Shri Rijhwani that basement of all buildings should be sealed upto 6" above high flood level and alternative arrangements made for ventilation.

(Action : Shri Muthachen)

The Committee then listed out the technical information necessary for it to proceed further with its work.

1. Contour plan of the area mentioned on page 1.
2. Complete rain fall data, maximum intensity of rain and time of concentration.
3. Investigation of the existing drainage system.
4. Design data of the existing drain.
5. Theoratical check of the existing drains.
6. Site check of the existing drains.
7. Assessment of the defective drains.
8. Causes of improper drainage and remedies.
9. H. F. L. of Nallahs & H. F. L. of River at these junctions.
10. Pumping arrangements for lowlying areas.

Shri Harbans Swarup was requested to furnish all the data available with him in respect of New Delhi area.

Shri Lokhande will furnish a note on the working of the storm water drains of the Old Delhi area. The basis of design and their functioning should be indicated in this note.

Shri Shori will furnish relevant data available with him in respect of rural Delhi which will be of use to the Committee.

(Action : M/s Harbans Swarup, Shori and Lokhande).

Area Near Lajpat Nagar

Shri Des Raj informed the Committee that the culvert under the Railway near Lajpat Nagar is not sufficiently wide with the result that all the water could not flow and the nallah began to overflow. It was, therefore, decided, that Shri Des Raj will go with the Divisional Engineer Railway and inspect the culvert and submit a report to the Committee suggesting remedies.

It was also decided that a list of bridges and culverts over the various nallahs with the hydraulic data should be made available to the Committee.

The Committee felt that the collection of data involves considerable amount of work and full time technical staff under the direction of a senior officer was necessary. As the Committee consists of members who cannot devote much time to this work, it was felt that the Committee could only indicate the lines on which investigation could be carried out and this staff should carry out the necessary detailed investigation. The Chairman will take up the question of separate staff separately.

It was decided to have the next meeting on 30th July, 1958 at 3·30 P.M.

V. KANDASWAMY,
Superintending Surveyor of Works,
Central Zones, C.P.W.D., New Delhi.

Appendix I.—(New Delhi)

1. Central Vista area and compound of adjoining bungalows.
2. Connaught Place behind Fire Brigade.
3. Queen Victoria Road.
4. Minto Road Bridge.
5. Punchkuin Road near Lady Hardinge College.
6. Hardinge Avenue Bridge.
7. Hasting Road.
8. Ashoka Road and Ferozeshah Road.
9. Raj Path.
10. Pandara Road and Humayun Road.
11. Market Road area.
12. Welleselly Road.
13. Barakhamba Road opposite Sapru House.
14. Link Road near C.B.R. Building.
15. Shahjahan Road.
16. Mansinh Road.
17. York Road.
18. Golf Link Area.
19. Nurjahan Road and Tagore Road.
20. Prithviraj Road.
21. Jorebagh Nursery.
22. Trathi Islands Akbar Road.
23. Lawrance Square.
24. Kaka Nagar.
25. Electric Lane.
26. Queensway (Janpath).
27. York Place.

II.—(Old Delhi)

1. Karol Bagh area bordering on both side *i.e.* Rajindra Road and Faiz Road.
2. Rohtak Road.
3. Sarai Rohilla.
4. Military Parade Ground.
5. Nai Basti.
6. Najabgarh Pumping Station.

III.—Rehabilitation Colonies

1. East and West Nizamuddin.
2. Jungpura A & B and Extension.
3. Lajpat Nagar Neighbourhood 1 and 2.

IV.—Other Colonies

1. Sarai Rohilla.
2. Area near Najaf Garh Nalla.
3. Ranjit Nagar.
4. Rana Pratap Bagh.
5. Kirti Nagar.
6. Shakti Nagar.

7. Roop Nagar.
8. Kamla Nagar.
9. Kingsway Camp.
10. Daka Colony.
11. Radio Colony.
12. Bara Khadi Khan.
13. Nai Basti.
14. Gur Ki Mandi.
15. Rajpur Village.
16. Chori Junction.
17. Nanak Pura.
18. Chandrawal Village.
19. Kashmeri Bagh.
20. Rajinder Nagar.

V.—OTHER AREAS

1. Shahdara.
2. Gita Colony.
3. Gandhi Nagar.
4. Selampur.

ANNEXURE X

Minutes of the Second Meeting of the Technical Sub-Committee Held on 30-7-1958 in the Conference Room, 'L' Block, New Delhi.

The following were present :—

1. Shri J. M. Rijhwani, ISE, Chief Engineer, C.P.W.D. in Chair.
2. Shri B. K. Guha, Addl. Chief Engineer, Northern Zone, Central P.W.D.
3. Shri O. Muthachen Addl. Chief Engineer, Central Zone, Central P.W.D.
4. Shri U. S. Rao, Dy. Chief Engineer, Northern Railways.
5. Shri H. P. Chatterjee, Chief Electl. Engineer, N.D.M.C.
6. Col. P. R. Kumar, E-in-C's Branch, New Delhi.
7. Shri M. A. Lokhande, Drainage Engineer, Delhi Corporation.
8. Shri B. R. Shori, Supdg. Engineer, Central W.P.C.
9. Shri Balbir Singh, Engineer Member, D.D.A.
10. Capt. L. V. Ram Krishna, Representative of E-in-C's Branch, Army Headquarters.
11. Shri N. M. Malkani, Superintending Surveyor of Works, Northern Zone, C.P.W.D.
12. Shri N. N. Khanna, Superintending, Engineer, First Circle, C.P.W.D.
13. Shri V. Kandaswamy, Superintending Surveyor of Works, Central Zone, C.P.W.D.

The following points were discussed :—

Collection of contour plans

Contour plans have been received from E-in C's representative and D.D.A's representative. M/s. Shori and Lokhande are to send the contour plans promised by them in the last meeting. After all the contour plans are received it will be checked up whether the contour plans for entire area to be covered by the Committee are available or not. Action will then have to be taken to obtain any missing contour plans. In these contour plans are to be indicated in separate colours areas that were inundated more than (1) 8', (2) 4' to 8', (3) 2' to 4' and 1' to 2'

(Action : M/s Shori & Lokhande).

Mr. Shori should send the data and details of drainage beyond Delhi State including irrigation channels and escapes. He was requested to send his note at an early date.

(Action : Shri Shori).

The rainfall data to arrive at the intensity of rainfall and run off was to be furnished by Mr. Ahuja. Mr. Shori was requested to expedite this.

(Action : M/s Ahuja & Shori).

It was also decided to request Shri P. K. Raman and Mr. A. Krishnan of the Met. Office, Poona who had prepared a paper on intensity, duration and frequency of rainfall at selected stations in India to attend the meetings of the Technical Sub-Committee when the question of intensity of rainfall and run off is considered.

(Action : Shri Kandaswamy).

Minto Road Bridge

The note prepared by Mr. Chatterjee on the drainage of the Minto Bridge area was then considered. Mr. Rao of the Railways agreed to examine the entire drainage scheme of the Railway Yard both on the East and West side of the railway lines and take adequate measures to prevent ingress of rain water from this area into the Minto Bridge. It was suggested to him that the brick pitching of the existing drain on the Connaught Place side should be carried right upto the top. The low lying area

through which the rain water finds its way into Connaught Circus and then on to the Minto Road Bridge could be raised and an intercepting drain provided. On the other side also a catch water drain should be provided by the C.P.W.D. along the road in front of the quarters. As the road has got steep longitudinal slope, possibility of providing intercepting drain across the road should also be examined. As on the Connaught Place side a hump should be provided on the Minto Road side also and this hump should be carried right upto the curb stone and block up the existing flow of water along the curb stone. The idea was that no rain water from areas adjoining the Minto Road Bridge should find access to the depression. Mr. Rao promised to examine the entire drainage scheme of the Railway Yard which will be considered in the next meeting of the Committee.

(Action : Shri Rao & Shri Khanna).

Regarding the pumps Mr. Chatterjee informed that it would be better to augment the pumping capacity by replacing the existing ones by bigger pumps. It was then decided that Mr. Chatterjee, Mr. Bhattacharya and Mr. Lokhande should prepare a note on the type of pump capacity etc. taking into consideration a run off of $\frac{3}{4}''$. This note will be of guidance for providing pumps in other areas as well.

(Action : M/s Chatterjee, Bhattacharya and Lokhande).

It was also decided that Mr. Khanna should co-ordinate with Mr. Rao on the proposal for providing a level crossing for use in case of emergency.

(Action : M/s Khanna & Rao).

Fire Brigade Lane :

The report of Mr. Harbans Swarup for strengthening the existing drain along the Bara Khamba Road was considered. This requires further clarification. Drain is reported to be flowing full beyond J point and it is this that delays the drainage of the Fire Brigade area. A new drain as now proposed should be worked out on the basis of $\frac{1}{2}''$ and $\frac{3}{4}''$ run off along Bara Khamba Road and Sikandra Road. How quickly this new arrangement would drain off the Fire Brigade area could also be indicated. This note with designs should be submitted to the Committee in the next meeting .

(Action : S.E., 1st Circle and Mr. Harbans Swarup).

The Committee decided that an inspection of the covered drain beyond Q point should be carried out. Along with it the conditon of the existing sump at Q point should also be examined. It was reported that this was functioning as a sewage well long ago and there is a baffle wall across the Nallah. The possibility of removing this baffle wall to increase the discharge of this drain should be examined. A note on this point should be prepared for consideration of the Committee in its next meeting.

(Action : Shri Khanna).

Mr. Muthachen then informed that the Lodi Gardens is subject to floods. Possibility of draining this area through any of the existing drains should be examined by the S.E., 1st Circle and a report submitted to the Committee in its next meeting.

(Action : Shri Khanna).

Durai Nallah :

Mr. Lokhande handed over a note on the working of the Durai Nallah. The main reason according to his report is restriction of waterway under the Railway Bridge. The Committee felt that this could not have been the only reason and requested Mr. Lokhande to furnish further hydraulic particulars both upstream and downstream in order to enable the Railway to check on its discharge through culverts. It was also suggested to Mr. Lokhande that a note should be prepared indicating the short term measures to be taken. The possibility of extending and strengthening the walls on the edge of this nallah should also be examined.

(Action : Mr. Lokhande).

Shahdara

The drainage scheme prepared by Mr. Lokhande in consultation with C.W.P.C. was discussed. It was pointed out that according to the present scheme very little areas will be commanded. Most of the areas are on contour of 665 and it is very doubtful whether areas of these contours could be able to drain in the proposed drainage scheme. Mr. Lokhande was asked to examine this in more detail and exactly mark out areas that could be effectively drained by this proposal. The members of the Committee however felt that in the present shape the scheme costing Rs. 15 lacs will be able to command hardly a small portion of the area.

(Action : Mr. Lokhande).

Area near Lajpat Nagar

No report on this was received by the Committee. Mr. Malkani, S.S.W. (N.Z.) was requested to furnish the hydraulic data of the existing road culverts to the Railways so that adequacy of the Railway bridge could be checked.

(Action : M/s Malkani & Rao).

The list of bridges and culverts with hydraulic data could be collected only after the staff for this purpose is posted.

The date for next meeting will be intimated in due course.

(V. KANDASWAMY)
Superintending Surveyor of Works, Central Zone, Central P.W.D.

ANNEXURE XI

Second interim report of the *ad-hoc* Committee appointed for investigation of the sub-soil water-table conditions in the New Delhi area

1. The Committee to investigate the sub-soil water-table in the New Delhi area was appointed by the Government of India in September, 1953. The terms of reference were :—

> "to examine the question whether the sub-soil water-table in New Delhi area is rising, and if so to suggest what, if any, protective measures are necessary to safeguard the buildings in New Delhi".

The Committee has held ten meetings. A preliminary report was submitted to Government with Chief Engineer's D.O. letter No. 348-E/A(88), dated the 7th January, 1954. In that report mention was made of the investigations required to enable the committee to gauge the cause of the rise and frame recommendations. During the deliberations of the Committee, other issues bearing on the subject arose and were also brought under examination. The final issues that have emerged are listed below :

(*i*) To what extent has the water-table risen ?

(*ii*) What are the causes of the rise of sub-soil water-table ?

(*iii*) Has the rising water table caused any damage to Buildings, surface soil, crops or trees, or is it likely to cause any damage by :

- (*a*) reduction in the lead-bearing capacity of the substratum on which foundations now rest :
- (*b*) rise of salts and development of alkalinty in the upper layers of the soil :
- (*c*) waterlogging.

(*iv*) Considering the nature of the strata, what are the possible and the most economical methods of lowering the sub-soil water-table.

(*v*) Is the sub-soil water nearest the ground surface suitable for irrigation ?

2. *Examination of old available data.*—In 1934, the Central P.W.D. began regular observations of sub-soil water levels in some parts of the New Delhi area. Observations pipes were installed at selected sites and water levels were observed daily in the beginning and later at increasing intervals. In addition some open wells were also kept under observation. During the period 1944—50 observation of these pipes was suspended and started again in 1950. The readings from 1950 onwards were taken once a month.

A record of total unfiltered water supply utilised in the irrigation of lawns, orchards and vegetable gardens has also been maintained. The rain-fall record was obtained from the Meteorological Department. The Committee also examined an old plan that was available with Mr. Walter George and date produced by the Central P.W.D. In the absence of any specific well observations prior to the construction of New Delhi the Committee considered that for the purpose of comparison with the present day spring levels, the spring level depth shown on the survey of India maps prepared in 1912 should be taken to be representative of the sub-soil water levels for the pre-construction period.

All available information on well observation levels, the rainfall figures and the total quantity of unfiltered water consumed from year to year, was plotted in the form of graphs. The examination of this data enabled the Committee to draw the broad conclusion that since 1912, a definite rise in the sub-soil water-table had taken place but the Committee were unable to gauge the yearly rate of rise and apportion it to the various factors causing this rise, because :

(*i*) The well observation figures were available, only for the years 1934—43 and 1950—53.

These observations had been suspended during the period 1944—1950.

(*ii*) Some of the observation pipes were found choked, therefore the figures relating to these pipes were not reliable.

3. *Installation of new well observation points.*—It was decided that existing observation pipes should be examined and those which were not functioning should be replaced.

The number of existing observation pipes was considered grossly inadequate to obtain an accurate picture of the whole of the New Delhi area. It was therefore decided to increase the number of pipes so as to form a net work over the whole area. The total number of wells and pipes now existing and under observations is 91. Their location is shown in Plan I. Observations are made regularly twice a month.

A number of these observation pipes are aligned perpendicular to the course of the river Jumna. Observations from these pipes have enabled the Committee to come to the conclusion that Jumna river levels affect only a very narrow strip along the river channel. As a factor affecting the problem under investigation, it can be ignored.

4. *Examination of well level data.*—The daily rainfall records for the Delhi area maintained by the Meteorological Department have been plotted on the water-table charts.

From an examination of the well level data and the rainfall figures of the period the following conclusions can be drawn :—

(*i*) Compared with 1912 the sub-soil water level has risen, the rise varying from 2 to 17 feet. Two typical diagrams, one for the observation pipes near the Western Court and the other (point J) near Mandi House are attached. Plan 2.

(*ii*) The sub-soil water level rises from June to October and falls from October to June.

(*iii*) Heavy downpour has a marked effect on the rise of sub-soil water level. W.L. For instance the heavy rainfall of October 1st, 1954, caused a sudden and an appreciable rise of the water-table varying from 0·67 feet to 3·25 feet. Such a large variation in the rise due to the same cause probably needs an explanation. It is well known that alluvial soils vary in texture and chemical composition even within the same area. The variation in water-table is largely due to this cause.

(*iv*) It is not possible to state if the water-table has attained an equilibrium or is still rising. More accurate observations are being made now of uniformly arranged wells and this will enable us to draw definite conclusion. Some conclusions are however possible by comparing the June 1954 and June 1955 observations of pipes for which reduced levels are available. The data is presented in Statement I. Out of the 30 points for which data is available one pipe shows neither a rise nor a fall. Out of the remaining 29, 22 pipes show a net rise varying from 0·08 to 7·42 feet and pipes register a fall varying from 0·25 to 2·41 feet. At Connaught Place and Museum sites the new tube-wells were working. The Uggarsain Bawli was also emptied in February 1955. This is reasonable for the depression in the water-table at these sites. It appears the regeneration into the Bawli after pumping was not sufficient to bring the water-table to the original level.

At site Nos. 22, 42 and 82 it appears readings were taken when the wells recently been worked. The readings thus are lower than they should rightly be. At sites 33 and 48, the fall is negligible. From these readings, the conclusion is that there is a rise in water-table during the period June 1954 to June 1955.

A factor that is to be taken into consideration is the record rainfall of nine inches in 24 hours on Ist October, 1954. This was responsible for a sudden jump in the water-table varying from 0·67 feet to 3·5 feet. Such heavy rainfalls are not a yearly feature but the meteorological records show that these do occur at intervals. It is, therefore, necessary that careful records are kept for such concentrated falls as a permanent feature of the observations, as they may be the major factor in the steady rise of the water-table.

5. *Causes of the Rise of Water-table.*—To investigate the causes of the rise in water-table the Committee have examined in considerable detail of the contribution that can be made by rainfall and by the unfiltered water supply utilised for irrigation.

(1) *Rain.*—Average annual rainfall for New Delhi area is 26 inches. The contribution from rain can be due to the direct addition of water to the already wet soil which is very pronounced when rain fall is heavy and concentrated.

In order to appreciate this, it is necessary to realise first the terrain as it existed in 1912 prior to the construction of New Delhi and to examine the new drainage system that has been constructed to deal with storm water.

Before the construction of the New Delhi capital the whole estate was open country with some cultivation subsisting on wells or on rain. In time of heavy rainfall there was no obstruction to the run-off. Two big natural drainages existed which carried away all the run-off of the cultivated and uncultivated areas. The first of these drainages was called the Okhla Navigation cut which had its source at Mithai-ka-pul. It ran along Connaught Place to the junction of Lodhi Road and Mathura Road and finally into Jumna river at Okhla.

The second drainage line was the old Kushak Nallah which used to start from near the South Avenue, passing through Roberts Road, York Road, York Place, Man Singh Road, then it took a southerly direction and joined the Barapulla Nallah near Golf Links which had its outfall into the river.

Both these natural drains have been filled up and the area forms part of the built-up area.

The New Drainage System.—The Government of India in their P.W.D. letter No. M.D. dated the 10th April, 1918, sanctioned the construction of a storm water Drainage System in the New Capital. It consists of branch and main drains. The former are designed for a precipitation of 1/4" and the latter for 1" per hour. The drainage system has no measuring devices nor are any records available of the volume of water carried during storms. There is, however no evidence that they were over-flooded their banks at any time since their construction.

The drainage system as it exists now is shown in Plan 3. The first system although it is called the Kushak Nallah is not the original Kushak Nallah but an artificially dug channel pitched with bricks or stone in its head reach. It starts from Punchkuin, runs along the tee of the Delhi Rock ridge, crosses the Kitchener Road passing near the Race Course road, it crosses Delhi Mathura Railway line, crosses Qutab Road and joins the Barapulla Nallah which has its out-fall into the Jamuna river. Although this drain takes little run-off from the New Delhi area it is important because it takes away the entire run-off from the Delhi ridge which otherwise would have entered the level part of the New Delhi Area and become an important factor in feeding the underground reservoir.

System No. 2.—This drainage line starts from Kitchener Road, travels along with its tributaries southwards till it reaches a point near Safdarjung. Here it turns North East and running along Prithviraj Road and Prithviraj Lane it crosses Lodhi Road and Sunehra Pul and joins the Barapulla Nallah. The whole of this drain is covered drain up to its junction with the Barapulla Nallah. The laterals are however all open surface drains.

System No. 3.—This third system of covered drain with its open surface laterals starts from the junction of the Reading Road on Park Street. It runs along Talkatora Road, Victoria Road and Mansingh Road and finally joins system No. 2, at point Q which is the junction of Shahjahan-Prithviraj Road and Man Singh Road.

System No. 4.—This system has its source at the junction of Panchkuin Road and Reading Road. It runs along Punchkuin Road, passes through Connaught Place and Curzon Road and joins System 3 at the junction of the Queensway and Man Singh Road.

System No. 5.—Starting from India Gate this drainage runs along Purana Quila Road, it crosses railway culvert No. 14 and then falls into the Jumna River. From India Gate to this junctions with the Delhi Mathura Road it is a covered drain after which it becomes an open Nallah.

System No. 6.—This system starts from north of Connaught Place near Chelmsford Road, crossing the railway line near the electric sub-station it runs along Rouse Avenue till it meets Hardinge Bridge. At this point it becomes an open Nullah and joins the river.

System No. 7.—The seventh system of drains starts from the junction of Circular Road and Minto Road. It travels along Circular Road and falls into the river near Delhi Gate Power House.

Every one of these Main drains have their branch drains which are open and lined with brick pitching along the sides and bed. The branch drains deliver into pipe drain of stone-ware or Hume pipe which vary in diameter from 12 inches to 24 inches. These join the main drains which consist of masonry barrels whose diameter increases from 24 inches to 102 inches. The total lengths of all the six systems are :—

(*a*) open drains brick pitched : about 150 miles.

(*b*) covered stone-ware or Hume pipes or brick-work barrels about 70 miles.

As remarked above, it has been observed that these seven drainage systems are capable of removing the run-off from New Delhi area. But the lawns of the various bungalows do not allow free flow of the rain water. In some cases the lawns are at a lower level than the roads. As a result most of the rainfall gets absorbed into the soil and is an important factor contributing to the rise of the sub-soil water table.

(*ii*) *Irrigation.*—The total quantity of unfiltered water utilised as irrigation amounts to a delta of approximately 55 inches in the irrigated area. Spread over the gross area it means a load of 22 inches which makes an appreciable contribution to the water-table.

(*iii*) *River water levels.*—Study of observed data show that the Jumna river levels have no influence on the sub-soil water level conditions of the New Delhi area. In the first instance, the flood levels are lower than the water-table and secondly the soil is so dense that any such lateral influence is an impossibility.

6. *Remedies.*—Regarding remedies the committee in their first report expressed the opinion that the solution of the problem lies in two directions :—

(*a*) Proper drainage of the built-up-area, *i.e.* compounds, lawns and garden areas, and quick removal of the storm water to the river and

(*b*) Depletion of the water table by pumping. It was recommended that a pilot pumping scheme should be started to determine the most suitable size of tube-wells and the extent of pumping required.

(*c*) The third remedy lies in the direction of measures of economy in the use of irrigation water.

(*a*) *Drainage of the compound areas* i.e. *quick removal of the storm water to the river.*—It has been brought to the notice of the Committee that originally many grassy lawns had been laid at a level lower than the surrounding roads to conserve all the rainfall. Now that it is realised that the water that stands in these lawns is a serious source of addition of water to the underground water-table, the lawns must be properly drained. The drainage of bungalow compounds is otherwise also defective and needs improving.

(*b*) (*i*) *Depletion of Water-table by pumping*.—In Plan I are shown depths from ground surface to sub-soil water for all observation pipes. On it have also been marked areas which are badly affected by the rising water table, areas which are moderately affected and those where the water table is still at a safe depth from the natural surface. The criterion adopted is a depth of 6 feet or less for the badly affected area, 6 to 10 feet for the moderately affected, and depth greater than 10 feet for the rest of the area.

In the badly affected area two sites, one near the Museum in Central Vista and the other near Connaught Circus were selected for an experiment. It was decided that as the water-table before construction stood at about 30 feet from the ground surface, pumping should be done from this depth. At both the sites bores of 12 inches size were sunk. In these bores were lowered four-inch pipes with a 10 feet length of strainer at the bottom of each tube well. The space between the strainer and the casing pipe was filled with stone ballast. The casing pipe was then withdrawn. In order that pumping should be continuous electric pumps were installed. To determine the distance to which the effect of tube well pumping extended special obeservation pipes were installed on all four sides of the tube-wells. These pipes were placed at distances of 50, 100, 200, 400 and 1000 feet. Special staff were appointed to record ovservations.

During the construction of the tubewells, it was observed that the entire soil profile to the depth of 30 ft. was of a type of soil which would not yield water easily. Water bearing sand strata are absent. It was decided that the supply actually obtained from these tubewells should be taken as the index of the water-yielding capacity of the soil in preference to laboratory tests.

At the Museum site with continuous pumping a discharge of 1100 gallons per hour was obtained and within a period of less than five hours the water table was lowered on an average by 5 inches to a distance of 400 ft. from the well, the degree of depression increasing towards the tubewell.

In statement 2 are presented date of the effect of pumping before heavy rainfall of October 1st 1954 and after that till 26th May, 1955. With continuous pumping after the heavy rain of October 1st, 1954, it has been possible to lower the water table to a depth lower than that prevailing prior to pumping *viz*., 1-9-54. This depression of the water-table is observed in all pipes to a distance of 200 feet from the tube well. Only in one pipe on the South side has the lowering extended to 400 feet. In all other directions the sub-soil water levels at this distance on 26-5-55, are higher than on 1-9-54. The results obtained from the Connaught Place tube well are similar.

(*b*) (*ii*) *Pumping from an open well*.—While pumping from the two tube-wells at Museum site and in Connaught Place was in progress, the Committee also explored the possibility of pumping from large existing open surface wells. It was considered that if these wells could yield larger volumes of water, pumping from them would help considerably in lowering the water-table of adjoining areas and if suitable water could also be utilised for irrigation. For their first experiment the Committee selected Uggar Sain Bawli on Curzon Road. A plan (4) of this Bawli is attached. The general belief about this 'Bawli' is that it is capable of yielding large volumes of water. Four pumping units were installed and pumping started on 27th January, 1955. It was continued for more than a month and it caused a total depression of 40 feet. A view of the Bawli after pumping is presented in photograph attached. The average recuperation rate was of the order of 4000 gallons per hour. Regular observations of water levels in a well situated in that locality at a distance of about 2000 feet. were made at the same time as the pumping was in progress. It was found that, in spite of the fact that a depression of about 40 feet in the water level in the Bawli was created there was no effect on the water table in the well 2000 feet away. The conclusion reached was that, in the locality in which this Bawli is situated, pumping from a large masonry well is not likely to be more efficacious in the lowering of the general water table, than a tube-well. Dredging and silt clearance of the Bawli were thought of but in view of the conditions of the Bawli structure, the idea was dropped.

In Vinay Nagar wehere the soil is more porous, the yield of water from open wells is much greater than that from the Bawli on Curzon Road. This is further

confirmed from observation of pipe readings in that locality. The fall in water-table in that area is much greater than that in any of the other New Delhi areas. The water level in almost all the pipes is now lower than before the heavy rainfall of October 1954, *vide* plan 5. The conclusion from this is that the soil of Vinay Nagar side is more porous than the rest of the New Delhi Area. This is due to the fact that there are sandy strata at lower levels in this area.

From theoretical considerations also it is not expected that pumping from a bigger diameter well would materially affect the lowering of the water-table. Experiments carried out at the Punjab Irrigation Research Institute—Physics Section—indicate that doubling the diameter of the strainer in a tube-well increases the discharge by eleven per cent only, and trebling the diameter increases the discharge by twenty-five per cent. These experiments were carried out in sand strata possessing high transmission co-efficients. When, however, pumping is done from columns of soil whose yielding capacity is poor the increase in the size of the well cannot have any marked influence on the yield. In statement 3 are presented results of analysis of strata samples taken at the time of the construction of the tube-well at the Museum site. It will be seen that majority of the samples are composed of fine particles of soil and that the amount of coarse sand is very little. This fineness of particles of the New Delhi soil is responsible for poor yield of water from the tube well.

(*b*) (*iii*) *Porous Concrete Drains.*—Another possible method of dealing with the rise in water-table is the use of porous concrete drains laid horizontally at a depth of say 8 to 10 ft. from the ground surface. The advantages of using long lengths of porous strainers are :—

(*a*) Large surface areas are exposed for the water to filter through,

(*b*) The pipes are laid at a depth of about 10′ and do not in any way obstruct the agricultural or horticultural operations,

(*c*) Pumps of considerable higher capacity can be installed thus leading to economy.

Whereas this method of dealing with the water-table may find favour in the case of new or unbuilt areas like big grassy lawns and gardens, it may not be practical in many built up areas. The digging of trenches in such areas would be extremely difficult proposition on account of the crossings with roads, boundary walls, pavements and possibly sewer and cable-ways.

The Committee, therefore, decided that the experiment with the porous concrete drains in the Central Vista as previously agreed upon may continue. The scheme for the laying of these porous pipes in a portion of the Central Vista is shown in Plan 6. As this is an experiment, it has been decided that one line of pipes on one side of the Kingsway should be laid. This will give experience in the method of laying, the difficulties encountered, the size of pipes required, the cost involved, and the pumping needed.

(*b*) (*iv*) *Tube-Well Scheme.*—A reference to Plan I would indicate that there is a well marked long stretch of land starting from Ajmeri Gate covering Queensway and ending near York Place which is all built up and in which the water-table is fairly high. It has been classed badly affected area. The Committee are of the opinion that without losing much time, this area should be taken up for a tube-well pumping scheme. To start with a tube-well should be provided for every 16 acres. Later on, if it is found necessary more tube-wells can be installed in between them. The results from the experiment being carried out in the Central Vista with porous concrete drains would enable a decision whether such drains can be more usefully installed in undeveloped areas which are likely to be taken up for construction later. In the meantime the installation of tube-wells and existing masonry wells in the compounds of privately owned bungalows, for irrigation, may be encouraged. For this it will be necessary to modify the existing clause in the lease deeds, which prohibits sinking of wells.

(*c*) *More economic use of Unfiltered Water Supply.*—It is understood that in a large number of places there is little control over the hydrants supplying unfiltered water. This leads to excessive use of water and wastage. More vigilance is required over the present methods of the use and abuse of unfiltered

water. The committee consider that one method of reducing the irrigation load is the use of sprinklers for irrigating lawns and gardens and recommend that their use should be encouraged.

7. *Depth to which water-table should be lowered, stabilised and maintained.*— For fixing a safe depth where the water table should be maintained two considerations are involved. The first consideration is the safeguarding of buildings and second is the protection of lawns, gardens and trees.

The damage to buildings can happen in two ways :—

(*a*) By the rise of sub-soil moisture through capillarity into floors and walls and the consequent disintegration that occurs due to the attack of salts like sodium sulphate. In the opinion of the Committee the solution of this difficulty lies in pumping and lowering the water-table.

(*b*) By the subsidence that may be caused on account of increased plasticity resulting from the presence of excessive moisture in the soil. The Committee feel that, as the majority of the old buildings are single storey, their foundations being 4 to 4½ feet deep and the water level being 6 to 10 feet from the ground surface, movement of these smaller buildings is unlikely, but the case of heavier buildings having deeper foundations requires investigation.

Mr. Walter George thinks that if the sub-soil water continues to rise, or even if it remains at its present level in certain areas, cracks may occur, over a period of years, in those heavier buildings in the designing of which practise care has not been taken in all walls to distribute the load equally.

With regard to the damage to grass, vegetables, shrubs and trees, the rising water-table can be harmful in the following ways :—

(*i*) The rising water-table brings salts with it. The salts reaching on the soil cause it to become alkaline. The greater the alkalinity the more impervious the soil becomes. This is harmful to plants. It reduces the workability of the soil.

(*ii*) With free evaporation at the soil surface, the rising current of sub-soil moisture leaves a residue of salt. Excess of salts at the soil surface and root zone of plants is harmful for plant growth.

That both the salt content of the soil and its alkalinity are on the increase is indicated from a reference to statement 4 which gives results of chemical analysis of soil samples taken from soil profiles the location of which is marked on plan 6.

(*iii*) In this statement figures for salt content and pH values above those considered normal have been underlined red.

For reference all pH values above 8·5 indicate high alkalinity. Salt contents above 0·2 per cent are considered high. The pH value is an index of soil alkalinity. A value below 7·0 indicates acidity and above 7·0 alkalinity.

Further study of statement 4 reveals :—

(*a*) That the total depth of soil profile above the water-table in sites I and II was 3 feet only. This is an isolated area situated in a depression in the Central Vista.

In profiles III and IV water-table was met at a depth of five feet, in profiles V and VI at 8 feet from the ground surface.

(*b*) From the salt percentage figures it appears that, as a result of upward movement of the salt laden water and evaporation, salt is accumulating at the soil surface. The salt percentage decreases from surface downwards. This makes the problem of reclamation comparatively easy, although without pumping it is not advisable to attempt to reclaim. After drainage has been provided, one season's leaching would be sufficient to reduce the salt contents to the normal. Normal irrigation after reclamation will be sufficient to keep down the tendency for accumulation of salt at the soil surface. As

a matter of fact when the water-table is lowered all the salt charged water will be removed before it gets the chance of travelling to the ground surface.

In profile III both the salt content and the pH values are normal throughout the depth of the profile.

(*c*) In profiles I, IV and V the alkalinity as represented by pH values is high. In profile IV it is high between the 3rd and the 5th feet and in profile V between the 5th and the 7th feet.

Methods for reducing soil alkalinity are known. The one that would be most suitable for the Central Vista is the addition of powdered gypsum. Another substance, a waste produce from the local D.D.T. Factory has come to the notice of the Committee. This material is being examined and, if found suitable and economical, will be used in treating badly affected areas.

8. *Quality of Water.*—The Services Division of the Central P. W. D. have carried out a survey of the well waters of the New Delhi Area. Samples of waters were examined in the chemical laboratories.

Figures for salt contents of these waters are given in Statement 5.

The standard by which waters are judged for suitability for irrigation is that, if the salt content of the water is less than 60 parts per 100,000, it is considered safe for irrigation. As the salt content rises above this figure the waters become more and more unsuitable both for irrigation and drinking.

If, however, waters contain calcium salts then the criterion for judging waters is not the total salt content but the " Salt-index " which takes into account the relative proportion of calcium and sodium salts. The following general formula for expressing the quality of water by a concrete value has been derived. All quantities in this formula refer to parts per 100,000.

Salt Index = (Total Na—24·50). [(Total Ca-Ca in Ca Co3) × 4·85]. The salt index is negative for all good waters and positive for those unsuitable for irrigation. The degree of badness may be reckoned as equivalent to the magnitude of this positive factor, and the degree of goodness as equivalent to the magnitude of the negative factor.

An examination of the soil, however, may reveal the pressure of calcium sulphate (Ca So_4) or calcium chloride (Ca C_{1_2}). A case like that may allow the use of water with even a positive salt-index.

There is, however, an upper limit beyond which the water must be rejected irrespective of the amount of calcium salts a soil may contain. Basing on the tolerance of sodium chloride for plants a maximum limit of 117 parts of sodium chloride per 100,000 parts of water has been laid down as a result of experience.

All waters are now being examined for salt-index. Judged by this standard waters from open sells at I point Punchkuin Road, Jhandewala Temple, Ugarsain Bawli, J. Avenue Vinay Nagar, well behind Sarojni Market Vinay Nagar, and the well near Prime Minister's House are suitable for irrigation.

9. *Summary and conclusions.*—Prior to the construction of New Delhi the whole area consisted partly of bare rocks, partly of uncultivated land and partly of cultivated area with many villages between. There were a few wells from which irrigation was carried out. Judging from the arid nature of the country and the lack of irrigation facilities, the cultivation must have been very limited. On the whole, it can safely be assumed that the area had fairly efficient natural surface drains which carried a very substantial part of the run-off to the river. Since there were no outside disturbing factors the water-level must have been in a state of equilibrium.

The construction of the town and the raising of the compound walls, have naturally had the effect of obstructing the natural run-off, or at least reducing it by a very substantial degree.

There is no detailed data available for the period prior to the construction of New Delhi, but the survey of India sheets give the depth of the sub-soil

water-table at certain points. Again certain well observations were started in the year 1934. Detailed observations have only recently been started.

The data available on the sub-soil water levels is of a limited nature, but there is sufficient evidence to lead us to the conclusion that a very substantial rise in the sub-soil water-table varying from 2 to 17 feet has taken place.

Whether this sub-soil water level has reached a state of equilibrium, it is difficult to say and the matter can only be decided by future observations.

Certain portions of the New Delhi area are indeed very badly affected, in these, the sub-soil water-table is 6 feet or less from the ground surface. In the moderately affected area the water-table varies from 6 to 10 feet and in the areas which are considered free from danger the sub-soil water-table is below the ten feet depth.

The soil of New Delhi consists of fine particles of clay. Experience by pumping has shown that the yield is poor and the effect does not travel to more than about 400 ft. There are no regular sand strata except in Vinay Nagar where the yield is far better.

No serious damage has occurred so far to buildings beyond minor cracks in one or two cases.

There is evidence that the salt contents and the alkalinity of the upper layer of the soil are on the increase and in due course, these may seriously affect the life of the vegetation; in a limited area deterioration has begun.

The remedy lies in three directions as given in the body of the report, *viz.* lowering the water-table by pumping on a large scale, economy in the use of irrigation water and improvement as far as possible in the surface drainage. None of these remedies is going to be easy or cheap. Pumping and improvement of the surface drainage system are expensive and money will have to be found. Economy in the use of irrigation water may be administratively difficult to enforce.

There is no evidence that the existing artificial surface drainage system has proved inadequate. It might have been inadequate, if the run-off had not decreased, *i.e.* if the run-off had not been obstructed by the compound walls. It is possible that with any subsequent improvement in the surface drainage of the built up area, the drainage system may have to be remodelled.

10. *Recommendations.*—The Committee make the following recommendations:—

(*a*) A comprehensive tube-well scheme should be drawn up for the badly affected and the moderably affected areas. For the former, the problem is urgent, for the latter it may not be so urgent, but it would be inadvisable to wait till the danger becomes serious. We must meet it half way, and prevent the rise of the salts to the surface because reclamation is expensive and it is a difficult operation to force the salts to the lower strata.

(*b*) Immediate start of a comprehensive survey for the purpose of improving the run-off and quick removal of the storm water to the surface drains.

(*c*) To enforce administrative measures for economy in the use of irrigation water.

(*d*) Reclamation of areas in which on account of the rise of salts damage to soil has already occurred.

An important point that has arisen in connection with the proposal of the lowering of the water-table is whether it will cause any damage to buildings. It is a well known fact that saturation of the soil leads to a reduction in its bearing capacity. Although the sub-soil water level now stands within 6 to 10 feet from the natural surface so far no damage to buildings has occurred. The important buildings of Delhi *viz.* the Secretariats and the Parliament House are founded on solid rock, but this is not so in the case of other buildings.

Two cases of cities where the lowering of the ground water-table has resulted in structural damage to buildings have come to the notice of the Committee. In the case of Greater Kansas City, the drought conditions of the year 1952-53, have resulted in the lowering of the ground water-table. As a result of damage occurred to as many as 65 per cent of the homes. Another similar case is that of Mexico City which lies in a wide flat valley surrounded by high mountains, at an elevation of approximately 7,400 feet above sea level. No major rivers enter the valley. However, in the past the rainfall and run-off from the surrounding mountains have been sufficient to keep the ground water level at or very near the surface throughout the entire section of the valley covered by the city. In the seventeenth century a tunnel was driven through the eastern mountains to drain out sewage and other waste water. This water loss, in combination with greatly increased pumping in the past few years, has seriously lowered the ground water levels in the sub-soil throughout the area.

Lowering of the ground water levels is causing a general settlement of the surface over the entire city. The present rate of settlement is reported to be approximately 12 to 15 inches per year and is attributed by the authorities to the removal of water from the soil.

Although there appears to be no ground for panic, yet the above two cases should made us wise.

It is true that in the very substantial rise of water-table that was already taken place and in spite of the yearly rise from June to October and the lowering from October to June, no serious settlement has been observed. Similar has been the experience in the Punjab. From this it is not an unreasonable anticipation that no serious damage to buildings will result but at the same time it would be extremely unwise to stop here and adopt no measures to initiate the investigations required for the solution of the problem.

The Committee therefore recommends that the necessary research to determine more exactly the quality of the New Delhi soil, its load bearing capacity when dry, its load bearing capacity in high water table conditions, and the likely changes that may take place when pumping from the sub-soil water table is done to stabilise the water table at a lower depth should at once be started. The results from these researches would enable decisions whether at all any subsidence in buildings is expected now or later; and if so, what precautions should be taken. The Committee feels that it would be more convenient if the investigations are carried out in Delhi. The nearest institute with the necessary equipment is the Central Road Research Institute.

The Committee is pursuing the study on the following lines:—

1. To continue pipe observations to determine more accurately the behaviour of the water-table as influenced by irrigation and rain.
2. To determine more exactly the number of tube-wells required to lower the water-table and maintain it at a depth of 10 feet from the ground surface in built-up areas. Finding out the capital and the maintenance costs of these tube wells as also the discharge and the quality of water obtained.
3. To investigate the usefulness of laying horizontally a series of prous pipe drains in the Central Vista at a depth of 10 feet from the ground surface and determine their sphere of influence, costs etc.
4. To have more intensive observations made if and when any damage to buildings in the way of movement or cracks comes to their notice.
5. To initiate fundamental research under the guidance of the Director Road Research Institute on all problems relating to subsidence as it is affected by the quality of the soil, the rising or the falling water-table and after discussion in their meetings recommend measures that should be taken to protect the buildings from damage.
6. To lay a programme of reclaming areas in which damage to soil, grass, vegetation and trees has occurred on account of the rising water-table and the consequent appearance of salts and alkali at the soil surface.

STATEMENT I

Statement showing Rise (+) and Fall (—) in Water level during the year June 1954 to June 1955.

Sl. No. of well or Bore	Sub-soil Water level in Ist fortnight of June, 1955	Sub-soil level in June, 1954	Rise + Fall —	Remarks
7.	691·65′	691·65′	0·00′	Kamla Market, Ajmeri Gate.
8.	695·85′	695·69′	+0·16′	Near Rly. Bridge.
9.	707·07′	705·65′	+1·42′	Multani Dhanda, Gali No. 2.
10.	704·01′	701·84′	+2·17′	Hari Masjid.
11.	744·82′	740·82′	+4·00′	Jhandewala Temple.
12.	712·67′	710·67′	+2·00′	Point I Panchkuin Road.
13.	702·76′	702·34′	+0·42′	Chitra Gupta Road.
20.	685·79′	686·49′	—0·70′	D. Point C. Place.
22.	677·68′	678·68′	—1·00′	Parsi Dharmshala.
23.	661·67′	660·67′	+1·00′	Opposite Muslim Cemetry, Mathura Road.
26.	679·85′	677·27′	+1.58′	J. Point Mandi House.
27.	682·62′	685·03′	—2·41′	Bawli Uggarsain.
28.	683·57′	683·32′	+0·25′	Western Court.
33.	679·90′	679·79′	+0·11′	Windsor Place.
39.	676·28′	675·61′	+0·67′	C. Point India Gate.
40.	679·68′	679·60′	+0·08′	Near Record Office.
42.	690·55′	692·30′	—1·75′	Gurdwara Rikab Ganj.
45.	683·91′	682·62′	+0·29′	Trimurti South Avenue.
46.	682·77′	682·52′	+0·25′	R/2 Circus.
47.	676·61′	678·11′	—1·50′	Museum Site, Central Vista.
48.	675·31′	675·56′	—0·25′	York Place.
50.	665·62′	665·37′	+0·25′	Shershah Mosque.
54.	675·04′	674·83′	+0·21′	S/2 Circus, Aurangjeb Road.
65.	662·58′	661·33′	+1·25′	Sunder Nursery.
69.	658·76′	657·59′	+1·17′	Lodhi Road.
74.	708·89′	701·47′	+7·42′	Dhola Kuan.
75.	678·94′	678·02′	+0·92′	Jor Bagh Road.
76.	678·78′	677·28′	+1·50′	Centre of Karballa.
77.	678·30′	676·47′	+1·83′	Aliganj Village.
82.	666·86′	667·48′	—0·62′	Jajpat Nagar Block 2-B.

STATEMENT 2

Showing Sub-soil Water Observation at the Tube Well Museum Site Central Vista

Distance from the Tube Well	North				South				East				West				Remarks
	50′	100′	200′	400′	50′	100′	200′	400′	50′	100′	200′	400′	50′	100′	200′	400′	
R. L. Tube Well itself.																	
Ground Level 687·20	686·92	636·75	686·69	686·46	686·88	686·24	686·47	685·72	686·95	686·85	686·83	686·54	686·94	686·52	686·65	687·00	
Top of Pipe R. L. 687·52	687·18	687·00	686·94	686·64	687·21	686·42	686·47	685·64	687·23	686·97	686·75	686·66	687·19	686·52	686·90	687·23	
Observation on 1-9-54 on the start of pumping . .	9′—2″	8′—11″	8′—5″	7′—9″	9′—3″	8′—7″	8′—8″	8′—3″	9′—3″	9′—0″	9′—10″	8′—8″	8′—3″	7′—11″	8′—8″	8′—9″	Tube well Started on 1-9-54.
Observations on 29-9-54 before the heavy rain of Oct. Ist. . .	9′—11″	9′—6″	9′—0″	8′—6″	10′—1″	9′—2″	9′—2″	8′—5″	10′—2″	9′—0″	9′—6″	9′—7″	9′—7″	9′—0″	9′—3″	9′—4″	
Observations on 2-10-54 immediately, after the rain. .	5′—1″	4′—10″	4′—7″	4′—10″	5′—6″	5′—0″	5′—3″	4′—11″	5′—6″	5′—3″	5′—3″	4′—5″	5′—4″	5′—7″	5′—2″	5′—7″	Approximately 10″ rain fall between 30-9-54 & 1-10-54.
Observations on 28-2-55 . .	9′—1″	8′—0″	6′—0″	5′—0″	9′—0″	8′—5″	7′—10″	7′—2″	9″—10″	8′—10″	7′—4″	5′—1″	7′—4″	8′—1″	7′—6″	6′—1″	
Observations on 26-5-55 . .	11′—2″	10′—4″	8′—2″	6′—6½″	10′—9″	10′—4½″	9′—10″	9′—11″	11′—9″	10′—10″	9′—8″	7′—0″	9′—1″	10′—1½″	9′—3″	8′—2″	

STATEMENT 3

Results of Mechanical Analysis of Soil Strata Samples received from X E N Services Division, New Delhi, pertaining to Museum Site.

Sl. No.	Depth	Clay Particles below ·002 mm. in size	Fine Silt between ·002 ·01 m.m.	Silt between ·01 ·002 m.m.	Fine sand between —02 0·2 m.m.	Coarse sand above 0·2 m.m.	Kankar %
1.	1′	18·8	16·7	11·6	52·5	0·6	Nil
2.	2′	18·0	16·8	12·8	51·8	0·6	Nil
3.	3′	11·8	9·2	5·9	61·8	1·0	Nil
4.	4′	16·2	4·3	2·8	76·2	1·2	Nil
5.	5′	27·3	14·3	10·8	46·0	1·5	3·4
6.	6′	28·4	17·9	3·0	49·5	1·3	Nil
7.	7′	24·3	13·2	12·7	48·7	0·8	Nil
8.	8′	30·5	15·2	5·9	48·4	1·1	Nil
9.	9′	32·0	15·3	7·9	42·6	1·0	Nil
10.	10′	28·5	15·8	6·0	48·0	1·6	6·7
11.	11′	20·0	15·6	5·6	55·2	3·1	13·3
12.	12′	16.8	13·1	7·6	60·3	3·0	25·1
13.	13′	13·6	9·6	3·9	70·8	1·3	Nil
14.	14′	18·3	14·5	6·5	54·0	6·6	28·4
15.	15′	7·2	7·4	5·0	77·8	2·7	2·2
16.	16′	9·8	5·7	5·7	74·7	4·7	0·9
17.	17′	9·0	6·8	4·5	77·7	2·1	Nil
18.	18′	9·6	10·0	0·1	76·5	3·8	Nil
19.	19′	10·8	8·9	6·2	69·5	4·6	0·75
20.	20′	17·0	12·6	8·5	54·2	7·8	3·1
21.	21′	14·7	14·4	7·2	55·0	8·8	7·0
22.	22′	12·9	12·2	7·9	55·5	11·1	4·7
23.	23′	16·0	12·1	7·6	54·5	10·1	1·42
24.	24′	8·7	14·4	10·6	54·5	11·8	Nil
25.	25′	17·7	14·3	7·0	57·5	3·6	1·8
26.	26′	18·9	14·7	9·0	48·0	9·4	5·2
27.	27′	22·0	15·9	8·6	45·5	8·1	5·6
28.	28′	26·3	18·5	8·8	40·0	6·0	7·2
29.	29′	27·3	17·9	12·4	37·5	4·9	5·3
30.	30′	12·9	9·1	3·8	73·5	0·6	Nil

STATEMENT 4

Chemical Analysis of Soil Samples taken from Central Vista

Sl. No.	Depth from Ground surface	Profile I		Profile II		Profile III		Profile IV		Profile V		Profile VI	
		pH	Percent Soluble Salts	pH	Percent Soluble Salts	pH	Percent Soluble Salt	pH	Percent Soluble Salt	pH	Percent Soluble Salt	pH	Percent Soluble Salt
1.	1st Foot	8·8	1·20	7·6	·56	8·2	·06	7·7	0·20	8·0	1·12	8·1	0·45
2.	2nd Foot	8·9	0·42	8·3	·40	7·9	·20	7·9	0·20	7·8	1·13	8·3	0·28
3.	3rd Foot	9·3	0·21	8·4	·20	8·2	·06	9·3	0·12	8·1	0·70	8·2	0·10
4.	4th Foot					8·4	·06	9·5	0·14	8·1	0·84	7·9	·03
5.	5th Foot					8·4	·06	9·5	0·14	8·8	0·30	7·8	·03
6.	6th Foot									9·4	0·14	7·9	·06
7.	7th Foot									9·0	0·10	7·9	·05
8.	8th Foot											8·3	·08

STATEMENT 5

Analyses of Samples of Well Waters

Sl. No.	Date of taking Water Sample	Name of Well	Parts per 10,000 of total Soluble Matter	Salt Index
1.	3-11-53	York Place (Bore lb. 48)	141	
2.	Do.	Windsor Place (Bore No. 33)	98	
3.	Do.	Connaught Place (Bore No. 20)	119	
4.	5-11-53	Well No. 9, Multani Dhanda, Gali No. 2	147	
5.	Do.	Wel. No. 10, Harimasjid, Pahar Ganj, Delhi		
6.	11-11-53	Well No. 13, Chitra Gupta Road	104	
7.	Do.	Well in City Extension Area	284	
8.	Do.	Do.	227	
9.	Do.	Do.	469	
10.	21-11-53	Well No. 12, Point I, New Delhi	50	Negative.
11.	Do.	Well No. 11, Jhandewala, Paharganj, Delhi	72	Negative.
12.	Do.	Well No. 8 Near Railway Bridge Paharganj, Delhi	114	
13.	24-11-53	Well No. 42, Gurdwara, Rikabganj	173	
14.	Do.	Western Court (Bore No. 28)	45	Negative.
15.	Do.	Well No. 27, Bawli Uggarsain	75	Negative.
16.	27-11-53	Well No. 15, B/2, C. Circus	121	
17.	Do.	Well No. 31, Mahadev Temple	320	
18.	Do.	Well No. 50, Shershah Masjid	240	
19.	2-12-53	Well No. 69, Lodhi Road	365	
20.	Do.	Museum (Bore lb. 47)	366	
21.	Do.	Well No. 67, Nizamuddin Rly. Station	160	
22.	31-8-54	Well near School between D & G Avenue behind Market Vinay Nagar	73	Negative.
23.	Do.	In front of market and between Mkt. and D avenue	106	
24.	10-1-55	Open well, Vinay Nagar	70	Negative.
25.	Do.	Tube well, Museum	189	
26.	Do.	Water from Vinay Nagar, Well near Factory Road	168	
27.	15-9-54	Tube well at D-Point, Connaught Circus	114	
28.	18-2-55	Well No. 27, Bawli Uggarsain	73	Negative.

ANNEXURE XII

Minutes of the meeting (20th) of the *Ad-hoc* Committee appointed for investigating into the sub-soil water conditions in New Delhi held on 5th August 1958, at Conference Room 'L' Block, New Delhi

The 20th meeting of the *Ad-hoc* Committee appointed for investigating into the sub-soil water conditions in New Delhi was held on 5th August 1958 at 10.00 A.M. Following were present:—

(1) Shri J.M. Rijhwani, Chief Engineer, CPWD (*Chairman*).

(2) Shri P.R. Ahuja, Director, Hydrology, CWPC.

(3) Shri R.S. Vasudeva, Director, IARI, Pusa.

(4) Shri Walter George, Architect.

(5) Shri M.L. Mehta, Consultant.

(6) Shri J.B. Mathur, Director of Horticulture, CPWD.

(7) Shri E.G.K. Rao, Agricultural Engineer, IARI, Pusa.

(8) Shri V. Kandaswamy, Superintending Surveyor of Works, Central Zone, CPWD, New Delhi.

(9) Shri Harbans Swarup, Executive Engineer, Sub-Soil Water Division, C.P.W.D.

Item 1 : *Consideration of the rainfall data and run-off to be adopted for drainage schemes in New Delhi in the light of latest rainfall of July* 1958.

The Chairman initiated the discussion and asked the Committee to consider the two notes circulated and decide the basis for designing the capacity of drains in the New Delhi area and the various Nagars. The Committee considered in detail the rainfall intensity chart for Delhi prepared by Sarva S/Shri Raman and Krishnan of the Meteorological Department of Government of India and the maximum intensity of rainfall recorded by the same Department during the heavy rainfall of July 1958. The Committee had also before them plotted rainfall chart for Delhi for the period 1845-1958 and came to the conclusion that the intensity of rainfall equal to 2·8 inches per hour for July 1958 must be considered a rarity. A drainage system for run-off on the basis of this intensity of rainfall would cost collosal amount of money, both for construction and maintenance, besides other physical difficulties. The Committee thought the drainage of Delhi should be such as to take the maximum intensity of rainfall calculated by S/Shri Raman and Krishnan, which is equal to 1·71 inches per hour, even though this intensity is likely to occur once in ten years. Having decided on the maximum intensity of rainfall, they proceeded to find out a suitable co-efficient for calculating run-off. They accepted that the Metcalf and Eddy's formula was the most suited for the Delhi area. Of the five types of areas considered by Metcalf and Eddy, the majority of New Delhi built up areas fall under the lower ladder of class 3, *viz.* "Residential portion with detached houses." They decided that the co-officient should be in the neighbourhood of 0.3 inches per hour. The Committee unanimously hold that the drainage system of New Delhi should cater for run-off of 0.5 inches per hour, and advised the Department to prepare their schemes accordingly.

In case of Nagars, the drainage system already designed is for a run-off of 0.5 inch per hour. The Committee advised that if on re-examination, any of the present Nagars or those proposed in future fall in a higher category *viz.* well built or densely built up portions, run-off should be calculated applying a higher co-officient and the drainage system remodelled or constructed accordingly.

The Executive Engineer, Sub-Soil Water Division was asked to recast his estimate for improving the drainage of New Delhi area in accordance with the recommendations of the Committee.

Item 2 : *Study of fluctuations of sub-soil water table in June* 1958 *readings, as compared with the corresponding readings of June* 1957, *and also the effect of heavy monsoon rainfall in July* 1958.

Note prepared by Mr. Mehta was discussed. The Committee noted that between June 1957 and June 1958, there had been a fall in water table in the badly affected area and that the rise in the moderately affected area was insignificant, and that in the affected area of a very low order.

Item 3 : *Consideration of the final report by the Central Road Research Institute, Delhi on investigations of the effects of lowering sub-soil water level on the stability of the existing structures in New Delhi.*

Shri V. Kandasamy invited the attention of the members of the Committee to the portion of the report of the Central Road Research Institute, reproduced below:—

> "The resulting displacements produce a settlement of the ground surface, that is roughly proportional to the descent of the water table. This aspect of the problem and only this aspect was taken up for investigation."

and said that it left an impression that there may be other aspects of the same problem, which might not have been considered. It was decided that on this clarification should be sought from the Director, Central Road Research Institute. As advised by the Central Road Research Institute, it was decided that the minimum distance from a structure at which a tube well can be installed should be 100 feet. Probability of soft patches under buildings should be carefully looked into, when the tube well is to be installed and in all such cases of soft patches, the site should be abandoned and new site selected. The Committee appreciated the report prepared by the Road Research Laboratory on the effects of lowering subsoil water which was lucid and comprehensive.

It was decided by the Committee that at present the working of the 16 tube wells should be regulated as not to allow the water table to be depressed more than 10 feet from the ground surface.

Item 4 : *Considerations of the report on the working of* 16 *tube wells in the badly affected areas.*

Note prepared by Mr. Mehta was discussed. The Committee decided that the pumping should be made continuous. Shri Harbans Swarup was asked to keep ready some portable pumps, so that in case of break-down etc., the working of the tube wells is not interrupted. He was asked to put up a note in collaboration with Electrical Engineer about the working of tube wells to Chief Engineer. Shri Harbans Swarup raised the point that for the new tube wells, the depth of the boring should be increased to the rock level or the first impervious stratum. The Chairman invited his attention to the trial experiments already carried out, which have formed the basis of the present scheme. On the basis of our experience with 16 tube wells already sunk it was suggested that the estimate should be prepared for a depth of 40 feet.

Item 5 : *Consideration of the report from Director Indian Agricultural Research Institute, Pusa on the rise of water table in the Institute Estate.*

Shri Vasudeva explained that the greater rise in the sub-soil water level in the Pusa Institute Estate was due to the filling up of the natural drainage channel. Since this drainage channel had been cleared, the rise was of a smaller magnitude. It was decided that the Committee would be interested in a more detailed study of the data, collected by the Indian Agricultural Research Institute, taking into consideration, the rainfall and irrigation data of the Estate. Shri M. L. Mehta was asked to prepare a note. Shri Vasudeva said that they would offer all help.

Item 6 : *Consideration of the progress report on the Working of porous concrete drains in the central vista.*

Shri Mehta explained with the help of a chart showing the sub-soil water leves, that with continuous pumping the water level, 60 feet away from the porous gallery had fallen to a depth of 8 feet. With very high rainfall of July,

the discharge of the porous drain had increased considerably and it was not possible for the present pump to empty the sump to provide a free out-fall.

The water table on account of heavy rainfall and inadequate pumping had risen within 3 feet from the ground surface. In some portions of the Central Vista in this reach, water was actually standing at the soil surface. Pumping was being continued. The Committee reiterated their former decision that four lines of porous galleries should be laid in the whole of the Vista. Shri Kandaswamy said that the estimates for this work had already been prepared and were being forwarded to Government.

Item 7 : *Consideration of the recommendations of superintending Geologist, Shri P. C. Hazra, for the procurement of core drill in connection with the investigations of the subsoil water table in New Delhi.*

Shri P. R. Ahuja stressed the necessity of preparing a proper geological map of the New Delhi area showing also sub-soil water contours, and suggested that in the preparation of this map the rural area round about Delhi should also be included. The Committee decided that a core drill should be provided to the Geological Department for investigating the sub-soil conditions of Delhi area, and preparing a Geological map.

Item 8 : *Considerations of the complete scheme for lowering and stabilizing the sub-soil water level at a depth of* 10 *feet from the ground surface and also the prevention of rise of water-table in colonies.*

On the note on the complete scheme prepared by Executive Engineer, Sub-Soil Water Division, the following decisions were taken by the Committee:—

(*i*) Raising of grassy lawns should be done in one operation, and estimates should be changed accordingly.

(*ii*) A proper survey should be carried out to locate lines of water supply pipes, which have developed holes and are leaking. A report should be prepared and estimates changed.

Item 9 : *Consideration of the lines on which the final report is to be prepared.*

The Committee approved generally the scheme circulated for preparing the final report of the Committee, they suggested some minor modifications in the arrangement of different chapters.

The Committee decided that the scheme for lowering sub-soil water level should be sent up to Government of India for sanction as and when ready. Executive Engineer, Sub-Soil Water Division and Director of Horticulture were asked to expedite the necessary estimates.

V. KANDASWAMY,
Secretary Ad-hoc *Committee and Superintending Surveyor of Works, Central Zone, Central P.W.D., New Delhi.*

GMGIPND—MS— WH&S—11-8-58—1000