

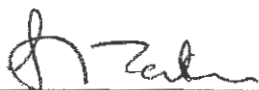
ANNEX

1. The Record of Discussions on the Project agreed upon between DSG and JICA on 25th February 2015, the Minutes of Meeting on the Project agreed upon between DSG and JICA on 19th January
2. The Minutes of Meeting on the Inception Report for the Project on 16th June 2015
3. The Minutes of Meeting on the Draft Final Report for the Project on 28th April 2017
4. The presentation materials in the Inception seminar
 - 4.1. The speech by the Minister of Lands and Rural Resettlement
 - 4.2. The speech by the Ambassador of Japan to Zimbabwe
 - 4.3. “Utilization of Digital Topographic Maps and Orthoimagery” by JICA Study Team
 - 4.4. “STATUS OF TOPOGRAPHIC MAPPING IN ZIMBABWE” by DSG
5. Materials on the preparation of Digital Topographic Maps and Orthophoto imageries of Harare
6. Materials on the promotion of the utilization of Digital Topographic Maps and Orthophoto imageries
 - 6.1. The Product Catalogue
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7. The presentation material by DSG in the training in Japan
8. Materials on the Technical Workshop for user of the Project Products
 - 8.1. The Description of Orthophoto imageries
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9. The presentation materials and local reports of the Final seminar
 - 9.1. “Project Results” by JICA Study Team
 - 9.2. “How the project products support local authority administration” by DSG and JICA Study Team
 - 9.3. “Utilization of the Project Products” by Chitungwiza City
 - 9.4. “Distribution of the Project Products and Plan for Future Mapping Projects in Zimbabwe” by DSG
 - 9.5. The local newspaper article reporting the project completion

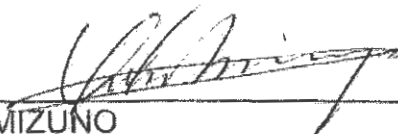
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RECORD OF DISCUSSIONS
ON
THE DEVELOPMENT OF A GEOSPATIAL INFORMATION
DATABASE PROJECT
IN
THE REPUBLIC OF ZIMBABWE
AGREED UPON BETWEEN
DEPARTMENT OF THE SURVEYOR GENERAL, MINISTRY OF
LANDS AND RURAL RESETTLEMENT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

Harare, February 25, 2015



Sophia Christine Tsvakwi
Permanent Secretary
Ministry of Lands and Rural
Resettlement



Yuko MIZUNO
Resident Representative
JICA Zimbabwe Office

Based on the minutes of meetings on the Detailed Planning Survey on the Development of a Geospatial Information Database Project (hereinafter referred to as "the Project") signed on 19th January 2015 between Department of the Surveyor General, Ministry of Lands and Rural Resettlement (hereinafter referred to as "DSG") and the Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA held a series of discussions with DSG and relevant organizations to develop a detailed plan of the Project.

Both parties agreed on the details of the Project and main points discussed as described in the Appendix 1 and the Appendix 2, respectively, and to request their respective governments to proceed with the necessary procedures for the implementation of the Project.

Both parties also agreed that the DSG, the counterpart to JICA, will be responsible for the implementation of the Project in cooperation with JICA, coordinate with other relevant organizations and ensure that the self-reliant operation of the Project is sustained during and after the implementation period in order to contribute toward social and economic development of the Republic of Zimbabwe.

The Project will be implemented within the framework of the Note Verbales to be exchanged between the Government of Japan (hereinafter referred to as "GOJ") and the Government of Zimbabwe (hereafter referred to as GoZ in this document).

Appendix 1: Project Description

Appendix 2: Main Points Discussed

Appendix 3: Minutes of Meeting on Detailed Survey for the Development of a Geospatial Information Database Project

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PROJECT DESCRIPTION

I. BACKGROUND

Urban population of Harare, the Capital of the Republic of Zimbabwe, has been increasing at a fast rate since its independence - increasing from 658 thousand people in 1982 to approximately 1.6 million people in 2012. As a result, to date, Harare is confronted with urban problems such as inadequate basic urban services, the collapse of public infrastructure and utilities, traffic congestion and expansion of the city as well as proliferation of informal settlements. This scenario has in a big way contributed to environmental degradation. While a very high proportion of inhabitants live in formally recognized residential areas, population increase has put a stress on the existing infrastructure, road networks, water supply and sanitation service distribution systems that was developed without such a rapid urban population growth in mind.

In 2013, the Government of Zimbabwe launched the Development Plan (Zimbabwe Agenda for Sustainable Socio-Economic Transformation (hereinafter referred to as "Zim Asset"), 2013-2018) geared towards sustainable development and social equity anchored on indigenization, empowerment and employment creation. To achieve the goals, Zim Asset raises infrastructure and utilities as one of the important factor out of 4 clusters. The infrastructure cluster is focused on the rehabilitation and recovery of infrastructure and utilities relating to water, sanitation and transportation.

When planning and developing these public infrastructures, large-scale topographic maps are necessary. However, the last topographic maps are out-of-date, having been updated more than 30 years ago and now these are out of date. Therefore, up-to-date large-scale topographic maps are dearly required for infrastructure planning, development and management in Harare.

Based on these backgrounds, the GoZ made an official request to the GOJ for technical cooperation for making 1:5,000 digital Topographic Maps to utilize them for public infrastructure planning, development and management.

II. OUTLINE OF THE PROJECT

1. Title of the Project

The Development of a Geospatial Information Database Project

2. Expected Goals which will be attained after the Project Completion

(1) Goal of the Proposed Plan

- 1) 1:5,000 large-scale Digital Topographic Maps and Geospatial datasets for the urban areas will be prepared.
- 2) 1:5,000 Digital Orthophoto Maps for peri-urban and surrounding area (smallholders and rural areas) will be prepared.

- 3) Digital Aerial Photographs will be prepared.
- 4) DSG will enhance its knowledge and skills to produce Digital Topographic Maps.

(2) Goal which will be attained by utilizing the Proposed Plan
The Digital Topographic Maps will be prepared, and maintained by the DSG and used for infrastructure planning, development and maintenance.

3. Outputs

- 1) One (1) set of 1:5,000 large-scale Digital Topographic Maps and datasets of the Project area
- 2) One (1) set of 1:5,000 Digital Orthophoto Maps of the Project area
- 3) One (1) set of Digital Aerial Photographs of the Project area
- 4) Global Navigation Satellite System (hereinafter referred to as "GNSS") and levelling survey results

4. Activities

- (1) Review of current situation
Current situations relevant to the Project including organization structure, mapping system, facilities management and control points shall be reviewed.
- (2) Production of Digital Topographic Maps
 - 1) Discussion of the specifications
 - 2) Acquisition of Digital Aerial Photographs
 - 3) GNSS survey
 - 4) Levelling
 - 5) Aerial triangulation
 - 6) Field identification and completion
 - 7) Digital plotting and compilation
 - 8) Symbolization
 - 9) Preparation of Digital Orthophoto Maps
- (3) Publicity of the Digital Topographic Maps
In order to accelerate practical use of the Digital Topographic Maps and Digital Orthophoto Maps, the data shall be accessed by the users after the completion of the project.
- (4) Technology Transfer
JICA missions will transfer the technology of the above mentioned items (4.(2)) and knowledge utilization and skills of the products through on-the-job training in the Republic of Zimbabwe
- (5) Country Specific Training in Japan.
The country specific training in Japan will be held for senior DSG staff for the purpose of checking and learning the procedure of map preparation.
- (6) Dissemination of the products
Recommendations for the wide and effective use of the products, especially for infrastructure planning, development and maintenance, shall be prepared.

5. Input

(1) Input by JICA

(a) Dispatch of Mission

For the implementation of the Project, JICA shall dispatch, at its own expense, a team of the JICA mission to the Republic of Zimbabwe.

Input other than indicated above, where and when necessary, will be determined through mutual consultations between JICA and DSG during the implementation of the Project.

(2) Input by DSG

DSG will take necessary measures to provide at its own expense:

- (a) Services of DSG's counterpart personnel and administrative personnel as referred to in II-6;
- (b) Convenient working environment and office space for the counterpart mission staff;
- (c) Supply or replacement of machinery, equipment, instruments, vehicles, tools, spare parts and any other materials necessary for the implementation of the Project other than the equipment provided by JICA;
- (d) Information as well as support in obtaining medical service;
- (e) Credentials or identification cards;
- (f) Available data (including maps and photographs) and information related to the Project;
- (g) Running expenses necessary for the implementation of the Project;
- (h) Expenses necessary for transportation within the Republic of Zimbabwe of the equipment as well as for the installation, operation and maintenance thereof; and
- (i) Necessary facilities to members of the JICA missions for the remittance as well as utilization of the funds introduced into the Republic of Zimbabwe from Japan in connection with the implementation of the Project

6. Implementation Structure

The roles and assignments of relevant organizations are as follows:

(1) DSG

(a) Project Director

Surveyor General of the DSG will be responsible for overall administration and implementation of the Project.

(b) Counterpart Personnel

Members of the DSG will be counterpart personnel of the Project.

(3) JICA Missions

The JICA missions will give necessary technical support, advice and recommendations to the DSG on any matters pertaining to the implementation of the Project. A leader of JICA missions will be the main counterpart to the project director of DSG.

(4) Joint Coordinating Committee

Joint Coordinating Committee (hereinafter referred to as "JCC") will be established in order to facilitate inter-organizational coordination. JCC will be held whenever deems it necessary. A list of proposed members of JCC is shown in the Annex 3.

7. Project Site(s) and Beneficiaries

The Project will cover the area shown in Annex 1. The beneficiaries of the Project will be people, who are living in, as well as persons and organizations carrying out developmental projects in Harare and its environs. Beneficiaries may include the groups dealing with infrastructure and conservation of natural resources.

8. Duration

The project will be carried out for approximately 24 months as shown in Fig Annex 2. The schedule is tentative and subjected to change when both parties agreed upon any necessity that will arise during the course of the Project.

9. Reports

JICA will prepare and submit the following reports to the DSG in English.

- (1) Ten (10) copies of Inception Report at the commencement of the first work period in the Republic of Zimbabwe
- (2) Ten (10) copies of Interim Report at the time about 12 months after the commencement of the first work period in the Republic of Zimbabwe
- (3) Ten (10) copies of Draft Final Report at the end of the last work period in the Republic of Zimbabwe
- (4) Ten (10) copies of Final Report within one (1) month after the receipt of the comments on the Draft Final Report

10. Environmental and Social Considerations

The DSG agreed to abide by 'JICA Guidelines for Environmental and Social Considerations' in order to ensure that appropriate considerations will be made for the environmental and social impacts of the Project.

III. UNDERTAKINGS OF THE DSG AND GOZ

1. The DSG and GoZ will take necessary measures to:

- (1) ensure that the technologies, skills and experience acquired by the Republic of Zimbabwe nationals as a result of Japanese technical cooperation will be utilized effectively in the implementation of the Project to contributes to the socio-economic development of the Republic of Zimbabwe, and
- (2) grant privileges, exemptions and benefits to members of the JICA missions referred to in II-5 (1) above and their families, which are no less favorable than those granted to experts and members of the missions and their families of third countries or international organizations performing similar missions in the Republic of Zimbabwe.

2. The DSG and GoZ will take necessary measures to:
 - (1) provide security-related information as well as measures to ensure the safety of members of the JICA missions;
 - (2) permit members of the JICA missions to enter, leave and sojourn in the Republic of Zimbabwe for the duration of their assignments therein and exempt them from foreign registration requirements and consular fees.
 - (3) exempt members of the JICA missions from taxes and any other charges on the equipment, machinery and other material necessary for the implementation of the Project;
 - (4) exempt members of the JICA missions from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to them and/or remitted to them from abroad for their services in connection with the implementation of the Project; and
 - (5) meet taxes and any other charges on the equipment, machinery and other material necessary for the implementation of the Project.

3. GoZ will bear claims, if any arises, against members of the JICA missions resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Project, except when such claims arise from gross negligence or willful misconduct on the part of members of the JICA missions.

IV. MONITORING AND EVALUATION

JICA will conduct the following evaluations and surveys to mainly verify sustainability and impact of the Project and draw lessons. The DSG is required to provide necessary support for them.

1. Ex-post evaluation three (3) years after the project completion, in principle
2. Follow-up surveys on necessity basis

V. PROMOTION OF PUBLIC SUPPORT

For the purpose of promoting support for the Project, DSG will take appropriate measures to make the Project widely publicized to the people of the Republic of Zimbabwe.

VI. Misconduct

If JICA receives information related to suspected corrupt or fraudulent practices in the implementation of the Project, DSG and relevant organizations shall provide JICA with such information as JICA may reasonably request, including information related to any concerned official of the government and/or public organizations of the Republic of Zimbabwe.

DSG and relevant organizations shall not, unfairly or unfavorably treat the person and/or company which provided the information related to suspected corrupt or fraudulent practices in the implementation of the Project.

VII. MUTUAL CONSULTATION

JICA and DSG will consult each other whenever any major issues arise in the course of Project implementation.

VIII. AMENDMENTS

The record of discussions may be amended by the minutes of meetings between JICA and DSG.

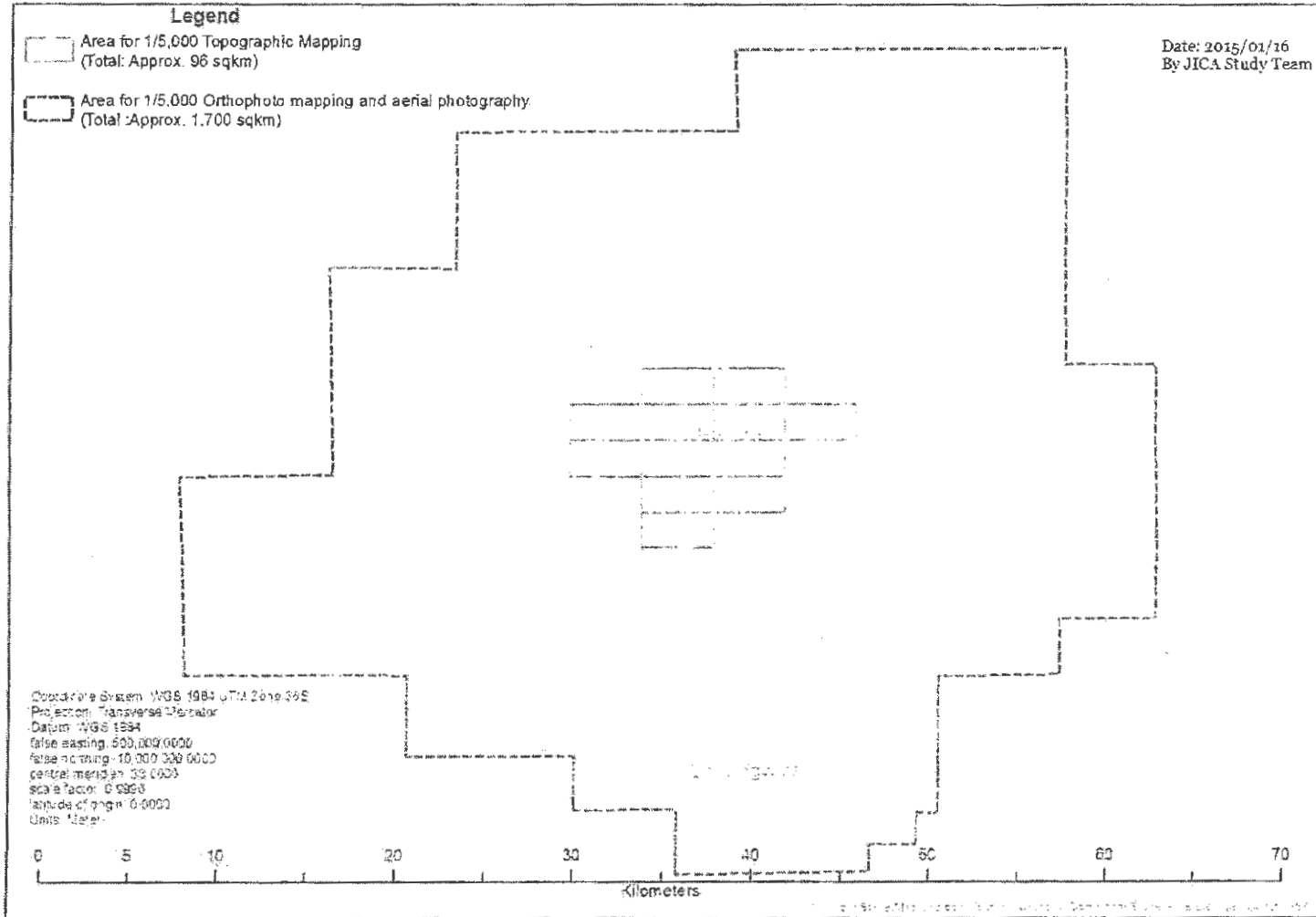
The minutes of meetings will be signed by authorized persons of each side who may be different from the signers of the record of discussions.

Annex 1 Project Area

Annex 2 Tentative Project Schedule

Annex 3 A List of Proposed Members of Joint Coordinating Committee

Annex 1: Project Area:



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Annex 3: A List of Proposed Members of Joint Coordinating Committee

A List of Proposed Members of Joint Coordinating Committee (JCC)

1. Function

JCC will be held at least the beginning of the project, the time of discussion for draft final report and whenever deems it necessary in order to fulfill the following functions;

- (1) To approve work plan, review overall progress
- (2) To conduct monitoring and evaluation of the Project
- (3) To exchange opinions on major issues arising during the implementation of the Project.

2. Members

- (1) Chair: Surveyor General, DSG
- (2) Members:
 - Three representatives, DSG
 - One Representative, JICA
 - The leader of members of JICA missions

The chair may invite necessary representatives of relevant ministries, relevant organizations and other than indicated above.

MAIN POINTS DISCUSSED

1. Project Area

Both parties agreed that Digital Aerial Photographs will be taken, from which the Digital Topographic Maps at the scale of 1:5,000 covering approximately 96km² and the Digital Orthophoto Maps covering approximately 1,700km² will be prepared in the Project. The areas to be covered are shown in Annex 1.

2. Import of Equipment

Both parties agreed that DSG will support the process of duty-free clearance of equipment procured outside Zimbabwe and earmarked for the project, and, if duty is not exempted, DSG shall pay all the necessary expenses for import procedures of the equipment referred to herein.

Both parties also agreed that the equipment thus imported shall be used exclusively for the implementation of the Project under the supervision of the JICA mission during the tenure of the project.

3. Equipment included the Project

Both sides confirmed that the Project will include the equipment for the activities of map development, which equipment include a Digital Photogrammetric Workstation with software, leveling equipment, and an A0 plotter, as major equipment.

If need for extra equipment arises, both sides will discuss again.

4. Copyright

Both parties agreed the followings about the copyright on Digital Topographic Map Data, Digital Orthophoto Data and Digital Aerial Photographs (hereinafter referred to as "the Product").

4-1 The Copyright of the Product produced in the Project belongs to GoZ, cared by the Department of the Surveyor General.

4-2 JICA shall receive Free and Express Copyright for the Products of the Project area that shall be governed by the Copyright Act Chapter 26:01 – General notice 2004.

4-3 DSG and JICA shall each keep the master-copy of the Product.

4-4 DSG agreed to allow JICA to provide the Product to persons or organizations in Japan on conditions that the persons or organizations shall:

- 1) Not use the Product in for commercial purposes
- 2) Not transfer the Product or copyright of the Product any other persons or organizations
- 3) Only use for the Product for the purpose in applied to JICA

5. Dissemination of the Final Report and Products

5-1 JICA and DSG agreed that the final report and products to be prepared by the Project shall be released to the public immediately after completion.

5-2 DSG agreed to take full responsibility for implementing the above.

6. Technology Transfer

DSG requested that the Project will focus not only on production of Topographic Maps and Ortophotos, but also capacity development for preparation and utilization of the Products. JICA proposed that DSG makes Digital Topographic Maps in some areas by themselves through on the job training with the assistance by the JICA mission, to which DSG has agreed.

7. Holding Seminar(s)

Both parties agreed that 2 seminars will be held; one on commencement and; another on completion of the Project, for the purpose of getting the comments or opinions and sharing the information on the Project with other ministries and agencies.

8. Country Specific Training

Both parties confirmed that the country specific training in Japan will be held for DSG staff. The timing and number of participants will be discussed through the course of the Project.

9. Project schedule management regarding Aerial Photography and Field Survey

In order for smooth implementation of the Project as shown in Annex 2 "tentative project schedule", it is desirable to complete aerial photography between May and the end of July 2015.


And the schedule of field survey will be informed to DSG from JICA mission in advance for the arrangements.

If the work of aerial photography or field survey were difficult to carry out during the scheduled period, JICA mission and DSG would discuss and find optimum measures for the smooth and quick implementation.

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MINUTES OF MEETINGS
ON
THE DEVELOPMENT OF A GEOSPATIAL INFORMATION
DATABASE PROJECT
IN
THE REPUBLIC OF ZIMBABWE
AGREED UPON BETWEEN
DEPARTMENT OF THE SURVEYOR GENERAL, MINISTRY OF
LANDS AND RURAL RESETTLEMENT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

Harare, 19th January 2015


Mrs. Sophia Christine Tsvakwi
Permanent Secretary
Ministry of Lands and Rural
Resettlement


Mr. Tomoyuki YASUDA
Leader
Detailed Planning Survey Team
Japan International Cooperation
Agency



INTRODUCTION

In response to the official request of the Government of the Republic of Zimbabwe (hereinafter referred to as "Zimbabwe") to the Government of Japan, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Detailed Planning Survey team (hereinafter referred to as "the Survey team") headed by Mr. Tomoyuki YASUDA to confirm contents of requests for the Technical Cooperation Project on the Development of a Geospatial Information Database Project (hereinafter referred to as "the Project").

The Survey team held a series of discussions with the representatives and officials from Department of the Surveyor General of Zimbabwe (hereinafter referred to as "DSG") and related ministries and agencies concerned with the scope of the Project and agreed the contents of the draft R/D as Attachment 1.

This document summarizes major points discussed and remarks expressed by both parties.

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Attachment 1: Draft Record of Discussion

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DRAFT RECORD OF DISCUSSIONS

ON

**THE DEVELOPMENT OF A GEOSPATIAL INFORMATION
DATABASE PROJECT**

IN

THE REPUBLIC OF ZIMBABWE

AGREED UPON BETWEEN

**DEPARTMENT OF THE SURVEYOR GENERAL, MINISTRY OF
LANDS AND RURAL RESETTLEMENT**

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

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The Project will be implemented within the framework of the Note Verbales to be exchanged between the Government of Japan (hereinafter referred to as "GOJ") and the Government of Zimbabwe (hereafter referred to as GoZ in this document).

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(4) Joint Coordinating Committee

Joint Coordinating Committee (hereinafter referred to as "JCC") will be established in order to facilitate inter-organizational coordination. JCC will be held whenever deems it necessary. A list of proposed members of JCC is shown in the Annex 3.

7. Project Site(s) and Beneficiaries

The Project will cover the area shown in Annex 1. The beneficiaries of the Project will be people, who are living in, as well as persons and organizations carrying out developmental projects in Harare and its environs. Beneficiaries may include the groups dealing with infrastructure and conservation of natural resources.

8. Duration

The project will be carried out for approximately 24 months as shown in Fig Annex 2. The schedule is tentative and subjected to change when both parties agreed upon any necessity that will arise during the course of the Project.

9. Reports

JICA will prepare and submit the following reports to the DSG in English.

- (1) Ten (10) copies of Inception Report at the commencement of the first work period in the Republic of Zimbabwe
- (2) Ten (10) copies of Interim Report at the time about 12 months after the commencement of the first work period in the Republic of Zimbabwe
- (3) Ten (10) copies of Draft Final Report at the end of the last work period in the Republic of Zimbabwe
- (4) Ten (10) copies of Final Report within one (1) month after the receipt of the comments on the Draft Final Report

10. Environmental and Social Considerations

The DSG agreed to abide by 'JICA Guidelines for Environmental and Social Considerations' in order to ensure that appropriate considerations will be made for the environmental and social impacts of the Project.

III. UNDERTAKINGS OF The DSG AND GoZ

1. The DSG and GoZ will take necessary measures to:

- (1) ensure that the technologies, skills and experience acquired by the Republic of Zimbabwe nationals as a result of Japanese technical cooperation will be utilized effectively in the implementation of the Project to contributes to the socio-economic development of the Republic of Zimbabwe, and
- (2) grant privileges, exemptions and benefits to members of the JICA missions referred to in II-5 (1) above and their families, which are no less favorable than those granted to experts and members of the missions and their families of third countries or international organizations performing similar missions in the Republic of Zimbabwe.

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2. The DSG and GoZ will take necessary measures to:
- (1) provide security-related information as well as measures to ensure the safety of members of the JICA missions;
 - (2) permit members of the JICA missions to enter, leave and sojourn in the Republic of Zimbabwe for the duration of their assignments therein and exempt them from foreign registration requirements and consular fees.
 - (3) exempt members of the JICA missions from taxes and any other charges on the equipment, machinery and other material necessary for the implementation of the Project;
 - (4) exempt members of the JICA missions from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to them and/or remitted to them from abroad for their services in connection with the implementation of the Project; and
 - (5) meet taxes and any other charges on the equipment, machinery and other material necessary for the implementation of the Project.
3. GoZ will bear claims, if any arises, against members of the JICA missions resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Project, except when such claims arise from gross negligence or willful misconduct on the part of members of the JICA missions.

IV. MONITORING AND EVALUATION

JICA will conduct the following evaluations and surveys to mainly verify sustainability and impact of the Project and draw lessons. The DSG is required to provide necessary support for them.

1. Ex-post evaluation three (3) years after the project completion, in principle
2. Follow-up surveys on necessity basis

V. PROMOTION OF PUBLIC SUPPORT

For the purpose of promoting support for the Project, DSG will take appropriate measures to make the Project widely publicized to the people of the Republic of Zimbabwe.

VI. Misconduct

If JICA receives information related to suspected corrupt or fraudulent practices in the implementation of the Project, DSG and relevant organizations shall provide JICA with such information as JICA may reasonably request, including information related to any concerned official of the government and/or public organizations of the Republic of Zimbabwe.

DSG and relevant organizations shall not, unfairly or unfavorably treat the person and/or company which provided the information related to suspected corrupt or fraudulent practices in the implementation of the Project.

VII. MUTUAL CONSULTATION

JICA and DSG will consult each other whenever any major issues arise in the course of Project implementation.

VIII. AMENDMENTS

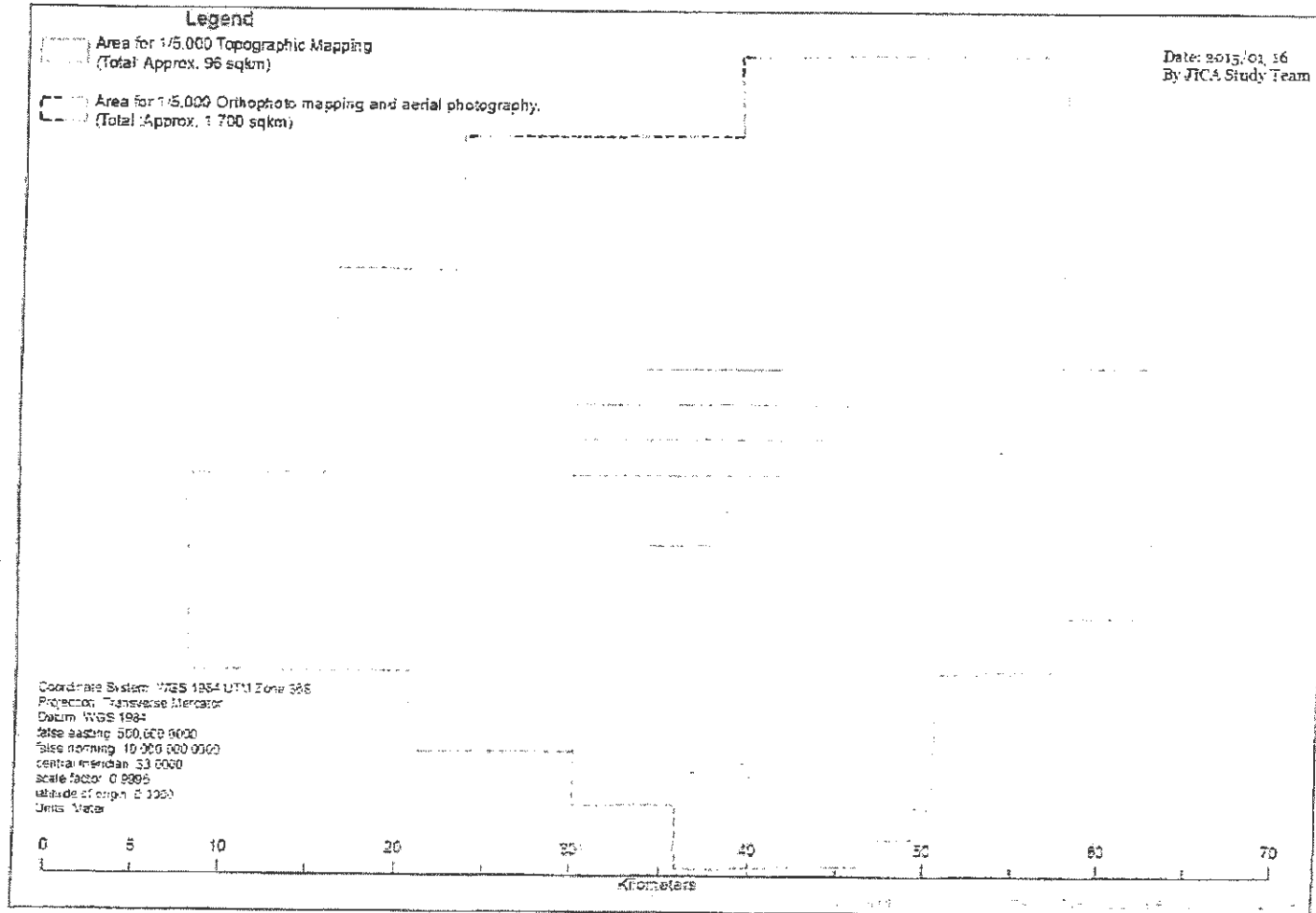
The record of discussions may be amended by the minutes of meetings between JICA and DSG.

The minutes of meetings will be signed by authorized persons of each side who may be different from the signers of the record of discussions.

- Annex 1 Project Area
- Annex 2 Tentative Project Schedule
- Annex 3 A List of Proposed Members of Joint Coordinating Committee
- Annex 4 List of Participants

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Annex 1: Project Area:



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Annex 2: Tentative Project Schedule:

		Month																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Items	work in Zimbabwe	[]			[]			[]			[]			[]			[]			[]			[]		
	work in Japan					[]															[]				
Reports	Reports	▲ IC/R											▲ IT/R											▲ DF/R	▲ F/R

OSIT


Annex 3: A List of Proposed Members of Joint Coordinating Committee

A List of Proposed Members of Joint Coordinating Committee (JCC)

1. Function

JCC will be held at least the beginning of the project, the time of discussion for draft final report and whenever deems it necessary in order to fulfill the following functions;

- (1) To approve work plan, review overall progress
- (2) To conduct monitoring and evaluation of the Project
- (3) To exchange opinions on major issues arising during the implementation of the Project.

2. Members

(1) Chair: Surveyor General, DSG

(2) Members:

Three representatives, DSG

One Representative, JICA

The leader of members of JICA missions

The chair may invite necessary representatives of relevant ministries, relevant organizations and other than indicated above.

Handwritten notes and signatures in the bottom right corner, including the letters "CST" and a signature.

Annex 4: List of Participants

<Zimbabwe>

Department of the Surveyor General

Mr. Edwin GUVAZA	Surveyor General
Mr. Canaan NDAMBAKUWA	Mapping Section
Mr. Enias CHINJEKURE	Mapping Section
Ms. Chipso CHANETSA	Mapping Section
Mr. Robert MUPONDI	Geodesy Section
Mr. Tafadzwa MAGWAZA	Geodesy Section
Mr. Regis KAPUYAH	Geodesy Section
Mr. Constantino RWIZI	Cadastral Section

<Japanese side>

Detailed Planning Study Team

Mr. Tomoyuki YASUDA	Leader
Mr. Takenori SATO	Precision Management
Mr. Takahiro UCHIDA	Survey Planning
Mr. Yoshiteru MATSUSHITA	Digital Topographic Mapping / Machinery Planning
Mr. Hiromichi MARUYAMA	Human Resource Planning / Utilization Planning

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MAIN POINTS DISCUSSED

1. Project Area

Both parties agreed that Digital Aerial Photographs will be taken, from which the Digital Topographic Maps at the scale of 1:5,000 covering approximately 96km² and the Digital Orthophoto Maps covering approximately 1,700km² will be prepared in the Project. The areas to be covered are shown in Annex 1.

2. Import of Equipment

Both parties agreed that DSG will support the process of duty-free clearance of equipment procured outside Zimbabwe and earmarked for the project, and, if duty is not exempted, DSG shall pay all the necessary expenses for import procedures of the equipment referred to herein.

Both parties also agreed that the equipment thus imported shall be used exclusively for the implementation of the Project under the supervision of the JICA mission during the tenure of the project.

3. Equipment included the Project

Both sides confirmed that the Project will include the equipment for the activities of map development, which equipment include a Digital Photogrammetric Workstation with software, leveling equipment, and an A0 plotter, as major equipment.

If need for extra equipment arises, both sides will discuss again.

4. Copyright

Both parties agreed the followings about the copyright on Digital Topographic Map Data, Digital Orthophoto Data and Digital Aerial Photographs (hereinafter referred to as "the Product").

4-1 The Copyright of the Product produced in the Project belongs to GoZ, care of the Department of the Surveyor General.

4-2 JICA shall receive Free and Express Copyright for the Products of the Project area that shall be governed by the Copyright Act Chapter 26:01 – General notice 2004.

4-3 DSG and JICA shall each keep the master-copy of the Product.

4-4 DSG agreed to allow JICA to provide the Product to persons or organizations in Japan on conditions that the persons or organizations shall:

- 1) Not use the Product in for commercial purposes
- 2) Not transfer the Product or copyright of the Product any other persons or organizations
- 3) Only use for the Product for the purpose in applied to JICA

5. Dissemination of the Final Report and Products

5-1 JICA and DSG agreed that the final report and products to be prepared by the Project shall be released to the public immediately after completion.

5-2 DSG agreed to take full responsibility for implementing the above.

6. Technology Transfer

DSG requested that the Project will focus not only on production of Topographic Maps and Ortophotos, but also capacity development for preparation and utilization of the Products. JICA proposed that DSG makes Digital Topographic Maps in some areas by themselves through on the job training with the assistance by the JICA mission, to which DSG has agreed.

7. Holding Seminar(s)

Both parties agreed that 2 seminars will be held; one on commencement and; another on completion of the Project, for the purpose of getting the comments or opinions and sharing the information on the Project with other ministries and agencies.

8. Country Specific Training

Both parties confirmed that the country specific training in Japan will be held for DSG staff. The timing and number of participants will be discussed through the course of the Project.

9. Project schedule management regarding Aerial Photography and Field Survey

In order for smooth implementation of the Project as shown in Annex 2 "tentative project schedule", it is desirable to complete aerial photography between May and the end of July 2015.

And the schedule of field survey will be informed to DSG from JICA mission in advance for the arrangements.

If the work of aerial photography or field survey were difficult to carry out during the scheduled period, JICA mission and DSG would discuss and find optimum measures for the smooth and quick implementation.

end

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2. The Minutes of Meeting
on the Inception Report for the Project
on 16th June 2015

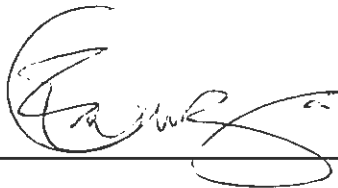
**MINUTES OF MEETING
ON
THE INCEPTION REPORT
FOR
THE DEVELOPMENT OF A GEOSPATIAL INFORMATION
DATABASE PROJECT
IN
THE REPUBLIC OF ZIMBABWE**

**AGREED UPON BETWEEN
THE DEPARTMENT OF THE SURVEYOR GENERAL, MINISTRY OF LANDS AND
RURAL RESETTLEMENT, GOVERNMENT OF ZIMBABWE**

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

Harare, 16 JUNE 2015

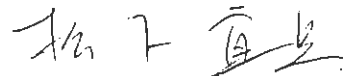


Mr. Edwin GUVAZA

The Surveyor General

Department of the Surveyor General.

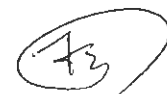
Ministry of Lands and Rural Resettlement



Mr. Yoshiteru MATSUSHITA

Team Leader

JICA Study Team



The JICA study team for “The Development of a Geospatial Information Database Project in the Republic of Zimbabwe” (hereinafter referred to as the Project), which is being organised by the Japan International Cooperation Agency (hereinafter referred to as JICA) arrived in Zimbabwe on 7 June, 2015 to start the project in Zimbabwe.

The JICA study team submitted 10 copies of the inception report (draft) to the Department of the Surveyor General (hereinafter referred to as DSG). Following that DSG and the JICA study team held a series of meetings between 11 and 15 June 2015 in order to discuss the inception report. A list of participants who attended the meetings is shown in appendix 1.

The inception report was accepted by DSG. The following points were confirmed by the JICA study team and DSG during the meetings.

1. The JICA study team explained the basic approach, methodology, specific work procedures, work processes, and human resource planning for the project. DSG agreed to discuss the specific details.
2. The JICA study team explained the outline of the Street Map of Harare. DSG agreed in principle the inclusion of the reproduction of the Street map of Harare as an addition to the contents of the record of discussions. The specific details will be discussed during the course of the project.



Appendix 1

List of Participants

Department of the Surveyor General

Mr. Guvaza Edwin	Surveyor general
Mr. Ndambakuwa Canaan F.H.T	Head of Mapping Branch
Mr. Chinjekure Enias	Mapping Branch
Ms. Chanetsa Chipo S	Mapping Branch
Ms. Chitewe Patience	Cadastral Branch
Mr. Rwizi Constantino	Cadastral Branch
Mr. Mupondi Robert	Geodesy
Mr. Chinoza Witness	ICT
Ms. Kaipa Memory	ICT
Ms. Lugube Winnie	Library
Mr. Ziki Bensen	Finance
Ms. Ward Audrey	Human Resources
Mr. Mamvura Ozwel	Human Resources
Mr. Muchawaya Rangarirai	Administration
Mr. Dzutizeyi Kennedy	Finance

JICA Study Team

Mr. Matsushita Yoshiteru	Team Leader
Mr. Koseki Junichi	Ground Control Point Survey
Dr. Kamusoko Courage	Procurement of Equipment, etc.

JICA Zimbabwe

Ms. Ochida Sayaka	Project Formulation Advisor
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3. The Minutes of Meeting
on the Draft Final Report for the Project
on 28th April 2017

**MINUTES OF MEETING
ON
THE
DRAFT FINAL REPORT
FOR
THE
THE DEVELOPMENT OF A GEOSPATIAL INFORMATION
DATABASE PROJECT
IN
THE REPUBLIC OF ZIMBABWE**

**AGREED UPON BETWEEN
DEPARTMENT OF THE SURVEYOR GENERAL,
MINISTRY OF LANDS AND RURAL RESETTLEMENT,
GOVERNMENT OF ZIMBABWE**

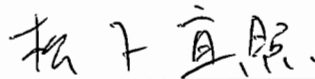
AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Harare, 28 April 2017



Mr. Edwin GUVAZA
Surveyor General
Department of the Surveyor - General,
Ministry of Lands and Rural Resettlement



Mr. Yoshiteru MATSUSHITA
Team Leader
JICA Study Team
for the Development of a Geospatial
Information Database Project
in the Republic of Zimbabwe

The JICA study team for “The Development of a Geospatial Information Database Project in the Republic of Zimbabwe” (hereinafter referred to as the Project), which is being executed by a consortium of Asia Air Survey Co. Ltd. and Pasco Corporation as the Consultant Team for the Project implementation on behalf of Japan International Cooperation Agency (JICA), arrived in Harare on 20th February 2017 for the final study.

The JICA Study Team submitted the Draft Final Report summarizing all the activities of the Project to the Department of the Surveyor General (hereinafter referred to as “DSG”) and a series of discussions on the Draft Final Report were held between the Study Team and DSG.

At the end of the Study, the Study Team expressed their gratitude for the cooperation and assistance provided by DSG for the execution of the Project and the DSG also expressed appreciation to the Study Team for their devotion and the successful implementation of the Project.

The Draft Final Report was accepted by the DSG. Some minor corrections on the Draft Final Report were pointed out by the DSG and the Study Team agreed to correct them at the time of the preparation of Final Report.

List of Participants

Department of the Surveyor-General

Mr. Edwin GUVAZA	Surveyor General
Mr. Robert MUPONDI	Deputy Director, Mapping
Mr. Enias CHINJEKURE	A/ Chief Technician, Photogrammetry

The JICA Study Team

Mr. Yoshiteru MATSUSHITA	Team Leader
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4. The presentation materials in the Inception seminar

- 4.1. The speech by the Minister of Lands and Rural Resettlement
- 4.2. The speech by the Ambassador of Japan to Zimbabwe
- 4.3. “Utilization of Digital Topographic Maps and Orthoimagery” by
JICA Study Team
- 4.4. “STATUS OF TOPOGRAPHIC MAPPING IN ZIMBABWE” by
DSG

SPEECH BY THE MINISTER OF LANDS AND RURAL RESETTLEMENT, HONOURABLE Dr. DOUGLAS MOMBESHORA (MP) ON THE OCCASION OF THE STAKEHOLDERS SEMINAR ON “THE DEVELOPMENT OF A GEOSPATIAL INFORMATION DATABASE” BILATERAL PROJECT BETWEEN THE DEPARTMENT OF THE SURVEYOR-GENERAL (DSG) AND JAPAN INTERNATIONAL COOPERATION AGENCY (JICA), AT THE RAINBOW TOWERS ON 03 JULY 2015.

Your Excellency, Ambassador YOSHINOBU HIRAISHI of Japan, the permanent secretary, Ambassador G. T. Mutandiro, the head of the JICA team Mr. YOSHITERU MATSUSHITA and members of the JICA study team, the Acting Surveyor-General, Mr. C. F. NDAMBAKUWA, invited stakeholders from the geo-information sector, ladies and gentlemen, comrades and friends. It is with great pleasure and honour that I welcome you to this seminar, an important milestone in the development activities of our great republic.

The main project objectives are two-pronged;

1. Capacity building for mapping in the Department of the Surveyor-General, and
2. Development of support infrastructure for the water supply and sanitation services in the city of Harare and its environs.

Essentially, the project entails mapping the urban and peri-urban areas for planning and management of infrastructure, a key strategic objective of the “infrastructure and utilities cluster” of the ZimAsset economic blueprint of the Government of Zimbabwe. In this project Digital topographic mapping will be done for an area of 96km² in the CBD at a scale of 1:5 000, while aerial photographs will be taken of an area approximately 1800km² of the greater Harare urban and peri-urban sprawl. The methodology involves flying acquiring digital aerial photography and using the photogrammetric surveying technique, produce the digital topographic maps, the orthophotomaps and revise the Harare street map.

Under project objective 1), DSG will be capacitated through acquisition of the modern Digital Photogrammetric Workstation (DPW) and other state-of-the-art surveying equipment and accessories. This will guarantee continuity of mapping programmes long after the experts have returned home. The DSG will be able to extend mapping programmes beyond greater Harare city.

Your Excellency, I would like to appreciate this bilateral cooperation which capacitates the DSG to fulfill its statutory mandate to undertake its administrative, regulatory, advisory and technical functions pertaining to land, aerial and space surveys and mapping for geo-information provision as provided-for by the Land Survey Act [Chap. 20:12].

In terms of objective 2), I would like to challenge the stakeholders here present and others not represented to take advantage of the products that will be produced and the technology that will be implemented in the DSG to develop our environs using the limitless opportunities provided by technology.

Your Excellency Ambassador YOSHINOBU HIRAIISHI, it is my proposal that such noble developmental activities be not limited to the capital city only. It is my hope that your good offices shall consider extending the programme beyond the perimeter of Harare. It is almost thirty (30) years since the country was covered fully using aerial photography for mapping. I therefore propose a long-term relationship with the DSG's efforts to provide up-to-date geo-information services.

Lastly I would like to challenge the DSG to justify the investment by producing modern products for our citizens and the tourism sector.

Your Excellency, I would like to appreciate you further for gracing this seminar by finding time off your busy schedule to witness this turning point in the history of the DSG.

I thank you.

OPENING ADDRESS BY H. E. MR YOSHI TENDAI HIRAISHI, AMBASSADOR OF JAPAN TO ZIMBABWE,
ON THE OCCASION OF THE INCEPTION SEMINAR FOR THE DEVELOPMENT OF A GEOSPATIAL
INFORMATION DATABASE PROJECT IN THE REPUBLIC OF ZIMBABWE

3 JULY 2015

MANGWANANI Mamuka sei? SALIBONANI LONKE.

Hon. Dr. Douglas Tendai Mombeshora, Minister of Lands and Rural
Resettlement

Mr. Canaan Ndambakuwa, Acting Surveyor General

All protocol observed,

Ladies and Gentlemen,

It is my great pleasure to make an opening address today at this important Inception Seminar which marks the kick-off of “the Development of a Geospatial Information Database Project in the Republic of Zimbabwe” .

This Project has been initiated as a result of a request from the Government of Zimbabwe for bilateral assistance from Japan. Our assistance is a part of Japan’s Technical Cooperation with Zimbabwe implemented by JICA, the Japan International Cooperation Agency. And here I am happy to recognize members of a Study Team for this project. This Study Team of consultants has been established by JICA for the smooth implementation of this project.

On one hand, the word ‘map’ is something quite familiar to all of us. In our everyday life we use or see various kinds of maps, such as a road map, a floor map and a weather map. These maps support our daily life in various ways. On the other hand,

‘mapping’ is a highly specialised and technical field and I confess that I only have a vague understanding about what is called as the ‘**Geospatial Mapping**’. So it is my hope that we will have a clearer and better understanding of what we are going to get as a result of this project by the end of this Seminar.

Basically, this project is designed to involve detailed and accurate mapping of **Harare** and its environs, including **Chitungwiza** and **Epworth**, through detailed aerial photography. One part of the outcome of the project, the detailed and accurate maps of the central part of Harare and the ‘ortho photo’ data of wider area of Harare, will be handed over to the Government of Zimbabwe, more specifically **the Department of the Surveyor General**. Another part of the project is the transfer of mapping technology to the Zimbabwean counterparts through training.

The detailed and accurate maps are crucial for the future development planning of infrastructure in the targeted areas such as water and electricity supply. This work was last done in this country more than thirty years ago and the maps currently being used are now obsolete. This Project is expected to be completed in two years’ time, in May 2017, by which time a Training Manual will have been produced.

As I said earlier we are also joined here by a JICA Study Team of consultants. I know that they are very much looking forward to working closely with their Zimbabwean counterparts in **the Department of the Surveyor General** and to impart their in-depth, up-to-date expertise to their counterparts. The development of local capacity is a very important component of this Project. I

sincerely hope that in the future the Department of the Surveyor General will make splendid maps of other cities in Zimbabwe by utilising expertise and knowledge acquired by this project.

Finally let me say that I am pleased to note that the Zimbabwean Government is very well represented here today. I would like to take this opportunity to express my deep appreciation to **Honourable Minister Mombeshora** for his attendance and continued valuable support to the success of this project in the future.

I conclude my remarks by wishing you a very fruitful Seminar.

THANK YOU. TINO TENDA. SIYA BONGA.

Utilization of Digital Topographic Maps and Orthoimagery

Hiromichi Maruyama
JICA Study Team

10:00 – 12:05 3rd July 2015 at The Rainbow Towers

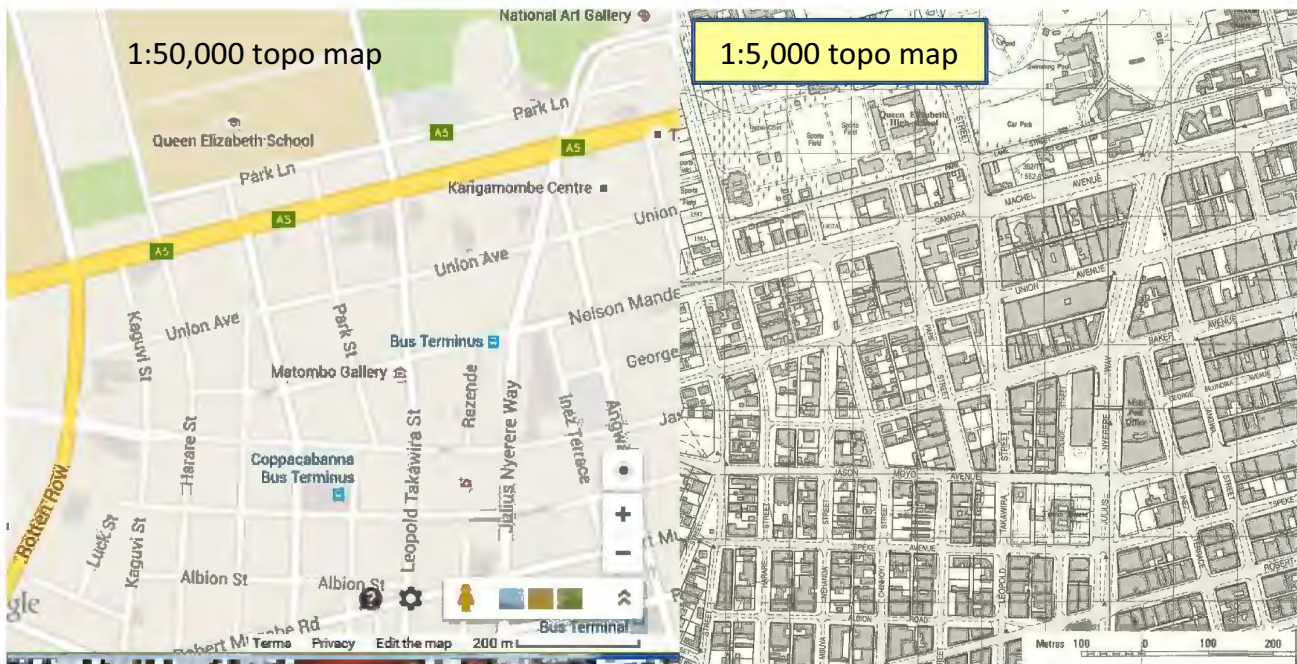
Inception Seminar for the Development of a Geospatial Information Database Project in the Republic of Zimbabwe

Utilization of Digital Topographic Maps and Orthoimagery

- Products from the Project
- Utilization of Digital Topographic Maps
- Utilization of Orthoimagery
- Towards the promotion of product utilization

Products from the Project

- 1:5,000 scale digital topographic maps



Products from the Project

- Orthoimagery of 20 cm ground resolution

50 cm



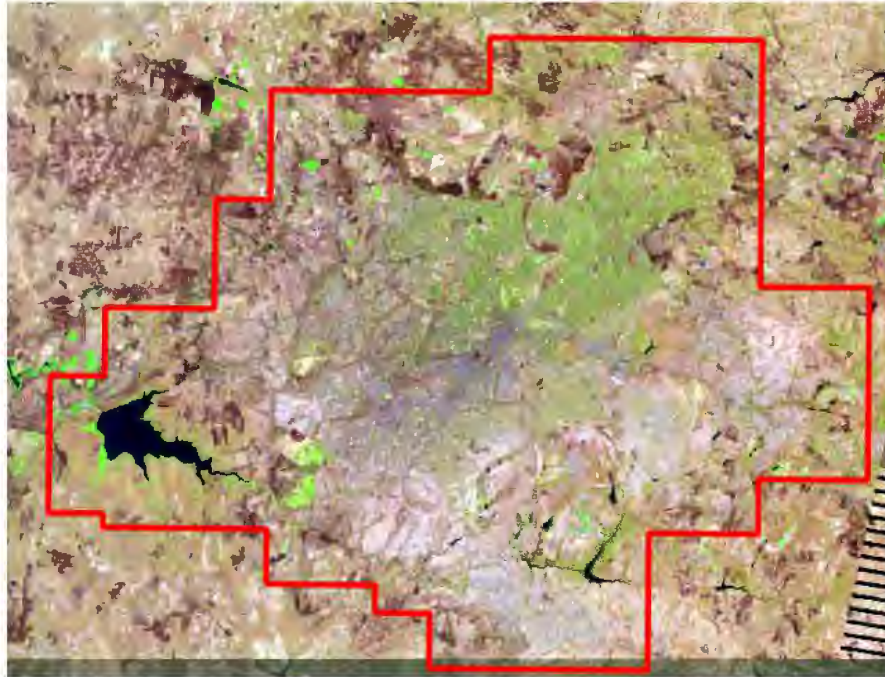
20 cm



Products from the Project

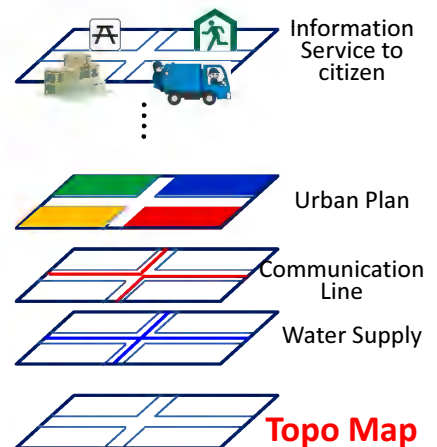
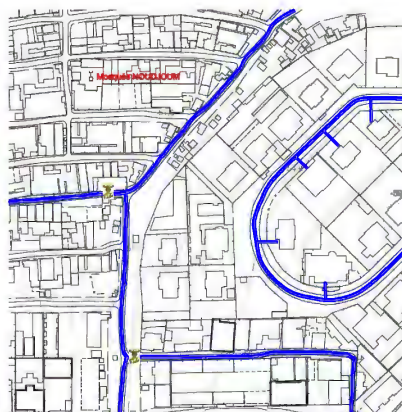
- Harare Map covering City of Harare using Orthoimagery and contour lines.

Background image is composed by Landsat 7 and Landsat 8 data
Data available from the U.S. Geological Survey.



Utilization of Digital Topographic Maps

- Urban development planning
- Maintenance of infrastructure facilities
- Efficient management and administration in local government

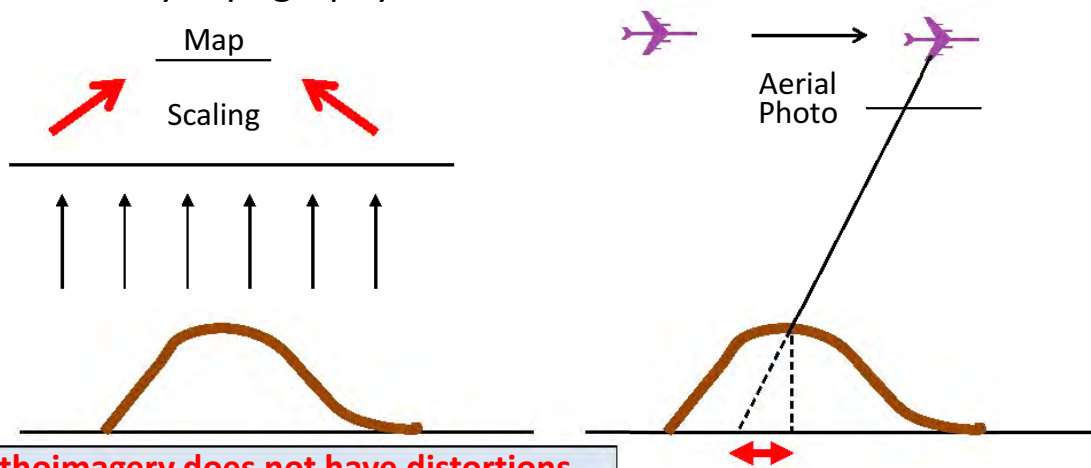


Utilization of orthoimagery

- What is orthoimagery?
- What is the difference between orthoimagery and topographic maps?
- Examples of utilization of orthoimagery

What is orthoimagery?

- Map is scaled representation of the earth surface viewed from directly above
- Aerial photo does not coincide with maps due to distortions caused by topography.



Orthoimagery does not have distortions caused by topography. Orthoimagery does geometrically coincides with a map.

Distortion caused by topography

Position of base of buildings is corrected. Roofs of Buildings, however, remains distorted because correction of distortions is made using elevation of the ground.

What are the differences of orthoimagery from topographic maps?

• Orthoimagery

- All objects on the earth surface included
- Objects are shown same as users see
- Users have to identify objects on the image
- Every object is shown equally
- Less time and cost for production

• Topographic maps

- Only selected objects defined by map specifications are included.
- Objects are represented following map specifications
- Users know what are the objects on the map from the map legend
- Important objects can be highlighted.
- More time and cost for production

Examples of Utilization of Orthoimagery

- Mapping or update of ground objects on the flat areas
- Understanding of present situation at the planning stage of various development
- Explanation of the development to the people concerned



Towards the promotion of product utilization

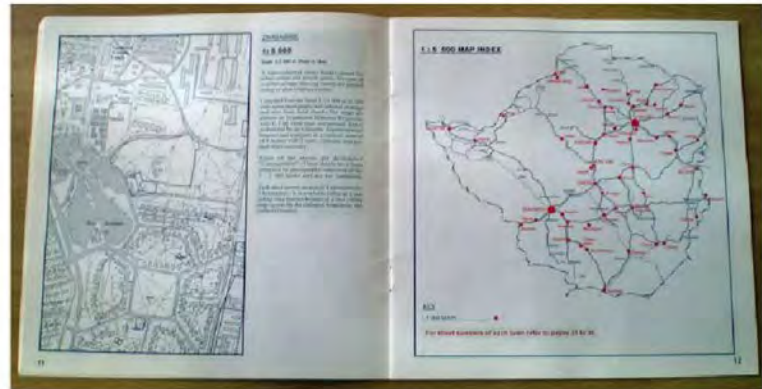
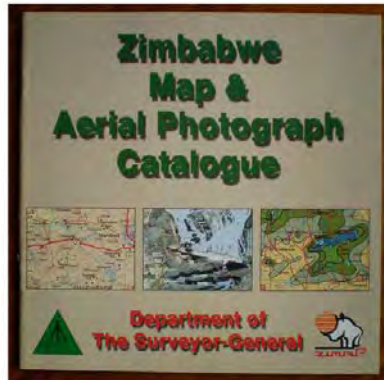
- Principle
 - User friendly products
 - Easy access to the products
 - Clear data policy
- Methodology
 - Interviews from various stakeholders in Zimbabwe
 - Workshop
 - Transfer Japanese experience

User Friendly Products

- User need should be taken into consideration
 - Transformation of data
 - vector / raster conv.,
 - file format conv. (e.g. shp, GML, KML)
 - Extraction of data
 - data of specific feature type (e.g. road, contour)
 - data of specific geographical area
 - Integration of data
 - Integration with other existing data such as cadastral data
 - Determination of basic unit for data provision
 - From seamless data to data divided into sheet by sheet
- Explanatory booklet for product

Easy Access to the Product

- Up-to-date Product Catalogue



- Study measures to promote easy access
 - Use of Web site
 - Diversification of product provision

Clear Data Policy

- Digital data is easily copied and modified.
- Strict data policy limits the potential of variety of uses of digital data for various purpose.
- License is usually granted when digital data is provided.



- **Clear data policy for Digital data is indispensable.**

Ask support from various stakeholders

- Interview
 - the situation of using geospatial information
 - Environment using geospatial information
 - User need about products
- Workshop
 - Manipulation of data and software at the user organizations



- **Reflect findings on the specifications of product to be provided to users**

Seminar commemorating the completion of the project

- Timing
 - First quarter in 2017
- Contents
 - Results of the project
 - Products to be provided to users
 - (Potential) use case of products by user organizations
 - Access and use of the products

Thank you for your attention !

Tatenda

Siyabonga Kakulu

ご清聴ありがとうございました。



DEVELOPMENT OF A GEOSPATIAL DATABASE



STATUS OF TOPOGRAPHIC MAPPING IN ZIMBABWE

Presented by Canaan F.
Ndambakuwa



Introduction

Various national developmental plans such as the building of industrial complexes, re-organisation of the national transportation network, modernisation of agriculture, development of water resources and sanitation health infrastructure and other utility facilities are an essential backbone for sustainable development.

In order to support these plans, detailed information on spatial status – especially large scale topographic maps are necessary



Aim of the Presentation

- To highlight the DSG's role in Geospatial Information Collection, Management and Mapping in Zimbabwe;
- To highlight the nature and status of Topographic Mapping In Zimbabwe
- To bring to the fore: the challenges the DSG is facing in Geospatial Information Collection, Management and Mapping endeavors, and the Desired State
- To introduce the UAVs as possible vehicles to be employed in DSG's mapping discipline

3



Presentation Outline

- DSG's Source of Authority and Mandate
- Summary of Map Production Methods
- Current Series Mapping Scales
- Planned Series Mapping Scales
- Current Challenges
- Desired Position
- Planned Way Forward
- Conclusion



4



DSG's Source of Authority and Mandate

- Land Survey Act [*Chapter 20:12*]
 - Sec. 7(a) Supervise and control the survey and charting of land for purposes of registration in the Deeds registry
 - Sec. 7(b) Supervise and control all matters pertaining to aerial and space surveys conducted and geo-information obtained in relation to Zimbabwe
 - Sec. 7(i) Prepare such maps as the Minister may direct

5



DSG's Source of Authority and Mandate

- Copyright Act [Chapter 26:01 - General Notice of 2004]
 - Applies in respect of the reproduction, updating and copying, and the storing, transmitting or translating in analogue or digital form, of maps, aerial photographs, plans, survey diagrams, charts, and other related spatial data, copyright in which subsists in the government of Zimbabwe
 - Copyright vests in the President in all maps, aerial photographs, plans charts, or related spatial data
 - Government copyright will be deemed to have been infringed by any person who, without the written consent of the Surveyor-General, copies any Surveyor-General's work, whether the copying is direct, in whole or in part, or from any map, aerial photograph, plan chart, or related spatial data based on any Surveyor-General's work

6



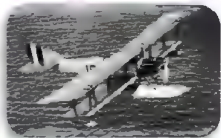
DSG's Source of Authority and Mandate

- In Zimbabwe, the Department of the Surveyor General (DSG) is the national mapping and surveying authority (NMSA) with the main task of producing national topographic base maps.
- These maps are made at various scales to address different user-needs and applications.
- These are the maps the above-cited Copyright Act applies

7



Map Production



- **AERIAL PHOTOGRAPHY**
 - Photo Interpretation
- **SATELLITE IMAGERY**
 - Image Classification
- **FIELD SURVEYS**
 - Photo-interpretation and Image Classification verification
- **LOCAL KNOWLEDGE**
 - Geographical Names
- **LAND DEMARCATION**
 - Cadastral documentation

8



Series Mapping Scales Topographic Base Maps [At Present]

- 1:5,000 Urban Areas x 932 maps
- 1:25,000 Harare x 18 maps
- 1:50,000 Whole Country x 571 maps
- 1:100,000 Lake Kariba Charts x 3 charts
- 1:250,000 Whole Country x 32 maps
- 1:500,000 Whole Country x 4 maps
- 1:1,000,000 Whole Country x 10 maps
- 1:1,000,000 Aeronautical Chart x 1 chart
- 1:1,000,000 Aeronautical Chart x 4 [ICAO]
- Various Scales Thematic

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Series Mapping Scales Topographic Base Maps [Planned]

- 1:1,250 Very High Density Settlements
- 1:2,500 Medium Density Settlements
- 1:5,000 Urban Areas - other
- 1:12,500 Outer-urban
- 1:25,000 Whole Country x 2,284 +/- maps
- 1:50,000 Whole Country x 571 maps
- 1:250,000 Whole Country x 32 maps
- 1:500,000 Whole Country x 4 maps
- 1:1,000,000 Whole Country x
- Various Scales Thematic

10

Current Challenges

- **OUTDATED Geospatial Information Database and Topographic Base Maps**
 - Aerial Photographs, Satellite Images, Topographic Base Maps and related products
- **Inappropriate Technology**
 - Hardware and Software
- **Under-Staffing**
- **Inadequate Skills and practices**



Desired Status

- **UP-TO-DATE Geospatial Information Database and Topographic Base Maps**
 - Aerial Photographs, Satellite Images, Topographic Base Maps and related products
- **Wide range of products output/exchange formats**
- **Cutting-edge (State of the Art) Technology**
 - Hardware and Software
- **Appropriate Staffing Level**
- **Skills in tandem with changing technology and International Best Practices in Geospatial Information Management and Mapping**



Planned Way Forward

1. Use of Satellite Imagery as a source for map generation and revision
 - ✓ Peri-urban and Rural Areas
2. Use of Digital Photogrammetry as a source for map generation and revision
 - ✓ Urban Areas
3. Use of Unmanned Aerial Vehicles (UAVs) as platforms for collecting geospatial data/information for use as source data/information for map generation and revision
 - ✓ Areas of rapid land-use and land-cover changes



13



What is a UAV?

1. UAV is an acronym for Unmanned Aerial Vehicle.
2. It is also known in the mainstream as a drone, and is also referred to as an Unpiloted Aerial Vehicle and a Remotely Piloted Aircraft (RPA) by the International Civil Aviation Organization (ICAO). It is an aircraft without a human pilot aboard.
3. Already UAVs are available that capture and process aerial data with mapping accuracy: 10mm horizontal and better than 25mm in height.



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Conclusion

- It would be a mission impossible for one organisation to try and collect all the data that it will need to operate a successful Geospatial Information System.
- Always there has to be inter-dependence and linkages within and without any institution for the purposes of obtaining appropriate data for building a successful National Geospatial Information Base.



15

Thank You



PRESENTED BY THE DEPARTMENT OF THE SURVEYOR GENERAL (DSG)

C/o: Cnaan F. H. T. Ndambakuwa
Chief Land Surveyor - GIS
Department of the Surveyor General
Box CY 540, Causeway
Harare
Zimbabwe



12

16

An introduction to Digital Aerial Photogrammetry: Latest technologies and trends

July 2015

JICA Study Team

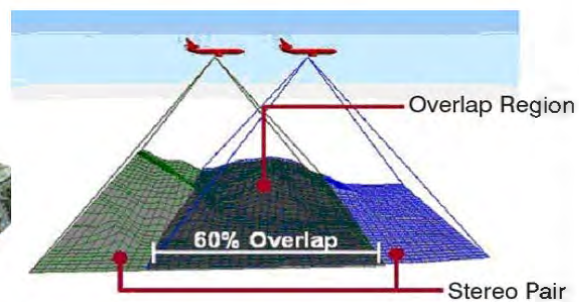
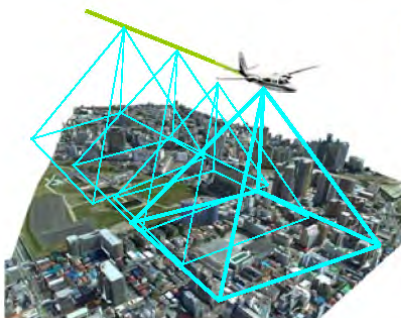
Japan International Cooperation Agency (JICA)

Purpose of Aerial Photogrammetry

Photogrammetry is a technique allowing precise measurements on objects, using the stereoscopic vision of this object from two or more overlapping images of this object.

Aerial photogrammetry consist into collection of geographical information with photogrammetry methods, with pictures taken from an airborne vehicle.

Aerial photogrammetry surveys can provide information on details not visible from the ground.



Digital Aerial Photography: Equipment

Large Format Photogrammetric camera
used in Harare Geospatial Information Database Project:
UltraCam Eagle



Digital Aerial Photography: System configuration

Segments of aerial photography platform integrated in the aircraft



Digital Aerial Photography: example of image



Digital Aerial Photography: Topography & Mapping



Digital Aerial Photography: Digital Vector Mapping



Digital Aerial Photography: Overall process from Planning to Delivery

Usual stages of photogrammetric project

1. Analysis and choice of the best system to be used
2. Flight planning
3. Data acquisition
4. Quality Control
5. Processing of images and trajectory (a.k.a. pre-processing)
6. Production of deliverables: orthos, mapping, ...

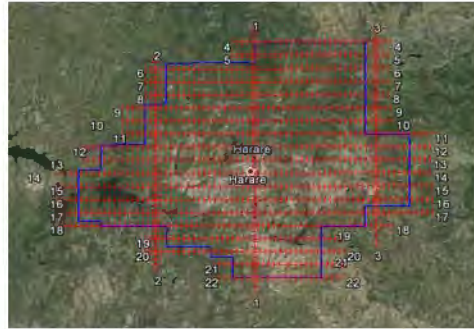
1. Analysis and choice of the best system to be used

1) Parameters

- Ground Sample Distance (GSD), measured in cm – the size of pixel on the ground. Linked to the expected accuracy / scale of the final products
- Flight altitude Above Ground Level (AGL)
- Forward overlap and side overlap – usually 60%-30%

2) Preparation and planning

- Preparation and planning the project is one of the most important stages in whole process
- Choice of a suitable aircraft and camera
- Determination of flight parameters: speed, line spacing
- Flight planning must be carefully design so that to achive client's requirements

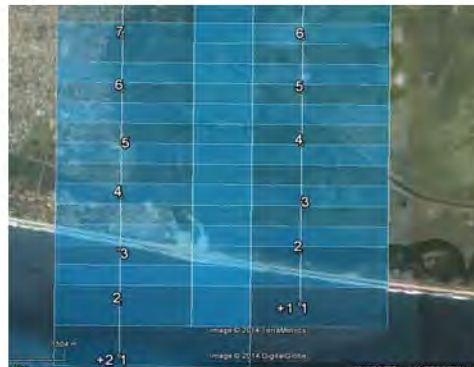


2. Flight planning

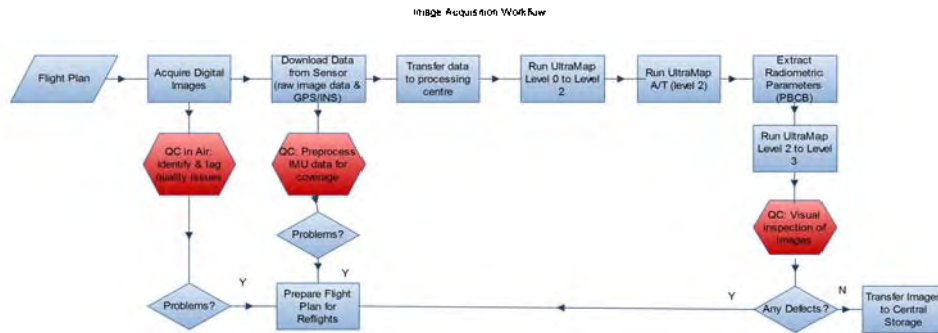
1) Flight planning is the process of determining the best possible position of flight lines to achieve requirements. Nowadays process is semi-automated and different flight planning software may be used, depending on the navigation system on board

2) Most popular flightplanning software:

- IGI Plan
- Leica MissionPro
- Topoflight
- internal company software



3. Data Acquisition

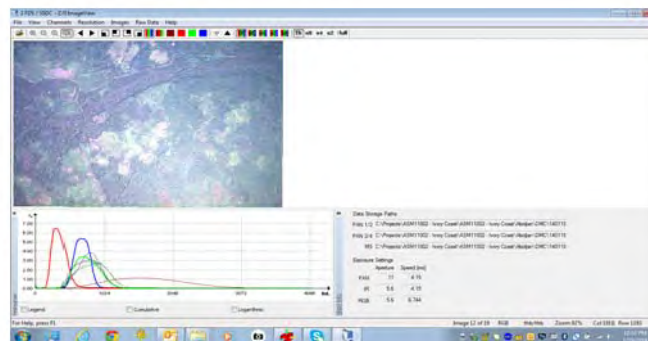


4. Quality Control 1

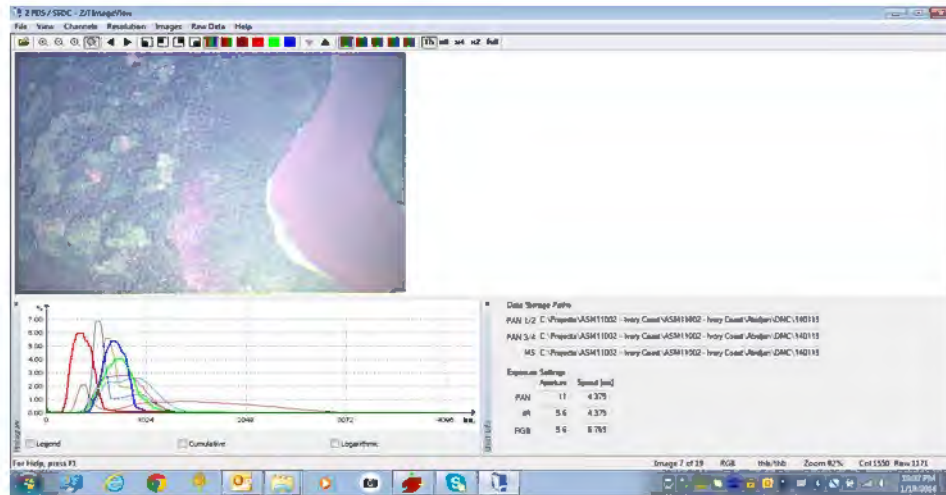
1) Quality control is the process to check if all acquired data are meeting accuracy and quality requirements. There are several ways to proceed. Though some systems have onboard QC equipment, in most of cases QC is done after finishing the flight.

2) Data to check:

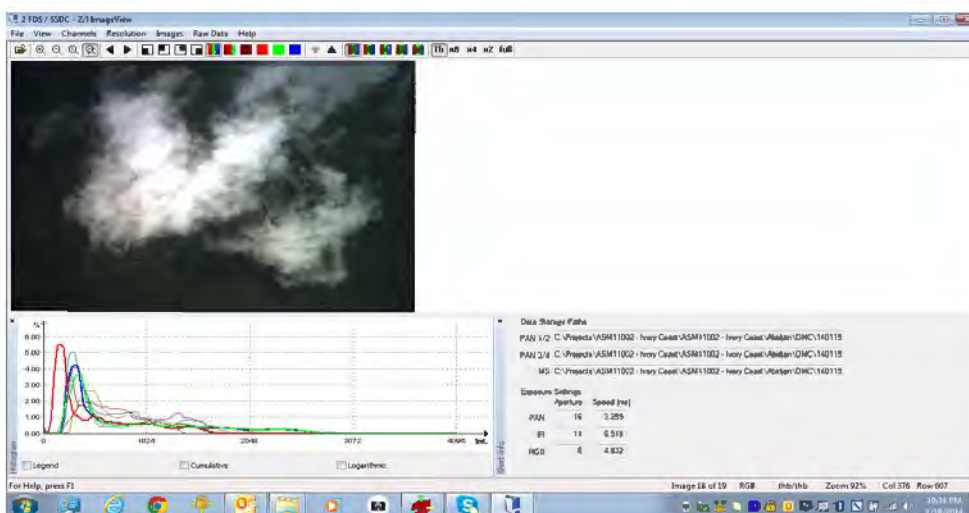
- Images
- INS/GPS data
- coverage



4. Quality Control 2



4. Quality Control 3



5. Pre-processing

1) During pre-processing stage, all previously checked data are put together for further processing / production

2) Stages of preprocessing

- Trajectory calculation (combining GPS + IMU airborne data together with ground GPS base stations data)
- Determining External Orientation parameters for each photo (EOs)
- Checking against known points (GCP's)



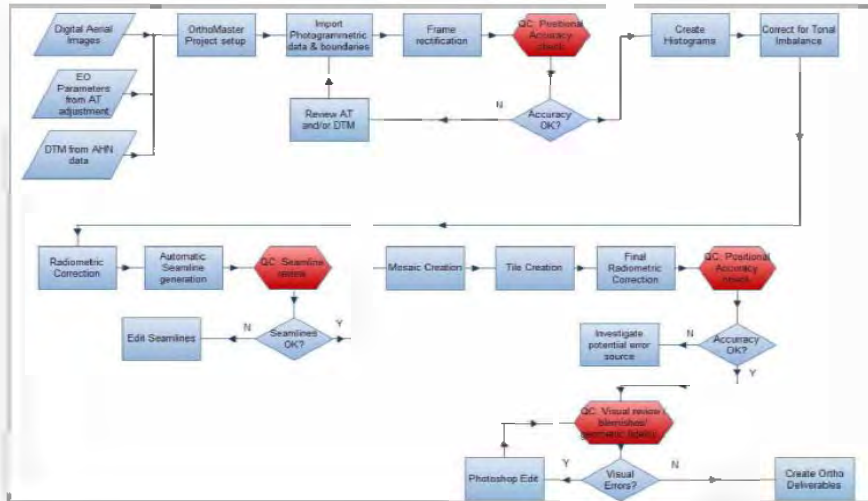
6. Production of deliverables

- Production is the stage where final products are prepared



Orthophotography generation

The diagram below shows typical steps for the generation of an orthophoto. It may differ from one software to another.



Aerial Photogrammetry – Accuracy

- The **absolute accuracy** is a value representing difference between known points (GCPs) and the same features on photos after adjustments. In metric units.
- Absolute accuracy is a combination of accuracies from all system components, and is dependent on following conditions:
 - Flight height
 - GPS measurements accuracy
 - Trajectory accuracy
- The typical product – an Orthophoto Map – has usually an accuracy of 1 to 1.5 pixels

Aerial Photogrammetry: digital vs analogic

Here below are presented the advantages of Digital Aerial photography compared to traditional analogic method:

[Technical aspects]

- Multispectral capabilities, which allows acquisition of four-band imagery for red, green, blue and near infrared colors.
- Wide-range of CCD sensor (12 bit) provides high color re-productivity

[Time and cost efficiency advantages]

- Acquisition of GPS/IMU data minimizes the number of aerial targets to be placed prior to the photography
- Development of films and scanning are not required
(Nowadays, analogue film is becoming difficult to obtain in the market)
- High resolution imagery eases the photo interpretation process
- Flight planning information can directly be used as in-flight navigation information for the photography

Digital Aerial Photogrammetry: Most common products

Several type of products can be created from Aerial Photogrammetry data, such as:

- Digital Terrain Model (DTM)
- Orthophoto mosaics
- Map
- 3D models



Digital Aerial photogrammetry: Data Usage 1

Aerial Photogrammetry is used in a large array of industries:

- Land survey
- Cartography
- Cadastral
- Archaeology
- Transportation Projects in conjunction with Ground Surveys
(Roadway, Railway, Bridge, Interstate)
- Fishery surveys
- Hydrocarbon exploration
- Mining
- Monitoring vegetation and ground cover



Digital Aerial photogrammetry: Data Usage 2

Renewables

Digital elevation data and land cover imagery to aid wind farm siting and site access



Oil and Gas

Photogrammetric and LIDAR mapping were combined to map a gas pipeline route in Algeria



Transportation

LIDAR intensity image acquired under Fugro's LIDAR framework with UK Highways Agency



Urban Planning

Accurate photogrammetric extraction of 3D data from vertical and oblique stereo imagery



National Mapping

Aerial photography and vector mapping, Ville de Pointe-Noire, Republic of Congo

The latest technology (2015)



Digital aerial photography



Survey aircraft with Digital Camera



LiDAR survey
Helicopter mounted



IFSAR system - GeoSAR



DRIVE-MAP
Mobile mapping system

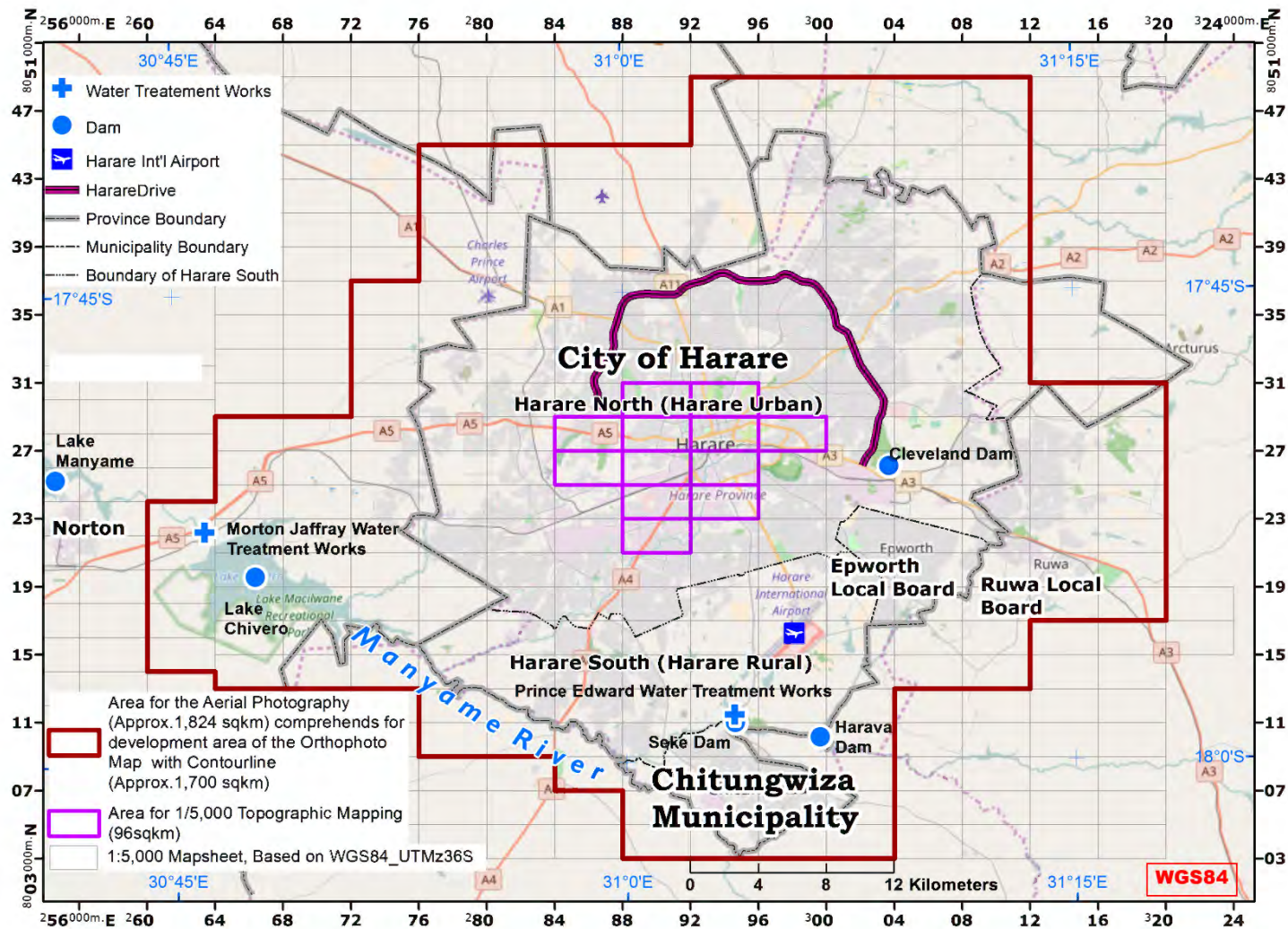


Drone

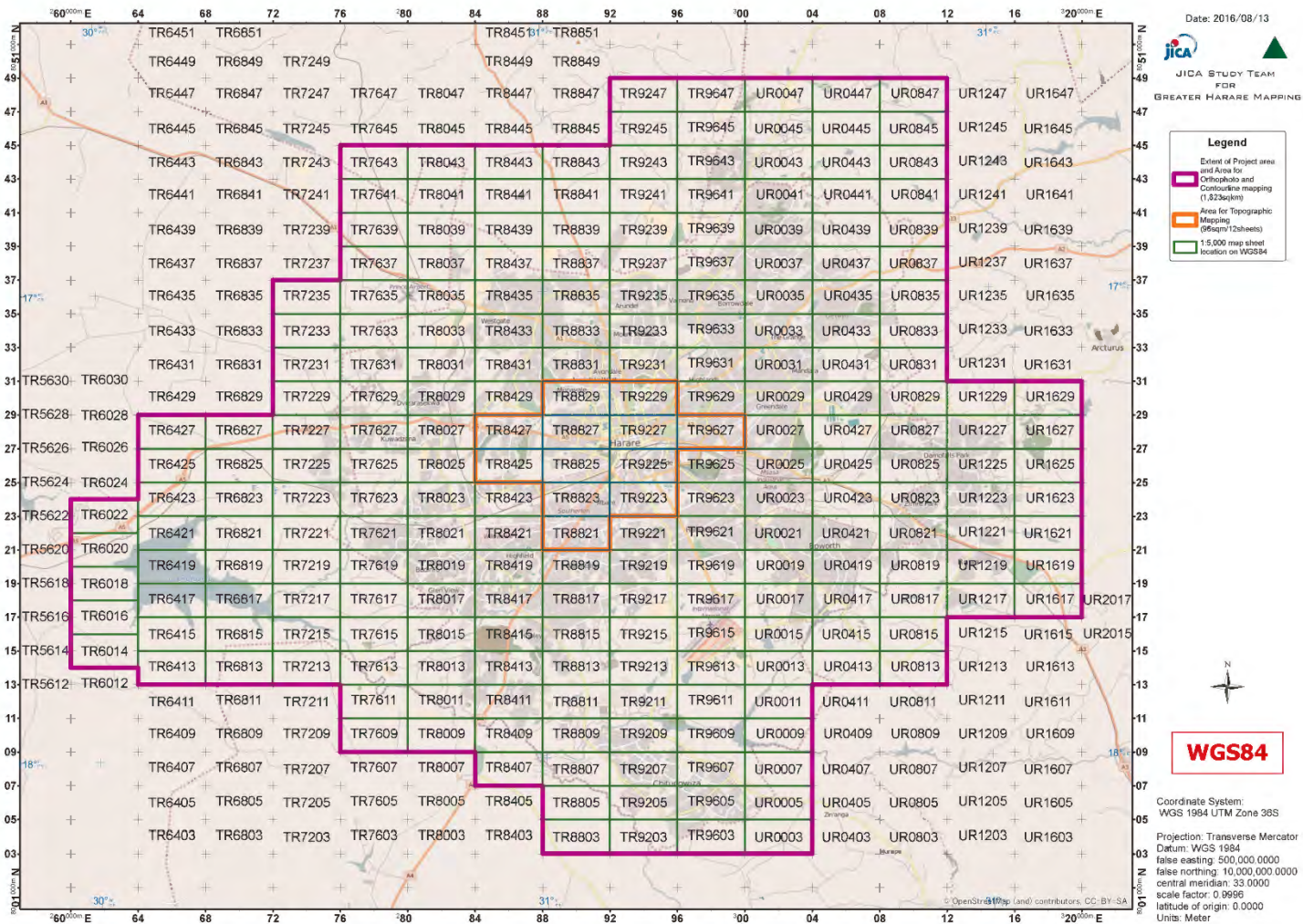
Thank You

5. Materials on the preparation of Digital Topographic Maps and Orthophoto imageries of Harare

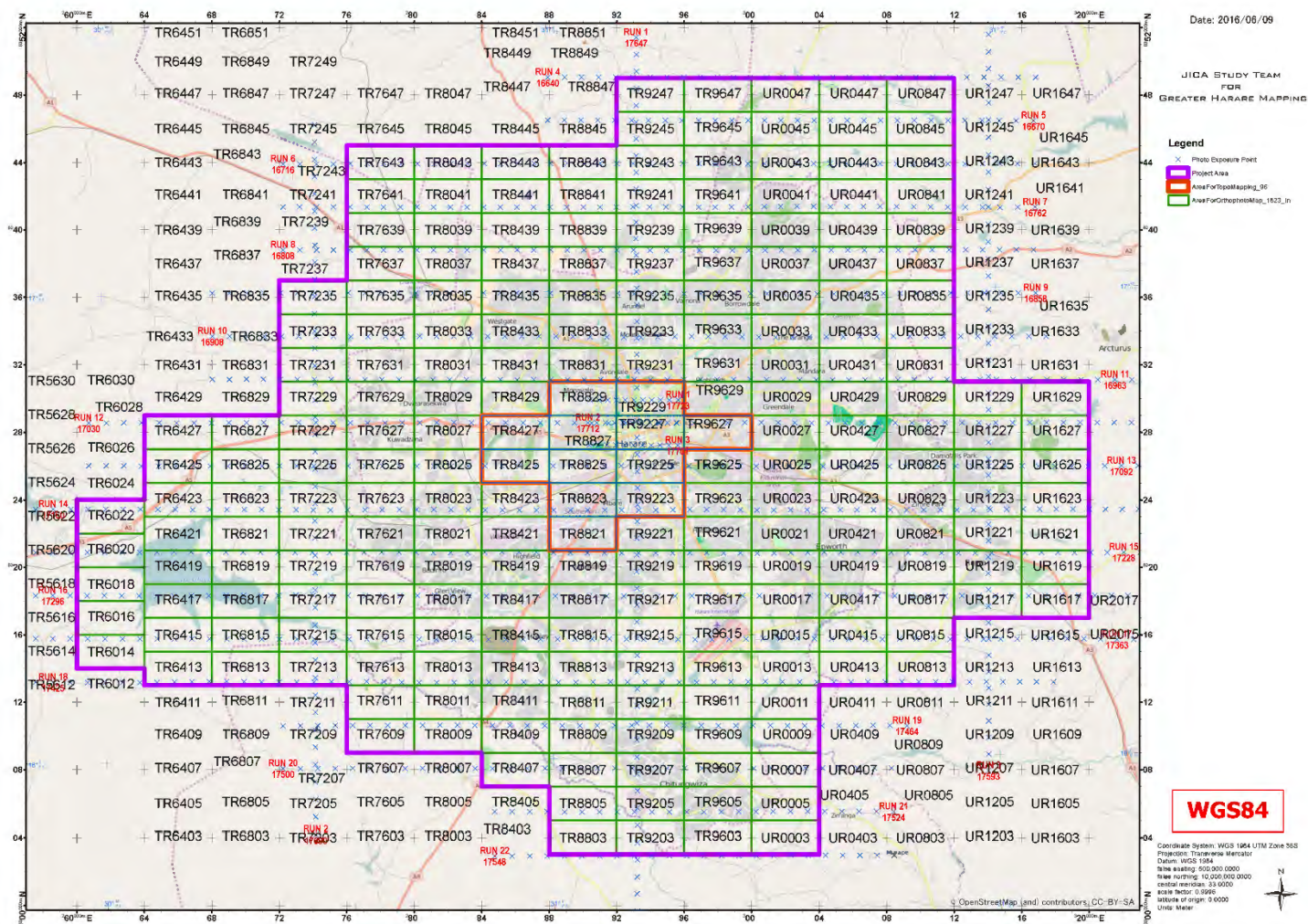
- 5.1. Project Area
- 5.2. Map sheet layout
- 5.3. Aerial PhotoID with map sheet index
- 5.4. Index map for GCPs and Aerial Photo
- 5.5. Flight strip and GCPs
- 5.6. GCPs, Leveling route and topography
- 5.7. GCPs, Leveling route with map sheet index
- 5.8. GCPs and Leveling route map
- 5.9. Aerial photography Trajectory
- 5.10. Outline of Aerial Triangulation
- 5.11. Existence of existing 1:5,000 topographic map sheet
- 5.12. Implementation year of past aerial photography for existing 1:5,000 topographic maps



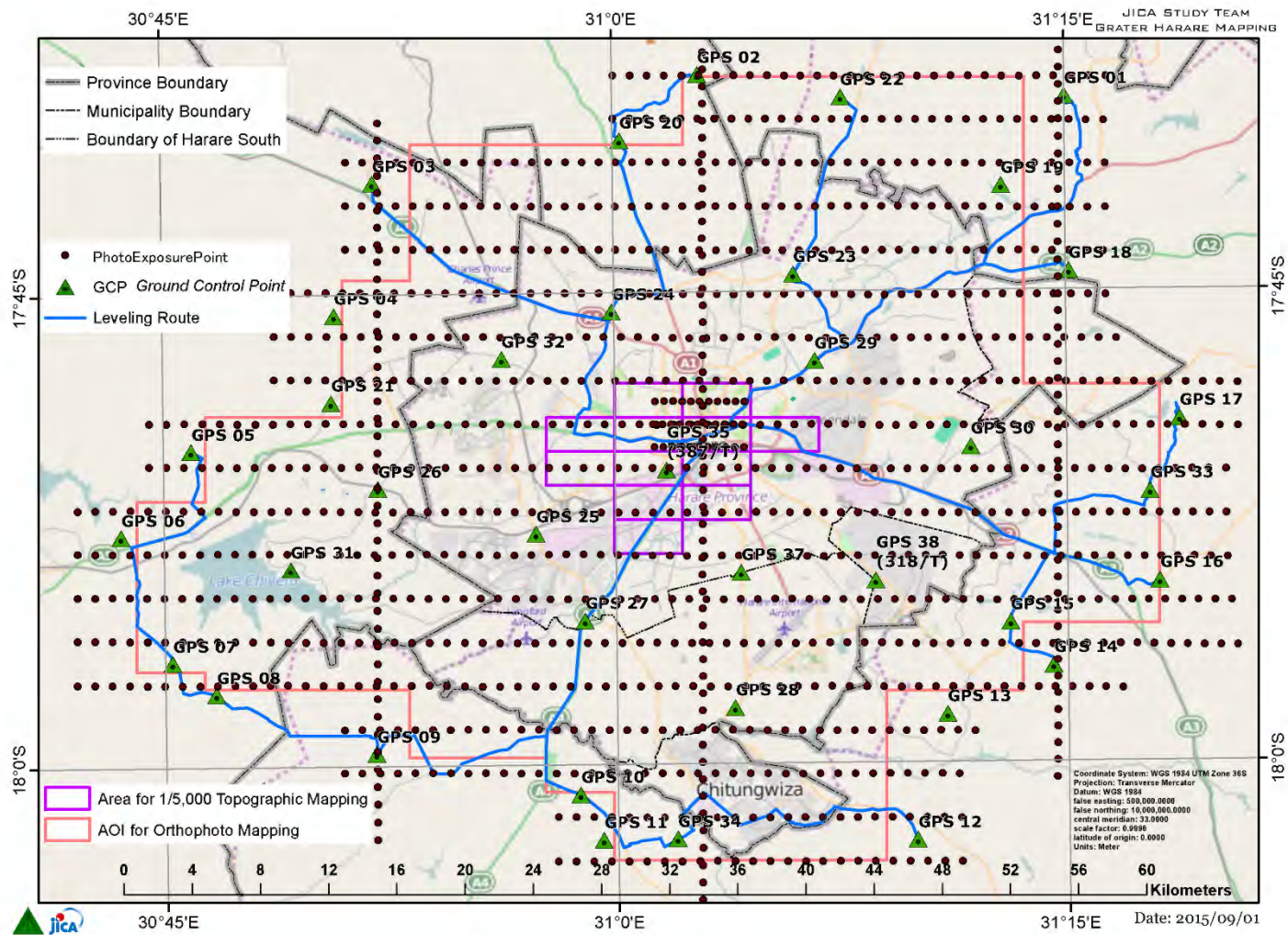
Project Area



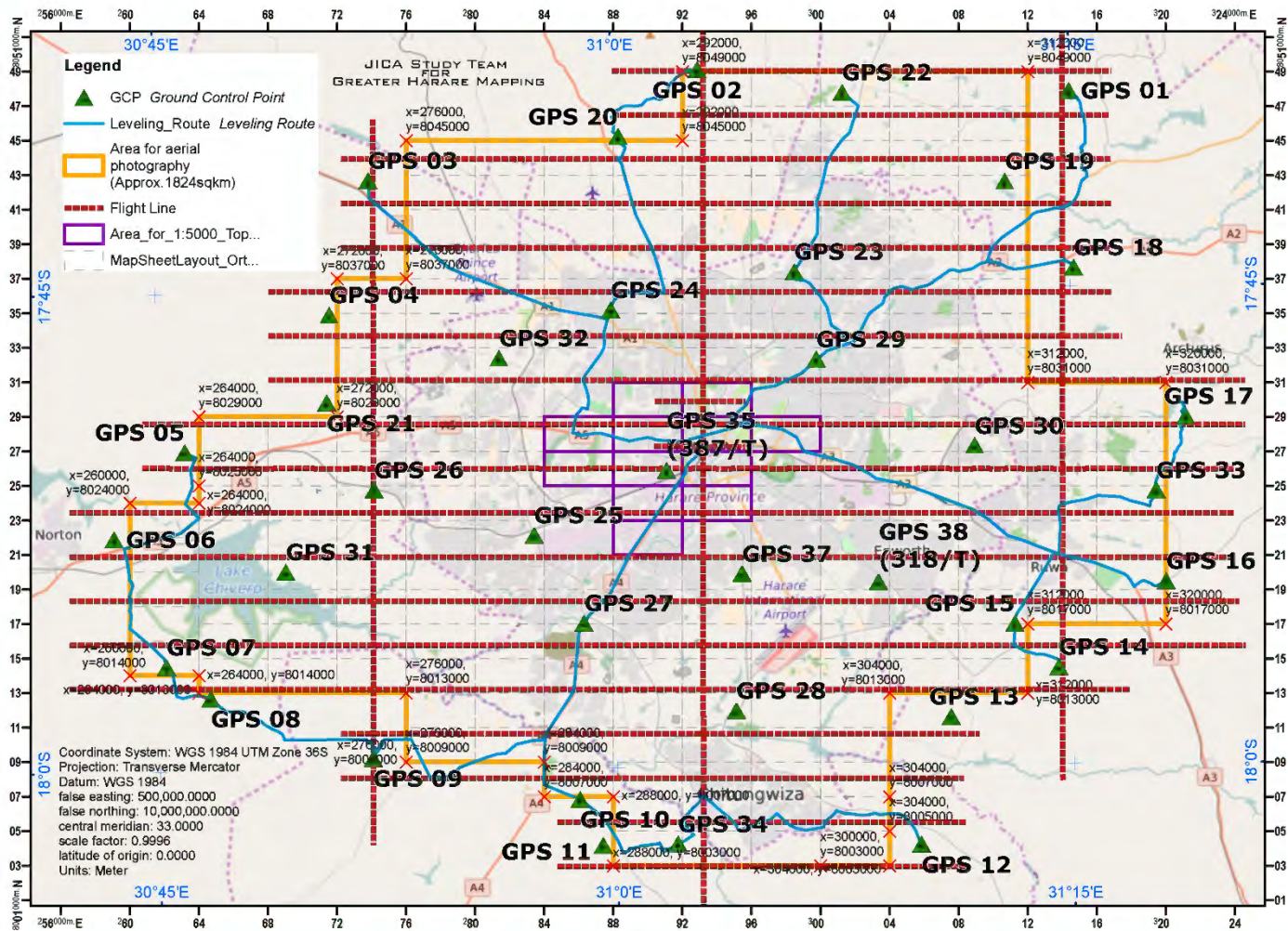
Map sheet layout



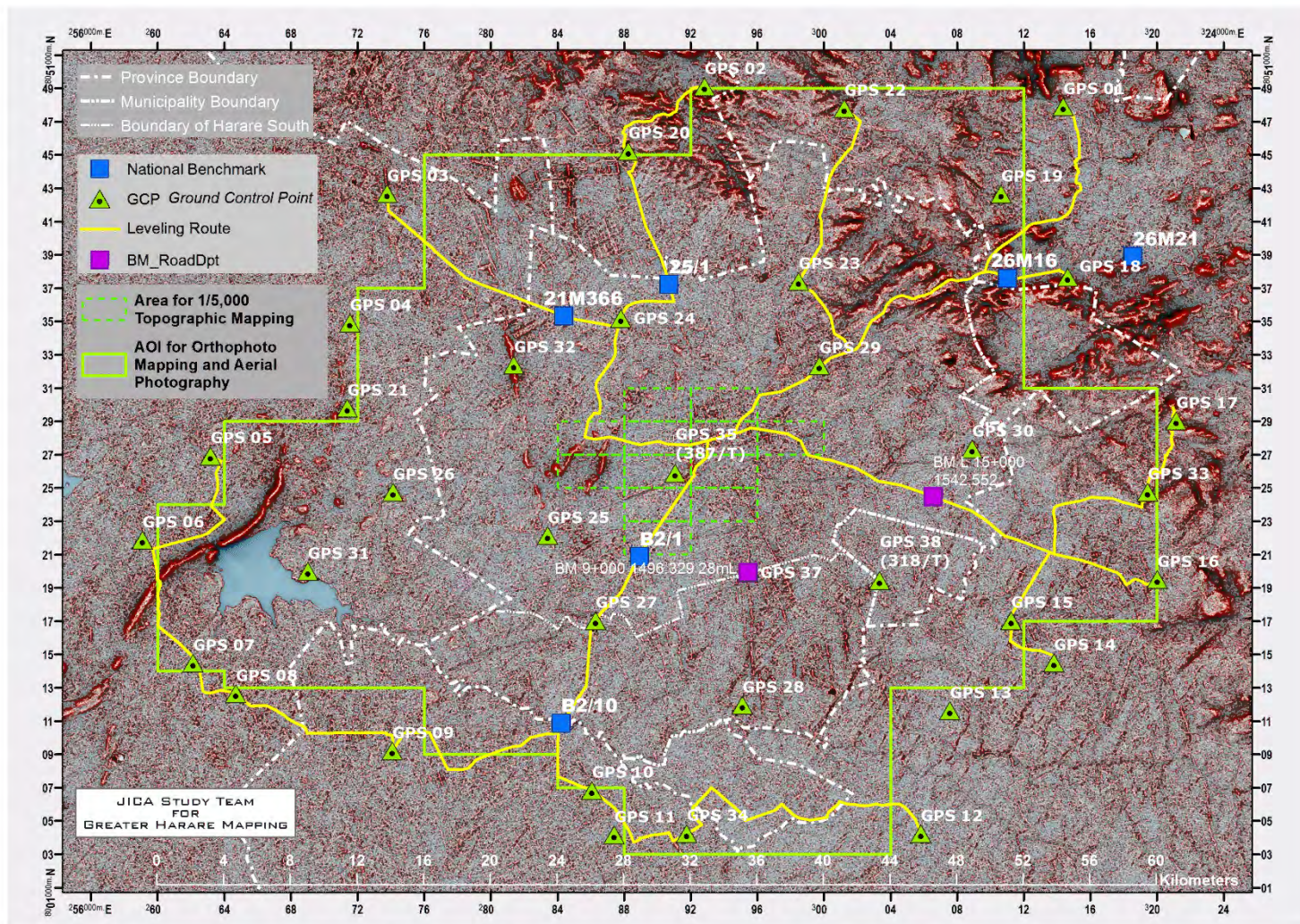
Aerial PhotoID with map sheet index



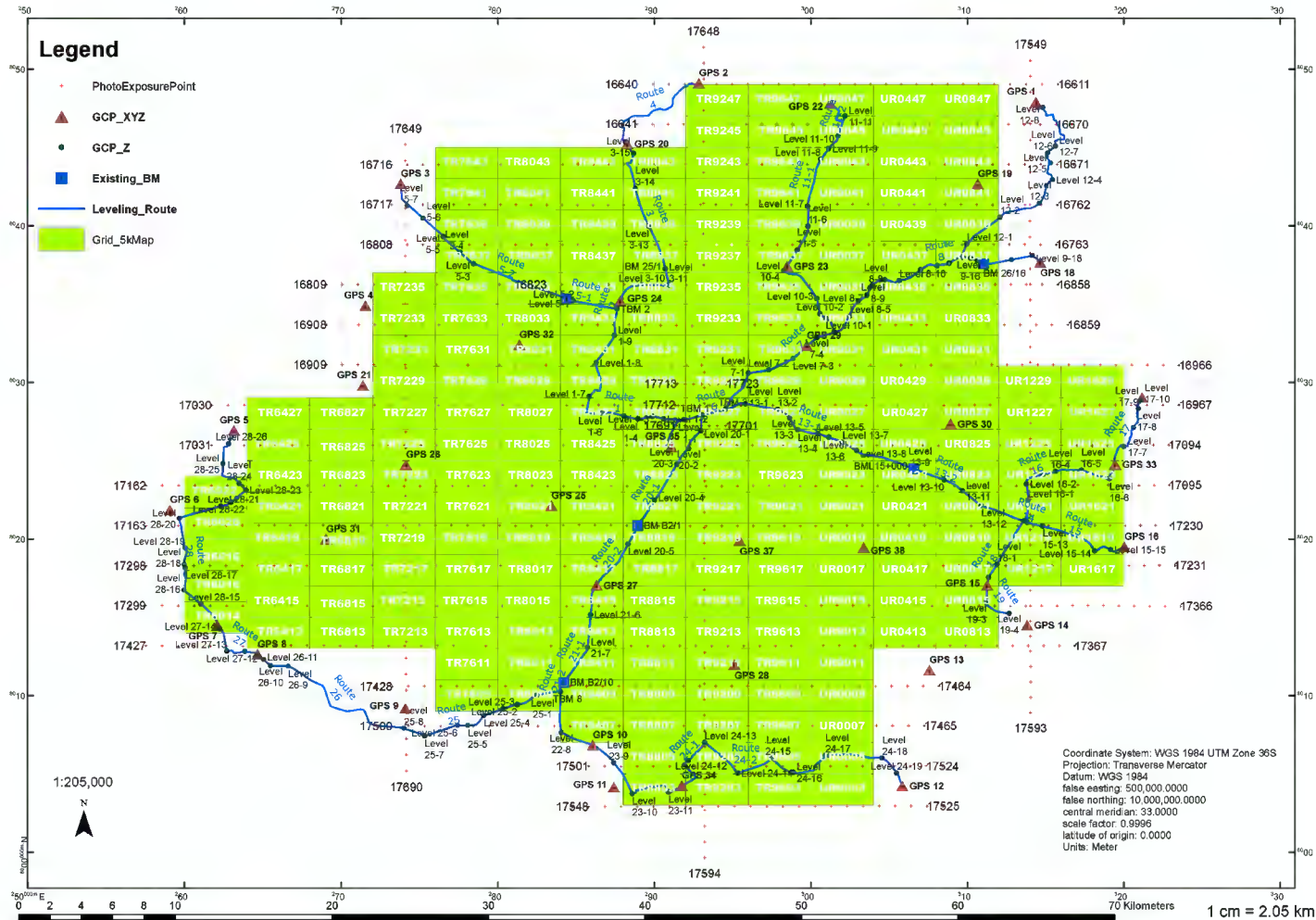
Index map for GCPs and Aerial Photo



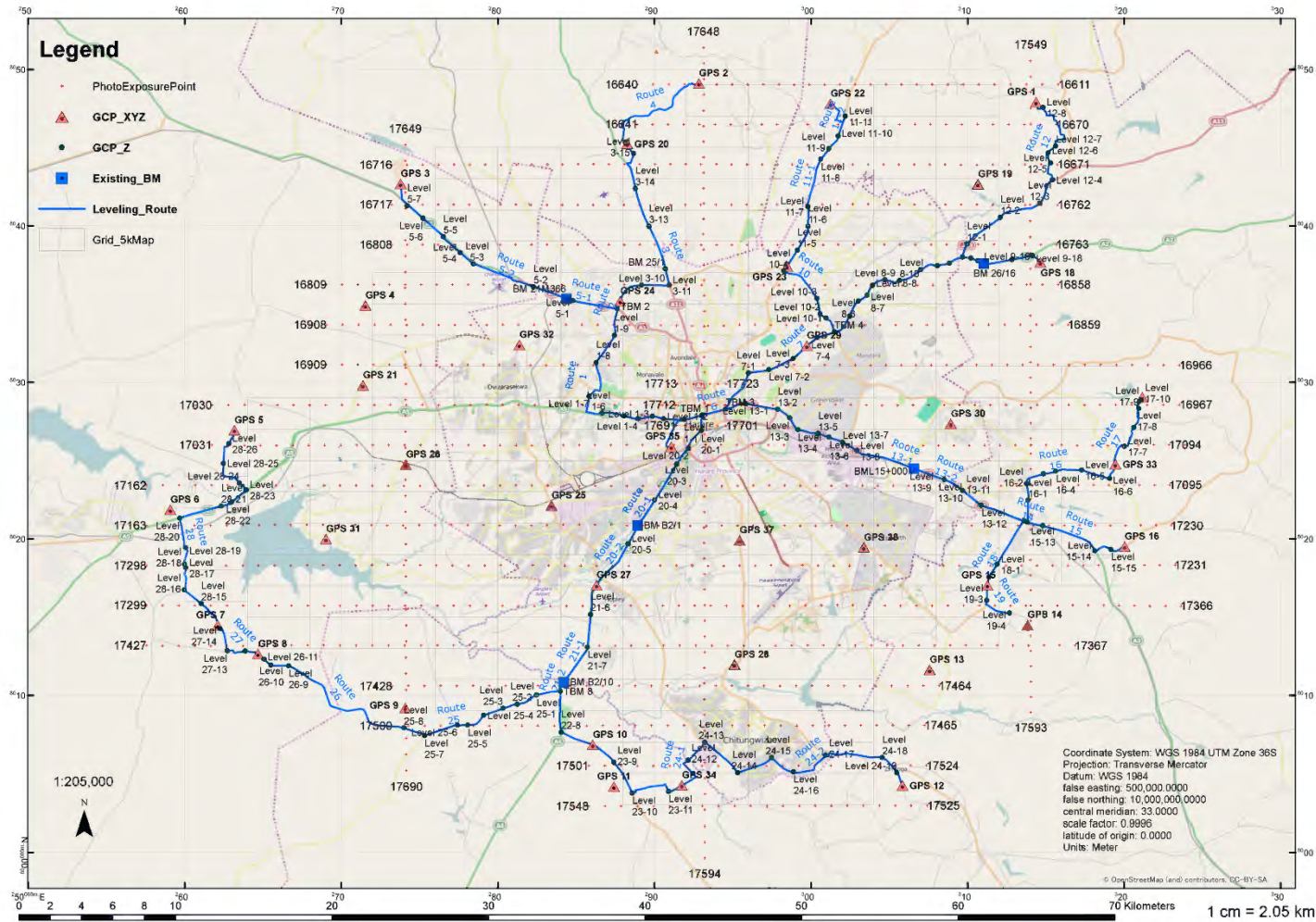
Flight strip and GCPs



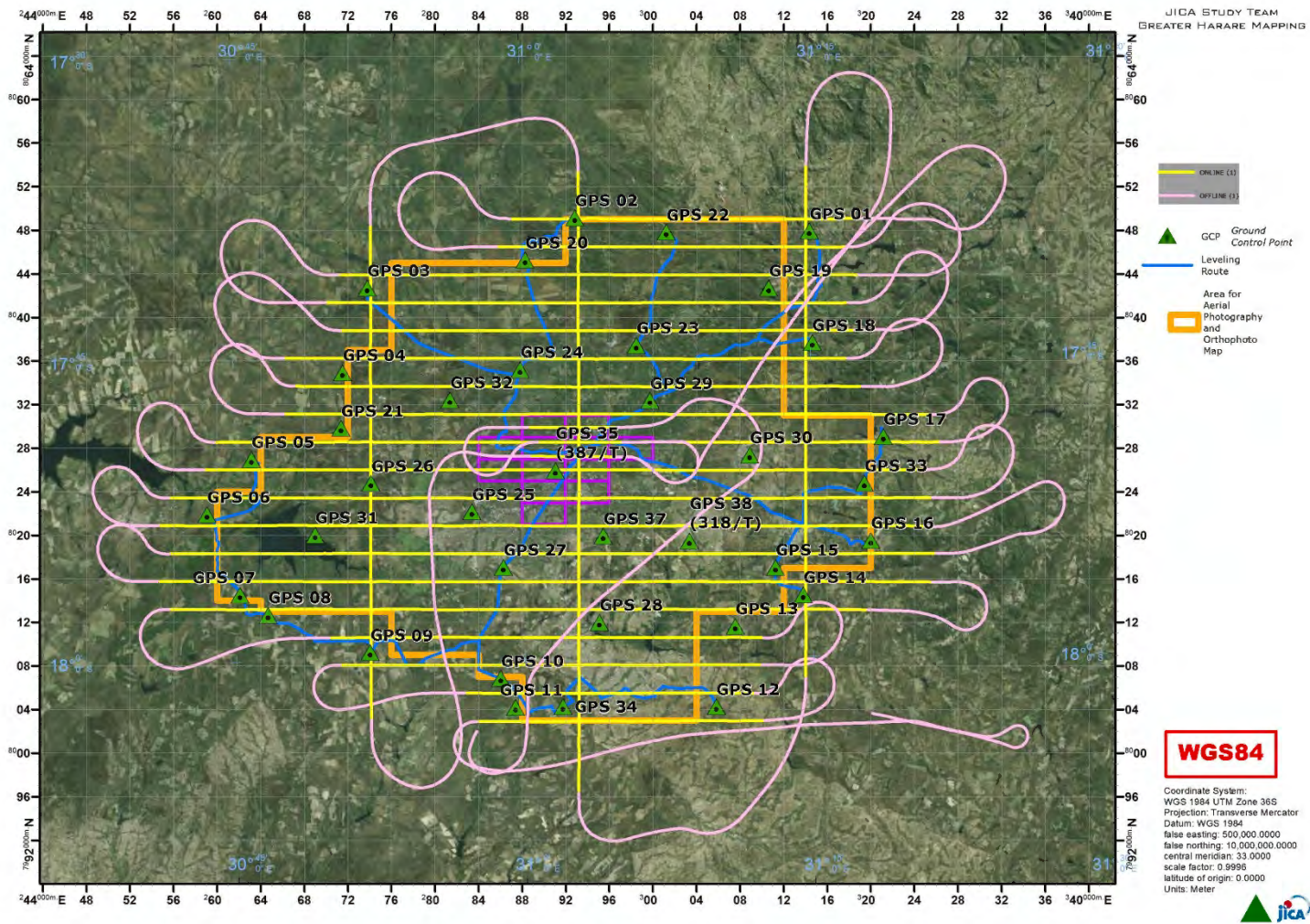
GCPs, Leveling route and topography



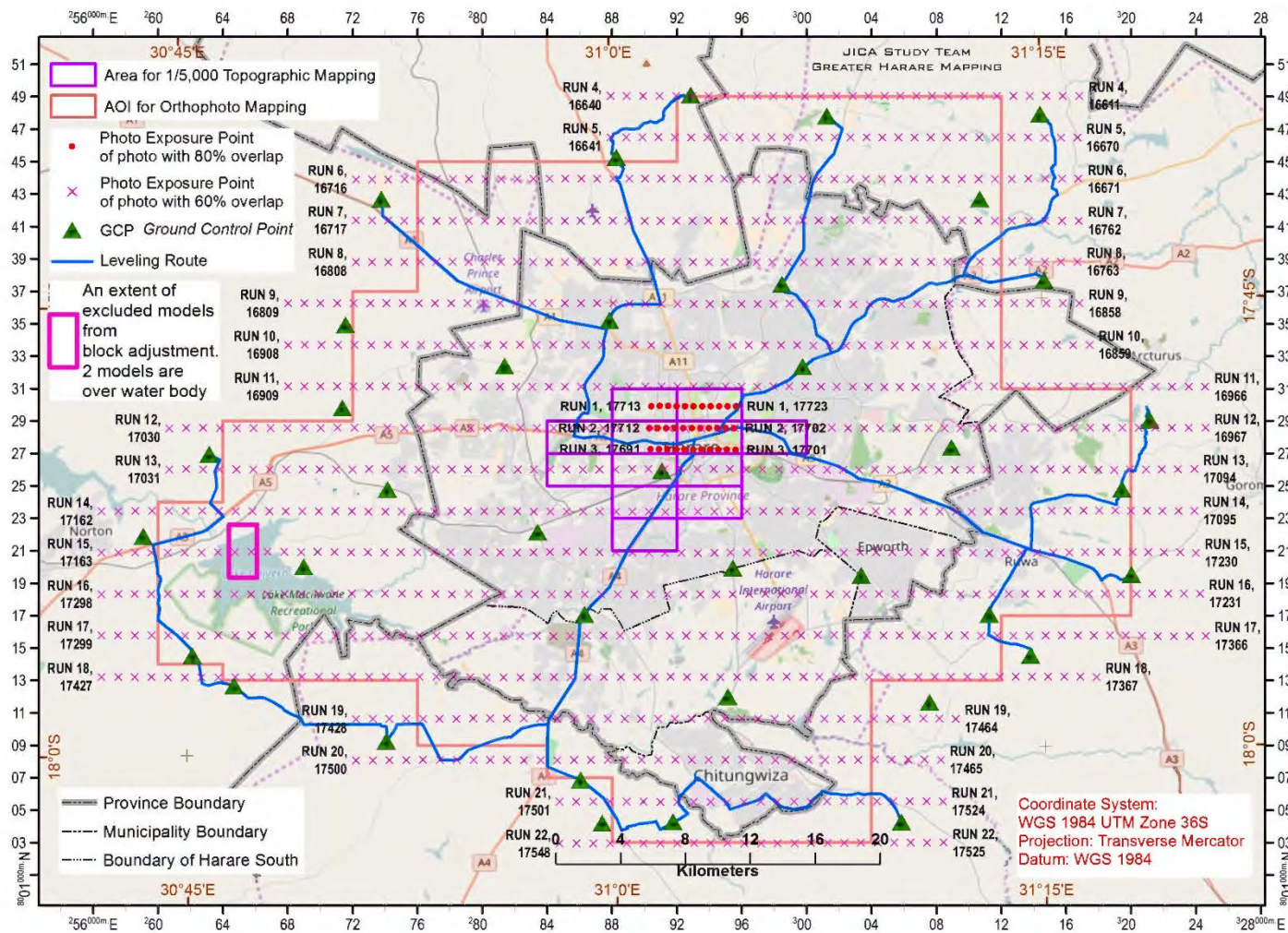
GCPs, Leveling route with map sheet index



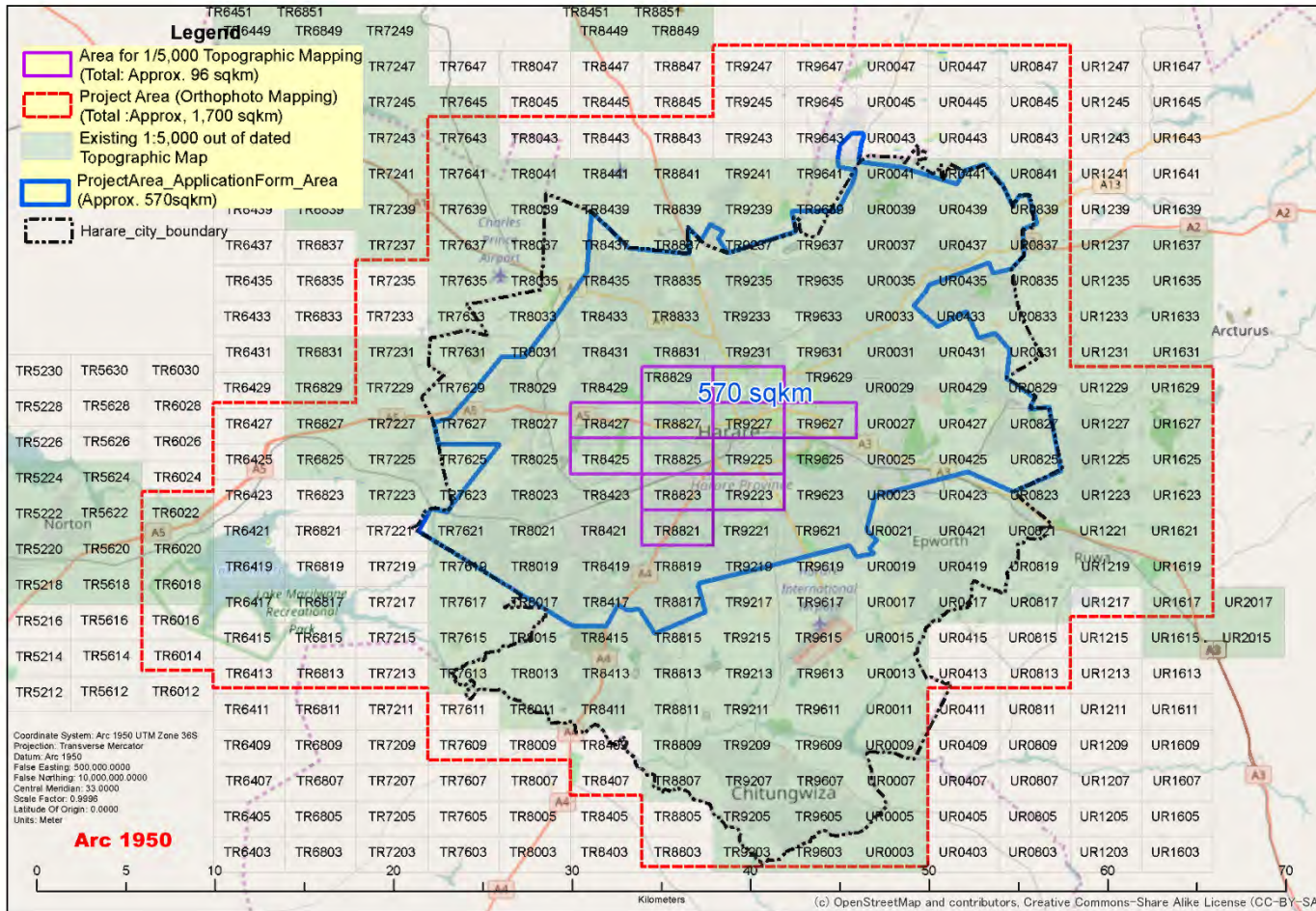
GCPs and Leveling route map



Aerial photography Trajectory



Outline of Aerial Triangulation



Existence of existing 1:5,000 topographic map sheet

Legend

AreaForOrthophotoMap_1823

Grid_5kMap_Harare_Arc1950_UTMz36S

Year_AerialPhotography

<Null>

1959

1960

1961

1965

1967

1968

1983

1985

1986

1987

7777

9999

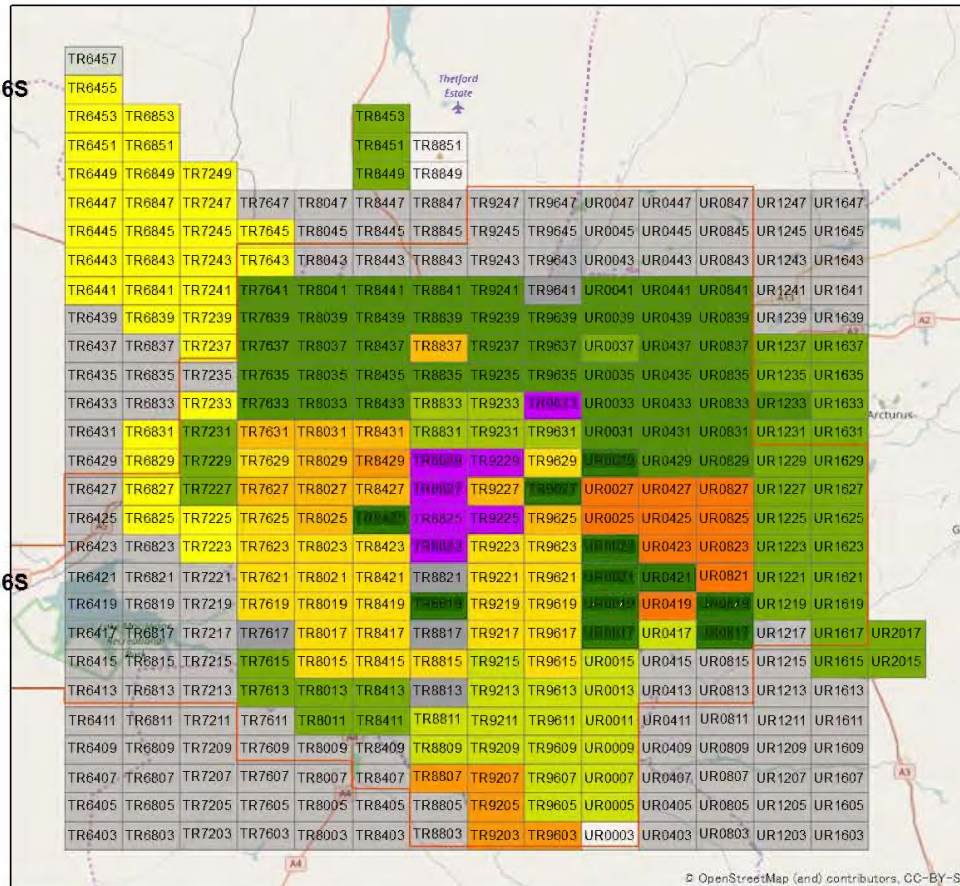
Grid_5kMap_Harare_Arc1950_UTMz36S

Existing_5kTopoMap

<Null>

0

1

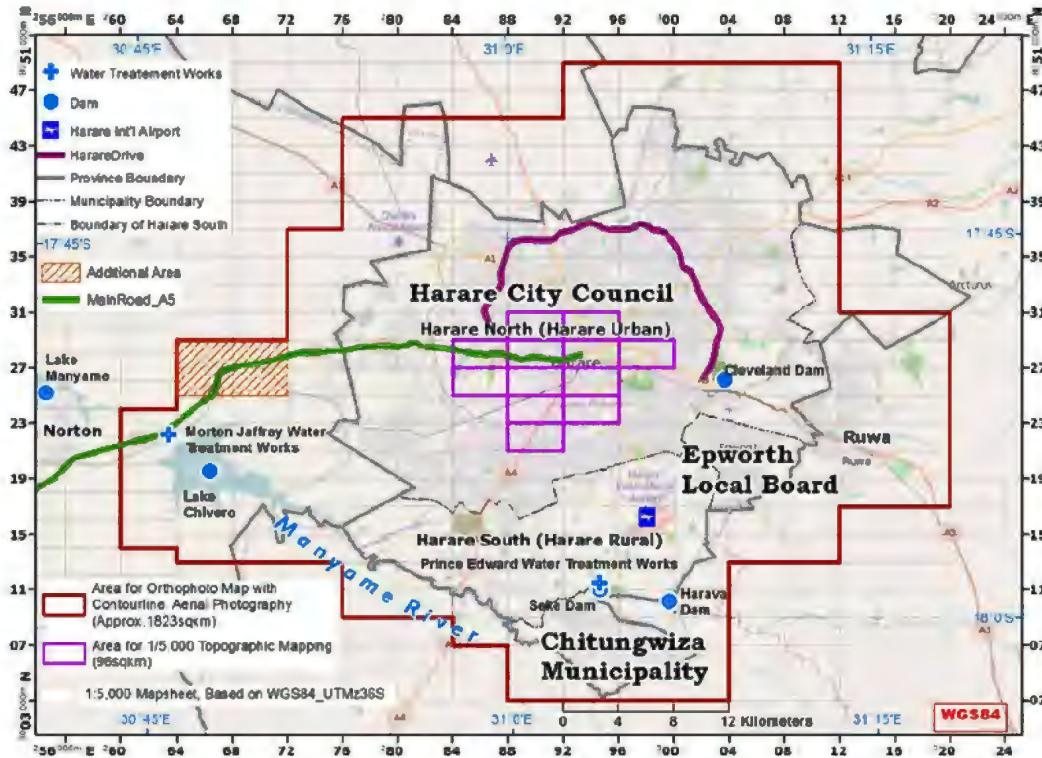


Implementation year of past aerial photography for exiting 1:5,000 topographic maps

6. Materials on the promotion of the utilization of Digital Topographic Maps and Orthophoto imageries

- 6.1. The Product Catalogue
- 6.2. Explanatory Document

Topographic map, Othophoto, and Street Map of Harare Boundaries



Head Office
 Department of the Surveyor General
 Electoral House
 49 Samora Machel Avenue
 P.O. Box CY 540 Causeway
 Harare, Zimbabwe
 Phone#:(+263 4)775550-2; 775604; 780807
 Fax#:(+263 4)749343
 Email: ds@internet.co.zw

Bulawayo Office
 Department of the Surveyor General
 Tredegold Building
 Leopold Takawira Avenue
 P.O. Box CY 1580
 Bulawayo, Zimbabwe
 Phone#:(+263 09) 64640
 Fax#:(+263 09) 62817
 Email: ds@internet.co.zw

GEO SPATIAL DATA AND INFORMATION PRODUCT CATALOGUE



THE DEPARTMENT OF THE SURVEYOR-GENERAL (DSG)

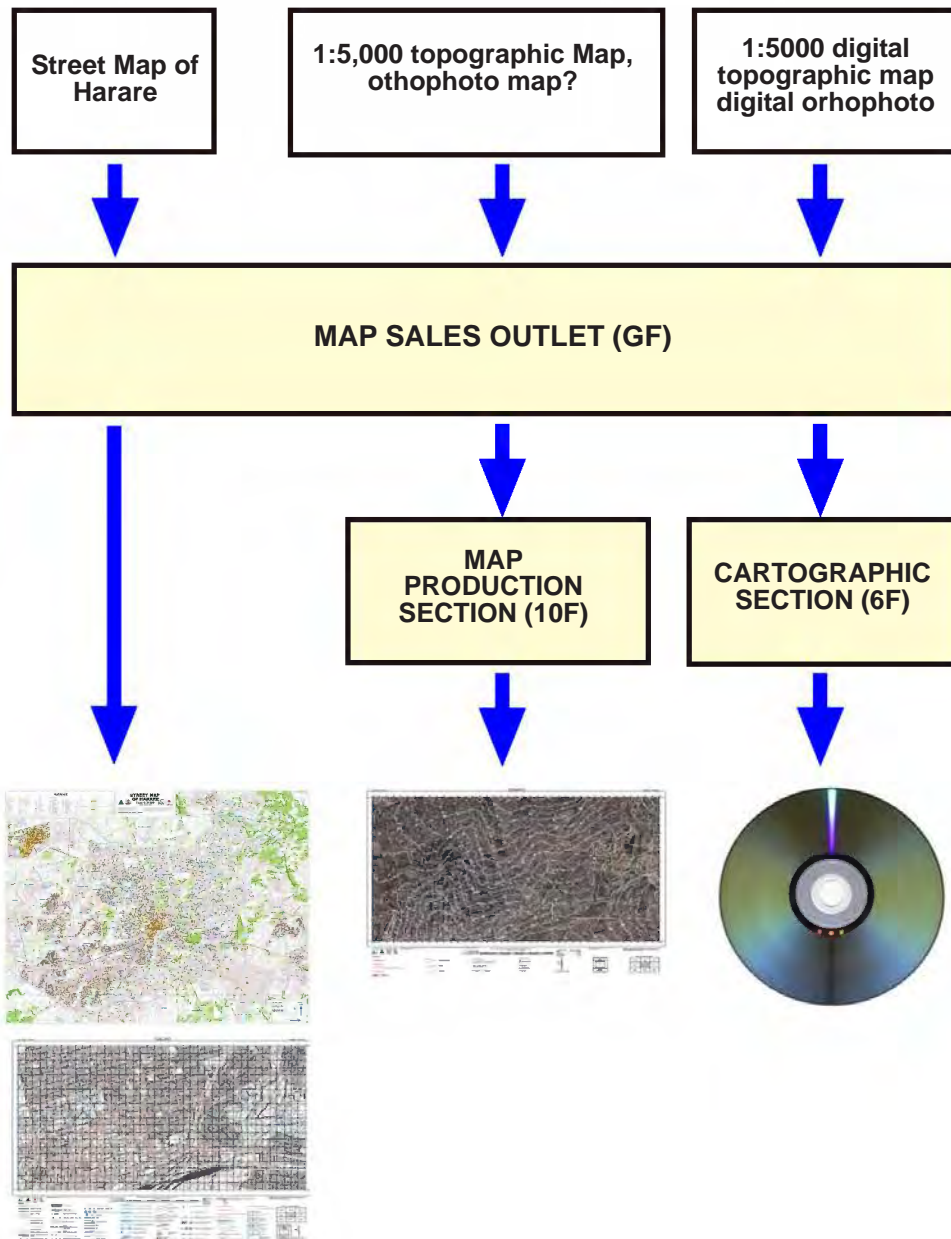
AND



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



How to get Maps and Data



Digital Orthophoto Imagery

Overview

This series consists of orthophoto imagery (raster format) that were produced from digital aerial photographs (with 20 cm ground resolution). The orthophoto imagery combines the image characteristics of an aerial photograph with the geometric qualities of a map. The orthophoto imagery can be used for digital mapping applications and as a base for geographic information analysis.

Specifications

Geodetic Reference System : WGS84

Map Projection : UTM Zone 36 S

Ground Resolution : 20 cm

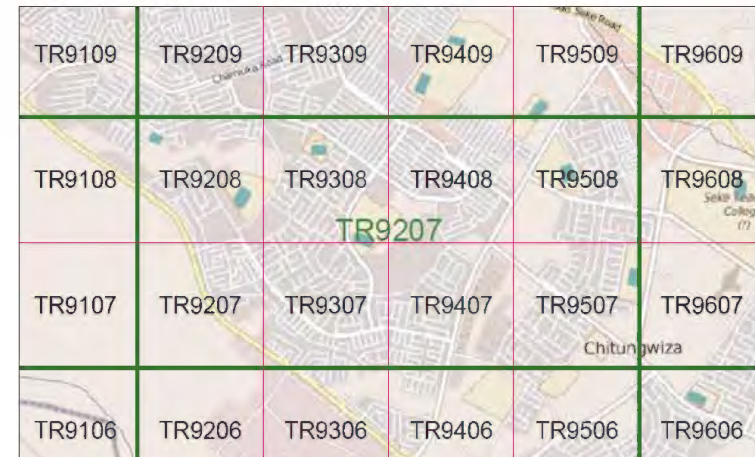
Format : Tiff with world file for georeferencing

Color : RGB 24 bits

Area : Covers an area of 1km x 1km on the ground

Digital Orthophoto Imagery Index

The figure below shows the index of the digital orthophoto imagery.





Cadastral data overlaid on digital orthophoto



3D representation using DEM

CONTENTS

1:34 000 Street Map of Harare	1-2
1:5,000 Topographic Map	3-4
1:5,000 Sheet Index	5-6
1:5,000 Orthophoto Map	7-8
Digital Topographic Data	9-10
Digital Orthophoto	11-12

Digital Topographic Data

Overview

The digital topographic data (for 1:2 m ap sheets) is available in vector form at. This data present elevation (contour lines), hydrography, geographic place names, and a variety of cultural features for use in GIS applications. The digital topographic data was also created from digital aerial photographs (with 20 cm ground resolution), which were acquired on 19 July, 2015. This digital topographic data series is useful for GIS users since it can be extracted for a specific use. For example, a building feature class can be extracted, and overlaid on other digital data for various purposes such as planning and facility management. Furthermore, the vector features can be rendered at any scale, and as a result zooming in and out on the map does not change the quality of the topographic data representation.

Specifications

Geodetic Reference System : WGS84

Map Projection : UTM Zone 36 S with 33 degrees as central meridian, false easting 500,000 m and false northing 10,000 m

Format : Available in ESRI shapefile (SHP) format

Area : Covers an area of 4 km x 2 km (same as the 1:5,000 topographic map sheet)

Feature Categories and Classes

The digital topographic dataset comprises seven feature categories and more than 100 feature classes (see table below).



Category	Feature Categories	Number of Feature Class
Transport	Road, Road facility, Railway Railway facility, Aviation, Water transportation	25
Building	Building Building Ancillary Structure	13
Structure	Miscellaneous structure, Fence Wall Retaining wall.	29
Water	Water Water related structure, Rapid and waterfall	15
Land Cover & Landuse	Specific Area Vegetation	23
Relief	Contour	9
Administrative	Province District, Municipality, Ward	4



1:5,000 Topographic Maps

Overview

This topographic series presents detailed and updated topographic maps for only 12 map sheets. The maps present elevation (contour lines), hydrography, geographic place names, and a variety of cultural features. The current-generation topographic maps are created from digital aerial photographs (with 20 cm ground resolution) that were acquired on 19 July, 2015.

Specifications

Geodetic Reference System : WGS84

Height: Orthometric heights of existing national benchmarks are used as a base of height

Map Projection : UTM Zone 36 South with 33 degrees as central meridian, false easting 500,000 m and false northing 10,000 m


Scale: 1:5,000


Map Sheet Area: Each map sheet covers an area of 2 km x 4 km


Legend


Below is part of the topographic map legend.


LEGEND (part)



Tarred Road, over 5m in width



Gravel Road, over 5m in width



Other Road, over 5m in width

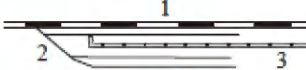

Footpath, over 5m in width



Path in garden, premise, over 5m in width

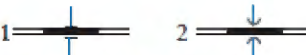

Tarred Road, less than 5m in width



Gravel Road, less than 5m in width


1. Embankment; 2. Cutting


1. Railway; 2. Siding;
3. Cable, rope and carrying way


Railway bridge over than 5m in length


1. Railway bridge, less than 5m in length;
2. Culvert

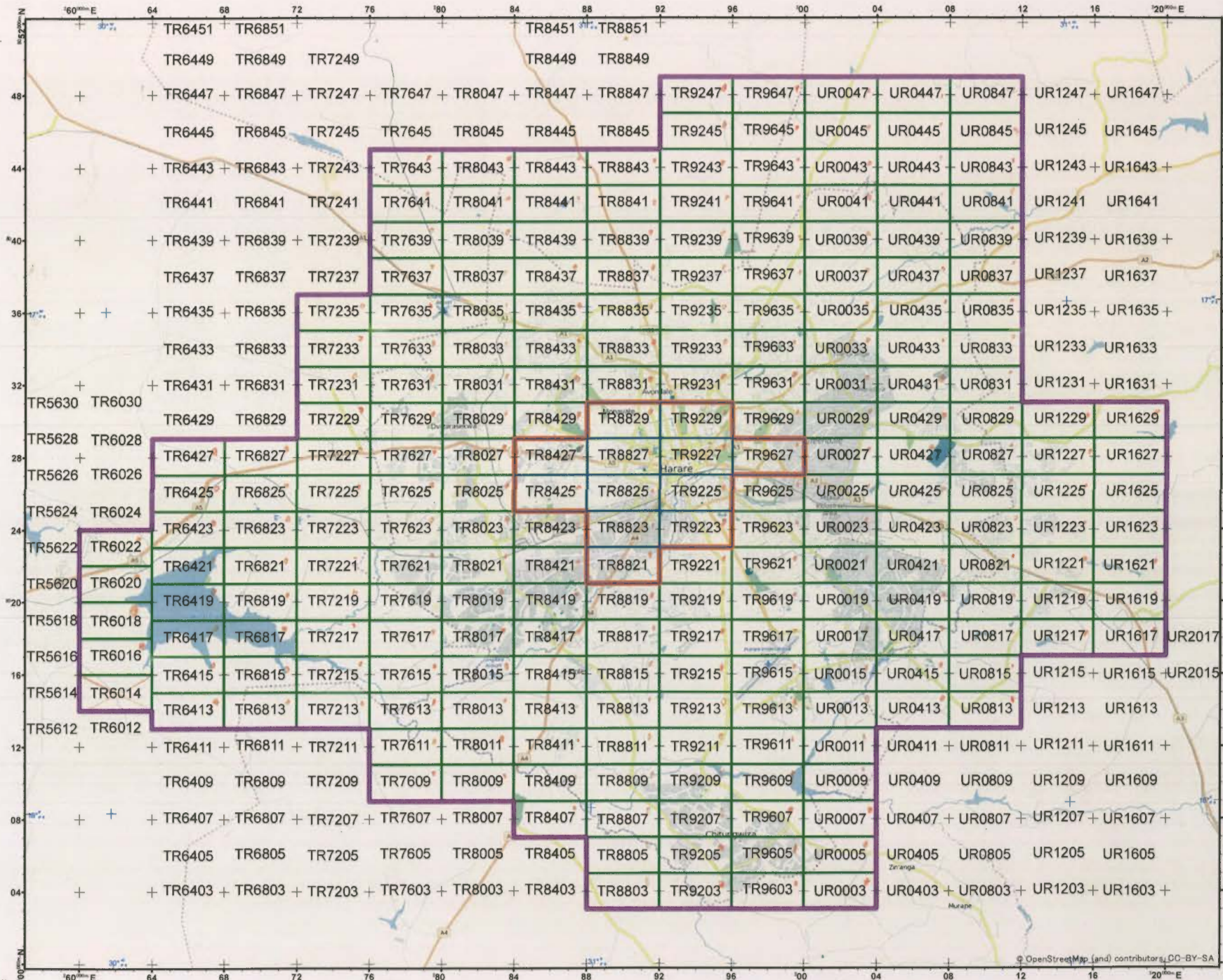

Airstrip with Taxi way or Apron

1:5 000 Sheet Index

Date: 2015/11/27

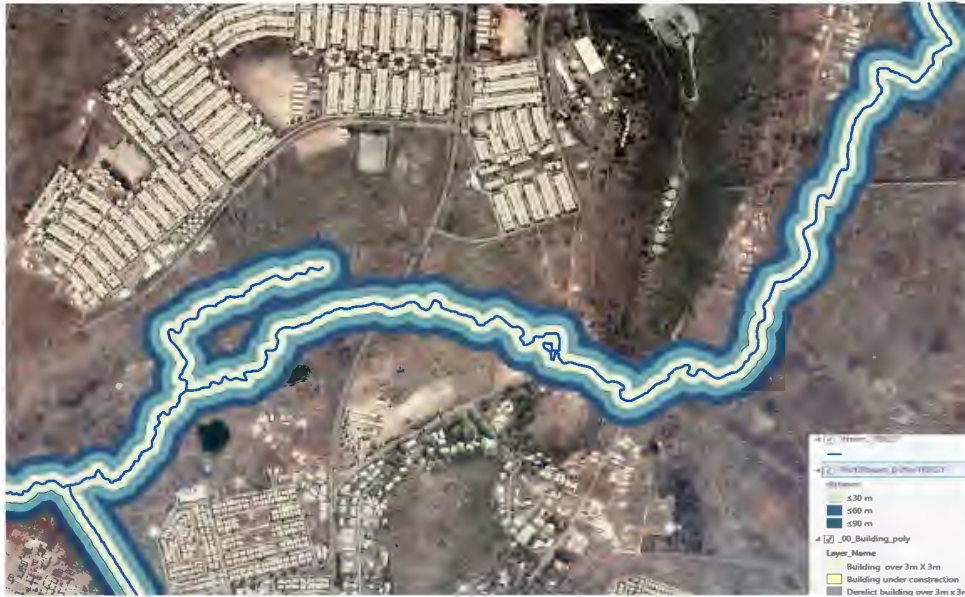
JICA STUDY TEAM
FOR
GRATER HARARE MAPPING

- Legend**
- Project Area
 - AreaForTopoMapping_98
 - AreaForOrthophotoMap_1823.Jn



Coordinate System: WGS 1984 UTM Zone 36S
Projection: Transverse Mercator
Datum: WGS 1984
false easting: 500 000 0000
false northing: 10 000 000 0000
central meridian: 33 0000
scale factor: 0.9996
latitude of origin: 0.0000
Units: Meter

© OpenStreetMap (and) contributors, CC-BY-SA



Digital topographic data and stream buffer zones overlaid on the orthophotomagey.



3D modelling from topographic data and building feature classes.

1:34,000 StreetMap of Harare

Overview

The StreetMap of Harare was updated using digital aerial photographs, which were acquired on 19 July, 2015. The streetmap covers a large area compared to the old streetmap due to expansion of the City of Harare. This comprehensive streetmap includes primary roads, secondary roads, railways, water features, parks, landmarks, building footprints and administrative boundaries. The street and road names as well as the administrative boundary are derived from old StreetMap of Harare, and therefore do not imply endorsement by DSG or any governing authority.

Specifications

Geodetic Reference System :WGS84

Map Projection :UTM Zone 36 S with 33 degrees as central meridian, false easting 500,000 m and false northing 10,000 m

Scale: 1:5,000

Map Sheet Area Covers approximately 36km x28km

Legend

Below is part of the StreetMap of Harare Legend.

REFERENCE

Police Station.....	+	Hospital.....	+
Fire Station.....	↑	Clinic.....	+
District Office.....	⌂	Fuel Station.....	⛽
School, Primary.....	🏫	Bus Terminus.....	🚌
School, Secondary.....	🏫	Hotel.....	🏨
College.....	🏫	Place Of Interest (POI).....	★
Library.....	📖	Beer Garden.....	🍺
Post Office.....	✉	Golf Course.....	⌂
Hall.....	🏠	Sports Club.....	⚽
Bank.....	🏦	Sports Ground / Facility.....	⚽
Cinema.....	🎬	Public Swimming Pool.....	🏊
Market.....	🏪	Stadium.....	🏟

1:5,000 Orthophoto Maps

Overview

This series is completely new, especially for the City of Harare. The orthophoto maps were produced from digital aerial photographs (with 20 cm ground resolution). The orthophoto map combines the image characteristics of an aerial photograph with the geometric qualities of a map. The orthophoto map is a uniform-scale image where corrections have been made for feature displacement such as building tilt as well as scale variations caused by relief. The orthophoto map can be used for mapping applications.

Specifications

Geodetic Reference System : WGS84

Height: Orthometric heights of existing national benchmark are used as a base of height

Map Projection : UTM Zone 36 S with 33 degrees as central meridian, false easting 500,000 m and false northing 10,000 m


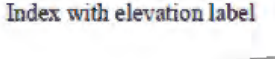


Scale : 1:5,000

Map Sheet Area : Each map sheet covers an area of 2 km x 4 km

Legend

Below is part of the orthophoto map legend.

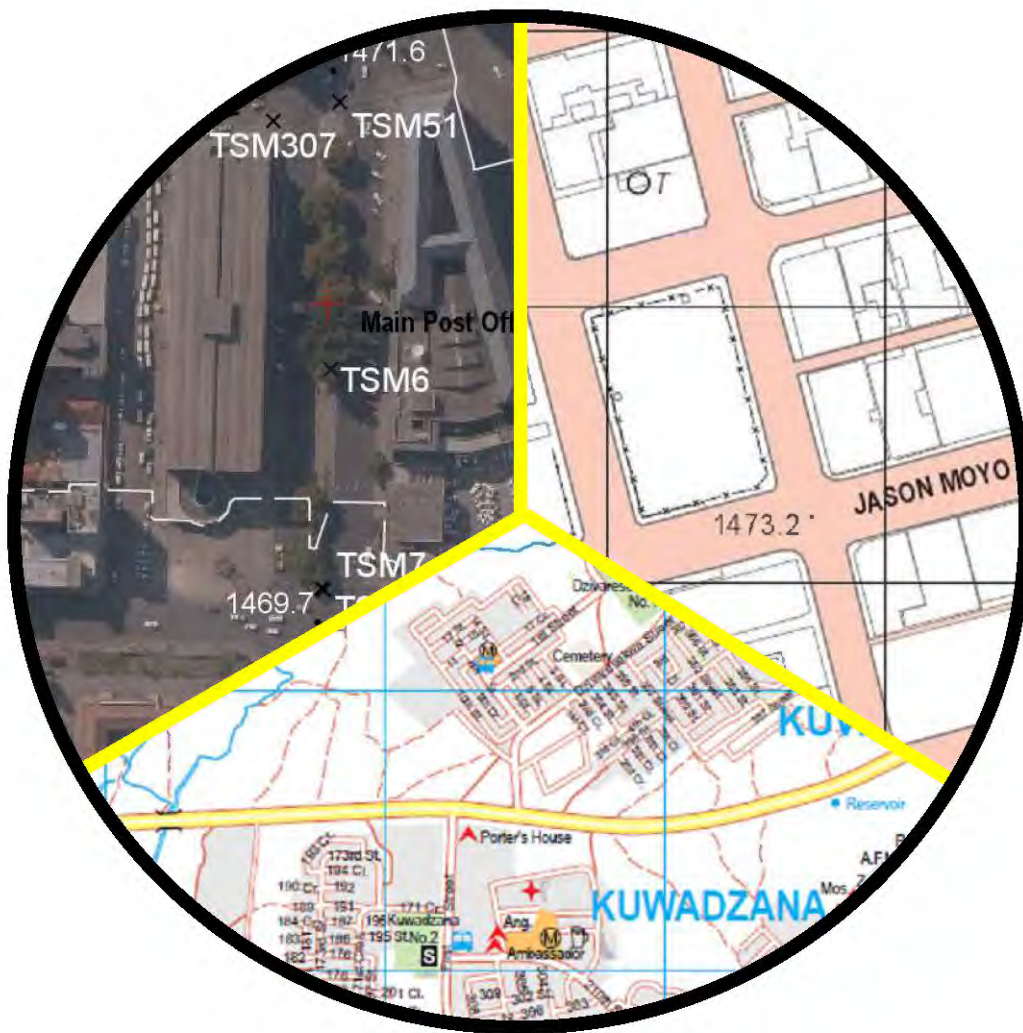
LEGEND (part)

Contour lines	Control Points, other points
	10'S
Index with elevation label	△ Trigonometrical Station
	13.2
Principal	† 13.4 Bench Mark
	× 56.3 Town Survey Mark
Supplemental	• 58.3 Spot height
	----- Municipality, Local Authority, Rural Council





Understanding Map Products



Department of the Surveyor General

Before using Topographic Map

- What is topographic map?
- How is the position on the earth represented?
 - [Geodetic Reference System](#)
 - [Map Projection](#)
- How are the objects on the earth described?
 - [Map specifications](#)
- How is topographic map produced?
 - [Aerial photography](#)
 - [Digital photogrammetric workstation](#)
 - [Digital orthophoto as intermediate product](#)
- Digital Topographic Map
 - [Format](#)
 - [GIS software](#)

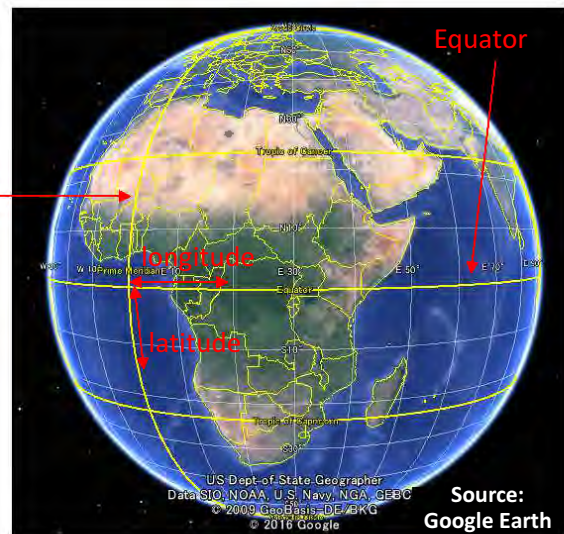
What is Topographic Map?

- Objects on the earth surface and information related with the points, areas, and regions are represented on media such as a paper.
- Earth surface is represented in scaled down and geometrically corrected manner.
 - [Geodetic reference system](#)
 - [Map projection](#)
- Depending on scale, the way of representing objects is devised so that situation on the earth surface with related information is understood properly. Use of symbols to represent features is one of such a way.
 - [Map specifications](#)

How is the position on the earth represented?

- Latitude and longitude
- Height
 - Geodetic reference system (Geodetic datum)

Prime of Meridian



- Shape of the earth was modelled as ellipsoid for **latitude and longitude**

- Reference ellipsoid characterized by semi-major axis **a** and semi-minor axis **b** (or flattening $1/f, f=(a-b)/a$)
- Latitude and longitude as well as direction are defined at the origin.
- **Height** is usually defined based on mean sea level.

How is the position on the earth represented (2)?

- Historically, geodetic reference systems were defined country (region) by country (region) separately.
- In Zimbabwe,
 - Arc 1950 : Ellipsoid Clarke 1880 (Arc)
 - $a: 6378249.145 \text{ m}, 1/f: 293.4663077$
 - Height: Port Elizabeth

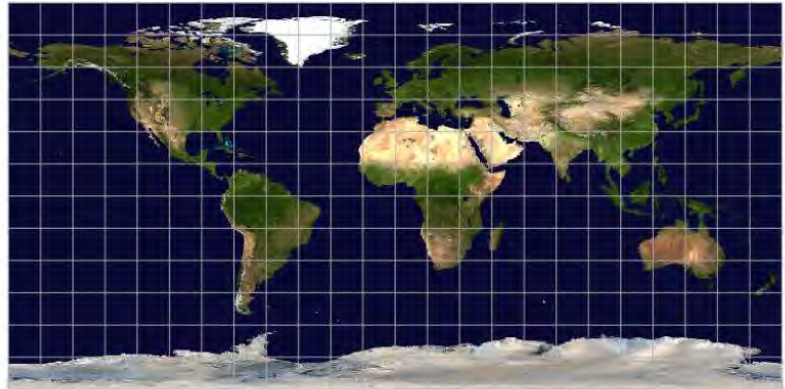
→ now many countries move to **apply geodetic reference system applicable globally** based on geocentric coordinate system such as **WGS84**

- $a: 6378137.0 \text{ m}, 1/f: 298.257223563$

→ All positions on the earth will be represented in consistent manner.

How is the position on the earth represented (3)?

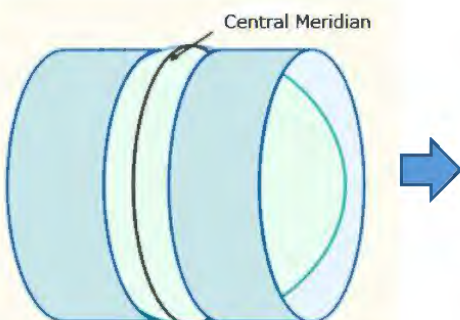
- Earth surface is not flat. How should it be mapped on the flat paper?
- lat and lon in Cartesian coordinates system?



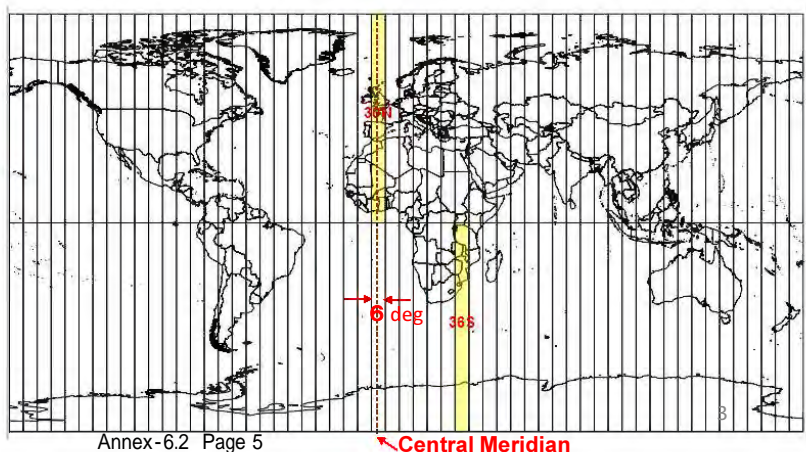
Neither angle between two lines nor area is not preserved!!

How is the position on the earth represented (4)?

- Projection from sphere to plane which has good property (e.g. preserving local shape or area) has been considered -> [Map projection](#)
- Conformal projection, which keeps shape locally is widely used for medium and large scale topographic maps
- UTM (Universal Transverse Mercator) projection is a typical example.



- Scale Factor at Central Meridian: 0.9996
- Origin: cross point between equator and central meridian
- Coordinate at origin in south semi-sphere: easting: 500 km, northing 10,000 km



How are the objects on the earth described?

- Map specifications suitable for map scale is defined.
- The smaller scale is, the more symbolization.



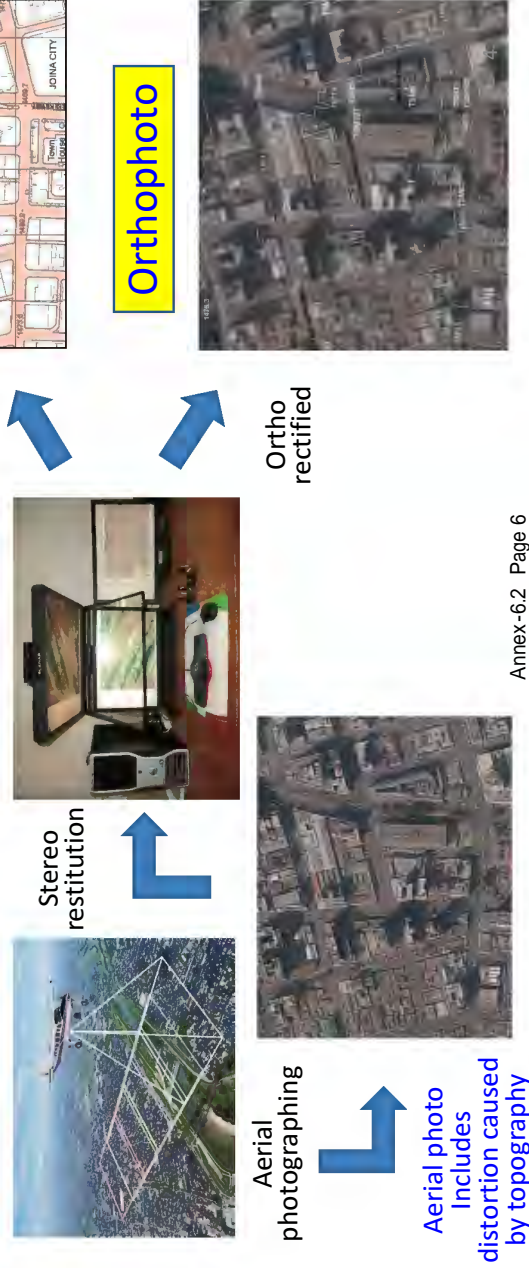
Original Map Scale is 1:34,000



Original Map Scale is 1:5,000

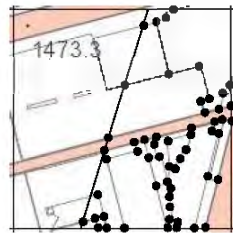
How is topographic map produced?

- Topographic map is produced from aerial photos. Sometimes from satellite imagery for relatively small scale maps.

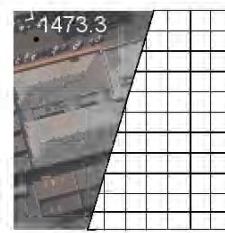


Digital Topographic Map

- Topographic map and orthophoto are available as digital data as well as papers
- Software to use such digital data is called GIS (Geographic Information System) software.
- Various open source GIS software such as QGIS are available whereas ARCGIS is most popular proprietary GIS software.
- There are two kinds of digital data: **vector** data and **raster** data. Vector data such as digital topographic map are comprised of points, lines and polygons. On the other hand, raster data such as orthophoto are like images.



Vector data
consists of points, lines
and polygons



Raster data
consists of pixels

Digital Topographic Map (2)

- Vector data
 - Vector data include various features such as roads, rivers, buildings, vegetation and annotations, which are classified in more detail and each detailed feature is called a layer. The layer is recorded as separate file or in distinguishable way in a big file.
 - Each detailed feature has feature code and has attribute data which explains the characteristics of each object in the detailed feature. For example, "building" might have number of stories as an attribute. Users can add any attributes required for their needs.
 - Users should understand the information described, which is normally called digital map specifications, before they start using digital data
 - **Format** should be known when digital data are dealt.
 - Typical format of vector data is .SHP which is defined by ESRI Corp. and handled by most of GIS software.
- Raster data
 - The structure is raster data is very simple. User should know the meaning of pixel value, format and information connecting the data to the location on the earth.
 - The typical format of raster data is .tif.
 - To specify the location of the raster image, the world file (a text file with .tfw as the extension in case of .tif file) is usually attached.

Digital Topographic Map (3)

- The world file is a text file with 6 lines consisting of following information:

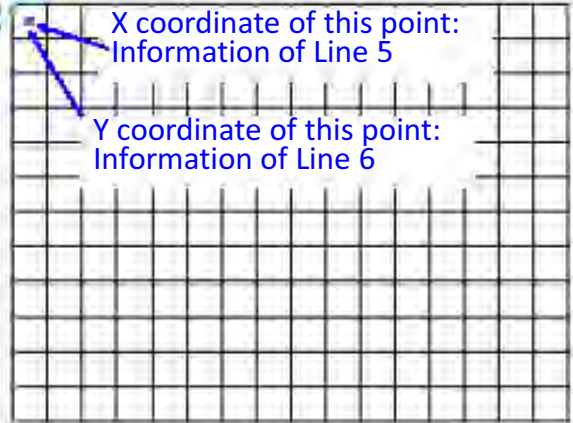
1. Length of x direction of a pixel
2. 0.0
3. 0.0
4. Length of y direction of a pixel with minus sign
5. X coordinate of the center of the pixel located in the most upper-left corner
6. Y coordinate of the center of the pixel located in the most upper-left corner

This length:
Information of Line 4

This length:
Information of Line 1

X coordinate of this point:
Information of Line 5

Y coordinate of this point:
Information of Line 6



Basic specifications of the products of JICA Harare Mapping project

- Aerial photography
 - Acquisition date: July 19, 2015
 - Flight height from the ground: 3,800 m
 - Ground resolution: 20 cm
 - Photographing: Fugro Geospatial B.V / SKM GISAIR OY Consortium
- Digital orthophoto: ground resolution: 20 cm,
area: 1700 km²
format: Tiff with world file(.tfw)
- Digital 1:5,000 topographic map: 96 km²
format: .SHP
- Harare Street Map: scale: 1:34,000
area: 1,008 km²

Basic specifications of the products of JICA Harare Mapping project (2)

- Framework referenced for surveying and mapping
 - Geodetic reference system: WGS84
 - Map projection: UTM zone 36S, central meridian: 33° E
False easting:500,000 m, False northing: 10,000,000 m
 - Height: Orthometric height referenced from existing national benchmarks in the area
 - Map sheet format: 4 km (West-East) by 2 km (South-North)

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
1	Administrative Boundary	Administrative Boundary	11010	Between Province	Line
2	Administrative Boundary	Administrative Boundary	11020	Between District	Line
3	Administrative Boundary	Administrative Boundary	11030	Between Municipality or Local Authority or Rural Council	Line
4	Administrative Boundary	Administrative Boundary	11040	Wards	Line

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
5	Transportation	Road	21011	Tarred Road, over 5m in width (Depicted as double line)	Line
6	Transportation	Road	21012	Tarred Road, less than 5m in width (Depicted as single line)	Line
7	Transportation	Road	21021	Gravel Road, over 5m in width (Depicted as double line)	Line
8	Transportation	Road	21022	Gravel Road, less than 5m in width (Depicted as single line)	Line
9	Transportation	Road	21031	Other Road, over 5m in width (Depicted as double line)	Line
10	Transportation	Road	21032	Other Road, less than 5m in width (Depicted as single line)	Line
11	Transportation	Road	21041	Footpath, over 5m in width (Depicted as double line)	Line
12	Transportation	Road	21042	Footpath, less than 5m in width (Depicted as single line)	Line
13	Transportation	Road	21051	Path in garden, premises, over 5m in width (Depicted as double line)	Line
14	Transportation	Road	21052	Path in garden, premises, less than 5m in width (Depicted as single line)	Line
15	Transportation	Road Facility	22011	Bridge for Road, length is over 5m (Portrayed at true length)	Line
	Transportation	Road Facility	22013	Area of bridge	Area
16	Transportation	Road Facility	22012	Bridge for Road, length is less than 5m (Represented as culvert symbol)	Point
17	Transportation	Road Facility	22020	Road Culvert	Point
18	Transportation	Road Facility	22031	Foot bridge, length is over 5m (Portrayed at true length)	Line
19	Transportation	Road Facility	22032	Foot bridge, length is under 5m (Applied for Significant one for map reading; portrayed at conventionalized)	Line
	Transportation	Road Facility	22033	Area of bridge	

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
20	Transportation	Road Facility	22380	Raw of trees, Line	Line
21	Transportation	Road Facility	22381	Raw of trees, Tree Type Symbol	Point
	Transportation	Road Facility	22382	Raw of trees, Tree Type Symbol	Point
22	Transportation	Railway	23011	Railway Track	Line
23	Transportation	Railway	23012	Railway Track, Side Track	Line
24	Transportation	Railway Facility	24011	Bridge for Railway, length is over 5m (Portrayed at true length)	Line
25	Transportation	Railway Facility	24012	Bridge for Railway, length is less than 5m (Represented as culvert symbol)	Point
		Railway Facility	24013	Area of bridge	
26	Transportation	Railway Facility	24020		Point
27	Transportation	Aviation	25010	Airstrip	Line
28	Transportation	Aviation	25020	Taxi way, and Apron	Line
29	Transportation	Water transportation	26010	Ferry, Point	point
29	Transportation	Water transportation	26020	Ferry, Label Symbol	Text symbol (Point) "Ferry"
30	Building	Building	30011	Building (Represented as complete roof outline with true dimension), over 3m X 3m	Area
31	Building	Building	30012	Building Minimum less than 3m X 3m	Point

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
32	Building	Building	30021	Huts(Represented as complete roof outline with true dimension), over 3mX3m	Area
33	Building	Building	30022	Huts less than 3m X3m	Point
34	Building	Building	30031	Derelict building, over 3m x 3m	Area
35	Building	Building	30032	Derelict building, less than 3m x 3m	Point
	Building	Building	30041	Structure similar as building over 3m X 3m	Area
36	Building	Building Ancillary Structure	34040	Swimming Pool, Outline	Area
37	Building	Building Ancillary Structure	34040	Swimming Pool, Label Symbol	Text symbol (Point) "SP"
38	Structure	Misc. Structure	42021	Monument,Outline, greater than 9sqm in plan area, depicted with correct shape and size	Area
39	Structure	Misc. Structure	42022	Monument, Point Symbol, less than 9 sqm in plan area (conventionalized as a black dot	Point
40	Structure	Misc. Structure	42210	Isolated tree (Bushy)	Point
41	Structure	Misc. Structure	42220	Isolated tree (Cone shaped)	Point
42	Structure	Misc. Structure	42241	Well (Represented as its outline), Area	Area
43	Structure	Misc. Structure	42241	Well (Represented as its outline), Label Symbol	Text symbol (Point) "W"
44	Structure	Misc. Structure	42242	Well (Represented as Conventionalized Symbol), Point	Point
45	Structure	Misc. Structure	42242	Well (Represented as Conventionalized Symbol), Label Symbol	Text symbol (Point) "W"
46	Structure	Misc. Structure	42261	Reservoir (Represented as its outline), Area	Area

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
47	Structure	Misc. Structure	42261	Reservoir (Represented as its outline), Label Symbol	Text symbol (Point) "R"
48	Structure	Misc. Structure	42262	Reservoir (Represented as Conventionalized Symbol), Point	Point
49	Structure	Misc. Structure	42262	Reservoir (Represented as Conventionalized Symbol), Label Symbol	Text symbol (Point) "R"
50	Structure	Misc. Structure	42290	Borehole, Point	Point
51	Structure	Misc. Structure	42290	Borehole, Label Symbol	Text symbol (Point) "BH"
52	Structure	Misc. Structure	42311	Tank (Represented as its outline), Area	Area
53	Structure	Misc. Structure	42311	Tank (Represented as its outline), Label Symbol	Text symbol (Point) "T"
54	Structure	Misc. Structure	42312	Tank (Represented as Conventionalized Symbol), Point	Point
55	Structure	Misc. Structure	42312	Tank (Represented as Conventionalized Symbol), Label Symbol	Text symbol (Point) "T"
56	Structure	Misc. Structure	42340	Chimney's and Mast (antenna pole)	Point
57	Structure	Misc. Structure	42391	Wind pump (Represented as its outline), Area	Area
58	Structure	Misc. Structure	42391	Wind pump (Represented as its outline), Label Symbol	Text symbol (Point) "WP"
59	Structure	Misc. Structure	42392	Wind pump (Represented as Conventionalized Symbol), Point	Point
60	Structure	Misc. Structure	42392	Wind pump (Represented as Conventionalized Symbol), Label Symbol	Text symbol (Point) "WP"
61	Structure	Misc. Structure	42610	Pipeline, Line	Line
62	Structure	Misc. Structure	42610	Pipeline, Label Symbol	Text symbol (Point) "P"
63	Structure	Misc. Structure	42650	Overhead powerline of 11kv or over (Prominent Only), Line	Line

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
64	Structure	Misc. Structure	42650	Overhead powerline of 11kv or over (Prominent Only), Label Symbol	Text symbol (Point) "Carrying capacity (voltage) kV"
65	Structure	Misc. Structure	42660	Pylon	Point
66	Water	Water	51011	River, Width to the high water level be over 5m (Depicted as Double Line) Line	Line
67	Water	Water	51011	River, Width to the high water level be over 5m (Depicted as Double Line) Fill Area	Area
68	Water	Water	51012	River (Depicted as Single Line)	Line
	Water	Water	51013	A certain underground section	
69	Water	Water	51030	Water Course	Line
	Water	Water	51033	A certain underground section	
70	Water	Water	51041	Drain, over 5m in width and/or over 5m in depth (Double Line), Line	Line
71	Water	Water	51041	Drain, over 5m in width and/or over 5m in depth (Double Line), Label Symbol	Text symbol (Point) "Drain" or "D"
72	Water	Water	51042	Drain, Less than 5m in width and/or over 5m in depth (Single Line), Line	Line
73	Water	Water	51042	Drain, Less than 5m in width and/or over 5m in depth (Single Line), Label Symbol	Text symbol (Point) "Drain" or "D"
	Water	Water	51043	A certain underground section	
74	Water	Water	51050	Dam, pond and Lake, Line	Line
75	Water	Water	51050	Dam, pond and Lake, Area	Area
76	Water	Water	51061	Canal, over 5m in width and/or over 5m in depth (Double Line), Line	Line

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
77	Water	Water	51061	Canal, over 5m in width and/or over 5m in depth (Double Line), Label Symbol	Text symbol (Point) "Canal" or "C"
78	Water	Water	51062	Canal, Less than 5m in width and/or over 5m in depth (Single Line), Line	Line
79	Water	Water	51062	Canal, Less than 5m in width and/or over 5m in depth (Single Line), Label Symbol	Text symbol (Point) "Canal" or "C"
		Water	51063	A certain underground section	
80	Water	Water	51081	Waterhole (Represented as its outline), Area	Area
81	Water	Water	51081	Waterhole (Represented as its outline), Label Symbol	Text symbol (Point) "WH"
82	Water	Water	51082	Waterhole (Represented as Conventionalized Symbol), Point	Point
83	Water	Water	51082	Waterhole (Represented as Conventionalized Symbol), Label Symbol	Text symbol (Point) "WH"
84	Water	Water	51091	Furrow, over 5m in width and/or over 5m in depth (Double Line), Line	Line
85	Water	Water	51091	Furrow, over 5m in width and/or over 5m in depth (Double Line), Label Symbol	Text symbol (Point) "Furrow" or "F"
86	Water	Water	51092	Furrow, Less than 5m in width and/or over 5m in depth, (Single Line), Line	Line
87	Water	Water	51092	Furrow, Less than 5m in width and/or over 5m in depth, (Single Line), Label Symbol	Text symbol (Point) "Furrow" or "F"
	Water	Water	51093	A certain underground section	
88	Water	Water related structure	52230	Dam wall (blackline)	Line
89	Water	Rapid & Waterfall	53010	Rapid	Line
90	Water	Rapid & Waterfall	53020	Waterfall	Line

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
93	Landcover & Landuse	Retaining Wall	61041	Prospecting trench, deeper than 15m and wider than 15m	Line
94	Landcover & Landuse	Retaining Wall	61042	Prospecting trench, Not deeper than 15m and wider than 15m	Line
95	Landcover & Landuse	Retaining Wall	61051	Embankment, Top of slope	Line
96	Landcover & Landuse	Retaining Wall	61052	Embankment, Foot of slope	Line
144	Landcover & Landuse	Retaining Wall	61061	Cutting, top of slope	Line
145	Landcover & Landuse	Retaining Wall	61062	Cutting, foot of slope	Line
97	Landcover & Landuse	Fence, Wall	61300	Fence	Line
98	Landcover & Landuse	Fence, Wall	61310	Hedge	Line
99	Landcover & Landuse	Fence, Wall	61320	Wall	Line
100	Landcover & Landuse	Specific Area	62010	Outlining for detail area in specific area or facility	Line
101	Landcover & Landuse	Specific Area	62030	National park	Line
102	Landcover & Landuse	Specific Area	62040	Forest land	Line
103	Landcover & Landuse	Specific Area	62050	Recreational park	Line
104	Landcover & Landuse	Specific Area	62060	Botanical reserve	Line
105	Landcover & Landuse	Specific Area	62300	Other pit, more than 5m in depth, Outline of Pit	Line

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
106	Landcover & Landuse	Specific Area	62300	Other pit, less than 5m in depth, Point for Labeling	Text symbol (Labeling from Point) "Annotation for Type of Pit"
107	Landcover & Landuse	Specific Area	62310	Quarry, Area	Area
108	Landcover & Landuse	Specific Area	62310	Quarry, Label Symbol	Text symbol (Point) "Q"
109	Landcover & Landuse	Specific Area	62340	Gravel pit, more than 5m in depth, Area	Area
110	Landcover & Landuse	Specific Area	62340	Gravel pit, more than 5m in depth, Label Symbol	Text symbol (Point) "Gravel"
111	Landcover & Landuse	Specific Area	62350	Clay pit, more than 5m in depth, Area	Area
112	Landcover & Landuse	Specific Area	62350	Clay pit, more than 5m in depth, Label Symbol	Text symbol (Point) "Clay"
113	Landcover & Landuse	Specific Area	62360	Sand pit, more than 5m in depth, Area	Area
114	Landcover & Landuse	Specific Area	62360	Sand pit, more than 5m in depth, Label Symbol	Text symbol (Point) "Sand"
151	Landcover & Landuse	Specific Area	62370	Deep Excavation, Line	Line
152	Landcover & Landuse	Specific Area	62380	Shallow Excavation, Line	Line
153	Landcover & Landuse	Specific Area	62390	Refuse heaps, Area	Area
154	Landcover & Landuse	Specific Area	62390	Refuse heaps, Label Symbol	Text symbol (Point) "Refuse"
155	Landcover & Landuse	Specific Area	62400	dump, Area	Area
156	Landcover & Landuse	Specific Area	62400	dump, Label Symbol	Text symbol (Point) "Dump"

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
115	Landcover & Landuse	Vegetation	63041	Firebreaks and other cut lines, more than 5m in width (Double), Line	Line
116	Landcover & Landuse	Vegetation	63041	Firebreaks and other cut lines, more than 5m in width (Double), Label Symbol	Text symbol (Point) "Cut line" or "C"
117	Landcover & Landuse	Vegetation	63042	Firebreaks and other cut lines, less than 5m in width (Single), Line	Line
118	Landcover & Landuse	Vegetation	63042	Firebreaks and other cut lines, less than 5m in width (Single), Label Symbol	Text symbol (Point) "Cut line" or "CL"
119	Landcover & Landuse	Vegetation	63130	Land under cultivation, Area	Area
120	Landcover & Landuse	Vegetation	63130		Text symbol (Point), "Cultivation" or "C"
121	Landcover & Landuse	Vegetation	63190	Orchards, Area	Area
122	Landcover & Landuse	Vegetation	63 0	Orchards, Label Symbol	Text symbol (Point), "Orchard"
123	Landcover & Landuse	Vegetation	63240	Plantation, Area	Area
124	Landcover & Landuse	Vegetation	63240	Plantation, Label Symbol	Text symbol (Point), "Plantation" or "P."
125	Landcover & Landuse	Vegetation	63241	Plantation, Tree Type Symbol	Point
125	Landcover & Landuse	Vegetation	63242	Plantation, Tree Type Symbol	Point
126	Landcover & Landuse	Vegetation	63310	Area of Trees and /or Bush, Light Density, Area	Area

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
130	Landcover & Landuse	Vegetation	63330	Area of Trees and /or Bush, Dense, Area	Area
133	Landcover & Landuse	Vegetation	63390	Natural Bush	
134	Landcover & Landuse	Vegetation	63410	Sand, Area	Area
135	Landcover & Landuse	Vegetation	63410	Sand, Label Symbol	Text symbol (Point) "Sand"
136	Relief	Contour	71010	Contour line Index, Line	Line
137	Relief	Contour	71010	Contour line Index, Label	Label (Text) for height on MSL value
138	Relief	Contour	71020	Contour line Standard	Line
139	Relief	Contour	71030	Contour line Supplemental	Line
140	Relief	Contour	71050	Contour line Index Depression	Line
141	Relief	Contour	71060	Contour line Depression	Line
142	Relief	Contour	71070	Contour line Supplemental Depression	Line
160	Relief	Contour	71120	Spot height, Point	Point
161	Relief	Contour	71120	Spot height, Label	Label (Text) for height on MSL value
143	Relief	Particular relief feature	72010	Cliff	Line
	Relief	Particular relief feature	72020	Slope	Line

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
146	Relief	Particular relief feature	72120	Rock outcrop, Area	Area
147	Relief	Particular relief feature	72120	Rock outcrop, Label Symbol	Text symbol (Point) "RK" or "Rock Outcrop"
148	Relief	Particular relief feature	72130	Rock pinnacle (large)	Area
	Relief	Particular relief feature	72140	Rock pinnacle (small)	Point
149	Relief	Particular relief feature	72150	Pan, Area	Area
150	Relief	Particular relief feature	72150	Pan, Label Symbol	Text symbol (Point), "Pan" or "P"
157	Control Point	Control Point	73010	Trigonometrical Station	Point
158	Control Point	Control Point	73020	Bench Mark	Point
159	Control Point	Control Point	73070	Town Survey Mark	Point
162	Annotation	Annotation	81990	Misc.(Unclassified) Name	Text
163	Annotation	Annotation	81010	Province name	Text
164	Annotation	Annotation	81020	District name	Text
165	Annotation	Annotation	81030	Municipality name	Text
166	Annotation	Annotation	81040	Ward name	Text
167	Annotation	Annotation	81210	Suburbs name	Text

	Category	Feature Group	Feature Code	Feature Class Name	Geometry Type of feature Class
168	Annotation	Annotation	81310	Annotations for streets, Point	Point
169	Annotation	Annotation	81310	Annotations for streets, Label	Label text (Point)
176	Annotation	Annotation	81510	Annotations for rivers, Point	Point
177	Annotation	Annotation	81510	Annotations for rivers, Label	Label text (Point)
176	Annotation	Annotation	81530	Annotations for rivers, Point	Point
177	Annotation	Annotation	81530	Annotations for rivers, Label	Label text (Point)
178	Annotation	Annotation	81410	Annotation for Proper name of Specific area (National Park, Forest Land, Recreational Park, Botanical Reserve etc...., Label	Label Text (Point)
178	Annotation	Annotation	81420	Annotation for Proper name of facility and Misc. structure, Label	Label Text (Point)
179	Annotation	Annotation	82000	Annotation text for Application use for a open area, a building or a structure. (Explanatory Annotation for a Area, a Building)	Text symbol (Point), "Golf course", "Sports field."

**7. The presentation material by DSG
in the training in Japan**

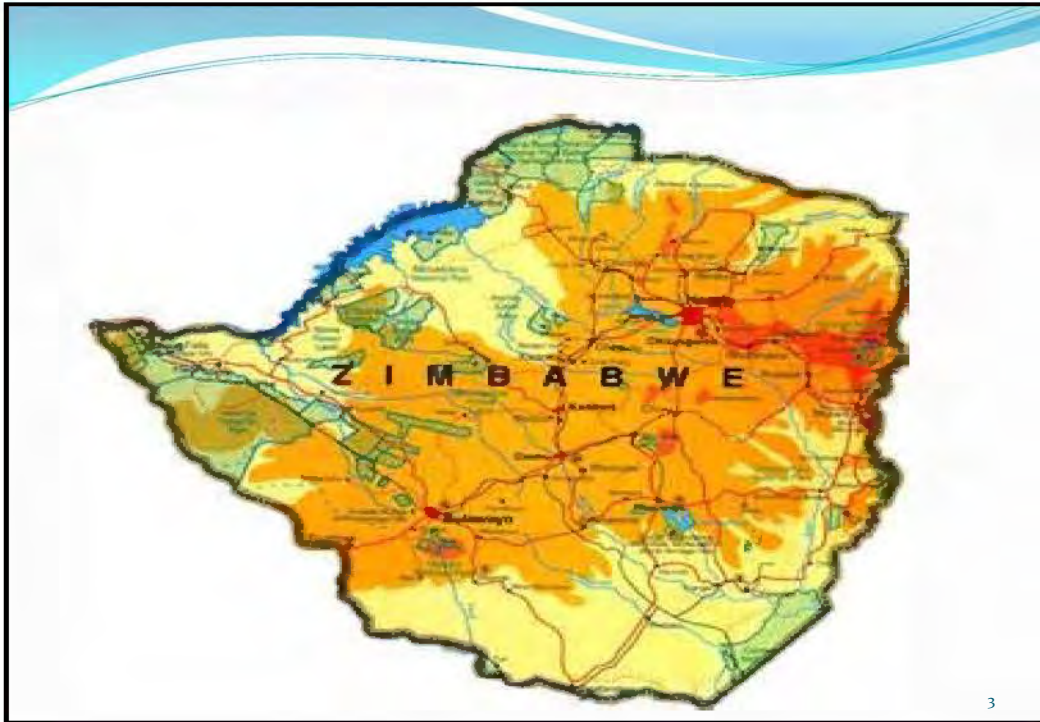
DEPARTMENT OF SURVEYOR GENERAL
(DSG)
ZIMBABWE

THE DEVELOPMENT OF A GEOSPATIAL INFORMATION DATABASE PROJECT
(DIGITAL MAP FOR HARARE)

1



2



DSG STRUCTURE

- Under Ministry of Lands and Rural Resettlement
- Has two Regional Offices: Harare & Bulawayo
- Composed of three Technical Departments:
 - a. The Cadastral Branch
 - b. The Mapping Branch
 - c. The Geodesy Branch

4

Overall Functions of DSG

Administer the Land Survey Act(Chapter 20:12)

1. Supervision and control of all cadastral survey work.
2. Maintenance of an up to date cadastral land information system.
3. Production, updating and maintenance of national map series, thematic maps and other value added map products.
4. Reaffirmation of Zimbabwe's international boundaries.
5. Establishment and maintenance of national geodetic control network.

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PRODUCTION OF NATIONAL MAPS

- ❑ One of the core business
- ❑ Production of the National Base Maps:
 - scale: 1:50 000 – Rural Zimbabwe (A total of 571 map sheets in this scale covering the whole country)
 - Scale of 1:5000 – Urban Areas (Cities, Towns and Rural Service Centres (see map)
 - Other scales (1: 25,000; 1:250,000)

However all scales last updated over 30 years ago:

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Production Of Thematic Maps

- Relief maps
- Aeronautical maps
- Electoral Maps
- Tourist maps
- City maps
- Educational maps
- Ecological farming zones
- General road network
- Climatic comfort and discomfort zones
- Schools and Health centres distribution maps
- etc.

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Immediate Needs

1. Urgent update of the 1:5,000 series as well as create new maps of that scale where there are no maps (in all Urban Areas (Cities, Towns and Rural Service Centres)).
2. Capacitation of the DSG:
 - ❑ Technology (Old technology defunct) about **10 workstations needed**
 - ❑ Continuous Staff development (80% of staff is technical)
 - ❑ Management Staff (management of geospatial data and information in new the digital – international best practices)(Short courses)

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Cont.

- ❑ Senior Operations Staff (Application of Digital Photogrammetry technology in the development of geospatial data and information and mapping)(short to **medium term**)
- ❑ **Junior Operations Staff** – New recruits (geospatial data/information collection, capture, processing and map production)(medium to long term)
- ❑ Senior and **Junior Operations Staff (in-depth knowledge of application of** Digital Photogrammetry technology in the development of geospatial data and information and mapping

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Why New Maps Required

- ❑ Increased urbanisation due to population increase and demand of urban land(growth of urban centres)
 - ❑ Unplanned settlement
 - ❑ Planning, Construction and Management of utility infrastructure (water, sewer, telecommunications, electricity, transport networks, etc.
- ❑ The recent land reform program in commercial farming areas and rural areas

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1:5,000 Topographic Map



ZIMBABWE

1 : 5 000

Scale: 1:5 000 or 20m to 1km

A topo-cadastral series mainly meant for urban centres and growth points. It's more of a technical map showing mostly the general outline or plan of urban centres.

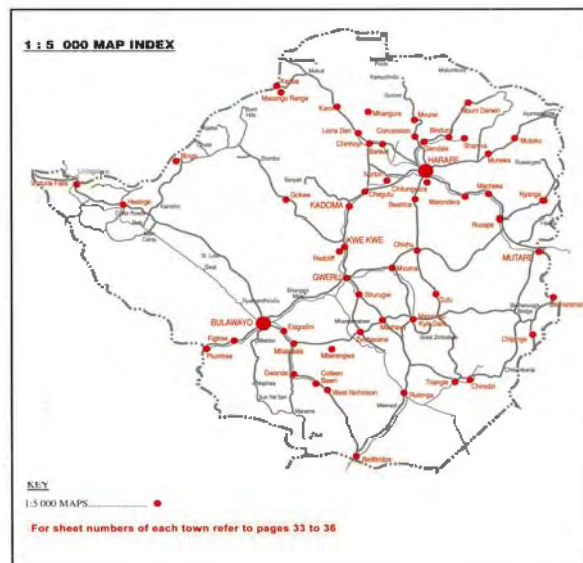
Compiled from the latest 1:24 000 or 25 000 scale aerial photographs and cadastral drawings and also from field checks. The maps are plotted on Transverse Mercator Projection with U.T.M. Grid lines overprinted. Relief is depicted by spot heights, trigonometrical beacons and contours at a vertical interval of 4 metres with 2 metre contours interpolated when necessary.

Some of the sheets are designated "Consequential". These sheets have been compiled by photographic reduction of the 1 : 2 500 series and are not contoured.

Each sheet covers an area of 4 kilometres by 2 kilometres. It is available either as a one colour map (topo-coloured) or a two colour map (green for the cadastral boundaries and cadastral numbers).

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1:5,000 scale map coverage



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Lessons Learnt from Japan Visit

- ❑ Japan has a National Authority that develops Base Geospatial Data/Information – GSI (this is in a way a replica to Zimbabwe’s DSG)
- ❑ GSI distributes Geospatial data/information free of charge to institutions and the public for further production of various thematic applications and maps
- ❑ JMC produces printed maps for distribution to users through wholesalers and bookshops
- ❑ GSI is fully funded by central government
- ❑ GSI constructs and maintains national geodetic control network, and has a complete national coverage of CORS – mainly used for disaster monitoring

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Cont.

- ❑ There is diverse usage of geospatial data by Japan government institutions, the private sector, NGOs and the public through sharing of data/information
 - Transport network management
 - Utility management (water, sewer, gas, electricity etc)
 - Asset Tax collection
 - etc.

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Desired Way Forward

- ❑ Have high resolution geospatial data/information for all Cities, towns and rural service centres of Zimbabwe by way of using modern technology and international best practices
- ❑ Establish GNSS CORS countrywide
- ❑ Establish NSDI for data sharing
- ❑ Develop staff in line with changing technology and practices in the realm of Geospatial Information Management

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Conclusion

- ❑ **Japan is well advanced in utilisation of geospatial data/information for sustainable socio-economic development – through sharing of the geospatial data/information**
- ❑ **Zimbabwe desires to do the same and anticipates continued collaboration with the Japanese government to achieve the above**
 - **Capacity building**
 - Technological
 - Staff development
 - Experience sharing

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END OF PRESENTATION

THANK YOU

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