Preparation of Development Plan for Fourteen Upazilas
Package-03

(Faridpur Sadar Upazila, Faridpur District; Bagmara Upazila, Rajshahi District and Gangni Upazila, Meherpur District

Final Survey Report
On
Physical Feature, Landuse, Topography and Photogrammetry
Faridpur Sadar Upazila, Faridpur

June, 2017

Executive Summary

Faridpur Sadar is an Upazila of Faridpur district in the division of Dhaka, Bnagladesh. The upazila occupies an area of 407.02 sq. km (BBS 2011. It is bounded by Char Bhadrasan Upazila to the north, Nagarkanda Upazila, Boalmari Upazila to the south, Rajbari sadar to the east and golandia Upazila of rajbari district to the west. This report contains detailed activities undertaken for Physical Feature Survey, Land Use Survey and Topographic Survey in Faridpur Sadar upazila, based on stereo satellite imagery through photogrammetric technology. High resolution ortho-rectified satellite image along with photogrammetric data are used in preparing base map for conducting the surveys.

This report contains four separate reports. These are: Physical Feature Survey, Land Use Survey, Topographic Survey and Photogrammetric Works. Physical Feature Survey Report covers how the features with their attribute are collected and processed for the preparation of base map for planning. Land Use Survey Report describes the methodology for acquiring and processing of land use data. Topographic Survey Report contains the acquisition and processing of topographic data by using the photogrammetric technology. The report on Photogrammetric Works contains the basic technologies of stereo satellite image processing and extraction of features.

Abbreviations and Acronyms

BM------------------------: Bench Mark

BUTM---------------------: Bangladesh Universal Transverse Mercator

DEM----------------------: Digital Elevation Model

DGPS---------------------: Differential Global Positioning System

DLRS---------------------: Directorate of Land Records & Surveys

DPI----------------------: Dot Per Inch

DPW---------------------: Digital Photogrammetry Workstation

DTM---------------------: Digital Terrain Model

GCP----------------------: Ground Control Point

GIS-----------------------: Geographic Information System

GPS----------------------: Global Positioning System

HBB---------------------: Herring Bone Bond

JPEG---------------------: Joint Photographic Experts Group

Km-----------------------: Kilometer

MSL---------------------: Mean Sea Level

PD-----------------------: Project Director

PM-----------------------: Project Manager

RL-----------------------: Reduced Level

RMS---------------------: Root Mean Square

RS------------------------: Revisional Survey

RTK-GPS----------------: Real Time Kinematic Global Positioning System

SOB----------------------: Survey of Bangladesh

TIN----------------------: Triangulated Irregular Network

TOR---------------------: Terms of Reference

UDD---------------------: Urban Development Directorate

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Chapter One: Introduction

1.0   Background

Faridpur Sadar Upazila (FARIDPUR DISTRICT) area 407.02 sq km, located in between 23°29' and 23°34' north latitudes and in between 89°43' and 89°56' east longitudes. It is bounded by Goa landa and Harirampur upazilas on the north, Saltha upazila on the south, Char Bhadrasan and Harirampur upazilas on the east, Boalmari, Madhukhali and Rajbari Sadar upazilas on the west. Upazila town is situated on the bank of Kumar River. This report contains detailed activities undertaken for Physical Feature Survey, Land Use Survey and Topographic Survey in Faridpur Sadar upazila, based on stereo satellite imagery through photogrammetric technology. High resolution ortho-rectified satellite image along with photogrammetric data are used in preparing base map for conducting the surveys. This report contains three separate reports. These are: Physical Feature Survey, Land Use Survey & Topographic Survey. Physical Feature Survey covers how the features with their attribute are collected and processed for the preparation of base map for planning. Land Use Survey portion describes the methodology for acquiring and processing of land use data. Topographic Survey contains the acquisition and processing of topographic data by using the photogrammetric technology. This report aims to give a potential view of the project 'Preparation of Development Plan for Fourteen Upazilas', for the Package-3, Faridpur Sadar Upazila. All required information for this report has been collected using the advanced technologies in the survey and data Rapid urbanization and development in an unplanned manner which tends to generate the collection process. The survey was carried out according to the methodology mentioned in the TOR. The Project Area map has been shown in **Map-1.1**.
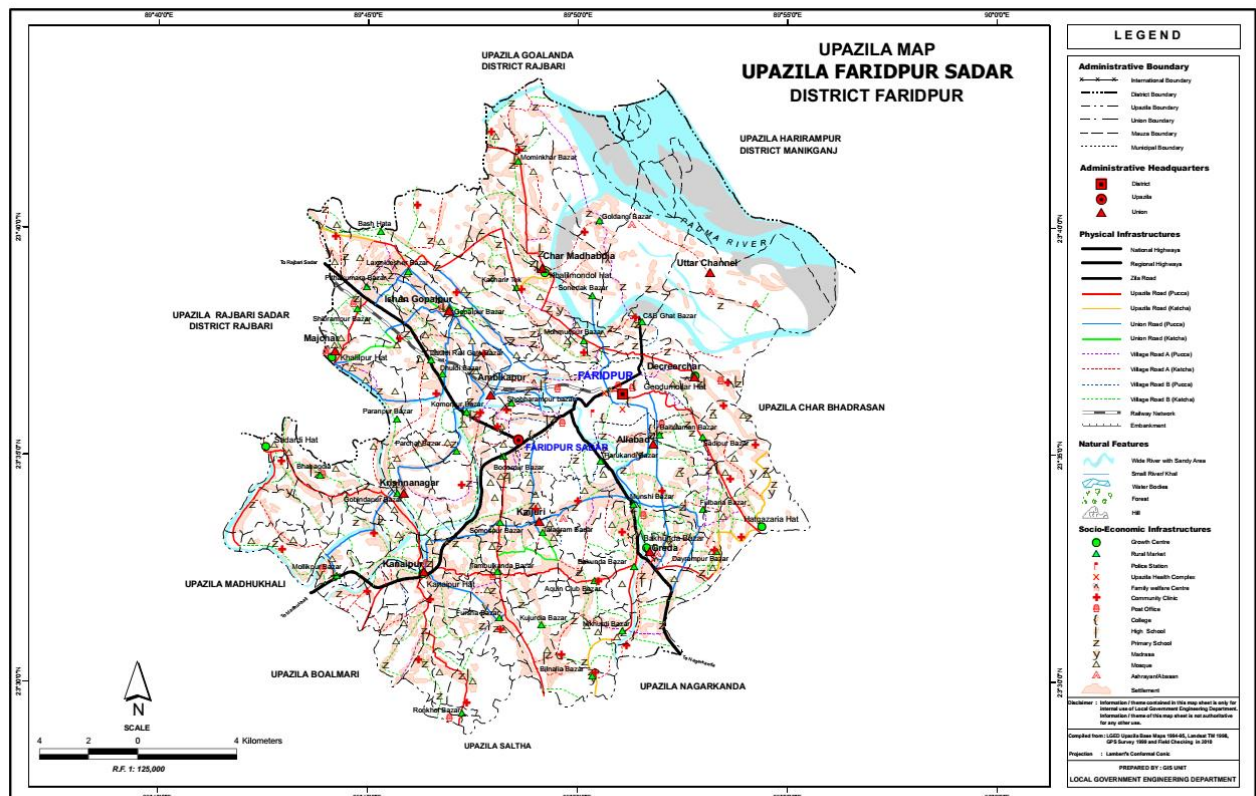
Map-1.1: Project Area Map of Faridpur Sadar Upazila

Chapter Two: Methodology

2.0   Reconnaissance Survey

A reconnaissance survey of the study area has been conducted to identify the existing problems, development constraints and future development potentialities of the upazilas. This reconnaissance survey has given the planning team an initial overview of the area that was necessary to set on the task of preparing a Master plan. This overview pertains not only to the physical features, prospects and problems of the area, but also the ideas, aspirations and mood of the local residents, which are very much essential to develop the methodological approach for required data collection.

2.1   Compilation and Preparation of Base Map

Preparation of base map is an important requirement for planning the project area. The base map will be used to depict the survey findings. Preparation of base map comprises the following item of works presented in sections.

Major task for the compilation and development of Geospatial data of Mouza maps have been summarized in the flow diagram as shown in **Figure-2.1**:

```
┌─────────────────────────┐
│  Collection of Mouza Maps │
│      from DLRS            │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│  Scanning of Mouza Maps   │
│     with 300 DPI          │
└─────────────────────────┘
            │
            ▼
┌──────────────────────┐   ┌─────────────────────────┐   ┌──────────────────────┐
│ Ground Control Point │──▶│  Geo-referencing of      │◀──│ Ground Control Point │
│ (GCP) collection from│   │  Raster Mouza Map        │   │ (GCP) Collection     │
│ Ortho-rectified      │   │                          │   │ through Field Survey │
│ Satellite            │   │                          │   │                      │
└──────────────────────┘   └─────────────────────────┘   └──────────────────────┘
                                      │
                                      ▼
                           ┌─────────────────────────┐
                           │ Digitization of Mouza Map│
                           │ and Mouza Attributes      │
                           │ Adding                    │
                           └─────────────────────────┘
                                      │
                                      ▼
                           ┌─────────────────────────┐
                           │ Edit Plot Checking on    │
                           │ Light Table /On-         │
                           └─────────────────────────┘
                                      │
                                      ▼
                           ┌──────────────┐          ┌─────────────────────────┐
                           │ Edit Plot     │─────────▶│ Other Attributes Adding  │
                           │ Correction    │          │ (Ward, Union, Upazila,   │
                           └──────────────┘          │ District, Geocode, etc.) │
                                  │                   └─────────────────────────┘
                                  ▼                              │
                           ┌──────────────┐                      ▼
                           │ Preparation   │          ┌─────────────────────────┐
                           │ of GIS Map    │          │ Edge-matching of         │
                           └──────────────┘          │ Mouza Map Sheets         │
                                                      └─────────────────────────┘
                                                                 │
                                                                 ▼
                                                      ┌─────────────────────────┐
                                                      │ Joining/Merging of       │
                                                      │ Mouza Map Sheets         │
                                                      └─────────────────────────┘
                                                                 │
                                                                 ▼
                                                      ┌─────────────────────────┐
                                                      │ Geospatial Data of       │
                                                      │ Mouza Maps               │
                                                      └─────────────────────────┘
```

Figure-2.1: Flow Diagram for Preparation of GIS Database using RS Mouza Map

2.1.1 Collection of Mouza Maps

The Consultant has collected all the Mouza maps covering the entire project area from DLRS office. The Mouza sheets having distortion due to rapping or pasting cloths/tape were avoided during collection of Mouza maps. The detail list of Mouza maps are provided in the **Annexure-I**.

Table-2.1: Mouza Maps Collection from DLRS

Upazila	Mouza Version	Mouza Maps		Collection Percentage
		Total No. of Sheet	No of Collected Sheet	
Faridpur Sadar	RS	329	326	99.08%

2.1.2 Approval of Collected Mouza Maps for Scanning and Digitization

After collection of Mouza maps of Faridpur Sadar Upazila from DLRS, all sheets were submitted to PM for review and quality check before scanning and digitizing. The PM of the project has approved all the Mouza maps in presence of the Consultant. A sample of approved scanned Mouza map is shown in **Figure-2.2**.
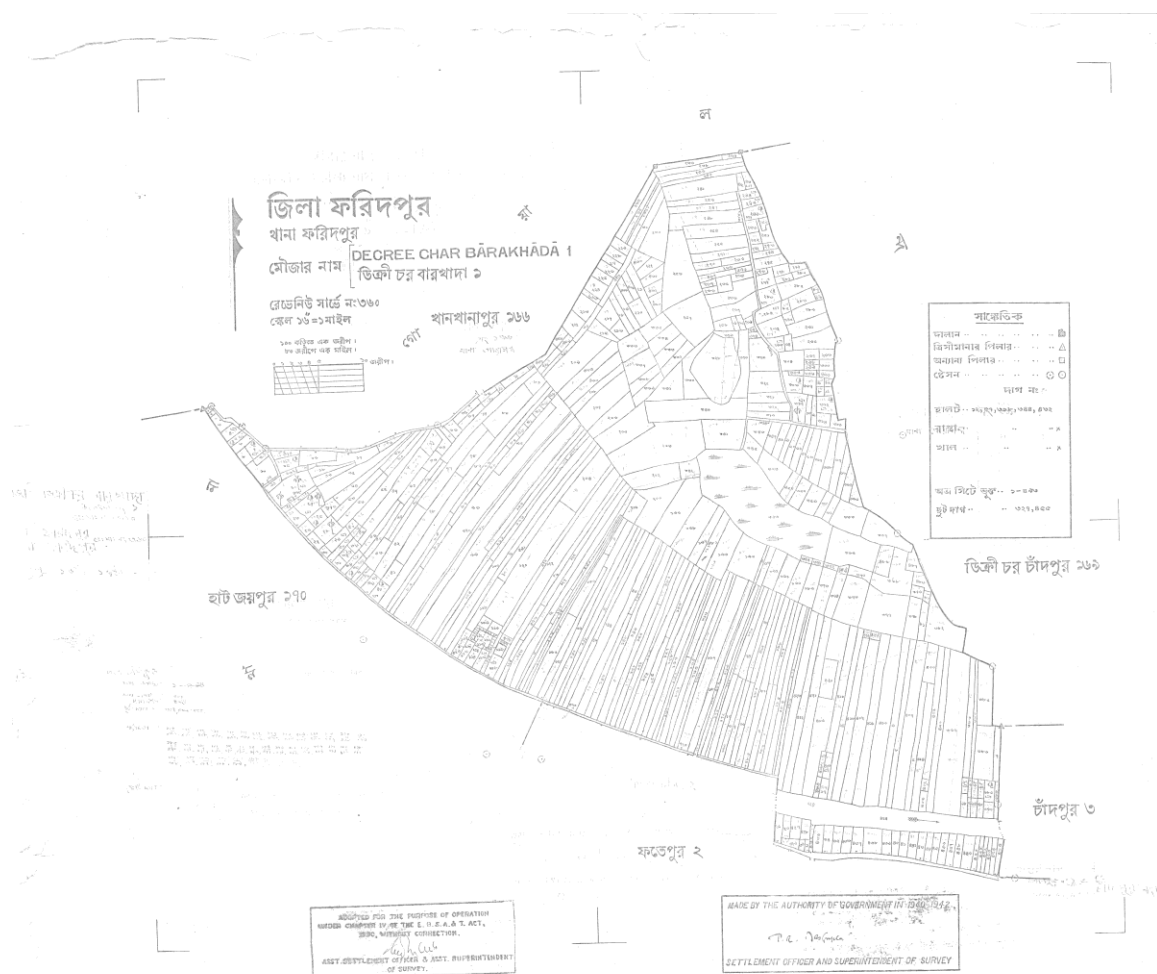
Figure-2.2: Sample of Scanned Mouza Map

2.1.3 Scanning of Mouza Maps

Scanning of all the Mouza maps/sheets was started immediately after their approval by PM. As per TOR, scanning of Mouza maps/sheets was carried out using drum scanner with 300 DPI to obtain good quality image and saved as JPEG format to be used later on for screen digitization. Extra care was taken during the scanning process for maintaining the proper rotation and alignment to minimize the distortion and deviation. As per TOR, the following specifications have been maintained.

Table 2.2: Specifications for Scanned Mouza Maps

Image Type	Grayscale
Image Format	JPEG
Image Resolution	300 dpi

Table 2.3: Specifications of the Scanner used for Scanning of Mouza Maps

Brand & Model	HP Design jet 815 mfp
Scan Resolution, enhanced	2400×2400 dpi, with variable resolution setting from 50 dpi in increments of 1 dpi
Scan Resolution, hardware	800×800 dpi
Bit Depth	24-bit color
Levels of grayscale	256
Maximum scan size	42×unlimited in

Table 2.4: Status of Scanning of Mouza Map

Upazila	Mouza Maps		Scanning Percentage
	Total No. of Hard Copy Sheets	**Total No of Scanned Sheets**	
Faridpur Sadar	**329**	**326**	99.08%

2.1.4 Preparation of Technical Specifications for GIS Database

A document on technical specifications of GIS database was prepared for storing spatial and attribute database of all layers including Mouza maps. Later this document was finalized in consultation with PM and GIS Experts of all the packages. This document is given in **Annexure-II**.

2.1.5 Digitization of Mouza Maps

The Mouza maps have been digitized through On-screen Digitization process using ArcGIS software. In brief, this process involves adding a scanned Mouza map in ArcMap, creating four empty shape files of three basic feature types (point, line, and polygon) in ArcCatalog, and using ArcMap's drawing tools and the mouse to trace features from the image into the shape files. All the features of a Mouza map such as Plot boundary, Plot number, Road, Canal, Building, Mosque, Temple, Traverse Station, Iron Pillar, etc., are created and stored with attributes in four different vector layers as per the

Technical Specification of GIS Database. For attaining maximum level of digitizing accuracy, the Data Frame properties have been set as Map Unit = Inch and Distance Unit = Inch to get 1:1 map scale and later zoom in to 1:30 scale during the digitization process. The **Figure-2.3** shows the on-screen digitization and a sample digitized Mouza map.
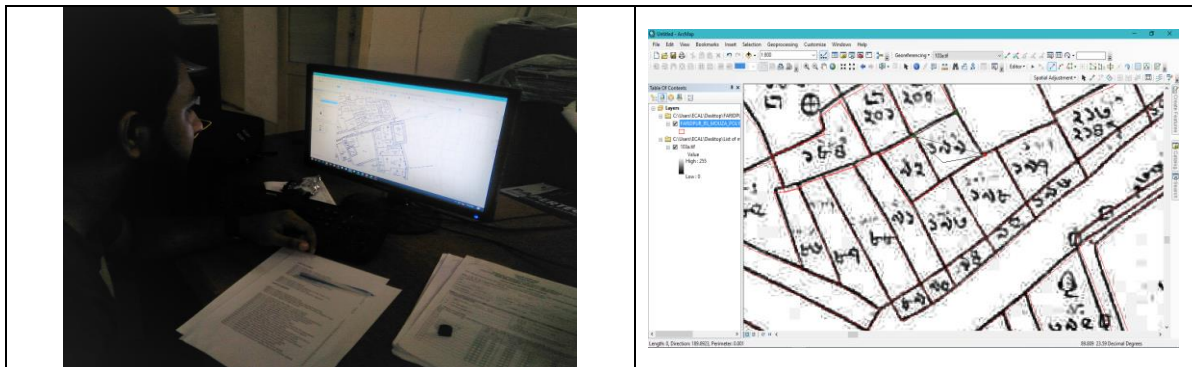
Figure 2.3: On Screen Digitization and Sample Digitized Mouza Map

Table-2.5: Status of Digitizing of Mouza Map

Upazila	Mouza Maps		Digitization Percentage
	Total No. of Mouza Sheets	Total No of Digitized Sheets	
Faridpur Sadar	329	326	99.08%

2.1.6 Edit Plot checking of the Digitized Mouza Maps

After digitization of Mouza maps edit plots were produced containing all the features in different colors. The digitized Mouza maps were checked and verified by superimposing on the original Mouza maps. This checking was done with the joint team of UDD and the GIS Expert. The observed errors normally were, wrong Id of lines, plot numbers and symbols. In some sheets, few arcs have found as missing.

After completion of edit plot checking, necessary corrections have been done using ArcGIS. After correction, the Mouza maps/sheets were printed out again and were checked to ensure that corrections were made accordingly. In this way, utmost effort has been made to ensure quality of digitization. After finalization of digitization of all the Mouza maps, both soft and hard copies of them have been submitted to Project Director.

2.1.7 Geo-referencing of Raster Mouza Map

Geo-referencing is the process of establishing real world coordinates or geographical coordinates of certain points of the map (at least 4 points) with great accuracy while the remaining points are calculated automatically, based on transformation formulas.

In addition to GCP survey for geo-referencing Mouza maps, Ortho-rectified satellite image of the study area has been used as a control layer. This layer contains a rich source of real world coordinates, because it is derived by aerial triangulation of stereo images in photogrammetric environment and later ortho-rectified by the generated DEM of the area. It should be noted here that a required number

of GCPs were acquired through RTK-GPS/DGPS method for the process of Aerial Triangulation that is a pre-requisite for photogrammetric works.

The Coordinate System used for both GCP and otho-rectified satellite image is the **Bangladesh Universal Transverse Mercator (BUTM2010)** which is established by the national mapping agency **Survey of Bangladesh** (SOB). The parameters of BUTM 2010 are as below:

Spheroid   : WGS 1984
Datum   : WGS 1984
Unit   : Meters
False Easting   : 500000
False Northing   : 0.0
Central Meridian   : 90.0
Scale Factor   : 0.9996
Latitude of Origin   : 0.0

Since, we can pick real world coordinates (Easting, Northing) of any point on the ortho-rectified satellite image, geo-referencing of Mouza map has been done by using this geometrically corrected satellite image as reference. The process of geo-referencing of Mouza map using satellite image is actually parcel (plot) of Mouza map matching with respect to the ortho-rectified satellite image. The **Figure 2.4** shows a sample geo-referenced raster Mouza map which is overlaid on ortho-rectified satellite image.

Figure-2.4: Sample Geo-referenced Raster Mouza Map Overlaid on Satellite Image

A suitable number of GCP (minimum 4), preferably plot corners and building corners, has been taken for proper geo-referencing of Mouza map depending on its size and 2nd Order Polynomial Transformation was

applied. Total RMS error was kept within 0.5/1.5 meter i.e. within 1 to 3 pixels of the satellite image. Thus individual sheet of the Mouza maps get properly georeferenced. Finally, permanently geo-referenced images of Mouza maps have been created by using 'Rectify' tool of ArcMap.

2.1.8   Geo-referencing of Vector Mouza Map

After geo-referencing of scanned image of Mouza maps (raster Mouza maps), geo-referencing of vector Mouza maps have been done. The vector maps i.e. the shape files of each Mouza map sheet have been spatially adjusted to the respective geo-referenced raster Mouza map sheet. The Spatial Adjustment Tools of ArcMap have been used to do this.

2.1.9   Edge Matching of Mouza Maps

A parcel or plot based digital map of the whole project area is a pre-requisite for planning. But edge-matching is a critical component of creating such a map. The project area encompasses many Mouzas each of which contains one or more than one map sheets. The adjacent Mouza maps are coincident and share the same location of coordinates, boundaries, or nodes. The problem is that, in reality, the common boundaries of adjacent Mouza map sheets actually do not match exactly with each other. Hence the edge-matching problem arises. Mouza maps are especially prone to this problem.

Edge-matching is used to align features along the edges of adjacent layers. Usually, the layer with the less accurate features is adjusted, while the other layer is used as the target layer. By superimposing the vectorized Mouza maps on satellite image the accuracy of the common boundaries with respect to satellite image have been investigated. Then, edge-matching of two adjacent Mouza map layers have been done by comparing the accuracy of their linear features with reference to the satellite image, identifying and keeping more accurate common features from one layer and deleting the less accurate features from other layer. In case of common roads, rivers or canals, the more accurate features have been kept entirely (both edges) from a Mouza map sheet and the same features which belong to other layer have been deleted. The arisen errors such as undershoots, overshoots, etc. have been fixed immediately after deleting features.

Figure-2.5: Sample Diagram of Edge-matching

2.1.10 Demarcation of the Project Area based on Mouza Maps

Mosaicing of all Mouza maps belonged to the Upazila form the actual boundary of the project area. Before mosaicking, edge-matched Mouza maps have been made as free of topological errors. Finally plot based mosaic Mouza maps of the project area have been created by using 'Merge' tool of ArcGIS. The boundary of this merged Mouza map becomes the Project Area Boundary with real world coordinates. Project Area Map of Faridpur Sadar Upazila is shown in **Map 2.1**

The consultant in cooperation with UDD officials has demarcated the actual boundary of the project in the newly formed mosaic Mouza map. Later on, the project boundary was finalized by field verification, which was considered and used for the project after duly approved by UDD.

From the mosaic Mouza map of the project area, the administrative boundaries such as District boundary, Upazila boundary, Union boundary, Mouza boundary and Mouza Sheet boundary have been created by using geo-processing tools of ArcGIS such as Dissolve, Erase, Intersect, Spatial Join, etc.
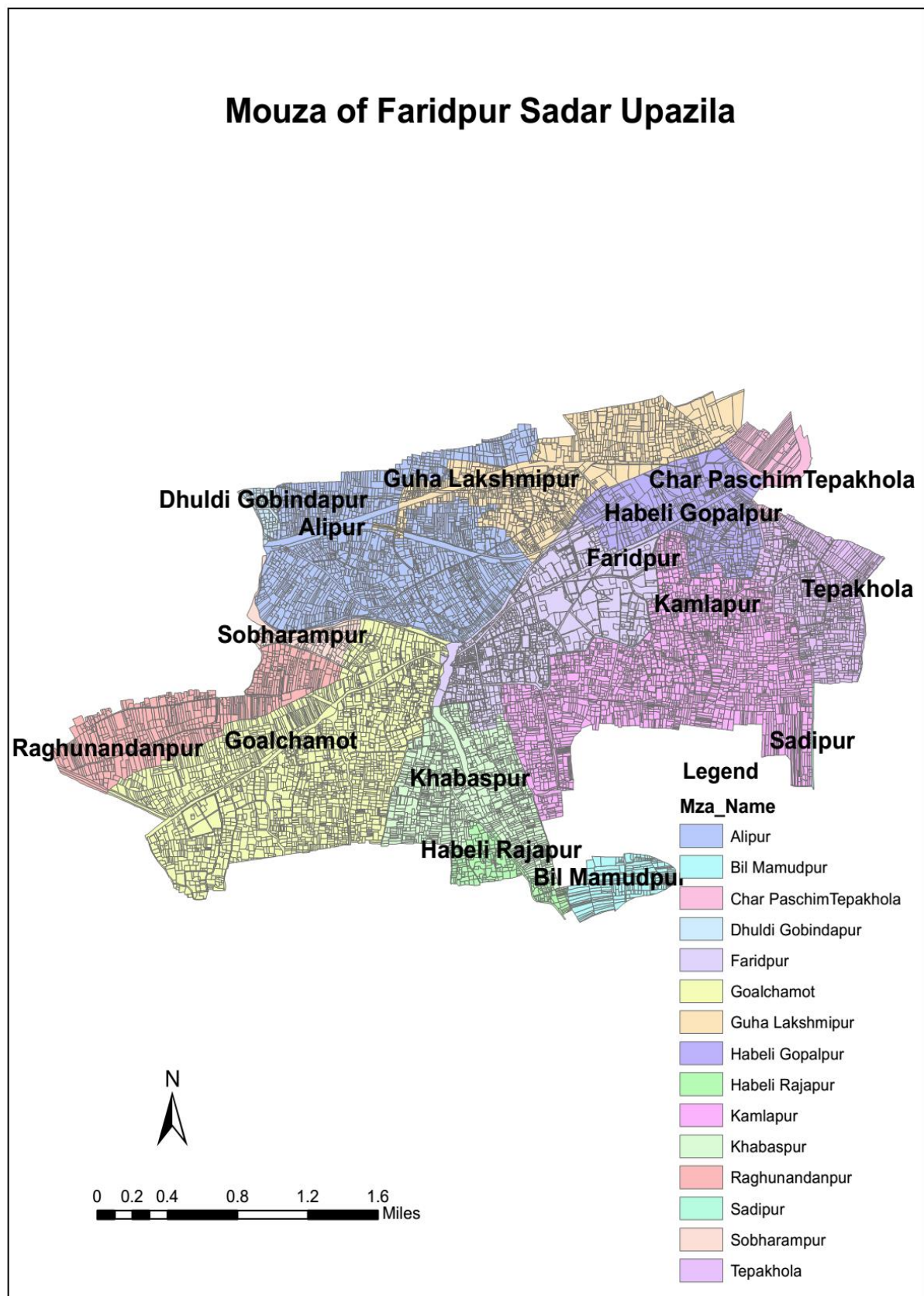
Map 2.1: Mouza Map of Faridpur Sadar Upazila (partial).

2.2 Establishment of Ground Control Point (GCP) / BM Pillars

A network of permanent Bench Mark (BM)/Ground Control Point has been established having real world coordinates (Easting, Northing, and Elevation) within the study area to carry out the topographic, physical features and land use survey. 19 BM pillars have been established in Faridpur Sadar Upazila. The network establishment for the survey comprises the following item of works:

2.2.1 Selection of Sites for BM Pillars with justification

Appropriate site selection is crucial for establishing BM pillars. The consultant has considered the following points in selecting sites for ground control points:

i. The site is suitable for RTK-GPS/DGPS observation. There exists Good Sky Visibility (15 degree cut of angle above the horizon) and far from mobile tower or high voltage electric line.

ii. The site is located on undisturbed location due to natural or human activities.

iii. The site is located on a corner of government own land, playground, school or beside of road.

iv. The site is located on such a place that is suitable to set up Total Station equipment in future work.

v. Two successive BM pillars are inter-visible and at least 100 meters apart.

2.2.2 Design of Pillars

BM pillars in the Study area have been constructed according to the design supplied by UDD. The approved design sheet appears at **Figure-2.6.**
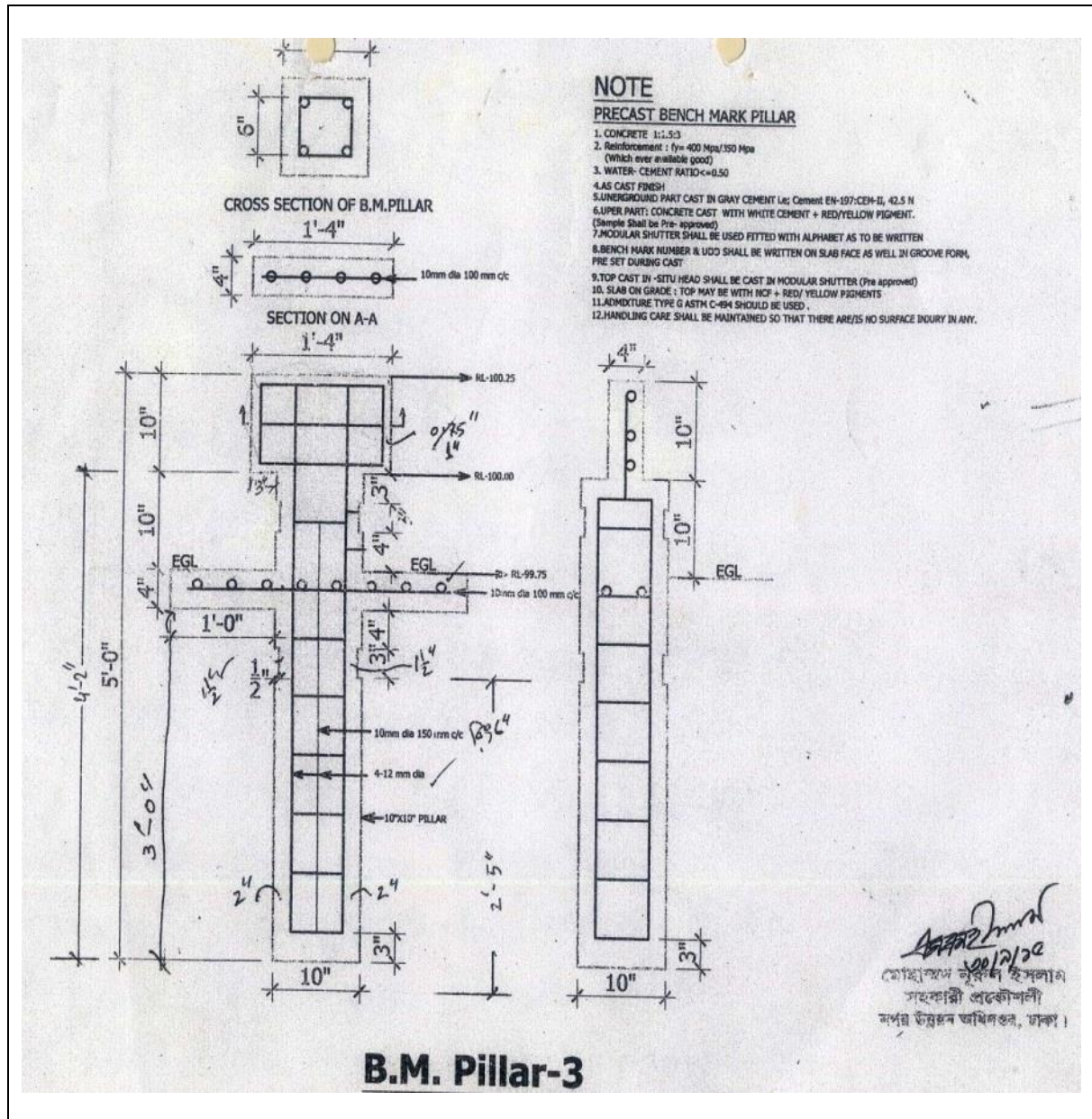
Figure-2.6: Design of BM Pillar

2.2.3 Construction of BM Pillars

Faridpur Sadar Upazila is covered by 19 BM pillars. The BMs are constructed as per approved design of BM pillar. The BM pillars have been installed in the field. Installation of the BM pillars has been monitored by UDD and the Consultant.

Plate-1: Sample of Constructed BM and Installed BM

2.2.4   Description of Reference BM Pillars

For the selection of reference BM, the survey team considered the BM 533, GPS 2317 and GPS 3533 of Survey of Bangladesh (SOB) as reference BM pillar in Faridpur Sadar Upazila. The information of Reference BM Pillars has been collected from Survey of Bangladesh.

Plate-2: Reference BM Pillar in Faridpur Sadar Upazila

The location and its x, y and z value are given in **Table-2.6**. On the basis of this reference BM, 14 BMs have been established as local reference control points within the Project Area.

Table-2.6: Location of Reference BM

ID no.	Height above MSL	Coordinate (WGS-1984)		Coordinate BUTM		Location
		Lat Ddmmss.ssss	Long Ddmmss.ssss	Northing	Easting	
BM 6181	7.6735	23.55204663333	89.77775694722	2607381.488	783574.112	19 meter south east from BSIC office. 15.6 meter west side of a light postand 3.7 meter north east from the narrow road of BSIC. Village: Mirgi, Upazilla: Faridpur Sadar, Dist: Faridpur.

Source: Survey of Bangladesh (SOB), 2017

2.2.5   Baseline Survey by RTK-DGPS Method

The baseline survey is the instantaneous data collection in static mode at two or more fixed points using two or more dual frequency RTK-GPS receivers. The measurement network for RTK-GPS baseline survey is planned by connecting the BM points to be established and the selected reference BM (Known latitude, longitude and ellipsoidal height) near the Study Area. A line connecting two measurement points is known as baseline.

The GPS measurements consists a simultaneous static measurement with two dual frequency GPS receivers one on the known reference BM (base) and another one will be on the BM to be established (Rover). The simultaneous measurement or logging time for a session is usually 20 minutes to an hour depending on the availability of satellite and distance. During taking the measurements, the GPS receivers at the two points record the satellites information or data and the stored data is processed using software.

Plate-3: RTK-GPS Observation

The GPS Survey Team has conducted survey by RTK/DGPS methods. The Base station has been

established by connecting to the Reference BM (BM 533, GPS 2317 and GPS 3533) of SOB) and 10 hours of continuous observation to get precise coordinates. After establishing the base station, the rovers are positioned on the newly installed BM Pillars one by one and observations have been made for each of the 13 BM in the project area.

2.2.6 Establishment of Coordinates (X, Y, Z) for BM Pillars

The GPS data acquired through RTK-GPS/DGPS survey has been processed by using post processing software and the co-ordinates (Northing, Easting and Elevation) of BM Pillars are achieved. Thus the coordinates of all the 13 BM pillars have been established in the Project Area along with their RL (height above MSL). The location of BM's and its x, y and z values are given with photograph of BM are given in **Table-2.7** and location of BM pillars are given in **Map-2.2**.

Table-2.7: Coordinates and Details of the BM Pillars

BM No.	RL	Lat.	Long.	Northing	Easting	Location	Photo
1	8.968	23.58954 551944	89.8091 3437222	2611598. 813	786697 .578	Faridpur Sadar upazila Complex, in front of the main building	
2	8.653	23.61546 563333	89.8429 2089167	2614538. 956	790090 .620	Vati-lokkhipur Govt. Primary school, front right side of entry gate	
3	8.629	23.59957 107778	89.8272 4735833	2612746. 085	788525 .238	Goalchamot primary school, right corner of the school building in back	

BM No.	RL	Lat.	Long.	Northing	Easting	Location	Photo
4	7.881	23.58871016944	89.83448678889	2611557.321	789288.294	Al-amin Govt. primary school, right corner of the school area	
5	8.879	23.61148178333	89.81802208889	2614047.197	787557.251	Gobindapur Primary school, at the front of school compound	
6	7.369	23.60120120833	89.83923790833	2612950.964	789745.991	Jhiltuli Govt. primary school	
7	9.119	23.61204400556	89.85654066389	2614187.560	791488.739	Tepakhola Govt. Primary school, front of school building	
8	7.922	23.59512760833	89.86165290278	2612323.618	792048.218	Rajendra College, Baitul aman, left side of entry to college	

BM No.	RL	Lat.	Long.	Northing	Easting	Location	Photo
9	8.093	23.58691682500	89.86145545833	2611413.439	792046.255	Aliabad UP complex, right corner of UP compound to the front	
10	7.271	23.55956519444	89.81443153333	2608287.645	787303.811	Koijuri UP complex, Left side of the entry of UP complex area	
11	7.338	23.54700246389	89.85697566667	2606981.704	791677.024	Gerda UP complex, front of UP	
12	8.606	23.63581633056	89.77958065833	2616666.555	783580.025	Ishan Gopalpur UP complex, at the right end corner of UP area	

BM No.	RL	Lat.	Long.	Northing	Easting	Location	Photo
13	8.087	23.60775399167	89.80082638333	2613599.653	785809.697	Ambikapur UP complex, Left side of the entry of UP complex area	
14	9.359	23.56968907778	89.75877820556	2609298.738	781597.940	Krishnanagar UP complex, Left side of the entry of UP complex area	
15	7.082	23.53980396111	89.77431584722	2606018.233	783248.889	Kanaipur UP complex, infront of the UP building	
16	9.679	23.63127574167	89.76180698333	2616128.270	781775.475	Machchor UP complex, Left side of UP main building	
17	9.244	23.65089920833	89.81765623333	2618413.916	787433.733	Char Madhobdi UP complex, Left back side corner of UP building	

BM No.	RL	Lat.	Long.	Northing	Easting	Location	Photo
18	8.717	23.66344 652778	89.8401 1410278	2619849. 622	789698 .298	North Channel UP complex, front right corner of UP building	
19	8.046	23.63053 491111	89.8547 0997222	2616232. 663	791260 .888	Aij Uddin Matobbor Kandi Primary school, right end corner of playing field	

2.2.7   Marking of BM Pillars

The number of the respective BM pillars has also been inscribed on the face of each pillar as per specification provided by UDD. The team members of the consultant firm have properly supervised the marking of Bench Mark Pillars.
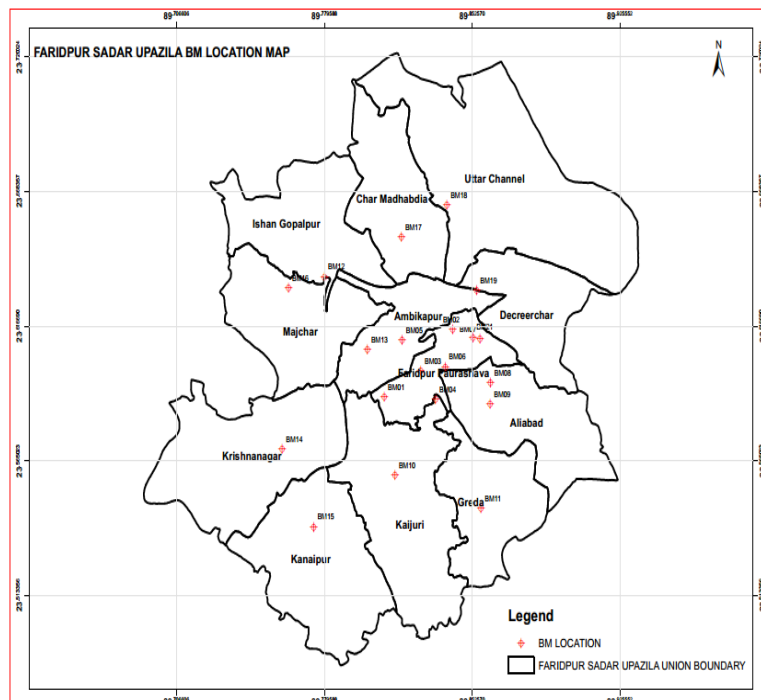
Map-2.2: Location of BM Pillars in Faridpur Sadar Upazila

2.3   Satellite Image Processing for Data Acquisition

Satellite image came with a certain level of processing. However, for the purpose of features extraction, further processing is needed in a number of steps. The step by step procedures has been shown in the **Figure 2.7**.

Figure-2.7: Workflow of Stereo Satellite Image Processing and Data Extraction

After collecting raw satellite imagery in stereo pairs, initial image processing has been done by performing Epi-polar Correction, Color Balance, Contrast Adjustment, Sharpening, Pyramid building and Bit Rate Setting. For geometrical correction of satellite images four reliable GCPs has been collected through RTK-GPS survey study area. Using these GCPs, Aerial Triangulation of the stereo

pairs has done and stereo model has been prepared for photogrammetric works. The detail procedure has been described in 2.4.

2.3.1 Physical Feature Extraction from Satellite Image

After initial image processing and building up of stereo models, extraction of physical features has been done by a team of skilled photogrammetrist. All type of physical features including Structures (katcha, pucca, semi-pucca, etc.), Roads, Water bodies, etc. have been extracted as 3D features. Each vertex of features contains z-value (elevation).
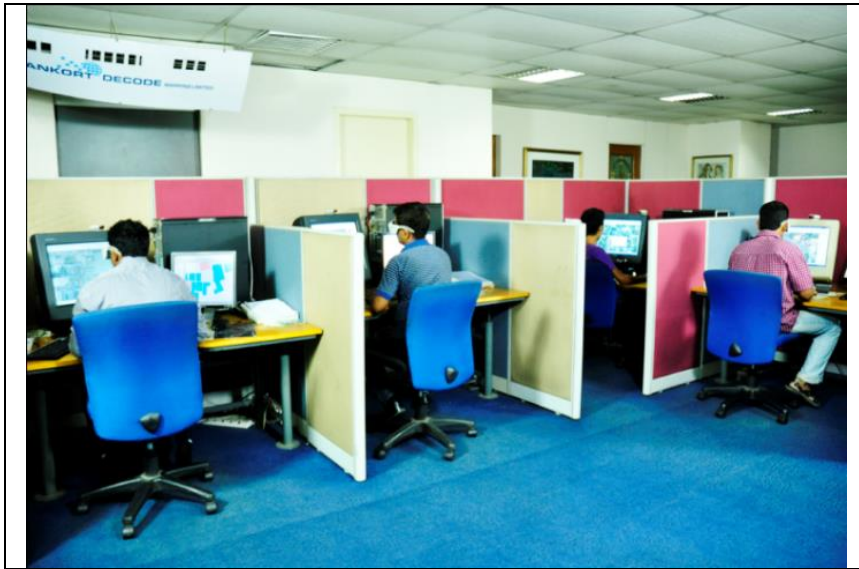
Plate-4: Digitization by Digital Photogrammetry

The Photogrammetric Expert and the GIS Expert has monitored the feature extraction works examine the data for their proper registration.

2.3.2 Preparation of Survey Base Map

The survey base map has been created by superimposing Project Area Maps derived from Mouza map and Satellite Image Processed data. This superimposition is very important to form a unique map and database comprising the data collected from satellite imagery and Mouza map data (e.g. plot no, Mouza name, JL no., sheet no.). These base maps have been used to collect attributes of the physical features and missing features which could not be extracted due to dense vegetation in the project area.

Entire Faridpur Sadar Upazila has been divided into 3564 grids and survey base maps have been prepared based on these grids. The base maps have been printed on A3 paper sheet at a scale of 1:990 to make sure that all required physical features are visible enough to carry out the survey works.

The Grids used to prepare survey base map is shown in **Figure-2.8** and Grids with photogrammetric data and satellite image is shown in **Figure-2.9**.

A sample base map comprising photogrammetric data and satellite image is shown in **Map-2.3** and photogrammetric data with Mouza map is shown in **Map-2.4**.
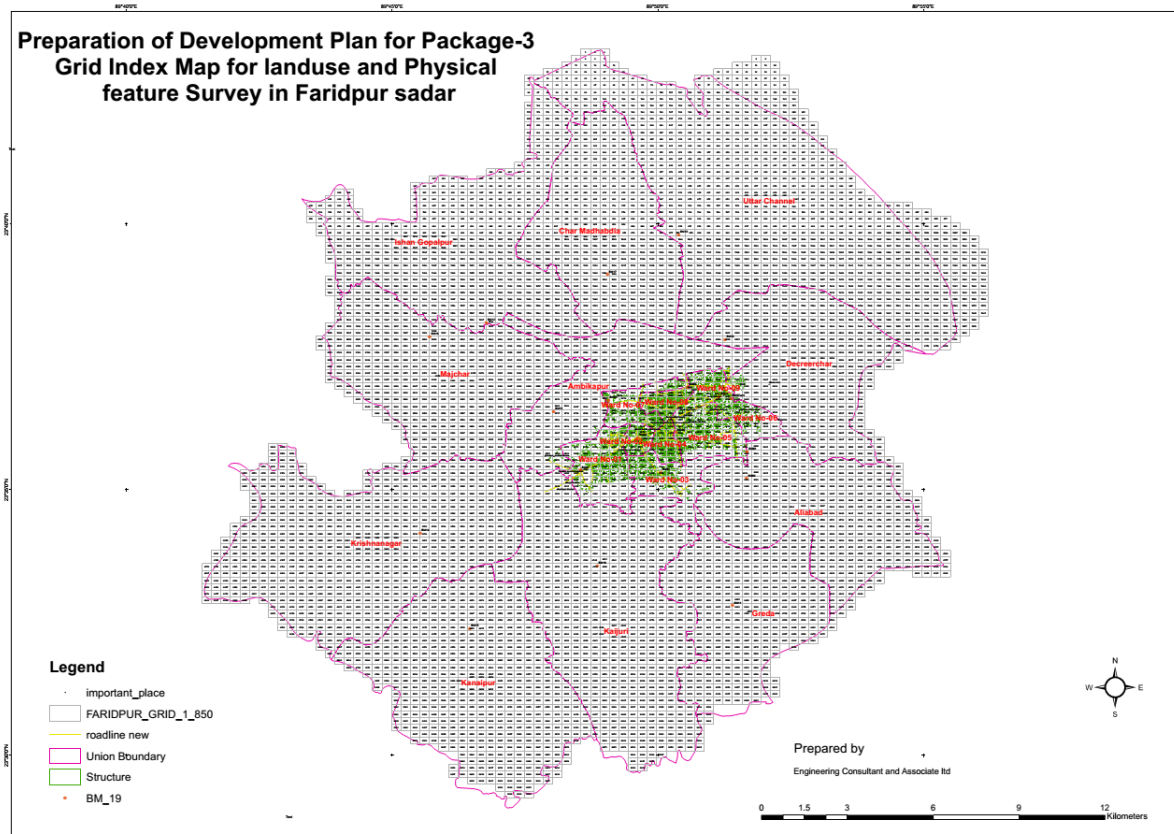
Figure-2.8: Grids for Survey Base Maps of Faridpur Sadar Upazila
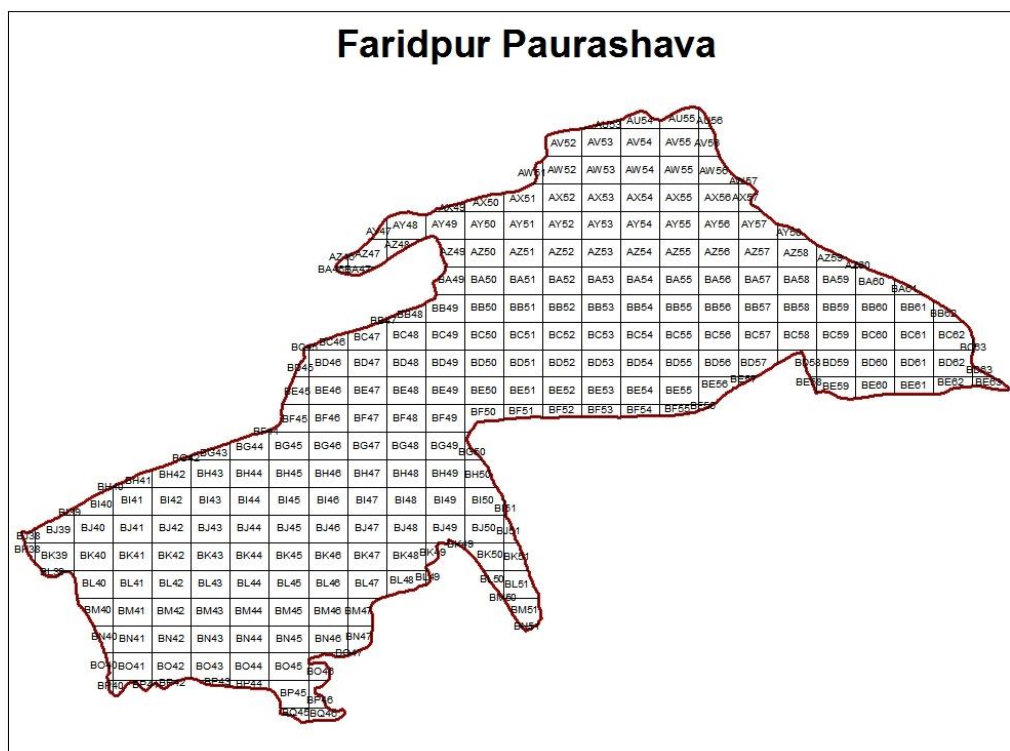
Figure-2.9: Survey Base Maps of Faridpur Sadar Upazila in Grids (Faridpur Paurashava)

Map 2.3: Sample Survey Base Map comprising Satellite Image and Photogrammetric Data

Map 2.4: Sample Survey Base Map comprising Mouza Map and Photogrammetric Data
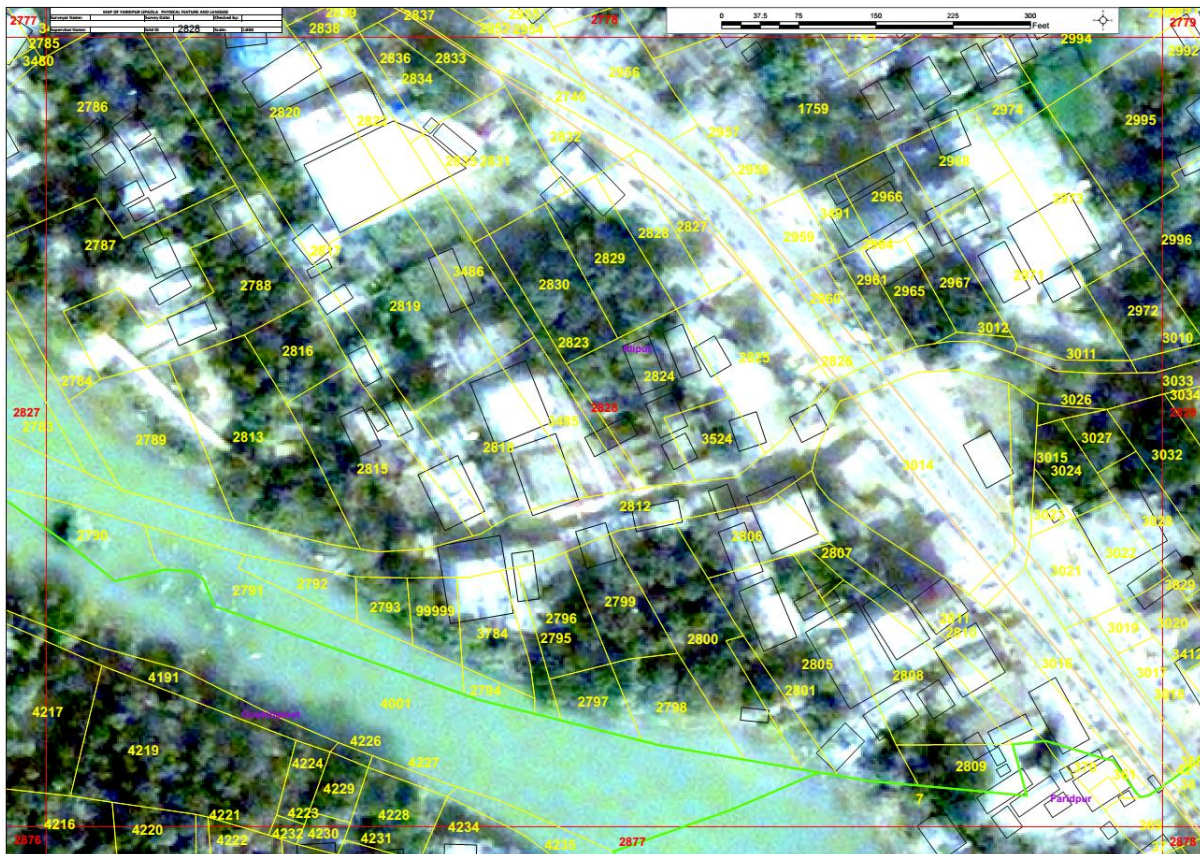
2.3.3   Preparation of Log Book for Attribute Collection

To collect attributes or textual information, a Log Book comprising data collection forms has been developed. A Form of the Log Book is given in **Annexure-III**. Each page of the book contains columns for collecting following information:

- ➢ Type of structure
- ➢ Use of structure
- ➢ Name of the structure, if any
- ➢ Construction year of the structure
- ➢ Owner of the structure
- ➢ Mobile no. of the owner of the structure, if possible
- ➢ Road name beside the structure, if any
- ➢ Plot no. and Mouza name belongs to the structure
- ➢ Ward/Union belongs to the structure
- ➢ Name of the location

2.4.   Image Collection

The satellite image was ordered to PCI India. The authorized reseller/partner of Airbus. 0.5 meter stereo pair image has been purchased by the Consultant for Faridpur Sadar. The specifications of the purchased satellite image are as below:

For Faridpur Sadar Upazila:

Image Sensor	: Airbus
Type	: Ortho ready stereo (3D)
Resolution	: 0.5m Panchromatic, 2.0 meter Multispectral
Source	: New Acquisition, 30th December 2016
Total Area	: 412.86 Sq. km.
Bit Rate	: 16 Bit
Company	: Airbus Defense and Space.

2.4.1   Image Pre-Processing

Satellite image came with two parts. One is multispectral band which resolution is 1.74 meter and another one is panchromatic which resolution is 0.5 meter. We need 0.5 meter multispectral image for feature extraction. After collecting raw digital images, the tasks involved in image processing are:

- ➢ Merge the image tile
- ➢ Color Balance
- ➢ Contrast Adjustment
- ➢ Pan-sharpening

2.4.2 Satellite Image Processing

Satellite image came with a certain level of processing. However, for the purpose of features extraction, further processing is needed in a number of steps. The step by step procedures has been shown in the **Figure-2.10**
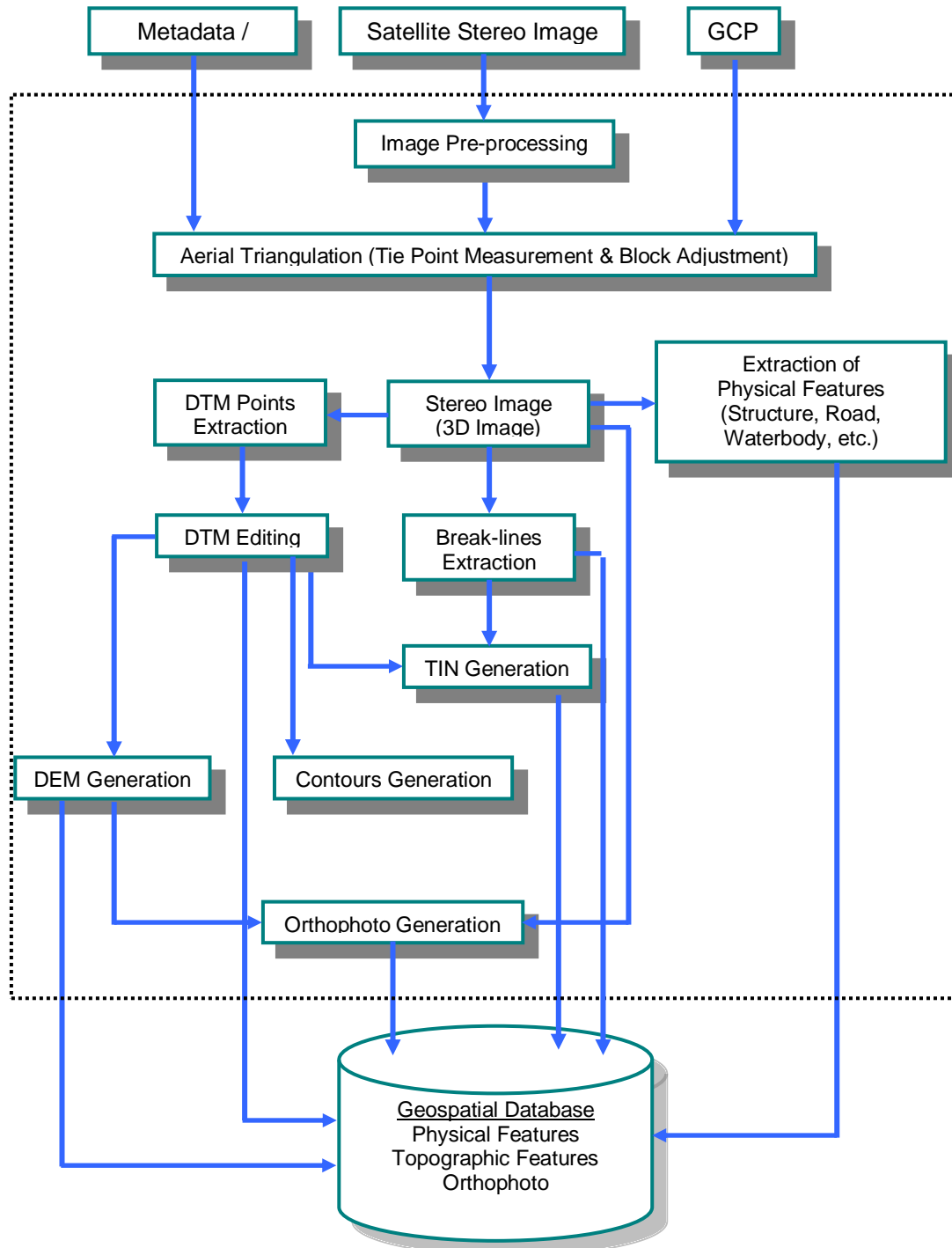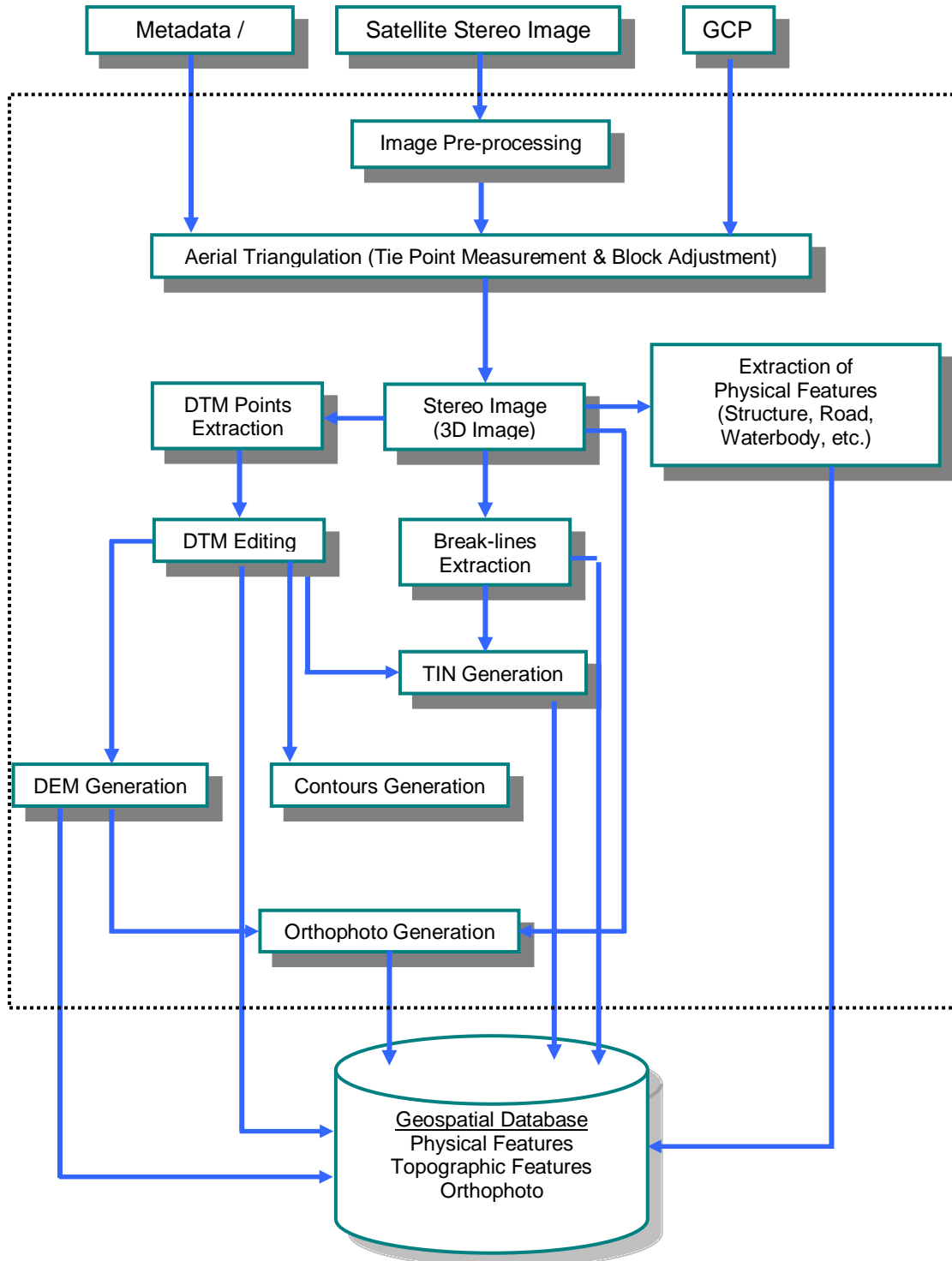

Figure-2.10: Workflow of Stereo Satellite Image Processing and Data Extraction

2.4.3   Merge, Color Balance and Pan-Sharpen

Satellite image comes with lots of small segment which called image tile so that image can be sent by the provider on DVD media. To create an individual image all image tiles have been merged and thus an individual large image has been created.

Image tiles may vary in color and contrast. So during the merge process, color and contrast has been adjusted to get a color balanced image. **Figure-2.11** shows the satellite image tiles without color and contrast balance.

During the image capturing time, satellite captures two types of image, one in multispectral (RGB & NIR) image which is low resolution (2.0 meter) and another in high resolution (0.5 meter) panchromatic image. For feature extraction, 0.5 meter high resolution (0.5m) multispectral image is required. To have this 0.5 meter multispectral image, pan-sharpening tools have been used. This tool produces a 0.5 meter multispectral image by combining 2.0 meter multispectral image and 0.5 meter panchromatic image. **Figure-2.12** shows the merged satellite image with color and contrast balance.
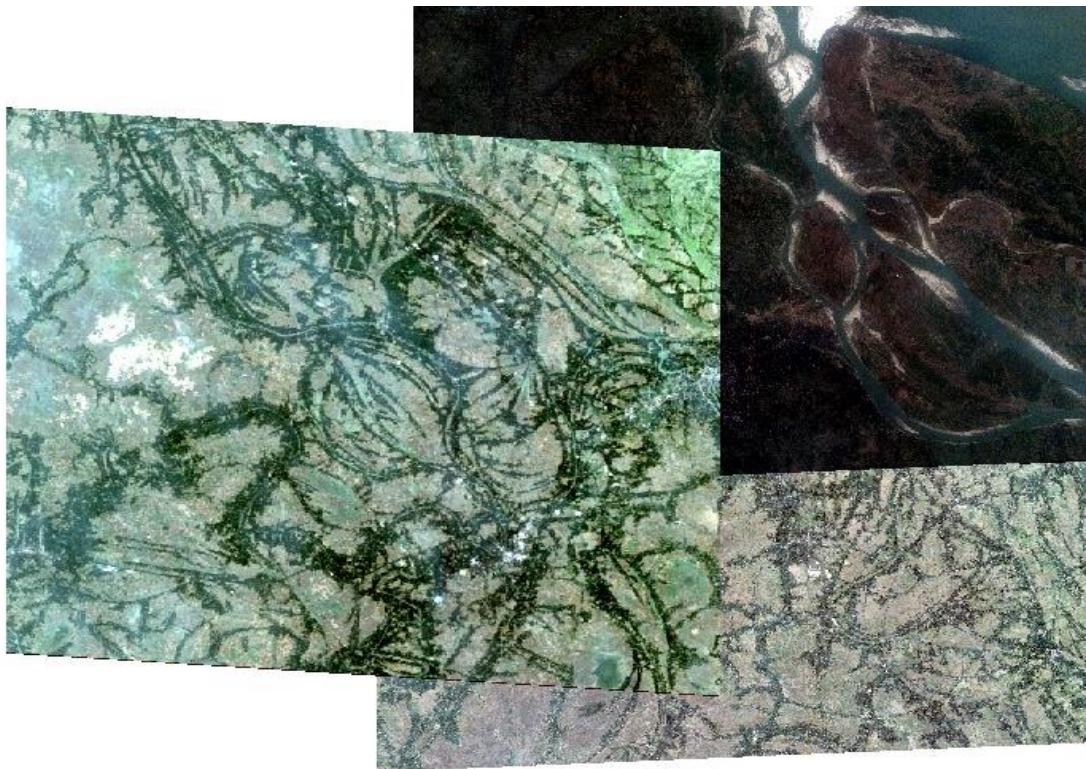
Figure-2.11: Tiles of satellite image without color and contrast balance
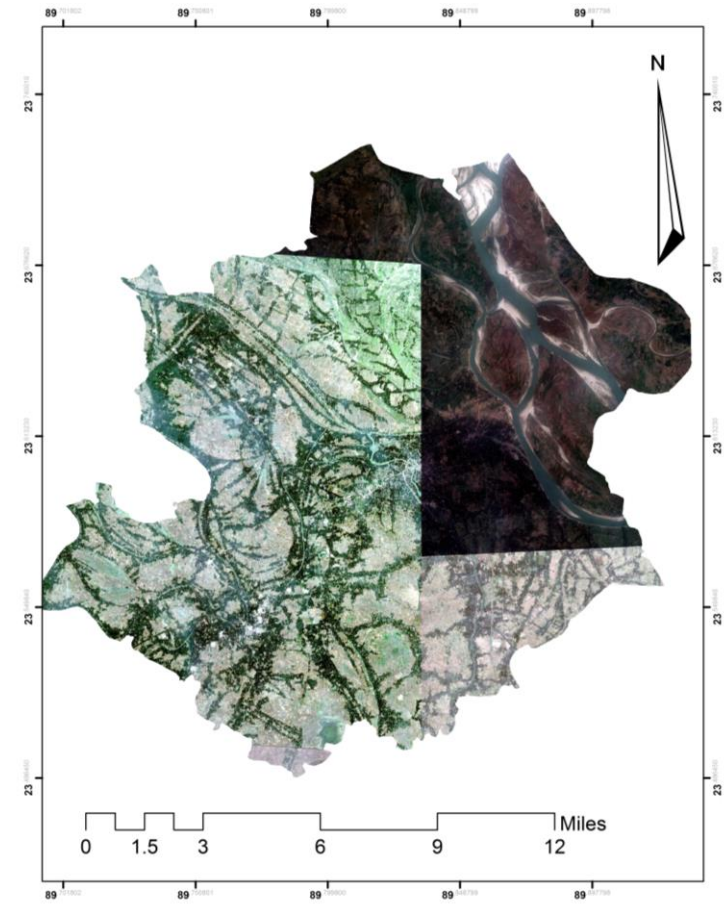
Figure-2.12: Merged satellite image with color and contrast balance

Figure-2.13: Satellite Image Multispectral Image 2.0 meter
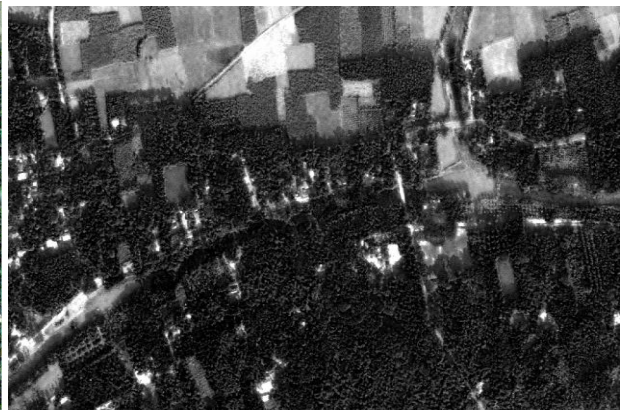
Figure-2.14: Satellite Image Panchromatic 0.5 meter

Figure-2.15: Pan-sharpen Image - multispectral 0.5 meter

2.4.3.1 Bit Rate, Pyramid and Epi-polar Correction

Bit Rate: In general practice 8 bit images are used. Satellite image can capture 11 bit image. Since the purchased satellite image is in 16bit, it has been changed the 16 bit to 8 bit for radio matric adjustment and better handling the image.

Pyramid: To efficiently view and pan the image, the pyramid of the image has been built. The DATEM Summit Evolution software has been used for image interpretation.

Epi-polar Correction: Epi-polar geometry is the geometry of stereo vision. When two cameras view a 3D scene from two distinct positions, there are a number of geometric relations between the 3D points and their projections onto the 2D images that lead to constraints between the image points. The 3D models have been created by using the Summit Evolution software.

2.4.4   GPS/INS Processing

Raw IMU (GPS/INS) data of image is processed and adjusted to accomplish Aerial Triangulation. In case of satellite image the RPC file is replaced the GPS/INS file.

2.4.5   Aerial Triangulation

Aerial Triangulation is a mathematical process used to determine the position and orientation of each photograph at the moment of exposure.

Table-2.8: Input-output in Aerial Triangulation

	Input for AT	Output of AT
(1)	IMU data	Geo-referenced Stereo Model
(2)	GPS (on board)	

(3)	GCP (collected from field)
(4)	Image
(5)	RPC file

The GCP and BM collected from SOB have been used for correcting the 3D satellite image coordinate using Inpho Match-AT software.

2.4.6 Digital Mapping (Feature Extraction) from Stereo Model

After the orientation of stereo models, digital mapping has been carried out. ArcGIS Geo-database model has been used for storing geo-spatial data. The Geo-database and its feature classes has been designed based on ToR.

Digital Photogrammetric Workstation (DPW) has been used as the platform for acquiring features from digital stereo images (model).

Feature registration has been done considering and measuring the position of the object under its accuracy level. The Summit Evolution & Stereo Plotter of DAT/EM has been used for identifying and registration of the objects and ArcGIS 9.3 of ESRI has been used for vector data storing and editing.

Plate-5: Digital Photogrammetric Workstation (DPW)
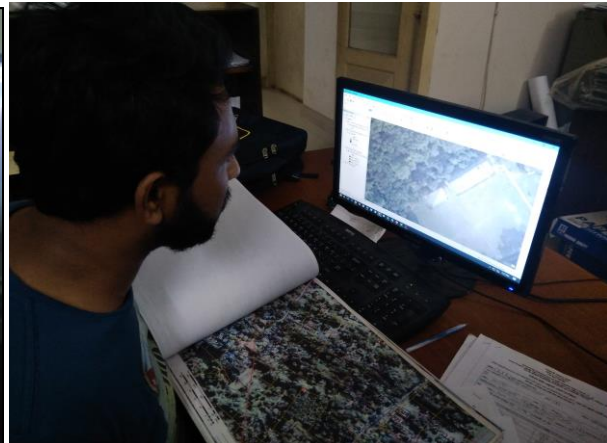
Plate-6: Photogrammetrist Extracting Features in DPW

Figure-2.16 and **Figure-2.17** shows the extracted features of Faridpur Sadar Upazila at a glance.

Figure-2.16: Extracted Features of Entire Faridpur Sadar Upazila by Photogrammetry
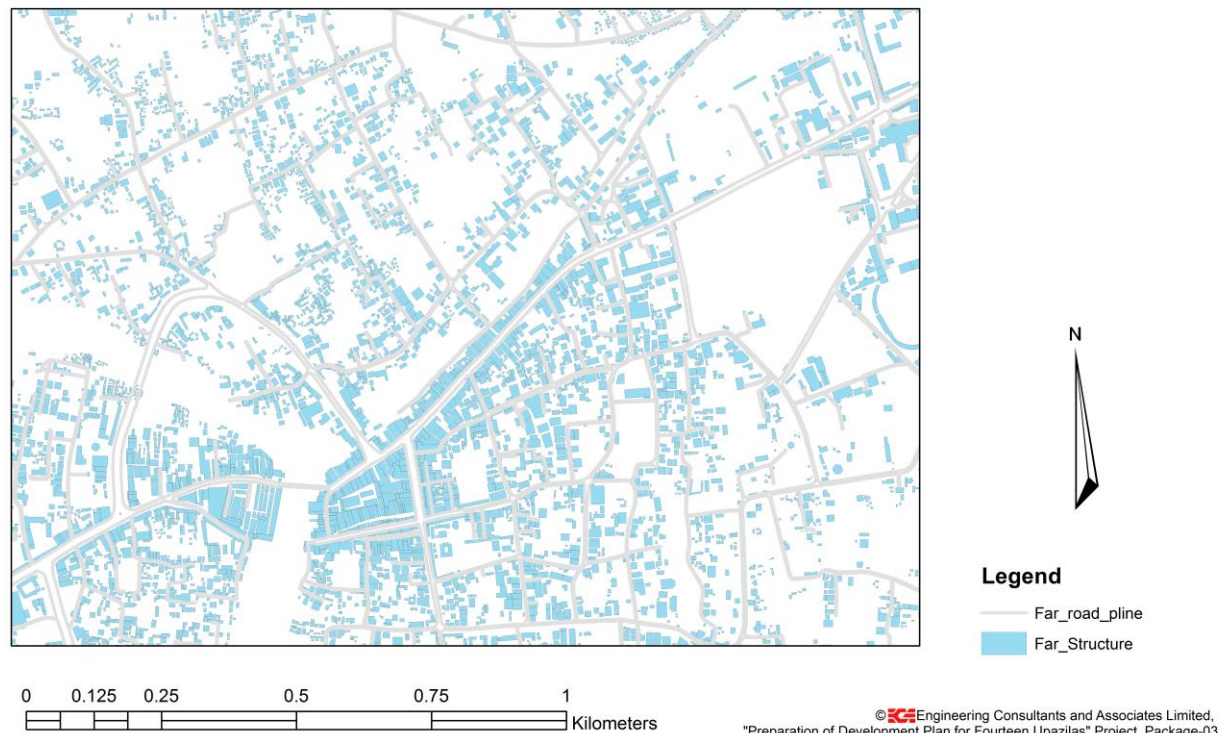
Figure 2.17: Enlarged Partial View of Extracted Features of Faridpur Sadar

For spot heights acquisition, firstly the DTM points have been generated automatically from stereo pair images by the software. Spot heights or land levels are extracted as DTM points at 10 m intervals for urban area and 20 m intervals for rural areas as described in the TOR. These automatically generated points have been then checked and edited by comparing them with stereo model in photogrammetric workstations. **Figure 2.18** shows the Digital Elevation Model of Faridpur Paurashava of Faridpur Sadar Upazila. **Figure 2.19** shows the Contour Lines partially of Faridpur paurashava of Faridpur Sadar Upazila.

The Break-lines have been created and edited after extraction of DTM Points.

The DTM Points and the Break-lines has been used later to create Triangulated Irregular Network (TIN), Digital Elevation Model (DEM) and the Contour Lines which is described in the Topographic Survey Report.
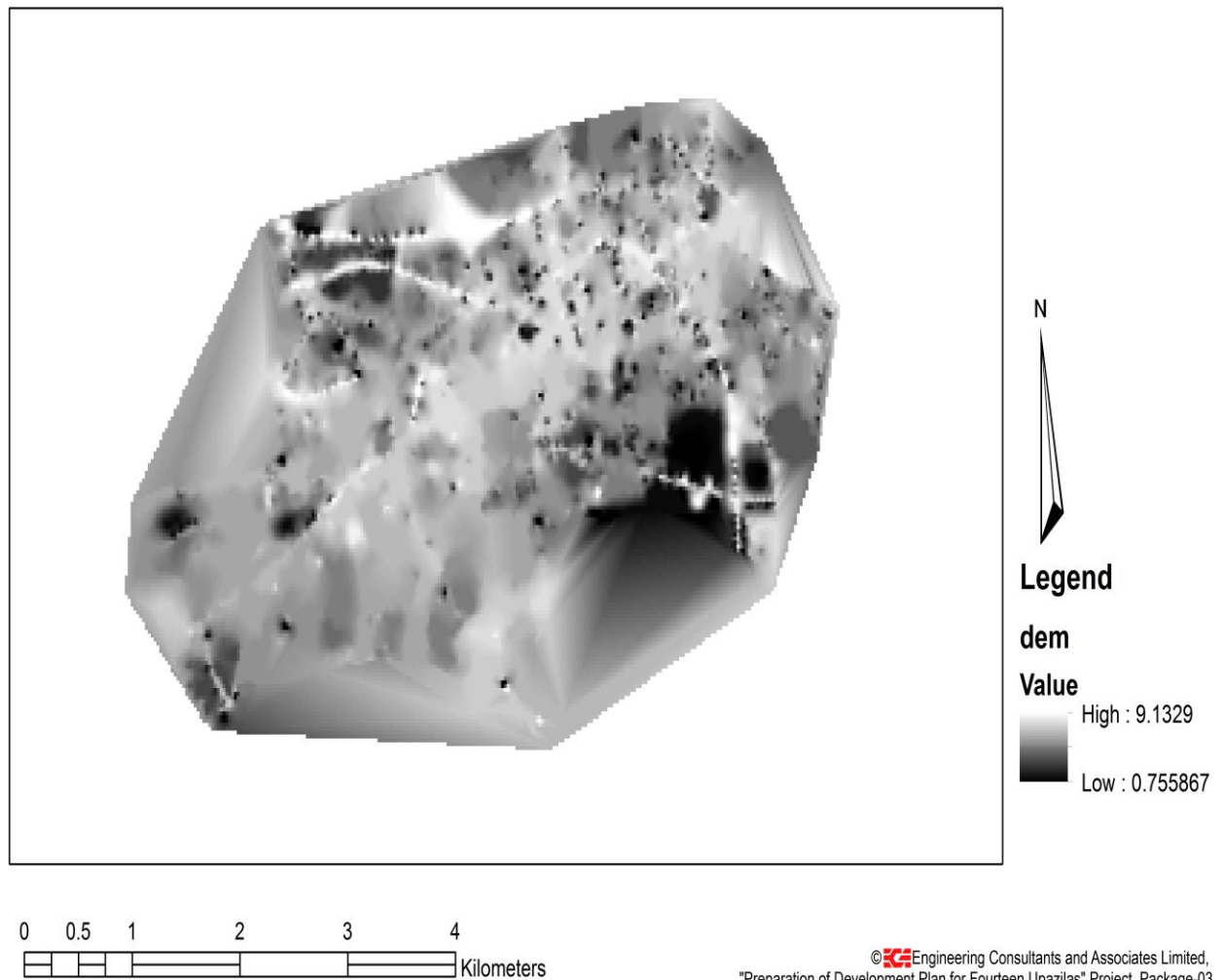
Figure-2.18: Digital Elevation Map (DEM) of Faridpur Sadar Paurashava (Partial)
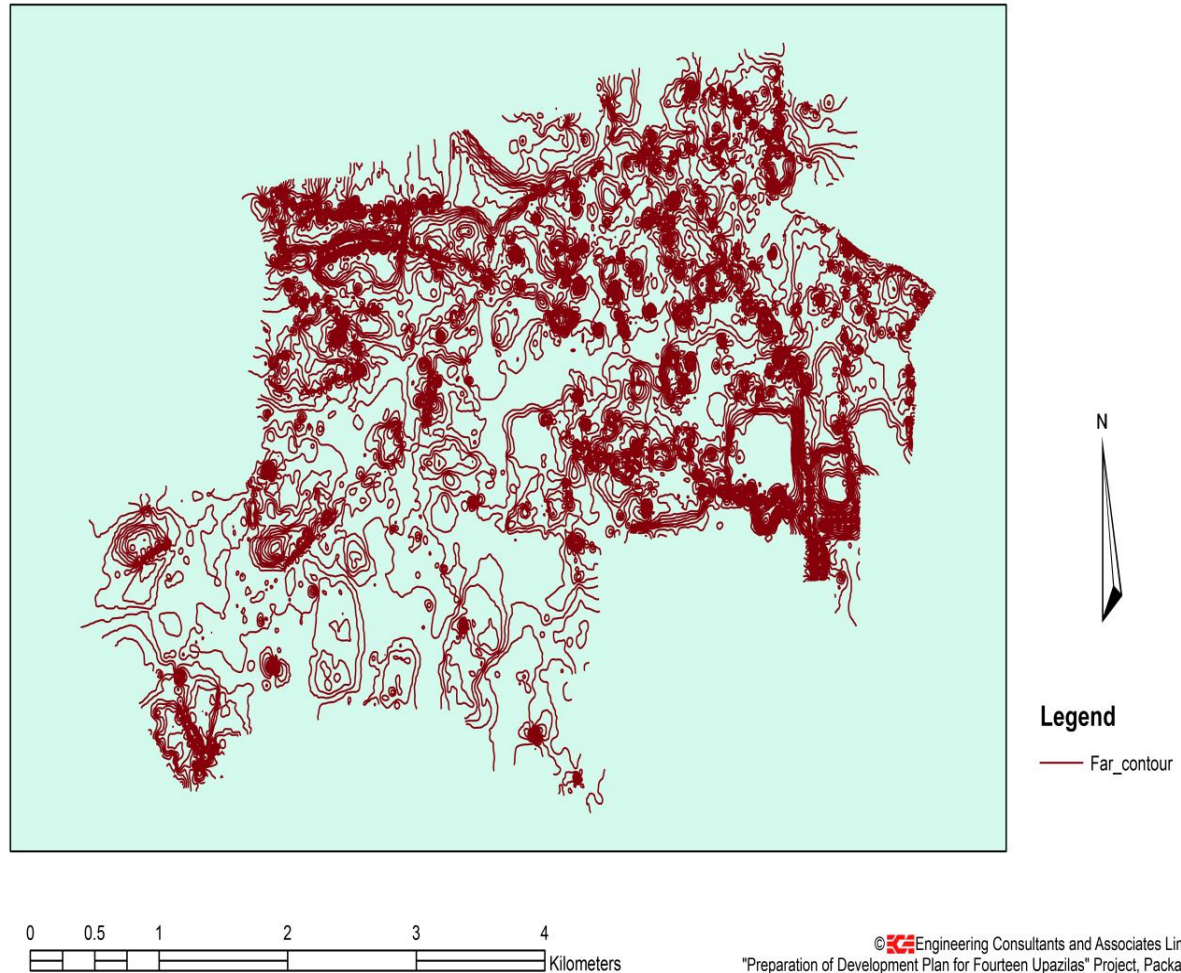
Figure-2.19: Contour Lines of Faridpur Sadar Paurashava (Partial)

2.4.7   Generation of Ortho-rectified Image

An ortho-rectified image or ortho-photo is an image which has been "corrected" for the geometric distortions (different projection, lens/sensor distortion, relief) so that it can be used as a map.

Using the DEM of the Upazila, the Ortho-rectified image has been created using photogrammetric software. Figure-2.20 shows a part ortho-rectified satellite image of Faridpur Sadar Upazila.
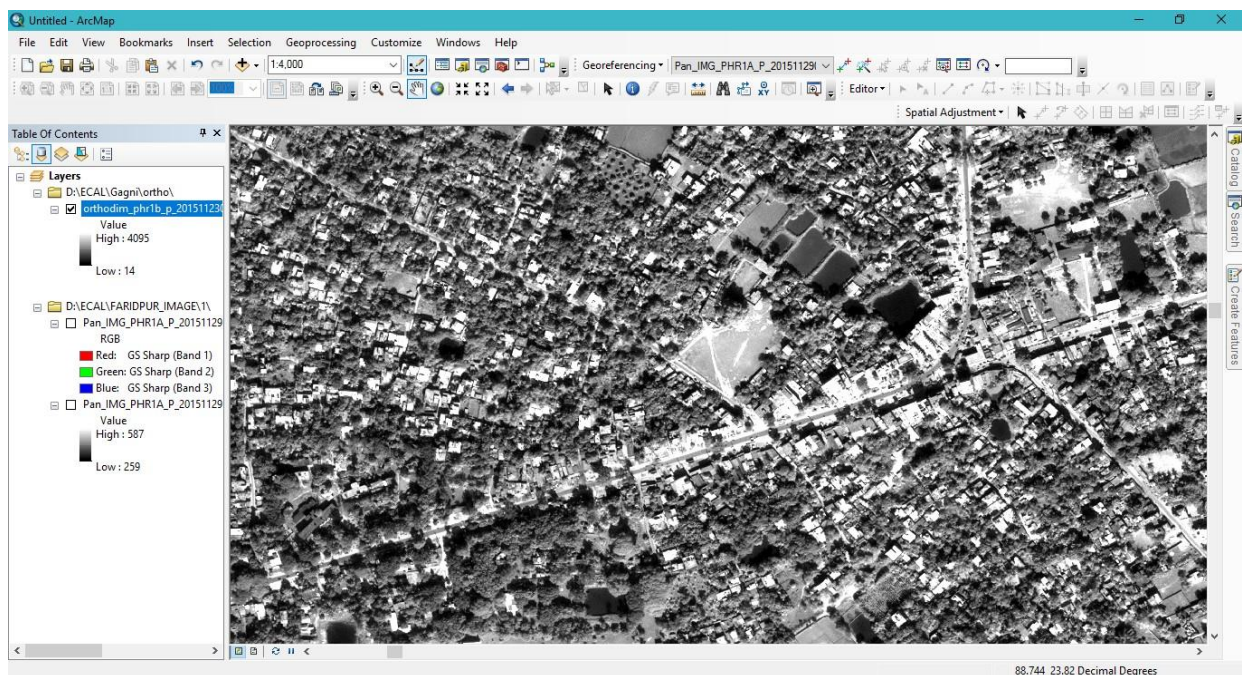
Figure 2.20: Ortho-Rectified Image of Faridpur Sadar Upazila (Partial)

Chapter Three: Physical Feature Survey

3.1   Field Level Data Acquisition

The portion contains the survey findings of physical feature survey consisting of all existing structures according to their floor height, structure type as well as uses like residential, commercial activities, industrial activities, educational facilities, health facilities, administrative uses, recreational facilities, religious facilities etc. Moreover it contains the findings of all types of road, bridge/culverts, dyke/embankment, drain/canal, sewer system, solid waste management, water supply system, utility services etc.

3.1.1   Mobilization of Survey Team

A dynamic and qualified survey team experienced with the GPS and Satellite Image based advance technology was mobilized to carry out physical feature survey, landuse survey and topographic survey. The composition of survey team with their qualification is given **Table-3.1**:

Table 3.1: Composition of Survey Team

Field of Expertise	Qualification	No. of Expert/ Technical Staff
Survey Expert	Bachelor of Urban & Regional Planning (BURP)	1
Survey Supervisor	Diploma in Survey/Civil Engineering	3
Surveyor	Diploma in Survey/Civil Engineering	10
Surveyor	Diploma in Survey Engineering	10

For physical survey this survey team was divided into 7 groups (each group contains two surveyors) to collect all features i.e. structures, water bodies, roads, etc. with their attributes. All these groups were supervised by the Survey Expert and the Survey Supervisor.

3.1.2   Physical Feature Survey

The Physical Feature survey in Faridpur Sadar Upazila has been carried out using the survey base maps as described in previous chapter. Survey team equipped with GPS/Smart Phone, tape, color pen, map sheet, log book, etc. have gone to field and collected required information. A sample surveyed map sheet is shown in **Figure-3.1** and a sample page of log book with collected information is shown in **Figure-3.2**.

Figure-3.1: Sample Scanned Base Map for Physical Features and Land use Survey

The survey team has collected following information from field:

➢ Position, dimension and number of story of all structures
➢ Type of structures according to their construction (Pucca, semi-pucca, katcha).
➢ Type of structures according to their use (Residential, Commercial, Industrial, Mixed use, etc.)
➢ Bridge/Culverts, drain along with flow direction width and depth, location of deep tubes well, overhead water tank, electric substation, telephone exchange, Water Treatment plant, waste disposal facilities.

Plate-7: Surveyors Working on the Field in Faridpur Sadar

Figure-3.2: Sample Log Book Page with Information Recorded in Field

3.2 Survey Data Processing & Analysis

3.2.1 Processing of Spatial and Attribute Data

After completion of field survey, all type of spatial data is properly processed to obtain layers of physical features such as Structures, Roads, Water bodies, etc. All surveyed sheets are scanned and geo-referenced to superimpose on the satellite imagery. The surveyed features (structures, roads, water bodies, etc.) marked on the sheets were then digitized using the ArcGIS software and stored them layer by layer as per Technical Specifications on GIS Database.

Plate-8: Updating Works through GIS

After digitizing all surveyed features, editing and merging and has been done to get complete data sets of different layers of physical features.

The attribute data collected in the Log Book during the field survey have been entered in a relational database through Microsoft Access. The **Figure-3.3** shows the interface of Data Entry and **Figure-3.4** shows the tabular view of entered data in Microsoft Access.

Figure-3.3: Log Book Data Entry Interface in Microsoft Access Software

Figure-3.4: Tabular View of Log Book Data Entry in Microsoft Access Software

The data entry works have been checked and processed as usable format. These attribute data have been linked to spatial data of structures through GIS. Finally structures and all other physical data layers have been developed and finally transformed them in to Bangladesh Universal Transverse Mercator (BUTM2010) Coordinate System.

The processed data have been symbolized using different attribute to visualize the physical features of the project area. Sample processed data has been shown in **Map-3.1** and **Map-3.2.** A 3D display of physical features has been shown in **Figure-3.5**.

Map-3.1: Structure Use in Faridpur Sadar Town Area
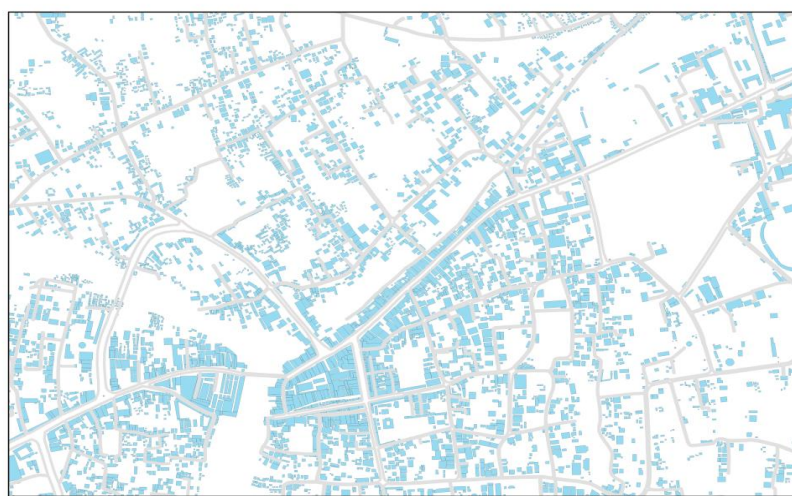
Figure-3.5: 3D Display of Physical Features in Faridpur Sadar Town Area

Physical Feature of Faridpur Paurashava
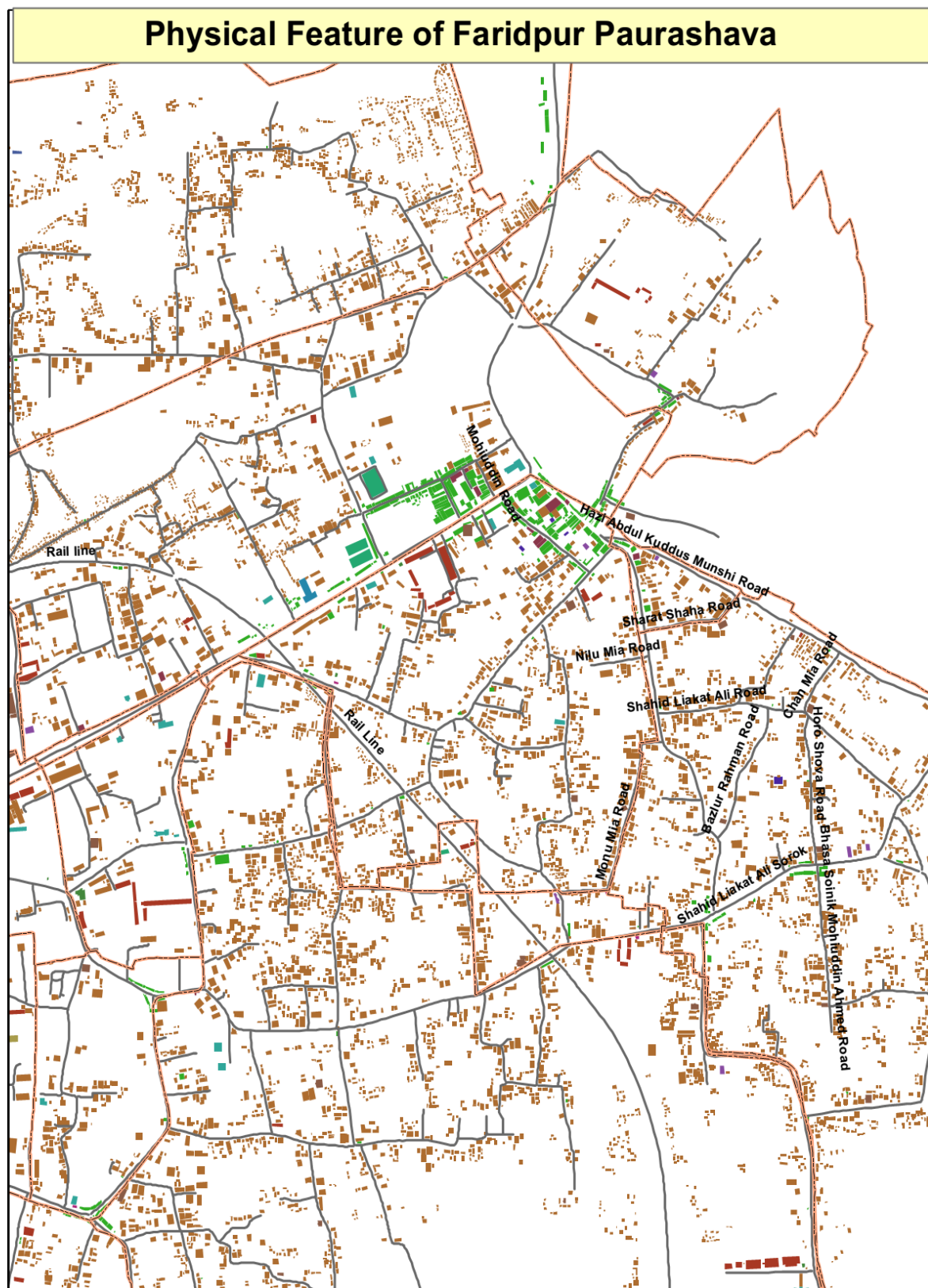
Map-3.2: Structure Type and Use in Faridpur Sadar Town Area

3.2.2 Development of GIS Database

A GIS database has been developed for systematically organizing, storing and easy retrieving the information and data of the project area. ArcGIS File Geo-database has developed this purpose, since File Geo-database offers structural, performance and data management advantages over Personal Geo-database or shape files. The geo-database contains all the layers generated from the Mouza maps, satellite images and field survey.
.
Specifications of these layers has been developed to standardize GIS data structure such as layer name, layer type, attribute types and attribute values, and provided in **Annexure-II**.

The **Figure-3.6** shows partial view of attribute table of Structures of Faridpur Sadar Upazila.

Figure-3.6: Attribute Table of Structure Database of Faridpur Sadar Upazila

The **Figure-3.7** shows partial view of attribute table of Road Centerline of Faridpur Sadar Upazila.

Figure-3.7: Attribute Table of Road Centerline of Faridpur Sadar Upazila

The **Figure-3.8** shows partial view of attribute table of Mouza Map of Faridpur Sadar Upazila.

Figure-3.8: Attribute Table of Mouza Map of Faridpur Sadar Upazila

The **Figure-3.9** shows partial view of Scanned Mouza Map Files of Faridpur Sadar Upazila.
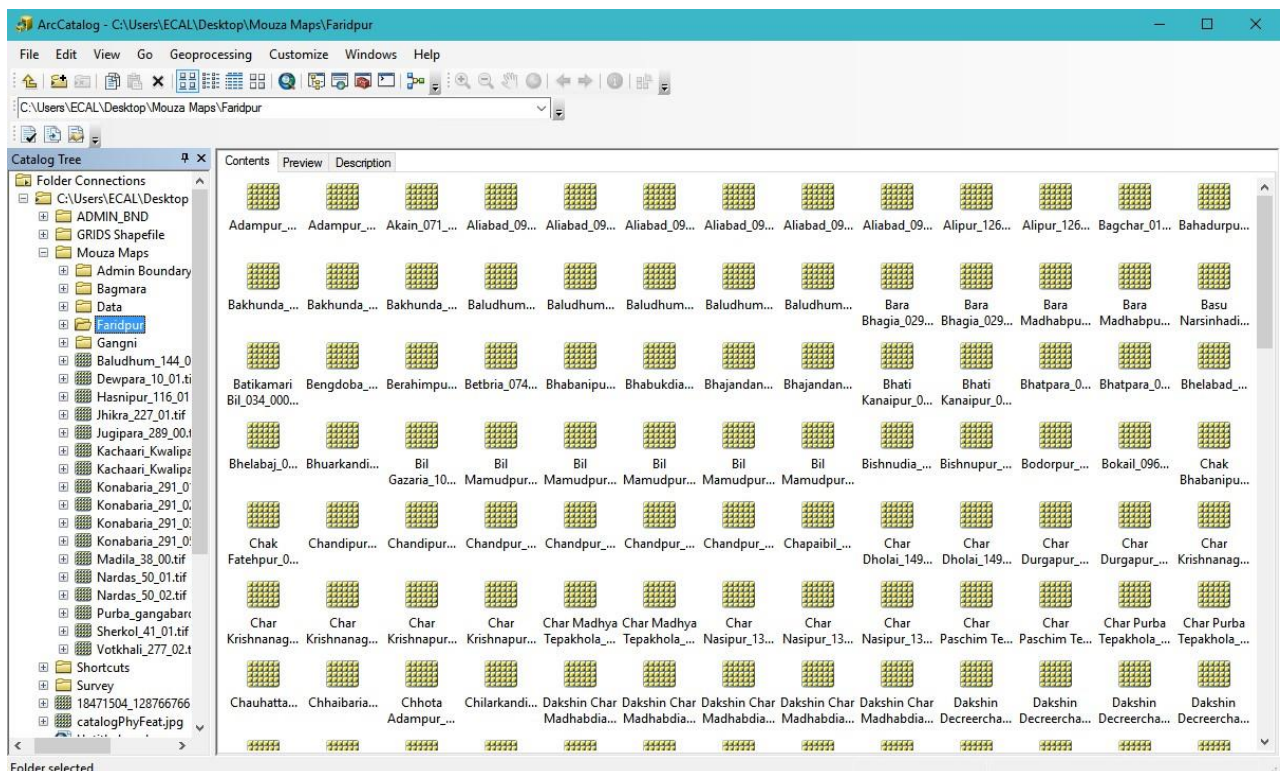
Figure-3.9: Catalog View of Scanned Mouza Map Files of Faridpur Sadar Upazila

The **Figure-3.10** shows partial view of Geodatabase of Digitized Mouza Maps Files of Faridpur Sadar Upazila.
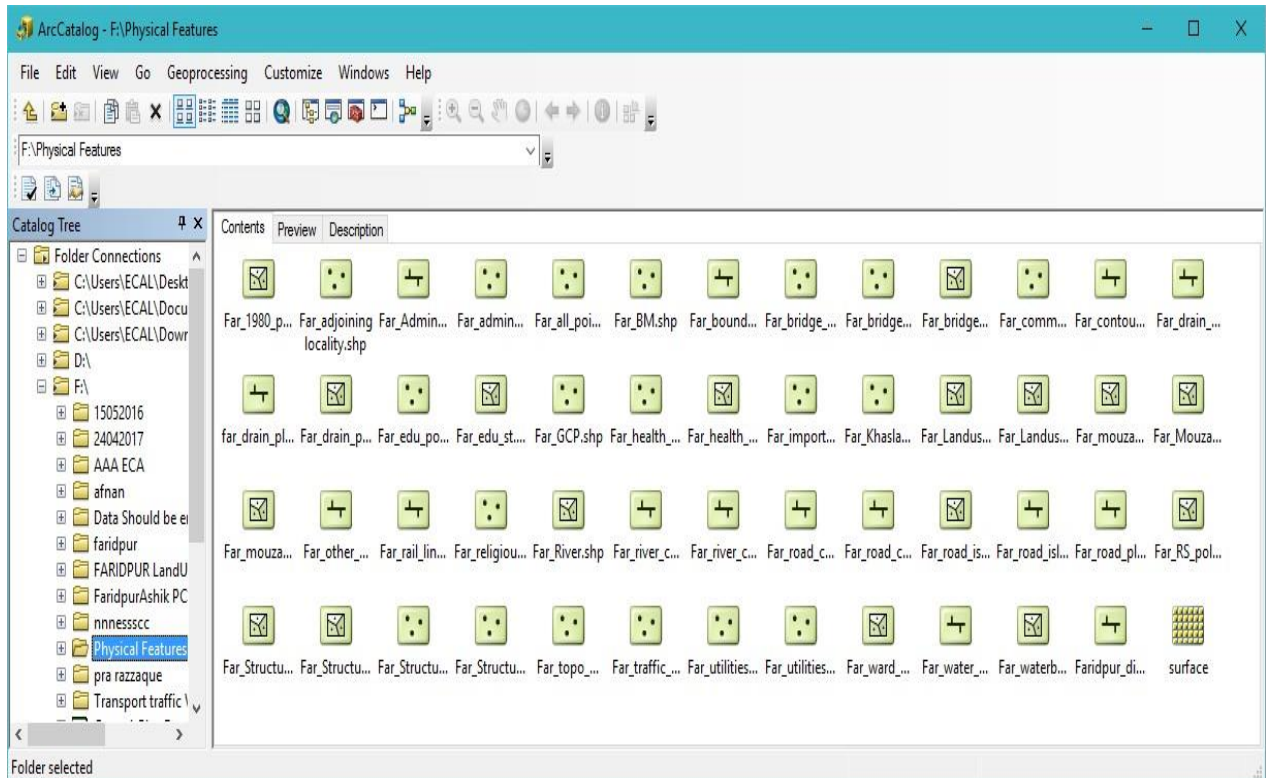
Figure-3.10: Catalog View of Geodatabases of Digitized Mouza Maps of Faridpur Sadar Upazila

3.2.3   Field Verification/Ground Truthing

After developing the GIS database and preparing the field checking map the accuracy of the physical feature database is checked by the UDD and the consulting firm jointly. From 17th august, 2016 the surveyors of UDD and consulting firm are visited the Faridpur Sadar upazila for field checking. Field checking is done by keeping focus on the following area:
- Dimension and shape of the features
- Accuracy of feature's attributes
- Missing objects.

Plate-9: Field Checking in Faridpur Sadar by UDD and Consulting Firm
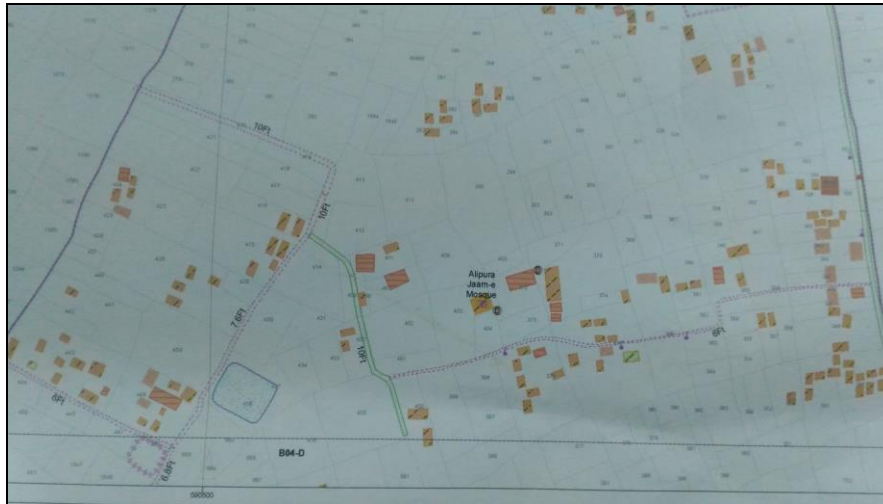
Plate-10: Physical Feature Map for Field Checking in Faridpur Sadar

3.2.4 Earthquake Vulnerability Assessment

Structural vulnerability assessment involves checking whether a building in a seismically active area has sufficient robustness to withstand a specific magnitude earthquake. This is done by analyzing the building structurally in terms of its design, construction and materials in terms of international standards and local building codes, as appropriate. Where buildings are found to be non-resistant or have insufficient resilience to an expected earthquake of a given magnitude (e.g. a 'design' earthquake) remedial measures can be designed and costed for subsequent retrofitting. In extreme cases, the buildings should be demolished and reconstructed.

For this vulnerability assessment some criteria of a structure have been assessed. Such as: Pounding effect, Tilting, ground setting, set back rules, Overhanging, Soft story, Short column etc. The survey has been done through the whole upazila and if any of the problems is found the data has been collected with pictures. Some example of data collection of vulnerability assessment is given below:

Plate-11: Vulnerability Assessment at Faridpur Sadar Upazila

Chapter Four: Land Use Survey

Land Use Survey is a major element in any planning endeavor. Thorough detail land use survey and collection of required information of the project area are needed that helps draw up the plan in a better way.

The Land use survey was carried out by recording the current use of the land in the study area. The current use of land was classified according to the provisions given in the TOR. Land use survey, basically, records the use of land by its functional activity such as residential, industrial, commercial etc. The maps prepared for physical survey were used as base map for land use survey. Land use features were identified and classified using the recorded code and separated in different layers during data processing stage, from where category wise land use map were drawn using the identification layers of each of the land uses features.

4.0   Field Level Data Acquisition

4.1.1   Mobilization of Survey Team

A dynamic and qualified survey team experienced with the GPS and Satellite Image based advance technology was mobilized to carry out land use survey and along with physical feature survey. The composition of survey team with their qualification is given below:

Table 4.1: Composition of Survey Team

Field of Expertise	Qualification	No. of Expert/ Technical Staff
Survey Expert	Bachelor of Urban & Regional Planning (BURP)	1
Survey Supervisor	Diploma in Survey/Civil Engineering	1
Surveyor	Diploma in Survey/Civil Engineering	12
Surveyor	Diploma in Survey Engineering	10

For Land use survey, this survey team was divided into 7 groups (each group contains two surveyors) to collect land use boundary and all physical features i.e. structures, water bodies, roads, etc. with their attributes. All these groups were supervised by the Survey Expert and the Survey Supervisor.

4.1.2   Land Use Survey

The Land use survey has been carried out by recording the current use of the land in the study area. The current use of land has been classified according to provision given in the TOR. Land use survey basically records the use of land by its functional activity such as residential, industrial or commercial. The maps prepared through physical survey have been used as base map for land use survey. Land use features were identified and classified using the recorded code and drawing the boundaries using different color pencils (Figure 4.1). The following color code has been applied in field work of land use map. The Figure 4.2 shows the land use base map after survey.

Figure 4.1: Color used by Color pencil for Land Use Demarcation

Figure 4.2: Landuse Base Map used in Faridpur Sadar Upazila

The methodology and technique followed are as follows:

- ➢ Checking every plot of land and demarking unique uses with color pencils
- ➢ Checking building and other structure and its current use.
- ➢ Checking infrastructure provisions
  - ✓ Social infrastructure e.g. school, hospital, etc. with location
  - ✓ Physical infrastructure e.g. housing, offices, energy, work, sanitation etc.
  - ✓ Transportation with width of roads with and without drainage links with other areas etc.
- ➢ Recording of natural physical conditions of the land like: rivers, drainage, canals etc.
- ➢ Review of topography of the area from the Topographic Maps.

4.2 Survey Data Processing & Analysis

4.2.1 Processing of Land Use Data

During data processing stage, all type of land use data has been properly processed to obtain the unique land uses. Firstly, survey map sheets have been scanned and geo-referenced, then land use boundary have been digitized with their attributes. On the other hand, physical feature data has been used to identify land use boundaries and categorize then into respective land use categories. The surveyed physical features (structures, roads, water bodies, etc. and land use boundaries, etc.) marked on the sheets were then digitized using the ArcGIS software.
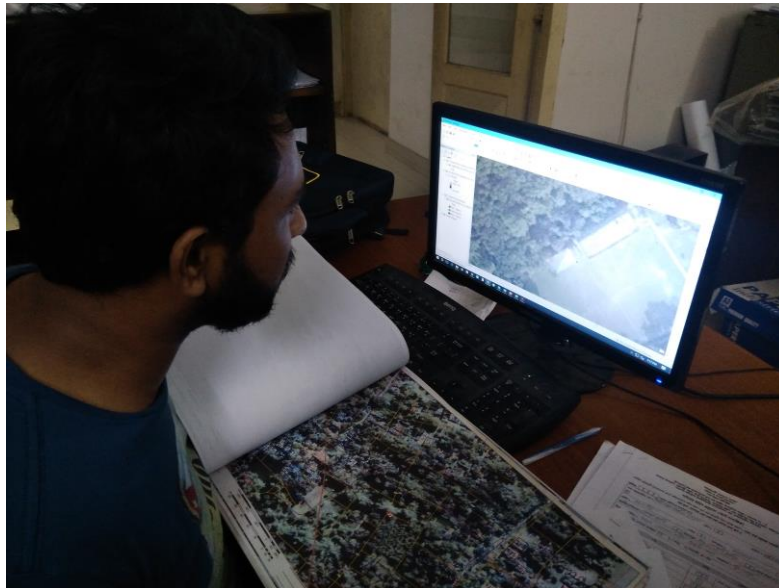
Plate-12: Updating works using Surveyed Map

4.2.2 Preparation of Land Use Map

Utilizing the land use and physical feature base map the land use maps were prepared showing the broad categories of land use. The characteristics of each land use area have fully been described in the survey report. The Land Use Maps were prepared at specified scale based on the data collected through land use survey and the information of the base map.

Details about land use have been provided in Table 4.2 and generalized land use pattern of Faridpur Sadar town area has been presented in Map-4.1.

Legend

- Agriculture
- Brick Field
- Bus Stand
- Commercial Activities
- Education and Research
- Government Office
- Graveyard
- Health Facilities
- Industrial Activities
- Mixed Use
- Non-government Office
- Open Space
- Recreational Facilities
- Religious Facilities
- Residential & Homestead
- Restricted
- Road
- Transport
- Warehouse
- Waterbody

0   0.5   1   2   3   4   Kilometers

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"Preparation of Development Plan for Fourteen Upazilas" Project, Package-03

Map-4.1: Land Use in Faridpur Sadar Town Area

Table 4.2: Land Use Categories

Sl. No.	Land uses	Illustrated
1.	**Urban Residential Zone**	Planned Residential Area, Govt. Quarters, Private Housing, Rest/Guest/Circuit House, Banglow, Mess, Orphanage/Old Home, Rural Homestead, Slum, Squatters. House type Pacca, Semi-pacca, Katcaha and Tin Shed are also enlisted at urban residential zone.
2.	**Rural Settlement**	Rural settlement includes the low dense residential area which is scattered and rural in nature. It may permit only low density uses. Aiming to control the growth in this zone, less service and facilities will be provided.
3.	**Commercial Zone**	Residential Hotel/ Hotel & Restaurant, Wholesale Rice Market, Wholesale, Vegetables Market, Wholesale Fish Market, Wholesale Paper Market, Wholesale Grocery Goods Market, Wholesale Fruit Market, Book Stall, Cloths Shop, Paper & Magazine, Stationery Shop, Shoe Shop, Bag & Leather Goods, Cosmetics, Spectacles, Electronic Goods, Audio Video Cassette, Utensils/Crockery, Sports Goods, Computer Goods, Motor Car Parts, Jewelry shops, Show Room, Furniture Shop, Department Store, Mobile Sales Center, Hardware Goods, Sweet Shop, Bakery Shop, Gift Shop, Press & Printing, Grocery Shop, Gun Shop, Iron & Steel Shops, Shopping Center/Mall, Shopping Mall, Super Market, Rubber Stamps, Phone-Fax-Photocopy, Cycle Store, Studio/Colour Lab, Drug/Pharmacy, Pottery shop, Electronics, Sports and Athletics, Kitchen Market, Katcha Bazar, Beauty Parlor/Hair dresser, Govt. Food Godown, Cold Storage, Others Godown. Growth centers, Small Bazar, Watehouses are also enlisted under commercial zone.
4.	**Mixed Use Zone**	Commercial – Residential, Office – Residential, Commercial – Industrial, Two or More categories more use.
5.	**General Industrial Zone**	Green and Orange, A categories as per The Environment Conservation Rules, 1997
6.	**Heavy Industrial Zone**	Other toxic and pollution industries (Orange B and Red categories as per the Environment Conservation Rules, 1997)
7.	**Government Services/ Administrative**	Deputy Commissioner's Office, Zila Parishad Office, SP Office/Police Headquarter, Civil Surgeon Office, LGED Office, Upazila Headquarter, Paurashava Office, Union Parishad Office, Settlement Office, Post office, Bank, Public Works Department Office, R&H Office, DPHE Office, Police Station, Ansar Camp, Jailkhana, Statistical Bureau Office, PDB Office, BWDB Office, DoE Office, All types of Government Office, Private Bank/ Insurance Company, Mercantile & Cooperatives, Money Exchange Center, Private company/Different types of NGO/CBO/Club, Construction Office, Commercial Group Office, Trading Corporation Office, Security Service Office, Law Chamber, Doctor's Chamber, Political Party Office, Professional's Association, Labor Union. Upazila Hearquarter, AC (Land) office can also mark as government services.
8.	**Non-Government Services**	Other office/service area which are not included in government services.
9.	**Educational and Research Zone**	Kindergarten and Nursery, Primary School, High School, College, Public University, Private University, Public Medical College, Private Medical College, Homeopathic Medical College, Engineering College/University, Law College, Social Research, Health Research, Economic Research, Vocational Training Institute, Physical Training Institute, Nursing

Sl. No.	Land uses	Illustrated
		Training Institute, Teachers Training College, Computer Training Institute, Dakhil Madrasa, Alim Madrasa, Fazil Madrasa, Kamil Madrasa, Hafezia Madrasa, Tutorial/ Coaching Center, Government Training Institute, Library, Museum, Social Welfare Institution, Kindergarten, University and Madrasas.
10.	Agricultural Zone	Single crop land, Double crop land, Triple crop land, Barren land, Mangogarden/Litchi/Jackfruit/Banana/Lemon/others, fruits garden etc., Different types of flower garden, Tree cultivation, Hatchery/Gher, Livestock / Poultry Farm / Diary Farm, Agricultural Research Area.
11.	Water body	Equal or more than 0.25 acre and justification by the consultant and wel land will merge with water body. Pond, Beels/Marshlands, /Lake/Ditch, Lakes, River, Khals, Streams, Drain.
12.	Open Space	Playground, Park, Botanical Garden, Stadium, Zoo etc. (Facilities without or with minimum building structure)
13.	Vacant Land	Barren Land, Char Land, Gravel Pits, Low Laying Area, Sand Quarries.
14.	Recreational Facilities	Facilities other than those mentioned to Open Space and indoor based facilities with designated building structure such as: Cinema Hall, Theater Hall, Museum & Art gallery, Auditorium /Community Center/Town Hall, Park/Playground/Amusement Park/Theme Park, Stadium/ Gymnasium/ Swimming Pool, Tennis Complex.
15.	Circular Network	All areas covered by the roads and rail ways (Broad/Meter Gauge) network. Bridge, Culvert, Foot over Bridge, Railway Bridge.
16.	Transport Facilities and Communication	Under transport and communication land use, both transport and communication services are considered. This category includes Roads, Airport, Helicopter Station, Rail Station, Bus/Truck Terminal/Stand, Boat/Ferry Ghat, Refueling Filing Station, Garage, Launch Terminals, Passenger Shed, Telephone Exchange, Ticket counter, Road Island, Footpath, Transport office, post office/Post Box, River Port, Traffic Signal Port etc.
17.	Utility Services	Utility services include Overhead Tank, Power Office/Control Room, Public Toilet, Sewerage Office, Waste Disposal, Water Pump House, Water Reservoir, Drainage and Sewerage System, Water/Sewerage Supply Line, Water Treatment Plant etc.
18.	Health Services/ Facilities	Govt. Hospital / Pvt Hospital / Mental Hospital/ Maternity/ Children Hospital / Clinic/ Diagnostic Center, Clinic, Community Hospital and Veterinary Hospital.
19.	Community Facilities/ Services	Community Center, Social Club, Slaughter House, Monument, Graveyard, Crematorium, Cemetery, Eidgah, Shahid Minar etc. which will provide service to the community.
20.	Religious Area/ Facilities	Mosque, Eidgah/Mazar/Dargha, Madrasha, Temple, Church, Pagoda, Graveyard, Cemetery, Cremation place.
21.	Historical and Heritage Site	The entire mentionable historical and heritage site.
22.	Restricted Area/ Facilities	A Restricted Area is an area where no one but certain people can enter. Here, the areas which are not accessible for the general public except some high ranked personnel are considered as restricted area. Cantonment/BDR/Navy, Reserved Forest, TV Station, Radio Station, T&T Board, Power Supply Station.
23.	Forest/ Groups of Trees	Designated Forest area or Forest land.
24.	Beach	Sea Beach
25.	Hilly Area/	Designated Hilly Area with Tilla.

Sl. No.	Land uses	Illustrated
	Hillock	
26.	**Miscellaneous**	Any other categories which are not related to above categories. EPZ, BM, Growth Centre, Fire Service, Garland, Brick Field, Drainage Outfall, Embankment, River cum embankment, Char, Coastline, Flood Wall, Slum.

The Legend for Existing Generalized Land use is shown in Figure-4.3.

Legend

Land Use

Urban Residential Zone		Rural Settlement	
Commercial Zone		Mixed Use	
Heavy Industrial Zone		General Industrial Zone	
Administrative/Government Services		Non-Government Services	
Agricultural Zone		Educational & Research	
Water Body		Open Space	
Vacant Land		Recreational Facilities	
Circular Network		Transportation Facilities and Communication	
Utility Services		Health Facilities	
Community Service		Religious Area	
Historical and Heritage Site		Restricted Area	
Forest Area		Hill / Hillock	
Beach		Miscellaneous	

Figure-4.3: Legend for Existing Generalized Landuse

🟢	Growth Center	�🠉	Telephone Pole	
◎	Small Bazar	⚲	Light Post	
Ⓚ	Kindergarten	⊠	High-Volt Electric Tower	
Ⓟ	Primary School	⛨	Tele-Communication Tower	
Ⓢ	School (Secondary/NGO/Others)	🏢	Market/Shopping Complex	
Ⓒ	College	⩗	Dustbin	
Ⓤ	University	🕮	Post Office/Post Box	
Ⓜ	Madrasa	Ⓓ	Shallow or Deep Tube-Well/ Water Pump House	
🏛	Museum			
🏠	Cinema Hall/Auditorium/ Theater Hall	🛈	Passenger shade	
✈	Monument/Shahid Miner	⟆⟆	Bridge	
🕌	Mosque/Mazar/Dargah	✕	Culvert	
🔔	Temple/Church/Pagoda	╫	Foot-over Bridge	
🏠	Historic Sites	✖	Railway Bridge	
┦	Electric Pole	╫	Railway Over Bridge	
■	Bench Mark (BM)	⊠	Sluice Gate	
◨	District Headquarter (DC Office)	🅵	Refueling Station	
⊙	Upazila Headquarter	◉	Power Plant/ Electric Sub-Station	
⬟	Pourashava Office			
▲	Union Parishad Office	🚒	Fire Service	
◉	Godown	🄻	Public Library	
▣	Bank	🛡	Police Box	
Ⓑ	Brickfield	◆	Industry	
🟢	Drainage Outfall	⚓	Boat Ghat	
🚍	Railway Station	⚓	Ferry Ghat/Landing/ Launch Terminal/River Port	
🚁	Helipad	🚌	Bus/Truck Terminal	

Figure-4.4: Legend for Existing Important Point Feature

Table- 4.3: Generalize Land Use Information of the Project Area (The table below is for Faridpur Sadar Paurashava)

Sl	LANDUSE	Area (Acre)
1	Administrative	10.917
2	Agricultural Area	2349.25
3	Commercial Area	35.69
4	Community Service	4.64
5	Educational & Research	25.12
6	Graveyard	3.5
7	Health Facilities	2.873
8	Industrial Area	4.63
9	Miscellaneous	8.52
10	Mixed Use	11.32
11	Recreational	1.40
12	Religious Area	9.27
13	Residential Area	6.3.67
14	Transportation and Communication	51.88
15	Water Body	213.79

Chapter Five: Topographic Survey

Topography is the study of the shape and features of the surface of the Earth and other observable objects. The topography of an area could refer to the surface shapes and features themselves or a description, specially their depiction in maps. Topographic surveys are carried out to identify and map the contours of the ground and features on the surface or slightly above or below the surface of the earth. Contours are imaginary lines that connect locations of similar elevation. A topographic map is a detailed and accurate two-dimensional representation of natural and human-made features on the Earth's surface. These maps are used for a number of applications like land use planning, resource management, , urban planning etc.

Topographic survey is a very important survey as it shows the suitable land for future development. Topographic Survey means measuring the surface of the earth of any area with standard known coordinates of X, Y, and Z value.

5.1 Field Level Data Acquisition

5.1.1 Mobilization of Survey Team

A dynamic and qualified survey team experienced with the GPS and Satellite Image based advance technology was mobilized to carry out land use survey and along with physical feature survey. The composition of survey team with their qualification is given below:

Table 5.1: Composition of Survey Team

Field of Expertise	Qualification	No. of Expert/ Technical Staff
Survey Expert	Bachelor of Urban & Regional Planning (BURP)	1
Survey Supervisor	Diploma in Survey/Civil Engineering	3
Surveyor	Diploma in Survey/Civil Engineering	10
Surveyor	Diploma in Survey Engineering	10

For Topographic survey, the survey team was divided into 7 groups (each group contains two surveyors) to collect topographic features which could not be collected through photogrammetry due to dense vegetation, clouds, etc. All these groups were supervised by the Survey Expert and the Survey Supervisor

5.1.2 Topographic Survey

The topographic survey of whole project area is inconvenient for direct ground surveying using RTK-GPS and Total Stations within a survey season. Hence, the Consultant adopted the photogrammetric surveying by which topographic data have been extracted from the 3D imagery (stereo imagery) of the project area.

In Photogrammetric Surveying, all topographic features are recorded in three dimensions (x, y, z coordinates) and topography is described by using mass points (spot levels) and break-lines (to describe a change of slope). Spot heights or land levels are extracted as DTM points at 10 m intervals for urban area and 20 m intervals for rural areas as described in the TOR. This data, together with 3D features (road edges, bank of river and other water bodies, etc), are used as break-lines to make Digital Terrain Models (DTMs), Digital Elevation Model (DEM), Triangulated Irregular Network (TIN), and the Contours.

In the densely vegetated area and clouded area RTK-GPS and Total Stations are used mainly to obtain 3-D data (X,Y, Z value) for enriching the photogrammetric data of roads, flood embankments and other drainage divides, drainage and irrigation channels. The Survey team carried out the survey to collect topographic features as much as possible using survey equipment and the satellite image based map sheets. The surveyors collected the following features from the field:

➢ Alignment of rivers, lake, canal and drainage channels etc. showing depth and direction of flow.
➢ Alignment of roads, embankments, dykes and other drainage divides.
➢ Outline of bazaars, water body, swamps, barren land, low land, borrow pits, forest, open space, restricted area, etc.

5.2 Data Processing & Analysis

5.2.1 Processing of Topographic Data

Using the photogrammetric data of DTM Points and the Break-lines Triangulated Irregular Network (TIN) and the Digital Elevation Model (DEM) has been generated. From these derived data the contour lines have been generated with 0.3 meter interval using ArcGIS software. **Map-5.1** shows the DEM of of Faridpur Sadar paurashava of Faridpur Sadar Upazila and the **Map-5.2** shows the Contour Lines partially of Faridpur Sadar Paurashava of Faridpur Sadar Upazila.

5.2.2 General Topography of Faridpur Sadar Upazila

Almost the whole of the Faridpur a number of small rivers and channels is uniform level. The general topography of the study area is ranges from **0.3 to 9.31** meter MSL.

Table 5.2: General Height Information

Total Project Area	Maximum Height (Meter)	Average Height (Meter)	Minimum Height (Meter)
407.02 sq.km	9.31	5.96	0.3

Map-5.1: Digital Elevation Model of Faridpur Sadar Upazila

0   0.5   1   2   3   4
Kilometers

© Engineering Consultants and Associates Limited,
"Preparation of Development Plan for Fourteen Upazilas" Project, Package-03
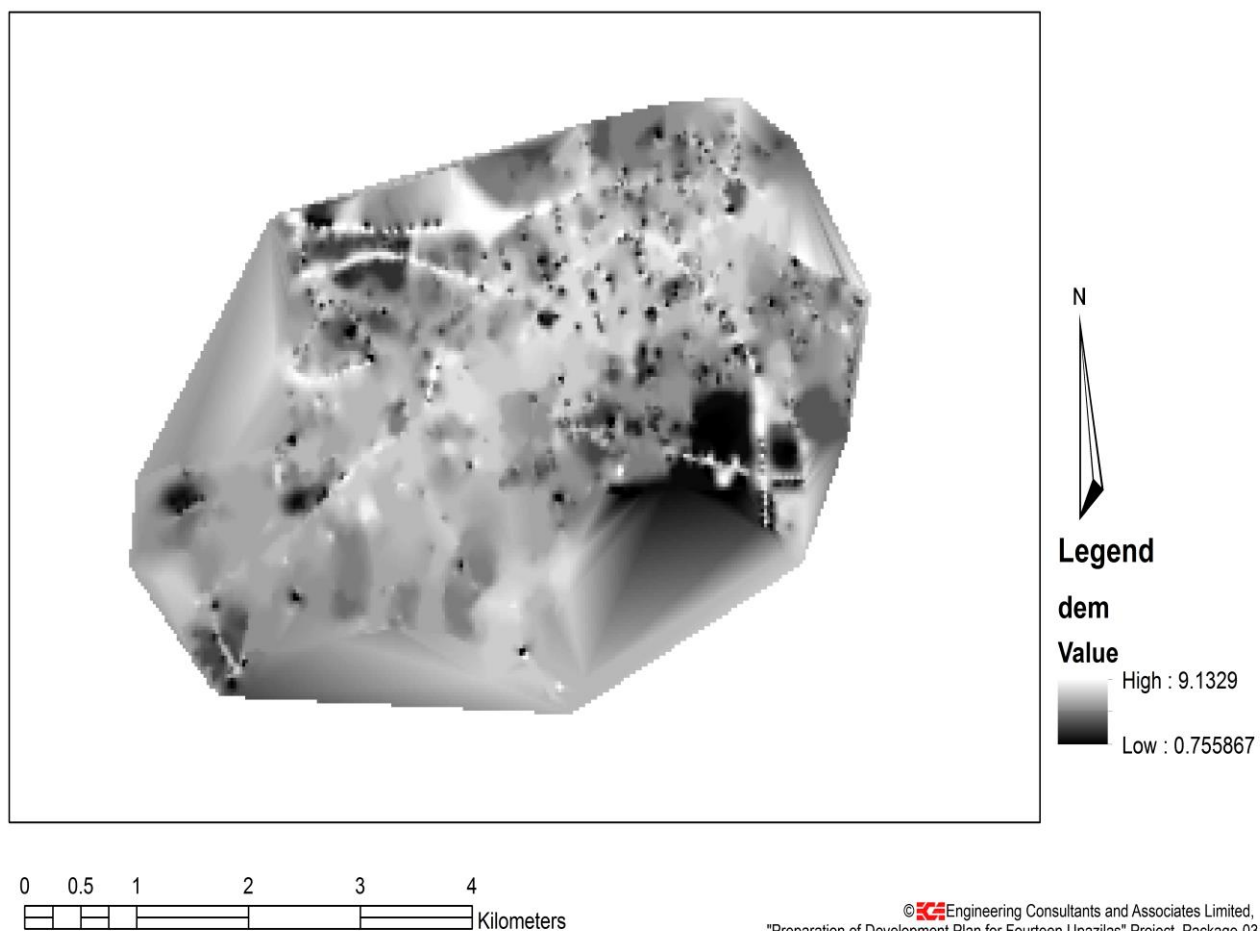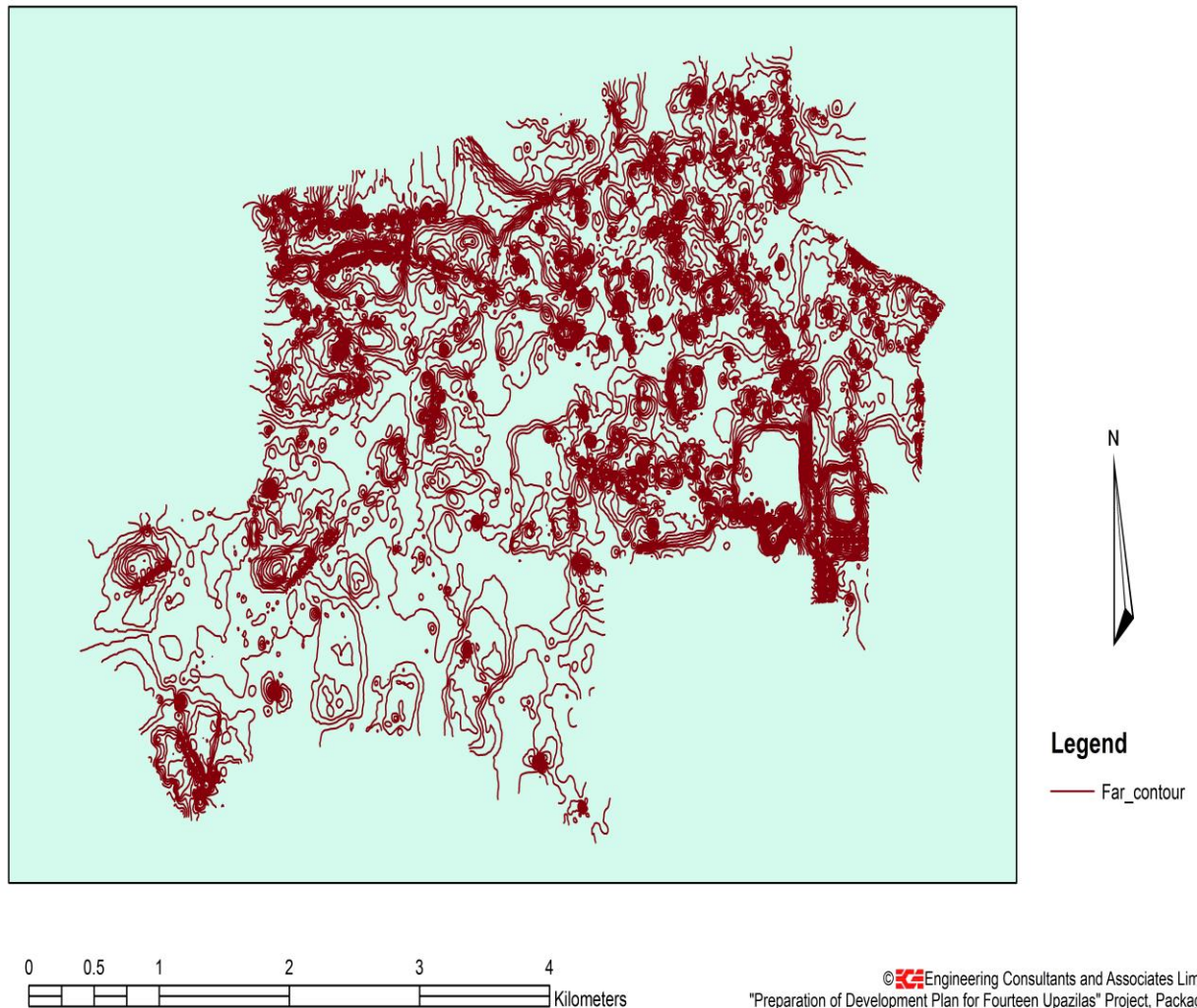
Map-5.2: Contour map of Faridpur Sadar Paurashava (Partial)

5.2.3 Alignment and Crest Level of Major Roads

The alignment is the route of the road and crest level is the top surface of road, usually known as carriageway.

Geographically, most of the study area lies above flood level and as a result road is the prime means of movement. In Faridpur Sadar, two major highways pass through the study area neighboring area like Faridpur Sadar to Nagarkanda Road, Rajbari Sadar to Faridpur Sadar Road etc. Besides, the study area is also well connected by number of arterial roads with all parts of the study area.

Table-5.3: Crest level of major roads along their alignment in Faridpur Sadar

Name of the road	Height of crest level from MSL, in meter		
	Minimum	**Maximum**	**Average**
Mujib Sarak	3.05	7.5	4.35
Rajbari Sadar to Faridpur Sadar Road	6.3	7.8	6.92
Faridpur Sadar to Bhanga Road	6.2	7.1	6.51

Source: Topographic survey, 2016

Chapter Six: Photogrammetric Works

6.1   Satellite Image Processing

Satellite image came with a certain level of processing. However, for the purpose of features extraction, further processing is needed in a number of steps. The step by step procedures has been shown in the **Figure-6.1**
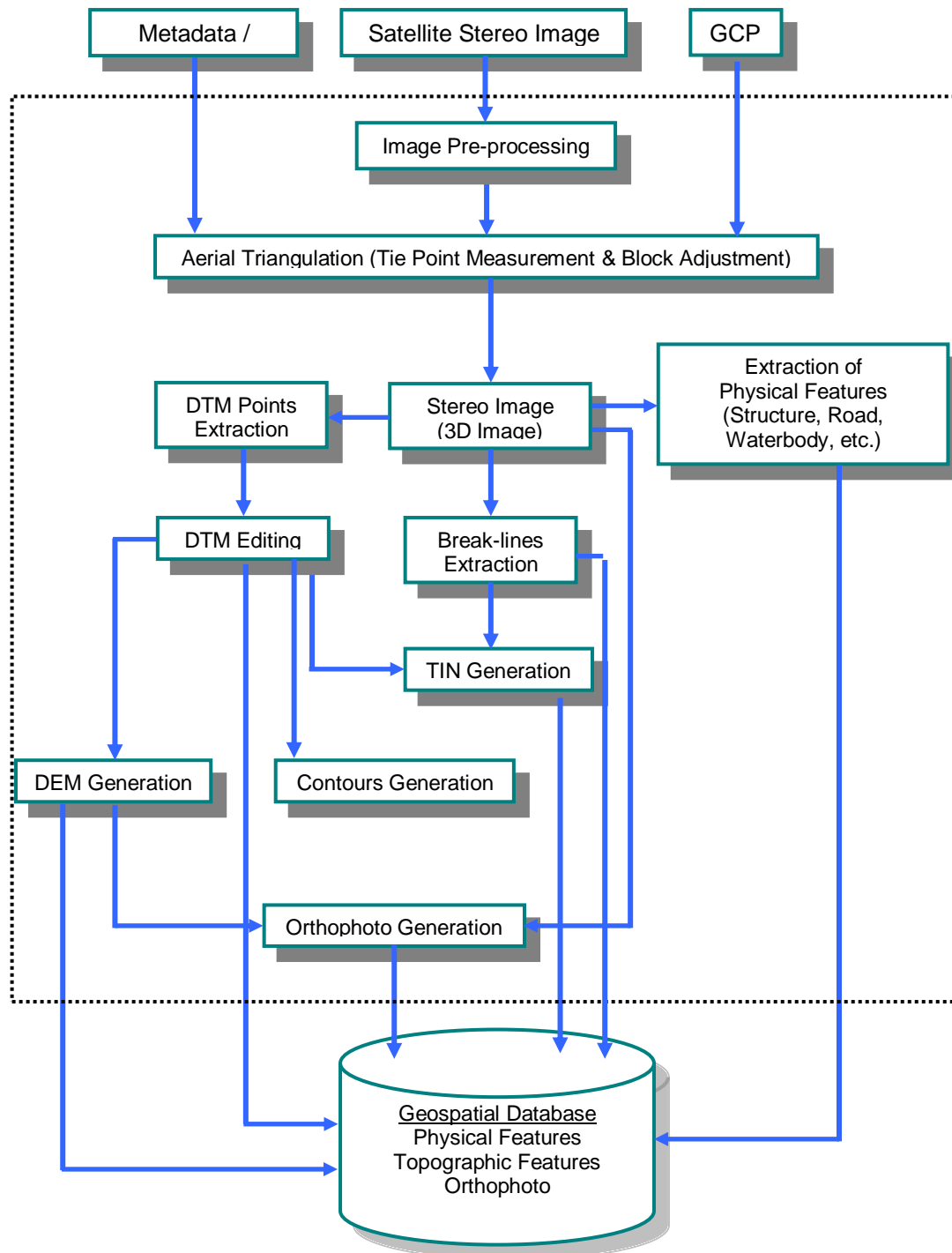
Figure-6.1: Workflow of Stereo Satellite Image Processing and Data Extraction

6.1.1   Image Collection

The satellite image was ordered to PCI India. The authorized reseller/partner of Airbus. 0.5 meter stereo pair image has been purchased by the Consultant for Faridpur Sadar. The specifications of the purchased satellite image are as below:

For Faridpur Sadar Upazila:

Image Sensor   : Airbus
Type   : Ortho ready stereo (3D)
Resolution   : 0.5m Panchromatic, 2.0 meter Multispectral
Source   : New Acquisition, 30 December 2016
Total Area   : 412.86 Sq. km.
Bit Rate   : 16 Bit
Company   : Airbus Defense and Space.

6.1.2   Image Pre-Processing

Satellite image came with two parts. One is multispectral band which resolution is 1.74 meter and another one is panchromatic which resolution is 0.5 meter. We need 0.5 meter multispectral image for feature extraction. After collecting raw digital images, the tasks involved in image processing are:

➢ Merge the image tile
➢ Color Balance
➢ Contrast Adjustment
➢ Pan-sharpening

6.1.2.1 Merge, Color Balance and Pan-Sharpen

Satellite image comes with lots of small segment which called image tile so that image can be sent by the provider on DVD media. To create an individual image all image tiles have been merged and thus an individual large image has been created.

Image tiles may vary in color and contrast. So during the merge process, color and contrast has been adjusted to get a color balanced image. **Figure-6.2** shows the satellite image tiles without color and contrast balance.

During the image capturing time, satellite captures two types of image, one in multispectral (RGB & NIR) image which is low resolution (2.0 meter) and another in high resolution (0.5 meter) panchromatic image. For feature extraction, 0.5 meter high resolution (0.5m) multispectral image is required. To have this 0.5 meter multispectral image, pan-sharpening tools have been used. This tool produces a 0.5 meter multispectral image by combining 2.0 meter multispectral image and 0.5 meter panchromatic image. **Figure-6.3** shows the merged satellite image with color and contrast balance.
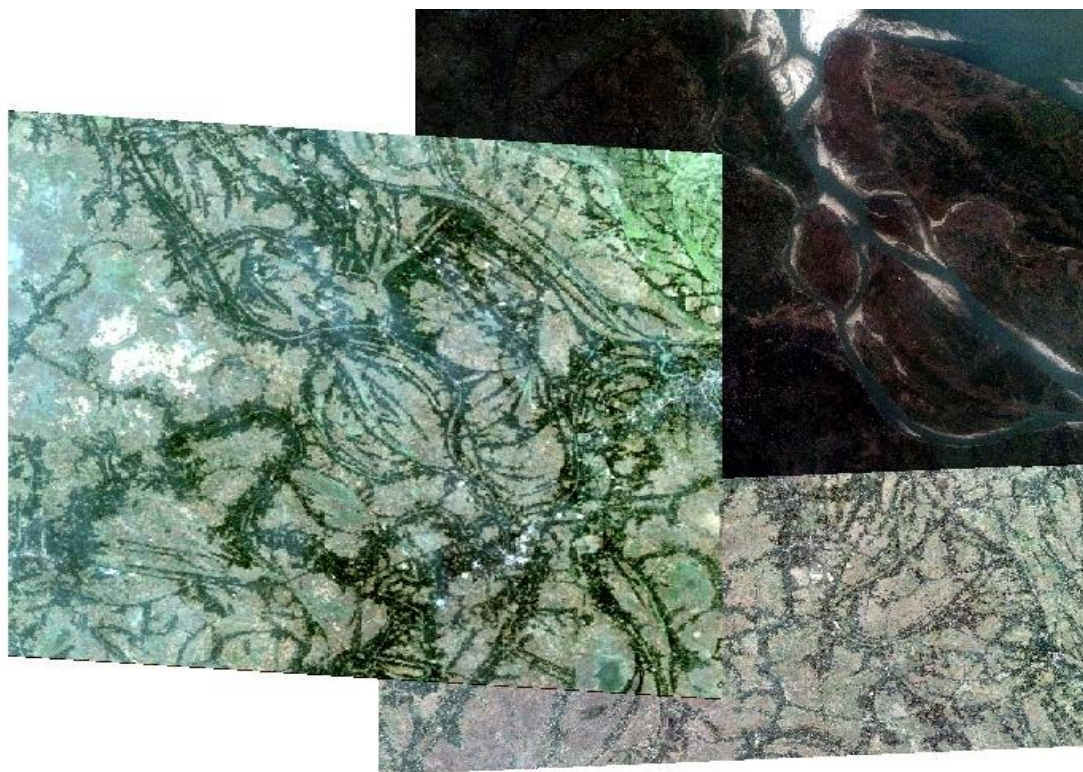
Figure-6.2: Tiles of satellite image without color and contrast balance
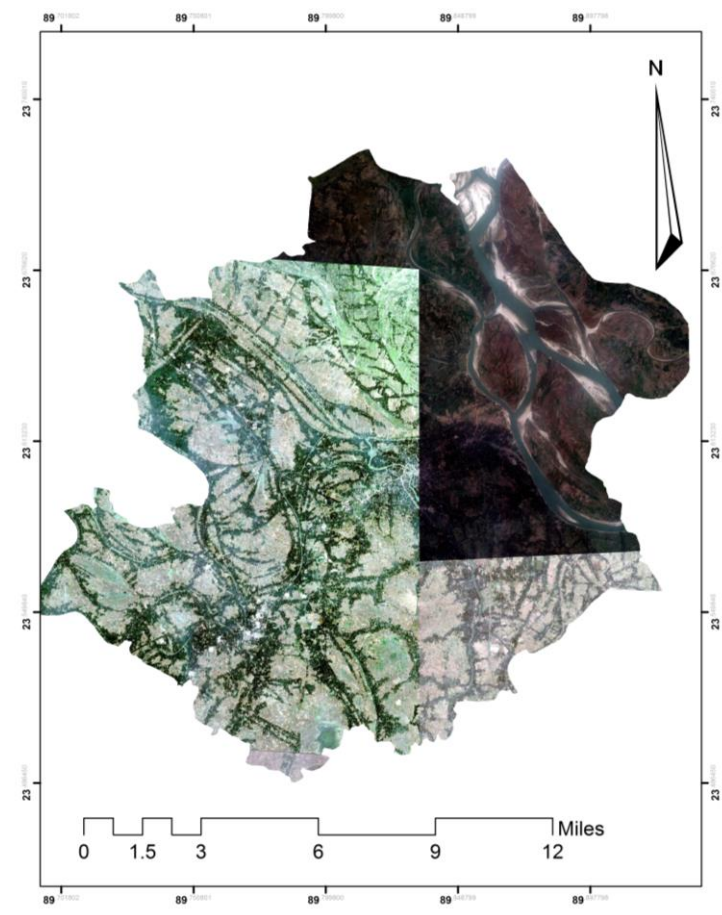
Figure-6.3: Merged satellite image with color and contrast balance
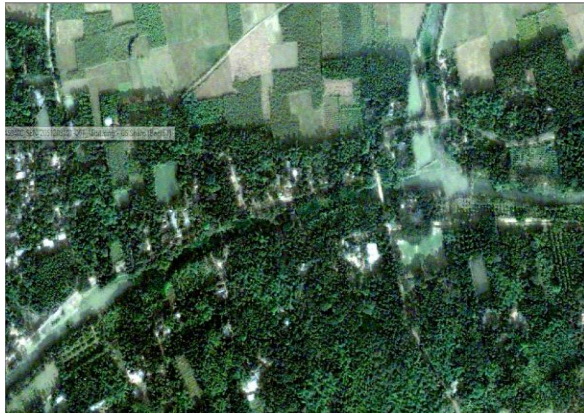
Figure-6.4: Satellite Image Multispectral Image 2.0 meter
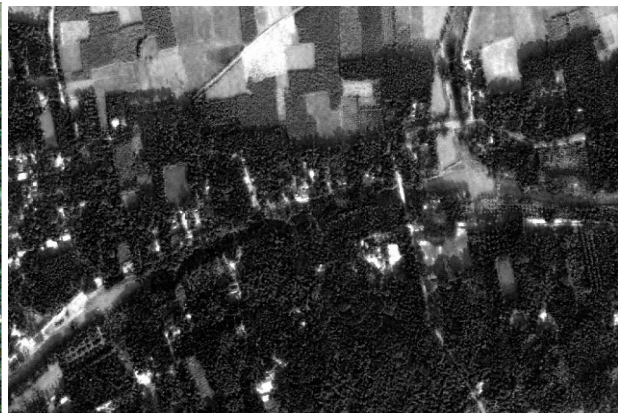
Figure-6.5: Satellite Image Panchromatic 0.5 meter
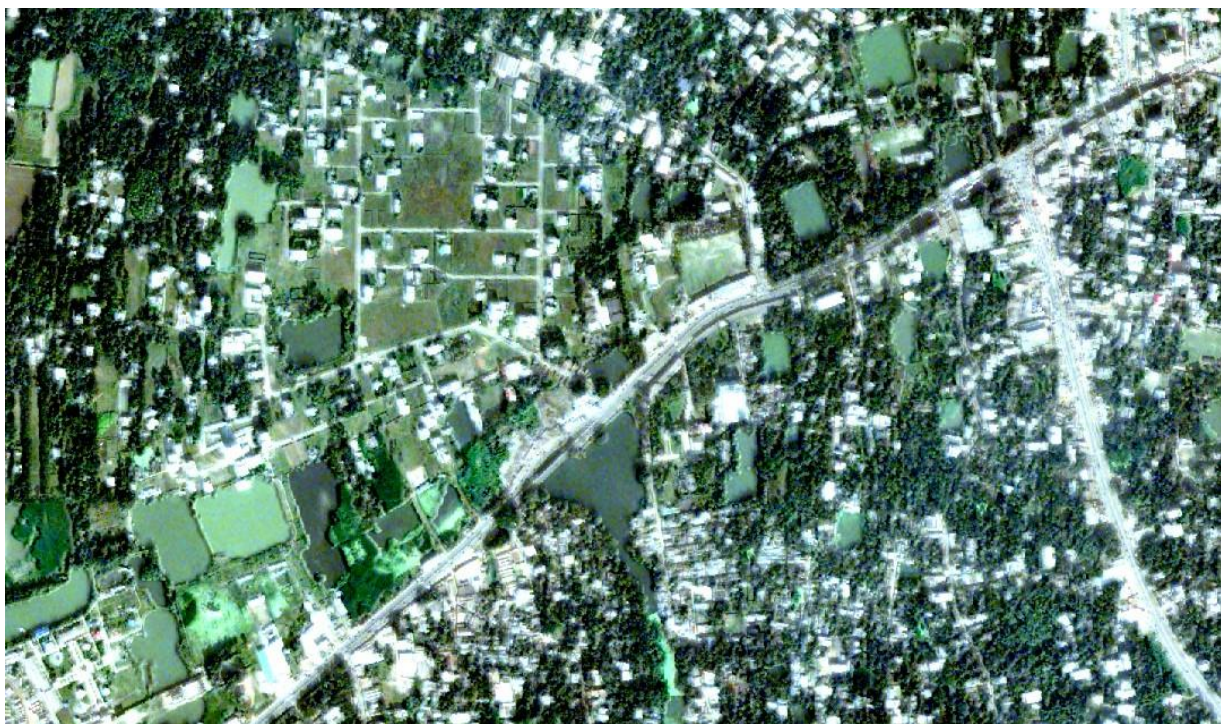
Figure-6.6: Pan-sharpen Image - multispectral 0.5 meter

6.1.2.2 Bit Rate, Pyramid and Epi-polar Correction

Bit Rate: In general practice 8 bit images are used. Satellite image can capture 11 bit image. Since the purchased satellite image is in 16bit, it has been changed the 16 bit to 8 bit for radio matric adjustment and better handling the image.

Pyramid: To efficiently view and pan the image, the pyramid of the image has been built. The DATEM Summit Evolution software has been used for image interpretation.

Epi-polar Correction: Epi-polar geometry is the geometry of stereo vision. When two cameras view a 3D scene from two distinct positions, there are a number of geometric relations between the 3D points and their projections onto the 2D images that lead to constraints between the image points. The 3D models have been created by using the Summit Evolution software.

6.1.3   GPS/INS Processing

Raw IMU (GPS/INS) data of image is processed and adjusted to accomplish Aerial Triangulation. In case of satellite image the RPC file is replaced the GPS/INS file.

6.1.4   Aerial Triangulation

Aerial Triangulation is a mathematical process used to determine the position and orientation of each photograph at the moment of exposure.

Table-6.1: Input-output in Aerial Triangulation

	Input for AT	Output of AT
(6)	IMU data	Geo-referenced Stereo Model
(7)	GPS (on board)	
(8)	GCP (collected from field)	
(9)	Image	
(10)	RPC file	

The GCP and BM collected from SOB have been used for correcting the 3D satellite image coordinate using Inpho Match-AT software.

6.1.5   Digital Mapping (Feature Extraction) from Stereo Model

After the orientation of stereo models, digital mapping has been carried out. ArcGIS Geo-database model has been used for storing geo-spatial data. The Geo-database and its feature classes has been designed based on ToR.

Digital Photogrammetric Workstation (DPW) has been used as the platform for acquiring features from digital stereo images (model).

Feature registration has been done considering and measuring the position of the object under its accuracy level. The Summit Evolution & Stereo Plotter of DAT/EM has been used for identifying and registration of the objects and ArcGIS 9.3 of ESRI has been used for vector data storing and editing.

Plate-13: Digital Photogrammetric Workstation (DPW)	Plate-14: Photogrammetrist Extracting Features in DPW
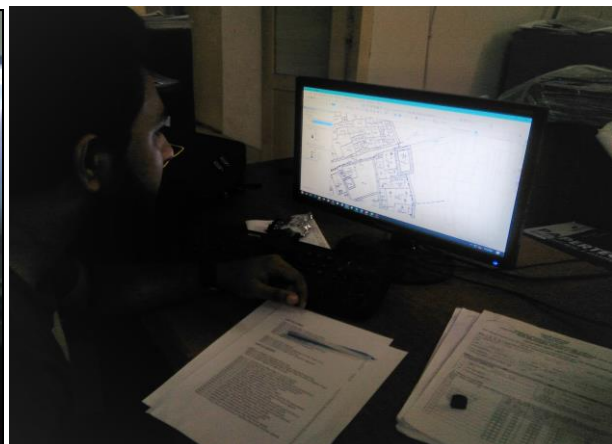
A team of photogrammetrists has digitized Building roof with MSL height, bridge/culvert, road, khal, pond, lake, ditch, marsh/swam, river, etc. All features have been digitized in 3-dimension (X,Y,Z).

Figure-6.7 and **Figure-6.8** shows the extracted features of Faridpur Sadar Upazila at a glance.
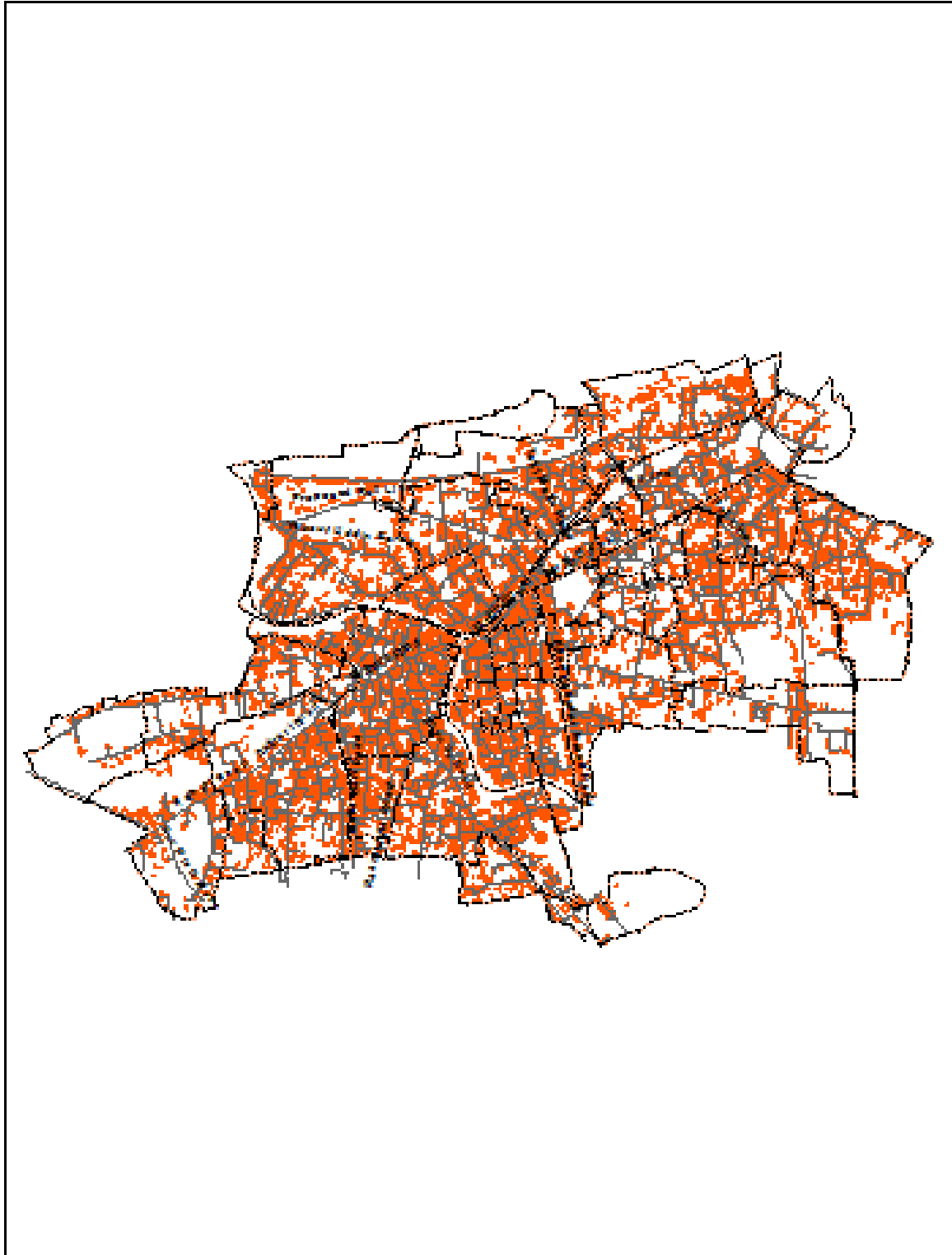
Figure-6.7: Extracted Features of Entire Faridpur Sadar Upazila by Photogrammetry

Figure-6.8: Enlarged Partial View of Extracted Features of Faridpur Sadar

For spot heights acquisition, firstly the DTM points have been generated automatically from stereo pair images by the software. Spot heights or land levels are extracted as DTM points at 10 m intervals for urban area and 20 m intervals for rural areas as described in the TOR. These automatically generated points have been then checked and edited by comparing them with stereo model in photogrammetric workstations. **Figure 6.9** shows the Digital Elevation Model of Faridpur Sadar Paurashava of Faridpur Sadar Upazila. **Figure 6.10** shows the Contour Lines partially of Faridpur Sadar paurashava of Faridpur Sadar Upazila.

The Break-lines have been created and edited after extraction of DTM Points.

The DTM Points and the Break-lines has been used later to create Triangulated Irregular Network (TIN), Digital Elevation Model (DEM) and the Contour Lines which is described in the Topographic Survey Report.
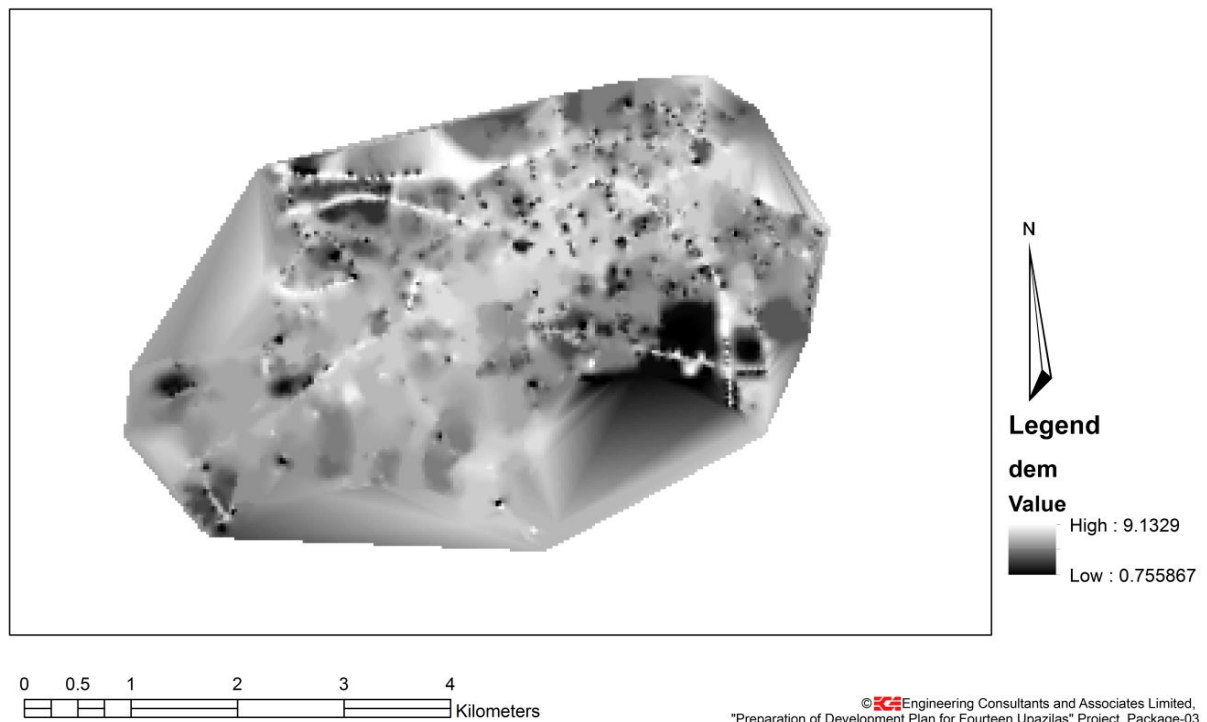
Figure-6.9: Digital Elevation Model (DEM) of Faridpur Sadar Paurashava (Partial)
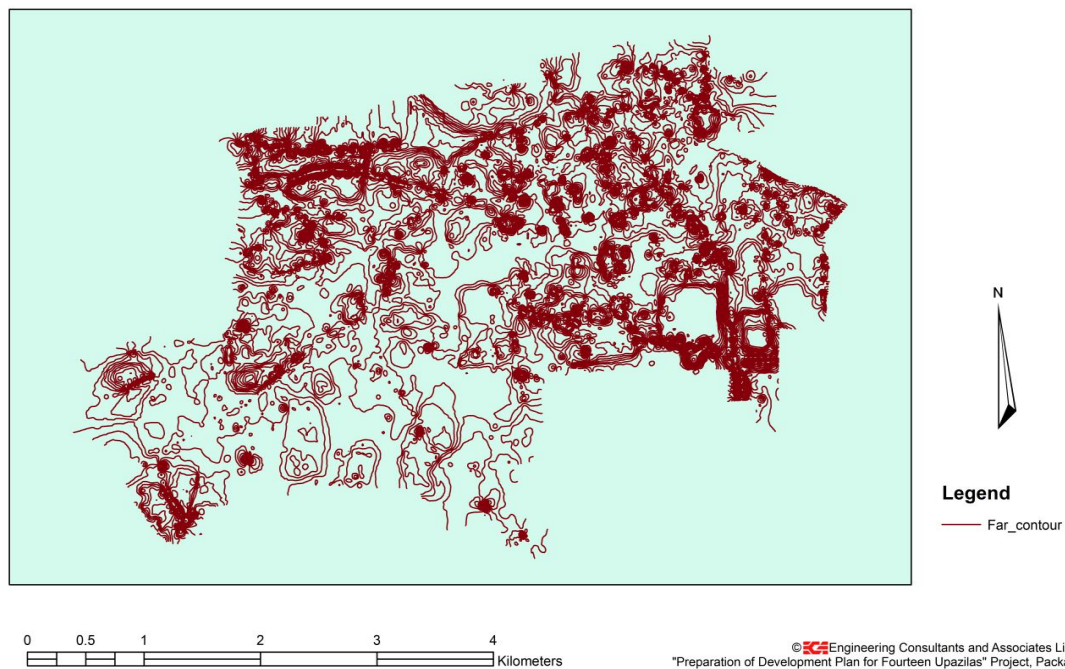
Figure-6.10: Contour Lines of Faridpur Sadar Paurashava (Partial)

6.1.6   Generation of Ortho-rectified Image

An ortho-rectified image or ortho-photo is an image which has been "corrected" for the geometric distortions (different projection, lens/sensor distortion, relief) so that it can be used as a map.

Using the DEM of the Upazila, the Ortho-rectified image has been created using photogrammetric software. Figure-2.20 shows a part ortho-rectified satellite image of Faridpur Sadar Upazila.
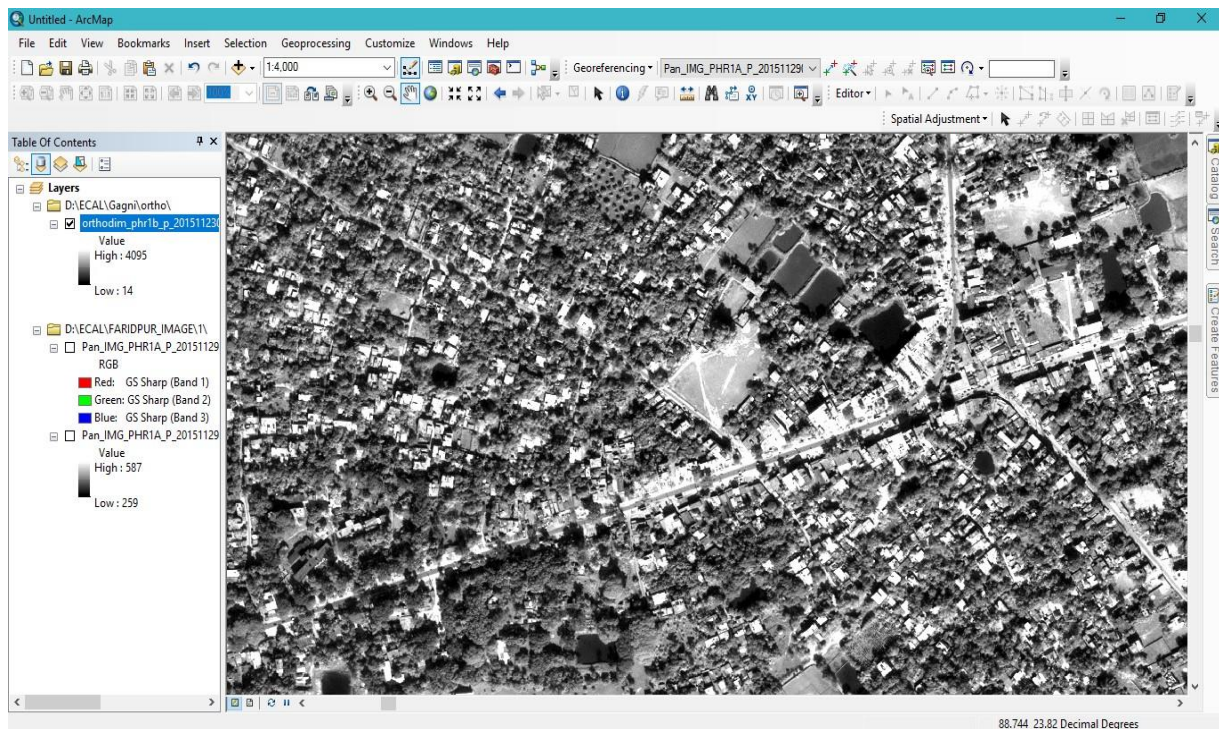
Figure-6.11: Ortho-Rectified Image of Faridpur Sadar Upazila (Partial)

Chapter Seven: Conclusion

The land use features of Faridpur Sadar Upazila have been acquired through field survey based on high resolution stereo satellite imagery and RTK-GPS. The existing land use data acquired through land use survey and photogrammetry can play vital role for preparation of development plans of Faridpur Sadar Upazila. By using these data in planning phase, decisions can be made where different socioeconomic activities such as agriculture, housing, industry, recreation, and commerce should take place and which areas should be protected from development due to environmental, cultural, historical, or similar reasons.

The topographic features of Faridpur Sadar Upazila have been acquired mainly through photogrammtric method by using high resolution stereo satellite imagery. These data may be updated and fine-tuned by RTK-GPS based Total Station survey especially in the vegetated and clouded area.

Topographic surveyed data and the derived data such as DEM, Contours, TIN, etc. can play important roles in hydrological analysis (watershed, stream network analysis and flood analysis, etc.), erosion and land slide analysis. Thus topographic survey data can be used to find out the suitable attributes for future developmental activities in the study area.

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iii. ToP Network. (2015). www.top-network.org retrieved December 2, 2015.

iv.   UDD. (2015). TOR. Dhaka: Urban Development Directorate.

Annexure-I: RS Mouza List: Faridpur Sadar Upazila

উপজেলা: ফরিদপুর সদর, জেলা-ফরিদপুর

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Annexure-II: Technical Specifications of GIS Data

This document contains the technical specifications for the development of GIS database. It has two sections: Section-A and Section-B. Specifications for Mouza map scanning and digitization have been provided in Section-A and specifications of GIS layers for preparing Survey and Plan Maps have been provided in Section-B.

Section-A: Specifications for Mouza Map Scanning & Digitization

This section contains the scanning specifications and digitization of Mouza maps.

A.1.0 Specifications for Mouza Map Scanning

The scanning specification of Mouza maps specifies Image Type, Image Format and Image Resolution and Image scale as follows:

Image Type	Color or Grayscale
Image Format	JPEG
Image Resolution	300 dpi

A.1.1 Directory Structure for Storing Scanned Mouza Maps

Directory Structure for systematically storing scanned image files of the Mouza maps may be as follows:

Directory Structure	**D:\GIS_Data\Project name & Package \ Division name\District name\Upazila name(Data Type)\Union name or Ward No** Where, - **D:\GIS_Data** is the root folder of the UDD's GIS database. - **\Project name** is the abbreviated name of the Project such as **Pkg-3_14Upazila** may be the abbreviated name of the project "Preparation of the Development Plan for Fourteen Upazila – Package-03". - **\Division name** is the name of the Division in which the project area located. - **\District name** is the name of the District in which the project area located. - **\Upazila name** is the name of the Upazila in which the project area located. - **\Data_Type** is the type of GIS data such as **Scanned Mouza Maps**, **Georeferenced Raster Mouza Maps**, **Survey Data**, **Proposed Plan Data**, etc. - **\Union_name** is the different name of the Unions of the respective Upazila or Ward number of the Paurashava. Example D:\GIS_Data_UDD\Pkg-3_14Upazila\Dhaka.div\Narsingdi.dis\Faridpur Sadar.upz\Scanned_Mouza**\.uni\Alibad_Union** is the **directory** to store the **scanned Mouza maps of Aliabad_Union of Faridpur Sadar_Upazila**.

A.1.2 File Naming Convention for Scanned Mouza Maps

A systematic naming convention must be followed to name the files of the scanned images of the Mouza maps.

File Name: **Mouza Name+_+JL no+_+Sheet No.jpg**

Where,
- **Mouza Name** is the name of the Mouza. No space or special character is allowed, underscore must be used in case of more than one word in the name.
- **JL no** is the Jurisdiction Line/List number (JL no) of the Mouza. It must be as 3 digit number
- **Sheet No** is the particular sheet number of the Mouza. It must be as 3 digit number

Example:

Mouza Name	JL No	Sheet No	File Name
Kanaipur	32	4	**kanaipur_011_001.jpg**

A.2.0 Specifications for Mouza Maps Digitization

The specifications for digitization of Mouza maps specifies the settings for map and display unit, scale or zoom level and vertex spacing during the process of on-screen digitization.

Map Unit	Inch
Display Unit	Inch
Scale (zoom level)	1: 15 to 30
No of vertices on linear or polygon feature	- Only 2 vertices along a straight line (or a straight segment of the feature) - Extra vertices are not allowed between Start and End point. - Sufficiently dense vertices must be used for curved/complex linear feature. - Vertex must be inserted at the junction of plot boundaries.
Coordinate System	Unknown (produced by scanning process)

A.2.1 Vector Layers for Mouza Map Digitization

Digitization of Mouza map must be done in five vector layers as the format of Shape file, Coverage or Geo data base Feature class. The Geodatabase is preferable.
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Features of the Mouza Map	Type of Layer	Name of Layer (as Shapefile/Coverage/Feature class)
All line features, such as plot boundary, road, waterbody, building, etc.	Polyline	**ML_XXX_XXX** Where, -**ML** represents **M**ouza map's **L**ine features. -XXX represents the JL number of the Mouza map (3 digit). -XXX represents the Sheet number of the Mouza map (3 digit).
Dag number (Plot no)	Point	**PN_XXX_XXX** Where, -**PN** represents **P**lot **N**umber of the Mouza map. -**XXX** represents the **JL number** of the Mouza map (**3 digit**).

Features of the Mouza Map	Type of Layer	Name of Layer (as Shapefile/Coverage/Feature class)
		-**XXX** represents the **Sheet number** of the Mouza map (**3 digit**).
Plot area	Polygon	**MP_XXX_XXX** Where, -**MP** represents **M**ouza map as **P**olygon (area) features. -**XXX** represents the **JL number** of the Mouza map (**3 digit**). -**XXX** represents the **Sheet number** of the Mouza map (**3 digit**).
Point features (except plot no)	Point	**PF_XXX_XXX** Where, -**PF** represents **P**oint **F**eatures of the Mouza map except plot numbers. -**XXX** represents the **JL number** of the Mouza map (**3 digit**). -**XXX** represents the **Sheet number** of the Mouza map (**3 digit**).
Other area features	Polygon	**AF_XXX_XXX** Where, -**AF** represents other **A**rea **F**eatures of the Mouza map -**XXX** represents the **JL number** of the Mouza map (**3 digit**). -**XXX** represents the **Sheet number** of the Mouza map (**3 digit**).

A.2.2 Attribute Structure of the Mouza Map Layers

Attribute structure of the above four layers must be as follows:

1) Layer name: **PN_XXX_XXX**
Feature Type: **Point**

This Layer will contain dag number (plot number) of the Mouza maps as point features. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Union	String	25	To contain name of the current Union.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza name+single space+JLno(3-digits) +single space+sheet no(3-digits)
Plot_No	Long Integer	10	To contain *dag* number (plot number)
Plot_Type	String	20	To contain following plot types - "Plot" - "Katcha Road" - "Semi-Pucca Road" - "Pucca Road" - "Halot" - "Pond" - "Canal" - "River"
Scale	String	20	To contain scale of the Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mouza as District code+Thana code+Union/Ward code+Mouza code.
UW_Geocode	String	6	To contain 6-digit BBS Geocode of Union or Ward as District code+Thana code+Union/Ward code
Remarks	String	100	To contain remarks, if any.

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2) Laye rname: **ML_XXX_XXX**
Feature Type: **Polyline**

This shape file/Coverage will contain all line features of the Mouza map. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Union	String	25	To contain name of the current Union.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Scale	String	20	To contain scale of the Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map
SV_Period	String	20	To contain survey period of the Mouza map; e.g 1973-85
Line_Code	Short Integer	10	To contain feature code or unique ID of different line feature. For example 11, 12 and 14 are the codes for Mouza boundary, Sheet boundary and Plot boundary respectively.
Line_Desc	String	30	To contain the type of plot boundaries and other line features such as - "Mouza boundary" - "Sheet boundary" - "Plot boundary" - "Katcha Road" - "Semi-Pucca Road" - "Pucca Road" - "Halot" - "Khal" - "Thoka/ Position mark of adjacent sheet" - "North line" - "Other line"
Remarks	String	100	To contain remarks, if any.

3) Layer name: **MP_XXX_XXX**
Feature Type: **Polygon**

This Layer will contain all the plots of the Mouza maps as area or polygon features. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Union	String	25	To contain name of the current Union.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Plot_No	Long Integer	10	To contain *dag* number (plot number)
Plot_Type	String	20	To contain following plot types - "Plot" - "Katcha Road" - "Semi-Pucca Road" - "Pucca Road" - "Halot" - "Pond" - "Canal" - "River"
Scale	String	20	To contain scale of the Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mouza as District code+Thana code+Union/Ward code+Mouza code.
UW_Geocode	String	6	To contain 6-digit BBS Geocode of Union or Ward as District code+Thana code+Union/Ward code
Remarks	String	100	To contain remarks, if any.

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4) Layer name: **PF_XXX_XXX**
Feature Type: **Point**

This shape file/Coverage will contain all point features except the plot numbers of the Mouza map. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Union	String	25	To contain name of the current Union.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza name + single space + JLno (3-digits) + single space + sheet no(3-digits)
Scale	String	20	To contain scale of the Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza map; e.g 1973-85
Point_Code	String	6	To contain the user ID of different point features. For example: 45 is the ID of Traverse Station (New)
Point_Desc	String	50	To contain Point description of point features such as - "Traverse Station [Old]" - "Traverse Station [New]" - GT Station, etc. And also to contain texts of label features of adjacent Mouza map such as "Sheet No. 2", "Aliabad No. 101", etc.
Remarks	String	100	To contain remarks, if any.

5) Layername: **AF_XXX_XXX**
Feature Type: **Polygon**

This shape file will contain all other area features such as Dalan (Building), Waterbody (Pond), etc. of the Mouza map. It must contain the fields as described in the following table:

Field Name	Field Type	Field Width	Purpose of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Union	String	25	To contain name of the current Union.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Scale	String	20	To contain scale of the Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza map; e.g 1973-85
AF_Code	Long Integer	6	To contain the user ID of different polygon features. For example: 31 is the ID of Permanent Structure (Dalan), 32 is for Tinshed Structure, etc.
AF_Desc	String	50	To contain type of features such as - "Permanent Structure [Dalan]" - "Tinshed Structure" - "Other Structure" - "Pond/Waterbody" - "Pan Baraz" - "Graveyard"
Remarks	String	100	To contain remarks, if any.

A.2.3 Feature Codes for Mouza Map Digitization

The following feature codes (Unique ID) must be assigned in appropriate fields for digitization of different features of the Mouza maps.

Feature Type/Item	Layer Name	Feature Code (ID)
International Boundary	ML_XXX_XXX	10
Division Boundary		11
District Boundary		12
Upazila Boundary		13
Union Boundary		14
Mouza Boundary		15
Sheet Boundary		16
Plot Boundary		17
Thoka/Adjacent\Match Line		18
Embankment		19
Hill		20
Road		21
Halot		22
Khal (Canal)		23
River		24
Rail Line		25
Slope		26
North Line		27
Pucca Road		28
Semi-Pucca Road		29
Katcha Road		30
Unknown Line		99
Permanent Structure [Dalan]	AF_XXX_XXX	31
Tin Shed Structure		32
Other Structure		33
Pan Baraz		34
Pond/Water Body		35
Graveyard		36
Missing or not readable plot number	PN_XXX_XXX	99999
Boundary Pillar	PF_XXX_XXX	41
Bench Mark		42
Iron Pillar		43
Traverse Station(Old)		44
Traverse Station (New)		45
GT Station		46
Other Pillars		47
Pucca Well		51
Tube Well		52
Mosque		53
Temple		54
Adjacent Mouza/Sheet		61
0tier Info		62
Demarcation Pillar		71
Settlement Pillar		72
Stone		73
Station		74

Feature Type/Item	Layer Name	Feature Code (ID)
Pucca Pillar		75
Municipality Pillar		76
CS Iron Pillar		77
Other Point Feature		88
Plot Boundary		14
Katcha Road		30
Semi-Pucca Road		29
Pucca Road	ML_XXX_XXX	28
Halot		22
Pond		14
Canal		23
River		24

Section-B: Specifications for the Layers of Survey and Plan Maps

This section contains the specifications of all physical features, topographical features and proposed plan features. It specifies the name of the spatial layers and the structure of their attribute tables.

B.1.0 File Naming Convention for GIS Layers

A systematic naming convention must be followed to name the layers of the physical, topographical plan features. The name is defined by abbreviated name of the layer with the geocode of the Division+District+upazila (UDD Upazila Master Plan 14 Upazila's) in the following tables:

Sl. No.	Division Name	Division Code	District Name	District Code	Upazila Name	Upazila Code
1	Dhaka	30	Dhaka	26	Nawabganj	62
2	Dhaka		Dhaka	26	Dohar	18
3	Chittagong	20	Chittagong	15	Rangunia	70
4	Chittagong	20	Cox bazar	22	Ramu	66
5	Rajshahi	50	Rajshahi	81	Bagmara	12
6	Dhaka		Faridpur	29	Faridpur Sadar	47
7	Dhaka		Mymensingh	61	Ishwarganj	31
8	Dhaka	30	Madaripur	54	Shibchar	87
9	Dhaka		Narsingdi	68	Shibpur	76
10	Dhaka		Narsingdi	68	Raipura	64
11	Rajshahi	50	Bogra	10	Sariakandi	81
12	Rajshahi		Bogra	10	Sonatala	95
13	Rangpur	55	Gaibanda	32	Saghata	88
14	Khulna	40	Meherpur	57	Gangni	47

File Name: **Layer Name+Division+District+Upazila Geocode will be added with Layer Name such as ADBL306864.**
Where,
- **Layer Name** is the abbreviated name of the layer. No space or special character is allowed.
- **Division Geocode** is the 2-digit BBS Geocode of the Division; eg. Geocode of Dhaka is 30.
- **District Geocode** is the 2-digit BBS Geocode of the Dhaka; eg. Geocode of Faridpur is 29.
- **Upazila Geocode** is the 2-digit BBS Geocode of the upazila; eg. Geocode of Faridpur sadar Upazila is 47.
Example:

Layer Description	Layer name
Administrative Boundary as line features	ADBL306864
Plots of Merged Mouza maps as polygon features	MMP306864
Plots of Merged Mouza maps as polyline features	MML306864
Plot Numbers of Merged Mouza maps as polyline features	MMN306864
Structures within the project area	STR306864
Existing Roads of the project area as polygon features	RDP306864
Existing Roads of the project area as polyline features	RDL306864
Centerlines of Existing Roads as polyline features	RDCL306864
Footpaths in the project area as polygon features	RDFP306864
Road Islands in the project area as polygon features	RDIL306864
Waterbodies in the project area as polygon features	WBD306864
Embankments in the project area as polygon features	EMB306864
DTM points (Spot Heights) on the project area as point features	DTM306864

BM pillars established in the project area as point features	BM306864
Contour lines of the project area as polyline features	CON306864
Existing Land use of the project area as polygon features	ELU306864
Rural Homestead areas of the project area as polygon features	HOM306864
Bridge, Culvert, etc. of the project area as polygon features	BRG306864
Bridge, Culvert, etc. of the project area as polyline features	BRGL306864
Bridge, Culvert, etc. of the project area as point features	BRGP306864
Existing Drains of the project area as polyline features	DRN306864
Boundary of the project area as polyline features	BW306864
Water Supply pipe lines of the project area as polyline features	WSL306864
Overhead Tanks in the project area as point features	OHT306864
High voltage Electric Supply Lines in the project area as polyline features	ESL306864
Utilities in the project area as point features	UTL306864
Sewerage network lines in the project area as polyline features	SEW306864
Other Polygon features of the project area as polygon features	OP306864
All other Point features of the project area as point features	AP306864
Important names of locations or structures of the project area as point features	NAM306864
Important Road Names in the project area as Annotation/Polyline features	RN306864
Centerlines of Proposed Roads in the project area as polyline features	PRL306864
Union/Ward derived by dissolving merged Mouza for Population mapping	POP306864
Proposed policy (Structure Plan) of the project area as polygon features	STP306864

B.1.1 Attribute Structure of the Layers
Attribute structure of the above layers must be as follows:

1) Layer name: **ADBL306864**
Feature Type: **Polyline**

This Layer will contain administrative boundaries of project area. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Line_Code	Long Integer	**10**	To Contain Polyline ID
Type	String	100	To contain the following administrative boundaries "International Boundary" "Division Boundary" "District Boundary" "Upazila Boundary" "Paurashava Boundary" "Union Boundary" "Ward Boundary" "Mouza Boundary" "Sheet Boundary" "Plot Boundary" "Katcha Road" "Semi-Pucca Road" "Pucca Road" "Halot" "Pond" "Canal" "River"

2) Layer name: **MMP306864**
Feature Type: **Polygon**

This Layer will contain plots of edge-matched and merged Mouza maps of project area as polygon features. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Paurashava	String	25	To contain name of the Paurashava.
Union_Ward	String	25	To contain name of the current Union or Ward No.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Plot_No	Long Integer	10	To contain *dag* number (plot number)
Plot_Type	String	20	To contain following plot types - "Plot" - "Katcha Road" - "Semi-Pucca Road" - "Pucca Road" - "Halot" - "Pond" - "Canal" - "River"
Scale	String	20	To contain scale of the Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mouza as District code+Thana code+Union/Ward code+Mouza code.
UW_Geocode	String	6	To contain 6-digit BBS Geocode of Union or Ward as District code+Thana code+Union/Ward code
Land_use	string	50	To contain existing land use as - "Administrative" - "Agriculture" - "Commercial" - "Circulation Network" - "Institutional" - "Flood Flow Zone" - "Industrial" - "Mixed Use" - "Recreational" - "Restricted / Special Use" - "Socio-Cultural" - "Transport & Communication" - "Urban Residential"

Field Name	Field Type	Width of the field	Purpose of the field
			- "Urban Services" - "Vacant Land" - "Water Body"
Single_Crop	string	50	To contain the single crop land
Double_Crop	string	50	To contain the double crop land
Triple_Crop	string	50	To contain triple crop land
Remarks	String	100	To contain remarks, if any.

3) Layer name: **MML306864**
Feature Type: **Polyline**

This Layer will contain line features of edge-matched and merged Mouza maps of project area as polyline features. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
ID	Long Integer	16	To Contain Mouza polyline ID.
Type	String	20	"Plot Boundary" "Sheet Boundary" "Mouza Boundary" "Katcha Road" "Semi-Pucca Road" "Pucca Road" "Halot" "Pond" "Canal" "River"
Remarks	String	100	To contain remarks, if any.

4) Layer name: **MMN306864**
Feature Type: **Point**

This layer will contain Plot numbers of edge-matched and merged Mouza maps of project area as point features. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila.
Paurashava	String	25	To contain name of the Paurashava.
Union_Ward	String	25	To contain name of the current Union or Ward No.
Mouza	String	100	To contain name of the Mouza name
JL_No	String	6	To contain JL Number of the Mouza
Sheet_No	String	6	To contain sheet no the Mouza
Mouza_JL_S	String	100	To contain Mouza name+single space+JLno(3-digits)+single space+sheet no(3-digits)
Plot_No	Long Integer	10	To contain *dag* number (plot number)
Plot_Type	String	20	To contain following plot types - "Plot" - "Katcha Road" - "Semi-Pucca Road" - "Pucca Road" - "Halot" - "Pond" - "Canal" - "River"
Scale	String	20	To contain scale of the Mouza sheet; e.g. "16 inch = 1 mile" or "32 inch = 1 mile", etc.
MZ_Version	String	20	To contain survey version of the Mouza map; e.g. CS, RS, BS, etc.
Revenue_No	String	100	To contain revenue number of the Mouza map.
SV_Period	String	20	To contain survey period of the Mouza map; e.g 1973-85
M_Geocode	String	9	To contain 9-digit BBS Geocode of Mouza as District code+Thana code+Union/Ward code+Mouza code.
UW_Geocode	String	6	To contain 6-digit BBS Geocode of Union or Ward as District code+Thana code+Union/Ward code
Remarks	String	100	To contain remarks, if any.

5) Layer name: **STR306864**
Feature Type: **Polygon**

This Layer will contain the information of each structure within the project area. It must contain thirteen fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Division	String	25	To contain name of the current Division.
District	String	25	To contain name of the current District.
Upazila	String	25	To contain name of the current Upazila
Pourashava			To contain name of Paurashava.
Union_Ward	String	25	To contain name of the current Union\Ward.
ID	Long Integer	16	To Contain Structure ID.
Plot_No	Long Integer	10	To Contain the plot No.
Area_Sqft	Double	0	To Contain Structure area in square feet.
Str_Type	String	20	To contain the type of the structure as follows - "Pucca" - "Semi-pucca" - "Katcha"
Storied	Short Integer	-	To contain the number of floors of the structure.
Str_Use1t	String	100	1. To contain the use (1st) of the structure. 2. The attributes should be according to the given "Existing_Landuse" categories.
Str_Use2t	String	100	To contain the use (2nd) of the structure.
Str_Use3t	String	100	To contain the use (3rd) of the structure.
Str_name	String	100	To contain the name of the structure.
Cons_Year	Short Integer	-	To contain the year of construction.
Undercons	String	3	To contain the information if it was being under construction during the feature survey. - Yes/No ; True/False ; 1/0
Struc_Owner	String	100	To contain the owner name of the structure.
Owner_Cell	String	100	To contain the owner Cell No. of the structure.
Struc_Use	String	100	To contain the structure use of the Government or private and so on.
Hyperlink	String	100	To contain the picture of the structure.
Holding_no	String	50	To contain Holding number of the structure.
Road_ID	String	50	To contain adjacent road number, It must be follow of the Road Categories.
Road_name	String	100	To contain the name of the nearby road
Locality	String	50	To contain the name of the location.

6) Layer name: **RDP306864**
Feature Type: **Polygon**

This Layer will contain the existing roads of the project area as polygon features. It must contain three fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Road_name	string	100	To contain the name of the road, if any
Road_ID	string	20	To contain the ID of Road
Road_type	string	20	To contain the physical type of the road as follows - "Pucca" - "HBB" - "Katcha"
Road_Class	string	100	To contain the Class of road according to RHD & LGED in the followings: RHD Road Class - "National Highways " - "Regional Highways" - "District\Zila Road" LGED Road Class - "Upazila Road(Pucca" - "Upazila Road(Katcha)" - "Union Road(Pucca)" - "Union Road(Katcha)" - "Village Road A (Pucca)" - "Village Road A (Katcha)" - "Village Road B (Pucca)" - "Village Road B (Katcha)"

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7) Layer name: **RDL306864**
Feature Type: **Polyline**

This Layer will contain the existing roads of the project area as polyline features. It must contain three fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field				
Road_name	string	100	To contain the name of the road, if any				
Road_ID	string	20	To contain the ID of Road				
Road_Type	string	20	To contain the physical type of the road as follows - "Pucca" - "WBM" - "HBB" - "Katcha"				
Road_Class	string	100	To contain the Class of road according to RHD & LGED in the followings: RHD Road Class - "National Highways " - "Regional Highways" - "District\Zila Road" LGED Road Class - "Upazila Road(Pucca" - "Upazila Road(Katcha)" - "Union Road(Pucca)" - "Union Road(Katcha)" - "Village Road A (Pucca)" - "Village Road A (Katcha)" - "Village Road B (Pucca)" - "Village Road B (Katcha)"				
Remarks	To prepare the inventory of road, Electricity, Telephone, drainage, Sewerage, pipe line and etc. The inventory will help for the present status of features. Please follow the example right side of the Data Table.	Chainage in Meters		Road_ Condition	Type	Additional +Field	
		From	To				
		0	500	Pucca	Pucca	To add more field as per Required.	
		500	504	Culvert	Culvert	To add more field as per Required.	
		504	1000	Katcha	Katcha	To add more field as per Required.	
		1000	1012	Bridge	Bridge	To add more field as per Required.	

8) Layer name: **RDCL306864**
Feature Type: **Polyline**

This shape file will contain the centerlines of the existing roads of the project area as polyline features. It must contain the following fields compatible to network analysis:

Field Name	Field Type	Width of the field	Purpose of the field
Road_name	string	100	To contain the name of the road, if any
Road_no	string	20	To contain road number, if any
Road_ID	string	20	To contain the ID of Road
Road_type	string	20	To contain the physical type of the road as follows - "Pucca" - "WBM" - "HBB" - "Katcha"
Road_Class	string	100	To contain the Class of road according to RHD & LGED in the followings: RHD Road Class - "National Highways " - "Regional Highways" - "District\Zila Road" LGED Road Class - "Upazila Road(Pucca" - "Upazila Road(Katcha)" - "Union Road(Pucca)" - "Union Road(Katcha)" - "Village Road A (Pucca)" - "Village Road A (Katcha)" - "Village Road B (Pucca)" - "Village Road B (Katcha)"
Road_width	numeric		To contain average width of the road segment in meter
Road_length	numeric		To contain calculated length of the road segment in meter
Num_Lanes	numeric		To contain number of lanes on the road segment such as 1, 2, etc.
Road_own	string	100	To contain the name of the department or organization to which the road segment belongs.
METERS	Double	-	To contain length of the road in meters
FT_MINUTES	Float	-	To contain the time duration needed to travel the arc from the start node unto the end node, measured in minutes.
TF_MINUTES	Float	-	To conation the time duration needed to ravel the arc from the end node unto the start node of the arc, measured in minutes,
Oneway	string	2	To contain the value to represent the possible directions to travel an arc
Hierarchy	Long		To contain order or rank assigned to road network elements.

9) Layer name: **RDFP306864**
Feature Type: **Polygon**

This Layer will contain footpath of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Road_name	string	50	To contain road name
Road_ID	string	20	To contain the adjacent Road ID
Width	numeric		To contain width of Footpath
Status	string	50	To contain footpath conditions.

10) Layer name: **RDIL306864**
Feature Type: **Polygon**

This Layer will contain road islands of the project area. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Road_name	string	50	To contain road name
Road_No	string	20	To contain road number if any
Road_ID	string	20	To contain the adjacent Road ID
Width	Long integer	20	To contain width of Island
Type	string	50	To contain footpath conditions.

11) Layer name: **WBD306864**
Feature Type: **Polygon**

This shape file will contain water bodies of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
WBD_ID	Long integer	20	To contain Water body ID.
Type	string	50	To contain following type of water bodies - "River" - "Khal" - "Irrigation Canal" - "Swamp" - "Pond" - "Ditch" - "Borrow Pits"
Type	string	50	To contain the use of water body such as Private or Public use

12) Layer name: **EMB306864**
Feature Type: **Polyline**

This Layer will contain embankment features of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Emb _name	string	100	To contain the name of the road, if any
Emb_ID	string	20	To contain the ID of Road
Emb_Type	string	20	To contain the physical type of the Embankment to follow the road preparing method.
Emb_Class	string	100	To contain the Class of the Embankment -"Road cum Embankment" -"Embankment"
Emb_width	numeric		To contain average width of the road segment in meter
Emb _width	numeric		To contain average width of the embankment segment in meter
Emb _length	numeric		To contain calculated length of the road segment in meter
Num_Lanes	numeric		To contain number of lanes on the road segment such as 1, 2, etc.
Owner	string	100	To contain the name of the department or organization to which the embankment segment belongs.
Remarks			To follow the Road preparing Methods.

13) Layer name: **DTM306864**
Feature Type: **Point**

This shape file will contain spot heights as 3D points at regular interval (10m x 10m OR 20m x 20m or as specified) in project area. It must contain four fields as described in the following table:

Field Name	Field Type	Width of the field	No. of Decimal Places	Purpose of the field
ID	Sort Integer	**10**		To contain the ID
RL	Double	-	-	To contain Reduced Level (RL) of a point in meter as referenced with PWD
Easting	Double	-	-	To contain X-coordinate of the point
Northing	Double	-	-	To contain Y-coordinate of the point

14) Layer name: **BM306864**
Feature Type: **Point**

This shape file will contain BM Pillars established in the project area. It must contain four fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
RL	Double	-	To contain Reduced Level (RL) of a point in meter as referenced with PWD
Easting	Double	-	To contain X-coordinate of the point
Northing	Double	-	To contain Y-coordinate of the point
Organization	String	100	To contain name of the organization
Cons_Year		10	To contain the year of construction
Remarks	String	100	To contain remarks, if any.

15) Layer name: **CON306864**
Feature Type: **Polyline**

This shape file will contain the contour lines of the area under project area. It must contain three fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Contour	Double	-	To contain the value (RL) of the contours up to three decimal places.
Label	Double	-	To contain the value of contour up to one decimal place. This can be used to label the contours in map.
Type	String	7	To contain the value of this field as follows: - "Index" - "Intermediate" The purpose of this field is to symbolize and label the contours only. (The values must be calculated in such way that after successive 4 thin (Regular) contours there should be one thick (Index) contour in map. That is if 0.00 is a thick (Index) contour then 0.3, 0.6, 0.9, and 1.2 will be (Regular) contours and 1.5 will be thick contour.

16) Layer name: **ELU306864**
Feature Type: **Polygon**

This shape file will contain existing land use of project area which will be prepared on the basis of physical feature and land use survey. It may contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Land_use	string	50	To contain existing land use as - "Administrative" - "Agriculture" - "Commercial" - "Circulation Network" - "Institutional" - "Flood Flow Zone" - "Industrial" - "Mixed Use" - "Recreational" - "Restricted / Special Use" - "Socio-Cultural" - "Transport & Communication" - "Urban Residential" - "Urban Services" - "Vacant Land" - "Water Body"
Single_Crop	string	50	To contain the single crop land
Double_Crop	string	50	To contain the double crop land
Triple_Crop	string	50	To contain triple crop land
Remarks	string	100	To contain remarks, if any.

17) Layer name: **HOM306864**
Feature Type: **Polygon**

This shape file will contain rural homestead areas in project area as polyline features. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Location	String	20	To contain the name of Mouza (Mouza_JL_Sheet) or the locality in which homestead areas lies.
Type			To contain the type of homestead area (Accordingly structures) -Urban -Rural

18) Layer name: **BRG306864**
Feature Type: **Polygon**

This shape file will contain Bridge/Culvert/Box culvert/Over bridge/Railway Bridge etc as polygon features in project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Length	Double	0	To contain the length of the bridge/culvert
Width	Double	0	To contain the width of the bridge/culvert
Abutment	Long integer	20	To contain the number of abutment
Span	Double	0	To contain the span of the bridge/culvert
Location	String	30	To contain the area name (Mouza_JL_Sheet or locality)
Remarks	String	254	To contain comments about the bridge such as conditions of abutment, deck, wing wall, etc. *** To follow the road map preparing methods.

19) Layer name: **BRGL306864**
Feature Type: **Polyline**

This shape file will contain Bridge/Culvert/Box culvert/Over bridge/Railway Bridge etc as polyline features in project area. Each feature must be a multipart feature. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Length	Double	-	To contain the length of the bridge/culvert
Width	Double	-	To contain the width of the bridge/culvert
Abutment	Double	-	To contain the number of abutment
Span	Double	-	To contain the span of the bridge/culvert
Location	String	20	To contain the area name (locality)
Remarks	String	254	To contain comments about the bridge such as conditions of abutment, deck, wing wall, etc. *** To follow the road map preparing methods.

20) Layer name: **BRGP306864**
Feature Type: **Polygon**

This shape file will contain Bridge/Culvert/Box culvert/Over bridge/Railway Bridge etc as point features in project area. It is expected that this shape file will be generated/produced from converting the Bridge_CL.shp file into centroids. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Length	Double	-	To contain the length of the bridge/culvert
Angle			To contain the Geographic angle of the bridge/culvert
Width	Double	-	To contain the width of the bridge/culvert
Abutment	numeric	20	To contain the number of abutment
Span	Double	-	To contain the span of the bridge/culvert
Location	String	20	To contain the area name (Mouza_JL_Sheet or locality)
Remarks	String	254	To contain comments about the bridge such as conditions of abutment, deck, wing wall, etc. *** To follow the road map preparing methods.

21) Layer name: **DRN306864**
Feature Type: **Polyline**

This shape file will contain the information of existing drains in the project area. It must contain three fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Type	string	20	To contain the (construction) type of the drain. The value of the field may be any of the following two - Surface (Katcha) - Surface (Uncovered) - Surface (Covered) - Pipe
Drain_width	Double	0	To contain the width of the drain
Drain_depth	Double	0	To contain the depth of the drain
Drain_radius	Double	0	To contain the radios of the drain
Road_ID	string	20	To contain the adjacent Road ID
Remarks	String	254	*** To follow the road map preparing methods.

22) Layer name: **BW306864**
Feature Type: **Polyline**

This shape file will contain boundary walls as line features of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Type	string	50	To contain line features such as Boundary wall.

23) Layer name: **WSL306864**
Feature Type: **Polyline**

This shape file will contain water distribution pipe network as line features in project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Type	string	20	To contain type of pipe (Steel, PVC, etc)
Dia	Double	0	Diameter of pipe in mm
Remarks	String	254	*** To follow the road map preparing methods.

24) Layer name: **OHT306864**
Feature Type: **Point**

This shape file will contain overhead water tanks as point features in project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Capacity	Double	-	To contain the capacity of the overhead tank.
Catchment	Double	-	To contain the catchment area in sq. meter
Owner	String	100	Contains the owner name

25) Layer name: **ESL306864**
Feature Type: **Polyline**

This shape file will contain High Voltage Electric Lines as line features in project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
capacity	string	20	Contains the capacity of each line as 11KV, 33 KV etc.
Owner	string	20	Contains the name of Organization
Remarks	String	254	*** To follow the road map preparing methods.

26) Layer name: **UTL306864**
Feature Type: **Point**

This shape file will contain locations of various utility features as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Type	string	20	To contain - "Electric Pole" - "Electric Tower" - "High Volt Electric Tower" - "Electric Box" - "Power Station" - "Power Sub-station" - "Transformer" - "Gas Transmission Center - "Light Post" - "Telephone Pole" - "Telephone Box" - "Fire Service Station" - "Traffic Signal Pole"
Owner			Contains the name of the owner
Remarks	String	100	*** To follow the road map preparing methods.

27) Layer name: **SEW306864**
Feature Type: **Polyline**

This shape file will contain sewerage network as line features in [project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Size	string	20	To contain pipe diameter of sewerage line
Type	string	25	Contains type of waste water carried by the sewerage line such as storm sewerage or household sewerage line etc.
Location	string	20	Contains location of sewerage line
Owner			Contains the name of the owner
Remarks	String	100	

28) Layer name: **OP306864**
Feature Type: **Polygon**

This shape file will contain various polygon features of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Type	string	50	To contain boundary of following features - "Graveyard" - "Crematorium" - "Cemetery" - "Eidgah" - "Restricted Area" - "Airport" - "Brick Field" - "Rikshaw Garage" - "Automobile Garage" - "Slum" - "Monument" - "Open Space" - "Parks" - "Playground" - "Stadium" - "Golf Course" - "Botanical Garden" - "Zoological Park" - "Power Plant/Station" - "Bus Terminal" - "Truck Terminal" - "Water Treatment Plant" - "Sewerage Treatment Plant" - "Waste Disposal Plant" - "Railway Station" - "Bazaar Boundary" - "Forest Land" - "Sand Fill" - "Swimming Pool" - - *Other if necessary*
Owner			Contains the name of the owner

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29) Layer name: **AP306864**
Feature Type: **Point**

This shape file will contain point features of project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Type	string	50	- "Airport" - "Bazar" - "Government Bank" - "Private Bank" - "Brickfield" - "Bridge" - "Bus Terminal" - "Cemetery" - "Church" - "Cinema Hall" - "College" - "Crematorium" - "Deep tube well" - "Dustbin" - "Filling Station" - "Graveyard" "Growth Center" - "Hand tube well" - "Historic site" - " Government High School" " Registered High School" " Non-Registered High School" - "Hospital/Clinic" - "Madrasa" - "Registered Madrasa" - "Non-Registered Madrasa" - "Mazar/Dargah" - "Monument" - "Mosque" - "Museum" - "Oil Reservoir/Depot" - "Over Bridge" - "Pagoda" - "Police Box" - "Police Station" - "Post Office" - "River Port" - "Government Primary School"

Field Name	Field Type	Width of the field	Purpose of the field
			- "Registered Primary School"
			- "Non-Registered Primary School"
			- "Sluice gate"
			- "Temple"
			- "Theater Hall"
			- "Truck Terminal"
			- "Under Pass"
			- "University"
			- "Private University"
			- "Well"
			- "Culvert"
			- *Other if necessary*
Name	string	50	To contain name of the feature, if any
PF_ID	Long integer	6	To contain the point feature ID.
PointType	string	50	To contain short name "GPS" of the feature, e.g. Government Primary School (GPS)
Owner			Contains the name of the owner
Remark	string		Contains Further Explanation

30) Layer name: **NAM306864**
Feature Type: **Point**

This shape file will contain the names of important places and structures as point features in project area.

Field Name	Field Type	Width of the field	Purpose of the field
Name	String	100	To contain - Name of locality, market, bazaar, important structure, historic site, university, play ground, poultry farm, river, khal, lake, pond, etc.

1) Layer name: **RN306864**
Feature Type: **Annotation/Polyline**

This shape file will contain the names of important places and structures as point features in project area.

Field Name	Field Type	Width of the field	Purpose of the field
Name	String	100	To contain the name of road segment.

32) Layer name: **PRL306864**
Feature Type: **Polyline**

This shape file will contain center lines of proposed roads as line features in the project area.

Field Name	Field Type	Width of the field	Purpose of the field
Width_m	Double	-	To contain width of the proposed road in meter
Width_ft	Double	-	To contain width of the proposed road in foot
From_To	String	100	To contain the names (of road/place) from where the road starts and to where the road ends.
Prop_type	String	20	To contain any of the two - "New" - "Widening"
Type	String	20	To contain any of the following - "Underground" - "Ground" - "Flyover" - "Viaduct"
Remarks	String	254	*** To follow the road map preparing methods.

33) Layer name: **POP306864**
Feature Type: **Polygon**

This shape file will contain polygon features of unions/wards derived from dissolved Mouzas of the project area. It must contain the field as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Union_Ward	String	50	To contain name of the Mouza
Area_BBS	Double	-	To contain area from BBS records
Area_GIS	Double	-	To contain area calculated by GIS software
Pop_2001	Long Integer	-	To contain Population in the year 2001
Pop_2011	Long Integer	-	To contain Population in the year 2011
Pop_2021	Long Integer	-	To contain Population in the year 2021
Pop_2035	Long Integer	-	To contain Population in the year 2035
Pop_den_2011	Double	-	To contain population density
Division	String	25	To contain name of Division
District	String	25	To contain name of District
Upazila	String	25	To contain name of Upazila
Union_Ward	String	25	To contain name of Union/Ward
Geocode	String	11	To contain BBS geocode of the Union
Remarks	String	254	Remarks, if any.

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34) Layer name: **STP306864**
Feature Type: **Polygon**

This shape file will contain proposed policy on the merged Mouza map of the project area. It must contain the fields as described in the following table:

Field Name	Field Type	Width of the field	Purpose of the field
Policy_Zone	String	50	To contain proposed policy on the plots.
Remarks	String	100	To contain remark, if any.

B.1.2 Point Feature Codes

The following feature codes (Unique ID) must be assigned in appropriate fields of the layers.

The following Point feature codes (Unique ID) will be used as follows:

Point Feature Categories	Unique ID
- "Airport"	255
- "Bazar"	260
- "Government Bank"	265
- "Private Bank"	270
- "Brickfield"	275
- "Bridge"	280
- "Bus Terminal"	285
- "Bus Stand"	290
- "Cemetery"	295
- "Church"	300
- "Cinema Hall"	305
- "Government Medical College"	245
- "Private Medical College"	250
- "Government College"	145
- "Government Woman College"	150
- "Registered College"	155
- "Non-Registered College"	160
- "Government Poly Technical Institute"	165
- "Private Poly Technical Institute"	170
- "Vocational Institute"	175
- "Jubo Unnayan Kendra"	310
- "Government Teacher's Training College"	235
- "Private Teacher's Training College"	240
- "Crematorium"	315
- "Deep Tube Well"	320
- "Dustbin"	325
- "Filling Station"	330
- "Graveyard"	335
- "Growth Center"	340
- "Hand Tube Well"	345
- "Arsenic Hand Tube Well"	350
- "Tara Pump"	355
- "Historic Site"	360
- "Government High School"	125
- "Government Girl's High School"	130

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Point Feature Categories	Unique ID
- "Registered High School"	135
- "Non-Registered High School"	140
- "Hospital/Clinic"	365
- "Government Kamel Madrasa"	180
- "Registered Kamel Madrasa"	185
- "Government Fazel Madrasa"	190
- "Registered Fazel Madrasa"	195
- "Government Alem Madrasa"	200
- "Registered Alem Madrasa"	205
- "Government Eftedayee Madrasa"	210
- "Registered Eftedayee Madrasa"	215
- "Non-Registered Madrasa"	220
- "Mazar/Dargah"	370
- "Monument"	375
- "Mosque"	380
- "Museum"	385
- "ASA NGO"	390
- "BRAC NGO"	395
- "Proshikha NGO"	400
- "TMSS NGO"	405
- "Other's NGO"	410
- "Insurance Company"	415
- "Life Insurance Company"	420
- "Oil Reservoir/Depot"	425
- "Over Bridge"	430
- "Pagoda"	435
- "Police Box"	440
- "Police Station"	445
- "Post Office"	450
- "River Port"	455
- "Government Primary School"	100
- "Registered Primary School"	105
- "Non-Registered Primary School"	110
- "K.G. School"	115
- "Kindergarten School"	120
- "Sluice Gate"	460
- "Temple"	465
- "Theater Hall"	470
- "Truck Terminal"	475
- "Under Pass"	480
- "Government University"	225
- "Private University"	230
- "Well"	485
- "Culvert"	490
- "Other if Necessary	To put or add the Unique ID accordingly 5 Interval

Annexure-III: Log Book of Physical Feature, Landuse, Vulnerability Assessment Attribute Collection Forms

Upazila:	
Union:	
Ward No:	
Grid ID:	
Sheet No.	
Mouza	

Preparation of Development Plan for 14 Upazilas (Package-1)
Urban Development Directorate, Ministry of Housing and Public Works
Physical feature and Landuse Survey

Date:	
Name of the Surveyor:	
Name of Supervisor:	

Data: Drain/Sewerage Line

ID	Type (Pipe/RCC/Brick/Kacha)	Width (m)	Depth (m)	Radius (m)	Road ID	Remarks

Code: OD= Open Drain, CD= Cover Drain, S=Sewer Line

ECAL, Dhaka

Upazila:	
Union:	
Ward No:	
Grid ID:	
Sheet No.	
Mouza	

Preparation of Development Plan for 14 Upazilas (Package-1)
Urban Development Directorate, Ministry of Housing and Public Works
Physical feature and Landuse Survey

Date:	
Name of the Surveyor:	

Name of Supervisor:	

Data: Road/Embankment

ID	Name	Type (Pucca/Kathca/HBB/Semi Pucca)	Width (m)	Shoulder (m)	Owner*

ECAL,

Code: R= Road, E= Embankment, ER= Embankment cum Road, ER= Embankment cum Road
* 1=LGED; 2=RHD; 3=Paurashava; 4=Union Parishad; 5= Upazila Parishad; 6= Zila Parishad; 7=Others

Upazila:	
Union:	
Ward No:	
Grid ID:	
Sheet No.	
Data	Bridge/Culvert

Preparation of Development Plan for 14 Upazilas (Package-1)
Urban Development Directorate, Ministry of Housing and Public Works
Physical feature and Landuse Survey

Date:	
Name of the Surveyor:	

Name of Supervisor:	

Data: Bridge/Culvert

ID	Type of Structure (Wooden/RCC/Steel)	Width (m)	Length (m)	Road ID	Northing	Easting	Name

Code: B=Bridge, C= Culvert

ECAL,

Upazila:	
Union:	
Ward No:	
Grid ID:	
Sheet No.	
Mouza	

Preparation of Development Plan for 14 Upazilas (Package-1)
Urban Development Directorate, Ministry of Housing and Public Works
Physical feature and Landuse Survey

Date:	
Name of the Surveyor:	

Name of Supervisor:	

Data: Agriculture/Vegetarian

ID	Type of Land (Paddy/Vegetables/Fruits/Others)	Cropping Pattern (Single Crop/Double Crop/Triple Crops/ Fallow Land/Others)	Remarks (Name if any)

Code: A= Agriculture, V=Vegetarian, 1=Single Crop, 2=Double Crop, 3=Triple Crop, 4=Fallow Land, 5=Others

ECAL

Upazila:	
Union:	
Ward No:	
Grid ID:	
Sheet No.	
Mouza	

Preparation of Development Plan for 14 Upazilas (Package-1)
Urban Development Directorate, Ministry of Housing and Public Works
Physical feature and Landuse Survey

Date:	
Name of the Surveyor:	

Name of Supervisor:	

Data: Water Body

ID	Type of Water Body (River/Khal/Beel/Baor/MarshLand/Pond/Gheer))	Owner (Individual/Public/Other)	Name	Width (m)	Depth (m)

ECAL,

Upazila:	
Union:	
Ward No:	
Grid ID:	
Sheet No.	
Mouza	

Preparation of Development Plan for 14 Upazilas (Package-1)
Urban Development Directorate, Ministry of Housing and Public Works
Physical feature and Landuse Survey

Date:	
Name of the Surveyor:	

Name of Supervisor:	

Data: Utilities

ID	Utility Type (Electric Pole, Telephone Pole, Mobile Tower, Deep Tube-well, Overhead Tank, Others)	Ownership (Individual/Public/Other)	Remarks

ECAL,

Code: EP=Electric Pole, TP=Telephone Pole, MT= Mobile Tower, DTW=Deep Tube-well, OHT=Overhead Tank, Others (Specify the Name)

Upazila:	
Union:	
Ward No:	
Grid ID:	
Sheet No.	
Mouza	

Preparation of Development Plan for 14 Upazilas (Package-1)
Urban Development Directorate, Ministry of Housing and Public Works
Physical feature and Landuse Survey

Date:	
Name of the Surveyor:	

Name of Supervisor:	

Data: Playground/Eid-gah Math/Graveyard/Garden/Park

ID	Ownership (Individual/Public/Other)	Name	Present Use

Code: PG=Playground, EM=Eid-gah Math, GY=Graveyard, G=Garden, P= Park

ECAL,

Upazila:	
Union:	
Ward No:	
Grid ID:	
Sheet No.	
Mouza	

Preparation of Development Plan for 14 Upazilas (Package-1)
Urban Development Directorate, Ministry of Housing and Public Works
Physical feature and Landuse Survey

Date:	
Name of the Surveyor:	

Name of Supervisor:	

Data: Bus/Truck/Railway Station/Hat/Bazar/Growth Centre

ID	Ownership (Individual/Public/Other)	Name	Northing	Easting

Code: B=Bus, T=Truck, R=Railway

ECAL,

Structure New_Id	Plot No.	Northing	Easting	Structure Type[1]	Floor	Structure Name	Structure Floor Information & Population No.												Day Population	Night Population	Structural Information(Y/N)									Landmark	Quality[2]
							1st Floor Use / Population		2nd Floor Use / Population		3rd Floor Use / Population		4th Floor Use / Population		5th Floor Use / Population		6th Floor Use / Population				Mobile Tower	Overhanging	Soft Story	Pounding	Short Column	Ground Set	Tilting	Set Back		
							Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night												
							Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night												
							Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night												
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							Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night												
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							Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night												
							Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night												

ECAL,

Structure Use: Residential=R; Commercial Use=C (Bank, Industry, Market NGO; Others=Mention Full Name; 1. Structure Type: Pucca=P, Semi Pucca=S, Katcha=K; 2. Quality: Good=1, Bad=2, Average=3

PHYSICAL FEATURE SURVEY

LAND USE SURVEY

TOPOGRAPHIC SURVEY

PHOTOGRAMMETRIC WORKS