i) Consumption area

Chambishi (Copperbelt Province)	Capacity 10,000 tons

ii) Production areas

Masansa (Central Province)	Capacity 5,000 tons
Mtirizi (Eastern Province)	Capacity 4,000 tons

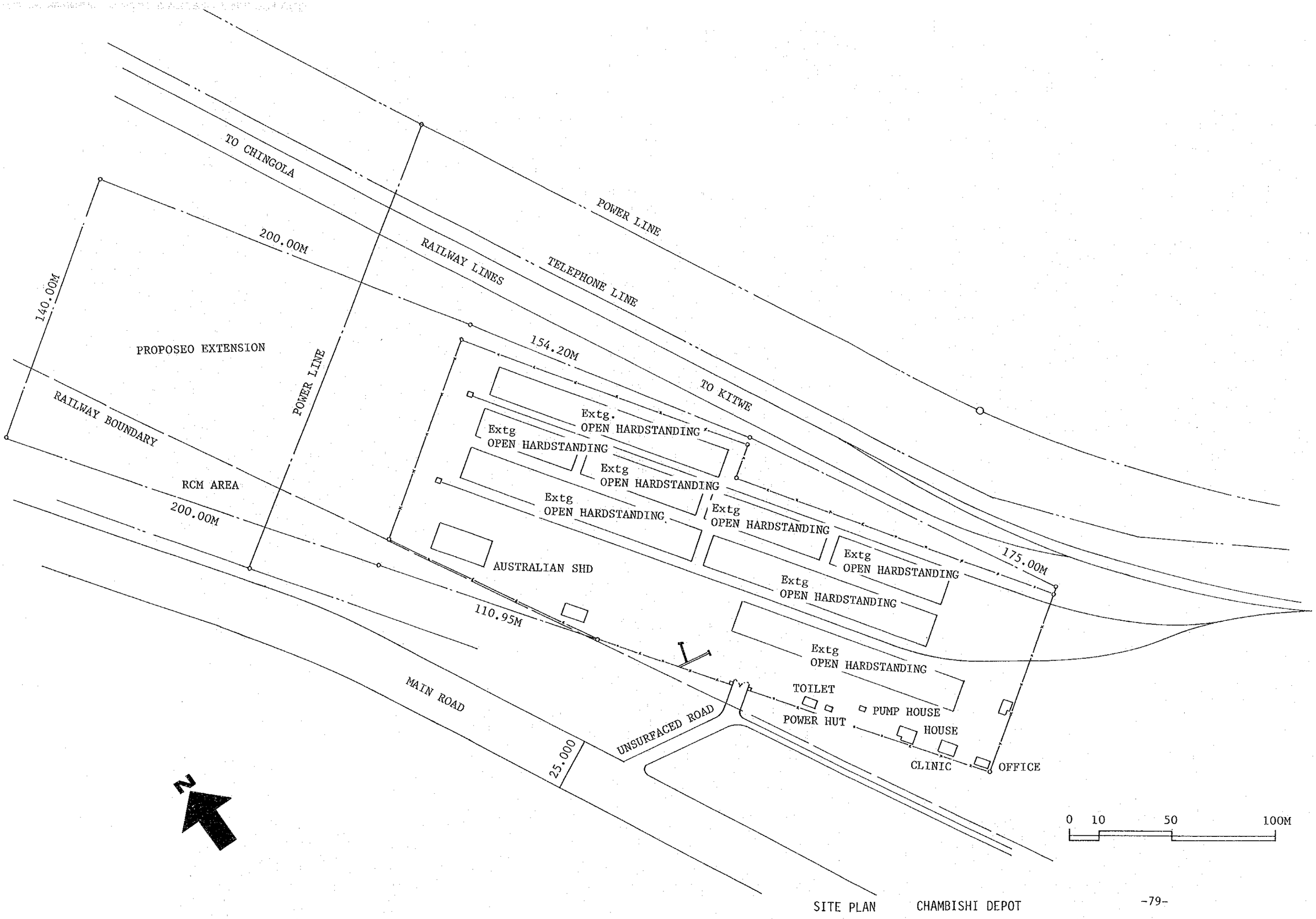
The study team acknowledges that it is necessary to construct storage-houses in Serenje in Central Province. However, the roads from farms to this proposed site are bad notwithstanding the wide grain collecting range. Therefore, it seems that the problem lies rather in the improvement of transportation conditions. Also this site is judged not to be appropriate for a permanent depot. For the these reasons, Serenje was excluded from this project.

3.2.6 Summary and drawings of proposed sites

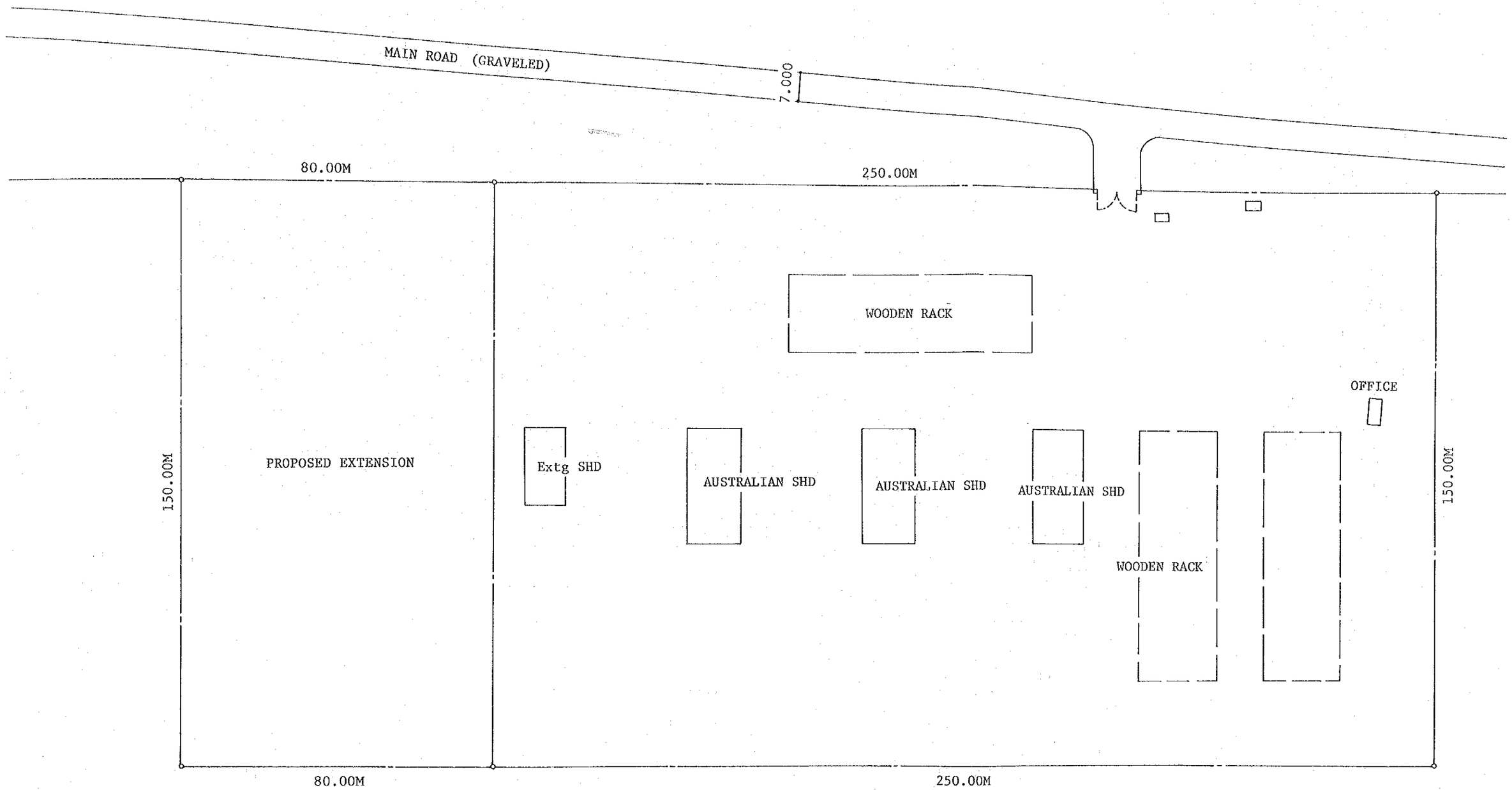
Summary of proposed sites surveyed

	Chambishi	Masansa	Mtirizi	Serenje
Area	2.8 ha	4.95 ha	1.5 ha	1.0 ha
Front road	Connected by 6 m unpaved road, about 100 m up to the highway (25 m wide)	7 m wide Gravel read	Unpaved 8 m road	4 m wide Unpaved
Frontage, shape	200 m x 140 m Extendable up to the highway	330 m x 150 m Extendable to the west by about 500 m	A pentagon 166 m on the major side x 76 m on the minor side	114.6 m x 92.7 m Extendable to the west by about 500 m and to the south by about 10 m
Location	Kalulushi District in Copperbelt Province	Mkushi District in Central Province	Nymba District in Eastern Province	Serenje District in Central Province
Undulation	Level difference of about 2 m	Almost flat	Almost flat	Level difference of about 4 m. On the side of a gently sloped hill.
Existing facilities	1 storagehouse by Australian assistance for gunny bags (500,000 bags) 9 open hard-standings (600,000 bags 54,000 tons)	3 storagehouses by Australian assistance (each 1,000 tons) 1 equipment storagehouse by the NAMB, open area for wooden racks.	1 storagehouse (5,000 bags) 1 open hard-standing, (10,000 bags) 1 equipment storage yard with roof Open area for wooden racks	1 storagehouse for fertilizers, seeds and chemicals (37,000 bags) 1 storagehouse for fertilizers and equipment (5,000 bags) 1 open hard-standing for 40,000 bags (3,600 tons) Open areas for wooden racks
Electricity	A transformer rated at 433 V, 20 A is installed to the south of the existing site.	Not available (Power transmission is planned to start near the site about 2 years later)	Not available	Planned, to become available several months later.
Water supply	An elevated water tank with a motor-driven pump (about 5 tons) in the existing depot.	1 borehole in the site (No water pump)	Not available	Waterworks reach to a nearby village.
Drainage	Available in a part of the existing site.	Not available	Not available	Not available
Transportation	Easy, since the site lies along the highway	About 70 km by an gravel road (available also in the rainy season) from the highway	Along highway	There are 2 narrow approach routes not available in the rainy season from the highway.
Railway	The existing site has 2 sidetracks (Extendable)	Not available	Not available	A railway passes near the site, impossible to construct a sidetrack.

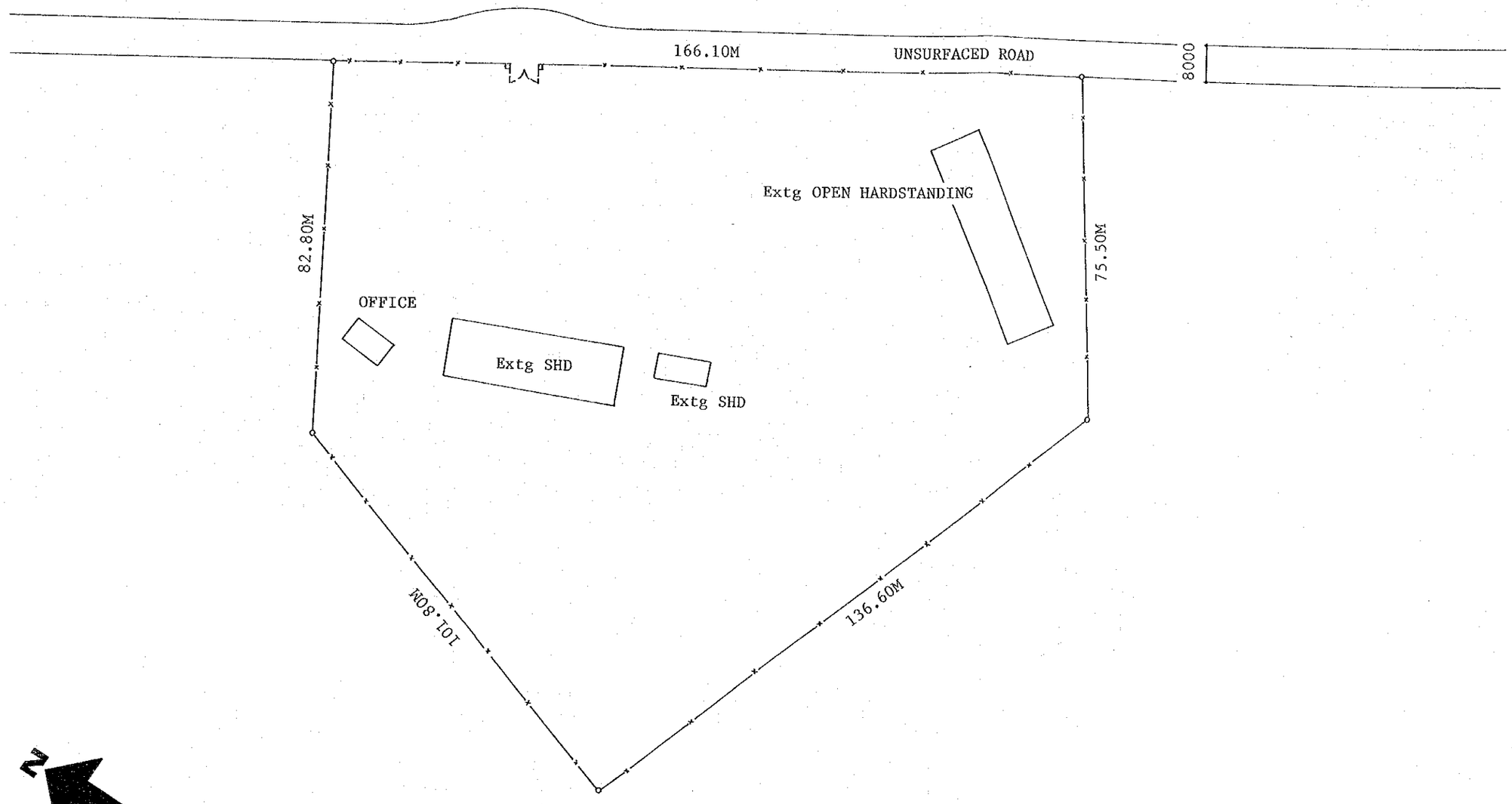
Land acquisition	The land is owned by the Zambia Railway. The NAMB has obtained permission to use the land	Owned by the NAMB	Owned by the NAMB	Owned by the NAMB
Others	It is necessary to: { transfer cables. fell trees and to prepare land.			



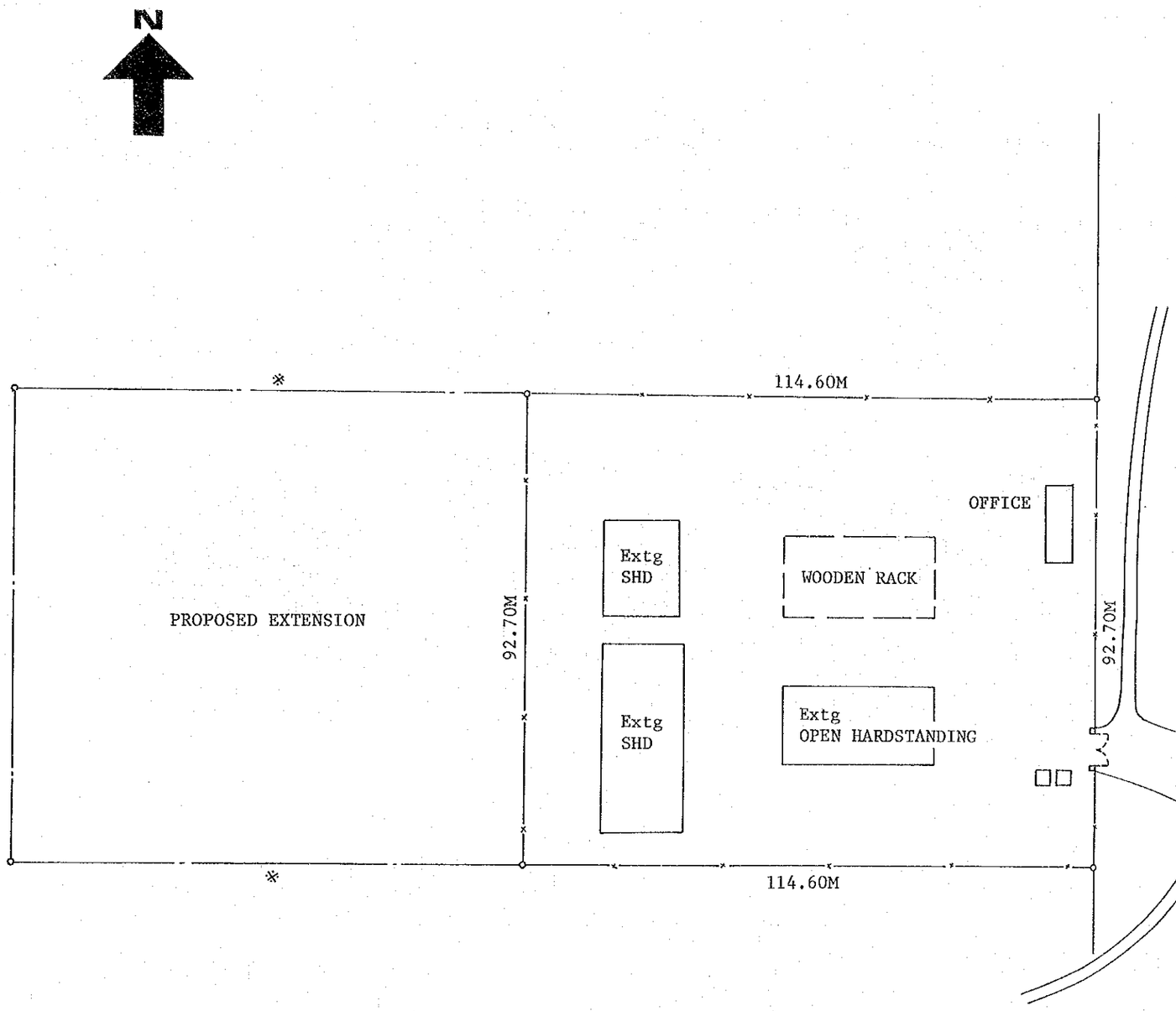
SITE PLAN CHAMBISHI DEPOT



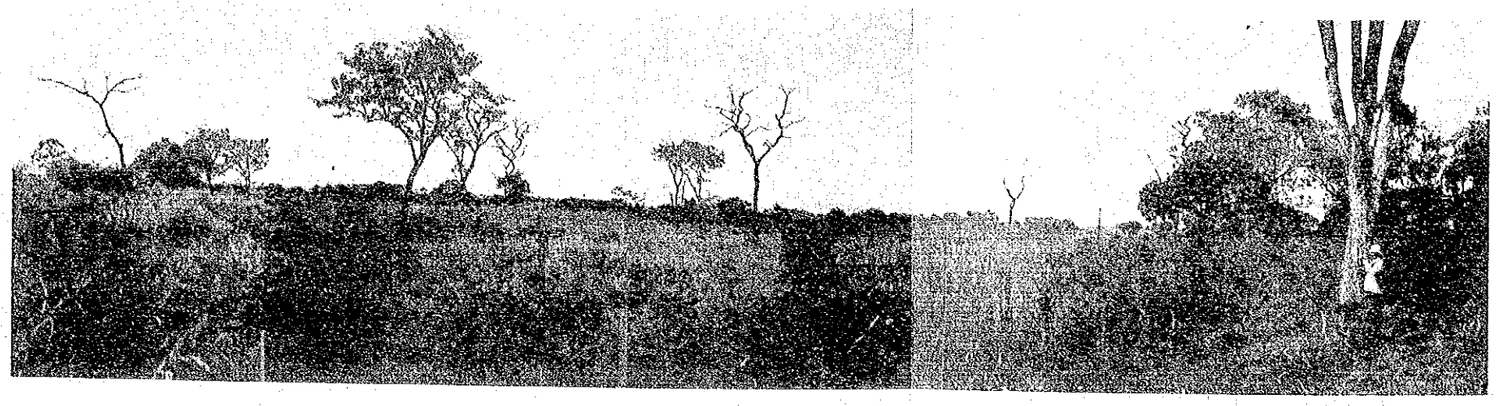
SITE PLAN MASANSA DEPOT 1:1000



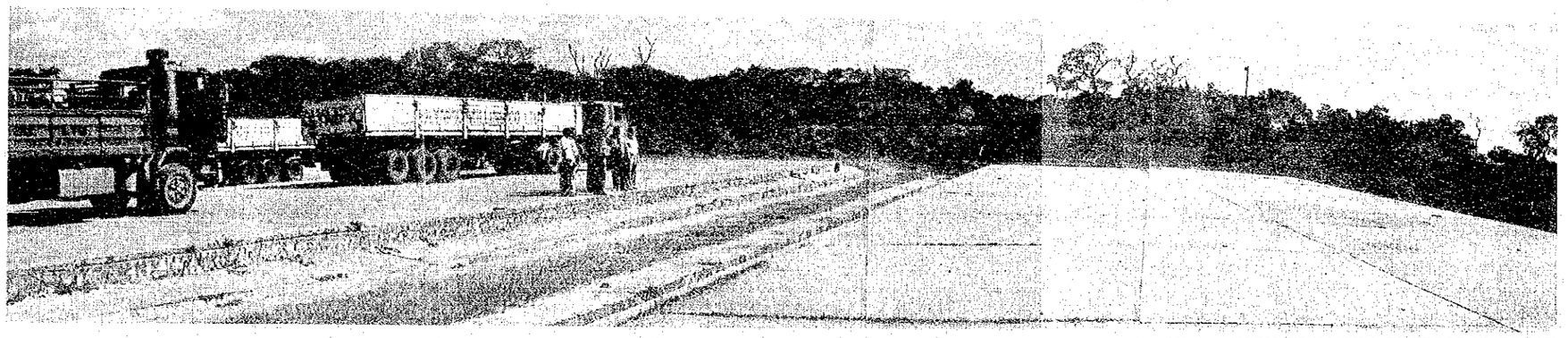
SITE PLAN MTIRIZI DEPOT 1:1000



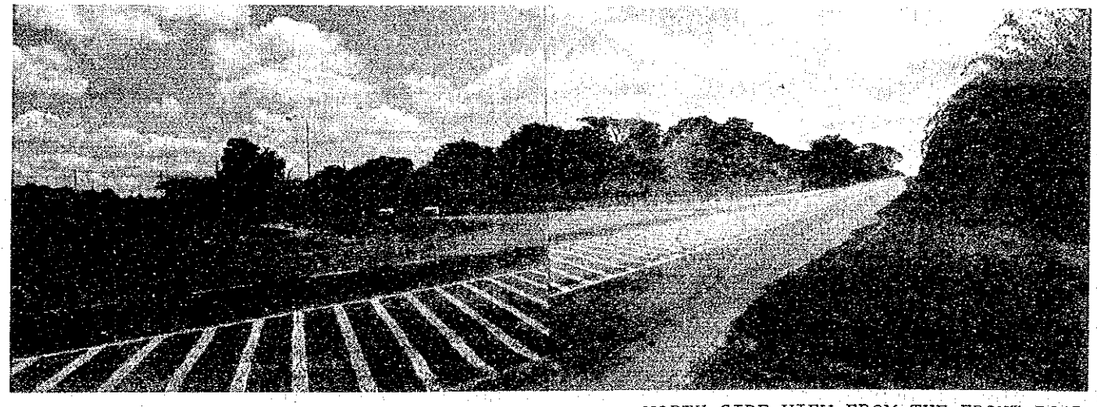
SITE PLAN SERENJE DEPOT 1:1000



PROJECT SITE, EAST SIDE VIEW

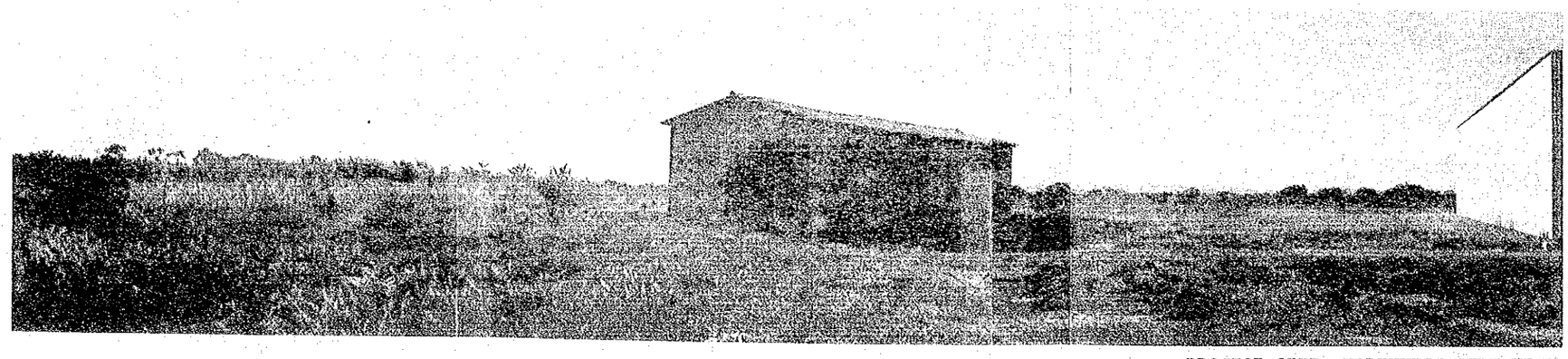


PROJECT SITE, VIEW FROM THE EXSISTING DEPOT

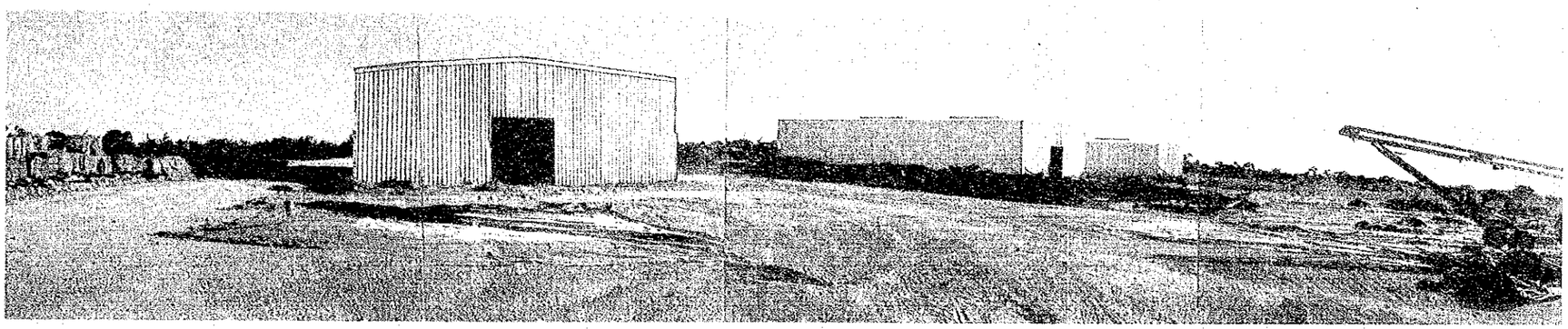


NORTH SIDE VIEW FROM THE FRONT ROAD

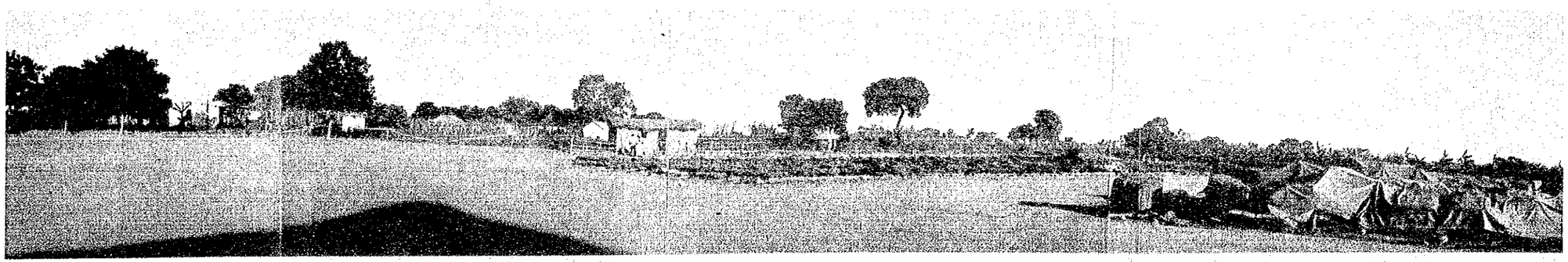
MARK SHOWING SITE BOUNDARY



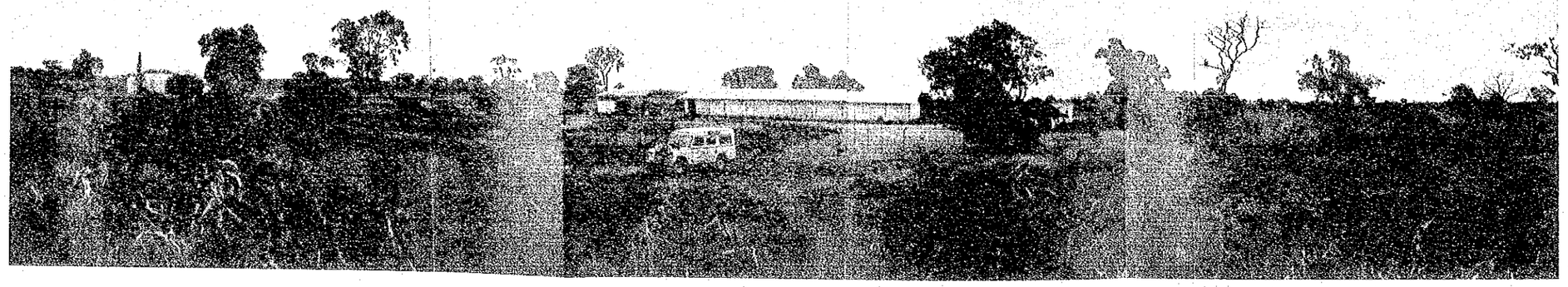
PROJECT SITE, NORTHWEST SIDE VIEW



EXISTING DEPOT, SOUTH SIDE VIEW



EXISTING DEPOT, EAST SIDE VIEW



PROJECT SITE, VIEW FROM THE FRONT ROAD

PROJECT SITE, EAST SIDE VIEW

PROJECT SITE, SOUTH SIDE VIEW

PROJECT SITE, WEST SIDE VIEW

3.3 Basic design

3.3.1 Basic design policies

As was discussed in the preceding sections, this project involves the construction of food grains storagehouses in Chambishi in Copperbelt Province, Masansa in Central Province, and Mtirizi in Eastern Province with capacities of 10,000 tons, 5,000 tons, and 4,000 tons respectively.

For the storagehouses, the following basic design guidelines are set in full consideration of the grain distribution system, the means of transportation, the cargo handling system, natural conditions, construction conditions, etc. in Zambia.

1) The storagehouses will be designed as far as possible economically and simply in consideration of the present state of food grain storagehouse in Zambia.

2) In consideration of the construction conditions in Zambia, the materials produced locally will be used as far as possible to facilitate the maintenance of the buildings.

3) The layout of buildings and facilities will be drawn up to facilitate grains to be carried in and out in full consideration of the siting requirements at each of the project sites. In principle, conveyors will be used to handle the cargoes in the storagehouse and the building will be designed to be most adequate according to this principle. Also the necessary conveyors will be included as a part of this project. The prerequisites to this construction project, such as the method of use for these conveyors, the method of stacking of grain bags, etc., are explained or proposed in the next section.

4) The building will have a tight structure to shut out such pests as birds, rats, etc. Also care will be taken so that the building has a sufficient natural ventilation. The walls and floor will be of such a structure as to shut out moisture as far as possible.

3.3.2 Storage and cargo handling plan

In principle, conveyors will be used to handle the cargoes. It is not planned to allow trucks to enter the building. Using trucks in the building would not only decrease the effective area, but also worsen the environment inside the building due to the mud brought in by the truck.

While the grain is carried in or out, the truck will be parked along the entrance. When a conveyor is installed in front of the entrance, it is planned to facilitate the cargo loading and unloading by installing a platform so that the conveyor top and the truck platform are almost on the same level. Also such a platform will be wide enough to allow the conveyor to be drawn out for the cargo handling near the entrance door. In principle, the cargoes will not be handled when it rains. To cover any eventuality, however, the platform will be equipped with a canopy.

(1) Conveyor system

Under this construction project, a combination of portable stacker and portable slat conveyors to meet the structure and scale of each storagehouse for cargo handling will be included.

The drawing attached hereto shows that it is possible to efficiently stack the bags which are carried into the building from a truck or a freight car by combining several conveyors according to the distance of conveyance.

The combination of conveyors has been set on the assumption that the bags are carried in from the sidetrack (freight) side only for Chambishi, and that they are carried in or out through either of the entrances on both sides of the building for Masansa and Mtirizi.

Meanwhile, the bags can be efficiently shipped by reversing the direction of rotation of the belts of the same combination of conveyors.

(2) Method of stacking

In Zambia, the maize bags are generally laid at the bottom all in the same direction, and then other maize bags are laid on them in an orthogonal direction, and so on. (This method of stacking is represented by and in the drawing attached hereto.) A stack which is made in this manner easily collapses.

Meanwhile, a stack which is made by combining 5 bags each (Tsugaru 5-gab stacking; represented by in the drawing) is stable and hardly ever collapses. Another merit of this method is that the number of bags can be accurately counted. In Zambia, this method of stacking is sometimes seen adopted for fertilizer, etc. For maize, however, the afore-mentioned method of stacking is adopted in most cases.

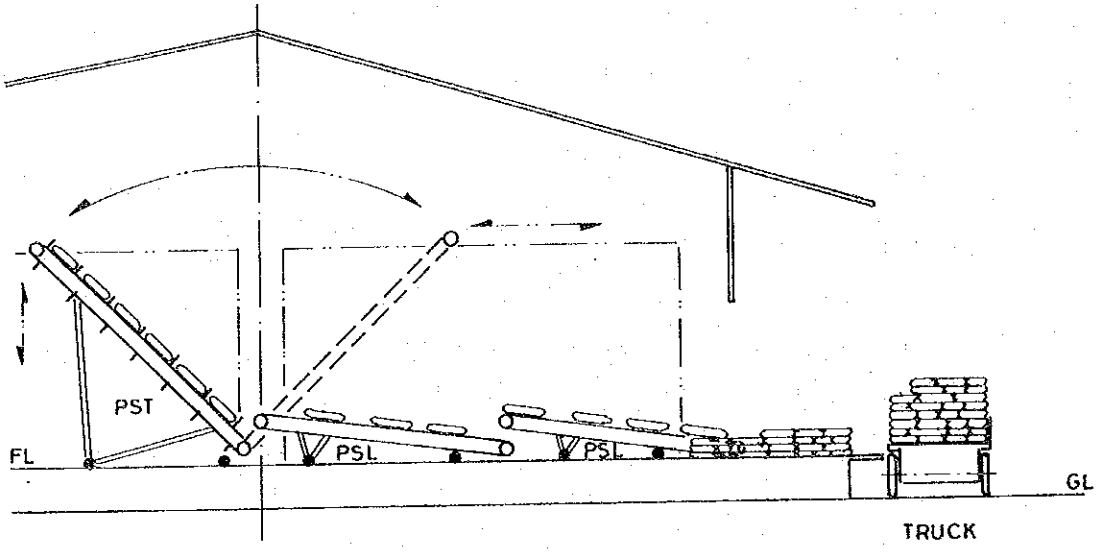
Unlike outdoor storage, the gap between the stacks and the inner walls of the building or between each stack is very small. It is necessary, therefore, to take considerations to prevent the stacks from collapsing both for the safety of workers and for the protection of the building walls.

It is ideal to stack all the bags in a building by the above-mentioned method of combining 5 bags each. To prevent the stacks from collapsing and to maintain safety, it seems necessary at least to adopt this method in stacking the bags at the four corners of each stack from the bottom to the top.

(3) Dunnage

In Zambia, the maize bags are traditionally stacked in a storage-house directly on the concrete floor without using dunnage. By this method, the maize in the gunny bags at the bottom directly absorbs moisture from the floor surface. Also condensation occurs due to the temperature difference between the floor and the underfloor. As a result, the quality of the maize at the bottom of the stack is often affected. To prevent this from happening, dunnage wood, pallets, plastic boards, etc. are usually laid. However, it seems hard to obtain such dunnage materials in Zambia. To prevent the afore-mentioned deterioration of quality, therefore, it is necessary

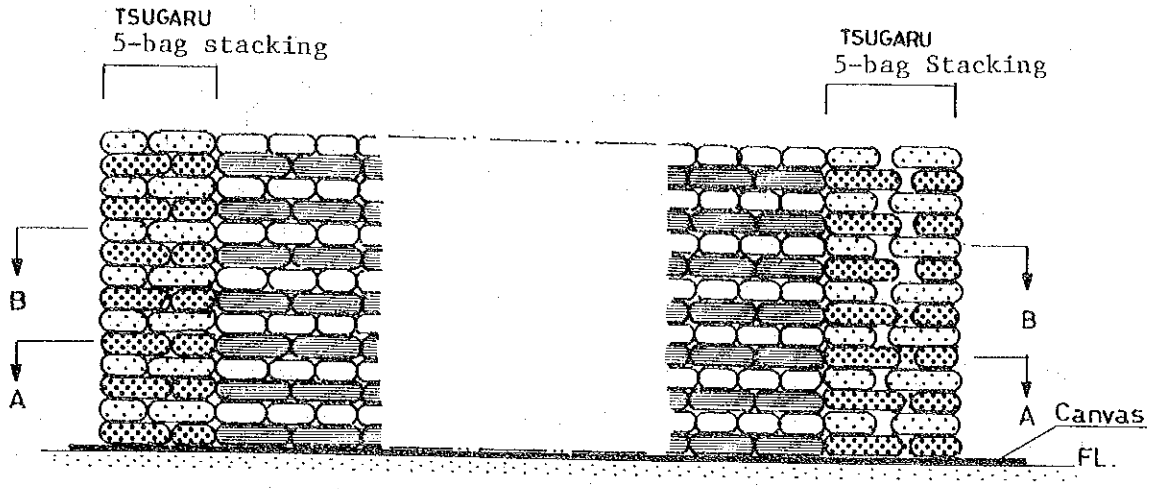
to stack the maize bags on waterproof tarpaulin sheets, which are generally used to cover the stacks.

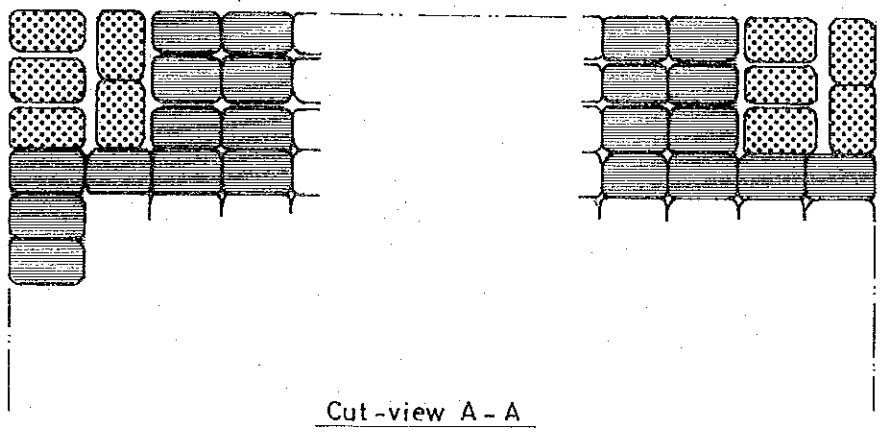


Location	Type of conveyor	Description	Q'ty
Chambishi	PST	8m, 2.2 kw	2
	PSL	7m, 1.5 kw	4
	PSL	6m, 1.5 kw	2
Masansa	PST	8m, 2.2 kw	1
	PSL	7m, 1.5 kw	2
Mtirizi	PST	8m, 2.2 kw	1
	PSL	7m, 1.5 kw	2

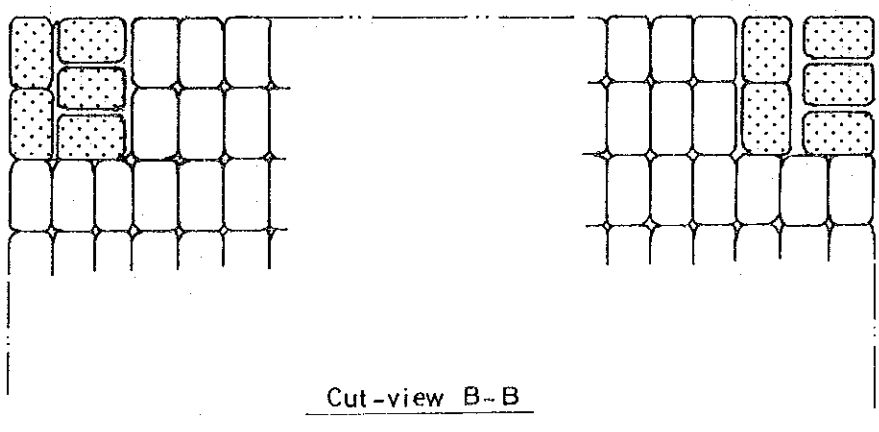
NOTE: PST ... Portable stacker conveyor
PSL ... Portable slat conveyor

METHOD AND DESCRIPTION OF STACKING SYSTEM



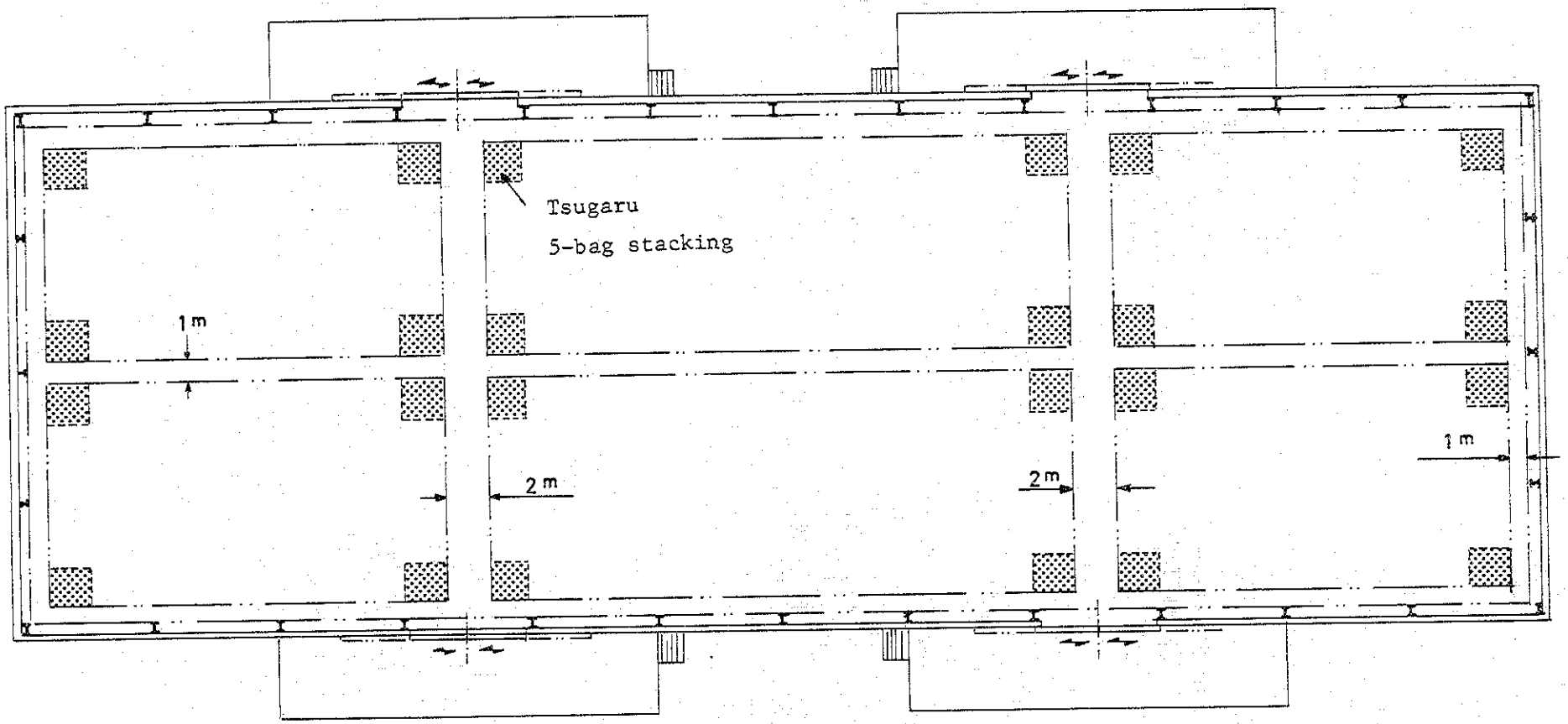


Cut-view A-A



Cut-view B-B

METHOD OF STACKING



FORM OF STACKING IN THE STORAGEHOUSE

(4) Building scales required for each storage capacity

Calculation requirements for building scales

1. Maize bag to be stored
   Size : 950 (L) x 570 (W) x 230 (H) (mm)
   Weight: 90 kg/bag

2. Method of stacking
   - The "Tsugaru 5-gab stacking" method will be adopted in the four corners. (See the drawing on p. 97 and 98). The old-numbered and even-numbered layers will have their own fixed directions.
   - Each stack will consist of 25 layers.

Estimation of scales

Area occupied by maize: 0.57 x 0.95 = 0.5415 m2/bag
Number of bags per unit area: 1/0.5145 = 1.84 bag/m^2
Storage volume per unit area in case of 25 layer stack:
1.84 bag/m^2 x 25 layer = 46 bag/m^2
46 bag/m^2 x 0.09 ton/bag = 4.14 ton/m^2

Assuming that, as a standard, the passage area accounts for 25% and the area which is exclusively for storage accounts for 75% respectively:

1) Building area of 10,000 ton capacity
   10,000 ton/4.14 ton/m^2 = 2.415.5 m^2
   2415.5m^2/0.75 = 3,220.67 m^2

2) Building area of 5,000 ton capacity
   5,000 ton/4.14 ton/m^2 = 1207.7 m^2
   1,207.7 m^2/0.75 = 1.610.25 m^2

3) Building area of 4,000-ton capacity

$4,000 \text{ ton}/4.14 \text{ ton}/m^2 = 966.18 \ m^2$

$966.18 \ m^2/0.75 = 1,288.24 \ m^2$

3.3.3 Facility plans

1) Site layout

(1) Chambishi (Copperbelt Province)

The project site which is adjacent to the existing depot, is about 2.8 ha in area. The existing depot has two railway sidetracks. The grain is carried into this depot by railway. These sidetracks will also be used to carry the grain into the storagehouses to be constructed. Of the two sidetracks, the one in the east will be extended and buildings will be allocated along it. It is planned that the grain will be carried in from the railway side and that it will be shipped from the opposite side by trucks. The site will be integrated with the existing depot. A new road from the highway will be constructed in the northwestern corner of the extended portion. In principle, the truck enters the site through the existing entrance, and leaves it along the new road after being loaded with the cargo in the storagehouses. To simplify the flow of traffic, the roads will generally be one-way.

The open area to the west of the building will be used as a parking space for trucks.

The existing depot has such annexes as an inspection room, an office, etc. Therefore, this project does not include offices, inspection rooms, etc.

A long building is subject to such structural restrictions as the installation of expansion joints which often causes rainleaks. To avoid this, two buildings have been planned.

Scale and contents of facilities

1) Scale

Area: 1,629.25 m^2 (24.5 m x 66.5 m)
Capacity: 5,000 tons
] x 2 buildings

2) Outdoor facilities and others

1. Extension of the railway sidetrack
2. Roads within yard
3. Side drainage ditches and seepage pits

(2) Masansa (Central Province)

The site which is adjacent to the existing NAMB depot, is mostly flat grassland with an area of about 4.95 ha and it will be integrated within the existing depot after completion.
One building with a capacity of 5,000 tons is planned to be constructed. It is so arranged that the major axis lies to the east and west to avoid the afternoon sun which heats up the building to an undersirable temperature. The grain can be carried in or out from either side of the longitudinal direction. Also a two-lane road is arranged around the building to give more free movement to the trucks. The trucks will enter and leave the site through the existing depot. The arrangement allows a new road to be constructed from the front road in the future.

Scale and contents of facilities

1) Scale

Area: 1,629.25 m^2 (24.5 m x 66.5 m)
Capacity: 5,000 tons

2) Outdoor facilities and others

1. Roads within yard
2. Side drainage ditches and seepage pits

(3) Mtirizi (Easter Province)

This storagehouse will be constructed inside the existing depot. This depot lies on a site which is a pentagon and which is

about 1.5 ha in area. It has such scattered buildings as a storage-house, a shed for equipment, offices, etc. and an open hardstanding. There are two vacant lots, one being located near the entrance and the other deepest end of the site. The one near the entrance will be used as a parking space for trucks or for wooden racks needed during an emergency. The building will be constructed on the vacant lot at the back. Similarly to Masansa, the grain will be able to be carried in or out from either side of the building. Since the site is small, however, the grain will be mainly carried in or out from the front side and the rear side will play an auxiliary role. Also a one-way road will be constructed around the building so that the trucks need not make U-turns. Thus considerations are taken to effectively utilize the small site.

Scale and contents of facilities

1) Scale

Area: 1,335.25 m^2 (24.5 m x 54.5 m)
Capacity: 4,000 tons

2) Outdoor facilities and others

1. Roads within yard
2. Side drainage ditches and seepage pits

2) Building Plan

(1) Storage and cargo handling plan

The structure of each building will be designed in consideration of the following points to achieve its functions.

(1) Sufficient ventilation to prevent excessive fluctuation in temperature
(2) Efficient cargo handling using conveyors
(3) Facilitated fumigation of tent

Openings are provided in the upper parts of the building side walls for sufficient natural ventilation. Also a branch path is provided, between the stacks, along the center of the building for ventilation and fumigation. For efficient cargo handling, a combination of portable stacker and portable slat conveyors is planned on the assumption that the grain is carried in from the sidetrack side (freight car) only for Cambishi, and that the grain is carried in or out through the entrances on both sides of the building for Masansa and Mtirizi. The main path is designed to be 2 m in width to allow conveyors to be installed. Meanwhile, the branch path width and the gap between the stack and the inner wall of the building is designed to be 1 m to allow workers to pass and the fumigation tent to be fixed.

For efficient cargo handling, the building has an elevated floor which is aligned with the truck or freight car platform.

All the buildings to be constructed have the same width in view of economy in construction. The capacity is adjusted by changing the length of the building. The building is 24.5 m in width. This is economically the optimum width for a building which has no columns inside. If the building interior is divided into two sections by a branch path along its center, as was mentioned earlier, the width of each stack becomes slightly over 10 m. Such a shape of the stack allows the cargo handling and fumigation to be conducted very efficiently.

(2) Building design

All of the buildings to be constructed in Chambishi, Masansa and Mtirizi have the same specifications. The capacity is adjusted by changing the length.

The building has an elevated floor which is about 1 m from the ground. This is not only convenient for cargo handling, but also effective in shutting out moisture from the underfloor.

For efficient cargo handling using conveyors, it is planned that two stacks are made across the center. Thus the transverse span becomes fairly large. Also it is impossible to install columns inside the building in view of cargo handling. Therefore, the building will be a steel structure which is suitable for a large span construction.

The building will have a simple gable roof in consideration of economy and of the prevention of rainleaks. For natural ventilation of the interior, continuous openings are provided under the eaves. These openings will be provided with bird nets to shut out birds and rats. The roofs will project over walls by a sufficient length to prevent rain water from entering the building.

The building interior cannot be lighted through the walls because of the stacked bags. Therefore,the roofs are provided with skylights. In this case, the illumination level is designed to be high enough for cargo handling, inspection, etc.

The exterior walls are made of bricks which are easy to obtain locally, to completely shut out moisture, heat and rain water. Also a moisture-proof sheet will be laid beneath the concrete.

3) Finishing

In view of the above principles, each section of the building will be finished as follows.

i) Roof

In consideration of the repairs to be made in the future, the roof will be slated with corrugated asbestos cement sheets which are easy to obtain locally. Also it will be provided with skylights of corrugated polyester sheets.

Corrugated asbestos cement sheet: Zambian Standard, ZS 004 Type B

ii) External wall: Locally produced brick masonry

iii) Floor

The floor is to be made of reinforced concrete and coated with a dustproof material in consideration of cleaning and dustproofness. Also expansion joints are provided at appropriate positions to prevent cracking due to thermal expansion or contraction and differential settlement.

iv) Entrance/Exit: Steel hanger door
H = 4,000 x W = 5,000

v) Opening: Steel bird net

vi) Foundation: Direct foundation of reinforced concrete

4) Structural design

The building to be constructed has a large span of about 25 m. It is impossible to install columns inside the building because of cargo handling. Due to such restrictions on the plan and due to the reason that a reinforced concrete structure, (which requires large amount of field work) is not suitable for this project in view of the limited construction period, a steel structure which requires less field work and which is suitable for a large span structure, is adopted.

The foundation will be designed according to the results of the soil investigation which is currently being conducted by the NAMB. Judging from the results of the visual inspection and from the condition of the existing buildings, it does not seem necessary to employ piling foundation, etc. Rather a direct foundation seems possible.

i) Design standatd, external forces and others

In Zambia, buildings are generally designed in conformity

to the British Standard (BS). In principle, the buildings to be constructed under this project are also designed in conformity to the BS.

The wind pressure is figured out in conformance to the BS, CP-3 Chapter V, Part 2 with the maximum value of 81.4 mph (36.3 m/sec) being taken as the basic wind speed on the assumption that the recurrence interval is 50 years from among the values shown in Appendix 7 attached hereto.

In Zamvia, the first seismograph was installed in Kabwe in 1959. Then in 1971, an observatory was set up in the Department of Physics of the University of Zambia. Records have been taken since then in various places.

According to the observation records which are shown in Appendix 7, there are earthquake belts along the borders with Tanzania and Malawi, in the zone from Lake Kariba to the Mozambique border and in the basin of the Kafue River. Except for the southwestern part of the country, earthquake motion is recorded in various places. All of the earthquakes which occur are small. Perusing the materials collected before the seismograph was installed, the maximum magnitude is about 6. Also the ground motion is about VI on the Modified Mercalli scale.

The soil is excellent at any of the project sites. Therefore, the horizontal seismic coefficient is assumed to be k = 0.05 on the basis of the Mercalli scale VII.

ii) Structural design

The main structure will be steel construction . The transverse structure will be rigid gable frames and the horizontal forces in the longitudinal direction will be transferred to the foundation through wall bracings. Meanwhile, the brick walls are supported by the steel structure against the horizontal forces.

iii) Foundation and floor

The foundation and the floor will be reinforced concrete construction and will be directly supported by the ground. The bearing capacity of subsoil which will be known by the result of the soil investigation, is expected to be at least about 10 ton/m^2. Therefore, the main column will have an independent footing and the brick walls will have strip footings respectively. The floor will be made of reinforced concrete slabs. Expansion joints will be provided against differential settlement in the future.

iv) Structural materials

As the structural materials, the following standard products will be used. The steel materials will be procured in Zambia except for those to be procured in Japan or in a third country.

Steel materials:	JIS SS41 or BS Grade 43 or equivalent
Reinforcements	:	to BS standard
Cement	:	Normal Portland cement which conforms to the Zambian Standard, ZS 001

5) Facility design

Handling of cargos is not done at night in Masansa and Mtirizi Depot where no utility power is available. Also the building interiors will not be illuminated. Lighting fixtures will be installed only inside the buildings in Chambishi Depot. For conveyors, electric power will be supplied in Chambishi Depot and receptacles will be provided at appropriate positions in the building. In Masansa and Mtirizi Depot, meanwhile, portable diesel engine generators will be used.

(1) Chambishi

i) Power receiving equipment

Electric power will be supplied to the receiving and transforming equipment to be installed at the site. The supply voltage will be 220 V. The power receiving and transforming equipment and the switchboard in the building will be connected by an underground cable. Each building will be equiped with a distribution board, through which the necessary motor and illumination powers will be supplied.

ii) Motor power equipment

A power source for conveyors will be installed at each entrance.

Portable stacker conveyor: 3-phase,
220V, 2.2 kW
50 c/s

Portable slat conveyor: 3-phase, 220V
1.5 kW, 50 c/s

iii) Lighting fixture and receptacles

The necessary lighting fixture and receptacles will be installed. Fluorescent lamps will be installed for illumination. Also protective nets will be provided.

(2) Masansa and Mtirizi

Portable diesel engine generator for conveyors

6) Outdoor facility

As was mentioned in 1) "site layout", in-site roads will be constructed for truck traffic at each project site. Since the ground is excellent, these roads will be no more than graveled. They will not be applied with special shoulder treatments such as curb-stones,

side ditches, etc. A U-ditch will be provided around the building to drain away rain water from the building. The water collected in this U-ditch will be discharged outside of the site through concrete pipe and will be drained by seepage.

The sectional areas of the U-ditch and of the concrete pipe are designed on the assumption that the intensity of rainfall is 60mm/hr. Meanwhile, the intensity of rainfall is assumed to be 135 mm/hr for a duration of 10 minutes for the eavesgutter. (See Appendix 7)

3.3.4 Equipment plan

The equipment to be attached to the storagehouses include cargo handling machines, dunnage, measuring instruments, inspection apparatuses, fumigation equipment, chemicals, etc. It has been decided to include the cargo handling machines, instruments and inspection apparatuses that are considered necessary to be introduced as the storagehouses which are to be constructed under this project. (See the lists below)

The conveyors which are currently installed at the depots at the project sites are not sufficient in number. Also many of them are not available due to breakdown, lack of parts, etc. Also the test apparatuses are not enough to sufficiently conduct the quality inspection. Furthermore, it was decided to include hand driven winnowers for efficient cleaning of the grain which drop from torn bags.

The test apparatuses will be included as one set which comprises the necessary instruments in appropriate numbers to allow sampling, moisture test, and the measurement of damaged grains and foreign matters, to be carried out accurately and quickly at each depot. The grain thermometer which is included in such a set, is used to measure the grain temperature as an index for quality control during long-term storage of maize.

The types and quantities of the equipment to be included are as follows.

(1) Chambishi

Portable stacker conveyor, 8 m	2
Portable slat conveyor, 7 m	4
Portable slat conveyor, 6 m	2
Hand cart	6
Hand drive winnower	4
Inspection apparatus	1 set

(2) Masansa

Portable stacker conveyor, 8 m	1
Portable slat conveyor, 7 m	2
Diesel engine generator	2
Hand cart	3
Hand drive winnower	2
Inspection apparatus	1 set

(3) Mtirizi

Portable stacker conveyor, 8 m	1
Portable slat conveyor, 7 m	2
Diesel engine generator	2
Hand cart	3
Hand drive winnower	2
Inspection apparatus	1 set

No utility power is available at the project sites in Masansa and Mtirizi. Therefore, diesel engine generators will be used to supply power to the portable conveyors at each of these sites.

One st of test apparatus comprises the following.

Moisture meter	2
Rough balance	1
Sieve for maize	3
Sample pan (large)	3
Sample pan (small)	50
Grain thermometer	5
Grain trier	3

3.3.5 Basic design drawings

(1) Chambishi

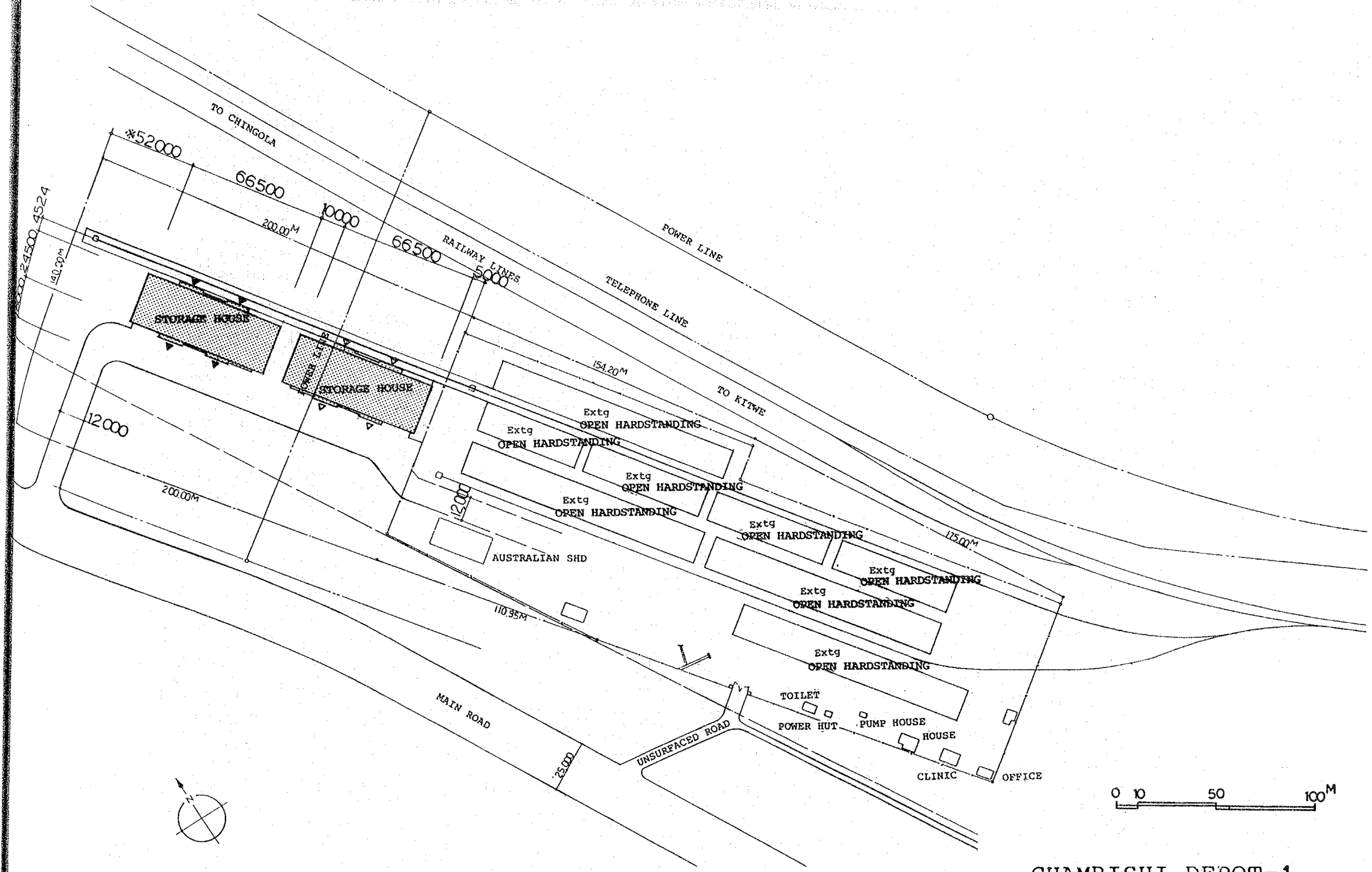
1. Site layout
2. Plan, elevation and section

(2) Masansa

1. Site layout
2. Plan, elevation and section

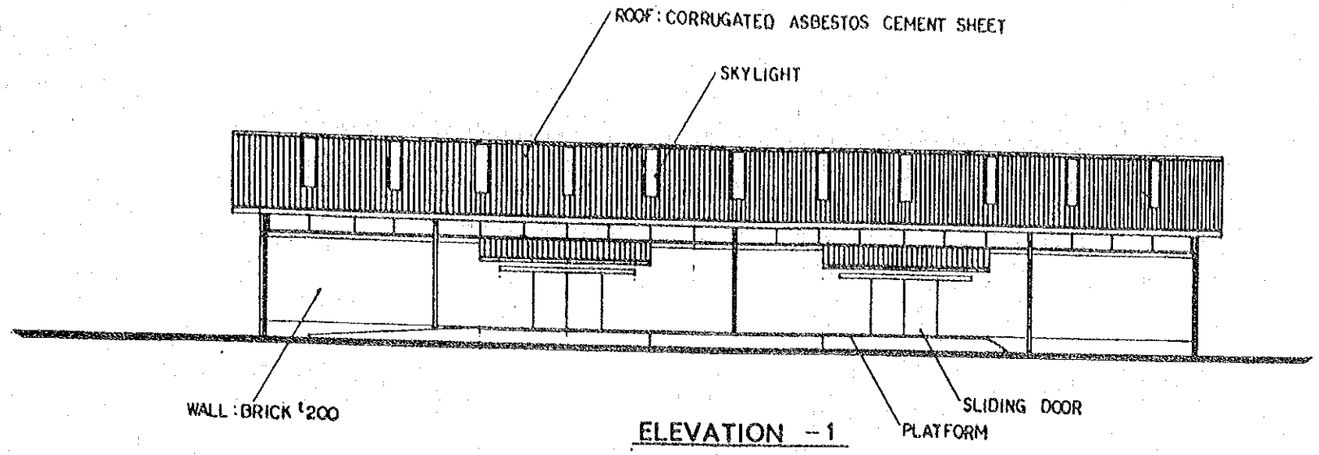
(3) Mtirizi

1. Site layout
2. Plan, elevation and section

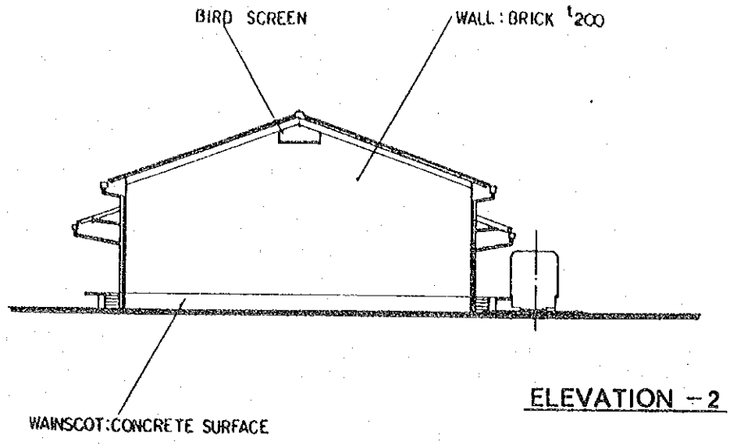


CHAMBISHI DEPOT-1

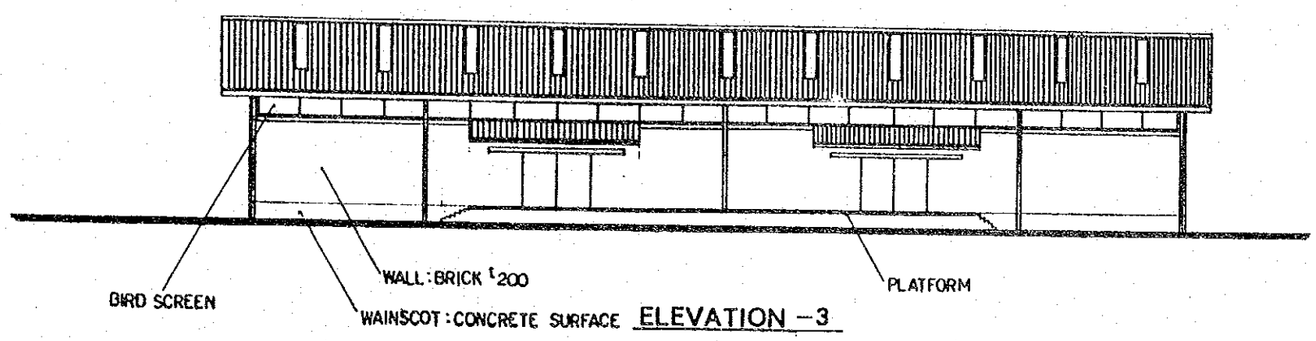
SITE LAYOUT



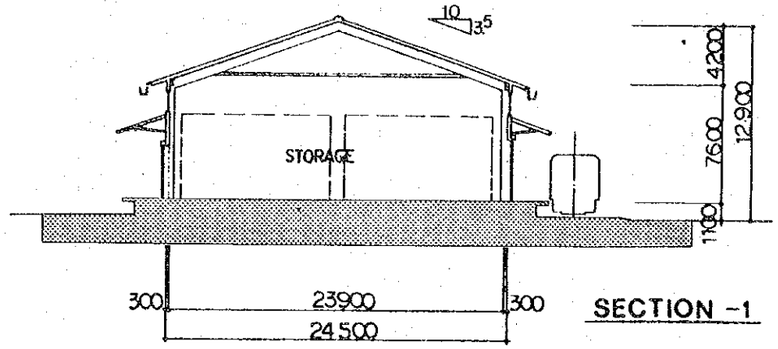
ELEVATION – 1



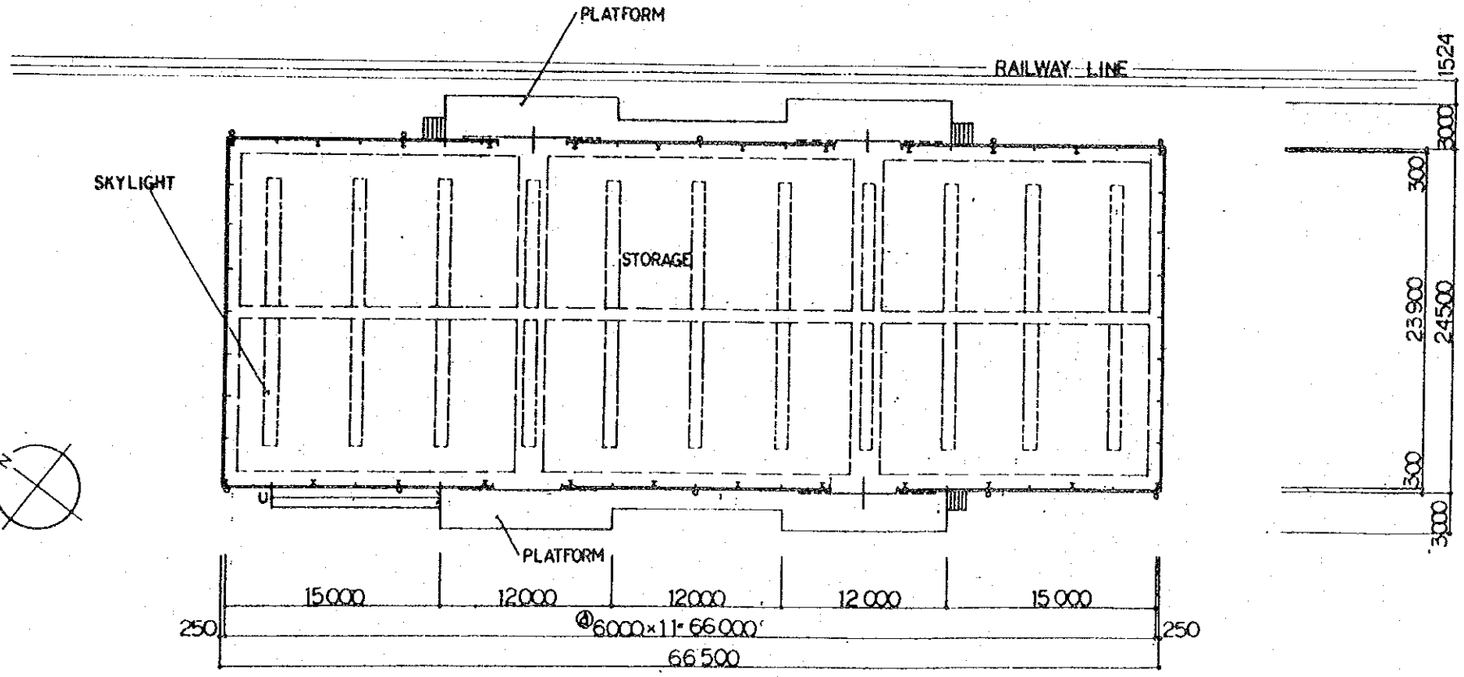
ELEVATION – 2



ELEVATION – 3



SECTION – 1

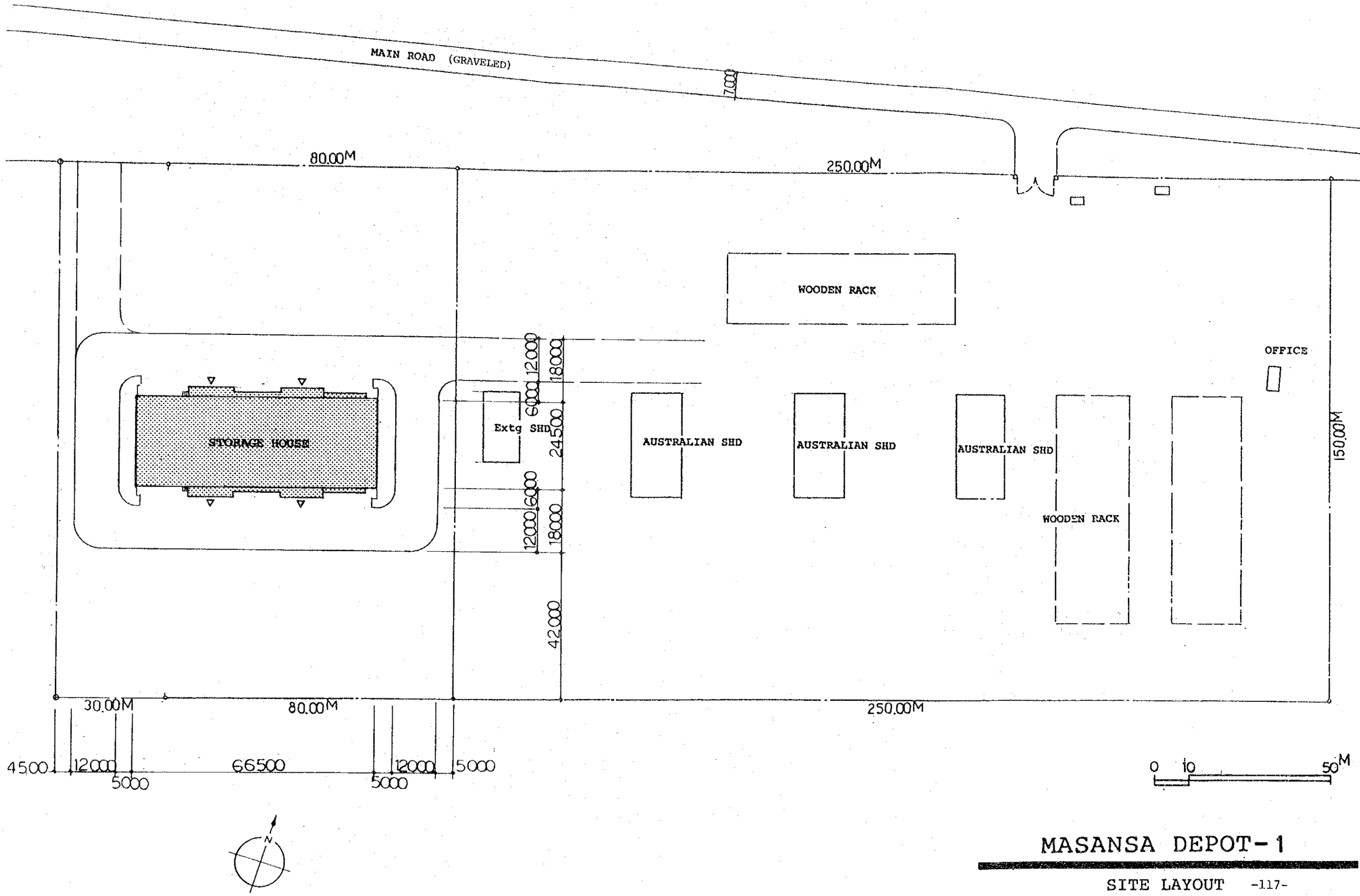


PLAN

0 5 10 20M

CHAMBISHI DEPOT-2

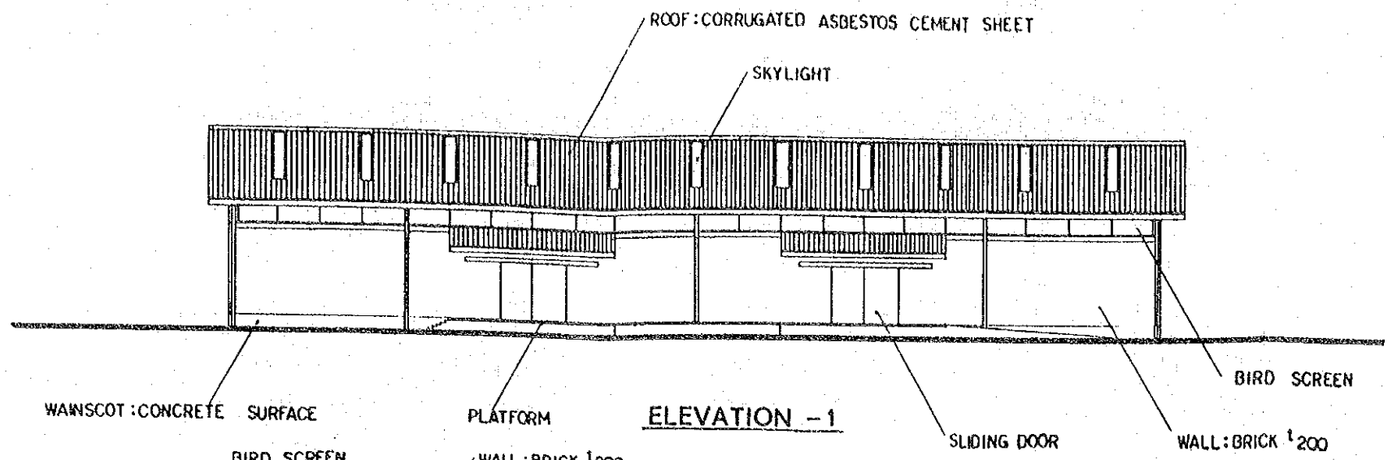
PLAN • ELEVATION • SECTION -115-



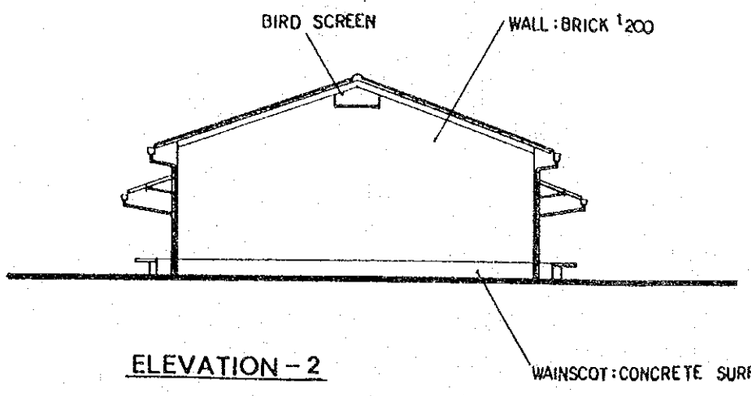
MASANSA DEPOT-1

SITE LAYOUT -117-

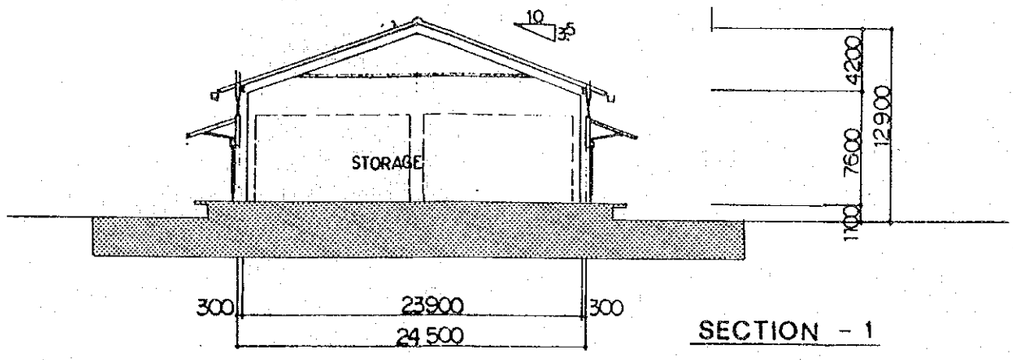
5



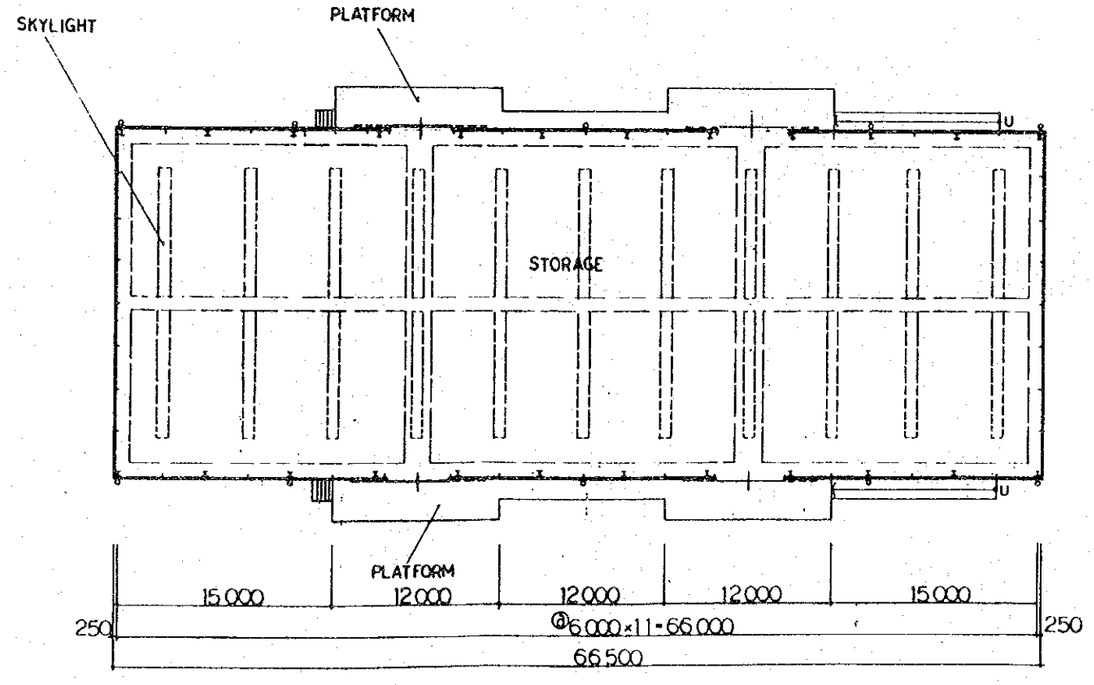
ELEVATION – 1



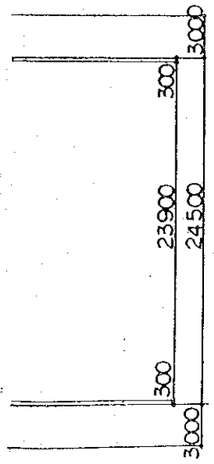
ELEVATION – 2

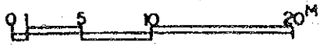


SECTION – 1



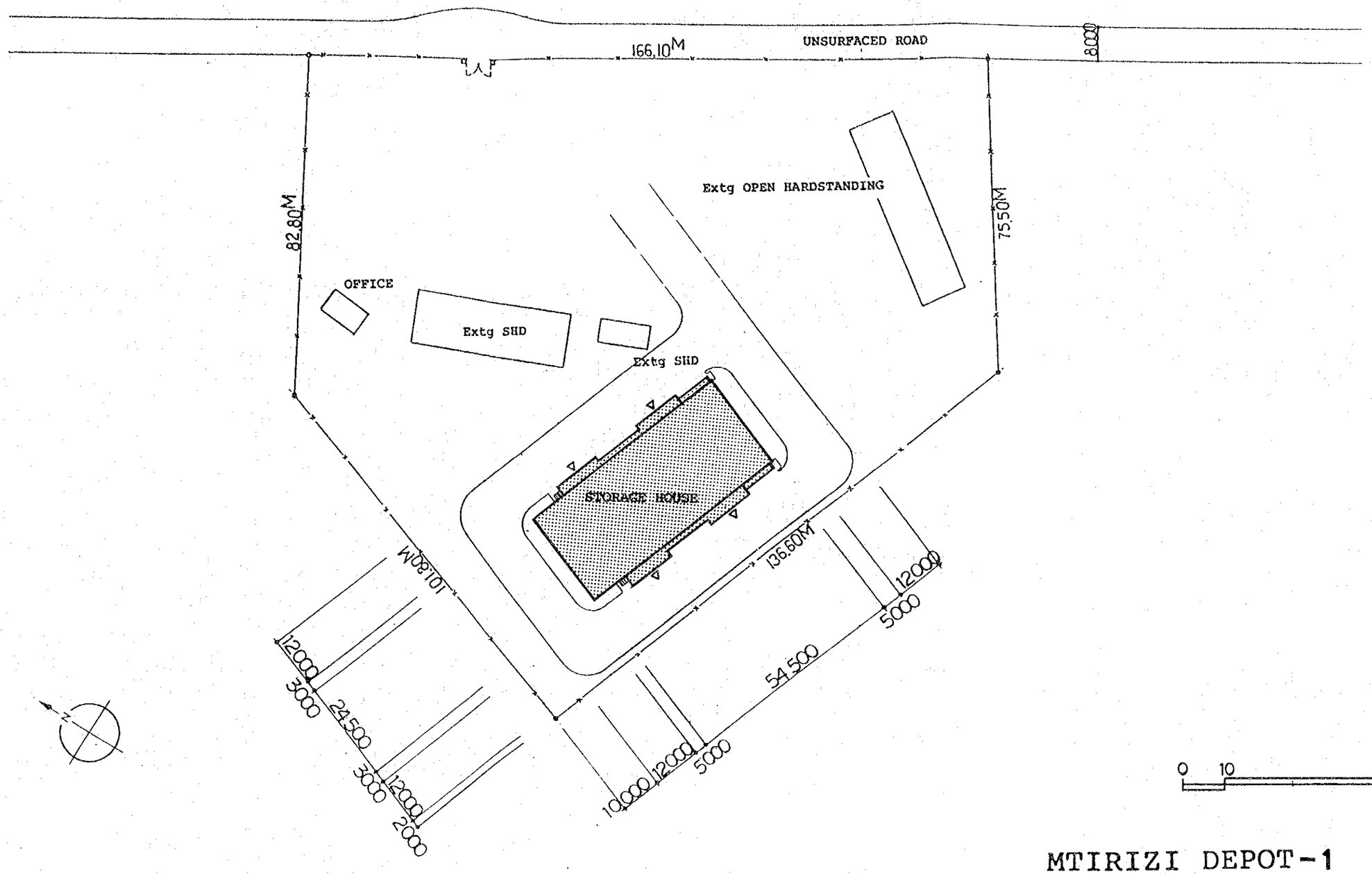
PLAN





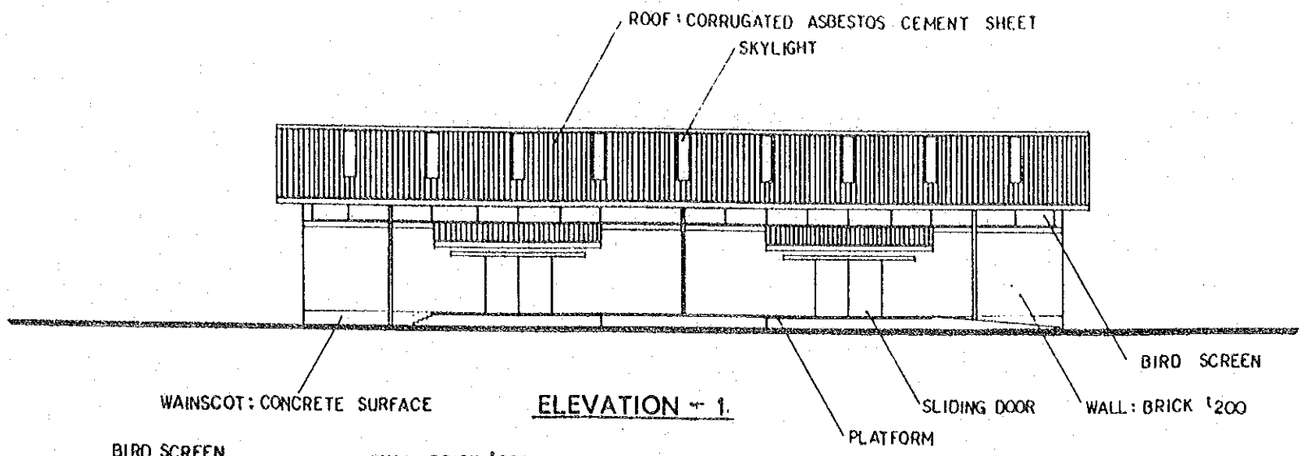
MASANSA DEPOT – 2

PLAN · ELEVATION · SECTION

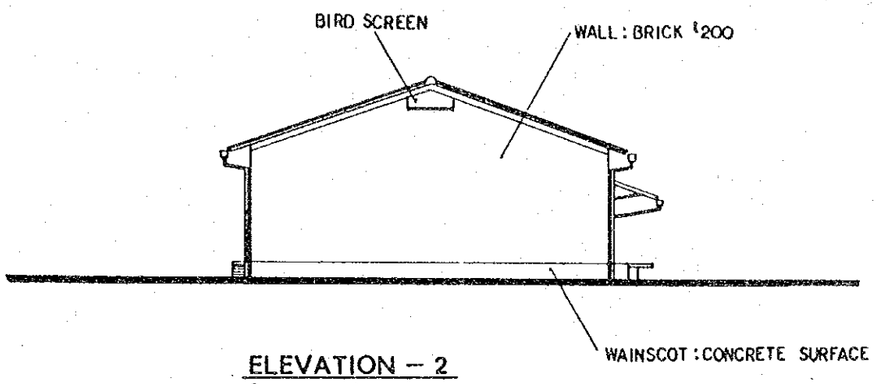


MTIRIZI DEPOT-1

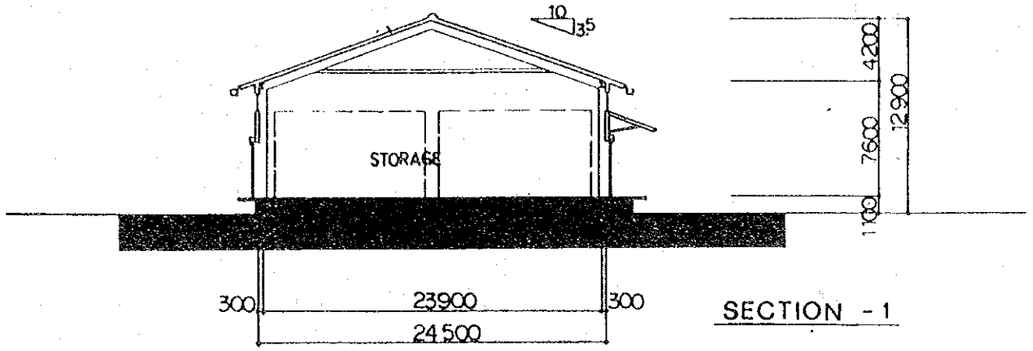
SITE LAYOUT -121-



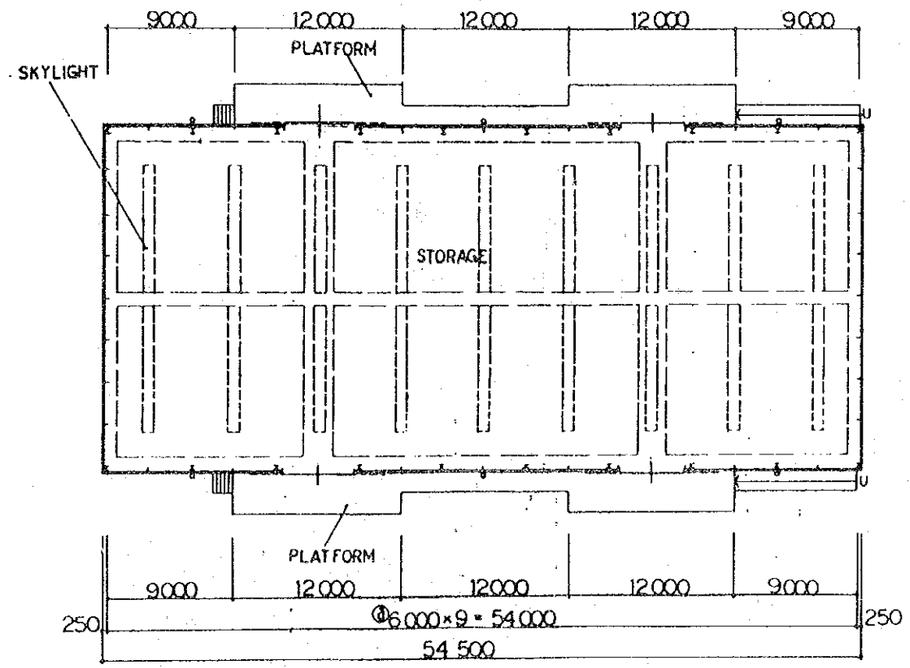
ELEVATION – 1



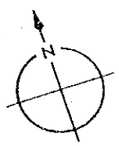
ELEVATION – 2

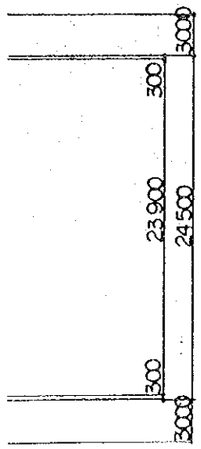


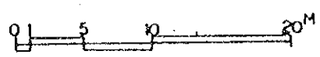
SECTION - 1



PLAN







MTIRIZI DEPOT – 2

PLAN · ELEVATION · SECTION

3.4 Outline of Costs

3.4.1 Estimation conditions

Most of the construction materials required for this project, such as gravel, sand, cement, reinforcements, bricks, corrugated asbestos cement sheets, etc., can be procured in Zambia. However, in Zambia, since steel materials are not manufactured and also steel structure fabricators are small, the steel structure will be procured in Japan or in a third country. Meanwhile, the large steel sliding doors manufactured in Zambia are poor in quality. Similarly to the steel structure, these will also be procured in Japan or in a third country. Such attached equipment as stacker conveyors, test apparatuses, etc. will be procured in Japan.

The estimation is based on the current exchange rates (May, 1984) of the U.S. dollar to the local currency (Kwacha) and to Japanese yen as follows

U.S. $ = 1.63 K
U.S. $ = 230 ¥

3.4.2 Scope of work

1) Items whose costs should be borne by the Government of Japan

   1. Construction of storagehouses including electric work

   2. Drainage system inside the site

   3. Roads inside the site and extension of railway sidetracks

   4. Cargo handling and grain inspection equipment

2) Items whose costs should be borne by the Government of Zambia

   1. Site preparation work including removal of trees, filling and land levelling.

2. Removal of the existing objects which become obstacles to the construction work, such as high voltage cables, underground pipes, etc.

3. Legal procedures required for the work

4. Gate-fence work

5. Leading-in of electricity up to the site boundary

6. Roads from public road to gate

7. Supply of electric power and water for the work

3.4.3 Estimation of cost to be borne by the Government of Zambia

Cost to be borne by the government of Zambia — Total — 47,000,000 Yen

Details

Item \ Project site	Chambishi	Masansa	Mtirizi
1. Site preparation including removal of existing objects	33,000,000	3,000,000	——
2. Construction of gates and fences	3,500,000	2,000,000	600,000
3. Construction of roads	1,200,000	——	——
4. Leading-in of electricity and supply water	500,000	——	——
5. Relocation of high-voltage cable	3,200,000	——	——
Total	41,400,000	5,000,000	600,000
Grand Total			47,000,000

CHAPTER 4
ORGANIZATION FOR IMPLEMENTATION OF PROJECT

Chapter 4. ORGANIZATION FOR IMPLEMENTATION OF PROJECT

4.1 Principal Undertakings

4.1.1 Operation organization

All of the storagehouses to be constructed under this project are at the existing NAMB depots. In principle, therefore, they will be operated by the present staff of each depot. The existing depots in production areas are being operated by the Cooperative Marketing Unions of each district under the NAMB's control, while all of those in consumption areas are being operated by the NAMB. The conpositions of these staffs at each depot are shown below. The storagehouses to be constructed, being a part of each depot, are considered to be manageable by the present staff along with the existing facilities.

4.1.2 Personnel training and assignment plan

The storagehouses to be constructed have been designed to be sufficiently manageable by the present staff. It is judged, therefore, that neither training nor assignment of the new personnel is particularly necessary.

4.1.3 Staff composition at existing depots

Chambishi Depot

Assistant branch manager	1 person
Senior operation clerk	1 person
Senior sales clerk	1 person
Senior purchase clerk	1 person
Sales clerk	1 person
Purchasing/receiving clerk	1 person
Assistant personnel officer	1 person
Engineering assistant	1 person
Secretary	1 person
Officer orderly	2 persons
Checker	5 persons

Labourer;	Foreman	2 persons
	Labourer	52 persons
Gateman		1 person
Total		71 persons

Masansa Depot

Manager		1 person
Grain checker		1 person
Sales clerk		1 person
Deposit clerk		1 person
Checker		2 persons
Labourer;	Foreman	1 person
	Machine operator	1 person
	Labourer	51 persons
Checker dispatched by the NAMB		2 persons
Total		61 persons

4.2 Construction Plan

The storagehouses under this project will be undertaken by the one who was selected by tender from among several companies of Japanese nationality with abundant experience in overseas works and sufficient capability to see the project through to its completion.

In Zambia, there are a considerable number of constructors with a considerable working capability who have been nurtured since it was under the British reign. As local subcontractors, those who are the most appropriate for this project will be selected by the Japanese constructor from among them.

In consideration of the siting requirements for the construction sites and of the conditions for maintenance after start-up, locally produced construction materials and local construction methods will be used as far as possible to enable the Zambian side to procure necessary materials and to carry out the work locally during repairs.

For the large and heavy main steel structure and the large steel doors at the entrance both of which were adopted in consideration of the efficient utilization of the storagehouses, meanwhile, the fabrication capability of the Zambia manufacturers is somewhat inferior. Also all of the steel materials that are used in Zambia are imported. As a result, the price of these steel structures comprises the domestic fabrication cost and price of the materials including transportation costs, importing costs, customs, etc. There is no big difference with respect of price, therefore, even if the steel structure is fabricated and transported from Japan or a third country. It will be advantageous, therefore, to procure the main steel structures and entrance doors, which do not require much care except painting once constructed, in Japan or a third country. These, if procured in a third country, will be somewhat inferior to the Japanese products in the accuracy, finish, etc. They are expected to have sufficient structural strength, however. For this project, which involves comparatively simple structures, it will be advantageous to procure them in a third country in view of the whole process in consideration of the transportation condition from Japan to Zambia (it is said to take 3 months for the cargo to reach the construction site after it is shipped from the specified port in Japan).

In Zambia, the rainy season lasts from December to March and there is a considerable amount of rainfall in this season, when drawing up the construction schedule, carring out outdoor work and transportation of large quantity of materials and particulary, such work which involves earth, as earth works, foundation works, etc., in consideration of soil which mainly consist of laterite, should be avoided as far as possible in this season.

Meanwhile, the production areas in Zambia of those materials which can be used in permanent buildings are limited. In this project, which involves the construction sites being scattered at three locations with their respective conditions, the points will include the transportation in Zambia of domestically produced materials and securing of skilled laborers as well as the adjustment of the timing of carrying in the materials to be procured in a third country.

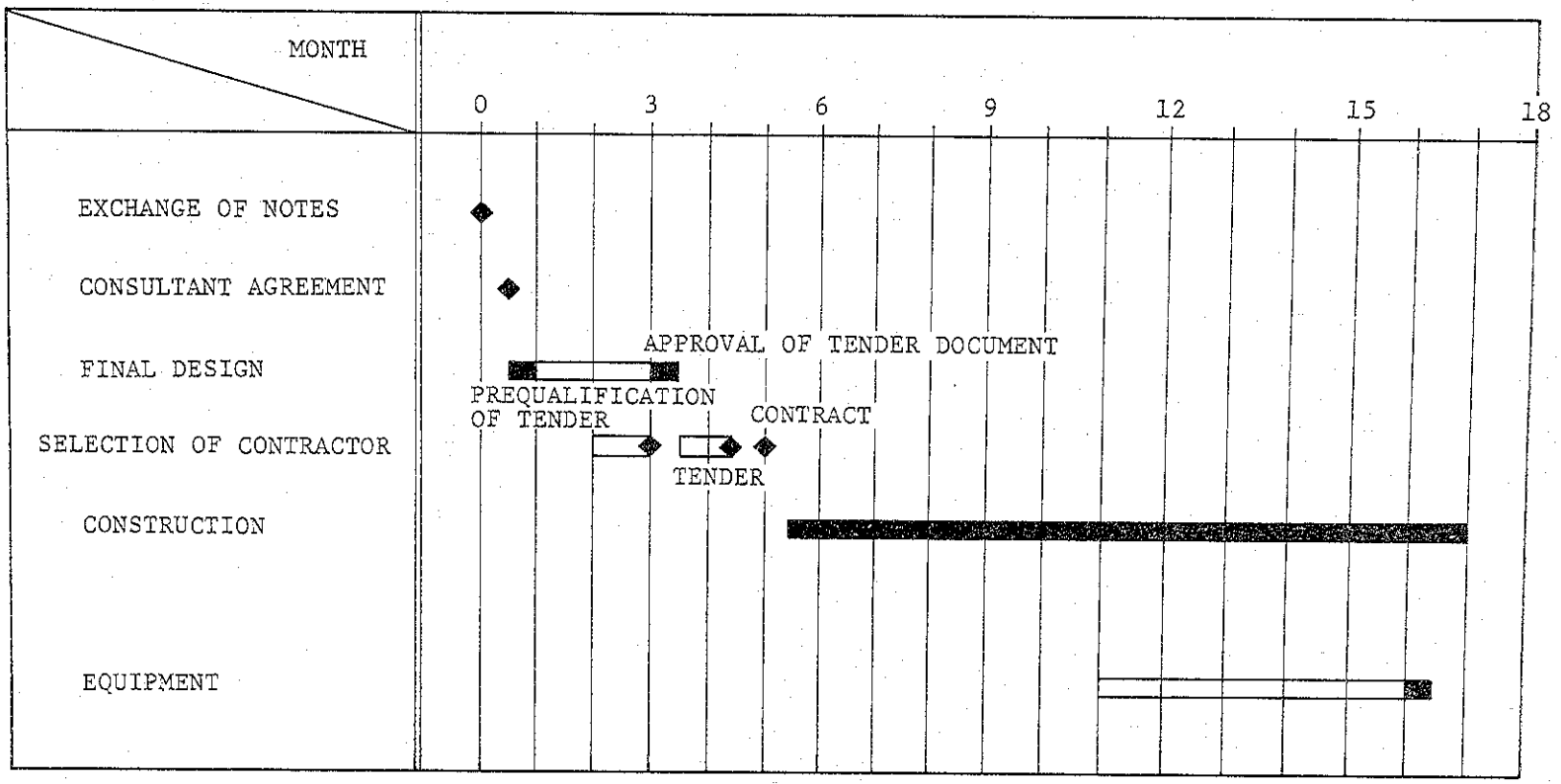
4.3 Scope of Work

The scope of work to be undertaken by the Japanese side and the Zambian side are specified in 3.4.2. "Scope of Work". From among the works which the Zambian side is responsible for, the site preparation work including the removal of existing objects such as high-voltage cables, etc. and the leading-in work of electricity, supply water and telephone lines should be over before the start of any construction work by the Japanese side, while the construction of gates and fences and of roads between the public road and the gate should be carried out before start of use after the completion of the construction work by the Japanese side.

4.4 Work Schedule

The detail of the work for the construction of the food grain storage-houses are illustrated in the following chart.

WORK SCHEDULE



NOTE: WORK IN JAPAN

WORK IN ZAMBIA

CHAPTER 5
EVALUATION OF PROJECT

Chapter 5. EVALUATION OF PROJECT

This project involves the construction of storagehouses for maize, which is the major marketed grain in Zambia, in such depots where most of crops has traditionally been stored outdoors, as the depot in Chambishi, the center of Copperbelt Province, the largest consumption area in the country; Masansa, the major shipping area in Central Province, the major maize producing area; and Mtirizi in Eastern Province, where the maize production has been rapidly increasing in recent years. This project also forms a part of the construction plan of food grain storagehouses which was drawn up by the Government of Zambia to reduce as far as possible the losses caused during grain distribution and which has been implemented under the assistance of foreign countries.

This is expected not only to reduce losses both in quality and quantity during storage but also to contribute to the compilation of a more flexible transportation plan. These storagehouses to be constructed which have a structure for smooth cargo handling and for appropriate lighting and ventilation by using brick walls to shut out moisture and heat and by installing bird nets and eliminating gaps from the entrance doors to shut out rats and other pests, will become a model for similar projects in the future.

Maize which is the staple food in Zambia, should be supplied on a stable basis in good quality and under good sanitary conditions. At present, however, quality inspections are not sufficiently conducted due to the lack of test apparatuses. It is believed that the cargo handling equipment and test apparatuses to be included as a part of this project will contribute to the improvement in the quality of maize together with the construction of storagehouses.

Quality control should be carried out throughout the distribution stage from harvesting by the farmer to the ultimate consumer. This project is expected to give an impact to the improvement in the quality of the marketed food grains in Zambia.

CHAPTER 6
CONCLUSION AND RECOMMENDATIONS

Chapter 6. CONCLUSION AND RECOMMENDATIONS

As was mentioned earlier, the food grains in Zambia has traditionally been stored by being piled up outdoors on open hard-standings or wooden racks. As a result, there have been big losses in both quality and quantity. It is impossible to change this habit in a day so that all the grains in distribution are stored in storagehouses. Rather it should be implemented under an elaborate plan which accurately forecasts the production, distribution and consumption amounts in the future. Naturally, this project plays a part in such a scheme. At present the Government of the Republic of Zambia is vigorously promoting the construction of food grain storagehouses under the assistance of foreign countries or international organizations. Under such circumstances, it is necessary to draw up a construction plan for food grain storagehouses which takes the future into account on a nation-wide basis and to implement it efficiently.

At the moment, Canada, which is giving Zambia the most assistance in constructing storagehouses mainly for maize, has been constructing storagehouses for maize at 1 location in Lusaka Province, 2 locations in Central Province, 6 locations in Eastern Province, 3 locations in Northern Province, 2 locations in Western Province, 2 locations in Northwestern Province and 1 location each in Southern and Luapula Provinces respectively. From the above-mentioned point of view, Chambishi in Copperbelt Province, Masansa in Central Province and Mtirizi in Eastern Province were selected from among the 7 sites that were proposed by the Government of Zambia to avoid the constructing of storagehouses at the locations covered by Canada. Such a selection is the most appropriate in view of the distribution condition of maize on a nation-wide scale. Also the study team conducted the study in collaboration with the EC which has a similar assistance program.

The study team proposes that the Government of Zambia in incorporate such considerations in its long-term unification plan.

As was discussed in the item on Serenje in Central Province which was not included in the project, the necessity for storagehouses and their construction sites are inseparable from the means of transportation. Therefore, the study team also proposes to consider the improvement in the transportation conditions at the end of the grains distribution network, such as the improvement in roads on the farmer's level, securing of a sufficient number of trucks, etc.

The storagehouse to be constructed under this project cannot cover the whole volume while the grain collection is at its peak. Rather they cover the maximum storage volume in the rainy season. It is necessary, therefore, to draw up the collection and shipment plans to eliminate outdoor storage in the rainy season by also using the existing facilities. Meanwhile, test apparatuses will be included as a part of this project. None of these apparatuses is hard to handle. It will become possible to supply food grains of good quality, if sufficient quality control is carried out by using them appropriately.

Finally the study team wishes that the new storagehouses will be fully utilized and that they will greatly contribute to the improvement in the grain distribution in Zambia.

APPENDIX

APPENDIX 1

MINUTES OF DISCUSSIONS

ON

THE CONSTRUCTION PROJECT OF FOOD GRAIN STORAGEHOUSES, THE REPUBLIC OF ZAMBIA

In response to the request by the Government of the Republic of Zambia for assistance in constructing Food Grain Storaghouses (hereinafter referred to as "The Project), the Government of Japan has sent through the Japan International Cooperation Agency (JICA) a study Team headed by Mr. Mitsui MATSUZU, Assistant Director, second Economic Cooperation Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, to conduct the Basic Design Study on the Project from May 15th to June 5th, 1984.

The team held a series of discussions and exchanged views with the relevant Authorities of the Government of the Republic of Zambia. As a result of the study and discussions, both parties have agreed to recommend to their respective Governments to examine the result of the survey attached herewith toward the realization of the Project.

MAY, 28th 1984.

M. Matsuzu

MISTUI MATSUZU
TEAM LEADER
JICA STUDY TEAM

Chabwera

GEORGE G. CHABWERA
GENERAL MANAGER
NAMBOARD

ANNEX I

Required Arrangements to be undertaken by the Government of the Republic of Zambia.

1. To secure land necessary for the construction of the facilities and to clear, fill and level the site as needed before the start of construction.

2. To provide facilities for distribution of electricity, telephone water supply and drainage and other incidental facilities outside the building.

3. To construct and prepare the access road to the Project site.

4. To ensure prompt unloading, tax exemption and customs clearance at ports of disembarkation in Zambia and prompt internal transportation therein of construction materials and equipment purchased under the grant.

4. To exempt Japanese nationals engaged in the Project from custom duties, internal taxes and other fiscal levies which may be imposed in Zambia with respect to the supply of the products and related training equipment and the services under the verified contracts.

6. To accord without delay to Japanese nationals whose services may be required in connection with the Project under the verified contracts such facilities as may be necessary for their entry into Zambia and their stay therein for the performance of their work.

7. To maintain and use properly and effectively the facilities constructed and equipment purchased under the grant aid.

8. To bear all the expenses, other than those to be borne by the grant, necessary for the construction of the facilities.

9. To undertake incidental civil works such as planting and fencing, if needed.

10. To provide the space necessary for such construction as temporary offices, working areas, stock yards and others.

11. To ensure that temporary electric power and water supply are made available for the construction and incidental activities relative to the Project.

ATTACHMENTS

1. The objective of the Project is to provide Food Grain Storagehouse with appropriate storage capacity and equipment for the National Agricultural Marketing Board (Namboard).

2. Realization that most of marketed crops are stored on open hardstanding (concrete slab platform without wall and roof) or merely on the flat ground at the proposed sites surveyed, the Japanese study team is convinced that the construction of storagehouse at certain proposed sites will bring about the remarkable effects in improving the grain distribution in the region and in minimising the post harvest losses.

3. In view of the above, the Japanese Study Team will convey the request of the Government of the Republic of Zambia to the Government of Japan that the latter will extend Grant Aid for the construction of Food Grain Storagehouses within the scope of the Japanese economic cooperation in Grant Form.

4. The Japanese Study Team is assured of the justification and of the effects to construct the storagehouses at Chambeshi and Masansa as a result of the recent survey on the maize distribution condition, peripheral environments and others, within the scope of the Japanese economic cooperation in grant form.

5. The optimum layout, scale and capacity, and structure will be formulated in Japan after analizing collected data and information, and it will be proposed in the Basic Design Study Report.

6. Equipment when deemed necessary for the operation of storagehouse will be taken up under the grant aid.

7. In view of the maize distribution condition in Serenje region, and peripheral environments of the proposed site, it is of the team's opinion that the justification of the construction of storagehouse at Serenje is not convincing for the grant aid.

8. Construction of storagehouse at Mtirize will be subject to the outcome of the survey to be done.

9. The Government of the Republic of Zambia will undertake the necessary measures listed in Annex I on condition that the grant aid by the Government of Japan is extended to the Project.

10. Both sides have confirmed that the Japanese Study Team explained Japan's Grant Aid Programme and that the Zambian side has understood it.

APPENDIX 2

MEMBERS OF THE STUDY TEAM

Mr. Mitsui MATSUZU	Team Leader	Assistant Director, Second Economic Cooperation Division, Economic Cooperation Bureau, Ministry of Foreign Affairs
Mr. Jun RISSEN	Food Grain Marketing	Assistant Director, Research Division, Food Agency, Ministry of Agriculture, Forestry & Fisheries
Mr. Takeshi KOMORI	Project Coordinator	Basic Design Division, Grant Aid Department, JICA
Mr. Akira TAKAHASHI	Chief Engineer	DAIKEN Architects & Engineers
Mr. Junichi NEGORO	Architectural Planner	"
Mr. Toshio KIMURA	Architectural Designer	"
Mr. Seiichiro HAYAKAWA	Food Grain Marketing	Overseas Merchandise Inspection Co., Ltd.

APPENDIX 3 List of Officials Concerned

1. Officials of the Government of Zambia Concerned

a. National Commision for Development Planning (NCDP)

Mr. W. Lufafa	Acting Permanent Secretary
Mr. L. C. Soko	Economist

b. Ministry of Agriculture and Water Development

Mr. Ne Mumba	Director of Agriculture

c. National Agricultural Marketing Board (NAMB)

Mr. G. G. Chabwera	General Manager
Mr. S. H. Zimba	Grains Marketing Manager
Mr. J. M. Chirwa	Chief Grains Marketing Officer
Mr. K. C. Nsokolo	Engineering Assistant

2. Embassy of Japan

Mr. Masatoshi Ota	Ambassador
Mr. Yosuke Yoshinaka	Counsellor
Mr. Yasufumi Kotake	Second Secretary
Mr. Mitsuo Ogura	Attache

3. EC

Mr. Muller	Head of desk, Southern Africa
Mr. Gyselinck	Desk Officer, in charge of Zambia
Mr. Kendall	Desk Officer, in charge of Coordination, Cofinancing

4. Delegation of The Commision of European Community in Zambia

Mr. Loher	Agricultural Advisor
Mr. Thompson	Technical Advisor

APPENDIX 4

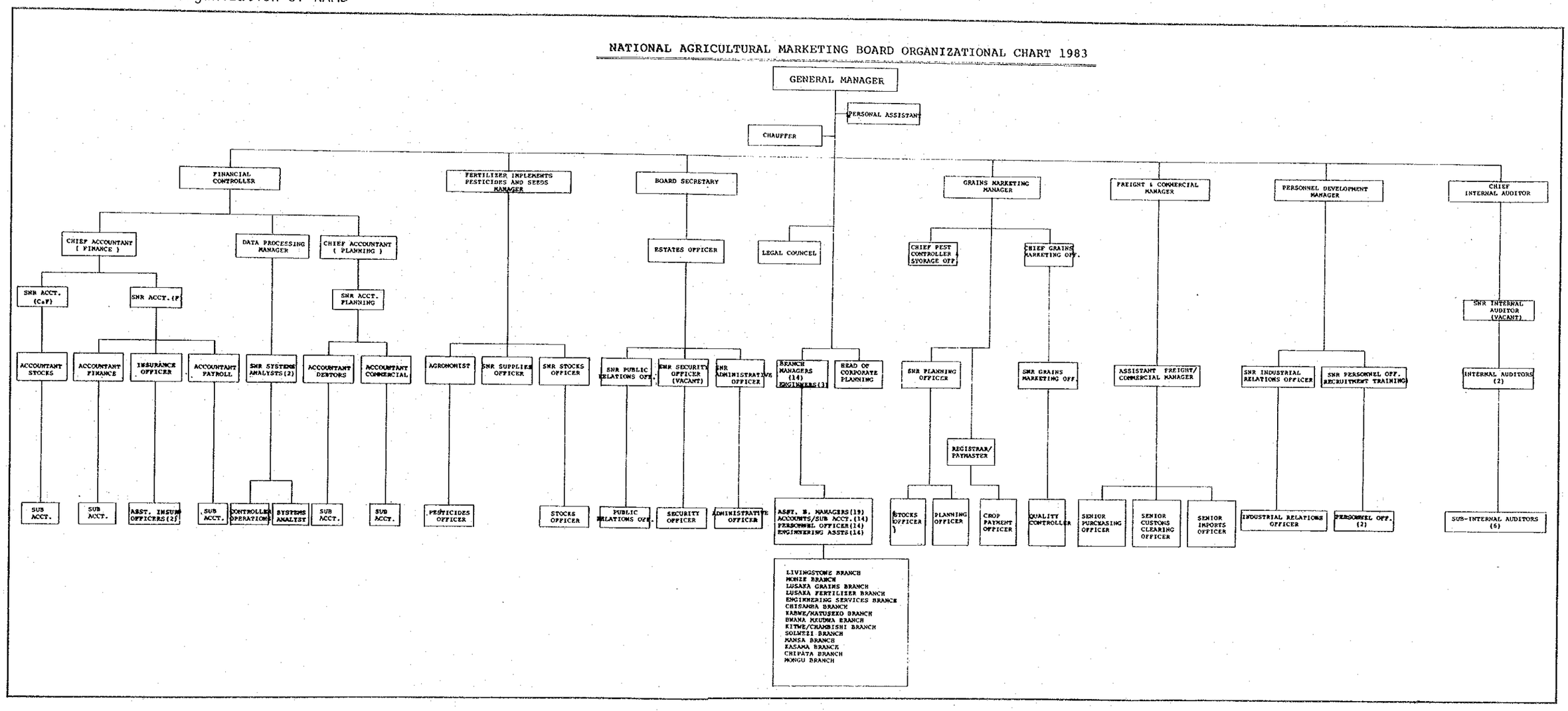
Schedule of Basic Design Study

Date	Day	Activity	
		Representatives of Government	Numbers of Consultant
5/13	Sun		Departure from Tokyo.
5/14	Mon		Arrival in and departure from London.
5/15	Tue		Arrival in Lusaka. Visit to Embassy of Japan. Visit to NAMB and explanation of purpose and schedule of survey.
5/16	Wed	Departure from Tokyo	Visit to NAMB and meeting. Visit to Engineering Dept. of NAMB and meeting.
5/17	Thu	Arrival in Brussels Visit to EC and meeting	Visit to NAMB Office and Cooperative Marketing Union in Kabwe for collection of information. Field survey of Masansa site.
5/18	Fri	Visit to EC. Departure from Brussels.	Visit to Kapri Mposhi Depot. Field survey of Serenje site.
5/19	Sat	Arrival in Lusaka	Visit to NAMB Office and Cooperative Marketing Union in Kabwe.
5/20	Sun	Meeting within the study team.	
5/21	Mon	Visit to Embassy of Japan. Visit and survey of CIDA's storagehouses in Lusaka. Visit to EC and exchange of viewes. Visit to NAMB and MAWD.	
5/22	Tue	Meeting with the officials of NAMB.	
5/23	Wed	Departure from Lusaka and Arrival in Kitwe, visiting NAMB Office in Ndola on the way.	
5/24	Thu	Field survey of Chambishi site. Departure from Chambishi and arrival in Lusaka.	
5/25	Fri	Visit and survey of EC's storagehouses for fertilizer in Shibuyunje.	

5/26	Sat	Analysis of findings. Meeting within the study team.	
5/27	Sun	Visit to the construction site of the Veterinary School of the University of Zambia under Japanese grant-aid. Visit to the Pediatric Hospital constructed by Japanese grant-aid.	
5/28	Mon	Visit to NCDP. Meeting with the officials of NAMB. Signing of the Minutes of Meeting. Visit to EC.	
5/29	Tue	Meeting within the team. Departure from Lusaka.	Same as left.
5/30	Wed	Arrival in Brussels. Visit to EC.	Visit to the Pest Control Office of NAMB and collection of information. Visit to a consulting engineers and request soil investigation of the sites.
5/31	Thu	Departure from Brussels.	Visit to Geological School of the University of Zambia to obtain data. Visit to EC.
6/1	Fri	Arrival in Tokyo.	Visit to a quantity surveyor.
6/2	Sat		Departure from Lusaka. Field survey of Mtirizi site. Arrival in Petauke.
6/3	Sun		Collection of information from Petauke Office of NAMB. Departure from Petauke and arrival in Lusaka.
6/4	Mon		Visit to the quantity surveyor. Visit and survey of a asbestos cement sheet factory and a steel structure fabricator.
6/5	Tue		Visit to NAMB. Visit to Embassy of Japan. Departure from Lusaka.

6/6	Wed		Arrival in Paris.
6/7	Thu		Departure from Paris.
6/8	Fri		Arrival in Tokyo.

APPENDIX 5. Organization of NAMB



APPENDIX 6 Stelected Statistical Data

SELECTED INDICATORS
(ANNUAL AND QUARTERLY FIGURES)

	Unit	1975	1976	1977	1978	1979	1980‡‡	1981	1982	1983	1983 Quarter I	II	III
1 Population (Mid-year est)	million	4.89	5.04	5.20	5.36	5.52	5.68‡‡	5 87	6.05	...	...	..	...
2. Gross Domestic Product													
At current purchasers' values ...	K.million	1,583 7	1,895.8	1,970.5	2,239.5	2,647.4	3,012.6	3,448.6	3,563.7	42,056	...	..	...
At 1970 purchasers' values‡ ...	K'million	1,435.5	1,519.4	1,446.5	1,483.5	1,369.9	1,417.8	1,484.0	1,453.7	1,476.5	...	..	...
At 1970 purchaser's values ...	K'million	1,048.3	1,067.7	983.8	1,004.7	10.33.0	1,045.0	1,106.2	960.6	1,045.9	...	..	...
Per Capita Gross Domestic Product													
At current prices	Kwacha	324	376-	379	418	479	530	588	589	674	...	..	...
At 1970 prices‡	Kwacha	293	301	278	277	248	250	253	240	236	...	..	...
At 1970 prices (Adjusted for terms of trade)	Kwacha	214	212	189	188	187	184	88	159	168	...	..	...
4. National Income													
At current market prices	K'million	1,269.1	1,522.0	1,577.4	1,809.1	2,156.1	2,404.0	2,916.6	2,881.3	3,456.9	...	..	...
At 1970 market prices	K'million	1,245.3	1,327.8	1,280.9	1,325.6	1,229.6	1,267.9	1,367.8	1,237.9	1,359.2	...	..	...
5. Per Capita National Income													
At curren. prices	Kwacha	259	302	304	338	390	423	497	477	554	...	...	...
At 1970 prices‡ ...	Kwacha	253	263	246	248	224	223	233	219	218	...	..	...
At 1970 prices	Kwacha	175	174	157	158	162	157	169	138	148	...	..	...
6 Copper production exports, price													
Production	'000 tonnes	640.3	712.9	659 8	655 6	584.8	610.2	560.6	584.5	..	151.3	142.7	147.8
Exports	'000 tonnes	641.2	745.7	666.6	589.4	651.1	621.7	551.8	628.0	...	...	..	...
LME Cash and Settlement Price per ton	Kwacha	794	1,00.7	1,01.6	1,090	1,572	1,719	1514	1374	..	1856	2035	...
7. Index of Production													
Mineral Production	1973—100	94.5	103.1	96.2	95.4	86.1	89.2	82.0	86.0	..	89.5	85.9	...
Manufacturing	1973—100	105.5	101.6	98.5	102 6	96.2	99.2	104.9	99.3	..	103.1	98.6	...
Electricity	1973—100	191.0	222.8	265.0	240.7	268.4	280.7	293.8	321.9	..	305.2	314.9	...
8 External Trade													
Exports	K'million	521.1	751 9	708 0	686 8	1,090.0	1,023.3	936.5	...	...	...	..	...
Imports	K'million	597.6	468.7	530.0	492.6	593.7	876.7	881.0	...	...	...	..	...
9. Prices													
Index Numbers of Consumer Prices													
High Income	1975—100	100.0	116.1	136 8	152 6	169 8	189.4	209.1	236.6	...	261.9	277.0	284.8
Low Income	1975—100	100 0	118.8	142.3	165 5	181.6	202.9	231.3	260.2	...	290.1	306.3	318.6
Index Numbers of Wholesale Price													
Including Copper	1966—100	147.0	175.7	211.6	246.4	306.2	334.3	352.1	375.5	...	429.5	458.8	486 8
Excluding Copper	1966—100	189.7	222.3	276 9	333 7	398.6	439.2	487.5	541.9	...	598.4	649.8	677.0
10. Employment and Earnings													
Number o employees as on 31st December													
Zambian	'000	361	341	344	343	351	359	355*	350†	...	...	..	...
Non-Zambian	'000	32	28	26	23	23	20	19*	17†	...	...	..	...
Total	'000	394	369	370	367	374	379	373*	368†	...	...	..	...
Average annual earnings													
Zambian	Kwacha	1,381	1 478	1,565	1,740	1,657	2,301	...	...	...	...	..	...
Non-Zambian	Kwacha	6,799	6,858	7,086	6,887	6,122	8,715	...	...	...	...	..	...
11. Government Finance													
Receipts	K'million	618	747	638	686	856	1174	1220	1191	...	225	187	179
Payments	K'million	855	936	821	815	956	1658	1389	1643	...	232	251	286
12. Money Supply	K'million	353	399	418	410	551	555	599	727	827	670	691	766

*30th June, 1981.
†30th June, 1982.
‡1980 Census of Population and Housing.
‡‡adjusted for changes in terms of trade

Source: Monthly Digest of Statistics, issued by Central Statistical Office

POPULATION BY PROVINCES AND URBAN AND RURAL AREAS

	1980 census	1974 Sample Census Final Results	1969 Census	1963 Census	1969-1980 Average annual growth rate (%)	1969-1974 Average annual growth rate (%)	1963-1969 Average annual growth rate (%)
Total Zambia	5,679,808	4,677,000	4,056,995	3,490,170*	3.1	2.9	2.5
Provinces:							
Central	513,835	397,000	358,655	309,407	3.3	2.1	2.5
Copperbelt	1,248,888	1,046,000	816,309	543,465	3.9	5.1	7.0
Eastern	656,381	570,000	509,515	479,866	2.3	2.3	1.0
Luapula	412,798	321,000	335,584	357,018	1.9	—0.9	—1.0
Lusaka	693,878	522,000	353,975	195,757	6.3	8.1	10.4
Northern	677,894	584,000	545,096	563,995	2.0	1.4	—0.6
North-Western ...	301,677	242,000	231,733	211,189	2.4	0.8	1.6
Southern	686,469	534,000	496,041	466,327	3.0	1.5	1.0
Western	487,988	460,000	410,087	362,480	1.6	2.3	2.1
Large Urban Areas:							
Chililabombwe ...	61,928	56,000	44,862	34,165	3.0	4.7	4.6
Chingola	145,869	134,000	103,292	59,517	3.2	5.3	9.6
Kabwe	143,635	99,000	65,974	39,522	7.3	8.4	8.9
Kalulushi	59,213	41,000	32,272	21,303	5.7	4.7	7.2
Kitwe	314,794	251,000	199,798	123,027	4.2	4.6	8.4
Livingstone	71,987	58,000	45,243	33,026	4.3	5.0	5.4
Luanshya	132,164	121,000	96,282	75,332	2.9	4.6	4.2
Lusaka	538,469	401,000	262,425	123,146	6.8	8.9	13.4
Mufulira	149,778	136,000	107,802	80,609	3.0	4.7	5.0
Ndola	282,439	229,000	159,786	92,691	5.3	7.4	9.5
Total Urban (including small urban areas) ...	2,440,419	1,663,000	1,192,116	715,020	6.7	6.9	8.9
Total Rural	3,239,389	3,014,000	2,864,879	2,774,484	1.1	1.0	0.5
Percentage Urban ...	43.0	35.6	29.4	20.5			

*Includes 666 railway travellers.

Source: Monthly Digest of Statistics

APPENDIX 7 Meteorological Data

Table 5.1 : AVERAGE WIND SPEEDS IN ZAMBIA

	Wind Speed in Knots				
	January	April	July	October	Annual
Chipata	2.9	4.1	4.9	6.4	4.5
Kabwe	3.6	5.4	6.1	7.1	5.2
Kasama	4.3	4.7	6.2	6.3	5.6
Livingstone	3.2	3.0	3.5	4.2	3.5
Lusaka	3.9	6.0	7.0	7.9	6.1
Mansa	2.3	3.4	4.2	3.8	3.6
Mongu	4.3	4.9	6.5	5.4	5.1
Ndola	3.1	4.0	5.2	5.4	4.4
Solwezi	1.5	1.7	2.0	1.1	1.7

Source: Climate Data for Architects in Zambia, Peter Hutchinson, Occasional Study No. 8, July 1976

Table 5.3 ANNUAL EXTREME WIND GUSTS (m.p.h.) FOR SELECTED RECURRENCE INTERVALS

Recurrence Inter Interval (years)	2	10	25	50	100
Probability of Occurence	.50	.10	.04	.02	.01
Kabwe	51.0	65.1	71.0	81.4	89.0
Kasama	49.0	61.0	68.5	74.6	81.0
Livingstone	49.0	56.6	61.0	64.2	68.0
Lusaka	43.5	52.3	57.0	61.6	65.5
Mongu	50.4	71.4	76.0	79.3	81.5
Ndola	41.4	51.5	57.8	62.7	68.2

Source: Climate Data for Architects in Zambia

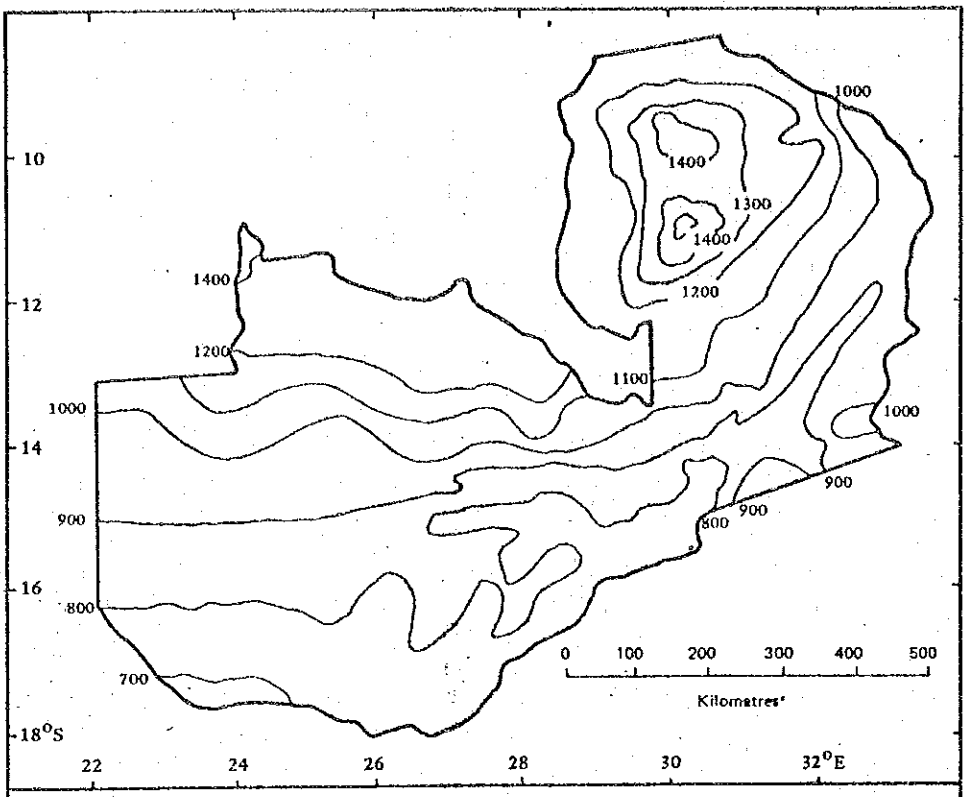


Fig. 4.1 *Mean Annual Rainfall (Millimetres).*

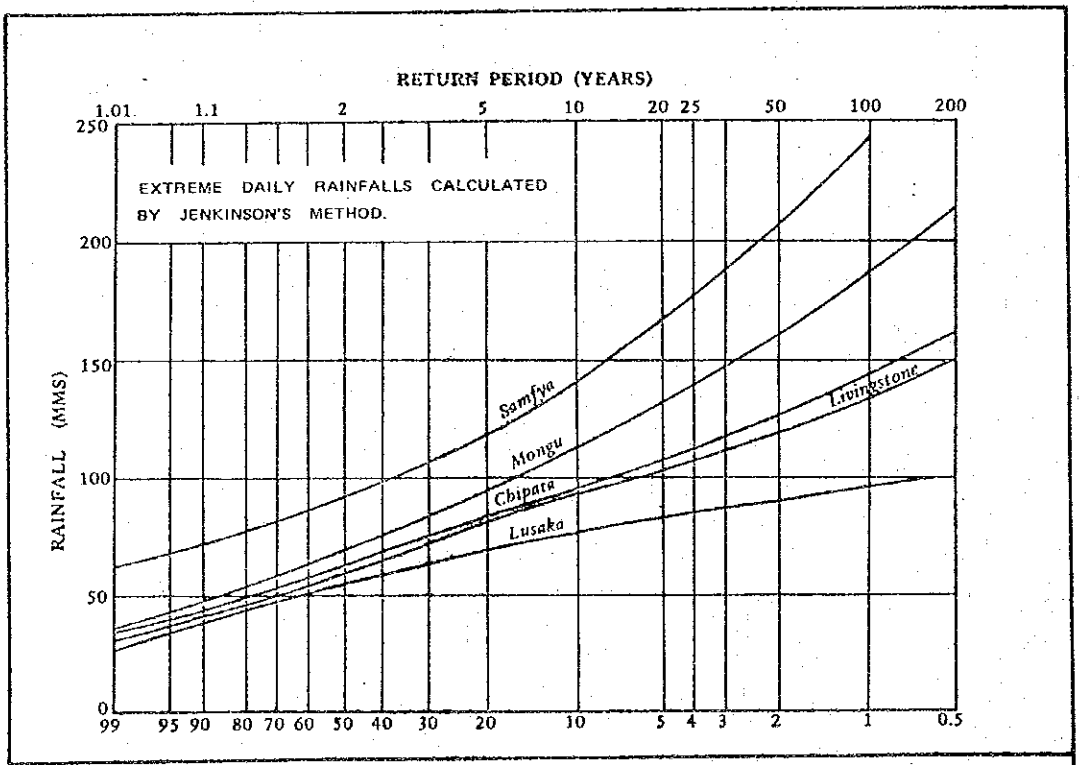


Fig. 4.2 *Percentage Probability for Exceedance in any one year for daily rainfall.*

Source: Climate Data for Architects in Zambia

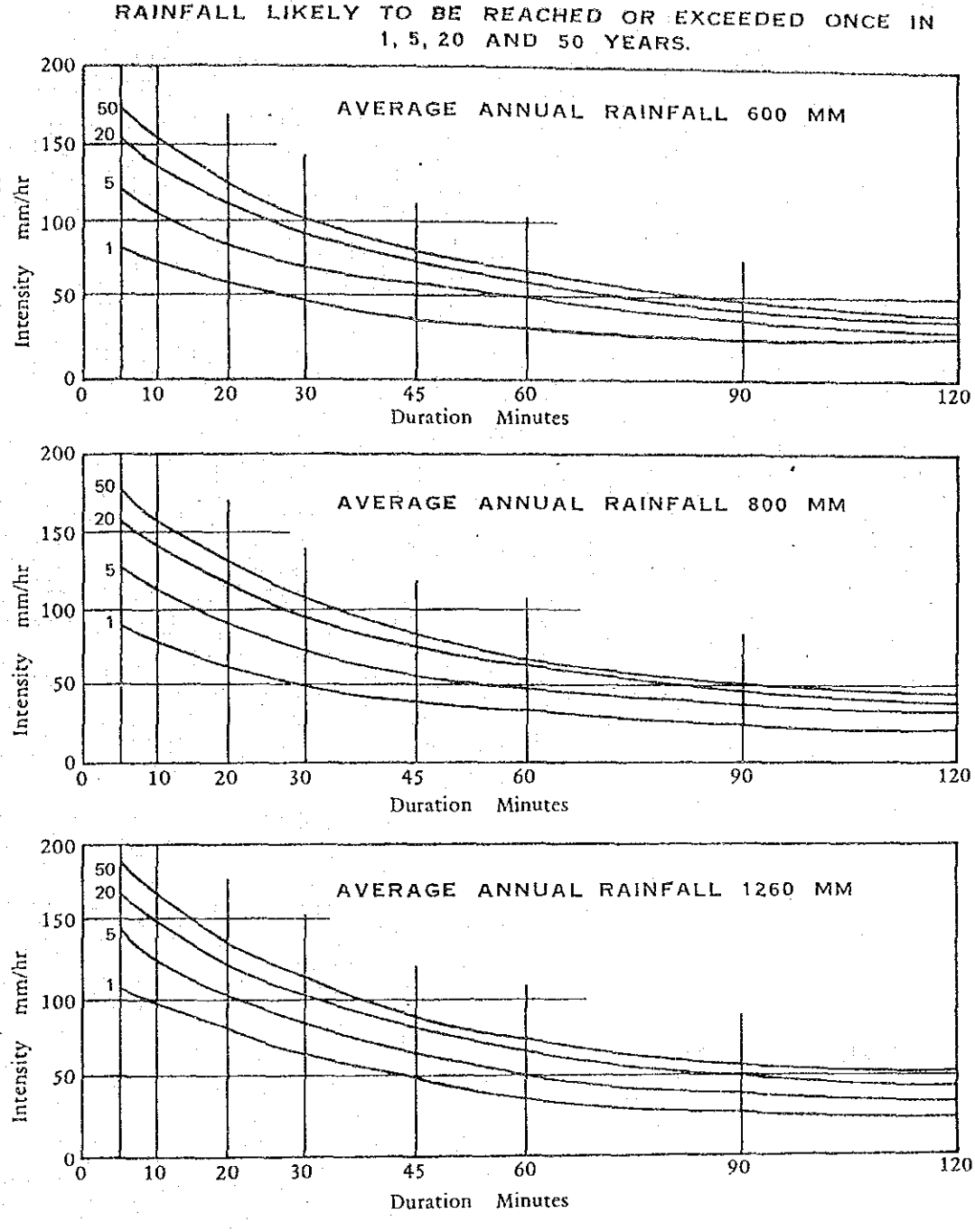


Fig. 4.3 *Rainfall intensity duration curves for Zambia.*

Source: Climate Data for Architects in Zambia

Table IV.I: RAINFALL PATTERN FROM VARIOUS AREAS OF ZAMBIA (MILLIMETRES)

Province	Station	Line	October total	November Decade I	November Decade II	November Decade III	November Total	December Decade I	December Decade II	December Decade III	December Total	January Decade I	January Decade II	January Decade III	January Total	February Decade I	February Decade II	February Decade III	February Total	Grand total
Control	Kabwe	a	20	21	30	46	97	67	86	88	241	87	89	80	256	71	63	55	189	803
		b	0	0	5	13	18	3	21	38	62	80	111	93	284	88	111	29	228	592
		c	26	2	23	175	200	75	41	5	121	23	69	165	257	136	45	0	181	785
	Serenje	a	11	30	45	63	138	82	101	96	297	81	96	82	239	98	105	87	290	957
		b	1	0	6	79	85	32	21	68	121	127	131	145	403	71	129	80	280	890
		c	11	12	41	140	193	59	87	20	165	47	74	176	297	–	–	–	–	–
Copperbelt	Ndola	a	18	28	42	60	130	79	98	102	297	102	106	98	306	89	81	73	243	976
		b	7	2	38	117	157	23	5	37	65	124	90	57	271	110	123	148	281	781
		c	27	7	34	80	121	85	102	39	226	32	72	210	314	73	69	0	142	830
Enstorn	Chipata	a	0	18	30	44	92	59	75	81	215	83	89	85	257	83	79	69	231	795
		b	14	0	0	17	17	40	0	53	93	34	104	59	197	103	42	33	178	499
		c	19	1	32	89	122	71	166	27	264	73	74	61	208	65	51	0	116	729
	Lundazi	a	8	13	19	33	65	51	68	72	191	71	75	72	218	69	66	61	196	678
		b	0	0	6	30	36	32	5	106	143	28	67	69	186	44	40	54	138	503
		c	52	3	37	60	100	30	47	30	107	81	67	80	228	133	124	22	279	766
Luapula	Mansa	a	37	40	56	71	167	85	100	97	282	89	86	81	256	77	72	68	217	959
		b	15	20	5	49	74	35	32	56	123	98	72	17	189	126	63	51	240	639
		c	126	62	90	86	238	99	78	116	293	53	50	122	225	67	152	0	219	1101
	Kawambwa	a	76	48	61	69	178	75	82	79	236	73	76	68	211	66	65	69	200	901
		b	71	9	9	37	55	168	75	100	343	37	90	127	254	17	49	19	85	808
		c	97	10	111	172	293	88	182	95	365	66	48	115	229	67	38	76	181	1165
LUSAKA	Lusaka	a	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	(International airport)	b	0	0	7	110	117	0	17	16	33	167	158	108	433	–	–	–	–	–
		c	74	1	0	118	119	107	45	20	172	33	31	154	218	–	–	–	–	–
Northern	Mpika	a	5	19	29	46	94	64	83	88	235	91	96	89	276	81	74	69	224	834
		b	49	0	0	114	114	40	7	0	49	111	70	148	329	80	115	90	285	824
		c	9	2	120	79	201	37	91	19	147	101	125	72	298	74	116	0	190	845
	Kasama	a	21	34	50	64	148	77	93	95	265	94	95	89	278	80	75	76	231	943
		b	8	0	17	53	70	126	5	75	206	0	72	18	90	29	114	31	174	548
		c	15	37	81	124	242	116	116	123	335	115	87	99	301	44	62	22	128	1041
North-Western	Mwinilunga	a	93	59	76	81	216	82	87	85	254	81	79	75	235	69	66	72	207	1005
		b	94	41	62	185	288	18	26	131	175	14	53	63	130	64	38	49	151	838
		c	218	89	82	48	219	60	127	73	260	135	126	94	355	114	41	0	155	1207
	Zambezi	a	43	33	43	54	130	63	74	75	212	73	74	72	219	71	69	62	202	806
		b	60	0	52	2	54	9	47	54	110	29	28	93	150	68	63	88	219	593
		c	39	38	63	99	200	92	31	33	156	60	43	101	204	–	–	–	–	–
Southern	Livingstone	a	23	18	25	36	79	48	60	61	169	59	60	58	177	58	56	46	160	608
		b	8	0	47	55	102	0	5	27	32	47	42	19	108	7	51	1	59	309
		c	148	9	14	0	23	57	12	46	115	12	46	132	190	88	48	0	136	612
	Choma	a	22	20	29	42	91	59	75	74	208	68	66	65	199	67	65	51	183	703
		b	7	7	4	136	147	16	14	17	47	56	62	31	149	17	76	17	110	460
		c	36	16	12	39	67	37	17	15	69	13	61	153	327	38	17	0	55	554
Western	Mongu	a	27	29	40	52	121	62	74	75	211	73	74	74	221	76	75	66	217	797
		b	3	0	23	34	57	36	32	34	102	28	62	86	176	14	50	64	128	466
		c	16	2	83	122	207	42	26	35	103	25	47	164	236	86	35	4	125	687
	Kaoma	a	26	27	38	50	115	64	77	77	218	73	73	71	223	72	70	60	202	784
		b	14	0	81	50	131	0	21	50	71	78	44	63	185	70	69	3	142	543
		c	84	7	22	47	76	37	10	36	83	31	100	104	235	26	13	0	39	517

Source: TNDP Annual Plan 1983

Line (A): Long tem average rainfall between 1950 and 1980.

Line (B): Rainfall in 1981-1982 crop season.

Line (C): Rainfall in 1982-1983 crop season.

Source: Miniatry of Power, Transport and Communications -- Meteorological Department.

Seismological Activity in Zambia

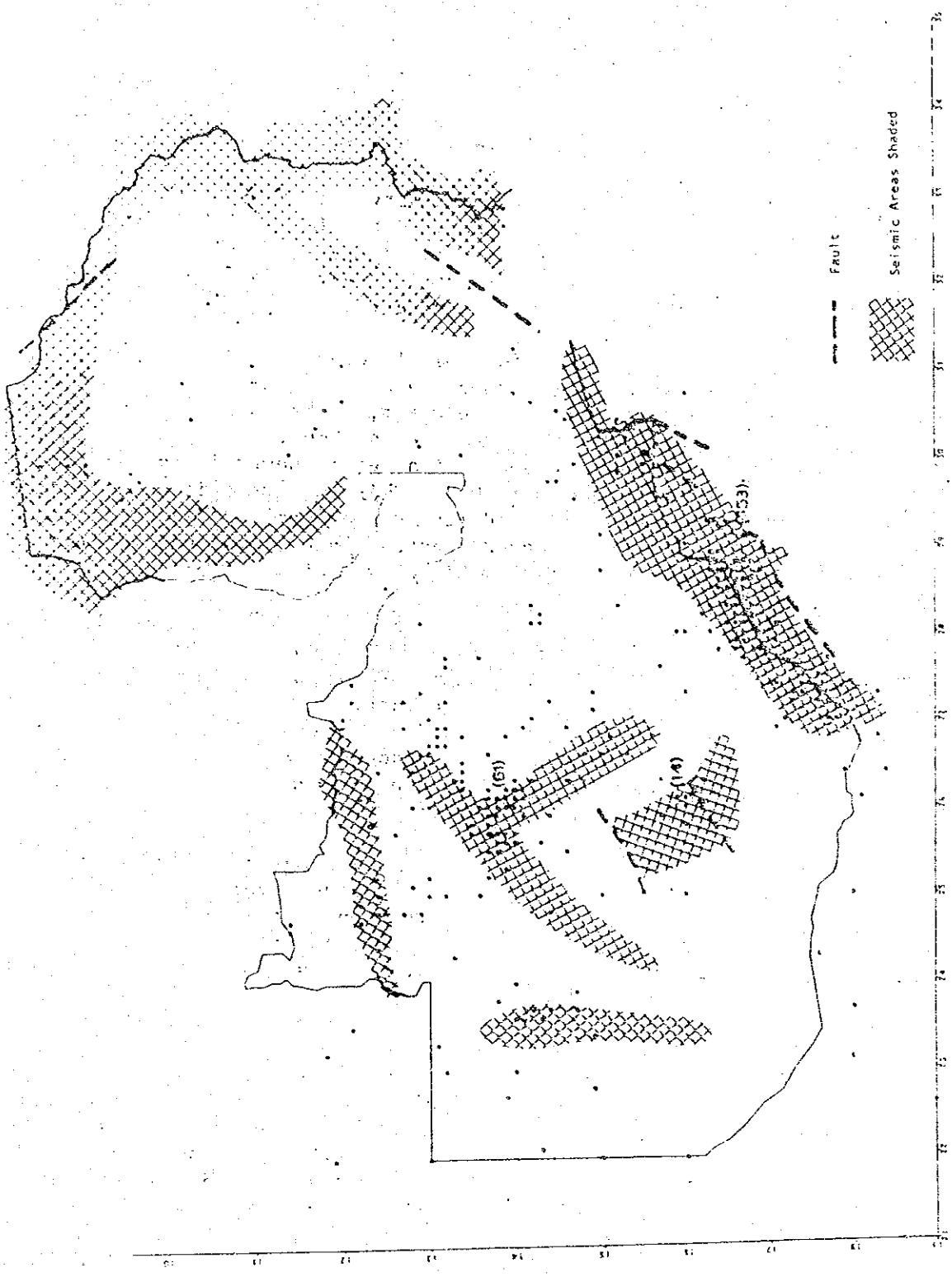


FIG 1. SEISMOLOGICAL ACTIVITY IN ZAMBIA. PERIOD: JANUARY 1966 TO OCTOBER 1973
(Based on information supplied by Geotz Observatory, Bulawayo)

Source: Seismology in Zambia,
by J.P. Henderson, issued by
Zambian Meteorological
Department.

APPENDIX 8 Data on Land Acquisition

ADM/EC/6/1

12 May 1982

The General Manager
Zambia Railways
P.O. Box 80935
KABWE

Dear Sir

DEPOT EXTENSION AT CHAMBESHI SIDING

The National Agricultural Marketing Board of Zambia (Namboard) is applying for the extension of its Existing Depot at Chambeshi Railways siding for its ever increasing storage problems at the depot.

The area in question is bordered and shaded red. The Board will be very grateful if authority is given to use the piece of Land in question.

Yours faithfully,
NATIONAL AGRICULTURAL MARKETING BOARD

K C NSOKOLO
Engineering Asst. (Surveys)
for/Chief Engineer.

79

ZAMBIA RAILWAYS

LEGAL AND ESTATES DEPARTMENT,
Buntungwa Street,
P.O. Box 935, 80935
Kabwe,
Zambia.
Telephone: 3811 Extension 365
Telex: ZA 43138, 81230

Your ref:

Our ref: 90:2435:01

10th November, 1982.

The Chief Engineer,
National Agricultural Marketing Board,
P.O. Box 30122,
LUSAKA.

ATTENTION MR. K. C. NSOKOLO
ENG. ASSTANT (SURVEY)

Dear Sir,

RE: DEPOT EXTENSION AT CHAMBISHI SIDING FOR NAMBOARD.

In reference to the above matter please find the attached Drawing No. 4/35 showing the Chief Civil Engineer's proposal shown bordered and hatched in green, as the area accepted for your Depot extension.

Please indicate if the proposal is accepted.

Yours faithfully,
ZAMBIA RAILWAYS

J. V. C. NKOLE
FOR/LEGAL COUNSEL.

/mm

E.A (Survey)
A. disawa
23/11/82

The Area marked and hatched Green is accepted as the area applied for
[illegible] letter [illegible]

3rd January, 1983

The General Manager,
Zambia Railways,
P.O. BOx 80935,
LUSAKA.

ADM/EC/6/11

ATTN: MR. J.T.C. NKOLE

Dear Sir,

re: EXTENSION OF CHAMBISHI DEPOT

This is to notify you that the National Agricultural Marketing Board of Zambia (Namboard) management has accepted the proposed boundary marked by Railway's Chief Civil Engineer as the required area by the Board.

This is in accordance to your letter of Ref No. 90:2435:01 dated 10th November, 1982 with the drawing NO. 4/35 attached to it, in which you wanted to know whether the proposal has been accepted by the Board.

Thanking you for your action.

Yours faithfully,
NATIONAL AGRICULTURAL MARKETING BOARD OF ZAMBIA

K. C. NSOKOLO
ENGINEERING ASSISTANT (SURVEYS)
for/CHIEF ENGINEER

/fbc.