# การทำแผนที่ดิจิตอลของตะกอนผิวดินในพื้นที่อู่ทอง จังหวัดสุพรรณบุรี

นายไอราพต แสงระยับ

ธรณีวิทยา

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รายงานนี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรบัณฑิต
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ปีการศึกษา 2558

# DIGITAL MAPPING OF SURFICIAL DEPOSITS IN U-THONG AREA, CHANGWAT SUPHANBURI.

Mr. Irapot Saengrayab

A REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF THE BACHELOR OF SCIENCE IN GEOLOGY
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(ผู้ช่วยศาสตราจารย์ ดร. สมบัติ อยู่เมือง)

อาจารย์ที่ปรึกษาโครงงาน

# บทคัดย่อ

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|---|---|
| **ชื่อโครงการ** | **การทำแผนที่ดิจิตอลของตะกอนผิวดินในพื้นที่อู่ทอง จังหวัดสุพรรณบุรี** |
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การทำแผนที่ดิจิตอลตะกอนผิวดินเป็นการประยุกต์เทคนิคในการทำแผนที่ธรณีวิทยา ซึ่งเป็นระบบที่ออกแบบมาเพื่อใช้วิเคราะห์ในเชิงวิทยาศาสตร์ โดยใช้เทคนิคโทรสัมผัส และเทคนิคระบบสารสนเทศภูมิศาสตร์เข้ามาช่วยในการศึกษา โดยการศึกษาครั้งนี้มุ่งเน้นศึกษาการสะสมตัวของวัสดุหรือตะกอนผิวดินที่ยังไม่แข็งตัวซึ่งสามารถบอกวิทยาของหิน ซึ่งเป็นข้อมูลพื้นฐานที่ใช้ในการพัฒนาพื้นที่ในอนาคต ซึ่งจะจัดทำในรูปแบบของแผนที่และข้อมูลดิจิตอล โดยพื้นที่ศึกษาครอบคลุมพื้นที่ 556 ตารางกิโลเมตร ของอำเภออู่ทอง อำเภอเมืองสุพรรณบุรี และอำเภอบางปลาม้า จังหวัดสุพรรณบุรี โดยใช้ข้อมูลที่สำคัญ ได้แก่ ภาพถ่ายดาวเทียม Landsat 8 OLI/TIRS ภาพถ่ายดาวเทียม THEOS แบบจำลองระดับความสูงเชิงตัวเลข มาทำการวิเคราะห์ประมวลผล และแปลความหมายเพื่อจำแนกหน่วยตะกอนผิวดินด้วยสายตา และการสำรวจตรวจสอบข้อมูลในภาคสนาม เพื่อนำมาใช้เลือกพื้นที่ตัวอย่างในการการจำแนกประเภทข้อมูลภาพแบบควบคุม และปรับแก้ขอบเขตหน่วยตะกอนผิวดิน

หน่วยของตะกอนผิวดินในพื้นที่อู่ทองสามารถแบ่งได้ทั้งหมด 8 หน่วย คือ หน่วย A ประกอบด้วย หินกรวดมน และ ดินสีแดงปนทรายแป้ง หน่วย B ประกอบด้วย ดินเหนียวปนทรายแป้งสีแดง หน่วย C ประกอบด้วย ดินเหนียวปนทรายแป้งสีน้ำตาลดำ หน่วย D ประกอบด้วย ดินเหนียวปนทรายแป้งสีเทาอมน้ำตาล หน่วย E ประกอบด้วย ดินเหนียวปนทรายแป้งสีน้ำตาล หน่วย F ประกอบด้วย ดินเหนียวสีน้ำตาลอ่อน หน่วย G ประกอบด้วย ดินเหนียวสีน้ำตาลดำ และ หน่วย H ประกอบด้วย ดินเหนียวสีน้ำตาล และหน่วยอื่นอีก 2 หน่วย คือ หน่วย หินดาน และ หน่วย ชุมชน-หมือง อยู่ในบริเวณภูเขาทางทิศตะวันตกของพื้นที่

ในการจำแนกหน่วยของตะกอนผิวดินด้วยการทำแผนที่ดิจิตอล โดยใช้ข้อมูลภาพถ่ายดาวเทียมและแบบจำลองระดับความสูงเชิงตัวเลขนั้น สามารถวิเคราะห์ข้อมูลในเชิงคลื่นได้ อีกทั้งข้อมูลจากการสำรวจตรวจสอบในภาคสนามยังมีความสำคัญในการยืนยันการแปความหมายแบบดิจิตอล ซึ่งเมื่อเลือกพื้นที่ตัวอย่างจากการออกภาคสนามมาวิเคราะห์ในการจำแนกประเภทข้อมูลภาพแบบควบคุมครั้งที่สองสามารถทำให้จำแนกหน่วยและขอบเขตของตะกอนผิวดินได้อย่างแม่นยำ ถึงแม้ว่าการทำแผนที่ดิจิตอลอาจไม่สามารถบอกลักษณะเฉพาะของตะกอนได้ทั้งหมด แต่สามารถทำการแปรการสะสมตัวของตะกอนในพื้นที่ที่มีขนาดใหญ่ได้ในเวลาอันสั้น


**คำสำคัญ :** การทำแผนที่ธรณีวิทยาดิจิตอล ตะกอนผิวดิน อู่ทอง สุพรรณบุรี

# Abstract

| | |
|---|---|
| **Project name** | **Digital Mapping of Surficial Deposits in U-Thong area, Changwat Suphanburi** |
| **Department** | **Geology** |
| **Producer** | **Mr. Irapot Saengrayab ID 5532747323** |
| **Advisor** | **Assist.Prof.Dr. Sombat Yumuang** |

Digital mapping of surficial deposits is applied geological mapping technique. The system is designed to provide a scientific analysis, by using remote sensing techniques and GIS techniques to help in the study that is focused on the unconsolidated sediments which is the basis information for the future development of the area. The study area covers an area of 556 square kilometers of Amphoe U-Thong, Amphoe Muang Suphanburi and Amphoe Bang Pla Ma. The prepared data are composed of satellite imagery (Landsat 8 OLI/TIRS, THEOS) and digital elevation model (DEM). The digital analysis, digital processing and interpretation are be used to classify the surficial deposits units in the study area. Besides, the observation data in the field are also collected in the study area to be used in the supervised classification and readjusted the boundary of the units to be the final surficial deposits map.

The study was able to classify the surficial deposits unit in the flat plain area into eight units including Unit A: gravel and red silt, Unit B: red silt and red clay, Unit C: Dark brown silty clay, Unit D: Brownish grey silty clay Unit E: Brown silty clay, Unit F: Light brown clay, Unit G: Dark brown clay, and Unit H: Brown clay. Besides, the other two different units, namely; Unit bedrock and Unit urban-mine are also classified in the western part of mountainous area.

Finally, main idea to classify surficial deposits units in U-Thong area that focuses in using satellite image and digital elevation model to classify the surficial deposits because the digital classification can be confirmed each unit identified from different spectral range. Anyway, the field data significantly to improve and confirm the detail and boundary of surficial deposits units by the second supervised classification. Although the digital classification cannot define the lithologic characteristic but they spend less time in the large area.



**Keywords:** Digital mapping, Surficial Deposits, U-Thong area

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# CHAPTER 1

# INTRODUCTION

In our world today, many living things on the surface of the earth have to face many kinds of natural disasters, it's true that recently people see human disasters as a very important issue, but at the same time, only one natural disaster can easily cause ten or more times as much damage as those damages created by human or other living things.

For many of the developed countries, these problems caused by natural disasters are considered to be more severe to deal with, since most of the developed countries they already have some source of disaster mitigation, or disaster preparedness programs within the country. In contrast, the developing countries normally wouldn't have such tools to help dealing with these problems, and they end up trying to get things fixed, rather than solving and protecting together at the same stage.

According the topic mentioned above, surficial deposits map is one of the tool that will brings much benefit to the management aspect of the issues that related to the natural disaster, as well as the planning processes. In Thailand there are so many databases can be found on this topic, but unfortunately there are only few researches to gather data from and help put together the important information.

## 1.1 Rationale

Surficial units of U-thong area in recent geological map contained with $Q_a$ $Q_{af}$, $Q_{mc}$ and $Q_c$. (DMR, 2007), as well as further classified as delta plain; blackish clay in lower central plain (J.R.P. Somboon, 1992). Besides, the interested surficial units of U-thong area are above 1.0 – 2.5 meters of mean sea level were also proposed to be more study (S. Sinsakul, 1998)

Digital mapping technology can be applied to traditional geologic mapping, reconnaissance mapping, and surveying of geologic features. At international digital field data capture (DFDC) meetings, major geological surveys discuss how to harness and develop the technology. Many other geological surveys and private companies are also designing systems to conduct scientific and applied geological mapping of, for example, geothermal springs and mine sites. (USGS, 2011)

Some features of digital mapping equipment are common to both survey or reconnaissance mapping and “traditional” comprehensive mapping. The capture of less data-intensive reconnaissance mapping or survey data in the field can be accomplished by less robust databases and available effective GIS techniques as well as available digital remote sensing data and techniques. (British Geological Survey and Geological Survey of Canada, 2012)

Superficial deposits or surficial deposits refer to geological deposits typically of less than 2.6 million years old. These recent unconsolidated sediments may include stream channel and floodplain deposits, beach sands, talus gravels and glacial drift and moraine. All pre-quaternary deposits are referred to as bedrock. (SGU, 2012)

Unconsolidated surficial materials may also be given a lithology. This is defined by grain size and composition, and is often attached to an interpretation of how the unit formed. Surficial lithologies can be given to lacustrine, coastal, fluvial, aeolian, glacial, and recent volcanic deposits, among others. Examples of surficial lithology classifications used by the US Geological Survey are, "Glacial Till, Loamy", "Saline Lake Sediment", and "Eolian Sediment, Coarse-Textured (Sand Dunes)". (USGS, 2011)

Sweden's quaternary geology databases contain information on the properties of superficial deposits. This information, particularly at a scale of 1:50 000, can be used for a number of different purposes in farming and forestry, including avoiding erosion, assessing growing conditions, gauging risks in terms of nutrient leaching and release of toxic substances, planning site preparation, road construction, felling and extraction operations, judging accessibility etc. (SGU, 2012)

The aim of this study is classify surficial units in U-thong area from modern technique (digital image classification) with satellite image, digital elevation model (DEM) and field observation data for developing the surficial deposits map that should be used for the applications in planning agriculture, land-use, watershed management and disaster reduction, etc.

## 1.2 Objective

Application of Remote sensing and GIS techniques for surficial mapping in the U-thong area.

## 1.3 Scope and limitation

This thesis is limited to identify parameters influencing the present deposits from satellite image (Landsat 8 OLI) base integrated with the application of the remote sensing and geographic information system (GIS) techniques.

## 1.4 Location of the study area

The study area (Figure1-1) is locate in Amphoe U-Thong, Changwat Suphanburi at the western of lower central plain Thailand. The area comprises approximately 556 square kilometers.

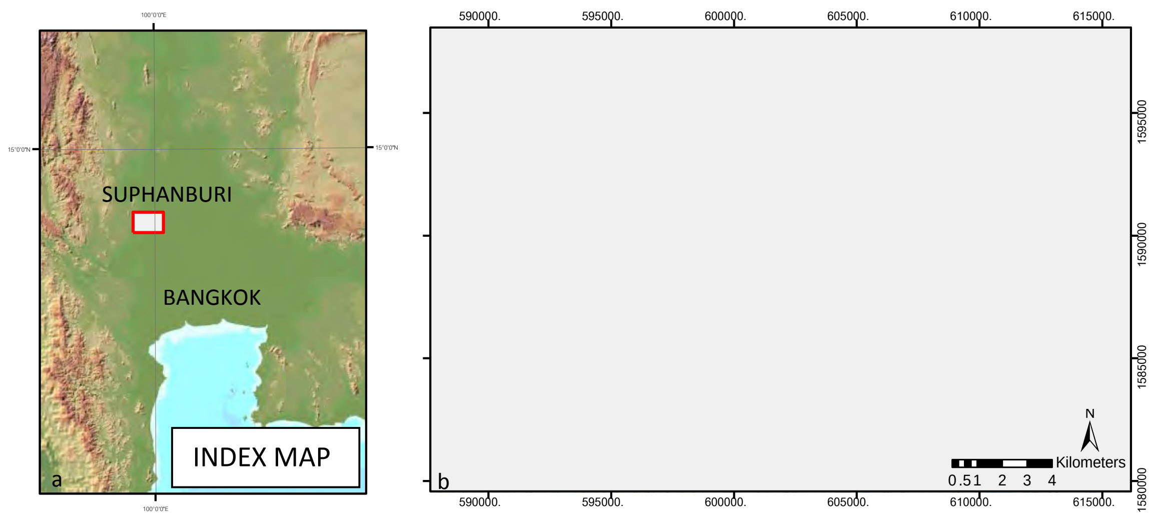



Figure 1-1 (a) Geographic map of study area. (b) Topographic map of study area.

## 1.5 Expected output

Surficial mapping in the U-thong area from remote sensing and GIS technique

# CHAPTER 2

# LITERATURE REVIEWS

## 2.1 Introduction

In this chapter, geology of the study area will be reviewed for the basic of geological units in the study area. Surficial deposits and digital classification are important part to describe how to analyst database for the final map. Besides, use of the remote sensing and geographic information system (GIS) techniques in digital classification are also mentioned.

## 2.2 Geology of study area

Department of mineral resources classified and descripted unconsolided sedimentary units in study area into 4 units (Figure 2-1), namely: $Q_a$ (Fluvial deposits: gravel, sand, silt, and clay of channel, river bank, and flood basin, $Q_{af}$ (Alluvial fan deposits: gravel, sand, silt, and clay of bedload and mass-flow built up as fans along marginal basin), $Q_c$ (Colluvial and residual deposits: gravel, sand, silt, laterite, and rock fragments, and $Q_{mc}$ (Coastal tide-dominated deposits: clay, silt, and fine-grained sand of tidal flat, marsh, mangrove swamp and estuary). (DMR, 2007)

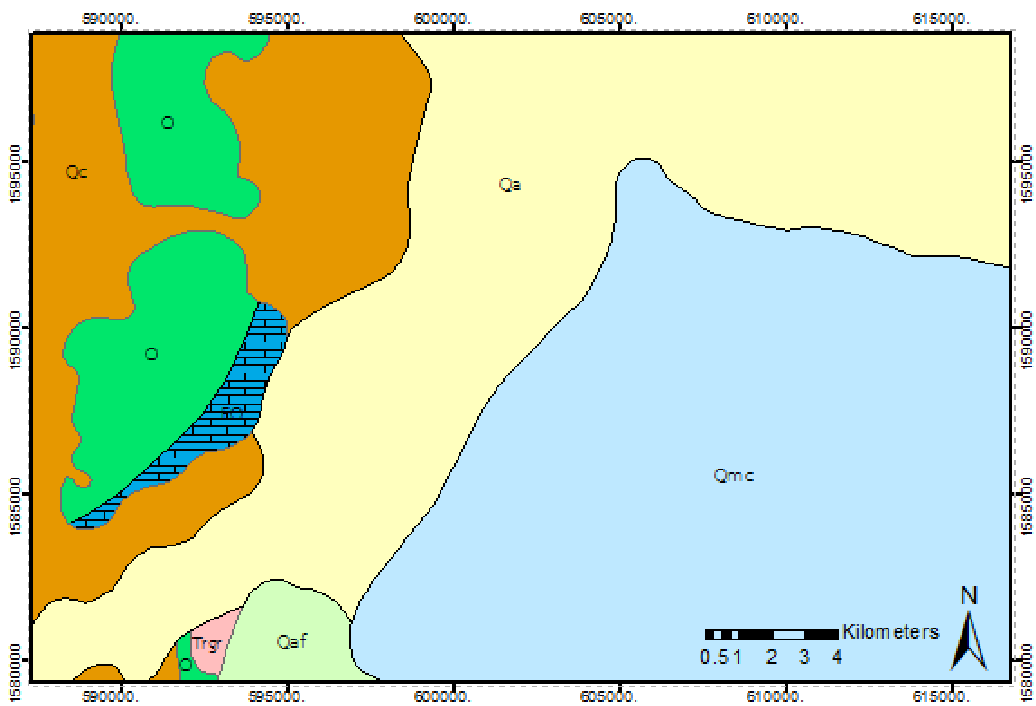



Figure 2-1 Geological map in study area derived from the Department of Mineral Resources (2007)

### 2.3 Surficial mapping

Traditional surficial geology maps contain additional information on glacial processes as well as information on glacial features, such as the spatial orientation and position of drumlinoid ridges, eskers, Rogen moraines, hummocky terrains, crag and tail structures, and striated surfaces. (L. Armand et al., 2012)

Further work is needed to test automated methods for extracting glacial or geomorphic features from remotely sensed imagery. This information could then be combined with surface material maps produced from remotely sensed data creating more complete, remote predictive, surficial geology maps (Figure 2-2). (L. Armand et al., 2012)

The method first discriminates the region into first-order terrains consisting of bedrock mountain highlands, basin piedmonts, and playa-basin interiors based on user-defined slope cutoffs applied to DEM data. The basin areas are subsequently classified into surficial map units such as active channels, ground-water discharge zones, and multiple age alluvial-fan piedmont units based on reflective properties of the associated surfaces in the satellite imagery. The surficial units are differentiated through systematic classification based on specific user-defined ranges of spectral (Figure 2-3) values for each unit. The spectral ranges used in the classification are largely dependent on the composite effects of surface characteristics and material properties, including depositional morphology and texture, pavement development, degree of surface clast varnishing, and (or) properties of exposed soils of the alluvial fan units. We have used the slope-curvature properties derived from the DEM data to discriminate the bajada areas that exhibit non-unique spectral characteristics. Slope curvature is particularly effective at differentiating young dissected surfaces from older dissected piedmont units. (A.S. Jayko, 2005)

Available geologic maps and field observations may be used both to iteratively calibrate the spectral classification scheme and to provide additional verification of the digital map output. Digital mapping combined with detailed field studies in selected areas provides useful regional maps of surficial units (Figure 2-4) until time and funding is available for more field intensive studies. In addition, anomalous areas on the thematic maps indicate where more detailed field or air photo work is warranted. The technique successfully distinguishes between bedrock, alluvial fans (generally multiple fan units), active washes, playas, playa rimming marshes and seeps and other active and inactive discharge zones in arid basin and mountain regions. Limitations occur in the subdivision of some fan units where the dominant detrital clast lithologies are not susceptible to varnish development. (A.S. Jayko, 2005)

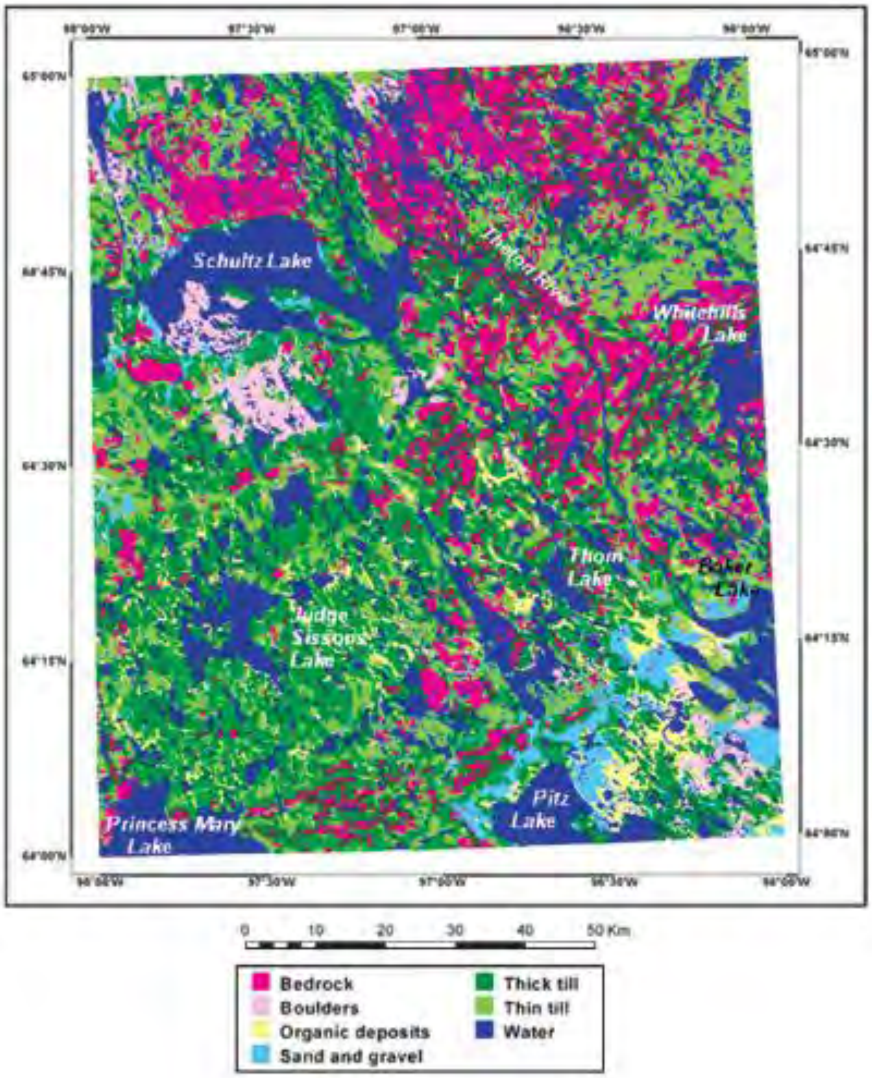



Figure 2-2 Surficial geology map of the Schultz Lake area. (Grunsky et al., 2009) with colour palette matchaing (McMartin et al., 2008)

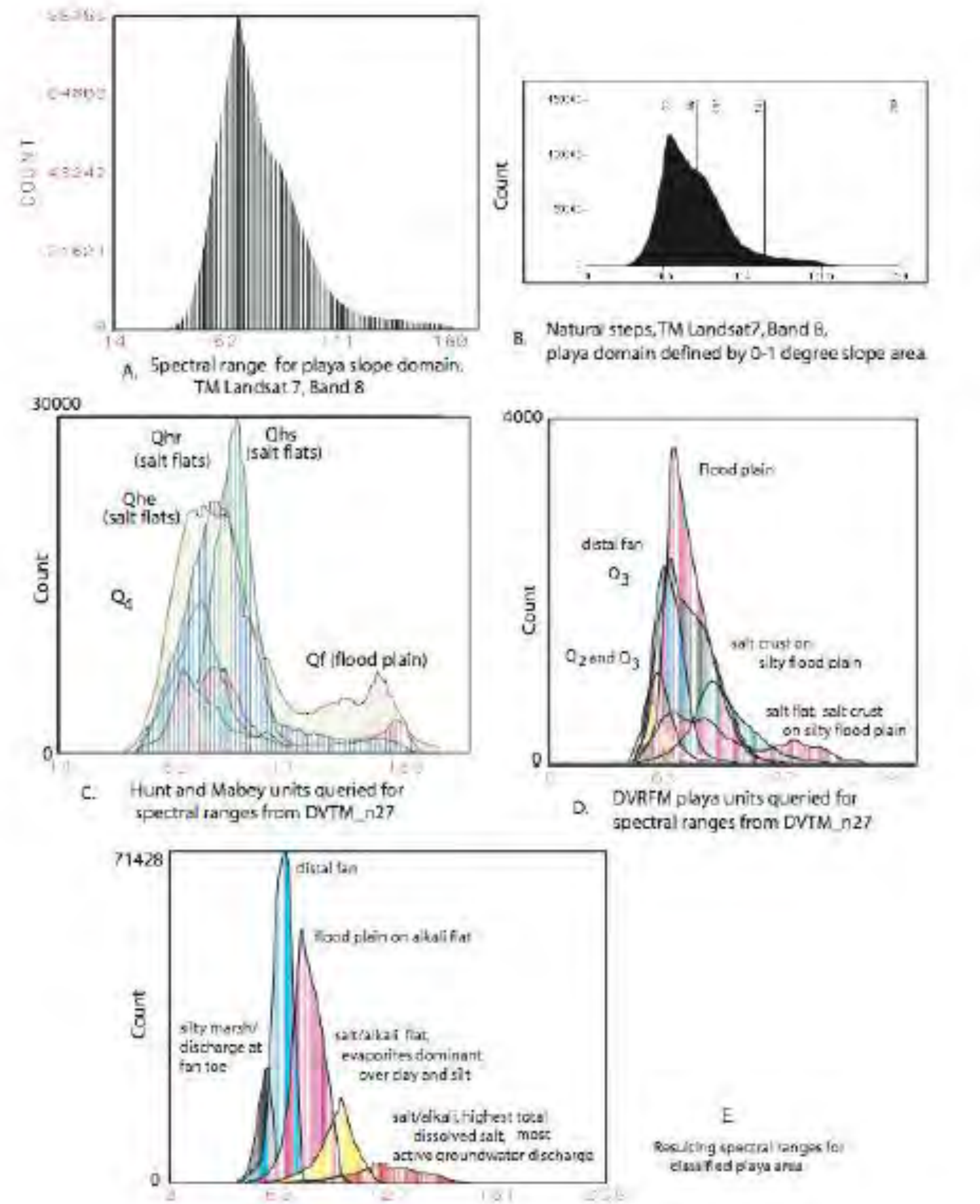



Figure 2-3 Histrograms of playa units, a.) entire fan domain, b.) natural breaks, c.) Hunt and Mabey (1966) Quaternary units, d.) classified playa units from Death Valley Regional Flow Model, and e.) classified playa units from thematic surficial deposits map.

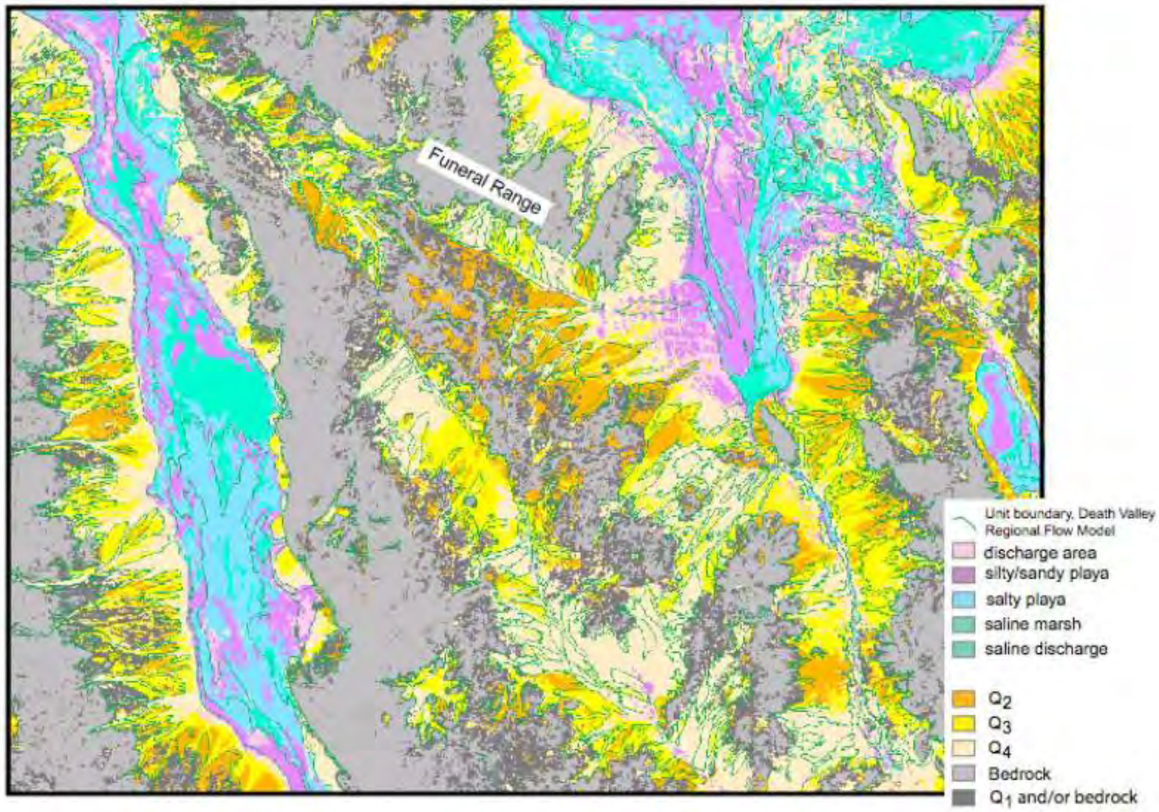



Figure 2-4 Thematic surficial deposits map with unit boundaries from the Death Valley Regional Groundwater Flow model overlain for comparison. Classification ranges for this map was selected to best fit the ground truth and Workman and others (2002).

### 2.4 Digital image classification

Features classification in an image uses the elements of visual interpretation to identify homogeneous groups of pixels which represent various features or land cover classes of interest. Digital image classification uses the spectral information represented by the digital numbers in one or more spectral bands, and attempts to classify each individual pixel based on this spectral information. This type of classification is termed spectral pattern recognition. In either case, the objective is to assign all pixels in the image to particular classes or themes. The resulting classified image is comprised of a mosaic of pixels, each of which belong to a particular theme, and is essentially a thematic "map" of the original image.

The classification need to distinguish between information classes and spectral classes. Information classes are those categories of interest that the analyst is actually trying to identify in the imagery, such as different kinds of crops, different forest types or tree species, different geologic units or rock types, etc. Spectral classes (Figure 2-5) are groups of pixels that are uniform with respect to their brightness values in the different spectral channels of the data. The objective is to match the spectral classes in the data to the information classes of interest. Rarely is there a simple one-to-one match between these two types of classes. Rather, unique spectral classes may appear which do not necessarily correspond to any information class of particular use or interest to the analyst. Alternatively, a broad information class (e.g. forest) may contain a number of spectral sub-classes with unique spectral variations. Using the forest example, spectral sub-classes may be due to variations in age, species, and density, or perhaps as a result of shadowing or variations in scene illumination. It is the analyst's job to decide on the utility of the different spectral classes and their correspondence to useful information classes (Figure 2-5).

Supervised classification, the analyst identifies in the imagery homogeneous representative samples of the different surface cover types of interest. These samples are referred to as training areas. The selection of appropriate training areas is based on the analyst's familiarity with the geographical area and their knowledge of the actual surface cover types present in the image. Thus, the analyst is "supervising" the categorization of a set of specific classes. The numerical information in all spectral bands for the pixels comprising these areas are used to "train" the computer to recognize spectrally similar areas for each class. The computer uses a special program or algorithm, to determine the numerical "signatures" for each training class. Once the computer has determined the signatures for each class, each pixel in the image is compared to these signatures and labeled as the class it most closely "resembles" digitally. Thus, in a supervised classification we are first identifying the information classes which are then used to determine the spectral classes which represent them.

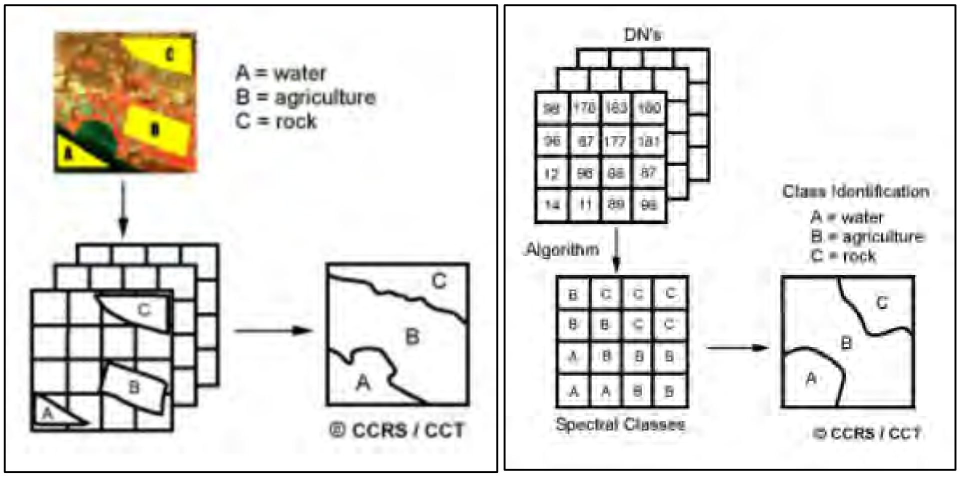



Figure 2-5 Left hand side is information class and Right hand side is spectral class

## 2.5 Remote sensing

Remote sensing is a tool or technique similar to mathematics. Using sensors to measure the amount of electromagnetic radiation (EMR) exiting an object or geographic area from a distance and then extracting valuable information from the data using mathematically and statistically based algorithms is a scientific activity. It functions in harmony with other spatial data-collection techniques or tools of the mapping sciences, including cartography and geographic information systems (GIS). (Clarke, 2001)

A combined formal definition of photogrammetry and remote sensing as: "the art, science, and technology of obtaining reliable information about physical objects and the environment, through the process of recording, measuring and interpreting imagery and digital representations of energy patterns derived from noncontact sensor systems". (Colwell, 1997)

The amount of electromagnetic radiance, *L* (watts m-2 sr-1; watts per meter squared per steradian) recorded within the IFOV of an optical remote sensing system (e.g., a picture element in a digital image) is a function of:

$$L = f\left(\lambda, s_{x,y,z}, t, \theta, P, \Omega\right)$$

where,

λ = wavelength (spectral response measured in various bands or at specific frequencies). Wavelength (λ) and frequency (υ) may be used interchangeably based on their relationship with the speed of light (*c*) where.

Sx,y,z = x, y, z location of the picture element and its size (x, y) t = temporal information, i.e., when and how often the information was acquired θ = set of angles that describe the geometric relationships among the radiation source (e.g., the Sun), the terrain target of interest (e.g., a corn field), and the remote sensing system P = polarization of back-scattered energy recorded by the sensor $\Omega$ = radiometric resolution (precision) at which the data (e.g., reflected, emitted, or back-scattered radiation) are recorded by the remote sensing system. (Jensen, 2007)

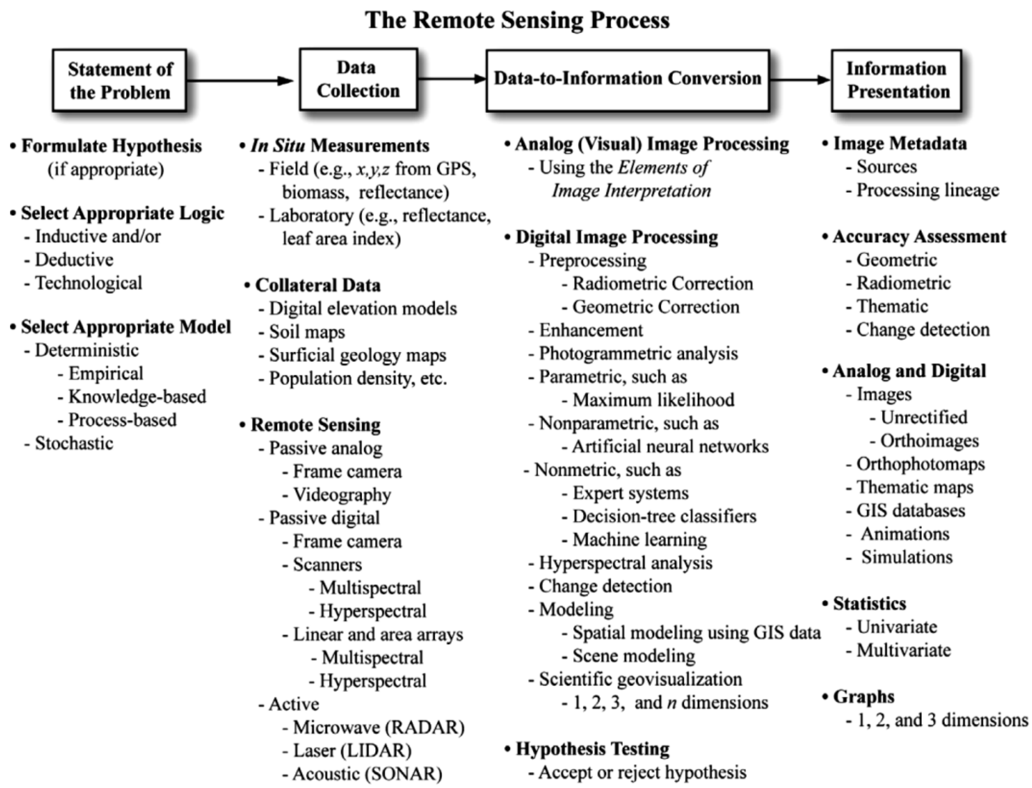



Figure 2-6 The remote sensing process (Jensen, 2007)

## 2.6 Geographic information system (GIS)

A geographic information system or geographical information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data.

Information related with Geographic Information Systems (GIS)

1. Preliminary data

a. maps = models of the Earth

(1) Traditional maps - paper drawings / models of the Earth

b. map distribution = spatial distribution

c. computers + digital information

d. computer assisted cartography (CAC) - digital maps

e. computer assisted drafting (CAD) - digital drawings

2. Cartographic process - data collection and map compilation

3. Map Features

a. points

b. lines

(1) straight line segments - between two points

(2) polylines - multiple segmented lines

c. polygons - lines that enclose areas

4. Map Layers

a. layers of spatial data that form "tracing overlays" on top of one another

b. examples of layers or themes or coverages for any given map region

(1) topography

(2) geology

(3) population density

(4) roads

(5) streams

(6) vegetation

(7) soils

5. LIS = land information systems

6. GPS = global positioning systems - satellite-based location system

7. Geodesy - measurement and mapping of the Earth's surface

a. Geodetic framework - position and elevation of points on the earth's surface

# CHAPTER 3

# THEMATIC DATA PREPARATION (METHODOLOGY)

The sources of input data and the steps of input data production will be comprehensively explained hereafter to indicate that data entry and production are the most cumbersome and time consuming steps of and kind of GIS and remote sensing techniques. The thematic data used in this study are to be prepared and processed below. Moreover, phases of surficial deposits analysis in GIS-based are also described. However, the detailed statistic digital mapping analysis of surficial deposits maps will be explained in the following chapter.

## 3.1 Database preparation

3.1.1 Geological map of Changwat Suphanburi (DMR, 2007).

3.1.2 Topographic map. (The Royal Thai Survey Department, 2006).

a. Map sheet number 4946I Map name AMPHOE U THONG.

b. Map sheet number 5087IV Map name AMPHOE MUEANG SUPHAN BURI.

3.1.3 Satellite imagery Landsat 8 OLI/TIRS code: LC81300502015075LGN00.

3.1.4 Satellite imagery THEOS 20140103_20130109.

3.1.5 Digital elevation model horizontal resolution 5 meters, vertical resolution 1 meter per pixel from Land development department (LDD).

3.1.6 Soil map of Changwat Suphanburi (LDD) (as shown in Figure 3-6).

## 3.2 Phase of surficial deposits analysis in remote sensing by visual classification method

In this phase the surficial units will be classified by visual classification method with Landsat 8 OLI band 777 (Figure 3-1). Band 7 is used to detect the wavelength of geology that shown in the grey scale whereas Landsat 8 OLI band 742 (Figure 3-2) is the combination band which the image from this band can be divided in color scale. THEOS (Figure 3-3) has high resolution suitable to analyze by the remote sensing technique. DEM (Figure 3-4) and slope analysis (Figure 3-5) are also used in the digital classification of surficial deposits units.

From the visual interpretation tchnique, each surficial deposits unit is divided from color, texture, pattern, shape, size and slope degree (Figure 3-7.1 – 3-7.10). The sequences of processing are as follow:

1.) Subdivide area into slope domains to distinguish bedrock, pediment or alluvial fan.

2.) Subdivide the pediments and fan defined slope areas into hilly units using spectral data classification.

3.) Subdivide the defined none slope area into wetland, and active wash using spectral data classification (supervised).

4.) Merge results into single grid.

5.) Evaluate results.

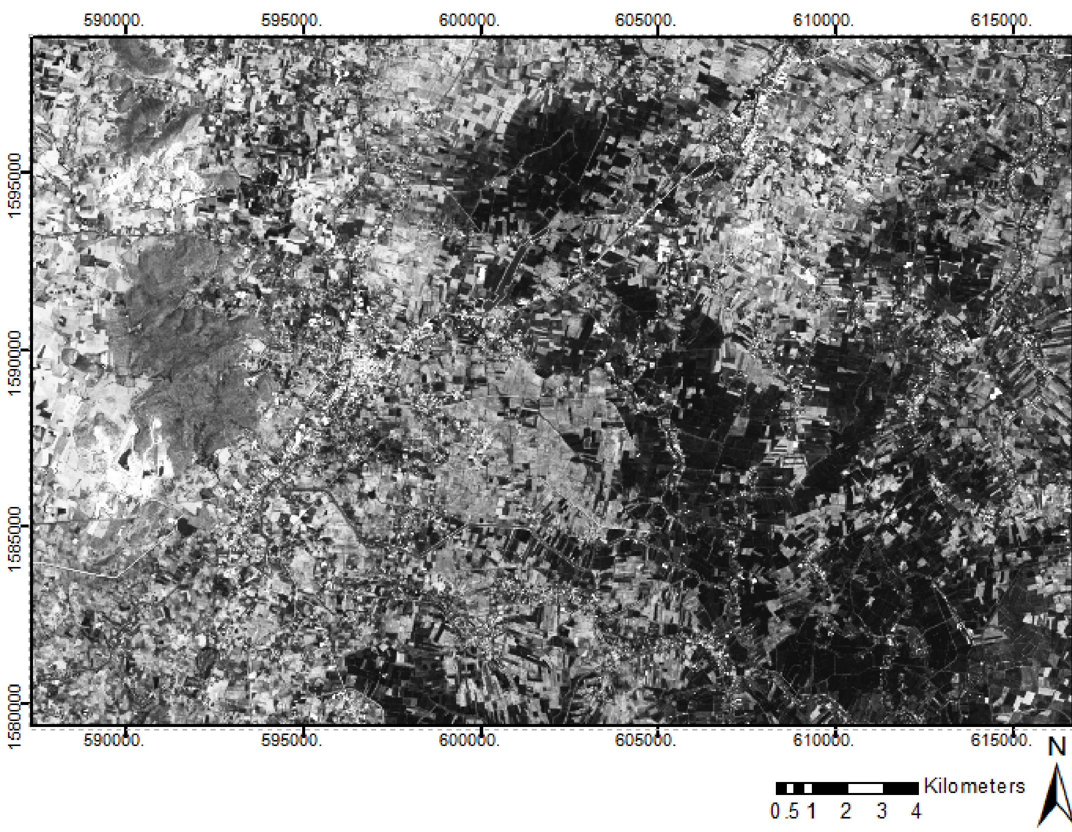



Figure 3-1 Satellite image of the study derived from landsat 8 OLI band 777.

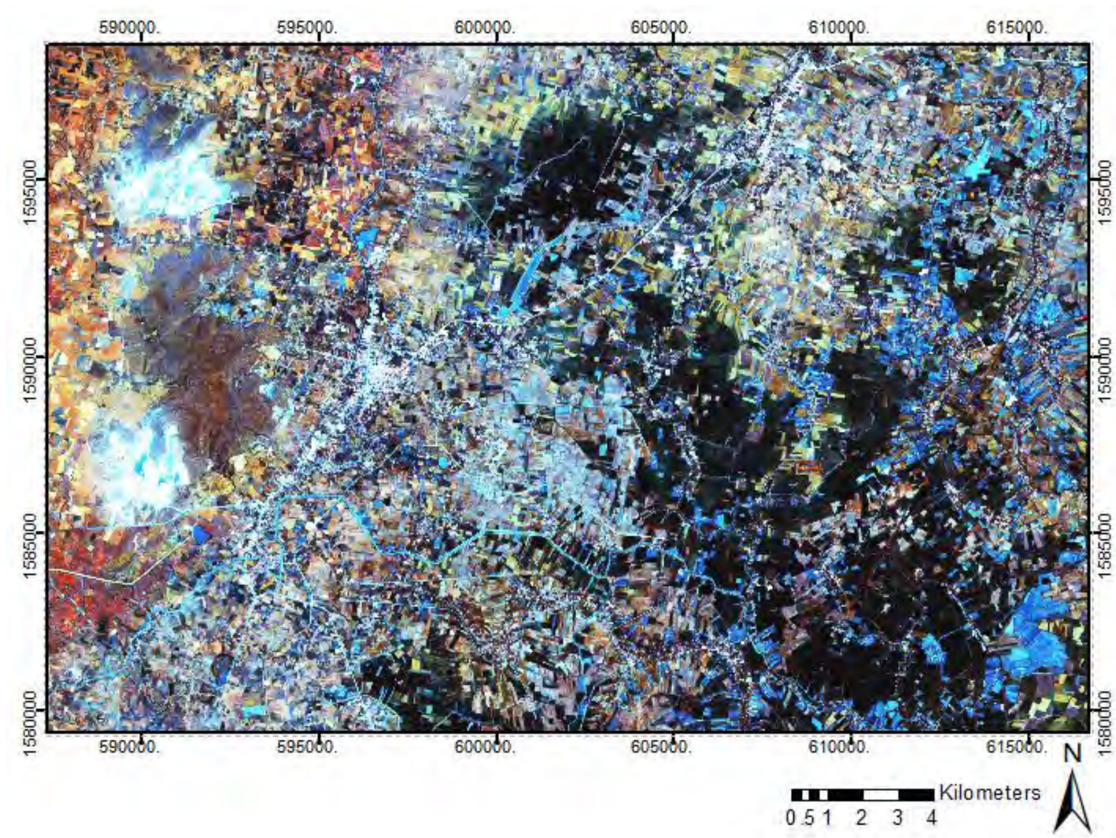



Figure 3-2 Satellite image of the study derived from Landsat 8 OLI band 742.

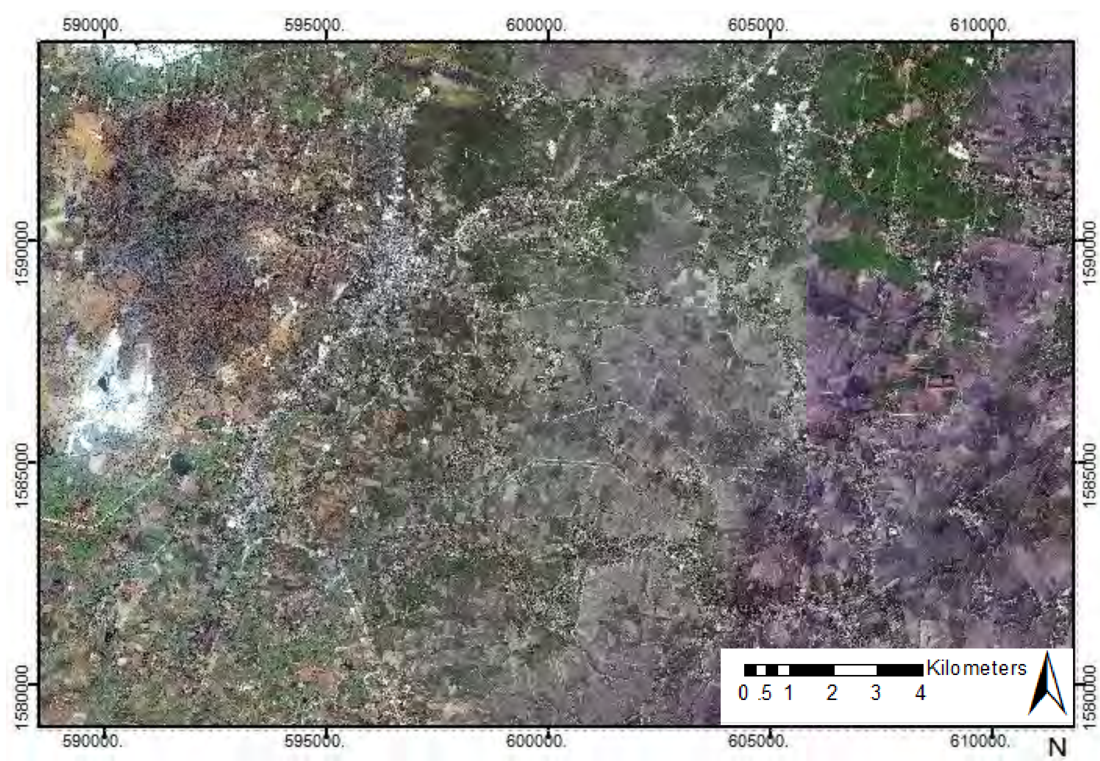



Figure 3-3 Satellite image of the study derived from THEOS date 20140103_20130109.

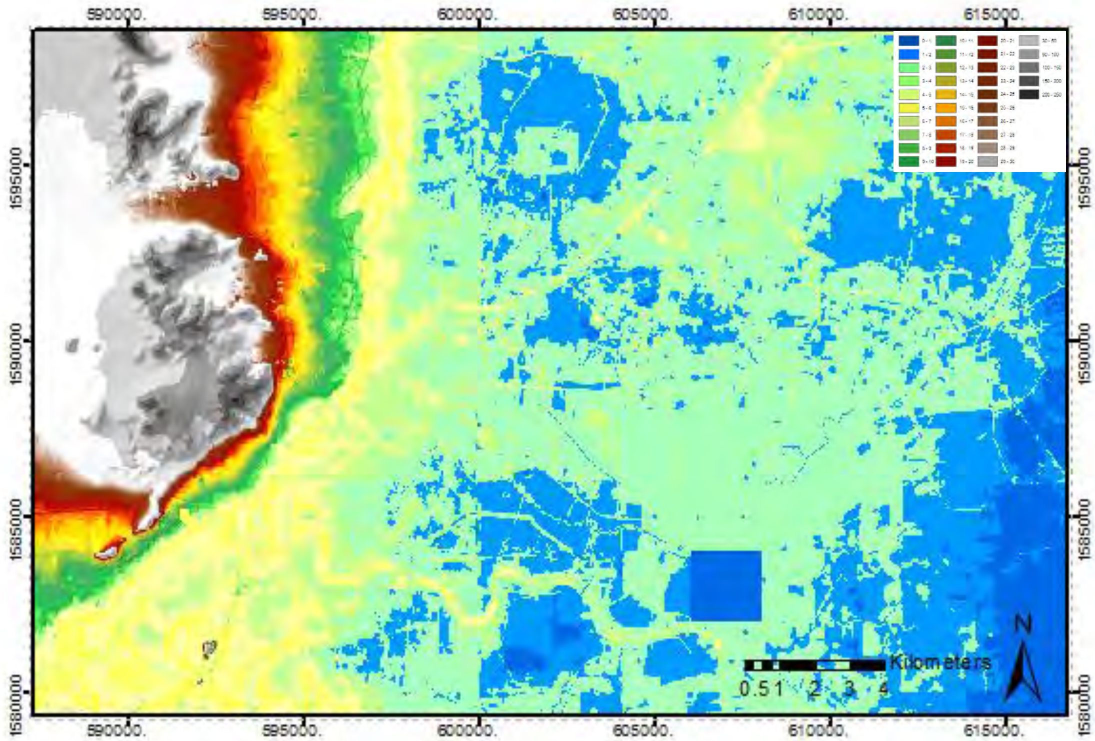



Figure 3-4 Digital elevation model of the study area that has horizontal resolution 5 meters and vertical resolution 1 meter per pixel; data source from Land development department (LDD).

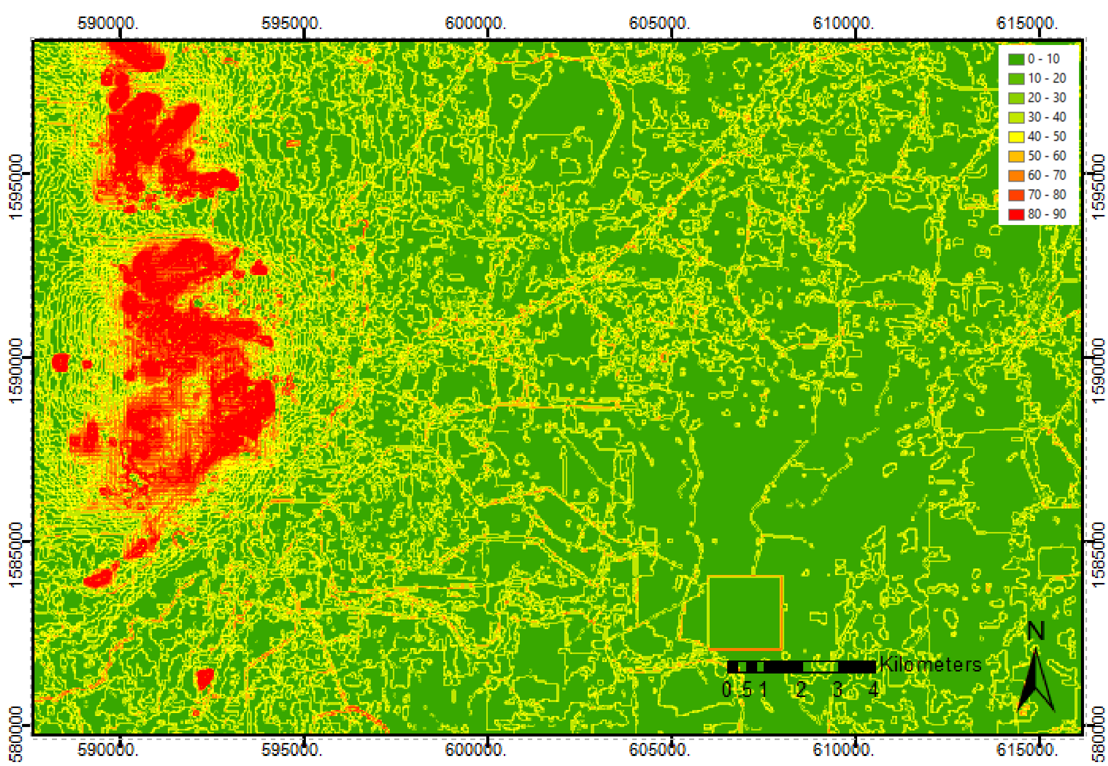



Figure 3-5 Slope analysis from DEM of the study area.

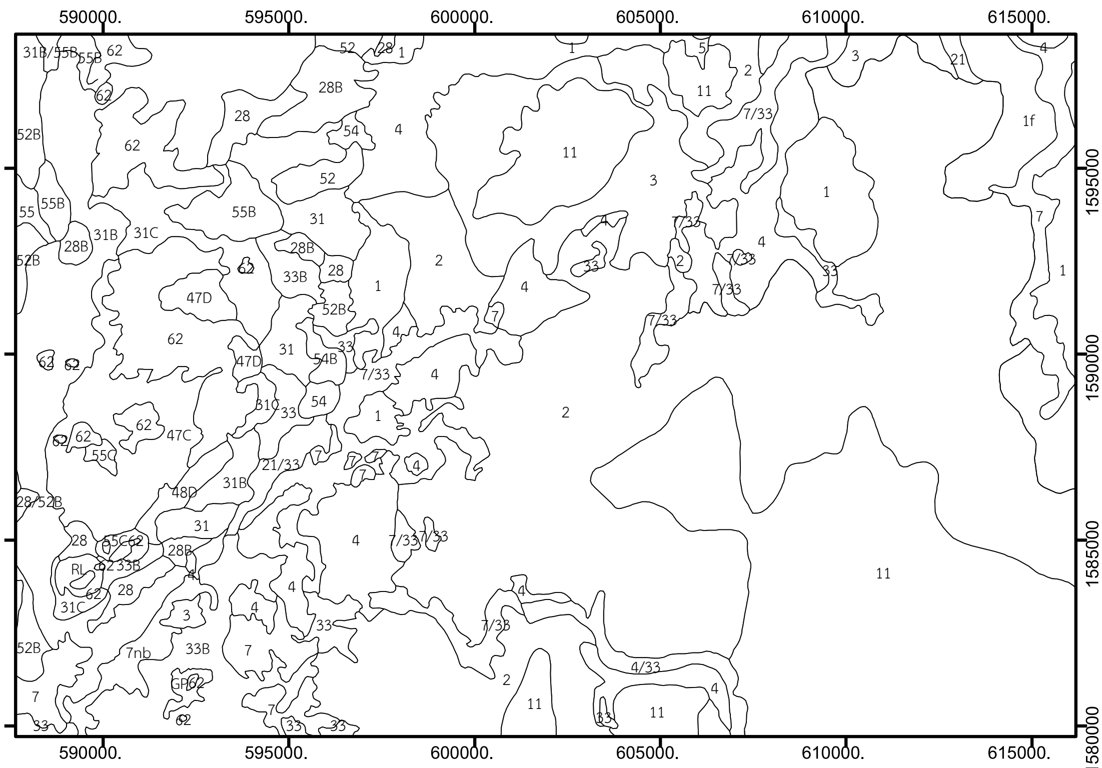



Figure 3-6 Soil unit of the study derived from Land development department (LDD).

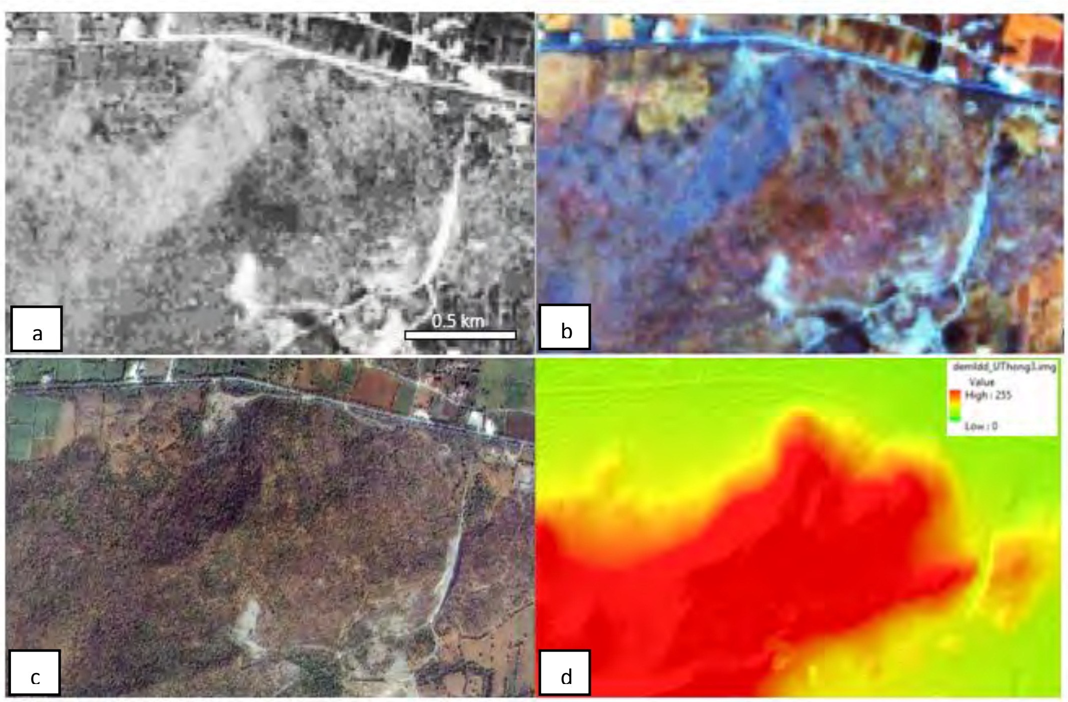



Figure 3-7.1 Visual classification of bedrock unit a.) Landsat 8 OLI band 7 b.) Landsat 8 OLI band 742 c.) THEOS imagery d.) DEM.

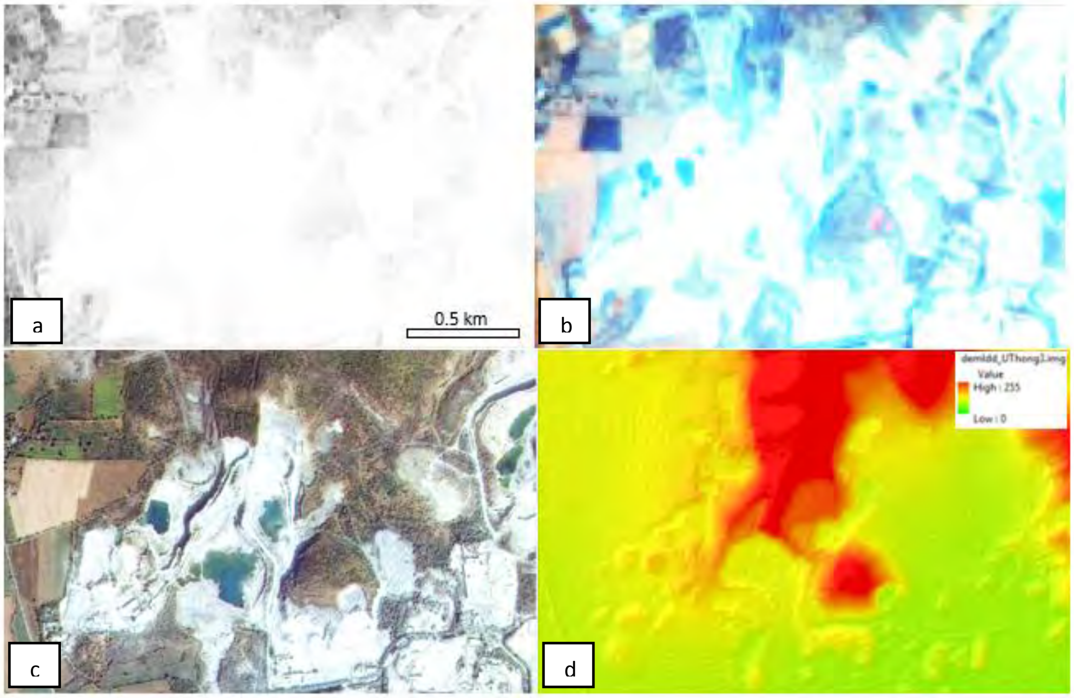



Figure 3-7.2 Visual classification of urban-mine unit a.) Landsat 8 OLI band 7 b.) Landsat 8 OLI band 742 c.) THEOS imagery d.) DEM.

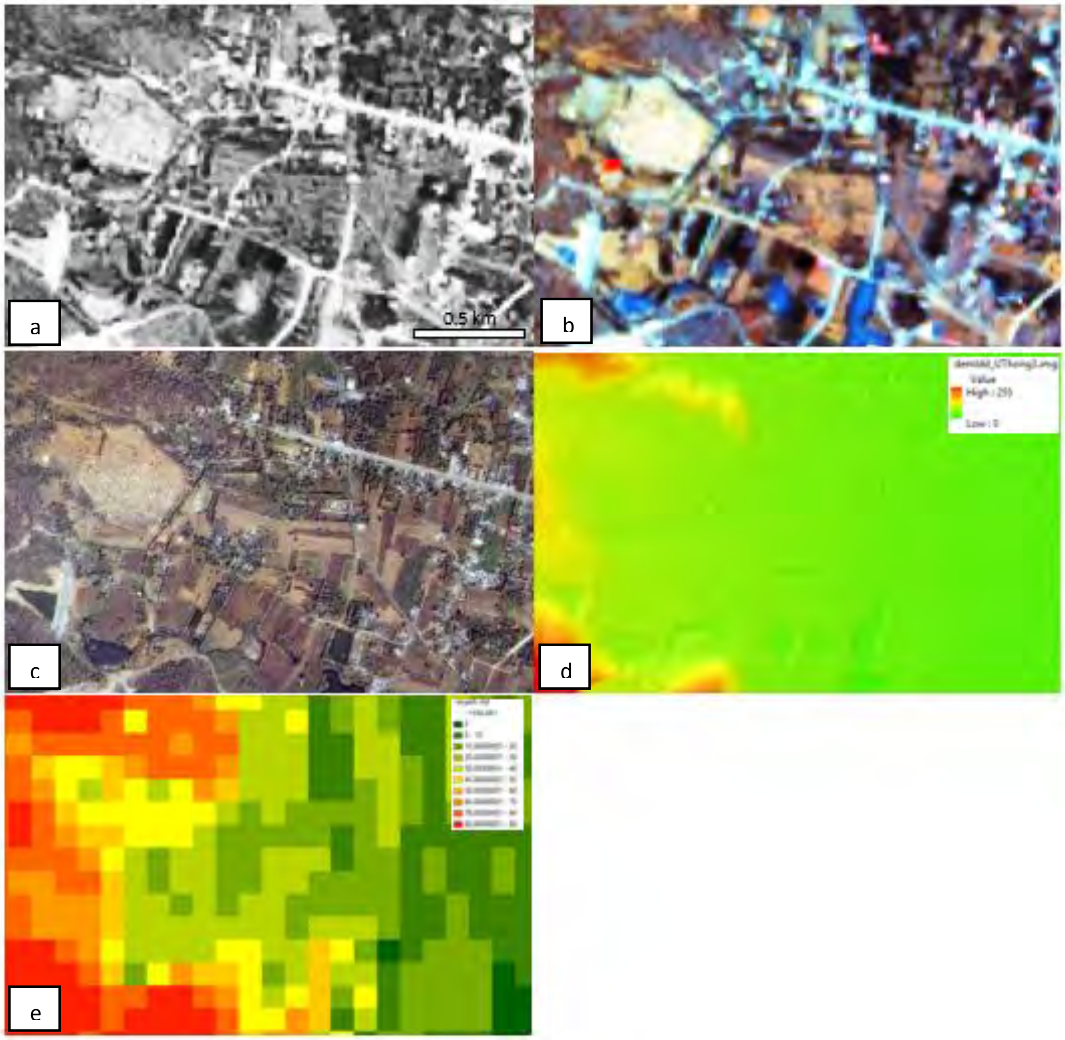



Figure 3-7.3 Visual classification of unit A a.) Landsat 8 OLI band 7 b.) Landsat 8 OLI band 742 c.) THEOS imagery d.) DEM e.) Slope.

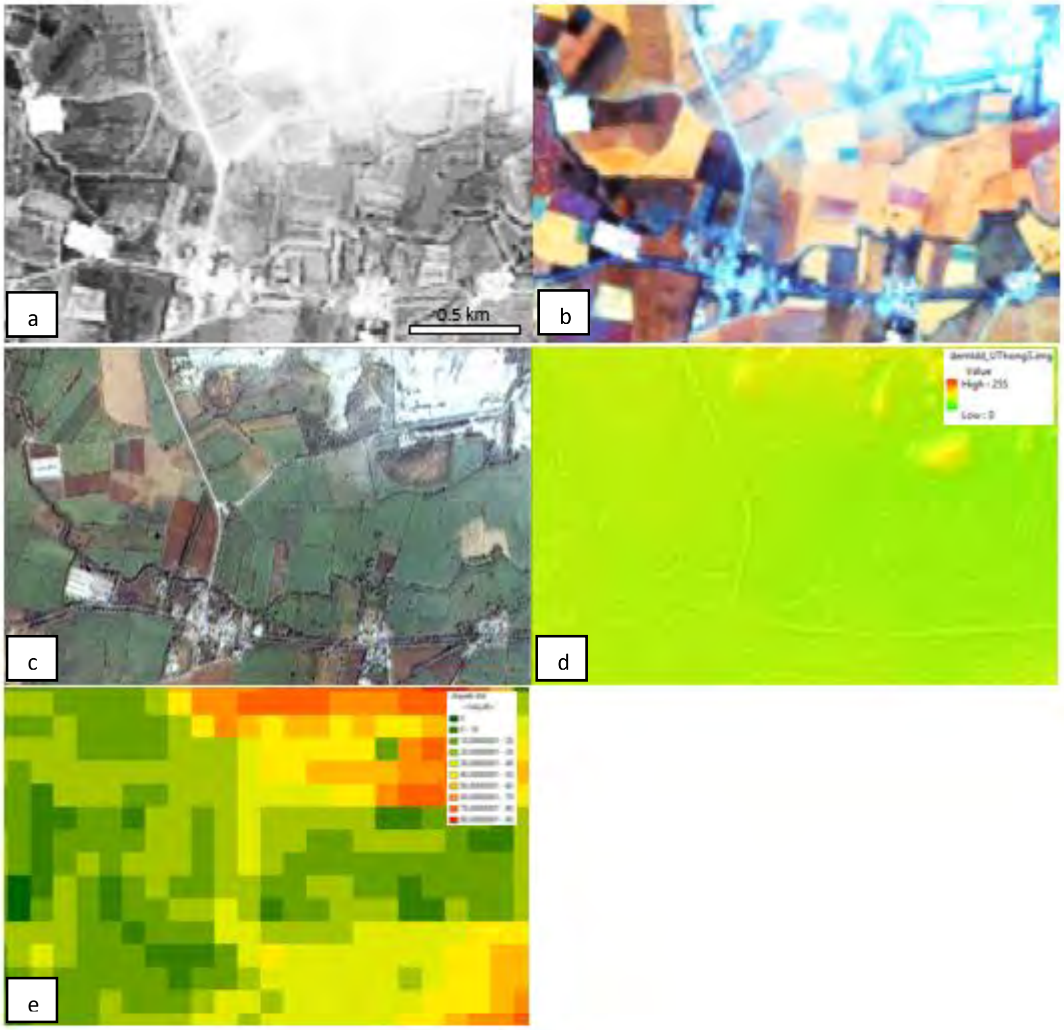



Figure 3-7.4 Visual classification of unit B a.) Landsat 8 OLI band 7 b.) Landsat 8 OLI band 742 c.) THEOS imagery d.) DEM e.) Slope.

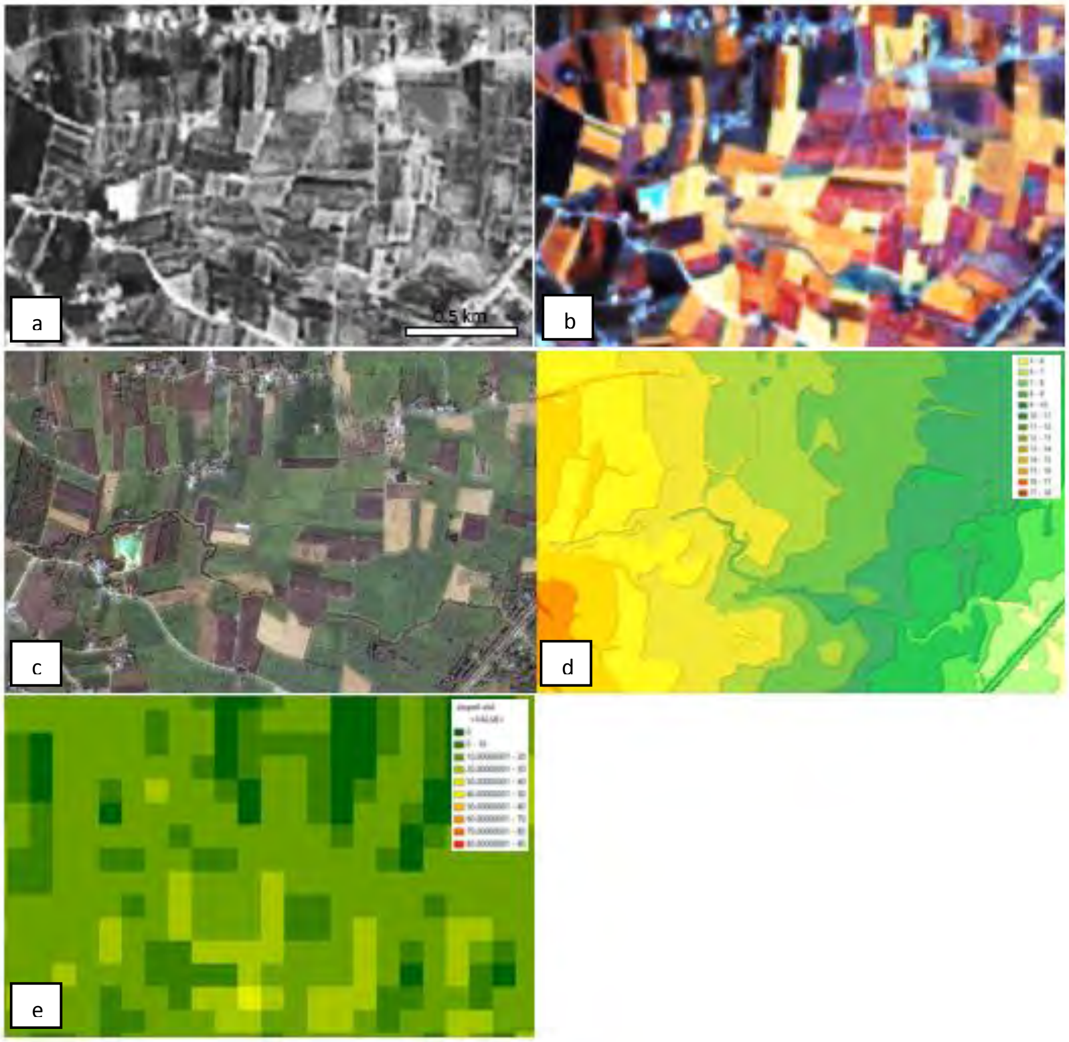



Figure 3-7.5 Visual classification of unit C a.) Landsat 8 OLI band 7 b.) Landsat 8 OLI band 742 c.) THEOS imagery d.) DEM e.) Slope.

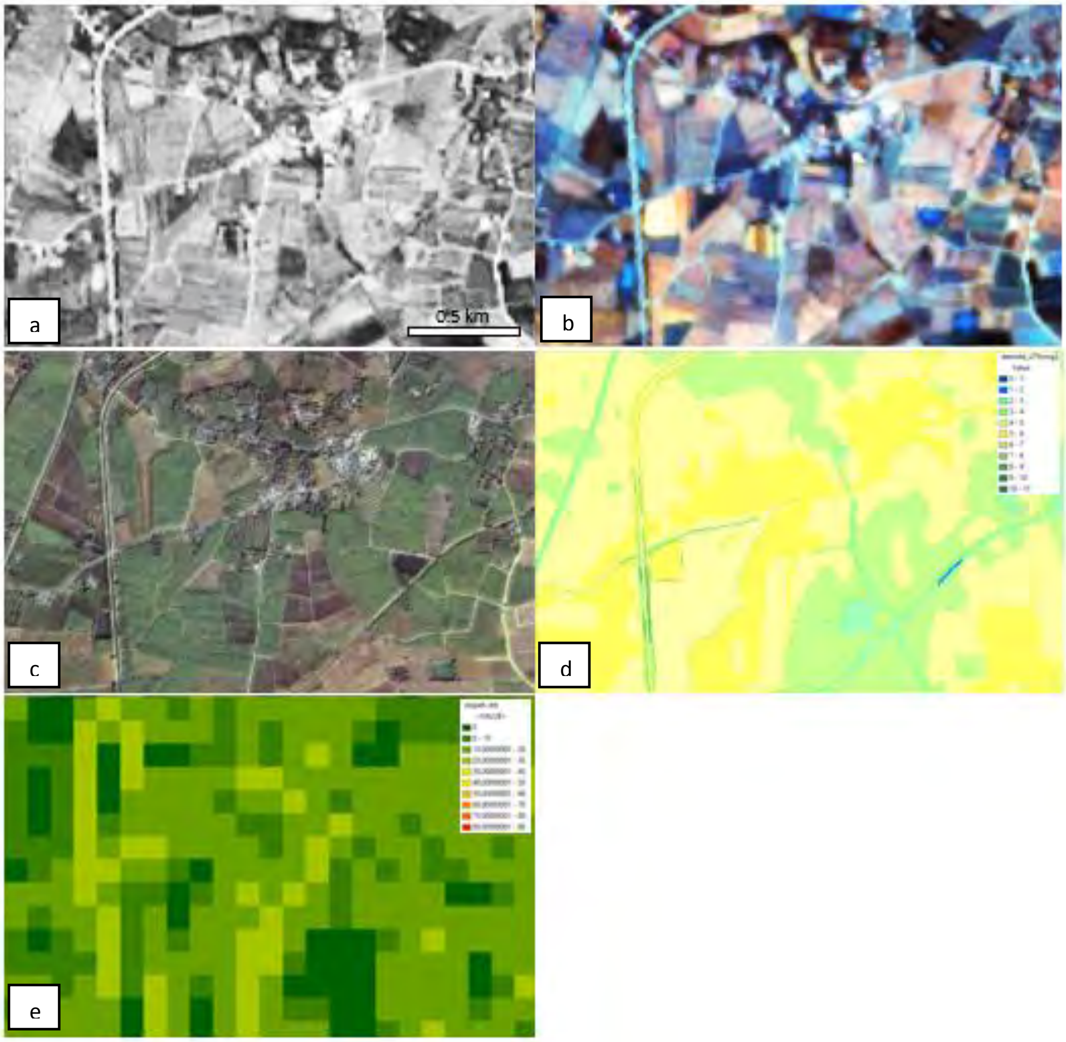



Figure 3-7.6 Visual classification of unit D a.) Landsat 8 OLI band 7 b.) Landsat 8 OLI band 742 c.) THEOS imagery d.) DEM e.) Slope.

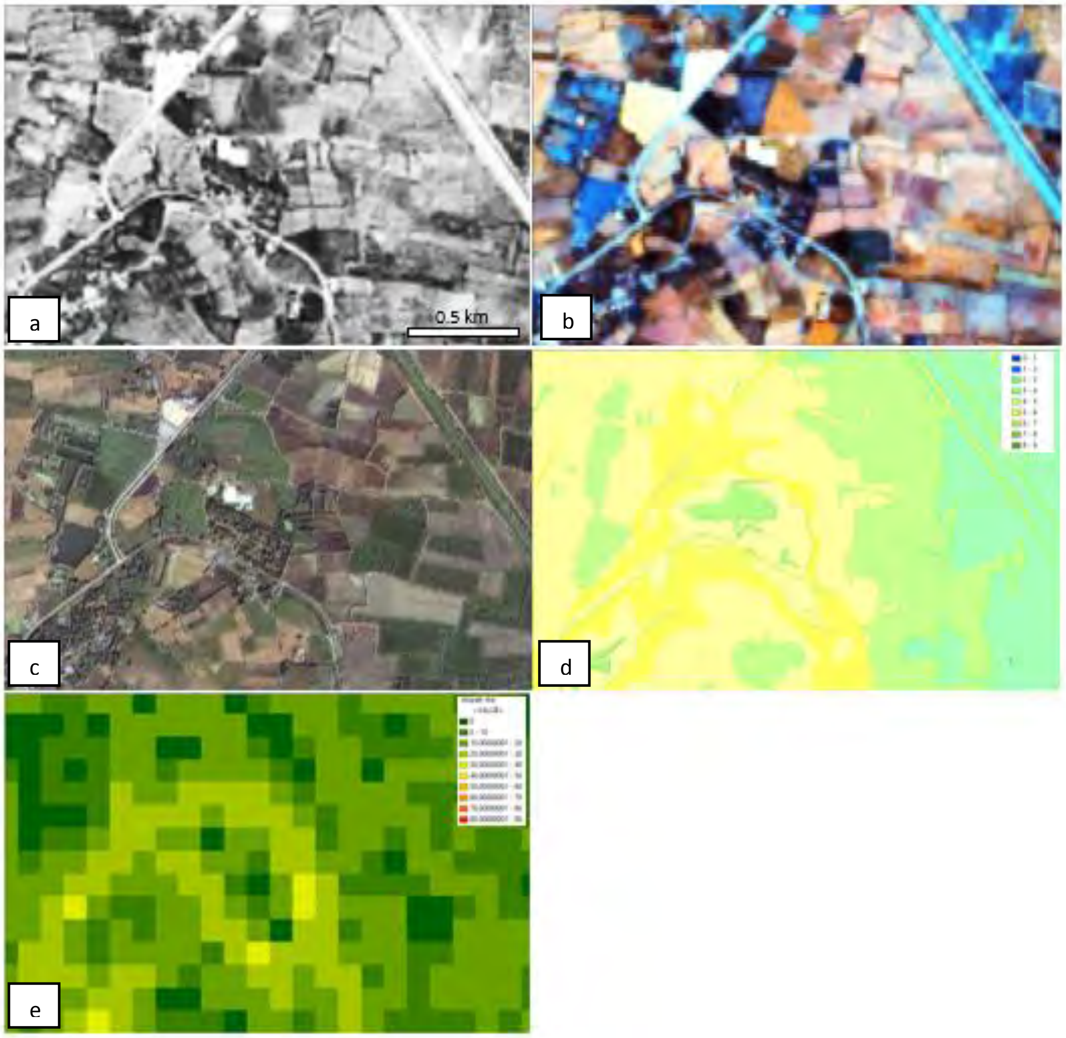



Figure 3-7.7 Visual classification of unit E a.) Landsat 8 OLI band 7 b.) Landsat 8 OLI band 742 c.) THEOS imagery d.) DEM e.) Slope.

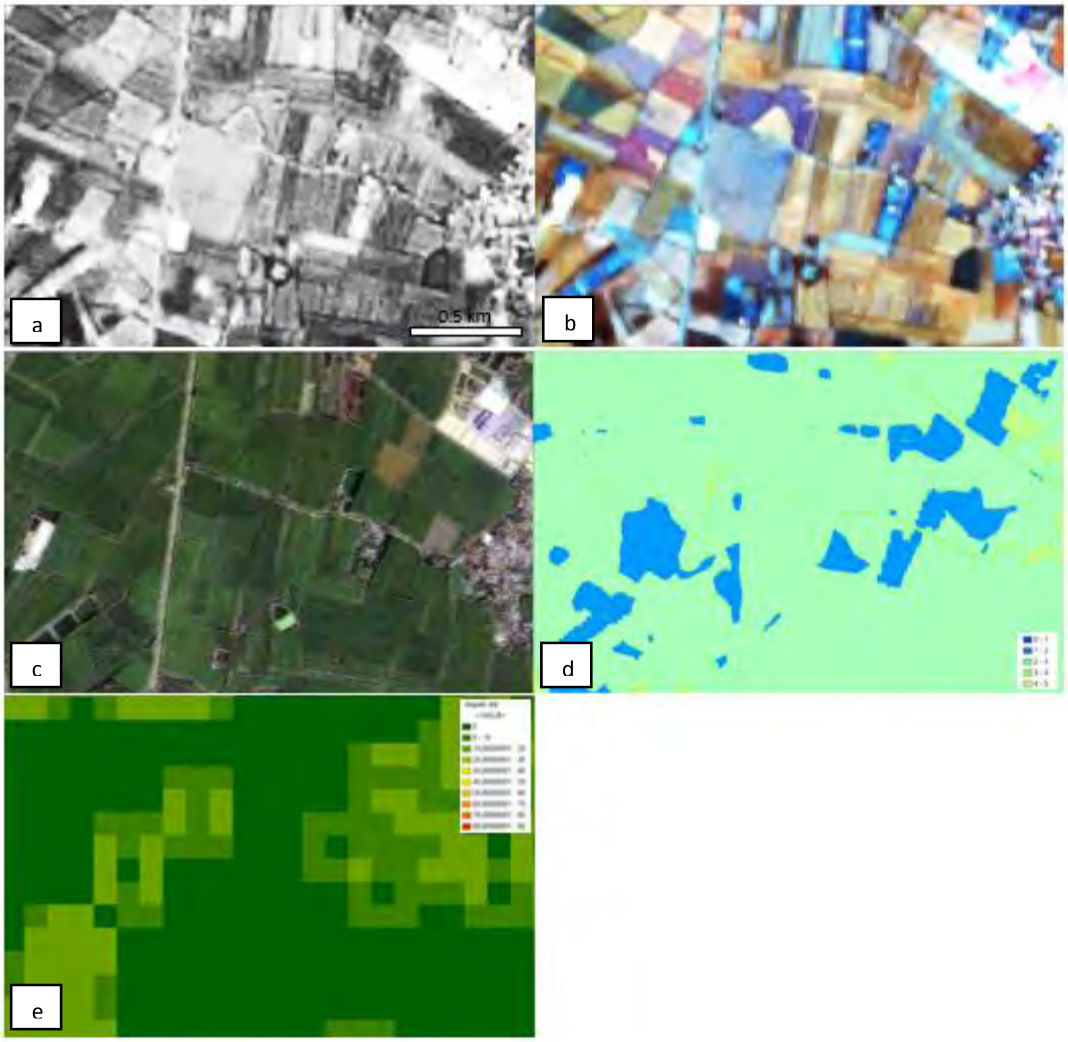



Figure 3-7.8 Visual classification of unit F a.) Landsat 8 OLI band 7 b.) Landsat 8 OLI band 742 c.) THEOS imagery d.) DEM e.) Slope.

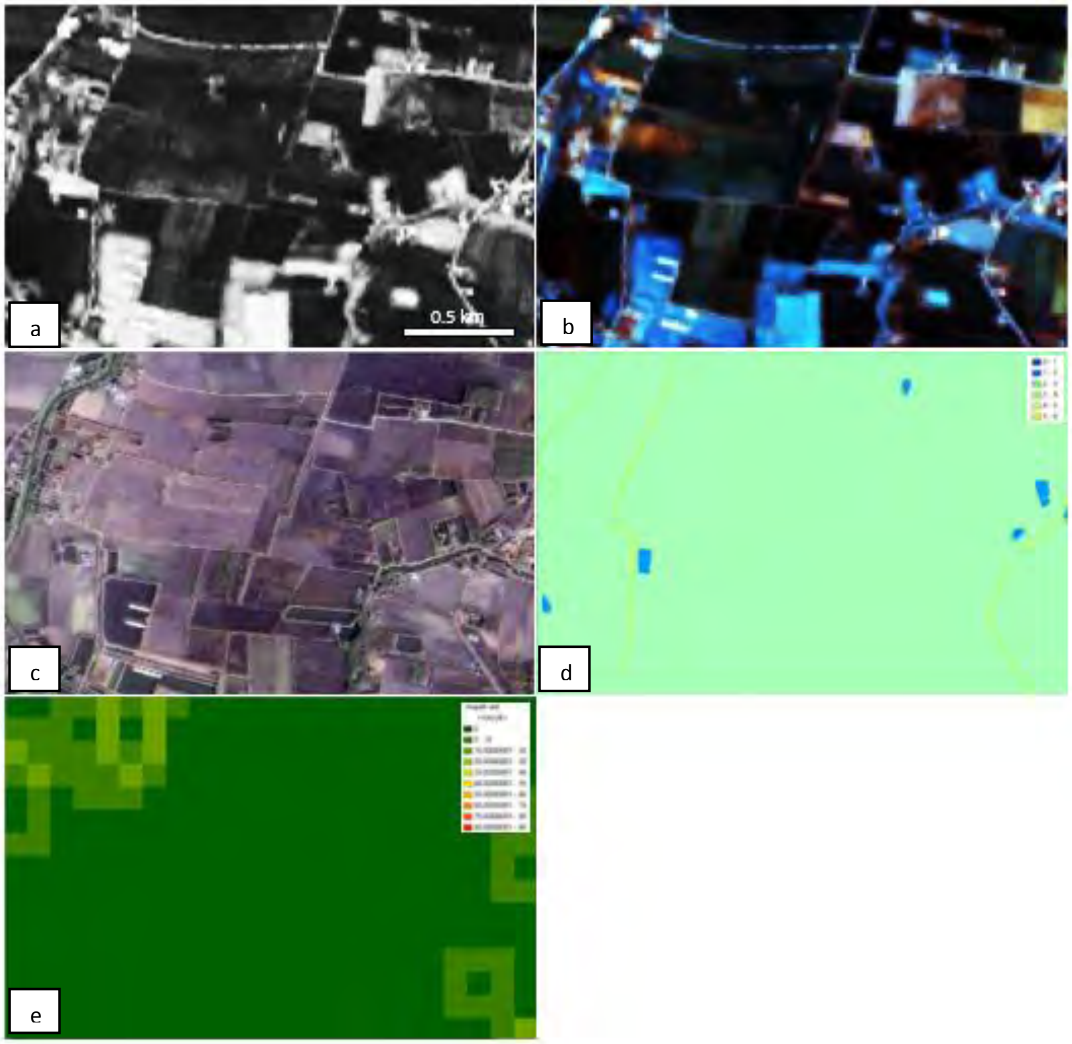



Figure 3-7.9 Visual classification of unit G a.) Landsat 8 OLI band 7 b.) Landsat 8 OLI band 742 c.) THEOS imagery d.) DEM e.) Slope.

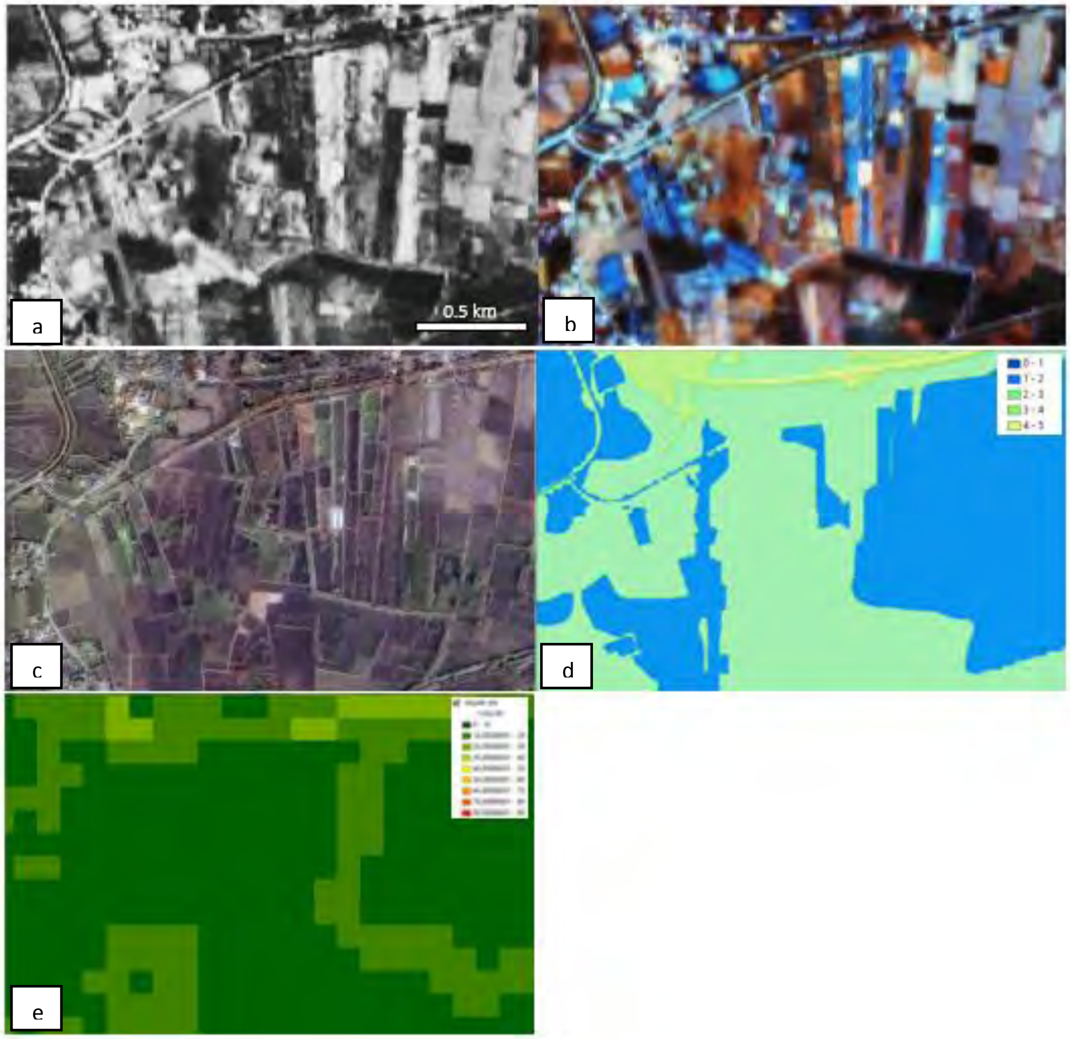



Figure 3-7.10 Visual classification of unit H a.) Landsat 8 OLI band 7 b.) Landsat 8 OLI band 742 c.) THEOS imagery d.) DEM e.) Slope.

### 3.3 Phase of surficial deposits analysis in digital image classification by supervised classification method

In this phase surficial deposits units are classified by selection of the training areas (Figure 3-8.1 – 3-8.10) from Landsat 8 OLI band 742 in the same unit that is classified by visual classification method.

From this phase, the surficial deposits units are classified into 10 surficial deposits units as follow:

1.) Bedrock: locate in along the western of U-Thong area, material is limestone and vegetation cover on the top.
2.) Urban-mine: This unit is collected from open land, city, and mine. White color show in band 742.
3.) Unit A: The unit is dominate in shape, color, pattern, and texture, so the training areas are chosen from the satellite image and slope analysis to classify.
4.) Unit B: The training areas are located in intermountain area, orange color and square shape are agent in this unit.
5.) Unit C: The training areas are located at the eastern of bedrock, and at the slope change area.
6.) Unit D: The training areas are located at the southwest of the area, color light blue is agent of this area.
7.) Unit E: Group of the training areas are located in the center of the study area, many disturbed area as well as the separation between the slope and flat area.
8.) Unit F: The training areas are detected from light color from satellite image, and are located at the northeast of the area.
9.) Unit G: The training areas for classify are dark blue and are located at eastern of this area.
10.) Unit H: The training areas are mainly classified from the shape in satellite image.

The histogram equalizer has been used for the satellite image before digital classification, because the value of spectral range will be defined by pixels from histogram image.

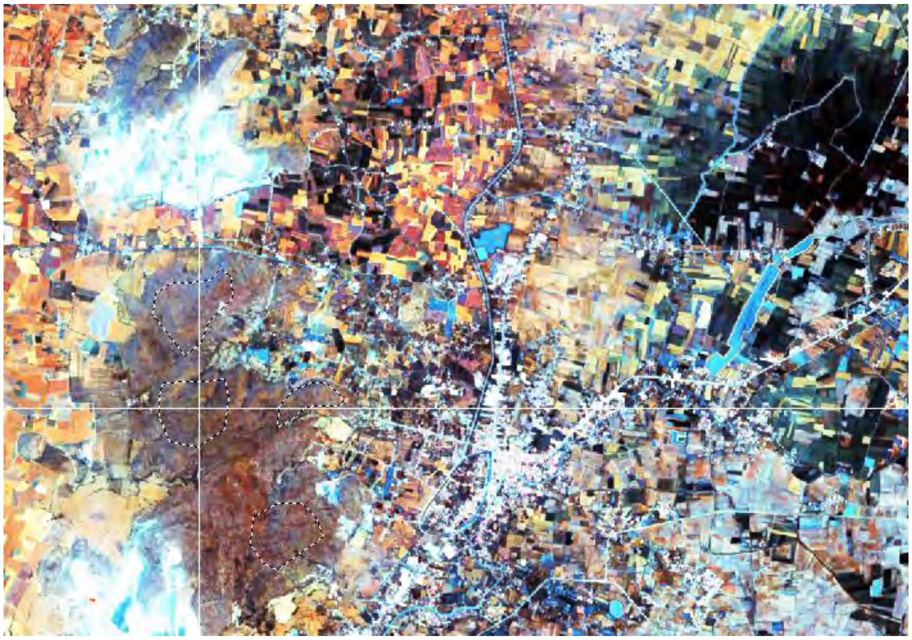


Figure 3-8.1 Training areas of bedrock unit from Landsat 8 OLI band 742.

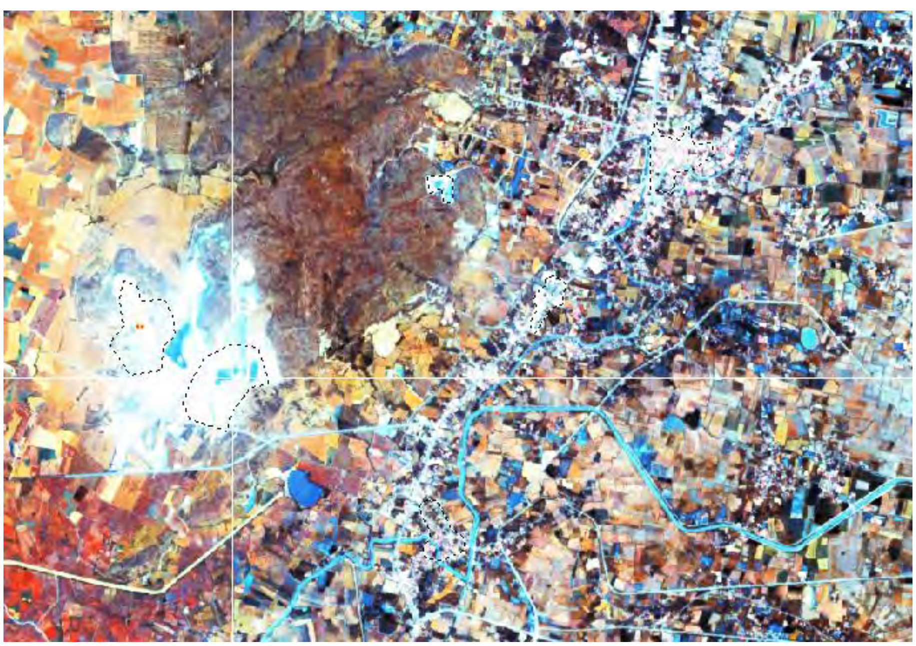


Figure 3-8.2 Training areas of urban-mine unit from Landsat 8 OLI band 742.

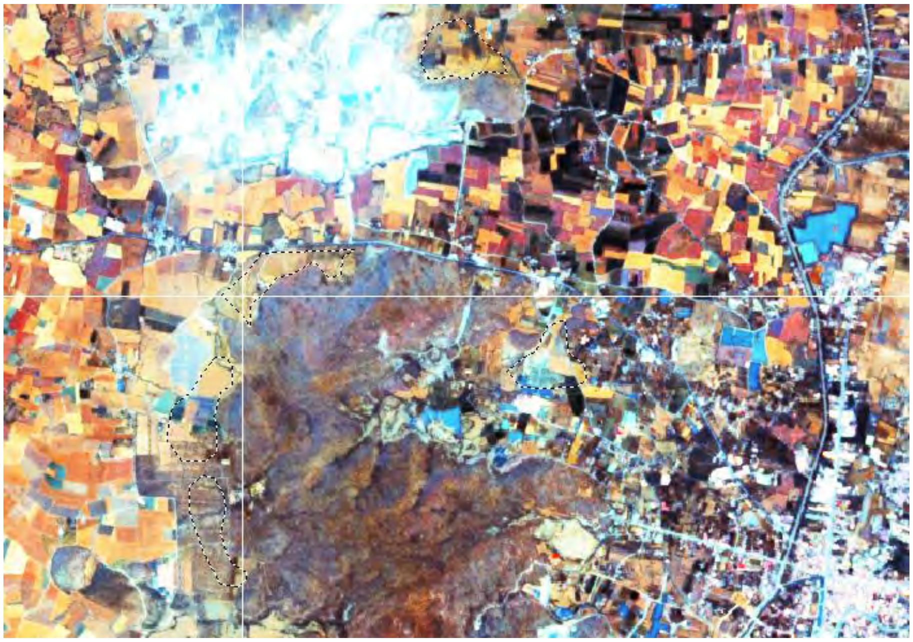


Figure 3-8.3 Training areas of unit A from Landsat 8 OLI band 742.

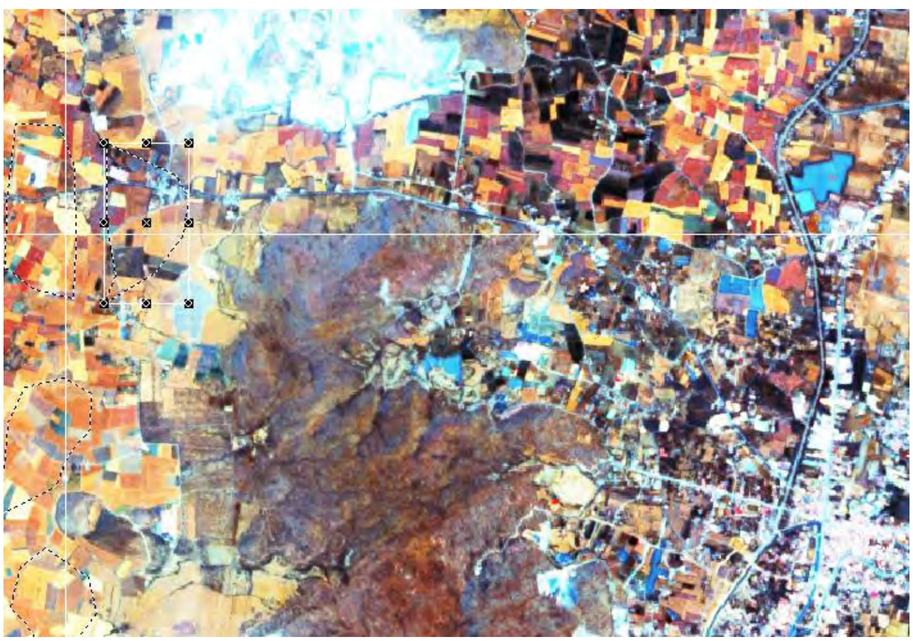


Figure 3-8.4 Training areas of unit B from Landsat 8 OLI band 742.

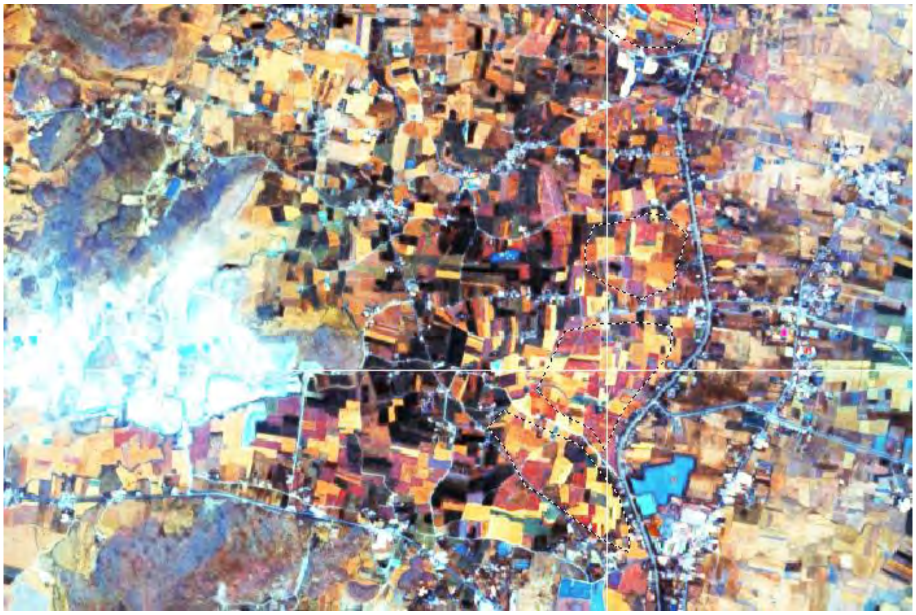


Figure 3-8.5 Training areas of unit C from Landsat 8 OLI band 742.

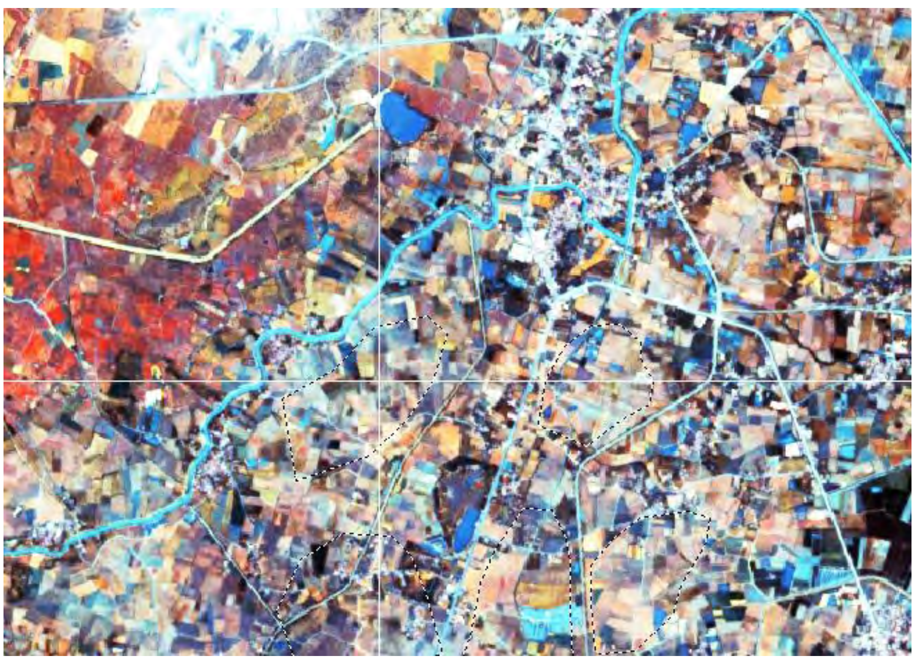


Figure 3-8.6 Training areas of unit D from Landsat 8 OLI band 742.

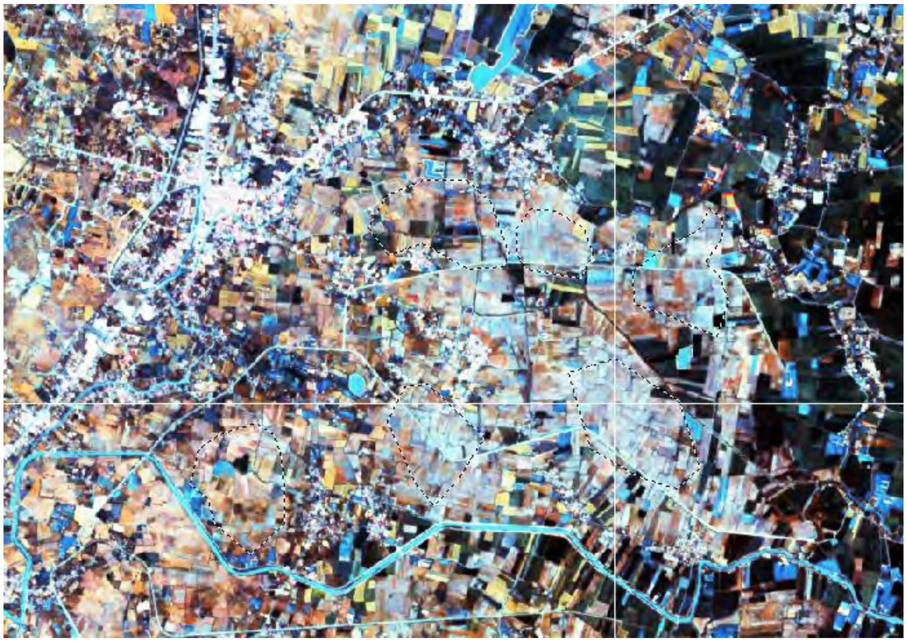


Figure 3-8.7 Training areas of unit E from Landsat 8 OLI band 742.

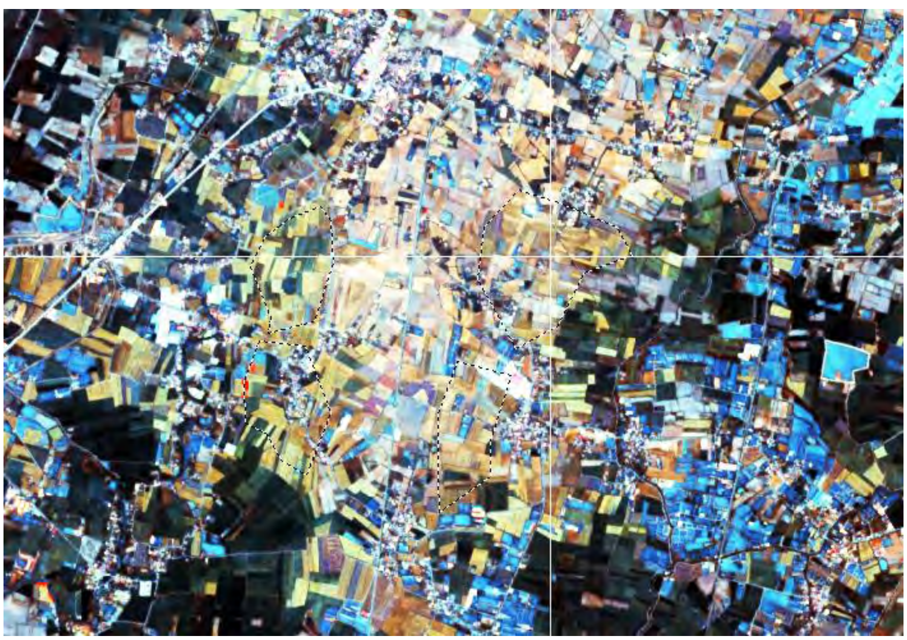


Figure 3-8.8 Training areas of unit F from Landsat 8 OLI band 742.

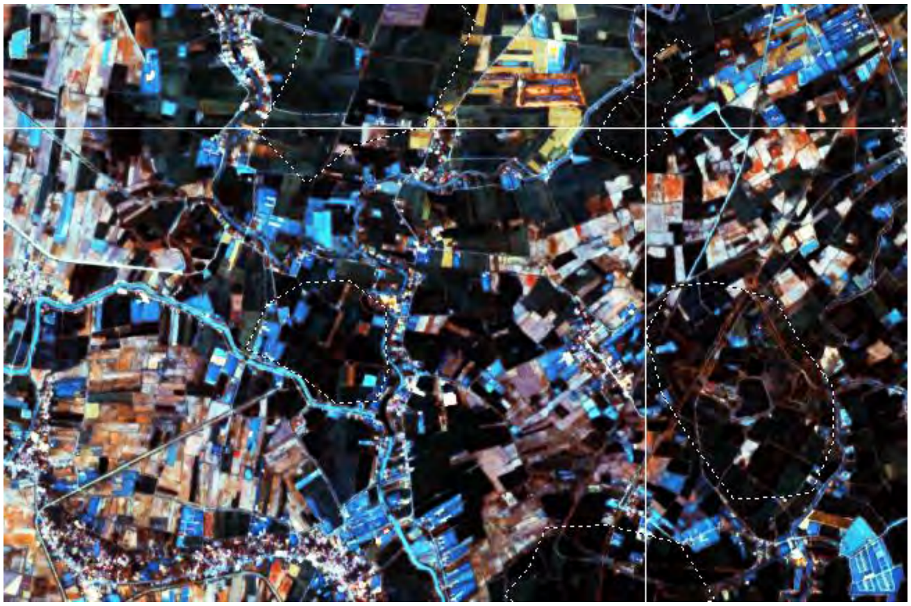


Figure 3-8.9 Training areas of unit G from Landsat 8 OLI band 742.

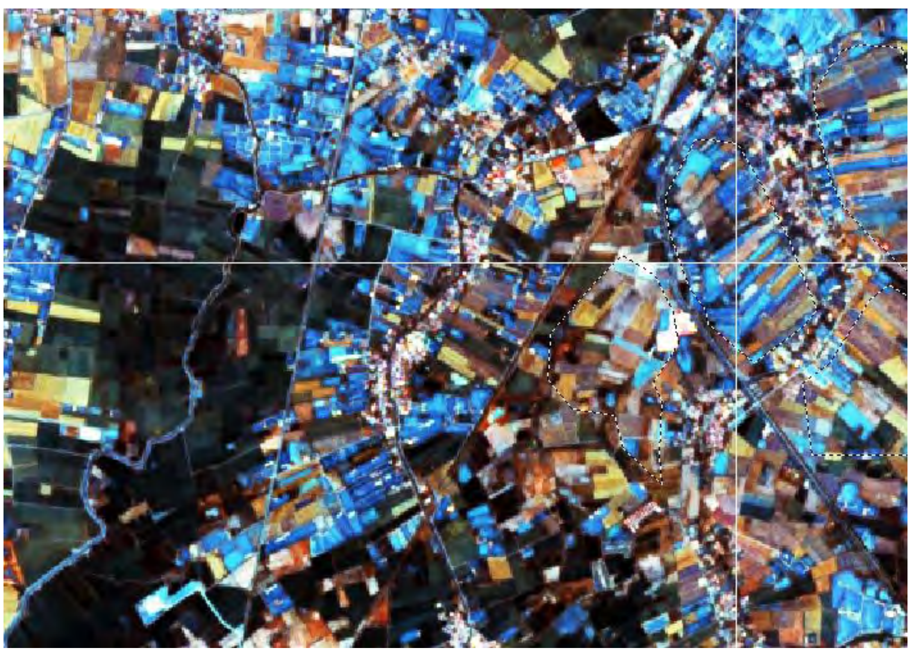


Figure 3-8.10 Training areas of unit H from Landsat 8 OLI band 742.

### 3.4 Phase of the compilation between visual classification and digital image classification

This phase is conducted by overlaying the result of visual classification with the result of digital classification by GIS techniques to create the boundary of each unit.

### 3.5 Preparation for field observation

This phase is performed by selecting the interested locations (Figure 3-8) form each unit after receiving the compile map between visual classification and digital image classification from the above phase. The high resolution satellite image from THEOS is very good to support this method.

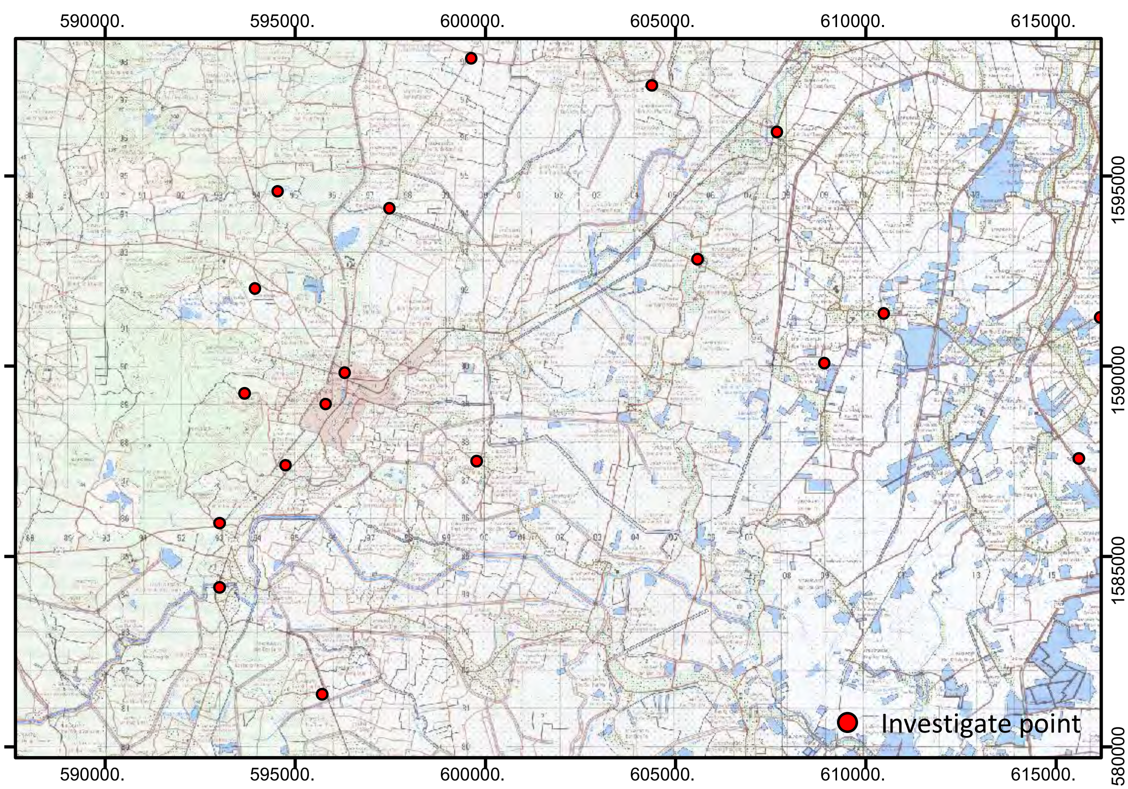
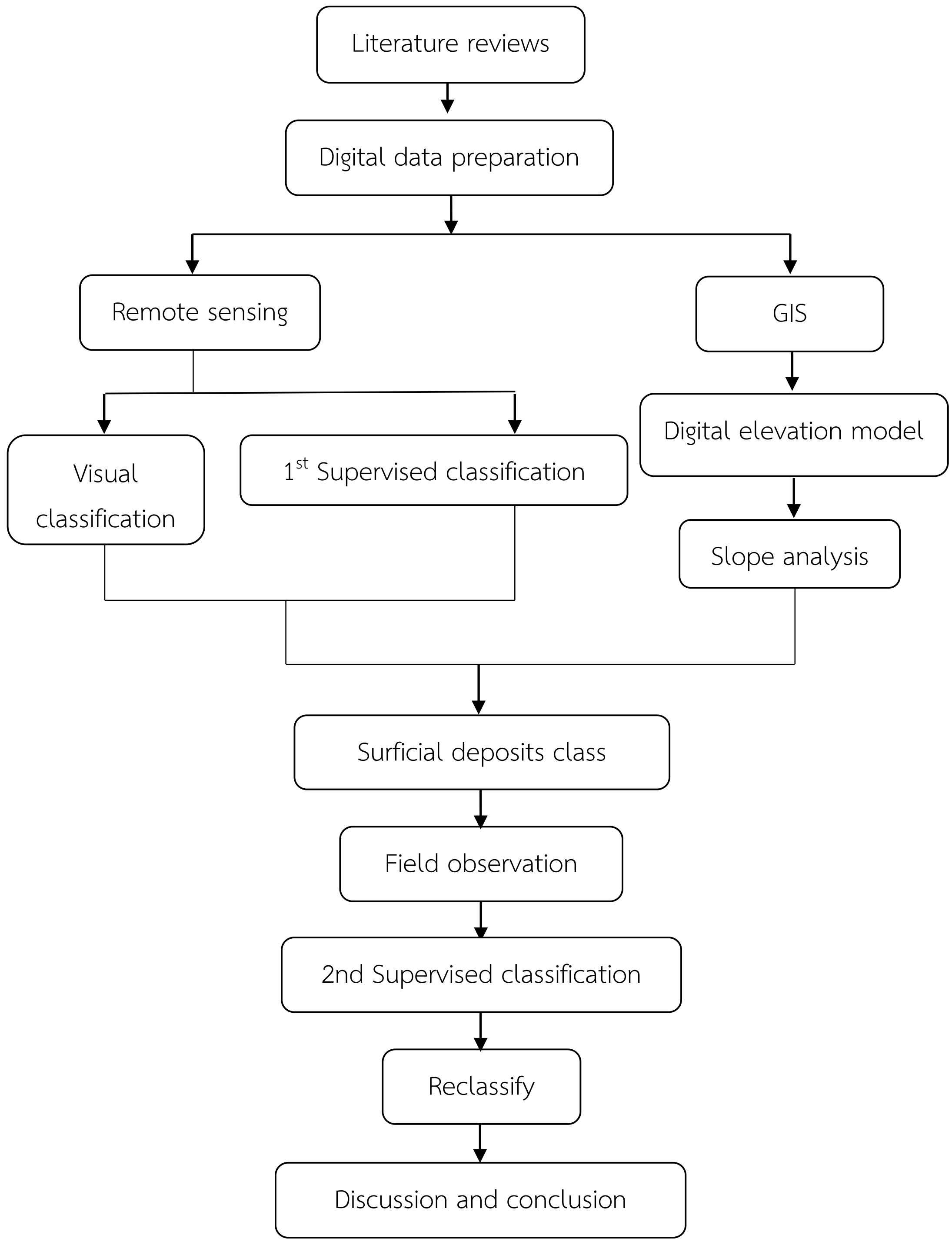



Figure 3-9 Field observation map with interested locations (in red circle).

### 3.6 Analysis of field data to use for the second supervised classification.

This phase is to reclassify the surficial deposits units by adding the training areas from field observation locations to supervised classification method again.

### 3.7 Methodology flow chart



# CHAPTER 4

# RESULTS

In this chapter surficial deposits units in U-Thong area are conducted from the significant and cost-effective information as previously mentioned in Chapter 3. Trends in surficial deposits analysis are briefly presented and the detailed statistical analysis digital classification in U-Thong area are proposed in detail as follows.

## 4.1 Surficial deposits analysis in remote sensing by visual classification

Each unit of the surficial deposits in the study area is divided from color, texture, pattern, shape, size and slope degree as shown in Figure 3-6.1 – 3-6.10. Surficial deposits unit can be divided to 10 classes as shown in Table 1 and Figure 4-1 as follow:

Table 4-1. Characteristics of the surficial deposits units in the study area that are classified by visual classification

| Unit | Grey scale | | | Texture | Pattern | Shape | Size[1] | Relation | LANDSAT 8 OLI band 742 | THEOS | DEM (meter) | Slope (degree) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | black | grey | white | | | | | | | | | |
| Bedrock | 10 | 80 | 10 | rough | field | irregular | large | mountain | blue, violet | brown, tree | 100-255 | >50 |
| Urban-Mine | 0 | 10 | 90 | smooth | line, field | irregular | medium | artificial | white, blue | white | - | - |
| A | 20 | 50 | 30 | rough | line, field | square | small | slope | colorful | brown | 40-100 | 30-50 |
| B | 10 | 30 | 60 | rough | field | square | small | flat, slope | brown, orange | green | 70-100 | 20-50 |
| C | 5 | 90 | 5 | rough | field | square | small | slope, stream | brown, orange, violet, dark blue | green, dark brown | 5-15 | 10-20 |
| D | 30 | 65 | 5 | rough | field | square, rectangle | small | stream cover | light blue, pink, light purple | Brown, green | 2-7 | 20-40 |
| E | 5 | 80 | 15 | rough | field, line, field | square | small | urban, field, pool | light brown, light blue, dark blue | green, light violet | 2-15 | 0-10 |
| F | 30 | 60 | 10 | rough | field | square | small | pool, field | light brown, blue | green, urban | 2-3 | flat |
| G | 80 | 10 | 10 | smooth | field | square | small | pool, wet land | blue, dark blue | light violet | 2 | flat |
| H | 10 | 60 | 30 | rough | field | square, rectangle | small | field, pool | brown10%,pink,blue, light blue | brown, green, light violet | 0-6 | Flat |

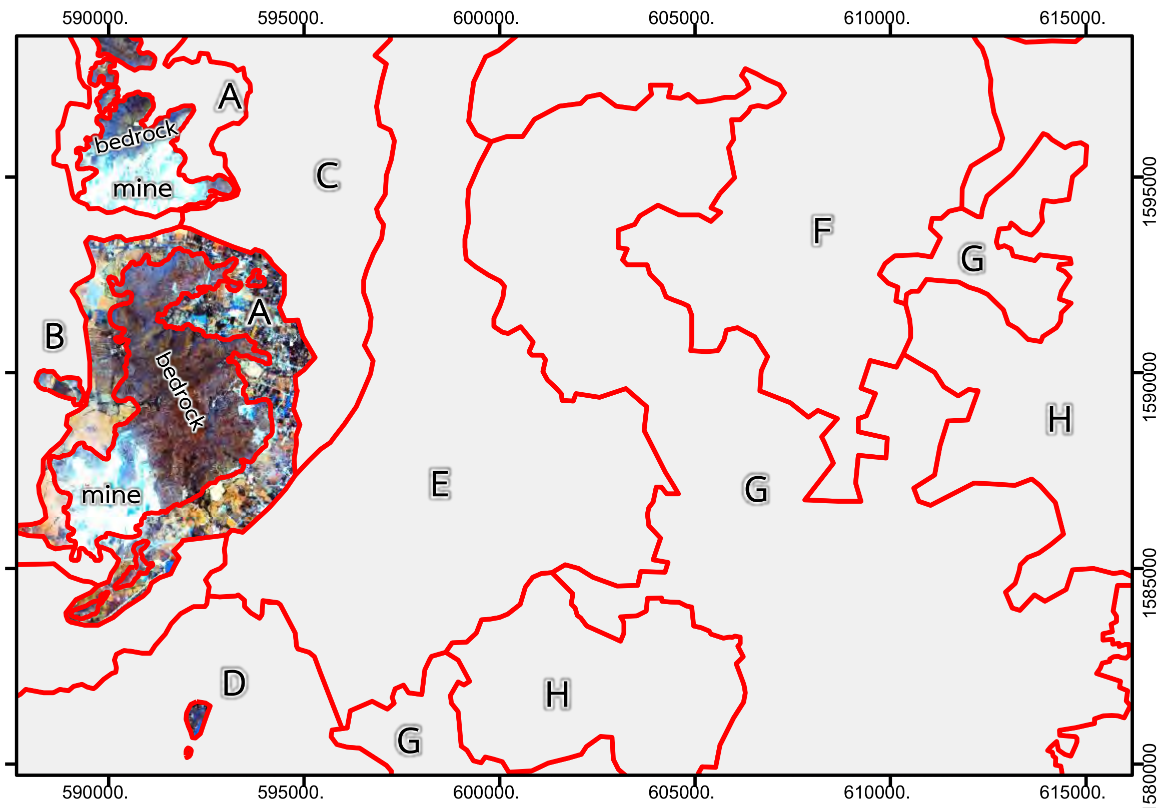



Figure 4-1 Surficial deposits map of the study area classified by visual classification method.

Each unit from the visual classification method are selected to be the training areas to be used for supervised classification method. This digital classification method can be classified in the large area, and also count the area in square kilometers. Moreover, the histogram data are derived from this classification and will be used to discussion in the last chapter.

## 4.2 Surficial deposits analysis in digital image classification by supervised classification

In this phase surficial deposits units are classified by select training areas to be used in supervised classification method (Figure 4-2) from landsat 8 OLI band 742 in the same unit of visual classification method. The histogram data (Table 4-2) is also derived from supervised classification method.

For each surficial deposits unit, the training areas are selected approximately 20 areas, and located each training area in the same unit derived from the visual classification method.

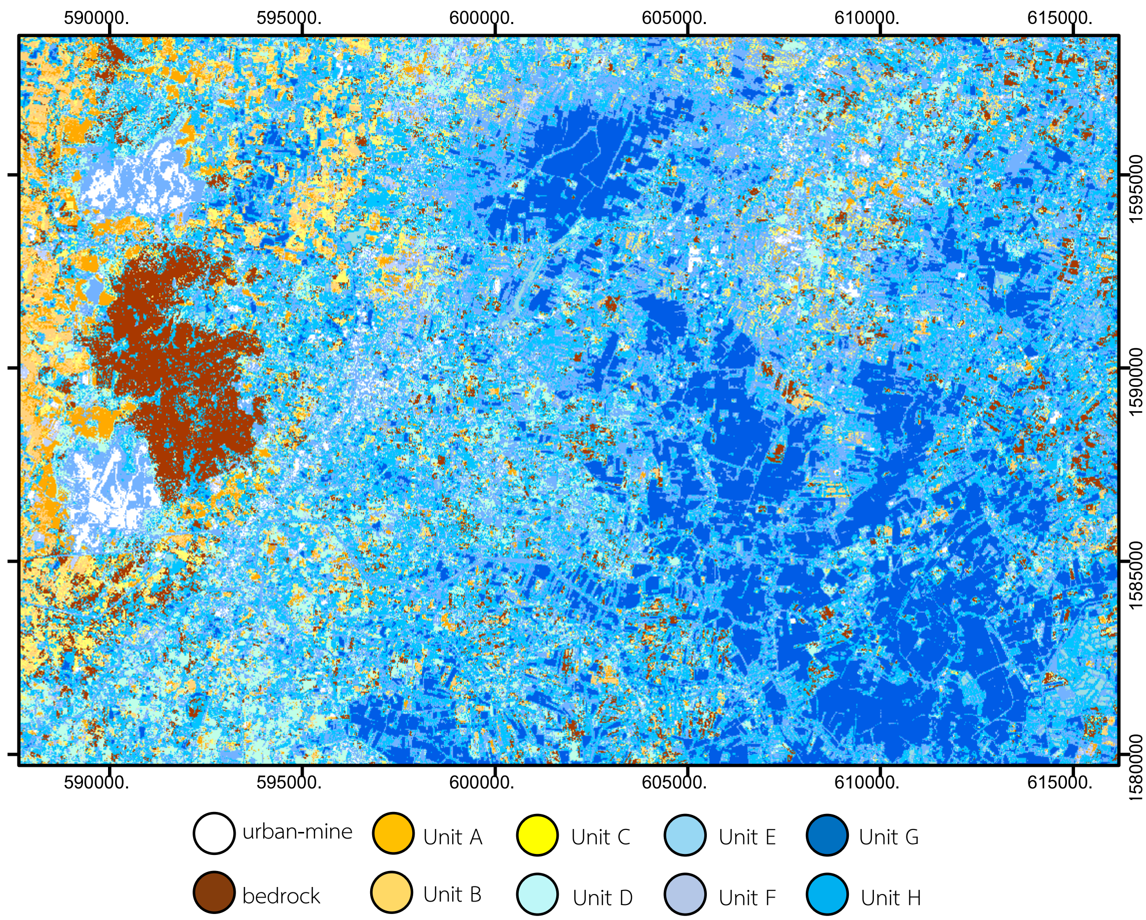



Figure 4-2 Surficial deposits map of the study area analyzed by supervised classification method.

Table 4-2 Histogram data derived from supervised classification of Landsat 8 OLI band 742 in the study area

| Data | Bedrock | Unit A | Urban-Mine | Water | Unit B | Unit C | Unit D | Unit E | Unit F | Unit G | Unit H | Row Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bedrock | 6157 | 81 | 0 | 0 | 274 | 433 | 92 | 170 | 112 | 0 | 772 | 8091 |
| Unit A | 56 | 4499 | 0 | 0 | 877 | 392 | 295 | 379 | 247 | 0 | 216 | 6961 |
| Urban-Mine | 0 | 38 | 5900 | 1 | 3 | 3 | 134 | 132 | 80 | 0 | 60 | 6351 |
| Water | 0 | 0 | 10 | 2778 | 0 | 0 | 15 | 2 | 0 | 2 | 267 | 3074 |
| Unit B | 36 | 578 | 5 | 0 | 5512 | 1324 | 99 | 321 | 380 | 0 | 503 | 8758 |
| Unit C | 23 | 75 | 9 | 0 | 683 | 4509 | 316 | 189 | 158 | 1 | 286 | 6249 |
| Unit D | 14 | 95 | 112 | 2 | 185 | 391 | 3334 | 784 | 513 | 2 | 435 | 5867 |
| Unit E | 142 | 869 | 49 | 4 | 359 | 162 | 2163 | 4507 | 1754 | 0 | 1901 | 11910 |
| Unit F | 23 | 199 | 33 | 0 | 248 | 294 | 332 | 295 | 2210 | 66 | 425 | 4125 |
| Unit G | 0 | 11 | 0 | 0 | 0 | 4 | 4 | 8 | 92 | 8332 | 343 | 8794 |
| Unit H | 161 | 584 | 40 | 100 | 349 | 414 | 887 | 648 | 779 | 129 | 3562 | 7653 |
| Column Total | 6612 | 7029 | 6158 | 2885 | 8490 | 7926 | 7671 | 7435 | 6325 | 8532 | 8770 | 77833 |
| Accuracy (%) | 93.11857 | 64.00626 | 95.810328 | 96.29116 | 64.92344 | 56.88872 | 43.46239 | 60.6187 | 34.94071 | 97.6 | 40.61574 | |

The histogram data or digital number (DN) will be used to compare the results from this method with other methods that has been used the same database of Landsat 8 OLI/TIRS.

### 4.3 Compilation of visual classification and digital image classification

GIS techniques are used to create the boundary of each unit (as shown in Figure 4-3).

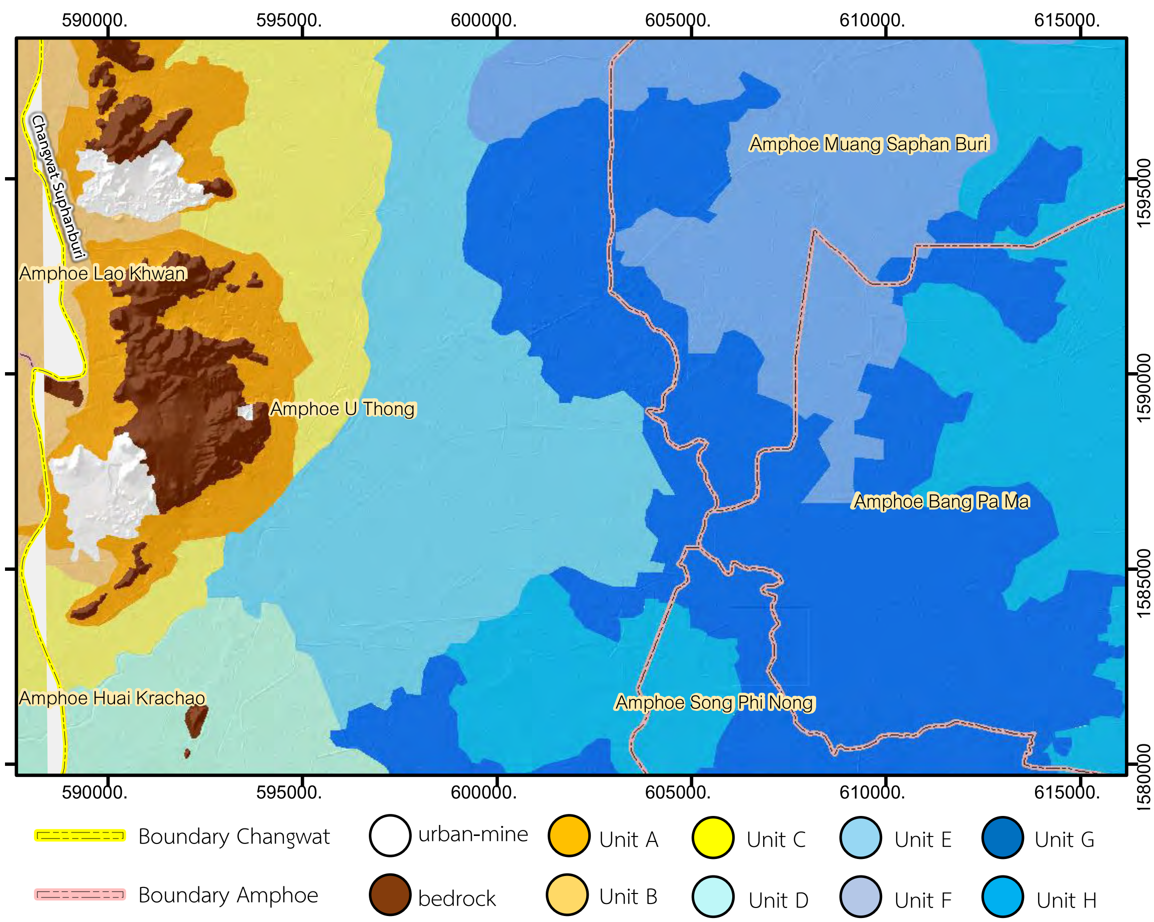



Figure 4-3 Surficial deposits map that is compiled from visual classification and digital image classification.

## 4.4 Field observation data

Table 4-3 Lithologic characteristics from field observation.

| Unit | Lithologic characteristics | | | | | |
|---|---|---|---|---|---|---|
| | Type(soil/unconsolidated/bedrock) | Color | Typical Grain size | Sphericity | Sorting | Composition |
| Bedrock | bedrock | - | - | - | - | - |
| Urban-Mine | - | - | - | - | - | - |
| A | - | - | gravel | medium | poorly | ferrous soil, limestone grains |
| B | soil | - | silty clay | - | - | ferrous soil, humus |
| C | soil | dark brown | silty clay | high | well | quartz, humus |
| D | soil | brownish grey | silty clay, clay | high | well | quartz, humus |
| E | soil | brown | silty clay | high | well | quartz, humus |
| F | soil | light brown | clay | - | - | - |
| G | soil | dark brown | clay | - | - | - |
| H | soil | brown | clay | - | - | - |

### 4.5 Second supervised classification

Surficial deposits unit map (as shown in Figure4-4) is derived from adding the training areas from field observation locations to be reanalyzed by supervised classification again. Besides, the spectral range of each unit are also shown in Figure 4-5(.1-.11)).

From the histogram analysis, Units A and Unit B are related in the spectral range of 235-240 whereas Unit D, Units E and Unit F are related in the spectral range of 200-210, Units C and H are related in the spectral range of 185-200, Unit G has the spectral range of 18-20, Unit bedrock has the spectral range of 121, and urban-min has the spectral range of 18-228.

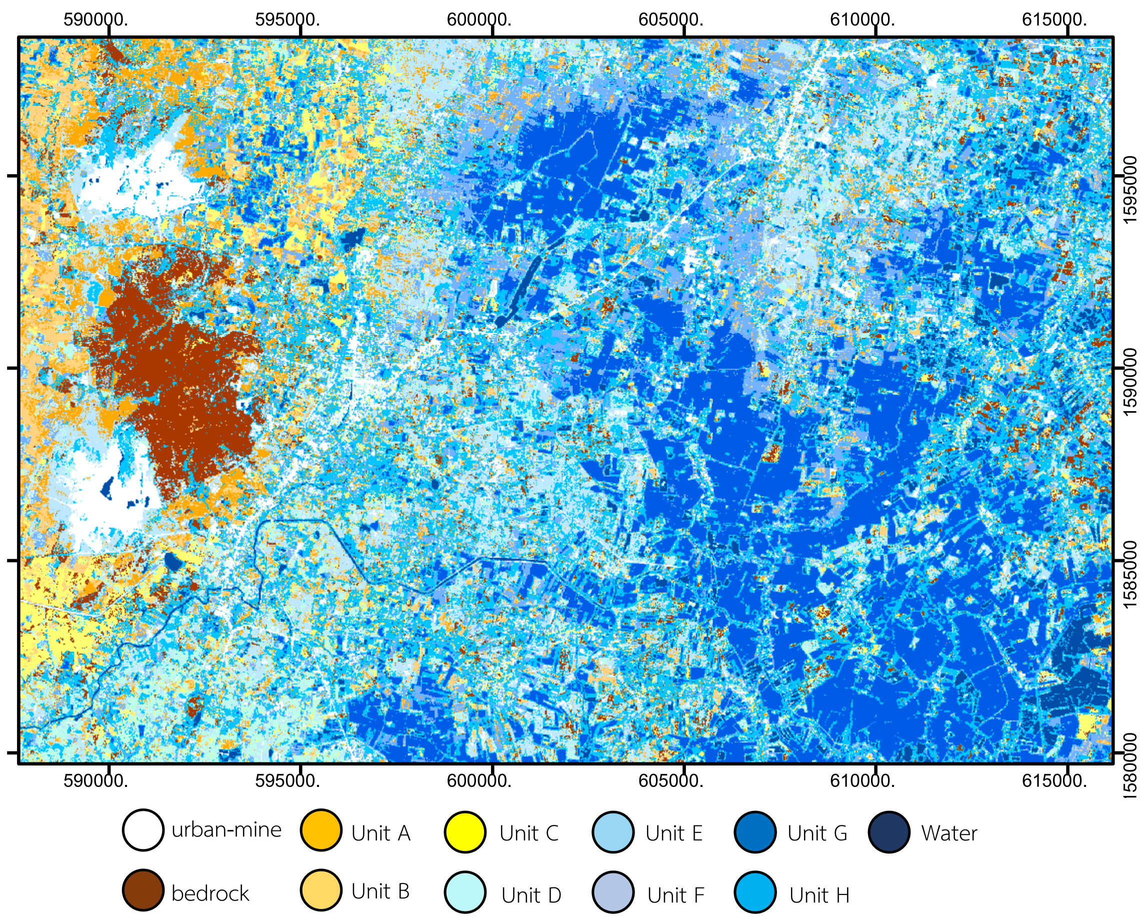



Figure 4-4 Surficial deposits map derived from the second supervised classification.

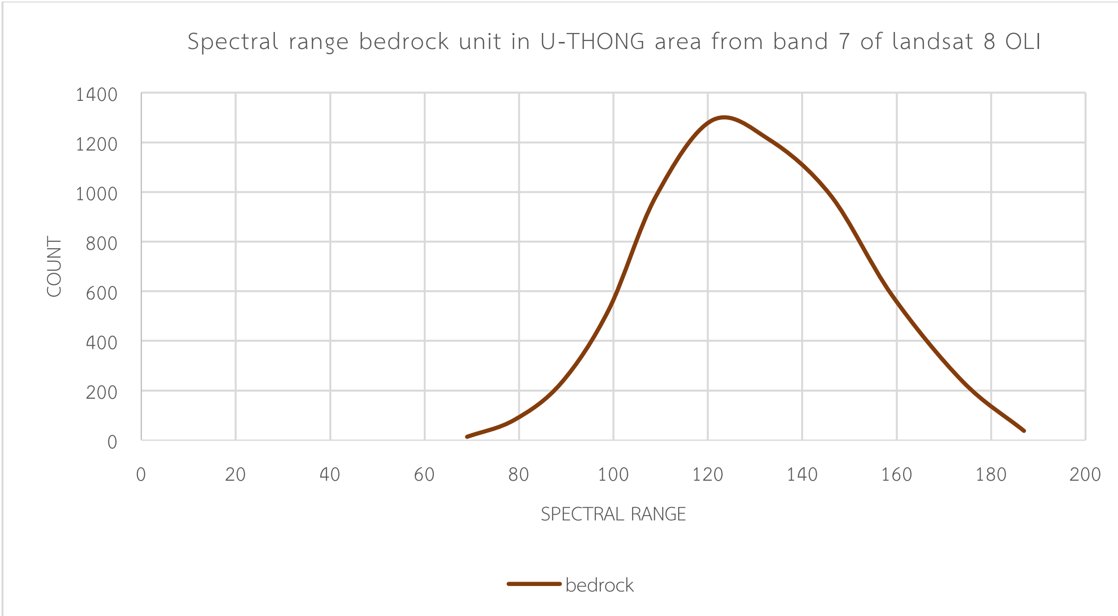



Figure 4-5.1 Spectral range of bedrock unit in U-Thong area from band 7 of Landsat 8 OLI.

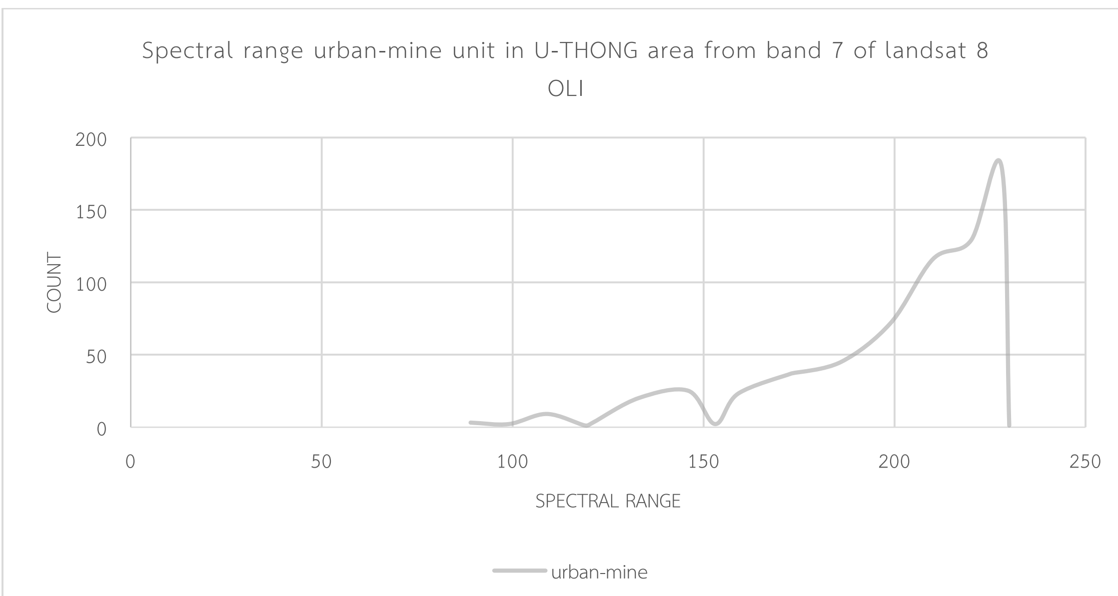



Figure 4-5.2 Spectral range of urban-mine unit in U-Thong area from band 7 of Landsat 8 OLI.

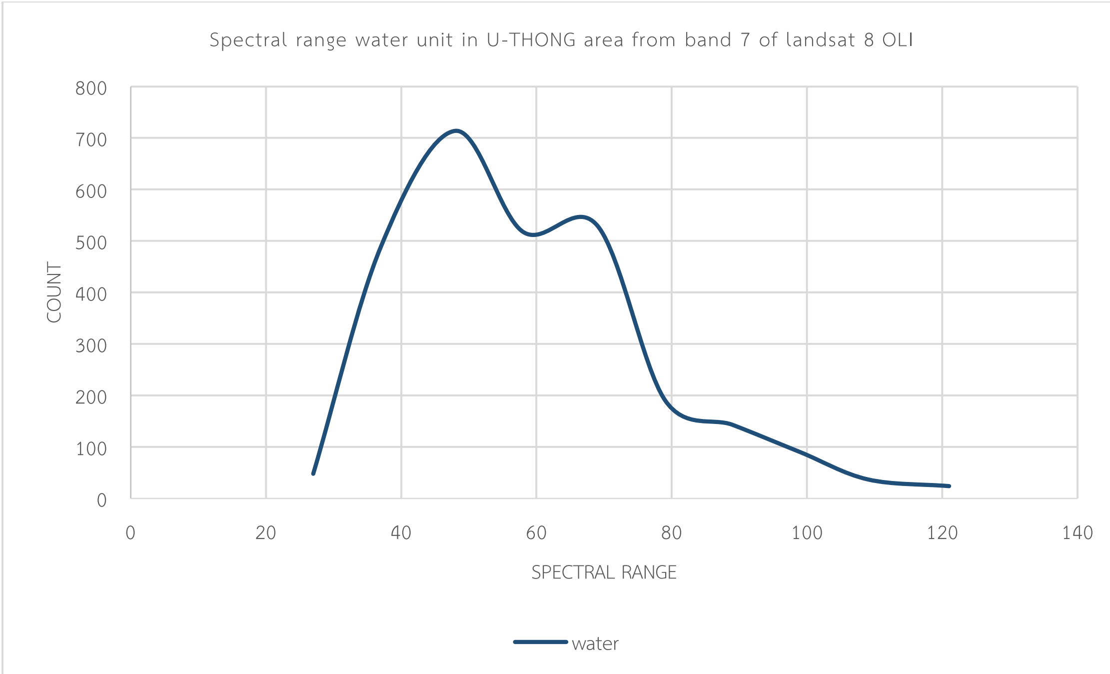



Figure 4-5.3 Spectral range of unit water in U-Thong area from band 7 of Landsat 8 OLI.

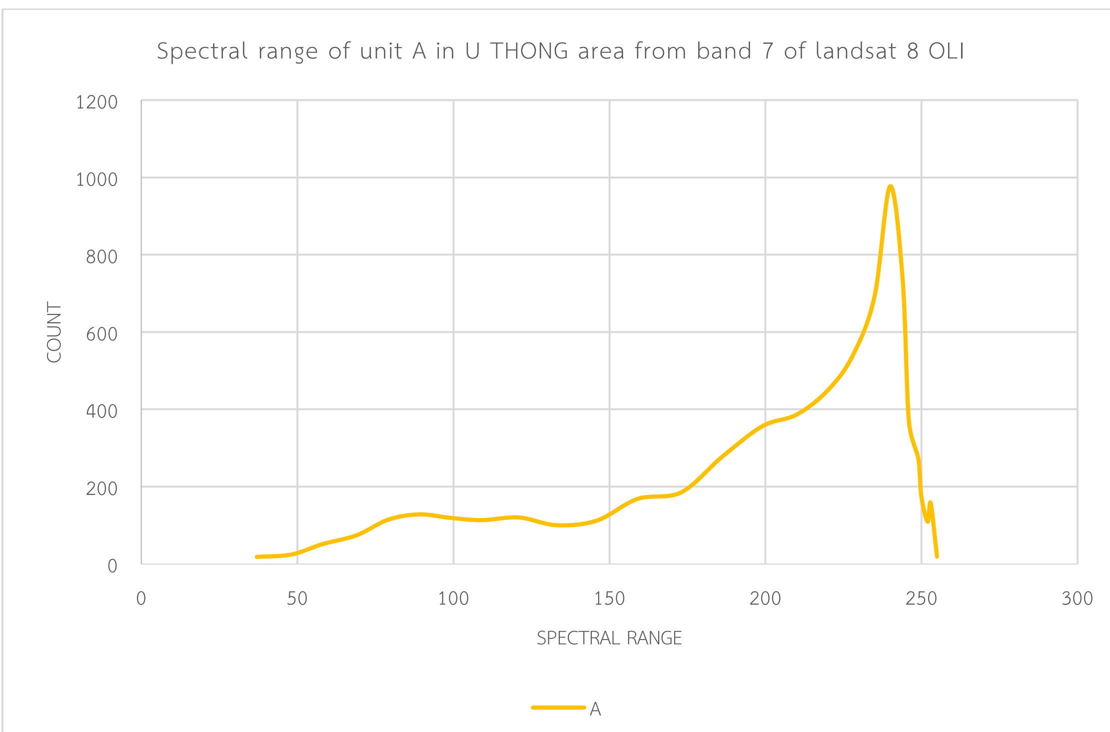



Figure 4-5.4 Spectral range of unit A in U-Thong area from band 7 of Landsat 8 OLI.

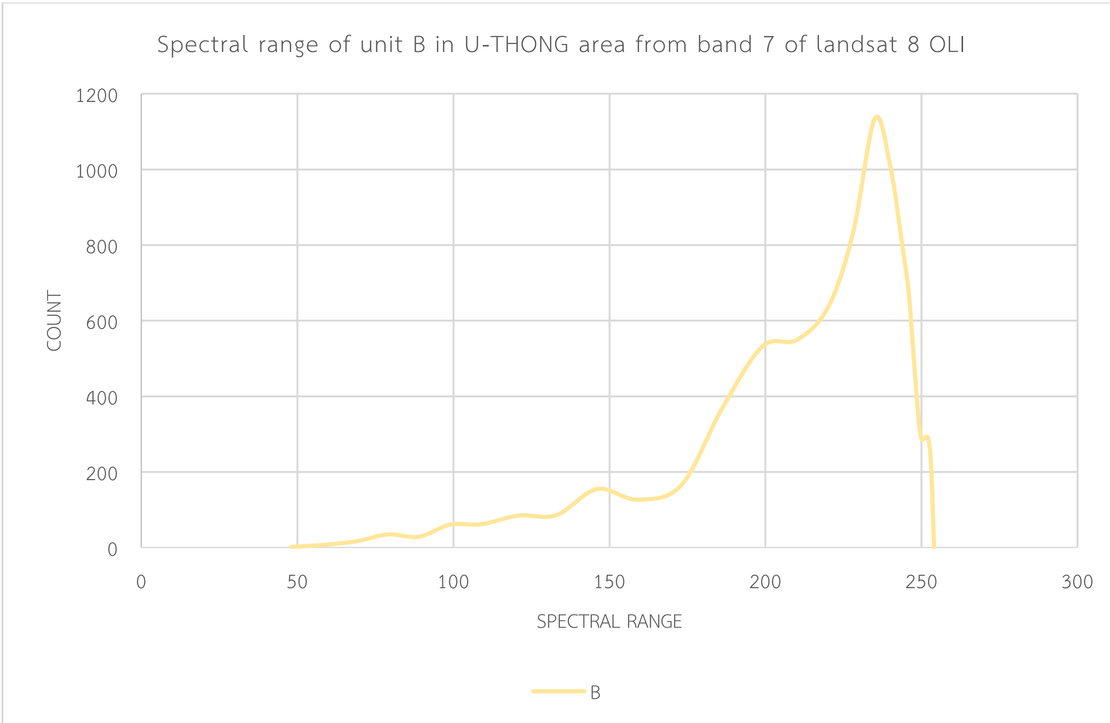



Figure 4-5.5 Spectral range of unit B in U-Thong area from band 7 of Landsat 8 OLI.

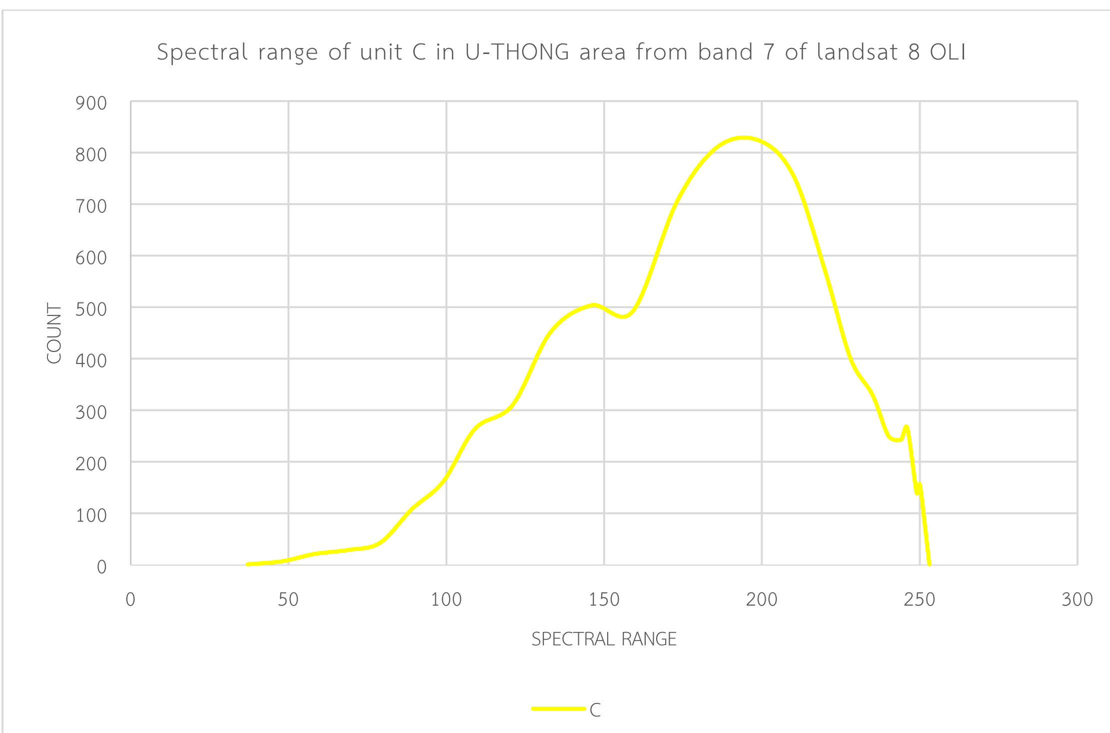



Figure 4-5.6 Spectral range of unit C in U-Thong area from band 7 of Landsat 8 OLI.

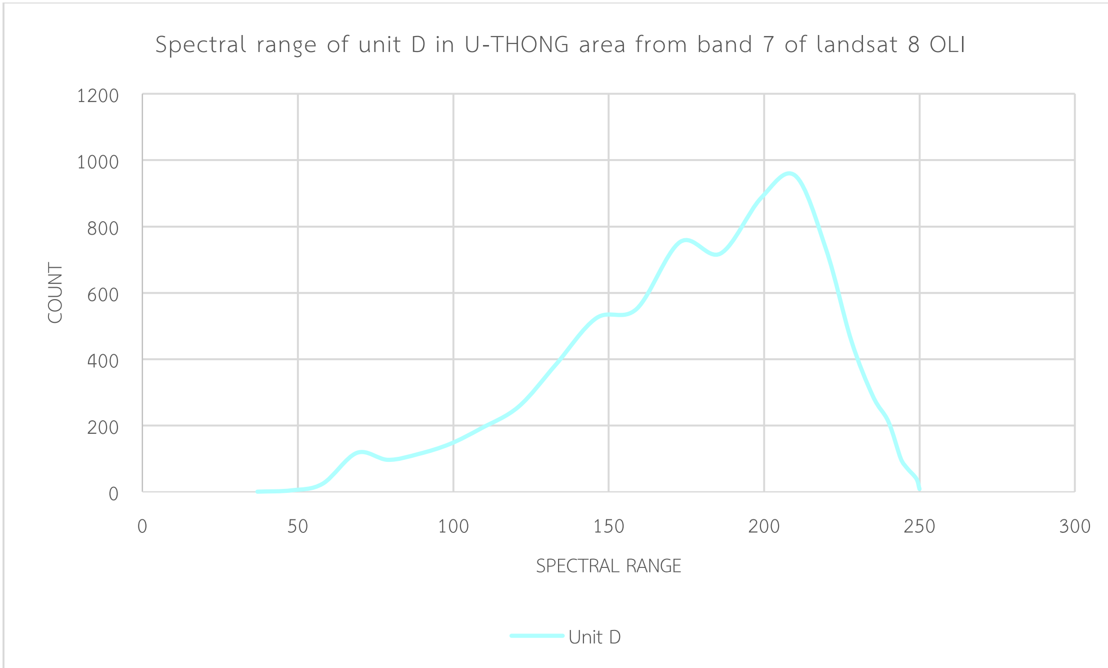



Figure 4-5.7 Spectral range of unit D in U-Thong area from band 7 of Landsat 8 OLI.

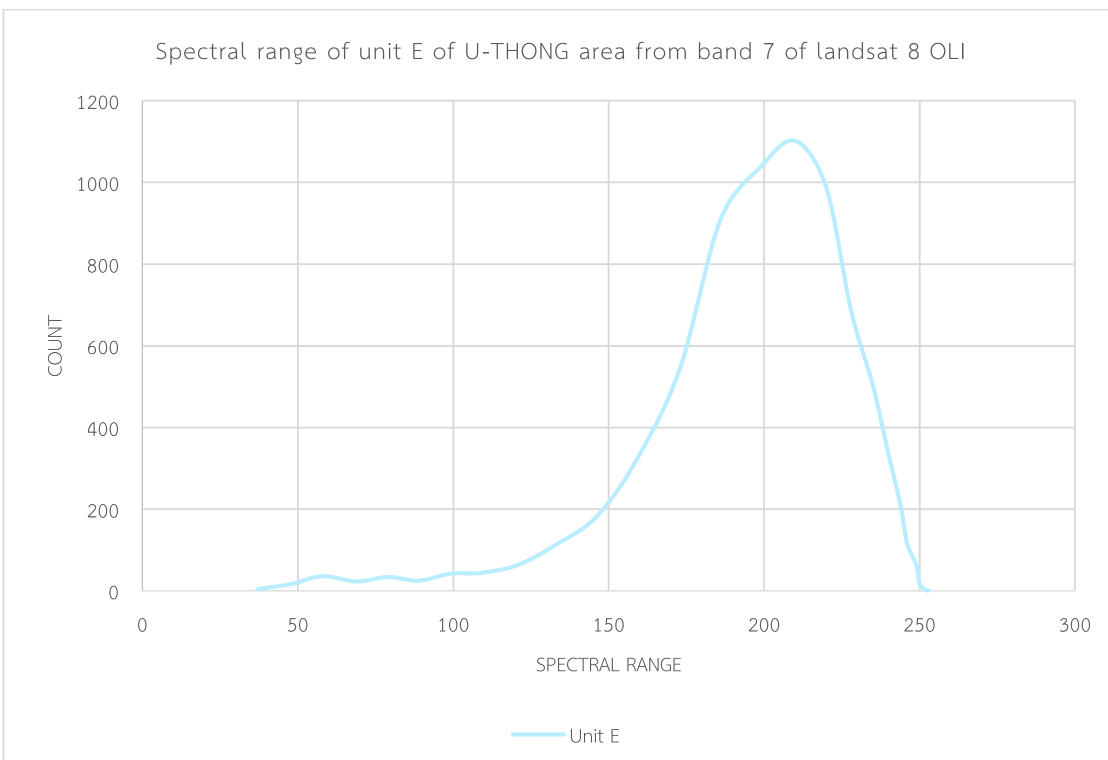



Figure 4-5.8 Spectral range of unit E in U-Thong area from band 7 of Landsat 8 OLI.

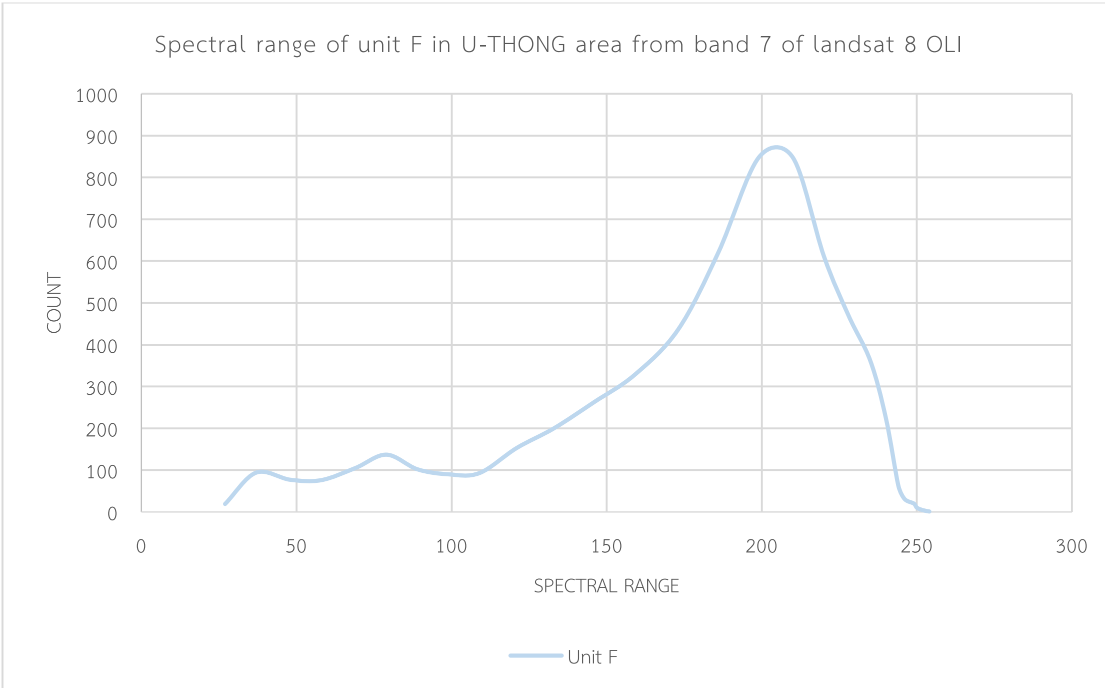



Figure 4-5.9 Spectral range of unit F in U-Thong area from band 7 of Landsat 8 OLI.

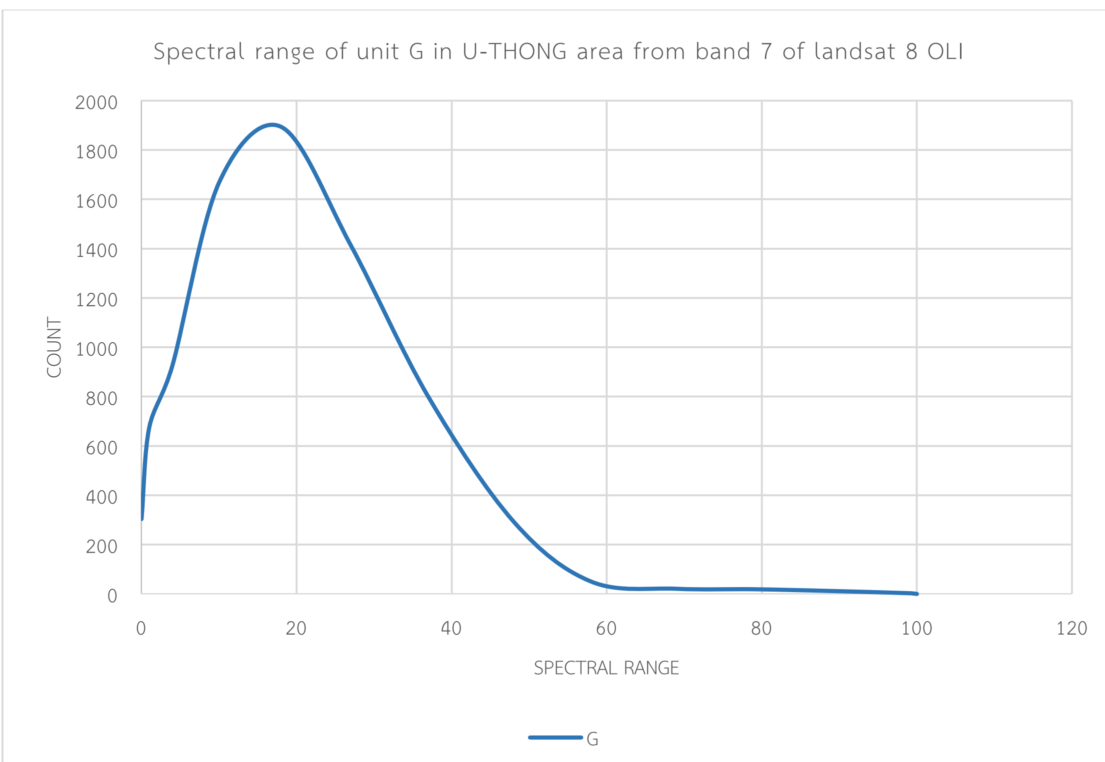



Figure 4-5.10 Spectral range of unit G in U-Thong area from band 7 of Landsat 8 OLI.

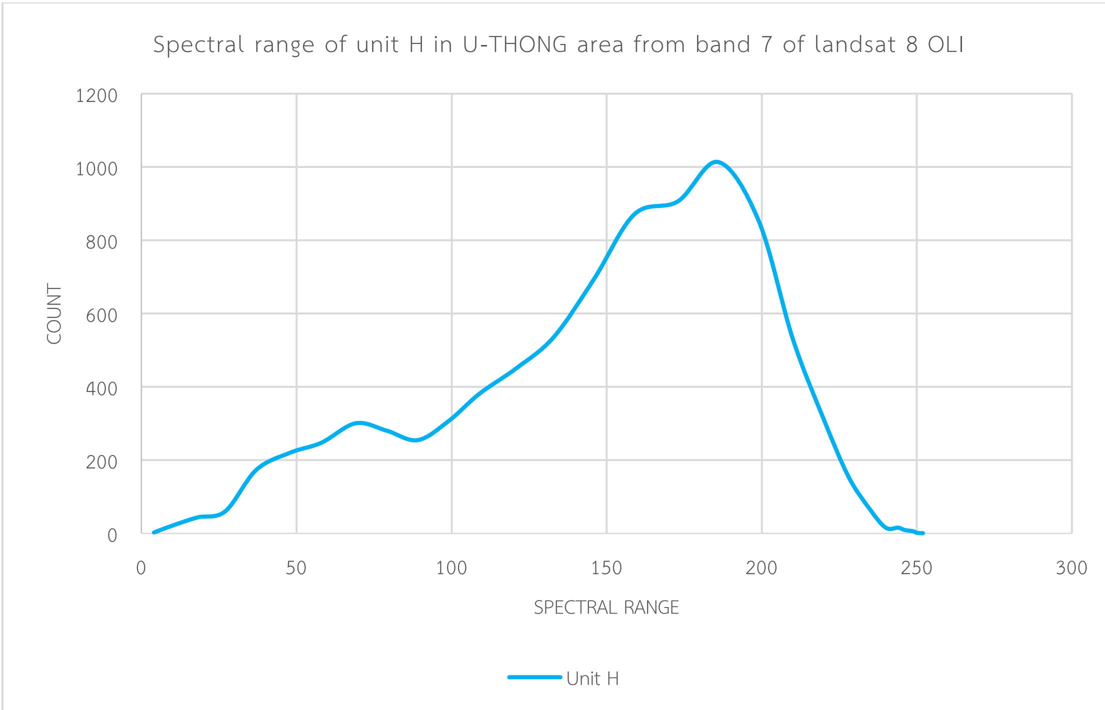



Figure 4-5.11 Spectral range of unit H in U-Thong area from band 7 of Landsat 8 OLI.

# CHAPTER 5

# DISCUSSION & CONCLUSION

In this chapter explain each of surficial deposits unit from visual classification and supervised classification following the result of U-Thong area. Moreover, compare and discussion with geological map as follow this chapter.

## 5.1 Compare the visual classification with first supervised classification

The different between visual classification and supervised classification (Figure 5-1) is boundary, accuracy and resolution. Visual classification boundary depend on eyes but supervised classification used computer to classify.

In group of slope analysis unit: A, B, and C it is very complex to digital classification because disturbed area from human activity, so when classify by training area in supervise method the error will show in the histrogram data (Table 4-2).

When we classify unit D, E, and F by supervised classification and compare with visual classification the boundary it is not clearly follow the figure 5-1, but unit G it is different, because it has sharp boundary with nearly unit, so easy to classify.

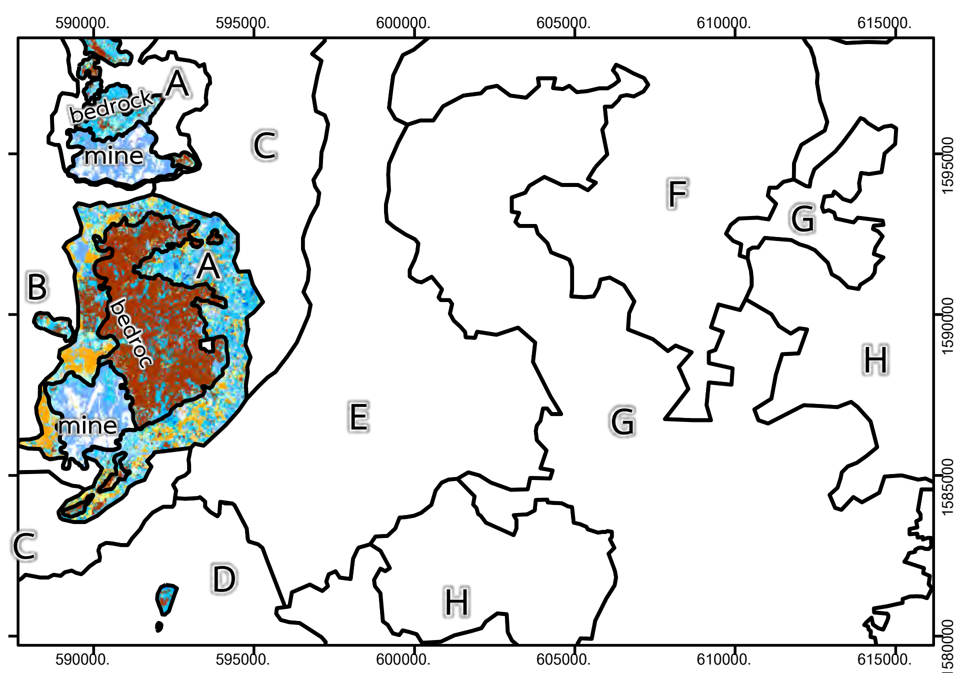



Figure 5-1 Overlay data between visual classification unit and first supervised classification unit.

## 5.2 Compare the visual classification with second supervised classification

In this topic we overlay the data between visual classification map and second supervised classification map (Figure 5-2) to reclassify unit of surficial deposits (Figure 5-3), because some unit of supervised has discontinuity boundary.

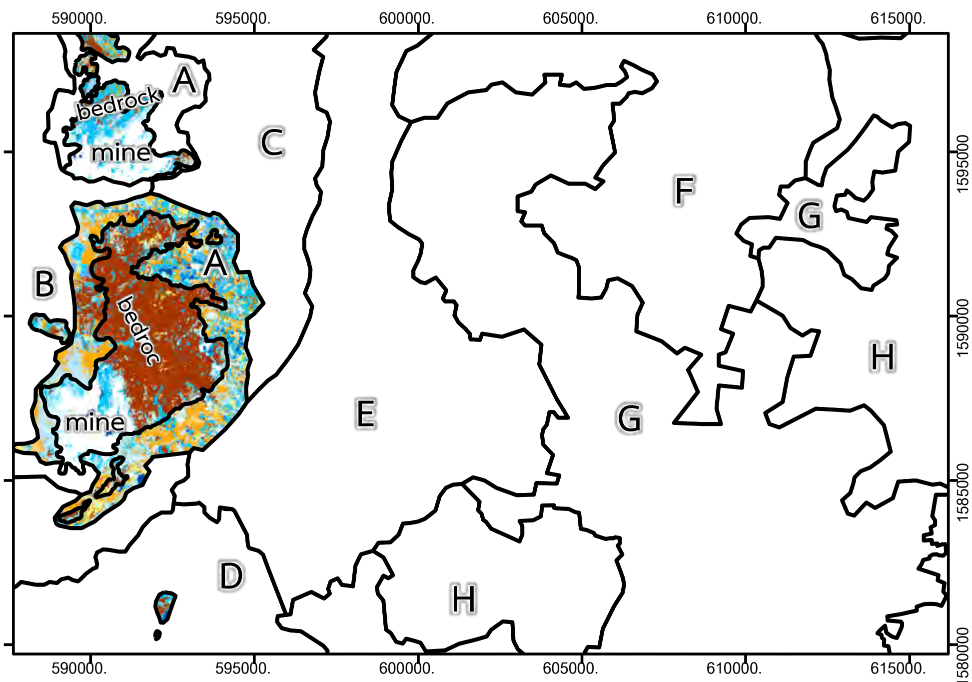



Figure 5-2 Overlay data between visual classification of surficial deposits unit and second supervised classification unit.

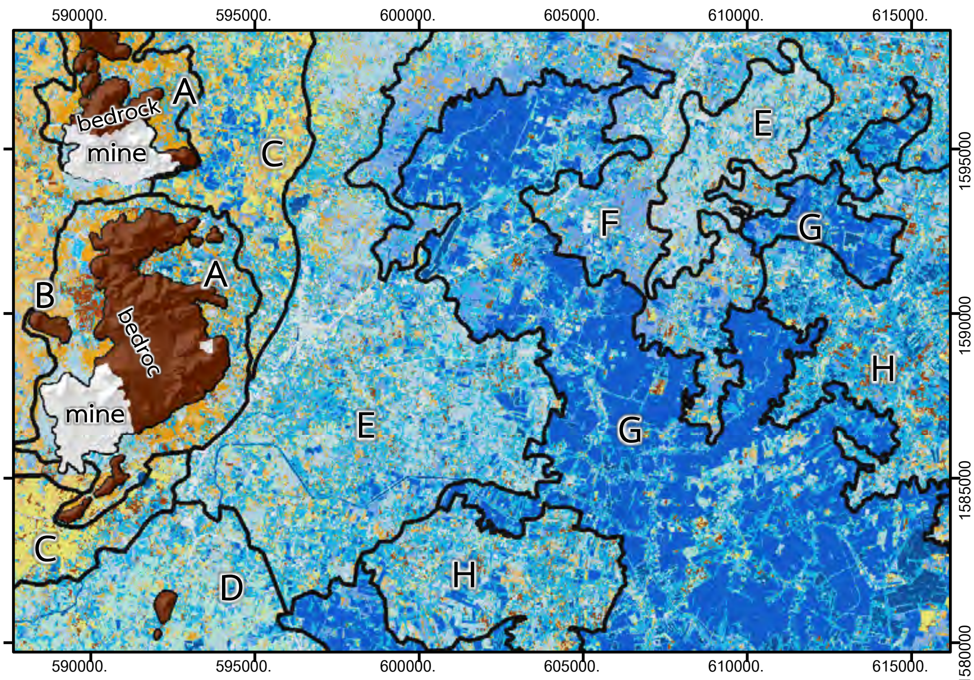



Figure 5-3 Overlay data between reclassification boundary of surficial deposits unit and second supervised classification unit.

## 5.3 Compare the second supervised classification with geological unit

Comparison of geological map, in mountain area we classify surficial deposits unit into 3 unit: A, B, and C, and also flat area we classify surficial deposits unit into 5 unit: D, E, F, G, and H. In mountain area of geological map classify into Qc, and flat area classify into Qa, Qaf, and Qmc, the comparison follow figure 5-4.

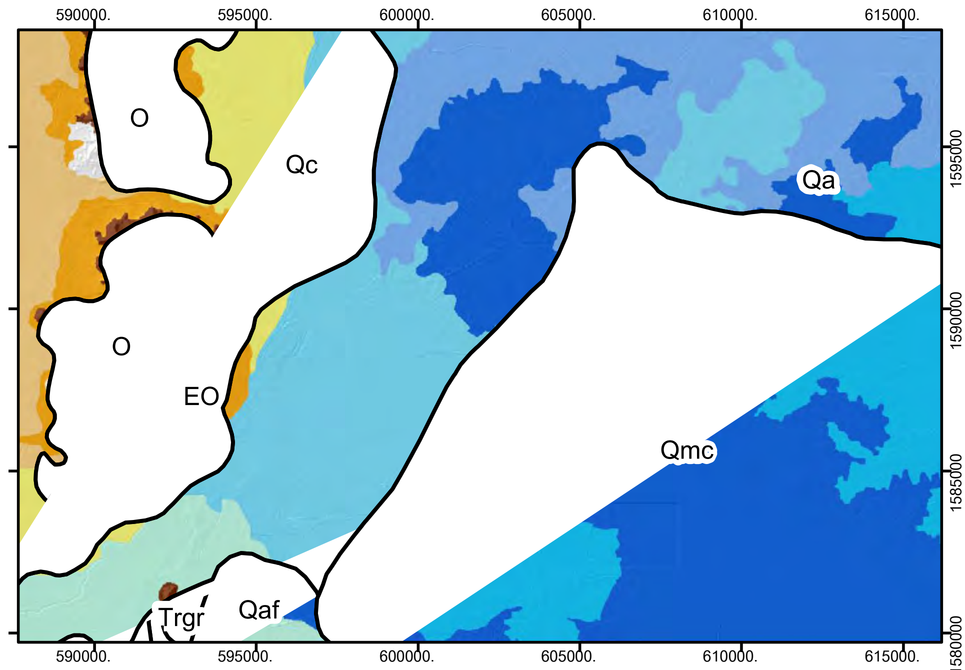



Figure 5-4 Overlay data between reclassify map of surficial deposits unit with geological unit.

## 5.4 Spectral range interpretation

The spectral range (Figure 5-5) can be representative the surficial deposits unit and compare with other value from another work to divide into the same unit.

In this study we group spectral range into 3 groups: wetland, hilly area, and flat area (agriculture).

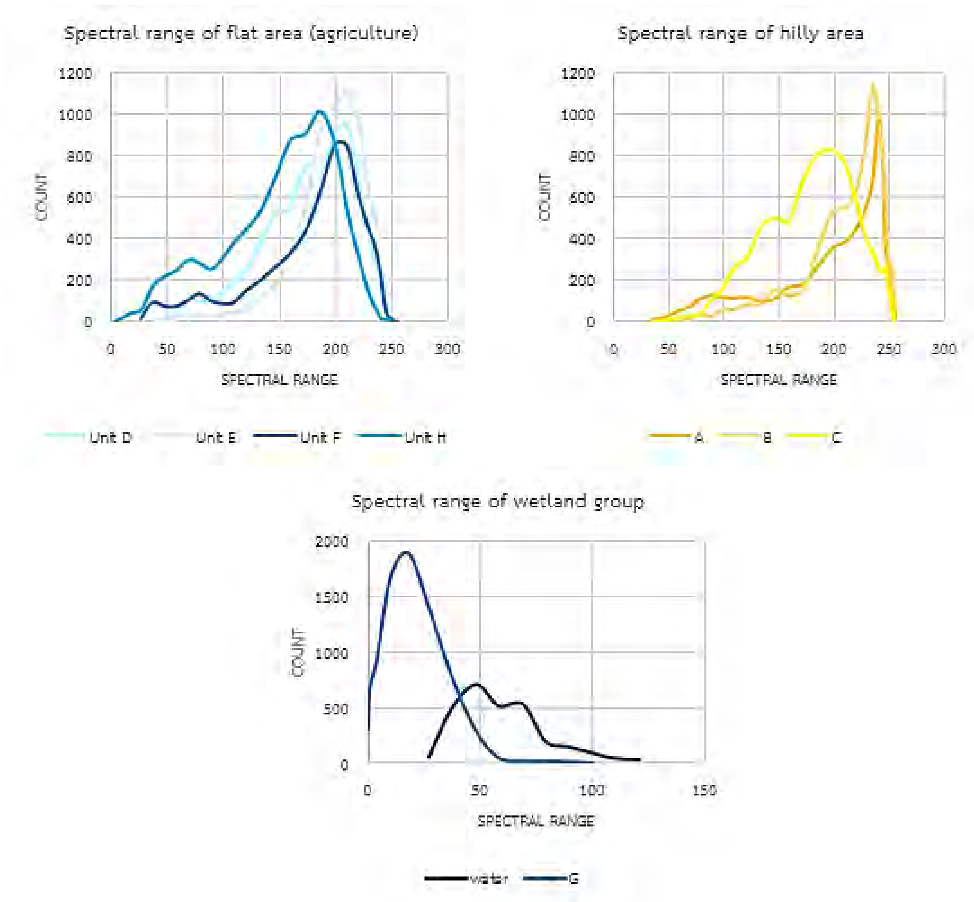



Figure 5-5 Spectral range in U-Thong area from band 7 of landsat 8 OLI. Classify into 3 groups: wetland, hilly area, and flat area (agriculture).

## 5.5 Conclusion

U-Thong area can be divided the surficial deposits unit from digital classification apply with remote sensing and GIS techniques into 11 units as follow the table 5-1 and figure 5-6.

The classification of bedrock, urban-mine, Unit A, Unit B, and C units that use DEM analysis to determine the slope. The slope of Unit B is 30-50 degrees, Unit A is 20-50 degrees and 10-20 degrees for Unit C. In division of Unit D, Unit E, Unit F, Unit G, and Unit H has classify from the digital analysis process and interpretation of satellite images Landsat 8 OLI/TIRS, THEOS satellite images, visual classification and explore data in the field, to select the training area used in the supervised classification technique.

In the histrogram analysis, Units A and Unit B are related in the spectral range 235-240, Unit D, Units E, and Unit F are related in the spectral range 200-210, Units C and H are related in the spectral range 185-200, Unit G has 18-20 in spectral range value, Unit bedrock has 121 in spectral range value, and urban-min has 18-228 in spectral range.

Main idea to classify surficial deposits units in U-Thong area is, we focus in satellite image and digital elevation model to classify, because the digital classification can be confirm each unit from different spectral range. Anyway, the field data significantly to improve and confirm the detail and boundary of surficial deposits unit. Although the digital classification cannot define the lithologic characteristic but they spend less time in the large area.

Table 5-1 The surficial deposits unit in U-Thong area classify by digital classification from Landsat 8 OLI band 7, Landsat 8 OLI band 742, THEOS imagery, Digital elevation model (DEM) and field observation data.

| Unit | Texture | Pattern | Shape | LANDSAT 8 OLI band 742 | THEOS | DEM (meters) | Slope (degree) | Lithologic characteristics | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Type(soil /unconsolidated/bedrock) | Color | Typical Grain size | Sphericity | Sorting | Composition |
| Bedrock | rough | field | irregular | blue, violet | brown, tree | 100-255 | >50 | bedrock | - | - | - | - | - |
| Urban-Mine | smooth | line, field | irregular | white, blue | white | - | - | - | - | - | - | - | - |
| A | rough | line, field | square | colorful | brown | 40-100 | 30-50 | - | - | gravel, silt | medium | poorly | - |
| B | rough | field | square | brown, orange | green | 70-100 | 20-50 | compare with soil unit LDD | | | | | |
| C | rough | field | square | brown, orange, violet, dark blue | green, dark brown | 5-15 | 10-20 | soil | dark brown | silty clay | high | well | quartz, humus |
| D | rough | field | square, rectangle | light blue, pink, light purple | brown, green | 2-7 | 20-40 | soil | brownish grey | silty clay, clay | high | well | quartz, humus |
| E | rough | field, line, field | square | light brown, light blue, dark blue | green, light violet | 2-15 | 0-10 | soil | brown | silty clay | high | well | quartz, humus |
| F | rough | field | square | brown, light brown, blue | green | 2-3 | flat | soil | light brown | clay | - | - | - |
| G | smooth | field | square | blue, dark blue | light violet | 2 | flat | soil | dark brown | clay | - | - | - |
| H | rough | field | square, rectangle | brown10%,pink,blue, light blue | brown, green, light violet | 0-6 | flat | soil | brown | clay | - | - | - |
| water | smooth | field | square | blue | dark blue | 1 | flat | - | - | - | - | - | - |

# References

British Geological Survey, Digital Geological Mapping. [Online]. 2559. https://en.wikipedia.org/wiki/Digital_mapping [2559, Jan 22]

Geological Survey of Canada, Digital Geological Mapping. [Online]. 2559. https://en.wikipedia.org/wiki/Digital_mapping [2559, Jan 22]

Hutangkura, T., 2012. Pollen analysis of the Holocene sedimentary sequences from the lower central plain of Thailand and its implications for understanding Paleo-environmental and phytogeographical changes. The lower of central plain, 24-75.

Jayko, A.S., Menges, C.M. and Thompson, R.A. 2005. Digital Method for Regional Mapping of Surficial Basin Deposits in Arid Regions, Example from Central Death Valley, Inyo County, California, by U.S. Geological survey.

Larocque, A., Leblon, B., Harris, J., Jefferson, C., Tschirhart, V., & Shelat, Y. 2012. Surficial materials mapping in Nunavut, Canada with multibeam RADARSAT-2 dual-polarization C-HH and C-HV, LANDSAT-7 ETM , and DEM data. Canadian Journal of Remote Sensing, 281-305.

L. T. K. Ho, Umitsu, M., Yamaguchi, Y. 2010. Flood hazard mapping by satellite images and SRTM DEM in the Vu Gia–Thu Bon alluvial plain, central Vietnam. Remote Sensing and Spatial Information Science, 38, Part 8.

Sinsakul, S., 1998. Environmental Geology Section, Geological Survey Division, Department of Mineral Resources, Bangkok, Thailand.

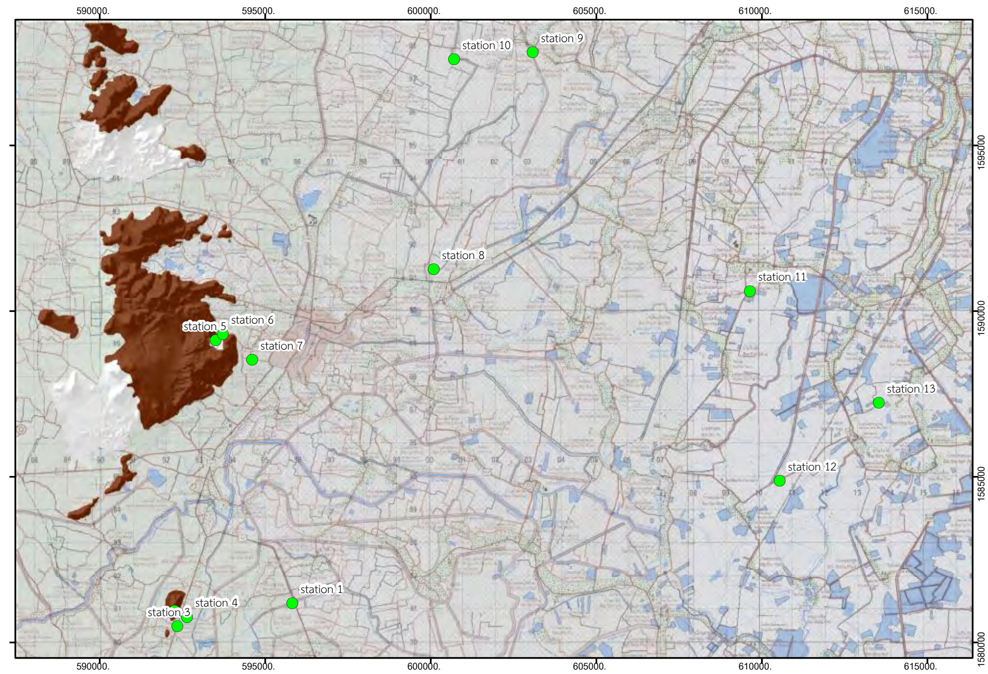
Somboon, J.R.P., Thiramongkol, N., 1992. Holocene highstand shoreline of the Chao Phraya delta, Thailand. Journal of Southeast Asian Earth Sciences, Vol. 7, No. 1, 53-60. The Geological Survey of Sweden, SGU, Definition of Surficial Deposits. [Online]. 2559. Available from: https://en.wikipedia.org/wiki/Superficial_deposits [2559, Jan 22]

USGS Rocky Mountain Geographic Science Center. "Surficial Lithology: Attribute information". US Geological Survey. Retrieved 15 September 2011.

Yumuang, S., 2005. Evaluation of potential for 2001 debris flow and debris flood in the vicinity of Nam Ko area, Amphoe Lom Sak, Changwat Phetchabun, Central Thailand.

**APPENDIC**

Field observation data




Survey map: Station 1 – Station 13

Surface of the station 1 located in unit E

Station 2: Slidely metamorphose limestone located in Unit bed rock

Station 3: trench near 324 road located in Unit E

Station 3: Stratigraphy of unconsolided sediment in trench near 324 road


Station 4: Insitue of limestone near 324 road

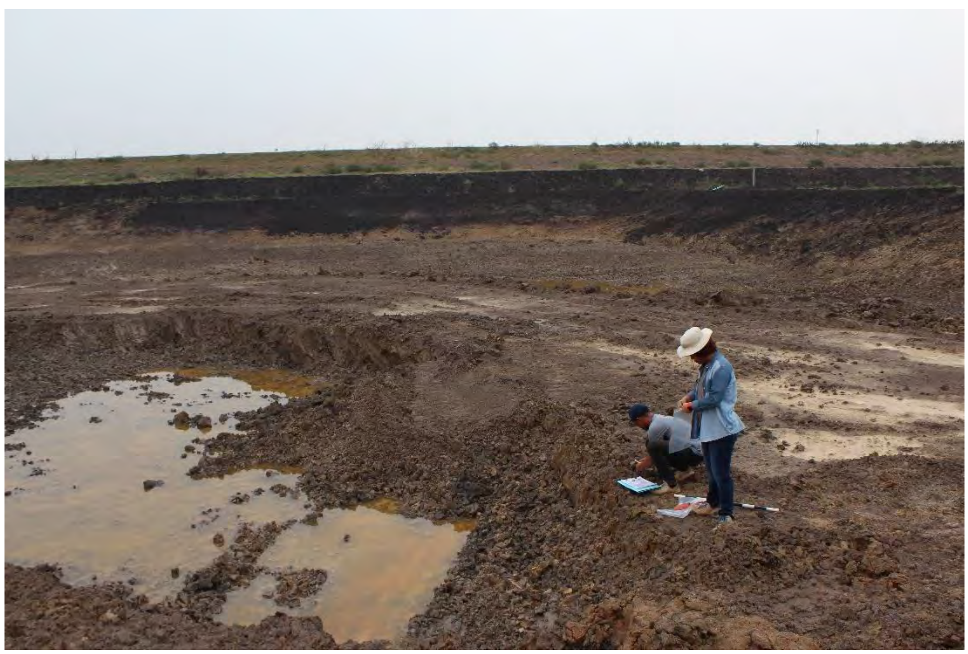
Station 4: Trench near 324 road

Station 5: Limestone located in Unit urban-mine

Station 6: Lapii on hilly area at unit bedrock

Station 6: Unconsolided sediment at unit bedrock

Station 7: Agriculture and disturb area in unit A



Station 8: Water reservoir in unit G

Station 9: Unit F

Station 10: Unit F

Station 11: Unit H

Station 12: Unit G