638

DOMESTIC

EAST AFR. PROT.

No 35962

C O
35962
Recd 10 OCT 07

(Subject)

Report on Tana River

Tr[illegible] with maps

1907

(Minutes.)

Mr Read

Mr Williams has not visited the Tana & is dependent on Mr Fawcus for his data. However it is clear that it would not be safe to allow any permanent works for the control of the river to be erected without further knowledge. I understand that Mr F. will be prepared to go ahead without asking for permanent rights to be conferred thereon.

The C. Agts. should be instructed to

38, VICTORIA STREET,
WESTMINSTER.
S.W

Oct. 9th. 1907.

639

C.O
35862

The Under Secretary of State,
Colonial Office,
S. W.

Sir,

I have the honour to forward herewith my report on the proposal for regulating the floods on the Rhine River in Switzerland, also two copies of the plan illustrating it.

I have the honour to be

Sir,

Your obedient servant.

C. M. Watson

GEORGE GRAHAM WILLIAMS
CIVIL ENGINEER
TELEPHONE: 2218 VICTORIA
TELEGRAMS: "ENGINEER, LONDON"

39, VICTORIA STREET,
WESTMINSTER,
S.W.

690

Oct 9th. 1907.

C C
35962
10 OCT 07

The Under Secretary of State,
Colonial Office,
S. W.

Sir,

BRITISH EAST AFRICA PROTECTORATE

PROPOSAL FOR REGULATING THE FLOODS ON THE TANA RIVER.

In accordance with instructions received in your 54378/1907 of the 25th. of September 1907 I have the honour to report on the proposal for regulating the floods on the Tana Riverss follows.

The Tana River has a total length from its source to the sea of about 600 miles. It is the natural drainage channel for a large watershed; it is not possible to ascertain exactly what the area is but it is apparently about 41,000 square miles. This area however bears no relationship to the size of the river itself for under normal conditions the discharge from only a comparatively small portion of the total watershed reaches the river.

The accompanying map shows what a marked difference there is between the number of permanent water courses in the uplands country above Hargana Falls and in the rest of the watershed nearer the coast. In the high land numerous tributaries join the main stream most of them flowing down the valleys leading from Kenia and the Aberdare range; whilst below Hargana for several hundred miles not a single tributary joins on either side. Several rivers rise in the hilly country on the west side of the watershed but, with the possible exception of the Five they all lose themselves in the plains through which the

1/12

Tana flows. The quantity of water flowing in the Tana itself appears to diminish as it approaches the sea, but I have no means of knowing to what extent this is the case.

The flow of water in the river Tana, in the dry weather has been estimated as being about 20,000 cubic feet per minute, but from a cross section of the river at that point which Mr. Pawcus has supplied me with I should say that this was much too small an estimate. The dry weather flow appears in fact to be at least six times that quantity.

The river is navigable from its mouth up to Hameye a distance of 400 miles along the river, and 300 miles in a strait line from the coast. Under present conditions navigation is only possible for boats of light draught and is rendered difficult by the number of sharp bends, snags, and sandbanks.

The total fall of the river between Belarti and the sea is 460 feet or an average of about 14 inches in a mile. The fall does not appear to be even throughout; near the coast the country is very flat and the fall of the river does not seem to average more than about 8 inches in the mile for a considerable distance.

The low lying land near the mouth of the river is flooded during the wet seasons, the floods apparently spreading over an area of country of nearly 700 square miles in extent. The land included in the concession asked for by Mr. Pawcus is almost entirely within this flooded area.

The mouth of the Tana River was in it within the last few years a mile [illegible] or more than it is now. Previously the present mouth had been the entrance of a small river called the Gui Creek and a length of about 5 miles. At some time it would be necessary for Mr. Pawcus should he be granted the concession to cut to connect the upper end of the tidal portion of this

river with the Tana. In [illegible] the canal was [illegible] from 6 to 7 feet wide and having a depth varying from a few inches to several feet.

Subsequently an effort was made to improve the canal for navigation by partly damming up the old course of the Tana below the canal inlet and increasing the flow down the canal with the intention of scouring out the bottom. The result was successful to such an extent that the depth of the canal was increased to about 20 feet and the river was entirely diverted, so that having forsaken its old course [illegible], it now flows through what was the [illegible] Canal to the new mouth near Kipini. In the meantime the original bed is becoming overgrown with vegetation and has partly filled up.

The land along the lower portion of the river is a kind of miniature Egypt, the Tana acting on a small scale in the same way as the Nile does in that country. Every year the river floods a large extent of country, saturating the ground with moisture, and depositing a layer of silt which fertilizes the land, making it suitable for growing cotton and other produce when the floods have subsided.

The disadvantage of the present condition of affairs is that the flooding continues over too great a part of the year. Owing to the fact that in the high land from which the Tana derives most of its water there are two distinct rainy seasons, the land near the mouth is flooded twice a year, for about six weeks in November and December, and for [illegible] months between February and May.

Mr. [illegible] wishes to get rid of the floods at [illegible] the year but to allow the longer flood to run its natural course.

[illegible] object in view he proposes in the first instance to cut through the bank which now [illegible] the entrance to the original river channel where it was diverted at [illegible] large sluices at that point which can be [illegible] when required. He also proposes to clean out [illegible]

river with the sea. In 19[illegible] the canal was [illegible] from 4 to 7 feet wide and having a depth varying from a few inches to several feet.

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The land along the lower portion of the river is a kind of miniature Egypt, the Tana acting on a small scale in the same way as the Nile does in that country. Every year the river floods a large extent of country, saturating the ground with moisture, and depositing a layer of silt which fertilizes the land, making it suitable for growing cotton and other produce when the floods have subsided.

The disadvantage of the present condition of affairs is that the flooding continues over too great a part of the year. Owing to the fact that in the high land from which the Tana derives most of its water there are two distinct rainy seasons, the land near the mouth is flooded twice a year, for about six weeks in November and December, and [illegible] months between February and May.

Mr. [illegible] wishes to get rid of the flooding [illegible] of the year but to allow the longer flood to run its natural course.

With this object in view he proposes in the first instance to cut through the bank which now blocks up the entrance to the original river channel where it was diverted at [illegible] and to put some large sluices at this point which can be opened when required. He also proposes to close up [illegible]

the old river bed and to straighten some of the sharp bends in it.

If these works are not sufficient for the purpose intended he contemplates a further work. The old Tana river after flowing from Charra to within a few hundred feet of the sea, turned abruptly at right angles, and, flowing behind the sand hills that line the coast, finally made its way into the sea about seven miles further west. By cutting through the sand hills at the bend the distance to the mouth of the river could be very much shortened. Mr. Fawcus proposes if he finds it necessary to do so to undertake this work and to fix sluices across the opening similar to those at Charra.

With regard to these proposals Mr. Fawcus clearly states that he has no intention of making any alteration in the present course of the river, and, providing that the opening and closing of the sluices is under the control of the administration, so that they will not be opened except when necessary, and that Mr. Fawcus undertakes to remove the sluices and to restore the river back to its present condition if required, it may be said at once that there does not appear to be any likelyhood of these works acting to the detriment of the river as long as it remains in its present condition.

On the other hand I have much doubt as to whether [illegible] will [illegible] Mr. Fawcus has [illegible].

The operation of getting rid of one set of floods whilst retaining another is one of considerable delicacy, and I am of opinion that Mr. Fawcus underestimates the quantity of water that [illegible] will have to deal.

In order to supplement the somewhat indefinite information obtainable with regard to the flood levels in the river I have endeavoured to arrive at some results from the registered rainfall on the upper watershed. There are only few statistics available for this purpose, but [illegible]

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In order to supplement the somewhat indefinite information obtainable with regard to the flood levels in the river I have endeavoured to arrive at some results from the recorded rainfall on the upper watershed. There are only few statistics available for this purpose, but [illegible] I am

[illegible] almost the whole of the watershed above Margara has a mean annual rainfall of over 40 inches, while it is probable [illegible] there is a rainfall on the [illegible] of much more than this.

The only gauges actually on the upper watershed are those at Nyeri, Fort Hall, and Kitui, of these I think Fort Hall is more likely to give results representative of the rainfall in the district. The record here has been kept since 1901 and the mean annual rainfall appears to be about 45 inches.

From the recorded figures it appears that although the rainfall during April is more than in any other month, averaging over 12 inches for the five years, November comes a good second with an average of nearly 8 inches. The maximum rainfall recorded during April is 13.30 inches and the maximum during November 11.00 inches.

In November 1906 when the rainfall at Fort Hall was 20.03 inches, the total at Nyeri was 6.75 inches, at Nairobi 5.67 inches at Machakos 9.08 inches, and at Kitui 18.30 inches. It therefore seems reasonable to suppose that there may be in any November an average of at least 8 inches of rain over the whole of the upper watershed.

Assuming that there is a rainfall of 8 inches during the month, and that 4/5 of this rain is lost by evaporation and absorption before it reaches the river, leaving only a quantity equivalent to 2 inches over the whole watershed or .16inches [illegible] Fall [illegible] the River [illegible] this with the whole south would be about 2,200 million cubic feet per day or over 1½ million cubic feet per minute.

The sections of the river at Kabete and Karifanq give the flood water level, but there is no accurate information as to the fall of the river in times of flood at the points where they are taken. The average fall between Nanyuki and the sea is about 3.5 feet per mile, but as it is considerably less than this in some places it must be more in others. The fall

is probably rather more than the average at Merifeno during floods, for the river [illegible] ought to be high at that point. [illegible] the [illegible] being [illegible] the fall and consequently the velocity will be greater.

If the fall is 1.15 feet a mile at Marvaso and 1.5 feet a mile at Merifeno the discharge of the river at times of flood would be at the rate of 1,000,000 cubic feet a minute in both places. This is less than the result obtained from the estimated rainfall, and the higher figure is in my opinion likely to be more accurate. No account is taken in these figures of any water which may find its way into the river from other parts of the watershed. The map shows that the Tiva, an important tributary, joins near Nomo. Although this river may be dry for a part of the year there seems to be no reason why it should not discharge large quantities of water during the wet seasons.

Mr. Fawcus estimates that the average depth of water throughout the flooded area is about 1 foot. Even supposing the depth to be no greater than this, the total quantity of water standing on 700 square miles is nearly 20,000 million cubic feet, which is about nine days flow at the rate of 1½ million cubic feet a minute.

Taking these facts at consideration I am of opinion that if Mr. Fawcus' scheme is to be effective it must be capable of getting rid of at least 1½ million cubic feet a minute. At this rate the sluices contemplated will not be large enough, and if they were, the channel of the old river and the present channel in combination would in my opinion be incapable of dealing with so large a quantity of water, even when a new opening is made through the sandbanks into the sea. During times of flood the whole of the country up to the sandbanks is covered with water and at that time both the existing river and the old river channel are doing [illegible] share of the work of

is probably rather more than the average at Marifano during floods, for the river banks appear to be high at that point, so the area being constricted the fall and consequently the velocity will be greater.

If the fall is 1.1[illegible] feet a mile at Marvaes and 1.5 feet a mile at Marifano the discharge of the river at times of flood would be at the rate of 1,000,000 cubic feet a minute at both places. This is less than the results obtained from the estimated rainfall, and the higher figure is in my opinion likely to be more accurate. No account is taken in these figures of any water which may find its way into the river from other parts of the watershed. The map shows that the Tiva, an important tributary, joins near Ngao. Although this river may be dry for a part of the year there seems to be no reason why it should not discharge large quantities of water during the wet seasons.

Mr. Pascoe estimates that the average depth of water throughout the flooded area is about 1 foot. Even supposing the depth to be no greater than this, the total quantity of water standing on 700 square miles is nearly 20,000 million cubic feet, which is about nine days flow at the rate of 1½ million cubic feet a minute.

Taking these facts at consideration I am of opinion that if Mr. Pascoe's scheme is to be effective it must be capable of getting rid of at least 1½ million cubic feet a minute. At this rate the sluices contemplated will not be large enough, and if they were, the channel of the old river and the present channel in combination would in my opinion be incapable of dealing with so large a quantity of water, even when a new opening is made through the sandbanks into the sea. During times of flood the whole of the country up to the sandbanks is covered with water and at that time both the existing river and the old river channel are doing their share of the work of

removing the water which apparently nevertheless continues to rise.

The land flooded acts in fact as a large equalising reservoir and stores the water brought down by the river, which the present outlets into the sea are incapable of dealing with, until the discharge from the high lands diminishes.

In my opinion the effect of Mr. [illegible]'s scheme will chiefly be to assist to shorten the period during which the floods remain on the land or possibly in a season of little rainfall to prevent the small amount of the flooding there would have occurred.

In the general way the best method of getting rid of floods near the mouth of a tidal river, is to concentrate the upland water and the tide in one channel of such a shape and size as to give the maximum effect to the scouring action of both.

The most active agents in keeping the mouth of a tidal river open are the tides, and by properly directing the tidal wave and training and dredging the mouth, a river can sometimes be immensely improved both from the point of view of navigation and of draining the land near the mouth.

Whether or not anything could be done in this way in the case of the Tana it is impossible to say without much more information than is at present available. The rise of the tide at spring tides is about 10 feet, and although not a very great rise, is sufficient if properly utilised to act along a considerable length of river.

A work of this nature is generally a most complicated one, and an ill-considered scheme may have precisely the opposite effect to that intended. The question would be rendered more difficult in this case by the conflicting interests which might be involved. For instance such works might be so successful as to prevent the flooding altogether, in which case

the fertilising action of the river would be lost.

I should therefore strongly recommend that no important work of improvement should be undertaken which could lead to any permanent alteration in its course until the question of the river and its future possibilities has been carefully studied as a whole.

The River Tana may prove to be a very important factor in the future development of East Africa. A river which is navigable to a point 200 miles from the sea, the end of the navigable portion being situated at the edge of a fertile district, within a radius of 150 miles from Fort Hall and 170 miles from Nairobi is likely to prove of the greatest value for the purpose of conveying produce to the coast. There seems also to be a possibility of extensive irrigation works, whilst the portion of the river above Hayness where there is a fall of several thousand feet in the 200 miles appears to offer opportunities for large power generating stations.

It seems very desirable that there should be a complete investigation of the whole question as soon as it can be undertaken, and before any works are projected which might clash with interests of more importance to the community.

Such an investigation should take the following possibilities into consideration.

(1) The improvement of the river itself for navigation by straightening the banks, by canalising, or by dredging, and the size and type of craft for which the river is adapted.

(2) Access to the head of the navigable portion from other parts of the Protectorate.

(3) The position of the mouth and its improvement of the entrance both from the point of view of navigation and the drainage of the land near the coast.

(4) Irrigation, either by constructing a barrage or other means

1774

(3) Gauging Stations.

Such an investigation would take some time for it [illegible] necessary to study the tides and currents at the coast, to carefully examine the condition of the river in terms of floods and of low water, and to survey and level the river and the surrounding country.

I do not consider there is any objection from the navigating point of view to the works contemplated by Mr. Pawsey' scheme if they are carried out subject to the following conditions.

(1) That no diversion is to be made in the present course of the river.

(2) That the sluices are to be under the control of the local Administration, who have the power if necessary (a) to order them to be opened, or (b) to refuse to allow them to be opened.

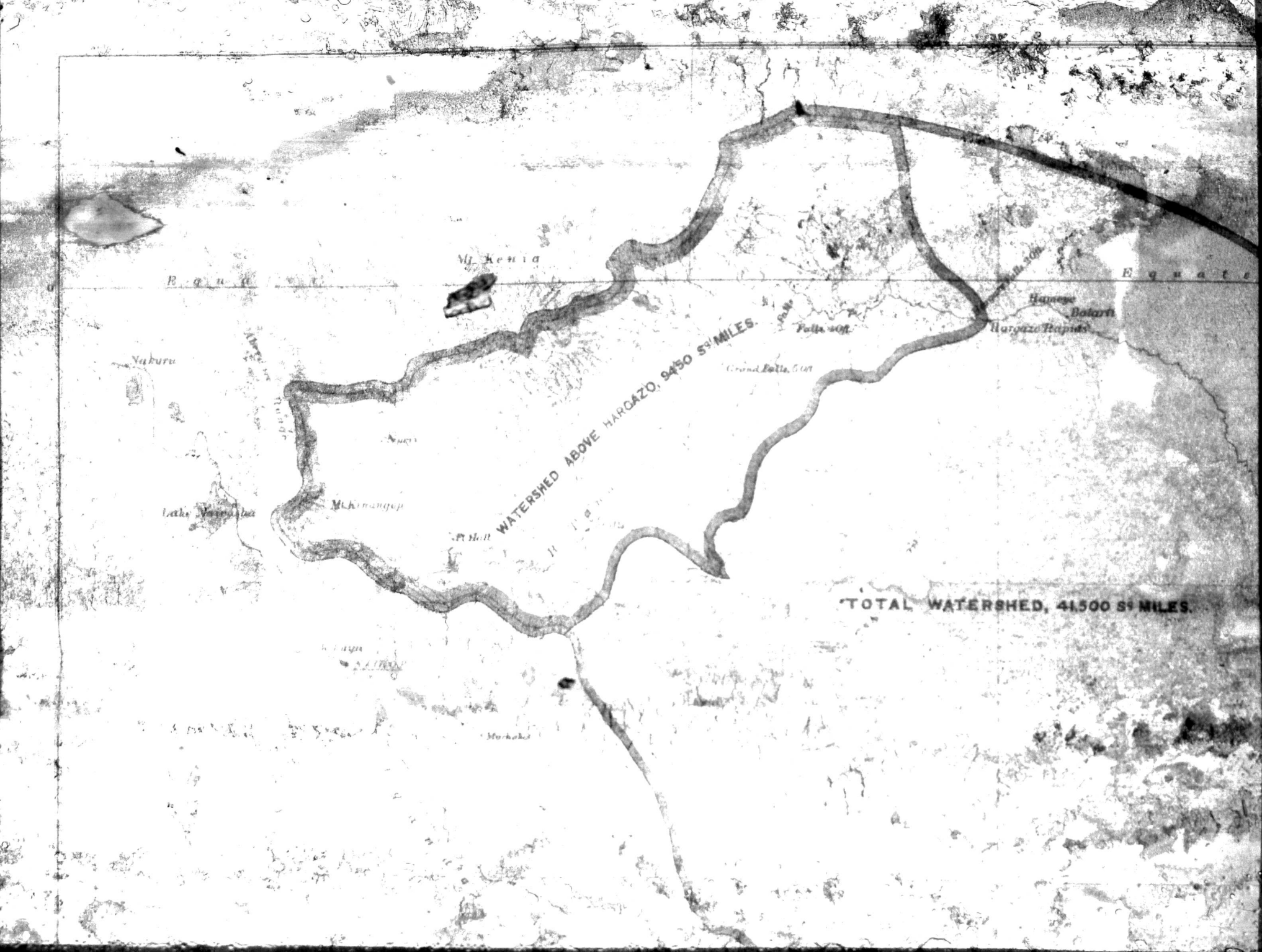
(3) That Mr. Pawsey should undertake to remove the sluices and to restore the river bank to its present condition at any time if required to do so.

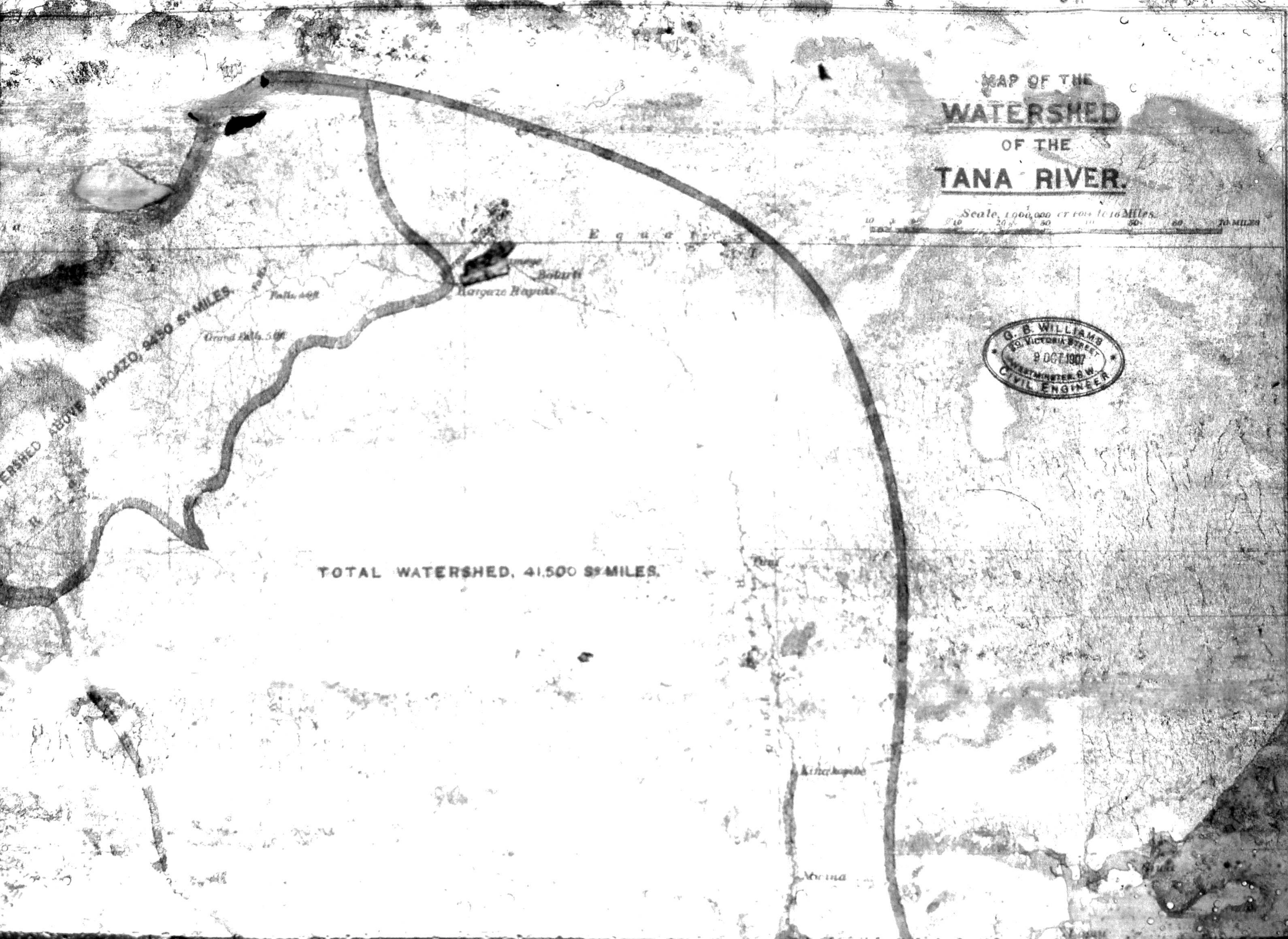
(4) That the right of the Government to alter or divert the present course of the river, to improve or deepen the entrance channel of the river itself or to abstract water from the upper portion of the river for irrigation or other purposes, should not in any way be affected, and [illegible]

[illegible]

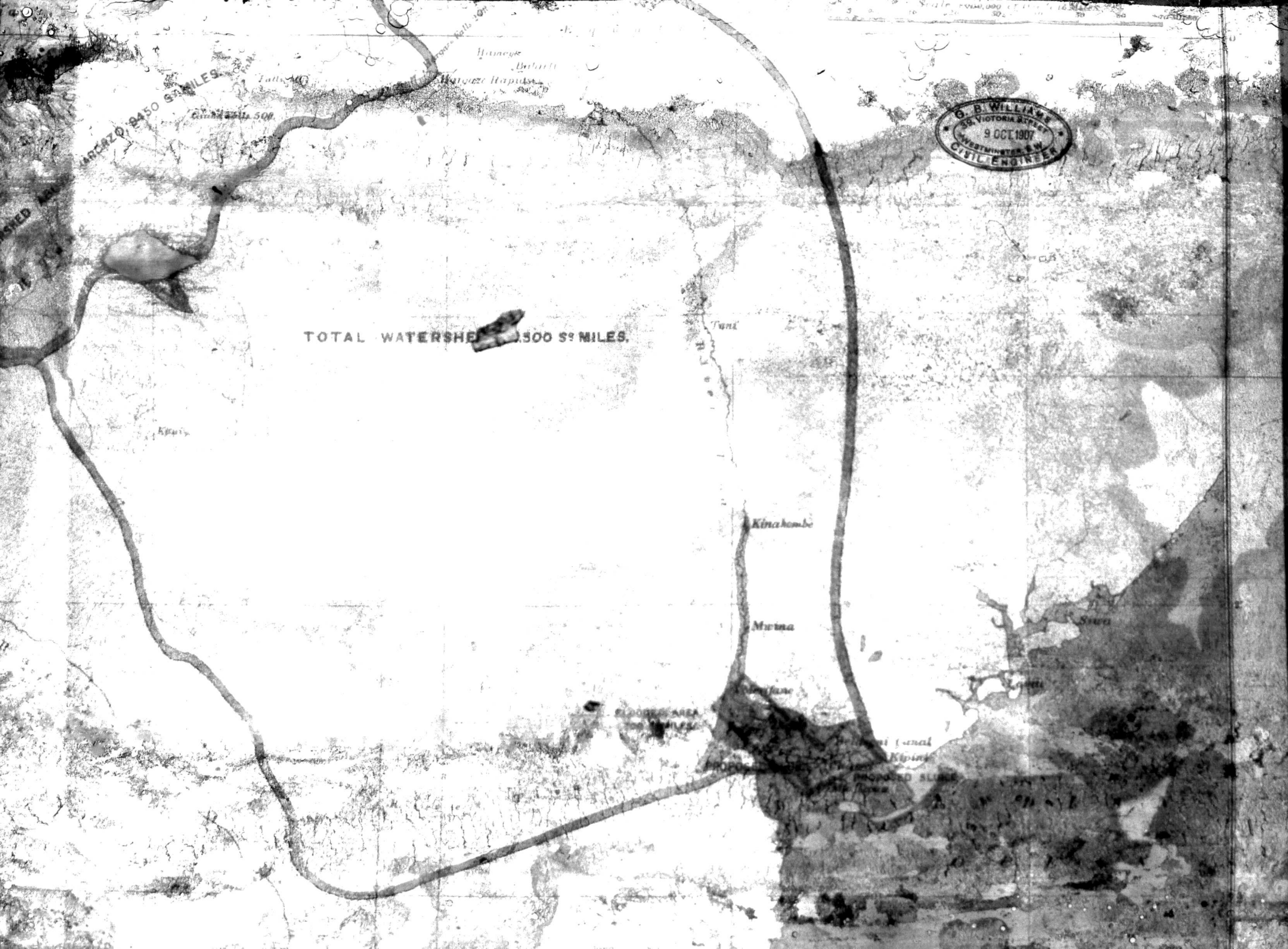
[illegible]

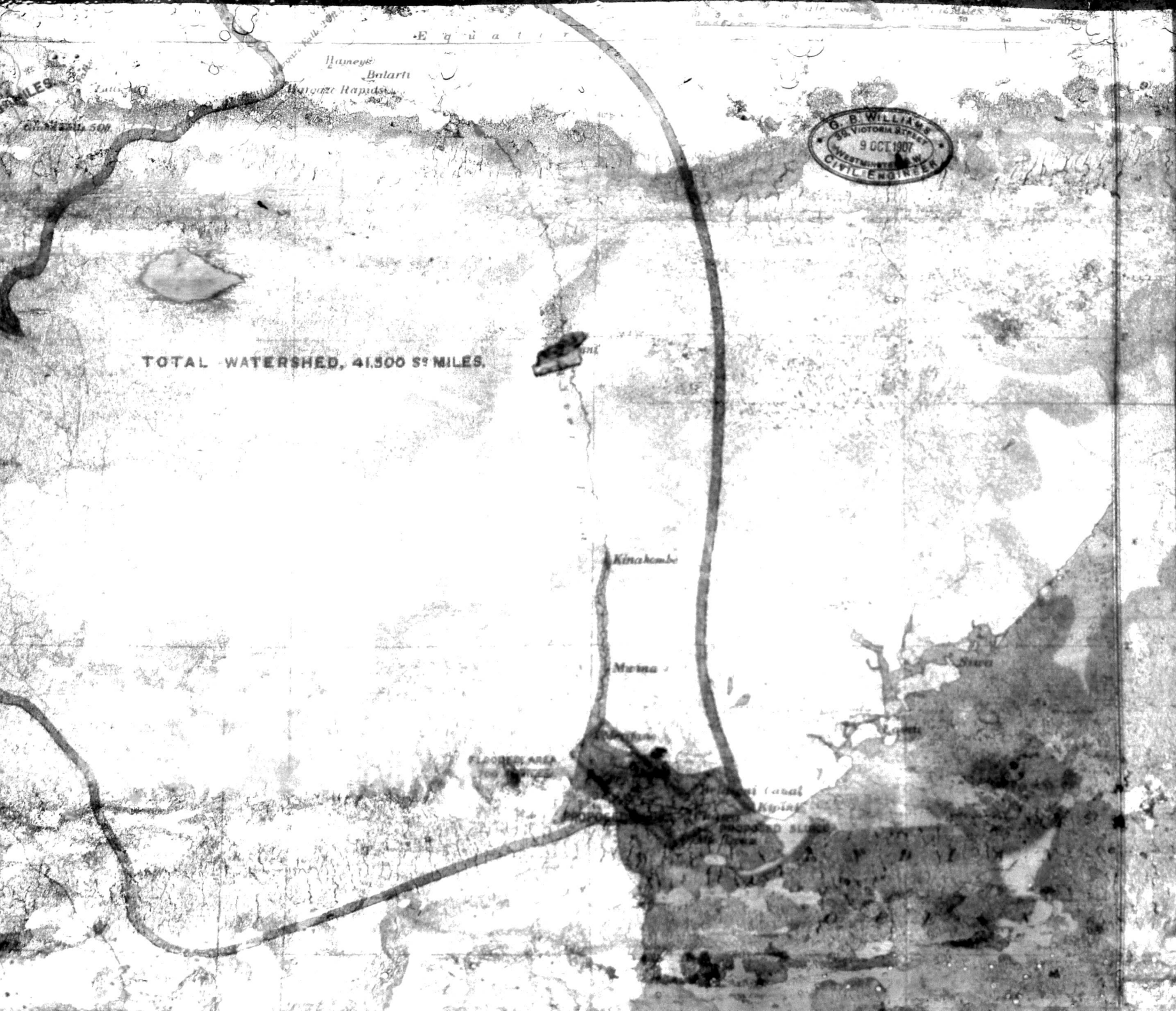
Your obedient servant,


Mt. Kenia
Equato
Equato
Nakuru
Lake Naivasha
Mt Kinangop
Mt Hall
WATERSHED ABOVE HARGAZO, 9450 Sq MILES.
Hargazo Rapids
TOTAL WATERSHED, 41500 Sq MILES.


MAP OF THE
WATERSHED
OF THE
TANA RIVER.
Scale 1/1,000,000 or 1 in. to 16 Miles.
70 MILES
G. B. WILLIAMS
30, VICTORIA STREET
9 OCT 1907
WESTMINSTER S.W.
CIVIL ENGINEER
ERSHED ABOVE HAROAZO, 9450 Sq MILES.
Grand Falls
Hargazo Rapids
Equator
TOTAL WATERSHED, 41,500 Sq MILES.


WATERSHED ABOVE
TOTAL WATERSHED, 41,500 Sq MILES.
Boundary


TOTAL WATERSHED 9500 Sq MILES.
Kinakombe
Mwina
Sawa
G. B. WILLIAMS
CIVIL ENGINEER
9 OCT 1907


Equator
Baineye
Bolarti
Kinakombe
Murua
TOTAL WATERSHED, 41,500 Sq MILES.
G. B. WILLIAMS
9 OCT 1907
CIVIL ENGINEER

701

Draft

DRAFT

CA

16 October 1907

Gentlemen,

I am directed by the S of S to inform you that he approves of your paying to Mr G Bromley Williams, 39 Victoria St, SW the sum of ten guineas (from EAP funds) in respect of a report which he has furnished to this Dept on the Tana River.

R L Antrobus

MINUTE

Mr. Lovell.

Mr. Read

Mr. Antrobus.

Mr. Cox.

Mr. Lucas

Mr. Graham.

Sir M. Ommanney.

Mr. Churchill.

The Earl of Elgin.

WR 15/10/07

Copy of 30149, 34378 and of 35962 & this letter to Gov EAP usual with ... original ...