National Power Authority (NPA)
Ministry of Energy and Water Resources (MEWR)
Republic of Sierra Leone

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR
THE URGENT IMPROVEMENT OF POWER DISTRIBUTION SYSTEM
IN FREETOWN
IN
THE REPUBLIC OF SIERRA LEONE

FEBRUARY 2012

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

YACHIYO ENGINEERING CO., LTD.

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PREFACE

The survey team held a series of discussions with Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey on the project for Rehabilitation of Substation and Transmission Line in Kilimanjaro Region in the United Republic of Tanzania, and organized a survey team headed by Mr. Kyoji FUJII of Yachiyo Engineering Co., Ltd. between March 2010 and January 2011.

the officials concerned of the Government of Sierra Leone, and conducted field investigations. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Sierra Leone for their close cooperation extended to the survey team.

February 2012

Kyoko KUWAJIMA

Director General,

Industrial Development and Public Policy Department

Japan International Cooperation Agency

SUMMARY

SUMMARY

① Overview of the Country

Republic of Sierra Leone (hereinafter referred to as “Sierra Leone”) is situated in the western part of the African continent; it has a total land area of 71,740 km^2 and a population of approximately 6 million (2008, according to the UNFPA). The capital city is Freetown. After gaining independence as a member of the British Commonwealth in April 1964, Sierra Leone, after independent as a member of British Commonwealth, became a republic in April 1971 and reached the fiftieth anniversary of its independence in 2011.

In terms of economy, Sierra Leone has traditionally been a powerful exporter of primary products (diamonds, gold, bauxite ore, cacao, coffee, etc.), which have been its main source of foreign currency, however, as a result of the civil strife that continued for roughly 12 years from 1991, exports of mineral ores were suspended, agricultural production was badly impeded as farmers (the large majority of the population) were forced to become refugees or internally displaced, and economic activities were badly hindered by the destruction of social infrastructure and so on. As a result, the Gross Domestic Product (GDP) at one point fell to 1.2815 trillion Leone (approximately 46.6 billion yen), which was less than half what it was before the outbreak of hostilities.

However, following the end of fighting in 2002, the economy started to grow again thanks to reconstruction assistance from donors. It recorded 27.4 percent growth in 2002 mainly on the back of agriculture (which accounts for roughly half of GDP), mining and service sectors (approximately 30 percent of GDP), and since then it has continued to grow at a rate of 7.4 percent on average. The real GDP in 2007 recovered to the pre-war level, however, there is concern over stagnation in the wake of the global economic crisis from 2009 onwards. Moreover, thanks to the support of the international community, efforts are being conducted with a view to rebuilding the domestic economy, finances and regional communities.

Looking at current major economic indicators, the GNI is US$1.78 billion (2008, World Bank), per capita GNI is US$320 (2008, World Bank), real economic growth is 4.0 percent (estimate for 2009, EIU).

In December 2008, President Koroma announced the Agenda for Change, which is the guideline for the second poverty reduction strategy (2009~2011), under which efforts are being made to make major reductions in poverty through economic growth based on major investment in infrastructure, enhancement of social services (education, public health, sanitation) and development of the private sector.

② Background of the Project

The infrastructure of Sierra Leone has been recovering since the end of civil strife in 2002, however, the power supply setup is still not adequate to serve the economic growth of the country. Particularly, in Western Area, where economic development and population concentration are advancing around the capital Freetown, the demand for power is increasing every year, however, the power supply cannot keep up and 77.1 percent of residents have no access to electricity in that area as of 2008.

Currently operating power sources in Western Area consist of Bumbuna Hydropower Plant (constructed under assistance from the World Bank (WB), African Development Bank and Government of Italy, etc., possessing rated output of 50 MW in the rainy season and 17 MW in the dry

season) and diesel generators that were installed at Kingtom Power Station (rated output 10 MW, handed over in March 2010) under Japan's Grant Aid. Moreover, another diesel generator (rated output 17.5 MW) commenced operation under assistance from the Arab Development Bank in March this year, thereby steadily lifting generating capacity nearer to the estimated latent demand in this area of 45 MW.

However, the current transmission and distribution capacity of Western Area is around 30~35 MW; moreover, the transmission and distribution loss caused by deterioration and lack of maintenance of equipment is more than 30 percent, meaning that generated power cannot be efficiently delivered to consumers. Therefore, in order to boost the power supply capacity of Western Area, in addition to increasing the amount of power supply, it is essential to improve and expand the transmission and distribution network. In order to remedy this situation, the Government of Sierra Leone issued the request to the Government of Japan for Grant Aid geared to promoting electrification of Western Area (where growing demand is forecast) based on reinforcing and extending the distribution network and constructing new substations.

③ Outline of the study findings and Project contents

In response to the request, JICA organized the Preparatory Survey Team and dispatched the first field survey team from November 14 through December 12, 2010. During this dispatch, the team reconfirmed the contents of the request and discussed the contents of implementation with related officials on the Sierra Leone side (responsible government agency: Ministry of Energy and Water Resources (MEWR) and implementing agency: National Power Authority (NPA)), investigated the Project site and collected related materials.

On returning to Japan, based on the materials obtained in the field survey, the team conducted examination on the necessity of the Project, its social and economic effects and its relevance and compiled findings into the Preparatory Survey Report (Draft). JICA dispatched the second field survey (outline explanation) team to Sierra Leone from May 15 to May 27, 2011 to explain and discuss the Preparatory Survey Report and reach a basic agreement with the related officials on the Sierra Leone side.

As a result of the study, the compiled assistance project intends to rehabilitate and restore distribution lines, extend distribution lines to non-electrified areas and construct a 33/11 kV substation in the capital Freetown and surrounding areas that suffer from extreme power losses caused by deterioration and overloading. The following table gives an outline of the basic plan.

Outline of the Project Activities

Project Contents
1. Construction of Goderich Primary Substation (1) Construction of Goderich Primary Substation building (including building services) - Substation building: reinforced concrete single story structure, total floor area 243.0 m^2 - Guardhouse: reinforced concrete single story structure, total floor area 3.24 m^2 - Auxiliary equipment (water tank, septic tank, soakage pit, foundations, main transformer, earthing transformer, station transformer, parking space, etc.) **2. Procurement and installation of the following equipment:** (1) Equipment for Wilberforce Primary Substation - 33 kV switchgear panel - 33 kV switchgear connection panel - Other necessary auxiliary equipment and foundations (2) Equipment for Goderich Primary Substation - Installation of 33 kV and 11 kV switchgear - Installation of 33/ll kV step-down transformer (15 MVA), station transformer (630 kVA) and 33 kV earthing transformer - Other necessary auxiliary equipment and foundations (3) Construction of 33 kV distribution line from Wilberforce Primary Substation to Goderich Primary Substation (approximately 5.8 km) (4) Construction of 11 kV distribution line (approximately18.5 km) - Construction of 11 kV distribution line from Babadori River to Sussex (repair and extension works; however, equipment and materials will only be supplied for the 11 kV distribution line in Goderich Village secondary substation, Goderich-2 secondary substation, and the densely populated area of Goderich. - Construction of necessary secondary substations (including transformer foundations, distribution panel foundations, fences and gates, etc.) **3. Procurement of the following equipment and materials (installation by the NPA)：** (1) Procurement of 11 kV distribution line equipment and materials Procurement of equipment and materials for Goderich Village secondary substation and Goderich-2 secondary substation and distribution line equipment and materials for the densely populated area of Goderich area (2) Procurement of equipment and materials for repair and extension of the low voltage distribution network in the Project target area (utility poles, overhead wire, cable, etc.) (3) Procurement of spare parts and maintenance tools for distribution and substation facilities (4) Procurement of construction machinery for maintenance (bucket truck, crane-equipped truck, rock crusher, etc.) (5) Procurement of operation and maintenance manual and implementation of OJT

④ Project implementation schedule and cost estimation

In the event where the Project is implemented under the Government of Japan's grant aid scheme, the estimated Project cost will be (*confidential*). The main items to be undertaken by the Sierra Leone side will be the leveling of site and erection of fences and gates for Goderich Substation (approximately 4.0 million yen), installation of 11 kV distribution lines for the densely populated districts of Goderich (approximately 3.5 million yen) and implementation of low-voltage distribution line installation works (approximately 4.5 million yen). The Project implementation period including the implementation design will be roughly 19 months.

⑤ Project Evaluation

(1) Relevance

Since the Project will contribute to the realization of Sierra Leone's poverty reduction strategy, development plans and energy policy and impart benefits to the general public, it is deemed to have high relevance as an aid undertaking.

(2) Effectiveness

1) Quantitative effects

Output Indicator	Current Value (2010)	Planned Value (2018)
Supply restriction time (hours/day, including failure interruptions)	12 hours/day	1 hour/day
Power quality (voltage drop %)	20% or more	Approx. 10%
Power (transmission and distribution) loss	30% or more	Approx. 20%

2) Qualitative effects

Implementation of the Project will make a major contribution towards the stable operation and vitalization of hospitals, public health centers, clinics and schools, etc. in the Project area, improvement in the quality of medical and educational services for local residents, and improvement in efficiency and vitalization of the operation of other public facilities, factories and tourist facilities, etc.

As can be seen above, since implementation of the Project can be expected to impart massive effects, its implementation under the grant aid scheme of the Government of Japan is confirmed to be valid. Furthermore, the setup on the Sierra Leone side in terms of personnel and budget planning is deemed to be sufficient for implementing the Project and conducting post-implementation operation and maintenance.

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7. Environmental Checklist and Monitoring Plan
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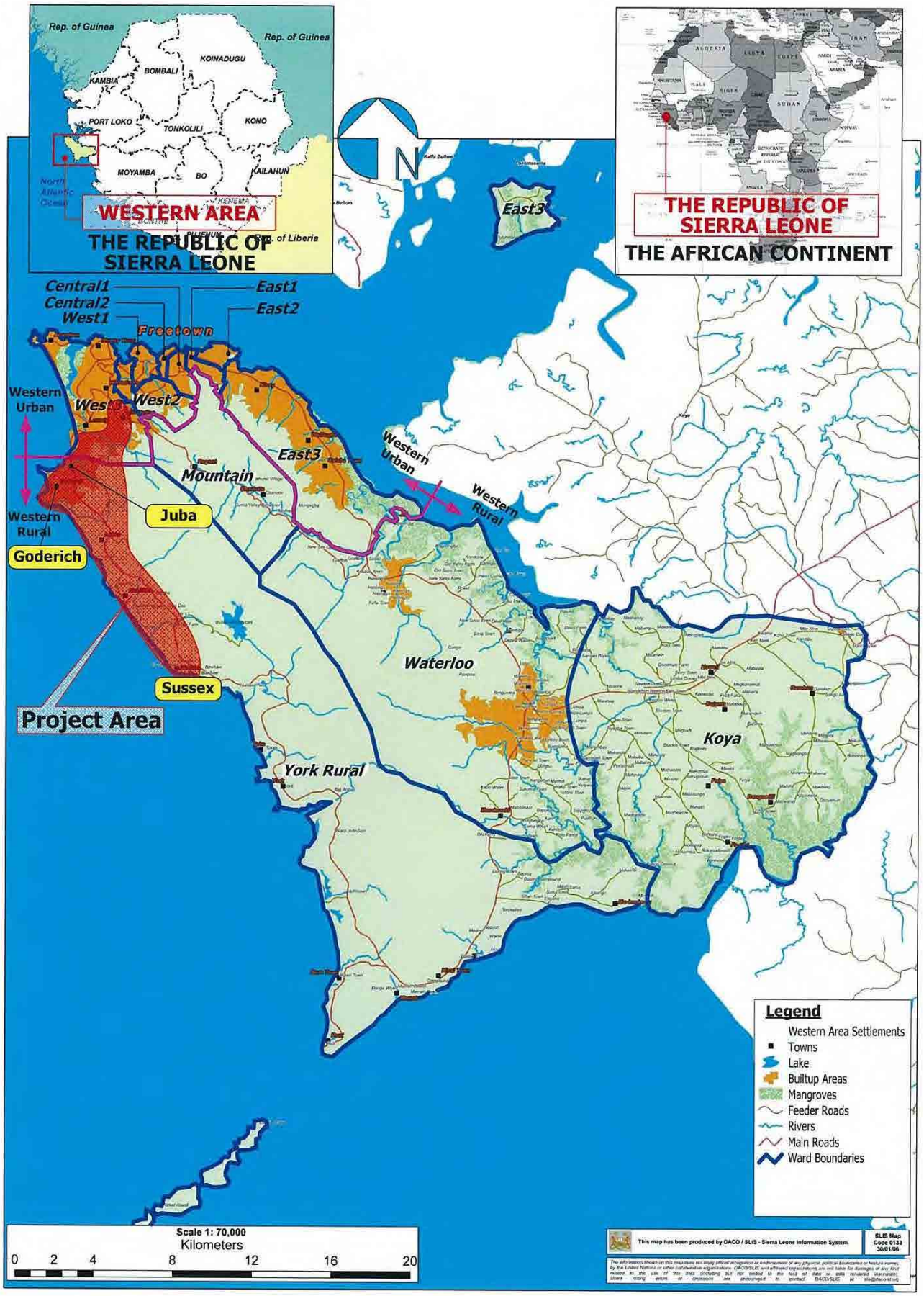
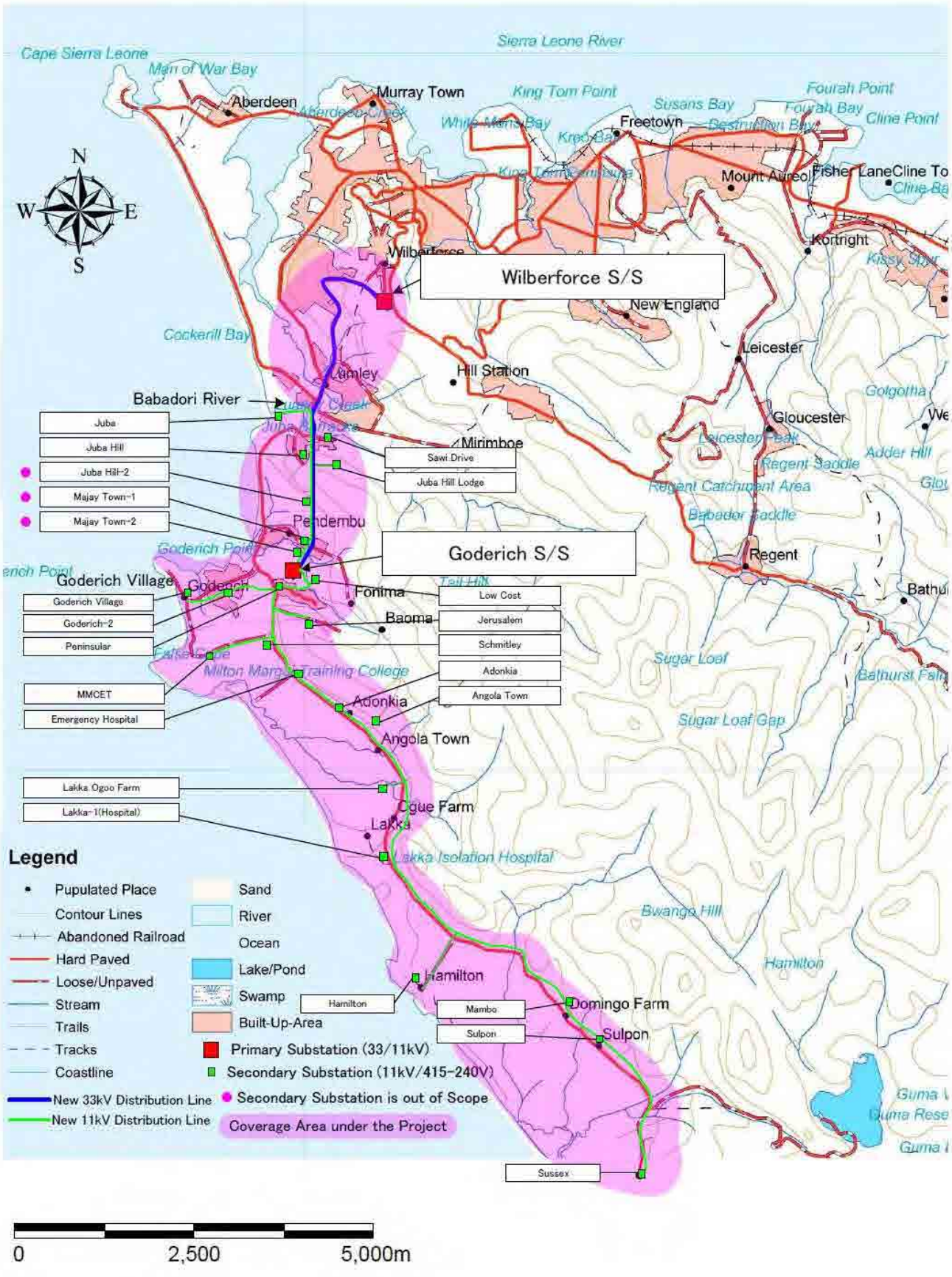
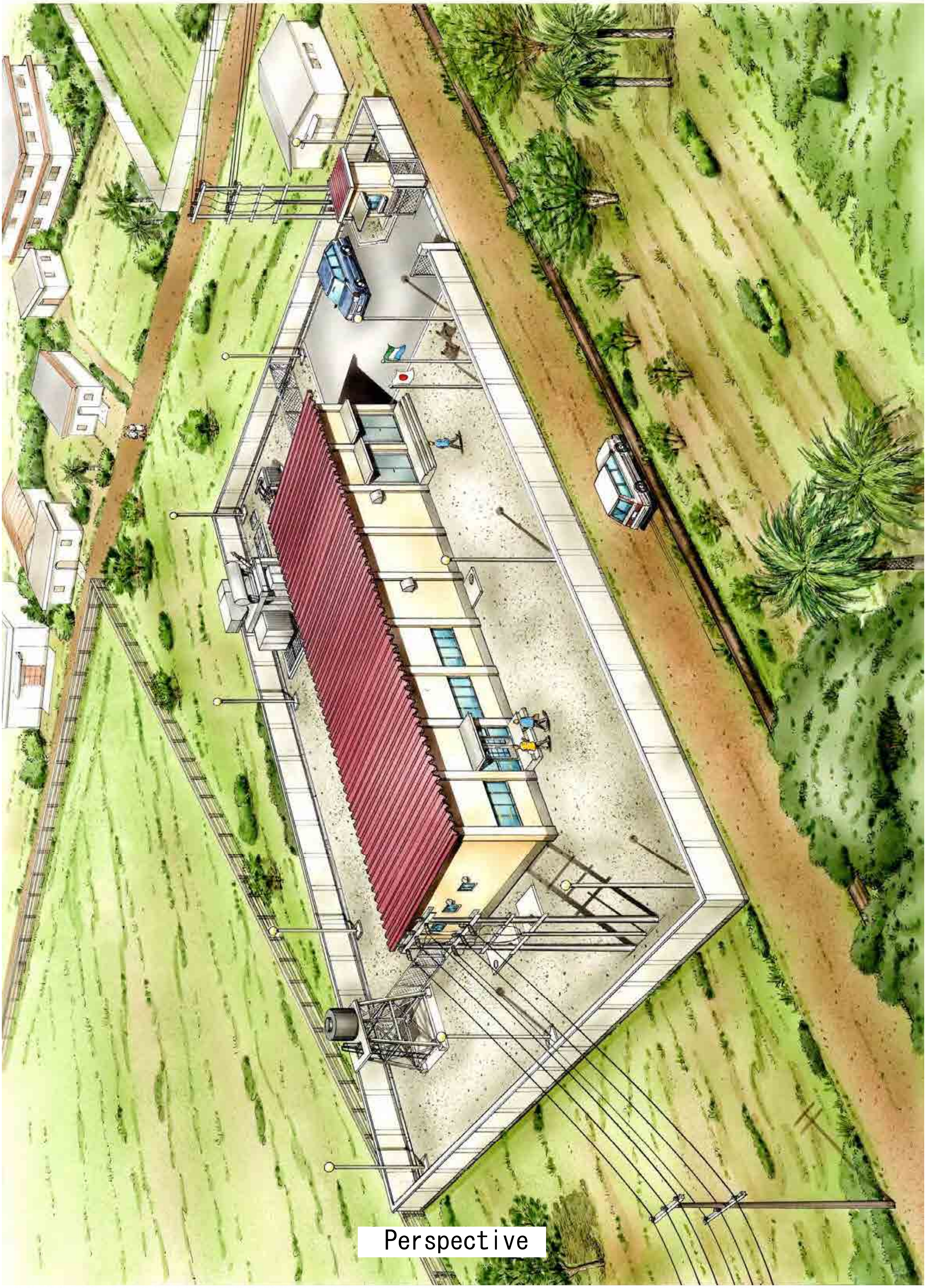
9. Letter for procedure to complete the EIA requirements（EPA→MEWR）
10. Approval Letter for issuance of EIA License （EPA→MEWR）



Project Location Map



Project Site Map



Perspective

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Abbreviations

AAAC	All Aluminium Alloy Conductor
ABC	Aerial Bundled Cable
ACSR	Aluminum Conductor Steel Reinforced
ASEAN	Association of Southeast Asian Nations
BADEA	Arab Bank for Economic Development in Africa
BHP	Bumbuna Hydroelectric Project
BHPP	Bumbuna Hydro Power Plant
BKPS	Bo-Kenema Power Services
DAC	Development Assistance Committee
E/N	Exchange of Notes
EC	European Commission
ECOWAS	Economic Community of West African States
ECOMOG	ECOWAS Monitoring Group
EIA	Environmental Impact Assessment
EIU	Economist Intelligence Unit
EPA	Environment Protection Agency
EU	European Union
G/A	Grant Agreement
GDP	Gross Domestic Product
GNI	Gross National Income
IDA	International Development Association
IEC	International Electrotechnical Commission
IMF	International Monetary Fund
ISO	International Organization for Standardization
JCS	Japanese Electrical Wire and Cable Maker's Association Standards
JEC	Japanese Electrotechnical Committee
JEM	Standards of Japan Electrical Manufacturer's Association
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
LIWV	Lightning Impulse Withstanding Voltage
MEWR	Ministry of Energy and Water Resources
MMCET	Milton Margai College of Education and Technology
NPA	National Power Authority
OJT	On the Job Training
OPEC	Organization of the Petroleum Exporting Countries
OPGW	Optical Ground Wire
O&M	Operation and Maintenance
PCB	Polychlorinated Biphenyl

PILC	Paper Insulated Lead Sheathed Cable
PRSP-II	Poverty Reduction Strategy Paper-II
PWP	Power and Water Project
RMU	Ring Main Unit
ROW	Right of Way
RUF	Revolutionary United Front
SLBC	Sierra Leone Broadcasting Company
UNFPA	United Nations Population Fund
UNICEF	United Nations International Children's Emergency Fund
WAPF	Western Area Peninsular Forest
WB	World Bank
XLPE	Cross Linked Polyethylene

CHAPTER 1 BACKGROUND OF THE PROJECT

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1-1 Background of the Project

Following the end of roughly 11 years of civil strife in 2002, Sierra Leone has been sustaining growth out of post-war reconstruction and has recorded a GDP growth rate of approximately 7 percent in recent years. In line with this, the demand for power centering around the metropolitan area of Freetown is growing, and the power demand is expected to rise from approximately 45.0 MW in 2010 to at least 130.0 MW in 2025. In spite of this, the present power supply output is unable to satisfy the demand and high system losses exist due to the impact of the deteriorated transmission and distribution equipment.

With a view to resolving this situation, the Government of Japan has so far constructed power generating facilities (diesel, 5 MW x 2 units), extended the distribution network and provided support for substation facilities and equipment via the grant aid program. Other donors have also provided assistance, starting with assistance for construction of a hydropower station (Bumbuna Hydropower Plant: plant output 50 MW) by the World Bank, and the power supply situation in the metropolitan area is improving, however, as transmission capacity has been unable to keep up with the growth of power generating facilities, high distribution losses (approximately 30 percent) are continuing and consumers are still not receiving adequate supply of stable power.

Against such a background, the Sierra Leone Ministry of Energy and Water Resources (MEWR) issued the request to the Government of Japan for reinforcement of the power distribution network, construction of new substation and promotion of electrification in the areas where demand was expected. Table 1-1.1 shows an outline of the components targeted in the Project.

Table 1-1.1 Outline of the Requested Components and Revisions

Requested Item		Component Outline		Order of Priority
		Request Stage	Field Investigation Stage	
(1) Construction of Goderich Substation				A
	1) Substation building and site area	• 2 story (site area approx.. 1,000m^2)	• 1 story (site area approx.. 1,500m^2)	
	2) Distribution and transformer facilities	• 33/11kV transformer (15MVA) • 33 kV grounding transformer • 33 kV,11kV switchgear 1 set • Other necessary equipment: 1 set	• 33/11kV transformer (15MVA) • 33 kV grounding transformer • 33 kV,11kV switchgear 1 set • Other necessary equipment: 1 set	
	3) Maintenance vehicle	• Aerial work platform truck and mobile crane, etc.	• Aerial work platform truck and mobile crane, etc.	
	4) Maintenance tools and test apparatus	• 1 set	• 1 set	
(2) Installation of 33 kV distribution line from Wilberforce Substation to the new Goderich Substation				A
	1) Installation of 33 kV distribution line	• Approx. 7km (with OPGW)	• Approx. 5.8km (with GW)	
	2) Wilberforce Substation	• 33 kV switchgear, 1 set	• 33 kV switchgear, 1 set	
(3) Rehabilitation of existing 11kV distribution equipment				B
	1) Supply of distribution transformers	• 5 sets (lightning conductors, fuses, switches)	• Implement rehabilitation works at 17 secondary substations (RMU).	
	2) Supply of ring main units	• 12 sets		
	3) Rehabilitation of 11 kV distribution line routes	• Approx. 10km	• Approx. 18.5 km	
(4) Procurement of low voltage distribution equipment and materials in the Goderich area				C
	1) Main distribution panel	• 1 set	• 1 set	
	2) Low voltage trunk line	• 1 set	• 1 set	
	3) Low voltage istribution line (to consumers)	• 1 set (including prepaid meters)	• No supply	
	4) Maintenance tools and test apparatus	• 1 set	• 1 set	

＊ Order of priority: A (Extremely high), B (High), C (slightly high)

1-2 Environmental and Social Considerations

1-2-1 Legislation related to Environmental and Social Considerations

(1) EIA License

In Sierra Leone, the Environment Protection Agency is responsible for procedures concerning Environmental Impact Assessment (EIA). This agency was established in December 2008 based on the Environmental Protection Agency Act, 2008 and under the jurisdiction of the Ministry of Lands, Country Planning and the Environment. The EIA implementation procedures are stipulated in the Environmental Protection Agency Act from Articles 23 to 39.

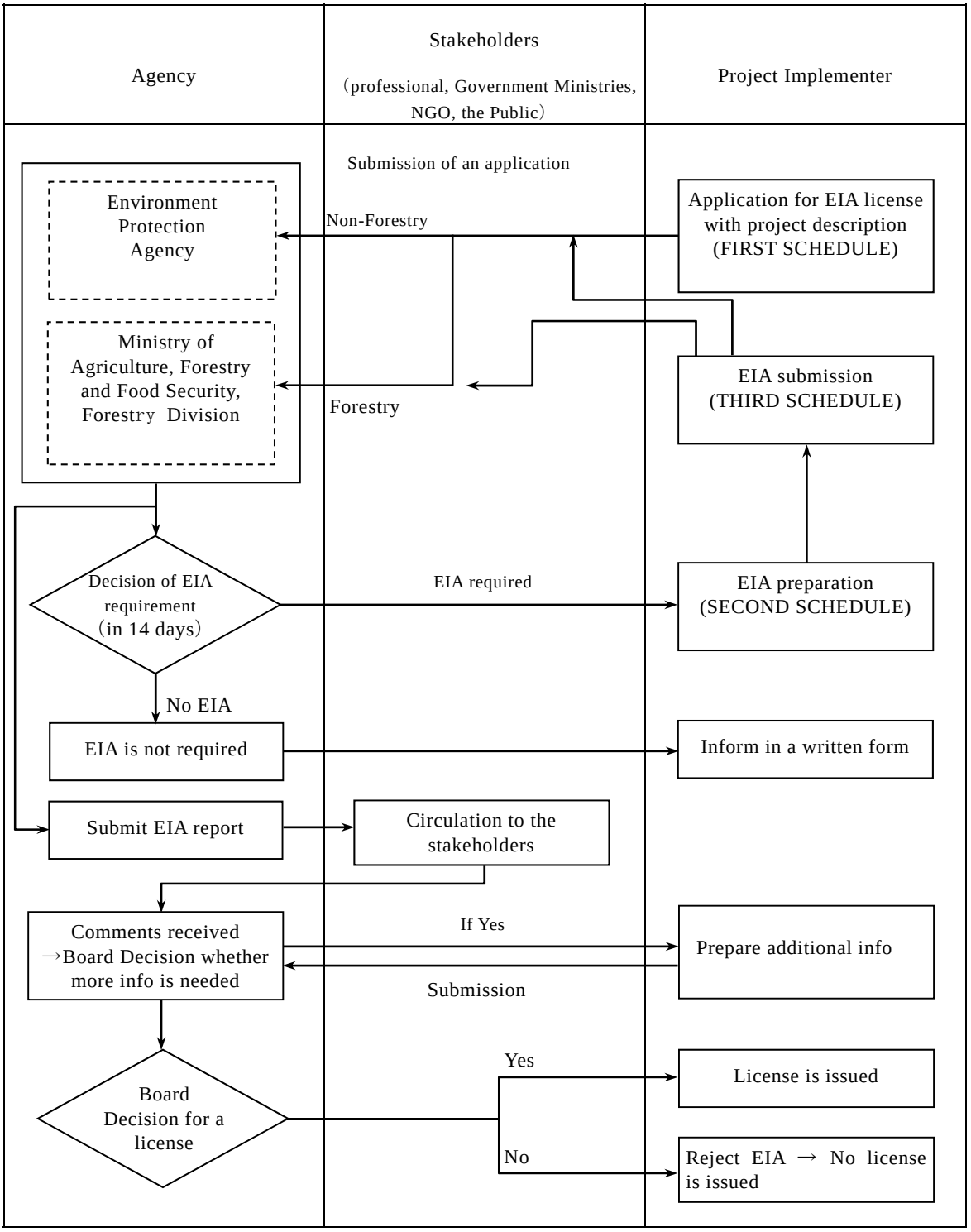
Table 1-2-1.1 shows an outline of the Environmental Protection Agency Act.

Table 1-2-1.1 Outline of the Environmental Protection Agency Act

Establishment of the Environmental Protection Agency (Articles 2~11)	Establishment and roles of committees; responsibilities and authority of the Director
Functions and management of the Environmental Protection Agency (Articles 12~22)	Guidance to other government agencies, general coordination and liaison concerning the environment; authorization, cancellation, orders, procedures and warnings, etc. concerning environmental issues; issue of standards and guidelines, ensuring of compliance with EIA procedures; promotion of survey, research and development of environmental issues with secretariats of international conventions, other agencies and regional assemblies, etc.; monitoring, etc.
Organization of the Environmental Protection Agency (Articles 12~22)	Establishment of the Chemical Control Department, Information, Education and Communications Department, Environmental Compliance Department, Interdepartmental and International Cooperation Department, Finance Department, and Administration Department
EIA (Articles 23~39)	EIA implementation procedure
Ozone layer depleting substances (Articles 40~52)	Management procedure

[Source] Prepared by the Study Team from the Environmental Protection Agency Act, 2008

The EIA implementation procedure is prescribed in the Environmental Protection Agency Act from Article 23 to Article 39 as shown in Figure 1-2-1.1.



[Source] JICA Metropolitan Area Power Supply Master Plan Study (September 2009)

Figure 1-2-1.1 Flow of EIA

EIA license registration is required in cases corresponding to projects prescribed under the first schedule shown in Table 1-2-1.2. In such cases, it is necessary to apply for an EIA license to the Environmental Protection Agency before the start of the project.

Table 1-2-1.2 First Schedule

(a)	Major change in use of renewable resources (for example, converting land for agricultural production, forests, pasture, rural development and timber production, etc.)
(b)	Major changes in agriculture and fisheries customs (for example, introduction of new species, large-scale mechanization and use of chemicals in agriculture)
(c)	Water resources development (for example, dam, drainage and irrigation projects, catchment basin development, water supply)
(d)	Infrastructure (for example, roads, bridges, airports, ports, transmission lines, pipelines, railways)
(e)	Industrial activities (for example, metallurgical plants, timber processing plants, chemical plants, power plants, cement plants, refining and petrochemical plants, agriculture)
(f)	Extraction industries (for example, mining, quarrying, extraction of sand, gravel, salt, peat, oil and gas)
(g)	Solid waste management and disposal (for example, sewerage systems and treatment plants, disposal sites, household and hazardous waste treatment plants)
(h)	Residential construction and development schemes
(i)	Establishment of entertainment facilities, car repair shops and welding plants
(j)	Importing of used cars

[Source] Prepared by the Study Team from the Environmental Protection Agency Act, 2008

In cases where a project falls under one of the descriptions given under the first schedule, the project implementer must make an application for an EIA license upon appending detailed information on the project. On receiving such an application, the Environmental Protection Agency determines whether or not an EIA is required within 14 days. The factors for determining whether or not an EIA is required are prescribed under the second schedule shown in Table 1-2-1.3 below.

Table 1-2-1.3 Second Schedule

(a)	Environmental impact on the community
(b)	Project location
(c)	Will the project cause changes in the project area?
(d)	Will the project cause major changes to the ecosystem in the project area?
(e)	Will the project detract from the aesthetic, leisure, scientific, historical, cultural or environmental properties of the project area?
(f)	Will the project impart risk to the habitats and seeds of flora and fauna?
(g)	Project scale
(h)	Scope of environmental deterioration
(i)	Will the project lead to greater demand for natural resources in the project area?
(j)	Cumulative environmental impact of the project and other activities

In cases where an EIA is not required, the Director of the Environmental Protection Agency notifies the applicant in writing. If an EIA is required, it is necessary to prepare and submit an EIA stating the information prescribed under the third schedule in Table 1-2-1.4.

Table 1-2-1.4 Third Schedule

(a)	Project location and surrounding area
(b)	Project principles, concept and purpose
(c)	Direct and indirect environmental impacts of the project
(d)	Potential social, economic and cultural impacts of the project affecting people and society
(e)	Communities, stakeholders and government agencies whose opinions have been heard
(f)	Countermeasures and means for averting, preventing, altering, mitigating or improving potential impacts on society and people
(g)	Alternatives to the proposed project
(h)	Natural resources in the target area used in the project
(i)	Project cancellation plan
(j)	Other information necessary for appropriately examining the latent environmental impacts of the project

The Environmental Protection Agency circulates the submitted EIA to corporate groups, associations, government agencies and NGOs, etc. in order to seek comments. Furthermore, it discloses the EIA to the general public via official gazettes and newspapers, etc. to invite further comment and examination. After receiving comments, it presents the EIA to the committee, which is composed of representatives from the following 10 agencies including the Ministry of Lands, Country Planning and the Environment:

1) Ministry of Lands, Country Planning and the Environment
2) Ministry of Local Government
3) Ministry of Mineral Resources
4) Ministry of Marine Resources
5) Ministry of Agriculture, Forestry and Food Security
6) Ministry of Tourism and Cultural Affairs
7) Ministry of Trade and Industry
8) Ministry of Transport
9) Ministry of Health
10) Petroleum Unit

This committee makes decisions on the following matters:

a) Issue of the EIA license
b) Request for additional information from the applicant within 21 days
c) Refusal of the EIA for imparting negative impacts on the environment, people and society

Following approval of the EIA, the committee instructs the Director to issue the license to the applicant. The Environmental Protection Agency conducts monitoring in order to review the environmental impacts of all projects for which licenses are issued.

(2) Other environmental controls and criteria

Sierra Leone has no concrete environmental controls or criteria containing numerical targets and so on; rather it uses the guidelines and figures that are laid down by the World Health Organization, World Bank and advanced countries.

1-2-2 Systems and Procedures concerning Land Appropriation and Resident Resettlement

(1) Land Ownership System

There are two types of land ownership system in Sierra Leone. One is the customary system, under which families, communities and individuals own land under the jurisdiction of the Paramount Chief, who is the traditional ruler in Sierra Leone. This customary system is practiced in all areas apart from Western Area. The other system is the modern free ownership system which is stipulated under law and is practiced in Western Area. Land in Western Area is either state-owned land or private land and can be bought, sold and leased. Accordingly, the land acquisition procedure and compensation method differ between Western Area and other areas.

(2) Land Acquisition and Compensation

1) Public Lands Act

The Constitution that was promulgated in 1991 allows the state to forcibly acquire land for the public benefit providing that it pays appropriate compensation, and the procedure for compulsory acquisition is prescribed in the Compulsory Acquisition of Property Act (Constitutional Safeguards), 1961. However, in Western Area, the Public Lands Act, 1961 is applied, under which land can be acquired either by consent or forcibly for the purpose of public projects. This act also stipulates the method of compensation for acquired land and other damages with respect to owners, residents and other stakeholders. Article 18 of the Public Lands Act explains that the following items should be taken into consideration when determining the amount of compensation.

i) Market price of the land
ii) Price increase that may possibly arise in the event of project implementation (increase in land price when a non-electrified area becomes electrified and so on)
iii) Damages that arise when a landowner’s land is split up (reduction in revenue due to reduction of fields, etc.)
iv) Damages arising in other assets and actual income
v) Costs arising when targeted parties have to change their residence or workplace (mainly damages arising from relocation of buildings (shops, etc.))

Whether compensation is paid in kind or in cash, the amount of compensation is determined in direct negotiations between the project implementer and affected parties

based on the amount assessed according to Article 18 of the Public Lands Ordnance. Therefore, there are cases where, according to domestic law, individuals who do not possess land rights are entitled to receive some form of compensation.

In cases of public projects, the Ministry of Lands, Country Planning and the Environment assesses land and building assets that need to be acquired by public project implementing agencies for public use. In cases where compensation is paid in kind, the Ministry of Lands, Country Planning and the Environment finds alternative land and prepares the necessary documents. In cases of cash compensation, the project implementing agency and Ministry of Lands, Country Planning and the Environment cooperate in negotiating with the affected parties.

2) NPA Act

The NPA Act (National Power Authority Act, 1982) explains cases for Western Area and for other regions. In Western Area, as is stipulated in Article 40 (1) (a), in cases where land cannot be acquired based on private agreement or consent, it is deemed possible to forcibly acquire land for public use according to the Public Lands Ordinance. It states that the NPA should pay all costs and compensation arising out of the land acquisition. In Article 33, it is stipulated that a judge can only order trees and buildings that impede power lines to be removed when proper compensation is paid to the owners. According to Article 42, if necessary, there are cases where the NPA can install transmission and distribution lines at the desired height alongside, under or across any road; moreover, there are cases where it can construct utility poles, etc. on roads and dig up roads upon conducting prior consultations with the concerned government agencies.

1-2-3 Resettlement in Line with Project Implementation

In the Project, since one abandoned building and two illegally occupied buildings have been confirmed on the scheduled construction site of Goderich substation, it will be necessary to resettle them. The NPA intends to compile a simple Resettlement Action plan (RAP), offer alternative land and provide the necessary guarantee money in accordance with related legislation (Public Lands Ordinance, 1961 and NPA Act (1982)) and experience in past World Bank supported projects (resettlement plan for the 33 KV transmission line construction project between Kingtom Substation and Wilberforce Substation and Blackroad Substation in 2004 and the revised plan of that project in 2007). It plans to prepare the simple RAP, finish paying compensation, and complete the resettlement before the start of Project implementation. Although the simple RAP was planned to be completed by April 2011, it was found to need the support of the Ministry of Energy and Water Resources (MEWR) (the responsible agency for the Project) at the preparation stage. NPA issued the letter to MEWR to request the support of this resettlement on 18th July, 2011. In this letter, NPA explained the situation of the resettlement and requested the urgent support. Moreover, the scheduled site of the substation currently belongs to Sierra Leone Broadcasting Company (SLBC), however, it sent a letter consenting to

use of the land to MEWR on December 23, 2010.

Concerning the new construction of 33 kV distribution lines and repair and extension of 11 kV distribution lines, it is basically planned to install distribution lines alongside existing roads and to maintain appropriate height and distance between lines and buildings to ensure that there is no need to resettle residents. Depending on the distribution line route, some utility poles and branch lines are located on privately owned land, however, the NPA intends to explain the plan to land users in advance and to secure agreements based on related legislation.

1-2-4 Scoping Plan

As Project implementation will not entail any major negative impacts, it is classified under environmental category B following "Guidelines for Environmental and Social Considerations (April 2004 version)". Minor negative impacts are envisaged in terms of small-scale involuntary resettlement of residents and impact on protected forest area. Other items include temporary traffic controls and power cuts during the construction works, impacts on local economy around the construction sites and on public sanitation by the construction works, as well as air pollution, water pollution, soil contamination, solid waste generation, noise, vibration and accidents arising in line with the works. The issue of small-scale resettlement of residents is discussed in section 1-2-3. As for the impact on protected forest, it has been confirmed that part of the 11 kV distribution line route intended for repair (around Lacka) is located on the WAPF boundary line (see Figure 1-2-4.1 and Figure 1-2-4.2). However, the area around this boundary line has already been developed, and the NPA and Study Team have confirmed with the Ministry of Agriculture, Forestry and Food Security that the Project is feasible providing that it is implemented along existing road. Since it will be necessary to notify the Ministry of Agriculture, Forestry and Food Security about the plans when implementing the Project, the NPA plans to give notification. Table 1-2-5.1 summarizes the expected impacts according to each implementation stage of the Project. For selecting the distribution line route, the utmost care will be taken to avoid impacts on protected forest districts, and in areas where there is even the slightest risk of impact, such risk will be negated through adopting green covering on cables.

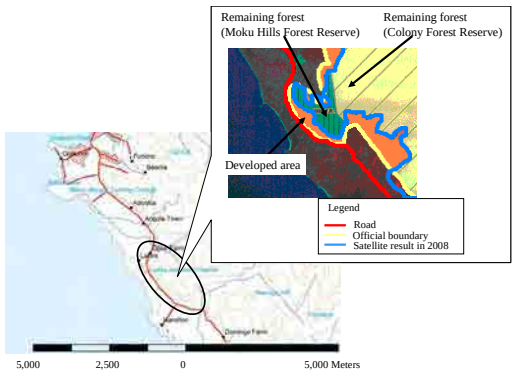


Figure 1-2-4.1 WAPF Boundary Line Around Lacka

Figure 1-2-4.2 Current Condition of the WAPF Boundary around Lacka

Table 1-2-4.1 Scoping Plan (Preparatory Survey)

1. Construction preparation and implementation phase				
Impact			Rating	Basis and Reasons
Social environment	1	Involuntary resettlement	B-	There are three buildings (one abandoned house and two illegally occupied houses) on the scheduled substation construction site so resettlement is necessary. Depending on the distribution line routes, some utility poles and branch lines, etc. are located on privately owned land, so it will be necessary to explain the plans in advance and obtain consent based on the NPA Act and Public Lands Ordinance. The distribution lines will pass through a densely populated area, however, appropriate height and clearance with residences will be maintained to ensure that resettlement doesn't become necessary.
	2	Local economy such as employment and livelihoods, etc.	B-	In Freetown, small stores are sometimes operated on roadsides. It is planned to utilize the existing distribution line routes alongside existing roads as much as possible, however, the livelihoods of some residents will be impacted. It will be necessary to consider the working times, etc. with a view to mitigating impacts.
	3	Land use and use of local resources	D	Since the substation site is state-owned land and the distribution line routes are configured alongside existing roads, there is not expected to be any impact.
	4	Social infrastructure and social organizations such as decision making organs, etc.	D	Since the substation site is state-owned land and the distribution line route is configured alongside existing road, there is not expected to be any impact.
	5	Existing social infrastructure and social services	B-	Temporary traffic controls and power cuts will be required during the distribution line works.
	6	Impoverished people, indigenous people, minorities	D	Since the substation site is state-owned land and the distribution line routes are configured alongside existing roads, there is not expected to be any impact.
	7	Imbalance of damage and benefits	D	Since the substation site is state-owned land and the distribution line route is configured alongside existing road, there is no possibility that imbalance will arise in the benefits.
	8	Cultural heritage	D	There is no heritage or cultural assets in the project area.
	9	Local conflicts of interest	D	There is no likelihood of conflicts of interest arising since the substation site is state-owned land
	10	Water use, water rights, right of entry	D	Since the substation site is state-owned land and the distribution line routes are configured alongside existing roads, there is not expected to be any impact.
	11	Public sanitation	B-	Since an influx of workers for the works, there will be an impact on public health. It is necessary that temporary toilets will be installed, waste products will be appropriately treated, and so on.
	12	Disasters and infections such as HIV/AIDS	D	There is no likelihood of disasters or infections arising.
	13	Topography and geology	D	Based on the results of topographical and boring surveys, there will be no impact in terms of topography and geology.

1. Construction preparation and implementation phase				
Impact			Rating	Basis and Reasons
Natural environment	14	Soil erosion	D	Based on the results of topographical and boring surveys, there will be no impact in terms of soil erosion.
	15	Groundwater	D	Based on the results of topographical and boring surveys, there will be no impact on groundwater.
	16	Conditions of lakes, marshes and rivers	D	Based on the results of topographical and boring surveys, there will be no impact on rivers.
	17	Coastal and ocean areas	D	Based on the results of topographical and boring surveys, there will be no impact on the ocean.
	18	Flora, fauna and biodiversity	D	The distribution lines route in the Project don't pass through a forest conservation reserve.
	19	Meteorological conditions	D	There will be no impact on meteorological conditions by the construction of the substation and distribution lines.
	20	Landscape	D	Since the substation will be designed in consideration of the environment and the distribution line will be configured alongside existing road, there will be no impact on landscape.
	21	Global warming	B^+	Improved transmission and distribution efficiency and so on will lead positive impacts, such as to reduced emissions of greenhouse gases, but will not have any negative impacts in terms of global warming.
Pollution	22	Air pollution	B^-	In line with the passage of works vehicles, small amounts of air pollutants will be generated.
	23	Water pollution	B^-	There is a possibility that the works will lead to the generation of muddy water.
	24	Soil pollution	B^-	As it is possible that oil will leak from substation transformers, it will be necessary to install oil fences, oil-water separation layers or oil pits.
	25	Solid wastes	B^-	It is possible that old transformers use PCB as insulation oil. When disposing of construction wastes, it will be necessary to survey related legislation, current conditions and appropriate disposal methods.
	26	Noise and vibration	B^-	Since noise and vibration can be expected during the works, it will be necessary to consider the method of bringing materials and setting works times, etc. with a view to mitigating impacts.
	27	Ground subsidence	D	Based on the results of topographical and boring surveys, the works will not cause ground subsidence.
	28	Odor	D	There will be no generation of odor by the construction of the substation and distribution lines.
	29	Sediments	D	There will be no generation of sediments by the construction of the substation and distribution lines.
	30	Accidents	B^-	There is a possibility that electric shocks and electrical accidents caused by contact with live wires will arise during the distribution line works. There is a possibility that the operation of works vehicles will lead to traffic accidents.

2. Service period				
Impact			Rating	Basis and Reasons
Social environment	1	Involuntary resettlement	D	There will be no resettlement of inhabitants as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	2	Local economy such as employment and livelihoods, etc.	B^+	Since enhancement of power supply will mitigate risks, there will be no negative impact on economic activities and lifestyles.
	3	Land use and use of local resources	B^+	Enhancement of power supply will improve the level of convenience.
	4	Social infrastructure and social organizations such as decision making organs, etc.	D	There will be no impacts as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	5	Existing social infrastructure and social services	B^+	Enhancement of power supply will improve the level of convenience.
	6	Impoverished people, indigenous people, minorities	D	There will be no impacts as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	7	Imbalance of damage and benefits	D	Since production activities and retailing activities in stores will not be conducted, there will be no generation of imbalances.
	8	Cultural heritage	D	No cultural heritage or assets exist in the target area.
	9	Local conflicts of interest	D	There will be no generation of conflicts as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	10	Water use, water rights, right of entry	D	Since the NPA has ownership rights, there will be no impact on interests.
	11	Public sanitation	B^+	Enhancement of power supply will improve the state of public health and sanitation.
	12	Disasters and infections such as HIV/AIDS	D	There will be no generation of disasters and infections as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
Natural environment	13	Topography and geology	D	There will be no impacts as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	14	Soil erosion	D	There will be no soil erosion as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	15	Groundwater	D	There will be no impact on groundwater as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	16	Conditions of lakes, marshes and rivers	D	There will be no impact on rivers as a result of operation of the substation in state-owned land and maintenance of the distribution lines.

2. Service period				
Impact			Rating	Basis and Reasons
	17	Coastal and ocean areas	D	There will be no impact on the ocean as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	18	Flora, fauna and biodiversity	D	The distribution line route in the Project doesn't pass through a forest conservation reserve.
	19	Meteorological conditions	D	There will be no impact on meteorological conditions as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	20	Landscape	D	There will be no impact on landscape since the substation will be designed in consideration of the environment and the distribution line will be configured alongside existing road.
	21	Global warming	B^+	Improved transmission and distribution efficiency and so on will lead positive impacts, such as to reduced emissions of greenhouse gases, but will not have any negative impacts in terms of global warming.
Pollution	22	Air pollution	D	There will be no air pollution as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	23	Water pollution	D	There will be no water pollution as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	24	Soil pollution	D	There will be no soil pollution as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	25	Solid wastes	D	There will be no generation of solid wastes as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	26	Noise and vibration	D	There will be no impact from noise and vibration as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	27	Ground subsidence	D	There will be no impact from ground subsidence as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	28	Odor	D	There will be no generation of odor as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	29	Sediments	D	There will be no generation of sediments as a result of operation of the substation in state-owned land and maintenance of the distribution lines.
	30	Accidents	D	There will be no generation of accidents as a result of operation of the substation in state-owned land and maintenance of the distribution lines.

Assessment (A^+: Major positive impacts are expected; A^-: Major negative impacts are expected; B^+: Some positive impacts are expected; B^-: Some negative impacts are expected; C: Survey is required as impacts are unclear; D: Impacts are minimal or non-existent).

1-2-5 Forecast Impacts and Mitigation Measures

Measures geared to averting and mitigating the impacts expected to arise due to Project implementation will be examined. Table 1-2-5.1 shows the draft plan for aversion and mitigation measures. All cost for these mitigation measures are included in the total Project cost, except for the cost to explain for residents. NPA, who is in charge of explanation for residents, shall hold the meeting with residents and/or take other methods to explain the contents of the Project and the construction with the support of contractors and consultant. The results of meeting shall be reflected the Project and the construction plan. For social consideration, a small scale resettlement will be necessary in this Project. The Security Section of NPA is in charge of this resettlement and plans to offer alternative land and provide the necessary guarantee money with support of MEWR. The contact person of the resettlement is an environmental engineer of NPA, and this resettlement shall be completed before the commencement of the construction.

The Study Team will explain and encourage the NPA to implement these measures during the Project construction phase and in tandem with the monitoring of environmental impacts after facilities go into service. Regarding to the monitoring, NPA will submit the monitoring results to the Environmental Protection Agency because this agency inspects the environmental impacts following the Environmental Protection Agency Act. As mentioned above, Sierra Leone has no concrete environmental controls or criteria containing numerical targets and so on; rather it uses the guidelines by the World Health Organization, World Bank and advanced countries. And NPA does not have the necessary equipment for the quantitative monitoring. Therefore, according to the international methods, NPA will implement the quantitative monitoring for items as much as possible, and the qualitative monitoring for other items, such as the periodical observation and discussion. The Security Section of NPA is in charge of this monitoring.

Table 1-2-5.1 Aversion and Mitigation Measures

Potential negative impacts		Countermeasures envisaged in the preparatory survey		Monitoring Method	Implementation Structure
		Planning stage	During execution		
1	Involuntary resettlement	・ In order to minimize resident resettlement, plan construction on state-owned land for substations and alongside existing roads for distribution lines. Concerning distribution lines, plan use of long-size utility poles and cables, etc. ・ In order to avoid unnecessary resettlement of residents, aim to secure appropriate height and clearance between residences and transmission and distribution facilities upon referring to experience in World Bank sponsored projects, etc.	・ Inform the local residents about the works plan. ・ Compile an appropriate works schedule. ・ Ensure that contractors adopt appropriate execution methods.	・ Discussions and information exchange with residents (occasionally) ・ Conduct regular discussions and inspections among the NPA, contractors and consultant and carry out guidance and improvement as needed (expected to record in progress reports monthly).	NPA, contractors and consultant
2	Local economy such as employment and livelihoods, etc.	・ Aim to minimize impact through securing appropriate height and clearance between transmission and distribution facilities (power lines, utility poles, etc.) and shops.	・ Inform the local residents about the works plan. ・ Compile an appropriate works schedule. ・ Ensure that contractors adopt appropriate execution methods.	・ Discussions and information exchange with residents (occasionally) ・ Conduct regular discussions and inspections among the NPA, contractors and consultant and carry out guidance and improvement as needed (expected to record in progress reports monthly).	NPA, contractors and consultant

Potential negative impacts		Countermeasures envisaged in the preparatory survey		Monitoring Method	Implementation Structure
		Planning stage	During execution		
5	Existing social infrastructure and social services	・ Concerning general traffic controls and power cut, minimize the impact on citizen lifestyles through compiling appropriate plans upon holding discussions with related agencies.	・ Inform the local residents about the works plan. ・ Compile an appropriate works schedule. ・ Ensure that contractors adopt appropriate execution methods.	・ Discussions and information exchange with residents (occasionally) ・ Conduct regular discussions and inspections among the NPA, contractors and consultant and carry out guidance and improvement as needed (expected to record in progress reports monthly).	NPA, contractors and consultant
11	Public sanitation	・ Install temporary toilets for construction workers, compile an appropriate plan to manage wastes	・ Ensure that contractors adopt appropriate use of toilets and waste management methods.	・ Conduct regular discussions and inspections among the NPA, contractors and consultant and carry out guidance and improvement as needed (expected to record in progress reports monthly).	NPA, contractors and consultant
22	Air pollution	・ In order to reduce exhaust gas emissions from works vehicles, compile an appropriate works plan and operating plan.	・ Periodically conduct the maintenance and inspection of works vehicles and equipment and ensure that contractors adopt appropriate execution methods.	・ Conduct regular discussions and inspections among the NPA, contractors and consultant and carry out guidance and improvement as needed (expected to record in progress reports monthly).	NPA, contractors and consultant

Potential negative impacts		Countermeasures envisaged in the preparatory survey		Monitoring Method	Implementation Structure
		Planning stage	During execution		
23	Water pollution	・ If necessary, include appropriate drainage facilities into the execution plan.	・ To ensure that muddy water is not generated, ensure that contractors conduct proper wastewater treatment.	・ Conduct regular discussions and inspections among the NPA, contractors and consultant and carry out guidance and improvement as needed (expected to record in progress reports monthly).	NPA, contractors and consultant
24	Soil pollution	・ In order to prevent oil leaks, install oil fences, oil-water separation layers or oil pits around transformers. ・ In order to prevent oil from infiltrating the ground, cover the necessary areas of substation sites with concrete or take other countermeasures.		・ Discussions and information exchange with residents (occasionally) ・ Conduct regular discussions and inspections among the NPA, contractors and consultant and carry out guidance and improvement as needed (expected to record in progress reports monthly).	NPA, contractors and consultant

Potential negative impacts		Countermeasures envisaged in the preparatory survey		Monitoring Method	Implementation Structure
		Planning stage	During execution		
25	Solid wastes		・ Carry construction wastes to appropriate disposal sites while preventing fly-off and dropping on the way. ・ Carry waste products including PCB to the storage area. ・ Ensure that contractors transport wastes properly so that it is not scattered over the surrounding area.	・ Discussions and information exchange with residents (occasionally) ・ Conduct regular discussions and inspections among the NPA, contractors and consultant, measure the volume of generated wastes and carry out guidance and improvement as needed (expected to record in progress reports monthly).	NPA, contractors and consultant
26	Vibration and noise	・ Compile an appropriate execution plan that gives consideration to the mitigation of vibration and noise during works. ・ Incorporate low-noise and low-pollution materials, equipment and machinery into plans.	・ Inform the local residents about the works plan. ・ Compile an appropriate works schedule. ・ Periodically conduct the maintenance and inspection of construction equipment and vehicles. ・ Ensure that contractors adopt appropriate execution methods. ・ Conduct appropriate traffic control.	・ Discussions and information exchange with residents (occasionally) ・ Conduct regular discussions and inspections among the NPA, contractors and consultant and carry out guidance and improvement as needed (expected to record in progress reports monthly).	NPA, contractors and consultant

Potential negative impacts		Countermeasures envisaged in the preparatory survey		Monitoring Method	Implementation Structure
		Planning stage	During execution		
30	Accidents	・ Ensure safety for local residents and thoroughly prevent accidents on sites. In order to prevent electric shocks and fires, etc. due to the distribution facilities, ensure safe distance between power lines and buildings. Also, enhance the safety factor of the distribution network. ・ Adopt optimum routes for works vehicles with a view to minimizing traffic accidents. ・ Adopt a works schedule that gives consideration to traffic rush hour times.	・ Comply with existing NPA safety rules. ・ Compile an appropriate works schedule. ・ Periodically conduct the maintenance and inspection of construction equipment and vehicles. ・ Ensure that contractors adopt appropriate execution methods. ・ Conduct appropriate traffic control.	・ Discussions and information exchange with residents (occasionally) ・ Conduct regular discussions and inspections among the NPA, contractors and consultant and carry out guidance and improvement as needed (expected to record in progress reports monthly).	NPA, contractors and consultant

CHAPTER 2 CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

In the Poverty Reduction Strategy Paper-II "Agenda for Change," which was announced on May 20, 2009, the Government of Sierra Leone specified construction, development and improvement in the four priority sectors of electric power, agriculture, roads and human resources development (education and public health) as the primary objective of the state.

Based on the superior objective indicated in Poverty Reduction Strategy Paper-II, the Project aims to reinforce, construct and repair power supply facilities, which are essential and necessary infrastructure for maintaining metropolitan functions and ensuring the stable operation of social and public facilities in Sierra Leone and improving the living standard of residents in Freetown and its expanding environs.

In order to achieve the above objective, the Project aims to contribute to construction of the stable power supply setup in Freetown through constructing the power distribution network, and thereby vitalize socioeconomic and public welfare activities and improve civic lifestyles in the capital Freetown and its environs.

The Project entails construction of 33/11 kV distribution substations, repair and extension of 33 kV distribution line facilities and 11 kV distribution lines and procurement of low voltage distribution equipment and materials, with a view to conducting safe, stable and efficient power distribution to areas where demand for power is growing or expected to grow due to population increase from Goderich to York in Freetown. These activities were raised as a top priority project in the Master Plan Study on Power Supply in Western Area (MP Study) that was implemented in 2008~2009.

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Concept

The Government of Sierra Leone requested the Government of Japan to conduct the Project as a grant aid undertaking and as part of the priority construction of power facilities proposed in the Master Plan Study on Power Supply in Western Area (MP Study) that was implemented by JICA based on the request by the Government of Sierra Leone in fiscal year 2009. The Project aims to improve existing power distribution facilities that are deteriorated, unstable and have much system losses in Freetown and its environs, and thereby vitalize socioeconomic and public welfare activities and improve civic lifestyles in that area. In terms of the basic policy, the need, validity and urgency of the Project will be verified, while maintaining collaboration with other donors, and the transmission and distribution network will undergo appropriate strengthening based on the future demand forecast that was proposed in the Master Plan Study.

(2) Concept regarding Natural Conditions

1) Temperature and Humidity

The Project area has a marine tropical climate with a high annual average temperature of 26℃ to 28℃ and a mean maximum temperature of 35.3℃, and humidity is also high at an average of 79.5 percent throughout the year, ranging from 72.5 percent to 87.5 percent.

Concerning the major substation and distribution facilities and equipment that will be installed outdoors in the Project, equipment structures will be designed to ensure that temperature is maintained in the normal operating range and operation and maintenance are not hindered irrespective of temperature rises caused by the outside temperature and direct sunlight. In particular, concerning humidity inside closed distribution panels, adoption of space heaters will be examined in order to prevent condensation caused by temperature differences. Furthermore, impact of salt damage will be considered in the design of equipment and materials for Goderich Primary Substation and distribution lines alongside the coast.

2) Rainfall

Annual average rainfall in Freetown is approximately 3,100 mm, which averages out to approximately 258 mm per month, however, this increases greatly to 479.4 mm per month during the rainy season which lasts from May to October (peak average monthly rainfall during the rainy season is 805.6 mm in August, while minimum average monthly rainfall is 171.3 mm in May). On the other hand, the dry season lasts from November to April, during which time average monthly rainfall dries up to 37.2 mm. Accordingly, there is a huge disparity in rainfall between the rainy and dry seasons. The total number of rainy days during the rainy season is 139 (peaking at 27 days per month), indicating that rain falls almost every day. In contrast, there are only 23 rainy days during the dry season. Therefore, equipment and facilities installed outdoors will be designed with consideration given to waterproofing.

3) Wind

Average monthly wind velocity in the Project target area ranges from 9 km/h to 14 km/h, and the annual average wind velocity is 12 km/h, indicating that there is little disparity between months in terms of wind velocity. However, the average number of squalls is four per month and around 24 per year, and winds during squalls can reach velocity of up to 90 km/h (approximately 25 m/sec). Accordingly, when selecting equipment, designs that can withstand the maximum wind velocity will be adopted.

4) Lightning

Sierra Leone experiences up to 18 days of lightning per month during the rainy season, and lightning is a relatively common occurrence throughout the year. Therefore, it will be necessary to incorporate lightning protection into distribution lines and distribution and substation equipment.

5) Earthquake

Since Sierra Leone has no history of earthquakes, there is no need to take earthquakes into account in the design, however, as a precaution against damage to equipment during transportation, horizontal vibration of 0.1G will be assumed as a design condition.

6) Salt Damage

As Goderich Primary Substation, which will be newly constructed, is situated approximately 700 m from the coastline, it will be necessary to select outdoor equipment that is resistant to salt damage.

(3) Concept regarding Socioeconomic Conditions

Since power interruptions will arise when switching between existing and new distribution and substation facilities in the Project, it will be necessary to compile the schedule and strive to shorten interruption times in order to minimize the impact on consumers.

When constructing power distribution lines, it will be necessary to select routes that minimize the need to cut trees and prepare access roads, etc. for construction vehicles. Moreover, during construction of foundations and electric poles and when conducting excavation works, it will be necessary to take ample care to ensure that underground infrastructure such as telephone lines, water supply and sewerage lines are not impacted; moreover, when conducting overhead line works, it will be necessary to design and construct facilities so as to soundly secure safe clearance with existing distribution lines, telephone lines and roads and avoid interference with existing infrastructure in accordance with applicable laws and regulations in Sierra Leone.

(4) Concept regarding Construction Conditions

Similar undertakings to the Project have been implemented in Freetown in recent years, for example, construction of Regent substation and distribution lines under Japan’s Grant Aid and construction of transmission and distribution lines by the World Bank; however, local contractors have very little experience of directly implementing construction of substations and installation of substation and distribution facilities but rather they have worked as subcontractors providing labor for overseas construction firms. Having said that, it is possible to procure transporting vehicles and small-scale construction equipment in Sierra Leone.

Moreover, since the Project works will entail switching of existing distribution equipment and cutting of power, it will be necessary to continually perform work with priority given to safety under the supervision of skilled engineers. If local workers are subcontracted by a Japanese contractor, it will be desirable to use workers who have experience with similar projects as much as possible.

(5) Concept regarding Utilization of Local Contractors and Materials

1) Utilization of Local Contractors

As a rule, local workers will be utilized as far as possible in the substation and distribution line construction and installation works in the Project. However, as Sierra Leone doesn't have large numbers of skilled engineers and technicians, it will be necessary to dispatch engineers and technicians from Japan or third countries in order to conduct quality control, schedule management, safety control, testing and adjustment, etc.

2) Utilization of Local Equipment and Materials

It is possible to procure basic works materials such as aggregate, cement and reinforcing bars in Sierra Leone, however, it will be necessary to procure finishing materials, AC and plumbing materials, distribution and substation equipment, piping, cables and other materials for mechanical and electrical works from Japan or third countries.

3) Procurement of Third Country Products

The substation and distribution equipment and materials currently used in Sierra Leone are all imported from Europe and other foreign countries. Accordingly, ample consideration will be given to procuring the equipment and materials necessary for constructing the Project substation and distribution facilities from DAC or ASEAN countries and other third countries.

When procuring equipment and materials from third countries, ample consideration will be given to price, quality, delivery schedule, availability of spare parts after equipment goes into service, post-sales service and compatibility with existing equipment.

(6) Concept regarding Maintenance Capacity of the Implementing Agency

Following the procurement and installation of Project equipment, the NPA will be responsible for conducting operation and maintenance as it does with existing equipment. Since the NPA owns and maintains substations of similar size to the Project facilities that have been constructed through past assistance from Japan and other donors, it is deemed to possess sufficient operation and maintenance capacity. However, since it lacks knowledge about preventive maintenance including routine inspections, etc., Japanese technicians will conduct OJT (on the job training) including guidance on the importance of routine inspections and periodic inspections, etc. during the works period as well as provide the necessary spare parts, test apparatus, maintenance tools and operation and maintenance manuals. Moreover, effort will be made to enhance the effective and efficient operation of facilities through proposing the operation and maintenance setup following completion and securing cooperation with the Project for Capacity Development for Maintaining Power Supply Facilities in the Republic of Sierra Leone implemented in parallel with the Project.

(7) Concept regarding the Scope and Grade of Facilities and Equipment, etc.

In consideration of the above conditions, the following basic concept is compiled regarding the contents, scope and technical level of equipment and materials to be procured in the Project.

1) Concept regarding the Scope of Facilities and Equipment

The Project entails the construction of substation and distribution facilities for providing stable supply of electricity to the inhabitants and social and public welfare facilities of the Project area based on the projected power demand in the target year of 2018 (five years after completion of works), and the Japanese side will conduct the minimum necessary procurement and installation of equipment. The Japanese side will also procure the low voltage distribution equipment, however, installation will be conducted by the Sierra Leone side in order to promote sustainable operation and maintenance technique of the distribution facilities, in parallel with "the Project for Capacity Development for Maintaining Power Supply Facilities in the Republic of Sierra Leone" being conducted by the Japanese side.

Moreover, in order to realize economic design, standard equipment and materials in compliance with international standards will be adopted as far as possible and the minimum necessary composition and specifications of equipment will be selected.

2) Concept regarding the Grade of Equipment

When conducting design of distribution equipment to be procured and installed in the Project, care will be taken to comply with the existing equipment composition, NPA technical criteria and works manuals and the technical levels of the NPA, which will be responsible for operation and maintenance following supply.

(8) Concept regarding Construction and Procurement Methods and Schedule

Since the Project will be implemented based on Japan's grant aid scheme, it will be necessary to complete the installation and handover (including OJT) within the period prescribed in the grant agreement signed between JICA and the Government of Sierra Leone. Moreover, in order to finish on time and realize the anticipated effects, it will be necessary to coordinate the works on the Japanese side with the works on the Sierra Leone side and compile the implementation schedule with a view to minimizing power interruptions in the existing distribution network and giving consideration to inland transportation routes, transportation methods, lead times and procedures, etc.

2-2-2 Basic Plan (Construction Plan / Equipment Plan)

(1) Overall Plan

1) Design Criteria

Upon examining the scale and specifications of the Project according to the above conditions, the following design criteria have been adopted.

① Construction site, location and altitude

Substation construction site: Freetown City, Goderich, 36 m above sea level

② Climate and natural conditions

Outside temperature:	Maximum and mean maximum 41.0℃ / 28.0℃
Annual mean	26.3℃
Minimum and mean minimum	17.0℃ / 25.0℃
Design temperature:	Indoor equipment 35℃ (maximum),
	Outdoor equipment 40℃ (maximum))
Design relative humidity	Maximum 88%
Design wind velocity	25 m/sec
Rainfall	Annual mean maximum 3,100 mm
Annual thunderstorm days (IKL)	95 days
Attached salt density	0.5 mg/cm2
Seismic force	Horizontal 0.1 G
	(only applicable to electrical items)
Bearing ground conditions (permissible bearing force)	250kN/m2
Salt contamination	0.5 mg/cm2 (heavy)

③ Applicable standards

Japan Industrial Standards (JIS): Applicable to industrial products in general

Japanese Electrotechnical Committee standards (JEC): Applicable to electrical products in general

Japan Electrical Manufacturers' Association standards (JEM): Ditto

Japanese Electric Wire & Cable Makers' Association standards (JCS): Applicable to electrical wire and cable

Technical standards concerning electrical equipment: Applicable to electrical works in general

International Electrotechnical Commission (IEC): Applicable to electrical products in general

International Organization for Standardization (ISO): Applicable to electrical and mechanical products in general

Related standards and criteria in Sierra Leone: Mainly applicable to works execution

④ Units of use

As a rule, the international system of units (SI units) will be applied.

⑤ Electric system

The electric system applied in the target project will be as indicated in Table 2-2-2.1 in compliance with existing equipment.

Table 2-2-2.1 Electric System

Item	Distribution Line		Low Voltage (AC)	DC
Nominal voltage	33 kV	11 kV	415-240 V	110 V
Peak voltage	36 kV	12 kV	460-252 V	121 V
Distribution method	3 phase 3 wire		3 phase 4 wire	2 wire
Frequency	50 Hz			-
Grounding method	Transformer grounding (non-effective grounding)		Direct grounding (effective)	(－) Side grounding

⑥ Lightning impulse withstand voltage (LIWV)

In designing transmission and substation facilities, the following lightning impulse withstand voltage (LIWV) applied to existing equipment will be adopted in order to coordinate insulation between equipment and secure insulation resistance over the entire system.

33kV system: LIWV 170 kV

11kV system: LIWV 95 kV (lightning arrester is 75kV)

2) Facilities Layout Plan

The layout plan of distribution and substation facilities to be constructed in the Project will be as follows.

① The site for Goderich Primary Substation to be constructed in the Project is indicated in Figure GR-C1. This land is currently owned by Sierra Leone Broadcasting Company (SLBC), however, it issued a letter of consent to use the land to the Ministry of Energy and Water Resources (MEWR) on December 23, 2010. The site measures 30 m x 50 m = 1,500 m^2 and there is a 6 m wide road on the east side running a water main from Gumadam to inner Freetown, while the west side is unused land containing a radio antenna owned by the SLBC.

② As is shown in Figures GR-C1 and GR-A1, Goderich Primary Substation is composed of the switchgear room, low voltage panel room, office, operation and maintenance office, warehouse, precision parts storeroom, entrance hall and toilets. Indoor cubicle type panels will be adopted for the 33 kV, 11 kV and low voltage panels, and outdoor equipment will be adopted for the 33/ll kV (main) transformer, earthing transformer and station service transformer. As a rule, on-site operation of equipment will be adopted.

③ Figure DL-C1 shows the standard drawing of the planned secondary substations, which will consist of 11 kV/415 V distribution transformer foundations, low voltage distribution panel foundations, gates and outer fences.

④ The 33 kV and 11 kV distribution line to be constructed in the Project will primarily comprise overhead lines, which are easier to construct and maintain, although underground cables will also be adopted as appropriate. Moreover, the existing distribution line routes will be followed as much as possible when constructing the new distribution lines. The buried depth of cables will as a rule be GL-1,200 mm under roads and other parts bearing heavy loads and GL-600 mm in other places.

(2) Outline of the Project Activities

Table 2-2-2.2 shows an outline of the basic Project works based on the abovementioned basic design concept, design criteria and facilities layout.

Table 2-2-2.2 Outline of the Project Activities

Project Contents
1. Construction of Goderich Primary Substation (1) Construction of Goderich Primary Substation building (including building services) - Substation building: reinforced concrete single story structure, total floor area 243.0 m^2 - Guardhouse: reinforced concrete single story structure, total floor area 3.24 m^2 - Auxiliary equipment (water tank, septic tank, soakage pit, foundations, main transformer, earthing transformer, station transformer, parking space, etc.) **2. Procurement and installation of the following equipment:** (1) Equipment for Wilberforce Primary Substation - 33 kV switchgear panel - 33 kV switchgear connection panel - Other necessary auxiliary equipment and foundations (2) Equipment for Goderich Primary Substation - Installation of 33 kV and 11 kV switchgear - Installation of 33/ll kV step-down transformer (15 MVA), station transformer (630 kVA) and 33 kV earthing transformer - Other necessary auxiliary equipment and foundations (3) Construction of 33 kV distribution line from Wilberforce Primary Substation to Goderich Primary Substation (approximately 5.8 km) (4) Construction of 11 kV distribution line (approximately18.5 km) - Construction of 11 kV distribution line from Babadori River to Sussex (repair and extension works; however, equipment and materials will only be supplied for the 11 kV distribution line in Goderich Village secondary substation, Goderich-2 secondary substation, and the densely populated area of Goderich. - Construction of necessary secondary substations (including transformer foundations, distribution panel foundations, fences and gates, etc.) **3. Procurement of the following equipment and materials (installation by the NPA)：** (1) Procurement of 11 kV distribution line equipment and materials Procurement of equipment and materials for Goderich Village secondary substation and Goderich-2 secondary substation and distribution line equipment and materials for the densely populated area of Goderich area (2) Procurement of equipment and materials for repair and extension of the low voltage distribution network in the Project target area (utility poles, overhead wire, cable, etc.) (3) Procurement of spare parts and maintenance tools for distribution and substation facilities (4) Procurement of construction machinery for maintenance (bucket truck, crane-equipped truck, rock crusher, etc.) (5) Procurement of operation and maintenance manual and implementation of OJT

(3) Equipment and Facilities Plan

1) Facilities Plan

The facilities to be constructed in the Project is comprise the building and auxiliary equipment of Goderich Primary Substation including building services and outdoor civil works. The 11 kV

transformer and low voltage switchgear at the secondary station will be installed outdoors, and foundations and fences, etc. will be included in the equipment installation works. The building outline of Goderich Primary Substation is as follows.

① Substation building

- Reinforced concrete single story structure, total floor area 243.0 m2
- Foundations: Reinforced concrete spread foundations
- Exterior finishing: Roof: Aluminum-zinc alloy coated steel sheets (t = 0.8 mm)
  Wall: Concrete block (t = 150 mm), mortar trowel finish + EP
- Interior finishing: As indicated in Table 2-2-2.3

Table 2-2-2.3 Substation Building Interior Finishing

Room	Region	Finishing/Specifications	Ceiling Height
Entrance hall Corridor Kitchenette	Floor	Mortar trowel finish and non-slip paint finish	
	Walls	Mortar trowel finish + EP	
	Ceiling	Decorative plasterboard	2,500 mm
Operation and maintenance office Office Test apparatus storeroom	Floor	Mortar trowel finish and non-slip paint finish	
	Walls	Mortar trowel finish + EP	
	Ceiling	Decorative plasterboard and insulation lining	3,000 mm
Low voltage panel room Switchgear room	Floor	Mortar and dust-resistant paint finish	
	Walls	Mortar trowel finish + EP	
	Ceiling	Decorative plasterboard and insulation lining	3,000 mm
Toilets	Floor	300 x 300 magnetic tiles (Non slip type)	
	Walls	300 x 300 China tiles	
	Ceiling	Decorative plasterboard	2,500 mm
Storage	Floor	Mortar trowel finish	
	Walls	Mortar trowel finish + EP	
	Ceiling	Decorative plasterboard	2,500 mm

- Fittings:Windows: Aluminum sash (partially with lattice) + pane glass 5 mm thick
- Doors: Steel (but wood for toilets and kitchenette)
- Building services: Air conditioning:Operation and maintenance office, office, low voltage panel room, switchgearroom
- Ventilation: Switchgear room, low voltage panel room, test apparatus storeroom, kitchenette, toilets, warehouse
- Sanitary ware: Kitchenette, toilets
- Human waste treatment: Septic tank,soakage pit (outdoor)
- Other: Reception counter

② Guardroom

- Concrete block structure, single story, total floor area 3.24 m2
- Foundations: Reinforced concrete spread foundations

- −Exterior finishing: Roof: Aluminum-zinc alloy coated steel sheets (t = 0.8 mm)
  Wall: Concrete block (t = 150 mm),
  mortar trowel finish + EP
- −Interior finishing: Mortar trowel finish + EP
- −Fittings: Windows: Aluminum sash (partially with lattice) +
  pane glass 5 mm thick
- −Doors: Steel
- −Other: Wood counter

③ Outdoor facilities

- −Transformer foundations: 33/11 kV step-down transformer, earthing transformer, station service transformer
- −Oil-water separation tank
- −Water tank and frame
- −Exterior light foundations (10), in-site road and paving

2) Equipment Plan Basic Items

When selecting the equipment and materials for construction of the substation, consideration will be given to securing ease of operation and maintenance following completion. Substation equipment will basically be monitored and controlled on-site by NPA operation and maintenance personnel, and outdoor lighting necessary for proper monitoring will be installed. Moreover, when selecting the equipment to be installed, consideration will be given to the local weather conditions, and fences will be built around the substation and transformers for safety purposes.

As a rule, under the following conditions, overhead lines will be adopted for the 33 kV and 11 kV distribution lines (joint use lines will be adopted in parts for the existing 11 kV line and low voltage trunk line).

① In areas with existing distribution line or low voltage distribution line, new distribution lines will be constructed on the same routes as far as possible with a view to reducing friction with residents and simplifying maintenance.

② Along roads that are scheduled for widening, distribution line routes will be planned alongside the planned routes.

③ When repairing existing distribution lines, effort will be made to compile execution plans with a view to shortening power interruption times as much as possible.

However, underground cable lines will be appropriately adopted in districts where roads are too narrow for the necessary right of way to be secured or where there is risk of contact with trees.

3) Contents of Equipment Plan

The major contents concerning the planned distribution network in Freetown are as indicated below.

① Installation of 33 kV switchgear in Wilberforce Primary Substation

Major items: 33 kV indoor circuit breaker panel and cable connection panel: 1 set

② Construction of 33 kV Goderich Primary Substation

Major items: 33 kV and 11 kV indoor switchgear panels 1 set

- Step-down transformer (33 / 11 kV, 15 MVA) 1 unit
- Earthing transformer 1 unit
- Station service transformer (11 kV/415-240 V, 630 kVA) 1 unit
- Administration building (approximately 243m2) 1 building
- Other necessary auxiliary equipment and foundations, etc. 1 set

③ Construction of 33 kV distribution line between the existing Wilberforce Primary Substation and Goderich Primary Substation

Major items: 33 kV overhead distribution line Approximately 5.6 km
・33 kV underground cable Approximately 0.2 km

④ Repair and extension of 11 kV distribution line and secondary substations

Major items: 11 kV overhead distribution line Approximately 17.5km
・11 kV overhead insulated distribution line Approximately 1.0km
・11kV/415/240V secondary substations Total 20 locations
- Total repair 15 locations
- New construction 4 locations
- Partial repair 1 location

⑤ Procurement of equipment and materials for repair of low voltage distribution lines

Major items: Low voltage trunk lines from secondary substations: Approximately 23 districts

⑥ Procurement of maintenance power tools and spare parts for distribution and substation equipment 1 set

4) Outline Specifications of Main Equipment

① Equipment to be installed at Wilberforce Primary Substation

Table 2-2-2.4 shows the contents of equipment to be installed at the existing Wilberforce Primary Substation.

In order to connect to the existing 33 kV switchgear panel (currently being installed in the WB Project), a 33 kV connecting panel will be installed in series to the existing panel, a 33

kV circuit breaker panel and 33 kV connecting panel will be prepared for Goderich Primary Substation, and connections will be made by 33 kV cable.

Table 2-2-2.4 Contents of 33 kV Switchgear Panel Installed at Wilberforce Primary Substation

Item/Equipment	Specifications	Quantity
Procurement and installation of 33 kV circuit breaker panel		1 panel
Model	Indoor closed type, air insulation type, vacuum or SF6 gas circuit breaker, 36 kV, 630 A, 25 kA 1 sec, pull-out type, with grounding device	
Procurement and installation of 33 kV connecting panel		2 panels
Model	Indoor closed type, air insulation type	
Procurement and installation of 33 kV power cable	(For connection to the existing 33 kV distribution panel and grid connection)	1 set
Model	18/30 (36) kV, single core copper conductor cable, XLPE insulation, PVC sheath, armor	
Size	185 mm^2	
Procurement of 33 kV line switch	(For grid connection)	1 unit
Model	Indoor type, vertical 1 point switching, with aboveground operated rod	
Rated voltage/current	33 kV/600 A	

② Goderich Primary Substation construction

－Outline of the 33/11 kV step-down transformer

● Capacity

Appropriate capacity will be selected out of the transformer standard capacity upon considering the peak forecast power demand five years after completion of the Project works (2018). Also, transformer with function of on-load tap changer will be adopted in consideration of load fluctuation. Accordingly, the step-down transformer (main transformer) to be installed at the substation in the Project target area will have the following specifications:

- Peak demand power: 12,500 kW
- Necessary capacity: 14,700 kVA (peak demand power/power factor 0.85)
- Main transformer capacity: 15,000 kVA

● Functions

The step-down transformer will be fitted with a load automatic tap changer (voltage adjustment range +5%～－15%、1.25% × +4, -12 tap) on the 33 kV side as a countermeasure for voltage drop.

- Outline of 33 kV power receiving equipment

The 33 kV switchgear panel will be equipped with a circuit breaker (vacuum or SF6 gas circuit breaker, 36 kV, 630 A, 25 kA, 1 sec), measuring instruments and protective relay, etc. and comprise a 33 kV power receiving panel, main transformer panel, earthing transformer panel and instrument panel. Also, a 33 kV distribution panel (CB, measuring instrument, protective relay, etc.) will be installed for connection to Tombo substation in the future.

- Outline of 11 kV distribution equipment

11 kV distribution equipment will be composed of receiving circuit from the 33/ll kV main transformer and distribution feeder panel. The number of feeders will be set upon taking future demand into account and an instrument panel and station service transformer panel will also be installed. Moreover, an 11 kV distribution panel for static condenser will be installed in future for improving voltage drop.

The distribution panel will be equipped with a circuit breaker (vacuum or SF6 gas circuit breaker, 12 kV, 630 A, 20 kA, 1 sec), measuring instruments and protective relay.

Each 11 kV distribution feeder will be an auto-reclosing type and power supply reliability will be enhanced through automatically re-switching the distribution circuit breaker in the event of light shorting accidents.

- Outline of station service equipment

In consideration of energy saving and ease of operation, the substation to be constructed in the Project will be fitted with photo-cell outdoor lights or automatic lights equipped with timer, and it will also have low voltage AC power supply and DC power supply equipment for station control purposes.

Table 2-2-2.5 shows the contents of the construction plan for Goderich Primary Substation, which will be constructed in the Project.

Table 2-2-2.5 Contents of Goderich Primary Substation

Item/Equipment	Specifications	Quantity
Procurement and installation of step-down transformer		1 unit
Model	Outdoor type, oil-immersed self-cooling, equipped with on-load tap changer, and 12 kV 10 kA lightning conductor	
Rated capacity/voltage	10 MVA、33 / 11 kV, 3 phase, +4～-12 tap x 1.25%（HV）, Dyn11	
Applicable standards	IEC/JEC	
Procurement and installation of 33 kV distribution panel		5 panels
Model	Indoor closed type, air insulation type, vacuum or SF6 gas circuit breaker, 36 kV, 600 A, 25 kA 1 sec, draw-out type, with grounding device	
Applicable standards	IEC/JIS/JEM	
Itemized breakdown	1) 33 kV power receiving panel 2) 11/33kV step-down transformer primary panel 3) 33 kV feeder panel (for future) 4) 33 kV grounding transformer primary panel 5) 33 kV instrument panel	1 panel 1 panel 1 panel 1 panel 1 panel
Procurement and installation of 33 kV grounding transformer		1 unit
Model	Outdoor type, oil-immersed self-cooling type, 300A, 10sec, Zn	
Procurement and installation of 11 kV distribution panel		8 panel
Model	Indoor closed type, air insulation type, vacuum or SF6 gas circuit breaker, 12 kV, 600 A and 1200 A, 20 kA 1 sec, draw-out type	
Applicable standards	IEC/JIS/JEM	
Itemized breakdown	1) 11/33kV main transformer secondary panel 2) 11 kV feeder panel (including 1 panel for future use) 3) 11 kV phase modifying panel (for future use) 4) 11 kV instrument panel 5) Station service transformer panel	1 panel 4 panel 1 panel 1 panel 1 panel
Procurement and installation of low voltage distribution panel		4 panel
Model	Indoor closed type, air insulation type	
Applicable standards	IEC/JIS/JEM	
Itemized breakdown	1) AC distribution panel (for auxiliary use) 2) Battery charging panel (including DC panel) 3) AC distribution panel (for local consumers)	1 panel 1 panel 1 panel
Battery	Fully closed lead battery 110 V	
Procurement and installation of station service transformer		1 unit
Model	630kVA, outdoor type, oil-immersed self-cooling type, 11kV/415-240V, Dyn11	

Item/Equipment	Specifications	Quantity
Procurement and installation of 33 kV line switch	(For grid connection)	1 unit
Model	Indoor type, vertical 1 point switching, with aboveground operated rod	
Rated voltage/ current	33 kV/600 A	
Procurement and installation of 33 kV lightning arrester	(For grid connection)	3 units
Model	Indoor type, gapless, with 3 phase batch surge counter	(1 unit/phase)
Rated voltage	36 kV	
Discharge current	10 kA	
Procurement and installation of 11 kV line switch	(For grid connection)	3 units
Model	Indoor type, vertical 1 point switching, with aboveground operated rod	
Rated voltage/ current	12 kV/600 A	
Applicable standards	JIS/JEC/JEM	
Procurement and installation of 11 kV lightning conductor	(For grid connection)	9 units
Model	Indoor type, gapless, with 3 phase batch surge counter	(1 unit/phase)
Rated voltage	12 kV	
Discharge current	10 kA	
Applicable standards	IEC	
Procurement and installation of 33 kV power cable	(For grid connection and station service use)	1 set
Model	18/30 (36) kV, single core copper conductor cable, XLPE insulation, PVC sheath, armor	
Applicable standards	IEC	
Size	185 mm^2	
Attachments	Termination kits, etc.	
Procurement and installation of 11 kV power cable	(For grid connection and station service use)	1 set
Model	6/10 (12) kV, 3-core copper conductor cable, XLPE insulation, PVC sheath, armor	
Applicable standards	IEC	
Size	185 m^2	
Attachments	Termination kits, etc.	

③ 33/11 kV distribution line

Drawings DL-G1~G4 show outlines of the 33/11 kV distribution line route and secondary substations.

－Types of distribution line conductors

Table 2-2-2.6 shows the specifications of the conductors to be used on underground and overhead distribution lines in the Project upon considering the examination results of the Master Plan (September 2009).

Table 2-2-2.6 Specifications of 33/11 kV Distribution Line Conductors

Item/Equipment	Cable Specifications	Remarks
33 kV overhead line	Aluminum cable steel reinforced (ACSR): 240mm^2 Overhead ground wire: Aluminum-covered steel wire (AC)	Line will satisfy line capacity of 33MVA
33 kV underground line	18/30 (36) kV, copper conductor, XLPE insulation, PVC sheath, 185mm^2 (1 phase 2 wires)	
11 kV overhead line	High-tensile aluminum alloy cable (AAAC), 120mm^2	Line will satisfy line capacity of 6 MVA
	Outdoor high-tensile aluminum alloy cable bridge polyethylene insulated cable (AAC-OC), 120mm^2	
11 kV underground line	6/10 (12) kV, copper conductor, 185mm^2, XLPE insulation, PVC sheath, armor	

(Note): XLPE: bridge polyethylene, PVC: polyvinyl chloride

－Outline of 33 kV distribution mounted poles

33 kV distribution lines will be equipped with overhead ground wire in order to prevent line shorting accidents. When repairing the existing 11 kV distribution line between Babadori River (Lumley District) and Goderich Primary Substation (approximately 2.3 km), the joint use approach with 11 kV distribution line will be adopted.

－Outline of 11 kV distribution lines

The following equipment will be considered on the route to Sussex district (approximately 13 km):

- Installation of section switches: Switches will be installed at intervals of approximately 3 km.
- Securing of the future 33 kV distribution line route: In consideration of 33 kV distribution line extension from Goderich Primary Substation to Tombo Primary Substation, 15 meter utility poles will be used in order to secure enough space for installing 33 kV distribution line and overhead ground wire along the 11 kV distribution line route. Crossarm fittings will only be fitted for the overhead ground

wire.

- Since part of the Sussex route (approximately 1 km) runs close by a protected forest reserve, outdoor-type high-tensile aluminum alloy wire bridge polyethylene insulated cable will be used.

－Quantity of distribution lines

The procured quantities of distribution line and overhead grounding wire comprise the plane distance measured on drawings (design quantity), as opposed to the planned installation quantity calculated by multiplying the design quantity by an allowance factor of 1.03 (slack, etc.). This is further multiplied by an allowance factor of 1.10 (works replenishment factor: 10%). The resulting quantities of 33/11 kV distribution lines to be constructed and procured in the Project are as shown in Table 2-2-2.7.

Table 2-2-2.7 33/11kV Distribution Line Quantities

(Unit: m)

No.	Item	33 kV distribution line		11 kV distribution line	
		ACSR 240	AC (overhead ground wire)	AAAC120	AAAC-OC
(1)	Design quantity ①	5,600	5,600	17,450	1,000
(2)	Planned installation quantity ② (① x 3 phase x 1.03 = ②)	17,304	---	53,920	3,090
(3)	Planned installation quantity ② (① x 1.03 = ②)	---	5,768	---	---
(4)	Planned procurement quantity ③ (② x 1.1 = ③)	19,034	6,345	59,312	3,399

④ 11/0.4 kV secondary substations

Figures DL-E1 and DL-C1 show the secondary substations that are to be constructed and repaired in the Project, and Table 2-2-2.8 shows the main specifications.

Table 2-2-2.8 Contents of 11/0.4 kV Secondary Substation Repairs

Item/Equipment	Specifications	Quantity
Distribution transformers		
Model	100～500kVA, 11kV / 415-240 V, 3 phase 4 wire, outdoor type, oil-immersed self-cooling, tap ±5% equipped with no-voltage tap changer, Dyn11	
Applicable standards	IEC/JEC	
Numbers of each capacity	100kVA 200kVA 315kVA（1 unit to be installed by the local side） 400kVA（1 unit to be installed by the local side） 500kVA	4 units 3 units 8 units 3 units 1 unit
Low voltage distribution panel		1 set
Model	Outdoor self-standing type, MCCB, ammeter (with peak demand), voltage indictor, voltmeter	（20 locations）
Civil works and distribution panels	Reinforced concrete spread foundations, CB fence, mesh door (with key)	1 set (12 locations)

⑤ Low voltage trunk line

Figures DL-GA1~GA3 show an outline of the low voltage distribution trunk line route, and Table 2-2-2.9 shows the main specifications.

Table 2-2-2.9 Contents of Low Voltage Trunk Line

Item/Equipment	Specifications	Quantity
Conductor		
Type	AAC 70 mm^2 , 95mm^2 and ABC 70 mm^2 , 95 mm^2	
Quantity	AAC 95 mm^2 87,028m AAC 70 mm^2 9,232m AAC 70 mm^2 483m AAC 95 mm^2 1,098m	87,028m 9,232m 483m 1,098m
Poles		
Type of pole	Steel tube pole, length 10 m	
Type of insulator	Low voltage shackle insulator, China	
Quantity of each type of pole	LA (AAC, drawing-in pole) LB (AAC, angular pole) LC (AAC, terminal pole) LD (ABC, drawing-in pole) LE (ABC, angular pole) 11kv common use (insulator set only)	234 sets 117sets 39 Sets 19 Sets 19 Sets 3,548 Sets
Low voltage cable		
Type	XLPE, 600V	
Quantity	120mm2x1C : 240mm2x1C : 50mm2x4C : 95mm2x4C :	410m 570m 1,263m 948m

5) Spare parts

Spare parts procured in the Project are classified as shown below, and the criteria for selection and supply quantities are also indicated. Table 2-2-2.10 shows the main items.

① Consumable items

Consumable items refer to parts that consume and deteriorate in everyday use and require periodic consumed replacement, and 100 percent of the annual forecast quantity will be procured.

② Replacement parts

Although these parts do not consume and deteriorated in everyday use, they have a high possibility of breakage requiring urgent replacement in the event of accidents. One unit or one set each will be procured.

Table 2-2-2.10 Spare Parts to be Procured in the Project

№	Item	Quantity
(1)	Expendable parts	
	1) Fuses	100% of each type
	2) Lamps	100% of each type
	3) Panel fluorescent lamps including glow lamps	2 of each type
	4) Silica gel	10kg
(2)	Replacement parts	
	1) Protective relays	1 set of each type
	2) Auxiliary relays	1 set of each type
	3) MCCB (each type)	1 set of each type
	4) Instrumentation transformer fuses (high voltage/low voltage)	1 set of each type
	5) 11 kV cable terminal materials	1 set of each type
	6) 33 kV cable terminal materials	1 set of each type
	7) Ballast and fuse for outdoor lightings	1 set of each type
	8) Distribution transformers	1 unit for each capacity
	9) 11 kV section switches	1 set
	10) 11 kV disconnecting switches + fuses	1 set

6) Maintenance test apparatus and tools

In the Project, the test apparatus and tools necessary for properly maintaining the substations and distribution network will be procured. Table 2-2-2.11 shows the main items.

Table 2-2-2.11 Test Apparatus and Tools to be Procured in the Project

№	Item	Quantity
(1)	Test apparatus	
	1) Analog tester	2 units
	2) Simple single phase relay tester	1 unit
	3) Simple 3-phase relay tester	1 unit
	4) Insulating resistance tester (megger) 500 V,1000 MΩ	1 unit
	5) Ditto 2500 V,100 GΩ	1 unit
	6) Portable earthing resistance tester	1 unit
	7) Phase rotation meter	2 units
	8) Low voltage detector	2 units
	9) 33 kV voltage detector	2 units
	10) Digital multi tester	2 units
	11) AC clamp meter	2 units
	12) Insulation oil tester	1 unit
	13) Transformer oil washing device	1 set
	14) Power analyzer	1 set
(2)	Tools	
	1) Hand tool set	4 sets
	2) Grounding tool sets (3-phase)	2 sets
	3) Cable drum jack (5 t)	2 units
	4) Cable drum stand	2 units
	5) Compressor (with cable dices)	1 set
	6) Cable cutter	1 unit
	7) Shimelar (3 units/phase)	2 sets
	8) Tension meter	6 units
	9) GPS（for ascertaining location）	2 units

7) Maintenance equipment

The following equipment will be procured for conducting the appropriate maintenance of substation and distribution facilities to be procured in the Project and implementing recovery works from accidents.

① Truck with Crane

One truck with crane (including necessary spare parts) will be procured in the Project for carrying heavy objects when replacing distribution transformers and moving cable drums, etc. The main specifications are as follows.

- Truck
  - Drive 2-wheel drive, left handle
  - Class of vehicle Minimum 4 ton class
  - Onboard passengers 2

- Engine — 4 cylinder diesel engine
- Accessories and spare parts — 1 set

● Crane

- Drive — Hydraulic crane, truck-loaded type; Truck engine drive
- Lift weight — 3 tons or more at 2.5 m
- Hook Height — Min. 12 m
- Swing angle — 360 degrees
- Accessories and spare parts — 1 set

② Truck with Bucket

One truck with bucket (including necessary spare parts) will be procured in the Project for conducting operation and maintenance work on overhead lines. The main specifications are as follows.

- Drive — 2-wheel drive, left handle
- Class of vehicle — Minimum 3 ton class
- Onboard passengers — 2
- Engine — 4 cylinder diesel engine
- Boom — 360 degrees, rotating speed 1 rotation/minute
- Bucket
  - Type — Hydraulic, truck-loaded type
  - Capacity — 2 passengers or 200 kg
  - Operation height — GL+ 12m (Min.)
  - Drive unit — Truck engine hydraulic pressure
  - Insulation class — 20kV/5 min.
- Accessories and spare parts — 1 set

③ Rock Breaker

Three rock breakers will be procured in the Project for use in cable laying and utility pole erection as part of the maintenance work for distribution facilities. The main specifications are as follows.

- Model — Portable type
- Operation — Compressed air operation
- Compressed air pressure — 6 – 7 kg/cm2
- Air compressor — Oil free / portable type engine driven with air receiver (100 liter)
- Accessories — Hose (100 m), hose reel, others

2-2-3 Outline Design Drawings

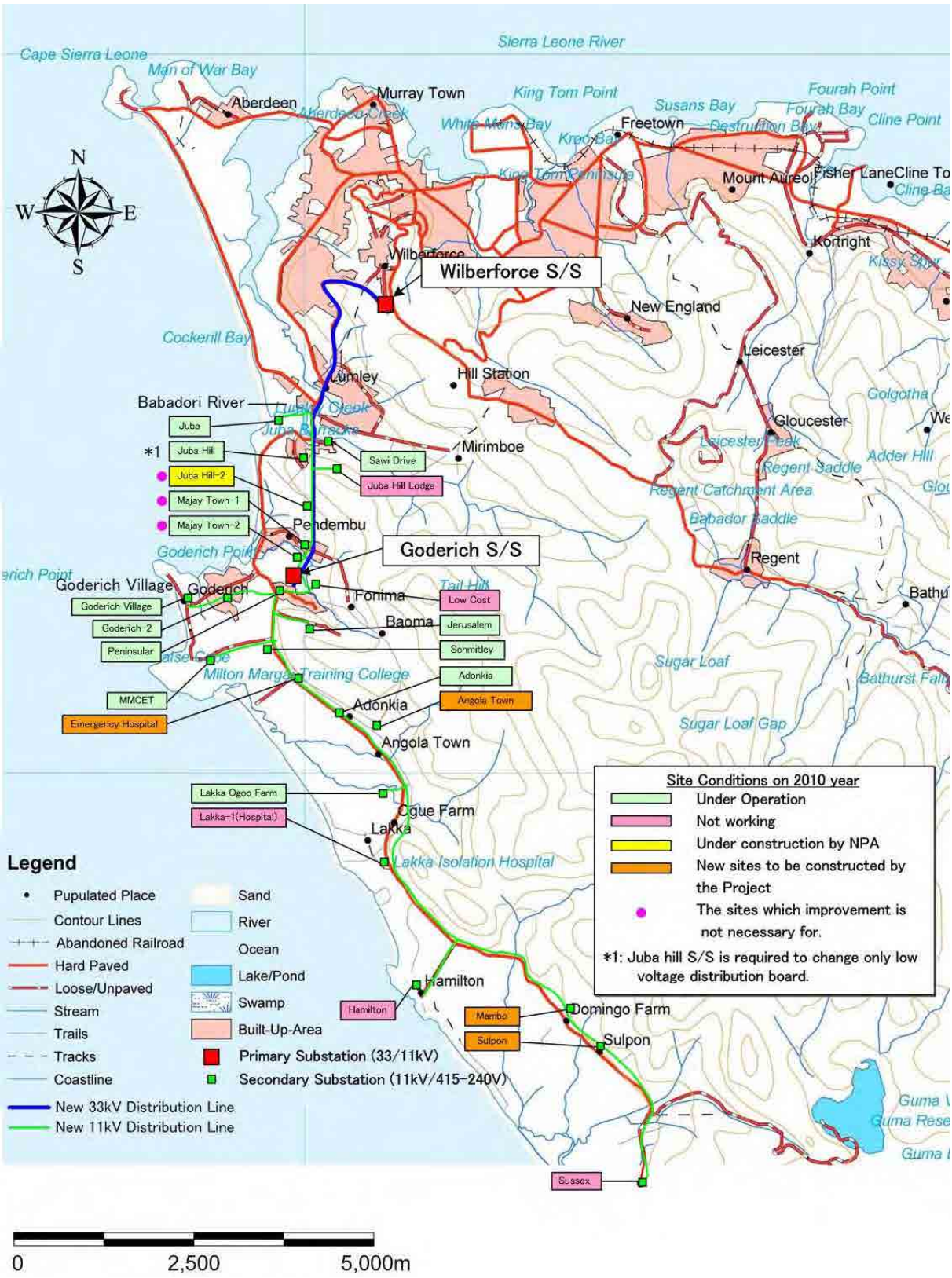
Outline design drawings for the Project are as follows.

	Drawing No.	Drawing Title
<Overall Project>		
(1)	CM-G1	Project Site Map
(2)	CM-G2	11/33kV Network Diagram in Freetown
(3)	CM-E1	Planned 11/33kV Network Diagram
<Wilberforce Substation>		
(4)	WB-G1	Site Map of Wilberforce Primary Substation
(5)	WB-G2	33kV SWGR Layout of Wilberforce Primary Substation
(6)	WB-E1	33kV Single Line Diagram of Wilberforce Primary Substation
＜Goderich Primary Substation＞		
(7)	GR-G1	Site Map of Goderich Primary Substation
(8)	GR-C1	Site Layout of Goderich Primary Substation
(9)	GR-A1	Elevation of Building for Goderich Primary Substation
(10)	GR-E1	11/33kV Single Line Diagram of Goderich Primary Substation
(11)	GR-E2	Low Voltage Single Line Diagram of Goderich Primary Substation
＜33/11 kV distribution line＞		
(12)	DL-G1	33kV Distribution Line Route
(13)	DL-G2	11kV Distribution Network Diagram (for Juba route)
(14)	DL-G3	11kV Distribution Network Diagram (for Goderich route)
(15)	DL-G4	11kV Distribution Network Diagram (for Sussex route)
(16)	DL-GE1	Route Map of 11/33kV Distribution Line (1/5) (Key Map / Legend)
(17)	DL-GE2	Route Map of 11/33kV Distribution Line (2/5)
(18)	DL-GE3	Route Map of 11/33kV Distribution Line (3/5)
(19)	DL-GE4	Route Map of 11/33kV Distribution Line (4/5)
(20)	DL-GE5	Route Map of 11/33kV Distribution Line (5/5)
<Secondary substation and standard 33/11 kV utility pole drawings>		
(21)	DL-C1	Foundation Plan of Secondary Substation
(22)	DL-E1	Single Line Diagram of Secondary Substation
(23)	DL-GA1	Pole Type for 11/33kV Distribution (CA Type: Combined Intermediate)
(24)	DL-GA3	Pole Type for 11/33kV Distribution (CC Type: Combined Middle Angle)

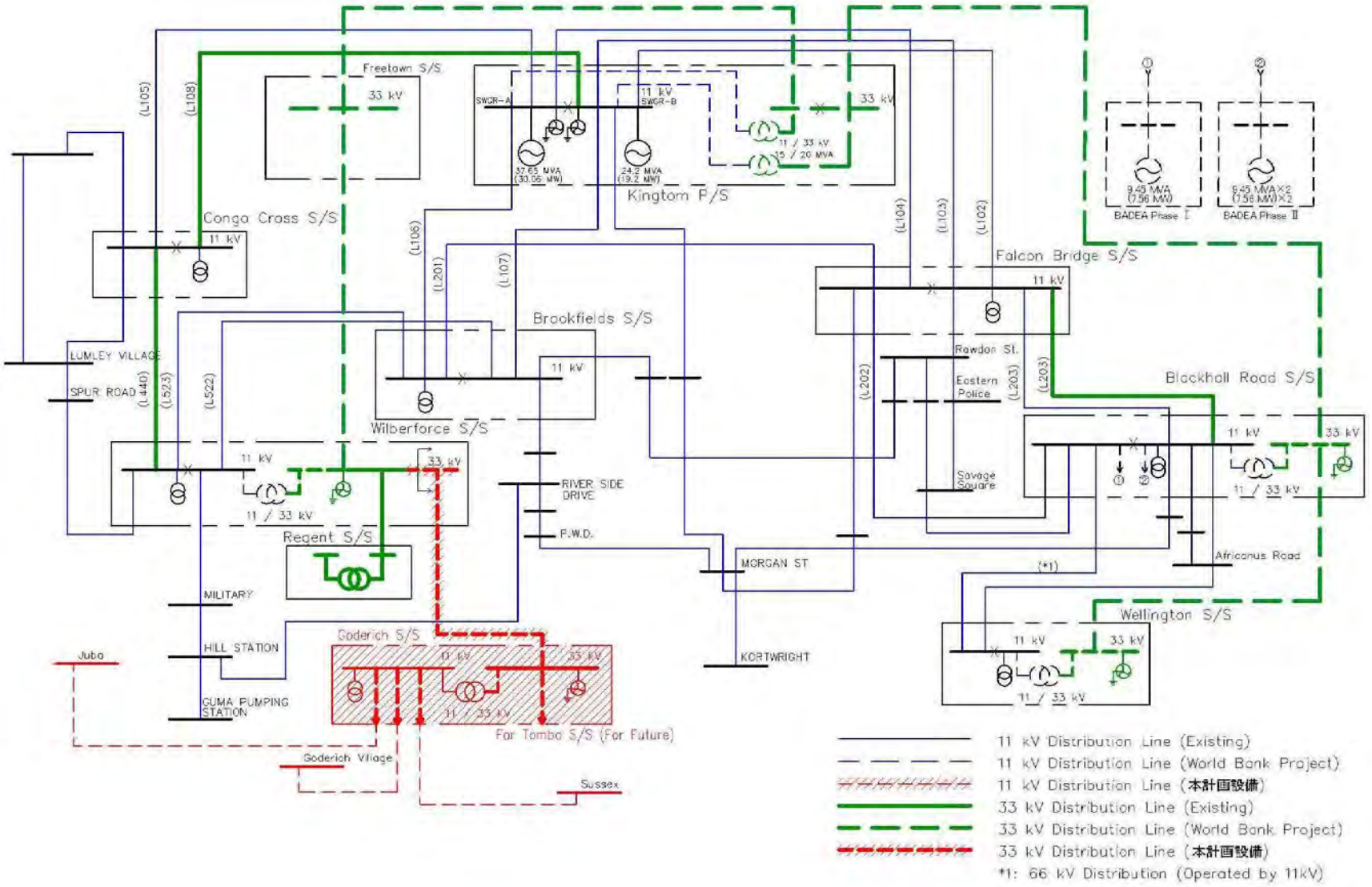
(25)	DL-GA10	Pole Type for 11kV Distribution (SA Type: Combined Intermediate)
(26)	DL-GA12	Pole Type for 11kV Distribution (SC Type: Combined Middle Angle)
(27)	DL-GA20	Pole Type for 11/33kV Distribution (1A/3A Type: Intermediate)
(28)	DL-GA22	Pole Type for 11/33kV Distribution (1C/3C Type: Middle Angle)
(29)	DL-GA29	Pole Type for 11kV Distribution (1L Type: Transformer with line end)
(30)	DL-GA30	Part List on each Pole Type for 11kV Distribution Line

<Low Voltage Trunk Line>

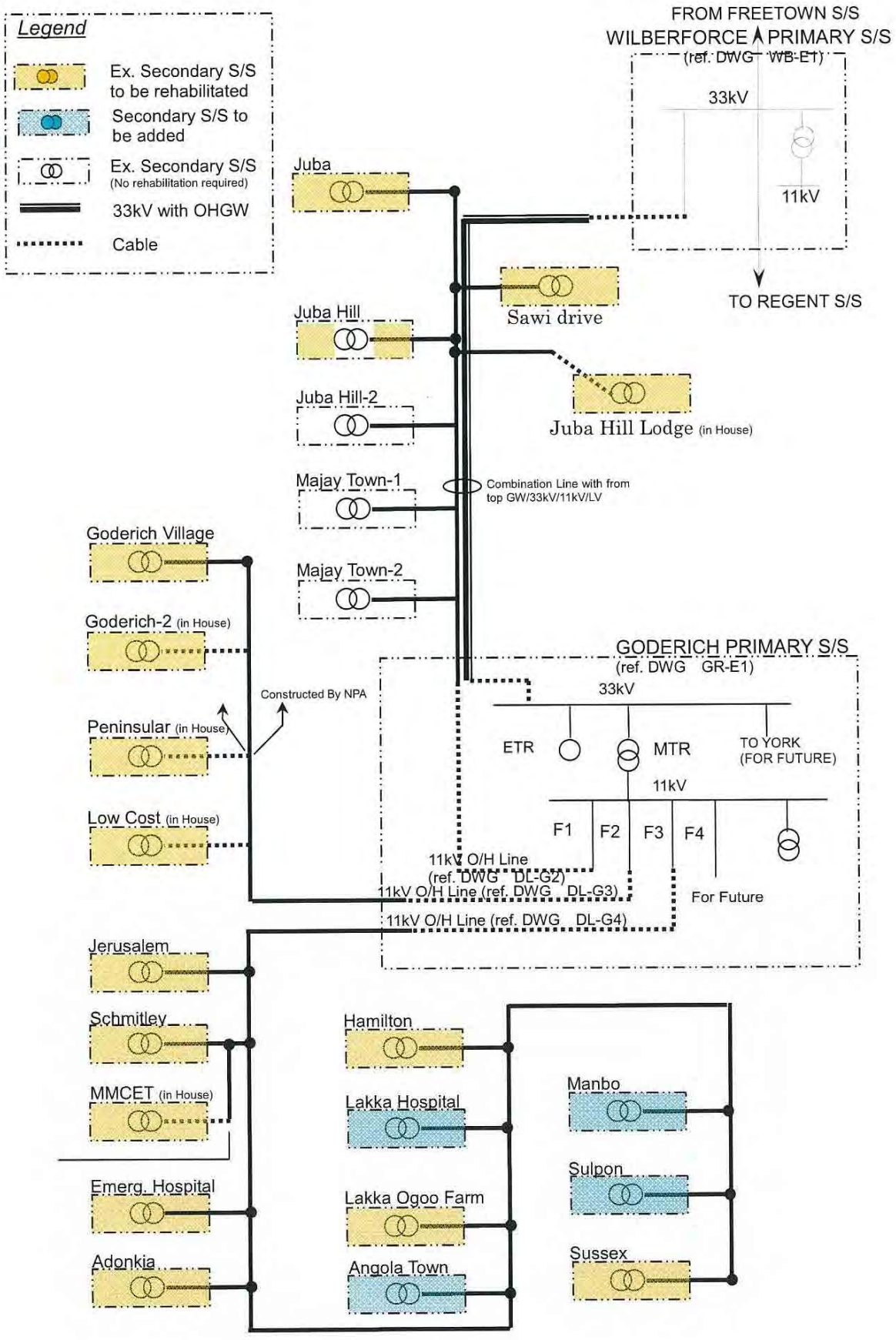
(31)	LV-G1～8	Planned Rehabilitation Map in Low Voltage Trunk Line (1/8～8/8)
(32)	LV-GA1～3	Pole Type for Low Voltage Distribution (Type LA, LB, LC, LD & LE)



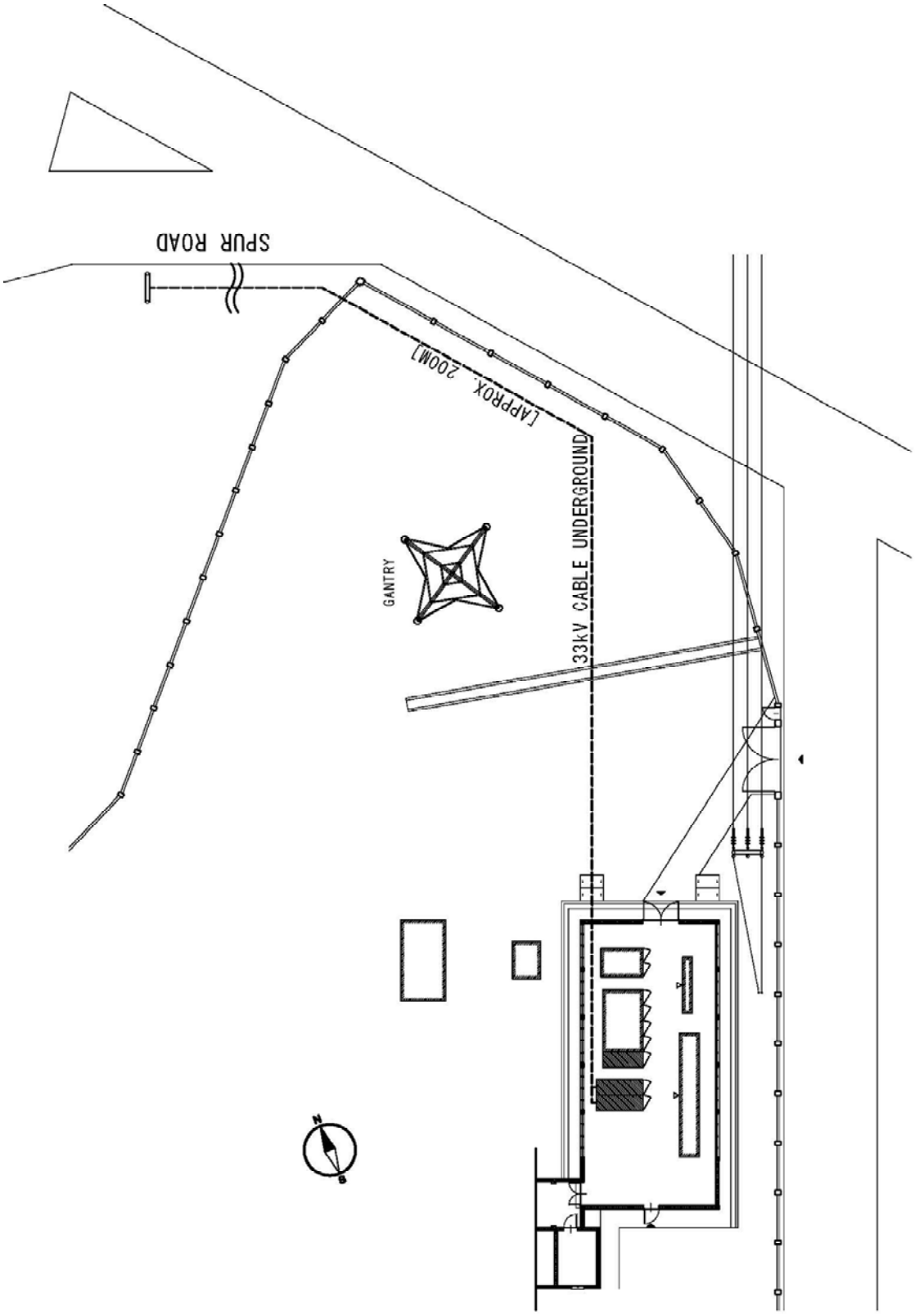
CM-G1 Project Site Map and Present Situation of Secondary Substation



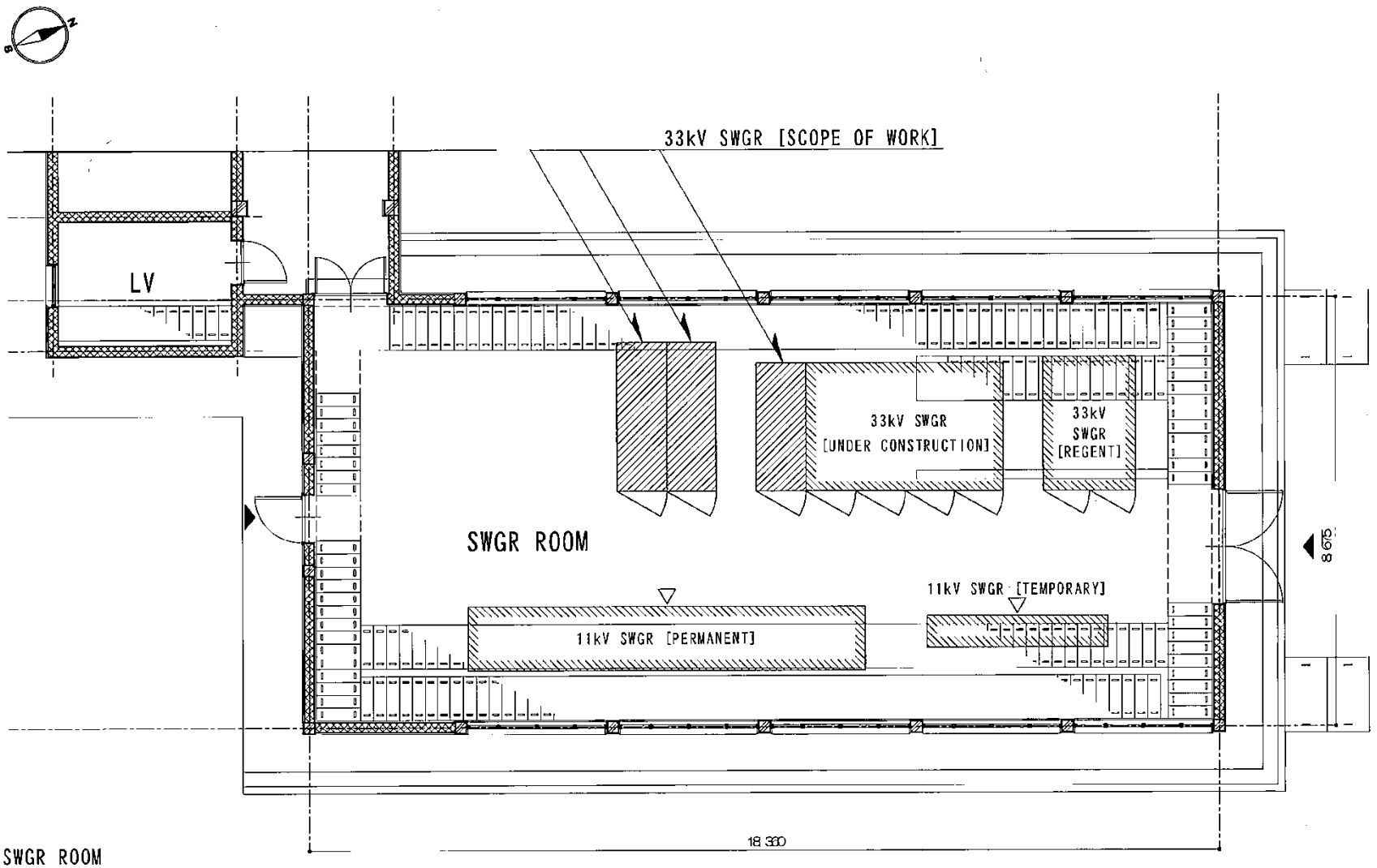
CM-G2 11/33kV Network Diagram in Freetown



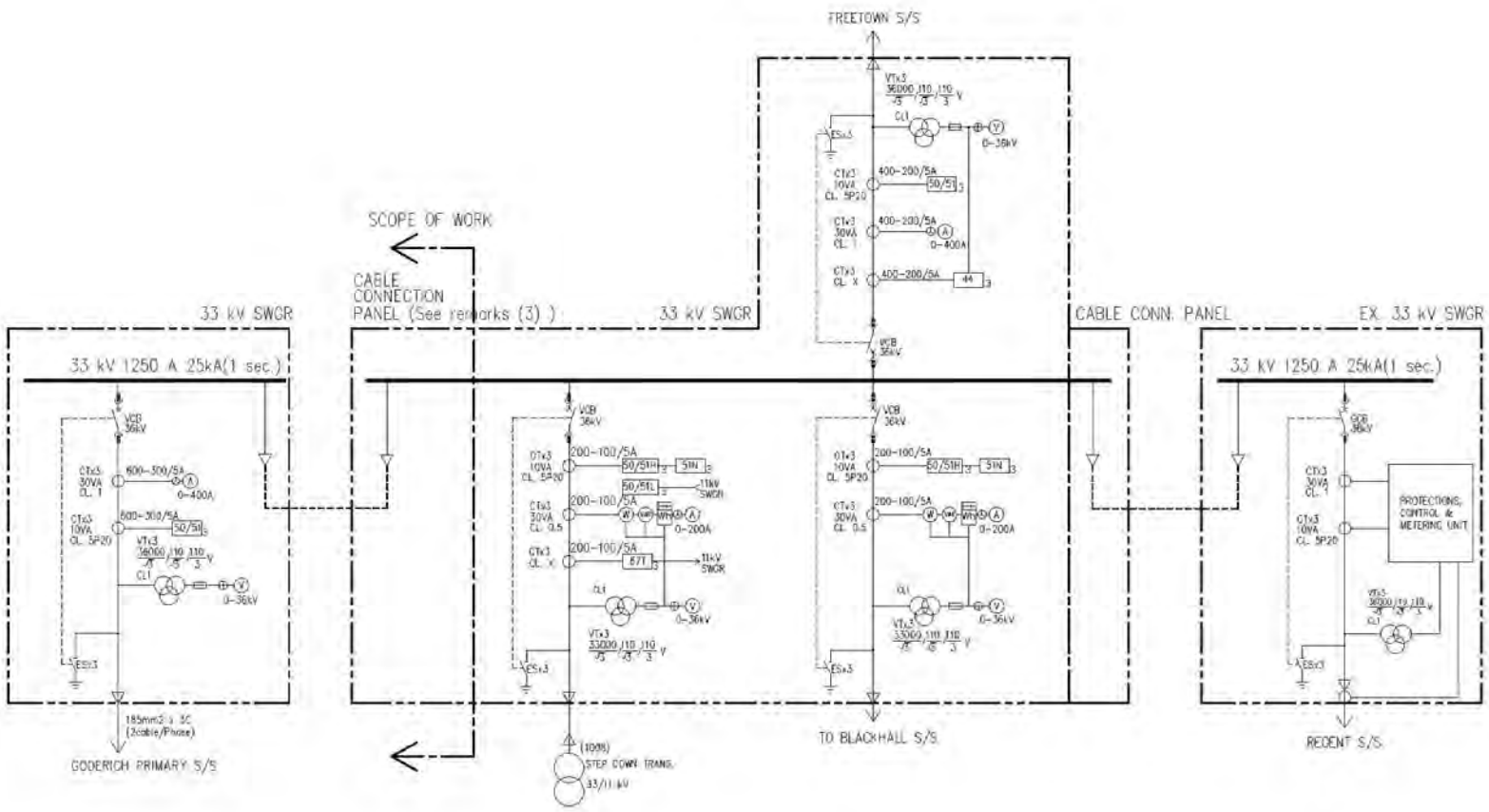
CM-E1 Planned 11/33kV Network Diagram



WB-G1 Site Map of Wilberforce Primary Substation



WB-G2　33kV SWGR Layout of Wilberforce Primary Substation



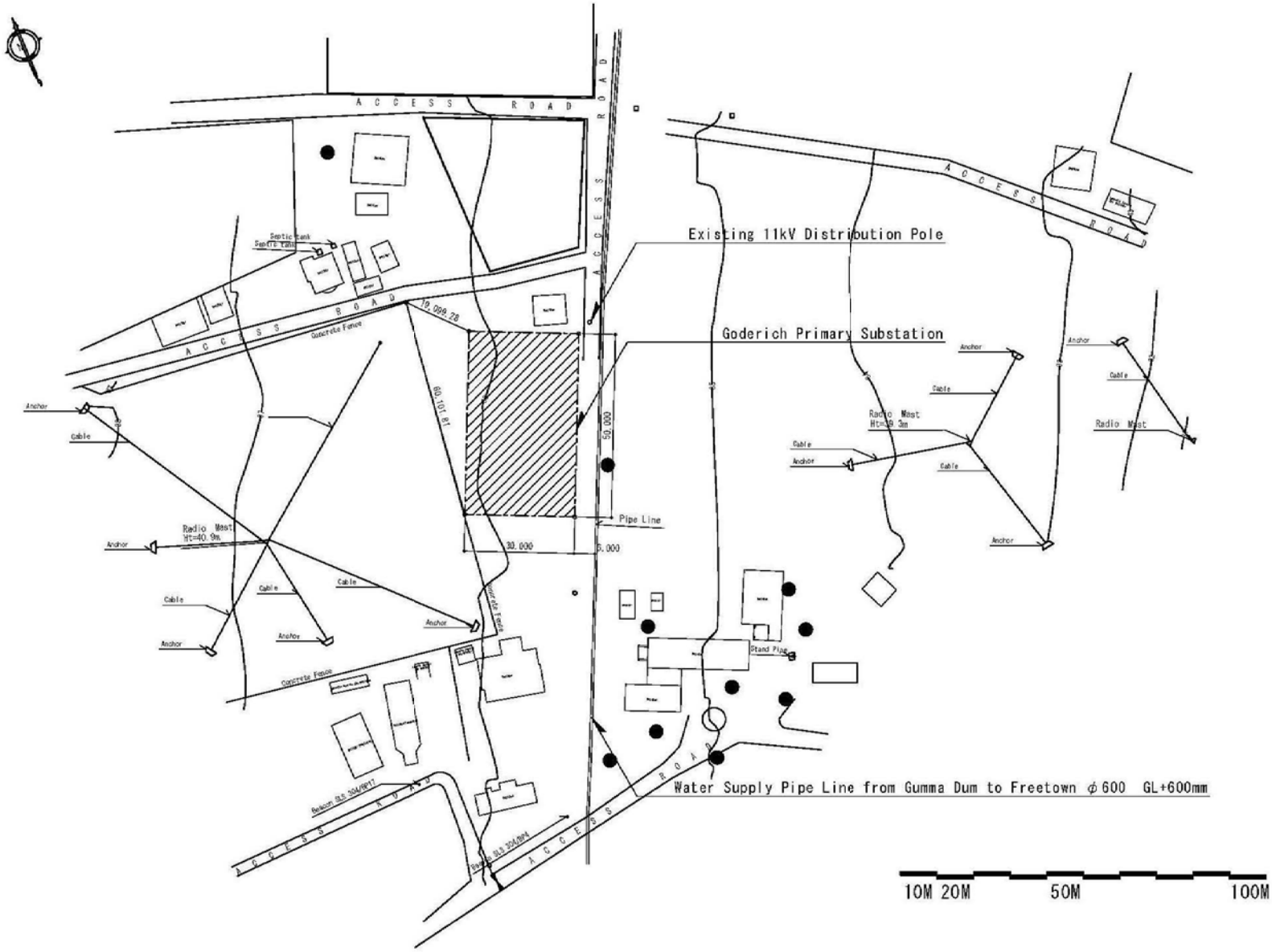
REMARKS

(1) 33kV Switchgears except for Regent Primary substation is under construction.

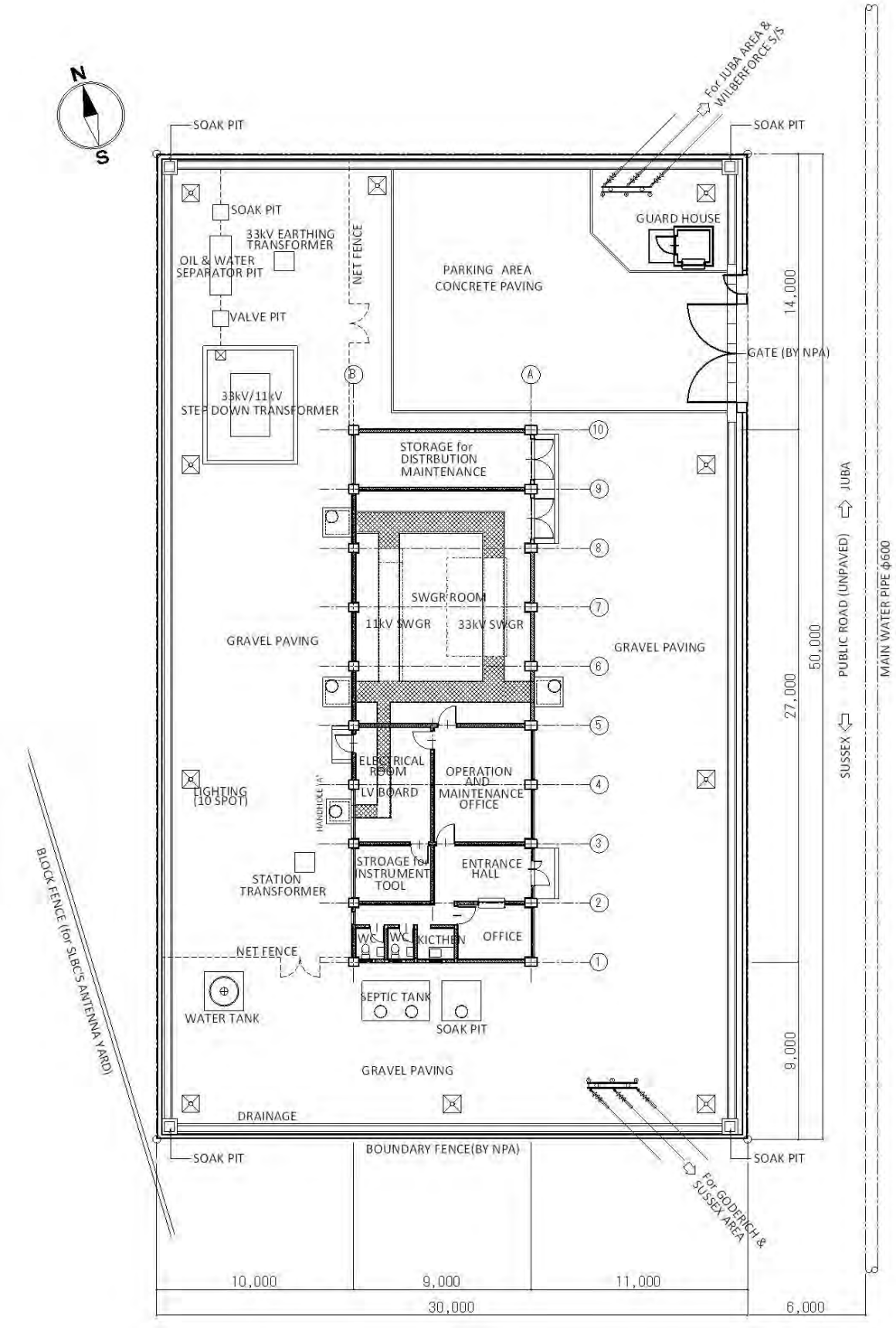
(2) 11kV Switchgears with AC/DC station service and step down transformer will be provided by NPA.

(3) 33kV Cable connection panel for Goderich S/S is provided by Japnese side.

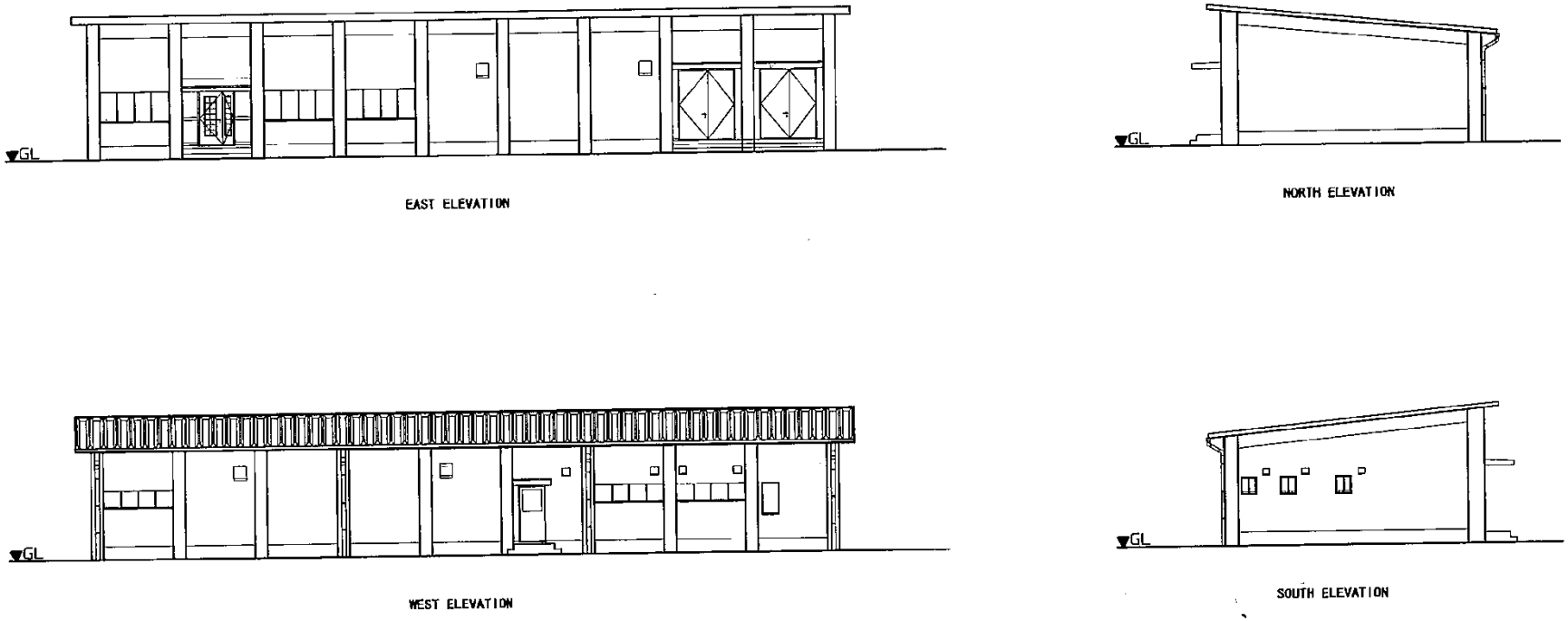
WB-E1 33kV Single Line Diagram of Wilberforce Primary Substation



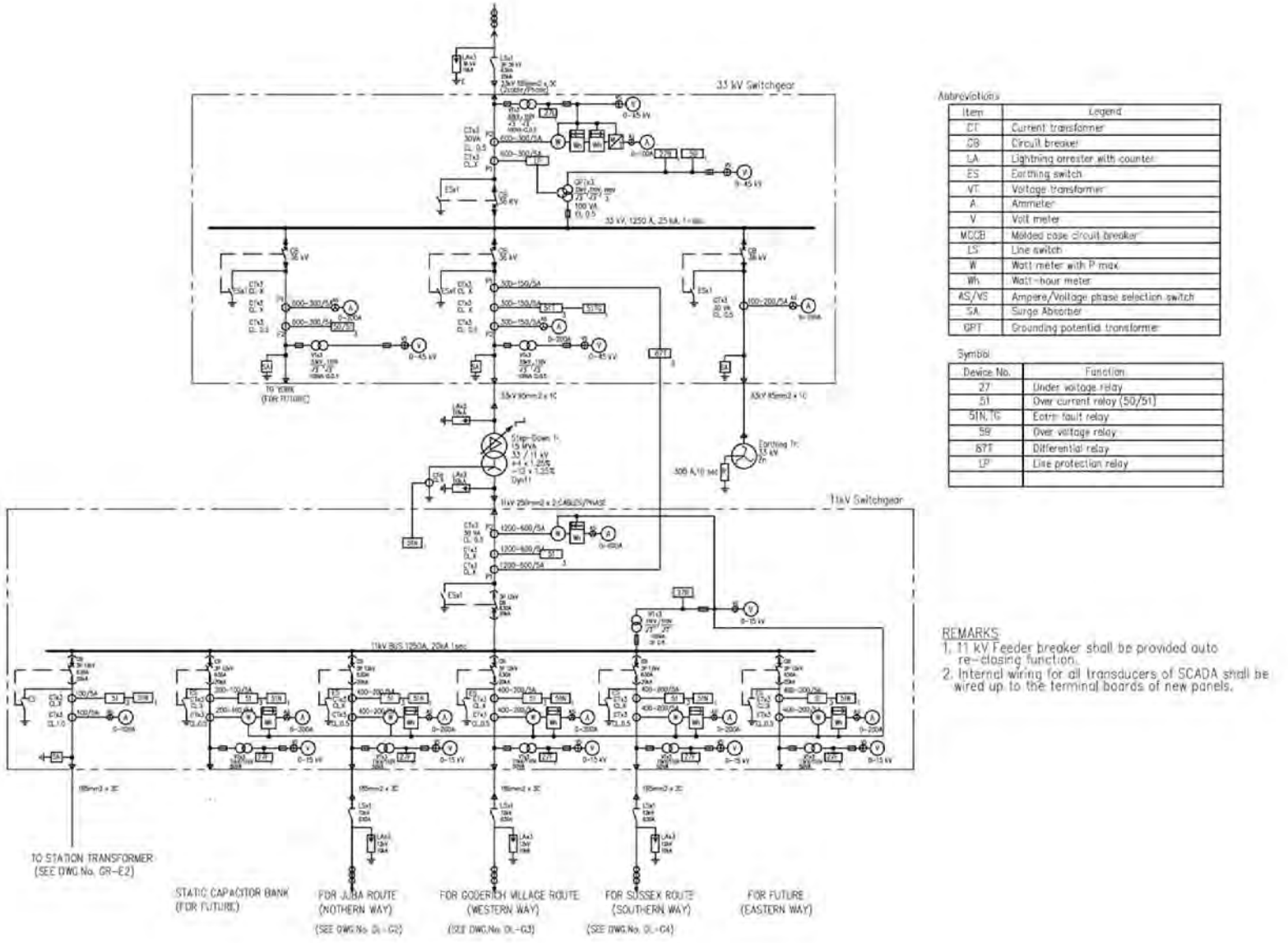
GR-G1 Site Map of Goderich Primary Substation



GR-C1 Site Layout of Goderich Primary Substation



GR-A1 Elevation of Building for Goderich Primary Substation



Abbreviations

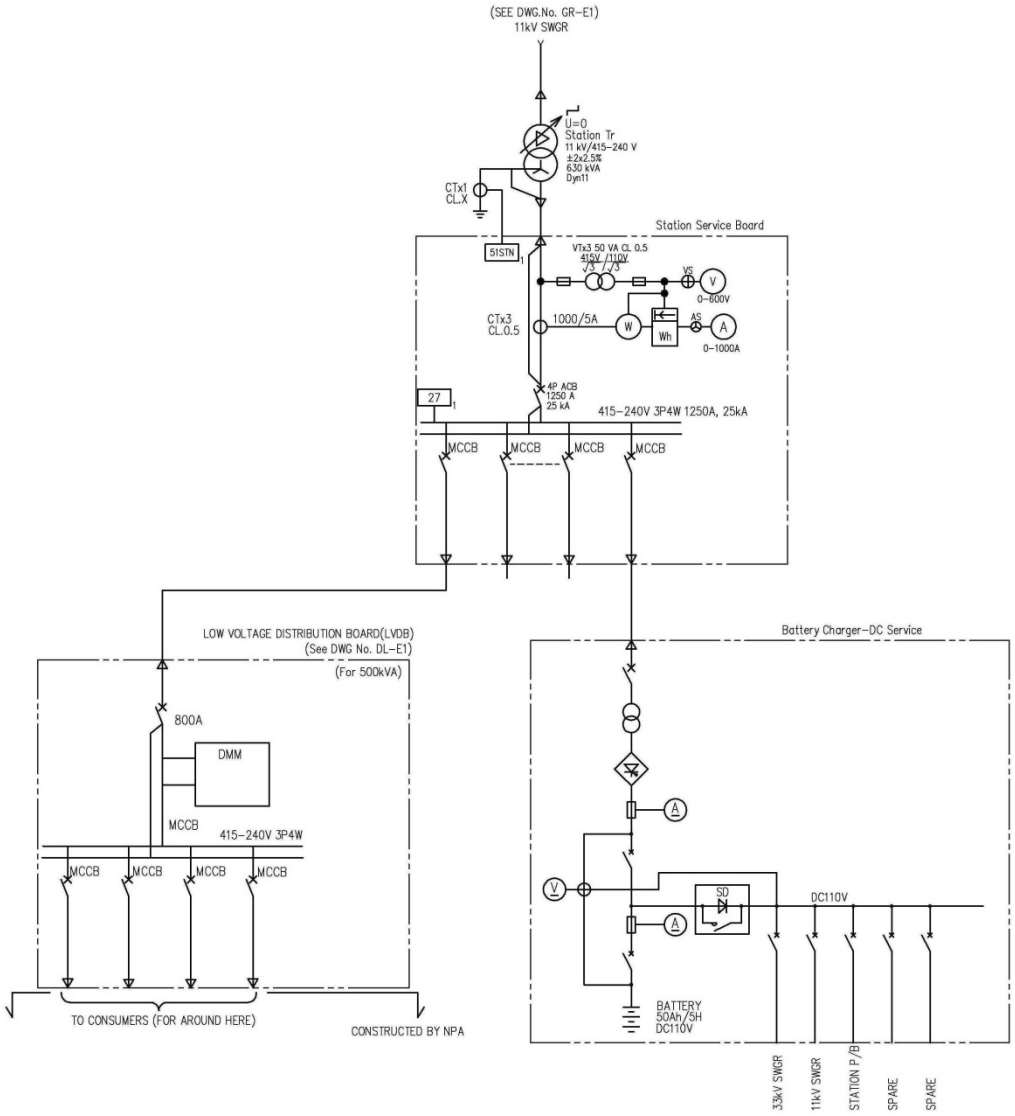
Item	Legend
CT	Current transformer
CB	Circuit breaker
LA	Lightning arrester with counter
ES	Earthing switch
VT	Voltage transformer
A	Ammeter
V	Volt meter
MCCB	Molded case circuit breaker
LS	Line switch
W	Watt meter with P max.
Wh	Watt-hour meter
AS/VS	Ampere/Voltage phase selection switch
SA	Surge Absorber
GPT	Grounding potential transformer

Symbol

Device No.	Function
27	Under voltage relay
51	Over current relay (50/51)
51N, TG	Earth fault relay
59	Over voltage relay
87T	Differential relay
LP	Line protection relay

REMARKS:
1. 11 kV Feeder breaker shall be provided auto re-closing function.
2. Internal wiring for all transducers of SCADA shall be wired up to the terminal boards of new panels.

GR-E1 11/33kV Single Line Diagram of Goderich Primary Substation



MCCB LIST OF STATION SERVICE BOARD

NO.	S E R V I C E	Q'TY	VOLTAGE (V)
1	CONTROL POWER FOR 33kV SWGR	1	240
2	CONTROL POWER FOR 11kV SWGR	1	240
3	CONTROL POWER FOR STATION BOARD	1	240
4	OUTDOOR LIGHTING	1	240
5	BATTERY CHARGER	1	240
6	LVDB	1	415-240
7	RECEPTACLES	1	415
8	SPARE (1)	2	240
9	SPARE (2)	1	415

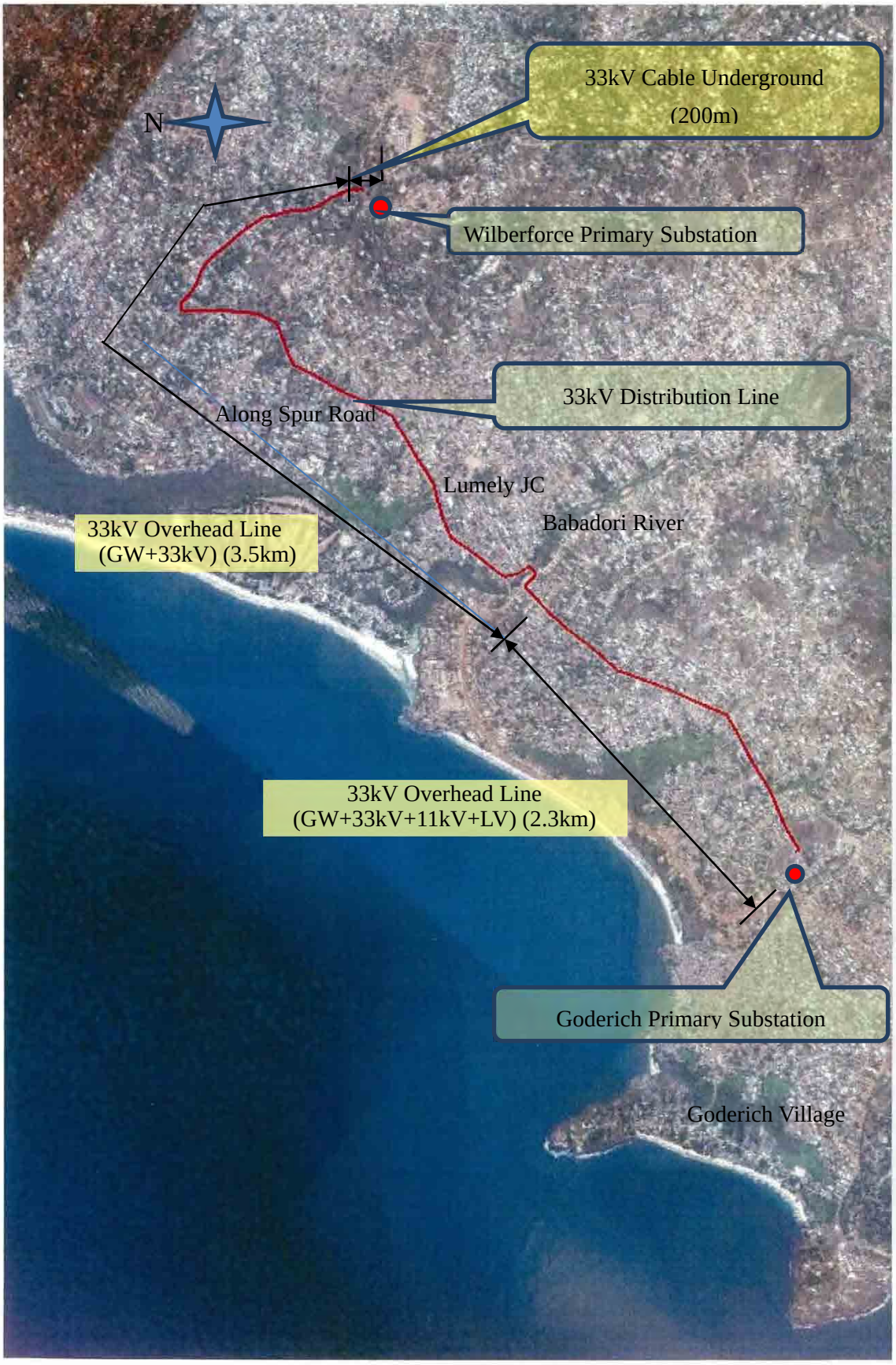
Abbreviations

Item	Legend
CT	Current transformer
A	Ammeter
V	Volt meter
MCCB	Molded case circuit breaker
W	Watt meter with P max.
Wh	Watt-hour meter
AS/VS	Ampere/Voltage phase selection switch
SD	Silicon dropper

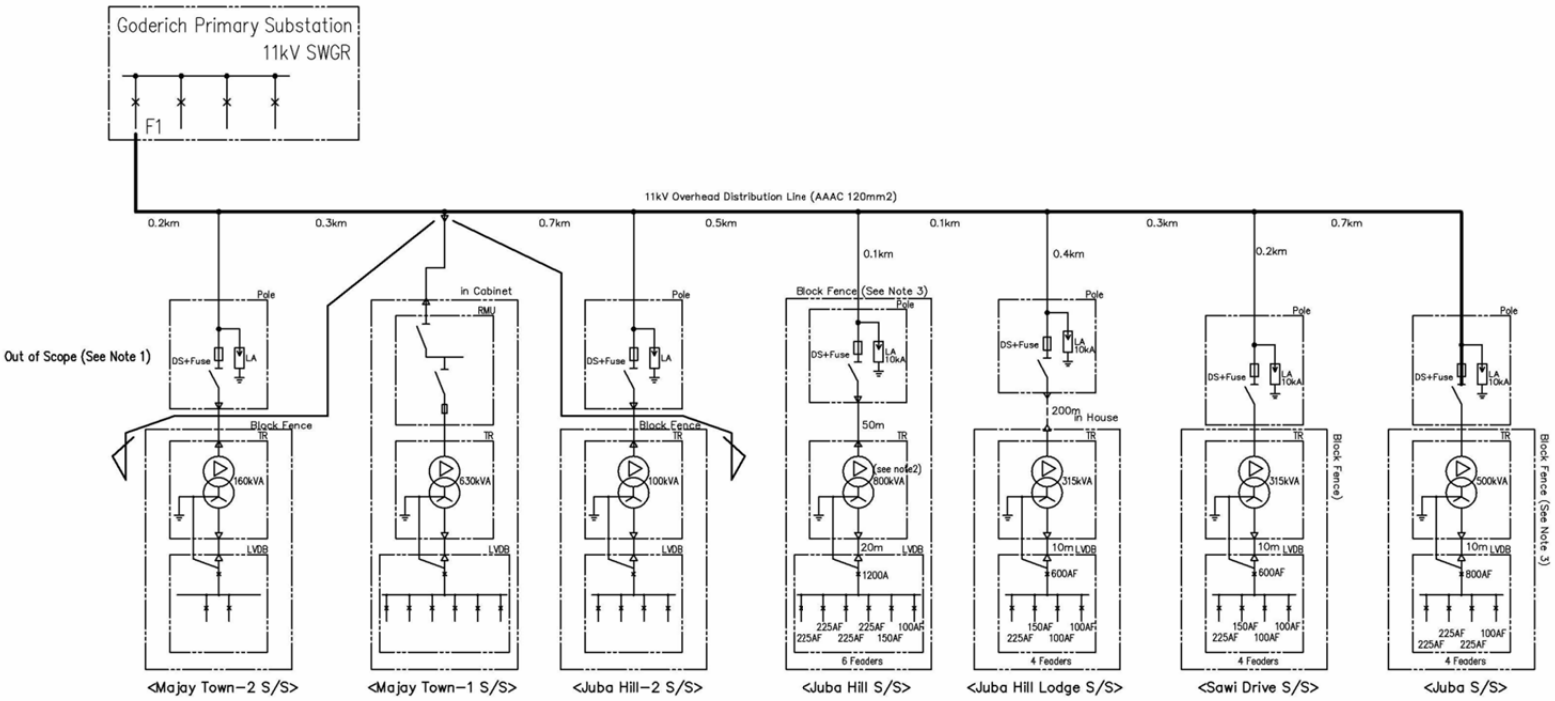
Symbol

Device No.	Function
27	Under voltage relay
51STN	Eatrh fault relay
50/51	Overcurrent relay

GR-E2 Low Voltage Single Line Diagram of Goderich Primary Substation



DL-G1 33kV Distribution Line Route

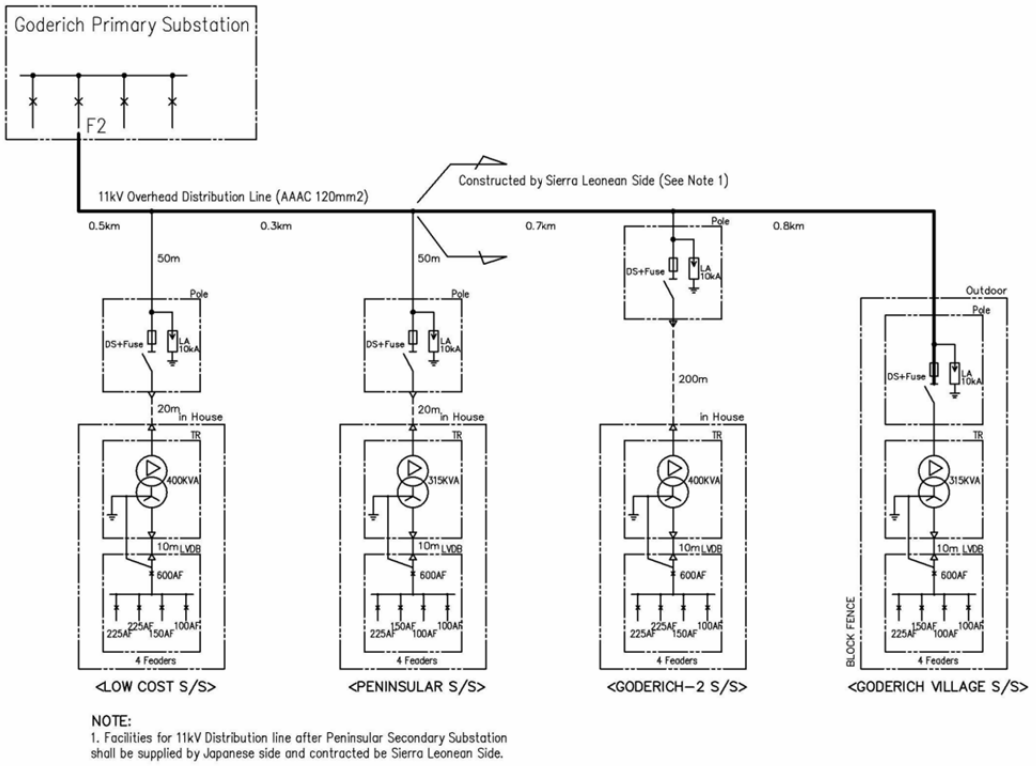


NOTE:
1. Three Secondary Substations named Majay Town-1, 2 and Juba Hill-2 above are used with existing facility.

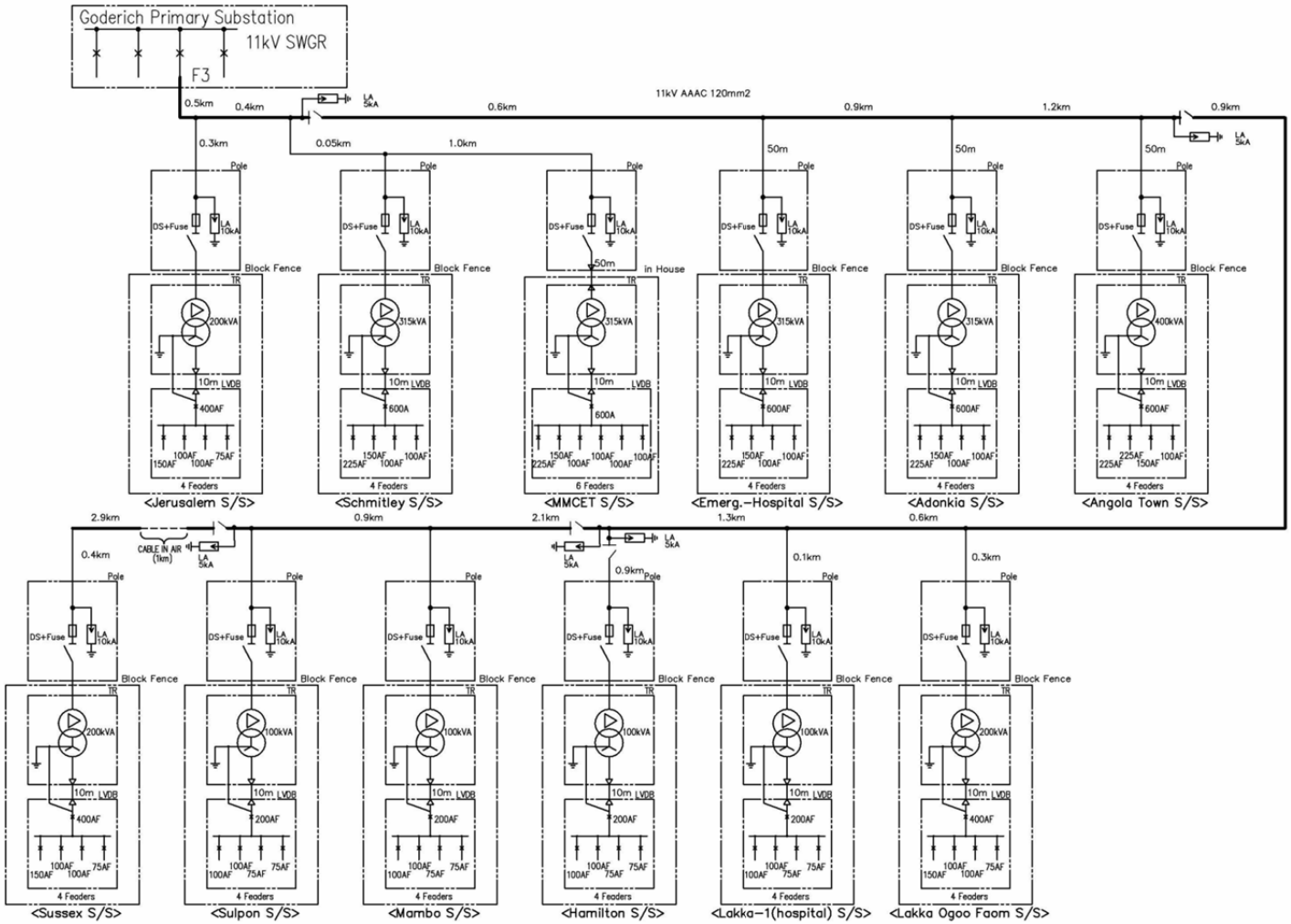
2. Transformer for Juba hill Secondary Substation have planned to change from 250kVA x 2units to 800kVA which supplied and installed by NPA.

3. Block fences of Juba hill and Juba secondary substation shall be used with existing one.

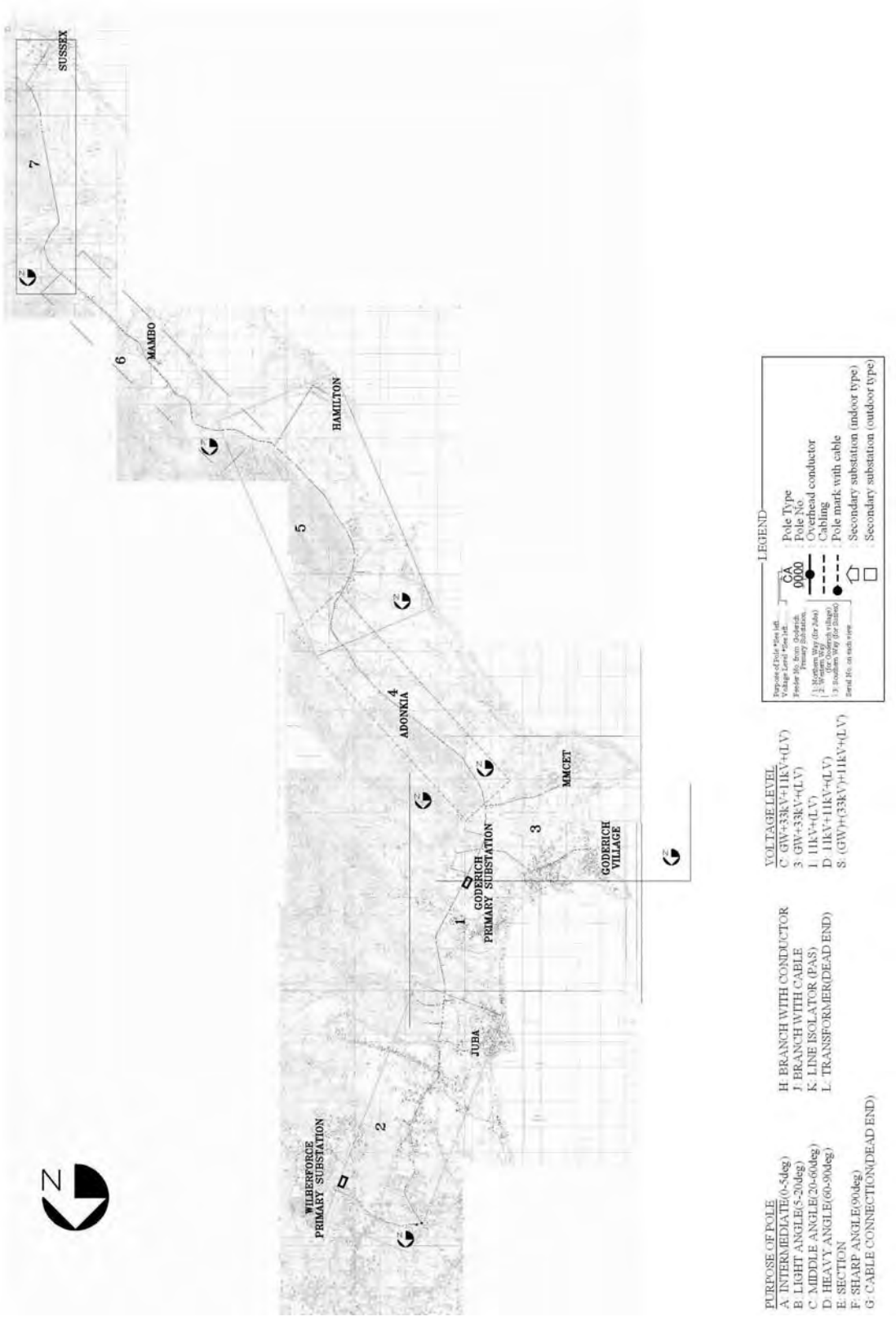
DL-G2 11kV Distribution Network Diagram (for Juba route)



DL-G3 11kV Distribution Network Diagram (for Goderich route)

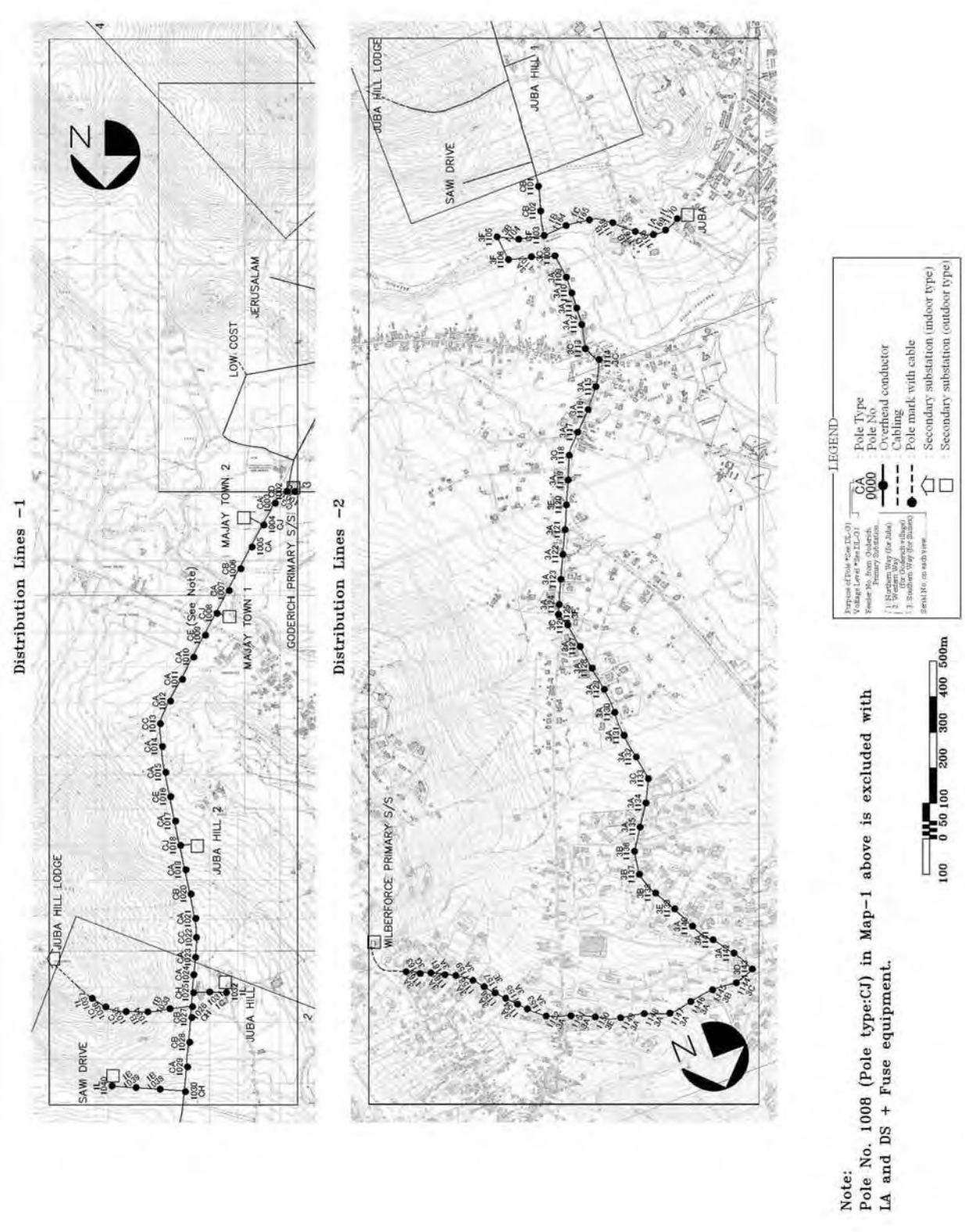


DL-G4 11kV Distribution Network Diagram (for Sussex route)



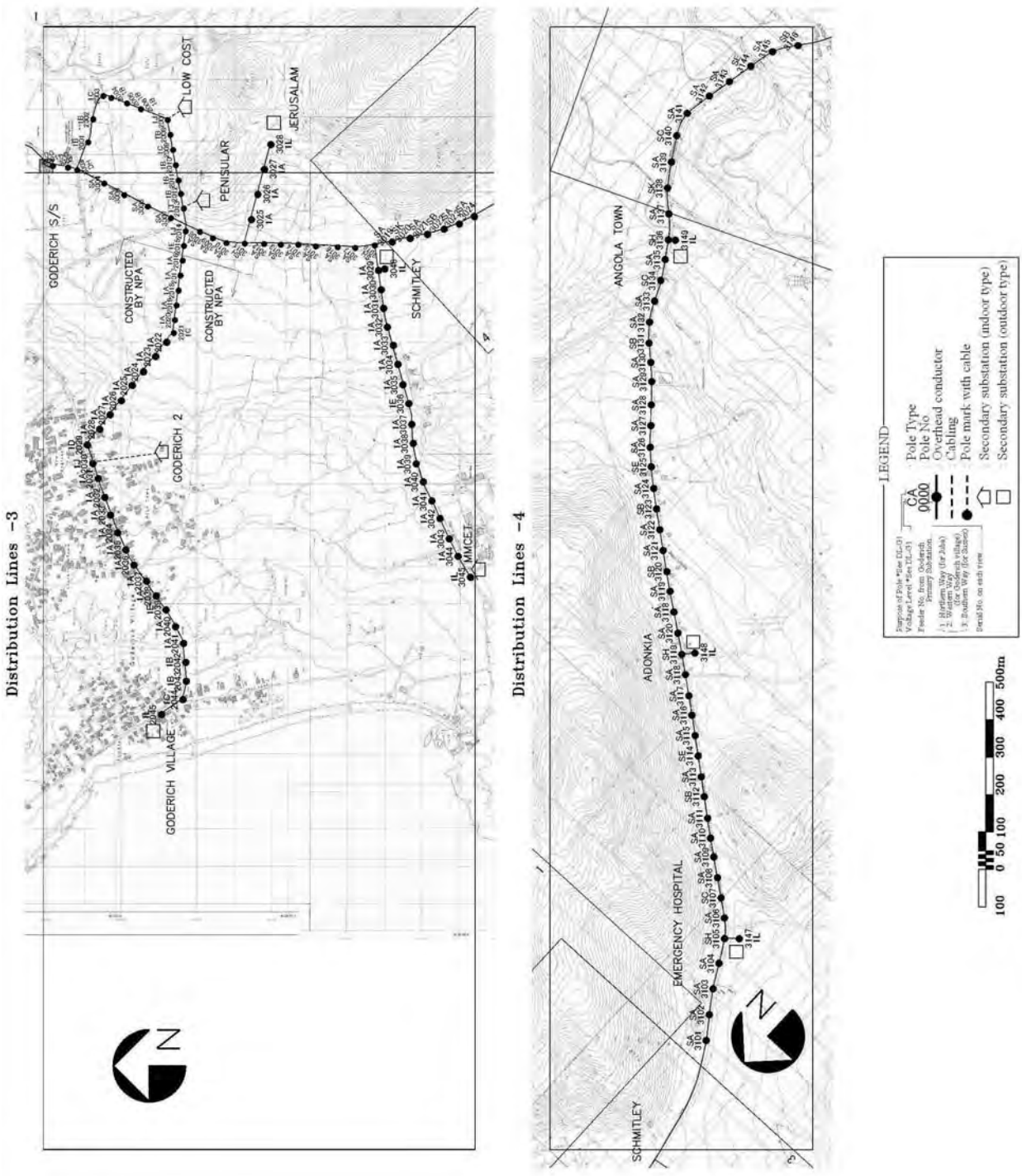
DL-GE1:Route Map of 11/33kV Distribution Line (1/5)

< Key Plan >



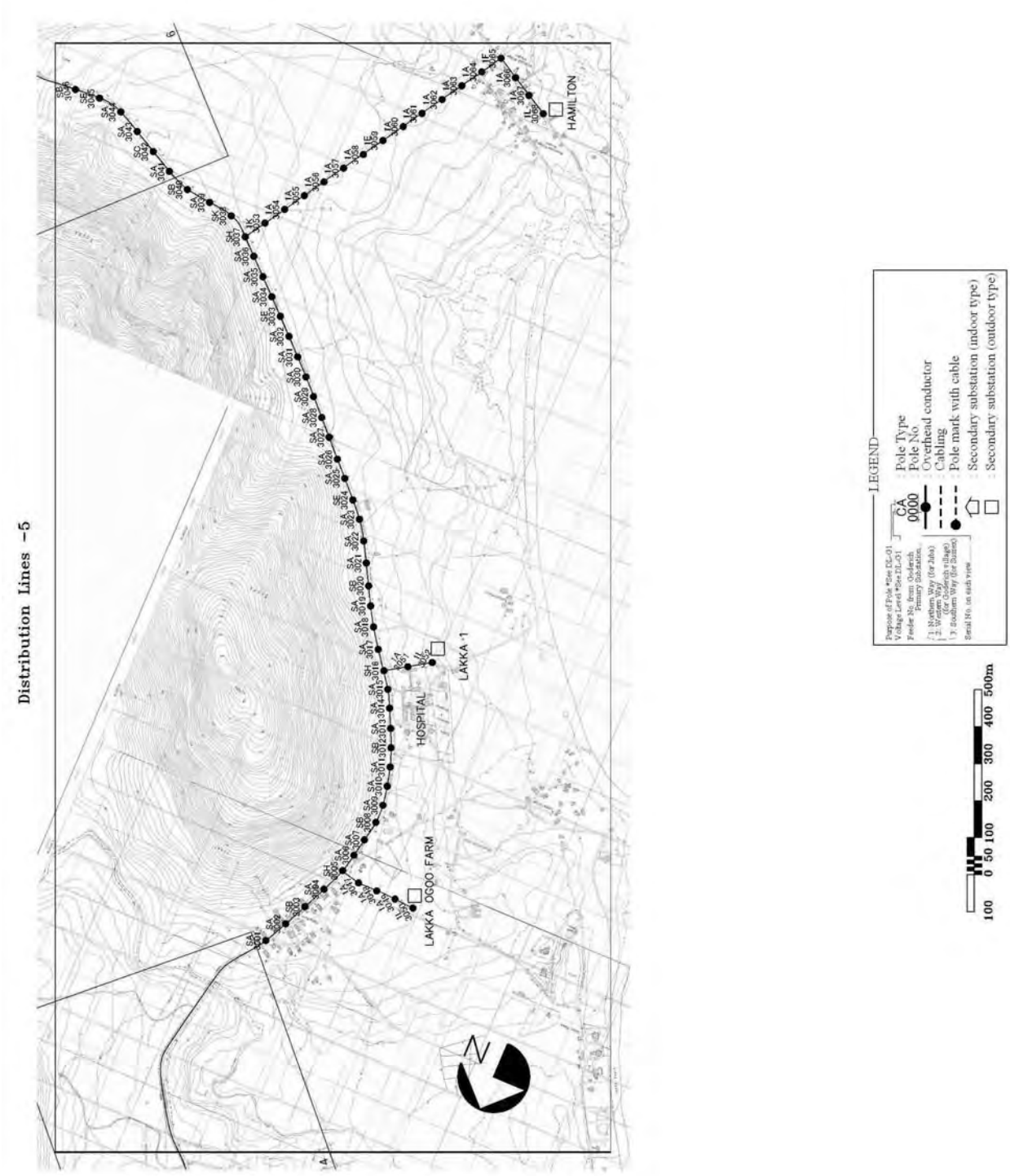
DL-GE2:Route Map of 11/33kV Distribution Line (2/5)

< Wliberforce & Juba >



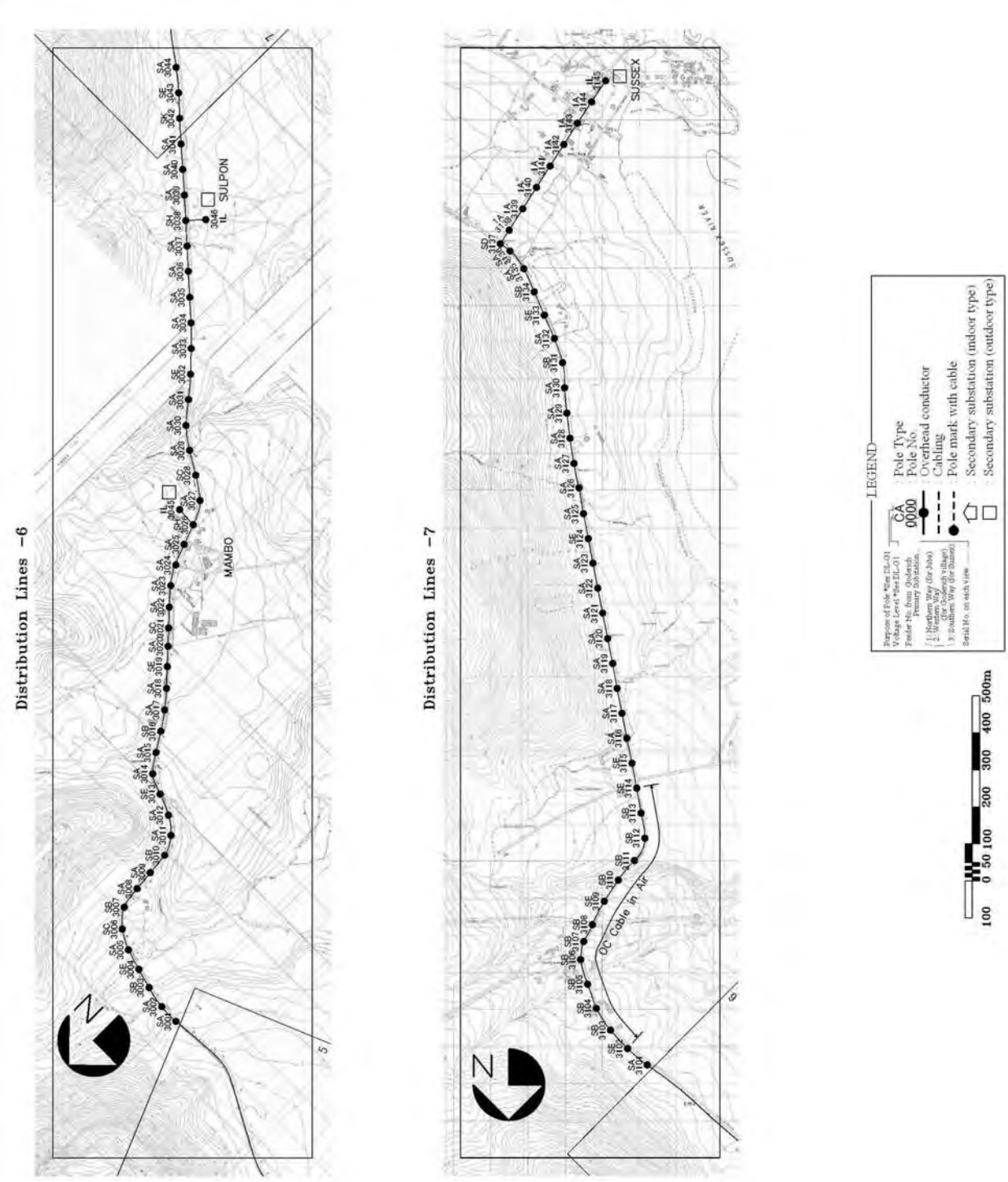
DL-GE3:Route Map of 11/33kV Distribution Line (3/5)

<Goderich & Adonkia >



DL-GE4:Route Map of 11/33kV Distribution Line (4/5)

< Lakka & Hamilton >



DL-GE5:Route Map of 11/33kV Distribution Line (5/5)

< Mambo & Sussex >