



JICA PROJECT TEAM

(A JOINT VENTURE OF YACHIYO
ENGINEERING CO., LTD and ORIENTAL
CONSULTANTS GLOBAL CO.,LTD)

PROJECT FOR DEVELOPMENT OF REGIONAL DISASTER RISK
RESILIENCE PLAN IN CENTRAL SULAWESI



GEOTECHNICAL SURVEY **FINAL REPORT**

Partial Palu Bridge IV Project (PB4 Project)

12nd June 2019

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Jakarta, 12 June 2019

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Subject: PROJECT FOR DEVELOPMENT OF REGIONAL DISASTER RISK RESILIENCE PLAN IN CENTRAL SULAWESI | Partial Palu Bridge IV Project (PB4 Project) | GEOTECHNICAL SURVEY Final Report

Dear Sir

In accordance with the Service Agreement between The JICA Project Team (A Joint Venture | consortium of Yachico Engineering Co., Ltd., and Oriental Consultants Global Co., Ltd.); and PT GEOMARINDEX, date April 25th, 2019 to carrying out a Geotechnical Survey for the project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi, we herewith submit a set of final report as completion documents to the mentioned agreement.

The report comprising the technical methodology and results of laboratory tested

We hope that data presented in this report will be satisfied for engineering purposes, and finally we thank you for attention.

Thank for your kind attention

Yours sincerely,

 **p.t. geomarindex**

Authorized Signature

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1. INTRODUCTION

1.1. Reference of Assignment

This report is written based on the Service Agreement between The JICA Project Team (A Joint Venture / consortium of Yachiyo Engineering Co., Ltd., and Oriental Consultants Global Co., Ltd.); and PT GEOMARINDEX, date March 8th, 2019 (and First Amendment, date: April 25th, 2019); to carrying out Geotechnical Survey for the project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi.

The parties:

- **The JICA Project Team (A Joint Venture / consortium of Yachiyo Engineering Co., Ltd., and Oriental Consultants Global Co., Ltd.);** which duly organized and existing under the laws of the Japan, with its principal office at CS Tower, 5-20-8 Asakubasahi, Taito-ku, Tokyo 111-8648, JAPAN, thereafter referred to as “the Consultant”, and;
- **PT GEOMARINDEX**, a limited liability company duly incorporated under the laws of the Republic of Indonesia, having its domicile at, 7th Floor Graha Simatupang Tower II A, Jl. Letjen. TB. Simatupang Kav. 38, Jakarta 12540, INDONESIA (thereinafter referred to as “the Sub-Consultant”).

1.2. The Survey Purpose and Objectives

The purpose of Geotechnical Survey (Investigation) work under this contract is to get more information about the condition and characteristics of the soil layer around the new bridge Project site. The results of Geotechnical Survey (Investigation) shall be used for the parameters of design analysis and construction design, especially the sub-structure.

1.3. The Project Site and Accessibility

Administratively, the project site is located at Palu Bridge IV or Ponulele Bridge, Palu City, Central Sulawesi, Indonesia. Address: Jl. Syaikh Muhammad Al-Khidhir, Central Sulawesi. Palu, in Central Sulawesi – Indonesia. All drilling equipment was mobilized by Container and truck (by land and Sea) from the Workshop Office in Kranggan (Bekasi, Eastern of Jakarta) to the project site, Palu. The location of the project site is shown in **Figure 1-1**.



Figure 1-1 Location of the Project Sites

1.4. Scope of Work

To achieve the goals in accordance to the scope of work under this contract, the works carried out include:

- Preparation, mobilization and demobilization of equipment and personnel.
- Core drilling works: 7 points (2 offshore points and 5 points in on land)
- Standard Penetration Test (SPT) executed at 1.0 m intervals.



- Undisturbed Soil Samples Shelby & Disturbed Soil Sample at specified depths for each Bore Hole
- Groundwater level monitoring for all boreholes
- Laboratory tests to determine physical and mechanical properties of the soil samples collected.
- Preparation and submission of a Factual Report and Final Report for the Geotechnical Investigation

1.5. Working Schedule

This work commenced upon signing of the survey work contract dated March 8th, with the preparation and subsequent mobilization of personnel and equipment to the site until the date of Final Report submission, on or before June 4th, 2019.

2. REFERENCE STANDARD AND DEFINITION

The Geotechnical Survey (Investigation) works was conducted following the standard procedure of The American Society of Testing and Material (ASTM). The following Table 2-1 shows the ASTM as Reference and type of Investigation works.

Table 2-1 ASTM Reference

ASTM Ref.	TYPE OF INVESTIGATION WORKS
GENERAL	
D420	Standard guide for investigating and sampling soil and rock
EXPLORATORY BORING, CLASSIFICATION, LOGGING AND SAMPLING	
D1587	Standard practice for thin-walled tube sampling of soils
D2113	Standard practice for diamond core drilling for site investigation
D2487	Standard classification of soils for engineering purposes (unified soil classification system)
D2488	Standard practice for description and identification of soils (visual-manual procedure)
D4220	Standard practice for preserving and transporting soil samples
IN-SITU TESTING	
D6089	Standard method for groundwater level measurement
D1586	Standard test method for penetration test and split-barrel sampling of soils



LABORATORY TESTING	
D422	Standard test method for particle-size analysis
D854	Standard test method for specific gravity of soils
D698	Test method for laboratory compaction characteristics of soil using standard effort (12,400 ft-lbs/ft ³ (600 kN-m/m ³))
D2166	Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
D2216	Standard test method for laboratory determination of water (moisture) content of soil and rock
D2217	Standard practice for wet preparation of soil samples for particle size analysis and determination of soil constants
D2435	Standard test method for one-dimensional consolidation properties of soils
D2850	Standard test method for unconsolidated un-drained compressive strength of cohesive soils in triaxial compression
D4318	Standard test method for liquid limit, plastic limit, and plasticity index of soils
D4643	Standard test method for determination of water (moisture) content of soil by the microwave oven method

3. METHODOLOGY AND INVESTIGATION WORK

3.1. Preparation

Preparation consisted of:

(1) Office Preparation:

Preparation in the office included: preparation of the administration set-up, equipment and personnel to be assigned in the field, checking of equipment to be used, etc., coordination with the Consultant's engineer.

(2) Field Preparation:

Preparation in the field included: coordination with the assignor in the site concerning technical and non-technical aspects to facilitate effective implementation of work, site orientation, and other related tasks.

3.2. Main Drilling



Geotechnical Survey (Investigation) was carried out at the selected locations around the site area designated by the Consultant. The main Drilling method for this Geotechnical Survey (Investigation) used Core Drilling Method. Core drilling was carried out by using hydraulic rotary drilling machine for this drilling progress at 7 (seven) points of boreholes under this contract. Suitable casing pipes were installed in order to facing soft or loose soil layers.



Standard Penetration Test (SPT) executed by default at 1.00 m intervals except at depths where Undisturbed Samples were to be collected. In accordance with the scope of work, terminal depth was determined when N values of sand and or clay were found to be more than 30 and 20, for six (6) consecutive tests. All SPT (Disturbed Samples) samples were retrieved from the split spoon sampler before being packed and sealed in plastic bags. They were then safely stored prior to transportation to the laboratory for testing.

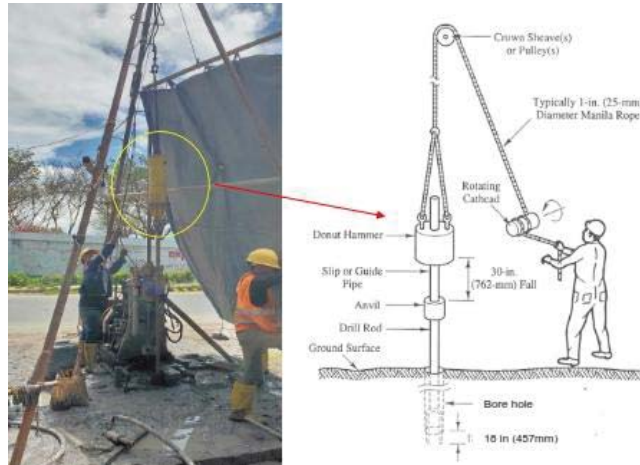
Besides SPT, Undisturbed Samples (UDS) were also obtained, catalogued, secured, and sent to the laboratory for testing (**Table 4.3**). Undisturbed sampling was carried out in accordance with the ASTM D 1587-83 (Standard Practice for Thin-Walled Tube Sampling of Soils). An undisturbed soil sample is taken from a specified depth using a Shelby tube sampler (a thin walled tube sampler) for soft to firm consistency of cohesive soils (SPT <10 blows/ft.). When the subsoil is relatively stiff, a mazier sampler was used to obtain the UDS. Subsequently, the UDS was properly handled to protect against shock, vibration, and changing of moisture content, in order to maintain the soil structure and physical composition to be as in original conditions, until it is extruded to be tested in the laboratory. The depth and recovery rate of each UDS is recorded in the respective borehole logs. Recovered cores from drilling/coring, were used to identify and thus determine soil classification and stratification; this too, is recorded in the borehole logs (**Appendix 3.1**). Recovered cores were placed in core boxes with the shallowest coring depth to the top left hand corner. Every core box was photographed and is presented in **Appendix 3.2**.



3.3. Standard Penetration Test (SPT)

The test procedure followed ASTM D-1586 and the obtained samples packed in plastic packs, and stored at their respective depths in core boxes.

Prior to testing, the bottom of the boreholes were thoroughly washed using bentonite and polymer drilling mud. The test was carried out by putting the split spoon sampler at the bottom of the borehole, and driving it downwards by blows originating from a 63.5 kg (140 lbs) donut hammer free falling from an approximated 76cm height until either 30cm has been penetrated or there is refusal.



Refusal is defined as the remainder of the 30cm penetration after 50 blows by the donut hammer. The graphic representation of the N-values resulting from the tests is in the drilling logs, and shows the stiffness and or compaction status of the soil layer by layer.

3.4. Undisturbed Soil Sampling

Undisturbed soil samples were carefully recovered from respective boreholes at determined depths and where soil conditions allowed, using a Shelby Tube Sampler and a Mazier Sampler. The Sampler was connected to the bottom of the drilling rods, and then carefully lowered to the bottom of the borehole.

The drill operators then had to carefully obtain the various soil samples with minimal disturbance to the soil samples.

Upon extraction, the recovered UDS were covered by paraffin seals at both sides of the UDS containers in order to maintain the soil samples natural condition. They were then carefully packaged expediently and sent to the laboratory for testing. Each UDS container was then labelled showing: the Project name, Location, Borehole No., Drilling depth and any other pertinent information.



3.5. Ground Water Level (GWL) Measurement

ASTM D-6089 reference was used to guide the measurement procedure of ground water level in the on-land boreholes by using a mechanical gauge with a weight. The measurements work of ground water level were made using a weighted measuring tape, by lowering the measuring tape gently into the borehole until it touched the water surface and the observed data recorded, in reference to the borehole's ground level (GL-0.00m).

Ground water measurements were carried out twice a day: once in the morning before drilling commenced, and also in the evening after drilling was completed. The ground water table was recorded every day in field note (drilling record form) and also shown in the borehole logs.

3.6. Laboratory Test

A series of laboratory tests were carried out to determine physical and mechanical properties in order to define the characteristics and technical parameters of subsurface soil in the investigation area.

The tests were applied to both undisturbed and disturbed soil samples taken from the investigation site. Laboratory tests of all samples were carried out by physical tests. The physical tests on the following items are carried out bases on the standard procedure of ASTM.

3.6.1. Physical Properties

- (1) Natural Water Content (W_n). This test was conducted following standard procedure of ASTM D-2216.
- (2) Specific Gravity (G_s). This test was conducted following standard procedure of ASTM D-854
- (3) Grain Size Analysis. This test was conducted following standard procedure of ASTM D-422 and D-1140.
- (4) Atterberg Limit Test. This test was conducted following standard procedure of ASTM D-423 and D-434.
- (5) Volume Unit Weight. This test was conducted base on standard procedure of ASTM D1556.



3.6.2. Mechanical Properties

- (1) Tri-axial Compression Test (Tx CU). This test was conducted following standard procedure of ASTM D-4767.
- (2) Tri-axial Compression Test (Tx UU). This test was conducted following standard procedure of ASTM D-2850.
- (3) Consolidation Test. This test was conducted following standard procedure of ASTM D-2435 in order to obtain Coefficient of Consolidation (Cu), Compression Index (Cc) and Re-compression Index (Cr) parameters of soil sample.
- (4) Unconfined Compression Test. This test was conducted following standard procedure of ASTM D 2166.
- (5) Direct Shear. This test was conducted following standard procedure of ASTM D 3080.

4. IMPLEMENTATION OF WORK

4.1. Location and Coordinates of Borehole Points

The borehole points were set and provided by the Consultant. **Table 4.1 & Figure 4.1** show the list of coordinates and their location in the project area respectively.

Table 4.1 Borehole points list of Coordinates

No.	Bore Hole	Co-ordinate in UTM 50 South		EGM-08	Remark
		Easting	Northing	Elevation	
	ID#	E (m)	N (m)	Z (m)	
1	GA-01	818,079.45	9,901,987.76	2.42	Left bank
2	GA-02	818,159.73	9,901,981.71	0.97	River-bed
3	GA-03	818,259.57	9,901,974.20	0.57	River-bed
4	GA-04	818,338.72	9,901,968.25	2.72	Right bank
5	GA-05	818,438.36	9,901,960.12	2.52	Right bank side
6	GA-06	818,616.83	9,901,971.53	2.54	Right bank side
7	GA-07	817,959.56	9,901,994.73	2.08	Left bank side



Figure 4.1 Location Point of Geotechnical Survey Works for Palu Bridge Project

4.2. Actual Survey quantity

The following **Table 4.2**, shows the actual survey quantities as well as their execution dates.

Table 4.2. Actual Quantity of Drilling Work and Execution Date

No.	Bore Hole ID#	Total Depth (m)	SPT (unit)	UDS Sample		Execution Timeline		Duration day
				Shelby (unit)	Mazier (unit)	Start	Finish	
1	GA-01	66	65	-	-	31-Mar-2019	11-Apr-2019	11
2	GA-02	66.38	58	4	5	16-Apr-2019	8-May-2019	22
3	GA-03	67.4	59	3	4	15-Apr-2019	7-May-2019	22
4	GA-04	69.45	69	-	-	28-Apr-2019	3-May-2019	5
5	GA-05	68.3	59	-	5	13-Apr-2019	25-Apr-2019	12
6	GA-06	65.45	55	1	8	14-Apr-2019	26-Apr-2019	12
7	GA-07	66.4	56	-	10	29-Apr-2019	7-May-2019	8



5. LABORATORY TEST

Laboratory testing was carried out to determine physical and mechanical properties of soil samples taken during survey investigation. **Table 5.1** shows samples recovered and shipped to the laboratory for testing.

Table 5.1. List of Recovered Undisturbed Samples for Laboratory Testing

Borehole No.	No	Sample ID No.	Sampling Depth (m)	Soil Type	Recovery (%)	Borehole No.	No	Sample ID No.	Sampling Depth (m)	Soil Type	Recovery (%)
Bor. GA-02	1	T-1	19.50-20.50	Silty CLAY	85	Bor. GA-05	5	M-8	51.00-52.00	CLAY	90
	2	T-2	23.00-24.00	Clayey SILT	74	Bor. GA-06	1	M-02	33.00-34.00	Clayey SILT	47
	3	T-3	26.00-27.00	Clayey SILT	90		2	M-03	36.00-37.00	Silty CLAY	90
	4	T-4	30.00-31.00	SILT	90		3	M-04	39.00-40.00	Clayey SILT	90
	5	M-1	33.00-34.00	Silty SAND	85		4	M-05	42.00-43.00	Clayey SILT	90
	6	M-2	36.00-37.00	Silty CLAY	90		5	M-06	45.00-46.00	Clayey SILT	60
	7	M-3	39.00-40.00	Clayey SILT	90		6	M-07	48.00-49.00	CLAY	90
	8	M-4	42.00-43.00	Clayey SILT	90		7	M-08	51.00-52.00	CLAY	90
	9	M-5	45.00-46.00	Clayey SILT	90		8	T-01	54.00-55.00	CLAY	75
Bor. GA-03	1	T-1	26.00-27.00	Silty CLAY	88		9	M-09	58.00-59.00	SILT	90
	2	T-2	29.00-30.00	Silty CLAY	90		Bor. GA-07	1	M-01	30.00-31.00	Silty CLAY
	3	T-3	32.00-33.00	Silty CLAY	73	2		M-02	35.00-36.00	CLAY	90
	4	M-1	39.00-40.00	Silty CLAY	77	3		M-03	38.00-39.00	CLAY	90
	5	M-2	44.00-45.00	Silty CLAY	90	4		M-04	41.00-42.00	Clayey SILT	90
	6	M-3	47.00-48.00	Silty CLAY	90	5		M-05	44.00-45.00	Clayey SILT	90
	7	M-4	50.00-51.00	Sandy SILT	72	6		M-06	47.00-48.00	Silty CLAY	90
Bor. GA-05	1	M-4	36.00-37.00	CLAY	66	7		M-07	51.00-52.00	Silty CLAY	90
	2	M-5	39.00-40.00	CLAY	85	8		M-08	54.00-55.00	Silty CLAY	90
	3	M-6	42.00-43.00	CLAY	100	9		M-09	57.00-58.00	Silty CLAY	70
	4	M-7	45.00-46.00	CLAY	90	10		M-10	60.00-61.00	Silty CLAY	90

5.1. Summary Laboratory Test

A summary of the results of laboratory testing is applied to soil samples applied to samples of undisturbed soil and disturbed soils taken from drilling results at the investigation site (GA-01 to GA-07). Completed results laboratory tested were shown in the **Appendix 5.1**.

Based on the land description and summary of the results of the related laboratory tests show that the soil taken from the depth variation ie at a depth of 0.00 to 35.00m is Gravelly SAND to Silty SAND. In-depth 19.00 to 61.00m is Clayey SILT to Silty CLAY which contains organic content in that layer. While the depth of 54.00 to 69.45m is silty SAND.



6. INTERPRETATION DATA

This chapter presents data and interpretation of the results of the field investigations.

6.1. General Geology

The General Geological condition of The Project area is adopted from Reconnaissance Geological Map of The Palu Quadrangle, Central Sulawesi presented by RAB Sukanto with collaboration of H. Sumadirdja T. Suptandar, S. Hardjoprawiro and D. Sunada, in the year of 1973 and published by Department of Mines And Energy, Directorate General of Geology and Mineral Resources, Geological Research and Development Center, Bandung (refer to **Figure – 5.1** as part of Geological Map adopted from the above mentioned Geological Map). This regional geological map is important to review and understand before we are going to prepare the geological map of the project.

The structure of the area is dominated by the NNW trending fault zone (Sukanto et. al, 1973). Its present expression is as a graben bounded by active faults, some of which have hot springs along their surface traces. Other faults and lineaments sub-parallel to the trend of the Palu fault zone occur along the eastern ridge. Many smaller faults and lineaments, approximately at right angles to this trend, are seen throughout the area. Easterly dipping thrust faults within the metamorphic complex and Tinombo formation indicate the compressive nature of the other faulting (no name). The youngest faulting on record was in 1968 near Tambo where following an earthquake, a NW trending normal fault formed and the land surface was offset 5 meters. On the downthrown side of the fault a coastal area of approximately 5 square kilometres subsided below sea level.

The Project area is within a low laying Alluvium and Coastal Deposit (Qap) zone. This formation consists of gravel, sand, mud, and coral limestone formed in fluvial, deltaic, and shallow marine environments are the youngest sediments in the area. Soil layers in this area up to about 100m below the surface are almost entirely of Holocene age. In the area near Labea and Tambo upheaved coral reefs form small low hills.

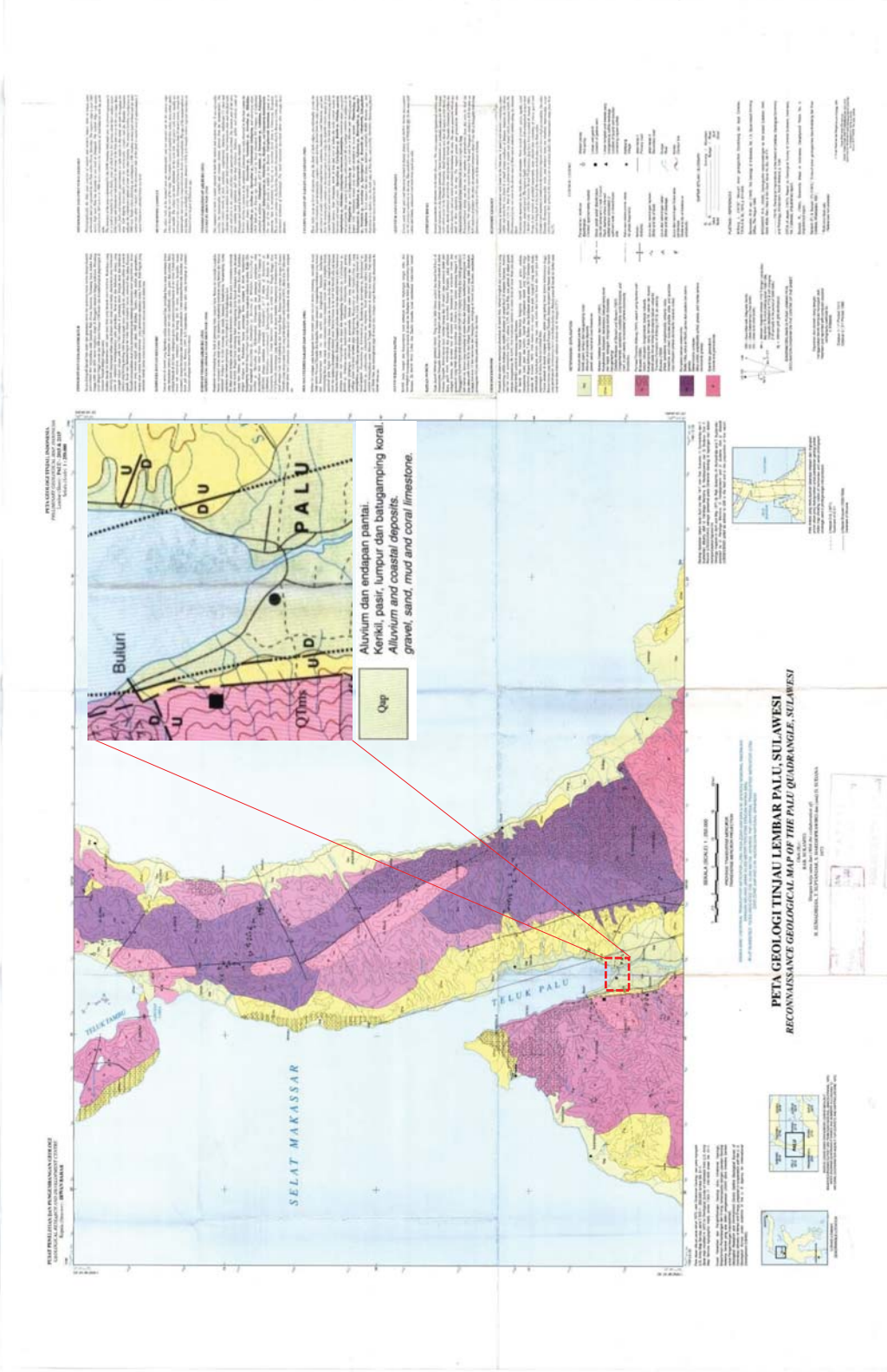


Figure 5.1. Regional geological map of Investigation Area in 1 : 100,000 scale .



6.2. Geological Condition of the Project Site

Based on the lithology and SPT N-values as presented in the drilling logs Appendix 3.1: Boring Log at site area, the material that composed each location of the project area varies greatly. Based on the type of soil composition, some location consists mostly of sand material and mix gravel with a thickness of 18.50 until 35 meters from the top soil, and continue layers of clayey or silt. Most of the soil condition on site area are already categorized as hard soil based on its SPT N value (>30) in cohesive soil and N value (>50) in granular soil, averagely those hard soils can be found below depth 13.00 meters.

Layer 1 was sedimented as the oldest soil layer that is observed from the borehole that underlying the following soil layers. Layer 2 is then sedimented with thickness of 1-7 meters on top of Layer 1, followed by Layer 3 with thickness of 21-42 meters. Sand and sandy gravel layers were found as lenses in Layer 3 with thickness of up to 8 meters. This shows some episode of high energy sedimentation that occurred in the same time as sedimentation of Layer 3. After this, the top of Layer 3 underwent eroding process that created the erosional surface that can be identified from the correlation. Following the erosional process was the deposition of Layer 4, which was coarse material that indicate the change from low to high energy depositional environment. The condition remained until present time.

Based on the SPT N-value and lithology as presented in drilling log at site area, material geology at project area can be classified in to four (4) layers, they were;

- **Layer 1: Silty SAND to Gravelly SAND**

Layer 1 mostly consist grayish brown to dark gray Silty SAND to Gravelly SAND and yellowish brown sand with consistency loose up to very dense. Mostly the SPT value of this layer is 3 up to >50 , and the thickness of this layer is about 19 meters up to 35 meters.

- **Layer 2: Silty CLAY to Clayey SILT**

Layer 2 mostly consist dark gray Silty CLAY to Clayey SILT insertion gray Sandy GRAVEL, and Clayey SAND to Silty SAND with low to high plasticity and consistency medium stiff up to hard. Mostly the SPT value of this layer is 8 up to >50 , and the thickness of this layer is about 21 meters up to 42 meters.



- **Layer 3: Silty SAND to Gravelly SAND**

Layer 3 mostly consist gray Silty SAND to Gravelly SAND with consistency very stiff up to dense. Mostly the SPT value of this layer is 15 up to >50, and the thickness of this layer is about 1 meters up to 12 meters.

- **Layer 4: Sandy SILT to Silty CLAY**

Layer 4 mostly consist gray Sandy SILT to Silty CLAY with consistency hard. Mostly the SPT value of this layer is up to >50, and the thickness of this layer is about 1 meter up to 4.5 meters.

Geological profile can be seen in the **Appendix 6.2**

6.3. Ground Water Level (GWL)

Based on the groundwater level observation in the Boreholes, average position of the GWL indicated as presented in the **Table-6.3** and **Appendix 6.3** below:

Table-6.3: Average position of the Groundwater level

No.	Borehole ID#	Ground Water Level (m)
1	GA-01	-0.52
2	GA-02	0.00 (on river)
3	GA-03	0.00 (on river)
4	GA-04	-1.1
5	GA-05	-1.5
6	GA-06	-0.6
7	GA-07	-0.3



7. CONCLUSIONS

The following summarized the results of this geotechnical survey work;

- (1) The geological composition of the waste material in the location was: alluvial.
- (2) Based on the type of soil composition can be differentiated consist of four (4) layers from the oldest to youngest layer 4 (Sandy SILT to Silty CLAY), layer 3 (Silty SAND to Gravelly SAND), layer 2 (Silty CLAY to Clayey SILT), layer 1 (Silty SAND to Gravelly SAND) all location consists mostly of sand material mixture gravel from the top soil, clayey and or silt material.
- (3) Groundwater level on the project site varies from (-0.30 to -1.50) meter below ground surface.

APPENDIX 3.1

BORING LOG

BOR. GA-01



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 01

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Otong, Dede, Warmin
Logged By : Maxwel J H Nainggolan

UTM Coordinates :
9901987.755 N
818079.454 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.42 m
Ground Water Level (GL-00) : 0.52 m
Terminal Depth (GL-00) : 66.00 m

Date of Commencement:
March 31, 2019

Date of Completion :
April 11, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST		SOIL SAMPLES		Water Content		Lab.Test	Rec (%) (m)
			SYMBOL	DESCRIPTION	BLOWS PENETRATION 45 cm N1 N2 N3	N-VALUE	DEPTH (m)	SYMBOL OF SAMPLES	PL	△w		
00.52				Fill Material, Silty SAND with some gravel and mix concrete, fine to medium grained, very loose								
01.00					3 1 2 N=3		SPT 01	△			w, GS, SA	0.20
02.00	0.42	2.00		Gravelly SAND (SW), light gray to gray, fine to coarse grained, medium dense	5 6 10 N=16		SPT 02	△			w, GS, SA	0.40
03.00				GL-3.00 to GL-4.00, Silty SAND	10 17 7 N=24		SPT 03	△			w, GS, SA	0.45
04.00				GL-4.00 to GL-5.00, medium to coarse Gravel	8 5 6 N=11		SPT 04	△			w, GS, SA	0.10
05.00					8 8 11 N=19		SPT 05	△			w, GS, SA	0.27
06.00					14 12 9 N=21		SPT 06	△			w, GS, SA	0.25
07.00					5 10 12 N=22		SPT 07	△			w, GS, SA	0.45
08.00	-05.58	6.00		Gravelly SAND (SW), gray, medium to coarse grained, medium dense to very dense, a trace of silt, fine gravel (φ 5-30mm).	10 16 20 N=36		SPT 08	△			w, GS, SA	0.45
09.00				GL-8.00 to GL-9.00, Silty SAND, dotted with GRAVEL	8 15 21 N=36		SPT 09	△			w, GS, SA	0.27
10.00				GL-11.00 to GL-12.00, Silty SAND	8 14 16 N=30		SPT 10	△			w, GS, SA	0.25
11.00				GL-13.00 to GL-14.00, Silty GRAVEL	10 17 22 N=39		SPT 11	△			w, GS, SA	0.39
12.00					8 17 20 N=37		SPT 12	△			w, GS, SA	0.37
13.00					10 19 24 N=43		SPT 13	△			w, GS, SA	0.43
14.00					3 9 18 N=27		SPT 14	△			w, GS, SA	0.27
15.00					13 18 26 N=44		SPT 15	△			w, GS, SA	0.44
16.00					3 8 19 N=27		SPT 16	△			w, GS, SA	0.45
17.00					6 12 17 N=29		SPT 17	△			w, GS, SA	0.45
18.00				GL-18.00 to GL-19.00, Sandy GRAVEL	10 18 29 N=47		SPT 18	△			w, GS, SA	0.30
19.00				GL-19.00 to GL-20.00, Silty SAND	12 28 22/10 N>=50/25		SPT 19	△			w, GS, SA	0.40
20.00				GL-20.00 to GL-21.70, SAND, coarse grained	4 16 25 N=41		SPT 20	△			w, GS	0.45
21.00					8 22 30 N=52		SPT 21	△			w, GS, SA	0.45
22.00				GL-22.00 to GL-23.00, very fine SAND	14 26 24/12 N>=50/27		SPT 22	△			w, GS	0.30
23.00				GL-23.00 to GL-24.00, Silty SAND	6 12 17 N=29		SPT 23	△			w, GS, SA	0.30
24.00					14 22 25 N=47		SPT 24	△			w, GS	0.31
25.00					12 17 20 N=37		SPT 25	△			w, GS, SA	0.27
26.00	-23.58	18.00		Silty CLAY (CL-ML), dark gray, high plasticity, stiff to very stiff, moist, some organic, at GL-28.60 to GL-29.35 organic wood decayed	3 5 9 N=14		SPT 26	△			w, GS	0.36
27.00					3 4 6 N=10		SPT 27	△			w, GS	0.34
28.00					2 3 5 N=8		SPT 28	△			w, GS, SA	0.32
29.00					25 12 10 N=22		SPT 29	△			w, GS	0.26
30.00					3 4 6 N=10		SPT 30	△			w, GS	0.45
31.00					2 4 5 N=9		SPT 31	△			w, GS	0.45
					2 4 6							



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 01

PROJECT :
The Project Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Otong, Dede, Warmin
Logged By : Maxwel J H Nainggolan

UTM Coordinates :
9901987.755 N
818079.454 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.42 m
Ground Water Level (GL-00) : 0.52 m
Terminal Depth (GL-00) : 66.00 m

Date of Commencement:
March 31, 2019

Date of Completion :
April 11, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST			SOIL SAMPLES		Water Content			Lab. Test	Rec					
			SYMBOL	DESCRIPTION	BLOWS	N-VALUE		DEPTH (m)	SYMBOL OF SAMPLES	PL	W	LL							
					N1	N2	N3	10	20	30	40	50	60						
64.00					N >= 50 / 28														
65.00					10 27 23/8														
66.00	63.58	05.00		Terminal Depth at GL-66.00m	N >= 50 / 21														

REMARKS :

- N = Uncorrected N-SPT
- GW = Ground Water Level
- HB = Hammer Blow
- M = Mazier
- T = Thin Wall Shelby Tube

- w = Natural Moisture Content
- GS = Specific Gravity
- ρt = Bulk Density
- SA = Sieve & hydrometer Analysis
- AL = Atterberg's Limits
- ST = Direct Shear Test
- UT = Unconfined Compression Test
- UU = Triaxial Compression Test (UU)
- CUB = Triaxial Compression Test (CUB)
- Cc = Consolidation Test

- Less than 3 % DOTTED
- 3 % - 10% TRACE
- 10% - 20% SOME
- 20% - 30% ADJECTIVE (SILTY/CLAYEY)
- 30% - 50% AND

SAMPLE

- Sample UDS : Undisturbed Sample
- SPT Sample

BOR. GA-02



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 02

PROJECT :
The Project Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Warmin
Logged By : Gema

UTM Coordinates :
9901981.707 N
818159.726 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 0.97 m
Ground Water Level (GL-00) : 0.00 m
Terminal Depth (GL-00) : 66.38 m

Date of Commencement :
April 16, 2019
Date of Completion :
May 08, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST			SOIL SAMPLES		Water Content		Date	Depth	Lab Test	Rec (%)
			SYMBOL	DESCRIPTION	BLOWS PENETRATION 45 cm N1 N2 N3	N-VALUE	DEPTH (m)	SYMBOL OF SAMPLES	PL	△ ^w	◇ ^{LL}				
01.00				Gravelly SAND (SW), grayish brown to dark gray, medium to coarse grained, medium dense, mix fine to coarse gravel (ø 5-50 mm). GL-6.00 to GL-7.00, Silty SAND	6 7 10		01.00	SPT 01	△			16/04/19	02.00	w, GS, SA	0.20
02.00		7 9 12			02.00		SPT 02	△			17/04/19	03.45	w, GS, SA	0.40	
03.00		5 10 11			03.00		SPT 03	△			17/04/19	03.45	w, GS, SA	0.40	
04.00		9 11 12			04.00		SPT 04	△			17/04/19	03.45	w, GS, SA	0.40	
05.00		7 9 10			05.00		SPT 05	△			17/04/19	03.45	w, GS, SA	0.40	
06.00		5 7 9			06.00		SPT 06	△			17/04/19	03.45	w, GS, SA	0.25	
07.00		3 6 11			07.00		SPT 07	△			17/04/19	03.45	w, GS, SA	0.39	
08.00	-7.03	8.00			10 17 19		08.00	SPT 08	△			18/04/19	13.45	w, GS, SA	0.29
09.00			7 10 23	09.00	SPT 09	△			18/04/19	13.45	w, GS, SA	0.44			
10.00			7 11 19	10.00	SPT 10	△			18/04/19	13.45	w, GS, SA	0.35			
11.00	-8.46	3.00	3 8 15	11.00	SPT 11	△			20/04/19	15.45	w, GS, SA	0.35			
12.00			7 17 26	12.00	SPT 12	△			20/04/19	15.45	w, GS, SA	0.42			
13.00			13 12 13	13.00	SPT 13	△			20/04/19	15.45	w, GS, SA	0.30			
14.00			12 19 21	14.00	SPT 14	△			20/04/19	15.45	w, GS, SA	0.40			
15.00			12 25 26/10	15.00	SPT 15	△			20/04/19	15.45	w, GS, SA	0.25			
16.00	-13.46	5.00	17 11 24	16.00	SPT 16	△			21/04/19	17.45	w, GS, SA	0.40			
17.00			20 24 25	17.00	SPT 17	△			21/04/19	17.45	w, GS, SA	0.32			
18.00			18 21 25	18.00	SPT 18	△			21/04/19	17.45	w, GS, SA	0.34			
19.00	-16.46	3.00	3 4 5	19.00	SPT 19	△			22/04/19	24.00	w, GS, SA	0.39			
20.00			5 6 7	20.00	T-01	△			22/04/19	24.00	w, GS, SA	0.85			
21.00			3 5 6	21.00	SPT 20	△			22/04/19	24.00	w, GS	0.41			
22.00			3 4 5	22.00	SPT 21	△			22/04/19	24.00	w, GS, SA	0.42			
23.00			3 4 5	23.00	SPT 22	△			22/04/19	24.00	w, GS, SA	0.44			
24.00			3 4 5	24.00	T-02	△			22/04/19	24.00	w, r, t, Cc, AL	0.74			
25.00			4 6 7	25.00	SPT 23	△			22/04/19	24.00	w, GS, SA	0.85			
26.00	-23.46	7.00	4 6 7	26.00	SPT 24	△			22/04/19	24.00	w, GS	0.45			
27.00			5 6 7	27.00	T-03	△			23/04/19	31.45	w, r, t, AL, SA	0.90			
28.00			4 5 6	28.00	SPT 25	△			23/04/19	31.45	w, GS	0.44			
29.00			4 6 6	29.00	SPT 26	△			23/04/19	31.45	w, GS, SA	0.45			
30.00			4 6 6	30.00	SPT 27	△			23/04/19	31.45	w, GS	0.44			
31.00			4 6 7	31.00	T-04	△			23/04/19	31.45	w, r, t, Cc, AL	0.90			
			4 5 6		SPT 28	△			23/04/19	31.45	w, GS	0.45			



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 02

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Warmin
Logged By : Gema

UTM Coordinates :
9901981.707 N
818159.726 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 0.97 m
Ground Water Level (GL-00) : 0.00 m
Terminal Depth (GL-00) : 66.38 m

Date of Commencement:
April 16, 2019
Date of Completion :
May 08, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST			SOIL SAMPLES		Water Content		Date	Depth	Lab Test	Rec (%)
			SYMBOL	DESCRIPTION	BLOWS	N-VALUE		DEPTH (m)	SYMBOL OF SAMPLES	PL	W				
32.00					N1 N2 N3	10 20 30 40 50 60	32.00	SPT 29	△						0.43
33.00				GL-33.00 to GL-34.00, Silty SAND				M-01	△			26/04/19	35.45	w, GS	0.85
34.00					5 8 10		34.00	SPT 30	△					w, GS	0.45
35.00					6 7 9		35.00	SPT 31	△					w, GS	0.40
36.00							36.00	M-02	△					w, GS	0.90
37.00					3 6 12		37.00	SPT 32	△					w, GS	0.45
38.00	-37.03	10.00			4 7 11		38.00	SPT 33	△					w, GS	0.39
39.00				Clayey SILT (ML), dark gray, stiff, low plasticity, trace of organic.			39.00	M-03	△					w, GS	0.90
40.00				GL-43.50 to GL-46.00 with some fine grained sand			40.00	SPT 34	△					w, GS	0.40
41.00					3 6 12		41.00	SPT 35	△					w, GS	0.39
42.00					6 9 12		42.00	M-04	△					w, GS	0.90
43.00					7 12 13		43.00	SPT 36	△					w, GS	0.37
44.00	-43.03	6.00			6 14 18		44.00	SPT 37	△					w, GS	0.39
45.00				Clayey SAND (SC), dark gray, stiff, with some clay, trace of organic.			45.00	M-05	△					w, GS	0.90
46.00	-45.03	2.00		GL-44.50 to GL-44.80 CLAY			46.00	SPT 38	△					w, GS, SA	0.38
47.00				Silty SAND (SM), gray, very fine to fine grained, dense to very dense			47.00	SPT 39	△					w, GS	0.30
48.00					22 44 6/1		48.00	SPT 40	△					w, GS	0.40
49.00					19 25 6/11		49.00	SPT 41	△					w, GS, SA	0.29
50.00					21 38 12/3		50.00	SPT 42	△					w, GS	0.20
51.00				GL-51.00 to GL-52.00: trace of gravel, fine to medium size gravel (ø 4-20 mm)			51.00	SPT 43	△					w, GS	0.28
52.00	-51.03	6.00			25 50/12		52.00	SPT 44	△					w, GS, SA	0.30
53.00				Clayey SILT (ML), gray, very stiff to hard, low plasticity			53.00	SPT 45	△					w, GS, SA	0.39
54.00				GL-52.00 to GL-52.45: trace of gravel with pebbles size gravel			54.00	SPT 46	△					w, GS	0.31
55.00				GL-53.00 to GL-54.00, Silty SAND			55.00	SPT 47	△					w, GS	0.38
56.00				GL-54.00 to GL-55.00: fine to medium grained sand			56.00	SPT 48	△					w, GS, SA	0.32
57.00				GL-55.00 to GL-58.45: very fine to fine grained sand			57.00	SPT 49	△					w, GS	0.34
58.00					18 28 22/7		58.00	SPT 50	△					w, GS	0.32
59.00	-58.03	7.00			19 21 29/12		59.00	SPT 51	△					w, GS	0.33
60.00	-59.03	1.00		Silty CLAY (CL-ML), gray, very stiff, high plasticity, trace of silt			60.00	SPT 52	△					w, GS, SA	0.37
61.00				Silty SAND (SM), gray, very fine to fine grained, medium to very dense			61.00	SPT 53	△					w, GS	0.32
62.00					7 8 8		62.00	SPT 54	△					w, GS	0.12
63.00				GL-60.00 to GL-61.00, Clayey SAND			63.00	SPT 55	△					w, GS	0.39
					14 40 10/2										
					25 50/12										
					18 25 25/12										
					N=50/27										
					15 26 24/11										



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 02

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Warmin
Logged By : Gema

UTM Coordinates :
9901981.707 N
818159.726 E

LOCATION :
Palu, Central Sulawesi


Borehole Elevation (EGM-08) : 0.97 m
Ground Water Level (GL-00) : 0.00 m
Terminal Depth (GL-00) : 66.38 m

Date of Commencement:
April 16, 2019

Date of Completion :
May 08, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST						SOIL SAMPLES		Water Content			Lab Test	Rec (%)												
			SYMBOL	DESCRIPTION	BLOWS			N-VALUE			DEPTH (m)	SYMBOL OF SAMPLES	PL	w	LL														
					N1	N2	N3	0	10	20	30	40	50	60			0	20	40	60	80	100	Date	Depth					
64.00					N=50/26										64.00	⊗ SPT 56	△						08/05	07/05/19					0.38
65.00					19 28 22/9										65.00	⊗ SPT 57	△								65.45				0.38
66.00					N=50/24																								0.38
66.38	-65.41	6.38			16 30 20/8										66.00	⊗ SPT 58	△								66.38				0.38
					Terminal Depth at GL-66.38m																								



REMARKS :

N = Uncorrected N-SPT
 = Ground Water Level
 HB = Hammer Blow
 M = Mazier
 T = Thin Wall Shelby Tube

w = Natural Moisture Content
 GS = Specific Gravity
 pt = Bulk Density
 SA = Sieve & hydrometer Analysis
 AL = Atterberg's Limits
 ST = Direct Shear Test
 UT = Unconfined Compression Test
 UU = Triaxial Compression Test (UU)
 CUb = Triaxial Compression Test (CUb)
 Cc = Consolidation Test

Less than 3% DOTTED
 3% - 10% TRACE
 10% - 20% SOME
 20% - 30% ADJECTIVE (SILTY/CLAYEY)
 30% - 50% AND

SAMPLE

 Sample UDS : Undisturbed Sample
 SPT Sample

BOR. GA-03



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 03

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Ramino
Logged By : Maxwel J H Nainggolan

UTM Coordinates :
9901974.198 N
818259.566 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 0.57 m
Ground Water Level (GL-00) : 0.00 m
Terminal Depth (GL-00) : 67.40 m

Date of Commencement:
April 15, 2019
Date of Completion :
May 07, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST			SOIL SAMPLES		Water Content		Date	Depth	Lab. Test	Rec (%)	
			SYMBOL	DESCRIPTION	BLOWS	N-VALUE	DEPTH (m)	SYMBOL OF SAMPLES	PL	LL						
01.00				Gravelly SAND (SW), grayish brown, fine to coarse grained, medium dense, some fine to coarse gravel (ø 5-60mm).	3 6 6	10	01.00	⊗ SPT 01	△			15/04/19	03.45	w, GS, SA	0.29	
02.00	- 01.43	2.00			6 6 8	14	02.00	⊗ SPT 02					16/04/19	05.45	GS, SA	0.00
03.00					6 8 8	16	03.00	⊗ SPT 03					17/04/19	11.45	GS, SA	0.25
04.00					4 7 10	17	04.00	⊗ SPT 04	△				18/04/19	16.00	w, GS, SA	0.35
05.00					4 2 3	5	05.00	⊗ SPT 05	△				19/04/19	18.00	w, GS, SA	0.45
06.00					11 12 12	24	06.00	⊗ SPT 06	△				20/04/19	22.45	w, GS, SA	0.28
07.00					3 5 7	12	07.00	⊗ SPT 07	△				21/04/19	25.41	w, GS, SA	0.45
07.80	- 07.23	5.80			4 8 10	18	08.00	⊗ SPT 08	△				22/04/19	30.45	w, GS, SA	0.35
08.00					11 15 20	35	09.00	⊗ SPT 09	△						w, GS, SA	0.32
10.00	- 10.43	2.20			10 18 25	43	10.00	⊗ SPT 10	△						w, GS, SA	0.43
11.00					6 13 15	28	11.00	⊗ SPT 11	△						w, GS, SA	0.33
12.00	- 11.88	2.45			16 12 20	32	12.00	⊗ SPT 12	△						w, GS, SA	0.33
13.00			18 28 22/12	>50/27	13.00	⊗ SPT 13	△						w, GS, SA	0.31		
14.00			17 26 24/10	>50/25	14.00	⊗ SPT 14	△						w, GS, SA	0.33		
15.00			10 22 28/12	>50/27	15.00	⊗ SPT 15	△						w, GS, SA	0.33		
16.00			19 28 22/10	>50/25	16.00	⊗ SPT 16	△						w, GS, SA	0.33		
17.00			15 25 25/11	>50/26	17.00	⊗ SPT 17	△						w, GS, SA	0.33		
18.00			13 28 22/7	>50/22	18.00	⊗ SPT 18	△						w, GS, SA	0.33		
19.00			20 24 26/10	>50/25	19.00	⊗ SPT 19	△						w, GS, SA	0.33		
20.00			19 30 20/9	>50/24	20.00	⊗ SPT 20	△						w, GS	0.31		
21.00			22 33 17/7	>50/22	21.00	⊗ SPT 21	△						w, GS	0.33		
22.00			13 20 30	>50	22.00	⊗ SPT 22	△						w, GS	0.36		
23.00			22 23 27	50	23.00	⊗ SPT 23	△						w, GS, SA	0.33		
24.00			12 18 25	43	24.00	⊗ SPT 24	△						w, GS	0.34		
25.00			19 25 25/11	>50/26	25.00	⊗ SPT 25	△						w, GS, SA	0.38		
26.00	- 25.43	13.55			26.00	T-1	⊗						w, CL, AL	0.88		
27.00			4 5 6	11	27.00	⊗ SPT 26	△						w, GS, SA	0.35		
28.00			4 6 7	13	28.00	⊗ SPT 27	△						w, GS	0.41		
29.00					29.00	T-2	⊗						w, CL, Cub	0.90		
30.00			5 7 9	16	30.00	⊗ SPT 28	△						w, GS	0.40		
31.00			6 6 7	13	31.00	⊗ SPT 29	△						w, GS, SA	0.36		
32.00																



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 03

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Ramino
Logged By : Maxwel J H Nainggolan

UTM Coordinates :
9901974.198 N
818259.566 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 0.57 m
Ground Water Level (GL-00) : 0.00 m
Terminal Depth (GL-00) : 67.40 m

Date of Commencement:
April 15, 2019
Date of Completion :
May 07, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST					SOIL SAMPLES		Water Content		Lab. Test	Rec (%)						
			SYMBOL	DESCRIPTION	BLOWS			N-VALUE	DEPTH (m)	SYMBOL OF SAMPLES	PL	LL	Depth			Depth					
					N1	N2	N3	0	10	20	30	40	50	60							
32.00																					
33.00					6	7	8														
					N=15																
34.00					6	7	7														
34.45	- 33.88	8.45			N=14																
35.00																					
35.00					2	3	4														
					N=7																
36.00					5	6	6														
					N=12																
37.00					17	26	24/10														
					N>=50/25																
38.00																					
38.45																					
39.00																					
40.00					5	6	8														
					N=14																
41.00					5	7	8														
41.45	- 40.88	7.00			N=15																
42.00					9	10	12														
					N=22																
43.00					6	8	9														
					N=17																
44.00																					
45.00					12	17	17														
45.45	- 44.88	4.00			N=34																
46.00					7	9	12														
					N=22																
47.00																					
48.00					7	10	13														
					N=23																
49.00					8	10	14														
					N=24																
50.00																					
51.00	- 50.88	5.55			12	16	24														
					N=40																
52.00					8	12	18														
					N=30																
53.00					10	15	20														
					N=35																
54.00					21	50/14															
					N>=50/14																
55.00					28	40	10/2														
					N>=50/17																
56.00					30	50/11															
					N>=50/11																
57.00					25	40	10/1														
57.50	- 56.93	6.50			N>=50/16																
58.00					10	15	20														
					N=35																
59.00					10	13	19														
					N=32																
60.00					15	20	20														
					N=40																
61.00	- 60.43	3.50			5	7	9														
					N=16																
62.00					25	35	15/8														
					N>=50/21																
63.00					25	50/11															
					N>=50/11																
					25	50/12															
					N>=50/12																



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 03

PROJECT :
The Project Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Ramino
Logged By : Maxwel J H Nainggolan

UTM Coordinates :
9901974.198 N
818259.566 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 0.57 m
Ground Water Level (GL-00) : 0.00 m
Terminal Depth (GL-00) : 67.40 m

Date of Commencement:
April 15, 2019
Date of Completion :
May 07, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST					SOIL SAMPLES		Water Content			Lab. Test	Rec (%)															
			SYMBOL	DESCRIPTION	BLOWS			N-VALUE	DEPTH (m)	SYMBOL OF SAMPLES	PL	w	LL																		
						N1	N2	N3	0	10	20	30	40	50	60	0	20	40	60	80	100	Date	Depth								
64.00					N >= 50/12																										
65.00					22 50/10																				07/05/19	67.40	w, GS	0.20			
66.00					N >= 50/10																								w, GS, SA	0.25	
67.00					21 50/12																									w, GS	0.25
67.40	- 66.83	8.70					20 40 10/10																							w, GS	0.35
			Terminal Depth at GL-67.40m																												

REMARKS :

N = Uncorrected N-SPT
⊗ = Ground Water Level
HB = Hammer Blow
M = Mazier
T = Thin Wall Shelby Tube

w = Natural Moisture Content
GS = Specific Gravity
pt = Bulk Density
SA = Sieve & hydrometer Analysis
AL = Atterberg's Limits
ST = Direct Shear Test
UU = Unconfined Compression Test
UU = Triaxial Compression Test (UU)
Cub = Triaxial Compression Test (Cub)
Cc = Consolidation Test

Less than 3% DOTTED
3% - 10% TRACE
10% - 20% SOME
20% - 30% ADJECTIVE (SILTY/CLAYEY)
30% - 50% AND

SAMPLE

Sample UDS : Undisturbed Sample
 SPT Sample

BOR. GA-04



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 04

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Otong & Dede
Logged By : Alvin

UTM Coordinates :
9901968.25 N
818338.99 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.72 m
Ground Water Level (GL-00) : 1.10 m
Terminal Depth (GL-00) : 69.45 m

Date of Commencement:
April 28, 2019

Date of Completion :
May 03, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST			SOIL SAMPLES		Water Content			Date	Depth	Lab.Test	Rec						
			SYMBOL	DESCRIPTION	BLOWS PENETRATION 45 cm	N-VALUE		DEPTH (m)	SYMBOL OF SAMPLES	PL	w	LL										
64.00					N1 N2 N3	10 20 30 40 50 60	64.00	⊗ SPT 64	△				03/05/2019	4.00								
65.00					N>=50/22		65.00	⊗ SPT 65	△													
66.00						10 27 23/8		66.00	⊗ SPT 66	△												
67.00						N>=50/21		67.00	⊗ SPT 67	△												
68.00	-65.28	7.00				8 31 19/7		68.00	⊗ SPT 68	△												
69.00						N.=50/17		69.00	⊗ SPT 69	△												
69.45	-66.73	1.45		Silty CLAY, grey, low plasticity, hard	10 17 33/13																	
				Terminal Depth at GL-69.45 m	7 17 20																	
					N=37																	

REMARKS :

N = Uncorrected N-SPT
 = Ground Water Level
 HB = Hammer Blow
 M = Mazier
 T = Thin Wall Shelby Tube

w = Natural Moisture Content
 GS = Specific Gravity
 pt = Bulk Density
 SA = Sieve & hydrometer Analysis
 AL = Atterberg's Limits
 ST = Direct Shear Test
 UT = Unconfined Compression Test
 UU = Triaxial Compression Test (UU)
 CUb = Triaxial Compression Test (CUb)
 Cc = Consolidation Test

Less than 3% DOTTED
 3%—10% TRACE
 10%—20% SOME
 20%—30% ADJECTIVE (SILTY/CLAYEY)
 30%—50% AND

SAMPLE

Sample UDS : Undisturbed Sample
 SPT Sample

BOR. GA-05



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 05

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Otong & Dede
Logged By : Alvin

UTM Coordinates :
9901960.12 N
818438.36 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.52 m
Ground Water Level (GL-00) : 1.05 m
Terminal Depth (GL-00) : 68.30 m

Date of Commencement:
April 13, 2019
Date of Completion :
April 25, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST		SOIL SAMPLES		Water Content		Lab. Test	Rec (%) (m)
			SYMBOL	DESCRIPTION	BLOWS PENETRATION 45 cm N1 N2 N3	N-VALUE	DEPTH (m)	SYMBOL OF SAMPLES	PL	Δ ^w		
01.05				Top Soil, grey, fine sand, some gravel, loose, quartz	3 3 3							
01.45	01.07	1.45			N=6			SPT 01	Δ		w, GS, SA	0.40
02.00				Gravelly SAND (SW), light grey to grey, fine to coarse grained, medium dense	8 6 6			M 01				0.00
03.00				GL-1.00 to GL-2.00, Silty SAND	N=12			SPT 02	Δ		w, GS, SA	0.20
04.00					6 8 10			SPT 03	Δ		w, GS, SA	0.25
05.00					8 14 15			SPT 04	Δ		w, GS, SA	0.28
06.00					N=29			SPT 05	Δ		w, GS, SA	0.23
07.00				GL-7.00 to GL-8.00, Silty SAND	4 6 8			SPT 06	Δ		w, GS, SA	0.31
08.00	- 05.48	6.55			N=14			SPT 07	Δ		w, GS, SA	0.00
09.00				Gravelly SAND (SW), grey, fine-medium grained, some gravel, medium dense to dense, some gravel, quartz	5 5 9			M 02				0.00
10.00				GL-9.00 to GL-10.00, Sandy GRAVEL	N=14			SPT 08	Δ		w, GS, SA	0.37
11.00				GL-12.00 to GL-13.00, Silty SAND	5 7 10			SPT 09	Δ		w, GS, SA	0.35
12.00				GL-14.00 to GL-15.00, Silty SAND	N=17			SPT 10	Δ		w, GS, SA	0.33
13.00					8 15 23			SPT 11	Δ		w, GS, SA	0.37
13.50					N=38			SPT 12	Δ		w, GS, SA	0.28
14.00					6 11 17			SPT 13	Δ		w, GS, SA	0.35
15.00	- 12.48	7.00			N=28			SPT 14	Δ		w, GS, SA	0.00
16.00				Sandy GRAVEL(GM), grey, fine-medium grained sand, some gravel - pebbles (φ 10-35 mm), dense	7 13 16			M 03				0.00
17.00				GL-17.00 to GL-18.00, Gravelly SAND	N=29			SPT 15	Δ		w, GS, SA	0.24
18.00				GL-19.00 to GL-20.00, Gravelly SAND	3 13 25			SPT 16	Δ		w, GS, SA	0.34
19.00					N=38			SPT 17	Δ		w, GS, SA	0.28
20.00					9 17 20			SPT 18	Δ		w, GS	0.33
21.00					N=37			SPT 19	Δ		w, GS, SA	0.34
22.00	- 19.48	7.00			13 15 21			SPT 20	Δ		w, GS	0.25
23.00				Silty SAND (SM), grey, fine-medium grained, very dense	N=36			SPT 21	Δ		w, GS, SA	0.29
24.00	- 21.48	2.00			16 23 24			SPT 22	Δ			0.40
25.00				Gravelly SAND (SW), grey, fine to medium sand, gravel (φ 10-30 mm) mixed, some gravel-gravel-pebbles, medium dense to dense	N=47			SPT 23	Δ		w, GS, SA	0.34
26.00				GL-26.5 to 27.00 coarse sand	12 20 22			SPT 24	Δ		w, GS	0.34
27.00				GL-28.80 to 29.00 trace silt & clay	N=42			SPT 25	Δ		w, GS	0.29
28.00				GL-30.00 to GL-31.00, Silty SAND	13 18 23			SPT 26	Δ		w, GS	0.34
29.00				GL-28.00 to 29.00, trace of SILT	N=41			SPT 27	Δ		w, GS, SA	0.33
30.00				GL-31.45 to 32.00 fine-medium SAND trace of gravel (φ 5-15 mm)	7 16 24			SPT 28	Δ		w, GS, SA	0.38
31.00					N=40							
					12 30 20/6							
					N>=50/21							
					13 24 26/11							
					N>=50/26							
					3 13 20							
					N=33							
					13 17 19							
					N=36							
					7 12 16							
					N=28							
					5 14 25							
					N=39							
					3 12 15							
					N=27							
					5 15 22							
					N=37							
					10 27 23							
					N=50							
					5 11 24							
					N=34							
					15 26 24/9							



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 05

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Otong & Dede
Logged By : Alvin

UTM Coordinates :
9901960.12 N
818438.36 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.52 m
Ground Water Level (GL-00) : 1.05 m
Terminal Depth (GL-00) : 68.30 m

Date of Commencement:
April 13, 2019

Date of Completion :
April 25, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST		SOIL SAMPLES	Water Content	Lab. Test	Rec
			SYMBOL	DESCRIPTION	BLOWS PENETRATION 45 cm N1 N2 N3	N-VALUE				
32.00					N >= 50/24		SPT 29	Δ	w, GS	0.34
33.00					14 25 25/10 N >= 50/25		SPT 30	Δ	w, GS	0.39
34.00					11 27 23/7 N >= 50/22		SPT 31	Δ	w, GS, SA	0.33
35.00	- 32.48	11.00			5 7 10 N=17		SPT 32	Δ	w, GS	0.39
36.00				Clayey SILT (ML), dark grey, medium plasticity, very stiff, dotted very fine sand, trace of silt GL-38.00 to 39.00 traces of fine sand			M 4	Δ	w, PL, Cub AL	0.66
37.00					9 10 11 N=21		SPT 33	Δ	w, GS, SA	0.45
38.00					3 6 7 N=13		SPT 34	Δ	w, GS	0.34
39.00							M 5	Δ	w, PL, ST	0.85
40.00	- 37.48	5.00		Sandy SILT (ML), grey, fine sand, medium dense to dense, trace of clay, quartz	5 9 28 N=37		SPT 35	Δ	w, GS, SA	0.45
41.00					4 13 16 N=29		SPT 36	Δ	w, GS	0.45
42.00	- 38.98	1.50		Clayey SILT (ML), dark grey, medium plasticity, medium dense, dotted very fine sand trace of silt			M 6	Δ	w, Cub, Co, AL	1.00
43.00				GL-43.00 to 44.50 organic matter	4 5 7 N=12		SPT 37	Δ	w, GS, SA	0.41
44.00				GL-44.50 to 46.00 increase organic matter	4 5 7 N=12		SPT 38	Δ	w, GS	0.42
45.00							M 7	Δ	w, PL, ST, AL	0.90
46.00	- 43.48	4.50		Sandy SILT (ML), dark grey, very fine sand dense-very dense, trace-some of silt & clay, quartz, trace of gravel (ϕ 2-3 mm)	8 16 34/12 N >= 50/27		SPT 39	Δ	w, GS	0.36
47.00				GL- 47.00 to 49.00 lamination of clay	11 24 26/12 N >= 50/27		SPT 40	Δ	w, GS, SA	0.32
48.00					6 12 19 N=31		SPT 41	Δ	w, GS	0.33
49.00	- 46.48	3.00		Clayey SILT (ML), dark grey, trace silt medium-high plasticity, trace gravel (ϕ 0.2-0.5 cm), medium dense			SPT 42	Δ	w, GS, SA	0.33
50.00				GL-49.00 to 49.50 Clayey SAND, fine sand	4 6 8 N=14		M 8	Δ	w, PL, ST, AL	0.90
51.00				GL-50.45 to 50.80 Fine SAND, some clay, trace silt	6 19 25 N=34		SPT 43	Δ	w, GS	0.32
52.00					7 9 17 N=26		SPT 44	Δ	w, GS	0.37
53.00					3 7 12 N=19		SPT 45	Δ	w, GS, SA	0.36
54.00					6 10 17 N=27		SPT 46	Δ	w, GS	0.45
55.00	- 53.48	4.00		Silty SAND (SM), dark grey, trace organic matter, some clay, medium dense to very dense	12 22 28/12 N >= 50/27		SPT 47	Δ	w, GS, SA	0.38
57.00				GL-56.00 to GL-57.00, Clayey SAND	4 7 11 N=18		SPT 48	Δ	w, GS, SA	0.29
58.00					16 40 10/5 N >= 50/20		SPT 49	Δ	w, GS	0.29
59.00	- 56.93	3.45		Gravelly SAND (SW), dark grey, medium grained, medium dense to dense	12 26 24/8 N >= 50/21		SPT 50	Δ	w, GS	0.33
60.00					7 17 26 N=43		SPT 51	Δ	w, GS	0.33
61.00					3 5 6 N=11		SPT 52	Δ	w, GS, SA	0.29
62.00					7 25 20 N=45		SPT 53	Δ	w, GS	0.28
63.00					5 12 18 N=30		SPT 54	Δ	w, GS	0.39
64.00	- 61.48	4.55			13 50/6					



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 05

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Otong & Dede
Logged By : Alvin

UTM Coordinates :
9901960.12 N
818438.36 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.52 m
Ground Water Level (GL-00) : 1.05 m
Terminal Depth (GL-00) : 68.30 m

Date of Commencement:
April 13, 2019

Date of Completion :
April 25, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST			SOIL SAMPLES DEPTH (m)	SYMBOL OF SAMPLES	Water Content PL Δ^w \diamond LL	Date Depth	Lab. Test (%) (m)	Rec												
			SYMBOL	DESCRIPTION	BLOWS PENETRATION 45 cm N1 N2 N3	N-VALUE																			
64.00	- 65.78	5.30		Gravelly SAND (SW), grey, fine-medium grained, very dense, quartz	N1	N2	N3	0	10	20	30	40	50	60	64.00		Δ	25/04/2019	w, GS	0.20					
65.00					28	50/9	N>=50/6										65.00		Δ						
66.00					30	50/6	N>=50/9											66.00		Δ					
67.00					20	50/9	N>=50/6											67.00		Δ					
68.00					15	50/15	N>=50/9											68.00		Δ					
68.30																									
				Terminal Depth at GL-68.30 m																					

REMARKS :

N = Uncorrected N-SPT
 Δ = Ground Water Level
HB = Hammer Blow
M = Mazier
T = Thin Wall Shelby Tube

w = Natural Moisture Content
GS = Specific Gravity
 ρ_t = Bulk Density
SA = Sieve & hydrometer Analysis
AL = Atterberg's Limits
ST = Direct Shear Test
UT = Unconfined Compression Test
UU = Triaxial Compression Test (UU)
CUb = Triaxial Compression Test (CUb)
Cc = Consolidation Test

Less than 3% DOTTED
3% - 10% TRACE
10% - 20% SOME
20% - 30% ADJECTIVE (SILTY/CLAYEY)
30% - 50% AND

SAMPLE

Sample UDS : Undisturbed Sample
 SPT Sample

BOR. GA-06



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 06

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Mail & Mirta
Logged By : Gema

UTM Coordinates :
9901971.532 N
818616.829 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.54 m
Ground Water Level (GL-00) : 0.60 m
Terminal Depth (GL-00) : 65.40 m

Date of Commencement:
April 14, 2019

Date of Completion :
April 26, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST					SOIL SAMPLES		Water Content			Lab.	Test	Rec	
			SYMBOL	DESCRIPTION	BLOWS			N-VALUE	DEPTH (m)	SYMBOL OF SAMPLES	PL	W	LL	Date				Depth
					N1	N2	N3	0 10 20 30 40 50 60				0 20 40 60 80 100						
00.60				Gravelly SAND (SW) deposit, gray, coarse grained, loose to medium dense, mix fine to medium coarse gravel (ø 5-25mm).	2	2	4			01.00	SPT 01	△						
01.00					N=6													0.39
02.00					5	7	12			02.00	SPT 02	△						0.37
02.80	-0.26	2.80		GL-1.50 to GL-2.80 fill material	5	10	11			03.00	SPT 03	△						0.33
03.00				Silty SAND (SM), gray, fine to medium grained, loose to medium dense, trace of gravel with fine to medium coarse gravel size (ø 5-15mm).	5	7	2			04.00	SPT 04	△						0.41
04.00					N=9													
05.00				GL-5.00 to GL-6.00, Gravelly SAND	5	10	11			05.00	SPT 05	△						0.40
06.00				GL-7.00 to GL-8.00, Gravelly SAND	7	10	12			06.00	SPT 06	△						0.00
07.00				GL- 9.80 to GL-10.50: SAND, coarse grained sand lamination	8	8	10			07.00	SPT 07	△						0.37
08.00					N=18													
09.00	-6.46	6.20		Silty SAND (SM), gray, fine to coarse grained, dense to very dense, trace of gravel.	7	11	14			09.00	SPT 08	△						0.00
10.00					N=25													0.33
11.00				GL-14.00 to GL-14.50 fine sand homogenous	10	12	17			10.00	SPT 09	△						0.38
12.00				GL-18.00 to GL-19.00, Gravelly SAND	10	16	22			11.00	SPT 10	△						0.35
13.00				GL-16.90 to GL-17.00 pebbles	8	10	25			12.00	SPT 11	△						0.42
14.00					N=35													0.08
15.00					8	17	34			13.00	SPT 12	△						0.00
16.00					N>50													0.00
17.00					5	7	9			14.00	SPT 13	△						0.00
18.00					N=16													0.00
19.00					9	24	27			15.00	SPT 14	△						0.00
20.00					N>50													0.33
21.00					15	24	24			16.00	SPT 15	△						0.45
22.00					N=48													0.43
23.00					8	15	29			17.00	SPT 16	△						0.42
24.00					N=44													0.20
25.00	-22.46	16.00		Gravelly SAND (SW), gray, medium grained, dense to very dense, fine to medium size (ø4-20mm)	17	27	24			18.00	SPT 17	△						0.39
26.00					N>50													0.43
27.00					10	17	24			19.00	SPT 18	△						0.42
28.00					N=41													0.20
29.00	-26.46	4.00		Silty SAND (SM), gray, fine to medium grained, medium dense to very dense, trace of gravel	13	25	26/10			20.00	SPT 19	△						0.39
30.00					N>50/25													0.43
31.00					15	29	22/10			21.00	SPT 20	△						0.41
					N>50/25													0.34
					5	4	10			22.00	SPT 21	△						0.36
					N=14													0.39
					18	30	21/8			23.00	SPT 22	△						0.30
					N>50/23													0.30
					8	11	22			24.00	SPT 23	△						0.30
					N=33													0.35
					7	14	20			25.00	SPT 24	△						0.35
					N=34													0.30
					14	20	31/14			26.00	SPT 25	△						0.30
					N>50/29													0.30
					10	19	25			27.00	SPT 26	△						0.30
					N=44													0.30
					23	37	15/3			28.00	SPT 27	△						0.35
					N>50/18													0.30
					19	24	27/8			29.00	SPT 28	△						0.35
					N>50/23													0.30
					19	23	30/5			30.00	SPT 29	△						0.30
					N>50/20													0.35
					9	10	12			31.00	SPT 30	△						0.35
					N=22													
					8	11	20											



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 06

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Mail & Mirta
Logged By : Gema

UTM Coordinates :
9901971.532 N
818616.829 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.54 m
Ground Water Level (GL-00) : 0.60 m
Terminal Depth (GL-00) : 65.40 m

Date of Commencement :
April 14, 2019
Date of Completion :
April 26, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST		SOIL SAMPLES	Water Content	Lab. Test	Rec		
			SYMBOL	DESCRIPTION	BLOWS	N-VALUE					DEPTH (m)	SYMBOL OF SAMPLES
32.00			[Vertical Line Pattern]	Clayey SILT (ML), greenish gray, very stiff, with trace of organic	N1	21	SPT 31	△	w, GS, SA	0.38		
33.00												
34.00						GL-34.30 to GL-34.40, some fine gravel	7 10 13	23	M-02	△	w, pt, AL	0.47
35.00							5 7 11	18	SPT 32	△	w, GS, SA	0.38
36.00												
37.00							4 5 7	12	M-03	△	w, pt, Cc, AL	0.90
38.00							3 7 8	15	SPT 33	△	w, GS, SA	0.40
39.00												
40.00						GL-40.00 to GL-41.00, Silty SAND	10 20 30	50	M-04	△	w, pt, CUB	0.90
41.00							8 15 17	32	SPT 34	△	w, GS, SA	0.38
42.00	-39.46	10.00	[Diagonal Line Pattern]	Silty CLAY (CL-ML), greenish gray, stiff to hard, with trace of organic								
43.00							5 7 8	15	M-05	△	w, pt, Cc, AL, SA	0.90
44.00							6 7 9	15	SPT 35	△	w, GS, SA	0.47
45.00												
46.00							10 14 19	33	M-06	△	w, pt, ST	0.60
47.00	-44.46	5.00					9 9 8	17	SPT 36	△	w, GS, SA	0.40
48.00						Clayey SILT (ML), greenish gray, very stiff, high plasticity, trace of silt						
49.00						GL-46.00 to GL-48.00 trace of silt	5 7 9	16	M-07	△	w, pt, CUB	0.90
50.00						GL-53.50 to GL-54.00 soft clay	6 9 11	20	SPT 37	△	w, GS	0.37
51.00												
52.00					3 5 9	14	M-08	△	w, pt, ST	0.90		
53.00					6 10 15	25	SPT 38	△	w, GS	0.43		
54.00	-51.46	7.00	[Vertical Line Pattern]	Silty SAND (SM), greenish gray, medium dense, trace of clay								
55.00							6 9 12	21	M-09	△	w, pt, SA	0.75
56.00	-53.46	2.00					9 24 26/10	50/25	SPT 39	△	w, GS, SA	0.43
57.00						Clayey SILT (ML), greenish gray, very stiff to hard, low plasticity, trace of clay	8 12 17	29	SPT 40	△	w, GS	0.40
58.00												
59.00							10 30 20/5	50/20	M-10	△	w, pt, UU	0.90
60.00	-57.46	4.00					10 21 30/10	50/25	SPT 41	△	w, GS	0.43
61.00							20 29 30/5	50/20	SPT 42	△	w, GS	0.39
62.00							17 29 25/7	50/22	M-11	△	w, pt, SA	0.35
63.00							16 24 26/7	50/22	SPT 43	△	w, GS	0.35
					12 20 30/14		SPT 44	△	w, GS	0.37		



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 06

PROJECT :
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Drilling Method : Rotary Drilling
Drill Master : Mail & Mirta
Logged By : Gema

UTM Coordinates :
9901971.532 N
818616.829 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.54 m
Ground Water Level (GL-00) : 0.60 m
Terminal Depth (GL-00) : 65.40 m

Date of Commencement:
April 14, 2019
Date of Completion :
April 26, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST			SOIL SAMPLES		Water Content		Date	Depth	Lab. Test	Rec				
			SYMBOL	DESCRIPTION	BLOWS	N-VALUE		DEPTH (m)	SYMBOL OF SAMPLES	PL	w					LL			
					N1	N2	N3	0	10	20	30	40	50	60					
64.00					N=50/29					64.00		SPT 54							
65.00					7 14 36/10														
65.40	-62.86	0.40			N=50/25					65.00		SPT 55							
Terminal Depth at GL- 65.40m																			

REMARKS :

N = Uncorrected N-SPT
 = Ground Water Level
HB = Hammer Blow
M = Mazier
T = Thin Wall Shelby Tube

w = Natural Moisture Content
GS = Specific Gravity
 ρ_t = Bulk Density
SA = Sieve & hydrometer Analysis
AL = Atterberg's Limits
ST = Direct Shear Test
UT = Unconfined Compression Test
UU = Triaxial Compression Test (UU)
CUb = Triaxial Compression Test (CUb)
Cc = Consolidation Test

Less than 3 % DOTTED
3 % - 10% TRACE
10% - 20% SOME
20% - 30% ADJECTIVE (SILTY/CLAYEY)
30% - 50% AND

SAMPLE

Sample UDS : Undisturbed Sample
 SPT Sample

BOR. GA-07



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 07

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Atang & Mail
Logged By : Gema

UTM Coordinates :
9901994.73 N
817959.56 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.08 m
Ground Water Level (GL-00) : 0.30 m
Terminal Depth (GL-00) : 66.40 m

Date of Commencement:
April 29, 2019

Date of Completion :
May 07, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST					SOIL SAMPLES		Water Content			Lab. Test	Rec (%)			
			SYMBOL	DESCRIPTION	BLOWS			N-VALUE	DEPTH (m)	SYMBOL OF SAMPLES	PL	△ ^w	◇ ^{LL}						
						N1	N2	N3	0 10 20 30 40 50 60			0	20	40	60	80	100		
00.30																			
01.00				Silty SAND (SM) deposit, brown to gray, coarse grained, loose, mix fine to medium coarse gravel (ø 5-25mm).		2	3	5	N=6		01.00	⊗	△					w, GS, SA	0.40
02.00						3	3	4	N=7		02.00	⊗	△					w, GS, SA	0.40
03.00	-0.84	3.00				2	7	6	N=13		03.00	⊗	△					w, GS, SA	0.15
04.00				Sandy GRAVEL (GM) deposit, brown to gray, coarse grained, medium dense to dense, mix fine to medium coarse gravel (ø 5-25mm).		5	5	7	N=12		04.00	⊗	△					GS, SA	0.35
05.00				GL-5.00 to GL-6.00: Gravelly SAND		9	16	21	N=37		05.00	⊗	△					w, GS, SA	0.33
06.00	-3.92	3.00				8	17	22	N=39		06.00	⊗	△					w, GS, SA	0.30
07.00				Silty SAND (SM), gray, fine to medium grained, dense, trace of gravel with fine to medium coarse size (ø 5-15mm).		9	16	16	N=32		07.00	⊗	△					w, GS, SA	0.40
08.00				GL-7.00 to GL-8.00: silty fine sand		8	14	18	N=32		08.00	⊗	△					w, GS, SA	0.45
09.00				GL-9.00 to GL-10.00: silty fine sand, greenish gray color		7	7	12	N=19		09.00	⊗	△					w, GS, SA	0.40
10.00						5	4	13	N=17		10.00	⊗	△					w, GS, SA	0.40
11.00						6	17	20	N=37		11.00	⊗	△					w, GS, SA	0.38
12.00						4	18	19	N=37		12.00	⊗	△					w, GS, SA	0.33
12.50	-10.42	6.50																	
13.00				Silty SAND (SM), gray, fine to medium grained, loose		2	4	4	N=8		13.00	⊗	△					w, GS, SA	0.30
14.00	-11.92	1.50				10	30	20/5	N>=50/20		14.00	⊗	△					w, GS, SA	0.15
15.00				Silty SAND (SM), gray, fine to medium grained, medium dense to very dense, some gravel with fine to medium coarse size (ø 5-15mm).		6	9	19	N=28		15.00	⊗	△					w, GS, SA	0.40
16.00						9	14	21	N=35		16.00	⊗	△					w, GS, SA	0.35
17.00						6	10	14	N=24		17.00	⊗	△					w, GS, SA	0.39
18.00						9	20	24	N=44		18.00	⊗	△					w, GS, SA	0.40
19.00						10	20	20	N=40		19.00	⊗	△					w, GS, SA	0.35
20.00	-17.92	6.00				10	25	25/14	N>=50/29		20.00	⊗	△					w, GS, SA	0.35
21.00				Gravelly SAND (SW), gray, medium to coarse grained, dense to very dense, coarse to pebble size gravel (ø 15-40 mm).		12	16	18	N=34		21.00	⊗	△					w, GS	0.20
22.00						16	20	22	N=42		22.00	⊗	△					w, GS	0.30
23.00	-20.92	3.00				7	14	18	N=32		23.00	⊗	△					w, GS, SA	0.30
24.00				Silty SAND (SM), gray, fine to medium grained, dense, trace of gravel with fine to medium coarse size (ø 5-15mm).		12	20	24	N=44		24.00	⊗	△					w, GS	0.30
25.00						7	11	18	N=39		25.00	⊗	△					w, GS	0.27
26.00						12	25	25/10	N>=50/25		26.00	⊗	△					w, GS, SA	0.40
27.00						10	21	27	N=48		27.00	⊗	△					w, GS, SA	0.30
28.00						5	7	10	N=17		28.00	⊗	△					w, GS, SA	0.30
29.00	-26.92	6.00				3	4	6	N=10		29.00	⊗	△					w, GS	0.41
30.00				Silty CLAY (CL-ML), gray, stiff to very stiff, high plasticity, moist														w, AL	0.75
31.00	-28.42	2.00				3	7	9	N=16		31.00	⊗	△					w, GS, SA	0.29
				Sandy GRAVEL (GM), gray, fine to medium grained (ø 5-15mm), medium dense		4	4	7											



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 07

PROJECT :
The Project Development of Regional Disaster
Risk Resilience Plan in Central Sulawesi

Drilling Method : Rotary Drilling
Drill Master : Atang & Mail
Logged By : Gema

UTM Coordinates :
9901994.73 N
817959.56 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.08 m
Ground Water Level (GL-00) : 0.30 m
Terminal Depth (GL-00) : 66.40 m

Date of Commencement :
April 29, 2019
Date of Completion :
May 07, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST			SOIL SAMPLES		Water Content			Lab. Test	Rec (%)		
			SYMBOL	DESCRIPTION	BLOWS	N-VALUE	DEPTH (m)	SYMBOL OF SAMPLES	PL	w	LL					
32.00				Clayey SILT (ML), gray, stiff to very stiff, high plasticity, moist, with trace to some gravel. GL-31.50 to GL-37: trace of gravel, with fine to medium size (ø 5-15mm). GL-37.00 to GL-39: silty CLAY with some gravel, with medium coarse size (ø 10-30mm).	N1	N2	N3	32.00	SPT 31	△				w, GS	0.40	
33.00					4	5	7	33.00	SPT 32	△					w, GS	0.40
34.00					4	6	9	34.00	SPT 33	△					w, GS	0.40
35.00					5	7	9	35.00	M-02	⊗					w, GS, SA	0.90
36.00					4	6	7	36.00	SPT 34	△					w, GS	0.43
37.00					17	28	22/5	37.00	SPT 35	△					w, GS	0.40
38.00					10	17	21	38.00	M-03	△					w, pt, ST	0.90
39.00	-36.92	7.50			10	17	21	39.00	SPT 36	△					w, GS	0.40
40.00					10	17	21	40.00	SPT 37	△					w, GS	0.43
40.70	-38.62	1.70			4	6	7	40.70	M-04	⊗					w, SA	0.90
41.00				4	6	7	41.00	SPT 38	△					w, GS	0.44	
42.00				4	5	7	42.00	SPT 39	△					w, GS	0.41	
43.00				35	50/5		43.00	M-05	△					w, pt, Cub	0.90	
44.00				17	29	21/12	44.00	SPT 40	△					w, GS	0.20	
45.00	-42.92	4.30		17	29	21/12	45.00	SPT 41	△					w, GS	0.37	
46.00				8	9	10	46.00	M-06	△					w, pt, Cc	0.90	
46.50	-44.42	1.50		6	9	11	46.50	SPT 42	△					w, GS	0.40	
47.00				5	7	12	47.00	SPT 43	△					w, GS	0.40	
48.00				7	17	20	48.00	SPT 44	△					w, GS	0.40	
49.00				14	23	25	49.00	M-07	△					w, pt, ST	0.90	
50.00				10	23	27/12	50.00	SPT 45	△					w, GS, SA	0.40	
51.00				22	32	18/3	51.00	SPT 46	△					w, GS	0.40	
52.00				10	23	27/12	52.00	M-08	△					w, pt, SA	0.90	
53.00	-52.92	8.50		22	32	18/3	53.00	SPT 47	△					w, GS	0.40	
54.00				14	23	25	54.00	SPT 48	△					w, GS	0.33	
55.00	-54.92	2.00		5	7	8	55.00	M-09	△					w, pt, SA	0.70	
56.00				7	30	20/5	56.00	SPT 49	△					w, GS	0.40	
57.00				7	30	20/5	57.00	SPT 50	△					w, GS	0.35	
58.00	-54.92	2.00		24	50/13		58.00	M-10	△					w, SA	0.90	
59.00				25	42	8/2	59.00	SPT 51	△					w, GS, SA	0.25	
60.00	-54.92	2.00		25	42	8/2	60.00	SPT 52	△					w, GS, SA	0.30	
61.00	-58.92	4.00		20	38	12/3	61.00	SPT 53	△					w, GS, SA	0.30	
62.00				10	21	29/11	62.00									
63.00							63.00									



PT. GEOMARINDEX

FINALLY BORING LOG

BH. NAME : GA - 07

PROJECT :
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Logged By : Gema

UTM Coordinates :
9901994.73 N
817959.56 E

LOCATION :
Palu, Central Sulawesi

Borehole Elevation (EGM-08) : 2.08 m
Ground Water Level (GL-00) : 0.30 m
Terminal Depth (GL-00) : 66.40 m

Date of Commencement:
April 29, 2019
Date of Completion :
May 07, 2019

DEPTH (m)	ELEVATION (m)	LAYER THICKNESS (m)	SOIL		STANDARD PENETRATION TEST			SOIL SAMPLES		Water Content		Date	Depth	Lab. Test	Rec
			SYMBOL	DESCRIPTION	BLOWS PENETRATION 45 cm	N-VALUE		DEPTH (m)	SYMBOL OF SAMPLES	PL	W				
					N1	N2	N3								
64.00					N=50/26			64.00	SPT 54		△	07/05/19		w, GS, SA	0.33
65.00	-63.92	4.00			12 25 25/14 N=50/29			65.00	SPT 55		△		66.45	w, GS, SA	0.40
66.00				Silty CLAY (CL-ML), gray, low plasticity, hard	14 26 24/10 N=50/25			66.00	SPT 56		△			w, GS	0.40
66.40	-65.32	1.45		Terminal Depth at GL-66.40m											

REMARKS :

N = Uncorrected N-SPT
▽ = Ground Water Level
HB = Hammer Blow
M = Mazier
T = Thin Wall Shelby Tube

w = Natural Moisture Content
GS = Specific Gravity
ρt = Bulk Density
SA = Sieve & hydrometer Analysis
AL = Atterberg's Limits
ST = Direct Shear Test
UT = Unconfined Compression Test
UU = Triaxial Compression Test (UU)
Cub = Triaxial Compression Test (Cub)
Cc = Consolidation Test

Less than 3 % DOTTED
3 % - 10% TRACE
10% - 20% SOME
20% - 30% ADJECTIVE (SILTY/CLAYEY)
30% - 50% AND

SAMPLE

Sample UDS : Undisturbed Sample
 SPT Sample

APPENDIX 3.2

PHOTO COREBOX

BOR. GA-01

BOR. GA-01 TERMINAL DEPTH GL-66.00 M

Depth 0,00 – 20,00 m		
0		1
1		2
2		3
3		4
4		5
5		6
6		7
7		8
8		9
9		10
10		11
11		12
12		13
13		14
14		15
15		16
16		17
17		18
18		19
19		20

1 Photo Corebox Bor. GA-01
The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 20,00 – 40,00 m		
20		21
21		22
22		23
23		24
24		25
25		26
26		27
27		28
28		29
29		30
30		31
31		32
32		33
33		34
34		35
35		36
36		37
37		38
38		39
39		40

2 Photo Corebox Bor. GA-01
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 40,00 – 60,00 m		
40		41
41		42
42		43
43		44
44		45
45		46
46		47
47		48
48		49
49		50
50		51
51		52
52		53
53		54
54		55
55		56
56		57
57		58
58		59
59		60

Depth 60,00 – 66,00 m		
60		61
61		62
62		63
63		64
64		65
65		66
66		67
67		68
68		69
69		70

BOR. GA-02

BOR. GA-02 TERMINAL DEPTH GL-66.38 M

Depth 0,00 – 20,00 m		
0		1
1		2
2		3
3		4
4		5
5		6
6		7
7		8
8		9
9		10
10		11
11		12
12		13
13		14
14		15
15		16
16		17
17		18
18		19
19		20

1 Photo Corebox Bor. GA-02
The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 20,00 – 40,00 m		
20		21
21		22
22		23
23		24
24		25
25		26
26		27
27		28
28		29
29		30
30		31
31		32
32		33
33		34
34		35
35		36
36		37
37		38
38		39
39		40

2 Photo Corebox Bor. GA-02
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 40,00 – 60,00 m		
40		41
41		42
42		43
43		44
44		45
45		46
46		47
47		48
48		49
49		50
50		51
51		52
52		53
53		54
54		55
55		56
56		57
57		58
58		59
59		60

Depth 60,00 – 66,38 m		
60		61
61		62
62		63
63		64
64		65
65		66
66		67
67		68
68		69
69		70

BOR. GA-03

BOR. GA-03 TERMINAL DEPTH GL-67.40 M

Depth 0,00 – 20,00 m		
0		1
1		2
2		3
3		4
4		5
5		6
6		7
7		8
8		9
9		10
10		11
11		12
12		13
13		14
14		15
15		16
16		17
17		18
18		19
19		20

1 Photo Corebox Bor. GA-03
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

BOR. GA-04 TERMINAL DEPTH GL-69.45 M



Depth 0,00 – 20,00 m		
0		1
1		2
2		3
3		4
4		5
5		6
6		7
7		8
8		9
9		10
10		11
11		12
12		13
13		14
14		15
15		16
16		17
17		18
18		19
19		20

1 Photo Corebox Bor. GA-04
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 20,00 – 40,00 m		
20		21
21		22
22		23
23		24
24		25
25		26
26		27
27		28
28		29
29		30
30		31
31		32
32		33
33		34
34		35
35		36
36		37
37		38
38		39
39		40

2 Photo Corebox Bor. GA-04
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 40,00 – 60,00 m		
40		41
41		42
42		43
43		44
44		45
45		46
46		47
47		48
48		49
49		50
50		51
51		52
52		53
53		54
54		55
55		56
56		57
57		58
58		59
59		60

Depth 60,00 – 68,30 m		
60		61
61		62
62		63
63		64
64		65
65		66
66		67
67		68
68		69
69		70

Depth 20,00 – 40,00 m		
20		21
21		22
22		23
23		24
24		25
25		26
26		27
27		28
28		29
29		30
30		31
31		32
32		33
33		34
34		35
35		36
36		37
37		38
38		39
39		40

2 Photo Corebox Bor. GA-03
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 40,00 – 60,00 m		
40		41
41		42
42		43
43		44
44		45
45		46
46		47
47		48
48		49
49		50
50		51
51		52
52		53
53		54
54		55
55		56
56		57
57		58
58		59
59		60

Depth 60,00 – 67,40 m			
60		61	61
61		62	62
62		63	63
63		64	64
64		65	65
65		66	66
66		67	67
67		68	68
68		69	69
69		70	70

BOR. GA-04

BOR. GA-04 TERMINAL DEPTH GL-69.45 M

Depth 0,00 – 20,00 m		
0		1
1		2
2		3
3		4
4		5
5		6
6		7
7		8
8		9
9		10
10		11
11		12
12		13
13		14
14		15
15		16
16		17
17		18
18		19
19		20

1 Photo Corebox Bor. GA-04
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 20,00 – 40,00 m		
20		21
21		22
22		23
23		24
24		25
25		26
26		27
27		28
28		29
29		30
30		31
31		32
32		33
33		34
34		35
35		36
36		37
37		38
38		39
39		40

2 Photo Corebox Bor. GA-04
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 40,00 – 60,00 m		
40		41
41		42
42		43
43		44
44		45
45		46
46		47
47		48
48		49
49		50
50		51
51		52
52		53
53		54
54		55
55		56
56		57
57		58
58		59
59		60

Depth 60,00 – 68,30 m		
60		61
61		62
62		63
63		64
64		65
65		66
66		67
67		68
68		69
69		70

BOR. GA-05

BOR. GA-05 TERMINAL DEPTH GL-68.30 M

Depth 0,00 – 20,00 m		
0		1
1		2
2		3
3		4
4		5
5		6
6		7
7		8
8		9
9		10
10		11
11		12
12		13
13		14
14		15
15		16
16		17
17		18
18		19
19		20

1 Photo Corebox Bor. GA-05
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 20,00 – 40,00 m		
20		21
21		22
22		23
23		24
24		25
25		26
26		27
27		28
28		29
29		30
30		31
31		32
32		33
33		34
34		35
35		36
36		37
37		38
38		39
39		40

2 Photo Corebox Bor. GA-05
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 40,00 – 60,00 m		
40		41
41		42
42		43
43		44
44		45
45		46
46		47
47		48
48		49
49		50
50		51
51		52
52		53
53		54
54		55
55		56
56		57
57		58
58		59
59		60

Depth 60,00 – 68,30 m		
60		61
61		62
62		63
63		64
64		65
65		66
66		67
67		68
68		69
69		70

BOR. GA-06

BOR. GA-06 TERMINAL DEPTH GL-65.45 M

Depth 0,00 – 20,00 m		
0		1
1		2
2		3
3		4
4		5
5		6
6		7
7		8
8		9
9		10
10		11
11		12
12		13
13		14
14		15
15		16
16		17
17		18
18		19
19		20

1 Photo Corebox Bor. GA-06
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 20,00 – 40,00 m		
20		21
21		22
22		23
23		24
24		25
25		26
26		27
27		28
28		29
29		30
30		31
31		32
32		33
33		34
34		35
35		36
36		37
37		38
38		39
39		40

2 Photo Corebox Bor. GA-06
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 40,00 – 60,00 m		
40		41
41		42
42		43
43		44
44		45
45		46
46		47
47		48
48		49
49		50
50		51
51		52
52		53
53		54
54		55
55		56
56		57
57		58
58		59
59		60



Depth 60,00 – 65,00 m		
60		61
61		62
62		63
63		64
64		65
65		66
66		67
67		68
68		69
69		70

BOR. GA-07

BOR. GA-07 TERMINAL DEPTH GL-66.40 M

Depth 0,00 – 20,00 m		
0		1
1		2
2		3
3		4
4		5
5		6
6		7
7		8
8		9
9		10
10		11
11		12
12		13
13		14
14		15
15		16
16		17
17		18
18		19
19		20

1 Photo Corebox Bor. GA-07
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 20,00 – 40,00 m		
20		21
21		22
22		23
23		24
24		25
25		26
26		27
27		28
28		29
29		30
30		31
31		32
32		33
33		34
34		35
35		36
36		37
37		38
38		39
39		40

2 Photo Corebox Bor. GA-07
 The Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi

Depth 40,00 – 60,00 m		
40		41
41		42
42		43
43		44
44		45
45		46
46		47
47		48
48		49
49		50
50		51
51		52
52		53
53		54
54		55
55		56
56		57
57		58
58		59
59		60

Depth 60,00 – 66,40 m		
60		61
61		62
62		63
63		64
64		65
65		66
66		67
67		68
68		69
69		70

APPENDIX 5.1

RESULTS OF LABORATORY TESTS

Detailed results of Laboratory tested is presented in Separate Volume



TABLE SUMMARY OF LABORATORY TEST RESULTS

JOB NO. : G-971
 PROJECT : PROJECT DEV/TT RDRR PLAN
 LOCATION : PALLU, CENTRAL SULAWESI



Bore Hole No.	Sample Depth (m)	type of sample	Index Properties										Engineering Properties																						
			specific gravity G _s	water content w _n %	wet density γ _w t/m ³	dry density γ _d t/m ³	void ratio e	deg of sat Sr %	wp %	lp %	Gravel %	Sand %	Sill %	Clay %	Classification USCS	UU - CU Triaxial			Direct Shear			Consolidation			Unconfined Compression										
			GS	wn	γ _w	γ _d	e	Sr	wp	lp	Gravel	Sand	Sill	Clay		c	φ	c'	φ'	c	φ	Cc	Cr	e _s	Pc	OCR	qu								
GA.06	41.00 - 42.00	DS	2.65	40	1.60	0.93	1.63	100	80	39	41	3.8	61.1	35.1																					
	42.00 - 43.00	UDS	2.45	72	1.60	0.93	1.63	100	80	39	41	12.7	33.1	54.2	MH							0.73	0.10	1.437	3.61	1.1									
	43.00 - 44.00	DS	2.63	41																															
	44.00 - 45.00	DS	2.57	57																															
	45.00 - 46.00	UDS	2.42	54	1.61	1.05	1.31	96													0.067														
	46.00 - 47.00	DS	2.60	36								3.70	46.80	49.50																					
	47.00 - 48.00	DS	2.67	35																															
	48.00 - 49.00	UDS	2.63	34	1.74	1.30	1.03	87					64.20	35.80																					
	49.00 - 50.00	DS	2.71	36																															
	50.00 - 51.00	DS	2.61	43																															
	51.00 - 52.00	UDS	2.75	35	1.78	1.32	1.09	89					54.3	45.7																					
	52.00 - 53.00	DS	2.64	41																															
	53.00 - 54.00	DS	2.70	27																															
	54.00 - 55.00	UDS	2.59	25	1.78	1.42	0.82	79					48.9	23.6	27.5																				
	55.00 - 56.00	DS	2.67	28																															
	56.00 - 57.00	DS	2.66	14																															
	57.00 - 58.00	DS	2.63	25																															
	58.00 - 59.00	UDS	2.65	30	1.68	1.45	0.83	96					6.6	57.9	35.5																				
	59.00 - 60.00	DS	2.70	20																															
	60.00 - 61.00	DS	2.67	22																															
	61.00 - 62.00	DS	2.69	17																															
	62.00 - 63.00	DS	2.66	13									75.8	24.2																					
	63.00 - 64.00	DS	2.66	14																															
	64.00 - 65.00	DS	2.63	15									86.9	13.1																					
	65.00 - 66.00	DS	2.68	13																															

Note : ***= Gravel
 # = NOT REQUESTED

Bekasi, 28 Mei 2019
 Laboratory Manager

Sintawati

Bore Hole No.	Sample Depth (m)	Type of sample	Index Properties										Engineering Properties																	
			specific gravity (G _s)	water content (w _n %)	water density (γ _w t/m ³)	dry density (γ _d t/m ³)	void ratio (e)	deg of sat (S _r %)	w _p %	w _L %	Ip %	Gravel %	Sand %	Silt %	Clay %	Classification USCS	UU - CU Triaxial		Direct Shear		Consolidation		Unconfined Compression							
			GS	w _n	γ _w	γ _d	e	S _r	w _p	w _L	Ip	Gravel	Sand	Silt	Clay		c	φ	c'	φ'	c	φ	C _c	Cr	e _s	P _c	OCR	q _u		
				%	t/m ³	t/m ³		%	%	%	%	%	%	%	%		kg/cm ²	deg	kg/cm ²	deg	kg/cm ²	deg				kg/cm ²	kg/cm ²	kg/cm ²	kg/cm ²	
GA.07	41.00 - 42.00	UDS	2.52	58	1.58	1.00	1.52	96					8.8	41.9	49.3								0.55	0.09	1.221	3.18	1.1			
	42.00 - 43.00	DS	4.63	37																										
	43.00 - 44.00	DS	4.63	39																										
	44.00 - 45.00	UDS	2.67	31	1.88	1.44	0.86	96																						
	45.00 - 46.00	DS	2.71	24																										
	46.00 - 47.00	DS	4.60	28																										
	47.00 - 48.00	UDS	2.70	37	1.8	1.31	1.06	95					4.70	59.00	36.30							0.44	0.06	1.148	3.05	0.9				
	48.00 - 49.00	DS	2.65	29																										
	49.00 - 50.00	DS	2.66	42																										
	50.00 - 51.00	DS	2.63	34																										
	51.00 - 52.00	UDS	2.56	43	1.74	1.22	1.10	100					9.2	36.8	54.00							0.170								
	52.00 - 53.00	DS	2.69	26									10.00	47.30	42.70															
	53.00 - 54.00	DS	2.63	22																										
	54.00 - 55.00	UDS	2.69	25	1.95	1.56	0.72	93					30.9	52.9	16.2															
	55.00 - 56.00	DS	2.67	21																										
	56.00 - 57.00	DS	2.67	26																										
	57.00 - 58.00	UDS	2.68	32	1.86	1.41	0.90	95					3.8	70.3	25.9															
	58.00 - 59.00	DS	2.60	43																										
	59.00 - 60.00	DS	2.64	38																										
	60.00 - 61.00	UDS	2.71	33	1.85	1.39	0.95	94					69.5	20.7	9.8															
	61.00 - 62.00	DS	2.70	23																										
	62.00 - 63.00	DS	2.67	22																										
	63.00 - 64.00	DS	2.65	30																										
	64.00 - 65.00	DS	2.64	21																										
	65.00 - 66.00	DS	2.66	22																										
	66.00 - 67.00	DS	2.66	24																										

Note :***=Gravel

Bekasi, 28 Mei 2019
 Laboratory Manager

Sintawati

APPENDIX 6.2

GEOLOGICAL PROFILE

PROJECT FOR
DEVELOPMENT OF
REGIONAL DISASTER RISK
RESILIENCE PLAN IN
CENTRAL SULAWESI

CLIENT :



CONSULTANT :



PT. GEOMARINDEX
GAMA SHARIPANG, TOWER 2 BLOCK A, 5/F
Jl. Ldt. Jm. TB. Simbulungur No. 38 Blok A 12540
Bonn, Hgr: +62 21 7813777 ; FAX: +62 21 7813413, 7803340
Email: info@geomarindex.com
www.geomarindex.com

NOTES :

NO.	STATUS	DATE	SIGN
1			
2			
3			
4			
5			

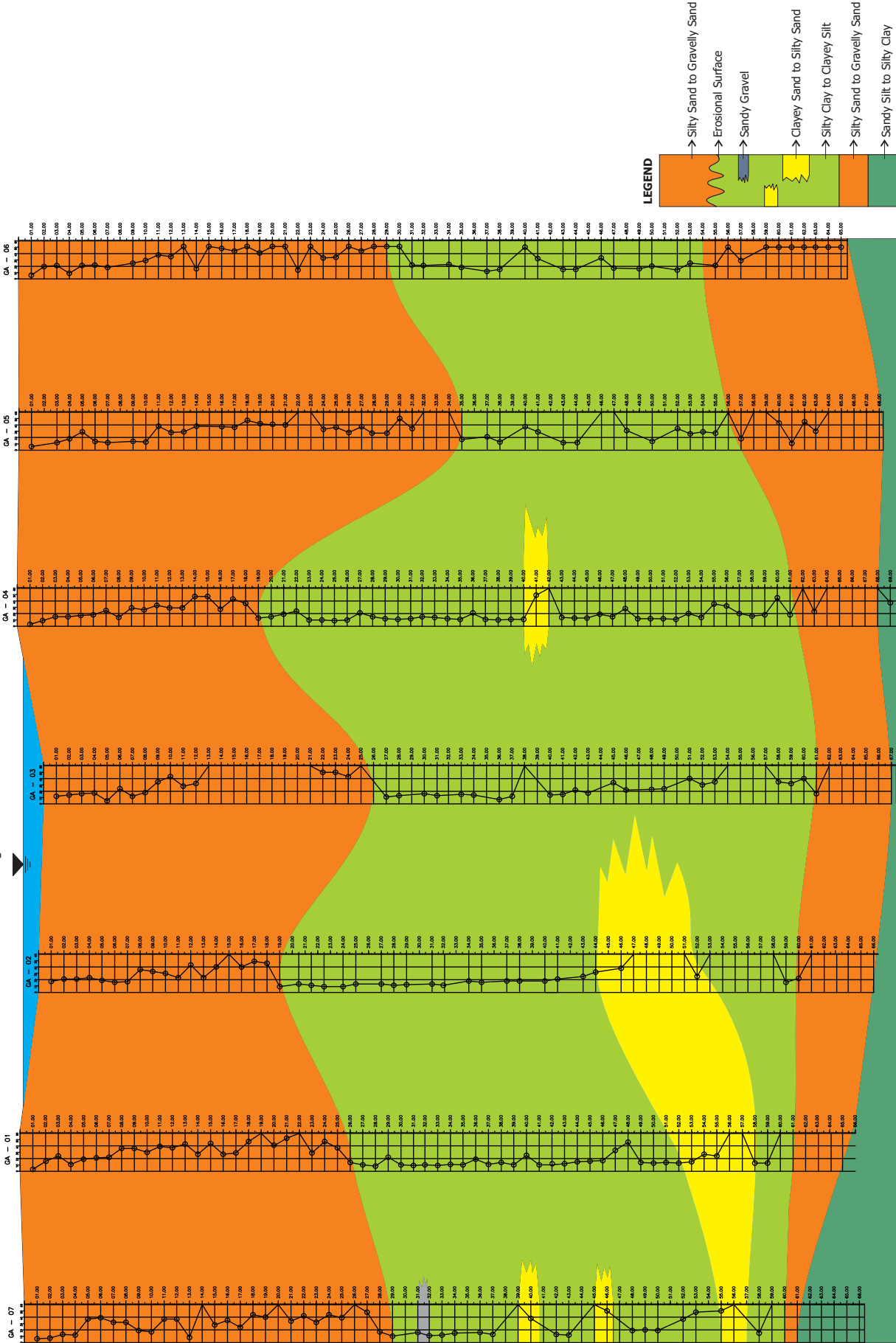
NO.	STATUS	DATE	SIGN
1			
2			
3			
4			
5			

SOIL PROFILE THROUGH
GA07-GA01-GA02-GA03-
GA04-GA05-GA06

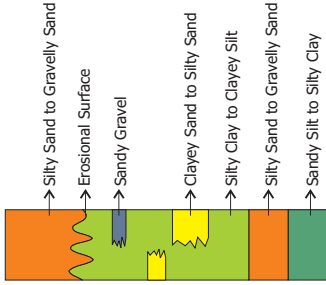
APPROVAL			
SCALE	DRAWN	RTS	DATE
			31/05/2019
	CHECKED		DATE
	APPROVAL		DATE
ISSUED FOR:	CODE	NO.	
JICA Project Team			
DATE : 31/05/2019			REV : 0

WEST ←

Existing river



LEGEND



APPENDIX 6.3

GROUND WATER LEVEL

Project Development of Regional Disaster Risk Resilience Plan In Central Sulawesi
 Location Palu Bridge 4
 Job Getechnical Survey

List Of Boreholes

No.	Bore Hole	Co-ordinate in UTM 50 South		EGM-08	Remark
		Easting	Northing	Elevation	
	ID#	E (m)	N (m)	Z (m)	
1	GA-01	818,079.45	9,901,987.76	2.42	Riverbank, west side
2	GA-02	818,159.73	9,901,981.71	0.97	River area
3	GA-03	818,259.57	9,901,974.20	0.57	River area
4	GA-04	818,338.72	9,901,968.25	2.72	Riverbank, east side
5	GA-05	818,438.36	9,901,960.12	2.52	Road side
6	GA-06	818,616.83	9,901,971.53	2.54	Eastern side
7	GA-07	817,959.56	9,901,994.73	2.08	Western side

