LAND SYSTEM CLASSIFICATION
A Case History: Jordan

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

AGLT Bulletin 2/78

L A N D S Y S T E M C L A S S I F I C A T I O N

A Case History: Jordan

by

C.W. Mitchell and J.A. Howard

Revision of 1975 report prepared for
the Food and Agriculture Organization
of the
United Nations

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME 1978

First printing 1979

Second printing 1980

TABLE OF CONTENTS

Land System Classification of Jordan

ABSTRACT

This report, which revises the 1975 Technical Report No. 1 (Land Resources Appraisal Project - Jordan 74/001), describes the result of a survey carried out in Jordan from May - August 1975 by C.W. Mitchell and the ensuing classification of the country into land systems and smaller land units. The methods used are based on those originally developed by the Australian CSIRO Division of Land Research and Regional Survey in Canberra and by J.A. Howard at the University of Melbourne (Victoria). Land systems were recognized on the basis of the main climatic zones, physiographic provinces and geological regions assisted by the interpretation of the phyto-geomorphic patterns on LANDSAT imagery. Each land system is described by means of a block diagram and is sub-divided into a number of land units which can be regarded as the basic units for land use planning. A table is given which enables correlations to be made between analogous land units in different land systems. Conclusions are drawn about the land systems and land facets suited to investigation for further development or requiring conservation measures.

ACKNOWLEDGEMENTS

Grateful acknowledgement is made of the keen interest and full support extended throughout the project by officials of the Government of the Hashemite Kingdom of Jordan and particularly to the Minister and members of the Department of Agricultural Research and Extension of the Ministry of Agriculture. Their help and that of others, including staff of FAO Headquarters in Rome and at the University of Reading (U.K.) contributed to the success of the project. Particular thanks are due to Dr. J. Sivarajasingham of FAO staff, Amman, for his management of the visit to Jordan by C.W. Mitchell and to Mr. C. Engeler (FAO, Rome) for assistance in preparing the LANDSAT mosaic.

1. Introduction

With the objective of classifying the Hashemite Kingdom of Jordan into land systems as a basis to future planning, management and land evaluation, a field reconnaissance was carried out in May and June 1975 by C.W. Mitchell and later the land system map was completed at a scale of 1:250 000. By using a semi-controlled mosaic of LANDSAT imagery for the base of the thematic map, the need for aerial photography was avoided and most of the costs associated with planimetric map production were eliminated. The unique characteristics of LANDSAT provide imagery which is almost an orthographic projection of the earth's surface and which gives acceptable accuracy for mapping at scales of 1:500 000 and smaller.

Four types of NASA LANDSAT-1 products were used in the study:

(a) Paper print enlargements of bands 5 and 7 for use in the field as base maps (scale about 1:250 000)

(b) 70mm transparencies (scale about 1:3 million) for colour additive viewing at FAO in Rome and at the University of Reading

(c) Colour composites, prepared from the transparencies (scale about 1:1 million)

(d) Carefully density balanced black-and-white prints (band 7 only) for preparation of the semi-controlled mosaic.

In addition available Skylab imagery was obtained. This unfortunately consisted only of a strip of false-colour film and multi-band photography covering the zone from Lake Tiberias to El Azraq (taken with the Skylab Earth Terrain Camera S190B and multi-spectral camera S190A). The Skylab photography had a much better resolution than the LANDSAT imagery on which objects as small as 5-10 ha were observed.

During the field reconnaissance, which was confined to East Jordan, reference was made to all appropriate available environmental information. The literature consulted is given in the reference.

Apart from local studies at large scale, such as that by Hunting Technical Services Ltd., for the Jordan Central Water Authority (1964), there are three main geological maps of the country. The first is at 1:250 000 and covers the western areas (Burdon, 1959). The second covers most of the country at 1:2 000 000 (U.S. Geological Survey, 1963). The most recent and detailed study was carried out by the German Geological Mission in Jordan and covers the whole country at 1:250 000 in 5 sheets (Bender, 1969).

2. Concept of land units

The term land unit is regarded as a general term to be used when referring to a homogeneous unit of land of any size whilst land system is identified as homogeneous according to certain pre-conceived criteria.

An example, of a very simple approach to the classification of land into units with some sort of homogeneity, is provided by the regional survey of Ungaya - Labrador (Hare, 1959). The region was divided into land units with the aid of aerial photographs. These units varied greatly in size and composition, but each unit was at least more homogeneous in characteristics of vegetation and landform than neighbouring units. Such a procedure of mapping has the merit of being simple, but is not likely to produce land units which can be similarly mapped by other workers nor used as framework for further work.

In earlier work, Bourne (1931) recognized land units of three different magnitudes and this can be viewed as the fore-runner of hierarchical classification needed in the present study. He recognized the need to divide the surface of the earth into natural regions of uniform characters and suggested that aerial photographs should be used to identify distinctive unit regions within larger physiographic regions; and aided by geological maps he proceeded to map unit regions (i.e. the fore-runner of land systems) and unit sites. He viewed an association of sites as constituting a distinct region (i.e. land system) and that a site (cf. land facet) for all practical purposes has similar physiography, geology, soil and edaphic factors.

The land system (or equivalent) is judged to be the most widely used land unit at the present time, although on occasions the term ''system'' may be misunderstood. It is primarily a major geomorphic unit having a predominantly uniform geology, climate (past and present) and a characteristic soil association. A first approach to land system classification was devised in 1947 by the Australian CSIRO Division of Land Research (Christian and Stewart). These authors, working at reconnaissance survey in northern Australia, described a simple land system as a group of close related topographic units, usually small in number, that have arisen as a product of common geomorphic phenomena and are appropriate for mapping at 1:250 000 to 1:1 000 000. They also recognized that land systems with certain affinities in common can be grouped into larger complex/compound land systems (cf. land sub-provinces, Howard, 1976).

The smaller distinctive topographic units, from which land systems are synthesized, were recognized by Christian and Stewart as also being distinctive in soil and vegetation. These ''units'' or land facets/facets as they are now commonly called, correspond to Bourne's sites and represent the basic practical sub-division of the landscape for practical and intensive management. Each land facet will also include at least one, and usually two or three soil series.

A smaller unit, the land element, can often be identified. That is the smallest sub-division of the landscape and is indivisible on the basis of landform/topography. Examples include the floors of small wadis which occur in many land systems, e.g. 7/11 facet 5 and 9/3 facet 2, the caves which form on the scarp slopes of land system 5/2 facet 2, and the small slopes on badlands such as form a part of land system 11/1 facet 3.

Recently, Howard (1970) introduced an intermediate unit between the (land) facet and land system, as otherwise the land system and land facet will vary greatly in size and composition from place to place. This unit, the land catena, consists of a chain of geographically related land facets and forms the major repetitive component of the land system. They normally include a number of soil series.

3. The land unit method of hierarchical sub-divisive classification

For completeness and to provide an overall correlative framework, four larger land units (macro-units) other than those described in the previous section may be recognized (see Fig. 1.0). These are, in descending order of magnitude:

The land zone: generally recognized major climatic zones (e.g. humid tropics, humid warm temperate, humid cool temperate).

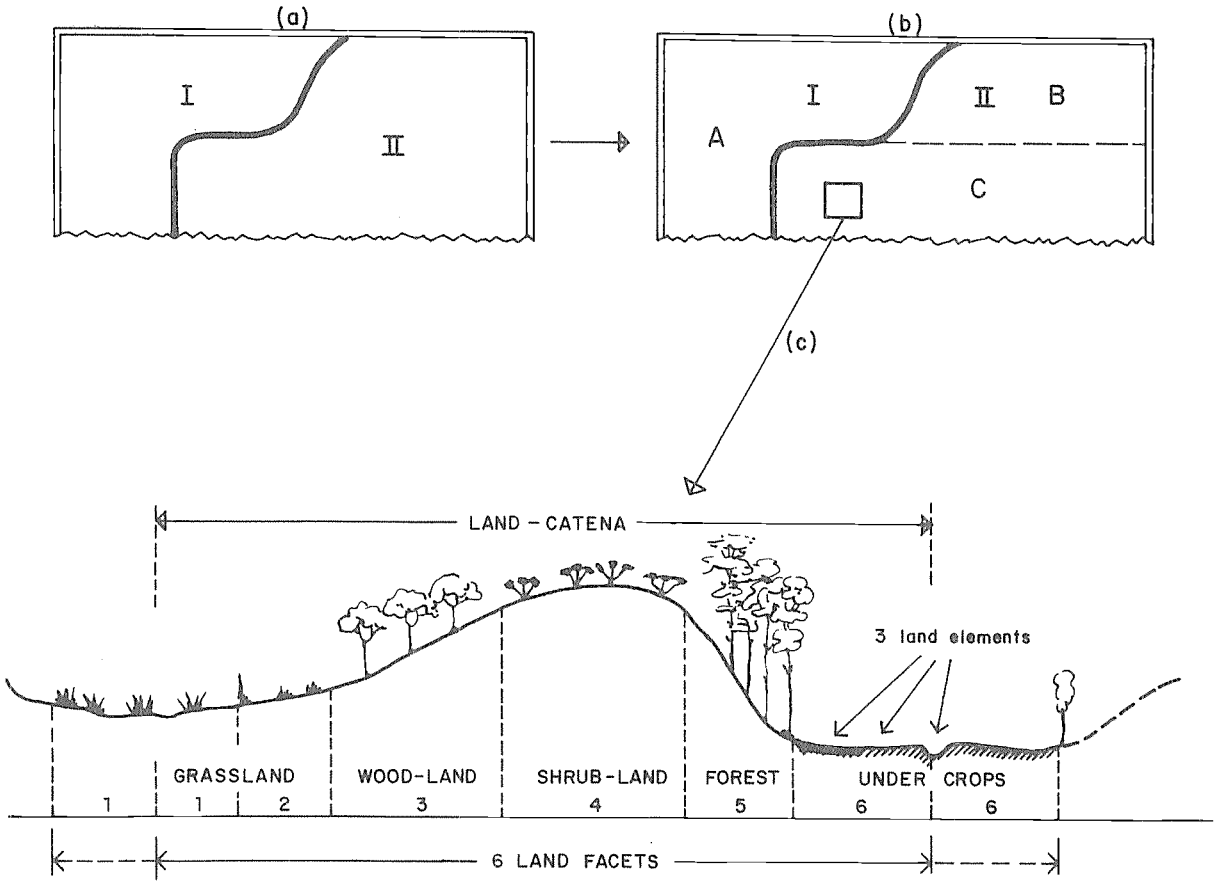
The land division: gross form expressive of a continental structure (e.g. within the humid cool temperate land zone of Europe occurs in the North European Plain 'Division').

The land province: an assemblage of surface forms expressive of a second order structure (e.g. Lowland Britain, Pyrenees). Sometimes sub-provinces are recognizable by a grouping of land systems with certain characteristics in common. These are readily seen on LANDSAT imagery.

The land region: surface form expressive of a lithological unit or a close lithological association having everywhere undergone geomorphic evolution (in U.K. examples include the Hampshire Basin and the Weald), which are equivalent to Bourne's unit regions (Bourne, 1931).

Further information on land unit classification is provided in Table A. It will be noted that these include a new land unit, the land sub-province, which is often the most conspicuous unit to be observed on LANDSAT imagery.

FIGURE 1.0 SUBDIVISIVE LAND CLASSIFICATION



(a)..... rural area, (within double-lines) as recorded on a part of a LANDSAT image and divided into 2 land regions (I, II).

(b)..... same area divided into 3 land systems (A, B, C).

(c)..... profile of a land catena, as observed in the field or on stereoscopic pair of aerial photographs, and forming a small part of land system C. Note the land catena comprises 6 land facets and that land facet 6, due primarily to floral and pedologic variations, can be sub-divided into 3 land elements.

TABLE A AGRICULTURAL LAND UNITS OBSERVED ON LANDSAT IMAGERY

Land Unit Macro-Units	Paramount discipline used to identify unit	Comments and description
Land division	Geography	The synoptic view provided by the satellite imagery is valuable for the identification of these extensive land units having a gross land form expressive of continental structure in which the climatic zones are evidenced by the uniform fit of the natural vegetation (panformation) to its continental landforms.
Land province	Physical geography	Major physiographic unit. Recognizable as a distinctive extensive assemblage of landforms expressive of a second order structure and the uniform fit of the natural vegetation (plant formations). Regional land-use patterns recognizable, which tend to fit the landforms.
Land sub-province	Regional geography	A major sub-division of a land province evidenced by the fit of vegetation and land-use patterns within an identifiable grouping of land-systems. A very convenient LANDSAT mapping unit.
Land region	Geology	A land unit, usually of considerable magnitude, which is identifiable mainly through the image characteristics of its simple or compound land system(s). The land region has surface properties of a lithological unit with a small range of surface forms. Vegetation and land-use pattern may/may not fit.
Micro-Units		
Land system (simple land system)	Geomorphology	A recurrent landform pattern of geographically and geomorphologically related smaller land units (e.g. land facets). Its imagery drainage pattern is distinctive and provides boundaries coinciding with major geomorphic features. These patterns are often enhanced by the vegetation. Vegetation and local land-use patterns usually fit. Has characteristic soil associations.
Land catena	Geomorphology	Often it is difficult to map these land units from LANDSAT imagery, but some can be identified. Has a characteristic soil association. Each land catena contains a recurrent grouping of geographically related smaller land units (vide Howard, 1970b) Often local land-use fits when field checked.
Land facet	Geomorphology/Botany	Normally cannot be mapped on LANDSAT imagery, but occasionally large facets are identifiable. A land facet comprises a distinctive unit of topography with which is associated an equally distinctive vegetation structure at the level of the plant subformation. Usually, climatic uniformity can be inferred from the vegetal structure. Local land-use usually fits. Has a characteristic soil series/soil association.
Land element	Botany	Occasionally recognized on LANDSAT imagery. Simplest part of landscape - for practicable purposes uniform in vegetation (i.e. plant association), climate, lithology, landform, hydrology and soil (i.e. characteristic soil phase/soil type). Uniform in topography.

4. The land unit method used in Jordan

The value of the land system method lies in its ability to give a rapid synopsis of the land resources of a large area so that detailed survey and research effort can be more effectively deployed. It can provide a general inventory which also gives a framework into which more detailed information of known smaller land units can be fitted. When similar areas are recognized on aerial photographs, and the same land facets can be found in the two areas, this framework can be used to make practical predictions of land properties from one to another.

Two weeks' preliminary work in Reading by C.W. Mitchell, using maps and the land satellite imagery, made it possible to sub-divide the land-surface into provisional land systems and to commence their descriptions.

The country was first divided into three climatic land zones: Mediterranean, steppe and desert. Within these, the main (physiographic) land provinces were delineated and the main (geological) land regions recognized. The land systems were then identified on the LANDSAT imagery and the provisional external boundaries of each land system delineated on an overlay on transparent stable acetate at a scale of 1:250 000. These overlays could be then superimposed on existing maps at the same scale. The land systems were defined and mapped on the basis of phyto-geomorphic sub-divisions which were recognizable on the LANDSAT imagery by changes in the tone, colour (hue, values, chroma), texture and drainage patterns.

During the three weeks' stay in Jordan most of the different landscapes were visited in the field, in collaboration with FAO field staff and Jordanian counterpart staff. The boundaries of the land system were more accurately mapped, their descriptions completed, and the classification refined and extended to include land catena and land facets. In the ensuing block diagrams land systems are identified before the decimal point (e.g. 12.) and the land facets after it. In such a brief study, it was not possible to provide a comprehensive survey of land facets, (e.g. Fig. 9.3) although many were identified (see block diagrams). In the block diagrams reference to land catena have been omitted, but they can be readily observed (e.g. Fig. 7.6, from the Jordan Valley, up escarpment, across erosion scarp, down erosion slopes to valley bottom; Fig. 7.7, from wadi across valley floor, up hill slope, across summit, down hill slope to wadi). Occasionally, it may be questioned whether it is correct to classify a land unit as a facet and not as a land element.

It is important to emphasize the difference between land units and soil units. Land units such as land facet, land element, etc., are based on material and surface form, while soil units such as the soil series are based on the soil profile and its horizons. Land units are generally recognizable on aerial photographs while soil units are not. The value of the former lies partly in their ability to lead to an understanding of the distribution of the latter.

In Table B, the finalized land systems are listed under the appropriate higher land units. The first symbol of the land system number indicates the land region to which it belongs. The second symbol, after the stroke, represents the physiographic sub-division of this. Land facets can be represented by the third and final symbol given in the table for each land system. Thus, the symbol 7/15.1 represents land facet 1 (gently undulating plan) of land system 7/15 (Irbid Plain). The figure 7 indicates that it belongs to the land region 7 (Belqa limestone).

The West Bank area was attempted last. As it could not be visited, reliance had to be placed entirely on satellite imagery, maps and literature sources. The scheme in this area is, therefore, somewhat more speculative than elsewhere.

Because of the short time in which the work was done, it is inevitable that full details on the sub-divisions of every land system could not be achieved. It will be seen that the tabular information, Section 4, is sketched in outline only and contains gaps. The diagrams are inevitably schematic and give only a generalized view of the land systems. Much reliance was placed on the range classification scheme by Hunting Technical Services Limited and the geological mapping. This, however, presented problems. The earlier geological surveys and maps used a simple nomenclature - Kurnub Series, Ajlun Series, Belqa

Series, etc., but the much more detailed and excellent work by the German Geological Mission in Jordan (Bender, 1969) used a completely different legend. The FAO investigation of the Sandstone Aquifer of East Jordan (1970), however, returned to the original nomenclature and produced a simplified geological map at 1:500 000 on this basis to accompany the report. For this reason and also for simplicity, the earlier nomenclature has been retained in this report, although actual geological boundaries have been checked with the maps of the German Geological Mission.

5. TABLE B. THE MAJOR LAND UNITS OF JORDAN

Land Zones	Land Divisions	Land Provinces	Land Regions	Land Systems
Mediterranean	East Jordan Plateau	Sandstone	Kurnub Sandstone (5)	5/1, 5/2
		Limestone	Ajlun Limestone (6)	6/2, 6/3, 6/4, 6/6, 6/8, 10/2
			Belqa Limestone (7)	7/3, 7/4, 7/15, 10/1
		Basalt	Miocene-Recent Volcanics (9)	9/1
	Palestine	Limestone	Tertiary Limestones	13/1, 13/2, 13/3, 13/4
Steppe	East Jordan Plateau	Sandstone	Quweira Sandstone (2)	2/2
			Ram-Um Sahm Sandstones (3)	3/2, 10/4*
			Kurnub Sandstone (5)	5/3
		Limestone	Ajlun Limestone (6)	6/1, 6/5
			Belqa Limestone (7)	7/1, 7/2, 7/5, 7/6, 7/7, 7/9, 7/11, 10/3
			Wadi Shallala and Dana Formations (8)	8/1
		Basalt	Miocene-Recent Volcanics (9)	9/2
	Palestine	Limestone	Tertiary Limestone	13/5
	Rift Valley	Unconsolidated materials	Quaternary deposits	11/1

* Also has analogies in other land systems.

TABLE B. THE MAJOR LAND UNITS OF JORDAN (cont.)

Land Zones	Land Divisions	Land Provinces	Land Regions	Land Systems
Desert	Arabian Shield	Granite	Aqaba Granite Complex (1)	1/1
		Sandstone	Quweira Sandstone (2)	2/1
			Ram-Um Sahm Sandstone (3)	3/1
			Kurnub Sandstone (4)	4/1
		Limestone	Ajlun Limestone (6)	6/7
			Belqa Limestone (7)	7/8, 7/10, 7/12, 7/13, 7/14
			Wadi Shallal (Belqa) and Dana Formations (8)	8/2, 8/4
		Basalt	Miocene-Recent Volcanics (9)	9/3, 9/4, 9/5
		Unconsolidated Materials	Quaternary Deposits	12/1, 12/2, 12/3, 12/4
	Rift Valley	Unconsolidated Materials	Quaternary Deposits	11/2, 11/3, 11/4

6. Correlations between land facets

Some notes have been appended to the individual land systems suggesting their main agricultural potential and conservation needs, with particular reference to certain of the land facets. These land facets should be viewed as storage 'pigeon holes' for information on land-use requirements, hazards and potential.

It is important, however, to be able to relate practical information on one land facet to analogous ones elsewhere. This can be done by means of a table of correlation between different land facets. Table C is designed for this purpose.

Table C is arranged in the form of a hierarchical classification. The land facets are identified by a number such as 7/10.2. The first part of this, i.e. 7/10, represents the land system. The number after the point represents the land facet as given in Section 4 of the Report.

There are three degrees of analogy of decreasing closeness. The closest analogies are between land facets representing the same physiographic type on the same geology in the same climatic zone. These groups of land facets are on the same line, undivided by semi-colons. A second, and somewhat less close degree of analogy, is between land facets representing the same physiographic units on the same rock type in the same climate. These are all listed under the same sub-heading, i.e. I.B.1 includes all sandstone plateau tops and hamadas in the desert zone. The third and weakest degree of analogy is between all the land facets which lie in the same climatic zone but on various types of rock. For instance, I.B. includes all plateau tops and hamadas, whatever their lithology.

It will, in general, be unsafe to expect much correlation or to attempt extrapolation for land development or soil conservation, beyond the second of these three degrees of analogy.

Because of lack of information and difficulty of access, the limited information on the land facet of the West Bank has made it impossible to include it in this scheme of correlations.

TABLE C. SCHEME OF CORRELATIONS BETWEEN LAND FACETS

(N.B. The symbol Belqa 1-2 represents Amman and Wadi Ghudran Formations, Belqa 3 represents Muwaqqar Formation, Belqa 4 represents Rijam Formation, and Belqa 5 represents Wadi Shallala Formation.

Land system numbers are shown before the decimal point, land facet numbers after it. Thus, 1/1.1 means land facet 1 on land system 1/1.)

I. DESERT ZONE

A. CRESTS

(1) Granite: 1/1.1

(2) Limestone: 7/12.1 (Belqa 1-2); 7/8.1, 7/13.1 (Belqa 3); 7/14.1 (Belqa 4 and Dana)

(3) Basalt: 9/3

B. PLATEAU TOPS AND HAMADAS

(1) Sandstone: 2/1.1 (Quweira); 3/1.1 (Ram-Um Sahm); 4/1.1 (Kurnub)

(2) Limestone: 7/10.1 (Belqa 1-4); 8/4.1 (Belqa 5 and Dana)

(3) Basalt: 9/4.1, 9/4.2, 9/4.3, 9/5.1 (Miocene-Recent)

(4) Quaternary: 11/2.1

TABLE C SCHEME OF CORRELATIONS BETWEEN LAND FACETS (cont.)

C. EROSION SLOPES (SCARPS)

(1) Granite: 1/1.2, 2/1.7, 2/2.3, 3/1.3

(2) Sandstone: 2/1.2 (Quweira); 3/1.2 (Ram-Um Sahm)

(3) Limestone: 6/7.1 (Ajlun); 7/12.2 (Belqa 1-2); 7/8.2, 7/13.2 (Belqa 3); 7/14.2 (Belqa 4); 8/4.2 (Belqa 5 and Dana)

(4) Basalt: 9/3.2 (Tuff); 9/4.6 (Hamada)

(5) Quaternary: 11/2.2

D. DIPSLOPES

(1) Limestone: 7/12.3 (Belqa 1-2)

E. SCREES AND BLOCK FANS

(1) Granite: 1/1.4

F. FOOTSLOPES

(1) Limestone: 3/1.4 (Ram-Um Sahm)

G. CASTELLATED FORMS

(1) Sandstone: 2/1.7 (Quweira)

H. GENTLE SLOPES (INTERFLUVES)

(1) Limestone: 7/10.2 (Undifferentiated Belqa 1-4); 8/2.1, 8/3.1 (Belqa 5 and Dana)

(2) Quaternary: 11/3.1

I. FANS

(1) Granite: 1/1.5

(2) Sandstone: 2/1.4 (Quweira); 4/1.3 (Kurnub)

(3) Quaternary: 11/3.2, 11/4.1

J. WADIS (INCISED)

(1) Granite: 1/1.3

(2) Sandstone: 2/1.5 (Quweira); 3/1.7 (Ram-Um Sahm); 4/1.4 (Kurnub)

(3) Limestone: 6/7.2 (Ajlun); 7/12.5 (Belqa 1-2); 7/8.4, 7/13.4 (Belqa 3); 7/14.4 (Belqa 4)

(4) Basalt: 9/4.4

K. ALLUVIAL VALLEY FLOORS

(1) Limestone: 7/10.3 (Undifferentiated Belqa 1-4); 7/12.4 (Belqa 1-2); 7/8.3, 7/13.3 (Belqa 3); 7/14.3 (Belqa 4); 8/2.2, 8/4.3 (Belqa 5 and Dana)

(2) Quaternary: 12/2.2, 12/2.3

L. SERIR (GRAVEL DESERT)

(1) Granite: 1/1.6

(2) Sandstone: 3/1.5 (Ram-Um Sahm)

(3) Quaternary: 12/3.1; 12/3.2

M. SAND PLAIN

(1) Sandstone: 2/1.8 (Quweira)

(2) Basalt: 9/5.2

TABLE C. SCHEME OF CORRELATIONS BETWEEN LAND FACETS (cont.)

N. MUD FLATS

(1) Granite: 1/1.7

(2) Sandstone: 2/1.6 (Quweira); 3/1.8 (Ram-Um Sahm)

(3) Limestone: 8/2.3 (Belqa 5 and Dana)

(4) Basalt: 9/4.5

(5) Quaternary: 11/2.3, 11/3.4, 12/1.3, 12/4.1

O. WETLAND

(1) Quaternary: 12/1.1

P. SEBKHA (SALT FLATS)

(1) Quaternary: 12/1.2

Q. BEACHES

(1) Quaternary: 11/2.4, 11/4.2

R. DUNES

(1) Sandstone: 3/1.6 (Quweira); 4/1.5 (Kurnub)

II. STEPPE ZONE

A. CRESTS

(1) Sandstone: 2/2.1 (Quweira); 3/2.1 (Ram-Um Sahm)

(2) Limestone: 6/1.1, 6/5.1 (Ajlun); 7/9.1, 7/11.1 (Belqa 1-2); 7/7.1 (Belqa 3); 7/2.1 (Undifferentiated Belqa 1-4)

B. PLATEAU TOPS (HAMADAS)

(1) Limestone: 7/1.1 (Belqa 1-2)

(2) Basalt: 9/2.1

C. EROSION SLOPES (SCARPS)

(1) Granite: 10/4.3

(2) Sandstone: 2/2.2, 10/4.2 (Quweira); 3/2.2, 10/4.1 (Ram-Um Sahm); 5/3.1, 10/2.3, 10/3.3 (Kurnub)

(3) Limestone: 6/1.2, 6/5.2, 7/6.2, 10/2.1, 10/3.2 (Ajlun); 10/1.1 (Undifferentiated Belqa); 7/1.2, 7/2.2, 7/5.2, 7/6.1, 7/9.2, 7/11.2 (Belqa 1-2); 7/2.2, 7/5.2, 7/7.2 (Belqa 3); 7/2.2, 7/5.2 (Belqa 4); 8/1.1 (Belqa 5 and Dana)

(4) Volcanic: 7/5.1, 8/1.2, 9/2.4, 10/3.1

D. DIPSLOPES

(1) Limestone: 6/1.3, 6/5.3 (Ajlun); 7/9.3, 7/11.3 (Belqa 1-2)

E. HILL TERRACES

(1) Sandstone: 5/3.2, 10/2.4 (Kurnub)

(2) Limestone: 10/2.2 (Ajlun); 7/5.3 (Belqa Undifferentiated)

F. HILLSIDE SCARS

(1) Limestone: 7/5.4 (Belqa Undifferentiated)

TABLE C. SCHEME OF CORRELATIONS BETWEEN LAND FACETS (cont.)

G. FOOTSLOPES AND PEDIMENTS

(1) Granite: 2/2.3

(2) Sandstone: 3/2.3 (Ram-Um Sahm)

H. FANS

(1) Sandstone: 2/2.4 (Quweira)

(2) Quaternary: 11/1.1, 11/1.2

I. WADIS

(1) Sandstone: 2/2.5 (Quweira); 3/2.4 (Ram-Um Sahm); 5/3.3 (Kurnub)

(2) Limestone: 7/6.3 (Ajlun); 7/1.3, 7/9.5, 7/11.3 (Belqa 1-2); 7/7.4 (Belqa 3); 8/1.4 (Belqa 5 and Dana)

(3) Basalt: 9/2.3

J. ALLUVIAL VALLEY FLOORS

(1) Limestone: 6/1.4, 6/5.4 (Ajlun); 7/5.5 (Belqa Undifferentiated); 7/1.2, 7/2.1, 7/9.4, 7/11.4 (Belqa 1-2); 7/2.2, 7/7.3 (Belqa 3); 7/2.3, 7/5.5 (Belqa 4); 8/1.3 (Belqa 5 and Dana)

K. MUD FLATS

(1) Basalt: 9/2.2

L. BADLANDS

(1) Quaternary: 11/1.3

M. WETLANDS

(1) Quaternary: 11/1.4

N. BEACHES

(1) Quaternary: 11/1.5

III. MEDITERRANEAN ZONE

A. CRESTS

(1) Limestone: 7/3.1 (Belqa 1-2)

B. PLATEAU TOPS

(1) Sandstone: 5/2.1 (Kurnub)

(2) Limestone: 6/2.1, 6/4.1, 6/6.1, 6/8.1 (Ajlun); 7/4.1 (Belqa 1-2); 7/15.1 (Belqa 3-4)

(3) Basalt: 9/1.1

C. EROSION SLOPES (SCARPS)

(1) Sandstone: 5/2.2, 6/2.3, 6/3.2, 6/4.3 (Kurnub)

(2) Limestone: 5/1.1, 6/2.2, 6/3.1, 6/4.2, 6/6.2, 6/8.2 (Ajlun); 7/3.2, 7/4.2 (Belqa 1-2)

(3) Basalt: 9/1.2

D. HILL TERRACES

(1) Limestone: 7/4.3 (Belqa 1-2)

TABLE C. SCHEME OF CORRELATIONS BETWEEN LAND FACETS (cont.)

E. UNDULATING LAND

(1) Sandstone: 5/2.1 (Kurnub)

F. ROCK FOOTSLOPES AND PEDIMENTS

(1) Sandstone: 5/2.3 (Kurnub)

G. SCARS ON HILL SLOPES

(1) Basalt: 9/1.4

H. DETRITAL PLAINS

(1) Sandstone: 5/2.4

(2) Limestone: 7/3.3 (Belqa 1-2)

I. ALLUVIAL VALLEY FLOORS

(1) Limestone: 7/15.2 (Belqa 3-4)

J. WADIS AND ERODED CHANNELS

(1) Sandstone: 5/1.3, 5/2.5, 6/2.4, 6/3.3, 6/4.4 (Kurnub)

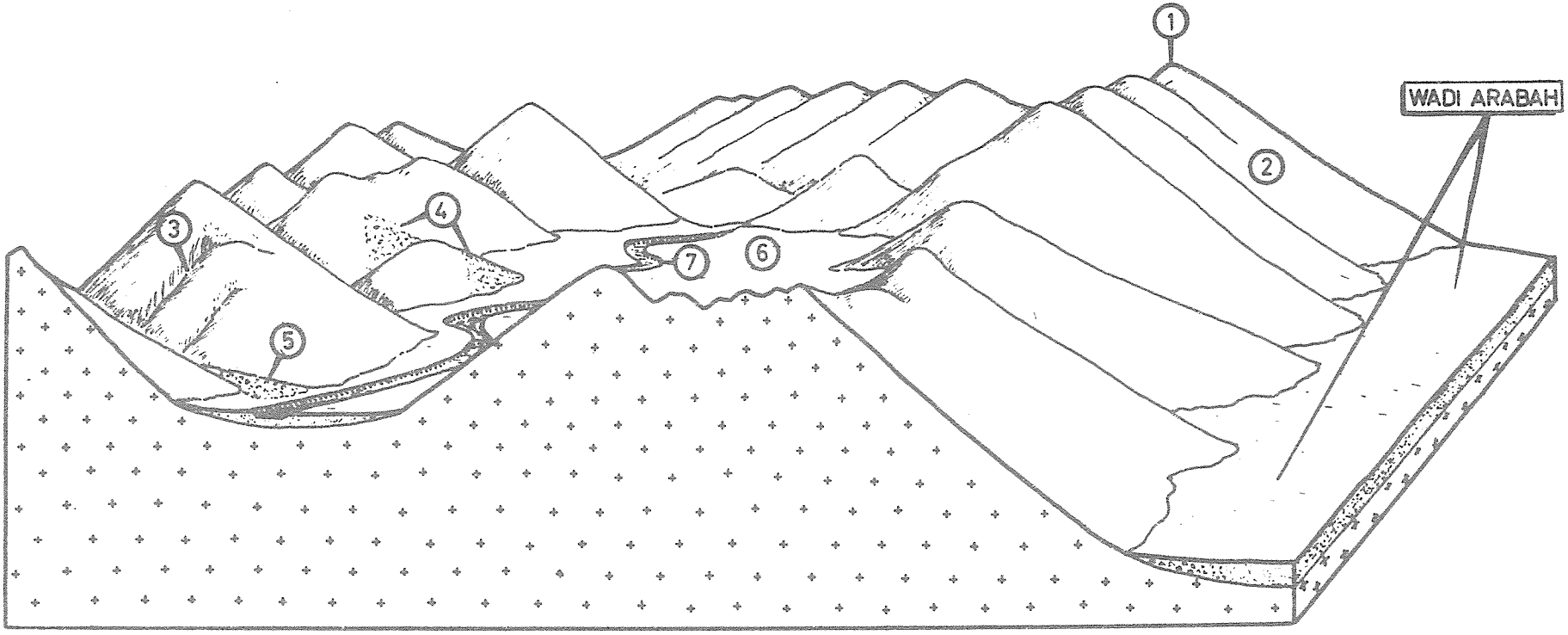
(2) Limestone: 6/6.3, 6/8.3 (Ajlun); 7/3.4, 7/4.4 (Belqa 1-2); 7/15.3 (Belqa 3-4)

(3) Basalt: 9/1.3

7. L A N D U N I T S O F J O R D A N

(with block diagrams)

1·1 AQABA GRANITE COMPLEX



1/1 AQABA GRANITE COMPLEX

Climate: Desert

Physiography: Dissected granite hills

Geology: Includes acid and basic igneous rock. Porphyry and narrow dolerite dikes locally prominent

Land Facets:

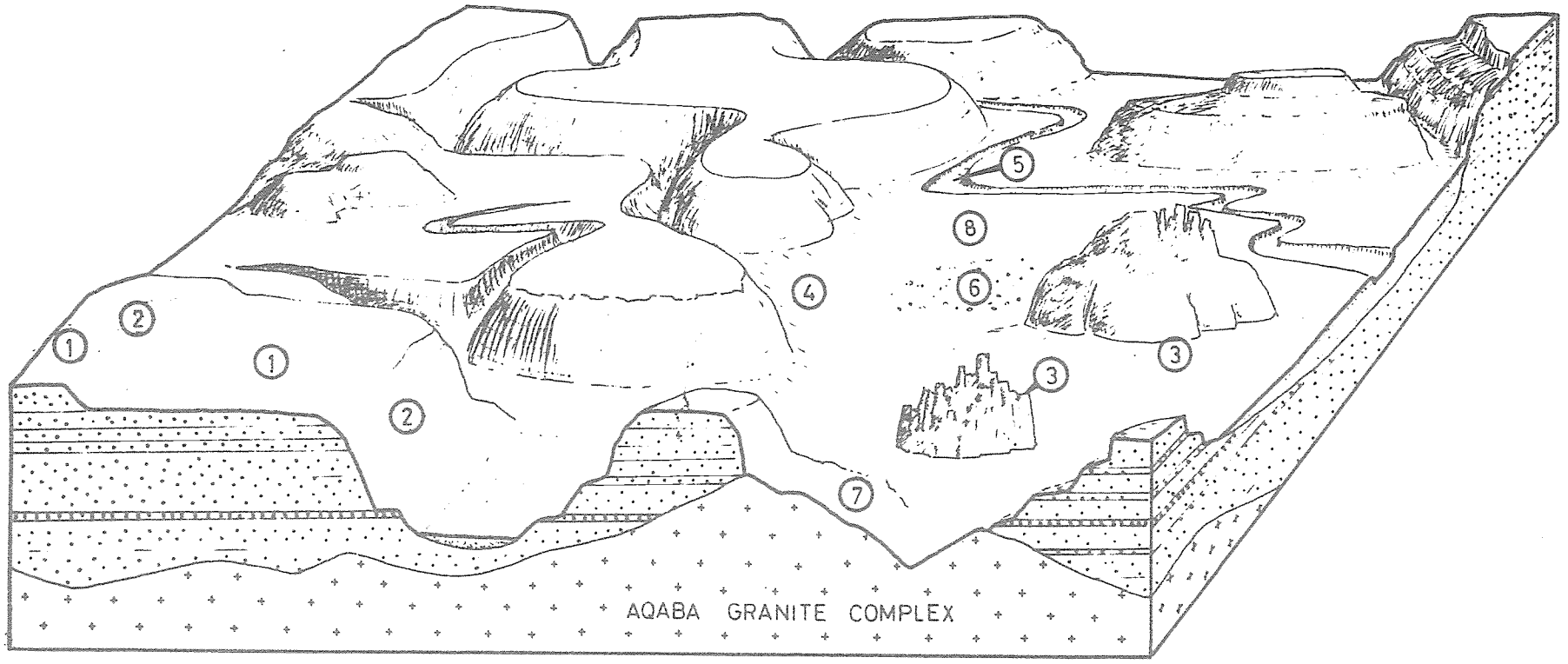
No.	Form	Soils	Vegetation*
1	Crests: bare rock	Lithosols	V. thin scrub
2	Bare rock slopes, including porphyry and dolerite dikes		(8a)
3	Wadis	Bouldery, stony and sandy regosols	Rather sparse scrub, Acacia spp., Retama raetam, (4bb, 4s, or 10b)
4	Steep screes and coarse block fans	Boulders	Sparse, deep-rooted chenopods and shrubs (8c, 4h)
5	Gravel fans (smaller stones than 4)	Gravel	Sparse Haloxylon salicornicum (4n)
6	Desert flats, including small wadis	Stony and sandy regosols	ND **
7	Mud flats	Salt and clay; saline	Almost bare

Some agricultural potential from Land Facet 7.

* Numerical symbols given under 'Vegetation' are those given by Hunting Technical Services (1956).

** ND = No data.

2·1 DISSECTED PLATEAU ON QUWEIRA SANDSTONE



2/1 DISSECTED PLATEAU ON QUWEIRA SANDSTONE

Climate: Desert

Physiography: Much dissected sandstone tablelands ('chebka')

Geology: Cambrian Quweira sediments, mainly sandstone, locally underlain by Aqaba Granite Complex.

Consists of 4 main subdivisions:

4. Intrusives
3. Upper Quweira Sandstone: red
2. Burj Limestone: contains limestone and marls
1. Lower Quweira Sandstone: red, contains conglomerate.

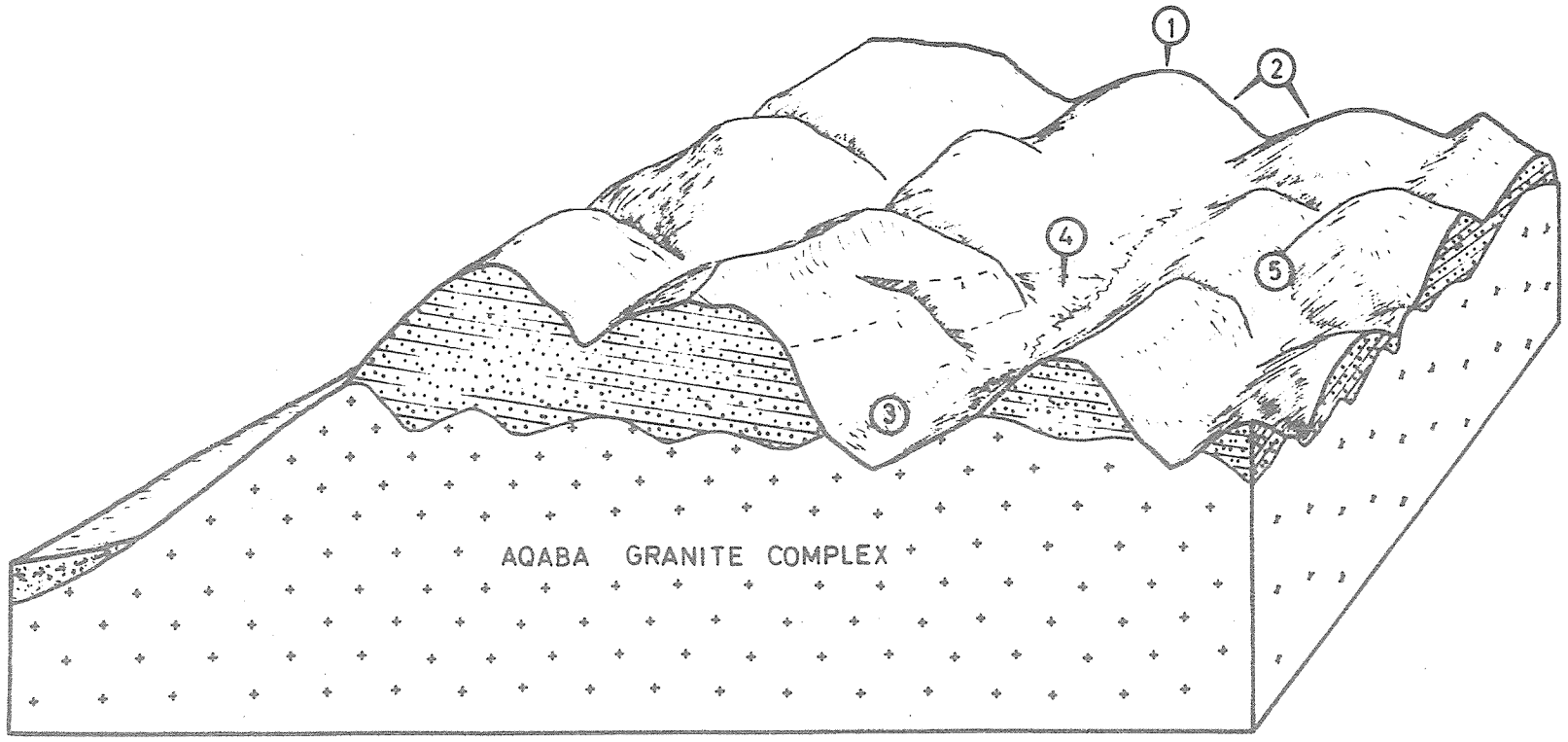
The Quweira is the equivalent of the more recently defined Disi Group.

Land Facets

No.	Form	Soils	Vegetation
1	Hamada of plateau surface	Hamada: thin and stony	Bare (8a, 8e)
2	Steep erosion slopes	Lithosols	Almost bare
3	Castellated forms	Lithosols	Bare
4	Fans	Stony regosols	N.D.
5	Wadis	Stony regosols	Thin scrub: Haloxylon salicornicum, Retama raetam (4bb)
6	Serir	Stony regosols	Almost bare (8e)
7	Granite slopes	Lithosols	V. thin scrub (8a)
8	Sand plain	Regosols	Communities dominated by Haloxylon salicornicum (4j)
9	Mud flats with takyr surface called 'qa'	Silt and clay, generally saline	Bare

Some irrigation is possible on Land Facet 9, e.g. the Qa Disi scheme near the Ma'an-Aqaba road.

2·2 DISSECTED OUWEIRA SANDSTONE PLATEAU NEAR WADI ARABAH



2/2 DISSECTED QUWEIRA SANDSTONE PLATEAU NEAR WADI ARABAH

Climate: Steppe

Physiography: Isolated remnants of deeply dissected sandstone, generally overlying or standing on a 'plinth' of granite.

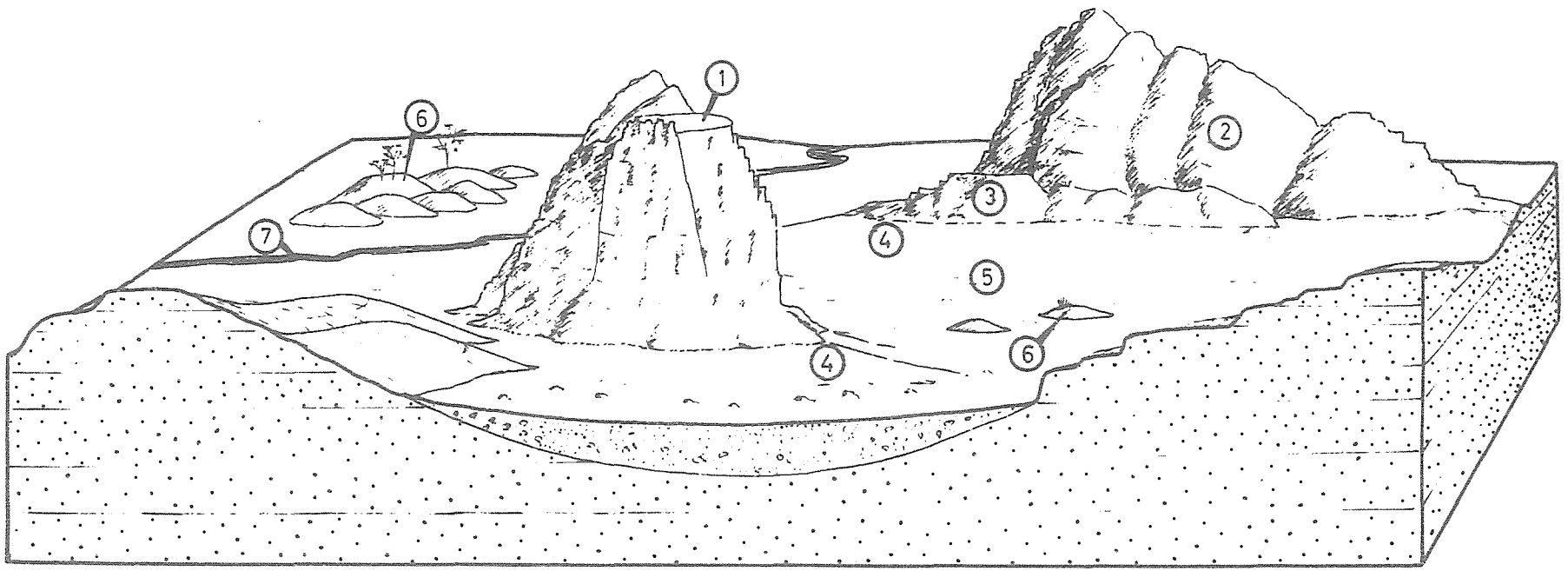
Geology: Quweira ≅ Disi) sandstone overlying Aqaba Granite Complex. For subdivisions see Land System 2/1.

Land Facets:

No.	Form	Soils	Vegetation
1	Crests	Stony, bare	N.D.
2	Sandstone scarp slopes	'' ''	N.D.
3	Granite footslopes	'' ''	N.D.
4	Fans	Stony, sandy unstratified	N.D.
5	Wadis	Stony	N.D.

This land system differs from 2.1 in its higher elevation and somewhat greater complexity of relief which does not include low areas of 'qa'. It has no significant agricultural potential.

3·1 DISSECTED RAM / UM SAHM SANDSTONE PLATEAUX OF SOUTHERN DESERT



3/1 DISSECTED RAM/UM SAHM SANDSTONE PLATEAUX OF SOUTHERN DESERT

Climate: Desert

Physiography: Dissected tabular sandstone country ('chebka') in sea of sandy detritus. ''Towering sandstone hills in sea of sand''.

Geology: A sequence of deposits ranging from mid-Paleozoic to Jurassic equivalent to Khreim of later terminology, dominantly sandstone but also containing limestones, shales, marls and gypsum. The sequence is as follows:

4. Zarqa (Jurassic) sandstone overlain by limonitic limestone and Cenomanian marly limestone
3. Zerqa (Triassic) red sandstone, shale, marl, gypsum
2. Um Sahm sandstone: well bedded, unjointed sandstone; pink, red, or mauve when broken, weathering to purple; distinct topography
1. Ram sandstone: even grained loosely cemented sandstone; massive; jointed; weathering to smooth rounded forms.

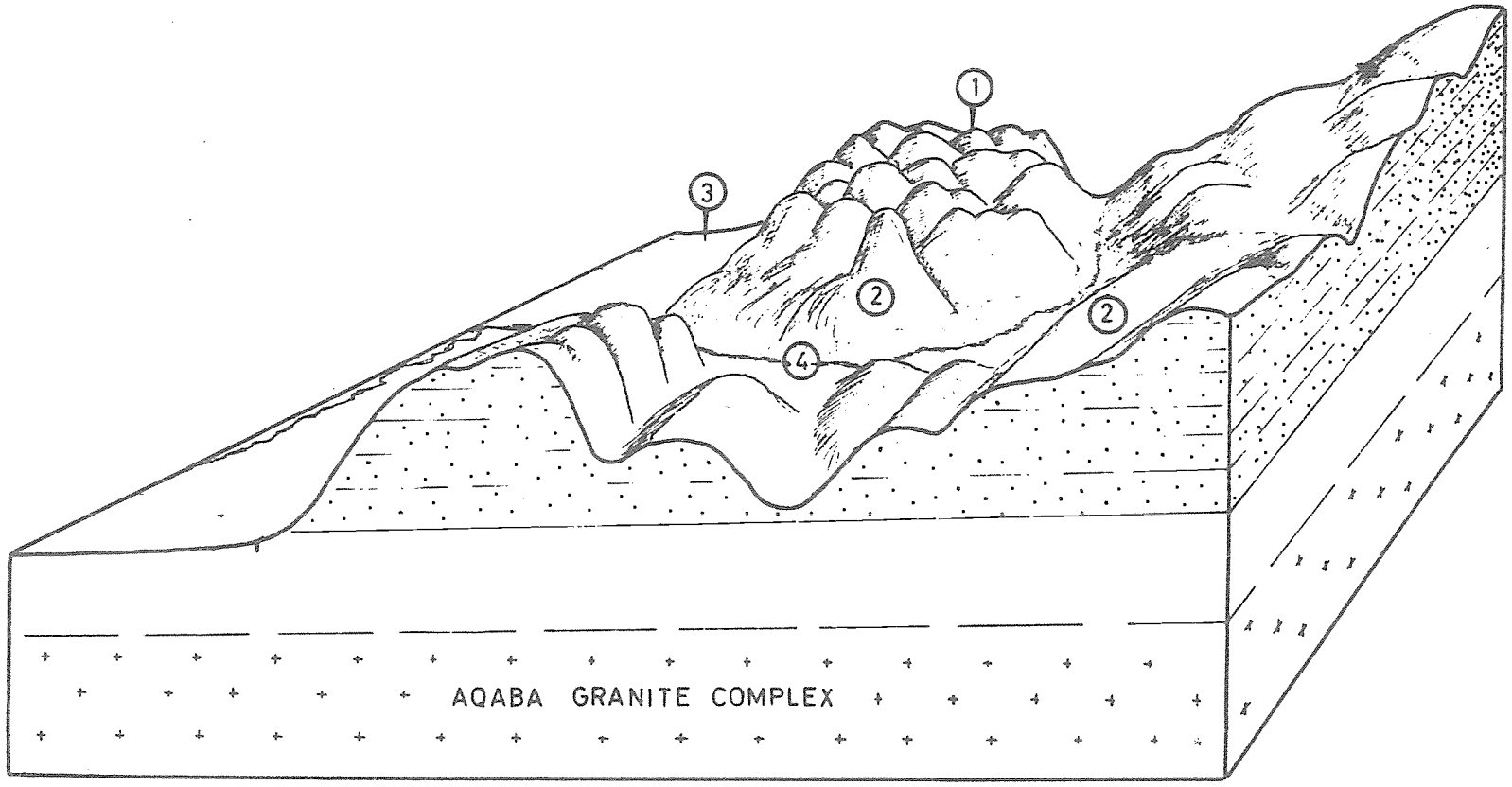
In places the underlying Quweira sandstone and the basal Aqaba Granite Complex appear in wadis.

Land Facets:

No.	Form	Soils	Vegetation
1	Plateau tops	Lithosols	Almost bare
2	Steep rock slopes	''	'' ''
3	Granite basal slopes	''	Sparse chenopods and shrubs (4k)
4	Sandy footslopes	Gravelly and sandy regosol	Scrub with Haloxylon salicornicum (4n)
5	Sandstone gravel plain	Gravelly regosol	Scrub on sandy hummocks
6	Sand dunes	Sandy regosols	Haloxylon salicornicum & H. persicum scrub (4j)
7	Wadis	Shallow sandy alluvium	Scrub including Haloxylon salicornicum, Artemisia judaica, Asteriscus graveolens, and annuals (4q)
8	Mud flats	Silt and clay somewhat saline	Bare, except for sparse annuals and chenopods at edges (11)

Some limited range potential on Land Facets 4-7. Some irrigation possible on 8, e.g. the irrigation scheme at Qa' Disi near the Wadi Ram.

3·2 DISSECTED RAM / UM SAHM PLATEAU REMNANTS NEAR WADI ARABAH



3/2 DISSECTED RAM/UM SAHM SANDSTONE PLATEAU REMNANTS NEAR WADI ARABAH

Climate: Steppe

Physiography: Uplifted and much dissected sandstone plateau areas near Wadi Arabah. Examples can be seen at Petra. The Ram sandstone is characterized by very steep rounded slopes with large vertical fractures and a variety of reddish hues.

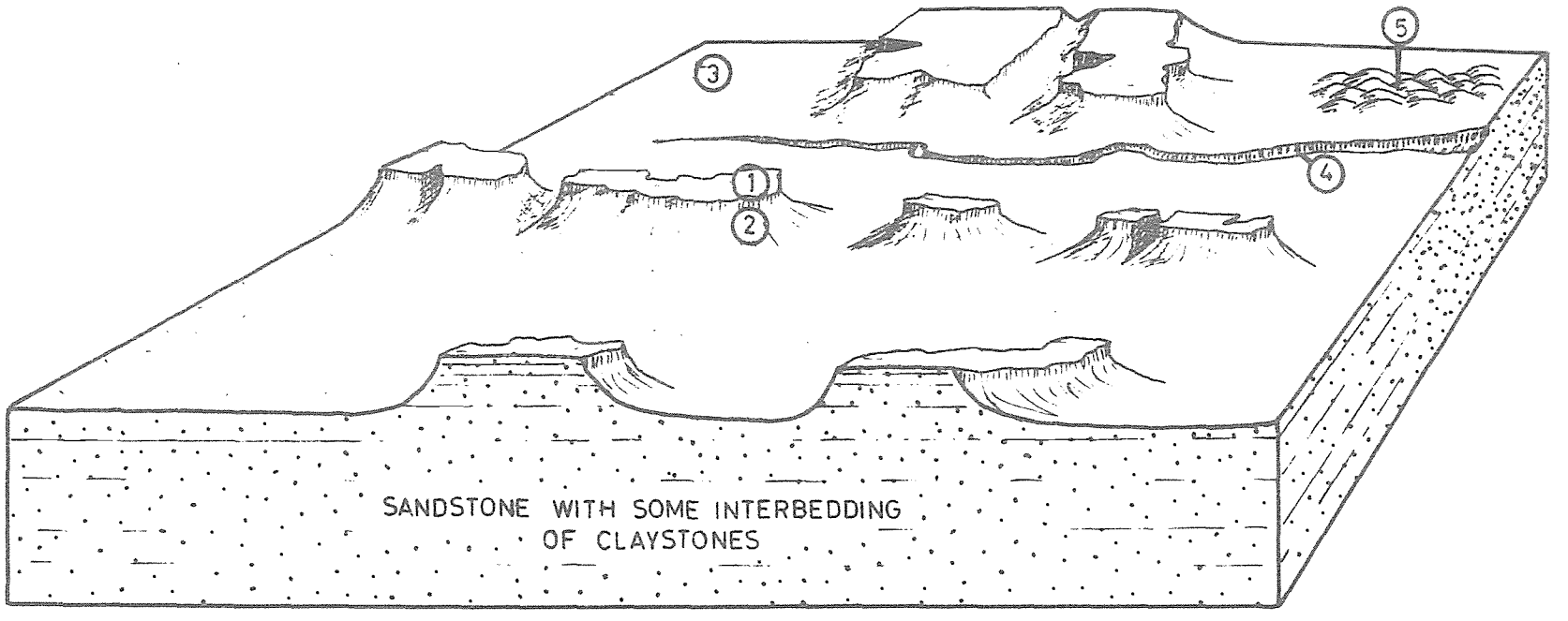
Geology: More or less horizontally bedded Ram/Um Sahm sandstones, roughly equivalent to Khreim in the newer terminology.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded summits	Bare	Bare (8a)
2	Steep to vertical slopes	Bare	Bare (8a)
3	Detrital footslopes	Stony)	Scrub can contain Juniperus phoenicea (4dd)
4	Stony wadis	Stony)	

Differs from Land System 3.1 in that although it has the same rock it occurs in more restricted areas and has suffered more tectonic action. For this reason it contains no flat open areas of silt or clay.

4·1 DISSECTED TABUK, ZARQA AND HATHIRA PLATEAU COUNTRY



4/1 DISSECTED TABUK, ZARQA, AND HATHIRA PLATEAU COUNTRY

Climate: Desert

Physiography: Dissected tabular country of south-eastern desert: a 'chebka' area with a covering of Quaternary drift which tends to become areally predominant as the hills decrease towards the East. Probably the most arid of all the land systems of Jordan.

Geology: A sequence of Silurian-Cenomanian sandstones and associated sediments including the following:

2. Neokom - Cenomanian: white, brown and mottled sandstones
1. Upper Ordovician - Silurian: fine sandstone and claystone.

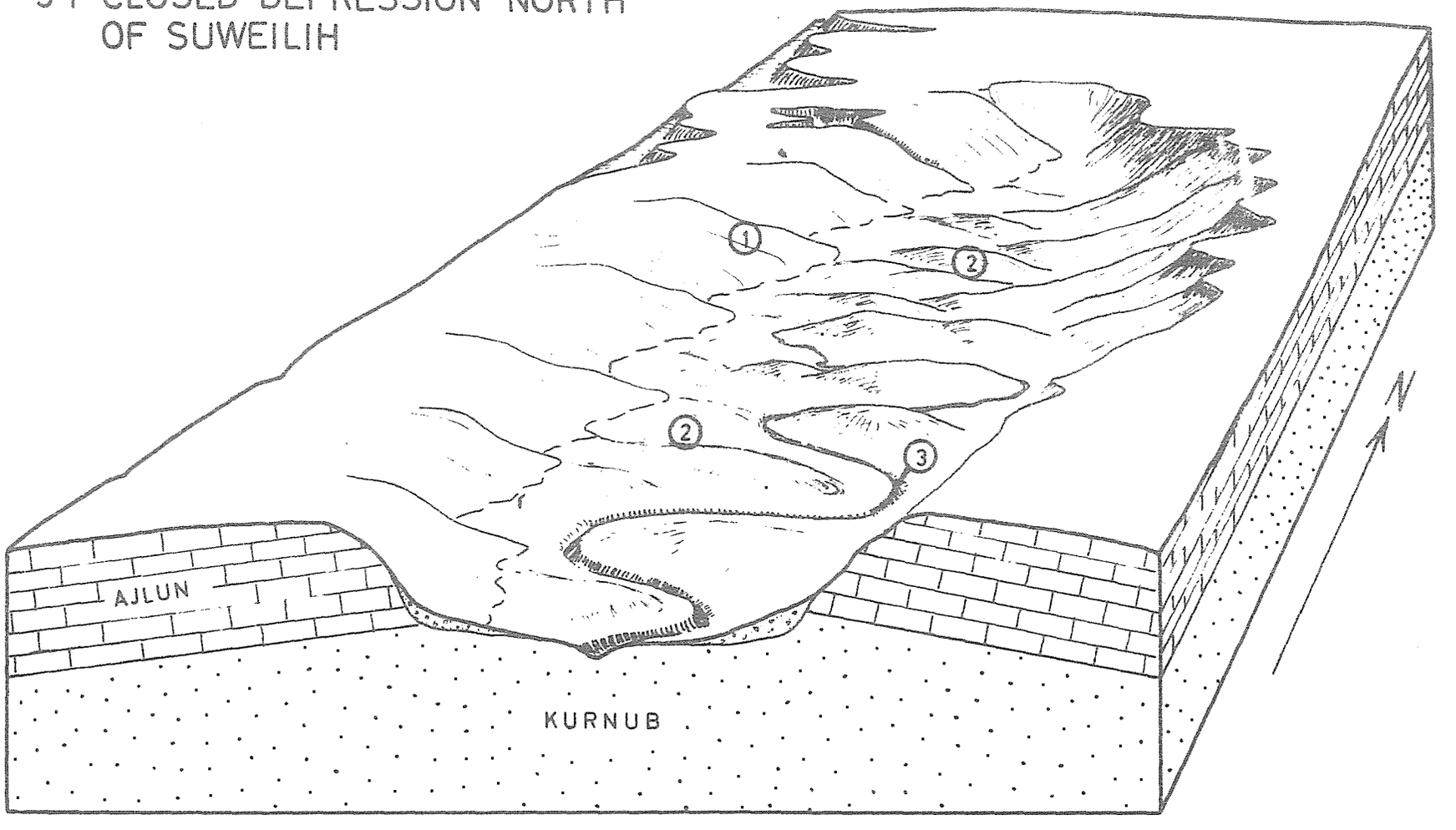
FAO (1970) identifies these deposits with Kurnub sandstones, but this land system has been given a separate index number because it is differently classified, e.g. by U.S. Geological Survey (1963)

Land Facets:

No.	Form	Soils	Vegetation
1	Plateau tops	Sandstone hamada	Almost bare (8a)
2	Sandstone slopes or 'breakaways'	Bare sandstone lithosols	Almost bare (8a)
3	Sandy and gravelly fans and serir	Regosols	Shrubby chonopods (8e)
4	Sandy wadi beds	Regosols	Retama raetam, Haloxylon spp., (4bb)
5	Dunes	Regosols	Sometimes Haloxylon persicum, Traganum nudatum, Haloxylon salicornicum (4j), sometimes bare (8h)

Too arid for anything but poorest grazing. Insufficient evidence to determine where there is irrigable land.

5·1 CLOSED DEPRESSION NORTH OF SUWEILIH



5/1 CLOSED DEPRESSION NORTH OF SUWEILIH

Climate: Mediterranean

Physiography: A clearly defined depression with a floor about 11 km x 4 km. The floor is gently undulating, well watered and cut by a number of streams. It rises towards the outer walls.

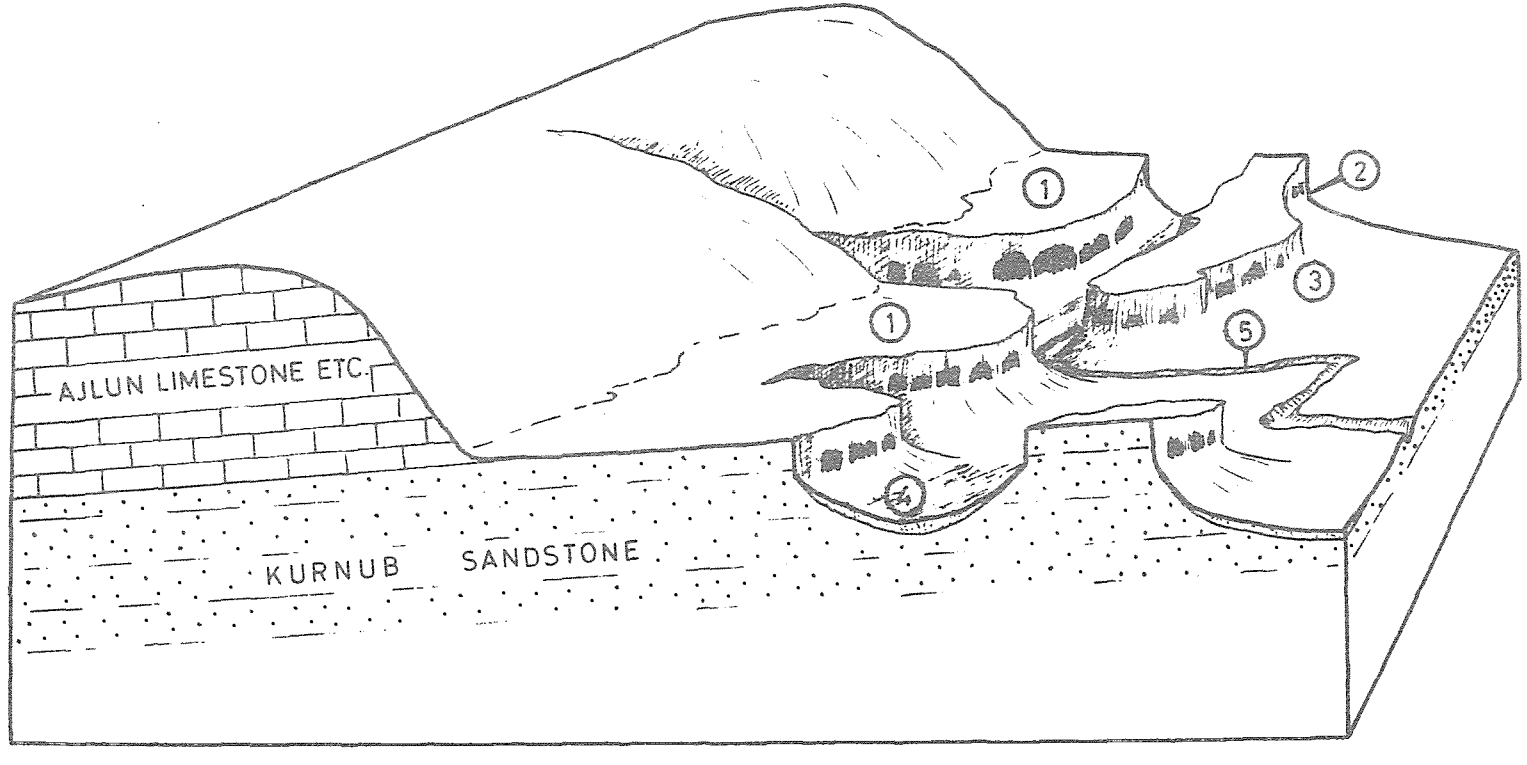
Geology: A breached anticline in Ajlun limestone eroded to reveal the underlying Kurnub sandstone, but the latter is covered near the edges by inwashed Quaternary material.

Land Facets:

No.	Form	Soils	Vegetation
1	Fringing footslopes of surrounding Ajlun limestone	Brown loams, somewhat stony	Cultivated cereals
2	Undulating basin land on Kurnub sandstone	Brown loams	Intensively cultivated with a variety of crops
3	Wadis	N.D.	N.D.

Land Facet 2 represents some of the best land in the Mediterranean Zone of Jordan. Land Facets 1 and 3 are somewhat liable to erosion.

5·2 DISSECTED TABLELAND REMNANTS ON KURNUB SANDSTONE



5/2 DISSECTED TABLELAND REMNANTS ON KURNUB SANDSTONE

Climate: Mediterranean

Physiography: The Kurnub sandstone forms a tabular landscape rather reminiscent of the Grand Canyon, U.S.A. This appears to be due to the thickness and competence of its capping bed. This land system occurs in deeply ravined areas on the plateau under a Mediterranean climate, whose drainage is mainly to the Jordan River.

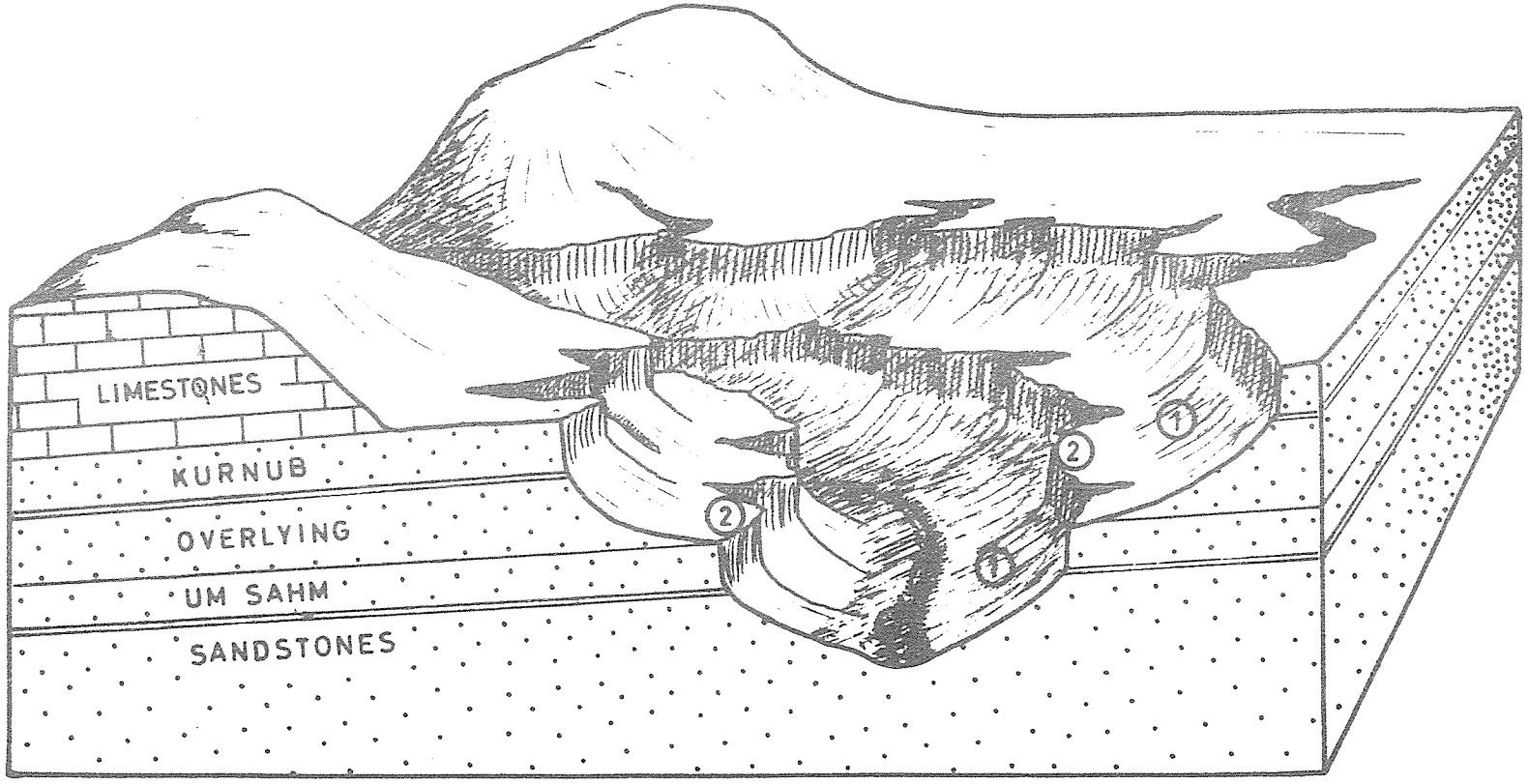
Geology: Kurnub sandstone: the top of the series of thick sandstone deposits especially well developed in the south of Jordan.

Land Facets:

No.	Form	Soils	Vegetation
1	Plateau top	Thin	N.D.
2	Scarp slopes. The top has a free face, cliff or 'kreb'. Sometimes the top part of the slope under this capping resembles an alcove as almost as vertical as the kreb	Bare	N.D.
3	Footslopes	Stony and gravelly	N.D.
4	Detrital plains	" " "	N.D.
5	Wadi channels	Stony	N.D.

Little agricultural potential except locally on Land Facet 1 in the plateau area.

5·3 WADIS ON KURNUB SANDSTONE DRAINING TO JORDAN



5/3 WADIS ON KURNUB SANDSTONE DRAINING TO JORDAN

(e.g. Wadi Sahm - Wadi Feifa and Wadi El Hameida - Wadi Khanzeira)

Climate: Steppe

Physiography: Deep ravines in elevated tableland

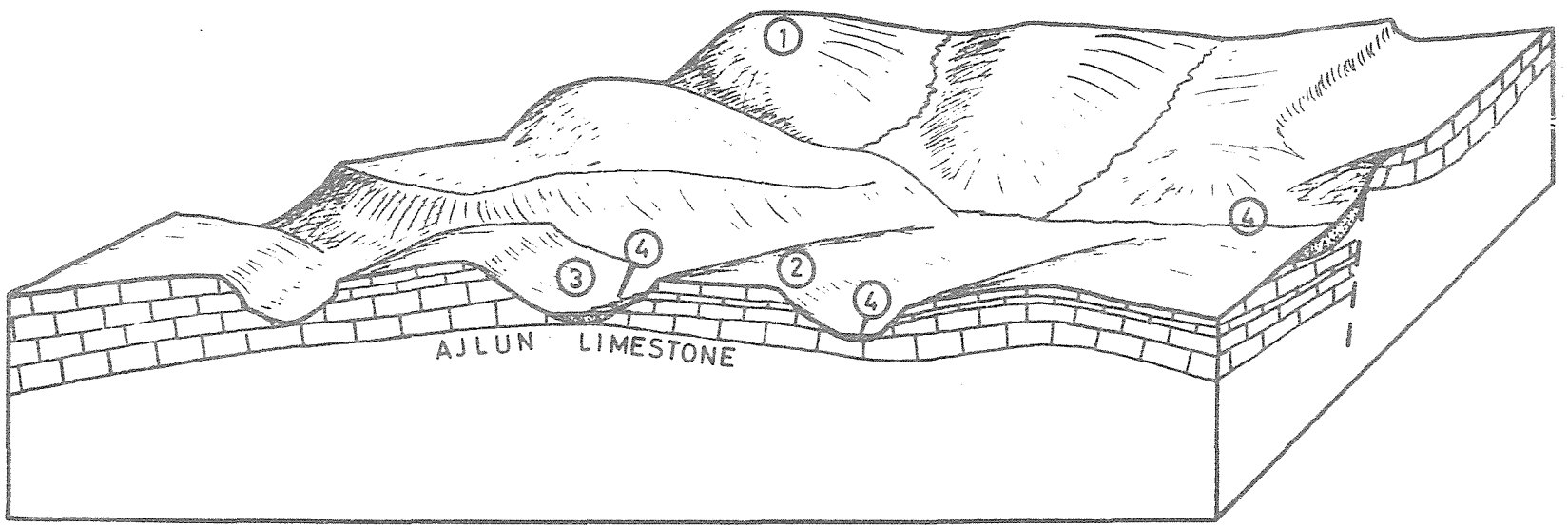
Geology: Valleys cut through Kurnub overlying Um Sahm sandstones

Land Facets:

No.	Form	Soils	Vegetation
1	Scarp slopes consisting of cliffs ('krebs') and 'breakaways'	Bare and stony	N.D.
2	Shelves or terraces		N.D.
3	Eroded channels		N.D.

This land system differs from 5/2 only in that it represents a single deep wadi rather than a landscape which includes a number of smaller ones.

6.1 EASTERN PLATEAU ON AJLUN LIMESTONE



6/1 EASTERN PLATEAU ON AJLUN LIMESTONE

Climate: Steppe

Physiography: This is the upper part of the eroded dipslope falling eastwards towards El Azraq Depression. It is a dissected semi-arid limestone area with a relief amplitude of about 50 m. It differs from the dissected area of Belqa limestone (Wadi Rijam Formation) (Land System 7.14) which lies to the east of it in that scarps are more pronounced, there is less chert covering and the tops of the hills do not show the same 'bald effect' due to the absence of dark chert.

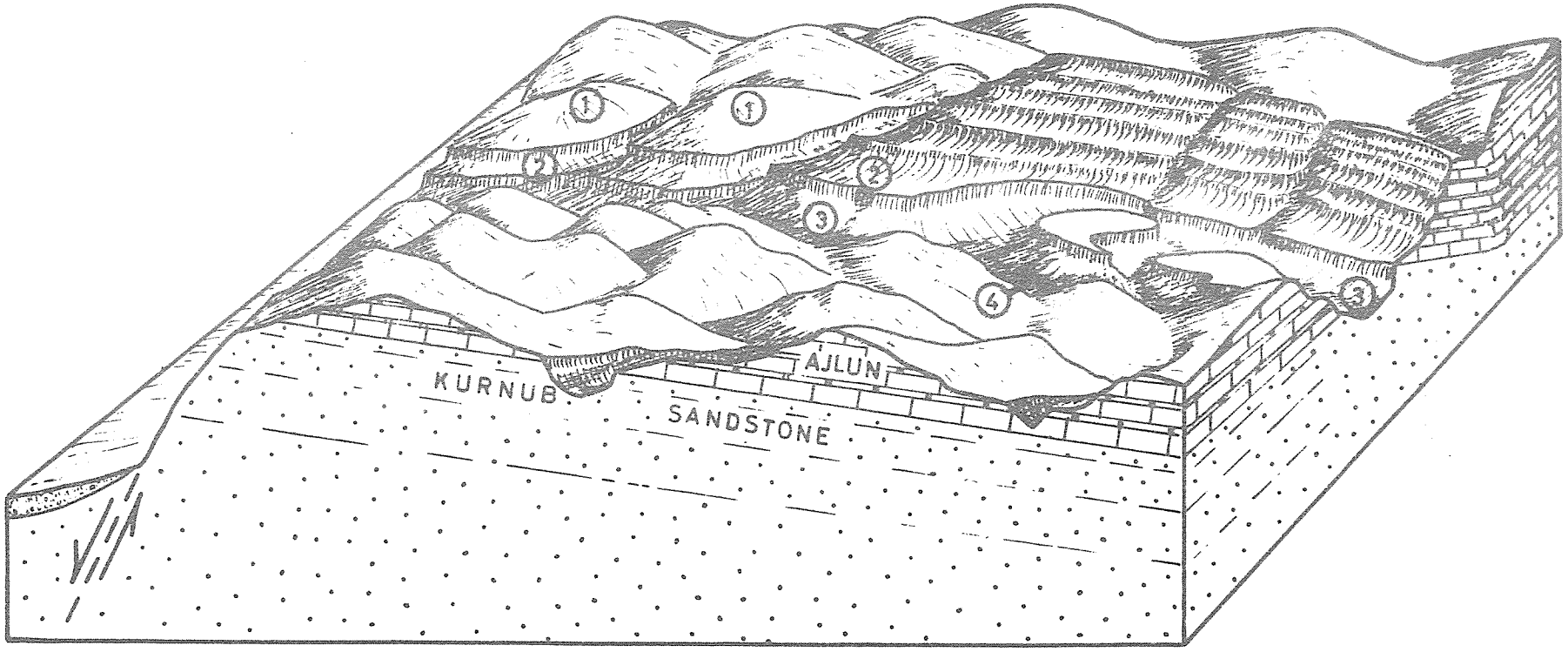
Geology: Wadi Sir limestone group of the Ajlun Series.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded crests	Lithosols	N.D.
2	Bare scarp slopes	Lithosols	N.D.
3	Dipslopes	Thin, stony soils	N.D.
4	Wide valleys	Regosols	N.D.

Almost entirely grazing

6·2 DISSECTED TABLELAND ON AJLUN LIMESTONE WITH DRAINAGE TO JORDAN



6/2 DISSECTED TABLELAND ON AJLUN LIMESTONE WITH DRAINAGE TO JORDAN

Climate: Mediterranean

Physiography: Deeply gullied tabular limestone plateau. Limestone forms rocky ridges and cliffs; shales, the softer slopes.

Geology: Ajlun limestone is marine Cenomanian-Turonian limestone with some dolomite and embedded marls, rarely shale, sandstone, or chalk. The thickness generally increases northwards. Consists of:

3. Senonian: chert beds
2. Turonian: bedded limestones separated by marls. Mud shales and sandstones appear further south
1. Cenomanian: bedded limestone separated by marls

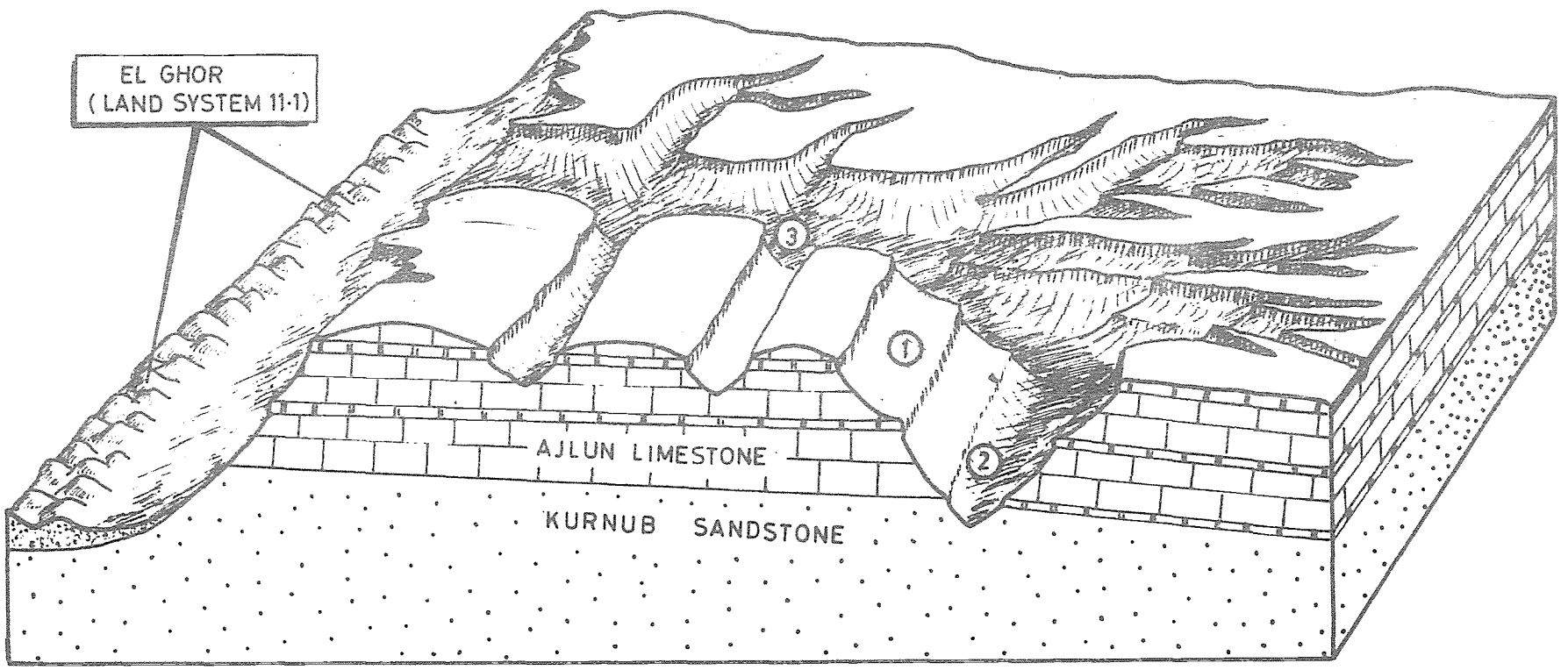
This overlies the Kurnub sandstone.

Land Facets:

No.	Form	Soils	Vegetation
1	Tabular limestone summits	Chert hamada	Grasses (1b) Some cultivation
2	Limestone slopes with interbedded marls	Shallow pockets of soil among rock outcrops	Grasses (1b) Some cultivation
3	Kurnub sandstone slopes exposed in deep wadis	Bare rock	N.D.
4	Wadi floors in Kurnub sandstone	Stony	Scrub including oleander

Differs from 6/8 in the somewhat lower altitude and rainfall. Some agricultural potential on Land Facets 1 and 2, but the latter is subject to erosion.

6·3 MAJOR WADIS IN AJLUN LIMESTONE DRAINING TO JORDAN e.g. WADI AJLUN, WADI RAJIB



6/3 MAJOR WADIS IN AJLUN LIMESTONE DRAINING TO JORDAN

(e.g. Wadi Ajlun, Wadi Rajib)

Climate: Mediterranean

Physiography: As for 6/2, except that this land system includes only the deep major wadis and not the surrounding dissected country.

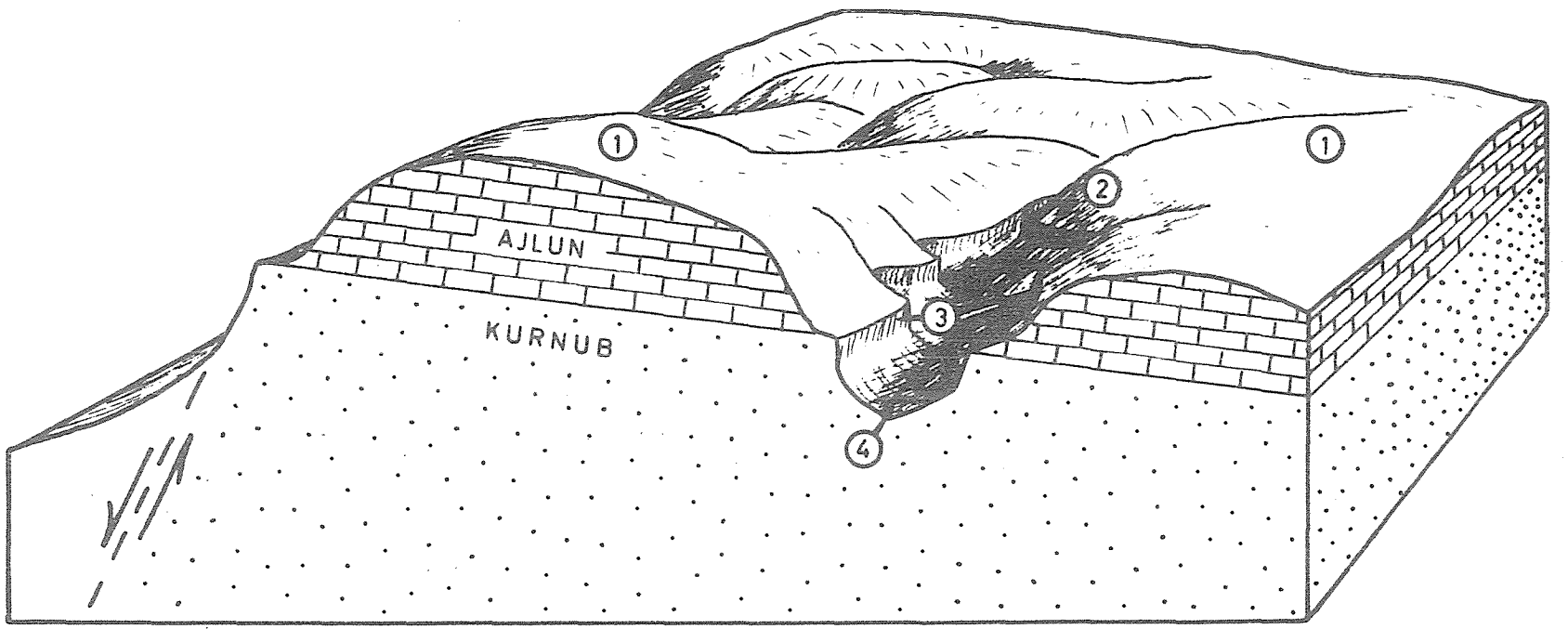
Geology: Ajlun Series: mainly limestone, but with interbedded marls and dolomites, overlying Kurnub sandstone.

Land Facets:

No.	Form	Soils	Vegetation
1	Upper limestone scarp slopes	Bare and thin, subject to creep and gullying	Grasses (1b), some cereal cultivation
2	Lower sandstone scarp slopes	,, ,, ,, ,,	Almost bare
3	Valley floors, widening to west, in Kurnub sandstone	Alluvial fill	Some cultivation beside river

The most important land-use problem is the protection of Land Facet 1 from soil erosion. Cultivation feasible on small areas of Land Facet 3.

6.4 DISSECTED AREA ON AJLUN LIMESTONE OVER KURNUB SANDSTONE DRAINING TO JORDAN



6/4 DISSECTED AREA ON AJLUN LIMESTONE OVER KURNUB SANDSTONE DRAINING TO JORDAN

Climate: Mediterranean

Physiography: A dissected landscape in which the valleys cut down through limestone to expose underlying sandstone on the plateau under Mediterranean climate.

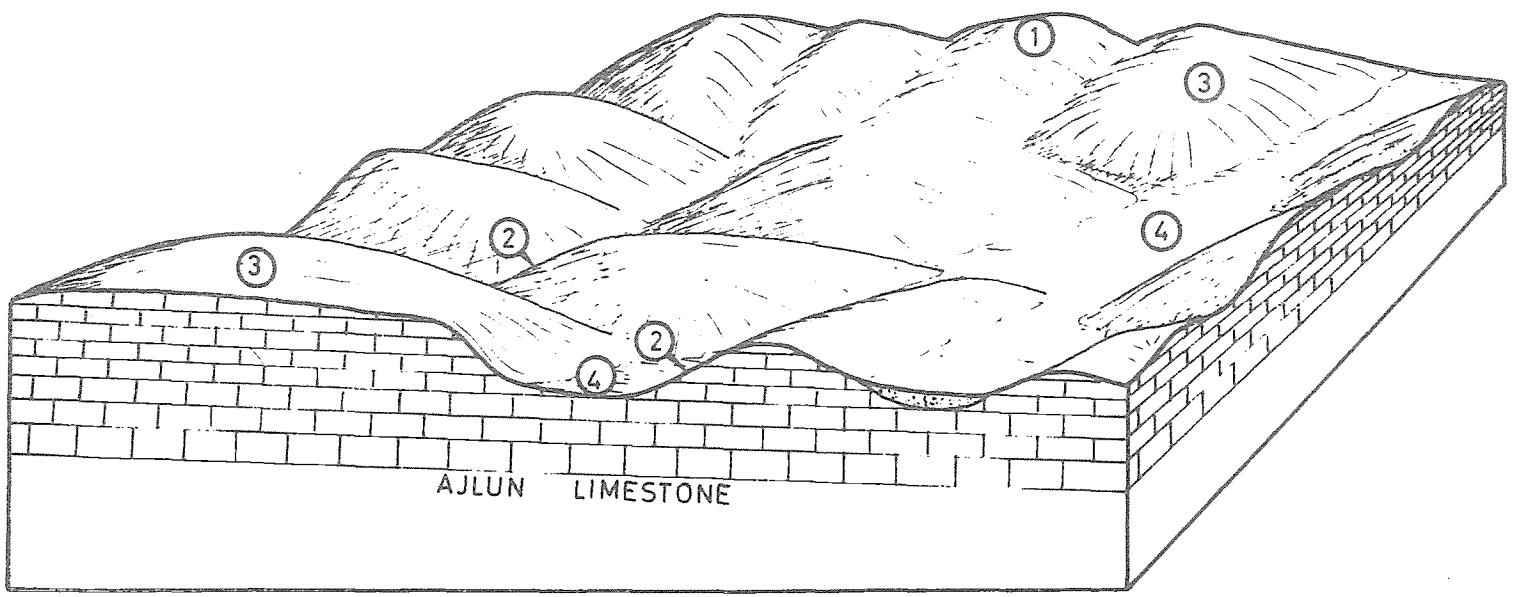
Geology: Ajlun limestone overlying Kurnub sandstone.

Land Facets:

No.	Form	Soils	Vegetation
1	Limestone plateau	Shallow loams	Some cultivation: grasses (1b)
2	Upper limestone scarp slopes	Bare and thin, subject to creep and gullying	Grasses (1b), some cereal cultivation
3	Lower sandstone scarp slopes	" " "	Almost bare
4	Seasonal wadis flushing after rain	Stony	Occasional patches of cultivation

Agriculture feasible on Land Facet 1. Counter-erosion measures necessary on Land Facet 2. Cultivation locally possible on Land Facet 4.

6·5 GULLIED STEPPE AREAS ON AJLUN LIMESTONE DRAINING TO EAST



6/5 GULLIED STEPPE AREAS ON AJLUN LIMESTONE DRAINING TO EAST

Climate: Steppe

Physiography: Very similar to 6/1, except that these areas lie about 200 km farther south in the zone draining towards El Jafr rather than to El Azraq. This is the upper part of the eroded dipslope falling towards El Jafr. It is a dissected semi-arid limestone area with a relief amplitude up to a maximum of 100-200 metres.

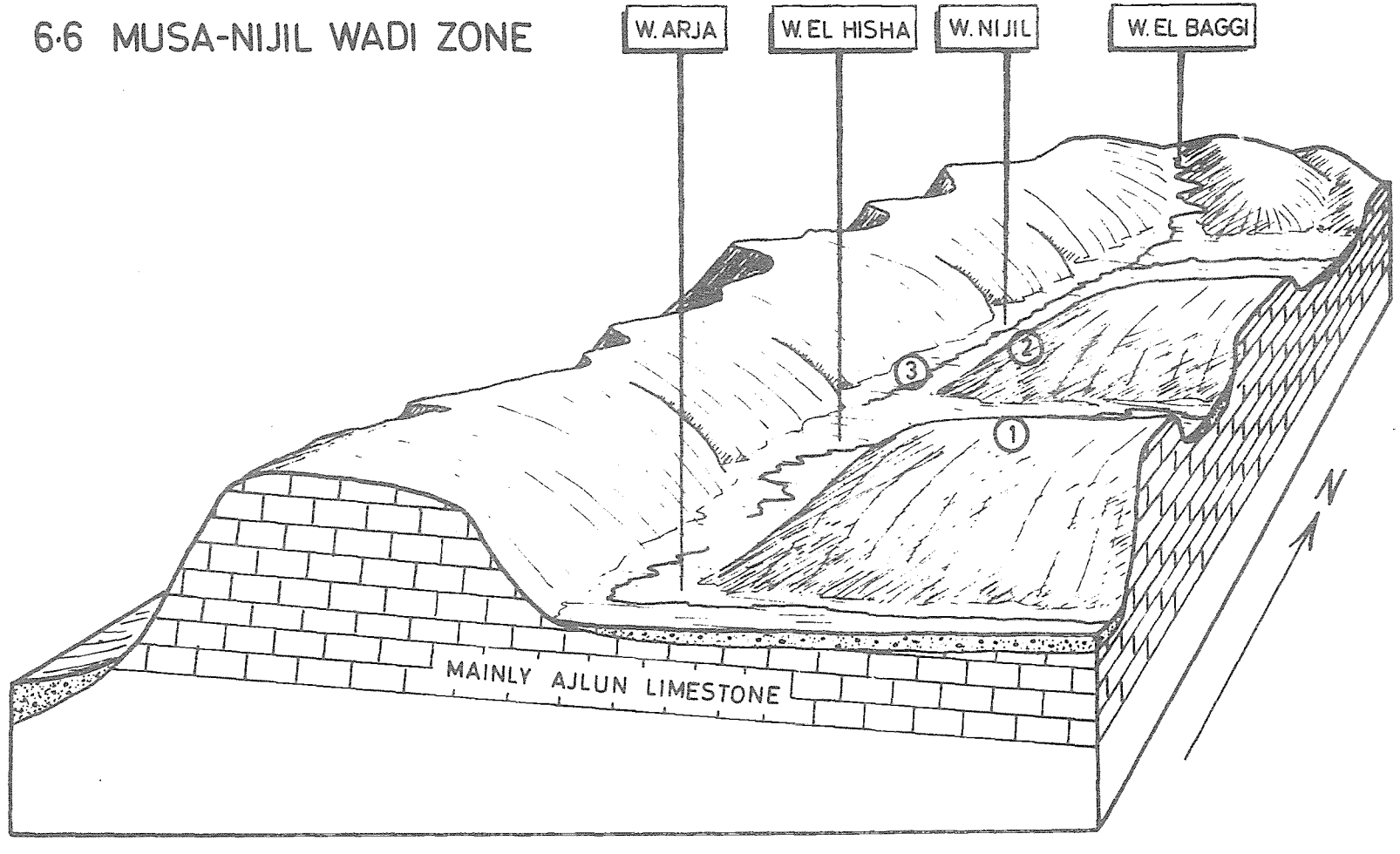
Geology: Ajlun limestone

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded crests	Lithosols	N.D.
2	Bare scarp slopes	Lithosols	N.D.
3	Dipslope	Thin, stony soils	N.D.
4	Wide valleys	Stony regosols	N.D.

Almost entirely grazing.

6·6 MUSA-NIJIL WADI ZONE



6/6 MUSA-NIJIL WADI ZONE

Climate: Mediterranean

Physiography: This unit was first defined by Willimott et al. (1964. pp. 19-20). This zone is distinct in that it consists of a series of wadis aligned north-south, unlike most wadis in this part of Jordan. It consists of the Wadi El Baggi in the north, the upper Wadi Nijil on the Fujeij, the Wadi El Hisha in its northward course and the head valleys of the Wadi Arja. This north-south zone has gentle slopes and unusually flat plateau tops giving rolling to hilly country free from rocky outcrops. The Wadi El Baggi, in particular, is broader and more open than those to the south, and its slopes on east and west rise only about 50 m above the wadi floor. As there are no tributary wadis, these slopes are extensive and free from steep sections. 13 km south of Nijil the road to Wadi Musa passes across more hilly country before entering the northern branch of the Wadi Musa. Here the wadi drops 325 m in 6 km, producing narrow wadi floors and steeper slopes, often terraced. The eastern boundary of this wadi is marked by the scarp of the Jebel Zubeira.

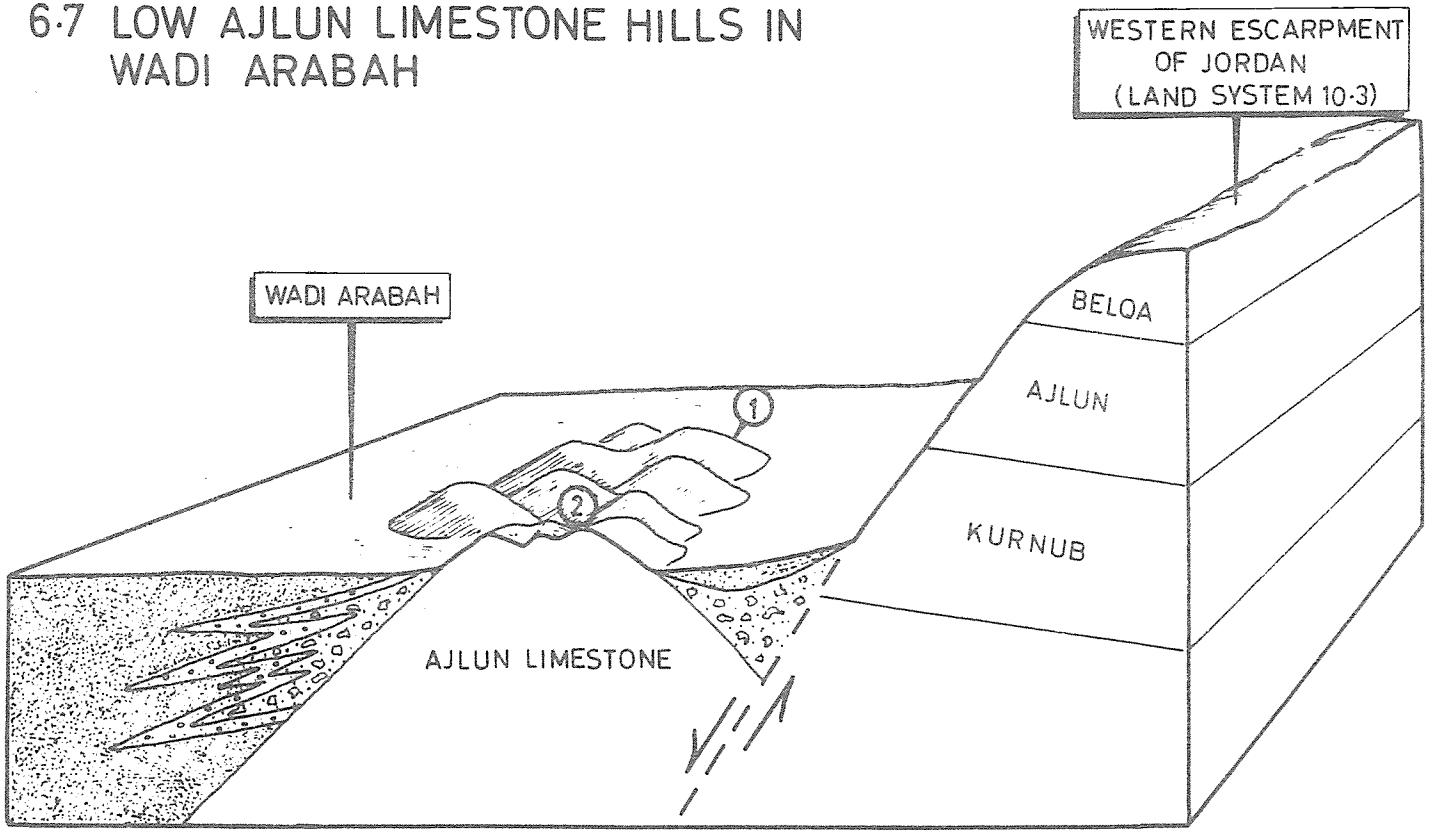
Geology: Mainly Ajlun limestone

Land Facets:

No.	Form	Soils	Vegetation
1	Plateau tops	Calcareous silty soils	Some cereal cultivation
2	Scarp slopes	Calcareous silty soils, locally bare rock	Oak scrub, some cultivation
3	Wadi floors	Stony, locally silty	Some cultivation

Soil conservation measures required on slopes. All land facets, except 3, have development potential, and this would be benefitted by afforestation.

6·7 LOW AJLUN LIMESTONE HILLS IN WADI ARABAH



6/7 LOW AJLUN LIMESTONE HILLS IN WADI ARABAH

Climate: Desert

Physiography: A low gullied outlier of Ajlun limestone standing up in the detrital plain of the Wadi Arabah.

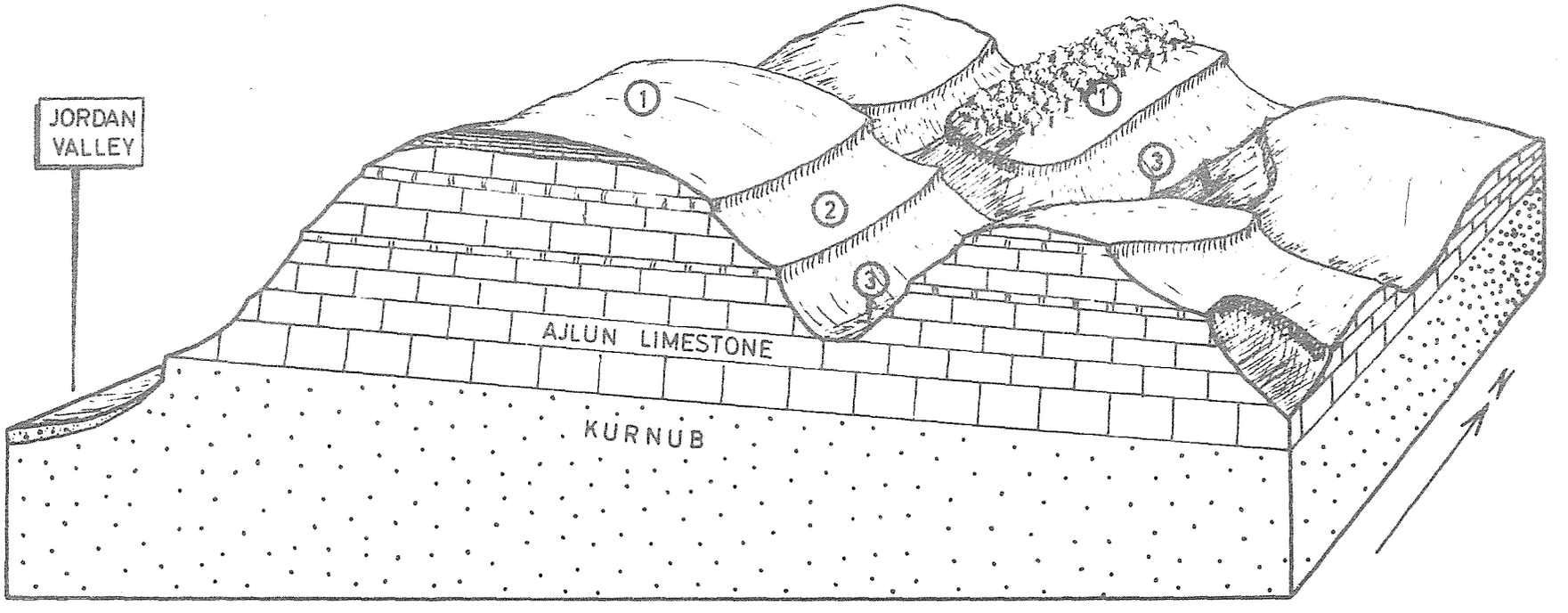
Geology: Undifferentiated Ajlun limestone

Land Facets:

No.	Form	Soils	Vegetation
1	Slopes	N.D.	N.D.
2	Wadis	N.D.	N.D.

No agricultural potential apparent.

6·8 HIGH UPLAND ON AJLUN LIMESTONE



6/8 HIGH UPLAND ON AJLUN LIMESTONE

Climate: Mediterranean

Physiography: This area is similar to 6/2 from which it has been separated because of its greater altitude, higher rainfall, and somewhat more spectacular dissection. It represents the area of highest altitude and rainfall in the country. It is essentially a deeply dissected tabular limestone plateau. Limestone forms rocky ridges and cliffs; shales, the softer slopes.

Geology: Ajlun limestone is more or less horizontally bedded and is equivalent to marine Cenomanian-Turonian limestone with some dolomite and embedded marls; rarely shale, sandstone or chalk. The thickness generally increases northwards. It consists of:

3. Senonian: chert beds
2. Turonian: bedded limestones separated by marls
1. Cenomanian: bedded limestone separated by marls.

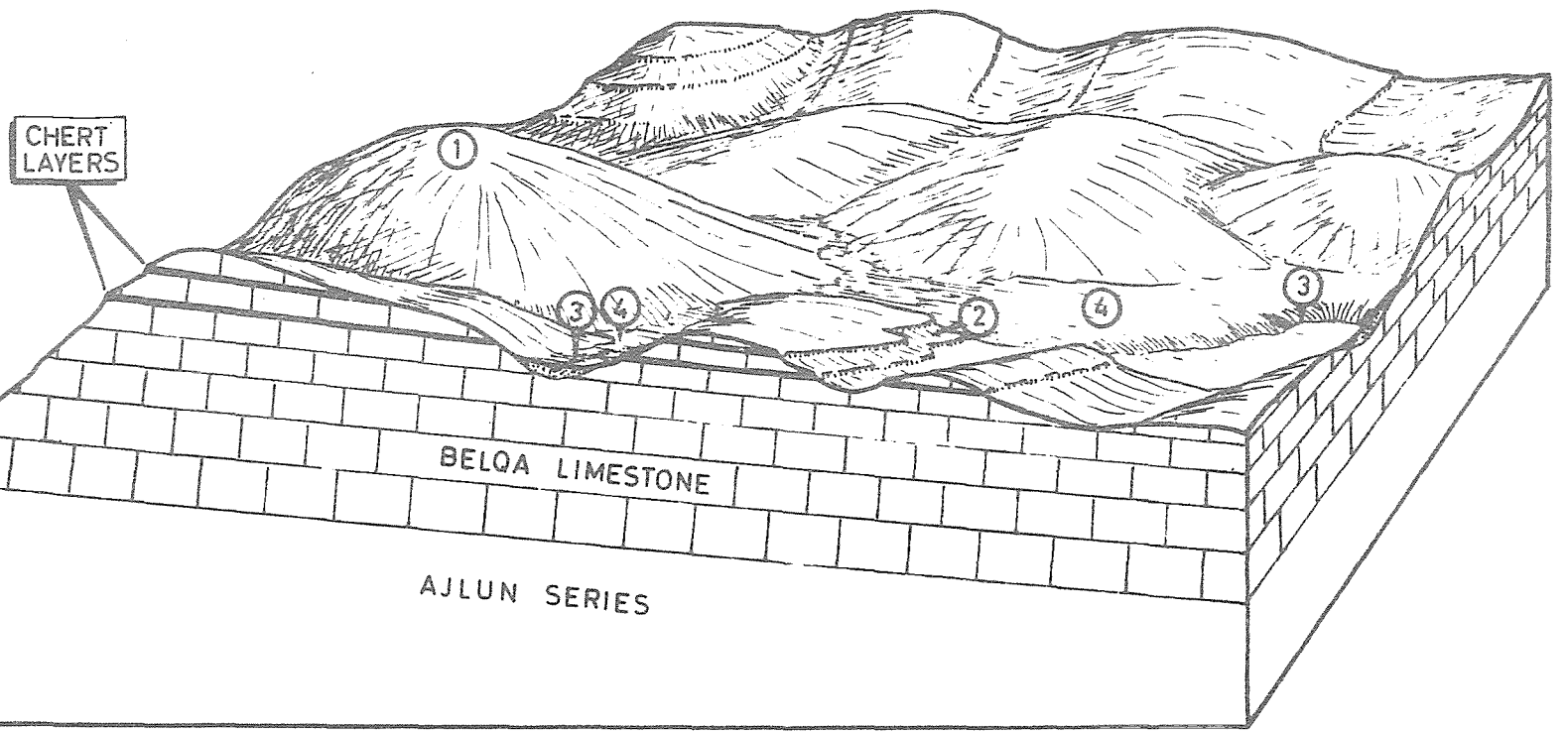
This is underlain by Kurnub sandstone.

Land Facets:

No.	Form	Soils	Vegetation
1	Tabular limestone summits	Thin Mediterranean brown earths	Oak woodland, some cultivation
2	Limestone scarp slopes	Shallow brown earths	" " "
3	Wadi floors	N.D.	Scrub, including oleander; some cultivation

All Land Facets suitable for development, though 2 requires protection from erosion.

7.1 EASTERN SLOPES OF PLATEAU ON BELQA LIMESTONE (AMMAN - WADI GHUDRAN FORMATION)



7/1 EASTERN SLOPES OF PLATEAU ON BELQA LIMESTONE (AMMAN-WADI GHUDRAN FORMATION)

Climate: Steppe

Physiography: The dissected upper part of the dipslope in the steppe zone, draining to the Wadi Sirhan.

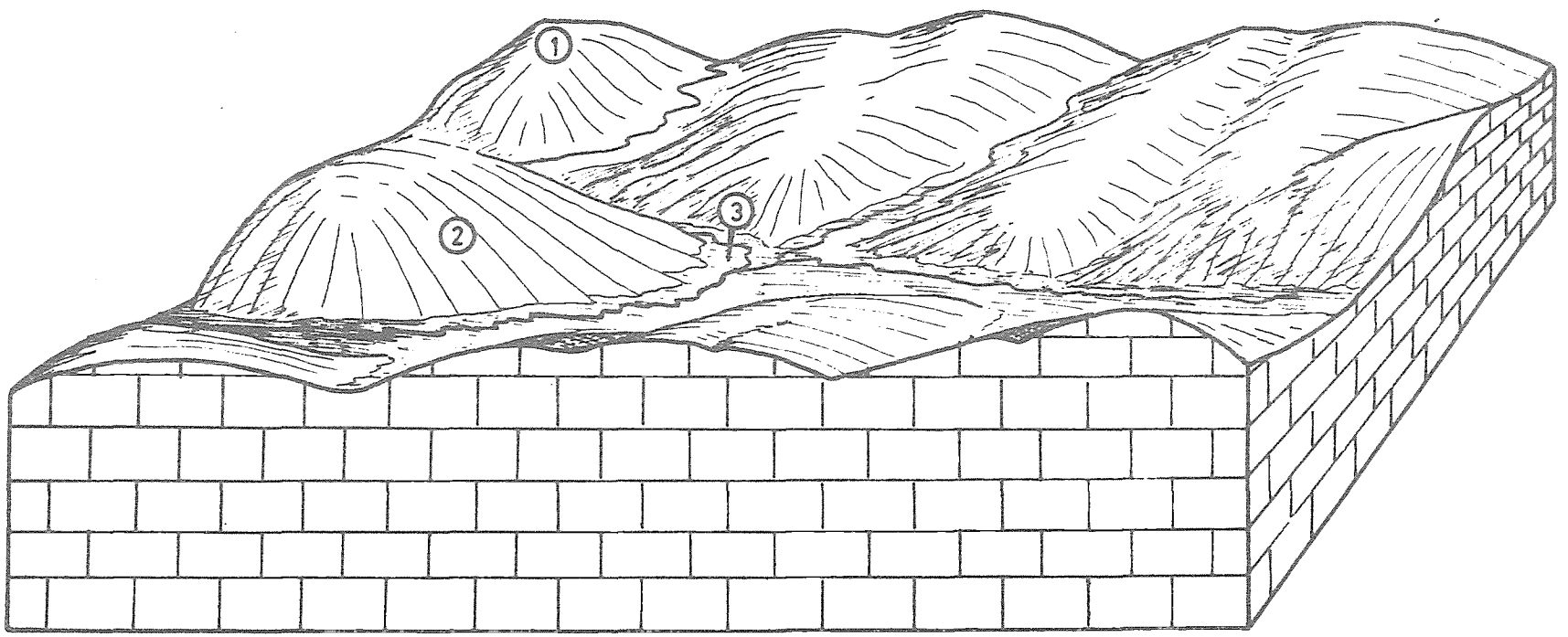
Geology: More or less horizontally lying Amman-Wadi Ghudran Formations (the lowest part) of the Belqa Group. They consist essentially of chalk and limestone beds with many bands of chert and some of marl and phosphate. The chert has the effect of giving greater resistance to erosion and 'armouring' the surface so that it retains a more accidented relief than where it is absent (e.g. in the Ajlun Series and the Muwaqqar Formation of the Belqa Series).

Land Facets:

No.	Form	Soils	Vegetation
1	Plateau tops	Thin loams	Grassland (1b)
2	Scarp slopes	Thin loams	Grassland (1b)
3	Wadi bottoms	Stony loams	N.D.
4	Alluvial valleys	Regosols	Grassland, locally cultivated (1a)

Greatest potential for development on Land Facet 4.

7·2 UNDULATING DISSECTED STEPPE ON BELQA LIMESTONE (UNDIFFERENTIATED) EAST OF IRBID PLAIN



7/2 UNDULATING DISSECTED STEPPE ON BELQA LIMESTONE (UNDIFFERENTIATED) EAST OF IRBID PLAIN

Climate: Steppe

Physiography: Low undulating stony limestone hills between Irbid plain to west and northern volcanic area east of Mafraq. Differs from 7/1 in drier climate and more subdued relief.

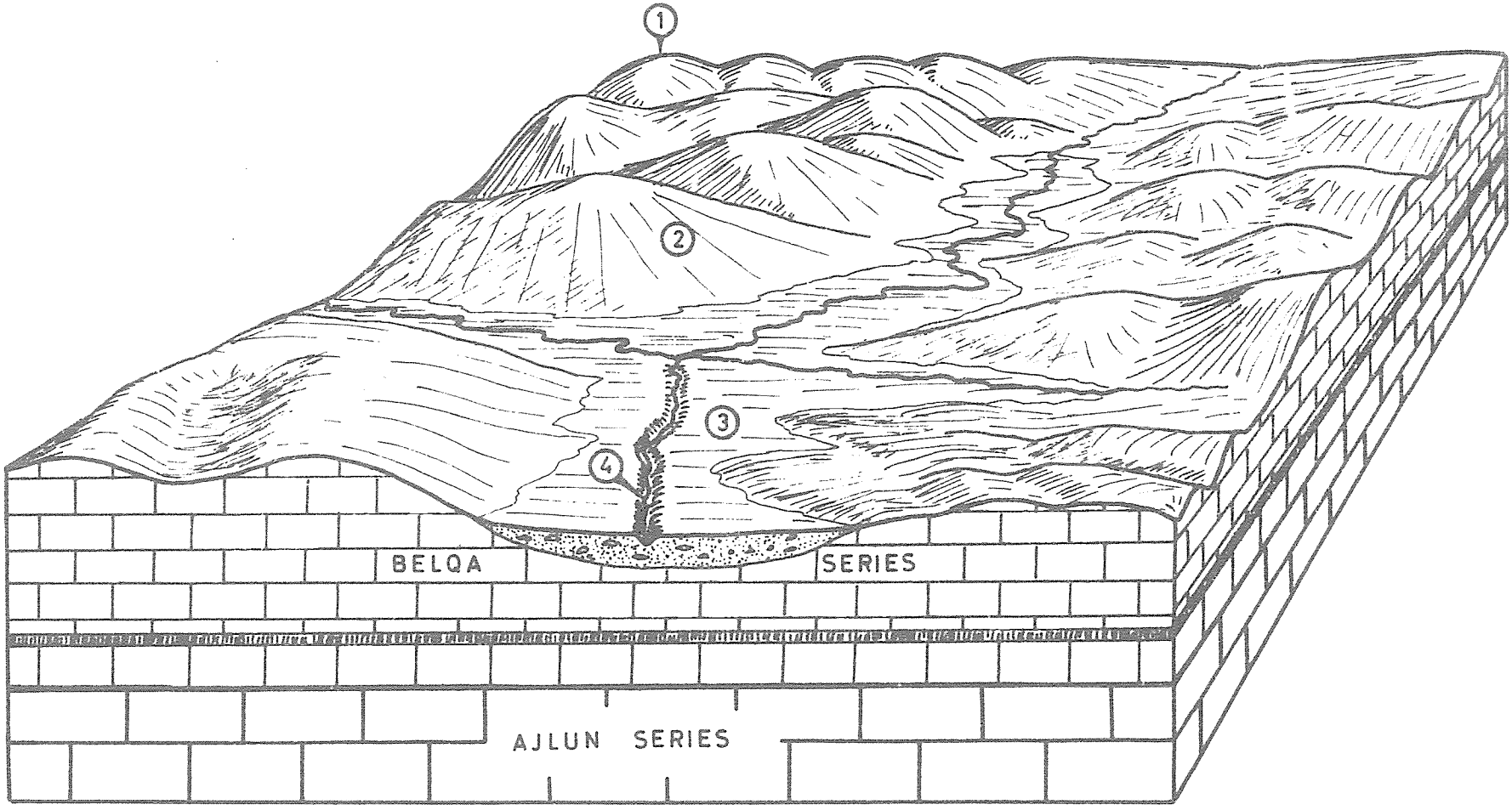
Geology: Belqa limestones, cherts, etc.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded bare tops	Light brown silts, free draining	Grassland (1b)
2	Slopes	" " "	" "
3	Wide valleys	Light brown silts, free draining and deep	Grassland (1b); locally some dry farming

Main potential is for grazing, except for agricultural development on Land Facet 3.

7.3 UNDULATING PLATEAU ON BELQA LIMESTONE (AMMAN - WADI GHUDRAN)



7/3 UNDULATING UNDISSECTED PLATEAU ON BELQA LIMESTONE (AMMAN-WADI GHUDRAN FORMATION)

Climate: Mediterranean

Physiography: Low undulating hills immediately south of the Irbid Plain. These are formed on the cherty limestones and chalk of the Amman-Wadi Ghudran Formation. It is the chert which makes this land stand up as hills in contrast to the lower country immediately to the north round Irbid which is formed on the less competent Muwaqqar chalk-marls.

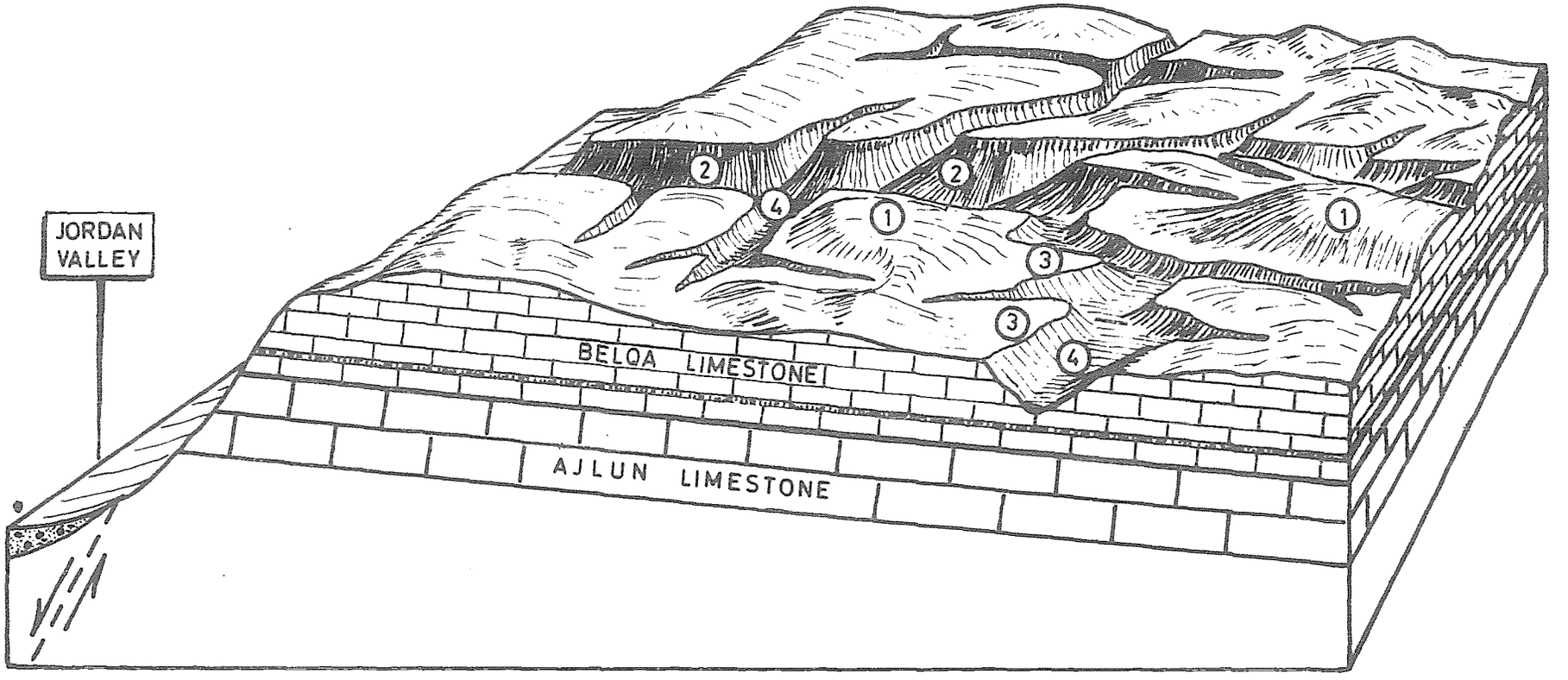
Geology: More or less horizontally bedded Amman-Wadi Ghudran Formation of the Belqa Series. These are mainly chalk and limestone but with interbedded marls, phosphates, and chert. The chert bands are highly significant in protecting the surface from weathering and in determining the hilly topography.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded hill tops	Calcareous loams	Grass (1b), some cultivation
2	Moderately gentle scarp slopes	" "	" " "
3	Wide alluvial depressions	Deep calcareous loams	" " "
4	Valleys, locally slightly incised	Stony	N.D.

Every land facet, but especially 3, has agricultural potential, but 2 requires care in protection from erosion.

7·4 DISSECTED PLATEAU ON BELQA LIMESTONE WITH MAJOR WADIS DRAINING TO JORDAN



7/4 DISSECTED PLATEAU ON BELQA LIMESTONE (UNDIFFERENTIATED BUT MAINLY AMMAN-WADI GHUDRAN FORMATION) WITH MAJOR WADIS DRAINING TO JORDAN

Climate: Mediterranean

Physiography: A limestone tableland with deeply cut valleys draining to the Jordan. Slopes are bare and stepped due to beds of differing competence. Chert bands are especially important in having high competence in protecting the landscape from erosion to base level. There are some terrace levels probably dating from episodes in the Quaternary valley formation.

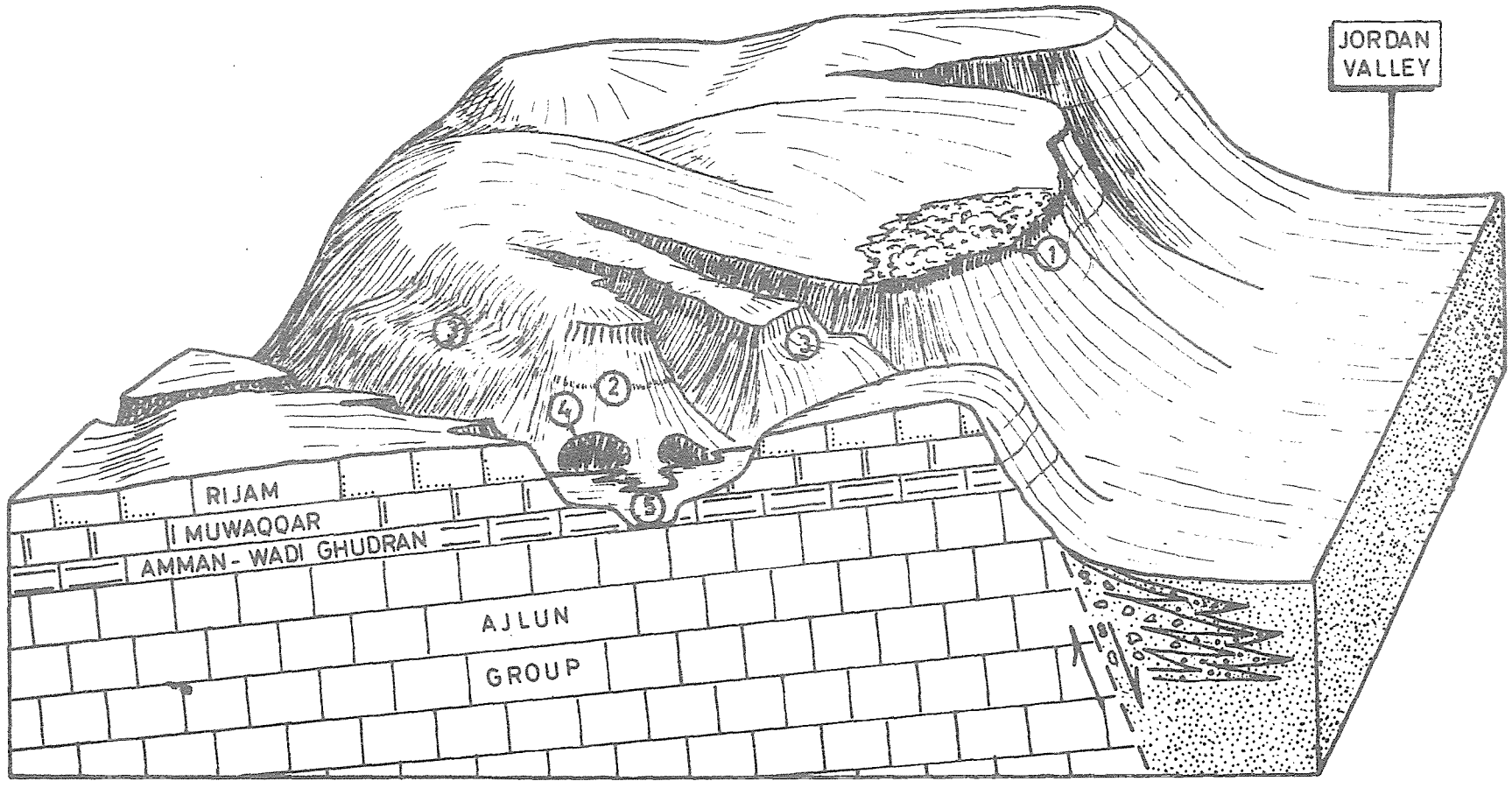
Geology: Belqa limestone, shales, dolomites and cherts, mainly from the Amman and Wadi Ghudran Formations, more or less horizontally bedded. The whole conformably overlies the less cherty Ajlun limestone.

Land Facets:

No.	Form	Soils	Vegetation
1	Plateau tops	Thin calcareous loams	Grass (1b) and cultivation
2	Limestone scarp slopes, stepped where more competent beds outcrop, cliffed at top	Thin	Scattered scrub (4d)
3	Valley terraces	Stony loams	Grass (1b) and local cultivation
4	Valley floors	Stony with areas of silt	Some areas of cultivation on silt

All require protection against erosion. Greatest land capability on Land Facets 1, 3, and 4.

7.5 YARMUK GORGES ON BELQA LIMESTONE



7/5 YARMUK GORGES ON BELQA LIMESTONE (UNDIFFERENTIATED BUT CAPPED BY RIJAM FORMATION)

Climate: Steppe

Physiography: A deep ravine draining out to El Ghor just south of Lake Tiberias. The scarp slope is remarkably straight for the whole height, cutting through almost the whole thickness of the Belqa Series.

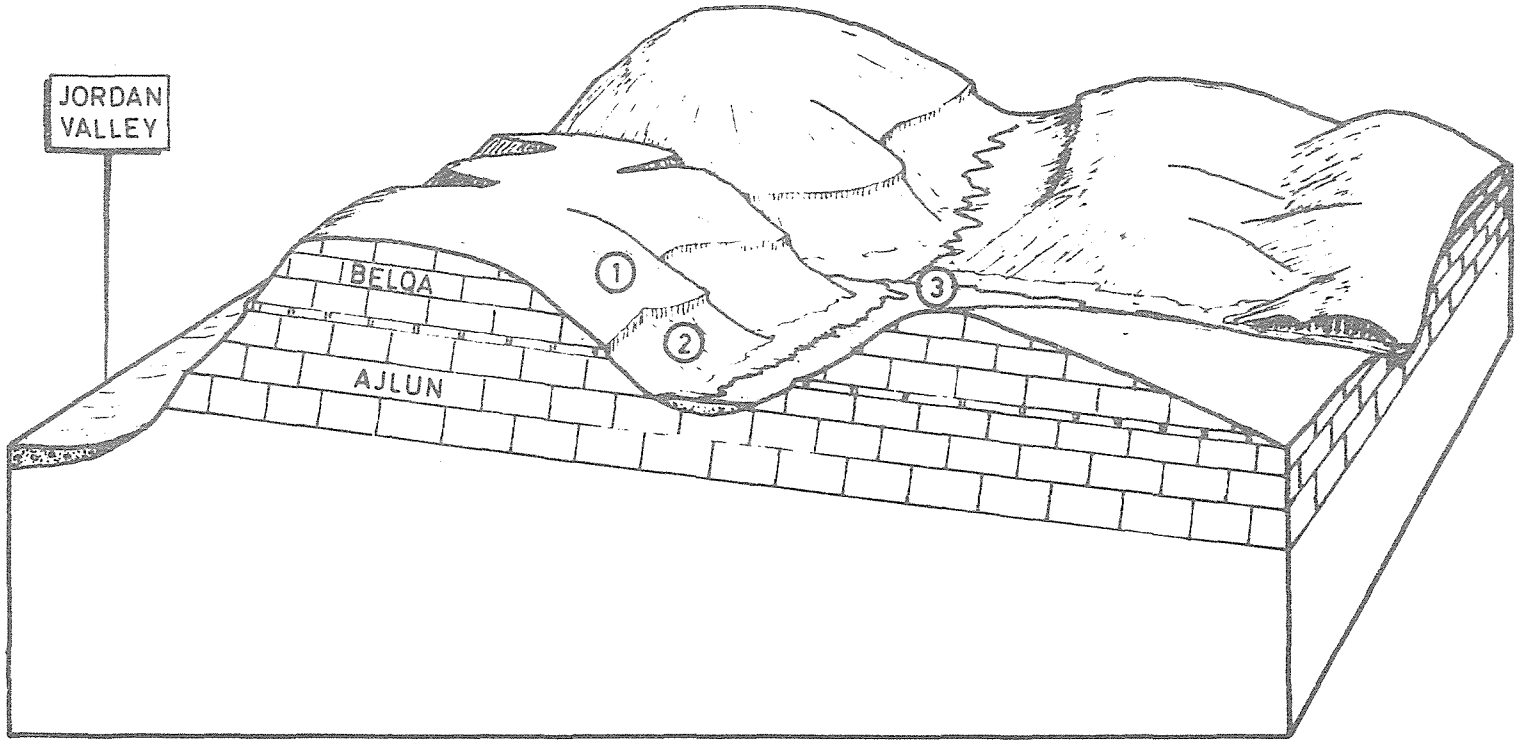
Geology: The Belqa here forms the main exposures in the valley. The top is the harder calcareous and cherty Rijam Formation, below this the Muwaqqar chalk-marls, and below this the cherty limestones of the Amman and Wadi Ghudran Formations. This is underlain by the Ajlun limestone. Near the western side it is locally capped by a Miocene-Recent volcanic flow.

Land Facets:

No.	Form	Soils	Vegetation
1	Steep slope on basalt	Bare and rocky	Scattered scrub (4d)
2	Scarp slope on Balqa limestones (stepped by harder beds)	Bare and rocky	" " "
3	Terraces	Stony calcareous loams	Grass (1b) and cultivation
4	Scars caused by river undercutting	Bare	Sparse scrub (4d)
5	Valley floors	Stony alluvium	Irrigated agriculture

Some agricultural use for rain-grown cereals on 3; irrigated agriculture beside the Syrian border on 5.

7·6 MAJOR GORGES ON BELQA LIMESTONE DRAINING TO JORDAN



7/6 MAJOR GORGES ON BELQA LIMESTONE (UNIDFFERENTIATED BUT MAINLY AMMAN-WADI GHUDRAN FORMATION) DRAINING TO JORDAN

Climate: Steppe

Physiography: Deep eroded gorges cut through the Belqa and into the Ajlun limestones forming high stepped escarpments. The steps are due to the outcrops of beds of greater competence, i.e. chert.

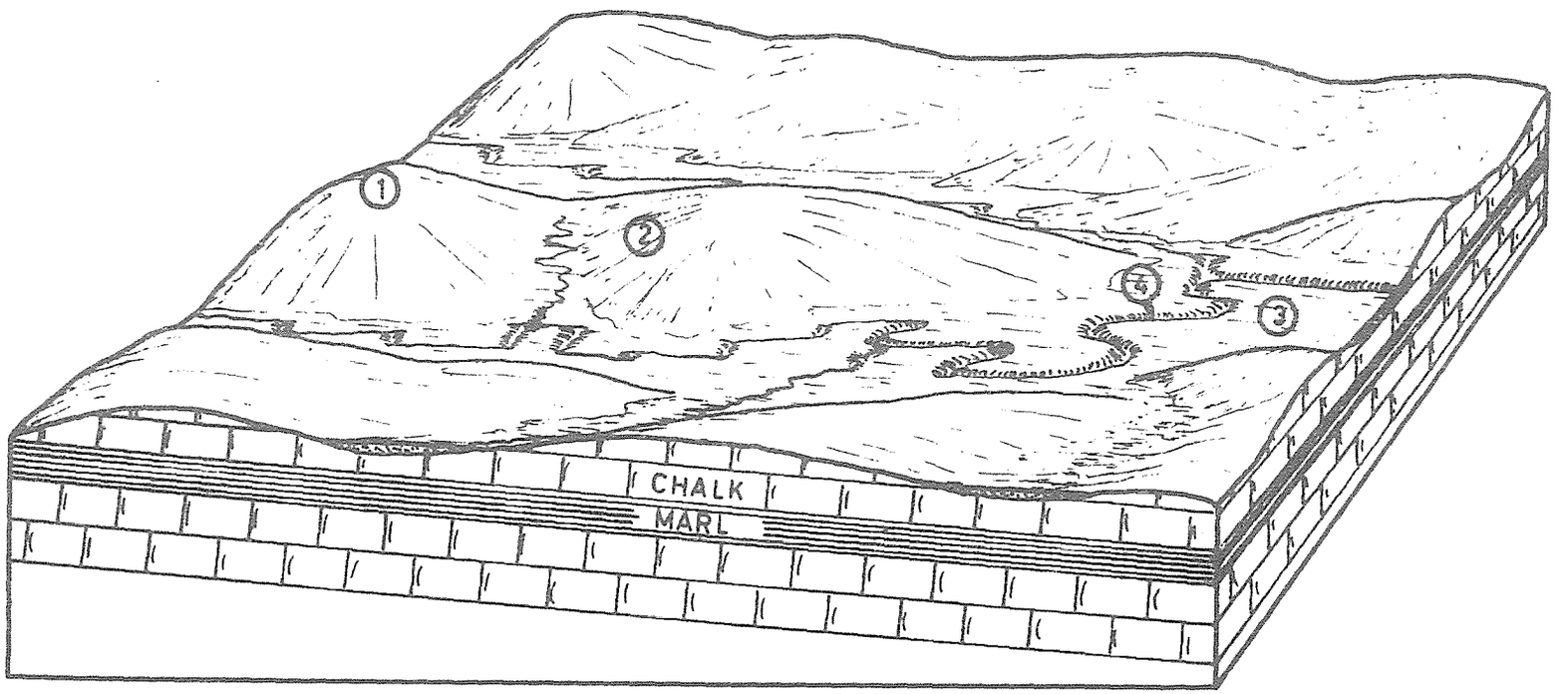
Geology: A more or less horizontally lying sequence of Amman-Wadi Ghudran cherty limestones and chalks, conformably overlying the less competent and purer Ajlun limestones.

Land Facets:

No.	Form	Soils	Vegetation
1	Erosion scarp slopes on Amman and Wadi Ghudran Formations	Almost bare, stony	Scattered scrub (4d)
2	Erosion slopes on Ajlun limestone	" " "	Scattered scrub (4d)
3	Valley bottoms	Stony alluvium	Some irrigation

Potential for grazing and afforestation on 1 and 2, irrigation on 3.

7·7 DISSECTED UPPER DIPSLOPE TO WADI SIRHAN ON BELQA LIMESTONE



7/7 DISSECTED DIPSLOPE TO WADI SIRHAN ON BELQA LIMESTONE (MUWAQQAR FORMATION)

Climate: Steppe

Physiography: Gently undulating country consisting of low rounded hills and wide alluvial floors. It can be seen on the Amman-Ma'an road in the area between Mahattat Daba'h and Mahattat as Suwaqah. It includes a large part of the western catchment of the playa called Qa'el Hafira and specifically much of the valley of the large Wadi Maghor.

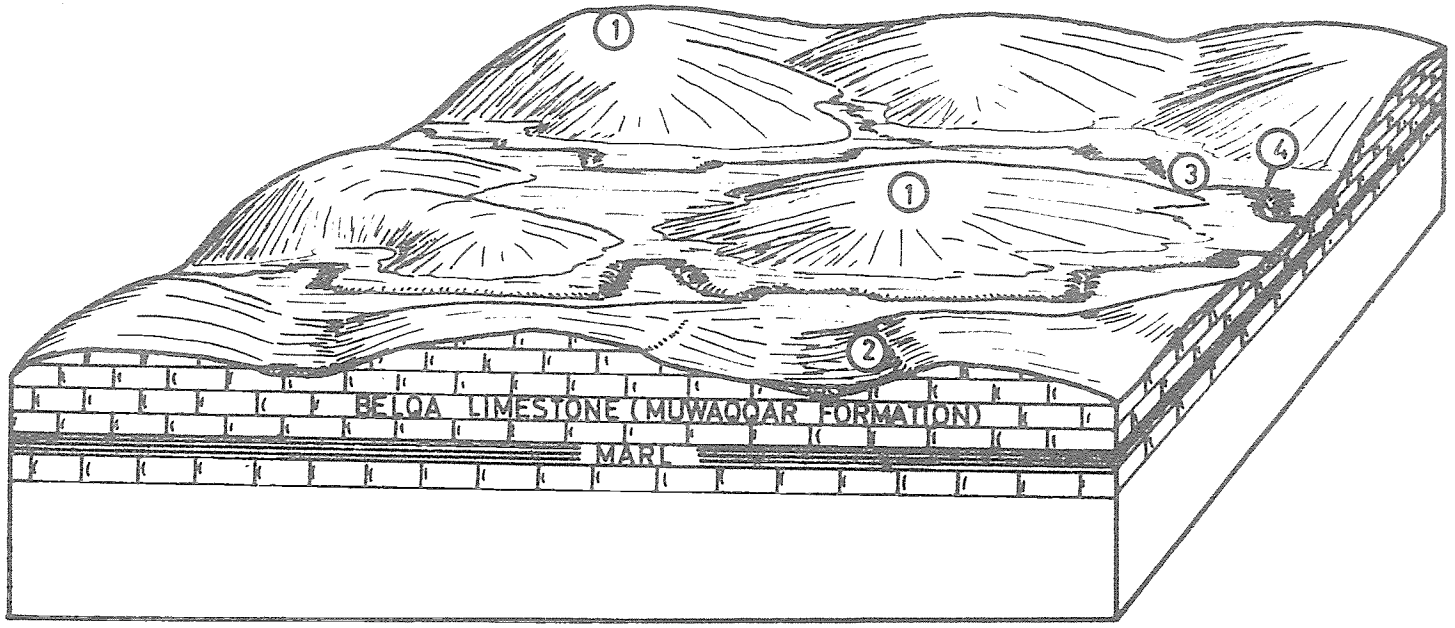
Geology: The subdued relief is due to the soft nature of the Muwaqqar chalk marls which have less chert and are softer than the other formations of the Belqa Series.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded hill summits	Chert hamada over soft calcareous material	Grazed scrub (4u)
2	Scarp slopes	Soft and calcareous underlying cherty surface	" " "
3	Valley floors	Deep calcareous and gypseous silt	Thick grazed scrub (4u)
4	Wadis	Calcareous and gypseous silt	Thick grazed scrub (4u)

Grazing only, but, given water, substantial areas of 3 appear suitable for irrigation development.

7·8 DISSECTED BELQA LIMESTONE AREA SURROUNDING QA' EL HAFIRA



7/8 DISSECTED BELQA LIMESTONE (MUWAQQAR FORMATION) AREA SURROUNDING QA'EL HAFIRA

Climate: Desert

Physiography: This land system is on the same material as 7/7 but it is more hilly and dissected, perhaps because of some local difference in the lithology of the Muwaqqar Formation. It is an area of low undulating gravelly hills with an arborescent drainage pattern mainly to the Qa' el Hafira.

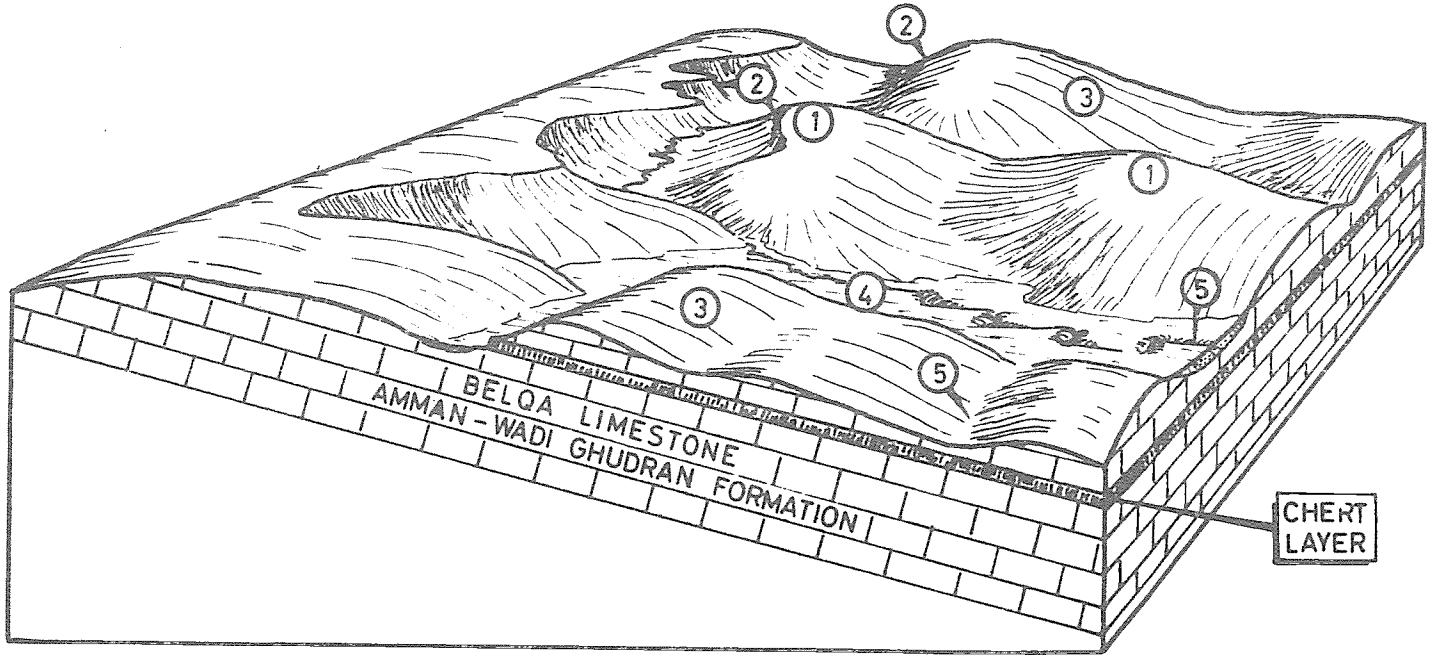
Geology: Muwaqqar chalk-marls of the Belqa Series more or less horizontally bedded.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded hill summits	Chert hamada over soft calcareous material	Grazed scrub (4u)
2	Scarp slopes	Soft and calcareous under cherty surface	" " "
3	Valley floors	Deep calcareous and gypseous silt	Thick grazed scrub (4u)
4	Wadis	Calcareous and gypseous silt	" " "

As for Land System 7/7, irrigation development would probably be possible on the analogous Land Facets 3 and 4 if water were available.

7.9 DISSECTED UPLAND ON BELQA LIMESTONE DRAINING TO EAST



7/9 DISSECTED UPLAND ON BELQA LIMESTONE (AMMAN-WADI GHUDRAN FORMATION) DRAINING TO EAST

Climate: Steppe

Physiography: Dissected Amman-Wadi Ghudran limestone country lying in the steppe zone immediately east of the main plateau between Amman in the north and the Fujeij in the south.

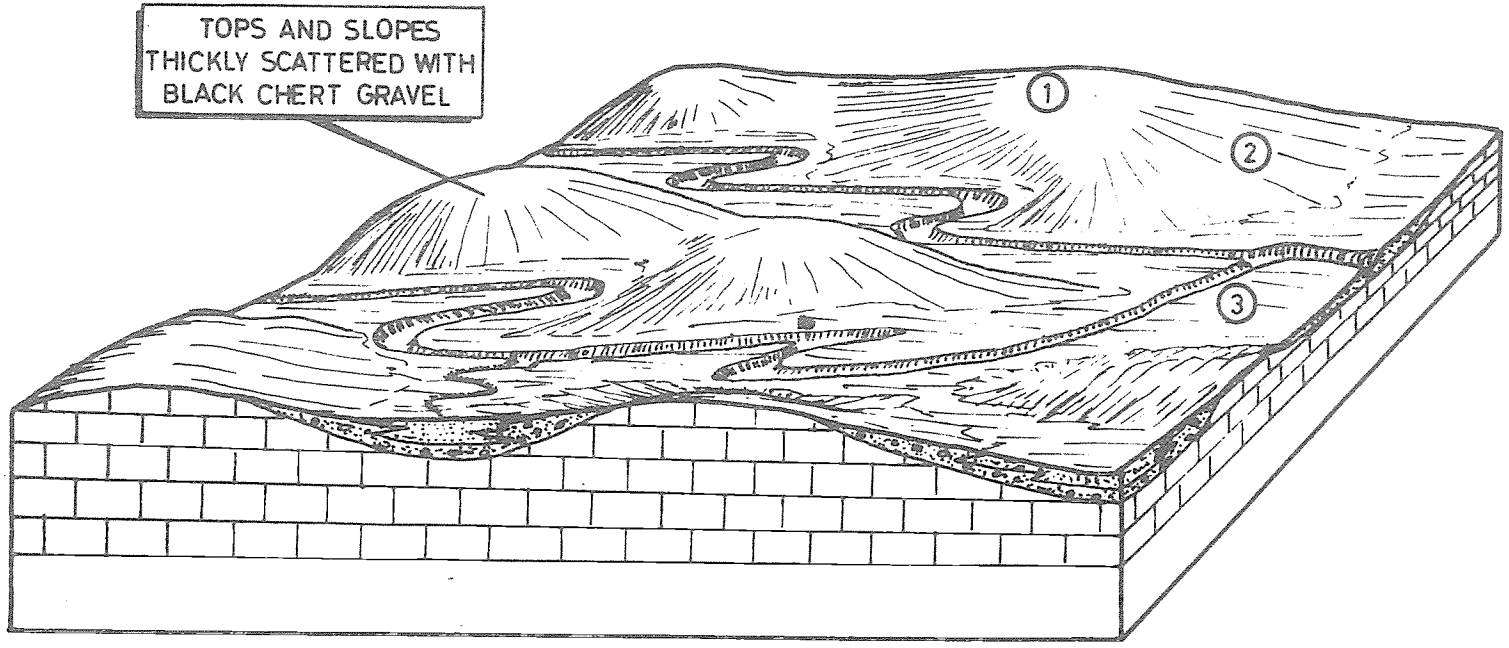
Geology: More or less horizontally bedded limestone, chalk, chert, marl, and phosphate of the Amman and Wadi Ghudran Formations of the Belqa Series.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded hill summits	Thin, cherty	Scattered scrub (4d & 8d)
2	Scarp slopes	Thin, cherty	Scattered scrub (4d & 8d)
3	Dip slopes	Thin, cherty	Scattered scrub (4d & 8d)
4	Alluvial valleys	Brown loam	N.D.
5	Wadis	N.D.	N.D.

Some cultivation on Land Facets 3 and 4, otherwise mainly grazing.

7·10 COLLUVIUM AND SURFACE WASH FANS TO EL AZRAQ AND EL JAFR



7/10 SURFACE WASH FANS TO EL AZRAQ AND EL JAFR DEPRESSIONS ON UNDIFFERENTIATED BELQA LIMESTONE

Climate: Desert

Physiography: Reworked Belqa materials forming wide, gently sloping but undulating bajadas round the El Azraq and Jafr depressions. In appearance the undulations are black due to the surface pavement of chert blackened with a desert patina. These are cut by meandering silty wadi spreads which show up a contrasting white colour on the satellite imagery. Relief decreases toward the depression centres.

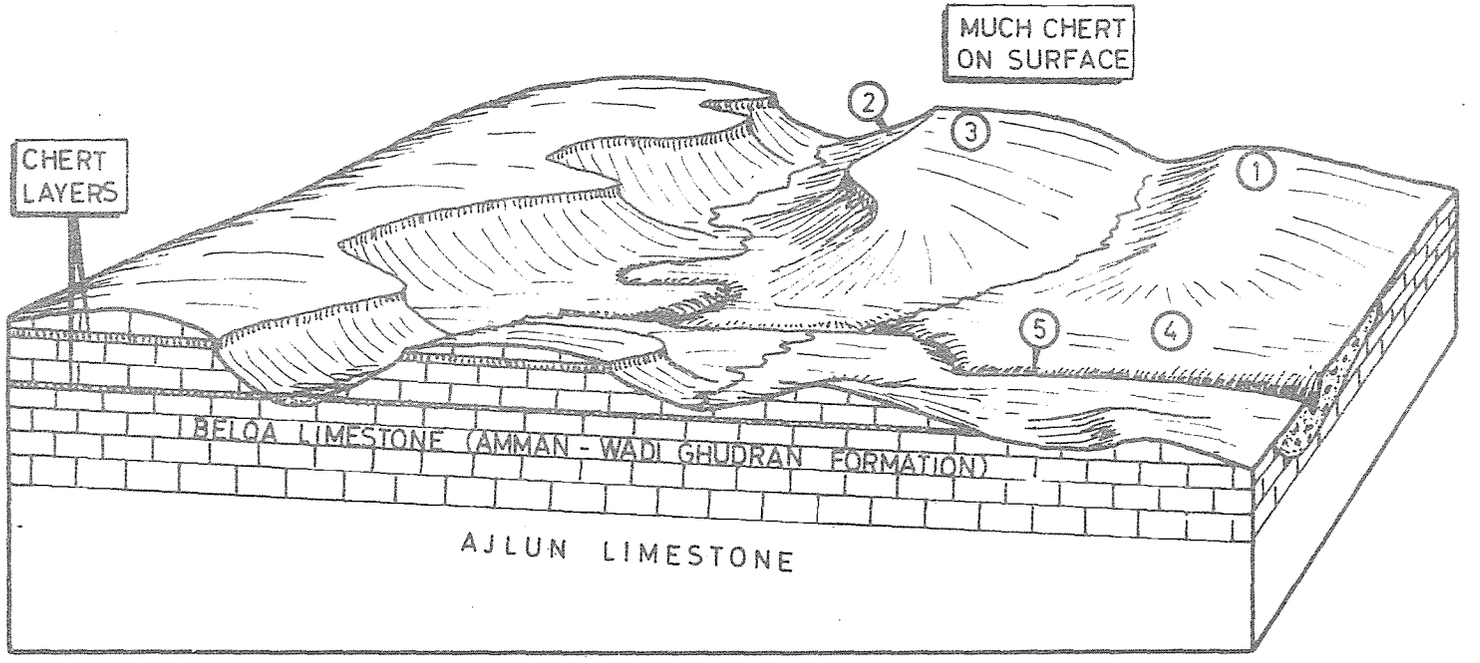
Geology: Surface material derived in situ or from Belqa deposits immediately upslope.

Land Facets:

No.	Form	Soils	Vegetation
1	Undulating plateau	Chert hamada	V. sparse xerophytic scrub
2	Gentle slopes	" "	" " "
3	Wide wadi beds	Silty soil with wind blown hummocks round vegetation	Scrub of salt bushes

Little potential except nomadic grazing.

7.11 DIPSLOPE TO EL JAFR ON BELQA LIMESTONE



7/11 DIPSLOPE TO EL JAFR ON BELQA LIMESTONE (AMMAN-WADI GHUDRAN FORMATION)

Climate: Steppe

Physiography: Dipslope on Amman-Wadi Ghudran Formation on east side of main plateau between Fujeij in the north and the latitude of Ma'an in the south. It lies in the steppe zone and is at the head of the catchment area flowing eastwards to El Jafr Depression. It is very similar to 7/9 of which it is an analogous southern extension. It differs in being narrower and somewhat more dissected.

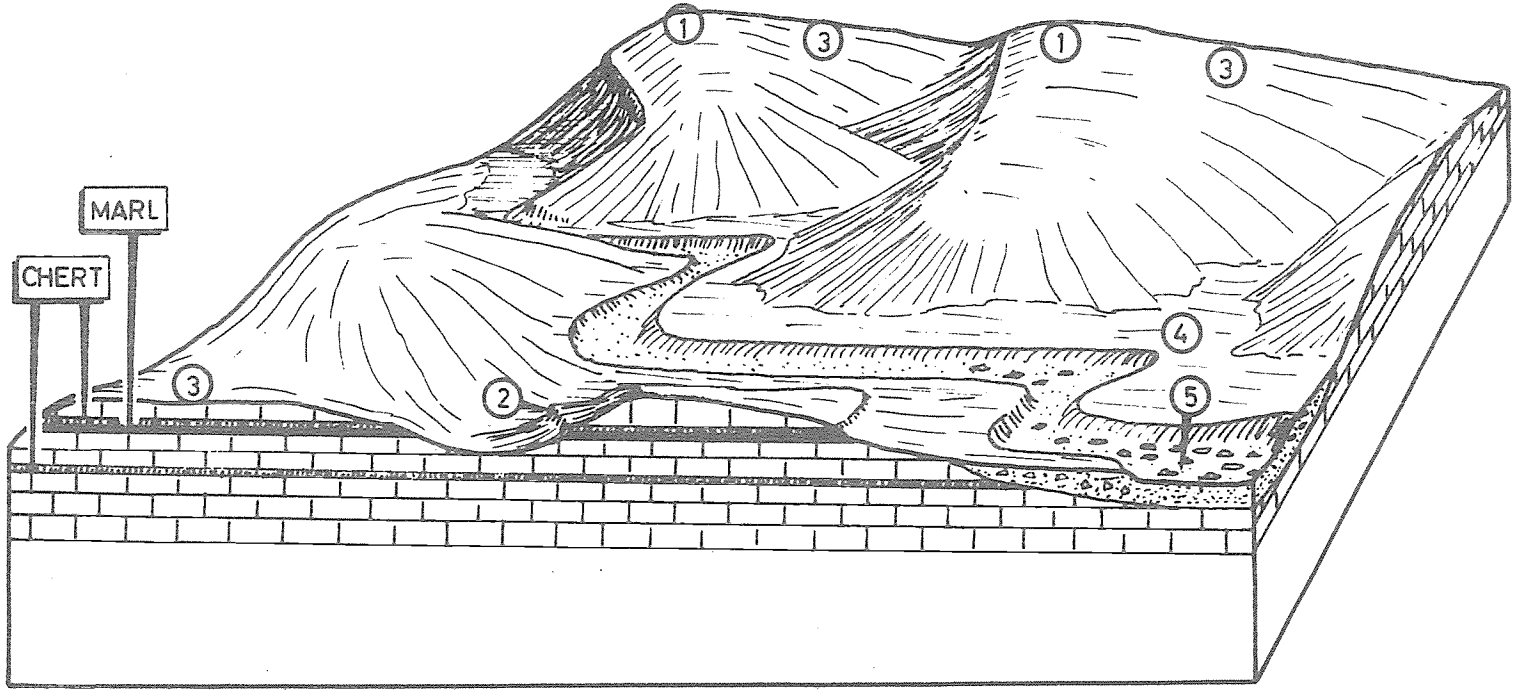
Geology: More or less horizontally bedded limestone, chalk, chert, marl, and phosphate of the Amman and Wadi Ghudran Formations of the Belqa Series.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded hill summits	Thin, cherty	Scattered scrub (4d and 8d)
2	Scarp slopes	" "	" " "
3	Dipslopes	" "	" " "
4	Alluvial valleys	Brown loams	N.D.
5	Wadis	N.D.	N.D.

No evidence of land use.

7·12 DIPSLOPE TO EL JAFR ON BELQA LIMESTONE



7/12 DIPSLOPE TO EL JAFR ON BELQA LIMESTONE (AMMAN-WADI GHUDRAN FORMATION)

Climate: Desert

Physiography: Similar to 7/11 but lying to the east of it in a desert climate and at lower altitude. There is, therefore, less run-off and dissection. Hills are lower and wadis wider. It generally presents the appearance of low, undulating, dissected hills covered with a mantle of blackened chert. Wadis are lighter in colour and filled with silt.

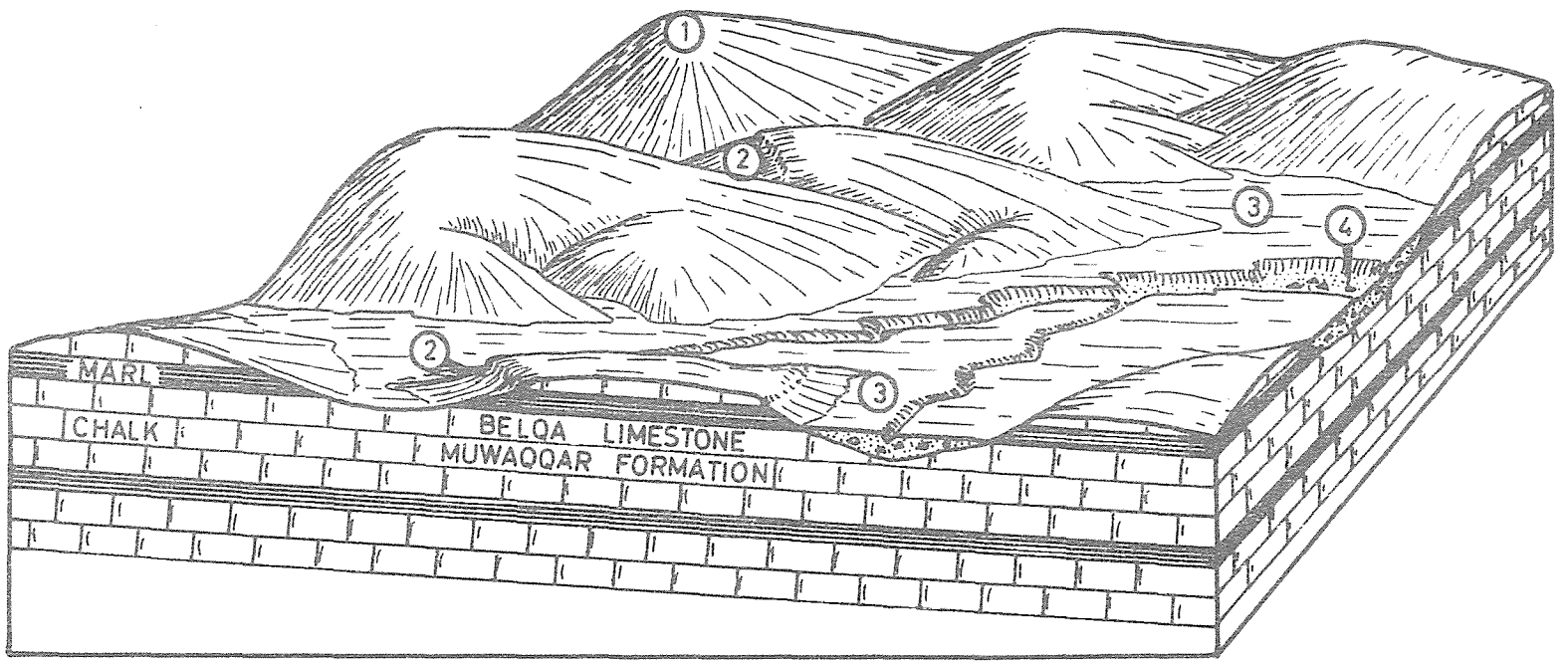
Geology: More or less horizontally bedded limestone, chalk, chert, marl, and phosphate of the Amman and Wadi Ghudran Formations of the Belqa Series.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded hill summits	Thin, cherty hamada	Desert scrub (4u)
2	Scarp slopes	" " "	" " "
3	Dip slopes	" " "	" " "
4	Alluvial valleys	Silts	Xerophytic scrub
5	Incised wadis	N.D.	N.D.

No evidence of land use.

7.13 DISSECTED DIPSLOPE TO EL JAFR ON BELQA LIMESTONE



7/13 DISSECTED DIPSLOPE TO EL JAFR ON BELQA LIMESTONE (MUWAQQAR FORMATION)

Climate: Desert

Physiography: Closely analogous to Land System 7/7 except that this drains to El Jafr Depression, is further south and has a somewhat more pronounced relief. This is because the rate of fall from the plateau to El Jafr is somewhat greater (c. 1000 m in 100 km) than that from the plateau to the Sirhan Depression (c. 500 m in 100 km). This Land System lies immediately to the east of 7/12 and has a more subdued relief both because it is at a lower altitude and because it lies on less competent rocks. In general it consists of low undulating hills with a mantle of dark coloured chert.

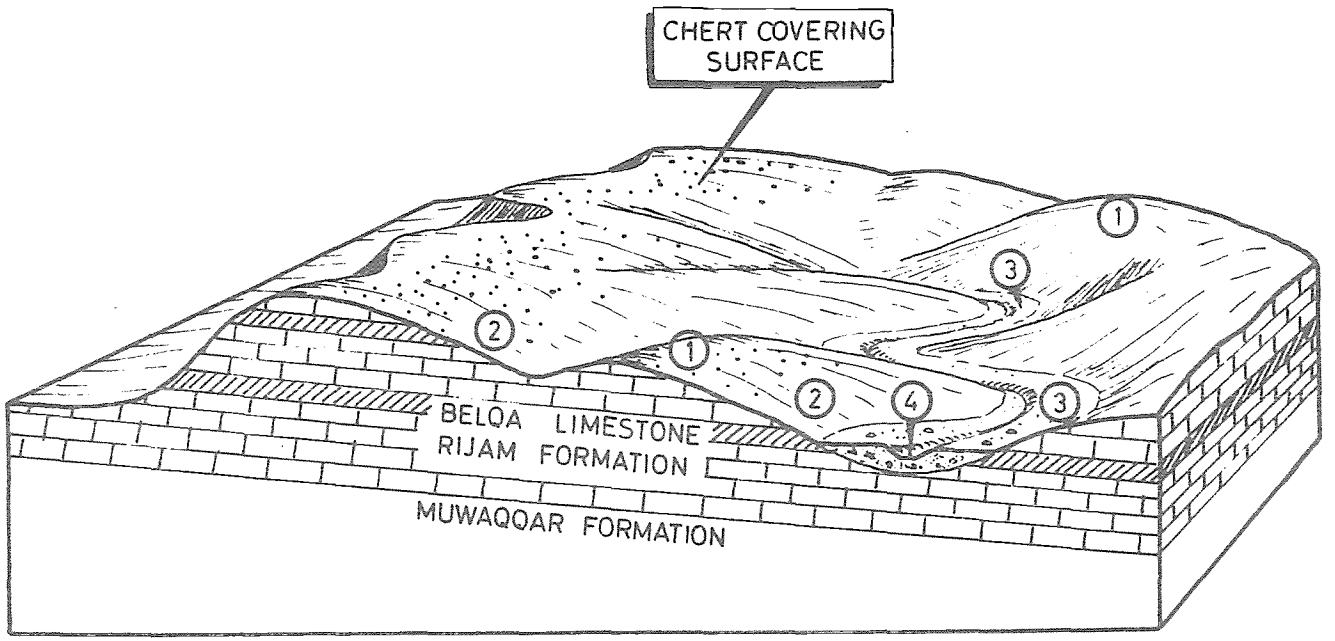
Geology: More or less horizontally lying chalk-marls of the Muwaqqar Formation, Belqa Series.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded hill summits	Chert hamada over soft calcareous material	Thin scrub (8a)
2	Scarp slopes	" " " "	" " "
3	Valley floors	Calcareous and gypseous silt with some chert	N.D.
4	Wadis	" " " "	N.D.

Desert grazing potential only, except that Land Facet 4 might be irrigable if water was available.

7·14 DISSECTED DIPSLOPE TO SIRHAN, EL AZRAQ AND EL JAFR DEPRESSIONS ON BELQA LIMESTONE



7/14 DISSECTED DIPSLOPE TO SIRHAN, EL AZRAQ AND EL JAFR DEPRESSIONS ON BELQA LIMESTONE (RIJAM FORMATION)

Climate: Desert

Physiography: The Rijam limestone has a very distinctive appearance giving rise to undulating hills up to perhaps 200 m in height covered with an abundant mantle of blackened chert. It seems to retain this essential character from the Mafraq - El Azraq road in the north to Jebel Rijam in the south and beyond. It is clearly distinct from the lower lying country formed on the underlying Muwaqqar chalk-marls to the west and from the higher land of the overlying Wadi Shallala Formation to the east.

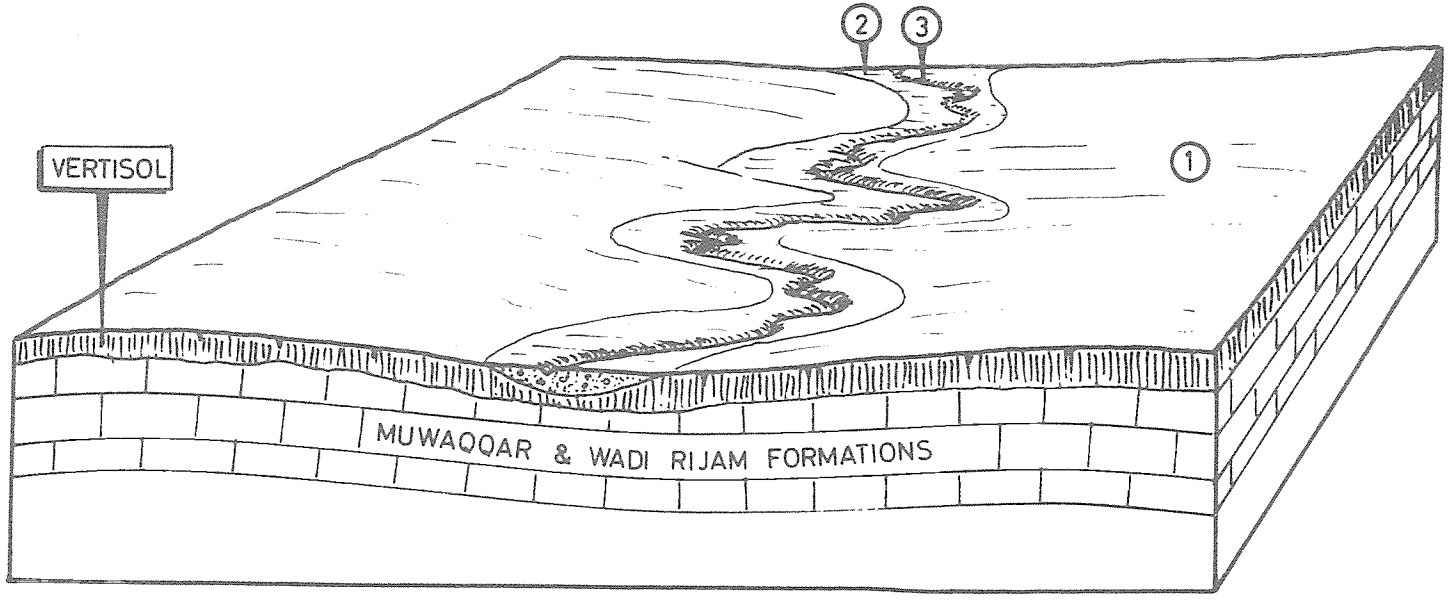
Geology: The Rijam Formation consists of about 60 m of approximately horizontally lying chalky and marly limestones and chert, with the chert forming the protective shield which ensures the survival of the topographic highs.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded hill tops	Chert hamada over limestone	Shrubby chenopods (8e)
2	Slopes	,, ,, ,,	,, ,, ,, ,,
3	Flat floored valleys	Silty	Chenopods on hummocks
4	Gullies	N.D.	N.D.

Little potential beyond desert range.

7.15 IRBID PLAIN



7/15 IRBID PLAIN (BELQA LIMESTONE: MUWAQQAR AND RIJAM FORMATIONS)

Climate: Mediterranean

Physiography: Largely a flat and level plain, becoming somewhat more hilly where overlying the Rijam Formation in the north.

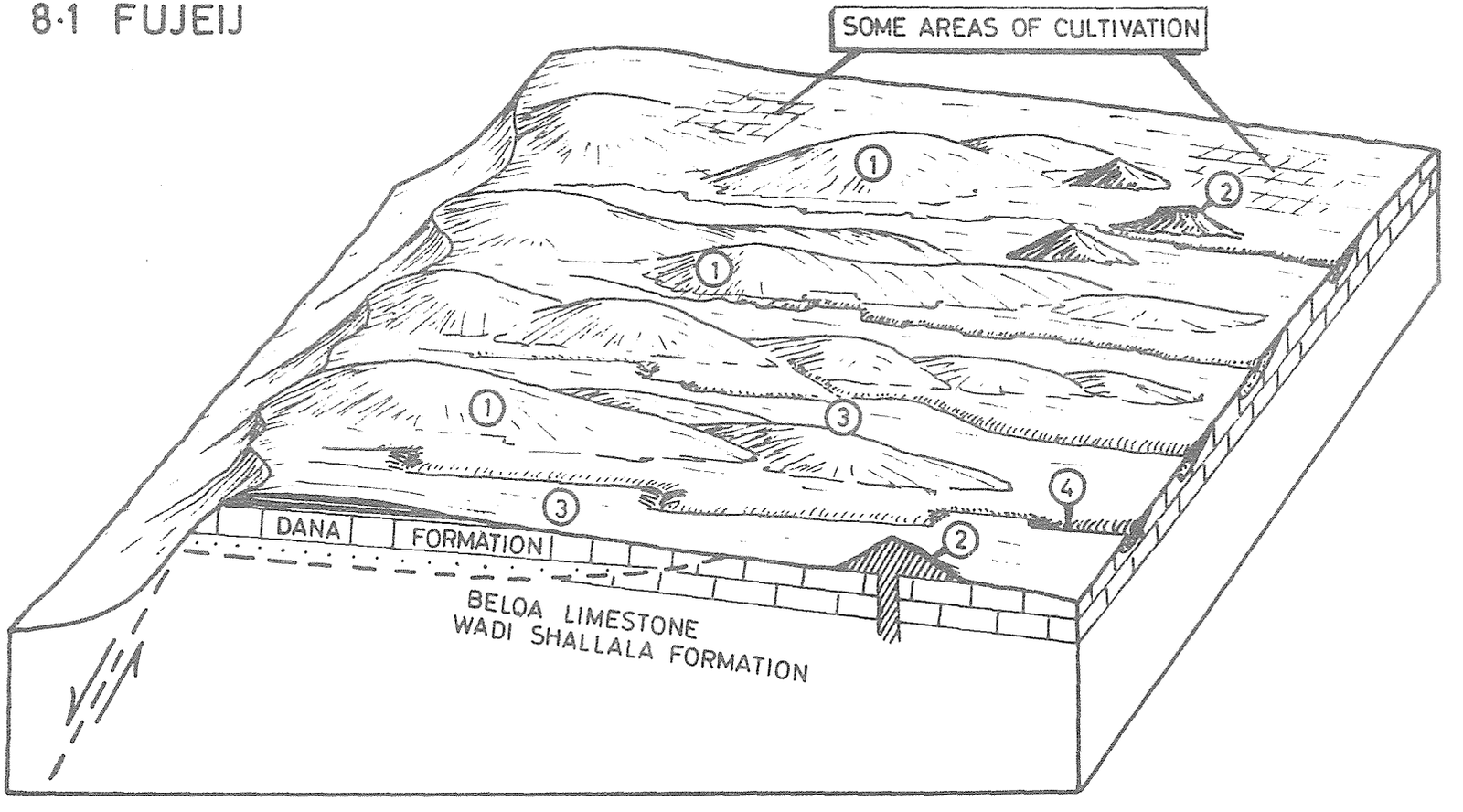
Geology: Developed on the chalk-marls of the Muwaqqar and Rijam Formations: giving rise to a deep rich Vertisol in places.

Land Facets:

No.	Form	Soils	Vegetation
1	Gently undulating plain	Vertisols	Cultivation and grasses (1b)
2	Alluvial vales	"	" " "
3	Shallow wadis	"	" " "

Probably the best continuous area of agricultural land in the country - round Irbid town.

8·1 FUJEIJ


SOME AREAS OF CULTIVATION
1
2
1
1
3
4
3
2
DANA
FORMATION
BELQA LIMESTONE
WADI SHALLALA FORMATION

8/1 FUJEIJ PLAIN OF TERTIARY LIMESTONE AND CHALK (WADI SHALLALA FORMATION OF BELQA SERIES AND DANA FORMATION)

Climate: Steppe

Physiography: Gently undulating surface, locally with flatter areas strewn with gravel, sand and boulders. It slopes gently from west to east, falling from about 1250 m at the western scarp edge (roughly followed by the Nijil-Tafila Road) to about 1100 m where it merges into the desert. The surface is cut by a number of east-west ridges separated by shallow wadis, and a few conical hills rising to about 100 m above the general surface are present in the central area. The largest of these, the Jebel el Dajaniyah (1242 m) is a volcanic vent.

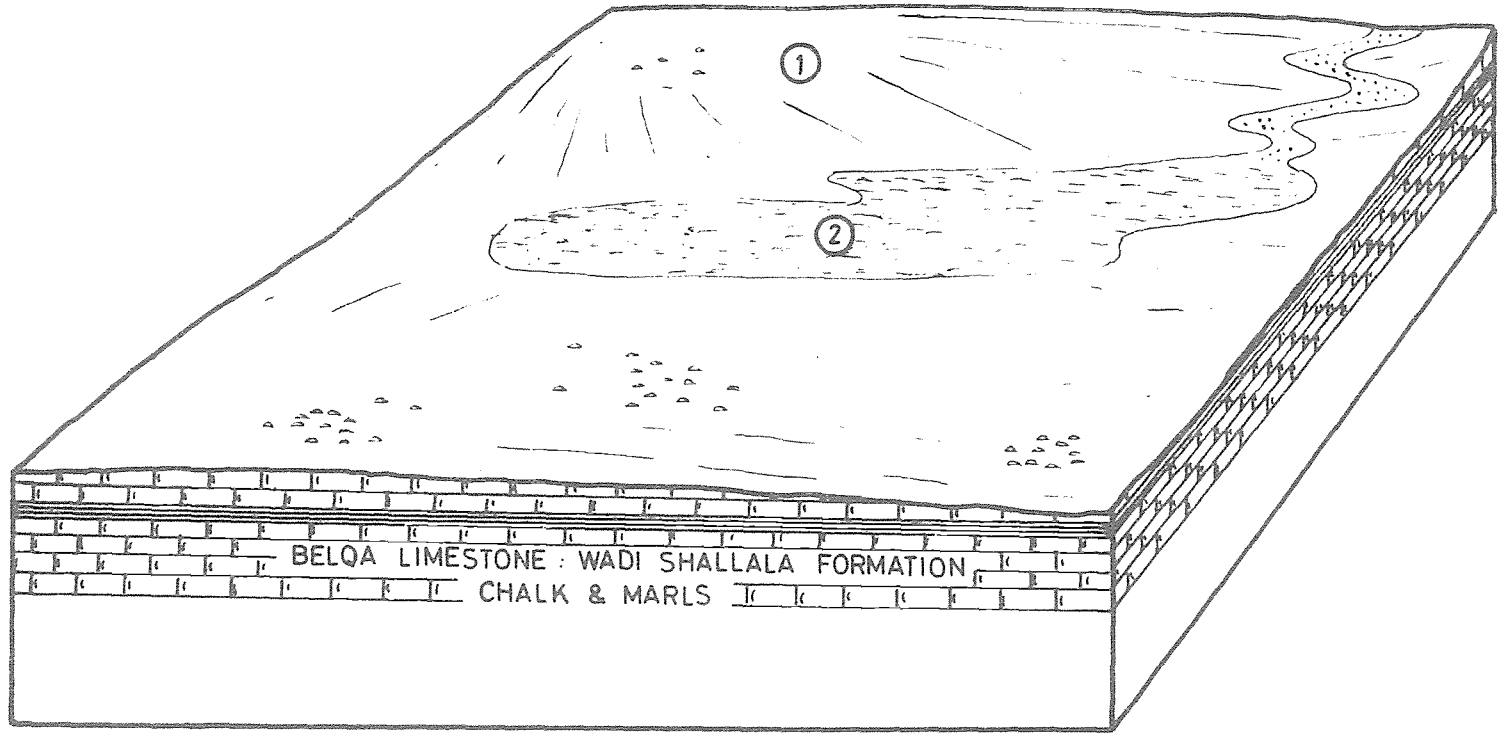
Geology: Marly and chalky limestone and chert of the Wadi Shallala Formation, and the sandstones, marls, limestones, and conglomerates of the unconformably overlying Dana Formation.

Land Facets:

No.	Form	Soils	Vegetation
1	Gentle slopes of E-W ridges including some rock outcrops	N.D.	Artemisia brush and patch-ploughing
2	Slopes of conical hills (volcanic)	Bare	" " " "
3	Wide valleys	Some alluvial fill	Artemisia brush; some cultivation
4	Wadis (generally shallow)	Stony	Artemisia brush

One of the best agricultural areas in the country, especially Land Facets 1 and 4.

8·2 EASTERN 'PAN HANDLE'



8/2 EASTERN 'PANHANDLE' ON TERTIARY LIMESTONE AND CHALK (WADI SHALLALA FORMATION OF BELQA SERIES)

Climate: Desert

Physiography: This land system includes all that part of the north-eastern 'panhandle' of Jordan which lies beyond the eastern extremity of the volcanic plain. H4 lies within it. It consists of an almost flat and level but slightly undulating gravelly desert plain interspersed with mud flats. The gravel is blackened and weathered chert. Beneath the gravel the surface is highly calcareous and gypseous.

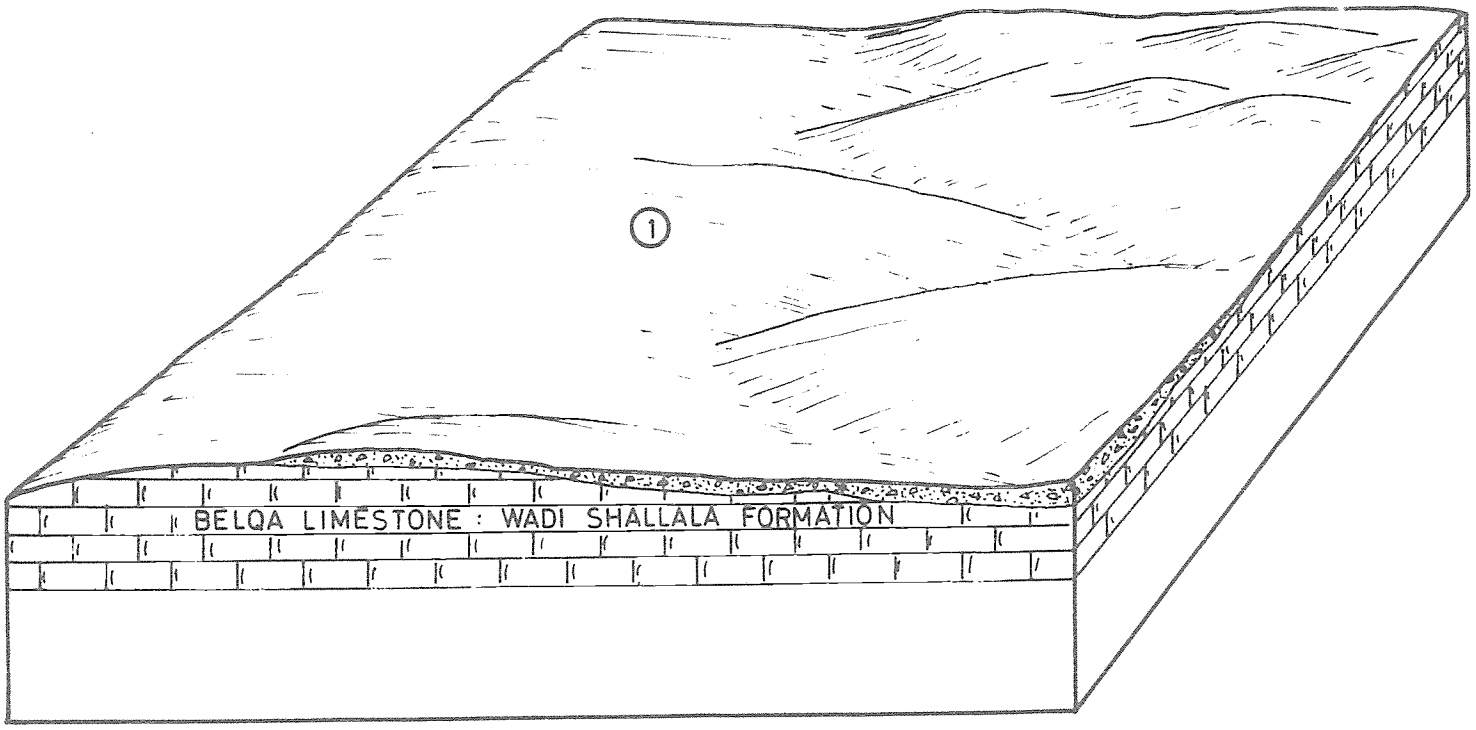
Geology: Almost all is underlain by the Wadi Shallala Formation, which is a sequence of about 60 m of white or light grey marl and limestone, containing chert.

Land Facets:

No.	Form	Soils	Vegetation
1	Low undulating mounds	A mantle of sharp blackened chert fragments (about 5 cm in diameter) over a calcareous soil	Almost bare
2	Sandy wadi beds	Silty	Almost bare
3	Mud flats	Silty hollows with polygonally cracked surface	Bare

When Land Facet 3 (mud flats) is more than about 100 m in diameter, they are mapped separately as Land System 12/1.
No agricultural potential without irrigation water.

8·3 QUATERNARY REG OVER TERTIARY LIMESTONE AND CHALK



8/3 QUATERNARY REG OVER TERTIARY LIMESTONE AND CHALK (WADI SHALLALA FORMATION OF BELQA SERIES

Climate: Desert

Physiography: This area lies in the southern part of the 'panhandle' where the photography indicates that the Wadi Shallala Formation has been overlaid by a substantial covering of Quaternary wind- (and water?) borne drift.

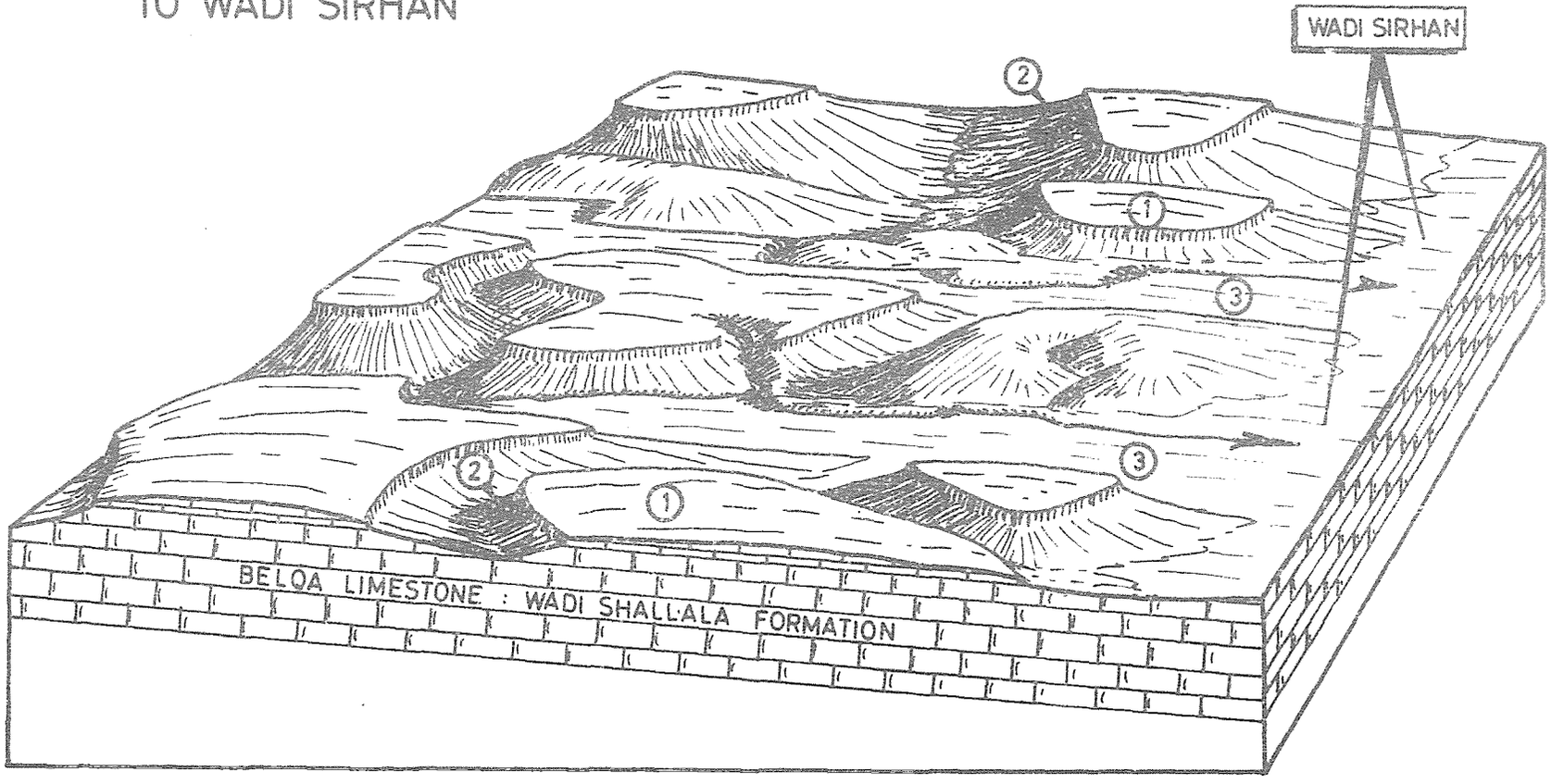
Geology: Wadi Shallala limestone: a sequence of about 60 m of white or light grey marl and limestone, containing chert.

Land Facet:

No.	Form	Soil	Vegetation
1	Undulating stony 'serir'	N.D.	N.D.

This land system was not visited. No apparent agricultural potential.

8·4 TERTIARY LIMESTONE AND CHALK : GULLIED DIPSLOPE TO WADI SIRHAN



8/4 TERTIARY LIMESTONE AND CHALK (WADI SHALLALA FORMATION OF BELQA SERIES): GULLIED DIPSLOPE TO WADI SIRHAN

Climate: Desert

Physiography: The Wadi Shallala limestone has a very distinctive appearance, giving rise to an easily recognizable tabular topography. It seems to keep this essential character in places as far apart in the desert zone as the neighbourhood of the Amman El Azraq road in the north and the south-eastern extremity of the country. It gives rise to low dissected tabular hills whose summits dip gently to the east.

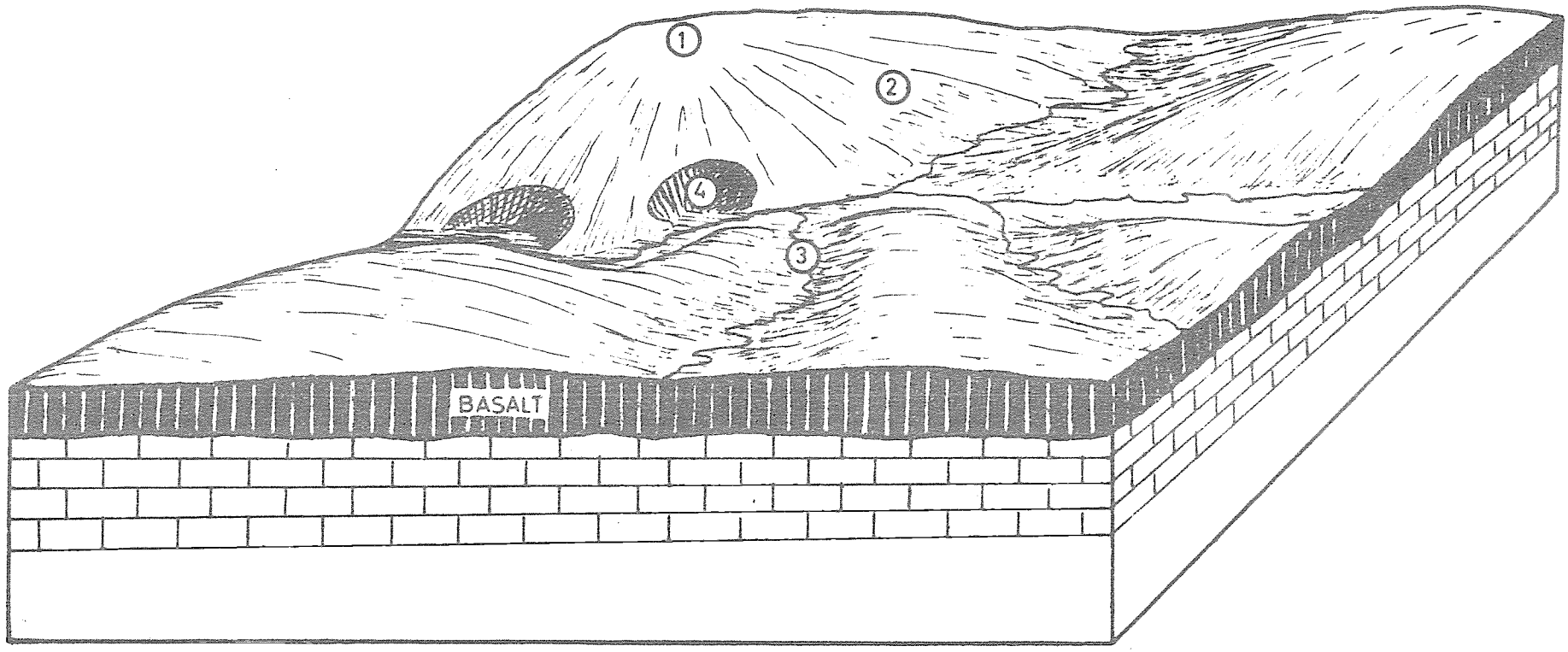
Geology: The Wadi Shallala limestone is a sequence of about 60 m of white or light grey marl and limestone which overlies the Rijam Formation. The upper limestone contains layers of chert in the form of spherical and bulbous concretions which form a strongly protective mantle when they appear at the surface and fracture. This chert mantle seems to explain the survival of outliers such as the Jebel El Hadi and Jebel Thulaythuwat. On the Jebel Waqf Es Suwan is a circular salt plug intrusion which has a surface form of low concentric hills formed by the volcanic upthrust of earlier deposits.

Land Facets:

No.	Form	Soils	Vegetation
1	Plateau tops	Limestone hamada with chert pavement	Sparse xerophytic scrub
2	Scarp slopes	Bare limestone and chert	Bare
3	Wadis	Silty	Xerophytic scrub

This land system has little agricultural potential, but as all drains toward the Wadi Sirhan, it must, in total, carry appreciable runoff.

9.1 BASALT PLATEAUX OF MEDITERRANEAN ZONE



9/1 BASALT PLATEAU IN MEDITERRANEAN ZONE

Climate: Mediterranean

Physiography: Gently undulating volcanic plains; cultivable land.

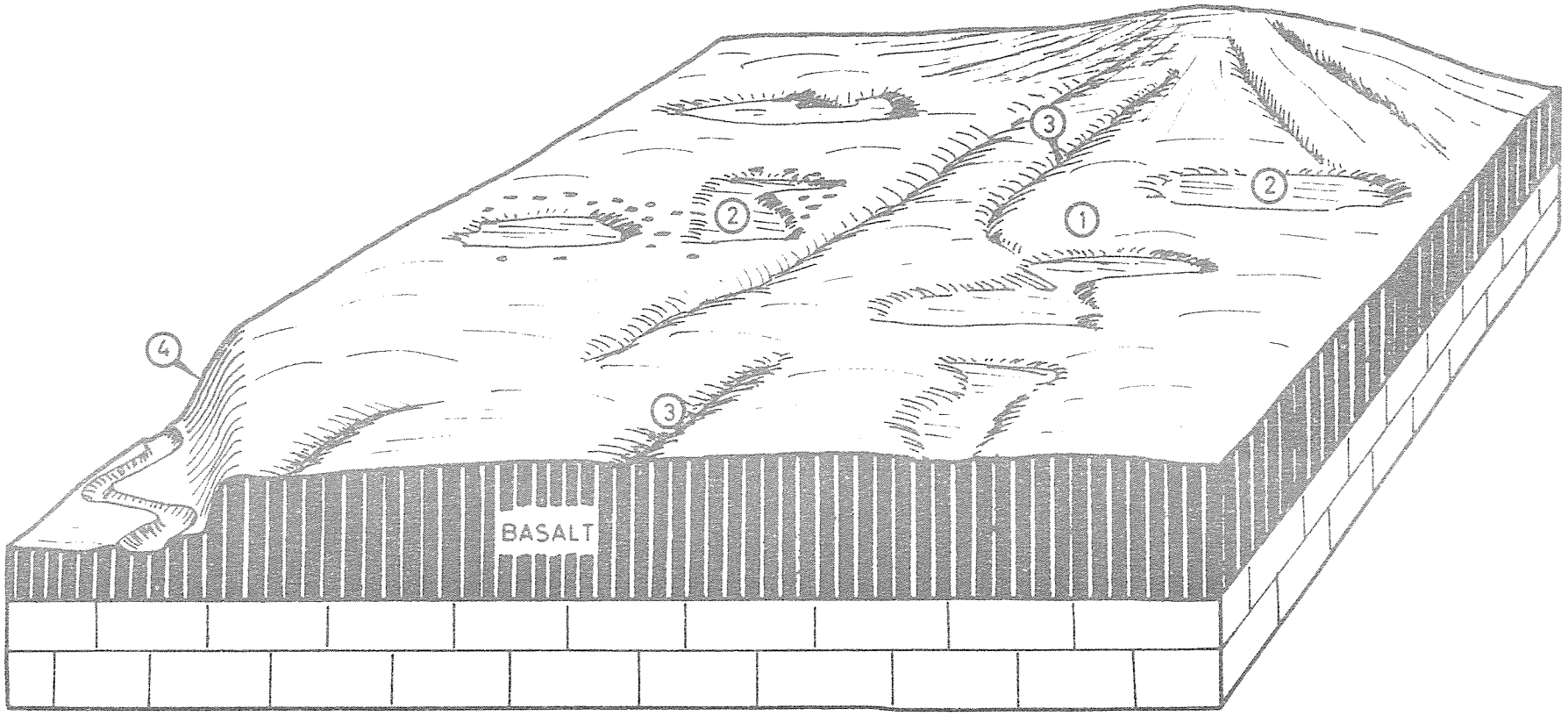
Geology: Miocene-Recent volcanic flows of variable thickness, mainly in the north of the country and overlying the Belqa Series.

Land Facets:

No.	Form	Soils	Vegetation
1	Plateau top	Brown loams	Cultivated cereals and grass (1b)
2	Gentle slopes	Deep brown loams	" " " "
3	Valley bottoms, locally incised	Stony	N.D.
4	Scars where undercut by drainage	Stony	Bare

Good agricultural land on Land Facets 1 and 2, and locally on 3.

9.2 BASALT PLATEAUX IN STEPPE ZONE



9/2 BASALT PLATEAUX IN STEPPE ZONE

Climate: Steppe

Physiography: Flat to gently undulating volcanic flow areas with stony surface.

Geology: Flat volcanic flow areas (basalt), generally associated with flow areas from Jebel Druze area, though found elsewhere.

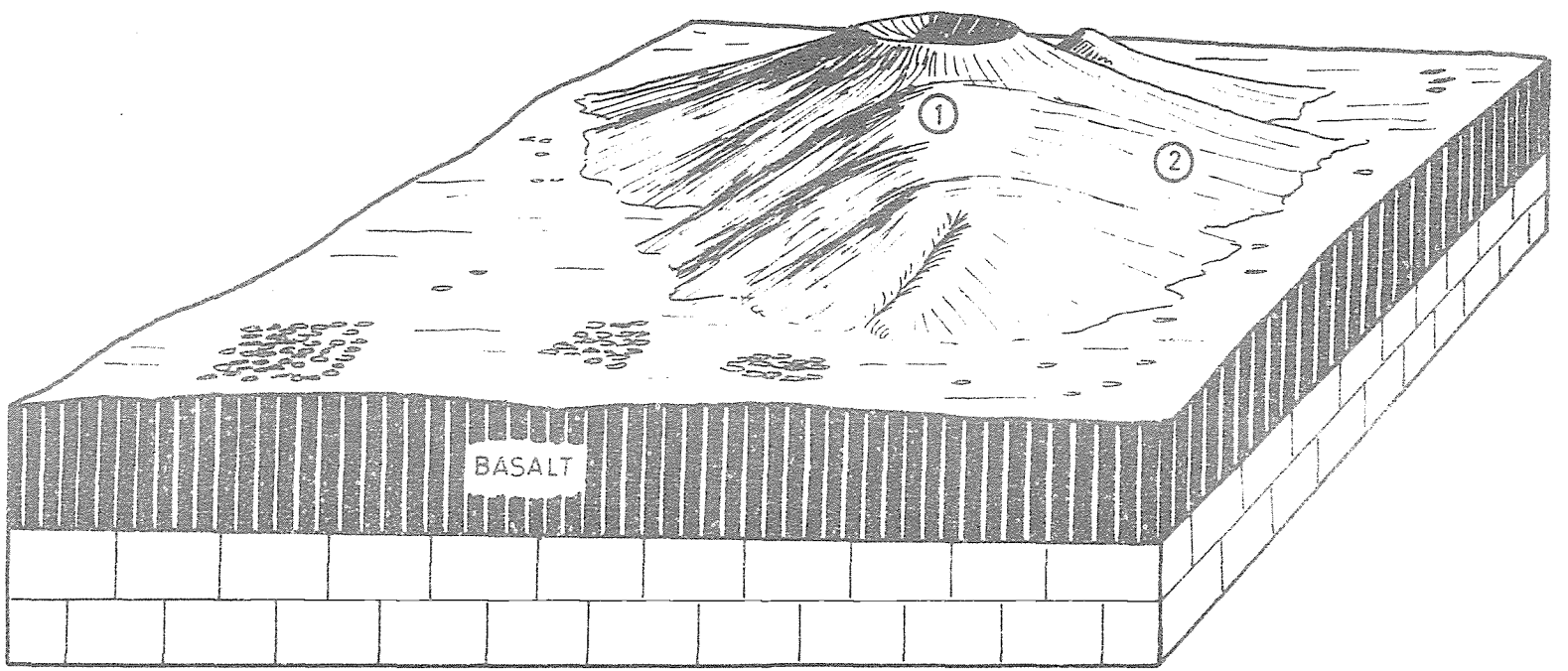
Land Facets:

No.	Form	Soils	Vegetation
1	Weathered basalt hamada	Stony loam. Some large stones on surface, a few cm to 1 m in diameter	Grassland (1c, 4x)
2	Mud flats	Loam	Bare, except edges where there are sparse annuals and chenopods (11)
3	Gullies	Bare rock	None (8b)
4	Steep slopes (e.g. plug in Wadi El Hasa)	Bare rock	None (8b)

Land Facets 1 and 2 cultivable where water gathers and where surface can be cleared of stones.

Photos: Poore and Robertson (1964). Plates 6, 11, 55.

9·3 BASALT-TUFF HILLS



9/3 BASALT-TUFF HILLS

Climate: Desert

Physiography: Rounded hills of tuff (solid volcanic ejecta) in the middle of the northern 'harras' area.

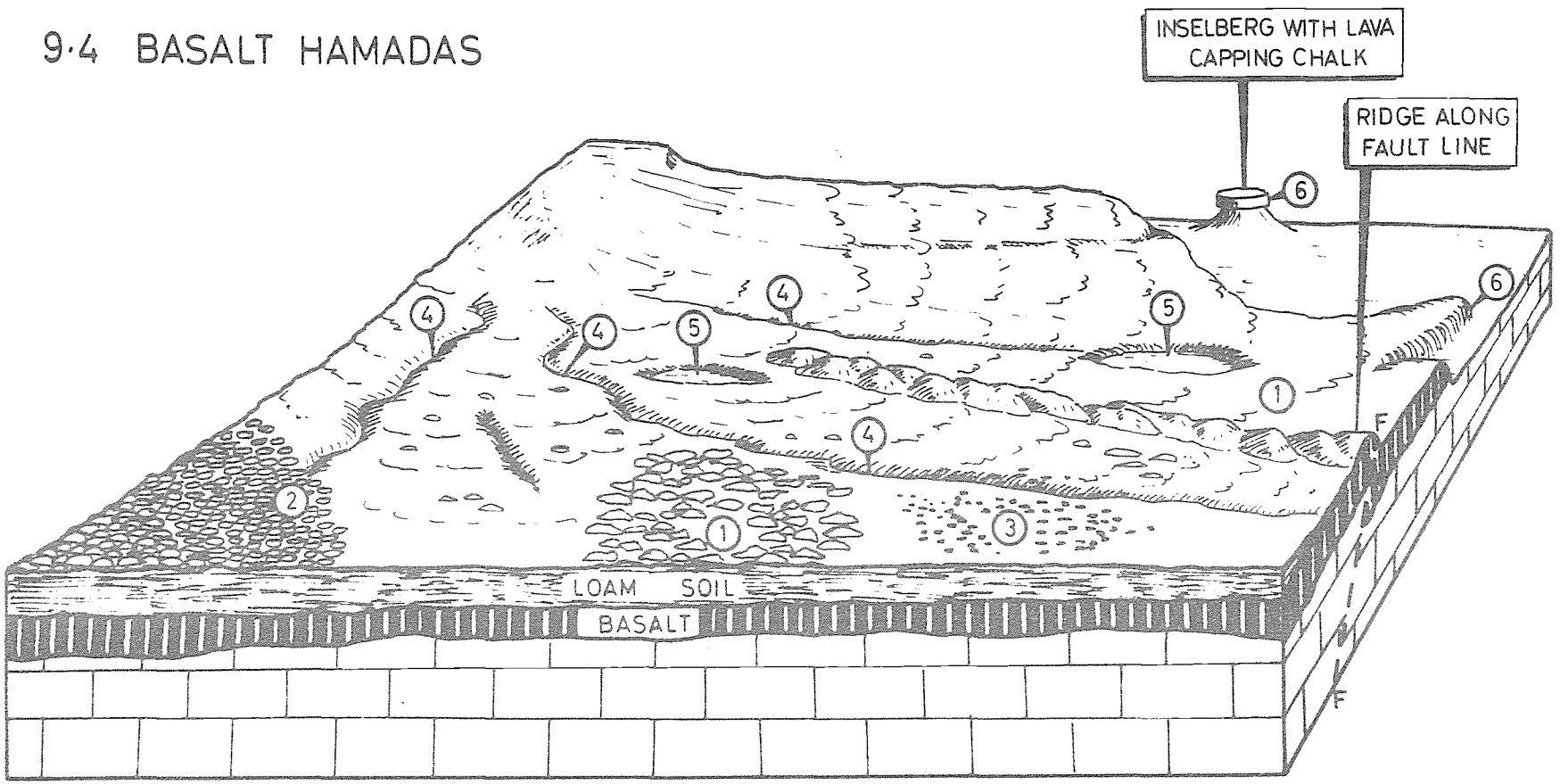
Geology: These represent volcanoes in the plain through which liquid material was forced upwards with such speed that it solidified as bombs, lapilli, tuff, and solid ash fragments on falling.

Land Facets:

No.	Form	Soils	Vegetation
1	Rounded summits	Lithosols. Hard, broken cindery surface	Almost bare
2	Sloping sides with some fine gullying	Lithosols. Harder bands where material has solidified into harder lumps	Almost bare

Valueless agriculturally, but the material can be dug out easily and is useful for road hard core.

9·4 BASALT HAMADAS



9/4 BASALT HAMADAS

Climate: Desert

Physiography: Hamadas covered with black basalt boulders ranging from a few centimetres to almost a metre in diameter.

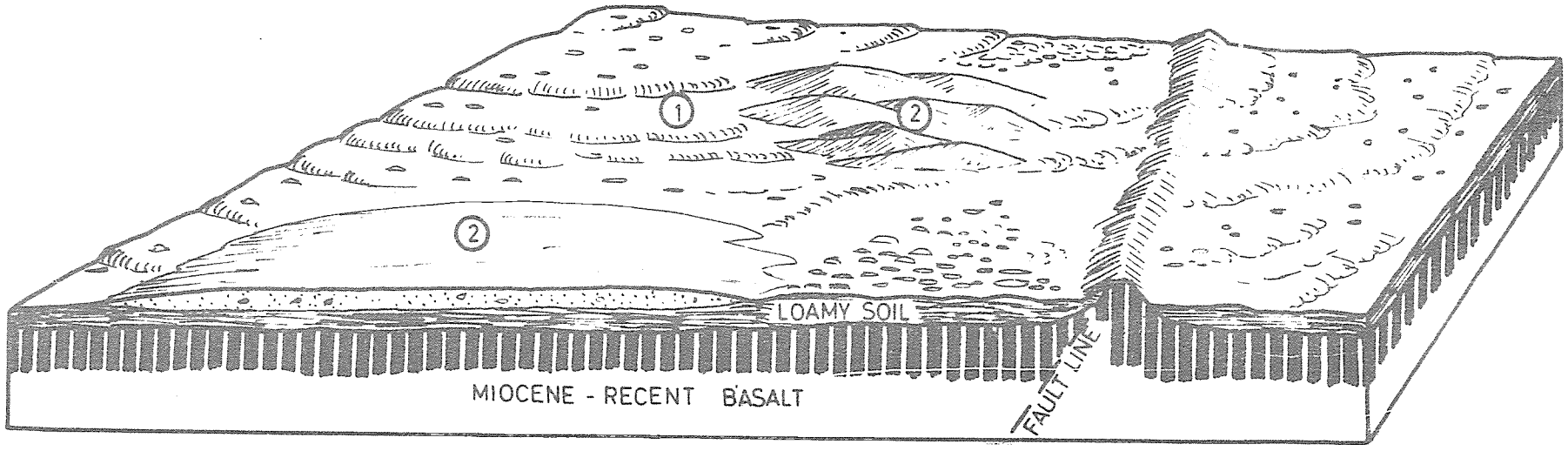
Geology: Miocene-Recent volcanic flows of 3 different ages (classed as B4, B5, and B6 by Bender, 1969), forming a complex surface.

Land Facets/Land Elements:

No.	Form	Soils	Vegetation
1	Hamada with large boulders (>30 cm)	Deep loam under boulders	Almost bare (8b)
2	Hamada with stones (5-30 cm)	Deep loam under stones	Almost bare (8b)
3	Hamada with gravel surface (2 mm - 5 cm)	Deep loam under gravel	Almost bare (8b)
4	Gullies	Stony	Almost bare
5	Mud flats	Deep loam	Bare, except for annuals and chenopods at edge (11)
6	Edges of floor (lobate form)	Bare rock	None

Land Facets 1, 2, and 3 would be cultivable if cleared and if water available. Land Facet 5 requires only water.
See also Land System 12/4.

9.5 BASALT HAMADAS WITH QUATERNARY COVER



9/5 BASALT HAMADAS WITH QUATERNARY COVER

Climate: Desert

Physiography: As for 9/4 except that there is a considerable covering of Quaternary material.

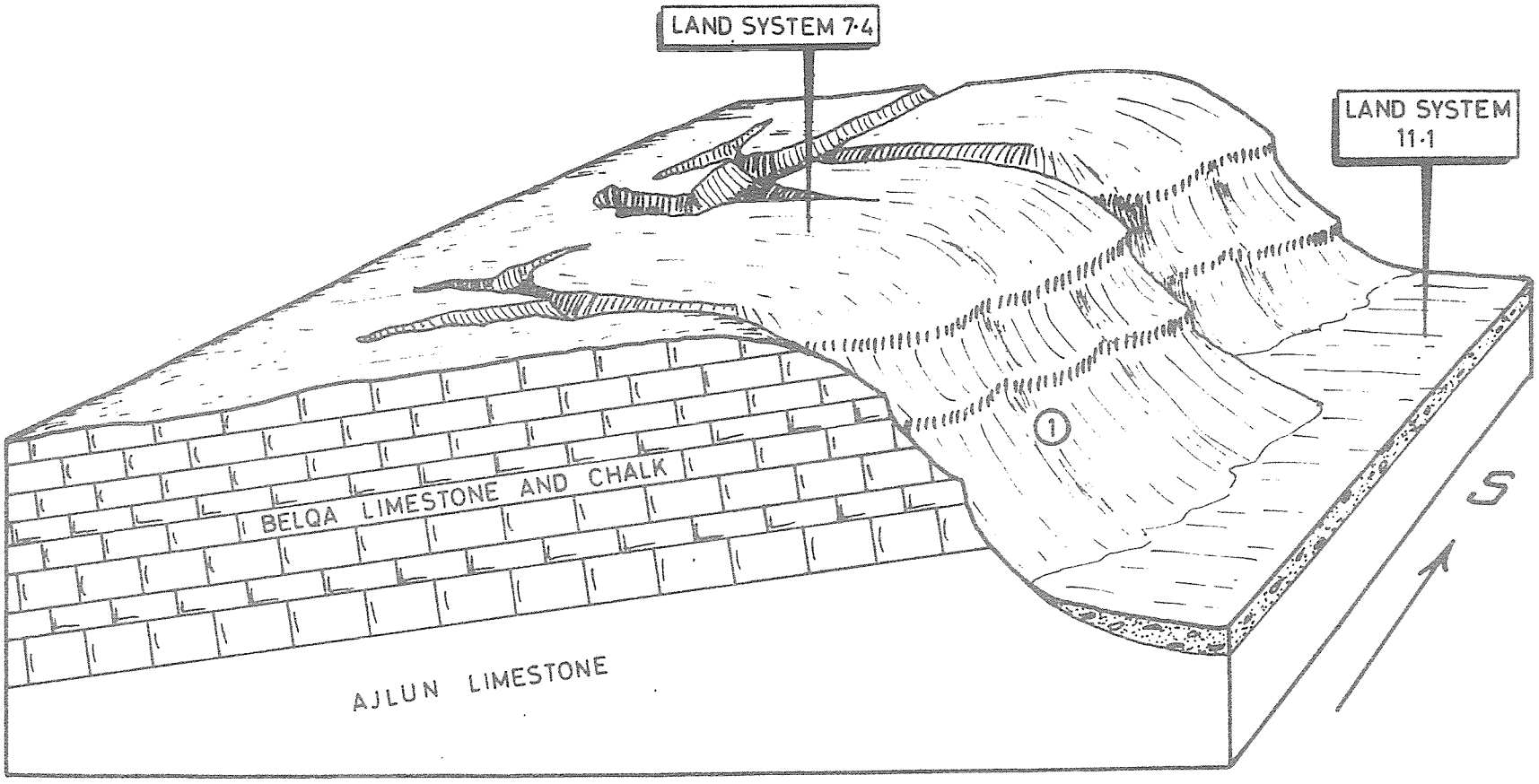
Geology: Miocene-Recent volcanics overlain by Quaternary water- and wind-borne deposits.

Land Facets:

No.	Form	Soils	Vegetation
1	Basalt hamadas	Stony surface below which is deep loam	Almost bare (8b)
2	Sandy drift, sometimes wind blown	Regosols	N.D. (8i)

Possibly some irrigable land if water was available.

10.1 WESTERN WALL OF JORDAN : NORTH SECTION FROM YARMUK TO TABAQAT FAHL



10. The Western Escarpment of Jordan. This includes four land systems related to the geological sequence exposed and especially to the rock which forms the upper slopes. Geological relationships can be seen from the cross section in Burdon (1959, Fig. 4).

10/1 WESTERN ESCARPMENT OF JORDAN: NORTHERN SECTION TO TABAQAT FAHL (NEAR WADI YABIS)

Climate: Steppe

Physiography: Mountain front cut by deep ravines. The distinctive feature is the rounded tops due to the chalk of the upper part of the Belqa Series.

Geology: Belqa Series overlying Ajlun limestone but the gullies do not generally cut down to the Ajlun.

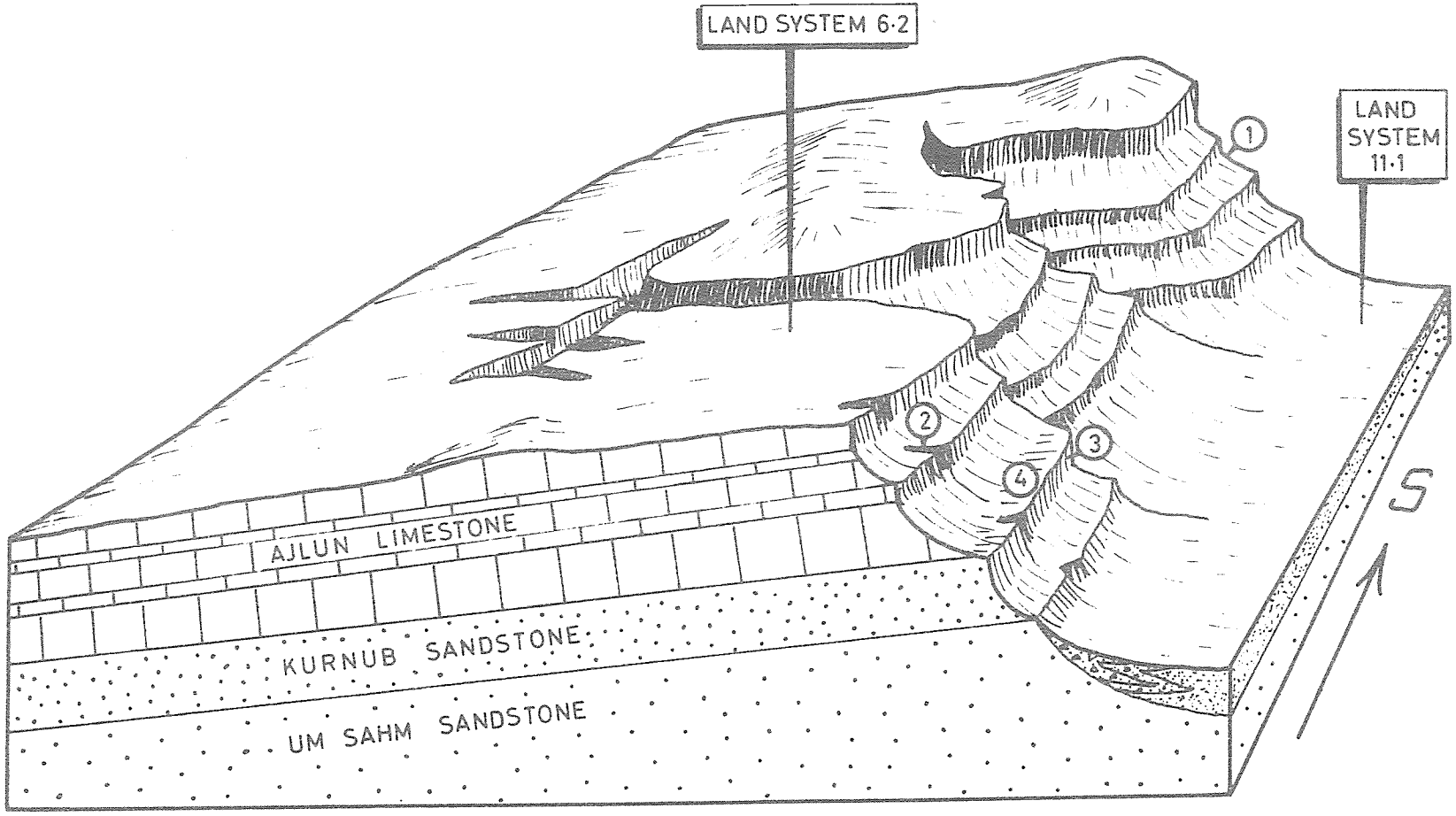
Land Facet:

No.	Form	Soil	Vegetation
1	Steep slopes stepped by competent beds	Thin eroded loams	Moderately dense scrub

The land facet in this land system is closely analogous to those found on slopes of the same geological formation in Land System 7.5.

There is some cultivation on more level areas. Protection needed against erosion.

10·2 WEST WALL OF JORDAN : SECTION FROM TABAQAT FAHL TO MOUNT NEBO



10/2 WESTERN ESCARPMENT OF JORDAN: SECTION FROM TABAQAT FAHL TO MT. NEBO

Climate: Steppe

Physiography: Mountain front cut by deep ravines. Especially steep and spectacular because formed in limestone.

Geology: Ajlun limestone overyling Kurnub sandstone which is exposed in wadis. The Wadi Zerqa even cuts through to the Um Sahm sandstone.

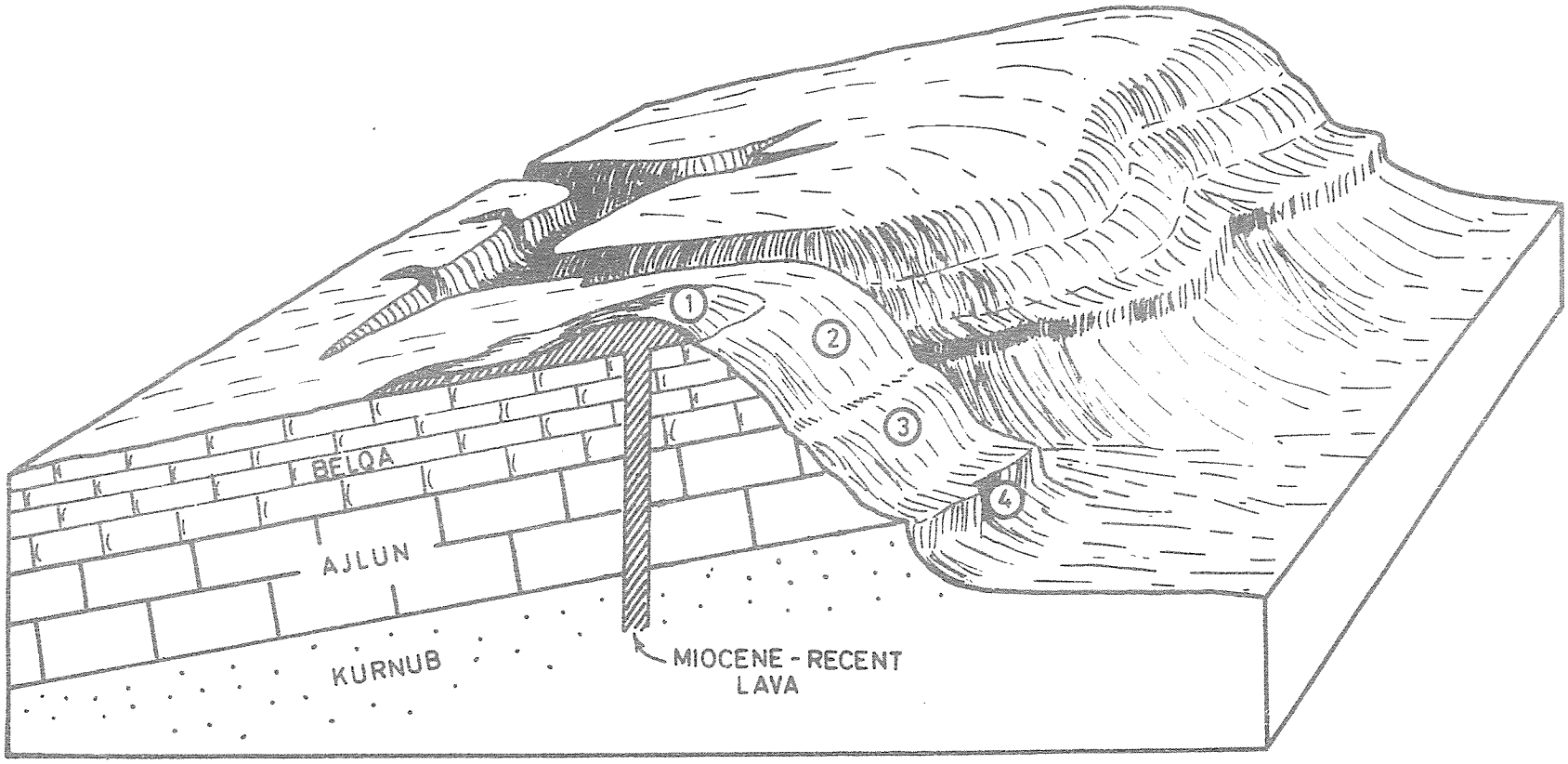
Land Facets:

No.	Form	Soils	Vegetation
1	Steep slopes on Ajlun limestone	Thin eroded loams	Scrub
2	Terraces on Ajlun limestone	Thin loams	Scrub
3	Slopes on Kurnub sandstone	Lithosols	Scrub
4	Terraces on Kurnub sandstone	Lithosols	Almost bare

The land facets in this land system are closely analogous to those found on the slopes of the same geological formations in Land System 6.3.

Cultivation possible where land not too steep. Protective measures against erosion required, especially on 1 and 2.

10·3 WEST WALL OF JORDAN : SECTION FROM MOUNT NEBO TO RAS EL NAQB



10/3 WESTERN ESCARPMENT OF JORDAN: SECTION FROM MOUNT NEBO TO RAS EN NAQB

Climate: Steppe

Physiography: The mountain front resembles a wall cut by ravines, some of which are the debouchments of major wadis, e.g. Mujib and Hasa. Both the wall and the plain at its foot become more arid southwards from south of Mt. Nebo. This mountain at 700 m overlooks the northern end of the Dead Sea at -392 m. Mountains near Ras En Naqb at over 1600 m overlook the Dead Sea - Gulf of Aqaba watershed at about 300 m a.s.l. Hence the wall rises in relative height southwards.

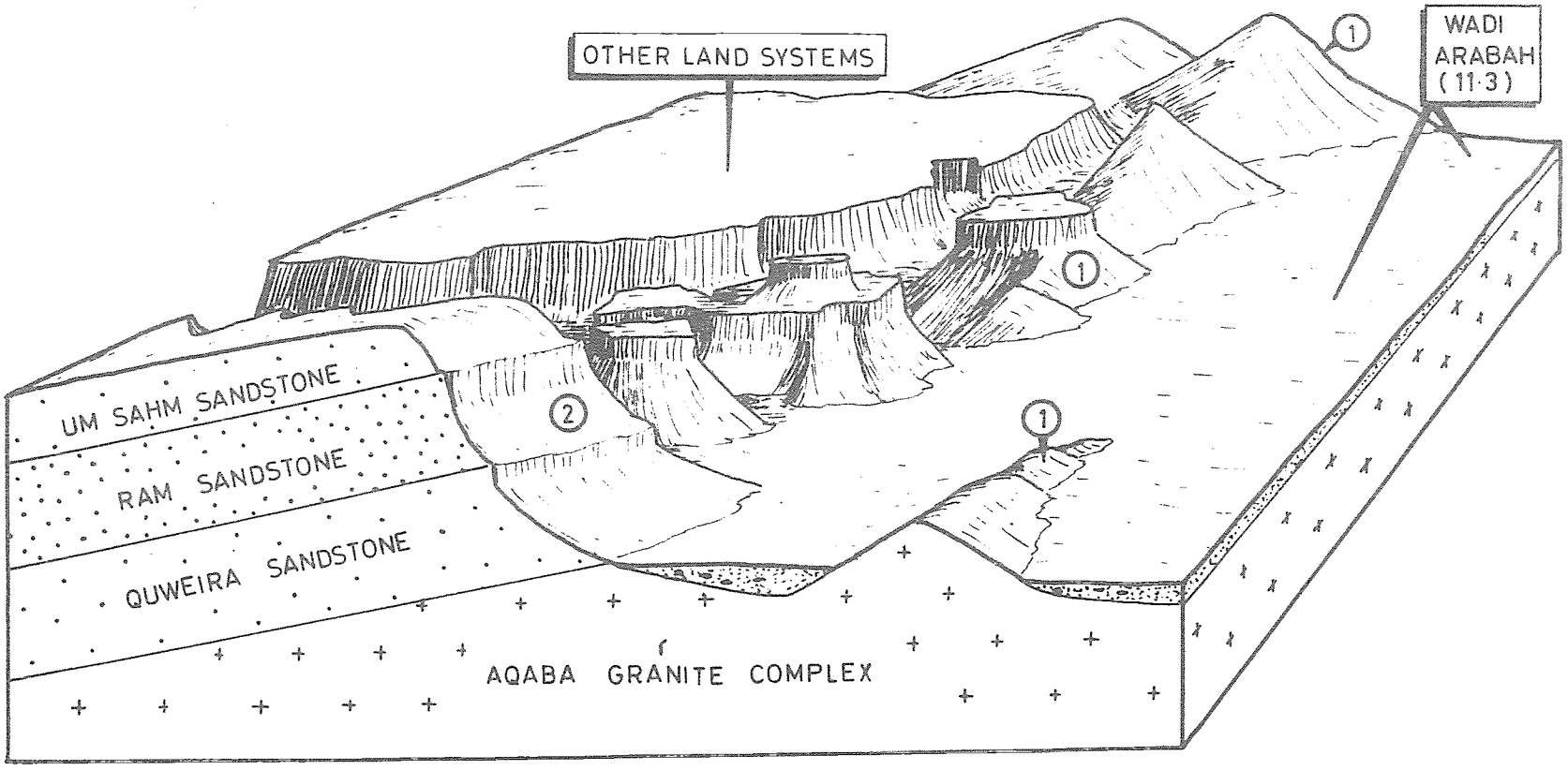
Geology: The surface is generally composed of Belqa chalk and limestone locally covered by volcanic flows. Ajlun limestone is locally exposed especially in deep ravines such as the Mujib and Hasa. These two wadis, indeed, cut through to the underlying Kurnub sandstone.

Land Facets:

No.	Form	Soils	Vegetation
1	Slopes on lava	Bare, rocky	N.D.
2	Slopes on Belqa limestone	" "	"
3	Slopes on Ajlun limestone	" "	"
4	Slopes on Kurnub sandstone	" "	"

The land facets in this land system are closely analogous to those formed on the slopes of the gorges draining to the Jordan, e.g. in Land System 7/6.

10·4 WEST WALL OF JORDAN : SOUTHERN SECTION FROM RAS EL NAQB TO THE GULF OF AQABA



10/4 THE WEST WALL OF JORDAN: SOUTHERN SECTION FROM RAS EN NAQB TO GULF OF AQABA

Climate: Steppe

Physiography: A somewhat tabular-looking wall about 1500 m high, broken by a number of large wadis flowing into the Wadi Arabah. Locally sandstone slopes overlie granite and there are detached granite hills in the Wadi Arabah.

Geology: The following sequence of deposits is exposed (from the top): Um Sahm sandstone, Ram sandstone, Quweira sandstone, Aqaba Granite Complex (Pre-Cambrian Basement).

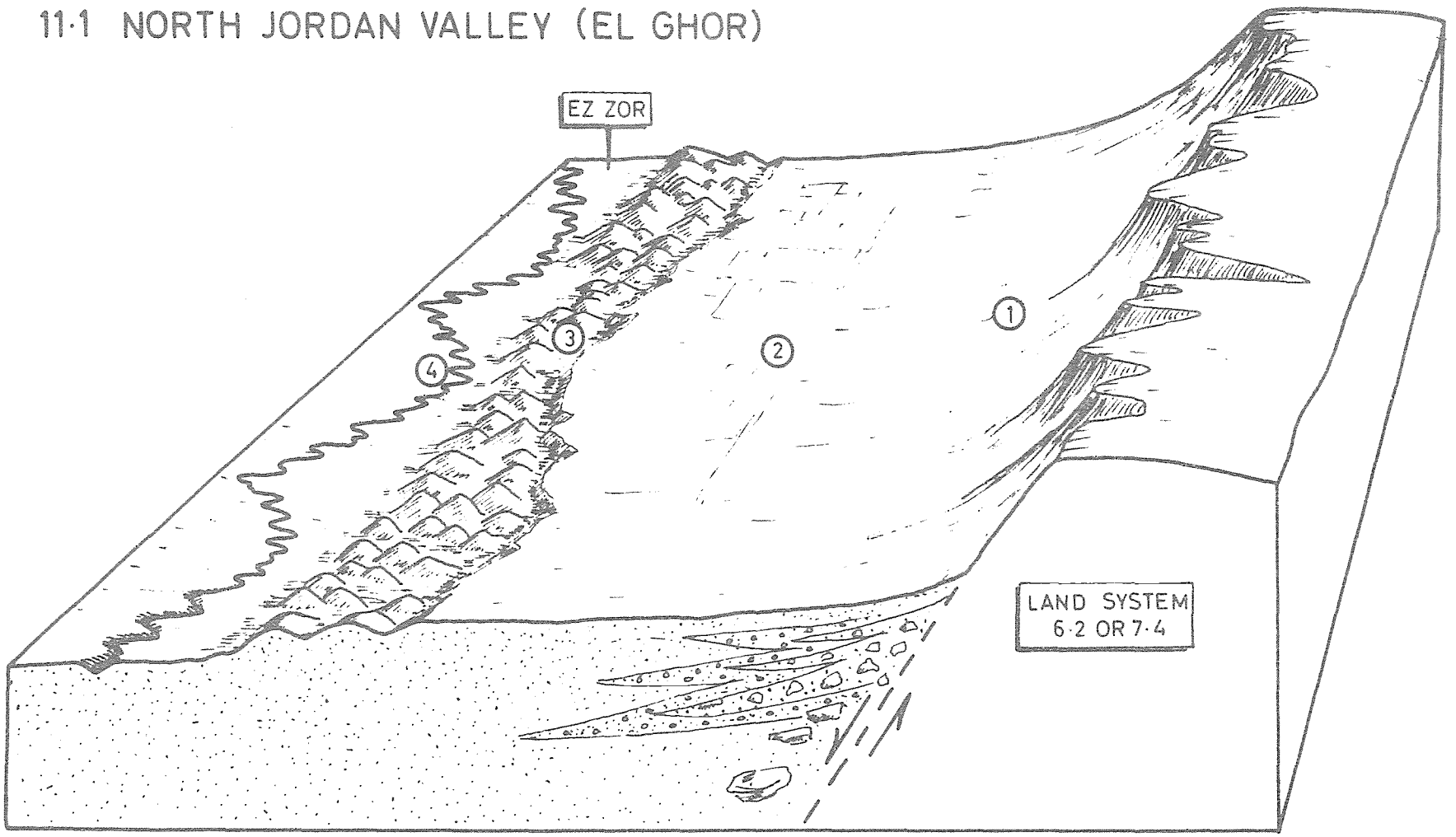
Land Facets:

No.	Form	Soils	Vegetation
1	Scarp slopes in Um Sahm/Ram sandstones	Bare lithosols	Almost bare
2	Scarp slopes in Quweira sandstone	" "	" "
3	Slopes on Aqaba Granite Complex	" "	" "

The same land facets occur here as can be seen in Land Systems 1/1, 2/1, 2/2, 3/1, and 3/2.

No potential, except for rough grazing.

11.1 NORTH JORDAN VALLEY (EL GHOR)



11/1 JORDAN VALLEY (EL GHOR): THE LOWLAND FLOORING THE JORDAN TRENCH FROM LAKE TIBERIAS TO THE DEAD SEA

Climate: Desert - becomes increasingly hot and arid southwards

Physiography: A detrital fan footslope falling in height to the valley of the Jordan.

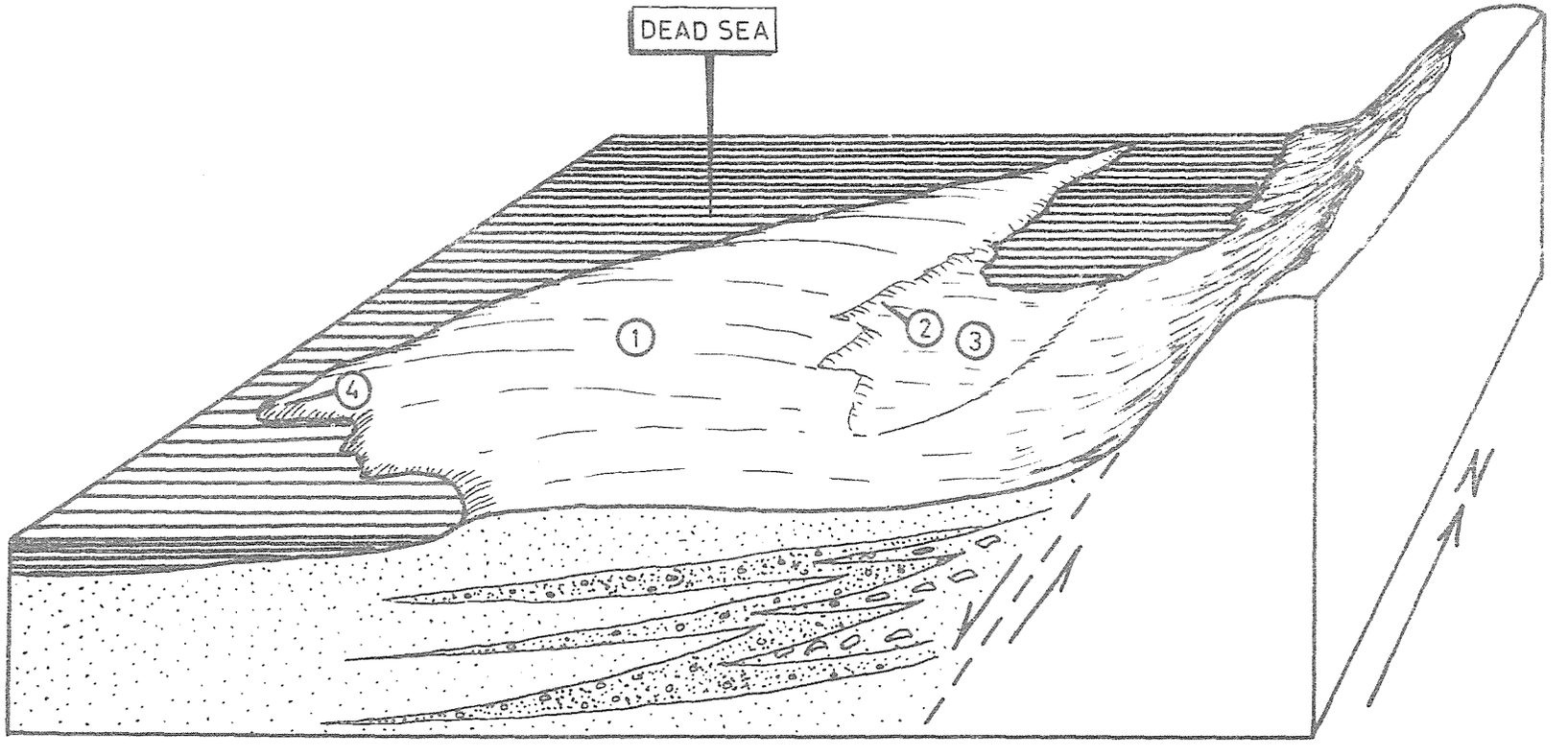
Geology: Quaternary material inwashed from neighbouring hills.

Land Facets:

No.	Form	Soils	Vegetation
1	Upper fan: steepest and widest at debouchment of wadis	Somewhat stony, sloping, loams	Dry farming of cereals
2	Lower fan	Less stony, deeper loams. Some high salinity	Intensively cultivated with sub-tropical crops where irrigated from East Ghor Canal. Some salt tolerant spp: saltbush, Tamarix spp., Calotropis procera
3	Gullied badlands	Saline silts	Salt tolerant vegetation, e.g. Tamarix spp., Calotropis procera
4	Jordan flood plain	Wet silty soils	Swamp vegetation (4i)
5	Beaches (Lake Tiberias and Dead Sea)	Stony, gravelly and sandy	Bare

Considerable development potential on Land Facets 1 and 2.

11·2 LISAN PENINSULA



11/2 LISAN PENINSULA

Climate: Desert

Physiography: A low plateau with a tabular landscape composed of fine-textured saline Quaternary material.

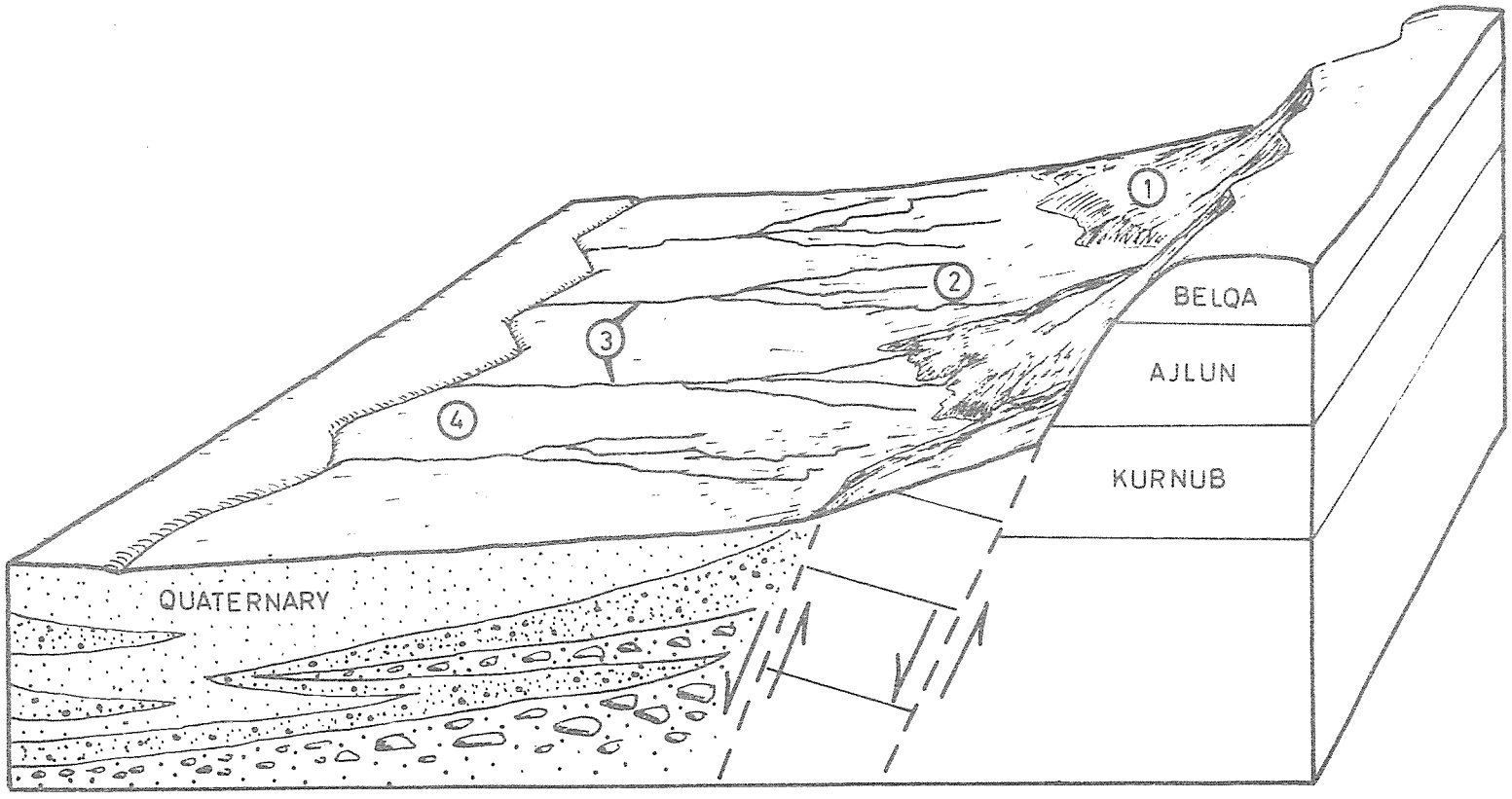
Geology: Lisan Series is a Quaternary fan deposit from the wadis flowing westwards off the plateau.

Land Facets:

No.	Form	Soils	Vegetation
1	Elevated 'plateau'	Saline, salty	Chenopods
2	Breakaway slopes	" "	"
3	Low saline plain	" "	"
4	Beach of Dead Sea	" "	Bare

No agricultural potential.

11·3 WADI ARABAH



11/3 WADI ARABAH

Climate: Desert

Physiography: The floor of the Rift Valley, known as the Wadi Arabah, is a somewhat complex detrital plain consisting in order from the floor of the Jordanian escarpment of a sequence of low foothills, a gullied footslope and a valley floor in the centre. It becomes increasingly barren and arid southwards.

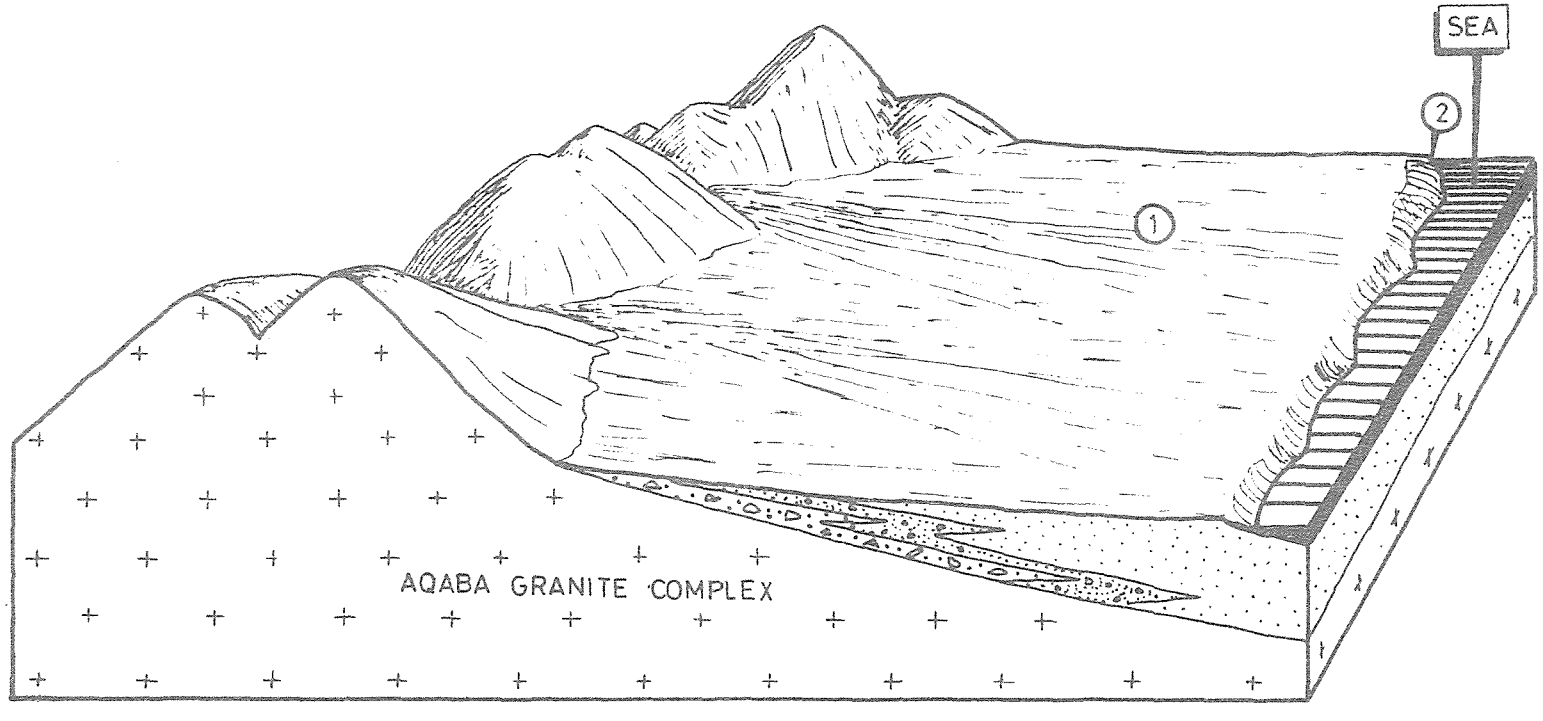
Geology: The valley floor is composed of Quaternary detritus. Some is derived from wadis further north, as Burdon (1959) demonstrates that there has been a lateral shift of the west wall of Jordan along a fault to carry it 107 km north in relation to the wadi floor. This has meant that the fans of the Wadi Hasa and Wadi Mujib are no longer anywhere near the mouths of their current positions.

Land Facets:

No.	Form	Soils	Vegetation
1	Slopes of low foothills	N.D.	N.D.
2	Alluvial fans	N.D.	N.D.
3	Gullies draining to centre of Wadi Arabah	N.D.	N.D.
4	Central valley floor	N.D.	N.D.

Without water, this valley is only suitable for nomadic grazing.

11·4 OUTWASH FANS FROM GRANITE SOUTH OF AQABA



11/4 OUTWASH FANS FROM GRANITE SOUTH OF AQABA

Climate: Desert

Physiography: The southernmost alluvial area of the Wadi Arabah in Jordan, draining directly into the Gulf of Aqaba.

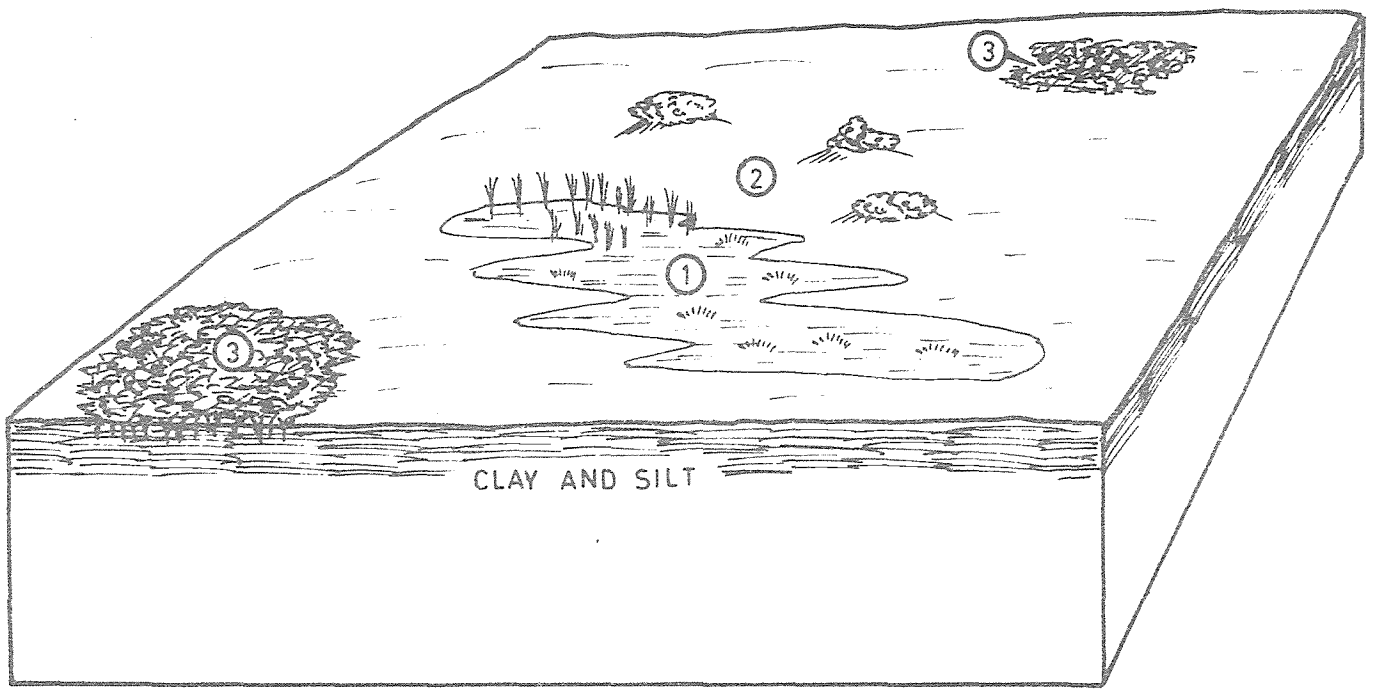
Geology: Recent detritus from granite.

Land Facets:

No.	Form	Soils	Vegetation
1	Alluvial fan	Gravelly	N.D.
2	Beach	Sandy	Absent

No agricultural potential.

12.1 PLAYA BASINS



12/1 PLAYA BASINS: GENERAL

Climate: Desert

Physiography: Flat and level seasonally flooded saline flats.

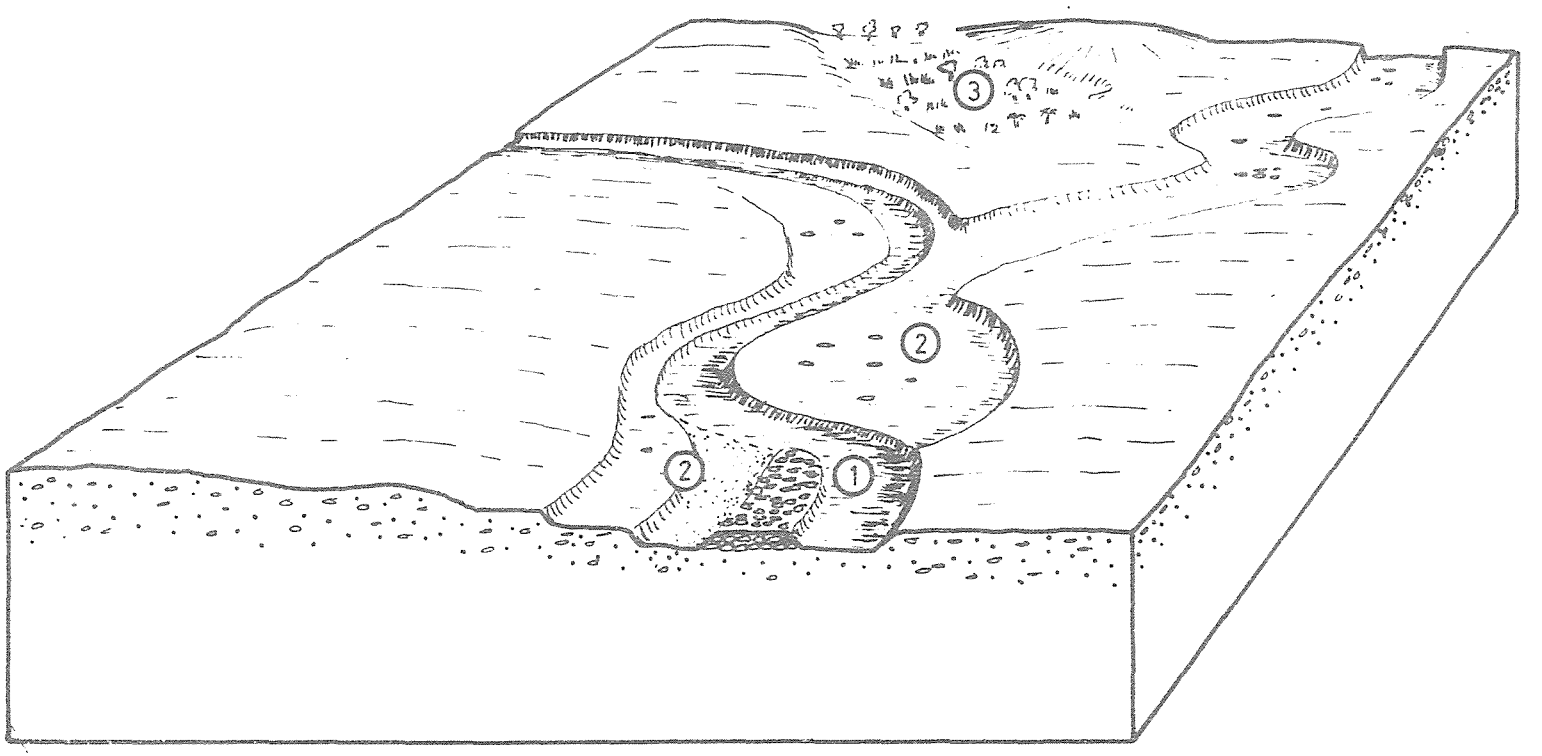
Geology: Quaternary deposits filling natural basins, e.g. Azraq, Jafr.

Land Elements:

No.	Form	Soils	Vegetation
1	Pools (Azraq area only)	Waterlogged, saline, some organic matter	Reed swamp with Juncus and Phragmites spp. (4g)
2	Salt flats	Highly saline with efflorescent salts	Tamarix passerinoides and halophytes. Nitraria retusa on mounds (4i)
3	Takyr: mud flats with polygonally cracked surface	Saline, but less so than 2	Almost bare

Land Element 3 justifies soil survey and careful irrigation. An irrigation scheme at El Jafr faces serious difficulty with salinity in soil and irrigation water.

12·2 BEDS OF MAJOR DESERT WADIS



12/2 BEDS OF MAJOR DESERT WADIS

Climate: Desert

Physiography: Large and ill-defined meandering wadis with bouldery, stony, gravelly, and sandy beds.

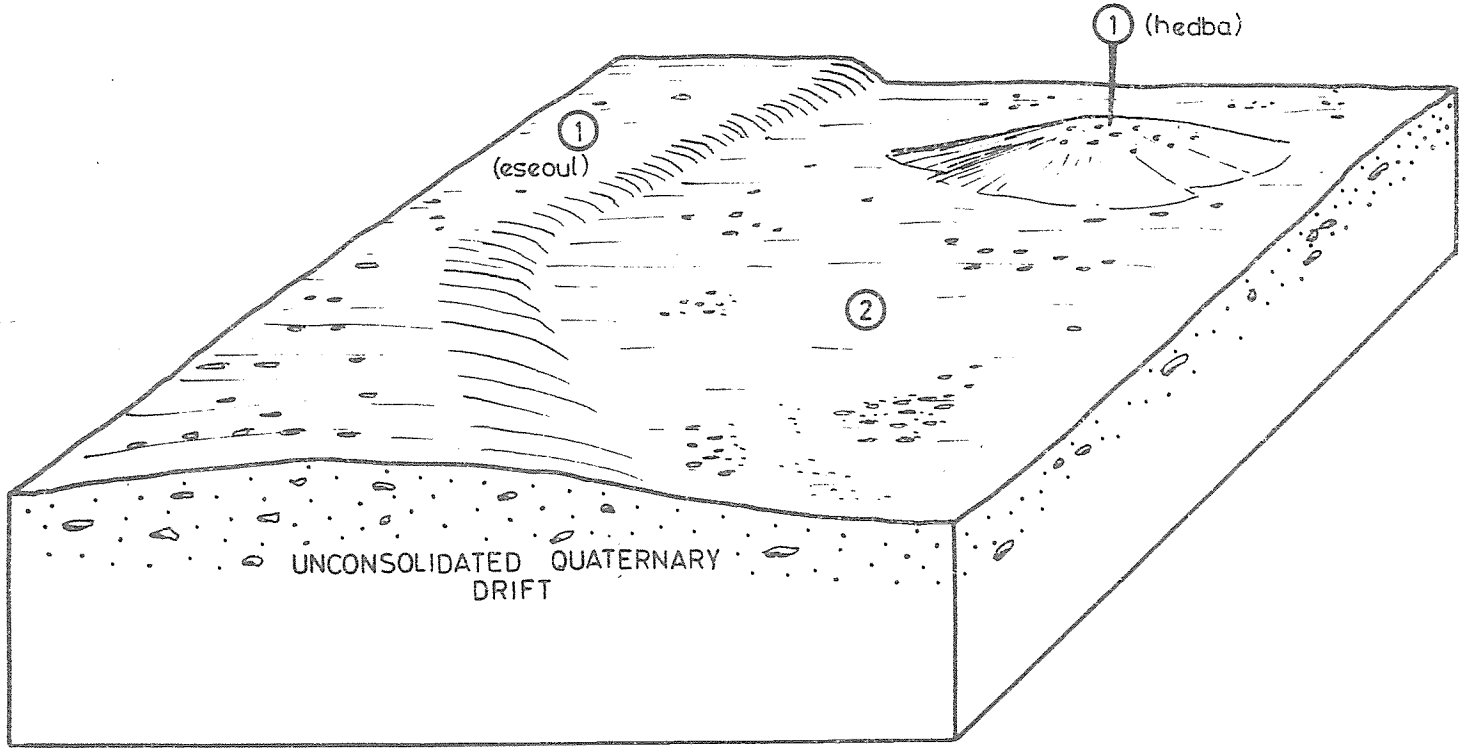
Geology: Quaternary erosion and deposition on existing slope of the land.

Land Facets:

No.	Form	Soils	Vegetation
1	Wadi channel	Sandy and gravelly Alluvium. Layered and well drained	Scrub, including such spp. as Retama raetam, Artemisia judaica, Haloxylon spp., Asteriscus graveolens, et al. depending on locality (4i, 4q, 4r, 4s, 4v)
2	Backslope of channel inundated only at high flow level	" " "	
3	Channels with vegetation arcs (in northern desert region) c.f. White (1969)	Silty alluvium	Artemisia herba-alba or Siedlitzia rosmarinifolia with assoc. spp.

Some capability for irrigation in small silty patches.

12·3 REG BASINS IN DESERT ZONE



12/3 REG BASINS IN DESERT ZONE

Physiography: Desert flats in alluvial areas containing stones where the finer material has been deflated to leave a reg.

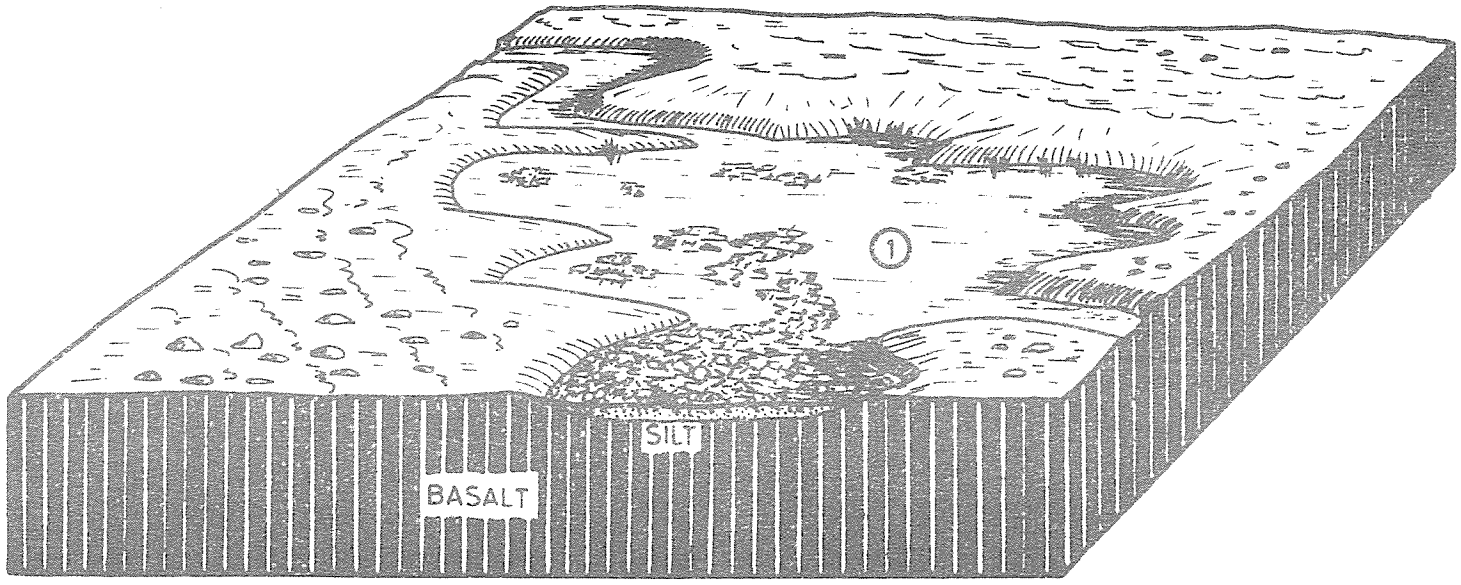
Geology: Generally on Quaternary terraces and the footslopes of fans.

Land Facets:

No.	Form	Soils	Vegetation
1	Reg mounts ('hedba' when small, 'eseoul' when large)	Sandy and silty alluvium under stones	V. sparse
2	Level reg areas	" " " "	" "

No potential without irrigation water, except nomadic grazing, and this is poor.

12·4 MUD FLATS ON VOLCANIC OUTCROPS



12/4 MUD FLATS ON VOLCANIC OUTCROPS

Physiography: The northern volcanic areas in steppe and desert climates yield an abundance of fine weathered material which collects into level mud flats. When small, these are included with the appropriate volcanic land system - where large, they constitute this land system.

Geology: Weathered Miocene-Recent basalts.

Land Facets:

No.	Form	Soils	Vegetation
1	Polygonally cracked takyr surface	Deep silt weathered from lava	Bare

These mud flats are potentially fertile and not highly saline. Given water they could be made productive. Clearance of stones would often enlarge their area substantially because weathered lava boulders and gravel frequently lie on the surface of a surprisingly deep loamy soil.

LAND SYSTEMS OF WEST BANK

(Provisional only)

13/1 SAMARIAN HILLS

A series of parallel north-south folds formed of Upper Cretaceous limestone overlain by Eocene chalk. The eastern half, which contains basalt and tuff patches, is known as the Samarian fold. Its eastern slopes follow fault lines and drop abruptly to the Rift but are cut by southeast-flowing canyons such as those of the Wadis Buqei'a and Fari'a. The western part is the Nablus Syncline, consisting of two uplifted mountain blocks separated by the graben of the Nablus valley. The younger, more resistant Eocene rocks in the centre of the syncline form Mts. Ebal and Gerizim and stand higher than the rest. This land system is better watered, less mountainous, and more valuable agriculturally than the Judean Hills.

13/2 JUDEAN HILLS

A Cretaceous limestone upland in the form of an upfold striking north-south and reaching a maximum altitude of c. 1000 m. The drainage network is relatively 'coarse' and mainly directed toward the west but with deep canyons draining the short distance eastwards from the watershed to the Dead Sea. The crest is highest toward the northern and southern ends with Jerusalem lying in a relatively lower saddle in the middle.

13/3 PLAIN OF JENIN

The slightly undulating southern end of the Jezreel valley consisting of a tectonic, fault-bounded alluvial plain thickly covered with alluvium and intensively cultivated.

13/4 SHEFELA (JUDEAN FOOTHILLS)

A transitional zone of gentle rounded hills between the Judean uplands and the coastal plain. It is up to 12 km wide and from 100 m to 400 m in altitude. The geological structure is a north-south trending syncline with a central core of Eocene strata (chalks and soft limestones) flanked east and west by Cretaceous chalks. It is cut by several fertile alluvial west-flowing valleys.

13/5 JUDEAN DESERT

The dry east slopes of the Judean dome rendered even drier by the rain shadow effect, the steep slopes, and the impermeability of the chalk rock. The flank of the upfold descending to the Dead Sea Rift is broken by a number of steep parallel escarpments. These are broken by deep eastward flowing canyons which drain into the Dead Sea, cutting through the younger Santonian (Upper Cretaceous) chalk to the underlying Cenomanian (Lower Cretaceous) limestones and dolomites.

8. BIBLIOGRAPHY, INCLUDING REFERENCES GIVEN IN TEXT

Aitchison, G.D., and Grant, K. (1967). The PUCE Programme of Terrain Description, Evaluation, and Interpretation for Engineering Purposes. Proc. Reg. Conf. Africa Soil Mech. Foundation Engng., 4th, Cape Town, 1968, 1:1-18.

Beckett, P.H.T., and Webster, R. (1970). Terrain Classification and Evaluation Using Air Photography: A Review of Recent Work at Oxford. Photogrammetria 26, 51-75.

Bender, Friedrich (1968). Geologiè von Jordanien: Beiträge zur Regionalen Geologiè der Erde. Vol. 7 (incl. geol. map 1:750 000). Gebrüder Borntraeger, Berlin.

Bender, Friedrich (1969). Geologische Forschung in Jordanien: Ger., Bundesanstalt Bodenforschung 3 Hanover-Buchholz, Alfred-Bentz-Haus. Geol. Johr 6., Beih., No. 81, 5-12.

Bender, Friedrich et al.(1969). Geologische Karte von Jordanien 1:250 000 (Ger., Bundesanstalt Bodenforschung, Hanover-Deutsche Geologische Mission in Jordanien)
Blätter: (1) Amman (4) Mahattat El Tufur
(2) Aqaba-Ma'an (5) Bayir.
(3) El Azraq

Bender, Friedrich (1974). Geology of Jordan. Supplementary edition in English with minor revisions. Trans. from the German in coop. with the Nat. Res. Authority, Amman, Jordan, by Moh'd Kamal Khdeir in assoc. with D. Parker and U. Wilkening. Gebrüder Borntraeger, Berlin-Stuttgart.

Bourne, R. (1931). Regional Survey and Its Relation to Stock-taking of Agriculture and Forest Resources of the British Empire. Oxford Forestry Memoirs No. 13.

Brink, A.B.A., and Williams, A.A.B. (1964). Soil Engineering Mapping for Roads in South Africa. Counc. Sci. and Ind. Res., Pretoria, Res. Rept. 227.

Burdon, David J. (1959). Handbook on the Geology of Jordan. Hashemite Kingdom of Jordan, Amman.

Christian, C.S., and Stewart, G.A. (1968). Methodology of Integrated Surveys. Aerial Surveys and Integrated Studies - Proc. Unesco Conf. Principles Methods Integrating Aerial Studies. Nat. Res. Potential Develop. Toulouse, 233-280.

Clapp, Frederick G. (1936). Geology and Bitumens of the Dead Sea Area, Palestine and Transjordan. Am. Assoc. Petr. Geol. B., v. 20, no. 7, 881-909, July.

Dapples, E.C. (1941). Surficial Deposits of the Deserts of Syria, Transjordan, Iraq, and Western Iran. J. Sed. Pet. v. 11, no. 3, 124-141.

Dearden, A. (1958). Jordan. Robert Hale, London.

Dowling, G. (1968). Land Evaluation for Engineering Purposes in Northern Nigeria. In Stewart G.A. Land Evaluation. MacMillan of Australia, Melbourne, 147-159.

FAO, A Framework for Land Evolution, 1976.

FAO, Mediterranean Development Project. Country Report: JORDAN, Rome, Sept. 1964.

FAO, Dryland Farming JORDAN. Soil Conservation in the Baq'a Valley. UNDP. AGS:SF/JOR 18. Technical Report 2. Based on the work of D.W. Danders, Soil Conservation Officer, Rome, 1970.

FAO, Technical Report 2. The Hydrogeology of the Mesozoico-Cainozoic Aquifers of the Western Highlands and Plateau of East Jordan. 1970.

FAO, Investigation of the Sandstone Aquifers of E. Jordan. Jordan. AGL:SF/JOR/9. UNDP. Rome. Interim Report, 1971.

Gibbons, F.R., and Downes, R.G. (1964). A Study of Land in South Western Victoria. Soil Conservation Authority, Victoria, Melbourne.

Glubb, John Bagot (1967). Syria, Lebanon, Jordan. Thames and Hudson.

Government of Jordan (1956). Report on the Range Classification of the H.K. of Jordan, by Hunting Technical Services Ltd. Jordan-U Department for Range and Water Resources.

Great Britain, Admiralty, Naval Intelligence Division (1943). Palestine and Transjordan. London.

Great Britain, Directorate of Survey, War Office and Air Ministry, (1960). Maps of the Hashemite Kingdom of Jordan at 1:500 000. Series 1404, Edition 3-GSGS.

Hare, F.K. (1959). A Photo-reconnaissance Survey of Labrador - Ungaya, Canadian Department of Mines and Technical Surveys. Memoire 6.

Harris, George Lawrence et al. (1958). Jordan, Its People, Its Society, Its Culture. New Haven, HRAF Press.

Hindle, P. (1964). The Population of the Hashemite Kingdom of Jordan, Geog. Journ. 130, 261-264.

Howard, J.A. (1973). A Basis for Ecological Planning: Phyto-Geomorphic Classification. Conference on Environmental Resources Management, University of Ife, Nigeria, 2-7 April 1973, FAO, Rome

Howard, J.A. (1970). Stereoscopic Profiling of Land Units from Aerial Photographs, Australian Geograph. XI(3), 259-68.

Huckriede, Reinhold, and Wiesemann, Gerd (1968). Der jung pleistozäne. Pluvial-see von El Jafr und weitere Daten zum Quartär Jordaniens. Geol. Palaeontol., vol. 2, 73-89. (Inc. geol. map at 1:100 000).

Hunting Technical Services and Sir M. MacDonald and Partners. (1964). East Bank Water Resources. Report on Hydrology. Govt. of Jordan Central Water Authority.

International Bank for Reconstruction and Development (1961). The Economic Development of Jordan: report of a mission organized by the IBRD at the request of the Government of Jordan. Baltimore, Johns Hopkins University.

Ionides, M.G. (1940). Report on the Water Resources of Transjordan and Their Development; Incorportating a Report on Geology, Soils and Minerals and Hydro-Geological Correlations by G.S. Blake. Government of Transjordan.

Jordan, Hashemite Kingdom of, (1965). Topographic Maps at 1:10 000. Universal Transverse Mercator. Produced for the United Nations Special Fund Project for Training and Demonstration in Afforestation in Jordan by AERO-PRECISA, Beirut.

Jordan Department of Lands and Surveys of the Jordan. (1949). Topographic Maps at 1:250 000. Ordnance Survey, Southampton.

Jordan Department of Lands and Surveys. Topographic Maps at 1:50 000. Prepared for the Ministry of Economy and the United States Agency for International Development to Jordan. Compiled by photogrammetric methods from aerial photography dated 1961 and 1963 and from existing data furnished by the Jordan Department of Lands and Surveys.

Lloyd, John William; Drennan, Donald Stewart Hall; and Bennell, Brian Marcus Underwood. (1968). A Groundwater Recharge Study in N.E. Jordan. Inst. Air. Eng. Proc., vol. 35, 615-631.

Long, G.A. The Biolclimatology and Vegetation of Eastern Jordan. FAO/57/2/1109, Rome, Feb. 1957.

Moorman, F. (1958). Soils of East Jordan. FAO, Rome.

Morf, Hans (1934). Vorweisung und Besprechung von morphologischen Flugaufnahmen aus Palästina und Transjordanien (abs). Schweizer. Naturf. Ges, Verh. 115 (Zürich). 448-449. (Physiography of Palestine and Transjordan).

Mountfort, Guy (1965). Portrait of a Desert. Collins, London.

Palestine Transverse Mercator Military Grid. (1942). Topographic Maps by 517 Corps, Field Survey Coy. R.E. from air photographs.

Patai, Raphael (1958). The Kingdom of Jordan. Princeton University Press, Princeton, N.J. 915-695.

Perrin, R.M.S., and Mitchell, C.W. (1970). An Appraisal of Physiographic Units for Predicting Site Conditions in Arid Areas. Military Engineering Experimental Establishment, Report No. 1111.

Poore, M.E.D., and Robertson, V.C. (1963). An Approach to the Rapid Description and Mapping of Biological Habitats. Sub-commission on Conservation of Terrestrial Biological Communities of the International Biological Programme. Nature Conservancy, London.

Quennell, A.M. (1951). Notes on a New Geological Map of Trans-Jordan (abs). Int. Geol. Cong., 18th, Great Britain, Rept. pt. 14, p 55.

Quennell, A.M. (1951). The Geology and Mineral Resources of (former) Trans-Jordan. Colonial Geol. and Min. Res. v. 2,, no. 2, 85-115. (Map at 1:500 000).

Schattner, Isaac (1962). The Lower Jordan Valley. Scripta Hierosolymitana, 11. Jerusalem.

Solignac, J.L.M. The Development Possibilities of the Azraq Area. Ec. Planning Div., Amman, 1/3/56. Hashemite K'dom of Jordan, Ministry of Economy.

South Levant. Topographic Maps at 1:250 000. (1956). Compiled, drawn and reproduced by 42 Survey Engineer Regiment. GSGS 8050 (MDR), Edition 1. Published by D. Survey, War Office and Air Ministry.

Trent, Virgil A., and Johnson, Robert F. (1967). Geologic map of the Haql quadrangle, Kingdom of Saudi Arabia, including a portion of the Hashemite Kingdom of Jordan ceded to Jordan after mapping was completed. 1:100 000. Saudi Arabia, Min. Petrol. Min. Res. Jeddah-USGS, Washington, D.C. (USGS Min. Invest. map Ml-12).

U.S. Geological Survey and Arabian American Oil Company (1963). Geologic Map of the Arabian Peninsula. 1:2 000 000. Joint Sponsors: Kingdom of Saudi Arabia, Ministry of Petroleum and Mineral Resources, and the U.S. Department of State. Miscellaneous Geologic Investigations Map 1-270 B-2, 1963.

Vaumas, E. de (1967). Phénomènes Karstiques en Mediterranée Orientale, in Phénomènes Karstiques. Fr. Cent. Rech. Doc. Cartogr. Geogr. Mem. Doc., vol. 4, 193-277.

Wetzel, Rene, and Morton, D.M. Contribution à la Géologie de la Transjordanie. Notes et Mémoires Moyen Orient t.7, 95-191.

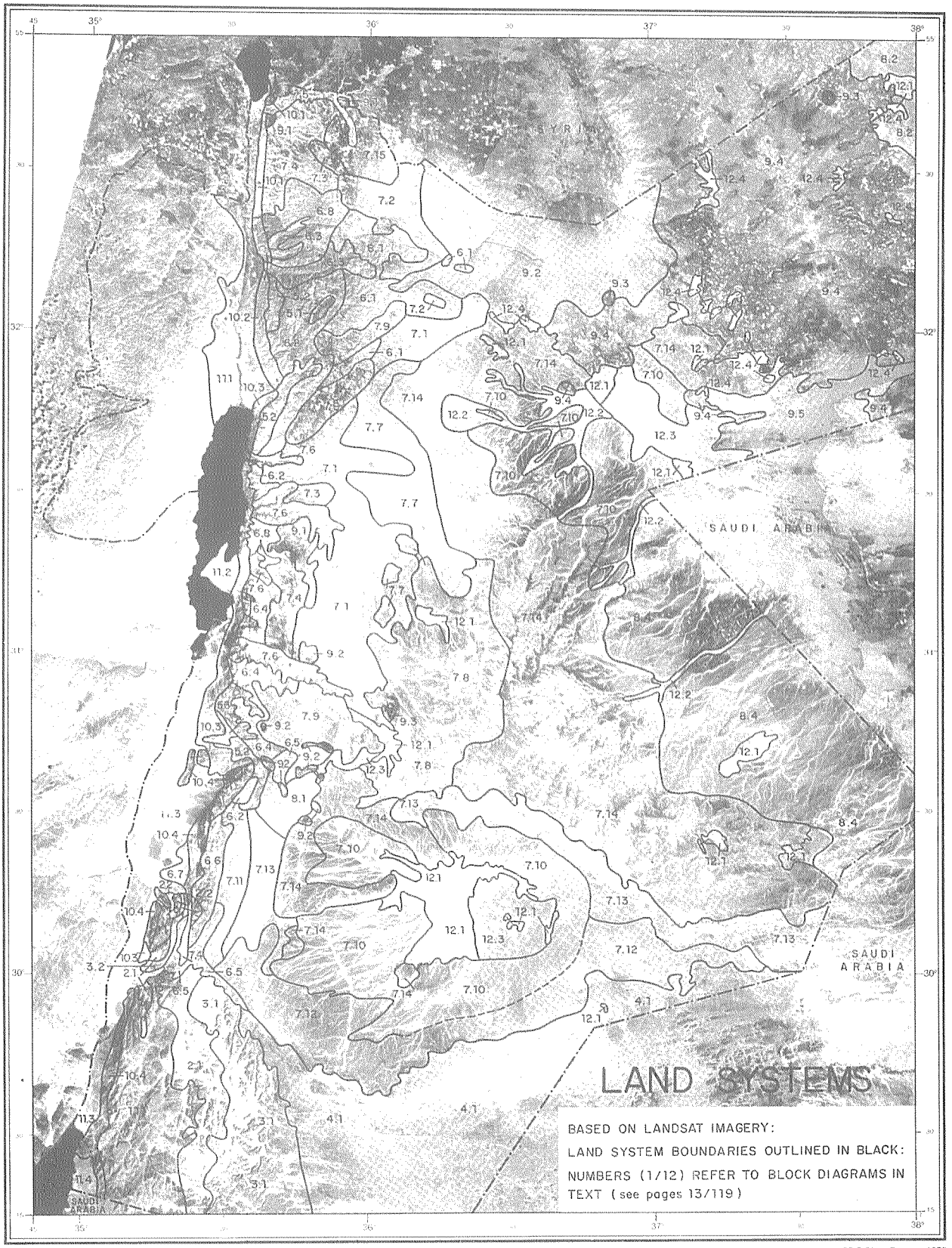
White, L.P. (1969). Vegetation Arcs in Jordan. Journal of Ecology, 57(2), 461-464.

Willimott, S.G. et al. (1964). Conservation Study of the Southern Highlands of Jordan. Ministry of Overseas Development, London.

Wolfart, Reinhard (1961). Ergebnisse hydrogeologischer Arbeiten in Jordanien und Saudi-Arabien. Deut. Geol. Ges. Z., vol. 113, no. 1, 8.

THE HASHEMITE KINGDOM OF THE JORDAN

LANDSAT - I SATELLITE IMAGERY MOSAIC



SOURCES OF INFORMATION

Base: LANDSAT - Imagery Band 7
Dates 13-15 September 1972

Reproduction and Cartography:
S. Pierro + G. Gabrielli Rome and
FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

Project: JOR/74/001

(approx) 1:1,000,000

0 10 20 30 40 50 60 70 80 90 100 Km

EDITION I Octobre 1975

M/L7327/E/6.80/2/400