

Site Investigation Of Warehouse structure Site For

Owner	خزينة المملكة/الهيئة الخيرية الاردنية المحترمين
Messrs.	دار العمران للتخطيط والعمارة الهندسية المحترمين
Plot No.	1253+1273
Basin No.	الغباوي/3
Location	الزرقاء
Report No.	2429291103



لإستعمال نقابة المهندسين الأردنيين

1. بدون تسوية.

2. هنجرين متلاصقات بمساحة لا تزيد عن (2000.0) م² للطابق

التاريخ: 2024/08/ 1



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تم التصميم بناء على الكودات والتعليمات الفنية السارية

SUBJECT:

Site Investigation of Warehouse structure Project for **Messrs.:** خزينة المملكة/الهيئة الخيرية الاردنية المحترمين

Messrs: دار العمران للتخطيط والعمارة الهندسية المحترمين

Plot No. 1273+1253 Basin no 3/الغباوي LOCATION Al-Zarqa

DEAR CUSTOMER,

ARC Engineering Study Is pleased to submit this report on the above subject. It includes the results of the field and laboratory investigation and recommendations to help design foundations of the building.

For any additional information, please contact our office. We would like to thank you for your confidence, and we are looking forward to furthering co-operation.

- ان عمل تقرير فحص التربة واستطلاع الموقع بالشكل الصحيح يضمن سلامة الحفرية ويخفض من مصاريف البناء من ناحية كميات الباطون والحديد المطلوبة لتنفيذ المشروع.

- حدد كود البناء الاردني أعماق الحفر للآبار السبرية والنقاط الاستكشافية في الموقع بعمق لا يقل عن ستة امتار طولية في الحفرة الواحدة

Very truly yours

Eng Mohammed Abu Rkheyah



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1. INTRODUCTION

Upon the request of: **خزينة المملكة/الهيئة الخيرية الاردنية المحترمين**

Messrs: **دار العمران للتخطيط والعمارة الهندسية المحترمين**

A site investigation was performed for the Proposed project of the Warehouse structure the project at Al-Zarqa this geotechnical report is submitted to help them to design a sound and safe foundations.

Our investigation was carried out on nine bore holes on 1 of Aug.2024 to evaluate the subsurface conditions to design the foundations.

2. SCOPE OF WORK

The method of investigation consists of the following: -

1. Collecting information's and maps particular to the project site such as public survey, site plan and land use maps.
2. Visiting to the site to collect information about present land use, surface Topography, geological features, and surface drainage.
3. Drilling of nine (9) boreholes and sampling of disturbed and undisturbed samples.
4. Carrying out necessary field and laboratory tests.
5. Developing conclusions and recommendations for foundation and design construction.

3. PROJECT CHARACTERISTICS

We have been informed by our client that the Proposed project has the characteristic summarized below:

Hangar(1)

NO. OF FLOORS	AREA OF FLOORS m ²	ELEVATION OF FINISHED FLOOR LEVEL
Ground Floor	1000.0 m ²	645.65

Hangar(2)

NO. OF FLOORS	AREA OF FLOORS m ²	ELEVATION OF FINISHED FLOOR LEVEL
Ground Floor	1000.0 m ²	645.0

4. SITE DESCRIPTION

a. Site Location

The investigated site located at (Al-Zarqa) Lot No. (1253+1273) Basin. No.3/الغباوي.



b. Existing Structures

No existing structures at the proposed building area, for more details please see the site plan enclosed.

c. Site Topography

The site is slope toward north.

For more details, please see the topographic map enclosed. See figure (1)

d. CLIMATE

Jordan is located within the semi-arid desert climate, except in some highland areas of it, where there is a Mediterranean climate, it rains fall during the winter months in quantities ranging from 400-800 mm and hot, dry summer and moderate relative humidity approx.

e. Ground water & cavities

No free water or cavities were encountered at any depth of the boreholes drilled.

5. SEISMOLOGY:

Type of material	Limestone
Coordinates	X, 417086.700, Y 546832.860
Site class	S_c
0.2 second spectral response acceleration, S_s	0.560
0.2 second site class coefficient F_a	1.2
1 second spectral response acceleration S_1	0.19
1second site class coefficient F_v	1.7
Peak ground acceleration PGA	0.24
Peak ground acceleration coefficient F_{PGA}	1.2
Potential Damage	Moderate

6. General Geology

The materials described below are geologically related to (kcaa)(B1/2) Amman formation, the UPPER CRETACEOUS period, and to the BELQA group. This formation consist of gray or brown thin to medium bedded chart, exhibiting a variety of textures (ranging from homogenous to brecciate) intermeddled with, limestone, marl, silicified chert and phosphate.

7. Field exploration and laboratory testing:

7-1 Drilling:

Nine bore holes were drilled at the site, at the locations shown on the site map enclosed within appendix. They were numbered as BH-1 through B-9 inclusive. The depths and elevations of the drilling were fixed on the attached log sheets within appendix and as follows in table 2.

Table 2: Boreholes Depths and Elevations

Borehole No.	Borehole Depth (m)	Elevation
BH-1	9	647.0
BH-2	6	647.0
BH-3	6	647.0
BH-4	9	647.0
BH5	6	645.0
BH-6	6	645.0
BH-7	9	645.0
BH-8	6	645.0
BH-9	6	645.0

The drilling was carried out with Atlas Copco Rotary drilling rig. The advance of the drilling operation was carried out through rotary air flush drilling method.

7-1-2 Sampling

Representative soil samples were obtained at different depths at all boreholes, samples were tested to get the bearing capacity of the rock and the highest and the lowest results were recorded in this report, using double tube core barrel 76 mm diameter, the Recovered samples were examined visually by our engineer and probably placed in sequence inside wooden box and shipped to the laboratory for further testing.

7-1-3 Laboratory testing:

Laboratory testing was carried out on the samples according to:

1. ASTM D 7012-e14 Standard Test Methods for Compressive Strength and Elastic Modulus of Intact Rock Core Specimens under Varying States of Stress
2. ASTM d 7263-21

8. Field testing:

Results of the above tests are shown in table (3)

BH No	Depth of Sample (m)	Density of Sample (gm/cc)	Water content (%)	qu (kg/cm ²) (From Test)	qa (kg/cm ²) qu/S.F	Material
BH-1	2.0	1.85	4.00	37.50	2.50	Limestone
BH-5	2.0	1.88	3.00	39.00	2.60	Limestone
BH-9	2.0	1.89	3.00	40.50	2.70	Limestone

9. Subsurface Ground Conditions:

9.1 Materials and Properties:

The findings of the boreholes were generally consistent with the anticipated geology of the site area and with each other, with some local variations.

Generalized subsurface profiles (ABC) are presented in (Figures no. 3). These profiles were constructed by direct interpolation between the similar encountered materials. The line connecting these materials is made for illustration purposes only and not considered as actual line.

Further details and information regarding the materials encountered and Strata thickness is presented in the logs of boring, (see Appendix).

9.2 materials evaluation

The field investigation and laboratory tests results of the previously

Mentioned ground materials show that these materials have the following general properties:

Yellowish cream weak limestone with intercalation of marl

10. Bearing Capacity:

10-1 calculation of bearing capacity of Limestone layer:

The allowable bearing capacity for the rock strata can be calculated by using.

The following equation which is recommended by Jordanian Site Investigation Code (K.B.A 4/1992)

$$q_a = q_u / F. S \text{ -----} \{Eq 1\}$$

Where.

q_a = The recommended allowable bearing capacity (Kg/cm²).

q_u = The unconfined compressive strength of the rock core with length (L) to diameter (D): $L = 2 D$.

F.S: Safety factor which depends mainly on the followings: -

The Rock Quality Designation (RQD) ----- Fig. (4)

By using minimum average RQD values which is (55) and by using figure (4) the safety factor will be (15) for Limestone.

Using this safety factor, the minimum Allowable Bearing Capacity is 2.5 kg/cm².

10-2- Calculation of maximum settlement:

For calculation the settlement we recommended to use the following equation
(After Josph – E. Bowles, 1991)

$$S = (C_d q B (1 - \mu^2)) / E_s$$

Where:

S: Settlement value. (mm)

q: Bearing pressure. (Kg/cm²)

B: foundation width. (mm)

μ : Poisson's ratio factor.

E_s : Modulus of elasticity (Kg/cm²)

C_d : Influence factor.

In case of the values of the following parameters applying the above equation:

$$S = (1.15 * 2.5 * 100 * (1 - 0.04)) / 10000 = 0.025 \text{ cm}$$

اسم المالك: خزينة المملكة/الهيئة الخيرية الاردنية المحترمين رقم القطعة: 1273+1253 الحوض: الغباوي/3
الموقع: الزرقاء

التوصيات والاستنتاجات

بعد قيامنا باستطلاع الموقع والقيام بالفحوصات المخبرية اللازمة وبناءً على تحليلنا لنتائج البحث والدراسة تبين لنا ما يلي:

- بناء على كود البناء الوطني والتعليمات الفنية السارية في النقابة فأن عمق الأساسات لا يقل عن 1.5 متر من المنسوب النهائي حول المبنى او الرصيف المحيط بالمبنى ايهما اقل.
- طبقة التأسيس عبارة عن صخر حوري اصفر كريمي اللون مع تداخلات من الصخر الجيري.
- ميول جوانب الحفرية 1.5:1 عامودي الى افقي اول 1.5متر ومن ثم يمكن التجريف بشكل عامودي
- ان قوة التحمل لطبقة التأسيس هي 2.5 كغم / سم².
- مواد التجريف في الموقع يمكن ان تصلح كمواد طمم في حال توافقت مع الشروط في الصفحة (17) ، تفصيل البند وارد في صفحة رقم 16.
- نوع الأساسات المقترح لمثل هذا النوع من مواد التأسيس هو أساسات منفصلة او كما يراه المكتب المصمم مناسباً.
- يجب عمل نظام تصريف للمياه وحماية الاساسات من مياه الامطار
- يجب الالتزام بإجراءات السلامة العامة في الموقع اثناء التجريف.



اسم المالك: خزينة المملكة/الهيئة الخيرية الاردنية المحترمين رقم القطعة: 1273+1253 الحوض: الغباوي/3
الموقع: الزرقاء

11. Conclusion and recommendations:

- Analysis of results obtained from field exploration and test results in addition to our previous experience led to the following conclusions and recommendations.
- The foundation material are composed of **Yellowish cream weak limestone with intercalation of marl**
- The calculated net allowable bearing capacity of the foundation materials are **2.5 kg/cm²** is recommended for design foundation.
- According to the Architecture design and Design of foundation Code by JEA The foundation could be laid at a depth not less than **1.5 m from the finishing floor level**.
- Shallow foundation is suitable for this type of rock is (isolated footing)
- The foundations for this building should be separated foundation. If the foundations are designed and constructed in accordance with the previous recommendations and if the field
- Conditions are not different from what the boreholes are, thus settlement will be negligible.



11-4 Excavation method and side slopes:

It is expected that the excavation will be through the topsoil extended to the Silty clay material mentioned previously. Therefore, mechanical equipment such as loaders and bulldozers will be required; Jack Hammer and/or excavator will be required to break the large boulders or rock. The last excavated 15 cm of this material shall be accomplished using manual equipment unless large boulders or hard materials are encountered. Moreover, the foundation level should be clean and free from accumulation of soils or water and/or any deleterious matters. This level shall be compacted properly before the construction of the foundation.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site.

Conditions as protection against cave-ins and is expressed as the ratio of horizontal distance to vertical rise (H: V).

Table (4) table allowable slopes

Soil or rock type	Maximum allowable slopes (H: V) (1) for excavations less than 20 feet deep (3)
stable rock	vertical (90°)
*typea(2)	3/4:1 (53°)
typeb	1:1 (45°)
type c	1 ½:1 (34°)

Footnote (1) Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal.

Footnote (2) A short-term maximum allowable slope of 1/2H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth shall be 3/4H:1V (53°).
Footnote (3) Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.

11-5 Excavations:

The bed rock excavations should not be steeper than 1. 0V: 1.5H. Flatter slopes may be required especially near the surface and 1.0V:1.5H from Limestone.

11-6 Drainage system:

An effective rainwater drainage system must be designed to get rid of rainwater percolation into the soil layers by constructing a series of manholes and gutters.

Such that the surface water is properly collected and drained away. It is also important to prevent domestic water seepage and septic-sewage water saturating the soil layers especially around the basement.

11-7 Mechanical works:

In the ground floor and basements, if any, mechanical works like hot and cool water lines, etc., should be properly fitted and checked to avoid any future water seepage through soil layers around foundations.

11-8 Sidewalks:

One meter width side walks around the building will be useful in protecting foundations from water passing through soil adjacent to walls and over foundations itself. The side wakes.

Should be slope outwards, and the top level of it must never be higher than the floor level inside the building.

11-9 Surroundings:

All water pipes, sewers, or any sources of water like small ponds around foundations must be under control and maintenance to avoid seepage of water. If the lot is not served in the city sewer system, then, the septic hole must be away from foundations and constructed of reinforced concrete and properly deep roots, or it must be away from building location, and home plants which need continuous irrigation must be planted away of the perimeter of the building.

- **Concrete works:**

A layer of blinding concrete 10 cm. thick should be placed under the footings in order to minimize chemical reaction between cement mortar and native rock.

Ordinary Portland cement can be used for substructure works.

- **Backfill Material: -**

A filter material consists of single size material should be used behind the retaining wall, however the recommended back fill material which will be used should be granular in general and should not contain the following:

Should not be classified as A6 or A7 if the material to be back filled from the excavated material.

Should be classified as A2-5, A2-4, A1-a, or A1-b if the material to be back filled from outside of the site.

Clayey soil which would reach maximum dry density after compaction lowers than 1.6gm/cm^2 .

Clayey soil with a natural moisture content 5% or more in excess of the optimum moisture content.

Soils with more than 5% of organic impurities. Boulders or rock fragments exceeding $\frac{2}{3}$ of the thickness of layer to be compacted.

12. Earth pressure coefficients:

Material type	Limestone	Compacted Selected Fill Material
Friction angle (ϕ)	37.0	30
Wall friction angle (calculated)	25.0	20.0
Cohesion, C kg/cm ² (estimated)	1.0	1.5
K ₀ (calculated) $(1 - \sin\phi)$	0.398	0.50
K _A (calculated) $\frac{1 - \sin\phi}{1 + \sin\phi}$	0.248	0.33
K _P (calculated) $\frac{1 + \sin\phi}{1 - \sin\phi}$	4.022	3.00

- **Important note:**

- This report was prepared by ARC. The above recommendations are based mainly on the information obtained from the drilled boreholes and do not necessarily reflect any variation which may be encountered.
- Re-evaluation of the above-mentioned recommendations and results becomes necessary if such variation is encountered.
- The owner should call us when the excavation work on the site has been done or he would be responsible.

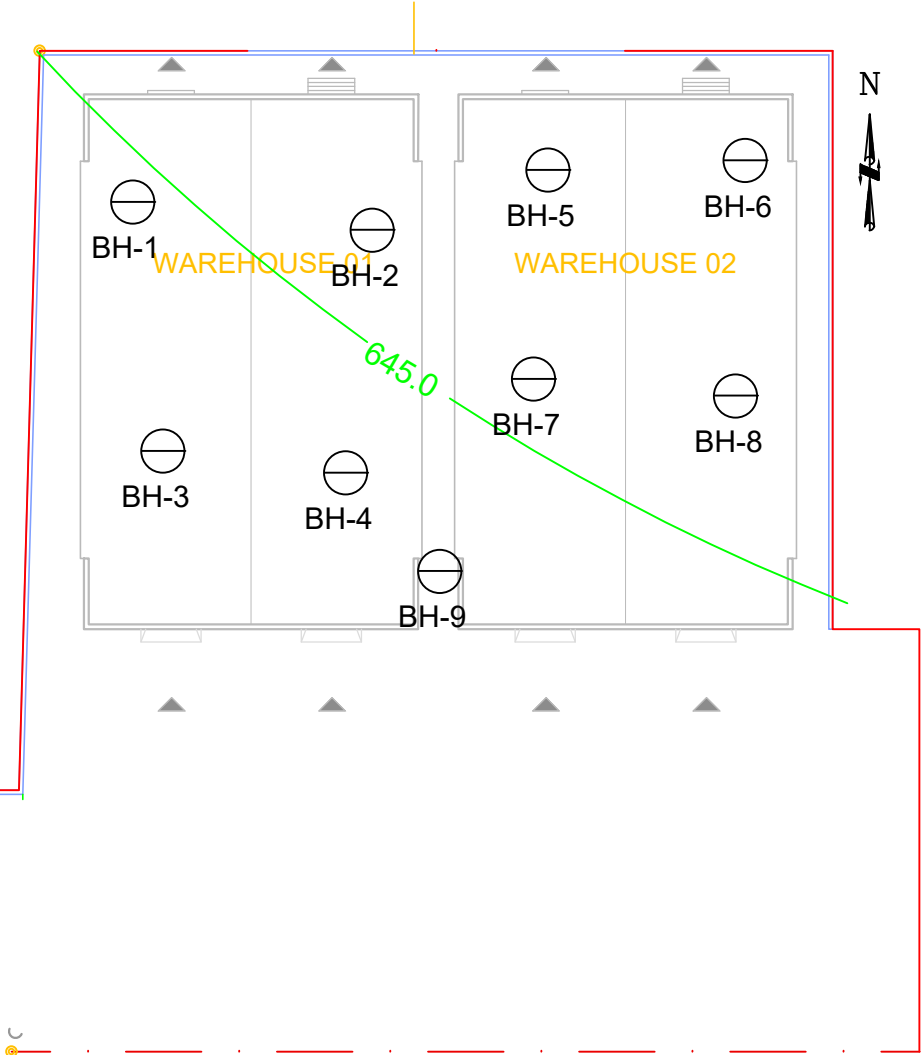
APPENDIX

- **The followings are enclosed to this report:**

1. Site plan
2. Log sheet No. 3
3. Geological profile
4. Geological map
5. Table of calculations
6. R Q D chart
7. Seismic map for Jordan
8. Type of soil profile & seismic factor.




رقم الحوض	رقم القطعة	اسم المالك
3	1253+1273	خزينة المملكة/الهيئة الخيرية الاردنية




رقم العقد	رقم المكتب	اسم المكتب	التاريخ
2429291103	2929	مركز ابو رخية للدراسات الهندسية	1/08/2024









BH-Data		
No.	Ele.	Depth
BH-1	647.0000	9
BH-2	647.0000	6
BH-3	647.0000	6
BH-4	647.0000	9
BH-5	645.0000	6
Bh-6	645.0000	6
BH-7	645.0000	9
BH-8	645.0000	6
BH-9	645.0000	6
Warehouse 1+Warehouse 2		
Floor	Area	F.F.L
Ground	1000.0	645.7
Ground	1000.0	645.0




material	Limestone
B.c	2.5 Kg/cm2




		Owner	خزينة المملكة/الهيئة الخيرية الاردنية		Borehole No: 1						
						Depth: 9 m					
		Location: Az Zarqa, Plot:1253+1273				Elevation: 647					
		Aug,1,2024.				Drilling Method : Rotary					
		SUBSURFACE PROFILE									
Depth (m)	Legend	Description	Sampler Symbol	TCR (%)	RQD (%)	Unconfined compression Kg/cm	SCR (%)	L.L (%)	Remarks		
1		Yellowish cream weak limestone with intercalation of marl		55	30	37.5					
2											
3											
4											
5											
6											
7											
8											
9											
		End of Boring									
CR : CORE RECOVERY. RQD: ROCK QUALITY DESIGNATION. SPT: STANDERD PENTRATION TEST UC. UNCONFIND COMPRESSIVE STRENGTH.											
			<input type="checkbox"/>	HAMMAR							
			<input checked="" type="checkbox"/>	S.P.T							
			<input type="checkbox"/>	CORE							




		Owner خزينة المملكة/الهيئة الخيرية الاردنية		Borehole No: 2									
				Depth: 6.0 m									
		Location: Az Zarqa, Plot:1253+1273		Elevation: 647									
		Aug,1,2024.		Drilling Method : Rotary									
SUBSURFACE PROFILE													
Depth (m)	Legend	Description	Sampler Symbol	TCR (%)	RQD (%)	Unconfined comp ression .Kg/cm	SCR (%)	L.L (%)	Remarks				
1		Yellowish cream weak limestone with intercalation of marl		59	28								
2													
3													
4													
5													
6													
		End of Boring											
CR : CORE RECOVERY. RQD: ROCK QUALITY DESIGNATION.													
SPT: STANDERD PENTRATION TEST UC. UNCONFIND COMPRESSIVE STRENGTH.													
			<input type="checkbox"/>	HAMMAR									
			<input checked="" type="checkbox"/>	S.P.T									
			<input type="checkbox"/>	CORE									




		Owner خزينة المملكة/الهيئة الخيرية الاردنية		Borehole No: 3					
				Depth: 6.0m					
		Location: Az Zarqa, Plot:1253+12'		Elevation: 647.0					
		Aug,1,2024.		Drilling Method : Rotary					
SUBSURFACE PROFILE									
Depth (m)	Legend	Description	Sampler Symbol	TCR (%)	RQD (%)	Unconfined compression ,Kg/cm	SCR (%)	L.L(%)	Remarks
1		Yellowish cream weak limestone with intercalation of marl		60	30				
2									
3									
4									
5									
6									
		End of Boring							
CR : CORE RECOVERY. RQD: ROCK QUALITY DESIGNATION. SPT: STANDERD PENTRATION TEST UC. UNCONFIND COMPRESSIVE STRENGTH.									
			<input type="checkbox"/>	HAMMAR					
			<input checked="" type="checkbox"/>	S.P.T					
			<input type="checkbox"/>	CORE					




		Owner	خزينة المملكة/الهيئة الخيرية الاردنية			Borehole No: 4				
						Depth: 9 m				
		Location: Az Zarqa, Plot:1253+1273				Elevation: 647				
		Aug,1,2024.				Drilling Method : Rotary				
		SUBSURFACE PROFILE								
Depth (m)	Legend	Description	Sampler Symbol	TCR(%)	RQD (%)	Unconfined compression Kg/cm	SCR (%)	L.L.(%)	Remarks	
1		Yellowish cream weak limestone with intercalation of marl		55	30					
2										
3										
4										
5										
6										
7										
8										
9										
		End of Boring								
CR : CORE RECOVERY. RQD: ROCK QUALITY DESIGNATION. SPT: STANDERD PENTRATION TEST UC. UNCONFIND COMPRESSIVE STRENGTH.										
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			<input checked="" type="checkbox"/>	S.P.T						
			<input type="checkbox"/>	CORE						

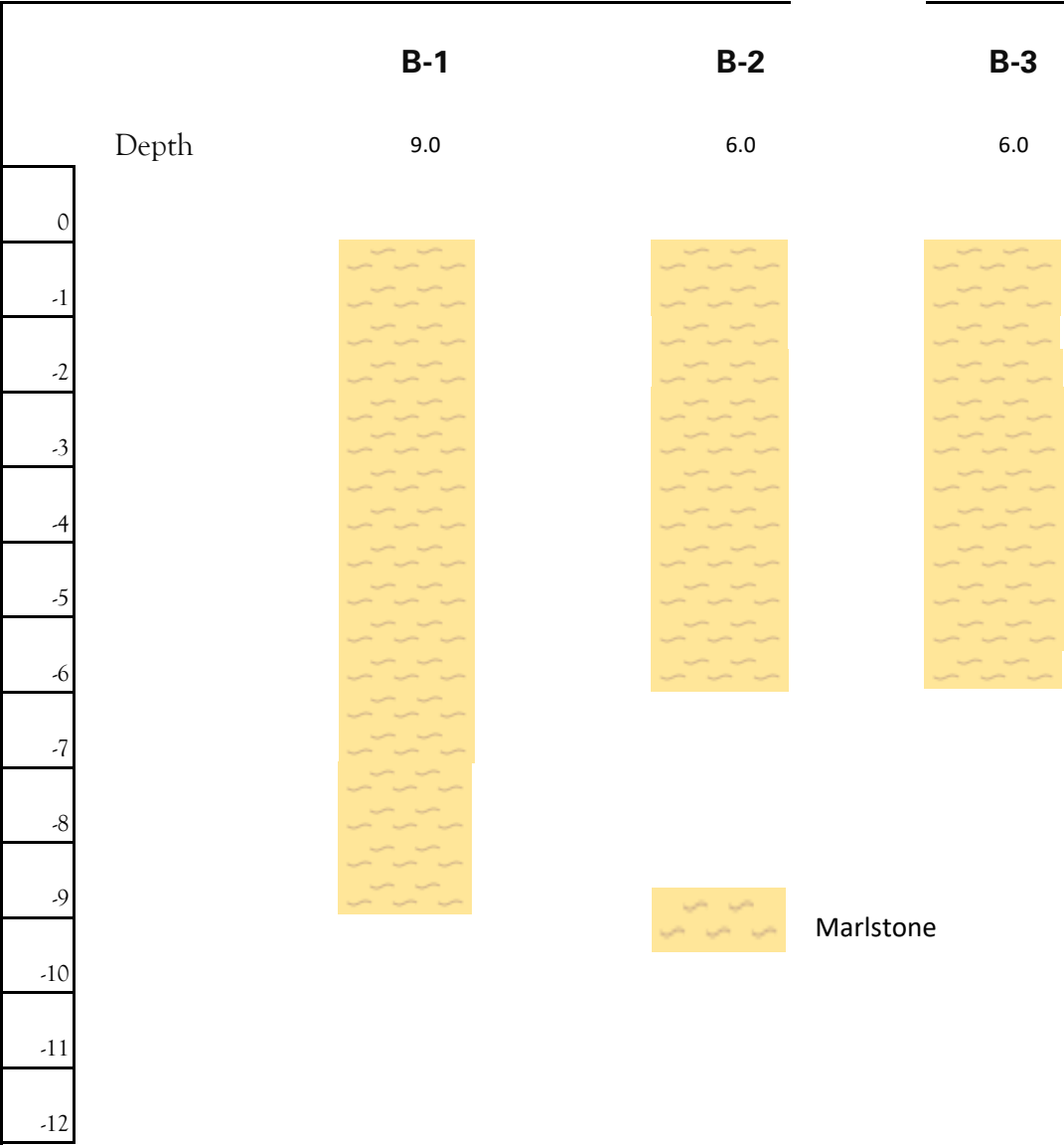
		Owner خزينة المملكة/الهيئة الخيرية الاردنية		Borehole No: 5									
				Depth: 6.0 m									
		Location: Az Zarqa, Plot:1253+1273		Elevation: 645									
		Aug,1,2024.		Drilling Method : Rotary									
SUBSURFACE PROFILE													
Depth (m)	Legend	Description	Sampler Symbol	TCR (%)	RQD (%)	Unconfined comp ression .Kg/cm	SCR (%)	L.L (%)	Remarks				
1		Yellowish cream weak limestone with intercalation of marl		59	28	39							
2													
3													
4													
5													
6													
		End of Boring											
CR : CORE RECOVERY. RQD: ROCK QUALITY DESIGNATION.													
SPT: STANDERD PENTRATION TEST UC. UNCONFIND COMPRESSIVE STRENGTH.													
			<input type="checkbox"/>	HAMMAR									
			<input checked="" type="checkbox"/>	S.P.T									
			<input type="checkbox"/>	CORE									

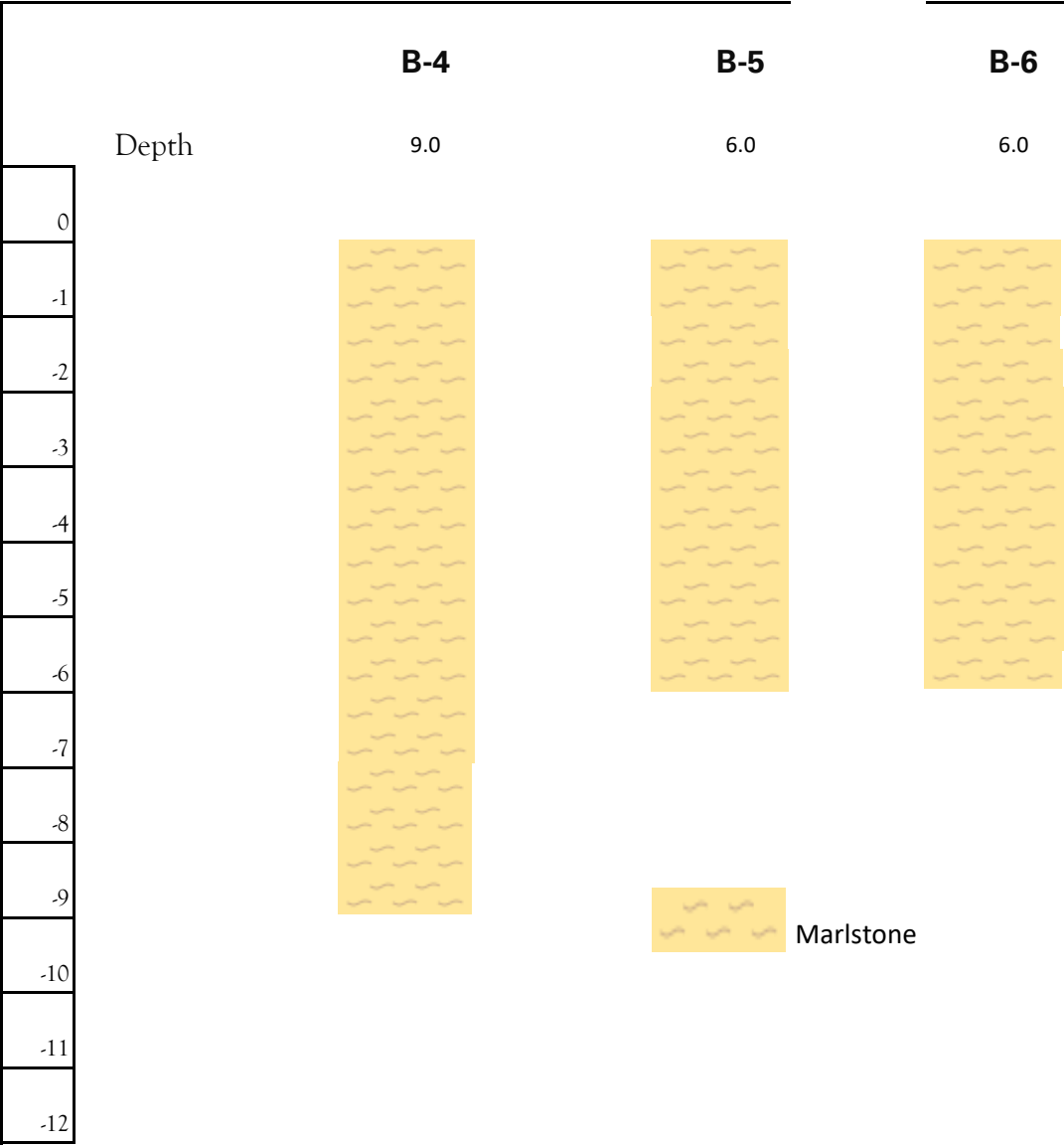
		Owner	خزينة المملكة/الهيئة الخيرية الاردنية		Borehole No: 6								
					Depth: 6.0m								
		Location: Az Zarqa, Plot:1253+12'				Elevation: 645.0							
		Aug,1,2024.				Drilling Method : Rotary							
SUBSURFACE PROFILE													
Depth (m)	Legend	Description	Sampler Symbol	TCR (%)	RQD (%)	Unconfined compression ,Kg/cm	SCR (%)	L.L(%)	Remarks				
1		Yellowish cream weak limestone with intercalation of marl		60	30								
2													
3													
4													
5													
6													
		End of Boring											
CR : CORE RECOVERY. RQD: ROCK QUALITY DESIGNATION.													
SPT: STANDERD PENTRATION TEST UC. UNCONFIND COMPRESSIVE STRENGTH.													
			<input type="checkbox"/>	HAMMAR									
			<input checked="" type="checkbox"/>	S.P.T									
			<input type="checkbox"/>	CORE									

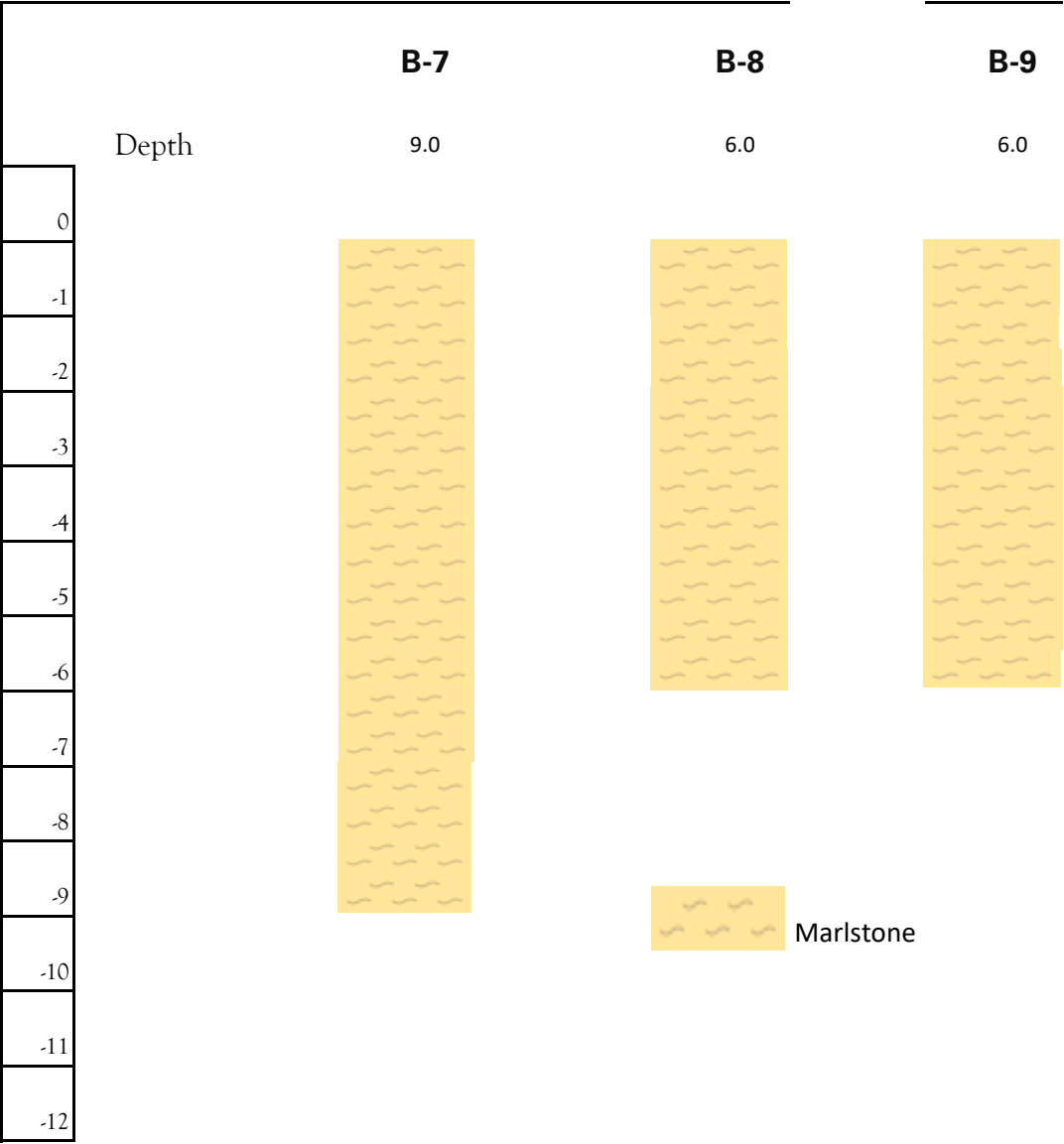
<div></div>		Owner	خزينة المملكة/الهيئة الخيرية الاردنية		Borehole No: 7				
				Depth: 9 m					
		Location: Az Zarqa, Plot:1253+1273		Elevation: 645					
		Aug,1,2024.		Drilling Method : Rotary					
		SUBSURFACE PROFILE							
Depth (m)	Legend	Description	Sampler Symbol	TCR(%)	RQD (%)	Unconfined compression Kg/cm	SCR (%)	L.L.(%)	Remarks
1		Yellowish cream weak limestone with intercalation of marl		55	30				
2									
3									
4									
5									
6									
7									
8									
9									
		End of Boring							
CR : CORE RECOVERY. RQD: ROCK QUALITY DESIGNATION. SPT: STANDERD PENTRATION TEST UC. UNCONFIND COMPRESSIVE STRENGTH.									
			<input type="checkbox"/>	HAMMAR					
			<input checked="" type="checkbox"/>	S.P.T					
			<input type="checkbox"/>	CORE					

		Owner خزينة المملكة/الهيئة الخيرية الاردنية		Borehole No: 8									
				Depth: 6.0 m									
		Location: Az Zarqa, Plot:1253+1273		Elevation: 645									
		Aug,1,2024.		Drilling Method : Rotary									
SUBSURFACE PROFILE													
Depth (m)	Legend	Description	Sampler Symbol	TCR (%)	RQD (%)	Unconfined comp ression .Kg/cm	SCR (%)	L.L (%)	Remarks				
1		Yellowish cream weak limestone with intercalation of marl		59	28								
2													
3													
4													
5													
6													
		End of Boring											
CR : CORE RECOVERY. RQD: ROCK QUALITY DESIGNATION.													
SPT: STANDERD PENTRATION TEST UC. UNCONFIND COMPRESSIVE STRENGTH.													
			<input type="checkbox"/>	HAMMAR									
			<input checked="" type="checkbox"/>	S.P.T									
			<input type="checkbox"/>	CORE									

		Owner خزينة المملكة/الهيئة الخيرية الاردنية		Borehole No: 9					
				Depth: 6.0m					
		Location: Az Zarqa, Plot:1253+12'		Elevation: 645.0					
		Aug,1,2024.		Drilling Method : Rotary					
SUBSURFACE PROFILE									
Depth (m)	Legend	Description	Sampler Symbol	TCR (%)	RQD (%)	Unconfined compression ,Kg/cm	SCR (%)	L.L(%)	Remarks
1				60	30	40.5			
2									
3									
4									
5									
6									
		End of Boring							
CR : CORE RECOVERY. RQD: ROCK QUALITY DESIGNATION. SPT: STANDERD PENTRATION TEST UC. UNCONFIND COMPRESSIVE STRENGTH.									
		<input type="checkbox"/> HAMMAR <input checked="" type="checkbox"/> S.P.T <input type="checkbox"/> CORE							







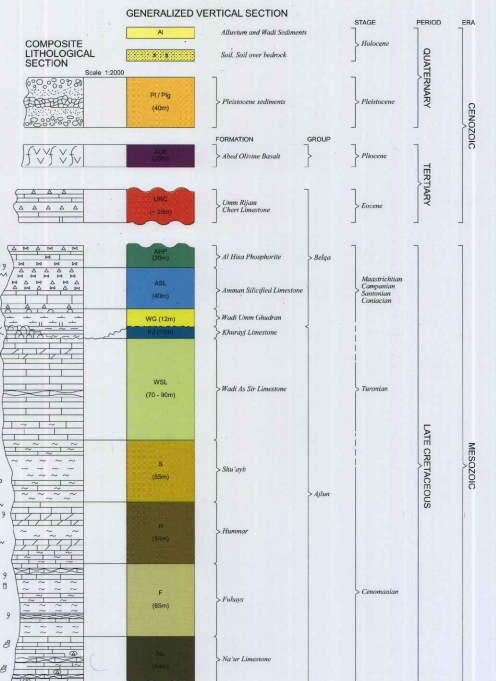
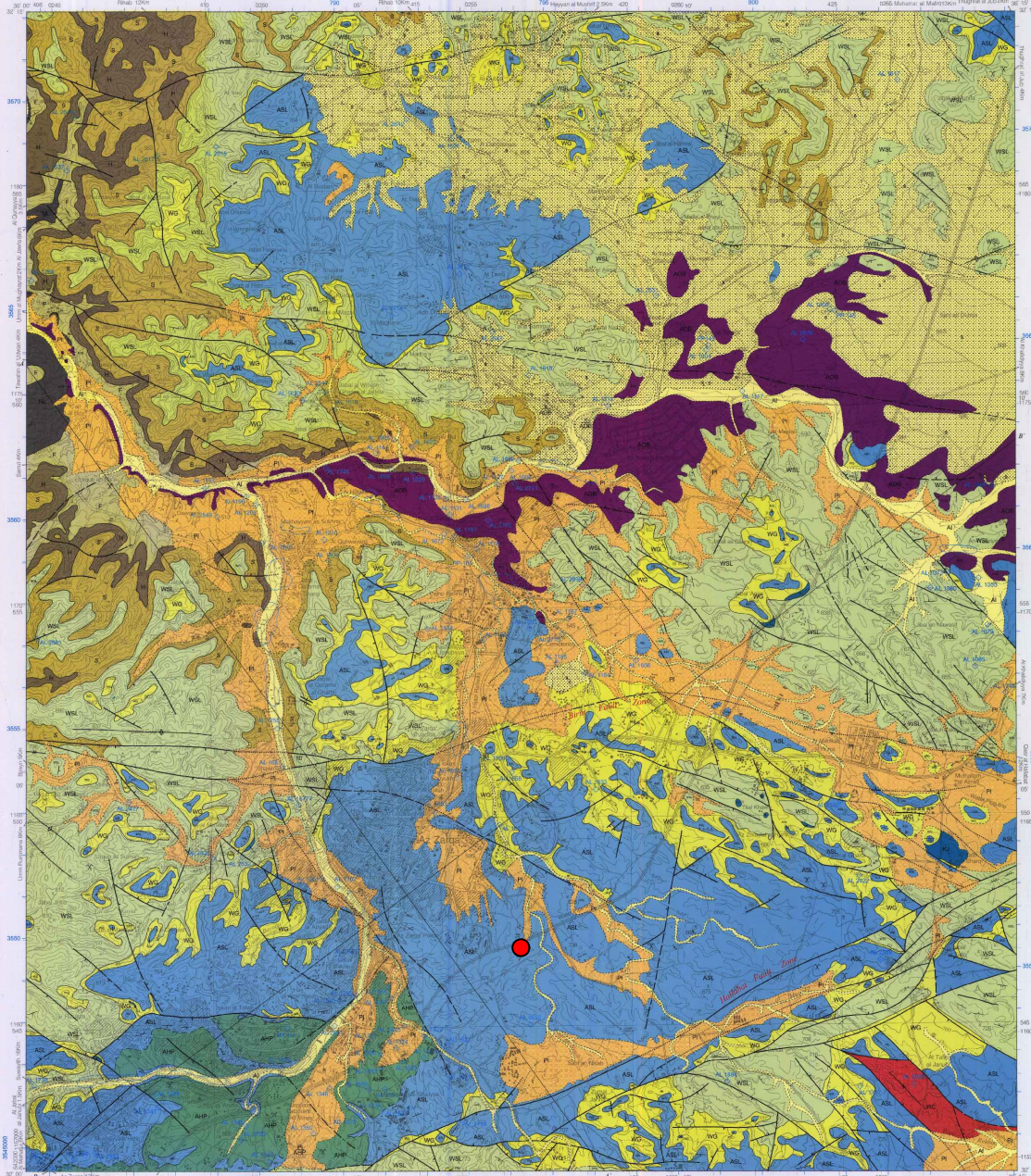
المملكة الأردنية الهاشمية
THE HASHEMITE KINGDOM OF JORDAN

سلطة المصادر الطبيعية
NATURAL RESOURCES AUTHORITY
GEOLOGY DIRECTORATE

خريطة الزرقاء الجيولوجية
GEOLOGICAL MAP OF
AZ ZARQA'
3254 III

Scale 1:50,000

GEOLOGICAL MAPPING DIVISION
NATIONAL MAPPING PROJECT
Geology by: Mohammed Abu Gubara, 2001



LEGEND FOR COMPOSITE LITHOLOGICAL SECTION

Limestone
Marly limestone
Nodular limestone
Phosphatic limestone
Dolomitic limestone
Coquillat limestone
Chalky limestone
Marl
Phosphatic
Phosphatic chert
Chert
Chalk
Glauber
Sand
Conglomerate
Basalt
Horizontal and vertical pitting

Ammonite
Gastropods
Bryozoa
Bryozoa
Oyster
Chert nodules
Th. Tubularia
Gyp
Gyp

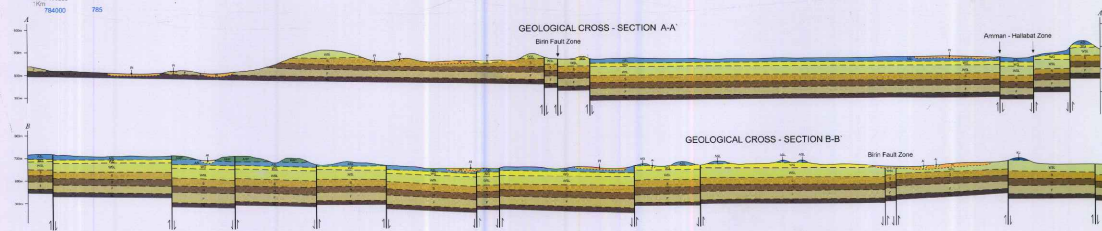
GEOLOGICAL SYMBOLS SHOWN ON MAP

Geological boundary, bedrock, inferred
Geological boundary, superficial deposits
Fault, strike-slip, downthrow side
Fault, inferred, not shown on surface
Fault, inferred, beneath superficial deposits
Strike-slip fault
Synclinal axis
Anticlinal axis
Unconformity, visible on aerial photographs
Dip and strike (more than 10°) (dip)
Dip (shown in degrees) and strike
Quaternary
Water well
Water field

TOPOGRAPHICAL SYMBOLS SHOWN ON MAP

Contour (20m interval)
Spot height
Roads
Wadi
Track
Cable
Canopy

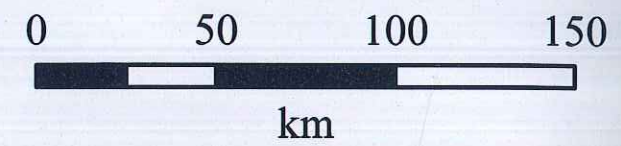
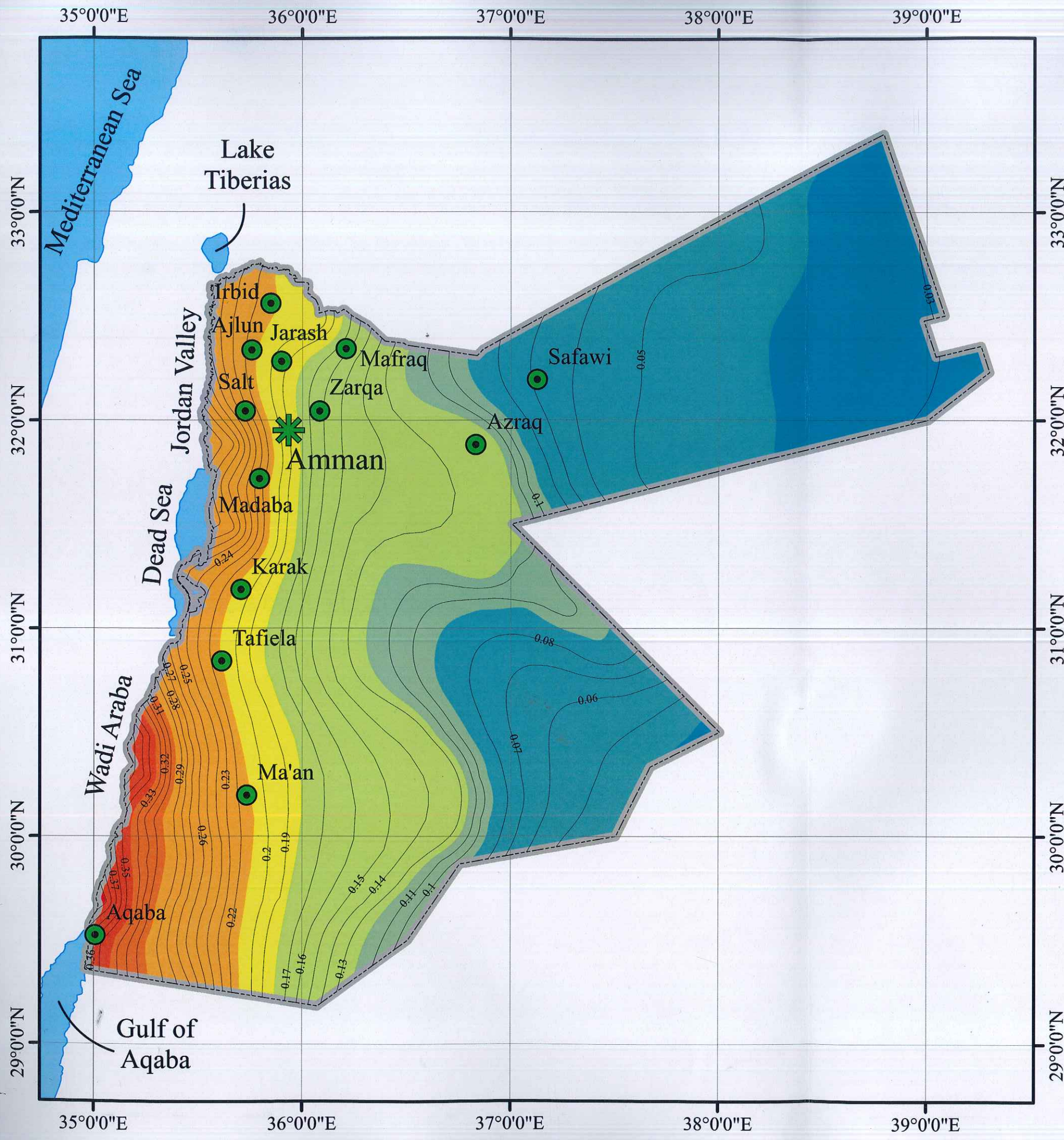
HORIZONTAL SCALE = 1:50,000
VERTICAL SCALE = 2.5x H.S.
(FOR ALL CROSS SECTIONS)



SHEET INDEX

JARASH	AL-HAFRAJ	UMMA AL-HADAD
3154 I	3254 IV	3254 I
SURWAYIL	AZ ZARQA'	QASR AL-HADAD
3154 II	3254 III	3254 II
AMMAN	BAIAB	QASR AL-HADAD
3153 I	3253 IV	3253 I





Cities

- Main Cities
- ✱ Capital City - Amman

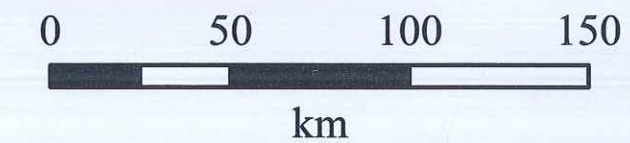
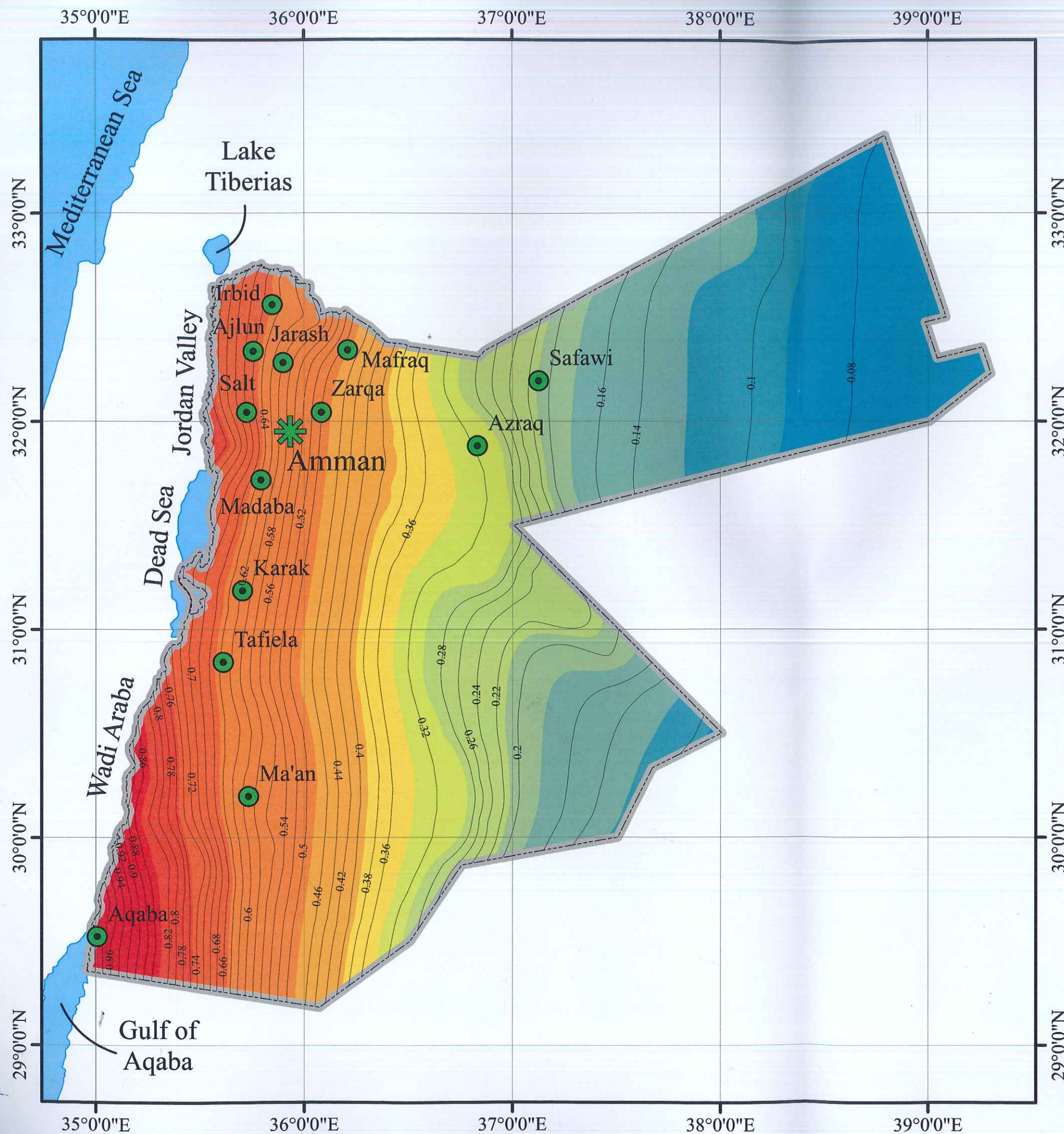
— S₁ Contour Lines
(Contour Interval 0.01)

S₁ for 1.0 s Spectral Response Acceleration

0.029 – 0.039	0.180 – 0.212
0.039 – 0.092	0.212 – 0.302
0.092 – 0.121	0.302 – 0.340
0.121 – 0.180	0.340 – 0.392
	0.392 – 0.483

This map is produced by:

1. Dr. Anis Shatnawi
(Coordinator - Strsuctural Engineering Expert)
2. Dr. Mahmoud Al-Qaryouti
(Seismology Expert)
3. Dr. Masdouq Al-Taj
(Geology Expert)
4. Dr. Salahuddin Jaber
(GIS Expert)



Cities

- Main Cities
- ✱ Capital City - Amman

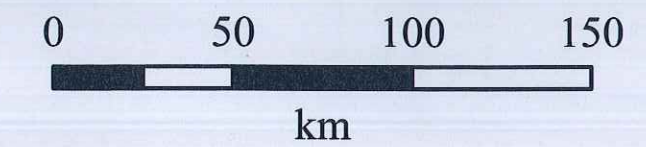
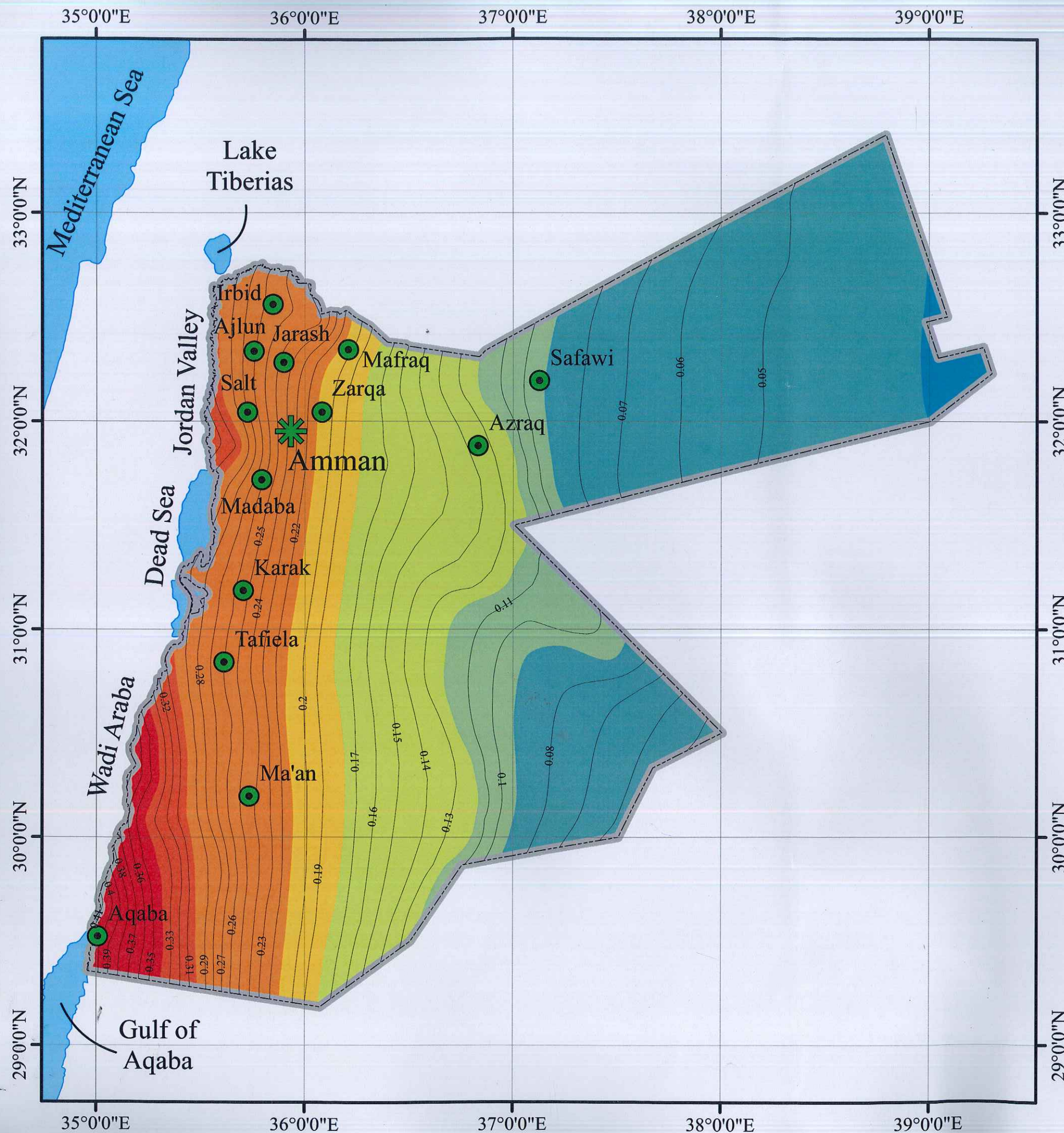
— S_s Contour Lines
(Contour Interval 0.02)

S_s for 0.2 s Spectral Response Acceleration

0.064 – 0.092	0.340 – 0.392
0.092 – 0.121	0.392 – 0.483
0.121 – 0.180	0.483 – 0.650
0.180 – 0.212	0.650 – 0.754
0.212 – 0.302	0.754 – 0.844
0.302 – 0.340	0.844 – 1.004

This map is produced by:

1. Dr. Anis Shatnawi
(Coordinator - Strsuctural Engineering Expert)
2. Dr. Mahmoud Al-Qaryouti
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3. Dr. Masdouq Al-Taj
(Geology Expert)
4. Dr. Salahuddin Jaber
(GIS Expert)



Cities

- Main Cities
- ★ Capital City - Amman

PGA Contour Lines
(Contour Interval 0.01)

PGA	Potential Damage
0.036 – 0.039	None
0.039 – 0.092	Very Light
0.092 – 0.121	Light
0.121 – 0.180	
0.180 – 0.212	Moderate
0.212 – 0.302	
0.302 – 0.340	
0.340 – 0.421	Moderate / Heavy

This map is produced by:

1. Dr. Anis Shatnawi
(Coordinator - Strsuctural Engineering Expert)
2. Dr. Mahmoud Al-Qaryouti
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(Geology Expert)
4. Dr. Salahuddin Jaber
(GIS Expert)

الجدول (٣-٣-٣): قيم معامل الموقع $(F_v)^*$.

معامل تسارع الاستجابة الطيفي المستنبط من خرائط الخطورة الزلزالية عند الفترة الزمنية (1.0) ث.					صنف الموقع
$0.50 \leq S_1$	$0.40 = S_1$	$0.30 = S_1$	$0.20 = S_1$	$0.10 \geq S_1$	
0.8	0.8	0.8	0.8	0.8	S_A
1.0	1.0	1.0	1.0	1.0	S_B
1.3	1.4	1.5	1.6	1.7	S_C
1.5	1.6	1.8	2.0	2.4	S_D
2.4	2.4	2.8	3.2	3.5	S_E
بحسب البند (١/٩/٣)، إلا إذا انطبق الاستثناء الوارد في الفقرة (١/٣/٨/٣). انظر أيضاً البند (٧/٣/٣).					S_F
* يُستخدم الاستكمال الخطي المستقيم من أجل القيم البينية لتسارع الاستجابة الطيفية المستنبط من الخرائط (S_1) عند الفترة الزمنية (1.0) ث.					

الجدول (٣-٣-٢): قيم معامل الموقع $(F_a)^*$.

معامل تسارع الاستجابة الطيفي المستنتج من خرائط الخطورة الزلزالية للفترة الزمنية القصيرة.					صف الموقع
$1.25 \leq S_s$	$1.00 = S_s$	$0.75 = S_s$	$0.50 = S_s$	$0.25 \geq S_s$	
0.8	0.8	0.8	0.8	0.8	S_A
1.0	1.0	1.0	1.0	1.0	S_B
1.0	1.0	1.1	1.2	1.2	S_C
1.0	1.1	1.2	1.4	1.6	S_D
0.9	0.9	1.2	1.7	2.5	S_E
بحسب البند (١/٩/٣)، إلا إذا انطبق الاستثناء الوارد في الفقرة (١/٣/٨/٣). انظر أيضاً البند (٧/٣/٣).					S_F
* يُستخدم الاستكمال الخطي للمستقيم من أجل تحديد القيم البينية لتسارع الاستجابة الطيفية المستنتج من الخرائط (S_s) للفترة الزمنية القصيرة.					

الجدول (٣-٧-١): معامل الموقع (F_{PGA}).

الوسيط الجيومتري من الخرائط للتسارع الأرضي الأقصى (PGA) للزلازل الأعظم المعتمد (MCE_G)					صنف الموقع
$0.5 \leq PGA$	$0.4 = PGA$	$0.3 = PGA$	$0.2 = PGA$	$0.1 \geq PGA$	
0.8	0.8	0.8	0.8	0.8	S_A
1.0	1.0	1.0	1.0	1.0	S_B
1.2	1.2	1.2	1.2	1.2	S_C
1.6	1.6	1.6	1.6	1.6	S_D
2.5	2.5	2.5	2.5	2.5	S_E
انظر البند (٧/٣/٣).					S_F
* يُستخدم الاستكمال الخطي المستقيم من أجل القيم البينية للتسارع الأرضي الأعظمي (PGA).					

الجدول (٣-٨-١): تصنيف المواقع وأنواع مقطع التربة.

صنف الموقع	اسم مقطع التربة / الوصف العام	معدل خواص التربة في مسافة (30) م العلوية من مقطع التربة		
		سرعة أمواج القص (\bar{v}_s) (م/ث)	فحص الاختراق المعياري (\bar{N}) (أو \bar{N}_{ck}) لطبقات التربة المفككة (عدد الضربات/م)	مقاومة القص دون تصريف (\bar{s}_u) (كيلو نيوتن/م ²)
S_A	صخر قاسي	$1500 < \bar{v}_s$	-	-
S_B	صخر	$760 < \bar{v}_s \leq 1500$	-	-
S_C	تربة عالية الكثافة وصخر طري	$360 < \bar{v}_s \leq 760$	$50 < \bar{N}$	$100 < \bar{s}_u$
S_D	مقطع تربة صلبة	$180 < \bar{v}_s \leq 360$	$15 < \bar{N} \leq 50$	$50 < \bar{s}_u \leq 100$
S_E^{-1}	مقطع تربة طرية	$180 \geq \bar{v}_s$	$15 \geq \bar{N}$ أو $15 \geq \bar{N}_{ck}$	$50 \geq \bar{s}_u$
S_F	تربة تتطلب تقييماً خاصاً للموقع يتضمن تحليل لاستجابة التربة بحسب البند (١/٩/٣)، إلا إذا انطبق الاستثناء الوارد في الفقرة (١/٣/٨/٣).			
(١) يتضمن صنف الموقع (S_E) أي نوع مقطع تربة يزيد فيه عمق التربة الطينية عن (3) م مع معامل لدونة ($PI < 20$) ومحتوى الرطوبة عالي ($w_{mc} \leq 40\%$) ومقاومة القص دون تصريف للتربة الطينية منخفضة ($\bar{s}_u > 25$) كيلو نيوتن/م ² . ويتم تحديد اللدونة ونسبة محتوى الرطوبة وفقاً للمواصفات القياسية الوطنية المعتمدة.				