



TANGANYIKA

Annual Report
of the
**Water Development
Department**
1954

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BRITISH GEOLOGICAL SURVEY



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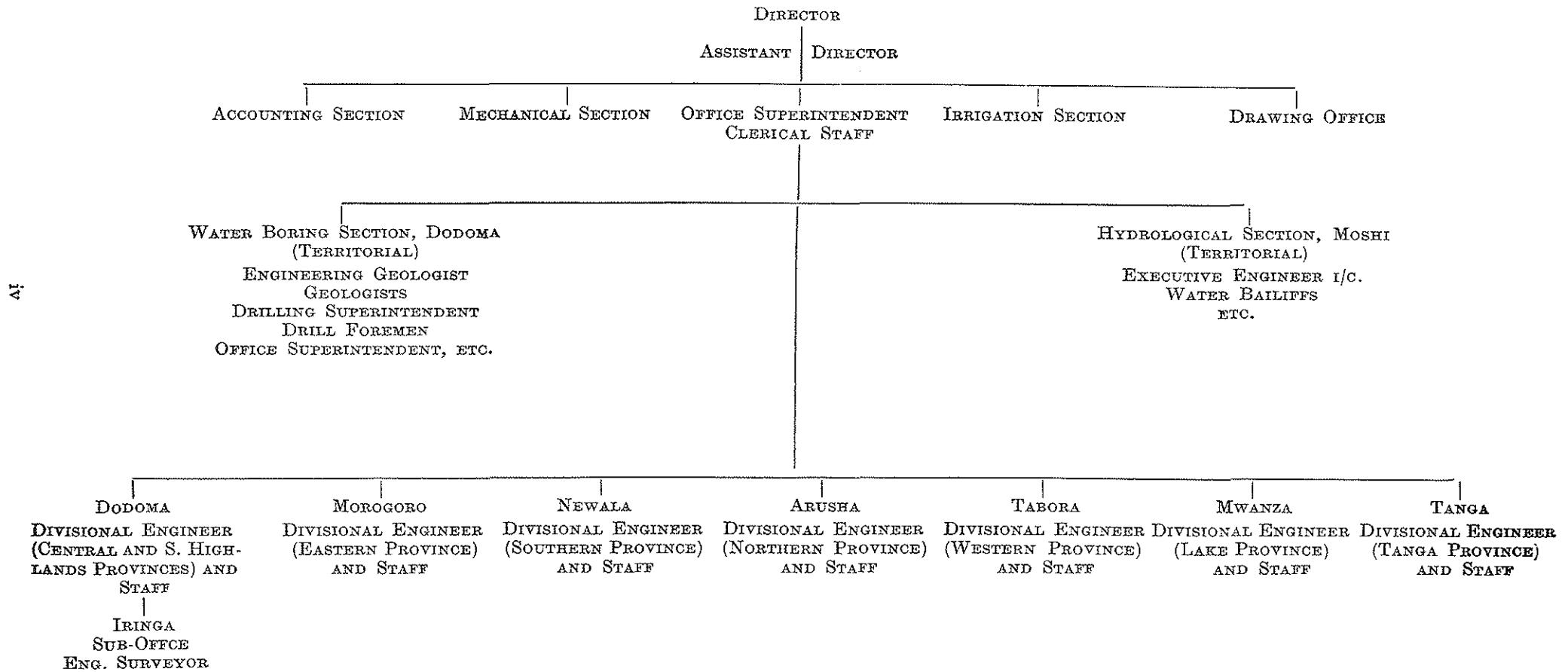
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ORGANIZATION OF THE WATER DEVELOPMENT DEPARTMENT



TANGANYIKA

ANNUAL REPORT OF THE WATER DEVELOPMENT DEPARTMENT, 1954

1.—INTRODUCTION

The Water Development Department was fortunate in being allocated additional posts for the financial year 1954-55 at a time when budgetary reasons prevented the expansion of practically all other departments in the territory. Expansion of the Water Development Department was necessary to meet the increased demands brought about by the progressive policy of the Government, especially in the field of irrigation.

Before reviewing the activities of the department during 1954 it is perhaps appropriate to mention here the effect the new policy will have on the country as a whole. It is based on recognition of the fundamental importance of primary production to the economic stability of the country and the well being of its people. Unfortunately, one of the main factors limiting the productive efforts of our primary producers is insufficient or badly distributed rainfall. Yet this need not be so as long as there is irrigable land and water supplies to command it. It is therefore the intention progressively to harness the water resources of the territory and to regulate the use of water to the best advantage. Thus irrigation and land development are now being linked with the provision of adequate water supplies for domestic purposes as the aim of policy. It means that the work of the Water Development Department will more than ever before be intimately and intrinsically connected with the economic life of the agricultural population of the country.

To set in motion this more progressive policy, the staff of the department will have to be steadily increased to cope with the planned programme of work connected with the systematic development of the river catchments and the construction of irrigation projects with the necessary distribution systems required to bring in vast areas of land under cultivation. Some of these projects would lend themselves to multi-purpose development in that they are designed not only for controlling floods and for conservation of water during the rainy season, to be released during the dry periods, but also for development of hydro-electric power and resultant industrial advancement.

As reported in the 1953 Annual Report, steps have already been implemented to study problems related to the harnessing of the flood waters of the Rufiji River. After his initial investigation and report on the Rufiji Basin survey, Mr. Simansky of the United Nations Food and Agricultural Organization returned to this territory at the end of July, accompanied by Mr. D. Astafieff, a prominent projects-planning engineer of considerable experience in hydrometric work. Since arrival they have organized a number

of survey teams to carry out a full-scale survey of the basin, setting up hydrometric stations at thirteen positions on the river for the acquisition of hydrological data and for selection of suitable multi-purpose reservoir sites. Mr. Gerald Lacey, the Colonial Office adviser on drainage and irrigation, and Mr. A. de Vajda, the Water Use Specialist of the Food and Agricultural Organization, also visited the territory in connection with the development of the Rufiji. The investigation of the latter must be regarded as a very long-term programme and several years of work, studies on pilot schemes and collection of hydrological data will be necessary before any practical proposals can be formulated.

In the meantime the Water Development Department will have to concentrate on the many other river basins for bringing into existence smaller irrigation schemes, and at the same time to continue with its usual activities, while preparing itself to shoulder ultimately the full responsibility for the proper utilization of the water resources of the territory. This will cover the construction, maintenance and improvement of rural water supplies, irrigation and drainage schemes.

The Mlali project met with full support from the Morogoro District Native Council, and work commenced on its construction during the latter half of the year. This project introduces the completely new concept of rights of occupation to the African villager, and agreement has been reached that eighteen families will be settled on ten acres of irrigated land each on the right bank of the stream, and some fifteen families on the left bank.

Engineering surveys were also carried out on a far larger irrigation project for resettlement of a section of the Chagga tribe, south of Moshi, and yet another scheme near Singida, where some 20,000 acre feet of water has already been impounded.

Although progress has been made on the divisional offices at Tanga, there is still no departmental representation in the Southern Highlands Province, which has to be administered from the Dodoma office. Likewise in the Southern Province, the divisional depot at Newala is still only of a temporary nature until a more permanent *pied-a-terre* has been established more centrally in the province.

2.—STAFF

The departmental organization remained the same as last year, as is shown on the organization chart.

The former Director, Mr. E. L. Smith, who was on sick leave during the early part of the year, proceeded to the United Kingdom on leave preparatory to retirement. It is gratifying to learn that he has since fully recovered his health and is once again in harness, having accepted a responsible post in West Africa. Mr. W. P. Steele, the Assistant Director, was called upon to act in the vacancy created by Mr. Smith's retirement.

Mr. W. A. Guthrie, O.B.E., who was formerly Director of Irrigation, Ceylon, vacated the post of Irrigation Engineer in July to become Director of Water Development on his return from a short leave. Such is the scarcity of experienced irrigation engineers that no replacement for the vacancy thus created and for the other two posts of Irrigation Engineer has yet been found.

A post of Irrigation Specialist was created to allow for the recruitment of a senior officer with wide experience of tropical irrigation work who could work in an advisory capacity at headquarters. An extra post of Irrigation Engineer was also created so that with two such engineers backed up by the additional assistant staff of two surveyors, two technical assistants, a tracer and a works foreman, apart from the ancillary office personnel, this department should have been in a position to tackle several irrigation projects during the year. Although the key posts have not yet been filled, it is pleasing to record that one such irrigation project is approaching completion at the end of 1954.

The increase in staff permitted, despite the exigencies of budgetary limitation is indicative of the importance with which Government regards the provision of rural water supplies and of irrigation projects. It is hoped that a change in title of the department to that of "Water Development and Irrigation" will give greater confidence to potential applicants for posts in this department and serve to fill some of the outstanding vacancies.

The additional posts created during the year were :

1 Irrigation Specialist	} On contract
1 Irrigation Engineer	
1 Executive Engineer	
1 Engineering Assistant (Mechanical)	
4 Engineering Surveyors	
2 Mechanical Superintendents	
2 Mechanics	
2 Works Superintendents	
3 Hydrological Assistants	
3 Water Bailiffs	
3 Works Foremen	
4 Storekeepers	
4 Irrigation Assistants (On contract)	
4 Junior Works Foremen	
4 Computing Assistants	
3 Junior Draughtsmen	
4 Clerks (Executive Division)	
1 Clerk (General Division)	
12 Clerks (Subordinate)	
4 Tracers (General Division)	
1 Telephone Operator	
4 Computing Assistants (General Division)	
20 Subordinate Staff	
8 Temporary Staff	

Against these increases, there was a decrease of one in the number of posts for Office Superintendent, and its replacement by a temporary post, and also replacement of one Stenographer's post by a temporary post.

The addition of four Engineering Surveyors was intended to accompany the creation of two irrigation teams, each headed by an Irrigation Engineer. As these latter posts have not been filled so far, the Engineering Surveyors have been attached to the various Divisional Engineers, in order to carry out the survey work which will enable a complete and detailed programme of work to be drawn up, for the provision of the necessary finance during the coming year. Unfortunately there is still a backlog of current work to be done, and it remains problematical whether advance budgetting can yet be assured.

The increase in Hydrological Assistants and Water Bailiffs was arranged to meet the growing demand for increased hydrological data, both to meet the requirements of the new Water Ordinance and for planning of irrigation engineering work, which is quite impossible unless accurate information is available on figures of streamflow. For processing the data thus obtained, the

posts of Computing Assistant (Executive and General Division) were created. It is hoped that recruits for the former posts will be obtainable from India or Ceylon, who could later train up likely local recruits, thus ensuring a constant flow of new locally-engaged personnel.

The Irrigation Assistants were similarly to be brought in from Ceylon as men with considerable experience in irrigation, to act as assistants to the Irrigation Engineers on particular irrigation projects. These posts are being advertised currently in the appropriate quarters.

The recruitment of Tracers and Clerical staff has been allowed for to support this programme of irrigation development, but still remains insufficient to cope with the vast amount of detailed work involved.

The following officers left the department during the year:

- 1 Director
 - 1 Executive Engineer
 - 1 Assistant Engineer
 - 1 Pupil Engineer
 - 1 Engineering Surveyor
 - 2 Drill Foremen
 - 1 Works Superintendent
 - 1 Water Bailiff
 - 5 Works Foremen
 - 1 Works Foreman Grade II
 - 2 Stenographers
- apart from temporary staff.

3.—EXPENDITURE

During 1954, a change in financial policy led to a six months' budget from January to June, and a yearly budget thereafter from July, 1954 to June, 1955. This report is therefore submitted in the middle of a financial year, for which reason it is not possible to quote the exact figures of expenditure which have been given in previous annual reports. The following statement of expenditure against the various heads gives approximate figures:

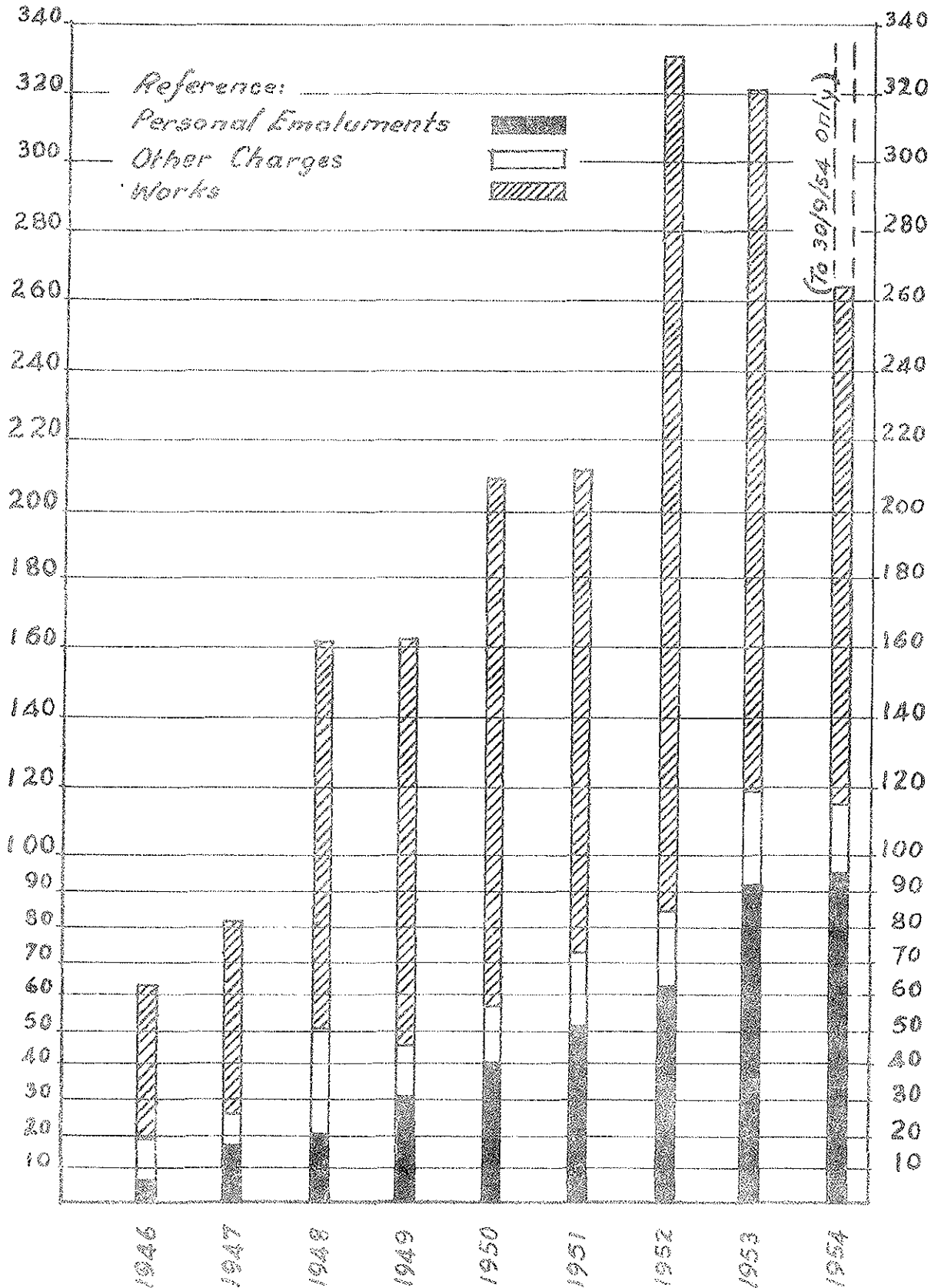
A.	Approved Estimates		Actual Expenditure		Estimated Expenditure	
	Jan.— June 1954	July 1954 June 1955	Jan.— June 1954	July— Dec. 1954	£	£
1. Personal Emoluments and Other Charges ...	71,435	150,039	59,189	67,000	...	...
2. Water Development Extraordinary ...	2,874	—	1,041	—	...	...
3. Plant, Buildings and Equipment ...	31,507	446,917	10,568	70,000	...	...
4. Development Works ...	90,000		56,498			
5. Special Items ...	359	3,770	335	1,400	...	...
6. Expenditure for Other Departments ...	11,620	10,636	7,394	1,000	...	...
7. Masai Dev. Plan ...	33,433	46,796	26,555	24,000	...	...
8. Non-native supplies, Exploratory works and W.D.D. Loans ...	5,506	11,000	496	3,000	...	...
9. Water Dev. Recurrent ...	2,750	—	2,547	—	...	...
10. Misc. Services ...	9,729	—	1,177	1,000	...	...
11. Survey of Pangani Basin	9,729	—	9,728	—	...	...
12. Rufiji Basin Survey ...	—	45,229	—	40,000	...	...
13. Dev. of Water Supplies ...	—	48,000	—	13,000	...	...
Total ...	268,942	762,387	175,528	220,400	...	...

A chart indicating comparative expenditure from 1946—1954 is annexed showing expansion of the activities of the department in recent years.

Thousand
£

EXPENDITURE CHART.

Thousand.
£



Plans were drawn up earlier in the year for the proposed expansion of the department in accordance with a wider demand for water by all the various Native Authorities throughout the country, and the programme came into operation in July. It will be appreciated however that to accomplish such an expanded programme of work a considerable expenditure on plant and equipment was necessary. The capital expenditure on plant, buildings and equipment during the current financial year is therefore likely to be much heavier than in subsequent years in relation to expenditure on development works. In subsequent years far more work can be expected on development by the use of the machinery thus acquired. Much of the equipment ordered under this financial year's allocation has still not been received, but there is nevertheless an already considerable increase in development works compared with the preceding year.

As much of the development work constructed by the department is being financed directly by Native Treasuries, it has become necessary to set up a new system for costing of works. A plant renewals fund has been created to enable new equipment to be purchased when the present plant becomes worn out. This naturally has led to greater burdens being placed on an already hard-pressed and under-staffed office organization at each division, but it at least has the merit of securing a planned future for the department which could not operate without the necessary earthmoving plant and machinery.

It is perhaps a rather unfortunate circumstance that in those areas which most lend themselves to the development of ground-water resources, especially the Central Province, the Native Authorities were sorely pressed financially during the year to meet the demand of famine relief works, and could not therefore find the funds to carry out so expensive a drilling programme as in the past, particularly as these installations carry with them fairly heavy annual maintenance charges in comparison with other types of supply. There has thus been a slight falling-off in expenditure on water boring.

4.—MAINTENANCE AND CONSTRUCTION OF RURAL WATER SUPPLIES

Outstation Supplies.—At the end of the year the following supplies were being maintained, those in *italic* having been completed during 1954:

Eastern Province—Utete, Kisarawe, Mafia.

Tanga Province—Handeni, Muheza, Same.

Northern Province—Mbulu, Oldeani, Loliondo, Tengeru, Babati, Ngorongoro.

Central Province—Kongwa, Kondoa, *Manyoni*.

Southern Highlands Province—Njombe, *Kibao*.

Southern Province—Newala, *Masasi*, *Tunduru*.

Lake Province—Malya, Biharamulo, Ngara, Nyalikungu, Geita, Nansio, Tarime, Ngudu.

Western Province—Nzega, Kasulu, Mpanda, Sumbawanga, Kibondo, Bukene.

At each of these outstations there were, in addition, either extensions or minor modifications (other than repairs) necessitated by altered conditions since the original supply was completed.

In some outstations difficulty has been experienced in securing satisfactory readings of water-meters, and unless more maintenance staff can undertake this work, it seems that this is likely to be a constant source of loss of revenue. It is now being considered whether this work of operation of outstation water supplies could not better be undertaken by the Public Works Department, which is well equipped for meter maintenance, and thus free the Water Development Department to carry on with development works.

It has become apparent that an increase in water rates will have to be made in these supplies to cover maintenance and running costs, and this matter is currently under review.

Native Authority Supplies.—Although there is a drive towards the development of irrigation, a considerable part of the department's activities will continue to be directed towards the provision of rural water supplies, both for domestic and stock use, and demands have continued to be received during the past year for further supplies of this nature. A stage appears to have been reached in the Central Province, however, especially in Ugogo, where the annual maintenance costs of pumping installations will just about equal the maximum funds which can be provided by the Native Treasury, so that no further money is available for development of new supplies. Where pumped supplies are concerned, this financial burden is no light one, and in such areas efforts have been directed towards encouraging the African villager to build his own small stock-pond. These small dams are not meant to act as major sources of supply, but to prevent overgrazing on land adjacent to more permanent water, and have the advantage of being almost negligible in maintenance costs once they have been constructed.

General acceptance throughout the country of the recommendations put forward for a more realistic attitude towards the maintenance of these rural supplies, and the setting up of a renewals fund as a separate function, have now led to the establishment of the following annual rates:

Native Authority Maintenance and Renewals Funds—Rates based on Capital Cost

<i>Type of Supply</i>	<i>Maintenance</i>		<i>Renewals</i>	
		<i>%</i>		<i>%</i>
Dams and cattle-troughs	0.50	...	0.20	...
Pipelines and cattle-troughs	1.25	...	1.0	...
Borehole installation with hand-pumps, windmills or power-pumps and cattle troughs	3.5	...	4.5	...
Power-pumped supplies other than at boreholes	8.0	...	5.0	...

Small hafirs or stock-ponds have not been included in the preceding schedule.

Major Makonde Scheme.—During the course of the year, a detailed report and estimate of the Major Makonde Water Supply project was considered by consultants, and legislation was enacted which made possible the formation of a corporation to put this major scheme into effect. Government is backing the finances of the corporation in order that the loan can be underwritten. One of the functions of this new corporation is to take over the existing Newala outstation supply, which has provided a pilot scheme upon which to assess the local reaction to the larger project. The pilot scheme will later be amalgamated with the major scheme, and maintenance will cease to fall upon the staff of this department.

5.—IRRIGATION

The staff of this section attached to the Head Office at Dar es Salaam consisted of one Irrigation Engineer, assisted for three months by an Assistant Engineer, newly recruited from England. In mid-July the Irrigation Engineer proceeded on four months' leave to the United Kingdom and this unfortunately brought the planning of further irrigation works to a temporary standstill.

The following irrigation schemes or proposals were dealt with during the first six months:—

A.—(a) *Mlali Scheme, Eastern Province.*—Designs of headworks and the channel system were completed and final engineering drawings prepared together with final report and estimate of £9,000 for the entire scheme. Construction was started by the Divisional Engineer, Morogoro, after the scheme had been accepted by the Native Authority. Good progress has been made with the construction. The headworks and channels for the right bank section of the scheme were practically completed and it is expected to bring the first 150 acres under cultivation early in 1955.

(b) *Lower Uru Pilot Scheme, Northern Province.*—This forms part of the Chagga Resettlement Scheme. The lay-out plan for a block of land 500 acres in extent, as well as the design for the channel system and structures, and the necessary engineering drawings, were prepared. The estimate for £4,600 was approved by the Chagga Council, who, it is of interest to note, are prepared to defray the whole cost.

For the expansion of the Pilot Scheme, or Stage I, a contract was placed with a private surveyor for a reconnaissance survey covering an area of 4,500 acres, and for an engineering survey with contours at 1-foot vertical intervals for an area of 1,000 acres. The first plans have been received and irrigation works will be designed as soon as possible.

(c) *Mianje Mungaa Dam, Central Province.*—A tower sluice with a 36 in. diameter conduit was designed and plans as well as an estimate prepared. The cost of this scheme is estimated as £3,250 and construction was commenced during the middle of the year. The gate is being supplied by Messrs. Adams-Hydraulics Ltd.

A reconnaissance survey of the valley below the dam was carried out by the Department of Lands and Surveys, and the contour plans with 25-foot vertical intervals have now been received to enable planning of the irrigation scheme to proceed. Engineering surveys, to prepare plans with 1-foot contour intervals of the land to be commanded by the scheme, are due to commence in 1955.

(d) A detailed engineering survey was made of the lands comprising the Konga scheme, near Morogoro in the Eastern Province, covering an area of 2,000 acres. Unfortunately no staff was available to proceed with the planning and lay-out of the irrigation facilities.

B.—Investigations were carried out for several other proposed irrigation schemes which are listed below:—

(a) *Bubu River Scheme, Central Province.*—Gauging stations at three possible dam sites were initiated for recording streamflow.

(b) *Luengera Valley, Tanga Province.*—Tenders for an engineering survey of 2,500 acres were called for, but the selected tenderer did not proceed with the work. It is hoped to carry out the survey with Water Development staff in 1955.

(c) *Mvuha Scheme, Eastern Province.*—A gauging station was erected at a point on the river where it debouches from the foothills, for recording of streamflow. In the meantime an aerial survey of the entire Mvuha Valley was made by the Department of Lands and Surveys and plans have now been submitted showing contours at 25-foot vertical intervals, which will determine the extent of the schemes to be covered by engineering surveys.

Other schemes dealt with on a preliminary basis under this heading were:—
Kihurio Valley Scheme, Luiche Delta and Matamondo Valley.

C.—Whilst on leave the Irrigation Engineer attended a special conference at the Colonial Survey Office, and the survey requirements of this department, especially in connection with location and planning of irrigation projects were discussed. In consequence, aerial surveys were started by the Colonial Survey Office to cover the more prominent river basins, including the Rufiji, Pangani, Ruvu, Mkomazi, Luengera and others.

D.—Although the output from this section during the year has not been spectacular, valuable data has been collected and surveys have been undertaken to enable the formulation of irrigation schemes to proceed at a greater speed than before, especially when the full irrigation staff will have become available.

6.—BORING SECTION

GENERAL

Geophysical investigations were carried out in thirty-three areas during the year, mainly in the Central Province, but others scattered over five other provinces. These investigations were principally in connection with rural stock and domestic water supplies, but in one or two cases were carried out at the request of the Railways Administration and the Overseas Food Corporation.

Seventy-one boreholes were drilled during the year, thirteen of which were for cleaning only. Fifty-four new boreholes were started and forty-eight completed. The total footage drilled was approximately 11,600 feet, plus 2,739 feet for cleaning, yielding about 60,000 gallons per hour.

For details of boreholes drilled see Appendix II.

GROUNDWATER GEOLOGY

NORTHERN PROVINCE :

Loliondo District.—The first boreholes so far sunk by the department in the Loliondo quartzite area indicate that the water table, if and when it exists, is very deepseated. One borehole at Oldonyo Narok struck water at nearly 300 feet, but a second on the Kenya border had to be capped without striking water at 451 feet. A third reached 293 feet after a small quantity of water had been struck at 150 feet, and no increase in yield was obtained at the total depth. Several borehole samples from the Loliondo area show a glass-clear quartz which possibly indicates re-crystallization under high pressure.

Monduli District, Ngata Nanyuki.—This borehole proved a failure, probably due to the fact that the borehole is fairly close to the Ruvu Escarpment and that the rocks at depth are drained by fractures connected with the Ruvu fault.

CENTRAL PROVINCE :

Kondoa District.—Boreholes sunk in the Chubi Mbuga to the north-east of Kondoa penetrated clays, marls and sandy deposits to the full depth of the hole—385 feet. It is considered that the Chubi Mbuga may, in the past, have been connected with a system of bays and lakes, offshoots of Lake Manyara, at the period when this lake had its maximum extension. This would account for the great thickness of superficial deposits in the Chubi boreholes.

Dodoma District.—The Makatupora depression was explored by four further boreholes and pumping tests were carried out by the Public Works Department. The water level in adjacent boreholes (500 feet from the one that was being pumped) did not fall when borehole 8/54 was pumped at an approximate rate of 5,500 gallons per hour. This result was unexpected as it is presumed that the water struck in the Makatupora mbuga is of the type known as “confined water” and this type of aquifer usually reacts immediately to pressure relief. Thus, one would have expected a sudden and definite lowering of the water level in the adjacent borehole. Two explanations seem possible: either the main aquifer is split up into several semi-disconnected aquifers, or the percolation rate of the main aquifer is very low.

The behaviour of borehole number 44/53 points to the possibility of semi-disconnected aquifers within the basin. This borehole was test pumped for 48 hours in December, 1953 and yielded 3,600 gallons per hour, but when it was re-tested in April, 1954, surged, cleaned and tested again, the yield was reduced to 650 gallons per hour.

Singida District.—Two boreholes were sunk in the Wembere depression to open up large potential grazing areas within this region. Both struck good quantities of water in Manyonga lake beds. The depth of the lake beds was considerable—in one borehole as much as 380 feet. Red, oxydized clays, containing but little lime, were encountered in the boreholes. In general, the lake beds were calcareous clays and limestones. The fluorine content in these waters tends to be high, as much as 40 p.p.m.

EASTERN PROVINCE :

Morogoro District.—The old river bed channel in the Mkata plain was again explored by one borehole, and water was again struck in gravels from 48 to 104 feet depth.

WESTERN PROVINCE :

A borehole was sunk for the Railway Administration near Ikusule Station on the Mwanza line. This borehole penetrated terrestrial sands and gravels and eventually lake beds of a similar type to the Manyonga lake beds which cover a large part of the Singida, Nzega, and Shinyanga Districts below the 3,800 feet contour line. The lake beds at Ikusule consisted of calcareous sandstones and blue limestones. The depth of the lake beds must be considerable as bedrock was not reached at the final depth of the Ikusule borehole—490 feet; this, despite the fact that the banded ironstone formation is outcropping only a mile from the borehole. It is, therefore, concluded that a considerable faulting of the granite and banded ironstone formations must have taken place before the lake beds were deposited.

TANGA PROVINCE:

Same District.—A relatively large supply of water was struck near Lembeni in basement rocks. The siting of a borehole on a cross fault below the main escarpment, and the occurrence of pegmatite dykes in the area, contributed to this success.

GEOPHYSICAL EXPLORATION

The percentage of successful boreholes has risen during the year. On final analysis, this is probably due to the fact that the accumulated results of hundreds of resistivity graphs taken during the last two or three years can now be compared with the respective borehole logs and analysed and evaluated properly.

There are, however, areas such as the Loliondo and Bukoba Districts where no previous experience of the relationship between resistivity graphs and the particular rock formations, is available. These areas are, therefore, likely to prove unpredictable for some time to come until more borehole results can be studied.

In the past, considerable difficulties have been encountered in keeping these resistivity instruments in working order. As a rule, they cannot be repaired by anybody except the makers, and unless a certain number of spare instruments are kept, the situation becomes precarious from time to time during the prolonged periods whilst instruments have to be sent to England or elsewhere for repair.

On the whole, little development has taken place in the design of these instruments, and not all those on the market can stand up to the constant hard use under local field conditions. The Megger geophysical earth tester, model 1936, so far seems to be the most suitable instrument from a working point of view. It is hardy, easy to operate, and mobile.

During the year, 165 depth probes totalling 10 miles and 35 traverses totalling 25 miles, were carried out.

QUALITY OF BOREHOLE WATERS

During part of 1953 and the whole of 1954, water from boreholes has been analysed for fluorine by the Geological Survey Department, which inaugurated these tests.

The result of the analyses of water from 47 boreholes shows that approximately 31 per cent of these boreholes have a fluorine content of more than 3.5 parts per million. The tolerance for fluorine, i.e. the maximum quantity which can be considered innocuous to human beings, has been put as low as 1 p.p.m. in the United Kingdom. By other authorities it has been put as high as 5 p.p.m. Using the United Kingdom standards, only eight of the 47 boreholes mentioned above would pass muster. It should, however, be noted that pipelines and springs at Oldonyo Sambu in Arusha area, carrying 41 p.p.m. fluorine have been used for fifty years by both Europeans and natives without apparently disastrous results.

As regards native livestock, investigation by the Veterinary Department shows that stock can survive on water containing 18 p.p.m. Using this figure as a maximum for stock water supplies, only six boreholes analysed so far have

been found to exceed this upper limit. The highest was obtained from a borehole in the Chubi mbuga in Kondoa District, and showed 80 p.p.m. The Wembere depression, unfortunately, also carried ground-water with a high fluorine content; four boreholes have shown from 25 to 40 p.p.m.

Ground-water with high fluorine content is, as a rule, alkaline due to the presence of sodium carbonate. This type of ground-water can be expected in areas where volcanic eruptions and lava flows have occurred in the past, and in lake sediments originating from such eruptions or laid down in water derived from a volcanic source. Thus it can be expected that in large areas in the Northern Province, including Manyara, and Loliondo areas and Arusha and Moshi Districts, the ground-water will carry fluorine.

The fluorine contamination is, however, not restricted to volcanic areas only. Certain intrusive granites in the Lake Province contain fluorspar, which is dissolved and contaminates the ground-water. This type of contamination has been noted in two boreholes in the Isanga Basin.

The Wembere and Chubi lake beds were possibly laid down in waters derived from volcanic eruptions and may also contain volcanic silts.

The problem of removing fluorine by filtering has been discussed with the Research Chemist of the Veterinary Department. He has experimented with certain chemicals on borehole water brought from the Wembere, and the results are promising. If money can be made available, the first full scale experimental filtering plant will be constructed by this department in the Wembere next year.

BOREHOLE DRILLING

Up to the middle of the year the Boring Section had been financed by Colonial Development and Welfare Funds, and boring for the Native Authorities had been subsidized. After the beginning of July, the use of these funds was restricted and it was ruled that every Native Authority would have to advance funds to cover the full expenditure on boring operations, except in special cases where financial assistance would be made available. The Central Province and Masailand authorities immediately cancelled fifteen to twenty boreholes, most of which had already been sited and surveyed. This threw the whole boring programme out of gear and new sites had to be found elsewhere, where funds were available, to keep the staff occupied.

Despite these set-backs, drilling has proceeded uninterruptedly in widely scattered areas from Loliondo in the north, to Tanga in the east, and throughout central Tanganyika. As already stated, seventy-one holes, including thirteen for cleaning only, were drilled during the year.

WELL SINKING AND BANKA DRILLING

Banka drilling and well sinking have been carried out in the Mbeya District by Messrs. Blackhall and Hermitte, and in the Rukwa depression, Sumbawanga and Chunya Districts for the International Red Locust Control Service. In the Rukwa depression 34 Banka boreholes were sunk, of which 33 struck potable water, and 31 were fitted with handpumps partly constructed from local material. This is the first time that Banka holes have been fitted with pumps, and it is hoped that these will work successfully.

Ten standard type wells yielding potable water were completed, the total footage being 90 feet. In addition, wells were deepened in the Mbeya District. Three large wells of 8-ft. diameter, totalling 60 feet, were sunk by a new method in the Eastern Province, and proved very successful. A Banka drill was also kept busy in the Eastern Province on various investigations connected with the design of small earth dams, and the sinking of wells.

The total footage of Banka drilling to the middle of December was 2,415 feet; of this, 847 feet were drilled for the International Red Locust Control Service.

During the year the oldest member of the department, Mr. James Blackhall, Works Foreman, had to resign at the age of 89 on account of ill health. Mr. Blackhall had been with this department, first as a Drill Foreman and later as a Works Foreman, for nine years. During these difficult years he worked hard, conscientiously and persistently and with great skill, often under difficult field conditions, thus setting a fine example to the younger generation. His services were indeed appreciated and the British Empire Medal was awarded to him in the 1955 New Year's Honours List.

7.—HYDROLOGICAL SECTION

The Hydrological Section continued to be hampered by inadequacy of staff, particularly of reliable field personnel. In an effort to meet the difficulties of recruitment, vacancies were created on the works staff for fifty Weir Recorders, and for Gauging Assistants in the subordinate service. By this means, it was hoped that Africans of a reasonable educational standard could be recruited locally, and trained in stream-gauging, thus freeing European Water Bailiffs and Hydrologists for more specialized work and for processing the field data. Likewise, the continued difficulty in filling outstanding vacancies for Engineer Hydrologists led to a change in the title to Executive Engineer. Any Civil Engineer is capable of acquiring the expert knowledge needed after a short period of practical training under one experienced in hydrology. This change of title will also make for greater flexibility within the department, as, in the past, an Engineer Hydrologist was not generally given the opportunity of taking over a division, and undertaking construction work. It is to be hoped that this change will also enable the Director of Colonial Recruitment more quickly to fill outstanding vacancies, although it is patent that there is a world-wide dearth of trained engineers.

With the departure on leave pending resignation of the Divisional Engineer from Arusha, the Engineer Hydrologist in charge of the Masailand development programme was obliged to take over the running of the whole division, as well as that of the Masailand scheme. As a result, he was lost to the Hydrological Section. With another Engineer Hydrologist away on leave for the major part of the year, and one unfilled vacancy in the ranks, it will be appreciated that the burden of registration of streams and riparian consumers, particularly in Moshi and Arusha Districts, in implementation of the new Water Ordinance, became extremely difficult. This is especially so in view of the thousands of African furrows on the slopes of Mount Kilimanjaro and elsewhere.

Because of preoccupation with work connected with the new Water Ordinance, the Hydrological Section still has to concentrate primarily on the Northern Province streams. In the Eastern Province, an active section of the

Divisional Engineer's staff has continued and expanded hydrological work, mainly in the Ruvu River and Ngerengere River catchments. In the Kilosa District and around Mbeya, there is a big demand for hydrological work, largely in connection with land alienation. So far, the department has not had the staff to cope with these additional areas, and it would seem that still further applications will have to be turned away until more staff can be recruited.

During the current year, fairly large orders were placed for stream gauging equipment. This will permit of the gauging of some of the larger streams in the country, whereon flood recordings have proved difficult to obtain with the existing equipment.

In order to keep this report condensed, no details of individual reconnaissances and surveys carried out by the Hydrological Section have been shown, but, as in the past, a list is given in Appendix VII of established gauging-stations, showing the maximum and minimum flows so far recorded.

The Engineer Hydrologist at Moshi has also, during the second half of the year, had to supervise the survey of some 5,000 acres for irrigation in the Lower Uru area south of Kilimanjaro. Although this survey is being carried out by contract, there is much detailed work which has to be done by the Water Development Department's surveyor. Liaison must also be maintained with the administration, who are anxious to resettle the Wachagga in the area as soon as possible, also with the contract surveyor undertaking the work, to whom every possible assistance has had to be given to accelerate the work.

8.—MECHANICAL SECTION

STAFF

This year it has again been shown how sadly lacking the department is in mechanical staff.

The Mechanical Engineer proceeded on vacation leave in June, necessitating the transfer of a Civil Engineer from one of the divisions to keep things moving at headquarters in his absence. Four Mechanical Inspectors have also been on long leave during the year, leaving a total of two in the territory. It remains difficult to recruit locally good standard temporary staff, and this has also been a continual source of worry. Notwithstanding the foregoing, it is surprising and pleasant to record that work has not suffered in any great degree.

Steps towards the organization of a more balanced Mechanical Section were taken at the start of the financial year, when a post of Engineering Assistant (Mechanical) and two additional posts each of Mechanical Superintendent and Mechanic were created. Most of these new posts are now filled.

The Engineering Assistant (Mechanical) has been posted to head office where his presence will be a great help to the Mechanical Engineer. It is hoped that much of the work on mechanical plant records and detailed analyses of plant and vehicle running costs, which has had to be shelved in the past, can now be undertaken. These records are particularly necessary now that the new Plant Maintenance and Renewals Funds are established.

The two additional posts of Mechanical Inspector raise the total to eight for the territory, allowing one to be posted to each of the larger divisions, including Tanga and Mwanza. The need will soon arise for Mechanical Inspectors at Morogoro and Newala.

WORKSHOPS

Three divisional workshops have been earmarked for expansion this year and early in 1955, and work is already under way on the construction of garage bays and stores at two of these. Plans for the third have been drawn up and are under consideration. Equipment is on order through the Crown Agents, which will allow each of these divisions to deal with all normal vehicle and plant repairs and maintenance, as well as provide facilities for the care and maintenance of the many outstation and Native Authority supplies, which come under the general control and supervision of the department. On completion of these three workshops, situated at Mwanza, Morogoro and Tanga, only two divisions will remain without comprehensive repair and maintenance facilities, a deficiency likely to be remedied very shortly.

Among the new equipment purchased for the established workshops, was a diesel injector servicing machine, which allows many diesel fuel injectors to be repaired where they would previously have been written off. In the first three weeks of its use this machine was estimated to have paid for itself twice over in recovery of old injector nozzles. A scheme is now under way whereby the division holding this machine will undertake repair work for the rest of the department.

On order, and due for delivery in the near future are two fuel pump test benches, which will greatly assist the work of maintaining diesel fuel pumps. It is hoped that these machines will be equally as successful in their own line.

A mobile borehole service hoist has been fabricated in Dodoma, and after trials was found to be very successful. Most of the parts used in its construction were obtained second hand and the total cost of the unit was less than that of a new Bedford lorry. The unit, dubbed the "Hoistmaster", has also proved most useful on the maintenance of the many boreholes in the Central Province.

VEHICLES

The following vehicles were purchased during the year:

Bedford Scammell	...	...	...	...	2
Bedford 7-ton	...	...	...	...	1
Bedford 5-ton	...	...	...	...	3
Bedford Tipper	...	...	...	...	1
Bedford 3-ton	...	...	...	...	1
Land Rover Pick-up	...	...	...	...	2
Land Rover	...	...	...	...	9

and the following are on order, with delivery expected in the next few months:

Bedford Scammell	...	...	...	...	2
Bedford Tipper	...	...	...	...	8
Bedford Pick-up (30 cwt.)	...	...	...	...	6
Scammell Medium Duty Tractor	...	...	...	...	1

this will bring the total holding of the department to:

Bedford (all types)	...	...	...	...	88
Land Rover and Land Rover Pick-up	...	...	...	...	24
Thornycroft	...	...	...	...	15
Others	...	...	...	...	13

The following vehicles are due for write-off:

Austin 3-ton	...	...	...	...	1
Fordson Pick-up	...	...	...	...	2
Land Rover	...	...	...	...	1
Bedford	...	...	...	...	3

In general, the standard of maintenance has been very good, and in one case only can the write-off of a vehicle be attributed to other than old age. Even in this case, although it is admitted that lack of maintenance was a contributory cause, bad roads and rough ground conditions played a large part.

EARTHMOVING EQUIPMENT

Quite an appreciable increase in earthmoving equipment has taken place this year with the purchase of the following equipment:

Tournapull "Model D" Roadster	...	...	...	3
Caterpillar "D.4" Tractor	...	...	...	8
Toolbar and Dozer blade for "D.4" tractor	...	...	...	1
Toolbar and Dozer blade for "D.2" tractor	...	...	...	1

The Tournapull Roadsters are an innovation, and it is hoped that they will fulfil the many arduous requirements of this department. Within one week of delivery, they were put to work on dam construction, and the subsequent reports on their performance are promising. The chief advantage of this type of tyred equipment is its high mobility. With a top speed of nearly 30 m.p.h., periods spent in transfer from job to job will be cut down greatly, resulting in a higher percentage of working time. There will also be a great saving in ancillary transporting vehicles and trailers. Rubber tyres have the disadvantage of not obtaining sufficient grip to enable a full load to be picked up in the scraper without assistance. A tilt trailer is therefore being purchased to transport a "D.4" tractor behind one of the Tournapulls, which will be used for pushing during loading.

Of the eight Caterpillar tractors purchased, four have been sent to Tanga Province, two to the Northern Province and one each to the Lake and Eastern Provinces. In every case ancillary equipment is available or expected shortly, but some will require overhaul or modification.

The Tanga team will be ready to go into action early in 1955. The two additional tractors at Arusha are already in use, and the ones for Mwanza and Morogoro should be delivered in a few weeks.

The total holding for tractors is now:—

Caterpillar D.7	...	...	...	...	5
Caterpillar D.4	...	...	...	...	12
Caterpillar D.2	...	...	...	...	8
			Total	...	25

International TD 18	...	...	...	...	3
Tournapull Roadster	...	...	...	...	3
Landsborough Findlay	...	...	...	...	3
Latil	...	...	...	...	4
Fordson Half Track	...	...	...	...	1
Fordson (wheeled)	...	...	...	...	2
			Total	...	16

and the following have been written-off:—

Landsborough Findlay	...	...	...	...	2
Hanomag	...	...	...	...	2

The tool-bars mentioned are new to the department, and it is hoped that they will take the place of rippers. The D.4 tool-bar has not yet been received, but the one working with the D.2 has exceeded all expectations in its capacity to rip hard soils.

OTHER PLANT

With the new emphasis on irrigation works, it has become necessary to consider the purchase of earth digging equipment, and a start has been made by the purchase of a Ruston Bucyrus 10 R.B dragline and back-actor. It is considered that this machine will be ideal for excavating irrigation channels and placing the spoil in position for bunding. It has not yet arrived, but should be here in time to go to work on either the Lower Uru pilot scheme or in the Eastern Province. A second similar machine has been placed on order recently and it is hoped to order further machines as the works programme expands.

More and more, as this country develops, the need for mechanization in all branches of construction work arises, and the divisions are slowly being equipped with new works plant including concrete mixers, blockmaking machinery, stone crushing plant and compressors. This does not mean unemployment for the local worker, but rather the more economic use of the country's labour resources.

PLANT MAINTENANCE AND RENEWALS FUNDS

A sound basis for the replacement of worn-out plant and transport has now been laid with the inauguration of the Plant Maintenance and Plant Renewal Funds, which came into operation at the start of the 1954-55 financial year.

Primarily, the aim of the funds is to make all maintenance work and cost of plant depreciation a direct charge against works. The hours worked or miles run by plant and vehicles are now debited directly against the particular job on which they are employed, at a fixed rate which covers a renewals charge and a maintenance charge. It is possible that in the light of experience, the rates may need modification at a later date.

As can be expected, the initial stages of the implementation of the scheme have thrown a considerable amount of extra work on the department. However, matters are sorting themselves out well and after six months' trial it is safe to say that the scheme will be successful.

9.—CONSTRUCTION SECTION

EASTERN PROVINCE

After only one year in the office at Morogoro, the then Divisional Engineer had to be brought down to head office to act as Assistant Director to relieve the pressure of work in Dar es Salaam, which had been without an Assistant Director since the preceding November. Fortunately, however, a young engineer had arrived in February, and with the improved communications between Dar es Salaam and Morogoro, no misgivings were felt at posting so new a recruit to take charge of the office there. He has justified the confidence placed in him, and no hiatus has resulted from the change.

Subsequent to a conference held in Dar es Salaam, and discussion with the local villagers, who showed marked interest and co-operation, it was decided to proceed with the construction of the Mlali Irrigation Scheme, which would bring about 350 acres under irrigation. Because of the necessity to settle families more permanently on their plots of land, the old attitude to land

tenure will have to be revised, and more permanent holding of one section of land by each family secured in order that the project can be operated on stable lines. When the beneficial results of planned irrigation become apparent, there is no doubt that there will be unending requests for further projects of this kind. Another area has been surveyed at Konga, some ten miles away, which will bring a further 2,000 acres under command, but detailed design of the necessary structure has been delayed by lack of staff.

The burning of a clamp of bricks made from the local clay at Mlali was tried out during the year, largely as an experiment in the use of local materials. The bricks produced, although sound, were ill-formed, and much wastage by overburning was noted. Larger clamps of not less than ten thousand bricks are necessary to reduce the amount of overburning. Despite the advantages of use of local materials, indications are that brickwork will not prove cheaper than sand-cement block construction. One living quarter, half in brickwork and half in blockwork was completed by the end of the year for the irrigation supervisor at Mlali.

At Ngerengere Minor Settlement, the borehole drilled to provide a domestic supply having yielded unpotable water, the Divisional Engineer had recourse to a large-diameter shallow well, sunk by the jetting technique. This proved extremely successful in the sandy formation encountered and a depth of 18 feet was attained in five days. The well is now being test-pumped to prove its yield before designing the piped supply system. Present indications are that the well will prove adequate to meet the demand.

Drilling was undertaken on behalf of the Department of Agriculture to secure a domestic supply to the proposed Indian Agricultural School at Wami, and a successful result was obtained, the yield being 1,700 gallons per hour.

The shortage of geological staff led to delays in geophysical prospecting for ground-water in areas adjacent to the Ruvu Valley for cattle-ranching, but later the Director of Geological Survey came to the department's aid and a Geophysicist was seconded for the job. The results are not yet to hand.

Owing to the preoccupation of the Morogoro divisional staff with the construction of the Mlali irrigation project, and the absence of any staff for processing the field data, it has not proved possible during the course of the past year to produce final reports on either the Ruvu or Ngerengere River schemes, but a further year's data has been added to the records.

Diamond drilling was carried out at the Kidunda dam site on the Ruvu by the Director of Geological Survey on behalf of this department, and special core-storage arrangements are in hand in Morogoro to safeguard the cores against the day when the dam construction project is ready to go ahead.

In Bagamoyo District, the hand-construction of dams to designs prepared by the Morogoro office has been encouraged by the filling of the Lugoba dam during a single freak storm. The local populace are now most enthusiastic about this type of work, and a second dam is being built at Mindu Tuleni. The Miono weir, which failed to fill last year, now provides at least a small supply in an area of notorious drought.

Close co-operation with the Rufiji survey under Mr. Simansky of the Food and Agricultural Organization has been maintained by the secondment of a Water Bailiff and a Works Foreman to the team, and the local recruitment of others to assist in hydrometric work.

SOUTHERN PROVINCE

The work of the Newala Division was given considerable impetus during the course of the year by the posting there of two Engineering Surveyors (one temporary) and a Storekeeper. The latter was able to assist the Divisional Engineer considerably by sharing the burden of purely routine organization and correspondence, apart from straightening up the stores organization. The housing problem is still most acute at Newala, however, and can only be overcome by the Divisional Engineer himself offering hospitality to the Storekeeper, whilst one of the Engineering Surveyors is obliged to "double up" with the Agricultural Officer. The other was given a tent and a task some distance away from the depot. This is a most unsatisfactory state of affairs, and greatly hampers the smooth working of the divisional organization. These increases in staff were unfortunately partly offset by the departure on vacation leave of the clerk for whom no replacement has been possible.

With the shift in emphasis on divisional activity away from Newala District, now that the Major Makonde project is to be a separate concern, the establishment of a permanent headquarters in the Southern Province for the Divisional Engineer is again under consideration. Many factors have a bearing on this problem, including the need for proximity to the Provincial Administration headquarters, proximity to the work and availability of housing and office accommodation.

The meeting of the Shadow Board of the Major Makonde Water Supply Scheme was held at Newala to discuss plans for the formation and registration of a corporation composed of Wamakonde shareholders, and to secure the necessary capital with which to finance the project. The economics of the scheme as set out in the departmental report, appeared very sound but, as an additional safeguard, consultants were called in to consider it from all aspects. Their report was favourable and they were later called in to carry out the actual survey and prepare the designs with a view to construction by contract as soon as possible. Legislation empowering the formation and registration of the Makonde Water Corporation was passed in December, and a General Manager has now been appointed to handle the corporation's affairs. The consultants' rough estimate of the cost of the scheme came to some £250,000 but as a safeguard, the originally estimated total capital of £320,000 has been budgetted for. It is hoped that this new supply, by making domestic water available over the expanse of the Makonde plateau, will enable the local people to increase the production of food crops and raise their standard of living.

The Newala outstation supply, forming the pilot scheme on which assessments of the reaction to the provision of a water-supply on the Makonde plateau have been based, was extended by a six-mile pipeline to a sparsely-settled area near Namiyonga, where an 11,000 gallon tank provided a day's storage. True to the assumption made, a fairly considerable resettlement took place shortly after the opening of the kiosk and the area around the water-supply point is now quite densely populated. It therefore appears that the provision of suitable water-supply points away from the edge of the plateau will draw the people from the present over-populated areas where the soil is in danger of becoming overworked. It is perhaps unfortunate that the slot-dispensing machines for affording a 24-hour sale of water at Namiyonga, which were ordered in January, could not be installed during the year so as to provide

the consultants with an idea of the reaction of the villagers to them. These slot-dispensers form an essential part of the proposed Major Makonde scheme and will eliminate kiosk attendants, and give longer hours of sale of water, enabling the villagers to draw off water whenever they wish, without limitation to the working hours of the kiosk attendants.

By divesting himself of the further details of the Major Makonde Project, the Divisional Engineer was able to direct his attention elsewhere in the province. An extensive gravity piped supply for the Lulindi/Chiungutwa/Masasi triangle was designed and approved to provide domestic supplies for new African resettlement and to encourage a limited amount of cattle-raising in the Masasi District. This will constitute the largest scheme undertaken by the division during the current year. Pending completion of the financial arrangements whereby the Masasi Native Treasury is borrowing the necessary funds, money has been made available to enable Stage I of the project to be started, and to place on order further materials for the remainder of the scheme.

In the Puchapucha area, near Tunduru, the Divisional Engineer is carrying out experiments on the rejuvenation of several springs, which now cease to flow during the dry season. The method covers the construction of numerous small check-dams and sub-surface dams. Older records indicate that many of these streams were perennial within living memory but, owing to gradual clearing of the bush, their peak flows have increased and the low flows dropped until the streams finally dry up altogether between the rains. The result of the trials so far carried out has shown that the methods used can bear useful fruit; many of the streams tackled have continued to run well on into the dry season, and it remains now to be seen whether they will become perennial once again. These experiments are being studied by the local tobacco farmers and the Agricultural Department with the keenest interest. The Divisional Engineer is confident that these methods can be applied in many other areas in the Southern Province and should greatly assist in development.

In Mtwara District, the Divisional Engineer is looking into the possibilities of development of irrigation in the Maharunga Flats, to the north of the Ruvuma. He also intends to investigate irrigation possibilities on the Mbwemkuru River in Lindi District, where there is the population pressure to give stimulus to such schemes and the promise of successful sites.

It is only fair to record that the Divisional Engineer has been considerably hampered by lack of transport during the course of the past year, as facilities for maintenance are of the most meagre in Southern Province and recruiting difficulties did not allow of the posting of a mechanic to Newala, even if accommodation had been available.

NORTHERN PROVINCE

As has been recorded earlier, the then Divisional Engineer departed on vacation leave, pending resignation in April, so that the Engineer Hydrologist, Arusha, had to shoulder the burden of office. Fortunately, he was not new to the work, having run the Arusha Division in former years, but it meant his having to abandon all hydrological work. The position was not helped by the departure on leave, pending resignation, of one of his two Works Superintendents, and the absence of the Works Foreman in charge of the Masailand earth-moving team, who also proceeded on leave.

In the meantime, however, work was kept going with the installation, at a number of existing boreholes in Central and Southern Masailand, of headworks, power-pumps and cattle-troughs. Similar works were installed also south-east of Mount Meru to implement the Meru Development Plan for the resettlement of a section of the Wameru. These developments, together with the Maji ya Chai pumped supply, now put an available supply of water within easy reach of all living in the area. The Maji ya Chai supply was completed early in the year.

The Londorossi/Engushai piped supply system for farms on West Kilimanjaro was finally completed early in the year, after much difficulty due to disputes between the various farmers. Silting trouble at the headworks, which called for an improved design at the intake weir, was also experienced.

In connection with the Lake Muchlur development scheme, the outlet channel was finally completed, after some extremely hard drilling and blasting through two pegmatite bars. To put this outlet channel into operation, the water level in the lake has to be raised some ten feet, and towards this end an embankment was constructed across a saddle on the lake-shore. A channel was also dug by communal labour, as a contribution to the scheme by the local inhabitants, to connect the lake with the Yaida River. Flood waters from the river will now be conserved in the lake and become available for serving the lower Yaida resettlement area, which has, during the intervening two years, been cleared of fly-bush. At a later stage, it may perhaps prove possible to start an irrigation project amongst a people who have already shown themselves well adapted to this form of agriculture.

In order that the Masai of Northern Masailand might be given some satisfaction with their share in development works under the Masai Plan, a drilling-rig was sent to Loliondo District to put down boreholes. One borehole so far has proved reasonably successful outside the northern boundary of the Serengeti National Park.

Because of the record prices fetched by the coffee crop during the past year, the Wachagga have been able to set aside ample funds for development and fairly extensive works have been carried out for them in the provision of rural water-supplies around Mount Kilimanjaro. One project, that of pumping water from Lake Chala at a rate of 40,000 gallons per day, was abandoned because of the practical difficulties. In its stead, an existing piped supply from the Mkuu springs in the forest glades above Mkuu village has been extended about eight miles eastwards and supplies 95,000 gallons per day to open up all the grazing available for Wachagga cattle, as far as the Kenya border.

During the past year, Southern Masailand, along the Kondoa/Handeni stock-route, was particularly hard hit by the drought, and it is pleasing to record that three boreholes, at Kimana, Kibaya and Mrijo, are being fitted out with headworks and watering-troughs, and a sixty-nine million gallon dam at Nalangi Tomon is now about half finished. When these come into operation, many of the cattle deaths from inadequate grazing will be eliminated.

Emergency measures in the Northern Province, calling for increased recruitment in the Special Constabulary, met with a 100 per cent response from the Water Development staff at Arusha, but not without placing a considerable burden on the individual officers. Not only had they to carry out their normal

duties in office hours, but had to perform long spells on patrol duty in addition. Although in certain areas the emergency measures have now been relaxed, the staff still remain on call and still frequently have to perform extra patrolling duties. It speaks well for all concerned that they continue to produce good results in the field in the face of these difficulties.

As a matter of interest, during its seven years of work, the Arusha Division has laid over 175 miles of piping, constructed sixteen dams totalling over half a million cubic yards of earthwork, and conserving over 2,800 million gallons of water for stock and domestic use. In addition, some twenty boreholes have been fitted with headworks and troughs and are now on the maintenance list.

TANGA PROVINCE

The Divisional Engineer at Tanga had at his disposal one room as a temporary office during the year, and this was not conducive to ease of working. He has, therefore, been pre-occupied for most of the year with the design and construction of a divisional depot, and it is satisfactory to report that he entered his new offices at the end of the year. Other work carried out included a design for a pumped water supply for Mombo Minor Settlement and improvements to the Muheza outstation supply by the construction of a 30,000 gallon high level storage tank, with the conversion of the original high level tank into a slow sand filter.

Meanwhile, earth-moving equipment was placed on order for the division, and four D.4 tractors were obtained. Front-wheel assemblies for three existing four-yard scrapers are now on their way to the division. As soon as the remaining D.4 can be fitted with the necessary tool-bar attachment, to permit ripping of heavy soils, the team will be ready for dam construction in the early months of 1955. A workshop is to be built to house the necessary maintenance machinery at Tanga for keeping this earthmoving plant in good repair, and it is to be hoped that a Mechanical Superintendent will have been engaged by the time the equipment takes the field.

The initial programme of dam construction will be in the Handeni District. Assistance may also be given, where this can conveniently be arranged, to the Eastern Province Division by the construction of dams just over the border in Bagamoyo District where the water problems are closely allied.

LAKE PROVINCE

Shortly after the Divisional Engineer's return from vacation leave, the Mwanza Division suffered the loss of its Assistant Engineer who had to be withdrawn to headquarters in Dar es Salaam to take over the work of the Mechanical Engineer, then going on leave in May. It is an indication of the inadequacy of staff in the department that a civil engineer had to be called upon to undertake this work, there being no replacement for the Mechanical Engineer. The position has since been eased by the recruitment of an Engineering Assistant (Mechanical) towards the end of the year.

It has been difficult to assist the Mwanza Division as much as desired by posting further office staff there, on account of the unending difficulty of finding accommodation. With field personnel, it is a different matter, since

they can be housed in caravans or portable huts on the job, but unless these officers are backed up by a certain minimum of office and mechanical maintenance personnel based on divisional headquarters, the organization becomes inefficient.

In the Bukoba District, a $2\frac{1}{2}$ mile gravity pipeline was laid at Kabirizi to provide 30,000 gallons of water per day for domestic purposes and for stock in the rain-shadow area west of the mountains skirting the western edge of Lake Victoria. At the same time, small pumped supplies were designed for the Native Authority and constructed by contract at Rwenjojo and Bugene. In addition, a drilling-rig was sent to Bukoba District but the first borehole sunk to 378 feet at Bugene proved a failure, giving inadequate water of poor quality. The casing was withdrawn and the rig moved elsewhere in the district.

At Tarime it is gratifying to report that the small vertical-flow sludge-blanket clarification tank installed during the preceding year gave extremely satisfactory results with little supervision, so that no filter is needed to secure a clear supply. This formed the prototype upon which designs have been based for use in other outstation installations.

In Sukumaland the enthusiasm of the African villagers to provide themselves and their cattle with water supplies continued unabated, and thirty-five small dams and hafirs were constructed during the course of the year under the guidance of officers of this department. The example, thus shown, has spread to other parts of the province, eleven dams being constructed by hand labour elsewhere. By employment of the Sukumaland earth-moving team of D.2 tractors and scrapers, five mechanically-built dams were constructed. In June, the Sukumaland Development Organization closed down and the major part of the equipment was transferred to this department, one officer at Malya being transferred at the same time, to become an Engineering Surveyor. He is still stationed at Malya, continuing the work of survey and setting out of small dams. The mechanic in charge of the D.2 team was also transferred to this department, to continue in charge of the earth-dam construction.

The Mwanza Division received a great stimulus during the latter part of the year when a team of Le Tourneau-Westinghouse Model D Roadster self-propelled scrapers was purchased from the funds made available under the Lint and Seed Marketing Board Loan. In a comparatively treeless country, like much of Sukumaland, earth-moving plant of this type is considered to be the most suitable for resolving the conflicting requirements of mobility and tractive power. It has the advantage of being completely mobile over public roads without the need of a low-loader, such as is necessary for crawler tractors. It has been found by experience, however, that a crawler tractor will still be necessary to reduce wheel-spin and consequent tyre wear when making heavy cuts. Thus the crawler, fitted with a dozer blade, will act as a pusher for assisting the Le Tourneau scrapers in loading, allowing them to make a fast cycle in top gear at something like 20 m.p.h. In tough going, the crawler can also be used to tow a ripper, loosening the hard mbuga soils ready for loading.

Although this team of three roadsters was received in Mwanza only in November, and was not yet provided with a pusher tractor, it still managed to complete the Missungwi dam, just south of Mwanza, during the training period

of the three new drivers, before the end of the year. This was at an average hourly production-rate of 70 cu. yards per machine which is considered to be good.

Full maintenance facilities are not yet ready at Mwanza for this equipment, but a small, well equipped workshop is planned and the plant is on order. Equipment such as the Le Tourneau Roadster is a good investment only if adequate maintenance facilities can be provided, and the future policy of the department in the selection of earth-moving plant may well hinge on the performance of this team.

The 420-million gallon dam at Malya, after two successive dry years fell to an extremely low level, the lowest since its construction in 1946, with the result that the Masinde canal had to be reopened. The lowering of the water could, in all probability, be ascribed to heavy drain-off for irrigation of some 100 acres below the dam. Here rice production, guided by the Agricultural Officer at Malya, shows considerable promise with excellent yields of up to 3,500 lb. of paddy per acre.

In July, the Sukumaland Agricultural Show was arranged at Ngudu and the department was represented by a stand, on which the Divisional Engineer put in a great deal of hard work.

It had been intended that a sub-office should be opened at Bukoba, with an Assistant Engineer in charge, to take over all departmental activities on that side of Lake Victoria. Although an office site was agreed upon, and plans prepared for the depot, none of the funds allocated for this purpose could be expended during the course of the year, due to the transfer of the Assistant Engineer to take over the work of the Mechanical Engineer at headquarters. Activities in the Bukoba District, therefore, continue to be controlled directly from Mwanza until the sub-office can be opened. This is bound to occasion a certain amount of difficulty owing to the length of communications.

WESTERN PROVINCE

Lack of field supervisory personnel has constantly dogged the Tabora Division over the past year's working, so that there has been some delay in the execution of the works programme. Although several Works Foremen were sent up to the division, there were other casualties and the general level of works supervision was not raised.

Matters were not helped by the absence on leave of the Engineering Surveyor from April to October, and the departure on leave of the Works Superintendent in August, followed by one of two permanent Works Foremen, after a long tour of service, in November. The Tabora Division also lost its Mechanical Superintendent but the Italian mechanic has managed to keep the divisional equipment running extremely well.

During the first half of October, the Divisional Engineer was himself absent from Tabora on a visit to British Somaliland, to give advice on the provision of an improved water supply to Hargeisha, at the request of the Governor of British Somaliland. This emphasizes the fact that the experience gained since the formation of the department in the provision of water supplies in a semi-arid country is a valuable pool of knowledge in the Colonial Engineering Service.

After completion of work at Silimuka hafir early in the year, the earth-moving team of D.2 tractors and one D.4 tractor was brought into the depot for reconditioning, and in May was sent up to Nzega to construct Sima dam. This dam is needed to improve the water supply for Nzega, where the construction of a fairly large hospital had rendered the existing source inadequate. The D.2 team, with two-yard capacity scrapers and a long haul, proved to be too light for the job, so that progress was slow. As a means of stepping-up progress, two D.4 tractors were ordered during the latter part of the year, for towing two four-yard rope-operated scrapers, but it is not expected that they will be able to take the field before the early part of 1955. The D.2 team will, it is expected, prove extremely useful for levelling on irrigation schemes, which is more the type of work for which it is suited. Dam construction in the Western Province should be greatly accelerated once the D.4 tractors are in the field.

In a similar way to Nzega, developments at Kibondo outstripped the existing water supply so that the scheme had to be redesigned. An alternative source was found but this entails pumping against a considerably greater head than hitherto—in fact, at the limit of the standard type of pumping machinery used by the department. Work is proceeding on the sinking of a concrete caisson at the present spring to form a collecting-chamber, and the installation of a larger pump. Some labour difficulties were met in the initial stages of the work but have since been overcome. If all goes well, the project should be completed early in 1955.

At Sumbawanga, growth of the outstation once again outstripped the existing supply, and in November funds were issued to allow for the sinking of a nest of wells in the existing spring. The present pump is to be replaced with a borehole-type deep well pump, so that the water-table can be reached even when it drops at the end of the dry season. The high-level storage tank is also to be increased to 10,000 gallons capacity. Eventually, 30,000 gallons per day will be supplied by the installation planned. At the end of the year, work had just started on the sinking of the first of the four wells at the spring.

At the request of the Department of Education, a water supply was designed and built for the Musiviyi Middle School, Kasulu District. This involved a small earth dam at the intake works, a hydraulic ram pump and a half-mile of 1½-in. rising-main to a 3,000 gallon high-level tank. After a certain amount of delay in receipt of materials, the work was finally finished in September.

The construction of a water supply with the greatest possible speed was called for on the arrival of Kikuyu detainees at the temporary camp at Urambo. With funds allocated by the Public Works Department, four wells were, eventually sunk to an average depth of 8 ft., many trials being carried out before a suitable aquifer was found. Shortly afterwards, the majority of the detainees were moved elsewhere, so that the water supply will now probably be handed over to the Native Authority.

Wells were also sunk in eastern Nzega District, primarily for stock watering along the edge of the Wembere plain, where lack of water has limited grazing quite seriously of late years. Boreholes in this area had proved so brackish as to be unpalatable, even to cattle, and recourse was finally had to shallow wells. Whether water will be available therefrom during the dry season remains to be seen.

At the end of January, the Mfufumo gravity pipeline was completed in Kahama District to supply water to cattle grazing to the south of the Mhandu hills. This consists of a quarter of a mile of piping leading to a 30-foot diameter cattle-watering trough. A supply of about 50,000 gallons per day is available, although only some 3,000 head of cattle are now using this supply.

At Bukene, in the Nzega District, a small supply was constructed for 2,000 head of cattle by sinking a well in the sandy bed of a stream and piping the water collected to a 20-foot diameter cattle-trough. This area has always been notoriously short of water, and the new supply will permit the holding of trade stock awaiting rail transport down to the coast. This job was completed with funds allocated by the Director of Veterinary Services.

A reconnaissance survey of some fifteen square miles of the fertile alluvial Luiche Delta, near Kigoma, was carried out early in the year and gauging-stations were established on the river to enable stream flow data to be gathered. This information will later be used to design an irrigation scheme which it is hoped to construct there.

CENTRAL AND SOUTHERN HIGHLANDS PROVINCES

The work in these two provinces was under the direction of an Assistant Engineer until June, when an Executive Engineer arrived to take charge. This made it possible for the former to concentrate on the design and the early stages of construction of the outlet works at Mianje Mungaa dam. The Assistant Engineer unfortunately departed on home leave towards the end of October and was not replaced.

A second Engineering Surveyor arrived in September and was posted shortly after to Iringa sub-office. This made it possible to give rather more attention to the long outstanding programme of water development works in the Southern Highlands Province.

During the first few months of 1954, the mechanical staff in Dodoma was sufficient to ensure a reasonable standard of maintenance, not only of the vehicles and works plant, but also of the many pumping installations for rural water supplies. On the departure on vacation leave of the Mechanical Superintendent, conditions became more difficult and have remained so ever since. Difficulties are being encountered principally in the ensuring of adequate maintenance for the borehole supplies scattered over a wide area of the province, and it is certain that more attention will have to be given thereto in the future if full benefit is to be obtained from work done in the past.

It was intended originally that there would be one Storekeeper responsible for the stores of both Engineering Geologist and the Divisional Engineer in Dodoma. This arrangement later proved impracticable and the separation of the two organizations was decided on. This made it necessary for the Statistics Clerk to assume responsibility for the stores of the Divisional Engineer, with the assistance of only a Temporary Storeman, and it imposed a most unfair burden on the former, besides failing to provide a reasonable standard of security for the stores. It is quite evident that a strengthening of the stores organization is required.

It is generally agreed that the staff in the Central Province will need all-round expansion, particularly if due attention is to be given to irrigation development, which offers the greatest possible opportunities for overcoming the periodic and frequent food shortages which afflict this part of the territory. Although it is difficult to say what grades of staff are the most urgently required, it may be stated that engineering surveyors and water bailiffs are top priority if the new schemes are to be soundly designed and the necessary hydrological data secured for future planning.

Very little has so far been done in the Southern Highlands Province, although the opportunities offered for water development are very great and there is no lack of pressure from outside sources for an early start to be made. For this reason, it is hoped that a new division can be established at Mbeya during 1955-56, and that the necessity for supervising work in the Southern Highlands Province from Dodoma will be eliminated, with a consequent increase in efficiency.

It was decided during the course of the year that a separate office should be provided for the Divisional Engineer in Dodoma, completely divorced from that of the Engineering Geologist. This office has been under construction for several months and is now nearing completion. Once the Divisional Engineer and his staff are able to move in, it should be possible to ensure greater efficiency in all branches of divisional work.

In the Central Province, work has continued on the Irangi Development Scheme, which is being carried out in collaboration with the District Commissioner, Kondoa-Irangi. The various works carried out during the year include two pipelines, two dams and a sub-surface dam, and in all cases the Divisional Engineer has been responsible for technical guidance. It is intended that this scheme shall continue for a further period on the present lines.

Works in Dodoma District have been restricted mainly to the installation of pumps and storage tanks at eighteen different borehole and well installations. In some cases, engine-driven pumps have been installed, in others, use has been made of windmills and hand pumps. The building of dams has been restricted to those constructed by tribal labour, under the general direction of the departmental officers.

Two pipelines have been completed in Kongwa District, one at Sagara and the other at Chunyu. The only work completed in the Manyoni District is an outstation water supply, which is now functioning satisfactorily.

Perhaps the most important activity in the Central Province at present is that connected with the preliminary stages of the Mianje-Mungaa irrigation project. Work on the installation of an outlet on the dam commenced towards the end of the year, and completion is expected within the next few months. At the same time, an aerial survey of the area earmarked for irrigation development downstream has been completed by the Department of Lands and Surveys, and the stage is now set for detailed engineering surveys which will enable the final plans to be prepared. It is hoped that utilization of the waters impounded by the Mianje-Mungaa dam will enable a considerable contribution to be made to the production of food supplies.

The next scheme of a similar nature, but on a somewhat larger scale, has been planned in the Bubu River catchment. Here, various dam sites have been surveyed on a preliminary basis and three gauging stations established for the measurement of discharge. Further assistance has been received here from the Department of Lands and Surveys with aerial photography and mapping, which will enable the study of the project to proceed without some of the delay common to project planning in this territory.

Very little has been attempted in the Southern Highlands Province, but the establishment of a new sub-office at Iringa will enable a bigger divisional programme to be attempted in future. The only staff available for posting to Iringa at the moment comprises an Engineering Surveyor, but allowance has been made in the estimates for 1955-56 for more staff, with a view to the organization being strengthened until such time as a separate division is established.

Several small earth dams were constructed, and modifications carried out to the Njombe outstation water supply, which is dependent on a hydraulic ram. The department also undertook the supervision of the installation of sluice gates on the Msovwe River, in connection with one of Daresco's small hydro-electric schemes.

Since the establishment of the new Government policy whereby Native Authorities are called upon to pay 100 per cent of the cost of water development works, it has been found very difficult to plan any distance ahead. It is, therefore, considered most essential that the question of financing future works receives urgent attention.

There is no doubt that, although the Central Province suffers from a rainfall below the territorial average, the possibilities of development, particularly for irrigation, are extremely favourable and there is no apparent reason why it should not become an exporter of food rather than a continual burden on the resources of neighbouring districts.

The latent natural resources of the Southern Highlands Province are above the average but, being comparatively well provided with water, the pressure on the services of this department has not hitherto made itself strongly felt. Nonetheless, it is felt that the time has come when a lot more must be done to take advantage of the resources offered by nature and it is confidently expected that, once the new divisional headquarters have been established at Mbeya, the programme of development will rapidly gain momentum to the great benefit of the local inhabitants.

10. CONFERENCES

INFORMAL HYDROLOGICAL CONFERENCE AT ALBERTVILLE, BELGIAN CONGO

During the early part of the year the Irrigation Engineer attended an informal conference with the Belgian Congo authorities, on the stabilization of Lake Tanganyika. Valuable information was obtained on the hydrological study now being pursued by the *Service des Voies Navigables, Section du Bief Supérieur, Albertville*, with the ultimate aim of maintaining the level of the lake between predetermined limits. This will have far-reaching effects on the utilization of the marginal land of the lake for cultivation by means of pump irrigation and reclamation.

COLONIAL SURVEY OFFICE CONFERENCE

A special conference was arranged by the Tanganyika Government with the Colonial Survey Office for discussion of the final survey programme to be launched in connection with the Rice Development Plan and also irrigation in general. Mr. A. F. M. Smith, Chief Surveyor of the Survey division, Dar es Salaam, and Mr. W. A. Guthrie, Irrigation Engineer, of this department, attended the meeting.

FORMAL HYDROLOGICAL CONFERENCE

Unfortunately, on account of illness, the Engineering Geologist, one of the two departmental delegates chosen by Tanganyika to attend the Formal Hydrological Conference held at Victoria Falls and in Salisbury, was unable to be present. The Acting Director was therefore the sole representative, and had to present two papers. These were of a particularly high standard, and the critical discussions which followed them afforded an excellent opportunity for an exchange of ideas. The Acting Director wrote a paper on sedimentation studies of a dam in Northern Tanganyika, and the Engineering Geologist one on ground-water, and the lively discussions thereon were made the brighter by the wit and searching queries of Mr. Gerald Lacey, the Adviser on Drainage and Irrigation to the Secretary of State. Mr. Lacey was fortunately able to attend the conference before coming to Tanganyika to look over the Rufiji Basin.

A most instructive visit was paid during the conference to the Inyadyadzi village irrigation project, and to the Sabi Valley Agricultural Experiment Station, where delegates were entertained by Dr. Charles Converse. The kindness of the Director of Irrigation, Southern Rhodesia, in looking after all delegates was very much appreciated.

11. IRRIGATION COURSES IN CEYLON

At the end of December, the Assistant Director went off to Ceylon on a two months' visit of study on irrigation schemes in that country. This is the first of a series of visits which it is hoped will be paid by officers of this department, by arrangement with the Government of Ceylon.

With fifty years of modern irrigation practice behind it, the Department of Irrigation there has much to teach Tanganyika, particularly in the development of village irrigation schemes, and it is the intention that as many engineers as possible should be afforded the opportunity of following this course of study, so that an improved knowledge of what irrigation stands for can be assured. The lessons thus learned can be applied to the good of the African villager and the improvement of the agricultural resources of the territory. Two other engineers will attend these courses in Ceylon in 1955.

12. CONCLUSION

Although the progress towards expansion made by the department during 1954 has not been marked, the past year can certainly be regarded as a period during which preparations were made for a vastly accelerated programme of work, especially in the sphere of irrigation. A great deal of equipment was ordered to enable such a programme to be pursued, and extra posts were approved. By the time the new equipment is received, the workshops of the department will be as up-to-date as any in East Africa, and provided the staff

allowed for can be recruited, there is every reason to hope that the development schedule of £400,000 which has been set as an aim will not only be attained, but exceeded. With a well-equipped and properly-staffed department, expenditure in the coming year will be concentrated on development works of greater magnitude than in the past, with due attention to the securing of hydrological data on an adequate scale.

With an increased burden thrust upon them by the creation of the new and extended development plan, the engineers' enthusiasm remains undimmed, in fact the prospect of using their engineering knowledge in the planning and construction of major irrigation projects has roused their spirits and they look forward to the future with increased enthusiasm.

Dar es Salaam,
31st January, 1955.

W. A. GUTHRIE, O.B.E., B.Sc. (Civ. Eng.), M.I.C.E.
Director of Water Development

APPENDIX I
WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure		Position of Works at end of year
			£	£	£	£		
	SOUTHERN HIGHLANDS PROVINCE							
	<i>Njombe District:</i>							
1.	Njombe ...	Alteration to Ram. Intake and extension of service	242	242	242	W.D.D.	242	Completed.
2.	Wangingombe	Earth dam. Capacity 9,000,000 gallons, with cattle tank	300	317	229	W.D.D.	317	Completed.
	CENTRAL PROVINCE							
	<i>Manyoni District:</i>							
3.	Manyoni ...	Minor Settlement supply from borehole. Output 3,600 gallons, 8 hour day	3,450	3,978	2,604	W.D.D.	3,978	Completed.
	<i>Kondoa District:</i>							
4.	Chandama ...	Earth dam. Capacity 13,000,000 gallons, with cattle tank	300	Tribal turnout	Tribal turnout	Irangi Development Scheme.		Completed.
5.	Jangalu ...	Earth dam. Capacity 50,000,000 gallons... ..	-	Tribal turnout	Tribal turnout	Irangi Development Scheme.		Completed.
6.	Busi ...	Gravity piped supply; 14,781 feet long; 18,000 gallons per day. Extension 3,600 feet	-	-	-	Irangi Development Scheme.		Original works completed, extension in hand.
	<i>Dodoma Depot:</i>							
7.	Dodoma ...	Building caravan, 1st	400	377	192	W.D.D.	400	Completed.
	Dodoma ...	Building caravan, 2nd	400	342	342	W.D.D.	400	In Hand.
	<i>Mpwapwa District:</i>							
8.	Sagara ...	Piped supply from Spring 40,000 gallons per day	285	265	265	O.F.C.		Completed.
9.	Chunyu ...	Piped supply from Railway pipe line 2,000 gallons per day	300	280	280	N.A.	300	Completed.
	<i>Singida District:</i>							
10.	Mianje Mungaa	Irrigation Scheme. Construction of dam and lower sluice to serve 10,000 acres approximately ...	3,250	1,747	1,747	W.D.D.		In Hand.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure	Position of Works at end of year
			£	£	£	£	
	EASTERN PROVINCE						
11.	<i>Morogoro District:</i> Mlali Irrigation Scheme ...	320 Acre Pilot Irrigation Scheme. Rice and other crops. For Native Authority	9,982	8,365	8,365	W.D.D. 9,982	85 per cent completed. Repayment of Loan by Native Treasury.
12.	Chazi Leprosarium	5,000 gallon Masonry Storage Tank with piped intake and delivery to Hospital and Superintendent's House	1,375	986	986	Medical Department 1,375	80% Completed. Delivery pipe to be laid.
13.	Ngerengere	8 ft. dia. well for proposed pumped supply	205	200	200	W.D.D. 200	Completed—Pumping Tests being made.
14.	Ruvu River Recorder, Kibungo	Automatic River level recorder with housing	250	230	230	W.D.D. 230	Completed. In operation.
15. to 18.	Hydrological Weirs—Mgera, Ngerengere, Morogoro and Lumwela Rivers ...	Concrete weirs with steel sharp crested Cippoletti and 90 degree notches ...	300	300	300	W.D.D. 300 Approx.	Completed. In Operation.
19.	Mkulazzi ...	Banka drilling for wells	—	15	15	W.D.D. 15 Approx.	Completed.
20.	W.D.D. Depot	Construction of Hydrological Store ...	750	746	746	W.D.D. 746	Completed.
21.	<i>Bagamoyo District:</i> Lugoba Dam ...	2.5 m.g. Hand Built dam for domestic use. Tribal turnouts and general organization by D.C., Bagamoyo ...	—	—	70	N.A. 70 Approx.	Completed.

APPENDIX I—(contd.)

WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. During Year	Division of Expenditure	Position of Works at End of Year
	EASTERN PROVINCE (contd.)						
22.	Mambani Dam	6.5 m.g. Hand built dam for domestic use. Tribal turnouts and general organization by D.C., Bagamoyo ...	—	—	70	N.A. 70	Completed.
23.	Chambezi Agric. cultural Station, Bagamoyo ...	Pumped supply from 8 ft. diameter well when proved ...	1,519	63	63	Agric. Department 1,519	Agr. Officer sinking trial well plus £63 for Banka Drilling.
24.	Banka Drilling—Miono Area Kilosa District:	Banka drilling for siting of village wells	—	25	25	N.A. 25	Completed.
25.	Kilosa Flood Protection ...	Maintenance of Flood Bank ...	500	454	454	W.D.D. 454	Bank maintained in good order.
26.	Kisarawe District: Maneromango Middle School Supply ...	8 ft. diameter well and alteration to school supply ...	450	275	275	Still to be decided	70 per cent completed.
	SOUTHERN PROVINCE						
27.	Newala District: Newala ...	6 mile extension to existing supply 6,000 g.p.d. ...	5,926	5,894	847	W.D.D. 5,926	Completed.
28.	Newala ...	Increase of pumping sump capacity, 5,000 galls ...	410	408	408	W.D.D. 410	Completed.
29.	Newala Ring Main	Ring main in low density housing area	700	600	600	Makonde Water Corporation	In Hand.
30.	Newala Depot: Newala ...	Extensions to temporary depot buildings (5,000 sq. ft.) ...	1,790	1,738	1,738	W.D.D. 1,790	90 per cent completed.
31.	Newala ...	Construction and renovation of caravans ...	600	500	500	W.D.D. 600	One completed. One in hand.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure	Position of Works at end of year
			£	£	£	£	
	SOUTHERN PROVINCE (contd.)						
	<i>Masasi District:</i>						
32.	Masasi ...	15,000 g.p.d. pumped supply to outstation from 24½ m.g. dam....	13,730	13,650	12,656	W.D.D. 13,730	Complete except for storage tanks and alum dosing apparatus.
33.	Lulindi/Luatala/Chiungutwa ...	Gravity piped supply 120,000 feet long to supply 60,000 g.p.d. ...	35,000	7,000	7,000	N.A. 35,000	Headworks dam completed: pipe laying started.
34.	Nyangoo ...	Gravity piped supply 7,500 feet long from existing EARH pipeline to supply 6,000 g.p.d. ...	1,700	1,050	1,050	N.A. 1,700	Excavation for pipe trench in hand.
	<i>Tunduru District:</i>						
35.	Puchapucha ...	Construction of experimental flood retention barriers over 8 mile length of Namiungo River. ...	650	280	280	W.D.D. 650	
	Tunduru ...	3,500 feet extension to outstation supply to serve new minor settlement	2,740	1,630	1,630	Loan from W.D. Loan	Stores ordered.
	<i>Mtwara District:</i>						
37.	Nanyamba ...	Hand built dam 11 m.g. capacity African communal effort ...	150	120	120	N.A. 120	Completed.
	<i>Lindi District:</i>						
38.	Mahiwa ...	Re-alignment of furrows on Agric. Dept. Experimental Farm ...	200	-	-	Agric. Department. 200	Investigations still in hand.
	NORTHERN PROVINCE						
	<i>Mbulu District:</i>						
39.	Massagaloda Dam ...	Masonry dam for domestic and cattle use ...	2,325	2,291	1,799	½ N.T. ¾ W.D.D.	Completed.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure	Position of Works at end of year
			£	£	£	£	
	NORTHERN PROVINCE (contd.)						
40.	Babati Outstation Supply	Installation of sand filter at intake. Replaced meters and built meter boxes	1,578	1,578	40	W.D.D.	Completed.
41.	Muchlur Dam	Completion of dam at natural overflow of lake 26,000 c. yd. Construction of stabilizing wall at outlet and surge chamber	5,844	4,079	1,400	W.D.D. 100%	Completed.
42.	Setchet Dam ...	Raising of existing dam by 10 ft. to increase storage. 4 in. pipeline through wall	3,003	750	750	N.T. 100% Funds.	25 per cent completed in hand.
	Arusha District:						
43.	Olkokola pipeline extension	Building intake weir at source, piping to connect with original lines and construction of 2 break pressure tanks	2,350	2,325	1,494	$\frac{1}{3}$ N.T. $\frac{2}{3}$ W.D.D.	Completed.
44.	Olkokola ...	Extension of piping from terminal point of above line to a point $2\frac{1}{2}$ miles below Great North Road. Construction of 1 break pressure point and 30-ft. diameter cattle trough ...	3,393	2,819	2,691	N.T. 100%	Completed.
45.	Loljoro Farms Supply ...	Reclamation of original piping and completing extension to source ...	6,075	6,378	432	Loan funds	Completed.
46.	Walatia ...	Replacing intake box by one of improved design incorporating a washout. Repairing cattle troughs ...	150	149	149	$\frac{1}{3}$ N.A. $\frac{2}{3}$ W.D.D.	Completed.
47.	Maji ya Chai ...	Replacing pump with a C.K. 3 centrifugal. Attendants' quarters built and bypassing line to 10,000 gallon storage tank	3,235	3,176	1,044	Meru Dev. Plan	Completed.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure	Position of Works at end of year
			£	£	£	£	
	NORTHERN PROVINCE (contd.)						
48.	Leguruki ...	Clearing access to pump intake and repairs to tanks	150	73	40	Meru Dev. Plan	Completed.
49.	3 Meru Bore-holes 5/51, 3/50, 13/49 ...	5/51 installation of hand pump and cattle trough. 3/50 installation of Diesel Engine and Pump 10,000 gallon storage and trough, Pump House and Attendants' Quarters. 13/49 as for 3/50 above	3,000	2,575	2,575	$\frac{1}{3}$ N.T. $\frac{2}{3}$ W.D.D.	Completed.
50.	Arusha Depot ...	Chain link fencing to 100 ft. extension to yard	500	477	477	W.D.D.	Completed.
		Building of 40 foot store for Masailand Stores	400	410	410	Masai Dev.	Completed.
		Installation of Diesel Engine and Pump 1,600 gall. Braithwaite tank and Pump house and water connections to yard	420	418	418	W.D.D.	Completed.
		Erection of Garage and Extension of Tractor Bays	2,000	850	1,350	W.D. Depot	In hand.
		Completion of one Caravan	200	62	62	W.D.D.	Completed.
		Making racks for Tractor Store	100	86	86	W.D.D.	Completed.
		Making racks for M.T. Store	50	37	37	W.D.D.	Completed.
51.	Moshi District: Useri Pipeline	Completion of storage tank and extending line to domestic dipping tank ...	75	87	87	N.A.	Completed.
52.	Kenia	Pipeline and three domestic dipping points and 25 ft. cattle trough 3,200 gallon Braithwaite tank	2,000	1,750	1,750	$\frac{1}{2}$ W.D.D. $\frac{1}{2}$ N.T.	Completed.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND 1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure	Position of Works at end of year
			£	£	£	£	
	NORTHERN PROVINCE (contd.)						
53.	Keni Mkuu Pipeline ...	Construction of intake weir piping to 7 domestic tanks and two cattle troughs. Keni further extension to 2 domestic tanks 10,000 gall. storage tank and cattle trough. Repairs to old weir and improvements to tanks and water points en route ...	10,150	7,250	3,000	½ W.D.D. ½ N.T.	90 per cent Completed
54.	Londrossi ...	Rebuilding of intake weir and silt chamber ...	500	491	491	W.D.D.	Completed.
55.	Mriti ...	Construction of a pipeline to 3 domestic points for East Kilimanjaro low-land development ...	2,267	1,605	1,605	N.T. 100% Funds.	In hand.
	<i>Masai Land District:</i>						
56.	Sukura ...	Earth Dam 44,000 cu. yds. Capacity, 137,500,000 galls for stock watering Completion of spillway ...	3,650	3,287	1,133	Masai Dev.	Completed.
57.	Longon Dam ...	Earth Dam 41,000 cu. yds. Capacity, 100,000,000 galls for stock watering	5,140	4,362	2,100	Masai Dev.	Completed.
58.	Nalangi Tomon Dam ...	Earth dam 46,100 cu. yds. Capacity 69,000,000 galls. for stock watering	4,113	500	500	Masai Dev.	In hand.
59.	Olgedju Ado Pipeline, Gelai	Pipeline, 8 break pressure tanks and 2 cattle troughs 30 ft. diameter ...	8,500	7,750	7,750	Masai Dev.	Completed.
60.	Mbuga Kitwei 3 Boreholes	(1) 105 ft. deep Diesel Engine and Lister Climax Pump storage tank and cattle trough ... (2) 136 ft. deep Windmill 10,000 gall. storage tank and cattle trough ... (3) 274 ft. deep Handpump and supply to cattle trough ...	2,740	1,611	1,611	Masai Dev.	Completed.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure	Position of Works at end of year
			£	£	£	£	
	NORTHERN PROVINCE (contd.)						
61.	Messerani Spillway Modification ...	Cut-off wall built to 900 ft. long x 2 ft. wide and average height 3 ft. 6 in....	250	183	183	Masai Dev.	Completed.
62.	Dosi Dosi Borehole ...	Handpump, 3,000 galls. circular cattle trough, 3 in. Rising Main ...	250	170	170	Masai Dev.	Completed.
63.	Magazeni Borehole ...	Handpump, 3,000 galls. circular cattle trough, 3 in. Rising Main ...	300	229	229	Masai Dev.	Completed.
64.	Borehole 8/52...	Pumphouse and Attendants' quarters, 10,000 galls. storage tank 2 ft. x 25 ft. cattle trough, Lister Climax Engine Pump, 4 ft. Rising Main ...	1,250	857	857	Masai Dev.	Completed.
65.	Borehole Olketedju 3/52 ...	Diesel Engine Climax Pump, 10,000 galls. storage tank, Cattle trough, attendants' quarters, 4 in. Rising Main ...	1,250	1,106	1,106	Masai Dev.	Completed.
66.	Borehole 19/53 Olgodon ...	Diesel Engine Climax Pump, 10,000 galls. storage tank, Cattle trough, attendants' quarters, 4 in. Rising Main ...	1,340	1,108	222	Masai Dev.	Completed.
67.	3 Southern Masailand Boreholes ... Kimana 26/50 Kibaya 23/50 Mrijo 13/50	Diesel Engine and Climax Pump 10,000 galls. storage Tank, Cattle Trough, Attendants' quarters 3 in. Rising Main ...	1,446	1,102	1,102	Masai Dev.	Awaiting redrilling to complete Mrijo.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure	Position of Works at end of year
			£	£	£	£	
	NORTHERN PROVINCE (contd.)						
68.	Naberera Auction Supply ...	Handpump fitted over well supplying 20 ft. diameter trough ...	300	200	200	Masai Dev.	Completed.
69.	Legumai Pipe line N/Masai-land ...	Pipeline to storage tank and cattle trough. 2 break pressure tanks ...	2,795	2,500	2,500	Masai Dev.	Completed.
70.	Makuyuni Borehole 10/52 ...	Diesel Engine Climax Pump, 10,000 galls. Storage 25 ft. long Cattle Trough, Attendants quarters, 4 in. Rising Main, for veterinary trade stock. Pump house and supply to Veterinary quarters ...	750	600	600	Veterinary Funds.	Completed.
71.	Ngorongoro Outstation Supply ...	Godwin Lister O.H. 3, Pump and 3,200 galls. Braithwaite storage to Rising Main ...	1,150	1,200	1,200	W.D.D.	Completed.
72.	Ngorongoro Masai Supply	Petter Engine and Evans Triple Rain Pump. 10,000 galls. storage from spring pumped to 30 ft. diameter cattle trough ...	2,425	1,898	1,898	W.D.D.	Completed.
	LAKE PROVINCE						
73.	Bukoba District: Kabirizi Pipeline ...	18,000 ft. of piping from springs to valley floor, two storage tanks, cattle and domestic troughs ...	6,132	5,950	2,615	W.D.D. 3,966 N.T. 1,989	Completed.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure		Position of Works at end of year
			£	£	£	£		
	LAKE PROVINCE (contd.)							
74.	Rwamishenye School ...	4,000 ft. of piping and pumped supply from stream to storage tank ...	1,500	1,500	1,500	N.A.	1,500	Completed by contract.
75.	Nyakahanga ...	Pumped supply from spring 9,000 ft. of piping and storage tank. Supplies hospital and village ...	2,500	2,300	2,300	N.A.	2,300	Work in hand by district staff.
76.	<i>Ngara District:</i> Ruganzu ...	18,000 ft. of piping from spring to storage tank with cattle trough ...	3,150	30	30	Govt.	30	Pipes ordered. Spring enclosed. Work to be done by district staff.
77.	<i>Geita District:</i> Geita Minor Settlement, Water Supply	Extension to distribution mains and metering of all supplies ...	260	260	42	W.D.D.	260	Completed.
78.	All Chiefdoms	7 hand built dams with total capacity of 40 million gallons ...	640	640	640	N.A.	640	Completed.
79.	<i>Shinyanga District:</i> Kampi ya Kanga Borehole ...	Hand-pumped borehole supply to cattle trough ...	903	1,168	1,168	N.A.	1,168	Completed by Tabora Division.
	Iselemagazi Borehole ...	ditto ...						
80.	All Chiefdoms	Windmill pumped borehole supply to storage tank and cattle trough 8 hand-built dams of 36 million galls. total capacity ...	700	700	700	N.A.	700	Completed.
81.	<i>Kwimba District:</i> Nyambiti Dam	30 million gallon earth dam with cattle troughs and domestic drawing off point. Piped for irrigation ...	2,800	800	800	W.D.D.	800	Earthworks 80 per cent completed. Concrete work finished.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure	Position of Works at end of year
			£	£	£	£	
	LAKE PROVINCE (contd.)						
82.	Kijima Dam ...	45 million galls. earth dam with cattle troughs, piped for irrigation below dam wall	3,850	-	-	-	Work not started.
83.	Ngudu minor Settlement Emergency supply ...	Borehole supply to bolster up dwindling dam supply to station and also to provide water for Sukumaland Show	2,200	2,200	2,200	W.D.D. 2,200	Emergency work completed but will be fitted into new scheme next year.
84.	All Chiefdoms	5 hand built dams of total capacity of 22 million galls.	480	480	480	N.A. 480	Completed.
85.	<i>Maswa District:</i> Mwankanga Dam	22 million galls. earth dam for cattle and domestic use	2,300	2,300	2,300	Suk. Dev. 2,300	Completed.
86.	Mwamatondo Dam ...	19 million gall. earth dam for cattle and domestic use	2,100	2,100	2,100	Suk. Dev. 2,100	Completed.
87.	Masinde Canal	Opening up canal to tap the water of the large Masinde Dam catchment to fill Malya Dam	240	240	240	W.D.D. 240	Completed.
88.	All Chiefdoms	5 hand built dams total capacity 36 million galls.	500	500	500	N.A. 500	Completed.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure	Position of Works at end of year
	LAKE PROVINCE (contd.)		£	£	£	£	
89.	<i>Ukerewe District:</i> Nansio Minor Settlement Water Supply	Extension to distribution mains to supply 45 Asian houses	342	150	150	W.D.D. 100 Occupiers 50	Work in hand. Nearing completion.
90.	Mwibara Chiefdom ...	3 hand built dams of 12 million galls. total capacity	280	280	280	N.A. 280	Completed.
91.	<i>Mwanza District:</i> W.D.D. Depot	Construction of workshops, stores, boundary wall, gates and W.C.'s ...	5,344	3,233	3,233	W.D.D. 3,233	Work in Hand.
92.	Missungwi ...	30 million galls. earth dam. For domestic use of settlement. Water to be chemically treated and pumped to distribution mains	4,426	1,000	1,000	W.D.D. 1,000	Dam nearing completion.
93.	All Chiefdoms	3 hand built dams, total capacity 14 million galls.	280	280	280	N.A. 280	Completed.
94.	<i>Biharamulo District:</i> Runazi ...	4 million galls. dam built by tribal turnout	100	100	100	N.A. 100	Completed.
95.	<i>Musoma District:</i> Majita, Ushashi and Ikizu Chiefdoms ...	3 hand built dams, total capacity 22 million galls.	240	240	240	N.A. 240	Completed.
96.	<i>North Mara District:</i> Tarime Minor Settlement Water Supply	Extension to distribution mains ...	200	80	80	W.D.D. 80	Work in hand.
97.	All Chiefdoms	7 hand built dams, total capacity 24 million galls.	400	400	400	N.A. 400	Completed.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND—1954

Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure	Position of Works at end of year
			£	£	£	£	
	WESTERN PROVINCE						
	<i>Tabora District:</i>						
98.	Tabora ...	Extensions to W.D.D. Depot ...	910	800	686	W.D.D. 800	90 per cent completed.
99.	Tabora ...	Construction of Caravans ...	1,920	1,693	1,070	W.D.D. 1,693	90 per cent completed.
100.	Tabora ...	Reconstruction of G.T. 1425 ...	300	300	300	W.D.D. 200	80 per cent completed.
101.	Igalula ...	Improvement to wells ...	83	81	78	W.D.D. 81	Completed.
102.	Urambo ...	Well supply to Kikuyu detention camp, Miombo ...	500	497	497	P.W.D. 497	Completed.
103.	Sikonge ...	Well supply to Mission Leprosarium	1,645	1,622	1,622	N.A. 1,622	Completed.
	<i>Nzega District:</i>						
104.	Silimuka ...	Repairs to dam well ...	100	96	96	W.D.D. 96	Completed.
105.	Bukene ...	Veterinary Department holding ground	680	680	680	Vet. Dept. 680	Completed.
106.	Nzega ...	Sima Dam, Nzega Water Supply extension, Phase I ...	9,298	4,223	4,223	W.D.D. 4,223	50 per cent completed.
	<i>Kahama District:</i>						
107.	Mfufumo ...	Gravity supply to cattle trough ...	700	688	328	W.D.D. 459 N.A. 229	Completed.
	<i>Kibondo District:</i>						
108.	Kibondo ...	Improvements to existing outstation supply ...	1,800	1,163	1,163	W.D.D. 1,163	60 per cent completed.
	<i>Kasulu District:</i>						
109.	Kasulu ...	Permanent pump house for outstation supply ...	200	139	139	W.D.D. 139	Completed.
110.	Musiviyi ...	Rammed supply for Middle School ...	1,670	1,664	1,664	N.A. 1,664	Completed.
	<i>Ufipa District:</i>						
111.	Sumbawanga ...	Improvements and extensions to outstation supply ...	1,580	826	826	W.D.D. 826	50 per cent completed.
	TANGA PROVINCE						
	<i>Tanga District:</i>						
112.	Muheza Water Supply ...	Extension to Supply. New Rising main duplication of pumping plant and new 30,000 galls. storage tank...	11,094	10,874	3,656	W.D.D.	Completed.

APPENDIX I—(contd.)
WORKS COMPLETED OR IN HAND—1954

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Serial No.	Name and Location	General Description	Est. Cost	Total Exp. to Date	Exp. during Year	Division of Expenditure	Position of Works at end of year
			£	£	£	£	
	TANGA PROVINCE (contd.)						
113.	Divisional offices. Workshops & Stores ...	Fencing and construction of offices (£4,500) Workshop (£1,300) Stores (£1,000)	7,300	5,800	5,800	W.D.D.	Offices completed. Workshop 20 per cent completed. Stores 50 per cent completed.
114.	Gombero B/H No. 27/50 ...	Installation of Rhodesian Well-Head Pump	127	100	100	N.T.	Completed.
115.	<i>Handeni District:</i> Nderema B/H No. 15/50 ...	Installation of Rhodesian Well-Head Pump	75	75	75	Vet. Dept.	Completed.
116.	<i>Pangani District:</i> Madanga B/H	Installation of Rhodesian Well-Head Pump	163	100	100	N.T.	Completed.
117.	Mtindiro Leprosarium ...	Installation of surface Hand Pump ...	75	70	70	Medical Dept.	Completed.

APPENDIX II

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
26/50 (1)	7.1.54	485	—	—	—	—	Masailand Development Scheme	Kimana, Masai, Northern	—	Cleaning.
5/51 (2)	15.1.54	277	—	—	—	—	Native Authority	Ongadongishu, Arusha, Northern	—	Cleaning.
44 7/53 (3)	28.9.54	Deepened from 350 to 385	960	276	280	22,400 p.p.m. 1,568 g.p.g 80 p.p.m. fluorine	Irangi Development Scheme	North Chubi Kondo, Central	Clays, marls and limestone	Abandoned: Water unusable owing to high salinity and excessive fluorine content.
42/53 (4)	19.1.54	262	2,600	65	80	Potable	Native Authority	Kivisini, Same, Tanga	Sands and quartz rubble	
43/53 (5)	13.1.54	250	1,200	79	117 and 160	41 g.p.g. 590 p.p.m. 1.5 p.p.m. fluorine	Public Works Department	Makatupora, Dodoma, Central	Clays, marls, with quartz rubble, and granite brash	
45/53 (6)	18.12.53	7	No water	—	—	—	Native Authority	Matangora Mbuga, Kongwa, Central	Clays	Abandoned due to heavy rains

APPENDIX II—(contd.)

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
1/54 (7)	30.1.54	330	No water	—	—	—	Native Authority	Ntiuka, Dodoma, Central	Granite-gneiss of the basement	Abandoned
2/54 (8)	12.2.54	220	1,500	30	45 and 190 to 200	123 g.p.g. 1,766 p.p.m. 2.9 p.p.m. fluorine	Provincial Administration	Ngudu Kwimba, Lake	Gravels, sands and dyke rock	
3/54 (9)	25.2.54	292	480	120	180 and 230	42 g.p.g. 598 p.p.m. 0.4 p.p.m. fluorine	Veterinary Department	Kilema, Kondoa, Central	Clays, marls and limestone quaternary	
4/54 (10)	3.2.54	173	160	104	120	66 g.p.g. 943 p.p.m. 1.1 p.p.m. fluorine	Public Works Department	Makatupora, Dodoma, Central	Clays, surface cement rocks, granite brash and granite	Test hole only.
5/54 (11)	26.2.54	130	2,000 plus	15	60	126 g.p.g. 1,810 p.p.m. 1.6 p.p.m. fluorine	Native Authority	Matamondo, Kongwa, Central	Sandy gravels and gneiss of the basement	

APPENDIX II—(contd.)

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
6/54 (12)	12.3.54	480	960 (Bailer Test)	90	140	126 g.p.g. 1,810 p.p.m. 1.2 p.p.m. fluorine	Masailand Development Scheme	Dossi Dossi S. Masai, Northern	Soils and granite gneiss of the basement	
7/54 (13)	19.2.54	91	2,400	27	35	Potable	Native Authority	Lembeni, Same, Tanga	Sands and pegmatite dyke of the basement	
49 13/49 (14)	21.1.54	248	—	—	—	—	Native Authority	Sanya Plains, Arusha, Northern	—	Cleaning
10/49 (15)	26.1.54	325	—	—	—	—	Native Authority	Sanya Plains, Arusha, Northern	—	Cleaning.
3/50 (16)	9.2.54	180	—	—	—	—	Native Authority	Usa, Arusha, Northern	—	Cleaning.
44/53 (17)	25.2.54	245	48-hour test 22-24 Dec. 1953-3,600 gph 11-hour test on 23.4.54-600 gph	83	160	Potable	Public Works Department	Makatupora, Dodoma, Central	Marls and marly granite rubble	Abandoned: Yield too low.

APPENDIX II—(contd.)

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
8/54 (18)	30.3.54	290	5,500	78	160 and 170	42 g.p.g. 606 p.p.m. 1.0 p.p.m. fluorine	Public Works Department	Makatupora, Dodoma, Central	Clays, marls and decomposed granite	Surged and cleaned in Aug. 1954
19/49 (19)	3.2.54	270	—	—	—	—	Native Authority	Arusha, Northern	—	Cleaned.
9/54 (20)	14.4.54	295	3,600	235	226	23 g.p.g. 340 p.p.m. 1.2 p.p.m. fluorine	Native Authority	Canuck Mine, Isaka, Western	Banded ironstone and sheared reef quartz Nyanzian	
10/54 (21)	13.3.54	230	1,800	115	123 and 160	49 g.p.g. 704 p.p.m. 2.0 p.p.m. fluorine	Native Authority	Tumbakose Rd., Kondo, Central	Marls, limestone and amphibolite schist of the basement	
11/54 (22)	3.4.54	430	No water	—	—	—	Masailand Development Scheme	Namekok, S. Masai, Northern	Gravelly cemented soil, granite-gneiss and gneiss of the basement	Unsuccessful
12/54 (23)	20.3.54	76	900	58	68	Potable	Native Authority	Madanga, Pangani, Tanga	Sands, limestones, fossil-carrying limestone-plio-pleistocene	

APPENDIX II—(contd.)

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
13/54 (24)	17.4.54	120	2,000	75	89	404 g.p.g. 5,780 p.p.m. 3.3 p.p.m. fluorine	Native Authority	Gulwe, Mpwapwa, Central	Granite-gneiss and hornblendite of the basement	
14/54 (25)	8.4.54	306	No water	—	—	—	Masailand Development Scheme	Ngata Nanyuki, Masai, Northern	Marls and gneiss of the basement	Unsuccessful
15/54 (26)	22.5.54	104	1,800	14	28	64 g.p.g. 927 p.p.m. 1.2 p.p.m. fluorine	Native Authority	Kibuyu, Pangani, Tanga	Pegmatitic gneiss, quartz and chlorite rock of the basement	
16/54 (27)	19.3.54	134	1,250	90	110	46 g.p.g. 667 p.p.m. 1.5 p.p.m. fluorine	Native Authority	Tumbakose Rd., Kondoa, Central	Marls, amphibolite and granite-gneiss of the basement	
17/54 (28)	10.4.54	53	No water	—	—	—	Native Authority	Itigi, Manyoni, Central	Weathered granite and fresh granite	Abandoned

APPENDIX II—(contd.)

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
18/54 (29)	15.6.54	260	Negligible	37	70 and 135	<i>First Test</i> 166 g.p.g. 9,444 p.p.m. 31 p.p.m. fluorine <i>Second Test</i> 308 g.p.g. 4,410 p.p.m. 34 p.p.m. fluorine	Native Authority	Kipanga, Dodoma, Central	Gravel, quartzite, granite and dyke rock Nyanzian?	Saline water. Abandoned
19/54 (30)	23.4.54	137	400	63	90	121 g.p.g. 1,730 p.p.m. 0.5 p.p.m. fluorine	Native Authority	Itigi, Manyoni, Central	Gypsum-carrying clays and granite	
20/54 (31)	17.10.54	451	No water	—	—	—	Masailand Development Scheme	Ngusero Sambu, N. Masai, Northern	Clays and quartzite of the basement	Capped. May pay to deepen.
21/54 (32)	5.6.54	480	1,250	170	240	81 g.p.g. 1,150 p.p.m. 0.7 p.p.m. fluorine	Native Authority	Matangoro, Mpwapwa, Central	Limestones, gravels and gneiss of the basement	

APPENDIX II—(contd.)

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
22/54 (33)	20.4.54	284	No water	—	—	—	Native Authority	Lukole, Mpwapwa, Central	Soils and granite-gneiss of the basement	Abandoned
23/54 (34)	17.6.54	490	1,100	112	90 to 95	39 g.p.g. 555 p.p.m. 2.4 p.p.m. fluorine	East African Railways and Harbours	Isaka/Ikusule, Nzega, Western	Clays, terrestrial gravels, sandy limestones and lake beds	
24/54 (35)	23.4.54	171	1,400	3	33	40 g.p.g. 570 p.p.m. 3 p.p.m. fluorine	Public Works Department	Singida, Central	Sands and weathered granite	
25/54 (36)	17.6.54	33	No water	—	—	—	Native Authority	Kwamdulu, Korogwe, Tanga	Sands and gneiss of the basement	Abandoned due to hard rock.
26/54 (37)	22.5.54	125	2,400	5	42 and 60	31 g.p.g. 440 p.p.m. 1.1 p.p.m. fluorine	Public Works Department	Singida, Central	Sands and weathered granite	
27/54 (38)	26.6.54	162	640	94	115	181 g.p.g. 2,160 p.p.m. 0.3 p.p.m. fluorine	Native Authority	Zoissa, Mpwapwa, Central	Gneiss of the basement	

APPENDIX II—(contd.)

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
28/54 (39)	12.6.54	81	Surface water only	—	—	—	Public Works Department	Singida, Central	Sands, clays and weathered granite	Abandoned
29/54 (40)	24.7.54	51	Negligible	18	4	—	Native Authority	Kwamdulu, Korogwe, Tanga	Sands and gneiss of the basement	Abandoned
30/54 (41)	29.6.54	380	1,200	160	190	78 g.p.g. 1,118 p.p.m. 26.5 p.p.m. fluorine	Native Authority	Wembere, Singida, Central	Marls, red clays, sands, Manyonga lake beds plio-pleistocene	Very high fluorine content
31/54 (42)	28.6.54	100	3,000	35	45	82 g.p.g. 1,178 p.p.m. 2.5 p.p.m. fluorine	Native Authority	Nondwa, Dodoma, Central	Clays, marls and basic granite	
32/54 (43)	21.7.54	200	2,000	73	125 and 160	177 g.p.g. 2,530 p.p.m. 3 p.p.m. fluorine	Native Authority	Magaga, Dodoma, Central	Marls, granite and dyke rock	

APPENDIX II—(contd.)
 DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
33/54 (44)	14.7.54	362	1,200	100	150	95 g.p.g. 1,355 p.p.m. 27 p.p.m. fluorine	Native Authority	Madalawa, Singida, Central	Clays, sands, marls, limestone, Manyonga lake beds—plio-pleistocene	High fluorine content
34/54 (45)	20.7.54	315	No water	—	—	—	Native Authority	Ndabwiti, Mpwapwa, Central	Gneiss of the basement	Unsuccessful
35/54 (46)	21.8.54	295	400	40	70	68 g.p.g. 970 p.p.m. 2.1 p.p.m. fluorine	East African Railways and Harbours	Ikusule, Nzega, Western	Manyonga (?) lake beds and banded ironstone of the Nyanzian	
36/54 (47)	10.8.54	150	3,600	6' 6"	10	Brine	Geological Survey	Ikassi, Dodoma, Central	Clays, maris, sands and limestone. Lake beds	Borehole drilled for brine
37/54 (48)	2.10.54	104	3,000	52	58	85 g.p.g. 1,220 p.p.m. 1.2 p.p.m. fluorine	Veterinary Department	Lloyds Ridge, Kilosa, Eastern	Clays, sands, gravels-alluvials	

APPENDIX II—(contd.)

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
38/54 (49)	26.8.54	300	1,300	128	170	238 g.p.g. 3,400 p.p.m. 0.6 p.p.m. fluorine	Native Authority	Pingalame, Mpwapwa, Central	Gneiss of the basement	
39/54 (50)	10.11.54	378	Negligible	80	110	—	Native Authority	Bugene, Bukoba, Lake	Clays and phyllites of the Muvu-Ankole	
40/54 (51)	16.9.54	319	1,250	284	293	84 g.p.g. 1,200 p.p.m. 11 p.p.m. fluorine	Masailand Development Scheme	Oldonyo Narok, N. Masai, Northern	Clays, marls, gneiss and quartzite of the basement	Fluorine content suitable for cattle only
28/52 (52)	28.8.54	116	—	—	—	—	Veterinary Department	Kimamba, Kilosa, Eastern	Alluvials	Cleaning
17/53 (53)	25.8.54	246	—	—	—	53 g.p.g. 756 p.p.m.	Public Works Department	Makatupora, Dodoma, Central	—	Cleaned and surging
21/50 (54)	9.9.54	185	—	—	—	40 p.p.m. fluorine	Native Authority	Ngongoro, Wembere, Western	Manyonga lake beds	Surged

APPENDIX II—(contd.)

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
41/54 (55)	4.10.54	138	720 (Bailer Test)	63	78	74 g.p.g. 2,490 p.p.m. 1.9 p.p.m. fluorine	Native Authority	Chakwale, Kilosa, Eastern	Biotite gneiss of the basement	
17/51 (56)	7.9.54	420	—	—	—	—	Native Authority	Zanka, Dodoma, Central	—	Cleaned
42/54 (57)	20.11.54	190	10	180	183	—	Native Authority	Kikubiji, Kwimba, Lake	Granite (?)	Samples not received
43/54 and 43A/54 (58)	—	120 110	Approx. 500	—	57 38, 51 and 80	—	Indian Agricultural School	Wami, Morogoro, Eastern	Alluvial clays and sands	Sand enters casing
44/54 (59)	14.10.54	100	No water	—	—	—	Kondoa Irangi Development Scheme	Central Ata, Kondoa, Central	Quartzite of the basement	Abandoned. Hole going off vertical
44A/54 (60)	28.10.54	185	3,600	101	110	79 g.p.g. 1,140 p.p.m. 6.5 p.p.m. fluorine	Kondoa Irangi Development Scheme	Central Ata, Kondoa Central	Clays, marls, sericite, quartzite and gneiss of the basement	

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APPENDIX II—(contd.)

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
13/50 (61)	—	515	2,800	370	405	88 g.p.g.	Native Authority	Mrijo, Arusha, Northern	—	Fishing and cleaning operations abandoned owing to technical difficulties
45/54 (62)	Approx. 10.12.54	600	Yield as 13/50	370	405	—	Native Authority	Mrijo, Arusha Northern	Limestone and gneiss of the basement	
46/54 (63)	—	293 to date	50	—	150	—	Masailand Development Scheme	Loliondo, N. Masai, Northern	Quartzite of the basement	
47/54 (64)	—	250	1,200	136	185	28 g.p.g. 400 p.p.m. 1.1 p.p.m. fluorine	Irangi Development Scheme	North Pahi Kondoa, Central	Clays, marls, sand and quartzite of basement	
48/54 (65)	—	120 to date	—	—	—	—	Veterinary Department	Kitaraka, Manyoni, Central		

APPENDIX II—(contd.)

DETAILS OF BOREHOLES DRILLED DURING THE YEAR 1954

Borehole Number (Serial No.)	Date Completed	Depth in feet	Yield per hour in gallons	Static water level in feet	Depth at which water was struck in feet	Salinity in grains per gallon and parts per million	Applicant	Locality and Province	Formation	Remarks
49/54 (66)	—	—	—	—	—	—	Lyella Development Scheme	Lyella, Nzega, Western		
50/54 (67)	—	110 to date	No water	—	—	—	Masailand Development Scheme	Pollalet, Loliondo, Northern	Quartzite of the basement	Hole going off vertical
51/54 (68)	—	28 to date	—	—	—	—	Native Authority	Busheshe, Bukoba, Lake		
52/54 (69)	—	—	—	—	—	—	Native Authority	Kwa Mtoro, Kondo, Central		

APPENDIX III
SHALLOW WELLS

Number	Locality	Depth in feet	No. of rings	Depth to water when struck	Remarks
	<i>Southern Highlands Province:</i>				
70	Iwindi	10	3	Seepage only.	
71	Panda	3	1	Very little seepage	
72	Jiga	7	3	2' seepage	
73	Itete	17½	—	No water	
74	Iwindi	10	4	6½'	
75	Saidi Ngongo	7½	3	5½'	
76	Jiga	10	4	7'	
77	Itete	15	3	12'	
78	Itete	5	2	2'	
79	Panda	5	1	3'	

APPENDIX IV
BOREHOLE COSTS FOR 1954—WORKING COSTS ONLY

Borehole Number	Total Footage in feet	Cost of Casing		Cost per foot including depreciation		Cost per foot excluding depreciation		Total Expenditure including depreciation		Total Expenditure excluding depreciation		Locality	Remarks
		Shs.	Cts.	Shs.	Cts.	Shs.	Cts.	Shs.	Cts.	Shs.	Cts.		
26/50	485	—	—	19	35	13	97	1,567	65	1,132	06	Mimana, N. Masailand	Cleaning
5/51	277	—	—	7	37	5	51	2,043	02	1,526	70	Ongadongishu, Arusha	Cleaning
43/53	250	—	—	23	32	15	79	5,831	47	3,949	07	Makatupora, Dodoma	Public Works Department
1/54	330	—	—	9	66	6	69	3,189	17	2,210	44	Ntiuka, Dodoma	Native Authority
2/54	220	3,249	00	43	71	36	31	9,617	20	7,989	55	Ngudu, Kwimba	Provincial Administration
3/54	292	4,702	50	25	52	22	83	7,452	71	6,666	47	Kilema, Kondoa	Veterinary Department
4/54	173	—	—	16	17	11	16	2,797	58	1,930	88	Makatupora, Dodoma	Public Works Department
5/54	130	1,519	80	25	66	22	97	3,335	55	2,986	11	Matamondo, Kongwa	Native Authority
6/54	480	2,017	80	26	88	19	90	12,900	99	9,552	30	Dossi Dossi, S. Masailand	Masailand Development Scheme
7/54	91	1,453	50	40	79	31	67	3,711	62	2,881	70	Lembeni, Same	Native Authority
13/49	248	—	—	2	79	2	04	692	88	507	88	Sanya Plains, Arusha	Cleaning
10/49	325	—	—	2	67	1	95	866	87	635	62	Sanya Plains, Arusha	Cleaning
19/49	270	—	—	3	54	2	49	955	93	672	07	Arusha	Cleaning
3/50	180	—	—	5	29	3	65	952	85	656	24	Usa, Arusha	Cleaning
44/53	100	—	—	26	03	16	86	2,603	93	1,686	65	Makatupora, Dodoma	Surging
8/54	290	6,016	64	35	47	30	66	10,288	24	8,890	55	Makatupora, Dodoma	Public Works Department
9/54	295	4,959	00	44	64	36	40	13,171	29	10,738	70	Canuck Mine, Isaka	Native Authority
10/54	230	2,171	70	18	63	16	32	4,285	65	3,754	34	Kondoa	Native Authority
11/54	430	—	—	8	50	6	59	3,653	15	2,831	70	Namelok, S. Masailand	Masailand Development Scheme
12/54	76	1,874	42	60	54	48	31	4,601	31	3,671	78	Madanga, Pangani	Native Authority
13/54	120	4,391	23	75	19	63	76	9,023	35	7,651	69	Gulwe, Mpwapwa	Native Authority
14/54	306	—	—	17	52	12	64	5,361	08	3,868	84	Ngata Nanyuki, Masai	Masailand Development Scheme
15/54	104	1,487	70	78	98	54	22	8,214	26	5,639	77	Kibuyu, Pangani	Native Authority
16/54	134	1,829	70	20	27	18	74	2,716	51	2,512	16	Kondoa	Native Authority
17/54	53	—	—	51	93	43	97	2,752	69	2,330	49	Itigi, Manyoni	Native Authority
18/54	260	—	—	32	39	23	30	8,423	33	6,058	96	Kipanga, Dodoma	Native Authority
19/54	137	2,359	80	29	43	25	73	4,032	24	3,525	60	Itigi, Manyoni	Native Authority
21/54	480	1,139	85	23	67	18	30	11,362	86	8,787	39	Matangoro, Mpwapwa	Native Authority
22/54	284	—	—	28	04	20	16	7,963	87	5,726	16	Lukole, Mpwapwa	Native Authority
23/54	490	8,181	59	31	71	27	66	15,537	05	13,552	66	Isaka/Ikusule, Nzega	E.A. Railways and Harbours
24/54	171	835	89	19	16	14	56	3,277	52	2,490	19	Singida	Public Works Department
25/54	33	—	—	87	05	55	40	2,872	83	1,828	13	Kwamdulu, Korogwe	Native Authority
26/54	125	2,354	59	31	69	28	09	3,961	34	3,511	77	Singida	Public Works Department

APPENDIX V
BOREHOLE POWER PUMP INSTALLATIONS—1954

Bore hole No.	Locality	Depth in feet	Yield of borehole g.p.h.	Capacity of pump g.p.h.	Headworks	Remarks
DODOMA DISTRICT						
22/51	Namuga	265	960	960	Climax No. 3 Long-Lister 5/1 Engine	10,000 Gal. Tank with Cattle Drinking Trough.
32/54	Magaga	200	2,000	1,000	Climax No. 3. Long-Lister 5/1 Engine	10,000 Gal. Tank with Cattle Drinking Trough.
MPWAPWA DISTRICT						
8/53	Mureti	250	1,020	1,000	Climax No. 3. Long-Lister 5/1 Engine	10,000 Gal. Tank with Cattle Drinking Trough.
41/53	Berege	70	1,250	300	Windmill-Climax	No Storage.
KONDOA DISTRICT						
20/53 3/54	Kisere	293	1,700	1,000	Climax No. 3. Long-Lister 5/1 Engine	10,000 Gal. Tank and Cattle Trough.
	Kelema	292	480	480	Climax No. 3. Long-Lister 5/1 Engine	No Storage.
MANYONI DISTRICT						
13/52	Outstation Water Supply	211	450	450	Climax No. 3. Long-Lister 5/1 Engine	Piped to Storage Tank and distributed to houses.
SHINYANGA DISTRICT						
14/52	Ng'wamamoto	340	300	300	Windmill-Climax	Storage Tank and Cattle Trough.
ARUSHA						
3/50	Meru	181	1,250	—		10,000 Gal. Storage and Trough.
13/49	Meru	248	3,100	—		10,000 Gal. Storage and Trough.
6/52	Mbuga Kitwei	105	300	1,050	Climax No. 3. Lister 5/1 Engine	Storage Tank and Cattle Trough.
32/52	Mbuga Kitwei	136	840	1,000	Windmill-Climax	Storage Tank and Cattle Trough.
8/52	Siminjiro... ..	256	Unknown	1,050	Climax No. 3. Lister 5/1 Engine	10,000 Gal. Storage and Trough.
3/52	Olketedju	284	900	1,050	Climax No. 3. Lister 5/1 Engine	10,000 Gal. Storage and Trough.
19/53	Olgodon	237	500	400	Climax No. 3. Lister 5/1 Engine	10,000 Gal. Storage and Trough.
26/50	Kimana	465	475	500	Climax No. 3. Lister 5/1 Engine	10,000 Gal. Storage and Trough.
10/52	Makuyuni	340	1,000	1,250	Climax No. 3. Lister 5/1 Engine	10,000 Gal. Storage and Trough.

APPENDIX VI
HAND PUMP INSTALLATIONS—1954

Bore-hole No.	Locality	Depth in feet	Yield of borehole g.p.h.	Capacity of pump g.p.h.	Headworks	Remarks
31/54	DODOMA DISTRICT Nondwa	100	3,000	100	Rhodesian Type Hand-pump	Small Cattle Trough.
27/52	MPWAPWA DISTRICT Rudi	212	500	200	Rhodesian Type Hand-pump	Small Cattle Trough.
14/53	Rubeho	267	330	100	Rhodesian Type Hand-pump	Small Cattle Trough.
16/54	KONDOA IRANGI DISTRICT Tumlakosi No. 1 ...	134	1,250	300	Rhodesian Type Hand-pump	No Storage.
10/54	Tumlakosi No. 1 ...	230	1,800	100	Rhodesian Type Hand-pump	No Storage.
5/52	MANYONI DISTRICT Township	283	200	200	Rhodesian Type Hand-pump	No Storage.
19/54	Itigi No. 2	137	400	100	Rhodesian Type Hand-pump	No Storage.
27/50	TANGA DISTRICT Gombero	200	3,600	300	Rhodesian Type Hand-pump	Small Cattle Trough.
15/50	HANDENI DISTRICT Ndereha	355	3,600	300	Rhodesian Type Hand-pump	Small Cattle Trough.
12/54	PANGANI DISTRICT Madanga	76	900	300	Rhodesian Type Hand-pump	Small Cattle Trough.
26/51	SHINYANGA DISTRICT Kampi ya Kanga ...	408	110	200	Rhodesian Type Hand-pump	Small Cattle Trough.
6/53	Iselemagazi	266	160	200	Rhodesian Type Hand-pump	Small Cattle Trough.
5/51	ARUSHA DISTRICT Kingori	282	680	300	Rhodesian Type Hand-pump	Cattle Trough.
32/52	Mbuga Kitwei	274	2,000	170	Rhodesian Type Hand-pump	Cattle Trough.
38/53	Magazeni	267	760	150	Rhodesian Type Hand-pump	Cattle Trough.
23/50	Kibaya	150	500	150	Rhodesian Type Hand-pump	Cattle Trough.

APPENDIX VII
DETAILED WORK—GAUGING STATIONS

Registered No.	Type of Gauge	River	Position on River		Date Readings Started	Recorded Maximum Flow to date Cusecs	Recorded Minimum Flow to date Cusecs
			Lat.	Long.			
NORTH CENTRAL DRAINAGE AREA NORTHERN PROVINCE							
62	2 C 1	S.G. 0-5 ft. Ngare Nanyuki	3° 04'S	36° 53'E	8. 7.53	18.5	6.9
	2 C 2	S.G. 0-5 ft. Ngare Nanyuki	3° 10'S	36° 52'E	24.11.53	23.2	21.8
	2 C 3	V Notch Olmolog Spring	—	—	9. 9.52	0.12	0.004
	2 C 4	V Notch Engushai	—	—	16. 9.50	0.3	0.007
	2 C 5	V Notch Londorossi	—	—	5. 6.53	0.4	0.3
	2 C 6	S.G. 10-20 ft. Ngare Nairobi North	3° 01'S	37° 04'E	6. 9.52	16.2	1.7
	2 C 7	S.G. 10-20 ft. Ngare Nairobi South	3° 02'S	37° 03'E	23. 9.52	15.7	0.7
	2 G 1	S.G. 5-10 ft. Themis	3° 22'S	36° 42'E	17. 6.53	14.9	1.6
	2 GA 1	S.G. 0-5 ft. Burke	3° 24'S	36° 39'E	3.12.52	4.6	3.4
	2 GA 2	S.G. 0-5 ft. Ngare Narok	3° 21'S	36° 40'E	26. 4.49	14.9	0.9
	2 GA 3	S.G. 0-5 ft. Naururu	3° 23'S	36° 41'E	2.12.49	3.7	1.8
	2 GA 4	S.G. 0-5 ft. Kidshenge	3° 23'S	36° 42'E	26. 4.49	9.4	1.1
	2 GB 1	S.G. 0-5 ft. Ngare Olmotony	3° 19'S	36° 38'E	1. 6.48	5.8	2.1
	2 H 1	S.G. 0-5 ft. Kiraruma	3° 20'S	36° 48'E	21. 3.54	Insufficient Data	
	2 H 2	S.G. 0-5 ft. Simba	3° 22'S	36° 52'E	21. 3.54	Insufficient Data	
	2 H 3	S.G. 0-5 ft. Mbulumbulu	3° 24'S	36° 54'E	21. 3.54	Insufficient Data	
	2 K 1	S.G. 0-5 ft. Yaida	4° 03'S	36° 22'E	4. 9.54	Insufficient Data	
INDIAN OCEAN DRAINAGE AREA KENYA							
	1 DC 12	S.G. 0-5 ft. Ivonokwa	—	—	12. 9.54	71	12
	1 DC 13	S.G. 0-5 ft. Njoro Tatu	3° 25'S	37° 41'E	11. 9.52	162	15
	1 DC 14	S.G. 0-5 ft. Njoro Mbili	3° 25'S	37° 41'E	10. 9.52	7.4	2
	1 DC 15	S.G. 0-5 ft. Njoro Sayai	3° 25'S	37° 41'E	10. 9.52	91	31
	1 DC 15A	S.G. 0-5 ft. Taveta Canal	3° 14'S	37° 48'E	1. 6.54	Insufficient Data	

APPENDIX VII—(contd.)
DETAILED WORK—GAUGING STATIONS

Registered No.	Type of Gauge	River					Position on River		Date Readings Started	Recorded Maximum Flow to date Cusecs	Recorded Minimum Flow to date Cusecs
							Lat.	Long.			
NORTHERN PROVINCE											
1 DC 3	S.G. 0-10 ft.	Ran	...	...	...	...	3° 30'S	37° 27'E	4. 2.52	100	6-0
1 DC 4	S.G. 0-10 ft.	Ran	...	...	...	...	3° 30'S	37° 21'E	14.12.53	Insufficient Data	
1 DC 5	S.G. 0-10 ft.	Ran	...	...	...	...	3° 21'S	37° 21'E	14. 8.52	1,000	1-7
1 DC 6	S.G. 0-10 ft.	Mue	...	...	...	...	3° 29'S	37° 28'E	8. 5.52	293-3	108
1 DC 7	S.G. 0-10 ft.	Mue	...	...	...	...	3° 02'S	37° 31'E	13. 8.52	460	Dry
1 DC 8	S.G. 0-10 ft.	Nanga	...	...	...	...	3° 22'S	37° 25'E	13. 8.52	14-8	Dry
1 DC 9	S.G. 0-5 ft.	Sholo	...	...	...	...	3° 23'S	37° 26'E	13. 8.52	3-9	Dry
1 DC 10	S.G. 0-5 ft.	Uchira	...	...	...	...	3° 24'S	37° 30'E	5. 5.53	13-9	Dry
1 DC 11	S.G. 0-10 ft.	Himo	...	...	...	...	3° 23'S	37° 33'E	7. 7.52	2,550	6-0
1 DD 1	S.G. 0-15 ft.	Kikuletwa	...	...	...	...	3° 31'S	37° 18'E	1. 5.52	Insufficient Data	
1 DD 2	S.G. 0-10 ft.	Kikuletwa	...	...	...	...	—	—	8. 7.52	39-9	Dry
1 DD 3	S.G. 5-20 ft.	Karanga	...	...	...	...	3° 21'S	37° 19'E	11.11.52	86-9	8-8
1 DD 4	Recorder	Weru Weru	...	...	...	...	3° 27'S	37° 18'E	13.10.52	5,060	110
1 DD 5	B.Ms. & S.G.	Weru Weru	...	...	...	...	3° 20'S	37° 16'E	25. 9.52	309-6	19-3
1 DD 6	S.G. 0-15 ft.	Weru Weru	...	...	...	...	3° 11'S	37° 15'E	18. 8.53	Insufficient Data	
1 DD 7	S.G. 10-15 ft.	Nsere	...	...	...	...	3° 19'S	37° 15'E	24. 9.52	180	2-4
1 DD 8	B.Ms. & S.G. 10-15 ft.	Kikafa	...	...	...	...	3° 19'S	37° 13'E	24. 9.52	157-6	19-8
1 DD 9	S.G. 10-20 ft.	Kware	...	...	...	...	3° 20'S	37° 10'E	1.10.52	23-7	Dry
1 DD 10	S.G. 0-10 ft.	Kware	...	...	...	...	3° 17'S	37° 09'E	16. 3.53	80	0-8
1 DD 11		Kware	...	...	...	...	—	—	28. 8.52	153-1	129-2
1 DD 12	S.G. 5-15 ft.	Sanya	...	...	...	...	3° 20'S	37° 07'E	10. 7.52	700	0-3
1 DD 13	S.G. 5-15 ft.	Sanya	...	...	...	...	3° 11'S	37° 04'E	29.11.52	22-9	0-2
1 DD 14	S.G. 0-5 ft.	Fuka	...	...	...	...	3° 12'S	37° 06'E	9. 3.53	76	Dry
1 DD 15	S.G. 5-20 ft.	Lawati	...	...	...	...	3° 14'S	37° 07'E	24.11.52	72-1	0-5
1 DD 16	S.G. 5-10 ft.	Rundugai	...	...	...	...	3° 26'S	37° 16'E	23. 7.53	5-9	3-9
1 DD 19	No Gauge	Nduruma	...	...	...	...	—	—	29. 6.48	131-2	31-4
1 DD 20	S.G. 15-20 ft.	Nduruma	...	...	...	...	3° 23'S	36° 47'E	29. 6.48	23-6	13-2
1 DD 21	S.G. 0-5 ft.	Kigwe	...	...	...	...	3° 23'S	36° 49'E	27. 4.49	5-1	0-5
1 DD 22	S.G. 0-5 ft.	Malala	...	...	...	...	3° 24'S	36° 49'E	12. 2.47	39-6	0-6
1 DD 23	S.G. 5-10 ft.	Malala	...	...	...	...	3° 22'S	36° 48'E	19. 5.53	38-6	0-7
1 DD 24	S.G. 0-5 ft.	Tengeru	...	...	...	...	3° 23'S	36° 50'E	15. 1.47	44-6	12

APPENDIX VII—(contd.)
DETAILED WORK—GAUGING STATIONS

Registered No.	Type of Gauge	River	Position on River		Date Readings Started	Recorded Maximum Flow to date Cusecs	Recorded Minimum Flow to date Cusecs
			Lat.	Long.			
NORTHERN PROVINCE							
1 DD 25	No Gauge	Tengeru	3° 23'S	36° 49'E	1.12.52	39.1	8.8
1 DD 26	S.G. 0-5 ft.	Usa	3° 26'S	36° 51'E	26. 4.49	66.2	27.7
1 DD 27	S.G. 0-5 ft.	Usa	3° 24'S	36° 52'E	3. 4.52	55.6	26.5
1 DD 28	S.G. 0-5 ft.	Maji ya Chai	3° 22'S	36° 54'E	12. 5.53	8.5	1.1
1 DD 29	S.G. 0-5 ft.	Maji ya Chai	3° 23'S	36° 53'E	10. 3.54	Insufficient Data	
1 DD 30	No Gauge	Ndurumanga	3° 23'S	36° 46'E	—	Insufficient Data	
1 DD 31	No Gauge	Magdarisho... ..	3° 22'S	36° 51'E	—	Insufficient Data	
1 DD 32	S.G. 0-5 ft.	Kigeri Kubwa	3° 22'S	36° 50'E	1.12.52	19.2	8.9
1 DD 33	No Gauge	Makumira	3° 23'S	36° 50'E	1.12.53	1.4	0.06
1 DD 34	S.G. 0-5 ft.	Kigeri Kidogo	3° 23'S	36° 51'E	2. 4.52	5.4	4.1
1 DD 35	S.G. 0-5 ft.	Usa	3° 22'S	36° 52'E	1. 3.54	Insufficient Data	
TANGA PROVINCE							
1 B 1	S.G. 0-10 ft.	Unba	4° 31'S	38° 25'E	30. 3.53	159	8.5
1 D 1	S.G.	Pangani	5° 21'S	38° 39'E	16. 6.51	3,660	438
1 D 2	S.G. 0-15 ft.	Pangani	5° 08'S	38° 23'E	10. 7.51	2,232	502
1 D 3	S.G. 0-10 ft.	Pangani	4° 58'S	38° 05'E	12. 3.52	No Flow Measurements	
1 D 4	S.G. 0-5 ft.	Kisikiboka	3° 48'S	37° 37'E	21.10.52	Insufficient Data	
1 DA 1	S.G. 0-15 ft.	Luengera	5° 08'S	38° 31'E	12. 4.53	957	Dry.
1 DA 2	S.G. 0-10 ft.	Luengera	5° 02'S	38° 33'E	30.10.52	550	2.9
1 DA 3	S.G. 0-10 ft.	Luengera	4° 54'S	38° 35'E	8. 5.52	350	9.0
1 DA 4	S.G. 0-10 ft.	Bululu	5° 02'S	38° 32'E	29.11.51	530	4.3
1 DB 1	S.G. 0-15 ft.	Mkomasi	4° 30'S	38° 05'E	19. 4.52	780	0.4
1 DB 2	S.G. 0-10 ft.	Zasseni	4° 28'S	38° 05'E	4. 2.52	540	6.6

APPENDIX VII—(contd.)
DETAILED WORK—GAUGING STATIONS

Registered No.	Type of Gauge	River	Position on River		Date Readings Started	Recorded Maximum Flow to date Cusecs	Recorded Minimum Flow to date Cusecs
			Lat.	Long.			
1 DB 3	S.G. 0-15 ft.	Ndungu	4° 22' S	38° 03' E	4. 2.52	490	0.2
1 DB 4	S.G. 0-10 ft.	Gonja	4° 18' S	38° 02' E	12. 7.52	145	1.3
1 DB 5	S.G. 0-10 ft.	Gonja	4° 17' S	38° 03' E	12. 7.52	68	1.6
1 DB 6	S.G. 0-10 ft.	Mombo	4° 58' S	38° 19' E	4. 2.52	1,000	6.3
1 DB 7	S.G. 0-10 ft.	Mkusi	4° 46' S	38° 19' E	12. 4.52	76	4.3
1 DC 1	S.G. 0-10 ft.	Ruvu	3° 33' S	37° 29' E	19. 8.52	Insufficient Data	
1 DC 2	S.G. 0-10 ft.	Ruvu	3° 31' S	37° 34' E	11. 7.52	218	80
1 DC 19	S.G. and V. Notch	Ngulu	3° 48' S	37° 42' E	9. 7.52	?	Dry
1 DC 20	S.G. and V. Notch	Hweni	3° 45' S	37° 42' E	10. 4.53	?	Dry
1 DC 21	S.G. and V. Notch	Nadido	3° 45' S	37° 42' E	10. 4.53	?	Dry
1 DC 22	S.G. and V. Notch	Vureni	3° 44' S	37° 43' E	10. 7.52	?	Dry
1 DC 24	S.G. 0-10 ft.	Buta	3° 40' S	37° 42' E	10. 4.53	Insufficient Data	
1 DC 30	S.G. 0-5 ft.	Soko	3° 30' S	37° 30' E	18. 9.54	Insufficient Data	
EASTERN PROVINCE							
1 H 1	S.G. 0-20 ft.	Ruvu	6° 33' S	38° 50' E	23. 9.50	—	169
1 H 2	S.G. 0-20 ft.	Ruvu	6° 48' S	38° 43' E	1. 8.50	8,956	202
1 H 3	S.G. 0-20 ft. Cableway	Ruvu	7° 16' S	38° 18' E	26. 7.50	11,945	90
1 H 4	S.G. 0-20 ft. Cableway	Ruvu	7° 03' S	37° 58' E	28. 6.50	8,550	95
1 H 5	S.G. 0-20 ft. Cable Auto Recorder	Ruvu	7° 01' S	31° 48' E	8.10.52	12,000	102
1 HA 1	S.G. 0-15 ft. on abutments	Ngerengere	7° 02' S	38° 22' E	22. 8.50	1,546	Dry
1 HA 2	S.G. 0-15 ft.	Ngerengere	6° 46' S	38° 08' E	11.10.50	Rateable for lowflows only	
1 HA 3	S.G. 0-15 ft. Cableway	Ngerengere	6° 45' S	37° 48' E	23. 8.50	1,565	Dry
1 HA 4	S.G. 0-14 ft. Auto Recorder Cableway	Ngerengere	6° 46' S	37° 42' E	23. 3.53	—	2
1 HA 5	S.G. 0-15 ft.	Ngerengere	6° 44' S	38° 06' E	12.11.52	—	Dry
1 HA 6	S.G. 0-15 ft.	Ngerengere	6° 47' S	37° 30' E	1. 9.50	1,120	3
1 HA 7	S.G. 0-20 ft. V. Notch 0-1.5ft. 12ft. Cipoletti Weir 1.5ft-2.5ft.	Mlali	6° 58' S	37° 20' E	12. 9.53	85.7	0.27

65

APPENDIX VII—(contd.)
DETAILED WORK—GAUGING STATION

Registered No.	Type of Gauge	River	Position on River		Date Readings Started	Recorded Maximum Flow to date Cusecs	Recorded Minimum Flow to date Cusecs
			Lat.	Long.			
1 HA 8	S.G. 0-5 ft. 15ft. Cipoletti Wier 0-1-5ft.	Morogoro	6° 51' S	37° 40' E	27. 3.54	497	0-7
1 HA 9	S.G. 0-10 ft. ditto	Ngerengere	6° 54' S	37° 36' E	25. 3.54	203	1-59
1 HA 10	S.G. 0-10 ft. V. Notch	Mgera	6° 56' S	37° 35' E	21. 3.54	—	0-45
1 HA 11	S.G. 0-10 ft.	Mlali	6° 56' S	37° 32' E	—	—	Dry
1 HA 12	S.G. 0-5 ft.	Mbalala	6° 58' S	37° 31' E	14. 4.54	—	Dry
1 HA 13	S.G. 0-5 ft.	Mbalala	6° 58' S	37° 31' E	14. 4.54	—	Dry
1 HB 1	S.G. 0-15 ft. Cableway	Mgeta	7° 28' S	37° 42' E	7.10.50	—	26
1 HB 2	S.G. 0-10 ft.	Mgeta	7° 02' S	37° 34' E	1. 6.54	—	26
1 HB 3	S.G. 0-10 ft.	Mgeta	7° 02' S	37° 38' E	30. 5.54	—	18-3
1 HB 4	S.G. 0-5 ft. 5 ft. Cipoletti	Mwarazi	7° 01' S	37° 38' E	12. 8.54	19-0	1-86
1 HC 1	S.G. 0-5 ft.	Mtombozi	7° 07' S	37° 46' E	2. 9.53	—	14
1 HC 2	S.G. 0-25 ft. Cableway	Mvuha	7° 12' S	37° 50' E	11. 3.54	—	57
1 HC 3	S.G. 0-15 ft.	Msonge	7° 07' S	37° 52' E	5. 3.54	—	2-32
1 G 1	S.G. 0-20 ft. Cableway	Wami	6° 26' S	37° 32' E	14.11.53	—	85
1 G 2	S.G. 0-15ft. Measured from Ferry	Wami	6° 14' S	38° 24' E	9. 6.54	—	140
1 GB 1	S.G. 0-5 ft.	Diwale	6° 10' S	37° 37' E	27. 8.53	—	41
1 GB 2	S.G. 0-5 ft.	Mkindu	6° 15' S	37° 33' E	28. 8.53	—	22
1 GB 3	S.G. 0-5 ft. 5ft. Cipoletti 0-1ft.	Chazi	6° 12' S	37° 34' E	9. 8.54	61	0-535
1 GD 1	S.G. 0-10 ft.	Miyombo	6° 55' S	37° 04' E	11.11.51	—	58
1 GD 2	S.G. 0-15 ft.	Mkondoa	6° 50' S	37° 00' E	12. 3.52	—	77
1 GD 3	S.G. 0-10 ft.	Hospital	6° 50' S	37° 00' E	16. 1.53	—	Dry
1 GD 4	S.G. 0-10 ft.	Mkondoa	6° 50' S	37° 09' E	22. 3.52	—	77
1 GD 5	S.G. 0-10 ft.	Mkombola	6° 31' S	36° 50' E	13. 9.52	—	26
1 GD 6	S.G. 0-15 ft.	Miyombo	7° 04' S	36° 55' E	9. 7.54	—	—
1 GD 7	S.G. 0-10 ft.	Ilinga	6° 44' S	37° 03' E	12. 9.54	—	—
1 GD 8	S.G. 0-10 ft.	Mkondoa	6° 52' S	37° 02' E	22.12.53	—	—
1 KA 1	S.G. 0-10 ft.	Yovi	7° 12' S	36° 45' E	10.11.51	—	23
1 KB 1	S.G. 0-5 ft.	Msolwa	7° 45' S	37° 00' E	13. 8.54	—	—
1 J 1	S.G. 0-10 ft.	Msimbazi	6° 51' S	39° 09' E	23.12.51	—	Dry
Temporary	S.G. 0-5 ft.	Lukurunge	—	—	15. 2.54	—	—
Temporary	S.G. 0-5 ft.	Mgera	—	—	15. 2.54	—	0-45
Temporary	S.G. 0-5 ft.	Ngerengere	—	—	15. 2.54	—	1-60

APPENDIX VIII
SUMMARY OF COMPLETED WATER DEVELOPMENT WORKS

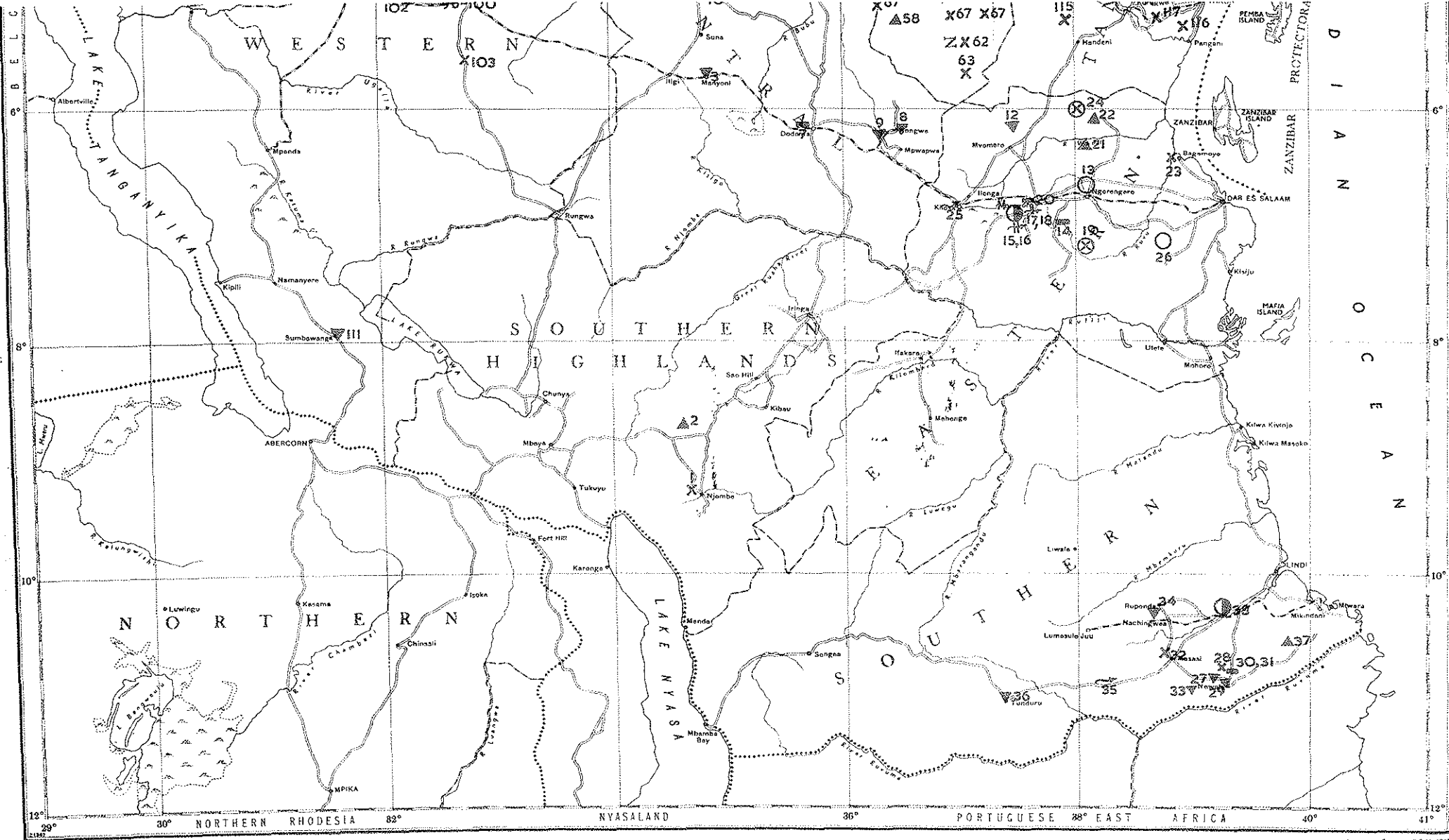
Item	Description	Completed during 1954	Total completed from 1946 to end of 1954
1.	Earth Dams and Hafirs completed	19 No.	77 No.
2.	Total Capacity—million gallons	2,079 *	4,634
3.	Gravity Pipelines completed	10 No.	66 No.
4.	Pumped and Hydraulic Ram supplies†... ..	42 No.	102 No.
5.	Total output of items 3 and 4—thousand g.p.d.	358	11,959
6.	Boreholes successfully completed	29 No.	164 No.
7.	Total footage of item 6	6,290 ft.	38,494 ft.
8.	Total Tested Yield of Item 6—g.p.d.	398,000	956,973
9.	Shallow wells successfully completed	8 No.	81 No.
10.	Total footage of item 9	69 ft.	1,250 ft.
11.	Windmill pumped supplies installed	2 No.	14 No.

*Includes raising of Lake Muchlur Dam increasing its capacity by 1,511 million gallons.

†Excluding windmill installations.

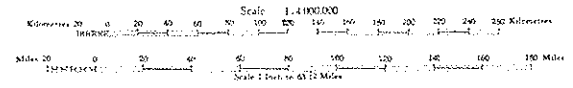
APPENDIX IX
DEPARTMENTAL TRANSPORT,
PLANT AND EARTH-MOVING EQUIPMENT

Item	Name	Qty.	Remarks
1. Petrol Vehicles ...	Bedford Crew-Utility	2	
	Bedford 30 cwt.	16	
	Bedford 2-3 ton	5	
	Bedford 3-4 ton	27	
	Bedford 5 ton	7	
	Bedford 5 ton Tipper	10	
	Bedford 7 ton	5	
	Bedford Scammell... ..	3	
	Dodge 15 cwt.	1	Workshop Truck.
	Ford Pickup	2	
	Ford Workshop	2	
	Ford 3 ton Breakdown	1	
	Landrover	20	
	Thornycroft "Nubian" 5 ton	15	
2. Diesel Vehicles ...	Vulcan 5-6 ton	3	
	Ruston Bucyrus 22W	9	
3. Drilling Rigs ...	Ruston Bucyrus 33W	1	
	Landsborough/Findlay	3	
4. Tractors Wheeled	Fordson Major	3	
	Latil	4	
	Tournapull Model "D"	3	With 7 cu. yd. scraper.
5. Tractors Tracked	Caterpillar D.2	8	
	Caterpillar D.4	10	
	Caterpillar D.7	5	
	International TD 18	3	To be re-conditioned.
6. Scrapers	La-Plante Choate, 4 cu. yd.	3	
	La-Plante Choate, 2 cu. yd.	5	
	Carryall, 4 cu. yd.	4	
	Landsborough/Findlay, 4 cu. yd.	3	
	Onion 7/9 cu. yd.	1	
	Le Tourneau, 8-11 cu. yd.	4	
	Killefer Rotary	4	
	Bartles 2-3 cu. yd.	2	
	Bartles 4 cu. yd.	3	
	Carryall 7 cu. yd.	3	Part of Tournapull Model "D" Unit.
	7. Rippers	Killefer	2
Landsborough/Findlay		2	
Onion		1	
Blaw Knox... ..		1	
Le Tourneau		1	
Bartles Series 20 S.H.		3	
Caterpillar D2-with Dozer Blade		1	
Caterpillar D4-with Dozer Blade		1	
Caterpillar		2	
Holman ATH 85		3	
9. Compressors ...	Broome and Wade S.V. 78	1	
	Pilcan Double-Drum with Lister Engine and Orange Peel Grap... ..	2	
10. Winches			
11. Concrete Mixers ...	Goodwin	7	
	Winget	6	
	Millar	1	
	Benford 10/7	1	
	Parker	6	
12. Trench Pumps (Engined) ...	Winget	4	
	Broomwade (Air)	1	
13. Caravans	All Types	34	
14. Trailers	Low Loader 18 ton	1	
	Landrover	10	
	Water Tank, 200 Gal.	5	
15. Rock Crushers ...	Baxter	1	
16. Mobile welding sets	Quasi-Arc-Ruston Hornsby	2	
17. Motor Cycle ...	B.S.A.—500 c.c.	1	



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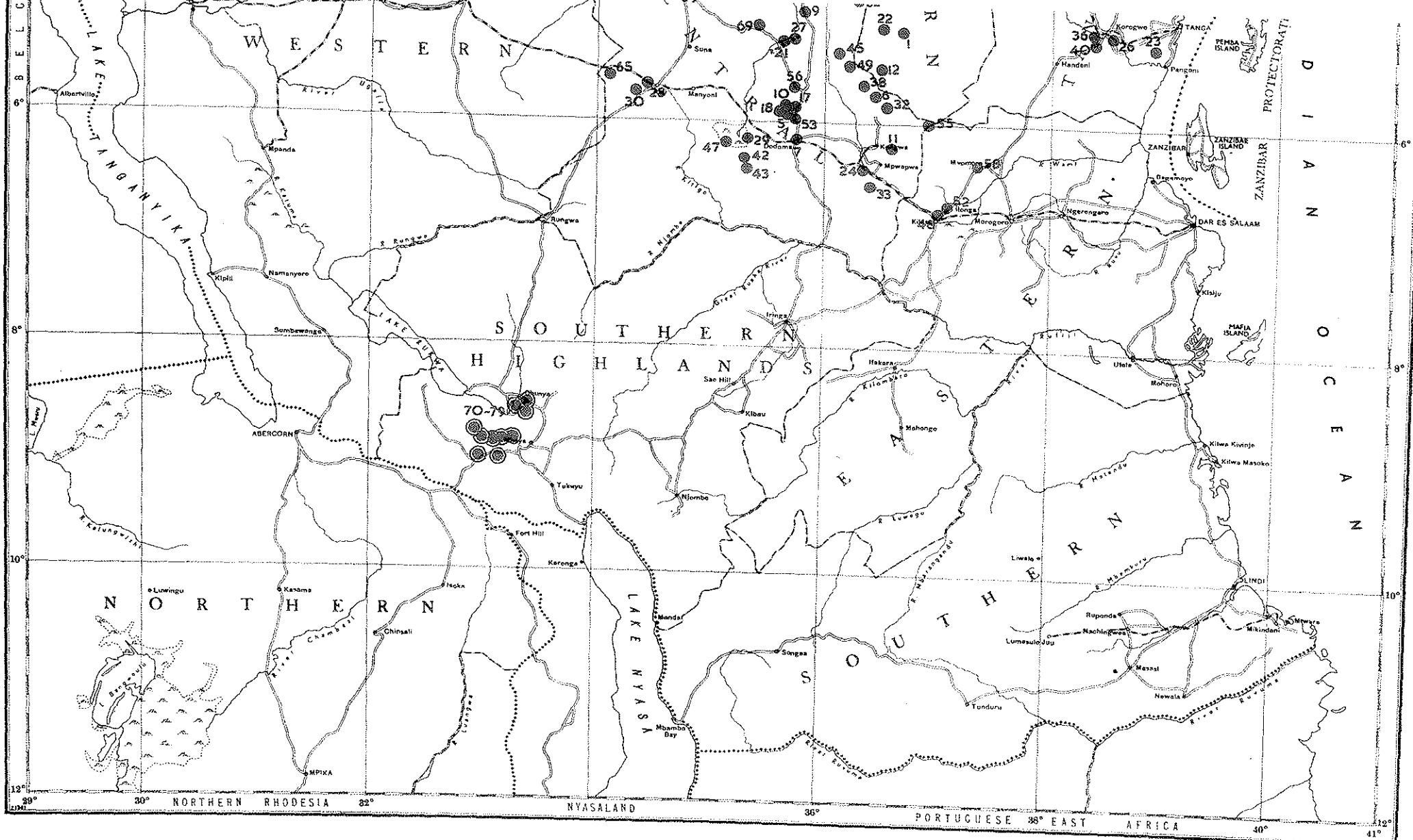
- BUILDINGS.....
- DAMS & HAFIRS.....
- PIPED SUPPLIES.....
- PUMPED SUPPLIES.....
- RIVER CONTROL WORKS.....
- WEIRS.....
- WELLS.....
- IRRIGATION SCHEMES.....
- BANKA DRILLING.....



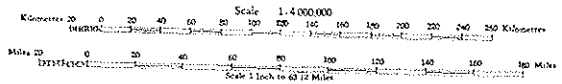
REFERENCE

Territorial Boundaries.....	Main Roads.....
Frontiers.....	Railways.....

LOCATION MAP WORKS COMPLETED AND IN HAND IN 1954. (APPENDIX I)



BOREHOLES.....● (APPENDIX II)
 SHALLOW WELLS.....⊙ (APPENDIX III)



REFERENCE

Territorial Boundaries
 Provincial
 Main Roads
 Railways

LOCATION MAP WORKS COMPLETED
 AND IN HAND IN 1954.

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